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Pratt Hansen Group Inc. – Elements Condominium Plan

Servicing & Stormwater Management Report

December 2021

The Jones Consulting Group Ltd.
#1-229 Mapleview Drive East, Barrie ON L4N 0W5

PRA-19078 (70)

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Record of Revisions

Rev. No.	Date	Description
1	February 2021	1st Detailed Design Submission
2	September 2021	2nd Detailed Design Submission
3	December 2021	3rd Detailed Design Submission

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Disclaimer

This Report was prepared by **The Jones Consulting Group Ltd.** for **Pratt Hansen Group Inc.** The material in the Report reflects **The Jones Consulting Group Ltd.'s** best judgment in light of the information available at the time of the Report preparation. Any use which a third party makes of this Report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **The Jones Consulting Group Ltd**. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this Report.

This report has been prepared, in part based on the *Subwatershed Impact Study* (SIS) prepared by **R.J. Burnside & Associates**, dated September 2016, and follows the recommendations outlined in the *Detailed Stormwater Management Report* for the Bistro 6 West Subdivision, prepared by **The Jones Consulting Group Ltd.**, dated August 2019.

Servicing & Stormwater Management Report

Pratt Hansen Group Inc. – Elements Condominium Plan
Mapleview Drive East, City of Barrie

1. Introduction

1.1. Appointment

The Jones Consulting Group Ltd. (TJCG) was retained by Pratt Hansen Group Inc. (client) to provide engineering services for the proposed residential site plan development located in the *Hewitt's Secondary Plan Area*, southeast of Mapleview Drive East and Yonge Street in the City of Barrie (City). The site plan development is to be known as the Elements Condominium Plan and is part of the Bistro 6 West Subdivision within the overall Hewitt's Gate Subdivision.

This *Servicing and Stormwater Management Report* has been prepared in support of the *Elements Condominium Plan* prepared by TJCG dated December 20th, 2021 to demonstrate how the lands will be serviced by the surrounding municipal infrastructure within the Kneeshaw Drive Right-of-Way.

In particular, this report examines the existing and proposed servicing infrastructure in relation to:

- Stormwater Servicing
- Water Servicing
- Sanitary Servicing
- Roads and Grading
- Utility Servicing

The design information presented herein, as well as within the design drawing set, has been completed in accordance with all relevant City, LSRCA, MOECP, and MTO design standards. Design information has been coordinated with the overall subdivision design for the Bistro 6 West Subdivision, also being completed by TJCG.

1.2. Property Description

The subject lands are generally rectangular in shape and comprised of approximately 3.15 hectares (ha) of land area. The subject property is legally described as Part of Lot 16, Concession 12 in the City of Barrie, County of Simcoe. The site plan is located within Block 598 of the *Hewitt's Gate Draft Plan of Subdivision*. A copy of the proposed *Site Plan* prepared by The Jones Consulting Group, dated December 20th, 2021, has been attached in **Appendix A**.

The lands are generally situated to the southeast of the intersection of Mapleview Drive East and Yonge Street. It is bound to the north by Mapleview Drive East, to the west by the existing GO Train railway, to the south by proposed single detached residential lands and townhome Block 155 in the *Bistro 6 West Subdivision*, and to the east by the future Collector Road referred to as Kneeshaw Drive on the *Hewitt's Gate Draft Plan*. The location of the subject property is identified in blue in relation to the proposed *Draft Plan* identified in red as shown below in **Figure 1**. A copy of the *Hewitt's Gate Revised Draft Plan to Draft Approved Plan of Subdivision* prepared by The Jones Consulting Group, dated June 4th, 2019, has been provided in **Appendix A.**

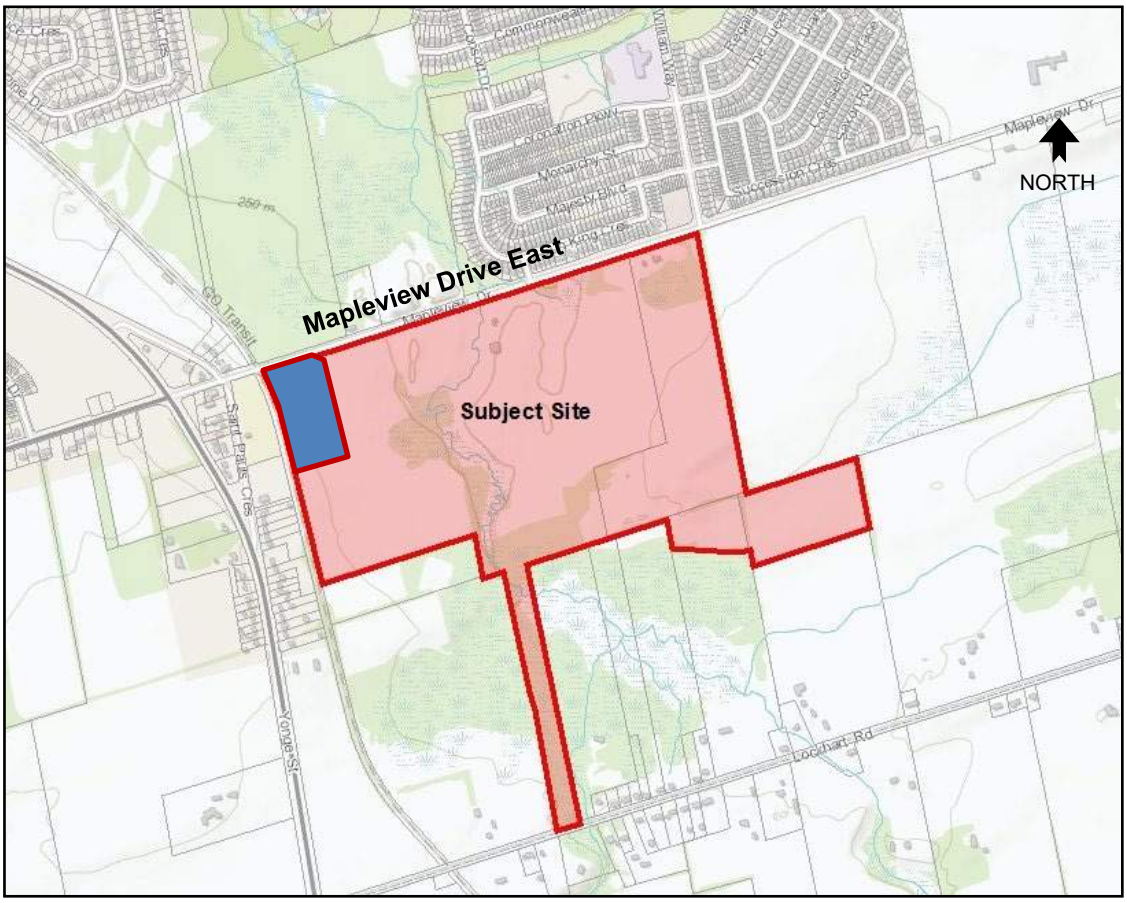


Figure 1 – Site Location Plan

1.3. Existing and Proposed Land Use

The pre-development land use is comprised of mainly cultivated open space utilized for agriculture, with treeline along the north boundary adjacent to Mapleview Drive East and west boundary next to the Metrolinx railway.

The current Draft Plan for Elements Condominium proposes 346 units based on three high density unit blocks. A copy of the *Elements Condominium Plan*, dated December 20th, 2021, is provided in **Appendix A**. A statistical breakdown of each land use as provided on the *Site Plan* has been included in **Table 1** below.

Table 1 - Land Use Breakdown

Elements Condominium Plan

(Proposed Block 598 on Hewitt's Gate Draft Plan)
Part of Lot 16, Concession 12
City of Barrie, County of Simcoe, 2021

SITE PLAN STATISTICS

Site Plan Area	3.15 ha.

Unit Count:

1 @ 94 Unit Apartment (6 Storey 'A')	94 Units
1 @ 156 Unit Apartment (6 Storey 'B')	156 Units
1 @ 96 Unit Apartment (6 Storey 'C')	96 Units
Total	346 Units (110 uph)

	REQUIRED	PROPOSED
Total Holdings	RM3	RM3
Site Plan Area	-	3.15 ha.
Lot Frontage	24.0 m	123.2 m
Front Yard	3.0 m	15.6 m
Interior Side Yard	5.0 m	30.0 m
Exterior Side Yard	2.0 m	7.3 m
Rear Yard	5.0 m	6.6 m
Lot Coverage	max 50 % (1.57 ha.)	20 % (0.64 ha.)
Accessory Structures	max 10 % (0.31 ha.)	0.00 % (0.00 ha.)
Landscape Open Space	min 25 % (0.79 ha.)	53 % (1.68 ha.)
Parking Coverage	max 40 % (1.26 ha.)	26 % (0.83 ha.)
Gross Floor Area	max 200 % (6.30 ha.)	110 % (3.43 ha.)

The *Functional Servicing Report* for the Bistro 6 West Subdivision development was prepared by TJCG in May 2019. Within the *Functional Servicing Report*, the Bistro 6 West residential subdivision included the proposed Elements Condominium Plan (previously named Bistro 6 West Site Plan), Bistro 6 Site Plan, Bistro 6 West Subdivision and roadway network as part of its servicing design. Applicable design measures were applied to Bistro 6 Site Plan and Elements Condominium Plan during the servicing design of the Bistro 6 West Subdivision to allow for their ultimate inception as part of the subdivision itself.

1.4. Supporting Documents

The following documents have been referenced in the preparation of this report:

- Pratt Hansen Group Inc. – Elements Condominium Plan, The Jones Consulting Group Ltd., December 20th, 2021
- Crisdawn Construction Inc. – Hewitt's Gate Revised Draft Plan to Draft Approved Plan of Subdivision, The Jones Consulting Group Ltd., June 4, 2019
- Crisdawn Construction Inc. – Bistro 6 West Subdivision *Functional Servicing Report*, The Jones Consulting Group Ltd., May 2019
- Crisdawn Construction Inc. – Bistro 6 West Subdivision Detailed Stormwater Management Report, The Jones Consulting Group Ltd., revised August 2019
- Crisdawn Construction Inc. – Bistro 6 West Subdivision Detailed Stormwater Management Report Addendum, The Jones Consulting Group Ltd., Addendum No. 1, October 2020
- Geotechnical Investigation, Proposed Bistro 6 West Development, Report No: 2 Revised by Peto MacCallum Ltd., dated May 19th, 2021
- Guelph Permeameter Testing, Proposed Bistro 6 West Development, Report No: 4 by Peto MacCallum Ltd., dated July 22nd, 2021
- Ground Water Level Monitoring, Proposed Bistro 6 West Development (Elements), Report No: 6 by Peto MacCallum Ltd., dated October 27th, 2021
- Hydrogeological Study in Support of Draft Plan – Bistro 6 West Subdivision, R.J. Burnside & Associates Ltd., Updated October 2019
- Technical Memorandum, Elements Condominium – Hydrogeology Brief, R.J. Burnside & Associates Ltd., dated August 10th, 2021
- Addendum to Hydrogeology Brief, R.J. Burnside & Associates Ltd., dated October 28th, 2021
- Hewitt's Secondary Plan Area Subwatershed Impact Study, Lover's, Hewitt's and Sandy Cove Creeks, R.J. Burnside & Associates Ltd., September 2016

- City of Barrie, Stormwater Drainage & Stormwater Management Policies & Design Guidelines, October 2020
- Lake Simcoe Region Conservation Authority, Watershed Development Guidelines, June 2020
- Lake Simcoe Region Conservation Authority, Technical Guidelines for Stormwater Management Submissions, September 2016
- Lake Simcoe Region Conservation Authority, Barrie Creeks, Lovers Creek and Hewitt's Creek Subwatershed Plan, 2012
- Credit Valley Conservation Authority & Toronto Region Conservation Authority, Low Impact Development Stormwater Management Planning and Design Guide, 2010
- Low Impact Development Stormwater Management Planning & Design Guide Wiki, Sustainable Technologies Evaluation Program, 2018
- Ministry of the Environment, Lake Simcoe Protection Plan, July 2009
- Ministry of the Environment, Stormwater Management Planning and Design Manual, March 2003
- Ministry of Transportation, Drainage Management Manual, February 2008
- City of Barrie, Hewitt's Secondary Plan Transportation Improvements Municipal Class Environmental Assessment, Phases 3 & 4, adopted by council June 19, 2017

2. Stormwater Management Plan

2.1. Introduction

The stormwater management plan is intended to provide an environmentally sound approach to stormwater and drainage issues. The issues can be divided into four categories: stormwater quality control, stormwater quantity control, water balance, and erosion & sediment control.

This report outlines a proposed design for the Elements Condominium Plan stormwater management system to meet the compulsory post-development quantity and quality control requirements of the City, LSRCA, MOECP, *Hewitt's Secondary Plan Area SIS*, and the *Bistro 6 West Subdivision DSWMR.*

The City of Barrie and the LSRCA require Level 1 (Enhanced) quality control for the stormwater runoff generated from this site. The proposed downstream Bistro 6 West Subdivision SWMF#7 pond has been sized to provide quantity control of the 100-year post- to pre-development peak flows and the extended detention (48 hour) for the 25mm storm event for erosion control for the subject lands as well as additional external lands described previously. The Elements Condominium Plan development is proposed to implement pre-treatment devices and site-specific LIDs to achieve Enhanced (Level 1) quality control.

The design of SWMF#7 is outlined in the *DSWMR* completed for the *Bistro 6 West Subdivision*, by The Jones Consulting Group Ltd., dated revised August 2019 (TJCG Project # PRA-12160 and City of Barrie File # D12-426) which demonstrates that the pond has been designed to provide the required SWM quantity control for the subject site.

In general, a treatment train approach is proposed to meet the subject lands' quality control requirements. This system will utilize lot level/source, conveyance and end-of-pipe controls to meet the objectives set out by the City, LSRCA, MOECP, the *SIS* and the *Bistro 6 West Subdivision DSWMR.* Treatment will be provided through a combination of Manufactured Treatment Devices (MTD's) and infiltration and filtration-based LID practices.

Refer to **Table 2** below for a list of the Stormwater Management Design Criteria to be addressed in the proposed Stormwater Management Plan.

Table 2 - Stormwater Management Design Criteria

Hewitt's Gate Subdivision - Stormwater Management Design Criteria		
Category	**Sub-Category**	**Target**
Quantity Control	Peak Flow Control	Meet the site's catchment area parameters as outlined for the design of SWMF7 within the Bistro 6 West Subdivision DSWMR.
	Runoff Volume Control	In accordance with *'Sites With Restrictions'* criteria *(LSRCA)*, targets established by SWMF catchment based on constraints, see Section 2.2.2.2. implementing Alternative #2 – minimum 5mm total volume control over impervious surface.
	Minor-Major System Conveyance	Minor System to convey 5-year event, Major System to convey 100-year event *(CoB, LSRCA)*
	Regulatory Storm Conveyance	Convey the Regional Event to a *sufficient outlet (CoB, LSRCA)*
Quality Control	Total Suspended Soils	Provide Level 1 (Enhanced) Protection, 80% Long Term Removal *(CoB, MOE, LSRCA)*
	Total Phosphorus	Minimum 80% Reduction in Post-Development Loading *(LSRCA)*
Water Balance		Meet the infiltration results achieved for the subject site within the Bistro 6 West Subdivision DSWMR.
Erosion & Sediment Control		Protect the site from first disturbance through to reinstatement from erosion and sediment wash-off to mitigate impacts on natural systems *(CoB, LSRCA)*

2.2. Site Physiography

2.2.1. Existing Soils Conditions

The soils found on the subject site are predominantly a Dundonald Sandy Loam (Ds) which belongs to Group B of the SCS Hydrological Soils Group Classification system. Soil Series are determined from the *Soil Map of Simcoe County, Report No. 29* of the *Ontario Soil Survey* produced by the Canada Department of Agriculture with the Ontario Department of Agriculture. Soil series and hydrological soils group are shown below in **Figure 2** and **Table 3.** An excerpt from the Soils Map is provided in **Appendix A**.

Figure 2 - Site Soils Identification

Table 3 - Soil Type Distribution

Soil Type	Soil Name	SCS Group	Total Area (ha)	Percentage Area (%)
Ds	Dundonald Sandy Loam	Group B	3.16	100.00

A geotechnical report (Peto MacCallium Ltd. Report No. 2 Revised) has been completed specific to the Elements Condominium Site Plan. Information obtained from the Geotechnical Report

(No.2 Revised) was used in the initial design of proposed Low Impact Development measures. The presence of artesian pressures is noted in some boreholes on the subject site due to elevated groundwater levels. A six-month long ground water monitoring program (Report No. 6) has been completed by Peto MacCallum Ltd. to provide a better understanding of seasonal groundwater fluctuations within the subject site. According to the findings of this study, seasonal groundwater across the site is anticipated to range in elevation between 251.9 and 256.9m. Drawing 2-1 of the report shows the location of the Boreholes in relation to the Condominium Plan. A closer look reveals that Boreholes 203 and 211 would be suitable boreholes to describe anticipated groundwater elevations in the vicinity of the proposed LID facilities. **Table 4** below summarizes the observed groundwater level measurements outlined with Peto MacCallum Ltd. Ground Water Level Monitoring Report dated October 27th, 2021.

Table 4 – Ground Water Level Measurements

Borehole/ Monitoring Well ID	Ground Surface Elevation	Observed Groundwater Depth and Elevation (m) by date					
		2021-04	2021-05	2021-06	2021-07	2021-08	2021-09
203	256.30	3.3 / 253.0	3.3 / 253.0	3.8 / 252.5	3.4 / 252.9	**3.2 / 253.1**	3.5 / 252.8*
211	255.05	0.7 / 254.4	**0.6 / 254.5**	1.2 / 253.9	1.0 / 254.1	0.9 / 254.2	3.2 / 251.9

* A mathematical error is present within the monitoring report. The shown result has been corrected.

Another geotechnical report (Report No. 4) was prepared to establish infiltration parameters for the LID features through Guelph Permeameter Testing. The in-situ underlying soils were determined to be silty sand till and silt & sand till. The infiltration rates determined from this additional testing have been coded into the PCSWMM models. **Table 5** below summarizes the testing results outlined within Peto MacCallum Ltd. Guelph Permeameter Testing Report dated July 22nd, 2021.

Table 5 – Guelph Permeameter Testing Results

Test Pit	Test Depth (m) & Elevation	Material Type	K_{fs} (cm/sec)	Infiltration Rate (mm/hr)	Factored Infiltration Rate (mm/hr)
1	0.6m / 255.1 1.5m / 254.2	Silty Sand Till	1.5×10^{-5} 1.4×10^{-5}	28 27	**11**
2	0.4m / 254.9 1.5m / 253.8	Silty Sand Till Sand and Silt Till	1.2×10^{-5} 1.8×10^{-5}	26 29	**11**
3	1.2m / 255.5 2.7m / 254.0	Silty Sand Till	2.4×10^{-4} 6.4×10^{-6}	32 22	**9**

2.2.2. Existing Drainage Conditions

The subject lands consist of approximately 3.16 hectares of land which is primarily used for agricultural purposes. The land's topography contains average slopes ranging from 3-5%, generally draining eastward towards the Natural Heritage System associated with the Hewitt's Creek watercourse. The land's topography ranges in elevation from a maximum elevation of 261 meters at the southwest property boundary to a minimum elevation of 255 meters near the northeast property boundary adjacent to the future Kneeshaw Drive and Mapleview Drive East intersection.

There are no existing stormwater management facilities on the subject lands and all flows are released uncontrolled to Hewitt's Creek. The existing drainage conditions are shown in the *Stormwater Management Plan Pre-Development Conditions*, **Drawing SWM-1** in **Appendix B**.

2.2.3. Proposed Drainage Conditions

Development of the subject lands will consist of high-density residential buildings and an internal looped driveway and parking areas to be built to City of Barrie standards, as well as Open Spaces for amenities.

The grading of the site will direct stormwater runoff to the internal road / parking lot where it is ultimately directed towards the proposed LID facilities through overland flow. Overflow from the LID facilities will be captured by the downstream storm sewer network which has been sized for the 100-year event. Major flows are to be collected and conveyed via the provided storm sewer connection to the 100-year pipe. Emergency flow will be directed overland to Kneeshaw Road and ultimately through the Bistro 6 Site Plan to SWMF7. The proposed end-of-pipe SWM facility as identified in the *Bistro 6 West Subdivision DSWMR* is an extended detention dry pond complete with a media filter LID in lieu of a traditional forebay. It has been sized to provide the required stormwater quantity control for the proposed development in addition to lands within the larger catchment area. The subject site will also include Low Impact Development (LID) measures to provide at-source controls that reduce runoff volumes, promote groundwater recharge, aid in maintaining water balance, and assist in phosphorus removal. The *Hewitt's Secondary Plan Area Subwatershed Impact Study (SIS)* has identified LID measures suitable for implementation within the subject property that are intended to achieve the LSRCA and City of Barrie targets for infiltration / filtration, water balance and total phosphorus removal. Further discussion regarding LID measures is provided in subsequent sections of this Report as well as in the *Detailed Stormwater Management Report* submitted for the proposed *Bistro 6 West Subdivision*.

West of Hewitt's Creek, and in accordance with the *SIS*, the proposed grading and drainage design includes the construction of a storm sewer system to convey flows up to and including the 100-year event from an external drainage area west of the GO Transit Rail Corridor, elsewhere referred to as Catchment 7A-EXT, as well as the proposed site, a medium density block shown as Catchment 7B. Runoff from Catchment 7A-EXT will be conveyed via a 100-year trunk storm sewer from the intersection of Yonge Street and St. Paul's Crescent, crossing the GO Transit Rail Corridor and traversing through Kneeshaw Drive, where it will collect runoff from the subject lands, Catchment 7B, adjacent lands, and eventually drain to SWMF#7; where captured runoff is treated for quantity control before discharging to Hewitt's Creek.

The stormwater management facility was designed as part of the *Bistro 6 West Subdivision* to meet the quantity control requirements outlined within the *SIS* along with those of the City of Barrie, LSRCA and MOE, before discharging to Hewitt's Creek. Further design details are provided in the *Bistro 6 West Subdivision Detailed Stormwater Management Report*, dated revised August 2019.

The *Stormwater Management Plan Post-Development Conditions LID Model Catchment Areas* illustrate the proposed drainage conditions (**Drawing SWM-2**, provided in **Appendix B**). The storm sewer design is also provided (**Drawings STM-1** and **SS-2** in **Appendix B**), which delineates the storm sewer subcatchments and storm sewer design sheet, respectively. The *Overall Stormwater Management Plans: West of Hewitt's Creek*, *Bistro 6 West Subdivision* have also been included as **Drawings SWM-1 & SWM-2** (TJCG Project No. PRA-12160) in **Appendix A** for reference as to how the subject site fits into the proposed subdivision's overall stormwater management plan.

2.3. Hydrology

2.3.1. PCSWMM Model

The development was hydrologically modeled using the latest version of the PCSWMM Professional computer program by Computational Hydraulics Int. PCSWMM is a GIS-based hydrologic and hydraulic modelling software capable of performing both event-based and continuous rainfall simulations for Stormwater Management Facility and Low Impact Development design, Water Quality Modelling, Water Balance and Erosion Threshold calculations, respectively. Furthermore, the PCSWMM model developed for the subject lands utilizes the Green-Ampt Method for determining infiltration losses, which allows for the direct incorporation of field-tested infiltration rates, providing a higher level of accuracy to reflect field conditions. Infiltration rates have been obtained through Guelph Permeameter testing and coded into the PCSWMM modeling with an appropriate factor of safety for sizing of the LID's.

The PCSWMM model used for this design is derived from the Peak Flow and LID models prepared for the *Bistro 6 West Subdivision DSWMR,* which were derived from the *SIS* model. The model has been truncated to include only the subject lands and the proposed LID's. The model input parameters (e.g. catchment area, flow lengths, proposed imperviousness) have been updated to reflect the proposed site plan design and can be found in **Appendix D**.

The hydrologic modeling includes only the post-development conditions as the target flow rates (pre-development) are established within the *Bistro 6 West Subdivision DSWMR* based on the SIS.

2.3.2. Design Storms & Climatology

The rainfall events used for the PCSWMM model simulations for various scenarios are based first on the *SIS* findings, which include the SCS Type II storm distribution for both the 6-hour and 24-hour durations. Modeling was then extended further to include the 12-hour duration SCS Type II Storm and the 4-hour duration Chicago Storm distributions to comprehensively evaluate the proposed system's response under a wider range of events, in accordance with the City's SWM Guidelines. The following events have been modeled:

- 4-hour Chicago rainfall distribution for the 100-year storm event;
- 6-hour SCS Type II rainfall distribution for the 100-year storm event;
- 12-hour SCS Type II rainfall distribution for the 100-year storm event;
- 24-hour SCS Type II rainfall distributions for the 100-year storm event;
- 25 mm 4-hour Chicago rainfall event; and
- Hazel Regional Storm Event.

In addition to modeling the above noted storm events, a continuous modeling simulation was developed to assess the drawdown characteristics of the LID measures, as well as assess Runoff Volume Capture, SWM Quality Control, and Post-Development Water Balance for the proposed site on an annual basis. The continuous modeling simulation uses a data set of hourly precipitation obtained in the City of Barrie for a 12-month period from June 1st, 2005 to May 31st, 2006, representing a typical year. To further the continuous model simulation, the corresponding sets of climatic data consisting of maximum and minimum daily temperatures, winds, etc. was coded into the PCSWMM model to simulate evapotranspiration processes. Inputs to the continuous modeling simulation mimic the model setup for the proposed condition continuous modeling completed as part of the *SIS*.

2.3.3. Modeling Approach & Rationale

As noted in **Section 2.3.1**, the hydrologic modeling includes only scenarios under post-development conditions. General naming convention for Subcatchments and Catchments provided in the *SIS* modeling has been maintained to remain consistent and for ease of comparison.

There are two (2) post-development condition models with each model run under a range of discrete and continuous storm simulations to assess the performance of proposed LID's. The post-development models evaluated are listed below:

- *Post-Dev-LID*: Post-Development LID Model, including a simulation for the 25mm storm, 100-year storms, Hazel Regional event and a continuous simulation,
- *External*: Post-Development External model, including simulations for the 100-year storms and Hazel Regional event.

The models are based on the original PCSWMM model developed by RJB for the *SIS* and further refined for the *Bistro 6 West Subdivision* stormwater management design. The original PCSWMM model has been truncated and then further refined to reflect the proposed site plan design and parameter estimates.

The revised model was initially created at the storm sewer subcatchments level of spatial detail, with parameters determined by the proposed grading design and a detailed land-use breakdown for each storm sewer subcatchment. For each subcatchment, the total imperviousness was calculated based on the proposed site plan layout. Other geometric parameters such as catchment width, slope, flow lengths, and infiltration parameters were assigned. Underlying soils data was incorporated based on soil textural class, and sub-area routing was determined dependent on the land use in the catchment.

The *Post-Dev-LID* model was constructed to assess the simulated performance of proposed LID measures in meeting Quantity Control (Runoff Volume Control Target), Quality Control (via Mass Balance Calculations), and Water Balance targets. The base model was utilized and subcatchment parameters were assigned to the corresponding catchment. All conveyance and drainage infrastructure elements were removed, and the respective subcatchments were hydrologically routed to their respective downstream LID facilities. Each of the LID facilities were initially sized based on a first principles approach, using the guidelines provided in the *CVC/TRCA Low Impact Development Stormwater Management and Planning Design Guide*. The facilities were then parametrized and coded into the model as independent subcatchments with the corresponding LID facility taking up the entire footprint. A *'No Rain'* gauge was then assigned to each of these LID subcatchments. This approach is supported on two assumptions; first, as the majority of proposed LID facilities are located at finished grade and second, the addition of an LID facility to an aggregated subcatchment will change its parameters such as weighted imperviousness, modifying the hydrologic response.

An iterative process was then undertaken to confirm the LID facilities were sized to capture at least the volume target established under the LSRCA's *Runoff Volume Control Targets for Sites with Restrictions.* Once the LID facility sizing was determined to confirm volumetric capture on a discrete event basis, a continuous simulation was run to assess a number of additional facility characteristics; including:

- adequate drawdown time of the LID facilities between events producing runoff;
- sufficient redundant volume is available if inter-event window is short (<72 hours);
- total infiltration volume on an annual basis, and;
- total capture volume on an annual basis.

Post-Dev-LID simulations were further extended to include the 100-year and Hazel regional storm events. Flows discharging from the relevant LIDs were used to size the structures and services immediately downstream.

The rationale for developing an initial model with such a high level of spatial detail was to establish overall SWMF catchment parameters to a higher level of confidence when completing the end-of-pipe facility designs, notwithstanding the storage effects of proposed LID measures. This base model could then also be used to develop additional model scenarios to determine if other Quantity Control or Water Balance targets are being met at varying levels of spatial detail and conservancy. Further details pertaining to the comparison of various model results are included in **Section 2.**

The *External* model was created to assess the conveyance of stormwater runoff from the Metrolinx corridor, Bistro 6 West Subdivision Railway Berm, Mapleview Drive East Roadway and Uncontrolled Elements Condominium Catchment Areas. The *Post-Dev-LID* model was duplicated and used as the base model for this simulation. The base model was stripped of all controlled flow areas and LID facilities.

Additional subcatchments external to the Elements Condominium Plan were added based on existing and proposed grading design and detailed land use breakdown. Other geometric parameters such as catchment width, slope, flow lengths, and infiltration parameters were assigned. Underlying soils data was incorporated based on soil textural class, and sub-area routing was determined dependent on the land use in the catchment. Conveyance infrastructure was modeled as a series of conduits and junctions with assigned cross sections and invert elevations based on existing and proposed grading. The subcatchments were hydraulicly routed to the upstream junctions and conveyed to the receiving outfall node. A hydraulic grade line analysis has been provided in **Appendix D** for reference.

2.3.4. Discretization

Model discretization for the *Post-Dev-LID* and *External* models, developed under the approach described previously, is summarized herein. Detailed land use breakdown analyses are provided in **Appendix C** and corresponding PCSWMM model input parameters are provided in **Appendix D.**

LID Modeling

The *Stormwater Management Plan Post-Development Conditions LID Model Catchment Areas* and *Storm Sewer Catchments* illustrate the proposed drainage conditions (**Drawing SWM-2 & STM-1**, provided in **Appendix B**). **Figure 3** below shows the *Post-Dev-LID* model schematic.

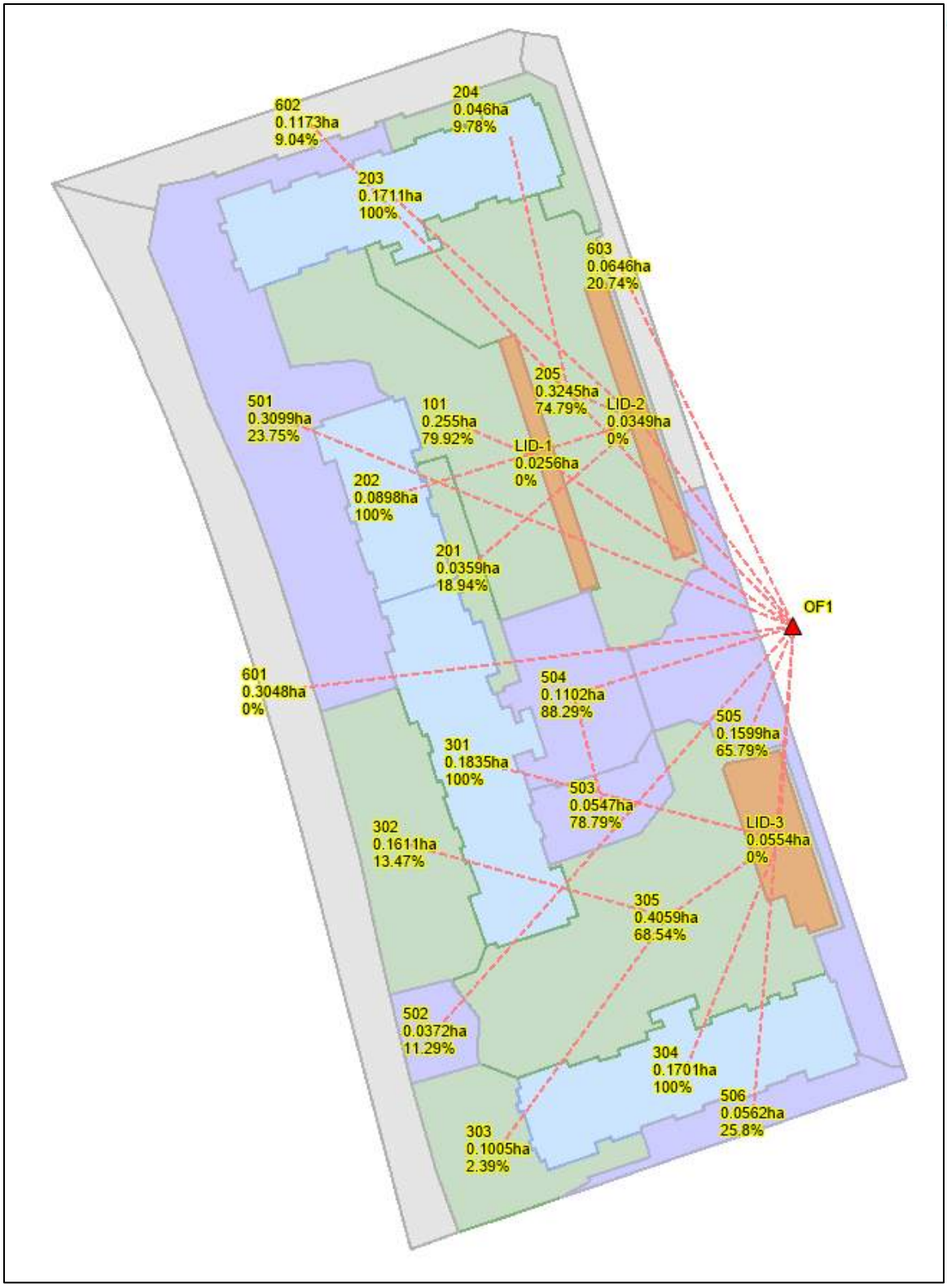


Figure 3 - *Post-Dev-LID* model schematic

The PCSWMM LID model for the subject lands includes twenty-three (23) discrete catchments.

- Catchment 101 is approximately 0.26 ha in size and represents internal drainage areas of the subject lands immediately adjacent to proposed buildings including landscaped areas and parking lot/driveway areas. Catchment 101 corresponds to Catchment area 401 on **Drawing STM-1**. This area is directed towards the LID-1 Rain Garden by overland flow.
- Catchments 201 to 205 approximately total 0.67 ha in size and represent internal drainage areas of the subject lands that drain to LID-2. This catchment is comprised of rooftop areas, parking lot/driveway areas and landscape areas. Catchments 201 through 205 correspond to catchments 402 through 406, respectively, on **Drawing STM-1**. Flows generated in these catchments are directed towards the LID-2 Rain Garden through both overland flow and the use of a third pipe system.
- Catchments 301 to 305 approximately total 1.02 ha in size and represent internal drainage areas of the subject lands that drain to LID-3. These catchment areas are comprised of rooftop areas, parking lot/driveway areas and landscape areas. Catchments 301 through 305 correspond to catchments 407 through 414 on **Drawing STM-1**. Flows generated in these catchments are directed towards the LID-3 Rain Garden through both overland flow and the use of a third pipe system.
- Catchments 501 through 504 are approximately 0.31 ha, 0.04 ha, 0.05 ha and 0.11 ha in size, respectively, and represent internal drainage areas that do not drain towards LID facilities. These catchment areas are comprised of parking lot surfaces and landscaped areas that are captured by the proposed internal 5-year storm sewer network. Flows captured in these areas are directed towards an Up-Flo Filter unit before discharging to the downstream 100-year storm sewer.
- Catchments 505 and 506 are approximately 0.16 ha & 0.06 ha in size, respectively, and represent internal developable area which is captured by infrastructure previously proposed in the Bistro 6 West Subdivision. These catchment areas are comprised of landscaped and parking lot/driveway areas. Flows generated from major storm events are conveyed to SWMF7 via segments of the 100-year storm sewer network within the Kneeshaw Drive right-of-way.
- Catchment 601 approximately totals 0.30 ha in size and represent internal drainage area that cannot be captured and directed towards SWMFs due to grading constraints. Flows generated from this area release uncontrolled towards the proposed drainage ditch

adjacent to the Metrolinx Railway. This area is comprised of landscaped areas within the railway berm slope.

- Catchment 602 is approximately 0.12 ha in size and represents internal developable area that cannot be captured and directed towards the SWMFs due to grading constraints. Flows generated from this area release uncontrolled towards the existing Mapleview Drive East roadside ditch. This area contains landscaped and paved areas.
- Catchment 603 is approximately 0.06 ha in size and represents Internal developable area which cannot be captured and directed to SWMFs due to grading constraints. Flows generated from this area release uncontrolled towards the future Kneeshaw Drive and Mapleview Drive East intersection where they are collected by the existing drainage system along Mapleview Drive East. This area is comprised of landscaped and paved areas.
- Catchments LID-1, LID-2 and LID-3 are 0.0256 ha, 0.0349ha and 0.0554 ha in size, respectively. These catchments represent internal developable area which has been used for the proposed LIDs. All LID facilities have been modeled with a 'NO RAIN' rain gauge and have been assigned their own respective LID control in PCSWMM.

This provides for a total catchment area of approximately **3.16 ha**, of which approximately 0.49 ha releases uncontrolled while the balance of the area is representative of internal catchments which are routed to proposed LID facilities or previously proposed infrastructure, and ultimately are directed towards SWMF7.

External Modeling

The *Stormwater Management Plan Post-Development Conditions LID Model Catchment Areas* and *Storm Sewer Catchments* illustrate the proposed drainage conditions (**Drawing SWM-2 & STM-1**, provided in **Appendix B**). **Figure 4** below shows the *External* model schematic.

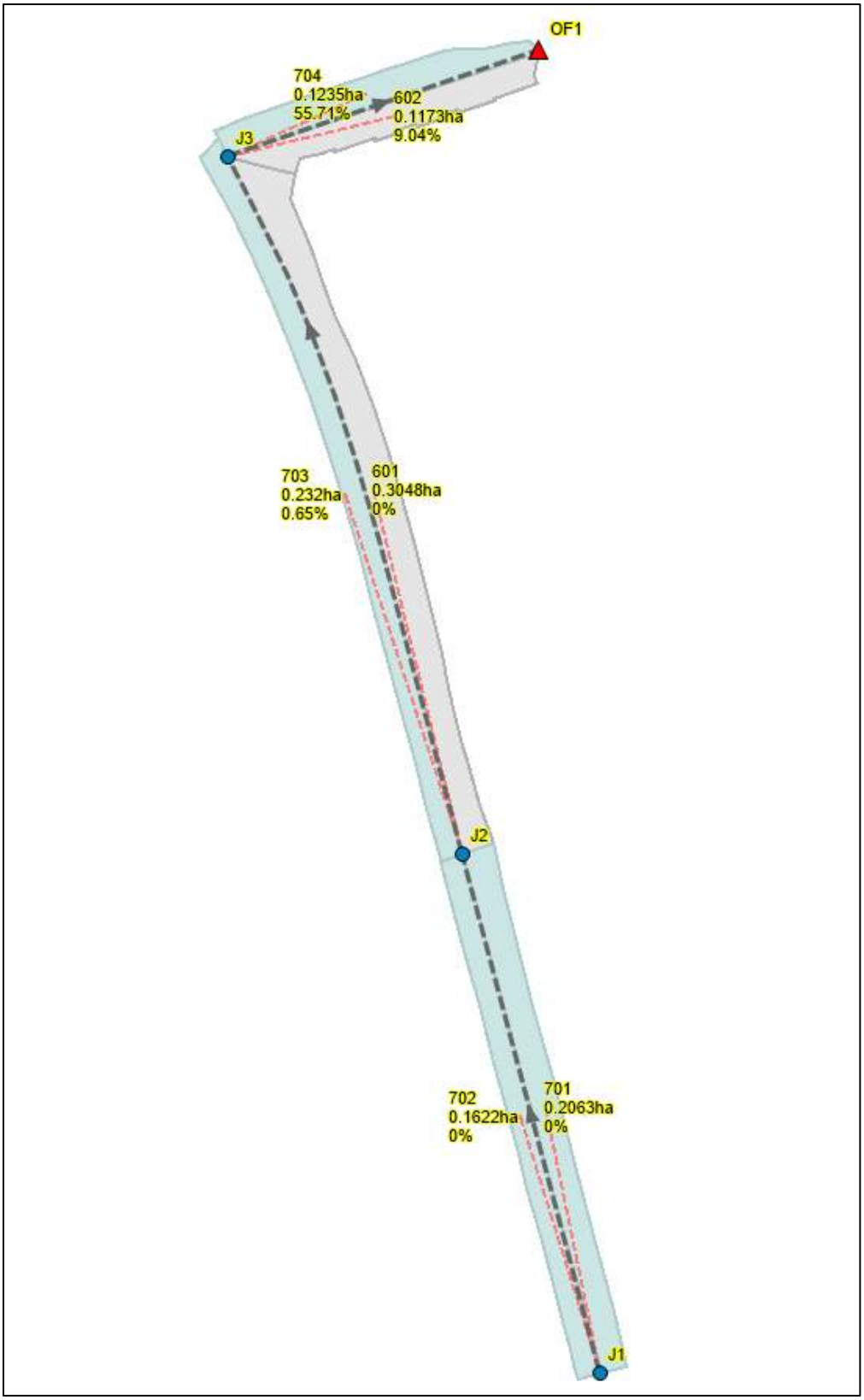


Figure 4 - *External* model schematic

The PCSWMM External model for the subject lands includes six (6) discrete catchments.

- Catchments 601 and 602 are approximately 0.30 and 0.12 ha in size and are identical to the catchments used in the Post-Dev-PF model. Both catchments represent internal drainage area that cannot be captured and directed towards SWMFs due to grading constraints. Flows generated are released uncontrolled to proposed drainage ditches adjacent to the Metrolinx Railway corridor and Mapleview Drive East.
- Catchments 701 to 704 approximately total 0.72 ha in size and represent drainage areas external to the subject lands that drain to the proposed drainage ditches adjacent to Mapleview Drive East and the Metrolinx Railway corridor. These catchments are comprised of paved and landscape areas. These catchment areas were created to assess the conveyance capacity of the proposed drainage ditches, and do not drain to SWMF7.

This provides for a total catchment area of approximately **1.15 ha** draining towards the Metrolinx and Mapleview Drive East drainage ditches.

2.4. Low Impact Development & Pre-Treatment Devices

Low Impact Development (LID) is a stormwater management strategy that seeks to mitigate the impacts of increased runoff and stormwater pollution by managing runoff as close to its source as possible. LID comprises a set of site design strategies that minimize runoff using a variety of SWM features that mimic natural or pre-development hydrology through the processes of infiltration, evapotranspiration, harvesting, filtration and detention of stormwater. These practices can effectively remove nutrients, pathogens and metals from runoff, and reduce the volume and intensity of stormwater flows.

As per the recommendations of the *SIS,* the City of Barrie, LSRCA and MOE, a suite of Low Impact Development measures are being proposed throughout the subject lands in an effort to reduce the reliance on end-of-pipe facilities and better mimic the natural hydrologic cycle. The subject lands will have on-site rain gardens adjacent to the parking lot areas, all designed in accordance with the *Credit Valley Conservation Authority & Toronto and Region Conservation Authority – Low Impact Development Stormwater Management Planning and Design Guide (2010)*.

Infiltration rates used throughout the design and modeling utilize a factor of safety of 2.5 and 3.0.

The *Ratio of Impervious Drainage Area to Footprint Surface Area of the Practice,* otherwise referred to as the *Imperviousness Ratio (I/P Ratio),* for each proposed LID was determined comparing the directly connected upstream drainage area (i.e. rooftop areas excluded) to the area of the proposed practice to ensure each facility meets the footprint surface area sizing criteria to provide the anticipated levels of water quality treatment. Further details and supporting calculations on the sizing of the LIDs are included in the *LID Design Notes*, included in **Appendix C** for reference.

Further description of the LID's proposed for the site is provided in the subsections below. Plan, section and detail drawings have been provided for all LID facilities. The catchment areas for the proposed LID's are shown on **Drawings SWM-2 & STM-1**, and LID Sections are shown on **Drawing LID-1** in **Appendix B**.

2.4.1. Manufactured Treatment Devices (CB Shields)

CB Shields have been proposed to line two catchbasin structures. These structures are immediately downstream of the snow storage areas and will collect salt and sediment concentrated runoff. Structures CB4 and CB5 will be outfitted with a treatment device such as a CB Shield (or approved equivalent). The TSS removal capability of a CB shield has now received ETV Approval and testing, a copy of which has been included in **Appendix C** for reference.

A CB Shield's TSS Removal efficiency is based on two key parameters; the size of the upstream drainage area and its imperviousness. The removal efficiency of an individual CB shield device has been estimated using an average drainage area of 0.45 ha, under the assumption that half of a Storm Sewer Subcatchment is captured by an individual inlet device. With the Subcatchment area having an average imperviousness of 60%, with each half the area draining to a respective inlet, the removal efficiency has been approximated at 50%.

In order to support longer term operation of the sediment capture devices, deepened sumps will be required on the above mentioned catchbasin structures (minimum 0.9m depth) to provide additional storage capacity and limit potential resuspension or scour of captured sediment.

2.4.2. Rain Gardens

A series of three (3) centralized LID features, elsewhere referred to as Rain Gardens, are proposed. The Rain Gardens will assist in meeting water quantity and quality objectives as part of the treatment train approach through filtration and infiltration of runoff. These facilities have been sized to capture and infiltrate the full runoff volume from the 25 mm storm generated from their respective contributing catchment areas, where flows will be distributed across the surface of the practice. The factored infiltration rates were determined through Guelph Permeameter in-situ testing conducted by Peto MacCallum Ltd. and have been assigned to their respective facilities. **Table 5** in **Section 2.2.1.** summarizes the Guelph Permeameter testing results. A summary of the Rain Gardens LID sizing is provided in **Table 6** below.

Table 6 – Summary of LID Sizing – Rain Garden

Rain Garden LIDs			
LID Number	LID-1	LID-2	LID-3
PCSWMM Drainage Area ID	101	201 - 205	301 - 305
Drainage Area	0.26 ha	0.67 ha	1.02 ha
Drainage area imperviousness	79.9%	77.2%	64.2%
25mm over impervious area	50.9 m^3	128.7 m^3	163.9 m^3
25mm Storm Runoff Volume (PCSWMM)	174.0 mm	316.7 mm	252.9 mm
LID Footprint Area	256 m^2	349 m^2	554 m^2
Design Infiltration Rate	11 mm/hr	11 mm/hr	9 mm/hr
Water Quality Volume (PCSWMM)	44.6 m^3	110.6 m^3	140.1 m^3
*MOE Volume Required (based on 40 m^3/ha)	10.2 m^3	26.7 m^3	40.8 m^3
**Provided LID Storage Volume	141.4 m^3	192.8m^3	306.1 m^3
***Drawdown Time	13.9 hr	26.6 hr	25.5 hr
****Drawdown Time (MOE SWMP&DM)	15.8 hr	28.8 hr	28.1 hr

* MOE Required Volume is based on the largest volume requirement for an Infiltration SWMP Type in MOE Table 3.2
** Refer to *LID Facility Estimation of Provided Storage Volume* calculations in **Appendix C**.
*** Drawdown time is extracted from the PCSWMM model results for the Storage Layer water level over time during the 25mm storm scenario. Refer to the LID Performance Graphical Model Output during the 25mm event in **Appendix D**.
****Refer to *LID Facility Drawdown Time Calculations* (MOE SWMP&DM) in **Appendix C**.

Three (3) rain gardens are proposed to be placed adjacent to the internal roadway. These facilities are proposed to fully capture and infiltrate the runoff from their respective contributing catchment areas. Gutter flow will be diverted through gutter spillways to shallow depressional areas located behind the sidewalk. Rooftop flows and flows captured by the storm sewers will be distributed to the storage layer of the rain garden by a perforated header pipe and distribution rows. The practices will be comprised of a 50mm River Stone / Hardwood Mulch surface, 500mm thick soil media, 100mm thick choke layer of 12mm diameter pea gravel and a 300mm storage layer of 19mm diameter washed clear stone. The engineered soil media has been designed as a Blend B filter media with 3-parts sand, 2-parts topsoil and 1-part organic soil components. The LIDs will have surface areas of 256 m^2, 349 m^2, and 554 m^2 respectively. Erosion protection will be provided at inlets with concrete spillway and gravel diaphragm placed to capture and retain any sediment entering the practice.

The proposed systems have *I/P* ratio's ranging between **5.2:1 to 7.9:1**, meeting the required criteria. Further details and supporting calculations on the sizing of this practice are included in the *LID Design Notes*, included in **Appendix C** for reference. Sections and details are included on **Drawing LID-1** in **Appendix B** for reference.

2.4.3. Up-Flo Filter

An Up-Flo Filter is proposed immediately upstream of the 100-year storm sewer. *Up-Flo Filter Unit UFF-4* (4-module) was selected for use in the subject lands with sizing provided by the manufacturer to meet the ETV particle size distribution and assist the treatment train in providing an *Enhanced Level* of quality control. *Up-Flo Filter ETV Performance Verification* documents have been included in **Appendix C**. The unit will treat stormwater captured by the internal 5-year storm sewer network before discharging to the downstream 100-year storm sewer.

An Up-Flow Filter's TSS and TP Removal efficiencies are based on two key parameters; the size of the upstream drainage area and its corresponding imperviousness. The removal efficiencies of the unit have been estimated by the manufacturer and is summarized below:

Up-Flo Filter

Area, Imperviousness %	0.51 ha, 42.6%
Proposed Unit	UFF-4 (4-modules)
TSS Removal	81.3%
TP Removal	48%
% Annual RV	90.4%

Detailed calculations pertaining to sizing and overall removal efficiency of the devices have been provided in **Appendix C.** The location of the proposed Up-Flo Filter unit is shown on **Drawings STM-1, SWM-2 and SS-1**. Specifications are provided on the detail sheets within the overall Civil Engineering Design drawing set.

2.4.4. Other Lot-Level LIDs

In accordance with the *SIS,* it is recommended that all catchments should incorporate an increased depth of absorbent topsoil of at least 300mm thick to promote at-source infiltration on pervious surfaces on lots. It is further recommended that any absorbent topsoil be amended with organic content (compost) as recommended in the *CVC/TRCA Design Guidelines* while scarifying subsoils and remaining as unconsolidated as reasonably possible to maintain void spaces. A study conducted in BC has asserted reductions in runoff volume and peak flows up to 50% from the placement of 300mm of absorbent landscaping (British Columbia Ministry of Land, Water and Air Protection, May 2002). Another study conducted in Ontario through the *Sustainable Technologies Evaluation Program (STEP)* has confirmed similar findings with a reduction in runoff of up to 27% (STEP, Residential Lot Level SWM Practices, 2013).

Other recommendations include downspout disconnection, where roof leaders are directed away from impervious surfaces. Though not explicitly quantified, sub-area routing was applied throughout all PCSWMM modelling to capture the benefit of re-routing runoff produced from rooftops to pervious surfaces. Additionally, it is recommended to incorporate rain barrels at the lot level where possible, to further reduce runoff volumes to downstream systems.

It should be noted that although the measures in this subsection are recommended, to remain conservative, they are not included in any of the SWM calculations.

2.4.5. LID Sizing

Low Impact Development BMP's selected to be implemented on the subject lands have been sized in accordance with the MOE *Stormwater Management Planning and Design Guidelines* and

the CVC & TRCA *Low Impact Development Stormwater Management Planning and Design Guide.* Each of the units have been sized in an effort to meet the following objectives:

1. Capture & retain onsite the runoff from the 25mm event over the total impervious area;
2. Conveyance of the runoff from the 100-year event via the overflow structure;
3. Provide Enhanced (Level 1) Quality Control;
4. Best Efforts to maintain pre-development water balance by promoting groundwater recharge through infiltration practices;
5. Best Efforts to reduce post-development Phosphorus loading to pre-development levels.

Each LID has been sized to adequately achieve the Runoff Volume Control target (Objective 1 above), and subsequently aids in achieving the remaining objectives for the overall site also listed above. A PCSWMM model was developed as described in **Section 2.3** of this report for the purpose of assessing the performance of the proposed LID's in meeting the Stormwater Management Objectives for the subject site. For further information, refer to the *LID Design Notes* provided in **Appendix C**.

2.5. Stormwater Quantity Control

In order to provide the required stormwater quantity control, the site will utilize a combination of source, conveyance, and end-of-pipe controls. The combination of LID measures and the extended detention dry pond's active storage and outlet controls will provide the required level of runoff volume control as well as attenuate post-development stormwater peak runoff to the allowable flow rates determined in the *SIS*. A summary of the *Water Quantity Control Design Criteria* is summarized below in **Table 7.**

Table 7 - Stormwater Management Quantity Control Design Criteria

Hewitt's Gate Subdivision - Stormwater Management Design Criteria		
Category	**Sub-Category**	**Area 7**
Quantity Control	Peak Flow Control *($m^3/s/ha$)*	Meet the site's catchment area parameters as outlined for the design of SWMF7 within the Bistro 6 West subdivision DSWMR
	Runoff Volume Control *(mm)*	5mm infiltration
	Minor-Major System Conveyance	Minor System – 5 Year Storm Major System – Regulatory Storm
	Regulatory Storm Conveyance	Route Overland to SWMF7

2.5.1. Peak Flow Control

In accordance with the *SIS* and *Bistro 6 West Subdivision DSWMR*, an end-of-pipe stormwater management pond (SWMF#7) will be utilized to provide peak flow control for the subject lands for all design storms up to the 100-year event. The pond's outlet structure and overflow weir have been sized to safely convey the Regional storm event, ensuring a 0.3m freeboard between the top of pond and the Hazel storm event's ponding elevation.

In order to demonstrate that the subject site achieves the required Peak Flow Control, the imperviousness of the drainage area has been compared to the parameters used for the overall Peak Flow Model in the Bistro 6 West Subdivision design of SWMF7. The areas are compared below:

In reviewing **Table 8** below, reference should be made to the Site Plan **Drawing SWM-2** in **Appendix B** and drawings from the *Bistro 6 West Subdivision (Phase 2 Registration – Block 3)* design (TJCG Project #PRA-12160 'Accepted for Construction' Drawing Set with the City of Barrie Approved stamp dated September 16, 2021) *Drawings STM-1 and SWM-1* in **Appendix A**. A summary calculation table has been provided with the *Land Use Breakdown* located in **Appendix C**.

Table 8 – PCSWMM Area Comparison

Subcatchment LID PCSWMM ID#		Reference Drawing	Contributing Area PCSWMM ID#	Contributing Area (ha)	Percent Impervious (%)
PRA-12160 Bistro 6 West Subdivision PCSWMM Areas					
Treated	7B-1	STM-1 & SWM-1	7B-1	2.74	62%
	7B-2*		7B-2	0.08	68%
	7B-3**		7B-3	0.02	20%
Sub-total:				2.84	62%
Untreated	705***	STM-1 & SWM-1	705	0.27	0%
	703****		703	0.05	70%
Sub-total:				0.32	11%
B6W Sub Total:				3.16	57%
PRA-19078 Elements Condominium Plan PCSWMM Areas					
Treated	LID-1	STM-1 & SWM-2	101	0.26	80%
	LID-2		201 – 205	0.67	77%
	LID-3		301 – 305	1.01	64%
	CB Shield & Up-Flo		501 & 502	0.35	22%
	Up-Flo Filter		503 & 504	0.16	85%
	CB Shield (external)		505	0.17	65%
Sub-total:				2.62	65%
Untreated	No LID	STM-1 & SWM-2	506	0.06	27%
			601 – 603	0.49	5%
Elements Condo Total:				3.16	55%

*There is a portion of area 7B-2 that is within the Elements Condominium Plan limits. The contributing area has been adjusted accordingly.
**There is a portion of area 7B-3 that is within the Elements Condominium Plan limits. The contributing area has been adjusted accordingly.
***There is a portion of area 705 that is outside the Elements Condominium Plan limits. The contributing area has been adjusted accordingly.
****There is a portion of area 703 that is within the Elements Condominium Plan limits. The Contributing area has been adjusted accordingly.

The comparison of the actual site plan drainage area to the drainage area from the Bistro 6 West Subdivision DSWMR for the design of SWMF7 demonstrates that the imperviousness of the proposed site plan is less than the allowable imperviousness in the Bistro 6 West Subdivision Peak Flow Model. Given that the drainage area and imperviousness parameters are the most sensitive parameter to the hydrologic model, the peak flows from the subject area would be less than those produced by the Peak Flow Model for the design of SWMF7. As such, there are no adverse effects to the downstream storm infrastructure and the SWM design for the site plan achieves the required Peak Flow control component of the Stormwater Management Quantity Control criteria.

Further details on the Quantity Control of SWMF#7 can be found in the *Detailed Stormwater Management Report* prepared for the proposed *Bistro 6 West Subdivision* by The Jones Consulting Group Ltd., dated August 2019 (TJCG Project No. PRA-12160).

2.5.2. Runoff Volume Control

The following targets were established for Runoff Volume Control under the *Bistro 6 West Subdivision DSWMR* and are based on the LSRCA *Technical Guidelines for Stormwater Management Submissions – Section 2.2.2.2. Flexible Treatment Alternatives for Sites with Restrictions, Alternative 2*.

Table 9 - Runoff Volume Control Targets by Area

Runoff Volume Control Targets (RVCt)	
	Area 7
RVCT (mm)	5
Area (ha)	10.50
Imp (%)	46%
Volume (m^3)	**241.0**

Runoff Volume Control is provided by a combination of the LID facilities as described in **Section 2.4.** Refer to the above-mentioned sections for the corresponding descriptions of the respective facilities. The Runoff Volume Control Target has been adjusted to the Elements Condominium Plan. The following table summarizes the site-specific Runoff Volume Control Target.

Table 10 – Elements Condominium Plan Runoff Volume Control Target

Runoff Volume Control Targets (RVCt)	
	Elements Condominium
RVCT (mm)	5
Area (ha)	3.16
Imp (%)	55%
Volume (m^3)	**86.8**

It can be shown that the infiltration target is achieved by calculating the provided capture volume available in the three proposed infiltration-based LID facilities. As previously summarized in **Section 2.4.2 Table 6**, the provided storage volumes in the three Rain Gardens are 141.4, 192.8 and 306.1 m^3. The volume control provided by the respective LID's are capped at 25mm over the contributing imperviousness area. Summing the provided LID volume results in a total of 343.7m^3,

translating to approximately **19.8** mm over the total site's impervious area (3.16 ha @ 55% impervious).

In order to meet the LSRCA criteria for Volume Control (LSRCA Technical Guidelines for Storm Water Management Submissions), the SWM design for the subject site is implementing Alternative 1 of Section 2.2.2.2. Flexible Treatment Alternatives. The site constraints influencing the SWM design include poor underlying soil infiltration rates and depth to groundwater that limits LID's to collect surface runoff only. The 12.5 mm of Volume Control required for Alternative 1 is achieved via infiltration-based LID's, noting that the total achieved Volume Control is actually **19.8 mm** of infiltration.

In addition to this first principles approach, the SWM design has simulated the performance of the proposed LID's in a hydrologic model (PCSWMM) for discrete events (the 4-hour Chicago 25mm storm event) and a continuous simulation (one year of data). Using the model simulations, the LID's are sized to ensure 100% capture of the 25mm event (quality storm event) and then simulated with one year of data via a continuous simulation to provide relevant annual results for mass balance quality control and water balance mitigation calculations. The discrete event capture, annual capture, and annual infiltration for each of the LID facilities is summarized in **Tables 11 & 12**. Refer to PCSWMM Post-Dev-LID model results in **Appendix D** and the LID Performance Summary results in **Appendix C**.

Table 11 – Hydrologic Model Results: *LID Model* (25mm)

LID Performance: Elements Condominium Plan – 25mm Event					
LID Name	**Subcatchment LID PCSWMM ID#**	**Contributing Area PCSWMM ID#**	**Contributing Area (ha)**	**Total Runoff Volume (cu.m)**	**Infiltration Volume (cu.m)**
Rain Garden #1	LID-1	101	0.26	44.55	39.12
Rain Garden #2	LID-2	201 – 205	0.67	110.55	102.07
Rain Garden #3	LID-3	301 – 305	1.02	140.11	127.15
CB Shields & Up-Flo	No LID	501 & 502	0.35	14.56	0.00
Up-Flo Filter	No LID	503 & 504	0.16	29.05	0.00
CB Shield	No LID	505	0.16	23.33	0.00
No LID	No LID	506	0.06	1.75	0.00
No LID	No LID	601 – 603	0.49	5.47	0.00
Sub-Totals			**3.16**	**369.37**	**268.35**

The results demonstrate that the proposed LID practices will exceed the RVC_T established for the Elements Condominium Plan and summarized previously in **Table 10**. A volume of **268.35 m³**,

corresponding to an equivalent depth of approximately **15.5 mm**, is captured and infiltrated during the Water Quality Event.

Table 12 – Hydrologic Model Results: *LID Model* (Continuous)

LID Performance: Elements Condominium Plan – Continuous					
LID Name	**Subcatchment LID PCSWMM ID#**	**Contributing Area PCSWMM ID#**	**Contributing Area (ha)**	**Total Runoff Volume (cu.m)**	**Infiltration Volume (cu.m)**
Rain Garden #1	LID-1	101	0.26	1,455.26	1,322.39
Rain Garden #2	LID-2	201 – 205	0.67	3,725.17	3,538.58
Rain Garden #3	LID-3	301 – 305	1.02	4,705.69	4,411.40
CB Shields & Up-Flo	No LID	501 & 502	0.35	474.88	0.00
Up-Flo Filter	No LID	503 & 504	0.16	1,238.55	0.00
CB Shield	No LID	505	0.16	760.08	0.00
No LID	No LID	506	0.06	78.05	0.00
No LID	No LID	601 – 603	0.49	350.41	0.00
Sub-Totals			**3.16**	**12,788.11**	**9,272.36**

Extending the simulation for a period of one (1) year using the data set described previously, the proposed LID practices capture approximately **9,272.36 m^3** annually, or **72.5%** of the annual runoff volume generated. The balance of runoff directed to the respective practices is discharged from the subject lands and conveyed downstream to SWMF7.

The results provided herein demonstrate that the proposed LID facilities will provide the required RVC_T on a discrete event and annual basis.

2.5.3. Minor-Major System Conveyance

The majority of the site's stormwater runoff will be conveyed to the proposed LID facilities mainly by overland flow. Storm sewers will be used to convey rooftop stormwater to the storage layer of the LIDs. The storm sewer system has been designed for the 100-year event using the Rational Method. LID facilities have been designed to capture and infiltrate all storm water runoff from the 4-hour Chicago 25mm storm event from the contributing catchment areas. In the event that a major storm event occurs, the emergency outlets for the LIDs have been designed to adequately convey the governing 100-year storm event and Hurricane Hazel Regional storm event to the 100-year storm sewer without surcharging. This was done by creating five additional LID PCSWMM models and simulating the LID performance under the 100-year storm events for the 4-hour Chicago storm distribution, 6-hour, 12-hour and 24-hour SCS storm distributions, as well as the

Hurricane Hazel Regional storm event. Modeling for the Hurricane Hazel Regional storm event has taken into account antecedent moisture conditions by assigning 100% initial saturated condition in the LID control editor for each LID facility. This was done to account for the saturated soil conditions due to the previous 36-hours of rainfall associated with the event. It was determined that the 6-hour SCS distribution storm event was the governing storm for LID-1 and the 4-hour Chicago distribution storm event was the governing storm for LID's 2&3. A table summarizing the LID peak flow release rates during the 100-year storm events and regional storm event has been provided below in **Table 13**.

Table 13 – Hydrologic Model Results: *LID Model*

LID Performance: Elements Condominium Plan – Peak Flow Events					
	PCSWMM Model Storm Simulations Peak Flow Rate (m^3/s)				
LID Facilities	**100yr 4hr CHI**	**100yr 6hr SCS**	**100yr 12hr SCS**	**100yr 24hr SCS**	**Hurricane Hazel**
LID-1	0.0931	**0.1251**	0.1096	0.1125	0.0321
LID-2	**0.4399**	0.3170	0.2914	0.2996	0.0832
LID-3	**0.4781**	0.4062	0.3535	0.3937	0.1149

The storm sewers immediately downstream of the LIDs were adjusted to adequately convey the governing 100-year storm peak flowrate. Refer to the *Storm Sewer Design Sheet* in **Appendix C**, **Drawings STM-1** and **SS-2** in **Appendix B**, and *100-year LID Outlet Flow vs. Time Graphs* and *Hazel LID Outlet Flow vs. Time Graph* in **Appendix D** for further details.

Additional modeling was completed to assess the conveyance capacity of the proposed drainage ditch adjacent to the Metrolinx Railway. This ditch will convey stormwater generated from the western portion of the proposed Elements Condominium & Bistro 6 West Subdivision Railway Berm and existing Metrolinx Railway corridor during the 100-year and Hurricane Hazel events. The conveyance channel will drain northwards to the existing Mapleview Drive East roadside ditch and ultimately be conveyed through ditching and culverts to the Hewitt's Creek Natural Heritage System. It was determined that the 100-year 6-hour SCS distribution storm event was the governing event producing the largest peak flows. A table summarizing the LID peak flow release rates during the 100-year storm events and Hurricane Hazel Regional storm event has been provided below in **Table 14**.

Supporting PCSWMM *External Hydraulic Grade Line Analysis Graphical Model Outputs* have been included in **Appendix D** for reference. Additional supporting *Metrolinx and Mapleview Drive East Capacity Calculations* have been provided in **Appendix C** for reference.

Table 14 – Hydrologic Model Results: *External Model*

LID Performance: Elements Condominium Plan – Peak Flow Events					
	PCSWMM Model Storm Simulations Peak Flow Rate (m^3/s)				
Nodes	**100yr 4hr CHI**	**100yr 6hr SCS**	**100yr 12hr SCS**	**100yr 24hr SCS**	**Hurricane Hazel**
J1	0.1500	**0.1584**	0.1381	0.1489	0.0231
J2	0.2793	**0.3721**	0.3200	0.3546	0.0568
J3	0.1988	**0.3379**	0.2867	0.3343	0.0785
OF1	0.1884	**0.3336**	0.2823	0.3278	0.0785

2.5.4. Summary of Quantity Control Performance

The foregoing sections affirm that the subject site's SWM design with regards to proposed LID measures and conformance with the design parameters for SWMF7, **have met all the requirements** under the *Quantity Control* site target categories.

Table 15 – Stormwater Management Quantity Control Performance

Elements Condominium Plan – Quantity Control Performance			
Category	**Sub-Category**	**Area 7**	**Target**
Quantity Control	Peak Flow Control *($m^3/s/ha$)*	Meet the site's catchment area parameters as outlined for the design of SWMF7 within the Bistro 6 West subdivision DSWMR	**Y**
	Runoff Volume Control *(mm)*	5mm infiltration	**Y**
	Minor-Major System Conveyance	Minor System – 5 Year Storm Major System – Regulatory Storm	**Y**
	Regulatory Storm Conveyance	Route Overland to SWMF7	**Y**

2.6. Stormwater Quality Control

As per the City and LSRCA requirements, *Enhanced* (Level 1) stormwater quality control is required for the site. Through a series of LID BMP's and pretreatment devices, Quality Control will be provided on-site to achieve the *Enhanced* (Level 1) targets and TSS removal for rainfall events on an annual basis.

The subject site has three (3) LID measures proposed, otherwise referred to as Rain Gardens 1 to 3. All of the LID systems promote infiltration, however, any overflow from the LID facilities is collected and directed to the 100-year storm sewer. As the name suggests, this storm sewer has been designed to convey peak flowrates experienced during the 100-year event. The 100-year storm sewer will convey flows to the main cell of the SWMF7 dry pond. SWMF7 has been previously designed to provide the required level of SWM quantity control. For additional design details,

please refer to the *Bistro 6 West Subdivision DSWMR* dated August 2019. An overview of the treatment trains and catchment-based performance are provided in the following subsections.

In addition to the typical quality control requirements, the incorporation of LID measures will provide phosphorus removal benefits to ensure that best efforts are taken to reduce post-development phosphorus loadings to pre-development levels (or a minimum 80% removal of TP from post-development). Phosphorus Loading calculations are detailed within **Section 2.6.3** below.

A summary of the SWMF Catchment specific *Water Quality Control Targets* is summarized below in **Table 16.**

Table 16 – Stormwater Management Quality Control Design Criteria

Elements Condominium Plan - Stormwater Management Design Criteria		
Category	**Sub-Category**	**SWMF7**
Quality Control	Total Suspended Soils	Provide Level 1 (Enhanced) Protection, 80% Long Term Removal *(CoB, MOE, LSRCA)*
	Total Phosphorus	Minimum 80% Reduction in Post-Development Loading *(LSRCA)*

2.6.1. LID Pollutant Removal Efficiencies

Throughout the Elements Condominium Plan, there are three (3) Rain Garden LID measures proposed to meet Water Quality Targets. These facilities have been sited and form a series of treatment trains in conjunction with the proposed MTD's to meet the Water Quality targets.

A summary of the proposed measures and their corresponding removal efficiencies is provided below in **Table 17**. Concentration-based removal efficiency values used are taken from the *Low Impact Development Treatment Train Tool, Help Guide, Section 3.6.1 – LID/Best Management Practices Removal Efficiencies, Version 1.2.1., April 2018.*

Table 17 – BMP Published Removal Efficiencies

LID BMP Concentration Based Removal Efficiencies		
LID Practice	**TSS Removal Efficiency (%)**	**TP Removal Efficiency (%)**
Rain Gardens/Infiltration System	75	25
CB Shields	50	0
Up-Flo Filter*	81.3	48

*Removal Efficiencies referenced from manufacturer specifications.

The Elements Condominium Plan LID pollutant removal efficiencies have been adjusted according to site specific constraints. All infiltrated flows have been awarded a 100% TSS and TP removal efficiency, whereas surficial outflows from the LID facilities have been awarded a 0% TSS and TP removal efficiency. Normally a 75% TSS and 25% TP removal efficiency would be awarded for LID outflows if the system utilizes an underdrain outlet for filtered runoff. Given the nature of the LID design it is anticipated that surficial outflows in excess of the 200mm surface storage depth will be released untreated to the 100-year storm sewer.

In addition, uncontrolled flows from the Elements Condominium Plan have been separated based on SWMF7 overall catchment boundaries. Uncontrolled catchment areas that are collected by catchbasins previously proposed within the Bistro 6 West Subdivision for Kneeshaw Road (excluding flows from the easement on the south-eastern corner of the property) have been granted a 50% TSS removal efficiency and 0% TP removal efficiency given that this system includes the use of CB Shields. Catchbasins that release to Mapleview Drive East or the Metrolinx Railway and ultimately discharge directly to the NHS are not granted a removal efficiency.

2.6.2. TSS Loading & Removal - Treatment Train Calculations

The removal efficiency of a series of BMP devices in a treatment train can be expressed as follows:

$$R = A + B - [(A \times B)/100]$$

Where: R = Total Treatment Train Removal Efficiency (%)

A = Removal Efficiency of 1st (Upstream) BMP (%)

B = Removal Efficiency of 2nd (Downstream) BMP (%)

This approach to calculating treatment train removal efficiencies can be extended to include more than two devices.

The predicted water quality performance of the site LID facilities has been established using a weighted average of the upstream catchment area size and corresponding treatment train removal efficiency. The removal efficiencies of each of the discrete treatment trains and overall catchment performance is summarized below in **Table 18.**

There are eleven (11) treatment trains established within the Elements Condominium Plan, as described below:

Table 18 – Elements Condominium Plan: TSS Concentration Removal Efficiency

Contributing Area PCSWMM ID#	Treatment Train	Area (ha)	Removal (%)
101	Rain Garden #1 (Infiltrated)	0.26	100.0
101	Rain Garden #1 (Surface Outflow)	0.26	0.0
201 – 205	Rain Garden #2 (infiltrated)	0.67	100.0
201 – 205	Rain Garden #2 (Surface Outflow)	0.67	0.0
301 – 305	Rain Garden #3 (Infiltrated)	1.02	100.0
301 – 305	Rain Garden #3 (Surface Outflow)	1.02	0.0
501 & 502	CB Shield & Up-Flo Filter	0.35	90.7
503 & 504	Up-Flo Filter	0.16	81.3
505	CB Shield	0.16	50.0
506	Uncontrolled Area to future Kneeshaw Drive & SWMF7	0.06	0.0
601 – 603	Uncontrolled Area to Mapleview Drive East	0.49	0.0
Total		**3.16**	**89.6**

The annual TSS loading is primarily driven by winter sand applied to treat roadways during winter control activities. A weighted average Event Mean Concentration (EMC) was derived using the land use specific EMC concentration values outlined in the *LIDTTT Help Guide*. Utilizing the removal efficiencies of the respective practices' tributary to a drainage area, the annual mass loading (kg/yr) and corresponding removal efficiency were calculated and are summarized as follows in **Table 19**. Refer to **Appendix C** for detailed *TSS Mass Balance calculations* as well as excerpts from the *Low Impact Development Treatment Train Tool, Help Guide, Section 3.6.2 – Land Cover Event Mean Concentrations.*

Table 19 – Overall TSS Removal Efficiency

Elements Condominium Plan - Overall TSS Removal Efficiency					
Drainage Area	**Annual Inflow (m^3/yr)**	**Annual Load IN (kg)**	**Annual Surface Outflow (m^3/yr)**	**Annual Load OUT (kg)**	**Mass Annual Removal Efficiency**
Elements Condominium Plan	12,788.1	984.2	2,902.0	102.2	**89.6%**

It can be observed above that a net reduction in total suspended solids of **89.6%** is achieved by implementing BMP's in the post-development condition for the Elements Condominium Plan.

Further, the pre-development total suspended solids load was estimated using a mass balance approach as outlined above and utilizing precipitation and runoff volume data obtained from the *Technical Memorandum, Elements Condominium – Hydrogeology Brief,* dated August 10th, 2021, completed by R.J. Burnside & Associates Ltd. and further outlined in **Section 2.7**. An Addendum to the Hydrology Brief has been provided by R.J. Burnside - dated October 28th, 2021 - indicating that it is in their professional judgement that the measurements conducted by Peto MacCallum Ltd. in 2021 confirm the previous interpretation by R.J. Burnside. Supporting calculations are provided below:

Pre-Development Annual TSS Estimate

Drainage Area:	3.16 ha
Runoff:	136 mm – *from Table WB-1 of RJB Water Balance Calculations*
Volume:	4,280 m^3/yr
EMC:	100 mg/L – *Row Crop Land Use*
Annual Load:	428.0 kg/yr

A total pre-development annual load of **428.0 kg/yr** was estimated, which indicates the site has reduced the annual total suspended solids load in the post-development condition by **325.8 kg/yr over estimated pre-development levels**.

Details of each of the proposed Treatment Trains and their removal rate calculations are included in **Appendix C** for reference.

2.6.3. Phosphorus Loading & Removal – Treatment Train Calculations

A pre- to post-development phosphorus balance has been estimated for the site to address the LSRCA policy requirements.

The site's stormwater management plan includes the LIDs as described in **Section 2.4**. The Phosphorus removal rates for BMP's are per the values provided in the MOE *Phosphorus Loading Tool* and *LSRCA SWM Guidelines*. The predicted water quality performance of Elements Condominium Plan has been established using a mass balance approach for each treatment train for the respective drainage areas based on their proposed hydraulic connections. The phosphorus removal efficiencies of each of the treatment trains and overall catchment performance is summarized below in **Table 20**.

Table 20 – Elements Condominium Plan: TP Concentration Removal Efficiency

Contributing Area PCSWMM ID#	Treatment Train	Area (ha)	Removal (%)
101	Rain Garden #1 (Infiltrated)	0.26	100.0
101	Rain Garden #1 (Surface Outflow)	0.26	0.0
201 – 205	Rain Garden #2 (infiltrated)	0.67	100.0
201 – 205	Rain Garden #2 (Surface Outflow)	0.67	0.0
301 – 305	Rain Garden #3 (Infiltrated)	1.02	100.0
301 – 305	Rain Garden #3 (Surface Outflow)	1.02	0.0
501 & 502	CB Shield & Up-Flo Filter	0.35	48.0
503 & 504	Up-Flo Filter	0.16	48.0
505	CB Shield	0.16	0.0
506	Uncontrolled Area to future Kneeshaw Drive & SWMF7	0.06	0.0
601 – 603	Uncontrolled Area to Mapleview Drive East	0.49	0.0
Total		**3.16**	**81.9**

A weighted average Event Mean Concentration (EMC) was derived using the land use specific EMC concentration values outlined in the *LID TTT Help Guide*. Utilizing the removal efficiencies of the respective practices' tributary to a drainage area, the annual mass loading (kg/yr) and corresponding removal efficiency were calculated and are summarized as follows in **Table 21**. Refer to **Appendix C** for detailed *TP Mass Balance calculations* as well as excerpts from the *Low Impact Development Treatment Train Tool, Help Guide, Section 3.6.2 – Land Cover Event Mean Concentrations.*

Table 21 - Overall TP Removal Efficiency

Elements Condominium Plan - Overall TP Removal Efficiency					
Drainage Area	**Annual Inflow (m^3/yr)**	**Annual Load IN (kg)**	**Annual Surface Outflow (m^3/yr)**	**Annual Load OUT (kg)**	**Mass Annual Removal Efficiency**
Elements Condominium Plan	12,788.1	3.081	2,902.0	0.558	**81.9%**

It can be observed above that a net reduction in phosphorus of **81.9%** is achieved by implementing BMP's in the post-development condition for the Elements Condominium Plan.

Further, the pre-development phosphorus load was estimated using a mass balance approach as outlined above and utilizing precipitation and runoff volume data obtained from the *Technical Memorandum, Elements Condominium – Hydrogeology Brief,* dated August 10th, 2021, completed by R.J. Burnside & Associates Ltd. and further outlined in **Section 2.7**. As previously

stated, an Addendum to the Hydrology Brief has been provided by R.J. Burnside - dated October 28th, 2021 - indicating that it is in their professional judgement that the measurements conducted by Peto MacCallum in 2021 confirm the previous interpretation by Burnside. Supporting calculations are provided below:

Pre-Development Annual TP Estimate

Drainage Area:	3.16 ha
Runoff:	136 mm – *from Table WB-1 of RJB Water Balance Calculations*
Volume:	4,280 m^3 / yr
EMC:	0.23 mg / L – *Row Crop Land Use*
Annual Load:	0.984 kg / yr

A total pre-development annual load of **0.984 kg/yr** was determined, which indicates the site has reduced the annual phosphorus load by **0.426 kg/yr over estimated pre-development levels.**

2.6.4. Summary of Quality Control Performance

The foregoing sections affirm that the proposed LID measures proposed for the site **have met all the requirements** under the *Quality Control* site target categories.

Table 22 - SWM Quality Control Performance

Elements Condominium Plan – Quality Control Performance			
Category	**Sub-Category**	**SWMF7**	**Target**
Quality Control	Total Suspended Soils	Provide Level 1 (Enhanced) Protection, 80% Long Term Removal *(CoB, MOE, LSRCA)*	**Y**
	Total Phosphorus	Minimum 80% Reduction in Post-Development Loading *(LSRCA)*	**Y**

2.7. Water Balance

The primary objective of the LSRCA's water balance target is to capture and manage annual rainfall on the development site to preserve the pre-development hydrology (water balance) through a combination of infiltration, evapotranspiration, absorbent landscaping, rainwater reuse and/or other LID practices. Various site-specific characteristics contribute to the ability to achieve water balance. They include, but are not limited to: soil permeability, the ability to collect and direct drainage into the ground, groundwater table elevations and seasonal fluctuations. Best efforts will be made via the SWM Plan to maintain groundwater recharge while considering site specific characteristics.

A site-specific water balance in accordance with the SIS recommendations has been completed for Elements Condominium Plan by R.J. Burnside & Associates Ltd. and is detailed in the *Technical Memorandum, Elements Condominium – Hydrogeology Brief,* dated August 10th, 2021. RJB completed a pre- to post-development water balance to estimate the infiltration volume deficit that would need to be mitigated via the proposed SWM Plan. The infiltration and runoff volume as calculated in the RJB Water Balance Assessment are presented in **Table 23** below and Tables WB-1 through WB-3 of the RJB study are provided in **Appendix A.**

Table 23 - Summary of Water Balance Calculations by RJB

Water Balance Runoff & Infiltration Volumes – RJB Table WB-3			
	Pre-Development	**Post-Development**	**Difference**
Impervious Area Runoff Volume (m^3/a)	0	13,655	+13,655
Pervious Area Runoff Volume (m^3/a)	4,280	1,889	-2,391
Total Runoff Volume (m^3/a)	4,280	15,544	+11,264
Total Infiltration Volume from Pervious Surfaces (m^3/a)	6,421	3,509	**-2,912**

The results summarized in the table above indicate that there is an increase in total runoff volume and a deficit in infiltration volume from pre- to post-development without accounting for LID's. The SWM Plan herein is intended to mitigate or reduce the water balance deficit as outlined above. Runoff generated from this development is directed to the proposed Low Impact Development (LID) measures. The LID's and their contributing drainage areas are shown on **Drawing SWM-2** in **Appendix B.**

Upon review of the *Environment Canada Daily Climate Normals* for the *Barrie WPCC* from the years 1979 to 2008, a statistical analysis of rainfall data was completed and it is noted that on an annual average over that time period, this gauge has received **928.1 mm** of total precipitation, comparable to the mean average annual precipitation of 939 mm for Hewitts Creek, published

in the *LSRCA Climate Data Set, April 2017* and comparable to average annual precipitation of 933 mm used by RJB in their water balance calculations.

The daily precipitation recordings were truncated following recommendations provided by the USEPA, removing any precipitation occurring during winter months (December, January and February) as they have been assumed to not directly produce runoff. This leaves a period of nine (9) continuous months in a given calendar year, which are described as *effective precipitation*, or precipitation events expected to produce runoff. In the nine (9) month period, there are on average 112.7 days of rainfall recorded, with 3.9 of those instances having a total depth of precipitation greater than 25 mm. There are, on average, 63.6 instances with a depth of precipitation greater than 2.0 mm but not greater than 25 mm, and 45.1 instances of precipitation events with a depth 2.0 mm or less. Events with recorded depth of 2.0 mm or less were removed from the data set as this is the lower limit of *Initial Abstractions* typically used in hydrologic modeling of urbanized areas. These two ranges encapsulate 96% of all recorded precipitation events on an annual basis.

Of key interest are the 63.6 recorded instances of precipitation events with a recorded depth between 2.1 and 25mm, as these events represent the lower and upper bounds of the *Water Quality Event* (WQE). These events were sorted and tallied for each given year of recorded data and represent on an annual average over the 30-year period, 56% of the total precipitation received in a calendar year. This *effective precipitation* driven by *Water Quality Events*, totalling 520.9 mm on average, is the subset of precipitation events deemed to be producing runoff, for which the LID facilities have been sized to treat. Effectively, all runoff generated from this subset of the annual precipitation is captured, treated, and infiltrated within areas draining to a proposed LID. Assuming hydrologic losses remain constant across these *Water Quality Events,* it can be inferred that if 56% of the total average annual precipitation is produced by events less than or equal to the design event of the facility, then 56% of the average annual runoff would therefore be captured by the LID facility. Furthermore, events exceeding the design event (25mm 4-hour storm) for the facility do not by-pass the LID in their entirety, as the by-pass is only engaged above a certain depth of flow in the upstream storm sewers.

Reviewing the results of the *Post-Dev-LID (Continuous)* model simulation and supported by the rationale above, we have predicted that approximately **72.5%** of the annual runoff generated from the site is captured and retained by the proposed LID practices. This is achieved through a combination of total capture of all *effective precipitation* events with a recorded depth between 2.1 and 25 mm, as well as capture of the initial portion of those events in excess of 25 mm. The 72.5% capture of annual runoff volume is applied to the total runoff volume (15,544 m^3/a per RJB's calculations) and equates to approximately **11,269 m^3/a**. The additional captured and

infiltrated runoff volume of **11,269 m^3/a** reduces the post-development infiltration deficit from **2,912 m^3** to a surplus of **8,357 m^3** annually.

In summary, the proposed stormwater management plan has undertaken a best-efforts approach to mitigate the established pre- to post-development water balance targets for development of the subject lands.

2.8. Erosion and Sediment Control

The proposed works require an Erosion and Sediment Control Plan to provide the appropriate protection of downstream receiving systems during construction. The proposed ESC works are outlined on **Drawings ESC-1** & **ESC-2** provided in **Appendix B**, including the construction and staging requirements at various phases of the development.

During construction, the majority of the development's natural features will be removed and the topsoil stripped within the development area. The exposed surface will be susceptible to erosion, increasing the potential for sediment runoff. To minimize local and downstream impacts from erosion and sedimentation during construction, the following measures have been recommended:

- Excess earth and topsoil is to be stockpiled away from the creek limits and/or removed from site. Stockpiles shall be seeded or covered with erosion control if left for periods of greater than 30 days.
- Temporary sediment control fencing should be erected around the perimeter of all grading activities, including double fencing along the boundaries adjacent to the Mapleview Drive and Kneeshaw Drive Right-of-Ways.
- Temporary sediment fabric and stone filters should be installed on catch basins until surface cover has been stabilized.
- Temporary rock flow check dams should be installed within drainage cut-off swales.
- A temporary construction access mud mat should be installed at the construction accesses to reduce the amount of materials that may be transported off site.
- Temporary erosion and sediment control sediment traps are to be constructed, complete with an overflow weir lined with rip-rap. The sediment traps' purpose is to detain runoff long enough to allow the majority of soil particles to settle out of suspension.
- Construction during drier months should be monitored for wind-borne transport of sediments. At the direction of the engineer, the contractor may be directed to water down exposed earth areas with an aqueous solution of calcium chloride.
- All disturbed areas not under immediate construction for 30 days, or not intended for building activities within a 3-month time period, should be stabilized with seeding.

3. Water Servicing

According to the Bistro 6 West Subdivision Drawings (TJCG Project #PRA-12160) '*General Servicing Plan, Drawing G-1*' (provided in **Appendix A**), a 300 mm diameter watermain and 600mm diameter CPP transmission watermain exist in the western boulevard of Kneeshaw Drive. Water service to the subject site is proposed via the 300 mm diameter PVC watermain with two 300 mm diameter services entering the site. The services are located along the north side of the site's proposed entrance and north of Building 'C'.

3.1. Supply, Distribution Zone, External Watermain

The subject property is located within Pressure *Zone 2 South* of the City of Barrie Water Distribution Network. Pressure *Zone 2 South* generally operates between elevations of 237m and 273m with variations in static pressure from 344 kPa (50psi) to 690 kPa (100psi). Elevations for the subject property vary from 265m to 254m; well within the *Zone 2 South* operating pressure range.

3.2. Proposed Watermain System

The development's projected design population and water supply flow rates are estimated based on the City of Barrie *Water Transmission and Distribution Policies and Design Guidelines* (December 2017), and MOE *Design Guidelines for Drinking Water Systems* (2008). The following design criteria have been used for calculating the person per unit (PPU) for the proposed high density residential buildings.

Unit Type	Design Population
High Density Residential	1.67 persons/unit

Based on the above design criteria and the proposed *Site Plan* statistics, the total population for Elements Condominium Plan has been calculated below.

Unit Type	Design Population
346 High Density Residential units x 1.67 PPU	578 people
Total projected population	**578 people**

In order to meet the development's potable and fire water demands, it is proposed that the subject lands be connected to the existing municipal system through a proposed connection via Kneeshaw Drive. Internally, the subject lands will be serviced with a 300mm diameter watermain, including all appropriate appurtenances in accordance with City of Barrie standards. Operating pressures within the water supply and distribution system must remain between 50 psi and 90 psi. A summary of the proposed demands for the development and scenarios is provided below.

Design Criteria:

- *Average Daily Flow (ADD) = 225 L/d/capita (City of Barrie Sanitary Design Guideline)*
- *Peak Hour Demand Factor (PHD) = 3.00 (MOE Drinking Water Guideline, 2008)*
- *Max. Day Demand Factor (MDD) = 2.00 (MOE Drinking Water Guideline, 2008)*
- *Min. Hour Demand Factor (MHD) = 0.50 (MOE Drinking Water Guideline, 2008)*
- *Fire Flow – Residential = 7,000 L/min (Fire Underwriters Survey)*

Peak Hour Demand:

Q = Pop. x ADD x PHD

Q = (578 persons x 225 L/d/capita x 3.00)/86,400

Q = 4.52 L/s

Minimum Hour Demand:

Q = Pop. x ADD x MHD

Q = (578 persons x 225 L/d/capita x 0.50)/86,400

Q = 0.75 L/s

Max. Day Demand:

Q = Pop. x ADD x MDD + FF

Q = (578 persons x 225 L/d/capita x 2.00)/86,400 + 7,000 L/min / 60

Q = 119.68 L/s

3.3. Water System Analysis

The SIS identifies that through the construction of the proposed external watermain capital projects by City of Barrie, there will be sufficient supply at the required flow and pressures to adequately service the proposed development.

A detailed Water System Analysis (WSA), dated February 8th, 2021, has been completed by Schaeffers Consulting Engineers for the development's proposed water distribution system. Schaeffers has been entrusted with the City's water model so that they can perform assessments on the watermain sizes for any developer / engineer in the Annexed Lands. The WSA demonstrates that the future lots are capable of achieving the minimum standards in the MOE and City of Barrie guidelines for water distribution systems. The WSA by Schaeffers has been provided under separate cover.

4. Sanitary Servicing

According to the Bistro 6 West Subdivision drawings (TJCG Project #PRA-12160), '*General Servicing Plan Drawing G1'* (provided in **Appendix A**), currently there is a proposed sanitary sewer located along Kneeshaw Drive in the immediate vicinity of the subject lands. Sanitary flows from the subject lands will be conveyed to the Kneeshaw Drive sanitary network, where they will be directed northwards to the Mapleview Drive East trunk sanitary sewer system. This connection will allow the subject site to be serviced efficiently by gravity. The sanitary sewer invert for the connection to the proposed site was provided by Jones Consulting as part of the Bistro 6 West Subdivision design.

The sanitary flow from the block will connect to the Kneeshaw Drive sanitary sewers via a proposed 250mm diameter PVC pipe. Design of the Kneeshaw Drive sanitary sewers has been completed in accordance with the City of Barrie *Sanitary Sewer Collection Policies and Design Guidelines (October 2017).* The external sanitary sewer design has been updated to analyze the impact to the downstream trunk sewer with regards to the current unit count proposed in the *Elements Condominium Plan* and has been provided in **Appendix C.**

The addition of 19 units in the proposed Elements Condominium Plan has caused a minimal impact on the downstream trunk storm sewer capacity. The peak population flow has increased 0.055 L/s between the Bistro 6 West Subdivision and the Elements Condominium Plan Sanitary Design Sheets, increasing the total flow from 8.341 L/s to 8.396 L/s. This increase in flow has also increased the d/D ratio from 0.212 to 0.214 and partial velocity from 1.079 to 1.094 m/s. The additional flows experienced has provided no measurable impact on the final sanitary sewer runs d/D ratio and partial velocity. For additional details on the Bistro 6 West Subdivision Sanitary Sewer Design Sheet please refer to PRA-12160 *Drawings SAN-1 & DS-1* provided in **Appendix A**.

The internal sanitary sewer design sheet has been provided in **Appendix C** and on **Drawing SS-2** in **Appendix B**.

5. Transportation

5.1. External Road Network

The City of Barrie *Official Plan Schedule '9D-1' Transportation Plan* identifies Mapleview Drive East as an arterial road and Kneeshaw Drive as a minor collector. A copy of the *OP Schedule '9D-1'* has been attached in **Appendix A**. Mapleview Drive East, which is a two-lane arterial road travelling in an east-west direction, is located at the northern boundary of the site across the subject lands' entire frontage. Kneeshaw Drive, which is a one lane minor collector road traveling in a north-south direction, intersects Mapleview Drive East to the north of the site and fronts the east side of the subject lands. Lockhart Road will ultimately be connected to Mapleview Drive East in subsequent phases of development (by others) by the extension of Kneeshaw Drive southward.

5.2. Internal Road and Parking Lot

Access to the site will connect to Kneeshaw Drive via a 4-lane way with a 2-lane entrance, and 2-lane exit. The site is connected by an extensive parking lot network which provides 254 outdoor parking spaces inclusive of 8 handicap parking spaces. A Fire access Route has been provided which alots for a 13.2 m road centerline radius and a 10.0 m curb line radius. Each building has provided additional underground parking totaling 174 parking stalls. For further details on the internal road and parking lots please refer to the Pavement Marking & Signage Plan **Drawing PM-1** in **Appendix B**.

6. Site Grading

The proposed grading will conform to the City of Barrie *Lot Grading and Drainage Standards Design Manual* (June 2016). The grading of Kneeshaw Drive conforms with the Hewitt's Gate Subdivision design such that road and lot grading will generally be directed east towards the proposed Bistro 6 West Subdivision with drainage towards the SWM facility known as Pond #7 on the west side of Hewitt's Creek.

The site grading plans (**Drawings SG-1** through **SG-4**) are provided in **Appendix B** for reference. Some of the specific areas of interest are discussed in more detail below.

6.1. Railway Berm

The proposed development abuts the Metrolinx – GO Transit corridor at its western limit and will be separated from the proposed development by a railway berm. The berm was designed in general accordance with the '*Metrolinx – GO Transit – Adjacent Development* Guidelines' (April 2013) which specifies design details like berm height and building setbacks. Building setback requirements are established to provide a buffer zone that contains the impacts associated with a potential train derailment; permits dissipation of rail-oriented emissions, vibration, and noise; and accommodates a safety barrier. As indicated in the below table, setback distances vary by land use and occupancy status. The following provides an overview of building setback requirements and conditions:

- The minimum building setback distance is measured from the mutual property line to the building face. The mutual property line is always the reference point for building setbacks, regardless of area conditions. See **Table 24**, below.
- Under typical conditions, the setback is measured as a straight-line horizontal distance. **Figure 5** below provides an illustration of a typical setback and berm installation for residential construction.

Land Use	General Safety Measures			General Technical Studies			Dev. Agreement / Env. Easement
	Setback	Berm	Fencing	Drainage	Noise	Vibration	
Residential	Mandatory 30 Metres	Mandatory 2.5 Metres	As Required 1.83 Metres	As Required	Mandatory	Mandatory	Mandatory
Commercial	Recommended 30 Metres	Recommended 2.5 Metres	As Required 1.83 Metres	As Required	Recommended	Recommended	Not required
Industrial	Recommended 15 Metres	Recommended 2.0 Metres	As Required 1.83 Metres	As Required	Recommended	Recommended	Not required
Institutional	Recommended 30 Metres	Recommended 2.5 Metres	As Required 1.83 Metres	As Required	Recommended	Recommended	Not required
Intensively Used Grounds	Recommended 30 Metres	Recommended 2.5 Metres	As Required 1.83 Metres	As Required	Recommended	Recommended	Not required
Low Occupancy Land Uses	Not Required*	Not Required*	As Required 1.83 Metres	As Required	Not Required	Not Required	Not required
Zone of Influence	Immediately Adjacent Sites (up to 120 Metres)				Sites within 300 Metres	Sites within 75 Metres	Sites within 300 Metres

Table 24 - GO Transit Land Use Guidelines
Standard Measures and Studies for Adjacent Development

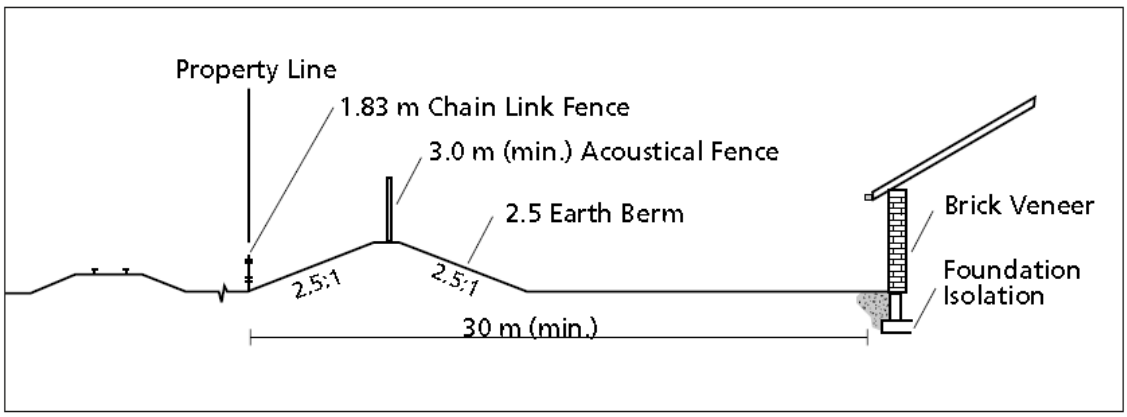


Figure 5 - Typical Building Setback and Berm for Residential Construction
Source: Earthtech Canada, "Final Report; Proximity Guidelines and Best Practices", RAC/FCM Proximity Guidelines

Railway berm locations and details can be found on **Drawings SG-3 & SG-4**, provided in **Appendix B**. A trapezoidal drainage channel has been provided within the site plan along the western property limits to convey stormwater runoff generated from the railway berm and neighbouring Metrolinx Corridor. All collected stormwater runoff will flow northwards to the existing Mapleview Drive East roadside drainage ditch.

6.2. Easements

Easements are an essential part of allowing access for future possible maintenance to proposed sewers. Due to grading and external servicing to accommodate the proposed Draft Plan, an easement is in place. Refer to *Easement Plan* Drawing **EAS-2** (TJCG Project No. PRA-12160)

(provided in **Appendix A**) which shows the location of the existing easement. The easement required in this situation is for a rear yard catchbasin, which collects drainage from the south-east corner of the proposed development. The catchbasin would be allowed to reach a maximum ponding depth before overtopping to an overland flow route.

6.3. Kneeshaw Drive Interim & Ultimate Profile

Kneeshaw Drive traverses the site north to south, connecting to Mapleview Drive East at its northern limit. Ultimately, grading at this intersection will require updating to accommodate future plans from the City to lower Mapleview Drive East under the existing railway. This future work results in two separate grading scenarios, the 'Interim' and the 'Ultimate'. The Ultimate Kneeshaw Drive profile governs service connection elevations within the intersection, with proposed connections made at depths that would not require future lowering once lowering of Mapleview Drive East is completed. Once established, grading in the Interim was completed to provide a smooth transition from the intersection into the proposed site. Both the interim and ultimate grading profile are shown on the Bistro 6 West Subdivision Drawings (TJCG Project #PRA-12160) '**Drawing PP-1 – Plan and Profile Kneeshaw Drive 0-020 to 0+290**' in **Appendix A**.

7. Utilities

The construction of Kneeshaw Drive will accommodate secondary utilities including Bell, hydro, gas and cable TV as part of the overall Bistro 6 West Subdivision requirements. Utility servicing will be provided to the subject site via connection to the services on Kneeshaw Drive. There are currently existing services on Mapleview Drive East, however, they are insufficient to service the proposed subdivision and upgrades and/or the installation of new services along Mapleview Drive East will be required.

The utility providers for the Hewitt's Secondary Plan Area are Enbridge Gas, Innpower, Alectra Utilities (previously known as Powerstream), Bell Canada and Rogers Cable.

Utility Servicing coordination for the entire Hewitt's Secondary Plan Area has been undertaken by the Hewitt's Landowner's Group (HLOG). The proposed development is to be serviced in accordance with the master servicing plans currently being established by the respective utility providers through consultations with HLOG. Specific utility servicing details are provided on the Electrical Design Drawings completed by Runge Engineering.

8. Conclusions

This Servicing & Stormwater Management Report identifies the recommended servicing design for the proposed Elements Condominium Plan development, part of the larger overall Hewitt's Gate Subdivision. This Report, read in conjunction with the *Bistro 6 West Subdivision Detailed Stormwater Management Report, Traffic Impact Study, and Civil Engineering Detailed Design Drawing Set,* outlines the proposed infrastructure required to service the lands in terms of water, wastewater, stormwater management, roads, grading, and conventional utilities.

This Report has been prepared based, in part, on the recommendations provided in the *Hewitt's Secondary Plan Area Subwatershed Impact Study* prepared by R.J. Burnside & Associates Ltd. (September 2016). In particular, this Report has recommended the proposed development can be adequately serviced based on the following:

- The provision of storm sewers and stormwater management facilities as outlined in **Section 2** and General Servicing **Drawing SS-1,** Storm Drainage Plan **Drawing STM-1,** Post-Development SWM Plan **Drawing SWM-2** and the STM Design Sheet in **Appendix C**. Further details on stormwater management and LID/pond design are provided within the Bistro 6 West Subdivision *Detailed Stormwater Management Report* by TJCG dated August 2019, submitted under separate application.
- The provision of watermains as outlined in **Section 3** and on the General Servicing **Drawing SS-1** and the Watermain Swabbing Plan **Drawing WM-1**.
- The provision of gravity sanitary sewers as outlined in **Section 4** and General Servicing **Drawing SS-1** and the Sanitary Drainage Plan **Drawing SAN-1** and the SAN Design Sheet in **Appendix C.**
- The provision of Transportation Infrastructure as outlined in **Section 5** of this Report. Proposed internal roadway and parking lot layout is outlined on the Pavement Marking Plan **Drawing PM-1**.
- The provision of a grading design as outlined in **Section 6** and on the Site Grading Plan **Drawings SG-1 & SG-2** and Section **Drawings SG-3 & SG-4**.
- The provision of Utility Infrastructure as outlined in **Section 7** of this Report and the Electrical Design Drawings completed by Runge Engineering.

In conclusion, it is recommended that the approval authorities accept this report in support of the *Site Plan Application*.

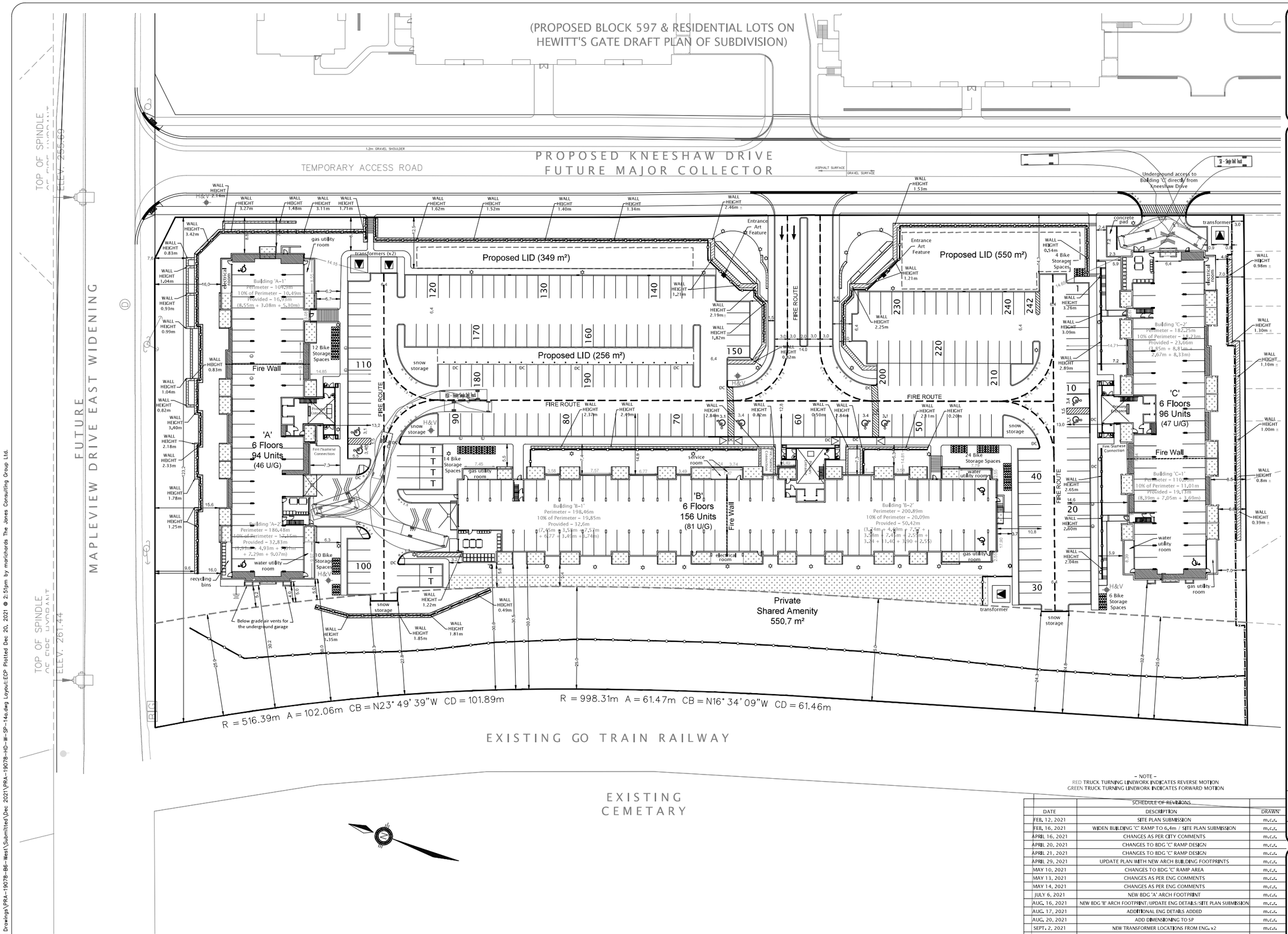
All of which is respectfully submitted,

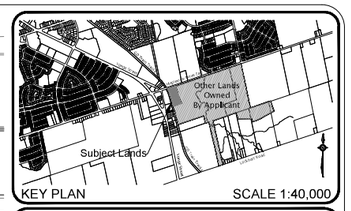
THE JONES CONSULTING GROUP LTD.

Appendix A

Planning and External Reference Information

- Pratt Hansen Group – *Elements Condominium Plan*, The Jones Consulting Group Ltd., December 20th, 2021,
- Crisdawn Construction Inc. – Hewitt's Gate Revised Draft Plan to Draft Approved Plan of Subdivision, The Jones Consulting Group Ltd., June 4th, 2019,
- Excerpt from the Soil Map of Simcoe County, Report No. 29 - Ontario Department of Agriculture,
- City of Barrie Official Plan, January 2018, Schedule 9D-1 Transportation Plan
- *Bistro 6 West Subdivision* Drawings – The Jones Consulting Group - Project # PRA-12160, Phase 2 Registration (Block 3) – Accepted for Construction Drawing Set with the City of Barrie Approved stamp dated September 16, 2021
    - G-1 General Servicing Plan
    - EAS-2 Easement Plan
    - STM-1 Storm Sewer Subcatchment Plan
    - SAN-1 Internal Sanitary Drainage Area Plan
    - DS-1 Design Sheets
    - PP-1 Plan and Profile Kneeshaw Drive STA. 0-020 to 0+290
    - SWM-1 Stormwater Management Plan Peak Flow Model Catchment Areas
    - SWM-2 Stormwater Management Plan LID Model Catchment Areas
- *Bistro 6 Site Plan Drawings* – The Jones Consulting Group - Project # PRA-17021, Site Plan Amendment March 2021
    - PP-1 Plan and Profile Temporary Access Road STA. 0+000 to 0+150
    - PP-2 Plan and Profile Temporary Access Road STA. 0+150 to 0+300
- Water Balance Information
    - Excerpts from RJB Technical Memorandum dated August 10, 2021 – Tables WB-1, WB-2, & WB-3





Elements Condominium Plan

(Proposed Block 598 on Hewitt's Gate Draft Plan)
Part of Lot 16, Concession 12
City of Barrie, County of Simcoe, 2021

SITE PLAN STATISTICS

Site Plan Area	3.15 ha.

Unit Count

1 @ 94 Unit Apartment (6 Storey 'A')	94 Units
1 @ 156 Unit Apartment (6 Storey 'B')	156 Units
1 @ 96 Unit Apartment (6 Storey 'C')	96 Units
Total	346 Units (110 uph)

	REQUIRED	PROPOSED
Total Holdings	RM3	RM3
Site Plan Area	-	3.15 ha.
Lot Frontage	24.0 m	123.2 m
Front Yard	3.0 m	15.6 m
Interior Side Yard	5.0 m	30.0 m
Exterior Side Yard	2.0 m	7.3 m
Rear Yard	5.0 m	6.6 m
Lot Coverage	max 50 % (1.57 ha.)	20 % (0.64 ha.)
Accessory Structures	max 10 % (0.31 ha.)	0.00 % (0.00 ha.)
Landscape Open Space	min 25 % (0.79 ha.)	53 % (1.68 ha.)
Parking Coverage	max 40 % (1.26 ha.)	26 % (0.83 ha.)
Gross Floor Area	max 200 % (6.30 ha.)	110 % (3.43 ha.)

Building A	
• GFA	9,468.24 m2
• Height in Stories	6
• Units	94
Building B	
• GFA	15,398.28 m2
• Height in Stories	6
• Units	156
Building C	
• GFA	9,468.24 m2
• Height in Stories	6
• Units	96

Parking Calculations

Required Parking (346 x 1.2)	416 Spaces	*416 Spaces

*Parking Breakdown

Typical Surface Parking Spaces	234 Spaces
Surface Barrier Free Parking Spaces	8 Spaces
Typical Underground Parking Spaces	168 Spaces
Underground Barrier Free Parking Spaces	6 Spaces
Total	416 Spaces*
Tandem Parking Spaces	6 Spaces
Total Including Tandem Spaces	422 Spaces

Barrier Free spaces calculated at 1 + (416 x 3%) = 14 required
(3.4 + 1.5 & 3.1 + 1.5 per barrier free space/shared aisle)

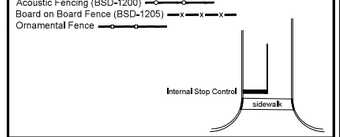
Bicycle Rack Storage (.2 x 346) 70 Required 70 Provided

General Amenity Area (10m²/unit) 3,460 m² **4,634.12 m²

**Amenity Area Breakdown

Shared Surface Amenity Area	550.7 m²
Private Balcony Area:	
- Building A	1,141.20 m²
- Building B	1,865.40 m²
- Building C	1,076.82 m²
- Private Balcony Area Total	4,083.42 m²
Combined General Amenity Area Total	4,634.12 m²

Fire Route
Retaining Walls
Light Standard (nts)
EV Charger Station (nts)
Hydro Transformer (nts)
Hydrant H&V
Timber Bollards (BSD-1217)
Acoustic Fencing (BSD-1200)
Board on Board Fence (BSD-1205)
Ornamental Fence



0 5 10 20 30M
SCALE 1 : 400 (A1)

PRATT HANSEN GROUP - BISTRO 6 WEST
ELEMENTS CONDOMINIUM PLAN

- NOTE -
RED TRUCK TURNING LINEWORK INDICATES REVERSE MOTION
GREEN TRUCK TURNING LINEWORK INDICATES FORWARD MOTION

SCHEDULE OF REVISIONS

DATE	DESCRIPTION	DRAWN
FEB. 12, 2021	SITE PLAN SUBMISSION	m.c.r.
FEB. 16, 2021	WIDEN BUILDING 'C' RAMP TO 6.4m / SITE PLAN SUBMISSION	m.c.r.
APRIL 16, 2021	CHANGES AS PER CITY COMMENTS	m.c.r.
APRIL 20, 2021	CHANGES TO BDG 'C' RAMP DESIGN	m.c.r.
APRIL 21, 2021	CHANGES TO BDG 'C' RAMP DESIGN	m.c.r.
APRIL 29, 2021	UPDATE PLAN WITH NEW ARCH BUILDING FOOTPRINTS	m.c.r.
MAY 10, 2021	CHANGES TO BDG 'C' RAMP AREA	m.c.r.
MAY 13, 2021	CHANGES AS PER ENG COMMENTS	m.c.r.
MAY 14, 2021	CHANGES AS PER ENG COMMENTS	m.c.r.
JULY 6, 2021	NEW BDG 'A' ARCH FOOTPRINT	m.c.r.
AUG. 16, 2021	NEW BDG 'B' ARCH FOOTPRINT/UPDATE ENG DETAILS/SITE PLAN SUBMISSION	m.c.r.
AUG. 17, 2021	ADDITIONAL ENG DETAILS ADDED	m.c.r.
AUG. 20, 2021	ADD DIMENSIONING TO SP	m.c.r.
SEPT. 2, 2021	NEW TRANSFORMER LOCATIONS FROM ENG. x2	m.c.r.
NOV. 17, 2021	NEW BDG 'C' ARCH FOOTPRINT/UPDATE DETAILS	m.c.r.
NOV. 19, 2021	NEW BDG 'C' ARCH FOOTPRINT/UPDATE DETAILS	m.c.r.
DEC. 3, 2021	UPDATE ENG DETAILS/SITE PLAN SUBMISSION	m.c.r.
DEC. 17, 2021	UPDATE ENG DETAILS/SITE PLAN SUBMISSION	m.c.r.
DEC. 20, 2021	MINOR REVISION - ENG CHANGES	m.c.r.

Raymond J. Duhamel
REGISTERED PROFESSIONAL PLANNER
R.P.P.

Date Issued:	APRIL 30, 2020
Checked By:	RD
Project No.:	PRA-19078
Drawn By:	m.c.r.
Drawing Name:	PRA-19078-HD-W-SP-14a.dwg

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
228 Maplevew Drive East, Unit 1, Barrie, Ontario L4N 0W5
Phone: 705-734-2538 Fax: 705-734-5566
www.jonesconsulting.com

PRATT HANSEN GROUP - BISTRO 6 WEST
CITY OF BARRIE

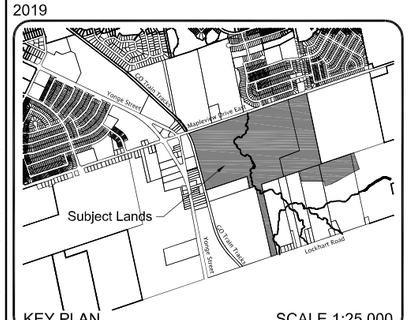
G:\Planning Drawings\PRA-19078-B6-West\Submitted\Dec 2021\PRA-19078-HD-W-SP-14a.dwg Layout:EGP Plotted Dec 20, 2021 @ 2:51pm by marichards The Jones Consulting Group Ltd.

Revised Draft Plan to Draft Approved Plan of Subdivision

Part of Lots 16, 17, and 18,
Concession 11 Former Town of Innisfil,
Now in the

City of Barrie

2019



HEWITT'S GATE

CITY OF BARRIE

STATISTICS		DRAFT PLAN	
		DRAFT APPROVED PLAN NOV. 2017	JAN. 2019
RESIDENTIAL LOT BREAKDOWN			
★ 13.7m SINGLES		108 units	95 units
✳ 13.7m SINGLES (SPECIAL)		n/a	4 units
■ 11.0m SINGLES		196 units	191 units
✪ 10.4m SINGLES		141 units	154 units
▼ 9.0m SINGLES (LOTS 1-531)		98 units	87 units
SUB TOTAL	19.10 ha.	543 units	531 units
STREET TOWNHOMES (6.7m) (BLOCKS 532-537 PART OF 538 & 539-552)	2.55 ha.	139 units	125 units
STREET TOWNHOMES (6.0m) (BLOCKS 553-557)	0.51 ha.	26 units	27 units
STREET TOWNHOMES (5.5m) (PART OF BLOCK 538)	0.03 ha.	n/a	2 units
STREET TOWNHOMES (4.5m) (BLOCKS 558-577)	2.14 ha.	97 units	121 units
BACK TO BACK TOWNHOMES (7.0m) (BLOCKS 578-587)	1.06 ha.	98 units	98 units
MULTI UNIT RESIDENTIAL (BLOCKS 588-598)	0.64 ha.	66 units	66 units
HIGH DENSITY RESIDENTIAL (BLOCKS 597 & 598)	7.67 ha.	546 units	546 units
FUTURE LOT BLOCKS (BLOCKS 599-605)	0.10 ha.		2 units
INSTITUTIONAL (BLOCKS 606 & 607)	3.20 ha.		
STORM WATER MANAGEMENT & DRAINAGE BLOCKS (BLOCKS 608-615)	7.94 ha.		
OPEN SPACE & PEDESTRIAN CONNECTIONS (BLOCKS 616-622)	3.01 ha.		
ENVIRONMENTAL PROTECTION (BLOCK 623 & 624)	17.48 ha.		
WIDENING & RESERVES (BLOCK 625-634)	1.23 ha.		
ROADS (MINOR COLLECTORS 'LALLY TERRACE', 'McAUSH STREET', & 'KNEESHAW DRIVE') (MAJOR COLLECTOR 'PRINCE WILLIAM WAY') (LOCALS (19.0m ROW) STREETS AS NOTED) (LOCALS (22.0m ROW) STREETS AS NOTED)	13.68 ha.		
TOTAL	80.34 ha.	1515 units	1518 units

OWNER'S CERTIFICATE

I, THE UNDERSIGNED, BEING THE REGISTERED OWNER OF THE SUBJECT LANDS, HEREBY AUTHORIZE THE JONES CONSULTING GROUP LTD., TO PREPARE THIS DRAFT PLAN OF SUBDIVISION AND TO SUBMIT SAME TO THE CITY OF BARRIE FOR APPROVAL.

DATE

CRISDAWN CONSTRUCTION INC.
PRATT DEVELOPMENT INC.

SURVEYOR'S CERTIFICATE

I CERTIFY THAT THE BOUNDARIES OF THE LANDS TO BE SUBDIVIDED AND THEIR RELATIONSHIP TO ADJACENT LANDS ARE ACCURATELY AND CORRECTLY SHOWN.

DATE

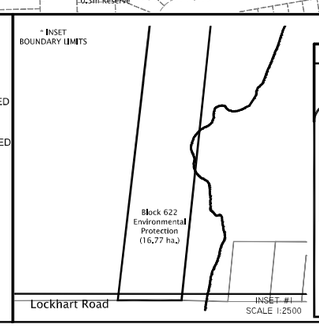
RUDY MAK, O.L.S.
ONTARIO LAND SURVEYORS

ADDITIONAL INFORMATION REQUIRED UNDER SECTION 51(17) OF THE PLANNING ACT

a) SHOWN ON DRAFT PLAN
b) SHOWN ON DRAFT PLAN
c) SHOWN ON KEY PLAN
d) RESIDENTIAL, SWM, MIXED USE, OPEN SPACE, INSTITUTIONAL & EP
e) SHOWN ON DRAFT PLAN
f) SHOWN ON DRAFT PLAN
g) SHOWN ON DRAFT PLAN
h) MUNICIPAL PIPED WATER TO BE PROVIDED
i) SANDY/CLAY LOAM
j) SHOWN ON DRAFT PLAN
k) ALL MUNICIPAL SERVICES TO BE PROVIDED
l) SHOWN ON DRAFT PLAN

10 0 10 20 30 40 50 METRES

DRAFT PLAN SCALE = 1:2000 (A1)



HEWITT'S GATE

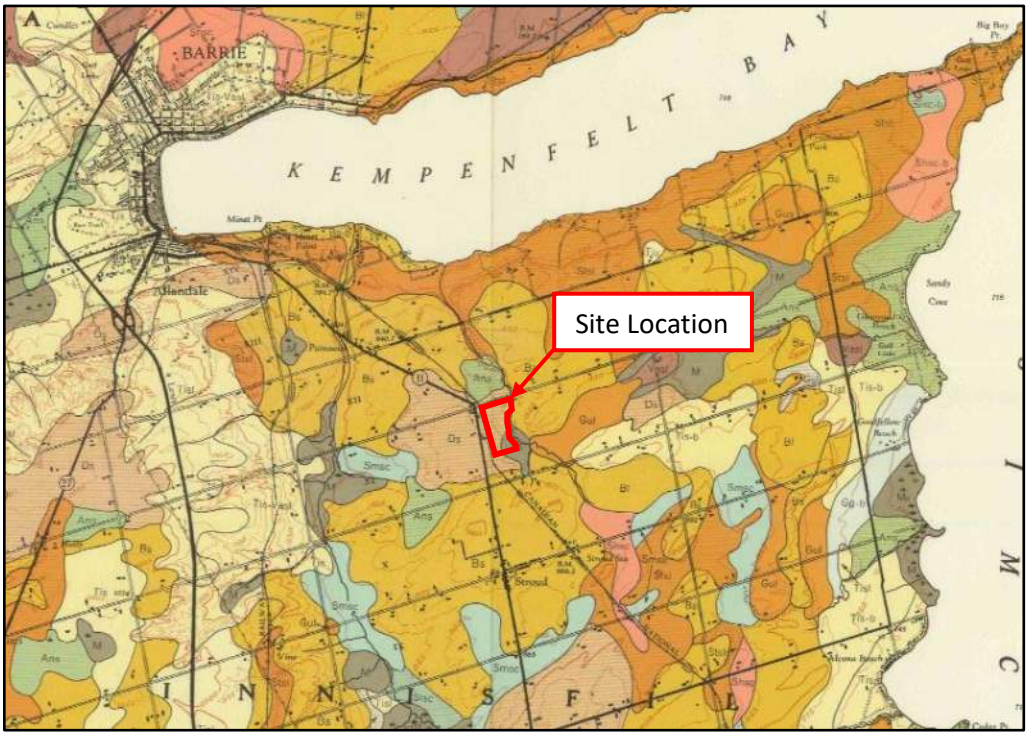
REVISED DRAFT PLAN TO DRAFT APPROVED PLAN OF SUBDIVISION

Raymond J. Dubarski REGISTERED PROFESSIONAL PLANNER R.P.P.

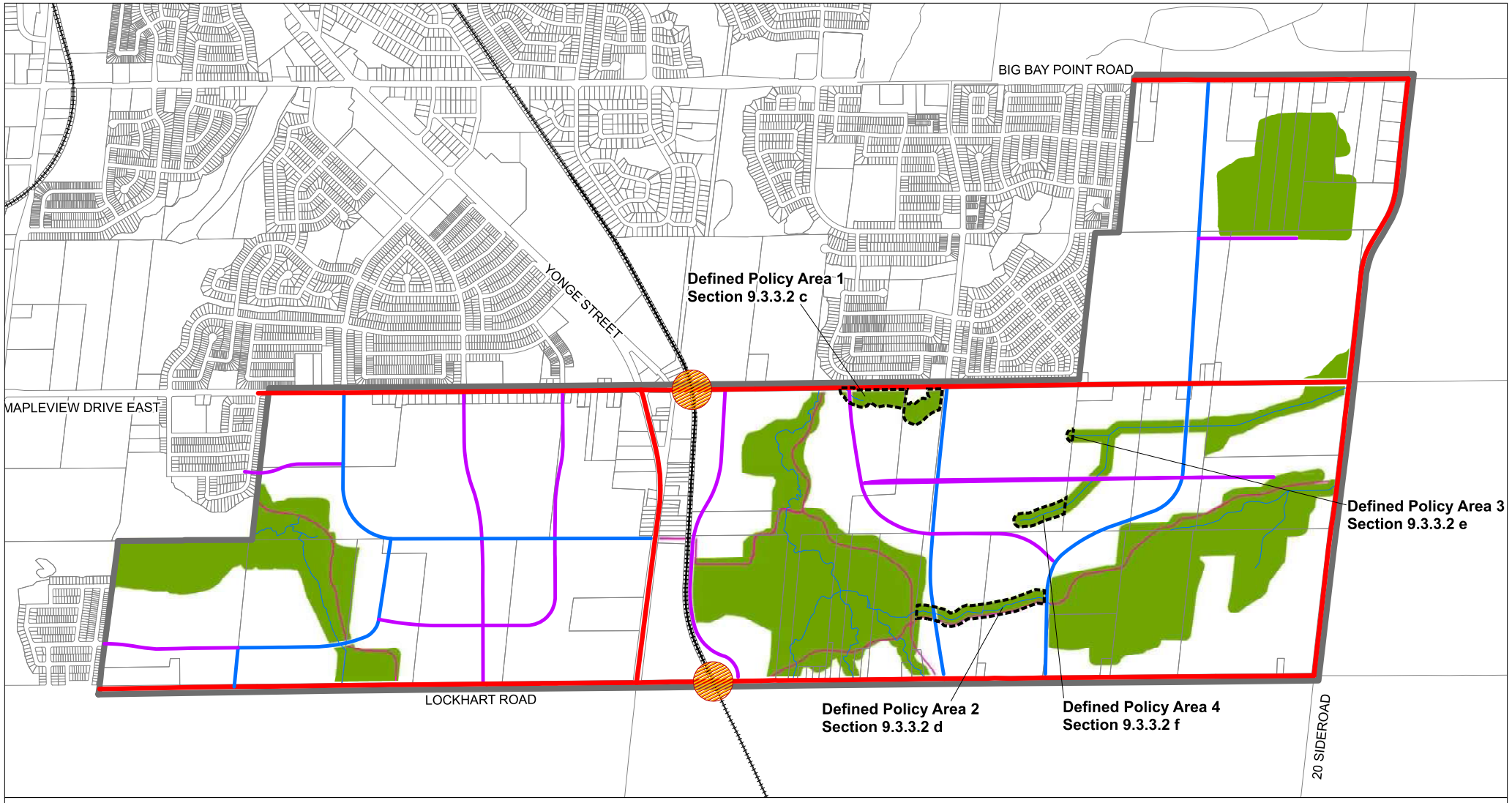
Date Issued:	JUNE 4, 2019
Checked By:	RD
Project No.:	PRA-12160
Drawing By:	m.c.r.
Drawing Name:	PRA-12160-H-F-2-10-03-04.dwg

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Drive East, Unit 1, Barrie, Ontario, L4N 0W5
Phone: 705-734-2538 Fax: 705-734-0156
www.jonesconsulting.com

Soils Map of Simcoe County
Ontario – South Sheet – Soil Survey Report No. 29



SERIES	BONDHEAD	GUERIN	LYONS	DUNDONALD	EDENVALE	MUCK
TYPE, SYMBOL, ACREAGE	loam Bl 41,400 sandy loam Bs 33,900 sandy loam — steep phase Bs-s 5,200 sandy loam — stony phase Bs-b 3,600	loam Gul 5,400 sandy loam Gus 1,700 loam — stony phase Gul-b 5,100 sandy loam — stony phase Gus-b 500	loam Ll 1,700 loam — stony phase Ll-b 100	sandy loam Ds 16,000 fine sandy loam Df 1,000	sandy loam Es 2,600	M 60,600
COLOUR						
SOIL MATERIALS	Light grey, calcareous, loam and sandy loam till			Outwash sand underlain by grey calcareous loam or sandy loam till at depths of 3 feet or less.		Well decomposed organic material over 1 foot deep underlain by rock, sand, silt or clay.
DRAINAGE	Good.	Imperfect.	Poor.	Good.	Imperfect.	Very poor.
TOPOGRAPHY	Smooth, moderately to steeply sloping.	Smooth, gently sloping.	Smooth, very gently sloping.	Smooth, gently sloping.	Smooth, very gently sloping.	Depressional.
SURFACE STONINESS	Slightly to very stony.	Slightly to moderately stony.	Slightly to very stony.	Stonefree.		Stonefree.
SURFACE REACTION	Neutral.			Slightly acid.		Neutral.
GREAT SOIL GROUP	Grey-Brown Podzolic.		Dark Grey Gleisolic.	Grey-Brown Podzolic.		Organic.
SERIES						
TYPE, SYMBOL ACREAGE						



Secondary Plan Boundary
Existing Parcel Fabric
Railway
Stream
Arterial
Major Collector
Minor Collector
Pathway System
Potential Grade Separation
Natural Heritage System
Defined Policy Area

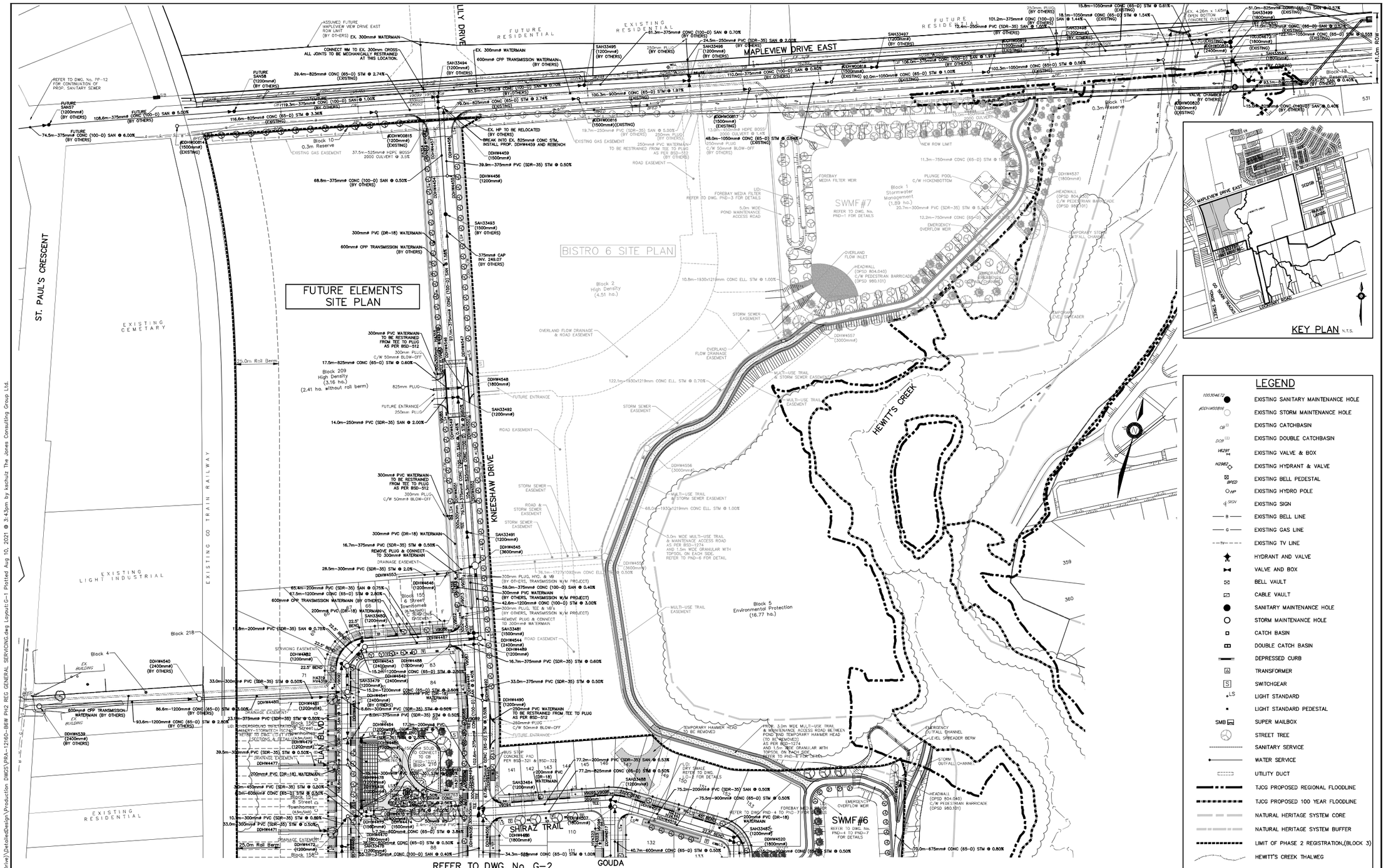
0 0.25 0.5 1 km

Schedule 9D-1

Transportation Plan

City of Barrie
Hewitt's Secondary Plan

May 2016



KEY PLAN N.T.S.

LEGEND

- EXISTING SANITARY MAINTENANCE HOLE
- EXISTING STORM MAINTENANCE HOLE
- EXISTING CATCHBASIN
- EXISTING DOUBLE CATCHBASIN
- EXISTING VALVE & BOX
- EXISTING HYDRANT & VALVE
- EXISTING BELL PEDESTAL
- EXISTING HYDRO POLE
- EXISTING SIGN
- EXISTING BELL LINE
- EXISTING GAS LINE
- EXISTING TV LINE
- HYDRANT AND VALVE
- VALVE AND BOX
- BELL VAULT
- CABLE VAULT
- SANITARY MAINTENANCE HOLE
- STORM MAINTENANCE HOLE
- CATCH BASIN
- DOUBLE CATCH BASIN
- DEPRESSED CURB
- TRANSFORMER
- SWITCHGEAR
- LIGHT STANDARD
- LIGHT STANDARD PEDESTAL
- SUPER MAILBOX
- STREET TREE
- SANITARY SERVICE
- WATER SERVICE
- UTILITY DUCT
- TJCG PROPOSED REGIONAL FLOODLINE
- TJCG PROPOSED 100 YEAR FLOODLINE
- NATURAL HERITAGE SYSTEM CORE
- NATURAL HERITAGE SYSTEM BUFFER
- LIMIT OF PHASE 2 REGISTRATION.(BLOCK 3)
- HEWITT'S CREEK THALWEG

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOWER'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 15CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900915.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M. G. FUS 90014215153 08-10-2021 PROVINCE OF ONTARIO

THE CITY OF BARRIE

ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION

September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

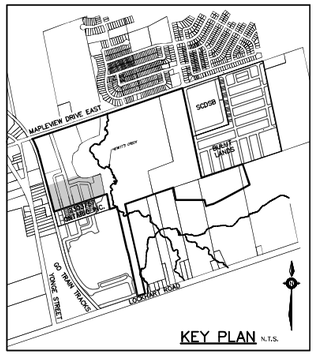
GENERAL SERVICING PLAN

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1056

DESIGN JJH/KS	SCALE: 1:1000	DATE OCTOBER 2020	
DRAWN KS	PROJECT PRA-12160	DWG. Nº G-1	
CHECKED DR			

ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160\Mapleview-Drive\Detailed Design\Production DWGS\PRA-12160-BBW PH2 REG GENERAL SERVICING.dwg Layout:G-1 Plotted Aug 10, 2021 @ 3:43pm by kschulz The Jones Consulting Group Ltd.



KEY PLAN N.T.S.

FUTURE HEWITT'S GATE EAST SUBDIVISION

LEGEND

- DEPRESSED CURB
- TJCG PROPOSED REGIONAL FLOODLINE
- TJCG PROPOSED 100 YEAR FLOODLINE
- NATURAL HERITAGE SYSTEM CORE
- NATURAL HERITAGE SYSTEM BUFFER
- LIMIT OF PHASE 2 REGISTRATION
- HEWITT'S CREEK THALWEG

ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160\MaplevIew-Drive\DetailedDesign\Production DWGS\PRA-12160-BRW PH2 REG SERVICING & EASEMENT PLAN.dwg Layout:EAS-2 Plotted Aug 09, 2021 @ 8:43am by kschulz The Jones Consulting Group Ltd.

BENCHMARK:

BENCHMARK NO: 01019805454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E. OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 15CM TOP OF COPING. N4901788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HIGH'S ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.002 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02em WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4906918.257 E608733.580 ELEV 232.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M. G. FUIS 90014913 08-10-2021 PROVINCE OF ONTARIO

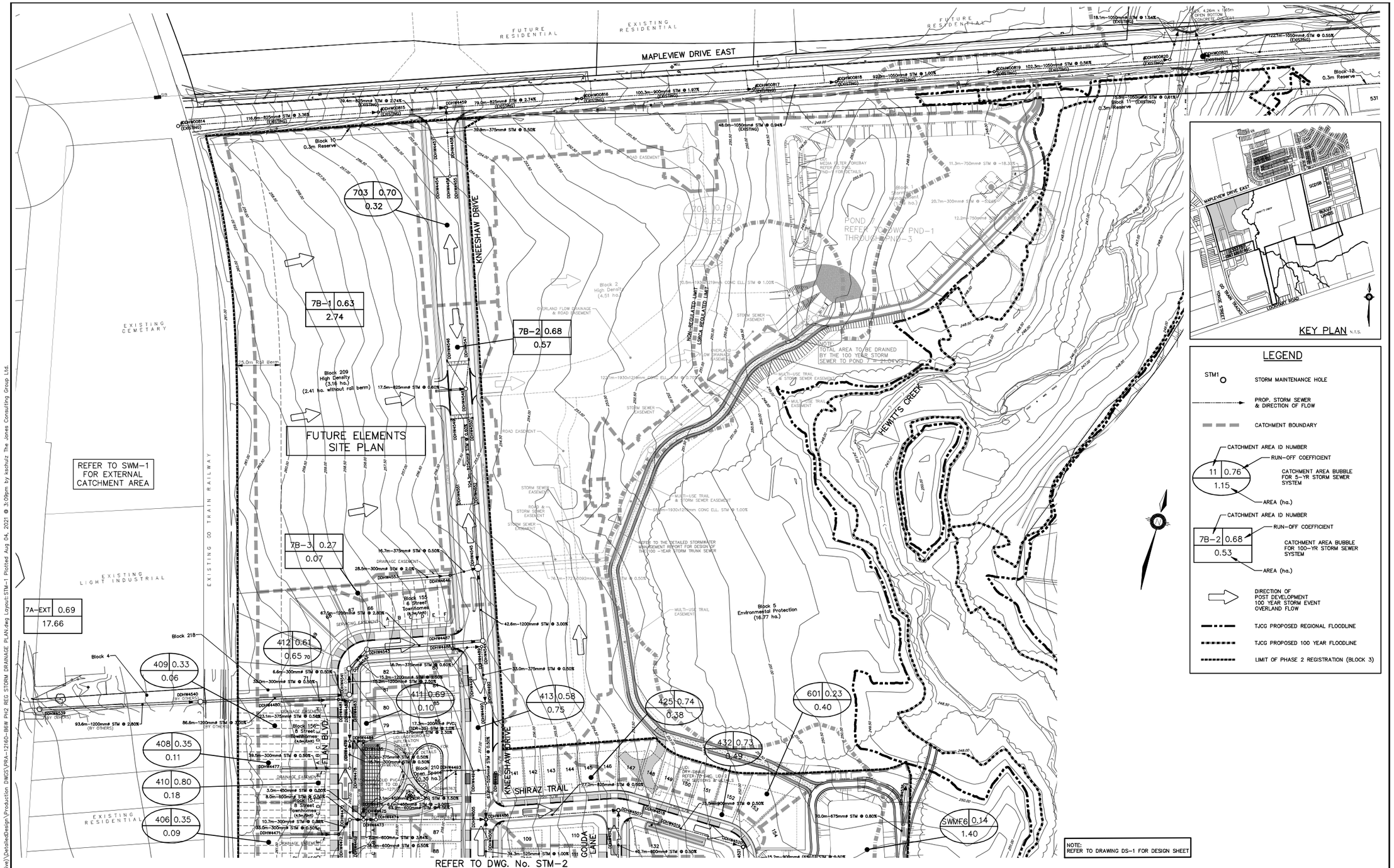
THE CITY OF BARRIE
ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION
September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

EASEMENT PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W8
P. 705.734.2538
F. 705.734.1056

DESIGN JJH/KS	SCALE: 1:1250	DATE OCTOBER 2020	
DRAWN KS	PROJECT PRA-12160	DWG. Nº EAS-2	
CHECKED DR			



KEY PLAN N.T.S.

LEGEND

- STM1 — STORM MAINTENANCE HOLE
- PROP. STORM SEWER & DIRECTION OF FLOW
- CATCHMENT BOUNDARY
- 11 | 0.76 / 1.15 — CATCHMENT AREA ID NUMBER; RUN-OFF COEFFICIENT; AREA (ha.) — CATCHMENT AREA BUBBLE FOR 5-YR STORM SEWER SYSTEM
- 7B-2 | 0.68 / 0.53 — CATCHMENT AREA ID NUMBER; RUN-OFF COEFFICIENT; AREA (ha.) — CATCHMENT AREA BUBBLE FOR 100-YR STORM SEWER SYSTEM
- DIRECTION OF POST DEVELOPMENT 100 YEAR STORM EVENT OVERLAND FLOW
- TJCG PROPOSED REGIONAL FLOODLINE
- TJCG PROPOSED 100 YEAR FLOODLINE
- LIMIT OF PHASE 2 REGISTRATION (BLOCK 3)

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E. OVER LOWE'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY ON THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL - 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.080 ELEV 232.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
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1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M. G. FUS 100149153 26-10-2021 PROVINCE OF ONTARIO

THE CITY OF BARRIE

ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION

September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

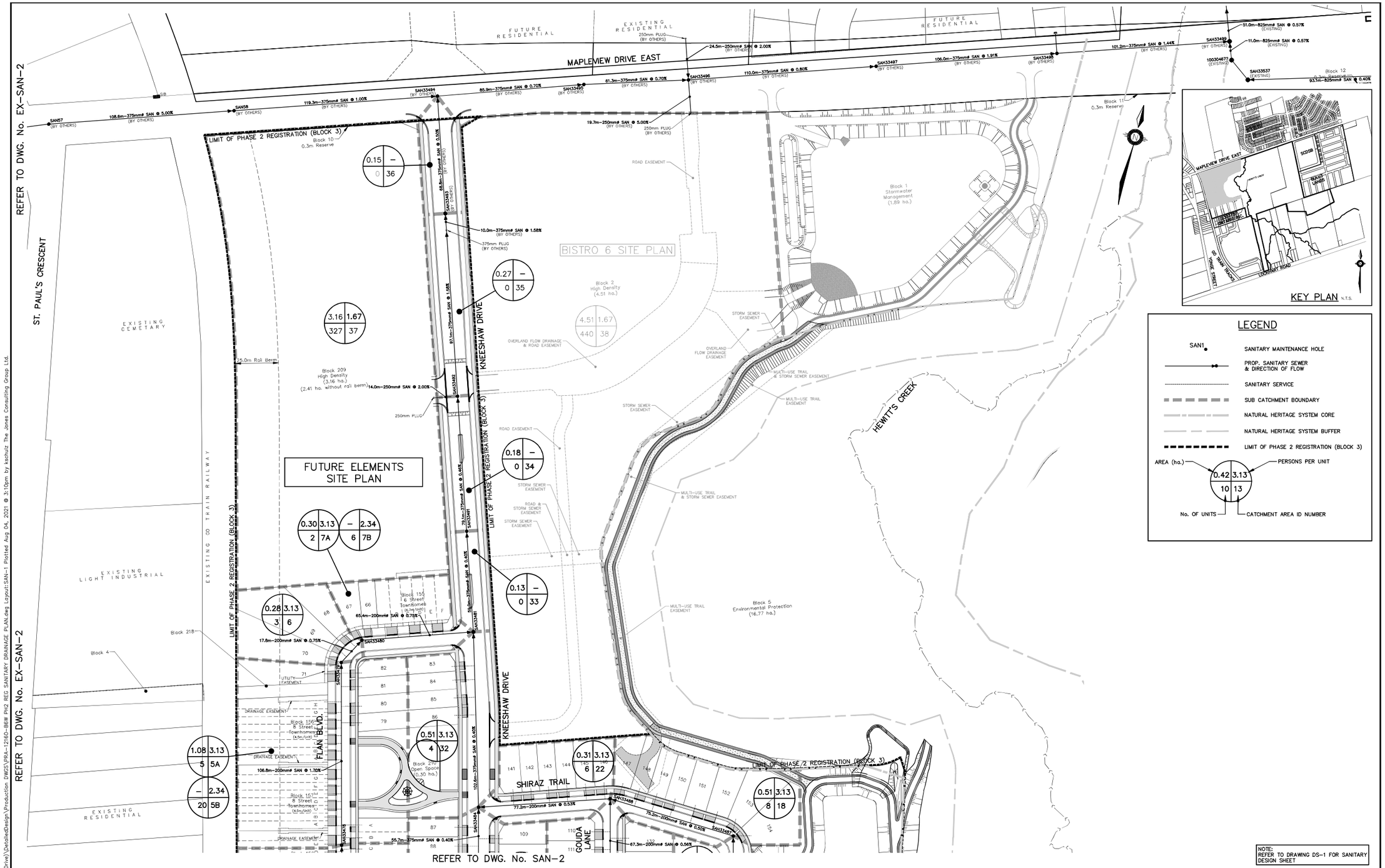
STORM SEWER SUBCATCHMENT PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Maplaview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.794.2588
F. 705.794.1066

DESIGN JJH/KS	SCALE: 1:1000	DATE OCTOBER 2020	
DRAWN KS	PROJECT PRA-12160	DWG. Nº STM-1	
CHECKED DR			

ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160\Maplaview-Drive\DetailedDesign\Production DWGS\PRA-12160-BRW PH2 REG STORM DRAINAGE PLAN.dwg Layout:STM-1 Plotted Aug 04, 2021 @ 3:09pm by kschutz The Jones Consulting Group Ltd.



NOTE:
REFER TO DRAWING DS-1 FOR SANITARY DESIGN SHEET

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOWE'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

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BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E609031.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900970.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
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2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M.G. RUS 100142153 PROVINCE OF ONTARIO

THE CITY OF BARRIE
ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION
September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

INTERNAL SANITARY DRAINAGE AREA PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W8
P. 705.794.2588
F. 705.794.1066

DESIGN	JJH/KS	SCALE: 1:1000	DATE OCTOBER 2020
DRAWN	KS	PROJECT PRA-12160	DWG. Nº SAN-1
CHECKED	DR		

ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160\Mapleview-Drive\DetailedDesign\Production DWGS\PRA-12160-BRW PH2 REG SANITARY DRAINAGE PLAN.dwg Layout:SAN-1 Plotted Aug 04, 2021 @ 3:10pm by kschulz The Jones Consulting Group Ltd.

Bistro 6 West Subdivision
5yr Storm Sewer Catchment Areas & Sizing

CLIENT: Crisdawn Construction Inc.
PROJECT: Bistro 6 West Subdivision
FILE: PRA-12160 (50)

DATE: March 2021
DESIGN: MG
CHECKED: MF

5 Year Storm Sewer Sizing

STREET NAME	AREAS	MANHOLE FROM	MANHOLE TO	LENGTH (m)	INCREMENT C	INCREMENT A	INCREMENT CA	TOTAL CA	FLOW TIME (min) TO	FLOW TIME (min) IN	I (mm/h)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	% FULL
Flan Boulevard	401	FUT.STM2	DDHW4462	57.3	0.59	0.36	0.21	0.21	10.00	0.75	109	0.064	0.50	450	0.202	1.3	31.5
Flan Boulevard	402	DDHW4462	DDHW4465	66.7	0.59	0.77	0.46	0.67	10.75	0.72	105	0.195	0.50	600	0.434	1.5	44.9
External*	6C-EXT				0.20	4.30	0.87	0.87									
Flan Boulevard	403	DDHW4466	DDHW4465	11.9	0.25	0.11	0.03	0.90	29.39	0.16	57	0.143	0.50	450	0.202	1.3	70.7
Flan Boulevard		DDHW4465	DDHW4467	35.2				1.57	29.55	0.38	57	0.248	0.50	600	0.434	1.5	57.1
Flan Boulevard	404	DDHW4468	DDHW4467	39.5	0.35	0.08	0.03	0.03	10.00	0.68	109	0.009	0.50	300	0.068	1.0	12.8
Flan Boulevard	405	DDHW4467	DDHW4470	38.0	0.77	0.12	0.09	1.68	29.93	0.41	56	0.264	0.50	600	0.434	1.5	60.9
Flan Boulevard	406	DDHW4471	DDHW4472	33.0	0.35	0.09	0.03	0.03	10.00	0.57	109	0.010	0.50	300	0.068	1.0	14.6
Flan Boulevard	407	DDHW4472	DDHW4470	10.7	0.80	0.15	0.12	0.16	10.57	0.18	106	0.044	0.50	300	0.068	1.0	64.9
Flan Boulevard		DDHW4470	DDHW4473	8.0				1.84	30.35	0.09	56	0.286	0.50	600	0.434	1.5	65.8
Block 210		DDHW4473	DDHW4474	7.2				1.84	30.43	0.03	56	0.285	3.84	600	1.203	4.3	23.7
Block 210		DDHW4473	DDHW4475	3.0								**0.120	0.50	450	0.202	1.3	59.5
Block 210		DDHW4475	DDHW4476	3.1								0.120	1.50	450	0.349	2.2	34.4
Flan Boulevard	408	DDHW4477	DDHW4478	39.5	0.35	0.11	0.04	0.04	10.00	0.68	109	0.011	0.50	300	0.068	1.0	16.6
Flan Boulevard		DDHW4478	DDHW4479	15.7				0.04	10.58	0.27	105	0.011	0.50	300	0.068	1.0	16.0
Flan Boulevard	409	DDHW4480	DDHW4481	33.0	0.33	0.06	0.02	0.02	10.00	0.57	109	0.006	0.50	300	0.068	1.0	8.8
Flan Boulevard	410	DDHW4481	DDHW4482	6.6	0.80	0.18	0.15	0.17	10.57	0.11	106	0.049	0.50	300	0.068	1.0	71.9
Flan Boulevard	411	DDHW4482	DDHW4479	23.1	0.69	0.10	0.07	0.24	10.58	0.34	105	0.069	0.50	375	0.124	1.1	55.7
Flan Boulevard		DDHW4479	DDHW4484	8.0				0.27	11.33	0.12	103	0.079	0.50	375	0.124	1.1	63.4
Flan Boulevard		DDHW4484	DDHW4485	2.2				0.27	11.14	0.02	103	0.078	2.30	375	0.266	2.4	29.4
Block 210		DDHW4474	DDHW4486	63.9				2.11	30.45	0.39	56	0.327	1.56	600	0.767	2.7	42.7
Flan Boulevard	412	DDHW4488	DDHW4489	16.7	0.61	0.65	0.39	0.39	10.00	0.23	109	0.119	0.60	375	0.136	1.2	87.6
Kneeshaw Drive		DDHW4489	DDHW4490	33.0				0.39	10.23	0.49	108	0.118	0.50	375	0.124	1.1	94.8
Kneeshaw Drive	413	DDHW4490	DDHW4486	67.6	0.58	0.75	0.43	0.83	10.72	0.80	105	0.242	0.50	525	0.304	1.4	79.6
Kneeshaw Drive	414	FUT.STM19	DDHW4498	74.7	0.70	0.25	0.18	0.18	10.00	0.59	109	0.053	2.42	300	0.150	2.1	35.3
Kneeshaw Drive	415	DDHW4498	DDHW4500	33.6	0.76	0.60	0.46	0.63	10.59	0.30	106	0.186	1.35	375	0.204	1.8	91.1
Kneeshaw Drive	416	DDHW4499	DDHW4500	42.6	0.66	0.22	0.15	0.15	10.00	0.73	109	0.044	0.50	300	0.068	1.0	64.3
Kneeshaw Drive	417	DDHW4500	DDHW4504	66.0	0.80	0.36	0.29	1.06	10.89	0.53	104	0.308	1.12	525	0.455	2.1	67.6
Kneeshaw Drive	418	DDHW4503	DDHW4504	42.6	0.61	0.22	0.13	0.13	10.00	0.73	109	0.041	0.50	300	0.068	1.0	59.2
Kneeshaw Drive	419	DDHW4504	DDHW4486	34.3	0.76	0.33	0.25	1.45	11.41	0.29	102	0.409	1.00	525	0.430	2.0	95.1
Shiraz Trail		DDHW4486	DDHW4507	77.2				4.39	30.85	0.68	55	0.675	0.50	825	1.015	1.9	66.5
Gouda Lane	420	DDHW4510	DDHW4511	33.1	0.70	0.78	0.54	0.54	10.00	0.44	109	0.164	0.50	450	0.202	1.3	81.6
Gouda Lane	421	DDHW4512	DDHW4511	38.5	0.60	0.21	0.13	0.13	10.00	0.65	109	0.039	0.50	300	0.068	1.0	56.7
Gouda Lane	422	DDHW4511	DDHW4515	62.4	0.77	0.26	0.20	0.87	10.56	0.74	106	0.255	0.50	525	0.304	1.4	82.9
Gouda Lane	423	DDHW4516	DDHW4515	38.5	0.58	0.16	0.09	0.09	10.00	0.66	109	0.028	0.50	300	0.068	1.0	41.2
Gouda Lane	424	DDHW4515	DDHW4507	40.7	0.69	0.25	0.17	1.14	11.40	0.44	102	0.321	0.50	600	0.434	1.5	73.9
Shiraz Trail	425	DDHW4507	DDHW4520	75.5	0.74	0.38	0.28	5.81	31.53	0.63	55	0.880	0.50	900	1.280	2.0	68.8
Shiraz Trail		DDHW4520	DDHW4521	15.2				5.81	32.16	0.13	54	0.869	0.50	900	1.280	2.0	67.9
Shiraz Trail		DDHW4521	DDHW4522	12.0				5.81	32.28	0.10	54	0.867	0.50	900	1.280	2.0	67.7
Shiraz Trail	426	DDHW4523	DDHW4522	38.5	0.60	0.17	0.10	0.10	10.00	0.32	109	0.031	2.20	300	0.143	2.0	21.6
External	301	FUT.STM30	FUT.STM31	91.3	0.66	1.41	0.93	0.93	10.00	1.08	109	0.280	0.50	525	0.304	1.4	92.0
External	316				0.72	0.56	0.40	1.33									
Shiraz Trail	427	FUT.STM31	FUT.STM32	75.0	0.84	0.09	0.08	1.40	11.38	0.33	103	0.402	3.60	525	0.816	3.8	49.3
External	318				0.68	0.74	0.51	0.51									
Shiraz Trail	428	FUT.STM32	FUT.STM33	43.6	0.82	0.07	0.06	1.97	11.41	0.31	102	0.556	1.00	675	0.841	2.3	66.1
Shiraz Trail		FUT.STM33	FUT.STM34	16.6				1.97	11.72	0.16	100	0.548	0.50	750	0.787	1.8	69.6
Shiraz Trail		FUT.STM34	FUT.STM35	15.7				1.97	11.88	0.13	99	0.544	0.50	750	0.787	1.8	69.1
Shiraz Trail	429	FUT.STM35	DDHW4524	67.4	0.60	0.18	0.11	2.08	12.01	0.63	99	0.570	0.50	750	0.787	1.8	72.4
Shiraz Trail	430	DDHW4524	DDHW4527	45.2	0.68	0.52	0.35	2.43	12.64	0.42	96	0.648	0.50	750	0.787	1.8	82.3
Shiraz Trail	431	DDHW4528	DDHW4527	38.5	0.60	0.18	0.11	0.11	10.00	0.65	109	0.033	0.50	300	0.068	1.0	47.7
Shiraz Trail		DDHW4527	DDHW4531	44.8				2.54	13.06	0.37	94	0.665	0.50	900	1.280	2.0	51.9
Shiraz Trail	432	DDHW4531	DDHW4522	10.1	0.73	0.49	0.36	2.90	13.43	0.08	93	0.746	0.50	900	1.280	2.0	58.3
Block 208		DDHW4522	DDHW4532	21.1				8.81	32.38	0.16	54	1.311	0.50	1050	1.931	2.2	67.9
Block 208		DDHW4534	DDHW4535	70.0								***0.411	0.80	675	0.752	2.1	54.7
Block 1		DDHW4537	DDHW4538	12.2								***0.641	0.50	750	0.787	1.8	81.4

Q= 0.0028*C*I*A (cms) C= RUNOFF COEFFICIENT RAINFALL INTENSITY (5 Year) = 853.608/(T.C. + 4.699)^0.766 A=AREA (ha)

Note: *Time of Concentration for External Area 6C-EXT was calculated using Airport Method
**Flow Rate represents quantity directed to LID facility via By-Pass Weir located in STM13
***Total Attenuated Piped Outflow from Ponds during 100-yr storm events, extracted from DSWMR (under separate cover)

Time of Concentration for Catchment 6C-EXT - Airport Formula

$$t_c = \frac{3.26 \times (1.1 - C) \times L^{0.5}}{S^{0.33}}$$

Tc= Time of concentration (minutes) = 29.39
C= Runoff Coefficient = 0.20
Sw= Watershed slope (%) = 2.5
L= Watershed length (m) = 185.759

Bistro 6 Subdivision
100yr Storm Sewer Catchment Areas & Sizing

CLIENT: Crisdawn Construction
PROJECT: Bistro 6 Subdivision
FILE: PRA-12160

DATE: August 15, 2019
DESIGN: MF

Storm Sewer Catchment Areas & Runoff Coefficients

Runoff Coefficient: Landscape	Impervious (Roof)	Impervious (Parking, Sidewalk)
0.10	0.95	0.90
0.10	0.95	0.90
0.10	0.95	0.90

Catchment	% Impervious	Weighted Runoff Coefficient
7B-1	62	0.63
7B-2	68	0.68
7B-3	20	0.27
EXT	69	0.69

Time of Concentration for Catchment 7A-EXT

$$t_c = \frac{(0.057)(L)}{(S_w)^{0.2}(A)^{0.1}}$$ Bransby-Williams Formula

Tc= Time of concentration (minutes) = 13.03
A= Watershed area (ha) = 17.66
Sw= Watershed slope (%) = 2.0
L= Watershed length (m) = 350
C= Runoff Coefficient = 0.69

100 Year Storm Sewer Sizing

AREAS	MANHOLE FROM	MANHOLE TO	LENGTH (m)	INCREMENT C	INCREMENT A	INCREMENT CA	TOTAL CA	FLOW TIME (min) TO	FLOW TIME (min) IN	I (mm/h)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	% FULL
7A-EXT	DDHW4539	DDHW4540	100.4	0.69	17.66	12.19	12.19	13.03	0.26	157	5.315	3.6	1200	7.397	6.5	71.9
	DDHW4540	DDHW4541	86.6				12.19	13.29	0.22	155	5.260	3.6	1200	7.397	6.5	71.1
	DDHW4541	DDHW4542	15.2				12.19	13.51	0.05	154	5.213	2.5	1200	6.164	5.5	84.6
	DDHW4542	DDHW4543	15.2				12.19	13.56	0.05	154	5.203	2.5	1200	6.164	5.5	84.4
	DDHW4543	DDHW4544	67.5				12.19	13.60	0.21	153	5.193	2.5	1200	6.164	5.5	84.2
	DDHW4544	DDHW4545	42.6				12.19	13.81	0.09	152	5.150	5.0	1200	8.674	7.7	59.4
7B-1	BLOCK 598	DDHW4548	17.5	0.63	2.74	1.73	1.73	10.00	0.14	180	0.864	0.6	825	1.112	2.1	77.7
7B-2	DDHW4548	DDHW4545	104.3	0.68	0.57	0.39	2.11	10.14	0.84	179	1.050	0.6	825	1.112	2.1	94.5
7B-3	DDHW4553	DDHW4554	28.5	0.27	0.07	0.02	0.02	10.00	0.49	180	0.009	0.5	300	0.068	1.0	12.8
	DDHW4554	DDHW4545	16.7				0.02	10.49	0.29	176	0.009	0.5	300	0.068	1.0	12.5
	DDHW4545	DDHW4555	76.1				14.32	13.90	0.48	152	6.030	0.5	1350	3.774	2.6	*159.8
	DDHW4555	DDHW4556	68.0				14.32	14.38	0.28	149	5.917	1.0	1500	7.069	4.0	83.7
	DDHW4556	DDHW4557	122.1				14.32	14.66	0.61	147	5.853	0.7	1500	5.914	3.3	99.0
	DDHW4557	DDHW4558	10.8				14.32	15.27	0.04	144	5.721	1.0	1500	7.069	4.0	80.9

Q= 0.0028*C*I*A (cms) C=RUNOFF COEFFICIENT RAINFALL INTENSITY (100 Year) = 1426.406/(T.C. + 5.273)^0.759 A=AREA (ha)

*Note: Refer to Hydraulic Gradeline Analysis completed using PCSWMM Software, detailed within DSWMR (under separate cover), which shows no surcharge in this vicinity.

Barrie
SANITARY SEWER DESIGN - LOCAL SEWER
Development Details Basis

DESIGN SHEET 1 of 1
FILE NO PRA-12160
CONTRACT / PROJECT Bistro 6 West Subdivision - Crisdawn Construction Inc.

n ≥ 0.013
M = 5/P^0.2 Babbit
M=1+[14/(4+P^0.5)] Harmon
Q_p = P*q*M/86.4
Q_i = I*A
Q_{tot} = Q_p + Q_i

Numbers in blue or text in red are equations
(Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

(Peak population flow where; q = 225 L/day/person; P = population in thousands) 225 litres/person/day
(Peak extraneous flow: I= 0.1L/s/ha over development area)
(Total peak flow as the sum of peak population flow and peak extraneous flow)

STREET / AREA	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q_p (l/s)	AREA (ha)	AREA (ACC) (ha)	Q_i (l/s)	Q_{tot} (l/s)	L (m)	D (mm)	S (%)	Qf FULL (l/s)	d/D[3]	d/D[3] >0.5 or >0.7	Velocity FULL (m/s)	Velocity Partial[1] (m/s)	Velocity[4] > 0.6 (m/s)
Area 2A - Singles Flan Boulevard	FUT. SAN31	SAH33476	9	9	3.13	28	28																	
Area 2B - Townhomes Flan Boulevard			14	14	2.34	33	33																	
				23			61	8.750	4.297	8.750	1.388	1.01	1.01	0.101	1.489	105.7	200	1.60%	41.487	0.129	Ok	1.321	0.610	Ok
Area 3A - Singles Flan Boulevard	SAH33476	SAH33477	6	6	3.13	19	19																	
Area 3B - Townhomes Flan Boulevard			7	7	2.34	16	16																	
				36			96	7.988	4.248	7.988	1.999	0.53	1.54	0.154	2.152	55.2	200	1.20%	35.929	0.166	Ok	1.144	0.615	Ok
Area 4A - Singles Flan Boulevard	SAH33477	SAH33478	1	1	3.13	3	3																	
Area 4B - Townhomes Flan Boulevard			20	20	2.34	47	47																	
				57			146	7.347	4.195	7.347	2.794	0.68	2.21	0.221	3.015	65.2	200	0.90%	31.115	0.210	Ok	0.990	0.613	Ok
Area 5A - Singles Flan Boulevard	SAH33478	SAH33479	5	5	3.13	16	16																	
Area 5B - Townhomes Flan Boulevard			20	20	2.34	47	47																	
				82			208	6.842	4.141	6.842	3.714	1.08	3.30	0.330	4.044	106.8	200	1.70%	42.764	0.207	Ok	1.361	0.835	Ok
Area 6 - Townhomes Flan Boulevard	SAH33479	SAH33480	3	85	2.34	7	215	6.796	4.136	6.796	3.814	0.28	3.58	0.358	4.172	17.8	200	0.75%	28.404	0.258	Ok	0.904	0.629	Ok
Area 7A - Singles Flan Boulevard	SAH33480	SAH33481	2	2	3.13	6	6																	
Area 7B - Townhomes Flan Boulevard			6	6	2.34	14	14																	
2 Refer to Trunk Sanitary Sewer Design Sheet				93			236	6.675	4.121	6.675	4.099	0.30	3.88	0.388	4.486	65.4	200	0.75%	28.404	0.268	Ok	0.904	0.642	Ok
Area 8 - Gouda Lane	FUT. SAN14	FUT. SAN15	17	17	2.34	40	40	9.529	4.334	9.529	0.987	0.32	0.32	0.032	1.019	66.5	200	2.00%	46.384	0.102	Ok	1.476	0.592	Check
Area 9 - Gouda Lane	FUT. SAN15	FUT. SAN16	5	22	2.34	12	51	9.050	4.312	9.050	1.213	0.12	0.44	0.044	1.258	15.7	200	2.00%	46.384	0.113	Ok	1.476	0.633	Ok
Area 10 - Gouda Lane	FUT. SAN16	FUT. SAN37	8	30	2.34	19	70	8.506	4.283	8.506	1.555	0.17	0.62	0.062	1.617	50.4	200	2.00%	46.384	0.127	Ok	1.476	0.682	Ok
Area 11 - Shiraz Trail	FUT. SAN17	FUT. SAN37	9	9	2.34	21	21	10.821	4.377	10.821	0.593	0.26	0.26	0.026	0.619	77.2	200	2.00%	46.384	0.080	Ok	1.476	0.510	Check
Area 12 - Shiraz Trail	FUT. SAN37	FUT. SAN40	0	39	0	0	91	8.071	4.254	8.071	1.918	0.09	0.97	0.097	2.015	52.8	200	2.90%	55.854	0.129	Ok	1.778	0.825	Ok
Area 13 - Shiraz Trail	FUT. SAN40	FUT. SAN41	0	39	0	0	91	8.071	4.254	8.071	1.918	0.03	0.99	0.099	2.018	16.5	200	0.50%	23.192	0.199	Ok	0.738	0.446	Check
Area 14 - Shiraz Trail	FUT. SAN41	FUT. SAN42	0	39	0	0	91	8.071	4.254	8.071	1.918	0.03	1.02	0.102	2.021	16.3	200	0.50%	23.192	0.199	Ok	0.738	0.446	Check
Area 15 - Shiraz Trail	FUT. SAN42	SAH33485	7	46	3.13	22	113	7.731	4.226	7.731	2.278	0.38	1.41	0.141	2.419	80.1	200	0.50%	23.192	0.218	Ok	0.738	0.469	Check
** ↑ SEWERS TO BE CONSTRUCTED IN FUTURE PHASE OF REGISTRATION ↑ **																								
Area 16 - Shiraz Trail	SAH33485	SAH33486	6	52	3.13	19	132	7.497	4.209	7.497	2.576	0.34	1.75	0.175	2.751	65.5	200	0.50%	23.192	0.232	Ok	0.738	0.487	Check
Area 17 - Shiraz Trail	SAH33486	SAH33487	3	55	3.13	9	141	7.395	4.199	7.395	2.722	0.20	1.95	0.195	2.916	49.2	200	0.50%	23.192	0.239	Ok	0.738	0.494	Check
Area 18 - Shiraz Trail	SAH33487	SAH33488	8	63	3.13	25	166	7.157	4.176	7.157	3.101	0.51	2.45	0.245	3.346	75.2	200	0.50%	23.192	0.256	Ok	0.738	0.512	Check
Area 19 - Gouda Lane	FUT. SAN37	SAH33489	16	16	3.13	50	50	9.100	4.315	9.100	1.187	0.70	0.70	0.070	1.257	99.3	200	1.80%	44.004	0.116	Ok	1.401	0.604	Ok
Area 20 - Gouda Lane	SAH33489	SAH33490	13	29	3.13	41	91	8.079	4.255	8.079	1.910	0.52	1.22	0.122	2.032	75.6	200	1.20%	35.929	0.161	Ok	1.144	0.605	Ok
Area 21 - Gouda Lane	SAH33490	SAH33488	10	39	3.13	31	122	7.615	4.219	7.615	2.421	0.42	1.65	0.165	2.585	67.3	200	0.56%	24.544	0.219	Ok	0.781	0.497	Check
Area 22 - Shiraz Trail	SAH33488	SAH33484	6	108	3.13	19	307	6.331	4.074	6.331	5.065	0.31	4.41	0.441	5.507	77.2	200	0.53%	23.878	0.326	Ok	0.760	0.603	Ok
1 Refer to Trunk Sanitary Sewer Design Sheet							307																	

DATE: March 8th, 2021 CALCULATED BY: MG CHECKED BY: DR

* For sizing of the 375mmø Trunk Sewer on Kneeshaw Drive, refer to Sanitary Sewer Design - Trunk Sewer worksheet.

(1) without extraneous flow
(2) with extraneous flow
(3) d/D>0.5 for pipes 375 and less, d/D>0.85 for pipes greater than 375
(4) Velocity check based on the lesser of full flow or partial velocity

Barrie
SANITARY SEWER DESIGN - TRUNK SEWER
Development Details Basis

DESIGN SHEET 1 of 1
FILE NO PRA-12160
CONTRACT / PROJECT Bistro 6 West Subdivision - Crisdawn Construction Inc.

n ≥ 0.013
M = 5/P^0.2 Babbit
M=1+[14/(4+P^0.5)] Harmon
Q_p = P*q*M/86.4
Q_i = I*A
Q_{tot} = Q_p + Q_i

Numbers in blue or text in red are equations
(Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

(Peak population flow where; q = 225 L/day/person; P = population in thousands) 225 litres/person/day
(Peak extraneous flow: I= 0.1L/s/ha over development area)
(Total peak flow as the sum of peak population flow and peak extraneous flow)

STREET / AREA	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q_p (L/s)	AREA (ha)	AREA (ACC) (ha)	Q_i (L/s)	Q_{tot} (L/s)	L (m)	D (mm)	S (%)	Qf FULL (L/s)	d/D[3]	d/D[3] >0.5 or >0.7	Velocity FULL (m/s)	Velocity Partial[1] (m/s)	Velocity[4] > 0.6 (m/s)
Mixed Use			Residential Multi-Density			3401	3401	3.914	3.396	3.914	34.658	24.59	24.59	2.459	37.127									
			Commercial 0.32 L/(s*ha)					2.000	2.000	2.000	3.187	4.98	4.98	0.498	3.685									
St. Paul's Development Area	SANMH57	SANMH25					3401	3.914	3.396	3.914	37.855	1.11	30.68	3.068	40.923		375	0.50%	123.977	0.395	Ok	1.123	0.986	Ok
EXT1 - Yonge St. - Institutional			Institutional 0.32 L/(s*ha)			0	0	2.000	2.000	2.000	3.680	5.75	5.75	0.575	4.255									
EXT2 - Yonge St. - Recreational Centre			Institutional 0.32 L/(s*ha)			0	0	2.000	2.000	2.000	4.659	7.28	13.03	1.303	5.962									
EXT3 - Yonge St. - Mixed Use Proposed			Residential 175 people/ha			655	655	5.442	3.911	5.442	17.615	3.74	16.77	1.677	19.292									
EXT4 - Yonge St. - Mixed Use Proposed			Residential 175 people/ha			1904	2559	4.144	3.500	4.144	35.947	10.88	27.65	2.765	38.712									
	YS STUB	FUT. SAN7				0	2559	4.144	3.500	4.144	35.947	0.00	27.65	2.765	38.712		300	1.00%	96.701	0.440	Ok	1.368	1.267	Ok
KNEESHAW DRIVE	SANMH1	SANMH7	Residential 147 people/ha			1227	1227	4.800	3.741	4.800	15.338	8.35	8.35	0.835	16.171		300	0.40%	61.159	0.351	Ok	0.865	0.719	Ok
Area 23 - KNEESHAW DRIVE (Trunk)	FUT. SAN10	FUT. SAN11					3786	3.831	3.355	3.831	46.108	0.70	36.70	3.670	49.778	15.0	375	0.40%	110.889	0.469	Ok	1.004	0.957	Ok
Area 24 - KNEESHAW DRIVE (Trunk)	FUT. SAN11	FUT. SAN12					3786	3.831	3.355	3.831	46.108	0.39	37.09	3.709	49.817	108.4	375	0.40%	110.889	0.469	Ok	1.004	0.957	Ok
Area 24 - KNEESHAW DRIVE (Local)	FUT. SAN11	FUT. SAN12	8	8	2.34	19	19	11.079	4.384	11.079	0.540				0.540	108.4	200	2.00%	46.384	0.075	Ok	1.476	0.493	Check
Area 25 - KNEESHAW DRIVE (Trunk)	FUT. SAN12	FUT. SAN13					3804	3.828	3.353	3.828	46.258	0.04	37.13	3.713	49.971	15.0	375	0.40%	110.889	0.470	Ok	1.004	0.958	Ok
Area 26 - KNEESHAW DRIVE (Trunk)	FUT. SAN13	FUT. SAN14					3804	3.828	3.353	3.828	46.258	0.15	37.28	3.728	49.986	43.7	375	0.40%	110.889	0.470	Ok	1.004	0.958	Ok
Area 26 - KNEESHAW DRIVE (Local)	FUT. SAN13	FUT. SAN14	3	3	2.34	7	7	13.480	4.428	13.480	0.246				0.246	43.7	200	2.00%	46.384	0.052	Ok	1.476	0.389	Check
Area 27 - KNEESHAW DRIVE (Trunk)	FUT. SAN14	FUT. SAN17					3811	3.826	3.352	3.826	46.314	0.22	37.50	3.750	50.064	61.1	375	0.40%	110.889	0.471	Ok	1.004	0.958	Ok
Area 27 - KNEESHAW DRIVE (Local)	FUT. SAN14	FUT. SAN17	5	5	2.34	12	12	12.171	4.408	12.171	0.371				0.371	61.1	200	2.00%	46.384	0.063	Ok	1.476	0.441	Check
Area 1 - FLAN BOULEVARD (Local)	FUT. SAN47	FUT. SAN31	24	24	2.34	56	56	8.894	4.304	8.894	1.301	0.88	0.88	0.088	1.389	100.9	200	1.70%	42.764	0.123	Ok	1.361	0.609	Ok
Area 28 - KNEESHAW DRIVE (local)	FUT. SAN31	FUT. SAN17	9	33	2.34	21	77	8.345	4.273	8.345	1.678	0.26	1.14	0.114	1.792	78.7	200	1.40%	38.808	0.146	Ok	1.235	0.614	Ok
Area 29 - KNEESHAW DRIVE (Trunk)	FUT. SAN17	SAH33482					3900	3.808	3.343	3.808	47.021	0.70	39.34	3.934	50.955	99.2	375	0.40%	110.889	0.475	Ok	1.004	0.962	Ok
Area 29 - KNEESHAW DRIVE (Local)	FUT. SAN17	SAH33482	14	14	3.13	44	44	9.346	4.326	9.346	1.067				1.067	99.2	200	2.00%	46.384	0.104	Ok	1.476	0.607	Ok
Area 30 - KNEESHAW DRIVE (Trunk)	SAH33482	SAH33483	16	30	3.13	50	3950	3.799	3.338	3.799	47.418	0.73	40.07	4.007	51.425	87.7	375	0.40%	110.889	0.478	Ok	1.004	0.964	Ok
Area 31 - KNEESHAW DRIVE (Trunk)	SAH33483	SAH33484	9	39	3.13	28	3978	3.793	3.335	3.793	47.640	0.42	40.49	4.049	51.689	55.7	375	0.40%	110.889	0.479	Ok	1.004	0.965	Ok
Refer to Interal Sanitary Sewer Design																								
1 SHIRAZ TRAIL TOTAL	SAH33488	SAH33484		108		19	307	6.331	4.074	6.331	5.065	0.31	4.41											
Area 32 - KNEESHAW DRIVE (Trunk)	SAH33484	SAH33481	4	151	3.13	13	4298	3.735	3.305	3.735	50.148	0.51	45.41	4.541	54.689	102.6	375	0.40%	110.889	0.495	Ok	1.004	0.978	Ok
Refer to Interal Sanitary Sewer Design																								
2 FLAN BOULEVARD TOTAL	SAH33480	SAH33481		93		236	236	6.675	4.121	6.675	4.099	0.30	3.88											
Area 33 - KNEESHAW DRIVE (Trunk)	SAH33481	SAH33491		283			4534	3.696	3.284	3.696	51.973	0.13	49.42	4.942	56.915	59.0	375	0.40%	110.889	0.507	Check	1.004	0.987	Ok
Area 34 - KNEESHAW DRIVE (Trunk)	SAH33491	SAH33492		283			4534	3.696	3.284	3.696	51.973	0.18	49.61	4.961	56.933	76.2	375	0.46%	118.915	0.487	Ok	1.077	1.040	Ok
Area 37 - BLK209 (High Density - 100units/ha)	BLK 209	SAH33492	327	327	1.67	546	546	5.643	3.954	5.643	8.025	3.16	3.16	0.316	8.341	14.0	250	2.00%	84.100	0.212	Ok	1.713	1.079	Ok
Area 35 - KNEESHAW DRIVE (Trunk)	SAH33492	SAH33493					5080	3.612	3.239	3.612	56.129	0.27	53.04	5.304	61.432	110.0	375	1.58%	220.387	0.361	Ok	1.995	1.667	Ok
Area 36 - KNEESHAW DRIVE (Trunk)	SAH33493	SAH33494					5080	3.612	3.239	3.612	56.129	0.15	53.18	5.318	61.447	68.8	375	0.50%	123.977	0.497	Ok	1.123	1.094	Ok
Mapleview Drive East	SAH33494	SAH33495					8481	3.260	3.025	3.260	83.537	0.21	84.08	8.408	91.945	85.9	375	0.70%	146.692	0.573	Check	1.328	1.371	Ok
Mapleview Drive East	SAH33495	SAH33496					8481	3.260	3.025	3.260	83.537	0.18	84.26	8.426	91.963	61.3	375	0.70%	146.692	0.573	Check	1.328	1.371	Ok
EXT 5 - Mapleview Drive East	PLUG	SAH33496									3.700	0.91	0.91	0.091	3.791	24.5	250	2.00%	84.100	0.144	Ok	1.713	0.856	Ok
Area 38 - BLK2 (High Density - B6 Site Plan)	BLK 2	SAH33496	440	440	1.67	735	735	5.318	3.852	5.318	10.176	4.51	4.51	0.451	10.627	24.7	250	4.95%	132.307	0.191	Ok	2.695	1.593	Ok
Mapleview Drive East	SAH33496	SAH33497					9216	3.207	2.990	3.207	92.187	0.37	90.04	9.004	101.191	110.0	375	0.80%	156.820	0.584	Check	1.420	1.477	Ok
Mapleview Drive East	SAH33497	SAH33498					9216	3.207	2.990	3.207	88.487	0.43	90.48	9.048	97.534	119.8	375	0.85%	161.646	0.560	Check	1.464	1.496	Ok
EXT 6 - Mapleview Drive East	PLUG	SAH33498									1.500	2.12	2.12	0.212	1.712	10.4	250	1.00%	59.468	0.116	Ok	1.211	0.513	Check
Mapleview Drive East	SAH33498	SAH33499					9216	3.207	2.990	3.207	89.987	0.34	92.93	9.293	99.280	87.3	375	2.10%	254.078	0.434	Ok	2.300	2.103	Ok

DATE: March 8th, 2021 CALCULATED BY: MG CHECKED BY: DR

(1) without extraneous flow
(2) with extraneous flow
(3) d/D>0.5 for pipes 375 and less, d/D>0.7 for pipes greater than 375
(4) Velocity check based on the lesser of full flow or partial velocity

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD. APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
08-10-2021
PROVINCE OF ONTARIO

THE CITY OF BARRIE

ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION

September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

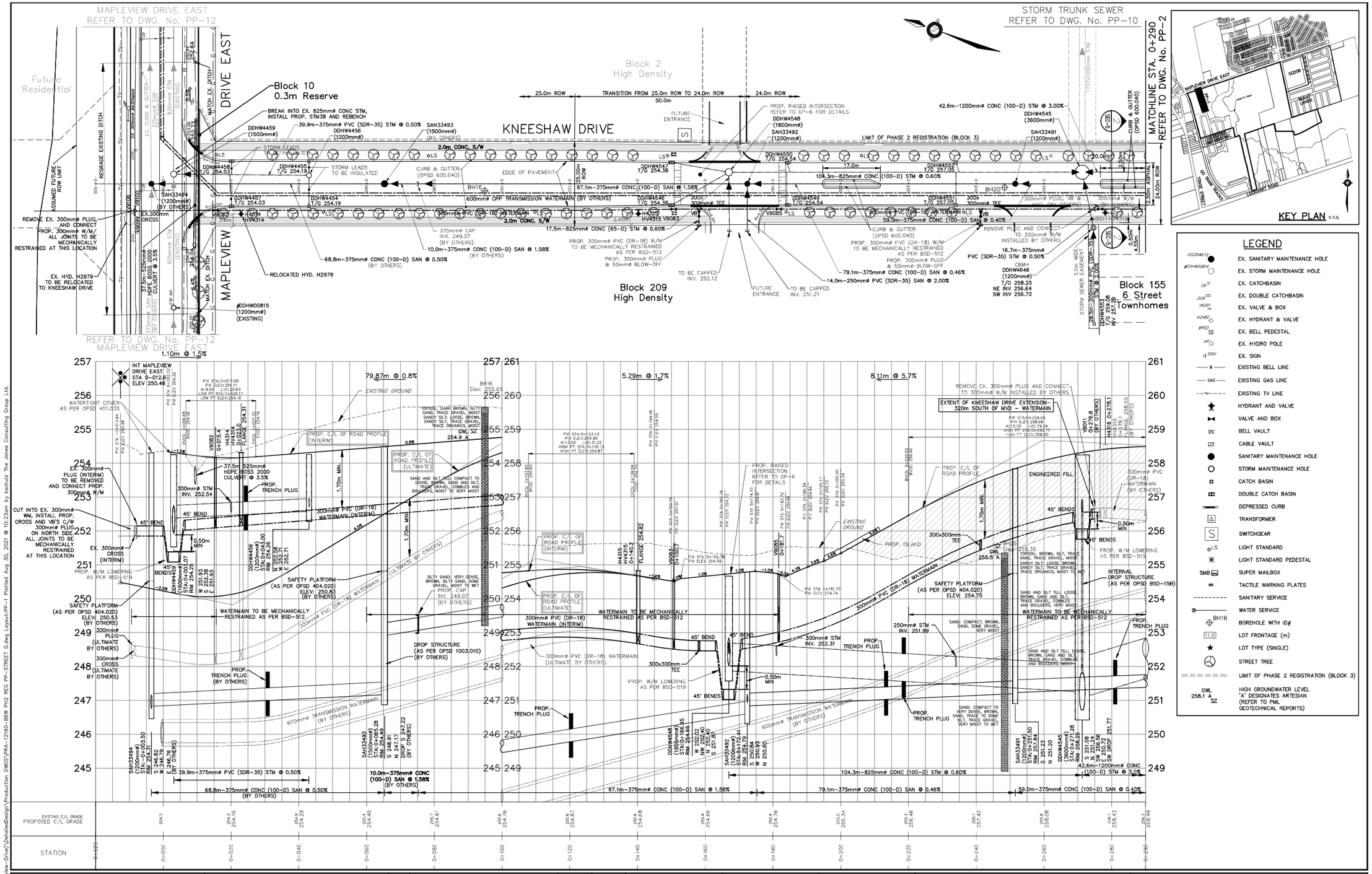
DESIGN SHEETS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN JJH/KS	SCALE:	DATE OCTOBER 2020
DRAWN KS	PROJECT PRA-12160	DWG. № DS-1
CHECKED DR		

ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160(Mapleview-Drive)\DetailedDesign\Production DWGS\PRA-12160-B6W PH2 REG DS-1.dwg Layout:DS-1 Plotted Aug 04, 2021 @ 3:13pm by kschulz The Jones Consulting Group Ltd.



ACCEPTED FOR CONSTRUCTION

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOWER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.859 E607264.100 ELEV 241.961

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.002 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
4.	ISSUED FOR PRE-SERVICING	AUG.2021	MF
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
08-30-2021
PROVINCE OF ONTARIO

THE CITY OF BARRIE

ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION

September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

PLAN AND PROFILE
KNEESHAW DRIVE
0-020 TO 0+290

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1058

DESIGN JJH/KS	SCALE: H=1:500 V=1:50	DATE OCTOBER 2020
DRAWN KS	PROJECT PRA-12160	DWG. № PP-1
CHECKED DR		

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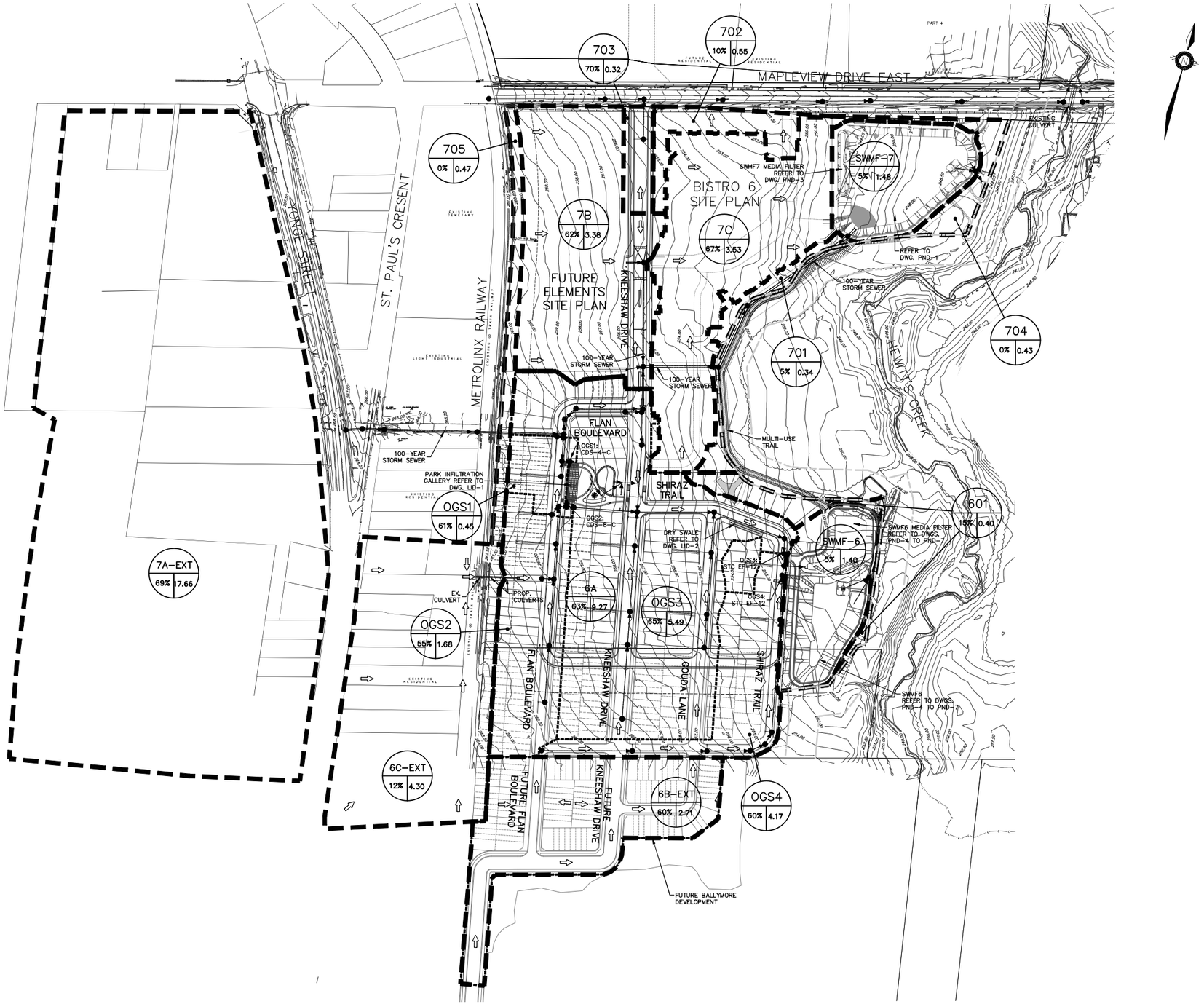
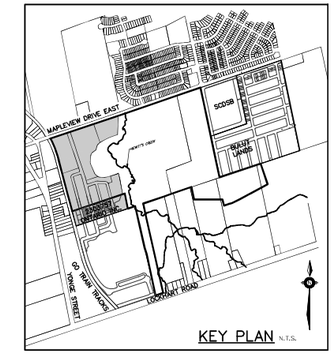




KEY PLAN N.T.S.

LEGEND

7 (ID#); 51% (IMPERVIOUS PERCENTAGE); 8.41 (AREA (ha.))	
	CATCHMENT BOUNDARY
250.00	EX. CONTOUR & ELEVATION
	PROP. OVERLAND FLOW ROUTE
	PROP. STORM SEWER
	EX. STORM SEWER
	PROP. OGS CATCHMENT AREA
	NATURAL HERITAGE SYSTEM CORE
	NATURAL HERITAGE SYSTEM BUFFER

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E. OVER LOWER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.961

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTH SIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.03km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4909870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100140153 CP-1-C-2-21 PROVINCE OF ONTARIO

THE CITY OF BARRIE
ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION
September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

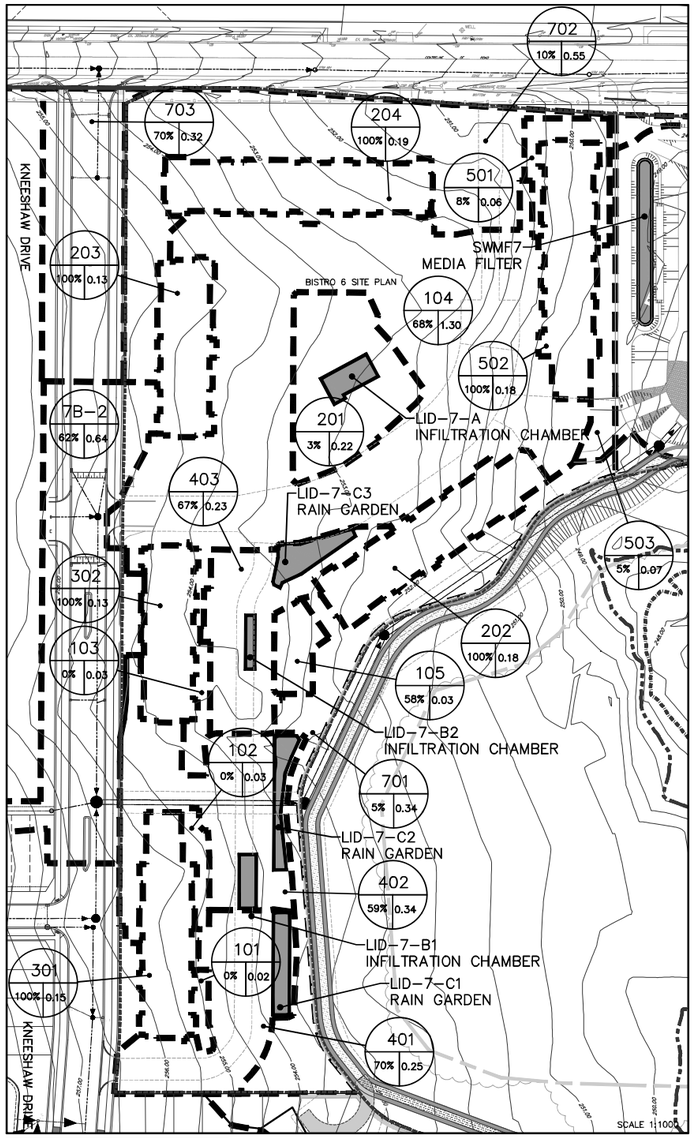
STORMWATER MANAGEMENT PLAN
PEAK FLOW MODEL
CATCHMENT AREAS

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

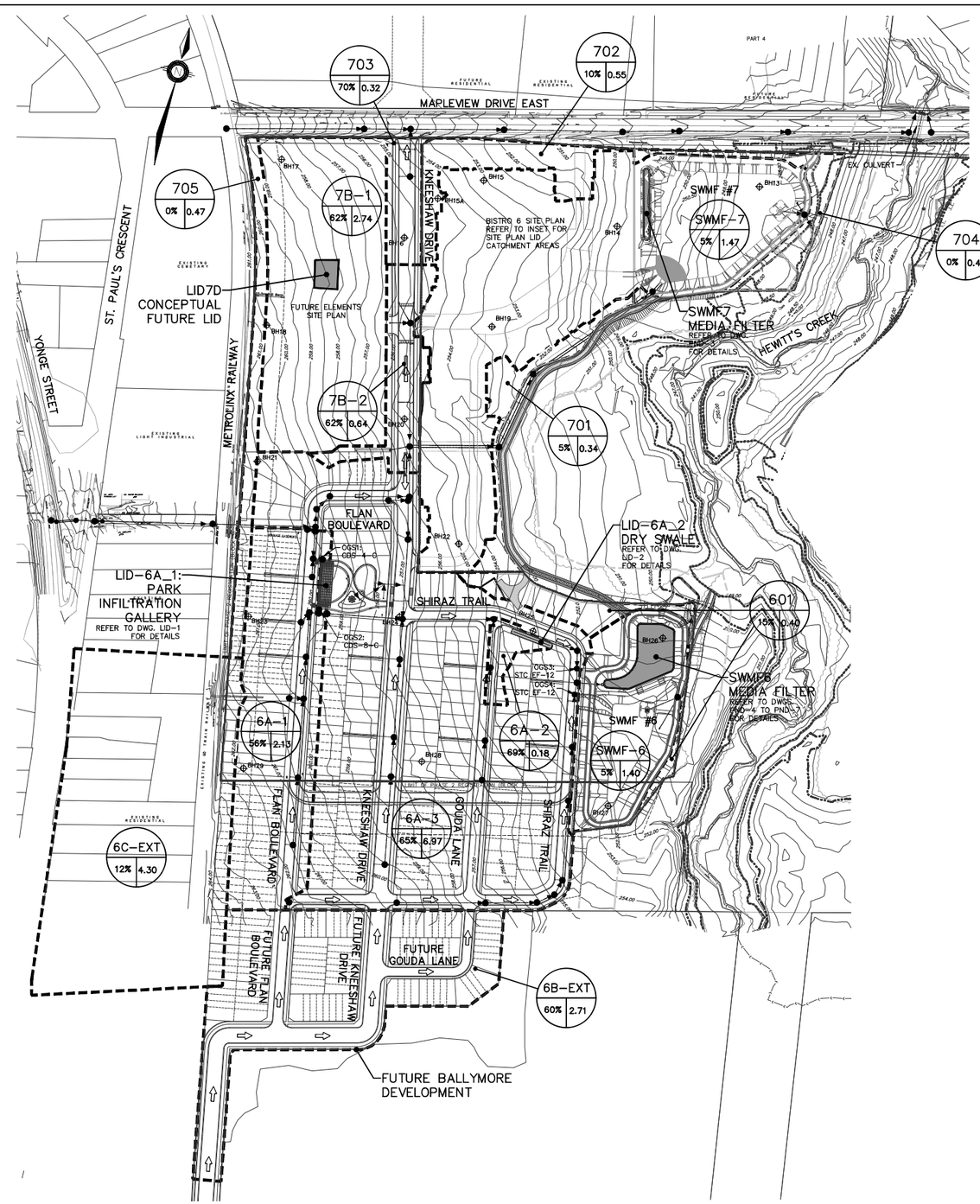
DESIGN JJH/KS	SCALE: 1:2000	DATE OCTOBER 2020	
DRAWN KS	PROJECT PRA-12160	DWG. № SWM-1	
CHECKED DR			

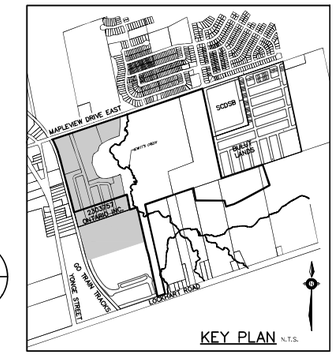
ACCEPTED FOR CONSTRUCTION

G:\Eng_3D\PRA-12160(Mapleview-Drive)\DetailedDesign\Production DWGS\PRA-12160-BBW PH2 REG SWM-1.dwg Layout:SWM-1 Plotted Aug 04, 2021 @ 3:41pm by kschulz The Jones Consulting Group Ltd.



REFER TO PRA–17021 – BISTRO 6 SITE PLAN FOURTH SUBMISSION PREPARED BY THE JONES CONSULTING GROUP DATED AUGUST 2019 FOR ADDITIONAL DETAILS





KEY PLAN N.T.S.

LEGEND

7C–2 (54% 0.25) — ID#; IMPERVIOUS PERCENTAGE; AREA (ha.)

- CATCHMENT BOUNDARY
- 250.00 — EX. CONTOUR & ELEVATION
- PROP. OVERLAND FLOW ROUTE
- PROP. STORM SEWER
- EX. STORM SEWER
- PROP. OGS CATCHMENT AREA
- NATURAL HERITAGE SYSTEM CORE
- NATURAL HERITAGE SYSTEM BUFFER

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65M EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N491078.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N491610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD, N491087.122 E607601.002 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009570.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3.	3RD COMPLETE SUBMISSION	AUG.2021	MF
2.	2ND COMPLETE SUBMISSION FOR PHASE 2 REGISTRATION	APR.2021	MF
1.	ISSUED FOR PHASE 2 REGISTRATION	OCT.2020	MF

LICENSED PROFESSIONAL ENGINEER M. G. FUS 100142153 CR-(C-2021) PROVINCE OF ONTARIO

THE CITY OF BARRIE

ACCEPTED AS TO FORM IN RELIANCE UPON THE PROFESSIONAL SKILL AND ABILITY OF THE JONES CONSULTING GROUP LTD. AS TO DESIGN AND SPECIFICATION

September 16, 2021

CRISDAWN CONSTRUCTION INC.
BISTRO 6 WEST SUBDIVISION
PHASE 2 REGISTRATION (BLOCK 3), CITY OF BARRIE

STORMWATER MANAGEMENT PLAN
LID MODEL CATCHMENT AREAS

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1058

DESIGN JJH/KS	SCALE: 1:2000	DATE OCTOBER 2020	
DRAWN KS	PROJECT PRA–12160	DWG. № SWM–2	
CHECKED DR			

ACCEPTED FOR CONSTRUCTION

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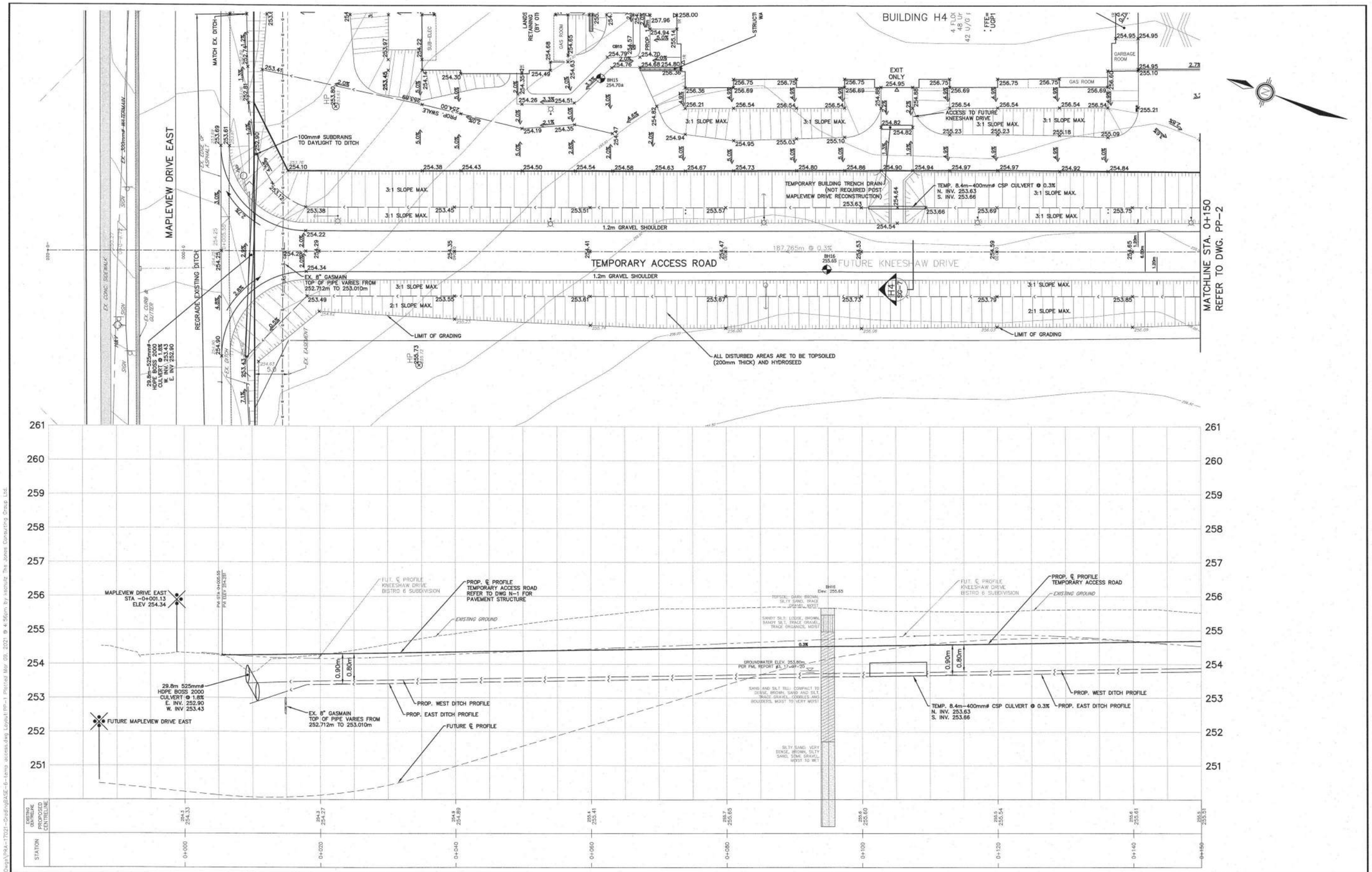

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.661

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 15m EAST OF HURONIA ROAD. N4910878.122 E607001.062 ELEV 246.996

BENCHMARK NO: 03120110053 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD. APPROXIMATELY 1.02m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
6	SITE PLAN AMENDMENT	21-03-08	DR
5	FOURTH SUBMISSION	19-08-30	DR
4	THIRD SUBMISSION	19-05-24	DR
3	SECOND SUBMISSION	19-01-11	DR
2	FIRST SUBMISSION	17-07-10	DR

LICENSED PROFESSIONAL ENGINEER
D. F. RICHARDSON
100112707
MAR 10/21
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
BISTRO 6
CITY OF BARRIE

PLAN & PROFILE
TEMPORARY ACCESS ROAD
STA. 0+000 TO 0+150

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN JJH	SCALE: H=1:250 V=1:50	DATE NOVEMBER 2018	
DRAWN JJH	PROJECT PRA-17021	DWG. № PP-1	
CHECKED DR			

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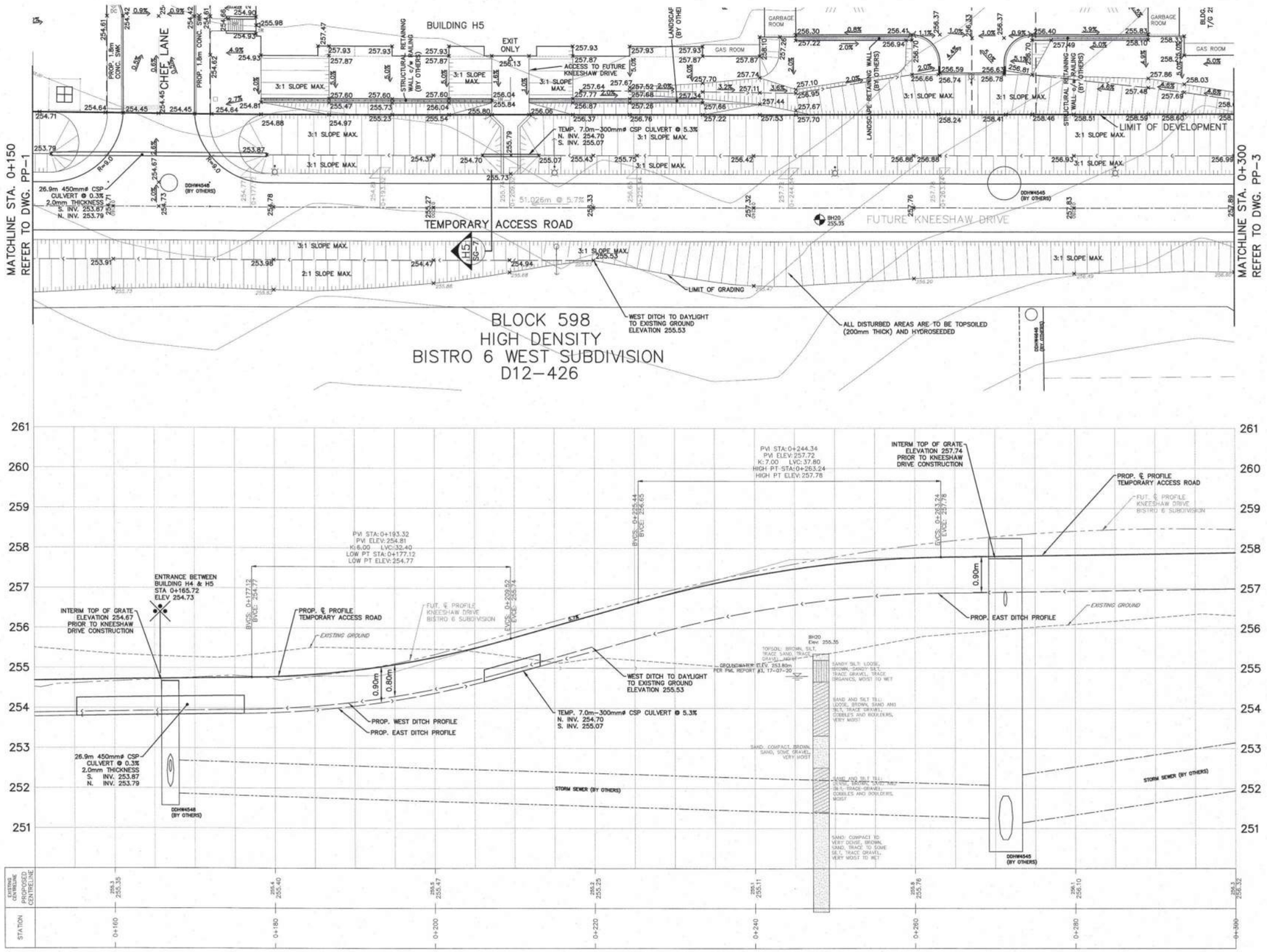

BENCHMARK:

BENCHMARK NO: 03191865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E. OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E507284.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E507799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E507605.062 ELEV 248.998

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.03km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900987.257 E508733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
6	SITE PLAN AMENDMENT	21-03-08	DR
5	FOURTH SUBMISSION	19-08-30	DR
4	THIRD SUBMISSION	19-05-24	DR
3	SECOND SUBMISSION	19-01-11	DR
2	FIRST SUBMISSION	17-07-10	DR

LICENSED PROFESSIONAL ENGINEER
D.F. RICHARDSON
100112787
NOV 10/21
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
BISTRO 6
CITY OF BARRIE

PLAN & PROFILE
TEMPORARY ACCESS ROAD
STA. 0+150 TO 0+300

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
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DESIGN JJH	SCALE: H=1:250 V=1:50	DATE NOVEMBER 2018	
DRAWN JJH	PROJECT PRA-17021	DWG. Nº PP-2	
CHECKED DR			

© \Eng_30\PRA-17021\Design Dwgs\PRA-17021-Design(BASE-6-temp access.dwg Layout:PP-2 Plotted Mar 09, 2021 @ 4:27pm by ashulla The Jones Consulting Group Ltd.

WATER BALANCE CALCULATIONS
Block 598
Bistro 6 West Subdivision
Barrie, ON
PROJECT No.300041559

BURNSIDE

TABLE WB-1

Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 150 mm (moderately-rooted vegetation in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-57	-27	17	39	58	0	**0**
Soil Moisture Storage max 150 mm	150	150	150	150	150	121	64	37	53	92	150	150	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
Soil Moisture Deficit max 150 mm	0	0	0	0	0	29	86	113	97	58	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	22	74	**340**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	50	37	35	20	5	0	0	0	0	0	13	44	**204**
Potential Direct Surface Water Runoff (independent of temperature)	33	25	23	13	3	0	0	0	0	0	9	29	**136**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 150 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - hilly land (avg slope ~ 4%)	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - sandy loam	0.4	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - predominantly cultivated land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.6**	

Latitude of site (or climate station) 44 ^{O} N.

WATER BALANCE CALCULATIONS
Block 598
Bistro 6 West Subdivision
Barrie, ON
PROJECT No.300041559

BURNSIDE

TABLE WB-2

Post-Development Water Balance Components

Based on Thornthwaite's Soil Moisture Balance Approach with a Soil Moisture Retention of 75 mm (urban lawn in sandy loam soils)

Precipitation data from Barrie WPCC Climate Station (1981 - 2010)

Potential Evapotranspiration Calculation	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Average Temperature (Degree C)	-7.7	-6.6	-2.1	5.6	12.3	17.9	20.8	19.7	15.3	8.7	2.7	-3.5	**6.9**
Heat index: $i = (t/5)^{1.514}$	0.00	0.00	0.00	1.19	3.91	6.90	8.66	7.97	5.44	2.31	0.39	0.00	**36.8**
Unadjusted Daily Potential Evapotranspiration U (mm)	0.00	0.00	0.00	25.18	58.76	88.02	103.48	97.59	74.33	40.47	11.47	0.00	**499**
Adjusting Factor for U (Latitude 44° 20' N)	0.81	0.82	1.02	1.13	1.27	1.29	1.3	1.2	1.04	0.95	0.8	0.76	
Adjusted Potential Evapotranspiration PET (mm)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
WATER BALANCE COMPONENTS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**YEAR**
Precipitation (P)	83	62	58	62	82	85	77	90	94	78	89	74	**933**
Potential Evapotranspiration (PET)	0	0	0	28	75	114	135	117	77	38	9	0	**593**
P - PET	83	62	58	34	8	-29	-57	-27	17	39	80	74	**340**
Change in Soil Moisture Storage	0	0	0	0	0	-29	-46	0	17	39	19	0	**0**
Soil Moisture Storage max 75 mm	75	75	75	75	75	46	0	0	17	56	75	75	
Actual Evapotranspiration (AET)	0	0	0	28	75	114	123	90	77	38	9	0	**555**
Soil Moisture Deficit max 75 mm	0	0	0	0	0	29	75	75	58	19	0	0	
Water Surplus - available for infiltration or runoff	83	62	58	34	8	0	0	0	0	0	60	74	**378**
Potential Infiltration (based on MOE metholodogy*; independent of temperature)	54	40	38	22	5	0	0	0	0	0	39	48	**246**
Potential Direct Surface Water Runoff (independent of temperature)	29	22	20	12	3	0	0	0	0	0	21	26	**132**
IMPERVIOUS AREA WATER SURPLUS													
Precipitation (P)	933	mm/year											
Potential Evaporation (PE) from impervious areas (assume 15%)	140	mm/year											
P-PE (surplus available for runoff from impervious areas)	793	mm/year											

Assume January storage is 100% of Soil Moisture Storage
Soil Moisture Storage 75 mm <-- See "Water Holding Capacity" values in Table 3.1, MOE SWMPDM, 2003

*MOE SWM infiltration calculations

topography - hilly land	0.1	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
soils - sandy loam	0.4	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
cover - urban lawn	0.15	<-- Infiltration Factors from the bottom section of Table 3.1, MOE SWMPDM, 2003
Infiltration factor	**0.65**	

Latitude of site (or climate station) 44 ^{O} N.

WATER BALANCE CALCULATIONS
Block 598
Bistro 6 West Subdivision
Barrie, ON
PROJECT No.300041559

BURNSIDE

TABLE WB-3

Water Balance for Pre- and Post-Development Land Use Conditions (with no SWM/LID measures in place)

Land Use Description	Approx. Land Area* (m^2)	Estimated Impervious Fraction for Land Use*	Estimated Impervious Area (m^2)	Runoff from Impervious Area** (m/a)	Runoff Volume from Impervious Area (m^3/a)	Estimated Pervious Area (m^2)	Runoff from Pervious Area** (m/a)	Runoff Volume from Pervious Area (m^3/a)	Infiltration from Pervious Area** (m/a)	Infiltration Volume from Pervious Area (m^3/a)	Total Runoff Volume (m^3/a)	Total Infiltration Volume (m^3/a)
Pre-Development Land Use												
Open Space /Agricultural	31,500	0.00	0	0.793	0	31,500	0.136	4,280	0.204	6,421	4,280	6,421
TOTAL PRE-DEVELOPMENT	**31,500**		**0**		**0**	**31,500**		**4,280**		**6,421**	**4,280**	**6,421**
Post-Development Land Use (with no LID measures in place)												
Landscape/ Open Space	16,800	0.15	2,520	0.793	1,998	14,280	0.132	1,889	0.246	3,509	3,887	3,509
Residential Building	6,400	1.00	6,400	0.793	5,075	0	0.132	0	0.246	0	5,075	0
Parking	8,300	1.00	8,300	0.793	6,582	0	0.132	0	0.246	0	6,582	0
TOTAL POST-DEVELOPMENT	**31,500**		**17,220**		**13,655**	**14,280**		**1,889**		**3,509**	**15,544**	**3,509**
% Change from Pre to Post											363	45
Effect of development (with no mitigation)											3.6 times increase in runoff	45% reduction of infiltration

* data provided by Jones Consulting Group Ltd.

** figures from Tables WB-1 and WB-2

To balance pre- to post-,
the infiltration target (m^3/a)= **2,912**

Appendix B

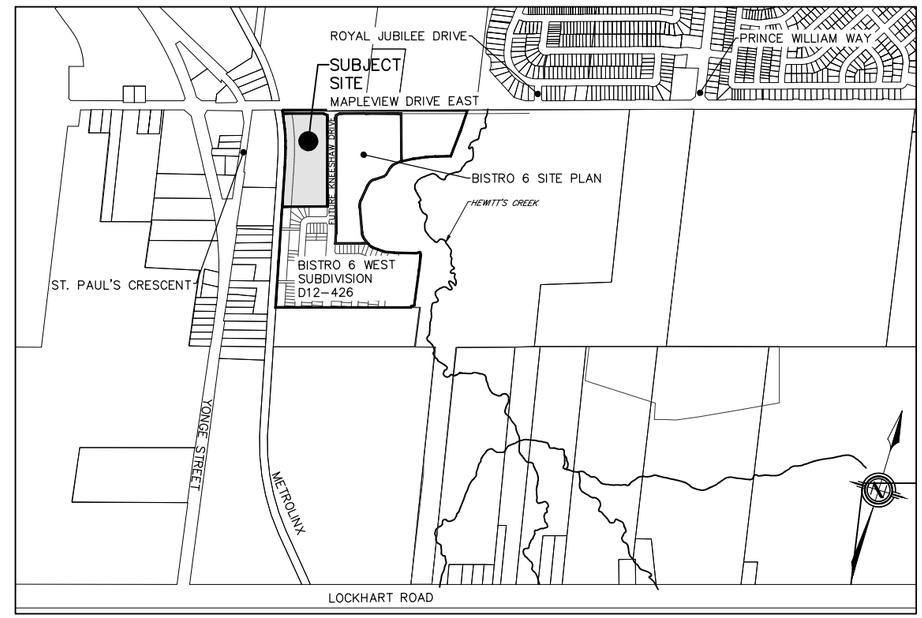
Reduced Engineering Submission Drawings

- N-1 General Notes
- ESC-1 Erosion and Sediment Control Plan
- ESC-2 Erosion and Sediment Control Details
- SG-1 Site Grading Plan with Existing Conditions
- SG-2 Site Grading Plan with Proposed Conditions
- SG-3 Railway Berm Sections
- SG-4 Railway Berm Sections
- SS-1 Site Servicing Plan
- SS-2 Sewer Design Sheets and Pipe Clearance Table
- SWM-1 Stormwater Management Plan Pre-Development Conditions
- SWM-2 Stormwater Management Plan Post-Development conditions LID Model Catchment Areas
- LID-1 Rain Gardens, LID Sections & Details
- STM-1 Storm Drainage Plan
- SAN-1 Sanitary Drainage Plan
- WM-1 Watermain Swabbing Plan
- PM-1 Pavement Marking and Signage Plan
- DET-1 Standard Details
- DET-2 Standard Details
- DET-3 Standard Details
- DET-4 Standard Details
- DET-5 Standard Details

ELEMENTS SITE PLAN
CITY OF BARRIE

DRAWING LEGEND

N–1	GENERAL NOTES
ESC–1	EROSION AND SEDIMENT CONTROL PLAN
ESC–2	EROSION AND SEDIMENT CONTROL DETAILS
SG–1	SITE GRADING PLAN WITH EXISTING CONDITIONS
SG–2	SITE GRADING PLAN WITH PROPOSED CONDITIONS
SG–3	RAILWAY BERM SECTIONS
SG–4	RAILWAY BERM SECTIONS
SS–1	SITE SERVICING PLAN
SS–2	SEWER DESIGN SHEETS AND PIPE CLEARANCE TABLE
SWM–1	STORMWATER MANAGEMENT PLAN PRE–DEVELOPMENT CONDITIONS
SWM–2	STORMWATER MANAGEMENT PLAN POST–DEVELOPMENT CONDITIONS LID MODEL CATCHMENT AREAS
LID–1	RAIN GARDENS, LID SECTIONS & DETAILS
STM–1	STORM DRAINAGE PLAN
SAN–1	SANITARY DRAINAGE PLAN
WM–1	WATERMAIN SWABBING PLAN
PM–1	PAVEMENT MARKING AND SIGNAGE PLAN
~~CUP–1~~	~~COMPOSITE UTILITY PLAN~~ REFER TO RUNGE ENGINEERING UTILITY DESIGN
DET–1	STANDARD DETAILS
DET–2	STANDARD DETAILS
DET–3	STANDARD DETAILS
DET–4	STANDARD DETAILS
DET–5	STANDARD DETAILS



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3RD DETAILED DESIGN SUBMISSION DECEMBER 2021

G:\Eng_3D\PRA-19078\Production DWGS\PRA-19078-COVER PAGE.dwg Layout:Title Plotted Dec 21, 2021 @ 4:57pm by kschulz The Jones Consulting Group Ltd.

1. GRADE AND CROSSFALL ADJUSTEMENT OF MAINTENANCE HOLE AND CATCHBASIN FRAMES WILL BE MADE USING PRODUCTS SPECIFICALLY MANUFACTURED FOR THAT PURPOSE.
2. ADJUSTMENT UNITS MUST BE CERTIFIED TO MEET ALL PERTINENT OPS, CSA, ASTM AND MTO-DSM LISTS, OR OTHER INDUSTRY GUIDELINES FOR MATERIALS, PERFORMANCE AND USE AS APPLICABLE.
3. ADJUSTMENT UNITS AND JOINTS WILL BE SEALED AND OR PARGED IN COMPLIANCE WITH MANUFACTURERS SPECIFICATIONS AND GUIDELINES
4. MORTAR IS USED FOR LEVELING OF PRECAST UNITS ONLY. THE THICKNESS OF MORTAR WILL BE 10mm TO FILL ALL VOIDS CREATED BY IRREGULARITIES IN THE PRECAST UNITS TO ENSURE AN EVEN SURFACE ONLY.

Barrie STANDARD DETAIL	GENERAL NOTES ROADWORKS	REV No. 1	DATE: OCT 2017 SCALE: N.T.S.	APPROVED DATE Oct. 28/17 DIRECTOR OF ENGINEERING
		BSD-N2		

GENERAL NOTES – STORM SEWER

STORM SEWER

A. STORM SEWER TO BE PROVIDED ON ALL ROADS WITH CURB AND GUTTER.

B. PLACE ALL CATCH BASIN LATERALS AT 2% GRADE UNLESS OTHERWISE NOTED. PIPE SIZE MINIMUM 250mm DIA. SINGLE, 300mm DIA. DOUBLE.

C. STORM SEWERS SHALL BE CONSTRUCTED WITH BEDDING AS PER OPSD–802.010 (GRAN. 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD–802.030 OR 802.031 CLASS B (GRAN. 'A' BEDDING MATERIAL) FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF ENGINEERING.

D. MAINTENANCE HOLE TOPS (FRAMES) AND CATCH BASIN (FRAMES) ARE TO BE SET TO BASE COURSE ASPHALT GRADE AND THEN ADJUSTED TO FINAL GRADE WHEN THE TOP LIFT OF ASPHALT IS PLACED. ALL ADJUSTMENT WILL BE ACCORDANCE WITH BSD–N2.

E. STORM SEWER TO BE LOCATED OFFSET 3.0m SOUTH OR EAST OF CENTRELINE UNLESS OTHERWISE SPECIFIED.

F. ALL CONNECTIONS TO THE STORM MAIN SHALL BE MADE WITH A STORM MANHOLE OR APPROVED FACTORY TEE CONNECTION AS PER OPSD–708.01 OR 708.03.

G. PIPE MATERIAL TO BE REINFORCED CONCRETE WITH A MINIMUM STRENGTH OF 50 N/m/mm CERTIFIED TO C.S.A. STANDARD A247.2–1982, CLASS 50–D (PREVIOUSLY C.S.A. STANDARD A257.2–1974, CLASS II) OR PVC CERTIFIED TO C.S.A. STANDARDS 182.2 AND 182.4.

H. STORM SEWER TO BE MINIMUM 300mm DIAMETER WITH JOINTS CONFORMING TO C.S.A. STANDARD A257.3.

I. ALL PIPE BEDDING MUST CONFORM TO OPSD. MAXIMUM COVER TABLE. NO FLEXIBLE PIPE SEWERS WILL BE INSTALLED WITH A DEPTH OF COVER GREATER THAN 6 METRES UNLESS SPECIFICALLY APPROVED BY THE DIRECTOR OF ENGINEERING.

J. ALL PIPE HANDLING INSTALLATIONS MUST BE IN STRICT COMPLIANCE WITH MANUFACTURES INSTALLATION GUIDES AND THE O.C.P.A. OR UNIBELL GUIDELINES.

K. SUMP PUMP DISCHARGE PIPING IN BOULEVARD:
IN THE EVENT OF OVERACTIVE SUMP PUMP ACTIVITY, A 150mm DIAMETER PVC DR–28 SEWER MAY BE INSTALLED, WHEN SO DIRECTED BY THE DIRECTOR OF ENGINEERING, ALONG THE FRONTAGES OF DESIGNATED LOTS, WITH AN OFFSET OF 0.6m FROM BACK OF CURB. THIS SEWER IS TO BE CAPPED AT THE UPSTREAM END AND IS TO OUTLET INTO THE NEAREST CATCHBASIN DOWNSTREAM. DEPTH OF SEWER IS TO BE EQUAL TO SUBDRAIN DEPTH. NOT TO BE DIRECTLY CONNECTED TO FOUNDATION DRAINS.

CITY OF BARRIE STANDARD — GENERAL NOTES STORM SEWERS — BSD-N5 — APPR'D: R.G.N. DATE: 92.05.15 DRAWN: L.A.J. SCALE: N.T.S.

NO.	REVISION	APR'D	DATE
4.	NOTE 'K' – SUMP PUMP DISCHARGE PIPING	B.R.	2003.01.07
3.	NOTE 'I' & 'J' – "DIRECTOR OF ENGINEERING"	B.R.	2002.10.28
2.	NOTE 'C' OPSD NUMBER REVISION	K.C.	2000.03.16
1.	NOTE 'D' CHANGED	K.C.	98.03.30

GENERAL NOTES – SANITARY SEWER

SANITARY SEWERS

A. SANITARY SEWER TO BE LOCATED AT THE CENTRELINE OF THE ROAD.

B. SEWERS SHALL BE CONSTRUCTED WITH BEDDINGS AS PER OPSD–802.010. (GRAN. 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD–802.030 OR 802.031 CLASS B (GRAN. 'A' BEDDING MATERIAL) FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF ENGINEERING.

C. MAXIMUM DEFLECTION FROM COMBINED LIVE AND DEAD LOADING SHALL NOT EXCEED ANY C.S.A., O.P.S. OR MANUFACTURERS RECOMMENDED SPECIFICATIONS.

D. PVC, CONCRETE AND PROFILE WALL PVC SEWERS SHALL HAVE RUBBER GASKET TYPE JOINTS AND SHALL BE CERTIFIED TO CONFORM TO ALL APPLICABLE CURRENT C.S.A. SPECIFICATIONS.

E. CONCRETE SANITARY SEWERS SHALL HAVE A MINIMUM STRENGTH OF 50 N/m/mm CONFORMING TO CSA STANDARD A257.2–1982, CLASS 50–D (PREVIOUSLY C.S.A. STANDARD A257.2–1974, CLASS 1).

F. MAINTENANCE HOLE TOPS (FRAMES) ARE TO BE SET TO BASE COURSE ASPHALT GRADE AND THEN ADJUSTED TO FINAL GRADE WHEN THE TOP LIFT OF ASPHALT IS PLACE. ALL ADJUSTMENT WILL BE ACCORDANCE WITH BSD–N2.

G. ALL CONNECTIONS TO NEW SANITARY MAINS SHALL BE PRE–MANUFACTURED, FABRICATED TEES. CONNECTIONS TO EXISTING SANITARY SEWER SHALL BE MADE WITH APPROVED FACTORY MADE TEES OR INSERTA–TEES IN STRICT ACCORDANCE TO MANUFACTURES GUIDELINES.

CITY OF BARRIE STANDARD — GENERAL NOTES SANITARY SEWERS — BSD-N3 — APPR'D: R.G.N. DATE: 92.05.15 DRAWN: L.A.J. SCALE: N.T.S.

NO.	REVISION	APR'D	DATE
4.	NOTE 'B' – "ENGINEERING"	B.R.	2002.10.28
3.	NOTE 'B' OPSD NUMBER REVISION	K.C.	2000.03.16
2.	NOTE 'F' CHANGED	K.C.	98.03.30
1.	CHANGES TO B. TO G.	K.C.	95.04.24

GENERAL NOTES

1. DRAWINGS

A. ALL DRAWINGS SHALL BE PRODUCED IN ACCORDANCE WITH CURRENT CITY OF BARRIE STANDARDS & SYMBOLS FOR PLAN & PROFILE DRAWINGS, GENERAL SERVICE PLANS AND LOT GRADING PLANS.

2. MEASUREMENTS

A. ALL DIMENSIONS ARE IN METRES, EXCEPT PIPE DIAMETERS, WHICH ARE IN MILLIMETRES, UNLESS SPECIFIED OTHERWISE.

3. GENERAL

A. ALL WORK SHALL BE IN ACCORDANCE WITH CURRENT CITY OF BARRIE STANDARD DRAWINGS (BSD) AND ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

B. ORDER OF PRECEDENCE OF STANDARD DRAWINGS IS FIRSTLY CITY OF BARRIE STANDARD DRAWINGS (BSD) AND SECONDLY ONTARIO PROVINCIAL STANDARD DRAWINGS (OPSD).

C. LOCATION OF EXISTING SERVICES ARE NOT GUARANTEED. THE CONTRACTOR IS REQUIRED TO NOTIFY THE VARIOUS UTILITY COMPANIES 48 HOURS PRIOR TO THE COMMENCEMENT OF ANY WORK.

D. A ROAD OCCUPANCY PERMIT IS REQUIRED FROM THE ROADS AND PARKS OPERATIONS BRANCH PRIOR TO THE COMMENCEMENT OF WORK WITHIN ANY CITY RIGHT–OF–WAY.

E. A SITE ALTERATION PERMIT IS REQUIRED FROM THE ENGINEERING DEPARTMENT PRIOR TO THE COMMENCEMENT OF ANY EARTH WORKS ON THE SITE.

F. NATIVE MATERIAL, SUITABLE FOR BACKFILL, SHALL BE COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY.

G. GRANULAR MATERIAL, USED FOR BACKFILL, SHALL BE PLACED IN LAYERS 150mm IN DEPTH MAXIMUM AND COMPACTED TO 100% STANDARD PROCTOR MAXIMUM DRY DENSITY.

H. ALL DISTURBED AREAS ARE TO BE REINSTATED TO THEIR ORIGINAL CONDITION OR BETTER, AS DETERMINED BY THE CITY ENGINEERING DEPARTMENT.

I. ALL SILT CONTROL AND EROSION PROTECTION DEVICES ARE TO BE IN PLACE PRIOR TO THE COMMENCEMENT OF CONSTRUCTION AND SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL CONSTRUCTION IS COMPLETE AND THE GRASS HAS ESTABLISHED GROWTH, SUBJECT TO APPROVAL BY THE CITY ENGINEERING DEPARTMENT.

CITY OF BARRIE STANDARD — GENERAL NOTES — BSD-N6 — APPR'D: R.G.N. DATE: 92.05.15 DRAWN: L.A.J. SCALE: N.T.S.

NO.	REVISION	APR'D	DATE
3.	3. NOTE: 3.E. REVISED & 3.I. ADDED	J.S.	05.01.10
2.	3.D. – "ENGINEERING DEPARTMENT"	B.R.	02.10.28
1.	3.E. TOPSOIL PERMIT		01.12.06

GENERAL NOTES – SANITARY SEWER

SANITARY SERVICE LATERALS

A. SANITARY LATERAL CONNECTION TO BE LOCATED AT THE CENTRELINE OF THE LOT AND CAPPED.

B. LOCATION OF LATERAL TO BE MARKED 2.0m PAST PROPERTY LINE WITH A 50 x 100mm WOOD MARKER, PAINTED GREEN, EXTENDING FROM SERVICE INVERT TO 300mm ABOVE GROUND LEVEL.

C. PIPE TO BE MINIMUM 100 mm DIA. PVC SDR28, RUBBER GASKET TYPE JOINTS AND SHALL CONFORM TO C.S.A. (B–182.2.3.4) (COLOURED) FOR A RESIDENTIAL HOUSE AND 150mm MINIMUM DIA. PVC SDR28 FOR INDUSTRIAL/COMMERCIAL DEVELOPMENT.

D. MINIMUM DEPTH OF LATERAL AT PROPERTY LINE SHALL BE 2.4m MEASURED FROM THE SEWER INVERT TO FINISHED GROUND SURFACE ELEVATION UNLESS NOTED OTHERWISE.

E. ALL CONNECTIONS TO NEW SANITARY MAINS SHALL BE PRE–MANUFACTURED, FABRICATED TEES. CONNECTIONS TO EXISTING SANITARY SEWER SHALL BE MADE WITH APPROVED FACTORY MADE TEES OR INSERTA–TEES IN STRICT ACCORDANCE TO MANUFACTURES GUIDELINES.

F. MINIMUM PIPE SLOPE TO BE 2.0%, MAXIMUM 8.0% (SEE OPSD–1006.010, 1006.020).

CITY OF BARRIE STANDARD — GENERAL NOTES SANITARY SEWERS — BSD-N4 — APPR'D: R.G.N. DATE: 92.05.15 DRAWN: L.A.J. SCALE: N.T.S.

NO.	REVISION	APR'D	DATE
2.	OPSD NUMBERS REVISED	K.C.	2000.08.17
1.	CHANGES TO B. TO G.	K.C.	95.04.24

GENERAL NOTES - WATERMAIN

1. CONTRACTORS SHALL INFORM THE CITY OF BARRIE WATER OPERATIONS DEPARTMENT A MINIMUM OF 48 HOURS IN ADVANCE OF THEIR INTENTIONS TO PERFORM WORK ON WATER INFRASTRUCTURE.

2. OPERATION OF HYDRANTS AND VALVES ON THE POTABLE WATER SYSTEM BY OTHER THAN QUALIFIED WATER OPERATIONS STAFF IS PROHIBITED BY CURRENT BY-LAW. CITY SERVICE FEES ARE PER THE CURRENT FEES BY-LAW. THE CITY'S WATER OPERATIONS STAFF WILL SWAB, PRESSURE TEST, CHLORINATE AND FLUSH ALL NEW WATERMAINS.

3. MINIMUM COVER OVER WATERMAIN SHALL BE 1.7m. THE MINIMUM HORIZONTAL SEPARATION BETWEEN WATERMAIN AND SEWERS SHALL BE 2.5m WHERE WATERMAIN CONFLICTS WITH SEWER PIPES, DEFLECT WATERMAIN HORIZONTALLY OR VERTICALLY WHILE PROVIDING A MINIMUM OF 0.5m CLEARANCE BETWEEN WATERMAIN AND SEWERS. MAINTAIN MINIMUM DEPTH OF COVER AT ALL TIMES.

4. WATERMAIN SHALL BE INSTALLED IN BEDDING AS PER OPSD 802.010 (GRANULAR 'A' EMBEDMENT MATERIAL) FOR FLEXIBLE PIPES AND OPSD 802.030 OR 802.031 CLASS 'B' (GRANULAR 'A' BEDDING MATERIAL, GRANULAR 'A' OR SELECT NATIVE COVER MATERIAL) FOR RIGID PIPE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF WATER OPERATIONS. ALTERNATIVE EMBEDMENT MATERIAL - SAND MEETING GRADATION REQUIREMENTS OF OPSS.MUNI 1004.05.07 COMPACTED TO 95% STANDARD PROCTOR MAXIMUM DRY DENSITY IS PERMISSIBLE WHERE NOTED IN STANDARD DETAILS. GEOTECHNICAL CERTIFICATION OF MATERIAL AND COMPACTION TESTING MUST BE PROVIDED EVERY 150 METRES. THE COMPACTION TESTING MUST INCLUDE THE ENTIRE EMBEDMENT ENVELOPE (HAUNCHES, BEDDING, TOP OF PIPE AND COVER).

5. COPPER WATER MAINS AND SERVICES 25mm TO 50mm IN DIAMETER SHALL BE EMBEDDED IN SAND 100mm ABOVE AND BELOW TO CONFORM TO OPSS.MUNI 1004.05.07.

6. RESTRAINING WILL BE REQUIRED ON ALL HYDRANTS. THRUST BLOCKS, AS PER OPSD 1103.010 AND 1103.020. RESTRAINING DEVICES MAY BE REQUIRED IN ADDITION TO STANDARD CONCRETE THRUST BLOCKING WHERE SOIL CONDITIONS WARRANT AT THE CITY'S DISCRETION.

7. NEW WATERMAINS TO BE PVC DR18 CL150 MINIMUM; DUCTILE IRON CL52 AS PER THE APPROVED MANUFACTURERS PRODUCTS FOR LINEAR WATER SYSTEMS LIST.

8. TRACING WIRE SHALL BE #12 AWG HIGH STRENGTH COPPER CLAD (HS-CSS) AND SHALL BE INSTALLED ON THE TOTAL LENGTH OF ALL WATERMAIN AND BROUGHT UP AT EACH HYDRANT AND CONNECTED TO FLANGE BOLT. ALL SPLICES TO UTILIZE CONNECTORS AS PER THE APPROVED MANUFACTURERS PRODUCTS FOR LINEAR WATER SYSTEMS LIST.

9. ALL WATER SERVICES SHALL BE MINIMUM 25mm TYPE 'K' COPPER OR 25mm CROSS-LINKED POLYETHYLENE UNLESS OTHERWISE APPROVED BY THE DIRECTOR OF WATER OPERATIONS. WATER SERVICE SADDLES SHALL BE USED WHEN TAPPING INTO PVC WATERMAIN.

10. SERVICE TAPPINGS SHALL BE PLACED AT A MINIMUM SEPARATION OF 1.0m AND A MINIMUM OF 0.6m FROM JOINTS. (ENDS OF PIPE)

11. RISER PIPES ARE TO BE INSTALLEDAS PER BSD-510, AND REMOVED AS DIRECTED. SWABBING SCHEDULE TO BE SUPPLIED BY A WATER OPERATIONS FIELD REPRESENTATIVE. ALL RISERS ARE TO BE RESTRAINED OR THRUST BLOCKED.

12. ALL NEW CURB STOPS AND BOXES TO BE LOCATED AT PROPERTY LINE AND OUT OF DRIVEWAYS AND SIDEWALKS.

City of BARRIE STANDARD DETAIL	GENERAL NOTES - WATERMAIN	REV No. 2	DATE: MAY 2015 SCALE: N.T.S.	APPROVED DATE May 29/15 DIRECTOR OF ENGINEERING
		BSD-500		

EROSION CONTROL NOTES

1. ALL TEMPORARY SILT CONTROL AND EROSION PROTECTION DEVICES (I.E. SILT FENCING, DRAINAGE SWALES, ROCK CHECK DAMS, SEDIMENT TRAPS, GRAVEL ACCESS PAD, ETC.) SHALL BE CONSTRUCTED PRIOR TO COMMENCEMENT OF SITE WORKS AND SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL CONSTRUCTION IS COMPLETE AND THE GRASS HAS ESTABLISHED GROWTH, SUBJECT TO APPROVAL BY THE CITY ENGINEERING DEPARTMENT.
2. ALL SEDIMENTATION CONTROL MEASURES ARE TO BE INSPECTED REGULARLY (MINIMUM WEEKLY), AS WELL AS AFTER EVERY RAINFALL EVENT AND ANY DAMAGED SILT CONTROL AND EROSION PROTECTION DEVICES SHALL BE PROMPTLY REPAIRED OR REPLACED BY THE CONTRACTOR.
3. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES.
4. AREAS WITHOUT STABLE GROUND COVER SHALL BE PROTECTED WITH SILTATION CONTROL FENCING, STRAW MULCH, ETC, AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION HAS BECOME ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
5. ALL DISTURBED GROUND LEFT INACTIVE FOR MORE THAN 30 DAYS SHALL BE STABILIZED BY SEEDING. (IF SEEDING IS APPROPRIATE DURING CURRENT SEASON)
7. ALL SITE DRAINAGE IS TO BE DIRECTED TO THE TEMPORARY SEDIMENT TRAPS AND OTHER CHECK DAMS VIA SHEET DRAINAGE, BERMS OR SWALES (AS NECESSARY) TO FACILITATE THE COMPLETION OF GRADING WORKS. THE CONTRACTOR SHALL CONSTRUCT ANY ADDITIONAL SWALES OR BERMS THAT MAY BE NECESSARY TO DIRECT RUN–OFF TO THE SEDIMENT TRAPS.
8. ALL CONSTRUCTION VEHICLES SHALL ENTER AND EXIT THE SITE FROM PROPOSED CONSTRUCTION ACCESS VIA THE GRAVEL ACCESS PAD.
9. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE INSPECTOR.
10. THE CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 805; CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES, AS WELL AS APPLICABLE MUNICIPAL STANDARDS AND/OR APPROVAL AGENCY STANDARDS.
11. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES, SUCH MEASURES MUST BE PRESENTED IN WRITING FOR APPROVAL BY THE CONTRACT ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE APPLICABLE APPROVAL AGENCIES.

GRADING NOTES

1. ALL DISTURBED AREAS TO BE RESTORED TO EXISTING CONDITIONS OR BETTER WITH A MIN. 200mm DEPTH OF TOPSOIL AND SOD IMMEDIATELY FOLLOWING COMPLETION OF GRADING.
2. ALL SLOPES SHALL BE RESTORED WITH A MIN. 200mm DEPTH OF TOPSOIL AND SOD IMMEDIATELY FOLLOWING COMPLETION OF GRADING.
3. ALL SLOPES ALONG BERMS AND DITCHES TO BE MAXIMUM SLOPES OF 3:1.

WATER SERVICING NOTES, AS REQUIRED BY THE CITY OF BARRIE

GENERAL

1. ALL REQUIRED PERMITS SHALL BE IN PLACE PRIOR TO INSTALLATION OF WATERMAIN AND SERVICES.
2. A ROAD OCCUPANCY PERMIT IS REQUIRED, AND CAN BE OBTAINED AT THE OPERATION CENTRE.
3. MINIMUM COVER OVER WATER MAIN TO BE 1.7m. THE MINIMUM HORIZONTAL SEPARATION BETWEEN WATER MAIN AND SEWER TO BE 2.5m. WHERE WATER MAIN CONFLICTS WITH SEWER PIPE, DEFLECT WATER MAIN HORIZONTALLY OR VERTICALLY WHILE PROVIDING A MINIMUM OF 0.5m CLEARANCE BETWEEN WATER MAIN AND SEWERS, MAINTAIN MINIMUM DEPTH OF COVER AT ALL TIMES.
4. ALL BENDS AND TEE'S SHALL BE RESTRAINED IN ADDITION TO THRUST BLOCKS.
5. ALL DOMESTIC AND FIRE WATER SERVICES WILL REQUIRE BACKFLOW PREVENTION AS PER CITY OF BARRIE BYLAW 2010–102.
6. SERVICES INSTALLED UNDER FLOORS SHALL BE FULLY RESTRAINED.
7. HYDRANTS SHALL BE INSTALLED AS PER BSD–507. ON SITE HYDRANTS SHALL BE CONSIDERED PRIVATE (PAINTED RED), AND ARE TO BE MAINTAINED BY THE OWNER
8. ALL FIRE SERVICES SHALL CONFORM TO THE MOST CURRENT BUILDING CODE AND NATIONAL FIRE PROTECTION ACT. THE REQUIREMENT SHALL BE THE RESPONSIBILITY OF THE DEVELOPER/OWNERS. INFORMATION MAY BE OBTAINED FROM THE INSURANCE UNDERWRITER, CITY OF BARRIE PLANNING AND DEVELOPMENT AND THE CITY OF BARRIE FIRE DEPARTMENT.
9. ALL NEW CURB STOPS AND BOXES TO BE LOCATED OUT OF DRIVEWAYS AND SIDEWALKS.
10. COPPER WATER SERVICES 19mm TO 50mm IN DIAMETER SHALL BE EMBEDDED IN SAND 100mm ABOVE AND BELOW.
11. ALL COPPER WATER SERVICE FITTINGS SHALL BE COMPRESSION STYLE. IF A CONDITION ARISES WHERE A COPPER SERVICE MUST BE JOINED UNDER THE FLOOR, THE COPPER SHALL BE JOINTED BY SILVER SOLDER CONNECTION ONLY.
12. CONTRACTOR SHALL INFORM THE CITY OF BARRIE OPERATIONS DEPARTMENT A MINIMUM OF 48 HOURS IN ADVANCE OF THEIR INTENTIONS TO WORK.
13. THE CITY WILL FLUSH THE NEW SERVICE AND CONTRACTOR WILL PERFORM PRESSURE TEST WITNESSED BY THE WATER FIELD COORDINATOR.
14. WATER WILL NOT BE AVAILABLE UNTIL SERVICES HAVE BEEN SAMPLED AND PASSES FOR BACTERIOLOGICAL COMPLIANCE, A CHECK VALVE SHALL BE INSTALLED FOR TEMPORARY WATER.
15. REFER TO DRAWING WM–1, FOR WATERMAIN TESTING AND DISINFECTION NOTES.
16. A FLAT RATE CONNECTION FEE ($2600.00) WILL BE REQUIRED FOR EACH OF THE 300mm WATER SERVICE CONNECTIONS.
17. AN ANNUAL CHARGE FOR EACH PRIVATE CONNECTION MADE TO THE MUNICIPAL WATER DISTRIBUTION SYSTEM WILL APPLY.
18. AN ANNUAL CHARGE FOR EACH PRIVATE FIRE HYDRANT SUPPLIED WITH WATER FROM THE MUNICIPAL WATER DISTRIBUTION SYSTEM WILL APPLY.
19. WATER SERVICES TO BE MECHANICALLY RESTRAINED. WATERMAIN TO BE MECHANICALLY RESTRAINED IN AREAS OF FILL.
20. FIRE FLOW REQUIREMENTS ARE OUTLINED IN THE INFOWATER MODELING BRIEF WATER SUPPLY SCHEME FOR BISTRO 6 WEST SITE (BLOCK 598) BY SCHAEFFERS CONSULTING ENGINEERS, DATED FEBRUARY 8, 2021. BUILDING DESIGN PARAMETERS RELATED TO FIRE FLOW REQUIREMENTS TO BE STRINGENTLY ADHERED TO.

100mm DOMESTIC AND 150mm FIRE SERVICES - BUILDINGS A, B, AND C

1. DOMESTIC AND FIRE SERVICE VALVES SHALL BE LOCATED IN THE BOULEVARD, UNLESS OTHERWISE NOTED.
2. DOMESTIC AND FIRE SERVICES SHALL BE MECHANICALLY RESTRAINED FROM THE TEE TO THE BUILDINGS.
3. DOMESTIC AND FIRE SERVICE RISERS ENTERING EACH BUILDING SHALL BE INSTALLED AS PER BSD–505.
4. DOMESTIC AND FIRE SERVICE TO BE HAND SWABBED OR A SWAB IS TO BE PLACED IN SERVICE AND REMOVED FROM RISERS.
5. THE 100mm DOMESTIC WATER SERVICE WILL REQUIRE A 100mm WATER METER (SUPPLIED AND INSTALLED BY THE OWNER) COMPLETE WITH A BYPASS ASSEMBLY AS PER BSD–533 AND SHALL BE LOCATED IN AN APPROPRIATELY SIZED MECHANICAL ROOM.
6. BACKFLOW PREVENTION SHALL BE PROVIDED ON ALL DOMESTIC AND FIRE SERVICES AS PER CITY OF BARRIE BYLAW 2017–121.

ENGINEERING NOTES

UNLESS OTHERWISE NOTED ON THE DRAWINGS, THE FOLLOWING REQUIREMENTS SHALL APPLY TO THE WORKS.

1. ALL MEASUREMENTS FOR THIS PROJECT ARE IN METERS, EXCEPT PIPE DIAMETERS WHICH IS IN MILLIMETRES, UNLESS OTHERWISE NOTED. ALL DIMENSIONS SHALL BE CHECKED AND VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO THE START OF ANY CONSTRUCTION. ANY DISCREPANCIES SHALL BE REPORTED IMMEDIATELY TO THE ENGINEER.
2. ALL MECHANICAL WORK SHALL BE PERFORMED IN ACCORDANCE WITH ALL APPLICABLE CODES, STANDARDS, RULES AND REGULATIONS, TO MEET THE REQUIREMENTS OF ALL AUTHORITIES HAVING JURISDICTION AND TO MEET THE DESIGN INTENT.
3. ALL WORK AND MATERIALS WITHIN THE PROPERTY BOUNDARIES SHALL CONFORM TO THE LATEST EDITION OF THE ONTARIO BUILDING CODE. WHERE THERE IS A CONFLICT BETWEEN THE FOLLOWING NOTES AND SPECIFICATIONS AND THE ONTARIO BUILDING CODE, THE DECISION OF THE CHIEF BUILDING OFFICIAL WILL GOVERN.
4. INFORMATION ON EXISTING SERVICES AND UTILITIES SHOWN ON THESE DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION. THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING THE NECESSARY UTILITY LOCATES PRIOR TO COMMENCING CONSTRUCTION.
5. ALL CORRUGATED STEEL PIPE TO BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS AND AS PER O.P.S.D. 801.010. ALL CSP TO BE 2.0mm THICKNESS GAUGE.
6. CONTRACTOR SHALL INFORM THE SITE (PROJECT) MANAGER A MINIMUM 24 HOURS IN ADVANCE OF HIS INTENTION TO COMMENCE WORK. CONTRACTOR SHALL AT ALL TIMES, PROVIDE SUITABLE BARRICADES AND FLAGGING PROTECTION IN ACCORDANCE WITH THE MINISTRY OF LABOUR PRACTICES, AND OCCUPATIONAL HEALTH AND SAFETY ACT.
7. THESE NOTES ARE GENERAL IN NATURE; FOR SPECIFIC DETAILS REFER TO CITY OF BARRIE AND ONTARIO PROVINCIAL STANDARDS AND SPECIFICATIONS.
8. SEWER PIPE MATERIAL (IF APPLICABLE): –POLYVINYL CHLORIDE PIPE SHALL CONFORM TO CSA–B–182.1 AND CSA–B–182.2 WITH BELL AND SPIGOT RUBBER GASKETED JOINTS COMPLYING WITH CSA–B182.2 AND CSA–B182.3. SANITARY PIPE SHALL BE SDR–35 AND ALL SANITARY SERVICE LATERALS TO BE SDR–28.
9. SEWER BEDDING WILL CONFORM TO O.P.S.D. 802.030 FOR RIGID PIPE INSTALLATION AND O.P.S.D. 802.010 FOR FLEXIBLE PIPE INSTALLATION. NATIVE MATERIAL USED FOR BACKFILL SHALL BE APPROVED BY A GEOTECHNICAL ENGINEER.
10. ALL TRENCHES ARE TO BE BACKFILLED WITH NATIVE MATERIAL AND COMPACTED TO AT LEAST 95% STANDARD PROCTOR DENSITY OR AS PER THE GEOTECHNICAL ENGINEER'S RECOMMENDATIONS. IN ADDITION, ALL STRUCTURES WITHIN TRAVELLED PORTION OF THE ROAD & PARKING AREAS SHALL HAVE NATIVE 4:1 FROST TAPERS FROM FROST LINE TO SUBGRADE.
11. MAINTENANCE HOLES:
–STEPS SHALL BE ALUMINUM ALLOY O.P.S.D. 405.010 SOLID CIRCULAR ALUMINUM OR APPROVED EQUAL.
–FRAMES AND COVERS SHALL BE DOMINION WHEEL FOUNDRIES DESIGN STD. 579 OR APPROVED EQUAL AND SELF LEVELLING FRAME AND GRATE/COVER SHALL BE USED FOR ALL NEW MAINTENANCE HOLES WITHIN ASPHALT ROADWAYS AS PER BSD–41 (OCTOBER 2017) O.P.S.D. 401.010 TYPE 'A'.
–SANITARY MAINTENANCE HOLES ARE TO HAVE CORE AND SEAL GASKETS ON ALL PIPE CONNECTIONS. 1200 DIAMETER MAINTENANCE HOLES – O.P.S.D. 701.010
–STORM MAINTENANCE HOLES TO BE 1200mm DIAMETER PER OPSD 701.010 UNLESS OTHERWISE NOTED. 1800mm DIAMETER MAINTENANCE HOLES – O.P.S.D. 701.012.
–MAINTENANCE HOLE BENCHING SHALL EXTEND TO PIPE OBVERT AND SHALL BE IN ACCORDANCE WITH DETAILS SHOWN AS PER OPSD 701.021.

12.) TEMPORARY ACCESS ROAD MAKE–UP: (REFER TO GEOTECHNICAL INVESTIGATION REPORT)
–70mm HL8 BINDER ASPHALT
–150mm OPSS GRANULAR "A"
–400mm OPSS GRANULAR "B"
INTERNAL ROAD & PARKING MAKE–UP:
–40mm HL3 BINDER ASPHALT
–70mm HL8 BINDER ASPHALT
–150mm OPSS GRANULAR "A"
–450mm OPSS GRANULAR "B"

13.) BARRIER CURB TO COMPLY WITH OPSD 600.110.

14.) CATCHBASIN STRUCTURES LOCATED IN THE VICINITY OF THE SNOW STORAGE AREAS TO HAVE MIN. 900mm SUMP DEPTH PER OPSD 705.010 AND BE FITTED WITH CATCHBASIN SHIELDS OR APPROVED EQUIVALENT. DETAIL PROVIDED ON DWG. No. DET–3.

METROLINX NOTES

1. THE PROPOSED DESIGN IS IN COMPLIANCE WITH FCM'S/RAC'S "GUIDELINES FOR NEW DEVELOPMENT IN PROXIMITY TO RAILWAY OPERATIONS".
2. MATERIALS/EQUIPMENT (OF ANY KIND) WILL NOT BE STORED/STOCKPILED WITHIN METROLINX RIGHT–OF–WAY.
3. ANY SPOILS/WASTE/DEBRIS WILL NOT BE DIRECTED TOWARD OR WITHIN THE METROLINX RIGHT–OF–WAY.
4. TRACK STRUCTURE WILL NOT BE DISTURBED OR CONTAMINATED AT ANY TIME DURING THE PROPOSED WORK.
5. CONSTRUCTION LIGHTING ON OR AROUND THE WORK AREA SHALL NOT IMPEDE RAILWAY OPERATIONS, OR IMPACT THE SIGHTLINES/VISIBILITY OF TRAIN CREWS OPERATING.
6. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR THE ADEQUATE PROTECTION OF ALL EXISTING INFRASTRUCTURE (i.e. UTILITIES, SERVICES, STRUCTURES, ROADWAYS, TRACKS, ETC.) DURING CONSTRUCTION OPERATIONS.
7. ALL DRAINAGE, DURING THE ENTIRE PROPOSED WORK, WILL BE DIRECTED AWAY FROM THE METROLINX DRAINAGE DITCHES AND ROW. THE PROJECT AND ITS CONSTRUCTION SHALL HAVE NO ADVERSE AFFECTS ON THE EXISTING AND FUTURE METROLINX DRAINAGE FACILITIES/DITCHES/GRADING. POSITIVE DRAINAGE SHALL BE MAINTAINED AT ALL TIMES, AND EXISTING DRAINAGE WITHIN METROLINX ROW SHALL NOT BE ALTERED.
8. PROTECTION OF THE INTEGRITY OF METROLINX ROW AND ALL ADJACENT RAILWAY INFRASTRUCTURE WILL BE PRIORITIZED.
9. ANYONE ENTERING METROLINX RIGHT–OF–WAY MUST COMPLETE THE PTS ONLINE TRAINING.
10. CONSTRUCTION, MAINTENANCE AND OPERATION OF THE LINE SHALL BE IN ACCORDANCE WITH THE LATEST TRANSPORT CANADA GENERAL ORDERS E–11 AND E–12 AND THE LATEST CANADIAN STANDARDS ASSOCIATION C22.3 No. 1–15 AND/OR C22.3 No. 7–15, AREMA AND MX ELECTRIFICATION REQUIREMENTS AS APPLICABLE.
11. PRIOR TO COMMENCING ANY WORK WITHIN OR ADJACENT TO THE METROLINX ROW, THE CONTRACTOR SHALL APPLY FOR AND RECEIVE A METROLINX WORK PERMIT APPLICATION (WPA). WHEN SUBMITTING THE WPA(s), THE CONTRACTOR SHALL ALLOW FOR SUFFICIENT TIME FOR THE REVIEW, REVISION, AND COORDINATION WITH METROLINX INTERNAL STAKEHOLDERS. THE CONTRACTOR WILL BE REQUIRED TO SUBMIT THE FOLLOWING (BUT NOT LIMITED) TO AECOM/METROLINX:
i) DETAILED WORK PLAN METHODOLOGY FOR THE PROPOSED UTILITY INSTALLATION;
ii) METHODOLOGY FOR ANY TRENCH/EXCAVATION;
iii) ANY DE–WATERING SCHEMES ON OR ADJACENT TO METROLINX RIGHT–OF–WAY, IF REQUIRED;
iv) ENVIRONMENTAL AND METROLINX RIGHT–OF–WAY IMPACT MITIGATION REQUIREMENTS FOR THE PROPOSED TRENCHLESS INSTALLATION;
(v) FLAGGING REQUEST FORM;
(vi) PTS TRAINING AND OTHER DOCUMENTS. THE CONTRACTOR SHOULD CONTACT AECOM/METROLINX FOR FURTHER DETAILS.

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19cm TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD. APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21–12–20	MF
2	2ND DETAILED DESIGN SUBMISSION	21–09–03	MF
1	1ST DETAILED DESIGN SUBMISSION	21–02–12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

GENERAL NOTES

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: N/A	DATE JANUARY 2021
DRAWN KS	PROJECT PRA–19078	DWG. № N–1
CHECKED DR		

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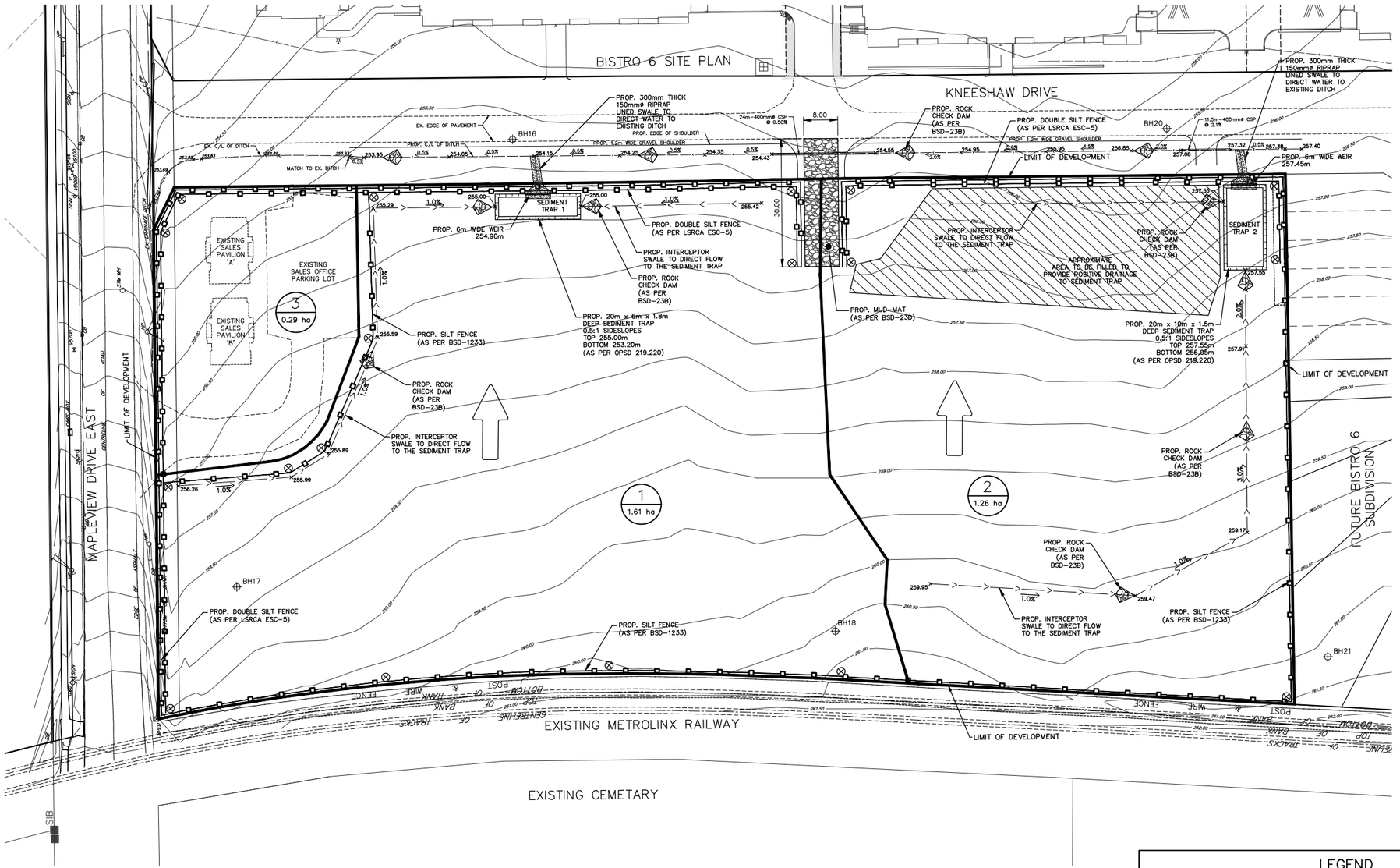

LEGEND

- EX. BUSH LINE
- EX. BORE HOLE
- DIRECTION OF SURFACE DRAINAGE
- PROP. SILTATION CONTROL FENCE AS PER BSD-1233
- EXISTING CONTOUR LINES
- PROP. CEDAR POST
- PROP. ROCK CHECK DAM AS PER BSD-23B
- DRAINAGE BOUNDARY
- MUD MAT(AS PER BSD-23D)
- PROP. CUT-OFF SWALE (MIN 0.5m DEPTH)
- AREA NO.
- AREA IN HECTARE
- EXTERNAL WORKS BY OTHERS

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF PART OF THE PROPOSED HEWITT'S GATE SUBDIVISION SITE LOCATED AT 793 MAPLEVIEW DRIVE EAST AND HAVE PREPARED THIS PLAN TO INDICATED THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADES AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

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BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

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NO.	REVISIONS	DATE	INITIAL
4	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
3	ISSUED FOR SAP APPLICATION	21-09-09	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

EROSION AND SEDIMENT CONTROL PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
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DESIGN MF	SCALE: 1:500	DATE FEB. 2021
DRAWN KS	PROJECT PRA-19078	DWG. Nº ESC-1
CHECKED DR		

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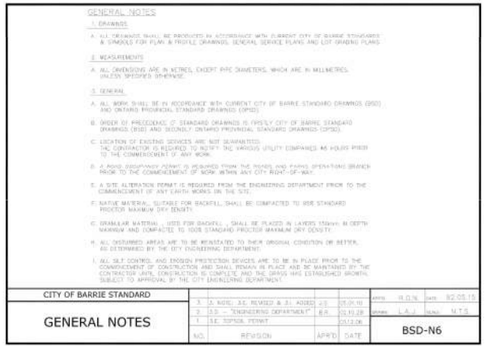

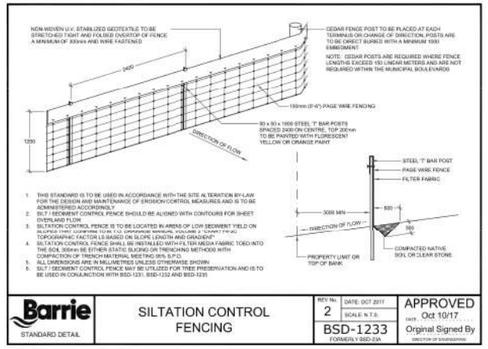

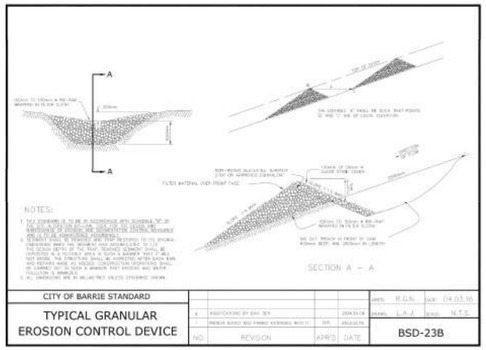

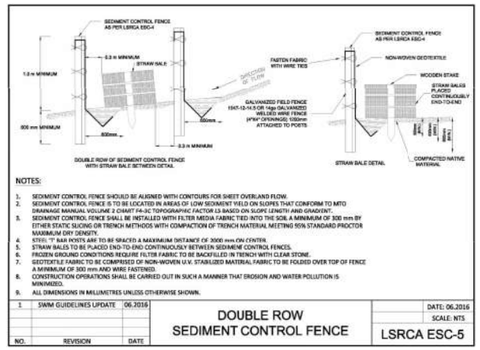

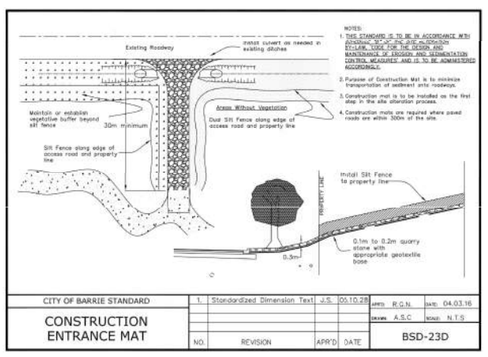

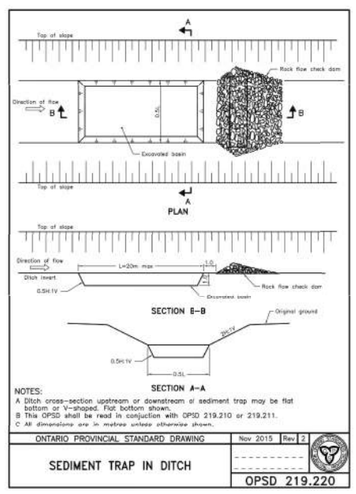

NOTE:
PROPOSED SEDIMENT TRAPS HAVE BEEN SIZED FOR 125M3/ha OF CONTRIBUTING AREA IN ACCORDANCE WITH THE GREATER GOLDEN HORSESHOE AREA CONSERVATION AUTHORITIES EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN CONSTRUCTION

EROSION CONTROL NOTES

1. THE ACCOMPANYING PLANS SET OUT THE MEASURES THAT WILL BE TAKEN BY THE DEVELOPER AND ITS CONTRACTORS TO CONTROL DOWNSTREAM SEDIMENT TO THE LOWEST LEVEL PRACTICALLY ACHIEVABLE. THE CONDITIONS AND TECHNIQUES SET OUT ARE TO BE FOLLOWED UNLESS APPROVED OTHERWISE BY THE CONTRACT ADMINISTRATOR, CONSERVATION AUTHORITY AND/OR MUNICIPALITY.
2. ALL TEMPORARY SILT CONTROL AND EROSION PROTECTION DEVICES (I.E. SILT FENCING, DRAINAGE SWALES, ROCK CHECK DAMS, SEDIMENT TRAPS, GRAVEL ACCESS PAD, ETC.) SHALL BE CONSTRUCTED PRIOR TO COMMENCEMENT OF SITE WORKS AND SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL CONSTRUCTION IS COMPLETE AND THE GRASS HAS ESTABLISHED GROWTH, SUBJECT TO APPROVAL BY THE CITY ENGINEERING DEPARTMENT.
3. ALL SEDIMENTATION CONTROL MEASURES ARE TO BE INSPECTED REGULARLY (MINIMUM WEEKLY), AS WELL AS AFTER EVERY RAINFALL EVENT AND ANY DAMAGED SILT CONTROL AND EROSION PROTECTION DEVICES SHALL BE PROMPTLY REPAIRED OR REPLACED BY THE CONTRACTOR.
4. THE CONTRACTOR MUST USE MATERIALS, CONSTRUCTION PRACTICES, AND MITIGATION TECHNIQUES IN ORDER TO PREVENT THE UNAUTHORIZED HARMFUL ALTERATION, DISRUPTION OR DESTRUCTION OF VEGETATION OR THE IMPAIRMENT OF WATER QUALITY.
5. THE CONTRACTOR SHALL BE PREPARED FOR UNEXPECTED CONDITIONS AND ACCORDINGLY HAVE STOCKPILED MATERIALS ON SITE FOR NECESSARY REPAIRS AS A RESULT OF FAILED OR INADEQUATE CONTROL MEASURES.
6. AREAS WITHOUT STABLE GROUND COVER SHALL BE PROTECTED WITH SILTATION CONTROL FENCING, STRAW MULCH, ETC, AND MAINTAINED BY THE CONTRACTOR UNTIL VEGETATION HAS BECOME ESTABLISHED IN THE SUBSEQUENT GROWING SEASON.
7. ALL EXPOSED SOIL MUST BE GRADED TO A STABLE SLOPE AND TREATED AS QUICKLY AS POSSIBLE TO PREVENT EROSION AND SEDIMENT FROM LEAVING THE SITE. ALL AREA STRIPPED OF VEGETATIVE COVER FOR LONGER THAN 30 DAYS SHALL BE TOPSOILED AND SEEDED AT THE DIRECTION OF THE ENGINEER.
8. ALL SITE DRAINAGE TO BE DIRECTED TO THE TEMPORARY SEDIMENT TRAPS AND OTHER CHECK DAMS VIA SHEET DRAINAGE, BERMS OR SWALES (AS NECESSARY) TO FACILITATE THE COMPLETION OF GRADING WORKS. THE CONTRACTOR SHALL CONSTRUCT ANY ADDITIONAL SWALES OR BERMS THAT MAY BE NECESSARY TO DIRECT RUN-OFF IN A CONTROLLED MANNER OF SUITABLE QUALITY.
9. ALL CONSTRUCTION VEHICLES SHALL ENTER AND EXIT THE SITE FROM PROPOSED CONSTRUCTION ACCESS VIA THE GRAVEL ACCESS PAD.
10. ANY DEWATERING WASTE SHALL BE DISCHARGED TO A VEGETATED AREA AT LEAST 30m FROM ANY WATERCOURSE AND FILTERED. FILTERING METHODS MUST BE APPROVED BY THE SITE INSPECTOR.
11. TECHNIQUES FOR EROSION AND SEDIMENT CONTROLS ARE TO ADHERE TO ACCEPTED ENGINEERING PRACTICE AND MUNICIPAL, CONSERVATION AUTHORITY AND ONTARIO PROVINCIAL STANDARD SPECIFICATIONS AND DRAWINGS. THE CONTRACTOR SHALL OBTAIN A CURRENT COPY AND BECOME FAMILIAR WITH OPSS 805: CONSTRUCTION SPECIFICATION FOR TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES, AS WELL AS APPLICABLE MUNICIPAL STANDARDS AND/OR APPROVAL AGENCY STANDARDS.
12. THE CONTRACTOR MAY CONSIDER ALTERNATIVE SEDIMENT AND EROSION CONTROL MEASURES, SUCH MEASURES MUST BE PRESENTED IN WRITING FOR APPROVAL BY THE CONTRACT ADMINISTRATOR AND MUST BE APPROVED IN WRITING BY THE APPLICABLE APPROVAL AGENCIES.

CONSTRUCTION SEQUENCE

THE FOLLOWING CONSTRUCTION SEQUENCE IS PROVIDED FOR CONTRACTOR GUIDANCE:

1. CONSTRUCT ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES INCLUDING SILT FENCE, TREE PRESERVATION FENCE, MUD MATS, CHECK DAMS, SWALES/BERMS, ETC.
2. CONSTRUCT TEMPORARY SEDIMENT TRAPS. STRIPPING AND REMOVAL OF TOPSOIL. TOPSOIL TO BE REMOVED FROM SITE.
3. PROCEED WITH EARTH EXCAVATION AND PRE-GRADING. PROCEED WITH SEEDING OF RESTORATION OF ALL DISTURBED AREAS AS DIRECTED BY ENGINEER. ALL AREAS STRIPPED OF VEGETATIVE COVER FOR LONGER THAN 15 DAYS SHALL BE HYDROSEEDED AT THE DIRECTION OF THE ENGINEER. HYDROSEED WITH FIBRETAC AT 100KG/HA. HYDROSEED MIXTURE OF 48% ANNUAL RYE GRASS, 48% FALL RYE, 4% RED CLOVER WILL NEED TO BE APPLIED TO ANY EXPOSED AREAS FOLLOWING TOPSOIL STRIPPING.
4. PROCEED WITH SITE WORKS I.E. SITE SERVICING AND SURFACE WORKS INSTALLATIONS.
5. REMOVE TEMPORARY SEDIMENT TRAPS. CONSTRUCT RETAINING WALLS AND LID MEASURES AT EAST PROPERTY LIMIT.
6. RESTORATION OF DISTURBED AREAS.
7. REMOVAL OF REMAINING SEDIMENT AND EROSION CONTROLS.

NOTE SILTATION AND EROSION CONTROL MEASURES ARE TO BE MONITORED AND MAINTAINED THROUGHOUT CONSTRUCTION AND NECESSARY REPAIRS TO BE PROMPTLY COMPLETED AS REQUIRED.

CONTINGENCY PLAN

IF UNFORESEEN EVENTS CAUSE THE STRATEGIES SET OUT IN THIS PLAN TO BE INSUFFICIENT OR INAPPROPRIATE TO MEET THE OBJECTIVE, THE CONTRACTOR IS EXPECTED TO RESPOND IN A TIMELY MANNER WITH ALL REASONABLE MEASURES CONSISTENT WITH SAFETY, TO PREVENT, COUNTERACT OR REMEDY DOWNSTREAM SEDIMENTATION AND EROSION.

IF A SPILL OCCURS IT SHALL BE REPORTED TO THE MINISTRY OF ENVIRONMENT & CLIMATE CHANGE & THE MINISTRY OF NATURAL RESOURCES AND FORESTRY. THE ON CALL CITY OF BARRIE ENVIRONMENTAL OFFICER SHOULD ALSO BE NOTIFIED VIA CELL PHONE (705) 725-3374.

IF APPROVAL AGENCIES DETERMINE THAT LONG TERM DAMAGE TO THE NATURAL ENVIRONMENT HAS OCCURRED DUE TO FAILURE OF THIS PLAN TO CONTROL SEDIMENTS, A RESTORATION PLAN WILL BE DEVELOPED BY THE CONTRACTOR IN CONSULTATION WITH AND APPROVAL FROM THE APPROPRIATE AGENCIES FOR IMPLEMENTATION BY THE CONTRACTOR.

SITE DATA		
OVERALL SITE AREA	3.16 Ha	
EXISTING LAND USE	(VACANT) AGRICULTURAL FIELD	
PREDOMINANT SOIL TYPE	SANDY LOAM	
	SEDIMENT TRAP 1	SEDIMENT TRAP 2
BOTTOM ELEVATION	253.20	256.05
TOP ELEVATION	255.00	257.55
OVERFLOW WEIR ELEVATION	254.90	257.45
DIMENSIONS (LxWxD)	20m x 6m x 1.8m	20m x 10m x 1.5m
STORAGE VOLUME	$216m^3$	$300m^3$
CATCHMENT AREA	1.61 Ha	1.26 Ha
REQUIRED STORAGE VOLUME BASED ON 125m³ OF DRAINAGE AREA TO POND	$201.25m^3$	$157.50m^3$

I HAVE REVIEWED THE PLANS FOR THE CONSTRUCTION OF PART OF THE PROPOSED HEWITT'S GATE SUBDIVISION SITE LOCATED AT 793 MAPLEVIEW DRIVE EAST AND HAVE PREPARED THIS PLAN TO INDICATED THE COMPATIBILITY OF THE PROPOSAL TO EXISTING ADJACENT PROPERTIES AND MUNICIPAL SERVICES. IT IS MY BELIEF THAT ADHERENCE TO THE PROPOSED GRADES AS SHOWN WILL PRODUCE ADEQUATE SURFACE DRAINAGE AND PROPER FACILITY OF MUNICIPAL SERVICES WITHOUT ANY DETRIMENTAL EFFECT TO THE EXISTING DRAINAGE PATTERNS OR ADJACENT PROPERTIES.

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE OVER LOVER'S CREEK, 0.656M EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD. APPROXIMATELY 1.020m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900980.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
4	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
3	ISSUED FOR SAP APPLICATION	21-09-09	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FUJS
100149153
12-22-2021
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

EROSION AND SEDIMENT CONTROL DETAILS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN	MF	SCALE: N/A	DATE FEB. 2021
DRAWN	KS	PROJECT PRA-19078	DWG. Nº ESC-2
CHECKED	DR		

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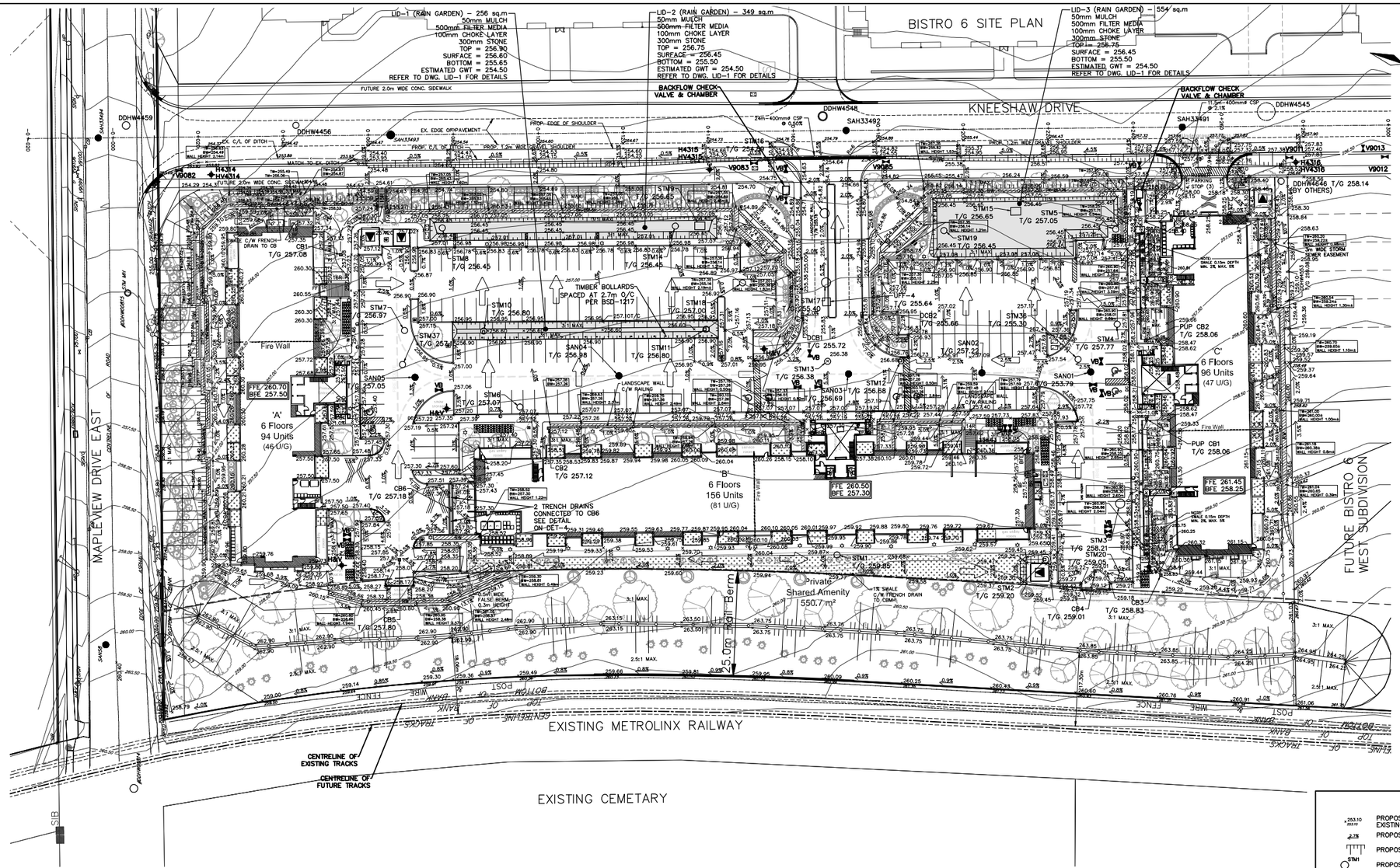

LEGEND

- PROPOSED GROUND ELEVATION / EXISTING GROUND ELEVATION
- PROPOSED GRADIENT AND DIRECTION
- PROPOSED 3:1 SLOPE (MAX.)
- STM1 — PROPOSED STORM MAINTENANCE HOLE
- CBMH7 — PROPOSED CATCHBASIN MAINTENANCE HOLE
- CB2 — PROPOSED CATCHBASIN
- DCB1 — PROPOSED DOUBLE CATCHBASIN
- SAN01 — PROPOSED SANITARY MAINTENANCE HOLE
- H&V — PROPOSED HYDRANT
- VB — PROPOSED VALVE BOX
- PROPOSED CURB STOP
- PROPOSED LIGHT STANDARD
- PROPOSED BELL PEDESTAL/HANDHOLES
- PROPOSED BELL DUCT
- PROPOSED BELL VAULT
- PROPOSED ROGERS VAULT
- PROPOSED HYDRO TRANSFORMER
- PROPOSED EV CHARGER STATION
- PROPOSED EMERGENCY OVERLAND FLOW ROUTE

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVEX'S CREEK, 0.65M EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28OM WEST OF THE NORTHEAST END OF BRIDGE, 19OM TOP OF COPING. N4910788.859 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 18O ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.528

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 900149153 (12-22-2021) PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

SITE GRADING PLAN
WITH EXISTING CONDITIONS

JONES CONSULTING GROUP LTD.
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DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. Nº SG-1	
CHECKED DR			

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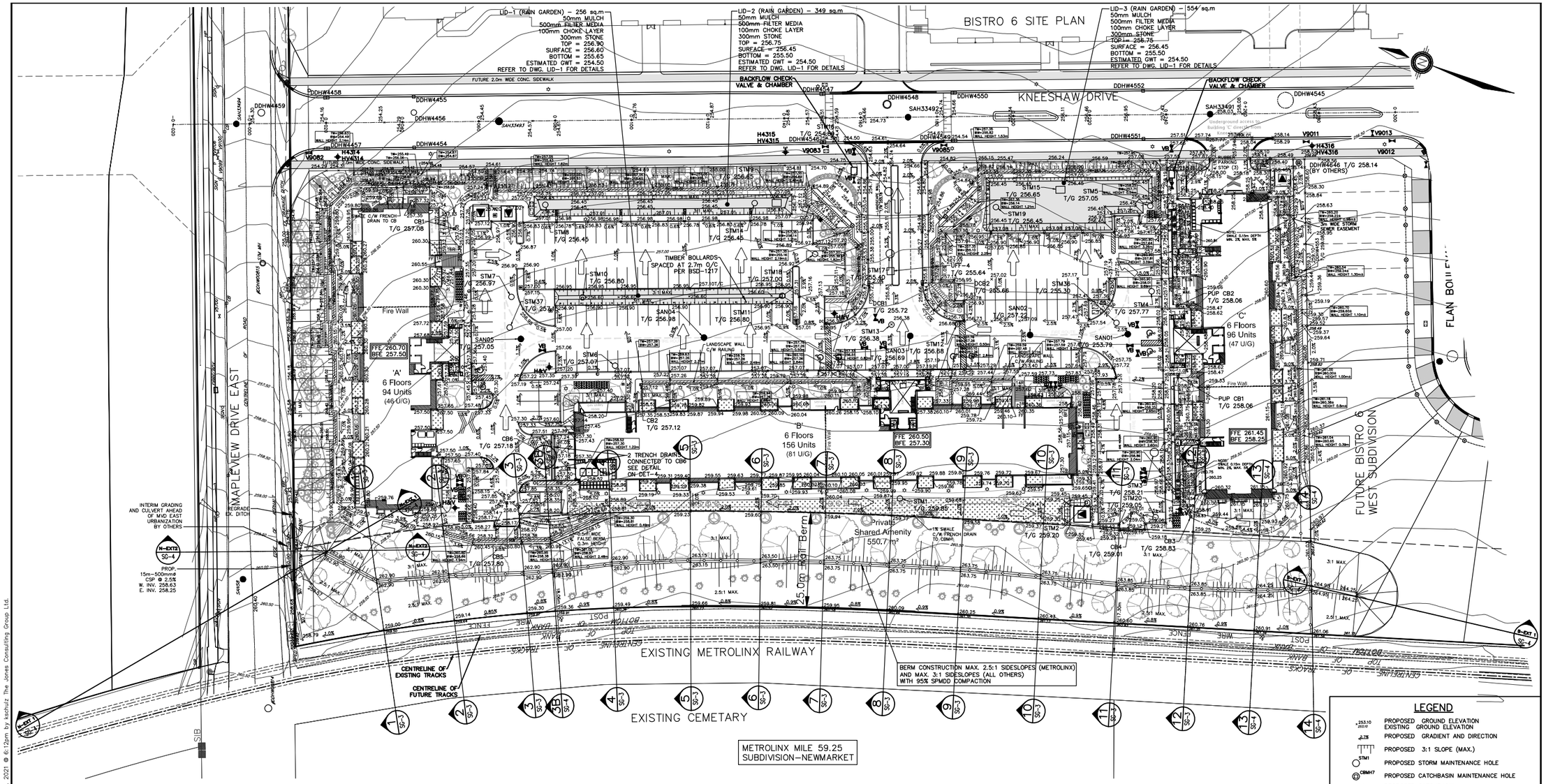

LEGEND

253.10 / 253.10	PROPOSED GROUND ELEVATION / EXISTING GROUND ELEVATION
2.2%	PROPOSED GRADIENT AND DIRECTION
	PROPOSED 3:1 SLOPE (MAX.)
STM1	PROPOSED STORM MAINTENANCE HOLE
CBMH7	PROPOSED CATCHBASIN MAINTENANCE HOLE
CB2	PROPOSED CATCHBASIN
DCB1	PROPOSED DOUBLE CATCHBASIN
SAN01	PROPOSED SANITARY MAINTENANCE HOLE
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	PROPOSED BELL DUCT
	PROPOSED BELL VAULT
	PROPOSED ROGERS VAULT
	PROPOSED HYDRO TRANSFORMER
	PROPOSED EV CHARGER STATION
	LANDSCAPE TREE
	PROPOSED EMERGENCY OVERLAND FLOW ROUTE

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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

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ELEMENTS SITE PLAN
CITY OF BARRIE

SITE GRADING PLAN
WITH PROPOSED CONDITIONS

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F. 705.734.1056

DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. Nº SG-2	
CHECKED DR			

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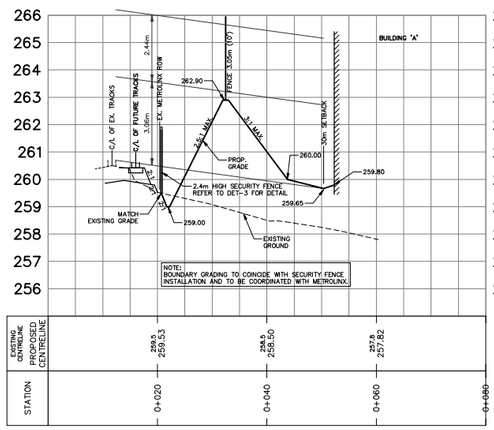

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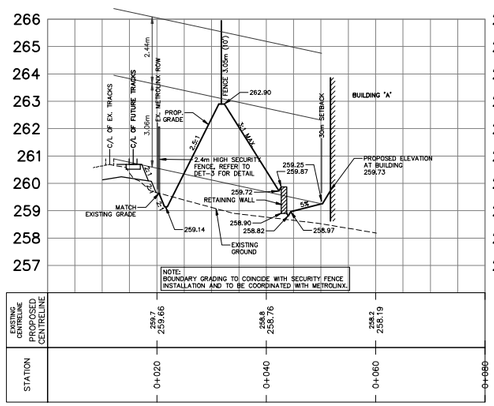

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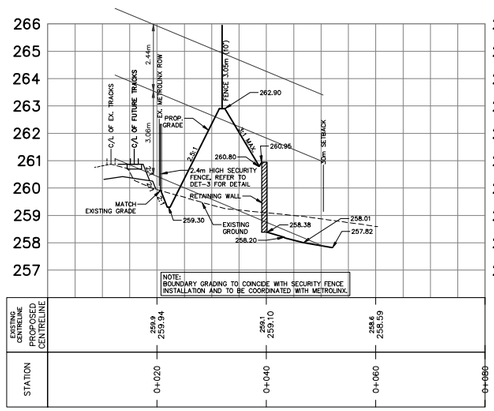

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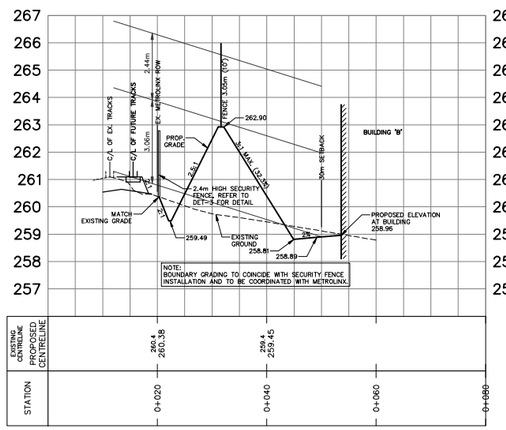

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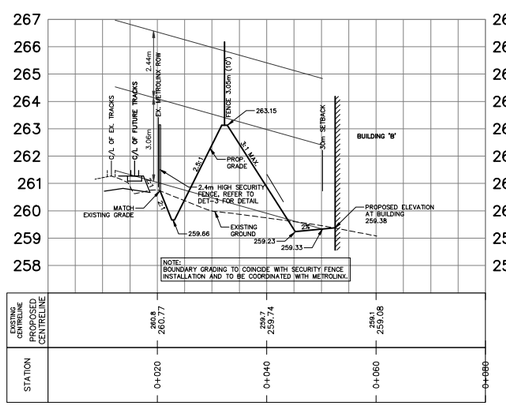

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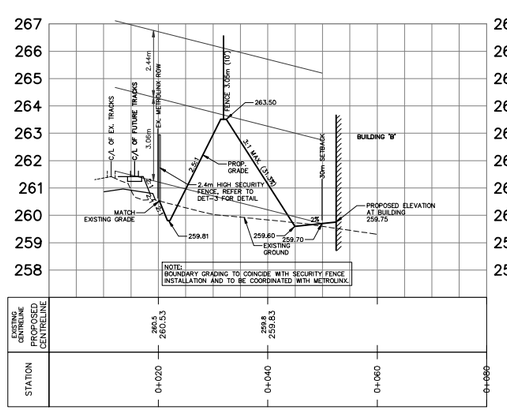

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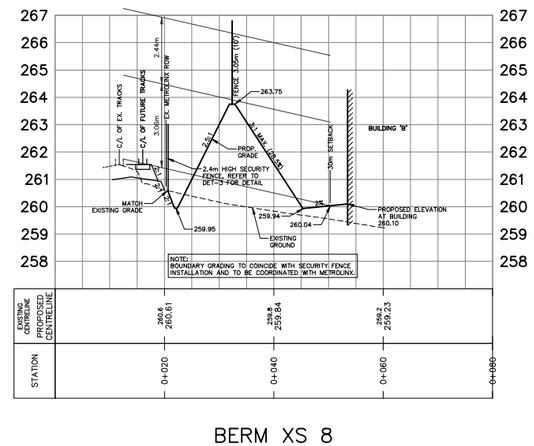

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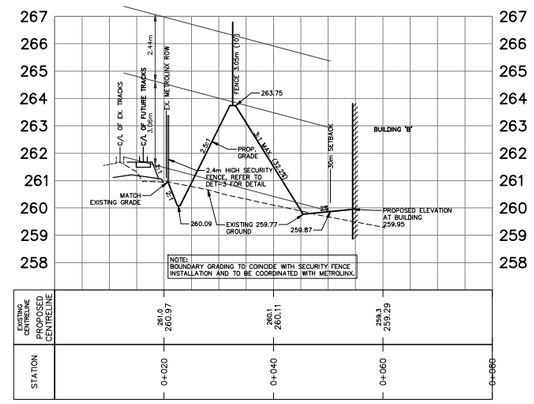

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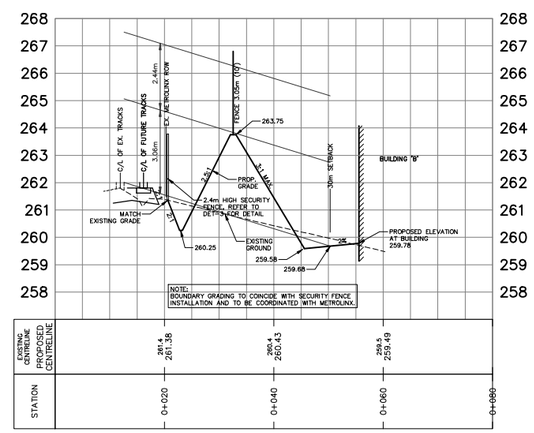

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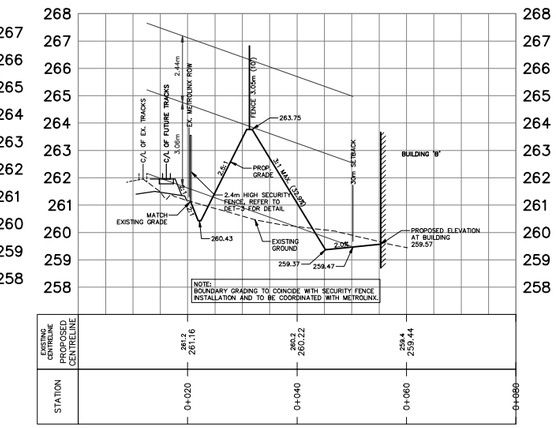

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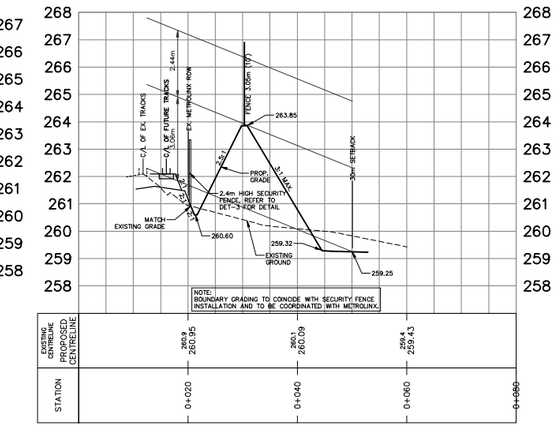

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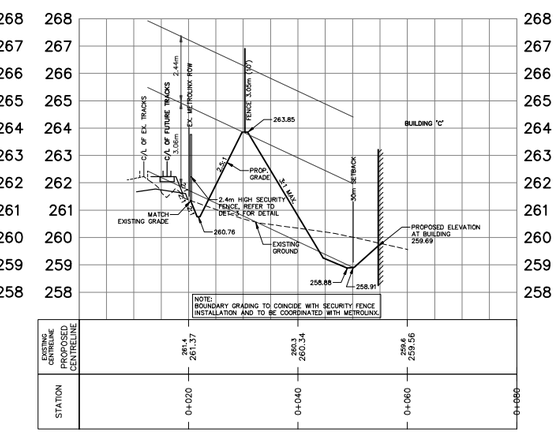

BENCHMARK:

BENCHMARK NO: D10198654 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 2KM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF DOPING. N4910788.859 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
4	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
3	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
2	ISSUED FOR METROLINX REVIEW	21-06-14	DR
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
12-22-2021
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

RAILWAY BERM SECTIONS

JONES CONSULTING GROUP LTD.
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DESIGN MF	SCALE: H.1:500 V.1:100	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. Nº SG-3	
CHECKED DR			

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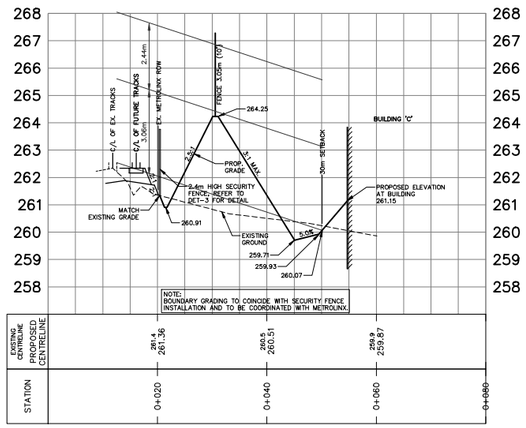

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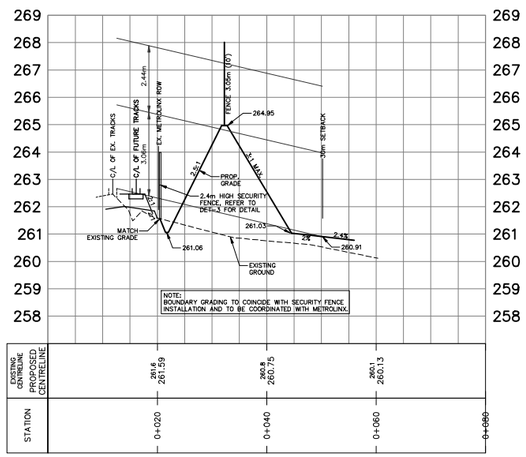

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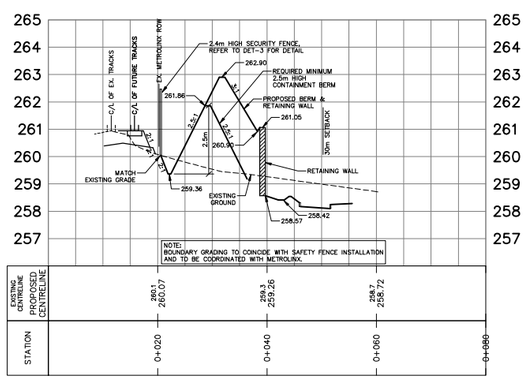

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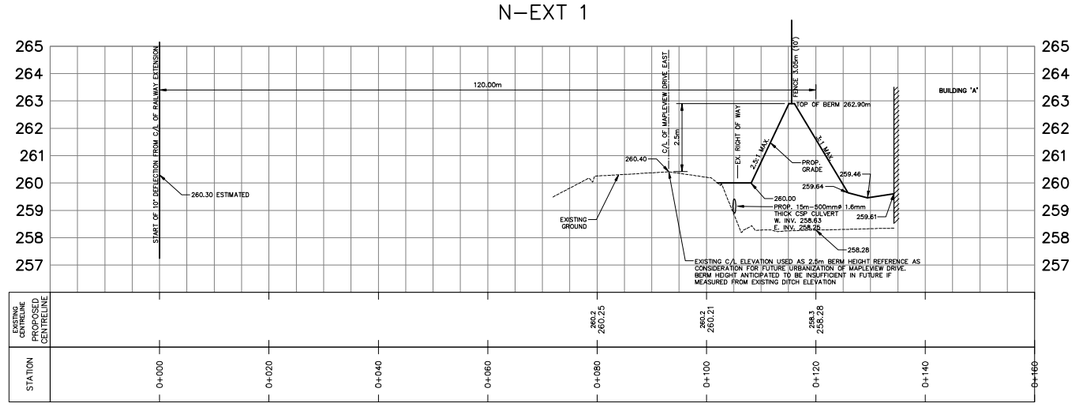

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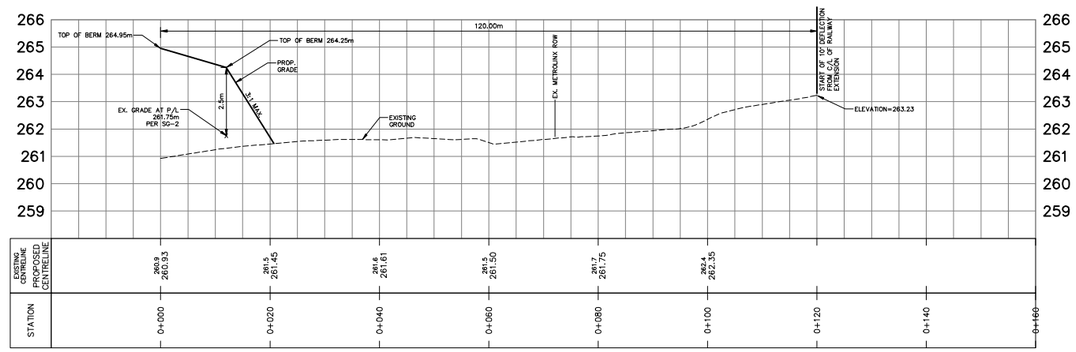

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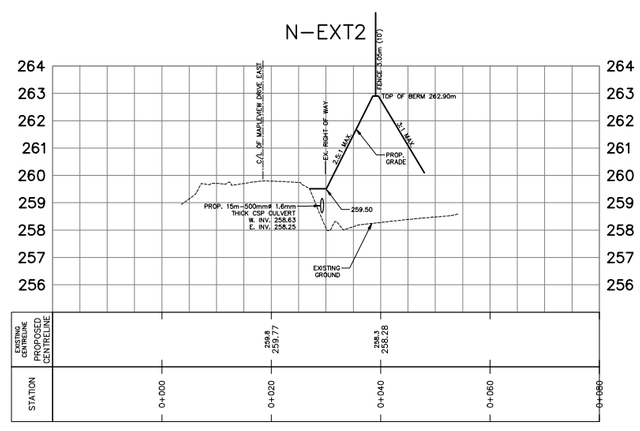

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVEX'S CREEK, 0.65M EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.559 E607264.100 ELEV 241.961

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.505

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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

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ELEMENTS SITE PLAN
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DESIGN MF	SCALE: H.1:500 V.1:100	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № SG-4	
CHECKED DR			

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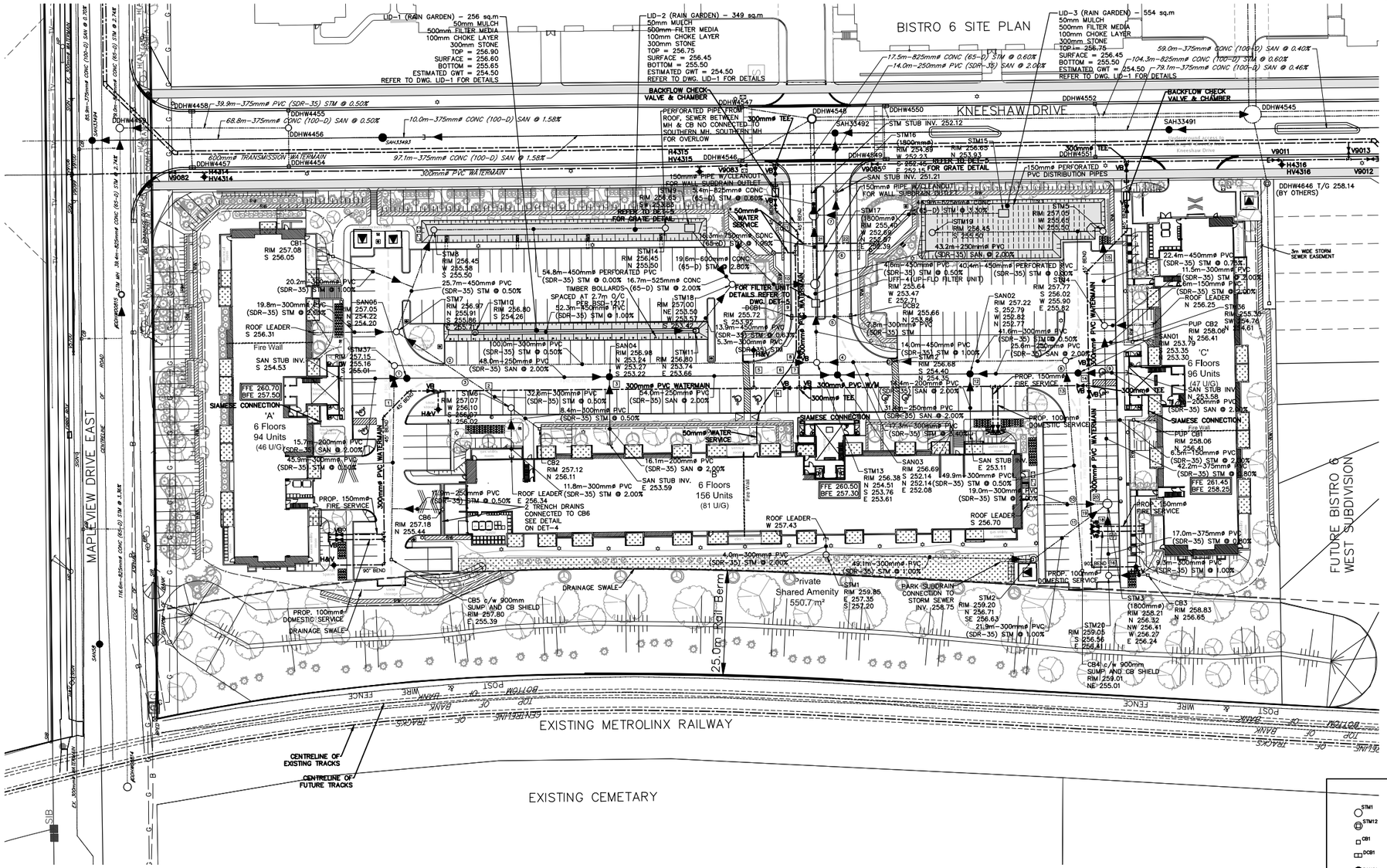

NOTE

REFER TO PIPE INTERFERENCE TABLES ON DWG. SS-2

- STORM AND SANITARY PIPE CLEARANCE LABEL
- WATERMAIN AND STORM OR SANITARY PIPE CLEARANCE LABEL

NOTE

1. DOMESTIC AND FIRE SERVICE VALVES SHALL BE LOCATED IN THE BOULEVARD, UNLESS OTHERWISE NOTED.
2. DOMESTIC AND FIRE SERVICES SHALL BE MECHANICALLY RESTRAINED FROM THE TEE TO THE BUILDINGS.
3. DOMESTIC AND FIRE SERVICE RISERS ENTERING EACH BUILDING SHALL BE INSTALLED AS PER BSD-505.
4. DOMESTIC AND FIRE SERVICE TO BE HAND SWABBED OR A SWAB IS TO BE PLACED IN SERVICE AND REMOVED FROM RISERS.
5. THE 100mm DOMESTIC WATER SERVICE WILL REQUIRE A 100mm WATER METER (SUPPLIED AND INSTALLED BY THE OWNER) COMPLETE WITH A BYPASS ASSEMBLY AS PER BSD-533 AND SHALL BE LOCATED IN AN APPROPRIATELY SIZED MECHANICAL ROOM.
6. BACKFLOW PREVENTION SHALL BE PROVIDED ON ALL DOMESTIC AND FIRE SERVICES AS PER CITY OF BARRIE BYLAW 2017-121.
7. 50mm WATER SERVICE TO THE LANDSCAPE FEATURES WILL EACH REQUIRE 50mm WATER METERS.

LEGEND

STM1	PROPOSED STORM MAINTENANCE HOLE
STM12	PROPOSED CATCHBASIN MAINTENANCE HOLE
CB1	PROPOSED CATCHBASIN
DCB1	PROPOSED DOUBLE CATCHBASIN
SAN01	PROPOSED SANITARY MAINTENANCE HOLE
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	PROPOSED BELL DUCT
	PROPOSED BELL VAULT
	PROPOSED ROGERS VAULT
	PROPOSED HYDRO TRANSFORMER
	PROPOSED EV CHARGER STATION
	LANDSCAPE TREE

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BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVE'S CREEK, 0.65M EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.859 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL - 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.020m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N49009870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 (12-22-2021) PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

SITE SERVICING PLAN

JONES CONSULTING GROUP LTD.
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DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № SS-1	
CHECKED DR			

G:\Eng_30\PRA-19078\Design Dwgs\PRA-19078_DESIGNBASE.dwg Layout:SS-1 Plotted Dec 21, 2021 @ 6:14pm by kschulz The Jones Consulting Group Ltd.

Elements Condominium
100-Year Storm Sewer Design Sheet

CLIENT: Pratt Hansen Group Inc.
PROJECT: Elements Condominium Site Plan
FILE: PRA-19078 (50)

DATE: December 2021
DESIGN: MG
CHECKED: MF

100-Year Storm Sewer Design Sheet

AREAS	MANHOLE FROM	MANHOLE TO	LENGTH (m)	INCREMENT C	INCREMENT A	INCREMENT CA	TOTAL CA	FLOW TIME (min) TO	FLOW TIME (min) IN	I (mm/hr)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	% FULL
						Storm water directed to LID-1										
401				0.99	0.26	0.25	0.25									
	STM10	STM11	52.3			0.00	0.25	10.00	0.49	180	0.126	1.00	450	0.285	1.8	**44.2**
	STM11*	STM18	13.9			0.00	0.26	10.49	0.16	176	0.1251	0.63	450	0.226	1.4	**55.3**
						Storm water directed to LID-2										
402	CB2	STM6	8.4	0.39	0.04	0.01	0.01	10.00	0.14	180	0.007	0.50	300	0.068	1.0	**10.2**
403	STUB	STM6	11.8	1.00	0.09	0.09	0.09	10.00	0.10	180	0.045	2.00	300	0.137	1.9	**32.9**
	STM6	STM7	32.6			0.00	0.10	10.14	0.56	179	0.052	0.50	300	0.068	1.0	**75.4**
404	STUB	STM7	19.8	1.00	0.17	0.17	0.17	10.00	0.17	180	0.086	2.00	300	0.137	1.9	**62.6**
405	CB1	TEE	20.2	0.30	0.05	0.01	0.01	10.00	0.25	180	0.007	1.00	300	0.097	1.4	**7.1**
	STM7	STM8	25.7			0.00	0.29	10.71	0.34	174	0.140	0.50	450	0.202	1.3	**69.2**
406	STM9**	STM18	16.7	0.93	0.32	0.30	0.92	11.04	0.10	171	0.4399	2.00	525	0.608	2.8	**72.3**
						Storm Water Directed to LID-3										
407	STUB	STM1	4.0	1.00	0.10	0.10	0.10	10.00	0.03	180	0.050	2.00	300	0.137	1.9	**36.6**
	STM1	STM2	49.1			0.00	0.10	10.03	0.60	180	0.050	1.00	300	0.097	1.4	**51.6**
408	STM2	STM3	21.9	0.34	0.16	0.05	0.15	10.63	0.27	175	0.075	1.00	300	0.097	1.4	**77.4**
409	STUB	STM3	19.0	1.00	0.08	0.08	0.08	10.00	0.16	180	0.042	2.00	300	0.137	1.9	**30.6**
410	CB3	STM20	9.3	0.24	0.11	0.03	0.03	10.00	0.11	180	0.013	1.00	300	0.097	1.4	**13.3**
	STM20	STM3	17.0			0.00	0.03	10.11	0.20	179	0.013	0.80	375	0.157	1.4	**8.2**
411	PUP CB1	TEE	6.5	0.38	0.01	0.00	0.00	10.00	0.09	180	0.002	2.00	150	0.022	1.2	**11.2**
412	PUP CB2	TEE	6.6	0.49	0.01	0.01	0.01	10.00	0.09	180	0.003	2.00	150	0.022	1.2	**13.7**
	STM3	STM4	42.2			0.00	0.27	10.90	0.60	172	0.131	0.80	375	0.157	1.4	**83.8**
413	STUB	STM4	11.5	1.00	0.17	0.17	0.17	10.00	0.10	180	0.084	2.00	300	0.137	1.9	**61.7**
	STM4	STM5	22.4			0.00	0.44	11.39	0.24	169	0.207	0.75	450	0.247	1.6	**84.0**
414	STM15***	STM16	44.9	0.93	0.37	0.34	1.03	11.64	0.21	167	0.4781	3.30	525	0.781	3.6	**61.2**
						Storm Water Directed to 100-Year Trunk Storm Sewer										
	UFF-4	STM17	4.6			0.00	0.26	12.64	0.06	160	0.113	0.50	450	0.202	1.3	**56.1**
	STM18****	STM17	19.6			0.00	1.18	11.14	0.09	171	0.559	2.80	600	1.027	3.6	**54.4**
	STM17****	STM16	16.3			0.00	1.44	12.70	0.11	159	0.635	1.00	750	1.113	2.5	**57.0**
	STM16****	DBI IW4648	22.9			0.00	2.47	12.81	0.18	158	1.086	0.60	825	1.112	2.1	**97.7**

Note: All runoff coefficients for sizing the 100-year storm sewer have been increased by 25% in accordance with Table 3.3 of the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines.

*Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 6hr SCS LID PCSWMM model for LID-1. Qp = 0.1251 m³/s

** Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 4hr Chicago LID PCSWMM model for LID-2. Qp = 0.4399 m³/s

***Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 4hr Chicago LID PCSWMM model for LID-3. Qp = 0.4781 m³/s

****Adjusted total CA values from LIDs have been carried forward through the design sheet.

Q= 0.0028*C*I*A (cms); C=RUNOFF COEFFICIENT; I-RAINFALL INTENSITY (100-Year) = 1426.408/(T.C. + 6.273)^0.789; A=AREA (ha)

Elements Condominium
5-Year Storm Sewer Design Sheet

CLIENT: Pratt Hansen Group Inc.
PROJECT: Elements Condominium Site Plan
FILE: PRA-19078 (50)

DATE: December 2021
DESIGN: MG
CHECKED: MF

5-Year Storm Sewer Design Sheet

AREAS	MANHOLE FROM	MANHOLE TO	LENGTH (m)	INCREMENT C	INCREMENT A	INCREMENT CA	TOTAL CA	FLOW TIME (min) TO	FLOW TIME (min) IN	I (mm/hr)	TOTAL Q (cms)	S (%)	D (mm)	Q FULL (cms)	V FULL (m/s)	% FULL
						Storm water directed to UFF-4 bypassing all LIDs										
501	CB5	STM37	45.9	0.35	0.31	0.11	0.11	10.00	0.79	109	0.033	0.50	300	0.068	1.0	**48.0**
	STM37	STM13	100.0			0.00	0.11	10.79	1.72	105	0.032	0.50	300	0.068	1.0	**46.1**
502	CB4	STM36	49.9	0.25	0.04	0.01	0.01	10.00	0.86	109	0.003	0.50	300	0.068	1.0	**4.1**
	STM36	STM12	41.6			0.00	0.01	10.86	0.72	104	0.003	0.50	300	0.068	1.0	**4.0**
503	STM12	STM13	17.3	0.78	0.05	0.04	0.05	11.58	0.11	101	0.015	3.40	300	0.178	2.5	**8.2**
504	STM13	UFF-4	14.0	0.86	0.11	0.09	0.26	12.51	0.13	97	0.068	1.00	450	0.285	1.8	**24.0**
	UFF-4	STM17	4.6			0.00	0.26	12.64	0.06	96	0.068	0.50	450	0.202	1.3	**33.8**

Q= 0.0028*C*I*A (cms); C=RUNOFF COEFFICIENT; I-RAINFALL INTENSITY (5-Year) = 853.608/(T.C. + 4.699)^0.766; A=AREA (ha)

SANITARY SEWER DESIGN - LOCAL SEWER
Development Details Basis

Barrie

DESIGN SHEET 1 of 1
FILE NO PRA-19078
CONTRACT / PROJECT Elements Condominium Plan - Pratt Hansen Group Inc.

n ≥ 0.013
M = 5/P^0.2 Babbit

Numbers in blue or text in red are equations

M=1+[14/(4+P^0.5)] Harmon — (Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

Q_p = P*q*M/86.4 — (Peak population flow where; q = 225 L/day/person; P = population in thousands) — 225 litres/person/day

Q_i = I*A — (Peak extraneous flow: I= 0.1L/s/ha over development area)

$Q_{tot} = Q_p + Q_i$ — (Total peak flow as the sum of peak population flow and peak extraneous flow)

STREET / AREA	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q_p (l/s)	AREA (ha)	AREA (ACC) (ha)	Q_i (l/s)	Q_{tot} (l/s)	L (m)	D (mm)	S (%)	Qf FULL (l/s)	d/D[2]	d/D[3] >0.5 or >0.7	Velocity FULL (m/s)	Velocity Partial[1] (m/s)	Velocity[4] > 0.6 (m/s)
Area 1 - Building C	BUILDING C	SAN01	96	96	1.67	160	160	7.211	4.182	7.211	3.010	0.17	0.17	0.017	3.027	11.7	200	2.00%	46.384	0.173	Ok	1.476	0.829	Ok
Area 2	SAN01	SAN02	0	96	0	0	160	7.211	4.182	7.211	3.010	0.16	0.33	0.033	3.044	25.6	250	2.00%	84.100	0.130	Ok	1.713	0.807	Ok
Area 3 - Building B (southern half)	BUILDING B	SAN02	78	78	1.67	130	130	7.516	4.210	7.516	2.550	0.14	0.14	0.014	2.564	14.4	200	2.00%	46.384	0.159	Ok	1.476	0.791	Ok
Area 4	SAN02	SAN03	0	174	0	0	291	6.402	4.084	6.402	4.845	0.09	0.56	0.056	4.901	31.4	250	2.00%	84.100	0.183	Ok	1.713	0.928	Ok
Area 5 - Building A	BUILDING A	SAN05	94	94	1.67	157	157	7.241	4.185	7.241	2.960	0.17	0.17	0.017	2.977	15.7	200	2.00%	46.384	0.171	Ok	1.476	0.827	Ok
Area 6	SAN05	SAN04	0	94	0	0	157	7.241	4.185	7.241	2.960	0.17	0.34	0.034	2.994	48.0	250	2.00%	84.100	0.129	Ok	1.713	0.803	Ok
Area 7 - Building B (northern half)	BUILDING B	SAN04	78	78	1.67	130	130	7.516	4.210	7.516	2.550	0.13	0.13	0.013	2.563	16.1	200	2.00%	46.384	0.159	Ok	1.476	0.791	Ok
Area 8	SAN04	SAN03	0	172	0	0	287	6.417	4.086	6.417	4.800	0.09	0.56	0.056	4.856	54.0	250	2.00%	84.100	0.163	Ok	1.713	0.928	Ok
Area 9	SAN03	SAH33492	0	346	0	0	578	5.580	3.941	5.580	3.396	0.13	1.25	0.125	3.521	57.2	250	2.00%	84.100	0.214	Ok	1.713	1.094	Ok

DATE: December 17th, 2021 — CALCULATED BY: MG — CHECKED BY: MF

* For sizing of the 375mma Trunk Sewer on Kneeshaw Drive, refer to Sanitary Sewer Design - Trunk Sewer worksheet.

(1) without extraneous flow
(2) with extraneous flow
(3) d/D>0.5 for pipes 375 and less, d/D>0.85 for pipes greater than 375
(4) Velocity check based on the lesser of full flow or partial velocity

Watermain Interference Table

Crossing No.	PIPE 1	PIPE 1	Clearance
1	WM Top 254.71	STM Bottom 255.21	0.50m
2	WM Top 255.48	STM Bottom 255.98	0.50m
3	WM Bottom 254.02	SAN Top 253.52	0.50m
4	50mmø WM Bottom 255.00	300mmø WM Top 254.50	0.50m
5	WM Bottom 253.29	SAN Top 252.79	0.50m
6	WM Bottom 253.14	SAN Top 252.64	0.50m
7	WM Bottom 253.07	SAN Top 252.57	0.50m
8	WM Top 254.03	STM Bottom 254.53	0.50m
9	WM Top 253.39	STM Bottom 253.89	0.50m
10	WM Top 252.49	STM Bottom 252.99	0.50m
11	WM Top 252.83	STM Bottom 253.33	0.50m
12	WM Bottom 253.58	SAN Top 253.08	0.50m
13	WM Top 254.29	STM Bottom 254.79	0.50m
14	WM Bottom 254.10	SAN Top 253.60	0.50m
15	WM Top 255.19	STM Bottom 255.69	0.50m
16	WM Top 255.89	STM Bottom 256.39	0.50m
17	WM Top 255.83	STM Bottom 256.33	0.50m
18	WM Top 255.82	STM Bottom 256.32	0.50m
19	WM Top 255.96	STM Bottom 256.46	0.50m
20	WM Top 255.90	STM Bottom 256.40	0.50m
21	WM Top 251.80	STM Bottom 252.30	0.50m
22	WM Bottom 252.20	SAN Top 251.70	0.50m

Pipe Interference Table

Crossing No.	PIPE 1	PIPE 2	Clearance
1	STM Bottom 255.18	SAN Top 254.47	0.71m
2	STM Bottom 255.93	STM Top 255.25	0.68m
3	STM Bottom 255.96	SAN Top 254.19	1.77m
4	STM Bottom 253.93	SAN Top 252.27	1.66m
5	STM Bottom 253.79	SAN Top 252.05	1.74m
6	STM Bottom 253.32	SAN Top 251.74	1.58m
7	STM Bottom 252.61	SAN Top 251.57	1.04m
8	STM Bottom 254.78	SAN Top 253.50	1.28m
9	STM Bottom 255.99	SAN Top 253.67	2.32m
10	STM Bottom 256.46	STM Top 255.23	1.23m
11	STM Top 255.26	STM Bottom 256.50	1.24m

BENCHMARK:

BENCHMARK NO: 01019862454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.695M EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 193CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE. 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD. APPROXIMATELY 1.020m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4909870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

SEWER DESIGN SHEETS
AND
PIPE CLEARANCE TABLE

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
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DESIGN MF	SCALE: N/A	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № SS-2	
CHECKED DR			

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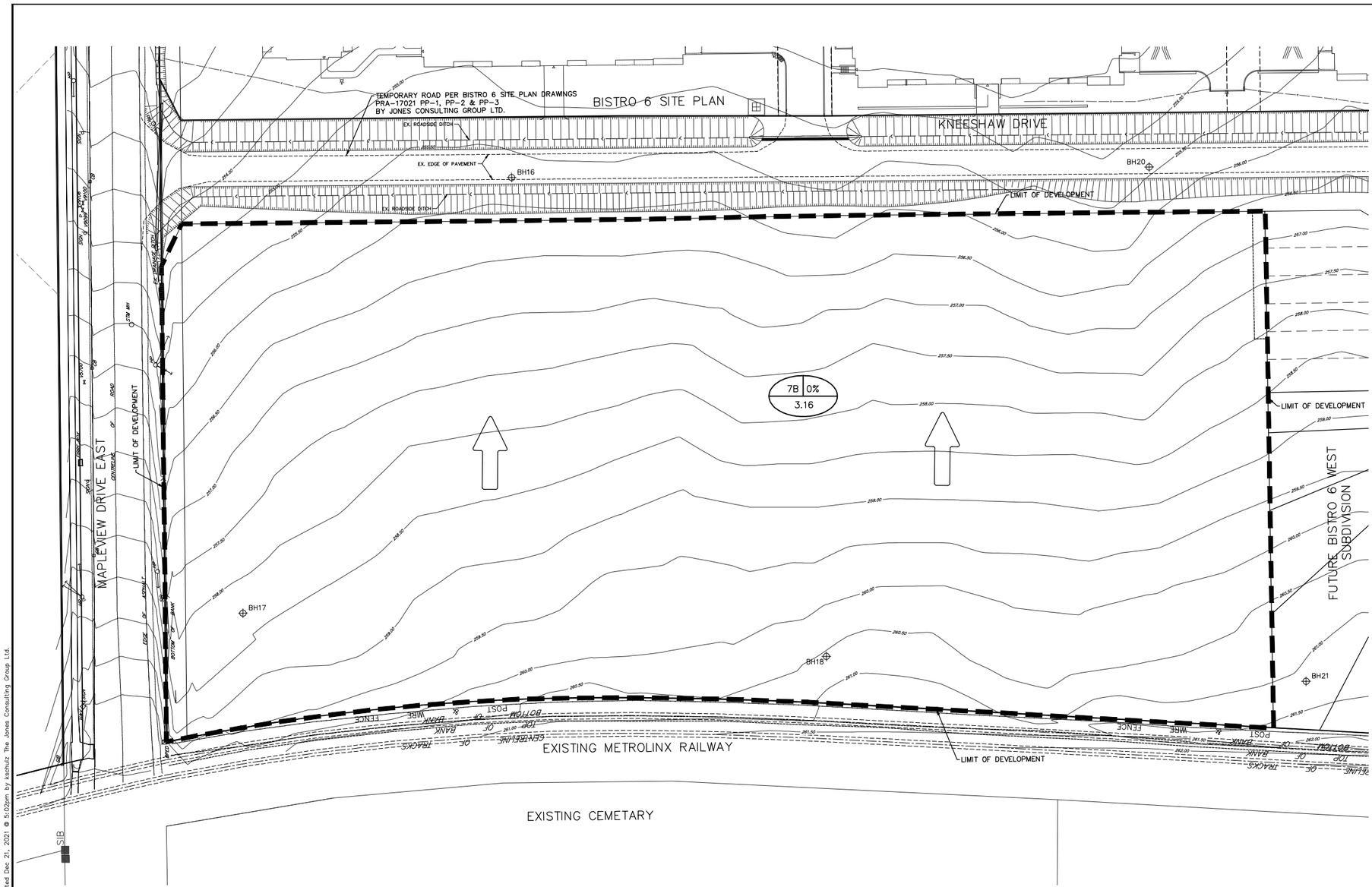

LEGEND

- STORM CATCHMENT AREA
- BH21 — EX. BORE HOLE
- OVERLAND FLOW DIRECTION
- CATCHMENT AREA ID NUMBER — 7a
- IMPERVIOUS % — 70%
- AREA IN HECTARES (ha) — 6.81

BENCHMARK:

BENCHMARK NO: 0101985454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.961

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02m WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
12-22-2021
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STORMWATER MANAGEMENT PLAN
PRE-DEVELOPMENT CONDITIONS

JONES CONSULTING GROUP LTD.
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DESIGN MF	SCALE: 1:500	DATE FEB. 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № SWM-1	
CHECKED DR			

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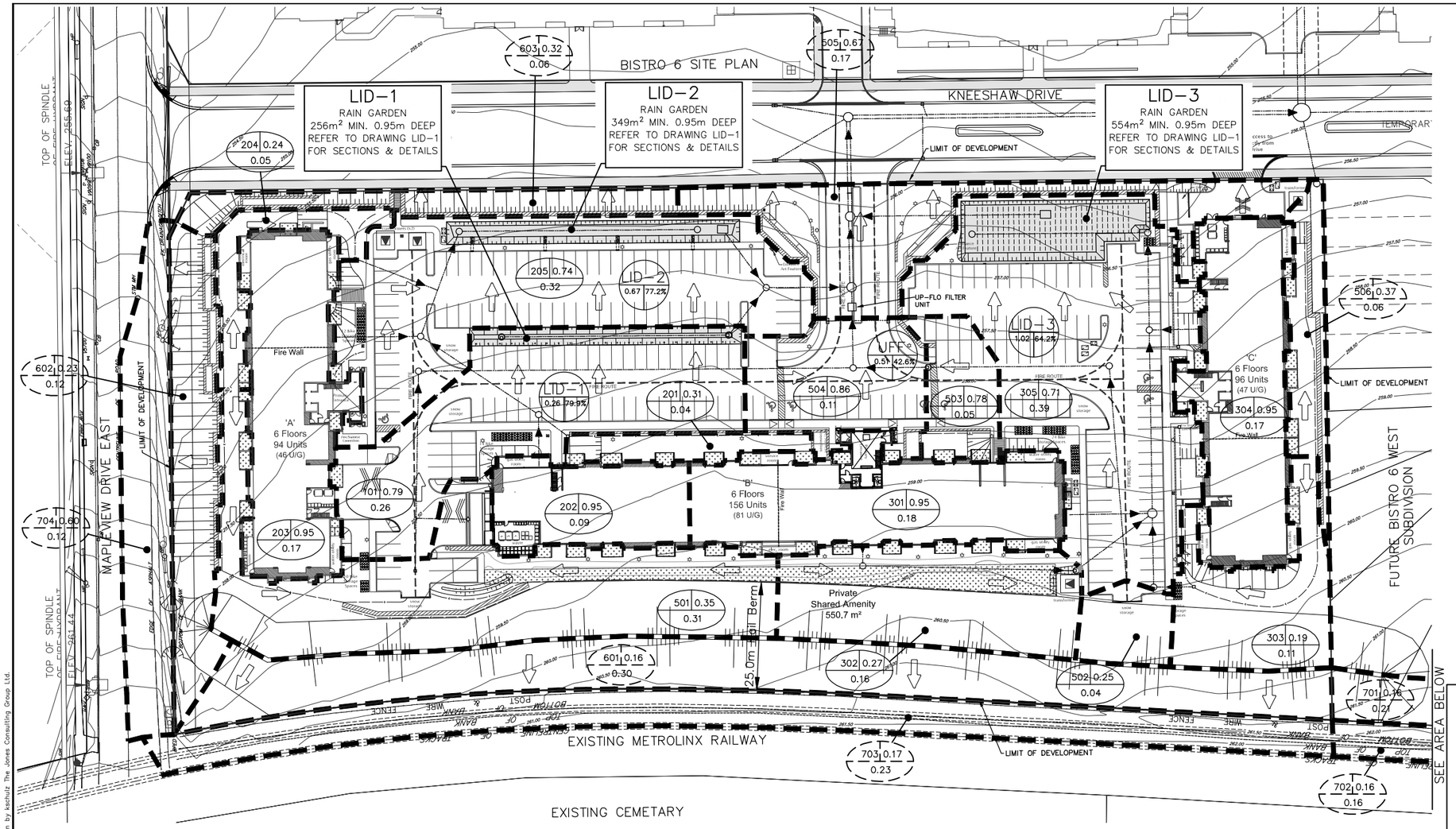
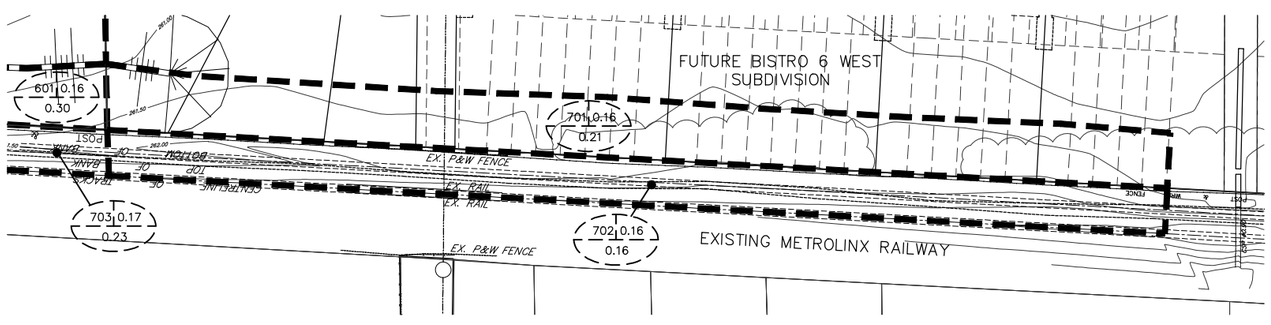




LEGEND

- PROPOSED 100 YR STORM SEWER, FLOW DIRECTION AND MAINTENANCE HOLE
- PROPOSED INTERNAL LOCAL STORM SEWER, FLOW DIRECTION AND MAINTENANCE HOLE
- CB — PROPOSED CATCH BASIN
- DCB — PROPOSED DOUBLE CATCH BASIN
- PROPOSED LID FOOTPRINT
- PROPOSED SWALE/DITCH
- STORM SUB-CATCHMENT AREA
- PROPOSED OVERLAND DRAINAGE FLOW DIRECTION
- INTERNAL CATCHMENT AREA NUMBER — 401 | 0.15 — RUNOFF COEFFICIENT; 0.27 — AREA (ha)
- EXTERNAL CATCHMENT AREA NUMBER — 502 | 0.32 — RUNOFF COEFFICIENT; 0.07 — AREA (ha)
- LID-1 — LID ID#; AREA (ha) 0.26 | 79.9% — IMPERVIOUS PERCENTAGE

CATCHMENT AREA ID NUMBERING SYSTEM		
AREA ID	RECEIVING LID OR OUTLET	LID TYPE
100'S	LID-1	RAIN GARDEN
200'S	LID-2	RAIN GARDEN
300'S	LID-3	RAIN GARDEN
500'S	SWMF7 MAIN CELL	NO LID
600'S	UNCONTROLLED INTERNAL	NO LID
700'S	UNCONTROLLED EXTERNAL	NO LID

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65M EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.505

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE KING STREET AND HURONIA ROAD INTERSECTION N4909870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

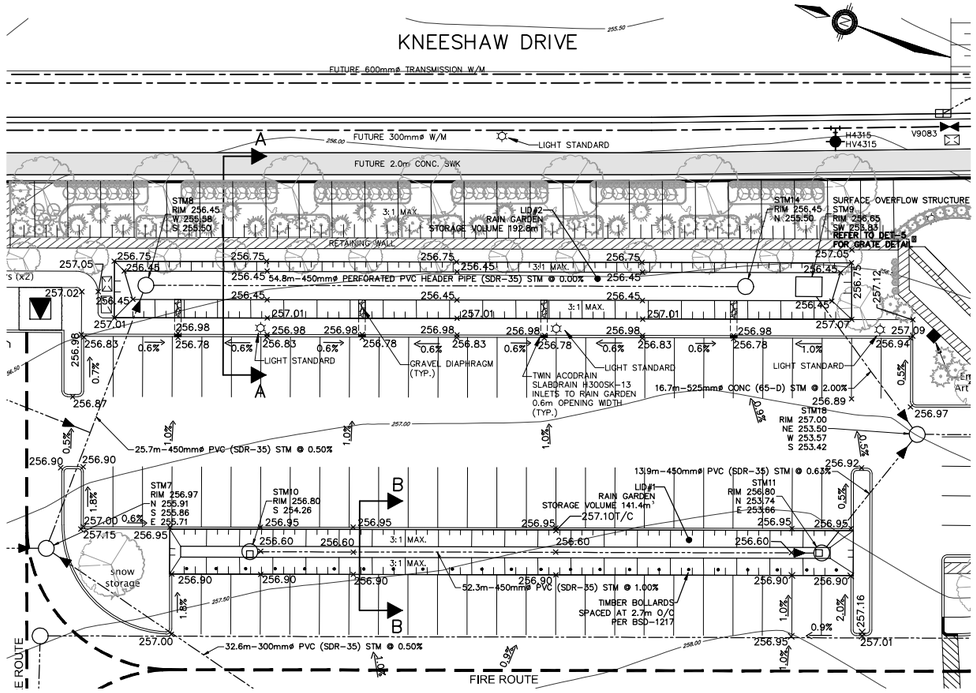
PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STORMWATER MANAGEMENT PLAN
POST-DEVELOPMENT CONDITIONS
LID MODEL CATCHMENT AREAS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W8
P. 705.734.2538
F. 705.734.1056

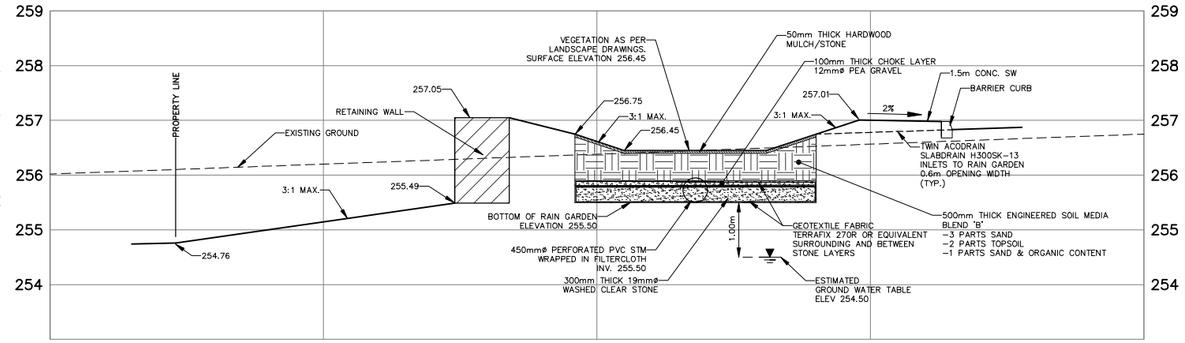
DESIGN MF	SCALE: 1:500	DATE FEB. 2021
DRAWN KS	PROJECT PRA-19078	DWG. Nº SWM-2
CHECKED DR		

G:\Eng_3D\PRA-19078\Production DWGS\PRA-19078-SWM-2.dwg Layout:SWM-2 Plotted Dec 22, 2021 @ 11:25am by kschulz The Jones Consulting Group Ltd.



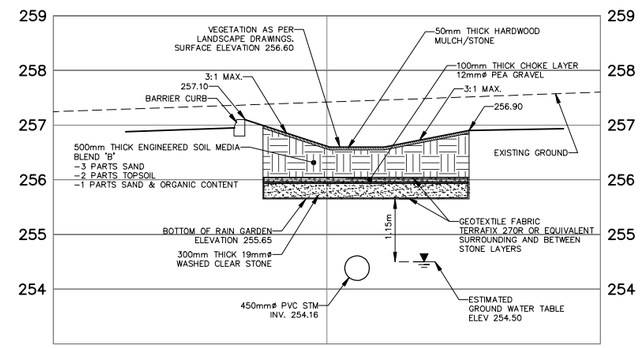
LID#1 & LID#2 RAIN GARDENS PLAN VIEW

1:250



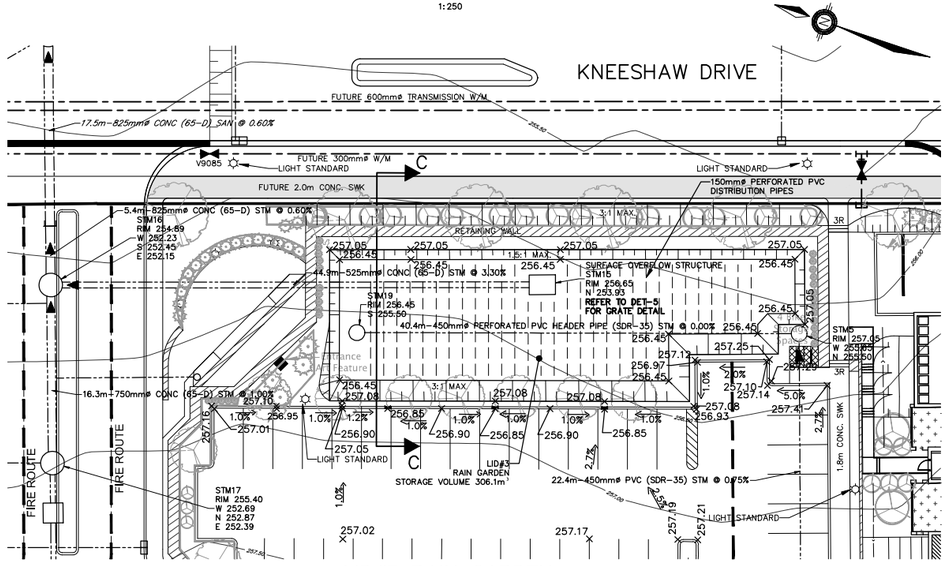
SECTION A–A

1:50



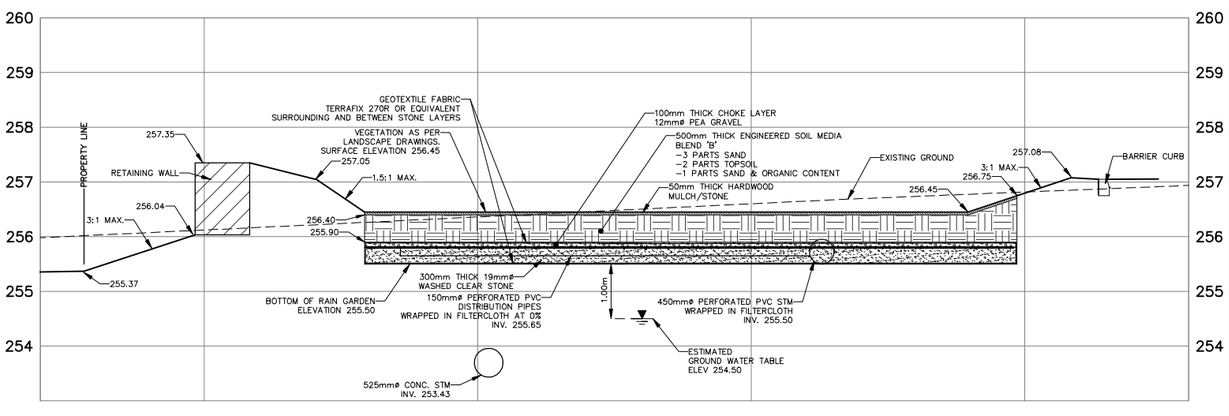
SECTION B–B

1:50



LID#3 RAIN GARDEN PLAN VIEW

1:250



SECTION C–C

1:50

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19CM TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE, FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910876.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4909870.237 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

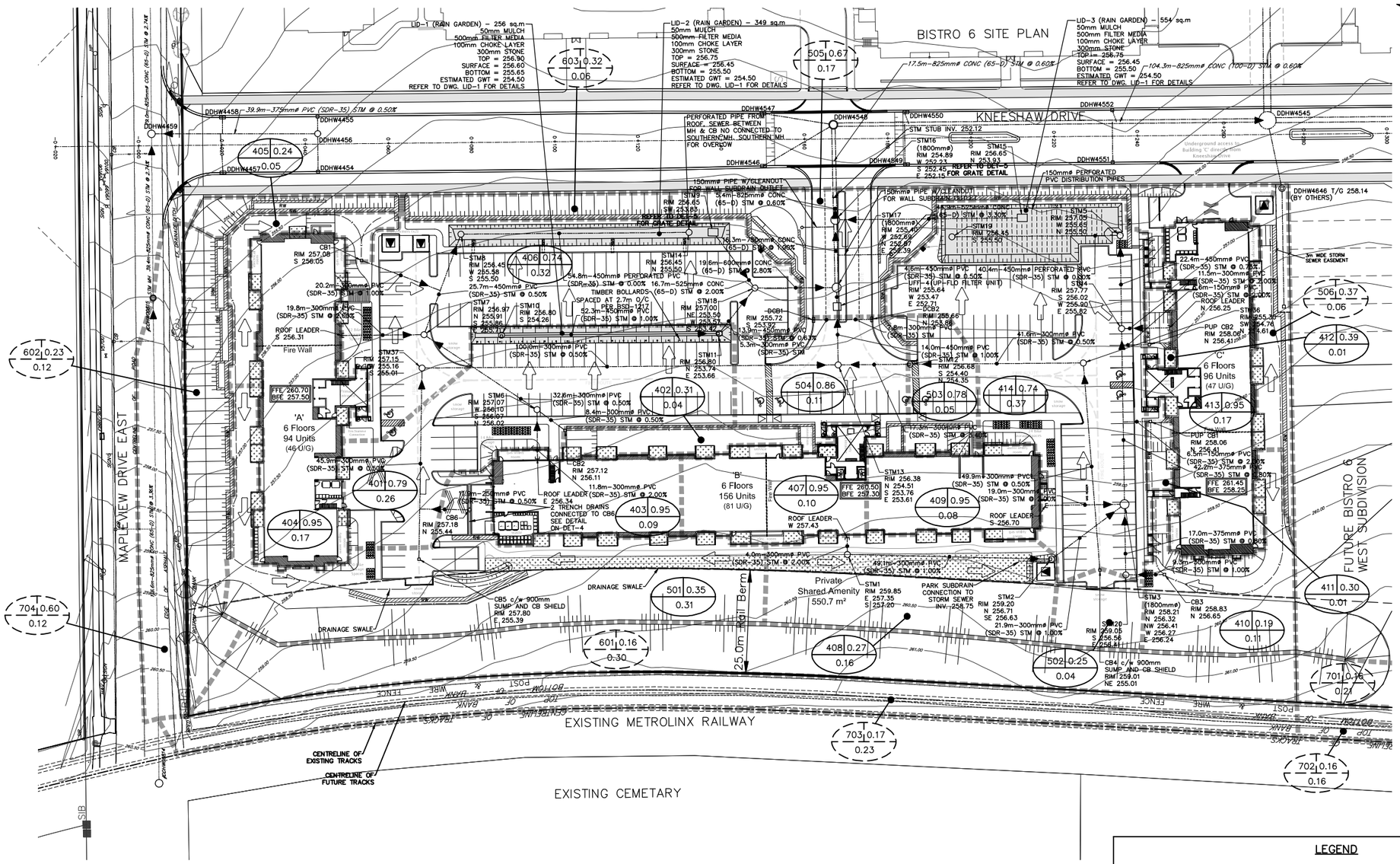
PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

RAIN GARDENS
LID SECTIONS & DETAILS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: AS NOTED	DATE FEB. 2021	
DRAWN KS	PROJECT PRA-19078	DWG. Nº LID-1	
CHECKED DR			

G:\Eng_30\PRA-19078\Production DWGS\PRA-19078-LID.dwg Layout:LID-1 Plotted Dec 21, 2021 @ 4:36pm by kschulz The Jones Consulting Group Ltd.



REFER TO DESIGN SHEET ON DRAWING SS-2

LEGEND

- PROPOSED STORM DRAINAGE BOUNDARY
- PROPOSED OVERLAND DRAINAGE FLOW DIRECTION
- INTERNAL CATCHMENT AREA NUMBER — 401 | 0.15 / 0.27 — RUNOFF COEFFICIENT / AREA (ha)
- EXTERNAL CATCHMENT AREA NUMBER — 502 | 0.32 / 0.07 — RUNOFF COEFFICIENT / AREA (ha)
- STM1 — PROPOSED STORM MAINTENANCE HOLE
- STM12 — PROPOSED CATCHBASIN MAINTENANCE HOLE
- DCB1 — PROPOSED DOUBLE CATCHBASIN
- CB2 — PROPOSED CATCHBASIN
- PROPOSED STORM SEWER INSULATION PER DETAIL ON DWG. DET-1

BENCHMARK:

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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STORM DRAINAGE PLAN

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № STM-1	
CHECKED DR			

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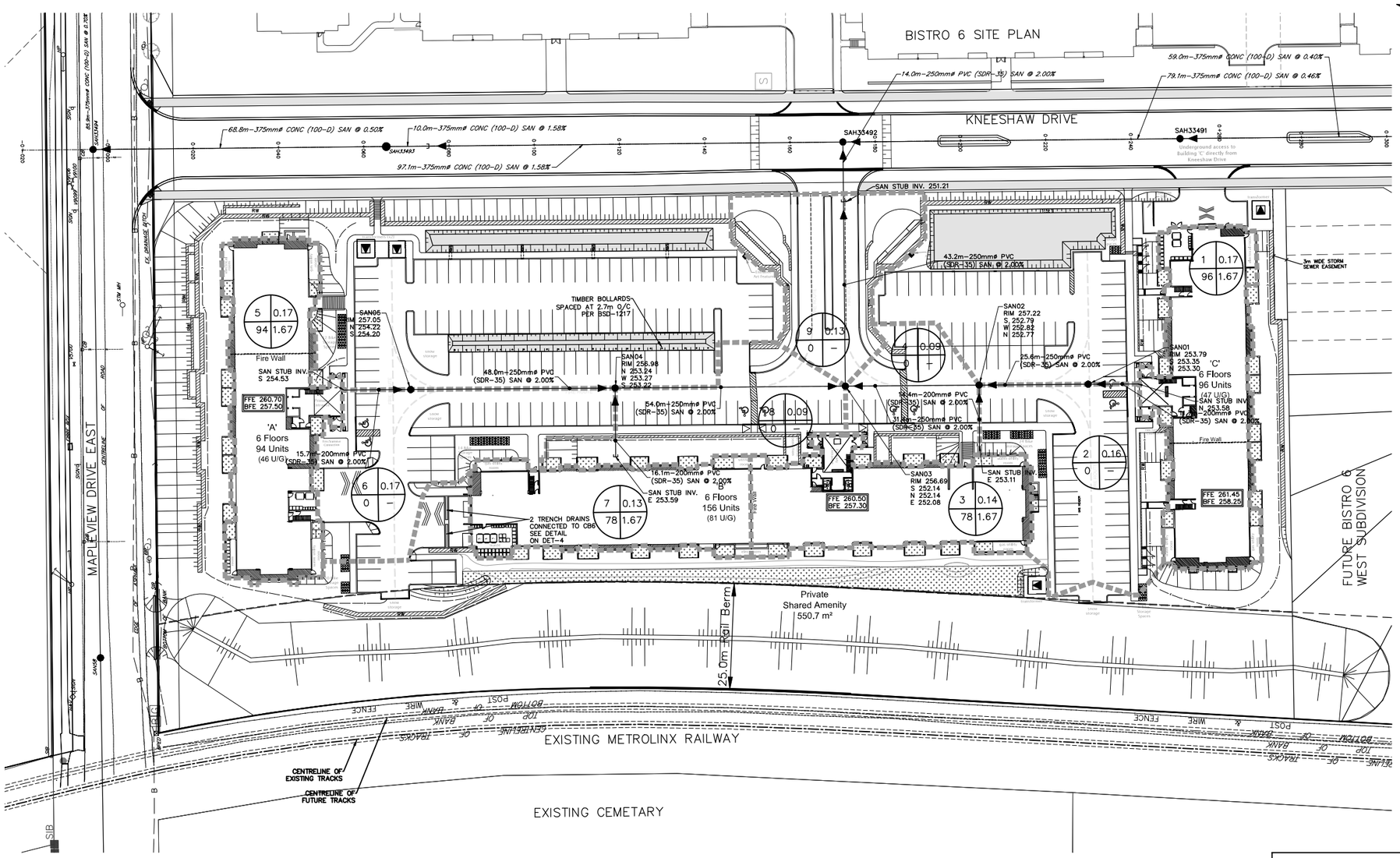

LEGEND

PROPOSED SANITARY DRAINAGE BOUNDARY

PROPOSED SANITARY DRAINAGE DIRECTION

SANITARY CATCHMENT AREA ID No. — 201 — AREA (ha) 0.32

NO. OF UNITS — 2 — PERSONS PER UNIT 3.13

SAN01 PROPOSED SANITARY MAINTENANCE HOLE

REFER TO DESIGN SHEET ON DRAWING SS-2

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BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N491610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N491087.122 E607601.062 ELEV 248.996

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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

SANITARY DRAINAGE PLAN

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № SAN-1	
CHECKED DR			

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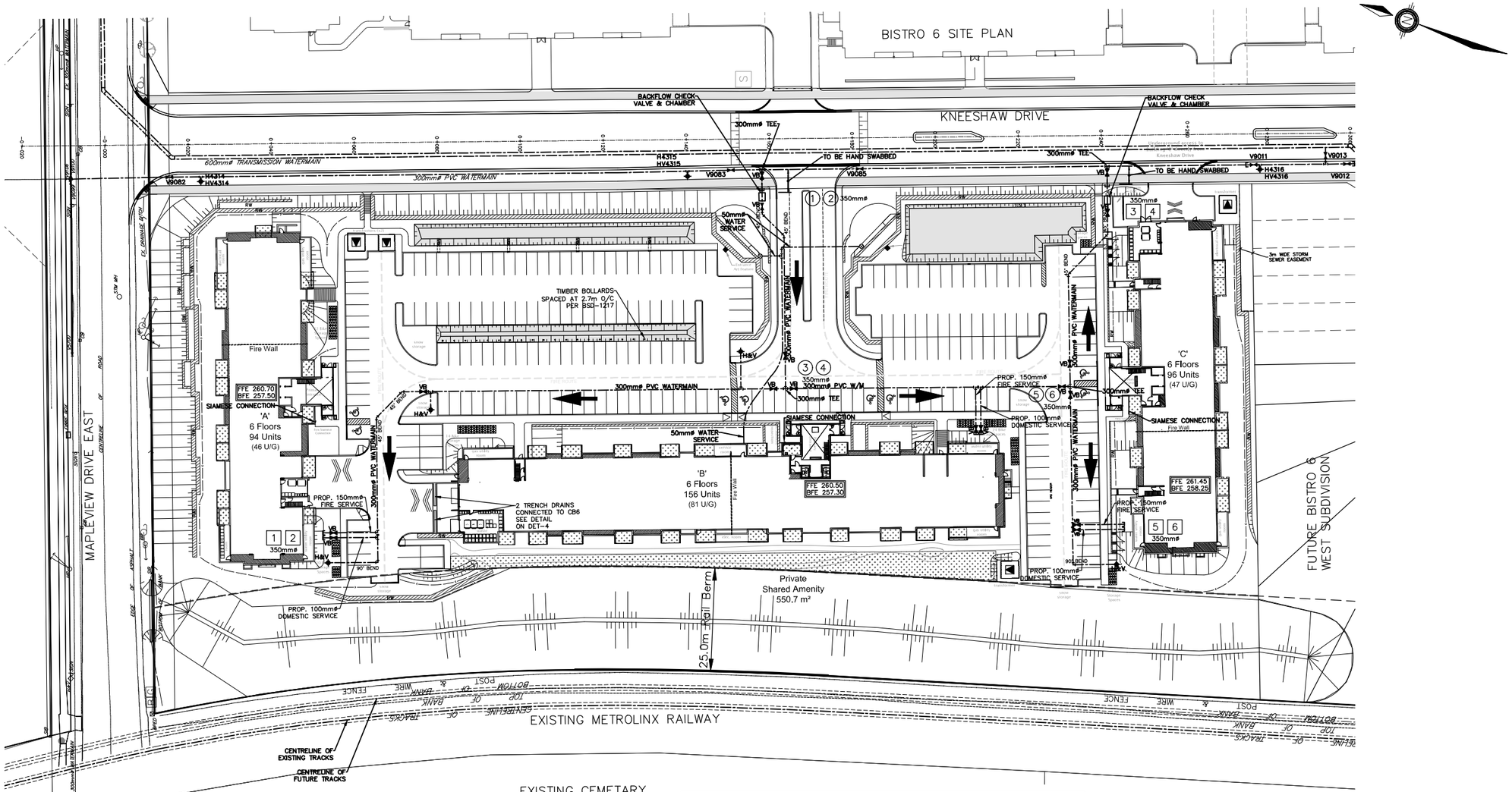

WATERMAIN TESTING AND DISINFECTION NOTES

1. THE FOLLOWING SEQUENCE WILL BE UTILIZED IN THE COMMISSIONING OF THE WATER SYSTEM: SWAB AND CHARGE THE WATERMAIN, PRESSURE TEST, CHLORINATE, FLUSHING AND SAMPLING.
2. ALL PROCEDURES ARE TO BE COMPLETED THROUGH A BYPASS CONNECTION TO THE EXISTING WATERMAIN, c/w BACKFLOW PREVENTION VALVE.
3. THE VALVES ARE TO BE OPERATED BY CITY REPRESENTATIVES ONLY.
4. THE FINAL CONNECTION TO THE EXISTING SYSTEM WILL NOT BE PERMITTED UNTIL ALL COMPONENTS OF THE TESTING AND DISINFECTION PROCEDURE HAVE BEEN COMPLETED TO THE SATISFACTION OF THE CITY.
5. HYDROSTATIC TESTING SHALL BE PERFORMED ON THE COMPLETED DISTRIBUTION SYSTEM IN SECTIONS NOT EXCEEDING 500 METRES IN LENGTH IN ACCORDANCE WITH AWWA C600. FOR POLYETHYLENE PIPE THE TESTING SHALL BE COMPLETED IN ACCORDANCE WITH OPSS 701. TESTING OF SECTIONS THAT CONSIST OF VARYING PIPE MATERIALS WILL NOT BE PERMITTED. ALL SECONDARY MAIN VALVES MUST BE OPEN DURING TESTING WITH THE EXCEPTION OF THOSE BEING USED TO DIVIDE THE SYSTEM INTO SECTIONS FOR THE PURPOSE OF TESTING.
6. THE SYSTEM SHALL BE DISINFECTED USING THE "CONTINUOUS FEED" METHOD IN ACCORDANCE WITH AWWA C651. FOLLOWING THE REQUIRED 24 HOUR CONTACT TIME, THE SYSTEM IS TO BE FLUSHED. THE CHLORINATED WATER MUST BE NEUTRALIZED USING AN APPROPRIATE CHEMICAL SUCH AS SODIUM THIOSULPHATE. THE DISCHARGED WATER WILL DRAIN TO THE ON-SITE STORM SEWER.
7. SAMPLES FOR BACTERIOLOGICAL TESTING SHALL BE COLLECTED BY THE CITY A MINIMUM OF 24 HOURS AFTER FLUSHING IS COMPLETED IN ACCORDANCE WITH AWWA C651. SAMPLES SHALL BE COLLECTED FROM EVERY 350 METRES OF NEW WATERMAIN PLUS ONE SAMPLE FROM THE END OF EACH OF THE LINES AND AT LEAST ONE SAMPLE FROM EACH BRANCH (OPSS 441.07.25). FOLLOWING THE RECEIPT OF TWO CONSECUTIVE SETS OF ACCEPTABLE TEST RESULTS THE CITY WILL PROVIDE WRITTEN NOTIFICATION THAT A FINAL CONNECTION CAN BE MADE TO THE EXISTING DISTRIBUTION SYSTEM.
8. A CONTINUITY TEST OF THE TRACER WIRE SHALL BE COMPLETED WITH POINT TO POINT READINGS RECORDED AND APPROVED BY THE CITY.
9. THE FINAL CONNECTION SHALL NOT BE MADE UNTIL ALL OF THE ABOVE TESTING REQUIREMENTS HAVE BEEN SATISFACTORILY COMPLETED AND THE CITY HAS PROVIDED WRITTEN NOTIFICATION TO PROCEED. THE LENGTH OF PIPE REQUIRED TO CONNECT THE NEW WATER SYSTEM TO THE EXISTING DISTRIBUTION SYSTEM SHALL NOT EXCEED 5.5 METRES AND SHALL BE DISINFECTED PRIOR TO INSTALLATION IN ACCORDANCE WITH AWWA C651.

NOTE

1. DOMESTIC AND FIRE SERVICE VALVES SHALL BE LOCATED IN THE BOULEVARD, UNLESS OTHERWISE NOTED.
2. DOMESTIC AND FIRE SERVICES SHALL BE MECHANICALLY RESTRAINED FROM THE TEE TO THE BUILDINGS.
3. DOMESTIC AND FIRE SERVICE RISERS ENTERING EACH BUILDING SHALL BE INSTALLED AS PER BSD-505.
4. DOMESTIC AND FIRE SERVICE TO BE HAND SWABBED OR A SWAB IS TO BE PLACED IN SERVICE AND REMOVED FROM RISERS.
5. THE 100mm DOMESTIC WATER SERVICE WILL REQUIRE A 100mm WATER METER (SUPPLIED AND INSTALLED BY THE OWNER) COMPLETE WITH A BYPASS ASSEMBLY AS PER BSD-533 AND SHALL BE LOCATED IN AN APPROPRIATELY SIZED MECHANICAL ROOM.
6. BACKFLOW PREVENTION SHALL BE PROVIDED ON ALL DOMESTIC AND FIRE SERVICES AS PER CITY OF BARRIE BYLAW 2017-121.
7. 50mm WATER SERVICES TO THE SITE PLAN ENTRANCE FEATURES WILL REQUIRE 50mm WATER METERS.

LEGEND

HAV	PROPOSED HYDRANT
VB	PROPOSED VALVE BOX
⊗	PROPOSED CURB STOP
(1) 350mmø	SWAB NUMBER, INSERTION LOCATION & SIZE
[1] 350mmø	SWAB NUMBER, REMOVAL LOCATION & SIZE
←	SWAB TRAVEL DIRECTION

BENCHMARK:

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BENCHMARK NO: 03120033029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL - 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

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LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
12-22-2021
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

WATERMAIN SWABBING PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № WM-1	
CHECKED DR			

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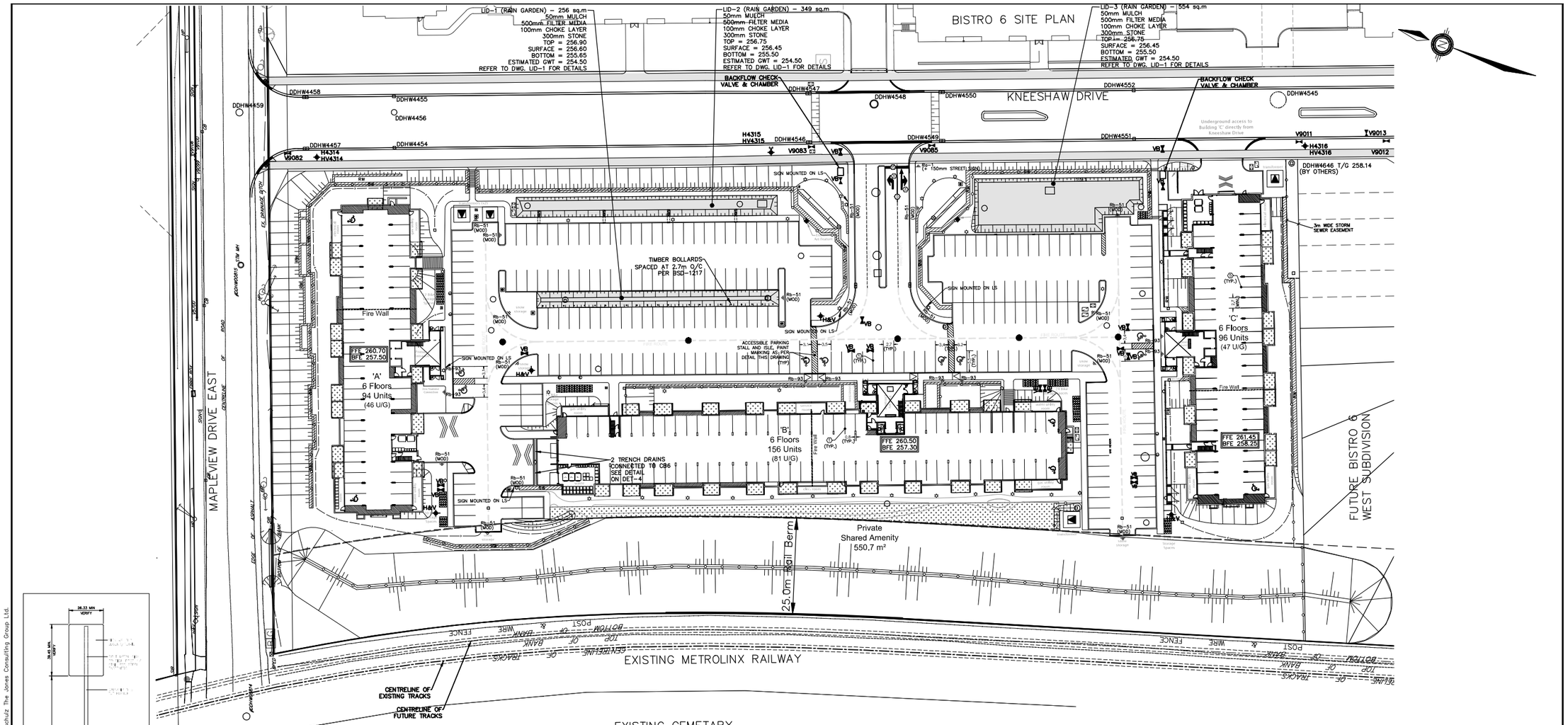
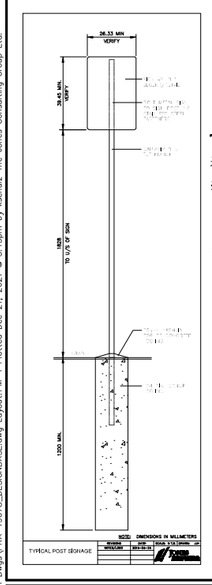
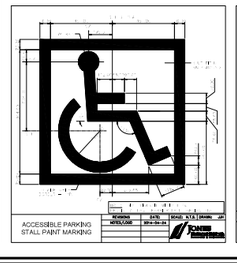
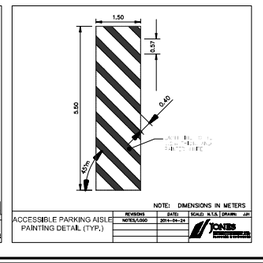




TYPICAL POST SIGNAGE



ACCESSIBLE PARKING STALL PAINT MARKING



ACCESSIBLE PARKING AISLE PAINTING DETAIL (TYP.)

REFER TO THE ONTARIO TRAFFIC MANUAL FOR ALL SIGNAGE AND PAVEMENT MARKINGS DETAILS UNLESS NOTED OTHERWISE

STOP SIGN Ra-1

NO PARKING – FIRE ROUTE MODIFIED Rb-51

DISABLED PARKING BY PERMIT ONLY RB-93

PAVEMENT MARKINGS LEGEND

1	SOLID YELLOW, 10cm
2	SOLID DOUBLE YELLOW, 10cm
3	36.3 BROKEN YELLOW, 10cm
4	SOLID YELLOW, 20cm
5	SOLID WHITE, 10cm
6	33.3 BROKEN WHITE, 10cm
7	36.3 BROKEN WHITE, 10cm
8	39.X BROKEN WHITE, 10cm
9	SOLID WHITE, 20cm
10	111 BROKEN WHITE, 10cm
11	33.3 BROKEN WHITE, 20cm
12	33.3 BROKEN WHITE, 30cm
13	SOLID WHITE, 30 cm
14	SOLID WHITE, 45 cm
15	SOLID WHITE, 60cm
20	SYMBOLS
[ ]	LIMITS OF MARKING

A	BROKEN WHITE, 40cmx40cm
B	BROKEN WHITE, 250cmx60cm

NOTES:

1. 333, 363, 393, DENOTES PAVEMENT MARKING SPACING (ie., 3m LINE, 3m GAP, 3m LINE)
2. USE (1) TO DENOTE PAVEMENT MARKING
3. USE [1] TO DENOTE PAVEMENT MARKING, TEMPORARY
4. USE (1) TO DENOTE PAVEMENT MARKING, TEMPORARY-REMOVABLE
5. USE (1) TO DENOTE PAVEMENT MARKING, DURABLE

NOTE:

1. ALL PAVEMENT MARKINGS AND TRAFFIC SIGNS SHALL CONFORM TO THE ONTARIO TRAFFIC MANUAL.
2. PAVEMENT MARKINGS FOR PARKING STALLS SHALL BE PAINTED WHITE AND CONFORM TO OPSS 1712.
3. PAINT COLOR SPECIFIED ON DRAWING, PAINT TO BE QUICK DRYING WATER BASED LATEX PAINT (WITHOUT GLASS BEADS)

LEGEND

- CURB DROP
- CATCH BASIN
- DOUBLE CATCH BASIN
- STORM MAINTENANCE HOLE
- CATCH BASIN MAINTENANCE HOLE
- DOUBLE CATCH BASIN MAINTENANCE HOLE
- SANITARY MAINTENANCE HOLE
- 3:1 MAXIMUM GRADING SLOPE UNLESS OTHERWISE NOTED
- Rb-93 PROPOSED SIGN & DESIGNATION
- PROPOSED HYDRANT
- PROPOSED VALVE
- PROPOSED CURB STOP
- PROPOSED LIGHT STANDARD
- PROPOSED BELL PEDESTAL/HANDHOLES
- PROPOSED BELL DUCT
- PROPOSED BELL VAULT
- PROPOSED ROGERS VAULT
- PROPOSED HYDRO TRANSFORMER
- PROPOSED EV CHARGER STATION

BENCHMARK:

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NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

PAVEMENT MARKING AND SIGNAGE PLAN

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2580
F. 705.734.1058

DESIGN MF	SCALE: 1:500	DATE JANUARY 2021	
DRAWN KS	PROJECT PRA-19078	DWG. № PM-1	
CHECKED DR			

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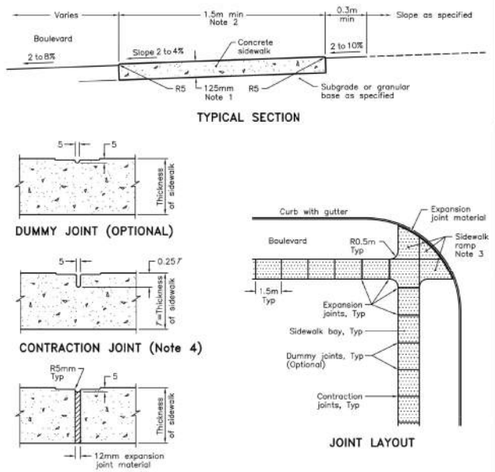
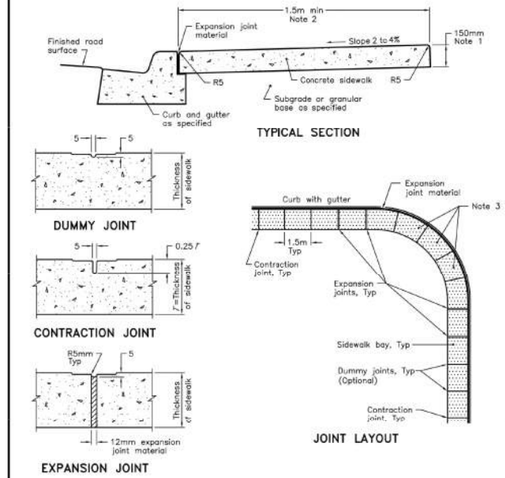


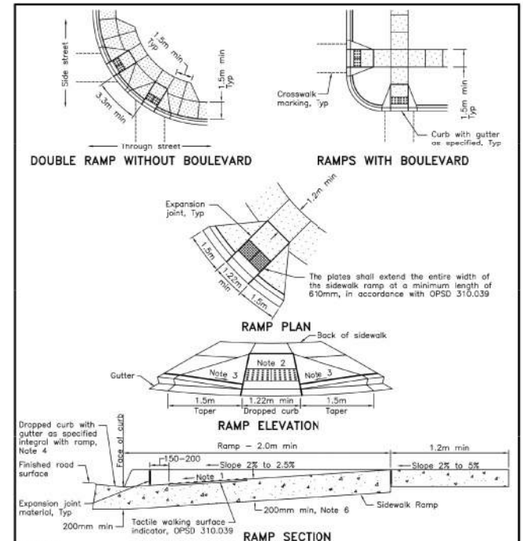
NOTES:
1 Sidewalk thickness at residential driveways and adjacent to curb shall be 150mm. At commercial and industrial driveways, the thickness shall be 200mm.
2 Sidewalk width shall be wider when specified.
3 This OPSD shall be read in conjunction with OPSD 310.030, 310.031, 310.033, and 310.039.
4 Contraction Joint may be tooled or sawcut.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 3
CONCRETE SIDEWALK		OPSD 310.010



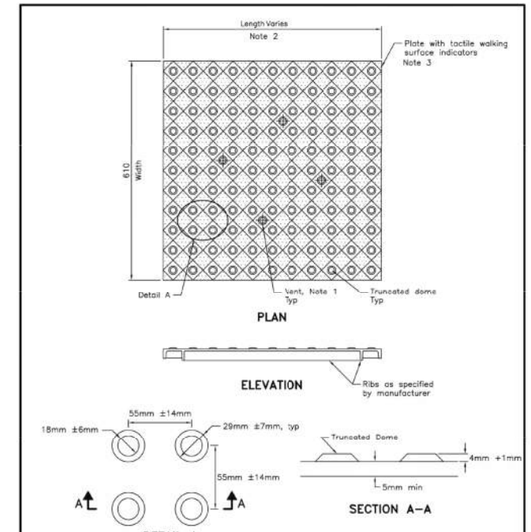
NOTES:
1 At commercial and industrial driveways, the thickness shall be 200mm.
2 Sidewalk width shall be wider when specified.
3 This OPSD shall be read in conjunction with OPSD 310.030, 310.031, 310.033, and 310.039.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 3
CONCRETE SIDEWALK ADJACENT TO CURB WITH GUTTER		OPSD 310.020



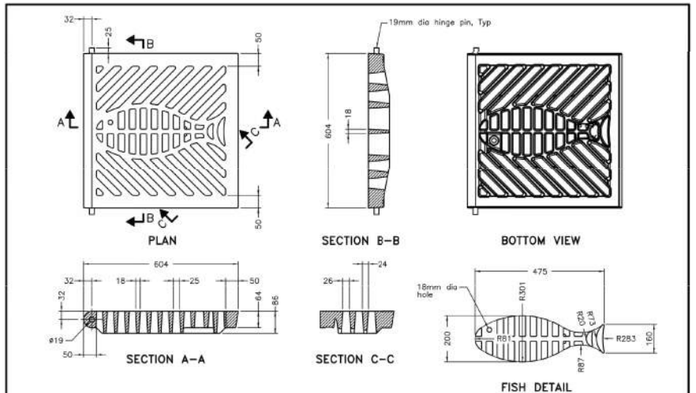
NOTES:
1 Slope of ramp shall not exceed 8%.
2 Cross slope of ramp shall not exceed 2% in either direction.
3 Cross slope of flared side of ramps shall not exceed 8%.
4 Dropped curb at ramp shall be modified to eliminate 30 mm step at gutter line.
5 Minimum thickness of ramp is 200mm. Minimum thickness of sidewalk and flared sides adjacent to ramp is 150mm.
A All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 1
CONCRETE SIDEWALK RAMPS AT UNSIGNALIZED INTERSECTIONS		OPSD 310.033



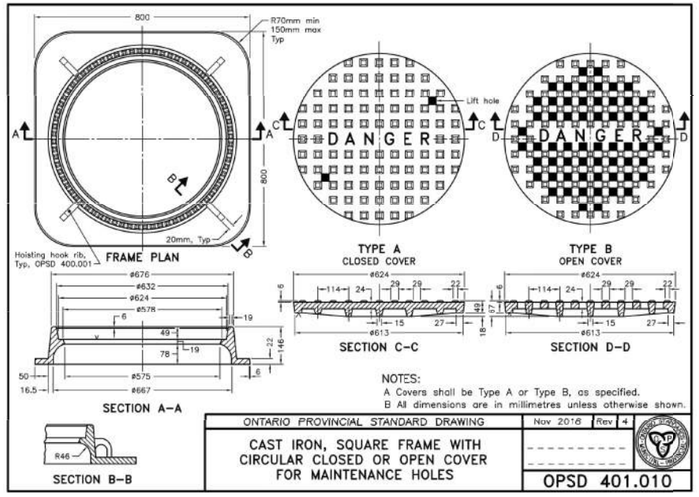
NOTES:
1 Vents shall be as specified by the manufacturer.
2 Length of plate may be increased to suit the curb depression width.
3 Material of plate shall be as specified in Contract Documents.
A Adjacent cast iron plates shall be permanently connected using a locking mechanism and any hardware shall be hot dipped galvanized.
B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 1
CONCRETE SIDEWALK RAMPS TACTILE WALKING SURFACE INDICATORS COMPONENT		OPSD 310.039



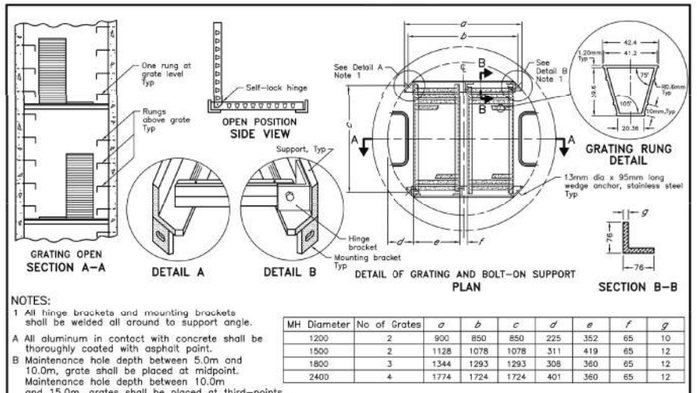
NOTE:
A This OPSD shall be read in conjunction with OPSD 400.020.
B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 0
CAST IRON, SQUARE FRAME FISH TYPE COVER		OPSD 400.050



NOTES:
A Covers shall be Type A or Type B, as specified.
B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4
CAST IRON, SQUARE FRAME WITH CIRCULAR CLOSED OR OPEN COVER FOR MAINTENANCE HOLES		OPSD 401.010



NOTES:
1 All hinge brackets and mounting brackets shall be welded all around to support angle.
A All aluminum in contact with concrete shall be thoroughly coated with asphalt paint.
B Maintenance hole depth between 5.0m and 10.0m, grate shall be placed at midpoint. Maintenance hole depth between 10.0m and 15.0m, grates shall be placed at third–points.
C All fasteners shall be 304 stainless steel.
D All welding shall be according to CSA W47.2 and W59.2.
E All aluminum components shall be 6000 series structural aluminum.
F All dimensions are in millimetres unless otherwise shown.

MH Diameter	No of Grates	a	b	c	d	e	f	g
1200	2	900	850	850	225	352	65	10
1500	2	1128	1078	1078	311	419	65	12
1800	3	1344	1293	1293	308	360	65	12
2400	4	1774	1724	1724	401	360	65	12

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2018	Rev 4
ALUMINUM SAFETY PLATFORM FOR CIRCULAR MAINTENANCE HOLES		OPSD 404.020

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BENCHMARK:

BENCHMARK NO: 01019855454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.659M EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19cm TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE. 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21–12–20	MF
2	2ND DETAILED DESIGN SUBMISSION	21–09–03	MF
1	1ST DETAILED DESIGN SUBMISSION	21–02–12	MF

LICENSED PROFESSIONAL ENGINEER
M. G. FLIS
100149153
12-22-2021
PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STANDARD DETAILS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
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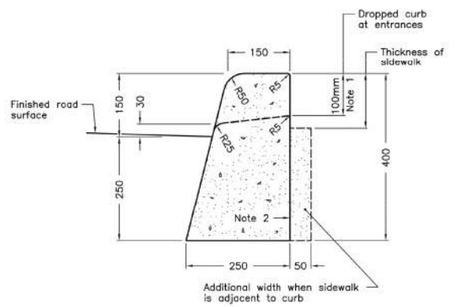
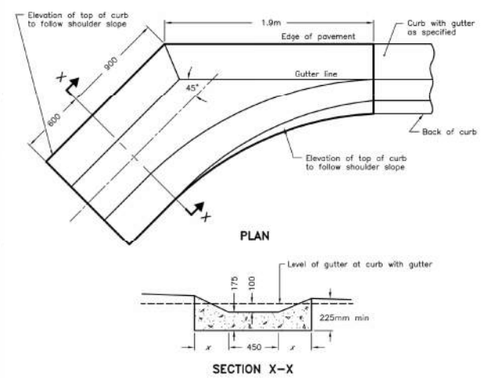
DESIGN MF	SCALE: N/A	DATE JANUARY 2021
DRAWN KS	PROJECT PRA–19078	DWG. Nº DET–1
CHECKED DR		



NOTES:
1 When sidewalk is continuously adjacent, the dropped curb at entrances shall be reduced to 75mm.
2 For slipforming procedure a 5% batter is acceptable.
A Treatment at entrances shall be according to OPSD 351.010.
B Outlet treatment shall be according to the OPSD 610 Series.
C The transition from one curb type to another shall be a minimum length of 3.0m, except in conjunction with guide rail where it shall be according to the OPSD 900 Series.
D All dimensions are in millimetres unless otherwise shown.

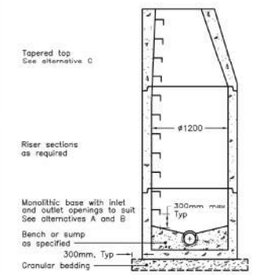
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2012	Rev 2
CONCRETE BARRIER CURB		OPSD 600.110

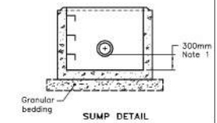


CURB with GUTTER Type	x
Barrier	200
Semi–Mountable	300
Mountable	400

NOTES:
A All dimensions are in millimetres unless otherwise shown.

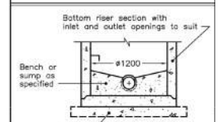
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2012	Rev 2
45° CONCRETE OUTLET FOR CONCRETE CURB WITH GUTTER AT END OF RUN		OPSD 605.030



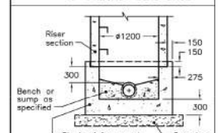


SUMP DETAIL

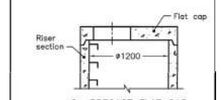
ALTERNATIVES



A PRECAST SLAB BASE



B CAST–IN–PLACE BASE

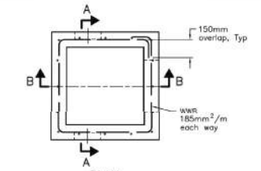


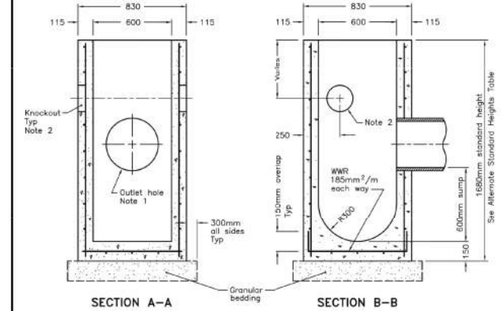
C PRECAST FLAT CAP

NOTES:
1 The sump is measured from the lowest invert.
A Granular backfill shall be placed to a minimum thickness of 300mm all around the maintenance hole.
B Precast concrete components shall be according to OPSD 701.030, 701.031, or 701.032.
C Structure exceeding 5.0m in depth shall include safety platform according to OPSD 404.020.
D Pipe support according to OPSD 708.020.
E For benching and pipe opening details, see OPSD 701.021.
F For adjustment unit and frame installation, see OPSD 704.010.
G All dimensions are nominal.
H All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 5
PRECAST CONCRETE MAINTENANCE HOLE 1200mm DIAMETER		OPSD 701.010

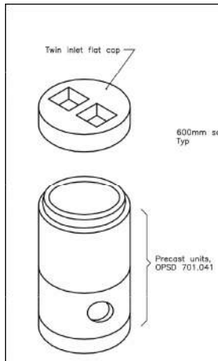
ALTERNATE STANDARD HEIGHTS	
ALTERNATIVE	DIMENSION
A	1980
B	1830
C	1520
D	1380



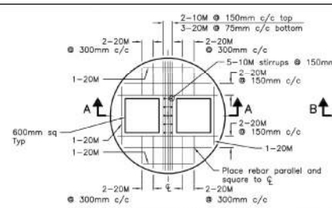


NOTES:
1 Outlet hole size 525mm diameter maximum, location as required.
2 200mm diameter knockout to accommodate subdrain. Knockout shall be 60mm deep.
A Centre reinforcing in base slab and walls ±20mm.
B Granular backfill shall be placed to a minimum thickness of 300mm all around the catch basin.
C Frame, grate, and adjustment units shall be installed according to OPSD 704.010.
D Pipe support shall be according to OPSD 708.020.
E All dimensions are nominal.
F All dimensions are in millimetres unless otherwise shown.

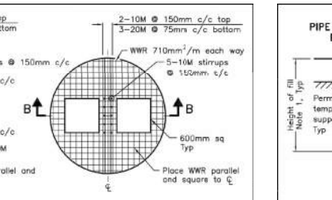
ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2019	Rev 4
PRECAST CONCRETE CATCH BASIN 600x600mm		OPSD 705.010



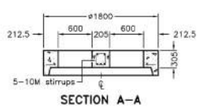
1500mm DIAMETER MAINTENANCE HOLE



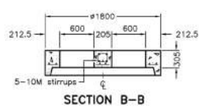
PLAN OF TWIN INLET FLAT CAP WITH REINFORCING STEEL BARS



PLAN OF TWIN INLET FLAT CAP WITH WWR



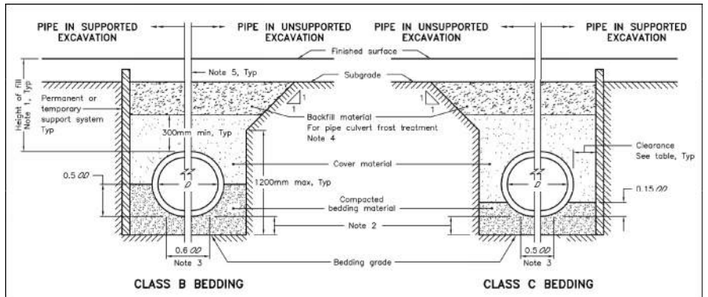
SECTION A–A



SECTION B–B

NOTES:
A All reinforcing steel shall have 25mm minimum cover.
B All dimensions are nominal.
C All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2014	Rev 2
PRECAST CONCRETE TWIN INLET FLAT CAP 1500mm DIAMETER		OPSD 703.021

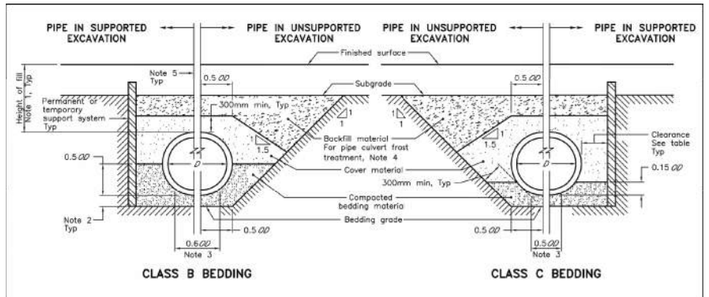


NOTES:
1 Height of fill is measured from the finished surface to top of pipe.
2 The minimum bedding depth below the pipe shall be 0.15D. In no case shall this dimension be less than 150mm or greater than 300mm.
3 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
4 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
5 Condition of excavation is symmetrical about centreline of pipe.
A Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
B All dimensions are in metres unless otherwise shown.

LEGEND:
D – Inside diameter
OD – Outside diameter

CLEARANCE TABLE	
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 3
RIGID PIPE BEDDING, COVER, AND BACKFILL TYPE 1 OR 2 SOIL – EARTH EXCAVATION		OPSD 802.030



NOTES:
1 Height of fill is measured from the finished surface to top of pipe.
2 The minimum bedding depth below the pipe shall be 0.15D. In no case shall this dimension be less than 150mm or greater than 300mm.
3 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
4 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
5 Condition of excavation is symmetrical about centreline of pipe.
A Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
B All dimensions are in metres unless otherwise shown.

LEGEND:
D – Inside diameter
OD – Outside diameter

CLEARANCE TABLE	
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING	Nov 2015	Rev 3
RIGID PIPE BEDDING, COVER, AND BACKFILL TYPE 3 SOIL – EARTH EXCAVATION		OPSD 802.031

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD, TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19cm TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.906

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900870.257 E608733.580 ELEV 252.807

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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STANDARD DETAILS

JONES CONSULTING GROUP LTD.
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DESIGN MF	SCALE: N/A	DATE JANUARY 2021
DRAWN KS	PROJECT PRA–19078	DWG. Nº DET–2
CHECKED DR		

G:\Eng_30\PRA-19078\Production DWGS\PRA-19078-Details.dwg Layout:DET-2 Plotted Dec 21, 2021 @ 5:08pm by kschulz The Jones Consulting Group Ltd.

High Security Fencing

The high security fence height above ground shall be 2.4 m.

The panel mesh shall consist of a minimum 4mm diameter high tensile wire, with aperture sizes (openings) 76.2mm x 12.7mm on centre or smaller fastened to suitable posts that allow for a minimum foundation depth of 1200 mm. The fence panels shall be strengthened with factory formed undulations within each mesh panel. Mechanical Fasteners shall be tamper proof and factory galvanized. Fastening hardware shall be concealed from the face of each panel and post. The mesh, posts, clamps and associated hardware are to be galvanized with an exterior finish coating capable of withstanding repeat climate variances within Southern Ontario.

1.1 High Security Fence

(a) When directed by Metrolinx the Contractor shall install high security fencing at ROW limits, at layover yards and at other locations instructed by Metrolinx. The manufacturer and product name of approved High Security fencing are listed below. Proposed equivalents recommended by the contractor will be subject to approval by Metrolinx prior to installation.

(i) Cochrane ClearVu

(ii) BETAFENCE- Securifor 3D

(iii) CLD- Securus Profiled

(iv) Bear Mountain – Bear Securi Mesh Barrier

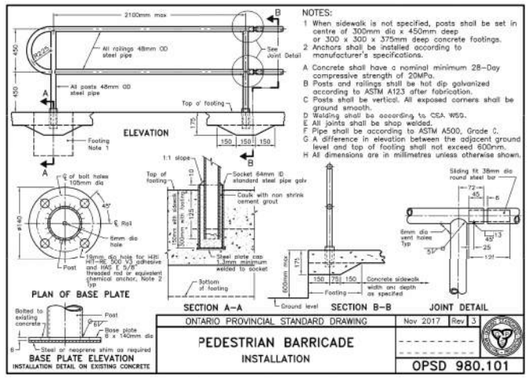
(b) The high security fence height above ground shall be 2.4 m.

(c) The panel mesh shall consist of a minimum 4mm diameter high tensile wire, with aperture sizes (openings) 76.2 x 12.7 mm centers or smaller fastened to suitable posts that allow for a minimum foundation depth of 1200 mm.

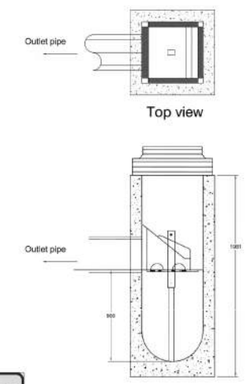
(d) The fence panels shall be strengthened with factory formed undulations within each mesh panel. Mechanical Fasteners – Shall be tamper proof and mechanically galvanized. Fastening Hardware shall be concealed from the non-rail side of each panel and post.

(e) Mesh to be galvanized with an exterior finish coating capable of withstanding typical climate variances within Southern Ontario.

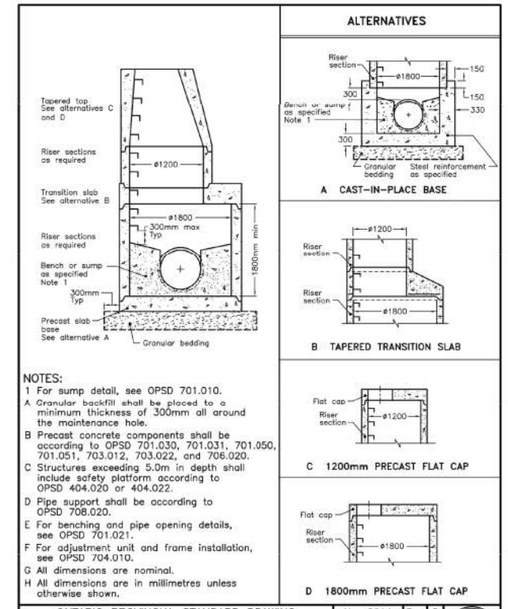
(f) Specification sheets and breach testing results for any proposed alternate products and materials shall be submitted to Metrolinx staff for approval.

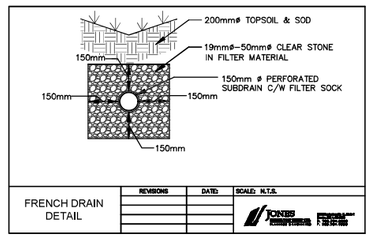


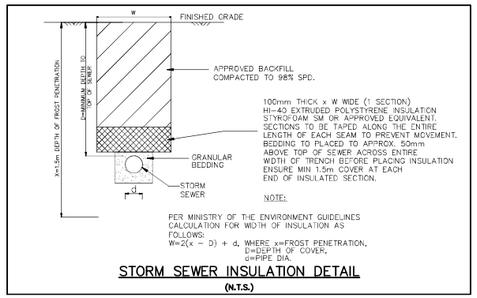
Notes
1. CB Shield can be installed at any time. In a non frozen condition.
2. The **frame and cover MUST BE well aligned** with the catchbasin for proper installation.
3. The catchbasin sump must be clean before installation
4. The grate should be at the same level as the standing water in the sump.

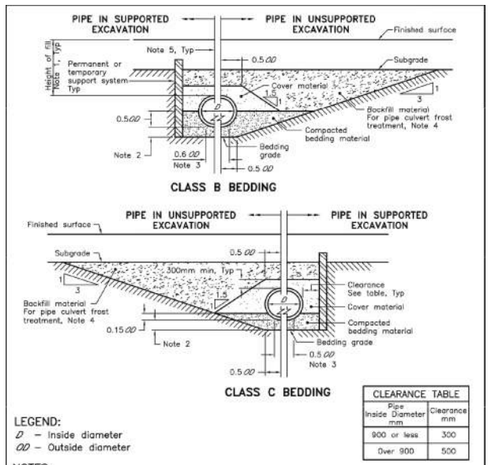


CB Shield (900mm Sump)







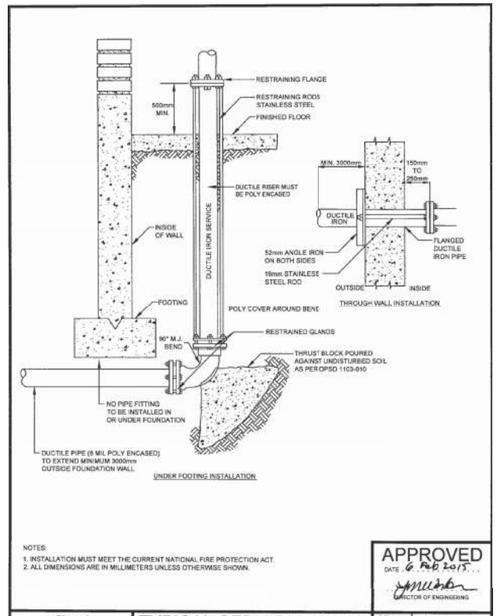


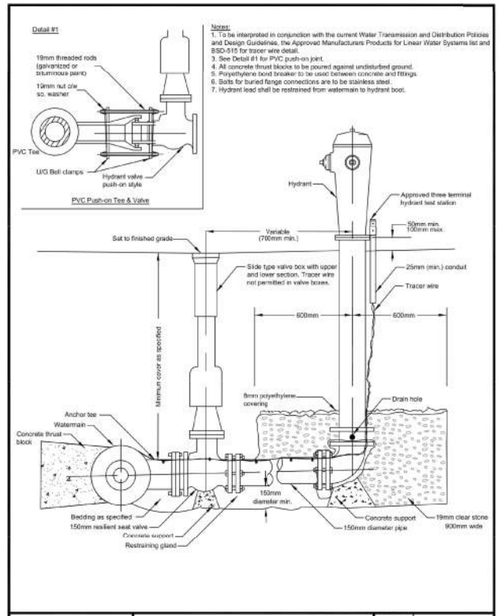
CLEARANCE TABLE	
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

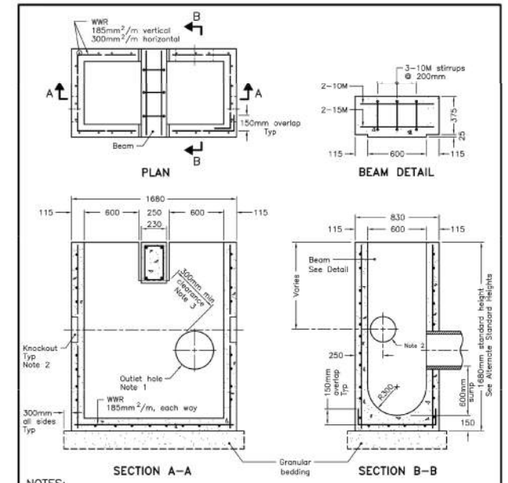
LEGEND:
⌀ – Inside diameter
⌀⌀ – Outside diameter

NOTES:
1 Height of fill is measured from the finished surface to top of pipe.
2 The minimum bedding depth below the pipe shall be 0.15⌀. In no case shall this dimension be less than 150mm or greater than 300mm.
3 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
4 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
5 Condition of excavation is symmetrical about centreline of pipe.
A Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
B All dimensions are in metres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2015 | Rev 3
RIGID PIPE BEDDING, COVER, AND BACKFILL
TYPE 4 SOIL – EARTH EXCAVATION
OPSD 802.032







ALTERNATE STANDARD HEIGHTS	
ALTERNATIVE	DIMENSION
A	1950
B	1830
C	1680

BENCHMARK:

BENCHMARK NO: 01019805454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19cm TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.996

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02dm WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900987O.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21–12–20	MF
2	2ND DETAILED DESIGN SUBMISSION	21–09–03	MF
1	1ST DETAILED DESIGN SUBMISSION	21–02–12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

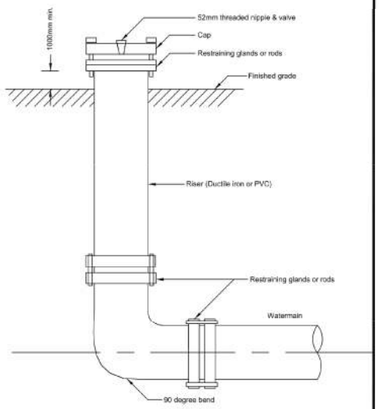
PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STANDARD DETAILS

JONES CONSULTING GROUP LTD. PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1056

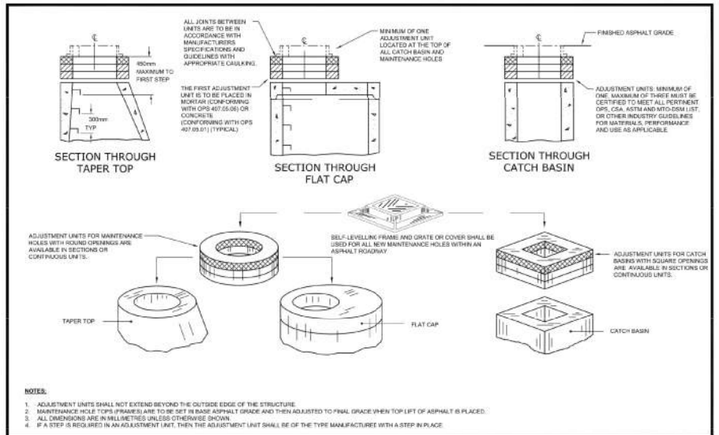
DESIGN MF	SCALE: N/A	DATE JANUARY 2021
DRAWN KS	PROJECT PRA–19078	DWG. № DET–3
CHECKED DR		

G:\Eng_30\PRA-19078\Production DWGS\PRA-19078-Details.dwg Layout:DET-3 Plotted Dec 21, 2021 @ 5:08pm by kschulz The Jones Consulting Group Ltd.



NOTES:
1. All dimensions are in millimeters unless otherwise shown.
2. Restraining glands or rods to be used for restraint.

Barrie	Temporary Riser Installation	REV No 2	DATE: May 2019
			SCALE: N.T.S.
		BSD-510	



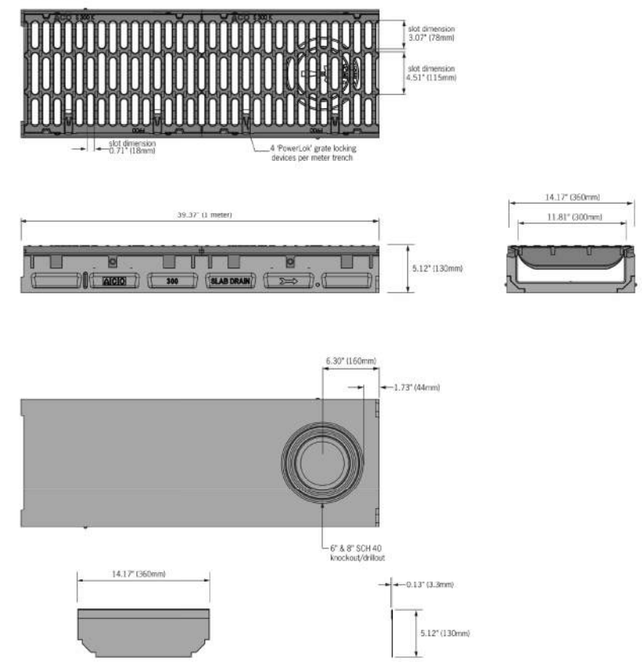
NOTES:
1. ADJUSTMENT UNITS SHALL NOT EXTEND BEYOND THE OUTSIDE EDGE OF THE STRUCTURE.
2. MAINTENANCE HOLE TOPS (FRAMES) ARE TO BE SET IN BASE ASPHALT GRADE AND THEN ADJUSTED TO FINAL GRADE WHEN TOP LIFT OF ASPHALT IS PLACED.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.
4. IF A STEP IS REQUIRED IN AN ADJUSTMENT UNIT, THEN THE ADJUSTMENT UNIT SHALL BE OF THE TYPE MANUFACTURED WITH A STEP IN PLACE.

Barrie STANDARD DETAIL	MAINTENANCE HOLE AND CATCH BASIN ADJUSTMENT UNITS	REV No. 3	DATE: Nov 2019
			SCALE: N.T.S.
		BSD-41	

ACO DRAIN

SlabDrain - H300SK-13 iron edged channel system with slotted grate

H300SK-13



Outlet flow rates

Product	Outlet size (Sch. 40)	Invert Depth	GPM	CFS
H300SK-13 channel	6" round	4.00	243	0.54
H300SK-13 channel	8" round	4.00	432	0.96

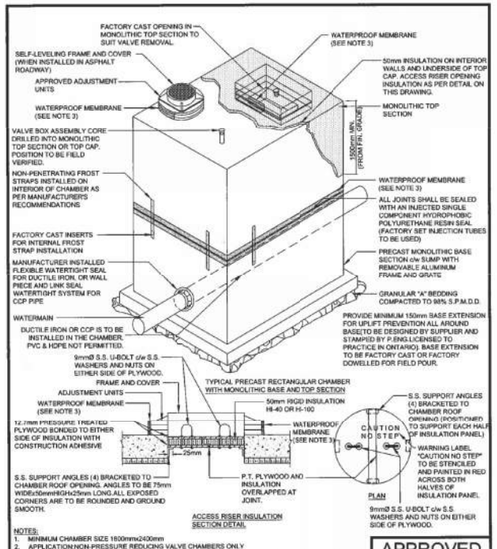
Note: These are the pipe flow rates at the specified outlet, **NOT** channel flow rates.

Apr 13/1

www.ACODrain.us

ACO

ACO Specification Information

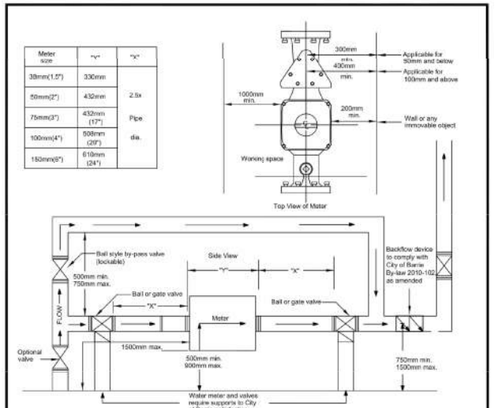


NOTES:
1. MINIMUM CHAMBER SIZE 1600mm x 2400mm
2. APPLICATION:NON-PRESSURE REDUCING VALVE CHAMBERS ONLY
3. WATERPROOF MEMBRANE TO EXTEND COMPLETELY AROUND RISER SECTION JOINTS WITH A MINIMUM OF 300mm WIDE STRAP.
4. ALL INSULATION TO BE RIGID TYPE EXTRUDED POLYSTRENE FOAM DOW HI-40 OR HI-100. ALL CHAMBER INSULATIONS TO BE INSTALLED WITH CONSTRUCTION ADHESIVE AND TAPCON ANCHORS AT MAX. 600mm SPACING IN ALL DIRECTIONS (MIN. 2 ANCHORS PER SHEET OF INSULATION).
5. SUMP c/w GRATE TO BE LOCATED AT THE BOTTOM OF THE ACCESS LADDER. SUMP SHALL NOT EXTEND THROUGH THE BOTTOM OF BASE.

APPROVED
DATE OCT 2017
DIRECTOR OF ENGINEERING

Barrie STANDARD DETAIL	TYPICAL TWO PIECE PRECAST RECTANGULAR CHAMBER DETAILS FOR WATERMAINS	REV No. 2	DATE: OCT 2017
			SCALE: N.T.S.
		BSD-525	

Meter size	"v"	"x"
38mm(1.5")	330mm	2.5x Pipe dia.
50mm(2")	432mm	
75mm(3")	432mm (17")	
100mm(4")	508mm (20")	
150mm(6")	610mm (24")	



* A key to the mechanical room to be supplied to the City of Barrie for meter reading and maintenance.

NOTES:
1. The diameter of the by-pass line shall match the diameter of the internal plumbing.
2. All materials to be supplied by the contractor except water meters. All meters larger than 50mm are to be supplied and installed by the contractor.
3. Butterfly valves or globe valves shall not be used.
4. All piping between water service entering the building and backflow device must be labeled 'No connection permitted'.
5. Backflow device must be installed within a maximum of 3 meters downstream of the water meter.
6. Meter wire, installed in conduit, to be run from meter location to outside of building at the direction of the Barrie Water Operations representative. Meter wire (22 gauge, 2 conductor, multiply, UV rated) supplied by the City of Barrie.
7. All dimension are in millimeters unless otherwise shown.
8. Contractor to provide flat secure (vertical) surface for the smart point to be mounted on.

Barrie	Typical Meter Installation for Domestic Services Requiring By-passes	REV No. 3	DATE: May 2019
			SCALE: N.T.S.
		BSD-533	

BENCHMARK:

BENCHMARK NO: 01019865454 LOCATED ON CONCRETE BRIDGE CARRYING MAPLEVIEW DRIVE E OVER LOVER'S CREEK, 0.65KM EAST OF HURONIA ROAD. TABLET IS SET HORIZONTALLY IN THE NORTH FACE, 5.45M NORTH OF CENTRELINE OF ROAD, 28CM WEST OF THE NORTHEAST END OF BRIDGE, 19cm TOP OF COPING. N4910788.889 E607264.100 ELEV 241.861

BENCHMARK NO: 03120030029 MAPLEVIEW HEIGHTS ELEMENTARY SCHOOL – 180 ESTHER DR. THE VERTICAL MONUMENT IS SET FLUSH IN CONCRETE FLAGPOLE BASE 4.7m SOUTH FROM THE SOUTHEAST CORNER OF THE MAIN ENTRANCE TO SCHOOL AND TABLET IS ON THE SOUTHSIDE OF THE FLAGPOLE BASE. N4911610 E607799 ELEV 250.508

BENCHMARK NO: 03120080054 LOCATED ON THE SOUTH LIMIT OF MAPLEVIEW DRIVE WEST APPROXIMATELY 1km EAST OF HURONIA ROAD. N4910878.122 E607601.062 ELEV 248.906

BENCHMARK NO: 03120110013 LOCATED ON LOCKHART ROAD ON THE NORTH SIDE OF THE BOULEVARD, APPROXIMATELY 1.02km WEST OF THE YONGE STREET AND HURONIA ROAD INTERSECTION N4900987O.257 E608733.580 ELEV 252.807

NO.	REVISIONS	DATE	INITIAL
3	3RD DETAILED DESIGN SUBMISSION	21-12-20	MF
2	2ND DETAILED DESIGN SUBMISSION	21-09-03	MF
1	1ST DETAILED DESIGN SUBMISSION	21-02-12	MF

LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STANDARD DETAILS

JONES CONSULTING GROUP LTD.
PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W5
P. 705.734.2538
F. 705.734.1056

DESIGN MF	SCALE: N/A	DATE JANUARY 2021
DRAWN KS	PROJECT PRA-19078	DWG. № DET-4
CHECKED DR		

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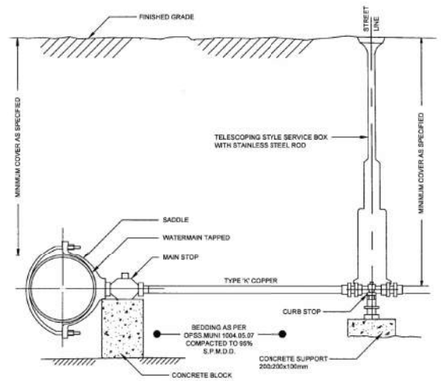


NOTES
1. ANY JUNCTION MADE IN SERVICE PIPE BETWEEN MAIN STOP AND CURB STOP TO BE MADE WITH APPROVED COUPLINGS. (FOR 50mm ONLY).
2. ALL WATER SERVICES TO BE INSTALLED AT RIGHT ANGLE TO THE WATERMAIN.
3. ALL TAPPINGS TO BE AT 3 OR 9 O'CLOCK POSITION ONLY.
4. 9/16mm (3/8") STAINLESS STEEL SERVICE BOX ROD.
5. SEE BSD-804 FOR 38mm AND 50mm NON-COPPER WATER SERVICES.
6. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SHOWN.

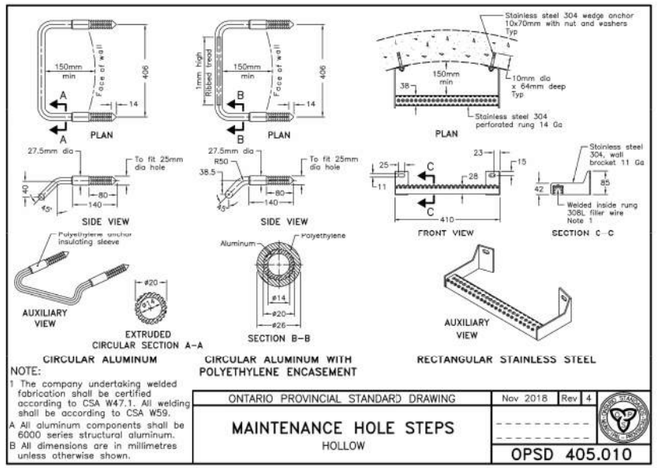
APPROVED
DATE 6 Feb 2015
DIRECTOR OF ENGINEERING

City of BARRIE
STANDARD DETAIL

COPPER WATER SERVICE CONNECTION DETAIL 38mm AND 50mm DIAMETER SIZES

REV No. 1 | DATE: FEB 2015 | SCALE: N.T.S.

BSD-503
(PREVIOUSLY BSD-49)

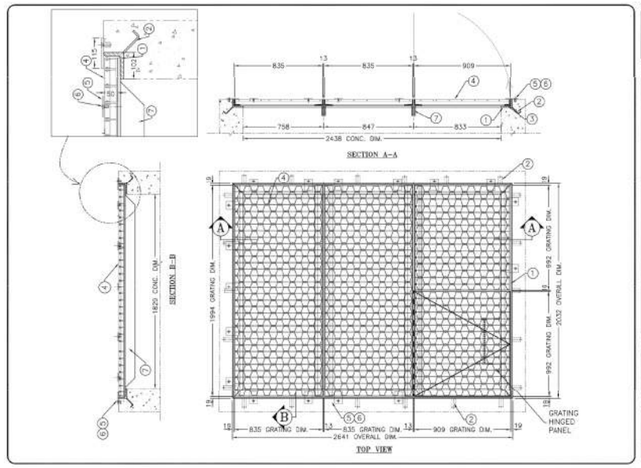


NOTE:
1 The company undertaking welded fabrication shall be certified according to CSA W47.1. All welding shall be according to CSA W59.
A All aluminum components shall be 6000 series structural aluminum.
B All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2018 | Rev 4

MAINTENANCE HOLE STEPS
HOLLOW

OPSD 405.010

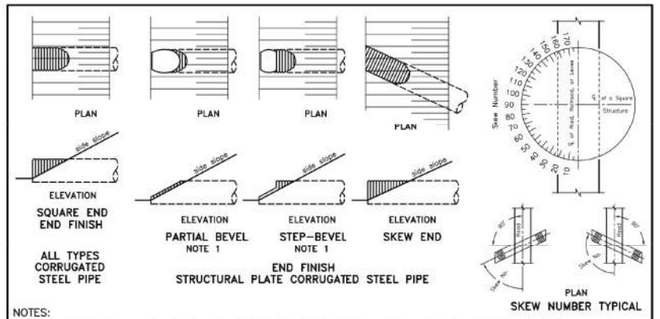


STEPCON
INDUSTRIES INC.
5384 Rodeo Rd., Unit 10-01
Mississauga, ONTARIO L4V 1T8
VOICE: (905) 897-0000
FAX: (905) 897-6801
Toll Free: 1-888-STEPCON

#	QTY.	MATERIAL	DESCRIPTION
1	1	GALV. STEEL (SAE 1045) G-2009	1524x1994 (60x78) WITH GRATING WELDED FRAME
2	24	GALV. STEEL (SAE 1045) G-2009	Ø 9x38mm (3x1.5") HD ANCHOR
3	2	GALV. STEEL (SAE 1045) G-2009	25.4x4x 38mm (1x1x1.5") WELDED UNDER FRAME
4	8	GALV. STEEL (SAE 1045) G-2009	38x4x1.5mm (1.5x1x.06") WELDED TO 3 x 40mm, 4 x 40mm (1.5" x 1.5") AND PERIMETER BARS 3 x 40mm (1.5") x 127mm (5") GRATING SUPPLIED IN SECTIONS, ONE OF THESE HINGED TYPE, AS SHOWN. ALL THE GRATING PANELS ARE SUPPORTED BY THE FRAME.
5	16	GALV. STEEL (SAE 1045) G-2009	4x1.5mm (1.5x1x.06") HINGE PLATE WELDED WITH WASHER
6	16	STAINLESS STEEL 304	#10 SS HEXHEAD SAW SCREW BOLT 4.76 DROP-IN ANCHOR
7	4	GALV. STEEL (SAE 1045) G-2009	152x76x4.5mm (6x3x1) GRATING SUPPORT ANGLES
8			
9			
10			

NOTES:
1) ALL STEEL MEMBERS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION.
2) WELDING SHALL CONFORM TO CSA W47.1 & CSA W59 LATEST EDITION
3) WELDED SURFACES REMAIN AS WELDED. 1/4" FILLET ALL AROUND.

DITCH INLET
GALVANIZED STEEL GRATING PANELS

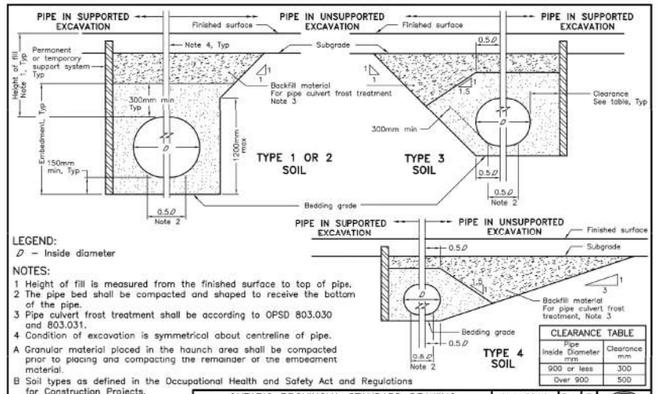


NOTES:
1 For a partial bevel or a step-bevel cut end finish, this OPSD shall be read in conjunction with OPSD 801.030.
A A skew end cut end finish shall not be combined with a partial bevel or a step-bevel cut end finish.
B Square end, partial bevel, or step-bevel cut end finish may be used on a culvert installed on a skew between skew numbers 60 and 120.
C A skew end cut end finish may be used on a culvert installed on a skew between skew numbers 50 and 130.
D Reinforcement of pipe ends or contour grading of embankment slope shall be as specified.
E Slope protection shall be as specified.
F All dimensions are in millimetres unless otherwise shown.

ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2017 | Rev 3

CUT END FINISH
CIRCULAR PIPE AND PIPE-ARCH
CORRUGATED STEEL PIPE

OPSD 801.010



LEGEND:
Ø – Inside diameter

NOTES:
1 Height of fill is measured from the finished surface to top of pipe.
2 The pipe bed shall be compacted and shaped to receive the bottom of the pipe.
3 Pipe culvert frost treatment shall be according to OPSD 803.030 and 803.031.
4 Condition of excavation is symmetrical about centreline of pipe.
A Granular material placed in the haunch area shall be compacted prior to placing and compacting the remainder of the embedment material.
B Soil types as defined in the Occupational Health and Safety Act and Regulations for Construction Projects.
C All dimensions are in metres unless otherwise shown.

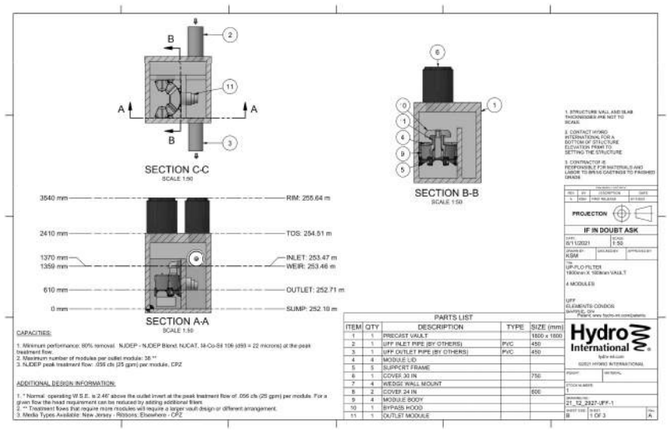
CLEARANCE TABLE

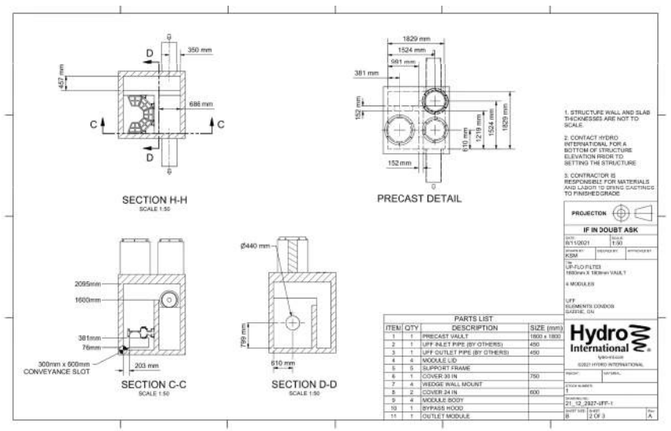
Pipe Inside Diameter mm	Clearance mm
900 or less	300
Over 900	500

ONTARIO PROVINCIAL STANDARD DRAWING | Nov 2014 | Rev 3

FLEXIBLE PIPE
EMBEDMENT AND BACKFILL
EARTH EXCAVATION

OPSD 802.010





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LICENSED PROFESSIONAL ENGINEER M. G. FLIS 100149153 12-22-2021 PROVINCE OF ONTARIO

PRATT HANSEN GROUP INC.
ELEMENTS SITE PLAN
CITY OF BARRIE

STANDARD DETAILS

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PLANNERS & ENGINEERS
229 Mapleview Dr. E, Unit 1
Barrie, ON L4N 0W6
P. 705.734.2538
F. 705.734.1056

DESIGN	MF	SCALE: N/A	DATE AUGUST 2021
DRAWN	KS	PROJECT PRA-19078	DWG. Nº DET-5
CHECKED	DR		

G:\Eng_30\PRA-19078\Production DWGS\PRA-19078-Details.dwg Layout:DET-5 Plotted Dec 21, 2021 @ 5:08pm by kschutz The Jones Consulting Group Ltd.

Appendix C

Supporting Calculations & Design Charts

- Detailed Land Use Breakdown – *Post-Dev-LID*
- Detailed Land Use Breakdown – *External*
- 100-Year Storm Sewer Design Sheet
- 5-Year Storm Sewer Design Sheet
- LID Facility Design Notes
- PCSWMM LID Performance Summary
- Low Impact Development Treatment Train Tool – Release Notes: Land Cover EMC's
- TSS & TP Mass Balance Calculations
- LID Facility Drawdown Time Calculations
- LID Facility Estimation of Provided Storage Volume
- External Metrolinx and Mapleview Drive East Capacity Calculations
- CB Shield ETV Performance Verification and Details
- ADS Up-Flo Filter (UFF-4) Sizing Summary
- Up-Flo Filter ETV Performance Verification
- Elements Condominium Plan Local Sanitary Sewer Design Sheet
- Bistro 6 West Subdivision Trunk Sanitary Sewer Design Sheet

Elements Condominium Plan
Detailed Land Use Breakdown

CLIENT: Pratt Hansen Group Inc.
PROJECT: Elements Condominium Plan
FILE: PRA-19078 (50)

DATE: December 2021
DESIGN: MG
CHECKED: MF

Post-Dev-LID Catchment Number	*STM Sewer* Catchment Number	Area (Ha)				Imperviousness			Runoff Coefficient			
		Landscape	Impervious (Roof)	Impervious (Parking, Sidewalk)	Total	TIMP (%)	XIMP (%)	SAR (%)	Landscape	Impervious (Roof)	Impervious (Parking, Sidewalk)	Weighted
101	401	0.0512	0.0019	0.2019	0.26	79.92%	79.18%	0.93%	0.16	0.95	0.95	0.79
LID-1 Total		0.0512	0.0019	0.2019	0.26	79.92%	79.18%	0.93%	0.16	0.95	0.95	0.79
201	402	0.0291	0.0068	0.0000	0.04	18.94%	0.00%	100.00%	0.16	0.95	0.95	0.31
202	403	0.0000	0.0898	0.0000	0.09	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
203	404	0.0000	0.1711	0.0000	0.17	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
204	405	0.0414	0.0044	0.0002	0.05	10.00%	0.43%	95.65%	0.16	0.95	0.95	0.24
205	406	0.0854	0.0029	0.2362	0.32	73.68%	72.79%	1.21%	0.16	0.95	0.95	0.74
LID-2 Total		0.1559	0.2750	0.2364	0.67	76.64%	35.43%	53.77%	0.16	0.95	0.95	0.77
301	407	0.0000	0.0999	0.0000	0.10	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
	409	0.0000	0.0836	0.0000	0.08	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
301 Sub-total		0.0000	0.1835	0.0000	0.18	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
302	408	0.1391	0.0056	0.0161	0.16	13.50%	10.01%	25.81%	0.16	0.95	0.95	0.27
303	410	0.1041	0.0037	0.0008	0.11	4.14%	0.74%	82.22%	0.16	0.95	0.95	0.19
304	413	0.0000	0.1687	0.0000	0.17	100.00%	0.00%	100.00%	0.16	0.95	0.95	0.95
305	411	0.0106	0.0014	0.0008	0.01	17.19%	6.25%	63.64%	0.16	0.95	0.95	0.30
	412	0.0086	0.0027	0.0008	0.01	28.93%	6.61%	77.14%	0.16	0.95	0.95	0.39
	414	0.0979	0.0014	0.2684	0.37	73.38%	72.99%	0.52%	0.16	0.95	0.95	0.74
305 Sub-total		0.1171	0.0055	0.2700	0.39	70.17%	68.77%	2.00%	0.16	0.95	0.95	0.71
LID-3 Total		0.3603	0.3670	0.2869	1.01	64.47%	28.29%	56.12%	0.16	0.95	0.95	0.67
501	501	0.2368	0.0115	0.0616	0.31	23.59%	19.88%	15.73%	0.16	0.95	0.95	0.35
502	502	0.0331	0.0000	0.0044	0.04	11.73%	11.73%	0.00%	0.16	0.95	0.95	0.25
503	503	0.0116	0.0028	0.0403	0.05	78.79%	73.67%	6.50%	0.16	0.95	0.95	0.78
504	504	0.0129	0.0012	0.0961	0.11	88.29%	87.21%	1.23%	0.16	0.95	0.95	0.86
505	505	0.0587	0.0011	0.1058	0.17	64.55%	63.89%	1.03%	0.16	0.95	0.95	0.67
506	506	0.0416	0.0074	0.0080	0.06	27.02%	14.04%	48.05%	0.16	0.95	0.95	0.37
Sub-total		0.3947	0.0240	0.3162	0.73	46.29%	43.03%	7.05%	0.16	0.95	0.95	0.53
601	601	0.3048	0.0000	0.0000	0.30	0.00%	0.00%	0.00%	0.16	0.95	0.95	0.16
602	602	0.1067	0.0000	0.0106	0.12	9.04%	9.04%	0.00%	0.16	0.95	0.95	0.23
603	603	0.0512	0.0000	0.0134	0.06	20.74%	20.74%	0.00%	0.16	0.95	0.95	0.32
Sub-total		0.4627	0.0000	0.0240	0.49	4.93%	4.93%	0.00%	0.16	0.95	0.95	0.20
Total		**1.4248**	**0.6679**	**1.0654**	**3.16**	**54.88%**	**33.74%**	**38.53%**	**0.16**	**0.95**	**0.95**	**0.59**

Up-Flo Filter Sizing												
501	501	0.2368	0.0115	0.0616	0.3099	23.59%	19.88%	15.73%	0.16	0.95	0.95	0.35
502	502	0.0331	0.0000	0.0044	0.0375	11.73%	11.73%	0.00%	0.16	0.95	0.95	0.25
503	503	0.0116	0.0028	0.0403	0.0547	78.79%	73.67%	6.50%	0.16	0.95	0.95	0.78
504	504	0.0129	0.0012	0.0961	0.1102	88.29%	87.21%	1.23%	0.16	0.95	0.95	0.86
Total		**0.2944**	**0.0155**	**0.2024**	**0.5123**	**42.53%**	**39.51%**	**7.11%**	**0.16**	**0.95**	**0.95**	**0.50**

Statistics for Table 7 - Servicing and Storm Water Management Report												
LID-1 Total		0.0512	0.0019	0.2019	0.2550	79.92%	79.18%	0.93%	0.16	0.95	0.95	0.79
LID-2 Total		0.1559	0.2750	0.2364	0.6673	76.64%	35.43%	53.77%	0.16	0.95	0.95	0.77
LID-3 Total		0.3603	0.3670	0.2869	1.0142	64.47%	28.29%	56.12%	0.16	0.95	0.95	0.67
501	501	0.2368	0.0115	0.0616	0.3099	23.59%	19.88%	15.73%	0.16	0.95	0.95	0.35
502	502	0.0331	0.0000	0.0044	0.0375	11.73%	11.73%	0.00%	0.16	0.95	0.95	0.25
503	503	0.0116	0.0028	0.0403	0.0547	78.79%	73.67%	6.50%	0.16	0.95	0.95	0.78
504	504	0.0129	0.0012	0.0961	0.1102	88.29%	87.21%	1.23%	0.16	0.95	0.95	0.86
505	505	0.0587	0.0011	0.1058	0.1656	64.55%	63.89%	1.03%	0.16	0.95	0.95	0.67
Total Treated		**0.9205**	**0.6605**	**1.0334**	**2.6144**	**64.79%**	**39.53%**	**38.99%**	**0.16**	**0.95**	**0.95**	**0.67**
506	506	0.0416	0.0074	0.0080	0.0570	27.02%	14.04%	48.05%	0.16	0.95	0.95	0.37
601 - 603 Sub-total		0.4627	0.0000	0.0240	0.4867	4.93%	4.93%	0.00%	0.16	0.95	0.95	0.20
Total Untreated		**0.5043**	**0.0074**	**0.0320**	**0.5437**	**7.25%**	**5.89%**	**18.78%**	**0.16**	**0.95**	**0.95**	**0.22**
Total		**1.4248**	**0.6679**	**1.0654**	**3.1581**	**54.88%**	**33.74%**	**38.53%**	**0.16**	**0.95**	**0.95**	**0.59**

Elements Condominium Plan
Detailed Land Use Breakdown - Metrolinx and Mapleview Drive East Ditch

CLIENT: Pratt Hansen Group Inc.
PROJECT: Elements Condominium Plan
FILE: PRA-19078 (50)

DATE: December 2021
DESIGN: MG
CHECKED: MF

External PCSWMM Catchment Number	*STM Sewer* Catchment Number	Area (Ha)				Imperviousness			Runoff Coefficient			
		Landscape	Impervious (Roof)	Impervious (Parking, Sidewalk)	Total	TIMP (%)	XIMP (%)	SAR (%)	Landscape	Impervious (Roof)	Impervious (Parking, Sidewalk)	Weighted
601	601	0.3048	0.0000	0.0000	0.3048	0.00%	0.00%	0.00%	0.16	0.95	0.95	0.16
602	602	0.3048	0.0000	0.0106	0.1173	9.04%	9.04%	0.00%	0.16	0.95	0.95	0.50
Sub-Total Internal		**0.6096**	**0.0000**	**0.0106**	**0.4221**	**2.51%**	**2.51%**	**0.00%**	**0.16**	**0.95**	**0.95**	**0.25**
701	701	0.2070	0.0000	0.0000	0.2070	0.00%	0.00%	0.00%	0.16	0.95	0.95	0.16
702	702	0.1616	0.0000	0.0000	0.1616	0.00%	0.00%	0.00%	0.16	0.95	0.95	0.16
703	703	0.2304	0.0000	0.0015	0.2319	0.65%	0.65%	0.00%	0.16	0.95	0.95	0.17
704	704	0.0547	0.0000	0.0688	0.1235	55.71%	55.71%	0.00%	0.16	0.95	0.95	0.60
Sub-Total External		**1.2633**	**0.0000**	**0.0703**	**0.7240**	**9.71%**	**9.71%**	**0.00%**	**0.16**	**0.95**	**0.95**	**0.37**
Total		**1.8729**	**0.0000**	**0.0809**	**1.1461**	**7.06%**	**7.06%**	**0.00%**	**0.16**	**0.95**	**0.95**	**0.33**

Elements Condominium
100-Year Storm Sewer Design Sheet

CLIENT: Pratt Hansen Group Inc.

PROJECT: Elements Condominium Site Plan

FILE: PRA-19078 (50)

DATE: December 2021

DESIGN: MG

CHECKED: MF

100-Year Storm Sewer Design Sheet

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	
Storm water directed to LID-1																
401				0.99	0.26	0.25	0.25									
	STM10	STM11	52.3			0.00	0.25	10.00	0.49	180	0.126	1.00	450	0.285	1.8	**44.2**
	STM11*	STM18	13.9			0.00	0.26	10.49	0.16	176	0.1251	0.63	450	0.226	1.4	**55.3**
Storm water directed to LID-2																
402	CB2	STM6	8.4	0.39	0.04	0.01	0.01	10.00	0.14	180	0.007	0.50	300	0.068	1.0	**10.2**
403	STUB	STM6	11.8	1.00	0.09	0.09	0.09	10.00	0.10	180	0.045	2.00	300	0.137	1.9	**32.9**
	STM6	STM7	32.6			0.00	0.10	10.14	0.56	179	0.052	0.50	300	0.068	1.0	**75.4**
404	STUB	STM7	19.8	1.00	0.17	0.17	0.17	10.00	0.17	180	0.086	2.00	300	0.137	1.9	**62.6**
405	CB1	TEE	20.2	0.30	0.05	0.01	0.01	10.00	0.25	180	0.007	1.00	300	0.097	1.4	**7.1**
	STM7	STM8	25.7			0.00	0.29	10.71	0.34	174	0.140	0.50	450	0.202	1.3	**69.2**
406	STM9**	STM18	16.7	0.93	0.32	0.30	0.92	11.04	0.10	171	0.4399	2.00	525	0.608	2.8	**72.3**
Storm Water Directed to LID-3																
407	STUB	STM1	4.0	1.00	0.10	0.10	0.10	10.00	0.03	180	0.050	2.00	300	0.137	1.9	**36.6**
	STM1	STM2	49.1			0.00	0.10	10.03	0.60	180	0.050	1.00	300	0.097	1.4	**51.6**
408	STM2	STM3	21.9	0.34	0.16	0.05	0.15	10.63	0.27	175	0.075	1.00	300	0.097	1.4	**77.4**
409	STUB	STM3	19.0	1.00	0.08	0.08	0.08	10.00	0.16	180	0.042	2.00	300	0.137	1.9	**30.6**
410	CB3	STM20	9.3	0.24	0.11	0.03	0.03	10.00	0.11	180	0.013	1.00	300	0.097	1.4	**13.3**
	STM20	STM3	17.0			0.00	0.03	10.11	0.20	179	0.013	0.80	375	0.157	1.4	**8.2**
411	PUP CB1	TEE	6.5	0.38	0.01	0.00	0.00	10.00	0.09	180	0.002	2.00	150	0.022	1.2	**11.2**
412	PUP CB2	TEE	6.6	0.49	0.01	0.01	0.01	10.00	0.09	180	0.003	2.00	150	0.022	1.2	**13.7**
	STM3	STM4	42.2			0.00	0.27	10.90	0.50	172	0.131	0.80	375	0.157	1.4	**83.8**
413	STUB	STM4	11.5	1.00	0.17	0.17	0.17	10.00	0.10	180	0.084	2.00	300	0.137	1.9	**61.7**
	STM4	STM5	22.4			0.00	0.44	11.39	0.24	169	0.207	0.75	450	0.247	1.6	**84.0**
414	STM15***	STM16	44.9	0.93	0.37	0.34	1.03	11.64	0.21	167	0.4781	3.30	525	0.781	3.6	**61.2**

Elements Condominium
100-Year Storm Sewer Design Sheet

CLIENT: Pratt Hansen Group Inc.

PROJECT: Elements Condominium Site Plan

FILE: PRA-19078 (50)

DATE: December 2021

DESIGN: MG

CHECKED: MF

100-Year Storm Sewer Design Sheet

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	
Storm Water Directed to 100-Year Trunk Storm Sewer																
	UFF-4	STM17	4.6			0.00	0.26	12.64	0.06	160	0.113	0.50	450	0.202	1.3	**56.1**
	STM18****	STM17	19.6			0.00	1.18	11.14	0.09	171	0.559	2.80	600	1.027	3.6	**54.4**
	STM17****	STM16	16.3			0.00	1.44	12.70	0.11	159	0.635	1.00	750	1.113	2.5	**57.0**
	STM16****	DDHW4548	22.9			0.00	2.47	12.81	0.18	158	1.086	0.60	825	1.112	2.1	**97.7**

Note: All runoff coefficients for sizing the 100-year storm sewer have been increased by 25% in accordance with Table 3.3 of the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines.

*Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 6hr SCS LID PCSWMM model for LID-1. Qp = 0.1251 m^3/s

** Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 4hr Chicago LID PCSWMM model for LID-2. Qp = 0.4399 m^3/s

***Total CA has been adjusted so the flow matches the peak flow release rate experienced during the governing 100yr 4hr Chicago LID PCSWMM model for LID-3. Qp = 0.4781 m^3/s

****Adjusted total CA values from LIDs have been carried forward through the design sheet.

Q= 0.0028*C*I*A (cms); C=RUNOFF COEFFICIENT; I-RAINFALL INTENSITY (100-Year) =1426.408/(T.C. + 5.273)^0.759; A=AREA (ha)

Elements Condominium
5-Year Storm Sewer Design Sheet

CLIENT: Pratt Hansen Group Inc.

PROJECT: Elements Condominium Site Plan

FILE: PRA-19078 (50)

DATE: December 2021

DESIGN: MG

CHECKED: MF

5-Year Storm Sewer Design Sheet

AREAS	MANHOLE		LENGTH	INCREMENT			TOTAL	FLOW TIME (min)		I	TOTAL Q	S	D	Q FULL	V FULL	% FULL
	FROM	TO	(m)	C	A	CA	CA	TO	IN	(mm/h)	(cms)	(%)	(mm)	(cms)	(m/s)	
Storm water directed to UFF-4 bypassing all LIDs																
501	CB5	STM37	45.9	0.35	0.31	0.11	0.11	10.00	0.79	109	0.033	0.50	300	0.068	1.0	**48.0**
	STM37	STM13	100.0			0.00	0.11	10.79	1.72	105	0.032	0.50	300	0.068	1.0	**46.1**
502	CB4	STM36	49.9	0.25	0.04	0.01	0.01	10.00	0.86	109	0.003	0.50	300	0.068	1.0	**4.1**
	STM36	STM12	41.6			0.00	0.01	10.86	0.72	104	0.003	0.50	300	0.068	1.0	**4.0**
503	STM12	STM13	17.3	0.78	0.05	0.04	0.05	11.58	0.11	101	0.015	3.40	300	0.178	2.5	**8.2**
504	STM13	UFF-4	14.0	0.86	0.11	0.09	0.26	12.51	0.13	97	0.068	1.00	450	0.285	1.8	**24.0**
	UFF-4	STM17	4.6			0.00	0.26	12.64	0.06	96	0.068	0.50	450	0.202	1.3	**33.8**

Q= 0.0028*C*I*A (cms); C=RUNOFF COEFFICIENT; I-RAINFALL INTENSITY (5-Year) =853.608/(T.C. + 4.699)^0.766; A=AREA (ha)

Project:	Elements Condominium	Date:	December 2021
File No.:	PRA-19078	Designed:	MG
Subject:	LID-1 - Bioretention System	Checked:	MF
Revisions:			

BMP Type **LOT LEVEL / CONVEYANCE CONTROL / END OF PIPE**

Bioretention Systems, designed per *CVC Section 4.5 - Bioretention,* generally involves practices that temporarily store, treat and infiltrate collected runoff. Systems can be constructed with or without underdrains to achieve full or partial infiltration based on native soil characteristics. The primary component of a bioretention system is the Filter Media, generally comprised of a mixture of Sand, fines and organic materials which improves water quality. Typically systems are vegetated and topped with mulch, have pre-treatment devices and a overflow by-pass. These systems are adaptable to sites and can range from simple rain gardens on a Lot Level to Large Cells in End-of-Pipe facilities

Common Concerns

1 Risk of Groundwater Contamination
2 Risk of Soil Contamination
3 Location on Private Property / Enforcement
4 Proximity to Foundations & Seepage
5 Winter Operation
6 Roadway Stability
7 Pedestrian Traffic

Physical Suitability and Constraints

1 Proximity to Drinking Water Sources i.e. WHPA's, not within 2yr Travel Time
2 Site Topography, locate on slopes 1 - 5%
3 Available Head should be 1.0 - 1.5m to drive filter
4 Water Table, minimum 1.0m separation from Bottom of Facility to SHGWT
5 Site Soils & Infiltration Capacity, min 15 mm/hr
6 Drainage Area, 5:1 to 15:1 Impervious Drainage Area to BMP Area
7 Pollution Hot Spot Runoff
8 Setback from Buildings, minimum of 5m from foundations
9 Proximity to Underground Utilities
10 Overhead Wires, Check Tree Canopies will not interfere with O/H Systems in place

Table 4.5.1 Ability of bioretention to meet SWM objectives

BMP	Water Balance Benefit	Water Quality Improvement	Stream Channel Erosion Control Benefits
Bioretention with no underdrain	Yes	Yes – size for water quality storage requirement	Partial – based on available storage volume and infiltration rates
Bioretention with underdrain	Partial – based on available storage volume beneath the underdrain and soil infiltration rate	Yes – size for water quality storage requirement	Partial – based on available storage volume beneath the underdrain and soil infiltration rate
Bioretention with underdrain and impermeable liner	Partial – some volume reduction through evapotranspiration	Yes – size for water quality storage requirement	Partial – some volume reduction through evapotranspiration

Table 4.5.2 Volumetric runoff reduction[1] achieved by bioretention

LID Practice	Location	% Runoff Reduction[1]	Reference
Bioretention without underdrain	Connecticut	99%	Dietz and Clausen (2005)
	Pennsylvania	80%	Ermilio (2005)
	Pennsylvania	70%	Emerson and Traver (2004)
Bioretention with underdrain	North Carolina	40 to 60%	Smith and Hunt (2007)
	North Carolina	33 to 50%	Hunt and Lord (2006)
	Maryland and North Carolina	20 to 50%	Li *et al.* (2009)
Runoff Reduction Estimate[2]		**85% without underdrain 45% with underdrain**	

BMP Sizing Guidelines

1 Commonly located near Impervious Surfaces generating runoff such as around parking lots, traffic islands, near buildings and in boulevards, online or offline config.
2 Geometry & Layout, typically linear or rectangular, can be orientated to fit many spaces but should be considered early in site layout & development
3 Maximum *Recommended* Footprint is typically based on Total Impervious Drainage Area, and ranges between 0.01 and 0.5 ha, with a max. of 0.8 ha.
4 Aim to orientate the cell to promote the spread of inflows evenly over the cell with flat slopes, multiple cells can be used in parallel or series
5 Pretreatment should be provided to ensure system longevity, forebay/gravel diaphragm, vegetated filter strips/grass swales or filter devices (OGS Units)
6 Conveyance by Direct Inlet, 3rd Pipe System, or Storm Sewer, an Overflow should be provided outletting to grade or a nearby Storm Sewer
7 Ponding levels are typically 150 - 250mm to limit length of inundation of planting. Deeper ponding depths may be recognized with a variation in plantings.
8 The infiltration rate of the soil in the pervious area should be at least 15 mm/hr
9 Filter Media will vary depending on type of system to be constructed. Typically includes a layer of Mulch (75mm) on Filter Medium (1000 - 1250mm), followed by a Pea Gravel Choking Layer (100mm) and the Storage Layer of 50mm Clear Stone (300 - 450mm) which may include an underdrain system.
10 Monitoring Wells 100 - 150mm in dia. should be installed to check for sediment buildup and ensure adequate drawndown times are being recognized
11 Underdrains should be placed a minimum of 100mm above the bottom of the Storage Layer, should be HDPE or equiv. with Smooth Interior Walls, and be a minimum of 200mm in dia. to accommodate freezing. Often a strip of Geotextile is placed between Filter Media and Pea Gravel Layer to prevent the migration of fines.
12 Facilities can be landscaped formally, and include a variety of plantings from low lying herbaceous materials to trees

Project:	Elements Condominium	Date:	December 2021
File No.:	PRA-19078	Designed:	MG
Subject:	LID-1 - Bioretention System	Checked:	MF
Revisions:			

BMP Sizing Calculations

1) Depth of a facility is a function of native soil infiltration rate, porosity of storage media, and targeted drawdown time as well full or partial infiltration:

a) i) **Storage Layer Depth w/ Underdrain**

Eq. 1.1 $d_{S\,MAX} = f' \times t / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage with Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual
t = time to drain (48 hrs. typ.)

ii) **Storage Layer Depth w/o Underdrain**

Eq. 1.2 $d_{S\,MAX} = f' \times 48 / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage without Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual

2) Remaining facility depth established by ponding, layering, and corresponding thickness to establish 1D storage volume.

3) Determine the total volume of runoff (WQV) produced by the Water Quality Event (WQE) in PCSWMM.

3) Facility footprint is then determined based on the Water Quality Volume (WQV) to be captured, as well as the available 1D storage volume in the reservoir:

Eq. 2 $A_P = WQV / (d_{P\,MAX} * V_R)$

Where: A_P = Minimum Footprint Area of Practice (m^2)
WQV = Water Quality Volume (m^3), Depth of Runoff (mm) * Catchment (m^2) OR Runoff Vol. (m^3)
$d_{P\,MAX}$ = Design Bioretention Cell Depth (m)

4) 3D facility draw down to confirm available capacity is within inter-event window: **Eq. 3** $t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

5) Check flowrate through media to ensure ponding depth provided is adequate: **Eq. 4** $Q_{MAX,\,M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

6) Check underdrain flowrate to ensure ponding depth provided is adequate: **Eq. 5** $Q_{MAX,\,P} = L \times B \times C_d \times Ao (2 \times g \times h_{MAX})^{0.5}$

7) Verify limiting flow rate is design peak inflow rate to mitigate ponding, provide additional hydraulic controls where required.

8) Size gravel diaphragm to provide sediment capture at specified clean out frequency (COF).

Bioretention Cell Sizer: *= user input* *= calculated / constant* *= design parameter*

1) $d_{S\,MAX} = f' \times t / 0.4$ **OR** $d_{S\,MAX} = f' \times 48 / 0.4$

$d_{S\,MAX}$ = **1320 mm** $d_{S\,MAX}$ = **1320 mm**

Where: f' = 11 *mm/hr*
t = 48 *hrs*

2)

Layer	Depth (mm)	VR	1D Storage (mm)
Freeboard	100	1.00	100
Ponding	200	1.00	200
Mulch / Stone	50	0.40	20
Filter Media	500	0.35	175
Choker Layer	100	0.40	40
Underdrain Dia.	0	0.40	0
Storage Layer (d_S)	300	0.40	120
Total Depth	**1250**		**655**

PCSWMM Catchment ID	LID-1	
LID Catchment Runon depth (mm)	173.97	mm
LID facility area (ha)	0.0256	ha

3) **Bioretention Practice Footprint**

Where: WQV = 44.54 m^3
$d_{P\,MAX}$ = 0.655 m

$A_P = WQV / d_P$

$A_{P\,MIN}$ = **67.99 m^2**

U/S Catchment Area: 2550 m^2
XIMP: 79.18% **TIMP:** 79.92%
Imp. Area: 2019 m^2 2037.96 m^2

Recommended Area Check (5:1 - 15:1 Ratio):
OK

4) **3D Facility Drawdown**

$t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

t_D = **20.5 hrs**

$A_{P\,MIN}$: 134.6 m^2
Length: 4.1 m
Width: 62.4 m
$A_{P\,ACT}$: **256** m^2
Aspect Ratio: 0.06571 :1
P: 133.2 m
V_R : 0.4

A_P based on I/P Ratio:
$A_{P\,MIN}$ = **134.6 m^2**
$A_{P\,MAX}$ = **403.8 m^2**

I/P_{PROV} : 7.89 :1
(assumed rectangular)
(weighted average)

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5) **Flow Through Media**

$Q_{MAX,\ M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

$Q_{MAX,\ M} =$ **0.013** m^3/s

K_M :	120.34	*mm /h*	(hydaulic conductivity of media)
$A_{P\ ACT}$:	256.0	m^2	(area of practice)
h_{MAX} :	0.75	*m*	(max. head = ponding + stone + media)
d_m :	0.5	*m*	(depth of media)

6) **Flow Through Underdrains**

$Q_{MAX,\ P} = L \times B \times C_d \times Ao\ (2 \times g \times h_{MAX})^{0.5}$

$Q_{MAX,\ P} =$ **0** m^3/s

Drain offset: N/A *mm*

L :	N/A	*m*	(total length of pipe)
B :	0.5		(clogging factor, typical 0.5)
C_d :	N/A		(coefficient of discharge)
Ao :	0.0000	*m*	(Open Area of Pipe / m length)
g :	9.81	m/s^2	(gravitational constant)
h_{MAX} :	N/A	*m*	(total head above top of pipe)

7) **Check Limiting Flow Rate**

Q_{25mm} :	0.126	m^3/s	(Calculated design peak flow from PCSWMM)
$Q_{MAX,\ M}$:	0.013		
$Q_{MAX,\ P}$:	0		

Is Q Limiting : YES

Maximum Total LID Inflow	1767	*mm/hr*	(PCSWMM 25mm WQE)
Area of Facility	256	m^2	

8) **Size Gravel Diaphragm for Sediment Capture**

$A_{REQ} = COF \times V_{SEDIMENT} / (D \times V_R)$

$A_{REQ} =$ **9** m^2

COF :	10	*yrs*	(desired clean-out frequency for practice)
$V_{SEDIMENT}$:	0.108	m^3/yr	(annual sediment capture from TSS mass balance)
D :	0.3	*m*	(total depth of diaphragm, typical 0.3m)
V_R :	0.4		(typical 0.4 for clear stone)
A_{PROV} :	256.0	m^2	(assume 25% overall area to trigger cleanout)
AREQ:	64.0	m^2	

ADDITIONAL NOTES: $C_{LID} = 160997 \times g^{0.5} \times C_d \times Aorif / A_P$ *PCSWMM Drain Coefficient Parameter Estimate*

Where: A_{ORIF} = cross-sectional flow area of underdrain x number of underdrain runs (m^2)

0 Underdrain Runs

PCSWMM LID Editor Inputs:

https://support.chiwater.com/77680/lid-control-editor

LID Type:	Bio-Retention Cell			Sub-Catchment Min. Area:	256.0 m^2					
Surface				Storage				Underdrain		
Berm Height (mm)	Veg. Vol. (Frac.)	Mannings 'n'	Surf. Slope (%)	Thickness (mm)	Void Ratio	Seepage Rate (mm / hr)	Clogging Factor	Drain Coef. (mm / hr)	Drain Exp.	Drain Offset (mm)
200	0	0.15	0.00%	400	0.4	11	0	0.00	0.5	0

Soil - *Texture Class Required for Filter Media (Loamy Sand)*

Thickness (mm)	Soil Texture Class	Porosity (frac)	Field Capacity (frac)	Wilting Point (frac)	Hydraulic Conductivity (mm / hr)	Conductivity Slope	Suction Head (mm)
500	Loamy Sand	0.35	0.062	0.024	120.34	5	49.02

Rerefences: **STEP Low Impact Development Stormwater Management Planning & Design Guide:** *https://wiki.sustainabletechnologies.ca/wiki/Main_Page*

Item	Page	Link
Eq.'s 1.1, 1.2, 2, 3	*Bioretention: Sizing*	*https://wiki.sustainabletechnologies.ca/wiki/Bioretention:_Sizing*
Eq. 4	*Flow Through Media*	*https://wiki.sustainabletechnologies.ca/wiki/Flow_through_media*
Eq. 5	*Flow Through Perforated Pipe*	*https://wiki.sustainabletechnologies.ca/wiki/Flow_through_perforated_pipe*

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BMP Type **LOT LEVEL / CONVEYANCE CONTROL / END OF PIPE**

Bioretention Systems, designed per *CVC Section 4.5 - Bioretention,* generally involves practices that temporarily store, treat and infiltrate collected runoff. Systems can be constructed with or without underdrains to achieve full or partial infiltration based on native soil characteristics. The primary component of a bioretention system is the Filter Media, generally comprised of a mixture of Sand, fines and organic materials which improves water quality. Typically systems are vegetated and topped with mulch, have pre-treatment devices and a overflow by-pass. These systems are adaptable to sites and can range from simple rain gardens on a Lot Level to Large Cells in End-of-Pipe facilities

Common Concerns

1 Risk of Groundwater Contamination
2 Risk of Soil Contamination
3 Location on Private Property / Enforcement
4 Proximity to Foundations & Seepage
5 Winter Operation
6 Roadway Stability
7 Pedestrian Traffic

Physical Suitability and Constraints

1 Proximity to Drinking Water Sources i.e. WHPA's, not within 2yr Travel Time
2 Site Topography, locate on slopes 1 - 5%
3 Available Head should be 1.0 - 1.5m to drive filter
4 Water Table, minimum 1.0m separation from Bottom of Facility to SHGWT
5 Site Soils & Infiltration Capacity, min 15 mm/hr
6 Drainage Area, 5:1 to 15:1 Impervious Drainage Area to BMP Area
7 Pollution Hot Spot Runoff
8 Setback from Buildings, minimum of 5m from foundations
9 Proximity to Underground Utilities
10 Overhead Wires, Check Tree Canopies will not interfere with O/H Systems in place

Table 4.5.1 Ability of bioretention to meet SWM objectives

BMP	Water Balance Benefit	Water Quality Improvement	Stream Channel Erosion Control Benefits
Bioretention with no underdrain	Yes	Yes – size for water quality storage requirement	Partial – based on available storage volume and infiltration rates
Bioretention with underdrain	Partial – based on available storage volume beneath the underdrain and soil infiltration rate	Yes – size for water quality storage requirement	Partial – based on available storage volume beneath the underdrain and soil infiltration rate
Bioretention with underdrain and impermeable liner	Partial – some volume reduction through evapotranspiration	Yes – size for water quality storage requirement	Partial – some volume reduction through evapotranspiration

Table 4.5.2 Volumetric runoff reduction[1] achieved by bioretention

LID Practice	Location	% Runoff Reduction[1]	Reference
Bioretention without underdrain	Connecticut	99%	Dietz and Clausen (2005)
	Pennsylvania	80%	Ermilio (2005)
	Pennsylvania	70%	Emerson and Traver (2004)
Bioretention with underdrain	North Carolina	40 to 60%	Smith and Hunt (2007)
	North Carolina	33 to 50%	Hunt and Lord (2006)
	Maryland and North Carolina	20 to 50%	Li *et al.* (2009)
Runoff Reduction Estimate[2]		**85% without underdrain 45% with underdrain**	

BMP Sizing Guidelines

1 Commonly located near Impervious Surfaces generating runoff such as around parking lots, traffic islands, near buildings and in boulevards, online or offline config.
2 Geometry & Layout, typically linear or rectangular, can be orientated to fit many spaces but should be considered early in site layout & development
3 Maximum *Recommended* Footprint is typically based on Total Impervious Drainage Area, and ranges between 0.01 and 0.5 ha, with a max. of 0.8 ha.
4 Aim to orientate the cell to promote the spread of inflows evenly over the cell with flat slopes, multiple cells can be used in parallel or series
5 Pretreatment should be provided to ensure system longevity, forebay/gravel diaphragm, vegetated filter strips/grass swales or filter devices (OGS Units)
6 Conveyance by Direct Inlet, 3rd Pipe System, or Storm Sewer, an Overflow should be provided outletting to grade or a nearby Storm Sewer
7 Ponding levels are typically 150 - 250mm to limit length of inundation of planting. Deeper ponding depths may be recognized with a variation in plantings.
8 The infiltration rate of the soil in the pervious area should be at least 15 mm/hr
9 Filter Media will vary depending on type of system to be constructed. Typically includes a layer of Mulch (75mm) on Filter Medium (1000 - 1250mm), followed by a Pea Gravel Choking Layer (100mm) and the Storage Layer of 50mm Clear Stone (300 - 450mm) which may include an underdrain system.
10 Monitoring Wells 100 - 150mm in dia. should be installed to check for sediment buildup and ensure adequate drawndown times are being recognized
11 Underdrains should be placed a minimum of 100mm above the bottom of the Storage Layer, should be HDPE or equiv. with Smooth Interior Walls, and be a minimum of 200mm in dia. to accommodate freezing. Often a strip of Geotextile is placed between Filter Media and Pea Gravel Layer to prevent the migration of fines.
12 Facilities can be landscaped formally, and include a variety of plantings from low lying herbaceous materials to trees

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BMP Sizing Calculations

1) Depth of a facility is a function of native soil infiltration rate, porosity of storage media, and targeted drawdown time as well full or partial infiltration:

a) i) **Storage Layer Depth w/ Underdrain**

Eq. 1.1 $d_{S\,MAX} = f' \times t / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage with Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual
t = time to drain (48 hrs. typ.)

ii) **Storage Layer Depth w/o Underdrain**

Eq. 1.2 $d_{S\,MAX} = f' \times 48 / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage without Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual

2) Remaining facility depth established by ponding, layering, and corresponding thickness to establish 1D storage volume.

3) Determine the total volume of runoff (WQV) produced by the Water Quality Event (WQE) in PCSWMM.

3) Facility footprint is then determined based on the Water Quality Volume (WQV) to be captured, as well as the available 1D storage volume in the reservoir:

Eq. 2 $A_P = WQV / (d_{P\,MAX} * V_R)$

Where: A_P = Minimum Footprint Area of Practice (m^2)
WQV = Water Quality Volume (m^3), Depth of Runoff (mm) * Catchment (m^2) OR Runoff Vol. (m^3)
$d_{P\,MAX}$ = Design Bioretention Cell Depth (m)

4) 3D facility draw down to confirm available capacity is within inter-event window: **Eq. 3** $t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

5) Check flowrate through media to ensure ponding depth provided is adequate: **Eq. 4** $Q_{MAX,\,M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

6) Check underdrain flowrate to ensure ponding depth provided is adequate: **Eq. 5** $Q_{MAX,\,P} = L \times B \times C_d \times Ao (2 \times g \times h_{MAX})^{0.5}$

7) Verify limiting flow rate is design peak inflow rate to mitigate ponding, provide additional hydraulic controls where required.

8) Size gravel diaphragm to provide sediment capture at specified clean out frequency (COF).

Bioretention Cell Sizer: *= user input* *= calculated / constant* *= design parameter*

1) $d_{S\,MAX} = f' \times t / 0.4$ **OR** $d_{S\,MAX} = f' \times 48 / 0.4$

$d_{S\,MAX}$ = **1320 mm** $d_{S\,MAX}$ = **1320 mm**

Where: f' = 11 *mm/hr*
t = 48 *hrs*

2)

Layer	Depth (mm)	VR	1D Storage (mm)
Freeboard	100	1.00	100
Ponding	200	1.00	200
Mulch / Stone	50	0.40	20
Filter Media	500	0.35	175
Choker Layer	100	0.40	40
Underdrain Dia.	0	0.40	0
Storage Layer (d_S)	300	0.40	120
Total Depth	**1250**		**655**

PCSWMM Catchment ID	LID-2	
LID Catchment Runon depth (mm)	316.73	mm
LID facility area (ha)	0.0349	ha

3) **Bioretention Practice Footprint**

Where: WQV = 110.5 m^3
$d_{P\,MAX}$ = 0.655 m

$A_P = WQV / d_P$

$A_{P\,MIN}$ = **168.8 m^2**

U/S Catchment Area: 6673 m^2
XIMP: *36.03%* TIMP: *77.16%*
Imp. Area: 2404 m^2 5148.89 m^2

Recommended Area Check (5:1 - 15:1 Ratio):
OK

4) **3D Facility Drawdown**

$t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

t_D = **21.1 hrs**

$A_{P\,MIN}$: 168.8 m^2
Length: 68.4 m
Width: *5.10* m
$A_{P\,ACT}$: **349** m^2
Aspect Ratio: 13.4118 *:1*
P: 145.1 m (assumed rectangular)
V_R : 0.4 (weighted average)

A_P based on I/P Ratio:

$A_{P\,MIN}$ = **160.3 m^2**
$A_{P\,MAX}$ = **480.9 m^2**

I/P_{PROV} : 6.89 :1

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5) **Flow Through Media**

$Q_{MAX,\ M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

$Q_{MAX,\ M} =$ **0.017** m^3/s

K_M :	120.34	*mm /h*	(hydaulic conductivity of media)
$A_{P\ ACT}$:	349	m^2	(area of practice)
h_{MAX} :	0.75	*m*	(max. head = ponding + stone + media)
d_m :	0.5	*m*	(depth of media)

6) **Flow Through Underdrains**

$Q_{MAX,\ P} = L \times B \times C_d \times Ao\ (2 \times g \times h_{MAX})^{0.5}$

$Q_{MAX,\ P} =$ **0** m^3/s

Drain offset: N/A *mm*

L :	N/A	*m*	(total length of pipe)
B :	0.5		(clogging factor, typical 0.5)
C_d :	0.6		(coefficient of discharge)
Ao :	N/A	*m*	(Open Area of Pipe / m length)
g :	9.81	m/s^2	(gravitational constant)
h_{MAX} :	N/A	*m*	(total head above top of pipe)

7) **Check Limiting Flow Rate**

Q_{25mm} :	0.309	m^3/s	(Calculated design peak flow from PCSWMM)
$Q_{MAX,\ M}$:	0.017		
$Q_{MAX,\ P}$:	0		

Is Q Limiting : YES

Maximum Total LID Inflow	3186	*mm/hr*	(PCSWMM 25mm WQE)
Area of Facility	349	m^2	

8) **Size Gravel Diaphragm for Sediment Capture**

$A_{REQ} = COF \times V_{SEDIMENT} / (D \times V_R)$

$A_{REQ} =$ **14.67** m^2

COF :	10	*yrs*	(desired clean-out frequency for practice)
$V_{SEDIMENT}$:	0.176	m^3/yr	(annual sediment capture from TSS mass balance)
D :	0.3	*m*	(total depth of diaphragm, typical 0.3m)
V_R :	0.4		(typical 0.4 for clear stone)
A_{PROV} :	349.0	m^2	(assume 25% overall area to trigger cleanout)
AREQ:	87.3	m^2	

ADDITIONAL NOTES: $C_{LID} = 160997 \times g^{0.5} \times C_d \times Aorif / A_P$ *PCSWMM Drain Coefficient Parameter Estimate*

Where: A_{ORIF} = cross-sectional flow area of underdrain x number of underdrain runs (m^2)

0 Underdrain Runs

PCSWMM LID Editor Inputs:

https://support.chiwater.com/77680/lid-control-editor

LID Type:	Bio-Retention Cell					Sub-Catchment Min. Area:	349.0 m^2			
Surface				Storage				Underdrain		
Berm Height (mm)	Veg. Vol. (Frac.)	Mannings 'n'	Surf. Slope (%)	Thickness (mm)	Void Ratio	Seepage Rate (mm / hr)	Clogging Factor	Drain Coef. (mm / hr)	Drain Exp.	Drain Offset (mm)
200	0	0.15	0.00%	400	0.4	11	0	0.00	0.5	0

Soil - *Texture Class Required for Filter Media (Loamy Sand)*

Thickness (mm)	Soil Texture Class	Porosity (frac)	Field Capacity (frac)	Wilting Point (frac)	Hydraulic Conductivity (mm / hr)	Conductivity Slope	Suction Head (mm)
550	Sand	0.4	0.062	0.024	120.34	5	49.02

Rerefences: **STEP Low Impact Development Stormwater Management Planning & Design Guide:** *https://wiki.sustainabletechnologies.ca/wiki/Main_Page*

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Subject:	LID-3 - Bioretention System	Checked:	MF
Revisions:			

BMP Type **LOT LEVEL / CONVEYANCE CONTROL / END OF PIPE**

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Common Concerns

1 Risk of Groundwater Contamination
2 Risk of Soil Contamination
3 Location on Private Property / Enforcement
4 Proximity to Foundations & Seepage
5 Winter Operation
6 Roadway Stability
7 Pedestrian Traffic

Physical Suitability and Constraints

1 Proximity to Drinking Water Sources i.e. WHPA's, not within 2yr Travel Time
2 Site Topography, locate on slopes 1 - 5%
3 Available Head should be 1.0 - 1.5m to drive filter
4 Water Table, minimum 1.0m separation from Bottom of Facility to SHGWT
5 Site Soils & Infiltration Capacity, min 15 mm/hr
6 Drainage Area, 5:1 to 15:1 Impervious Drainage Area to BMP Area
7 Pollution Hot Spot Runoff
8 Setback from Buildings, minimum of 5m from foundations
9 Proximity to Underground Utilities
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Table 4.5.1 Ability of bioretention to meet SWM objectives

BMP	Water Balance Benefit	Water Quality Improvement	Stream Channel Erosion Control Benefits
Bioretention with no underdrain	Yes	Yes – size for water quality storage requirement	Partial – based on available storage volume and infiltration rates
Bioretention with underdrain	Partial – based on available storage volume beneath the underdrain and soil infiltration rate	Yes – size for water quality storage requirement	Partial – based on available storage volume beneath the underdrain and soil infiltration rate
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Table 4.5.2 Volumetric runoff reduction[1] achieved by bioretention

LID Practice	Location	% Runoff Reduction[1]	Reference
Bioretention without underdrain	Connecticut	99%	Dietz and Clausen (2005)
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Runoff Reduction Estimate[2]		**85% without underdrain 45% with underdrain**	

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4 Aim to orientate the cell to promote the spread of inflows evenly over the cell with flat slopes, multiple cells can be used in parallel or series
5 Pretreatment should be provided to ensure system longevity, forebay/gravel diaphragm, vegetated filter strips/grass swales or filter devices (OGS Units)
6 Conveyance by Direct Inlet, 3rd Pipe System, or Storm Sewer, an Overflow should be provided outletting to grade or a nearby Storm Sewer
7 Ponding levels are typically 150 - 250mm to limit length of inundation of planting. Deeper ponding depths may be recognized with a variation in plantings.
8 The infiltration rate of the soil in the pervious area should be at least 15 mm/hr
9 Filter Media will vary depending on type of system to be constructed. Typically includes a layer of Mulch (75mm) on Filter Medium (1000 - 1250mm), followed by a Pea Gravel Choking Layer (100mm) and the Storage Layer of 50mm Clear Stone (300 - 450mm) which may include an underdrain system.
10 Monitoring Wells 100 - 150mm in dia. should be installed to check for sediment buildup and ensure adequate drawndown times are being recognized
11 Underdrains should be placed a minimum of 100mm above the bottom of the Storage Layer, should be HDPE or equiv. with Smooth Interior Walls, and be a minimum of 200mm in dia. to accommodate freezing. Often a strip of Geotextile is placed between Filter Media and Pea Gravel Layer to prevent the migration of fines.
12 Facilities can be landscaped formally, and include a variety of plantings from low lying herbaceous materials to trees

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Subject:	LID-3 - Bioretention System	Checked:	MF
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BMP Sizing Calculations

1) Depth of a facility is a function of native soil infiltration rate, porosity of storage media, and targeted drawdown time as well full or partial infiltration:

a) i) **Storage Layer Depth w/ Underdrain**

Eq. 1.1 $d_{S\,MAX} = f' \times t / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage with Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual
t = time to drain (48 hrs. typ.)

ii) **Storage Layer Depth w/o Underdrain**

Eq. 1.2 $d_{S\,MAX} = f' \times 48 / 0.4$

Where: $d_{S\,MAX}$ = Maximum Depth of Storage without Underdrain
f' = Design Infiltration Rate (mm/hr) - Use FS Rate, not actual

2) Remaining facility depth established by ponding, layering, and corresponding thickness to establish 1D storage volume.

3) Determine the total volume of runoff (WQV) produced by the Water Quality Event (WQE) in PCSWMM.

3) Facility footprint is then determined based on the Water Quality Volume (WQV) to be captured, as well as the available 1D storage volume in the reservoir:

Eq. 2 $A_P = WQV / (d_{P\,MAX} * V_R)$

Where: A_P = Minimum Footprint Area of Practice (m^2)
WQV = Water Quality Volume (m^3), Depth of Runoff (mm) * Catchment (m^2) OR Runoff Vol. (m^3)
$d_{P\,MAX}$ = Design Bioretention Cell Depth (m)

4) 3D facility draw down to confirm available capacity is within inter-event window: **Eq. 3** $t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

5) Check flowrate through media to ensure ponding depth provided is adequate: **Eq. 4** $Q_{MAX,\,M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

6) Check underdrain flowrate to ensure ponding depth provided is adequate: **Eq. 5** $Q_{MAX,\,P} = L \times B \times C_d \times Ao (2 \times g \times h_{MAX})^{0.5}$

7) Verify limiting flow rate is design peak inflow rate to mitigate ponding, provide additional hydraulic controls where required.

8) Size gravel diaphragm to provide sediment capture at specified clean out frequency (COF).

Bioretention Cell Sizer: *= user input* *= calculated / constant* *= design parameter*

1) $d_{S\,MAX} = f' \times t / 0.4$ **OR** $d_{S\,MAX} = f' \times 48 / 0.4$

$d_{S\,MAX}$ = **1080 mm** $d_{S\,MAX}$ = **1080 mm**

Where: f' = 9 *mm/hr*
t = 48 *hrs*

2)

Layer	Depth (mm)	VR	1D Storage (mm)
Freeboard	200	1.00	200
Ponding	200	1.00	200
Mulch / Stone	50	0.40	20
Filter Media	500	0.35	175
Choker Layer	100	0.40	40
Underdrain Dia.	N/A	0.40	N/A
Storage Layer (d_S)	300	0.40	120
Total Depth	**1350**		**755**

PCSWMM Catchment ID	LID-3	
LID Catchment Runon depth (mm)	252.88	mm
LID facility area (ha)	0.0554	ha

3) **Bioretention Practice Footprint**

Where: WQV = 140.1 m^3
$d_{P\,MAX}$ = 0.755 m

$A_P = WQV / d_P$

$A_{P\,MIN}$ = **185.6 m^2**

U/S Catchment Area: 10211 m^2
XIMP: 28.17% **TIMP:** 64.23%
Imp. Area: 2876 m^2 6558.53 m^2

Recommended Area Check (5:1 - 15:1 Ratio):
OK

4) **3D Facility Drawdown**

$t_D = (V_R / f') \times (A_P / P) \times \ln [(d_P + (A_P / P) / (AP / P)]$

t_D = **31.2 hrs**

$A_{P\,MIN}$: 191.8 m^2
Length: 42.6 m
Width: 13.0 m
$A_{P\,ACT}$: **554** m^2
Aspect Ratio: 3.27692 :1
P: 115.0 m
V_R : 0.4 (weighted average)

A_P based on I/P Ratio:
$A_{P\,MIN}$ = **191.8 m^2**
$A_{P\,MAX}$ = **575.3 m^2**

I/P_{PROV} : 5.19 :1

Project:	Elements Condominiums	Date:	December 2021
File No.:	PRA-19078	Designed:	MG
Subject:	LID-3 - Bioretention System	Checked:	MF
Revisions:			

5) **Flow Through Media**

$Q_{MAX,\ M} = (K_M \times A_P \times (h_{MAX} / d_m)) / 3.6 \times 10^6$

$Q_{MAX,\ M} =$ **0.028** m^3/s

K_M :	120.34	*mm /h*	(hydaulic conductivity of media)
$A_{P\ ACT}$:	554	m^2	(area of practice)
h_{MAX} :	0.75	*m*	(max. head = ponding + stone + media)
d_m :	0.5	*m*	(depth of media)

6) **Flow Through Underdrains**

$Q_{MAX,\ P} = L \times B \times C_d \times Ao\ (2 \times g \times h_{MAX})^{0.5}$

$Q_{MAX,\ P} =$ **0** m^3/s

Drain offset: N/A *mm*

L :	N/A	*m*	(total length of pipe)
B :	0.5		(clogging factor, typical 0.5)
C_d :	0.6		(coefficient of discharge)
Ao :	N/A	*m*	(Open Area of Pipe / m length)
g :	9.81	m/s^2	(gravitational constant)
h_{MAX} :	N/A	*m*	(total head above top of pipe)

7) **Check Limiting Flow Rate**

Q_{25mm} :	0.351	m^3/s	(Calculated design peak flow from PCSWMM)
$Q_{MAX,\ M}$:	0.028		
$Q_{MAX,\ P}$:	0		

Is Q Limiting : YES

Maximum Total LID Inflow	2280	*mm/hr*	(PCSWMM 25mm WQE)
Area of Facility	554	m^2	

8) **Size Gravel Diaphragm for Sediment Capture**

$A_{REQ} = COF \times V_{SEDIMENT} / (D \times V_R)$

$A_{REQ} =$ **20.25** m^2

COF :	10	*yrs*	(desired clean-out frequency for practice)
$V_{SEDIMENT}$:	0.243	m^3/yr	(annual sediment capture from TSS mass balance)
D :	0.3	*m*	(total depth of diaphragm, typical 0.3m)
V_R :	0.4		(typical 0.4 for clear stone)
A_{PROV} :	554.0	m^2	(assume 25% overall area to trigger cleanout)
AREQ:	138.5	m^2	

ADDITIONAL NOTES: $C_{LID} = 160997 \times g^{0.5} \times C_d \times Aorif / A_P$ *PCSWMM Drain Coefficient Parameter Estimate*

Where: A_{ORIF} = cross-sectional flow area of underdrain x number of underdrain runs (m^2)

0 Underdrain Runs

PCSWMM LID Editor Inputs:

https://support.chiwater.com/77680/lid-control-editor

LID Type:	Bio-Retention Cell					Sub-Catchment Area:	554.0 m^2			
Surface				Storage				Underdrain		
Berm Height (mm)	Veg. Vol. (Frac.)	Mannings 'n'	Surf. Slope (%)	Thickness (mm)	Void Ratio	Seepage Rate (mm / hr)	Clogging Factor	Drain Coef. (mm / hr)	Drain Exp.	Drain Offset (mm)
200	0	0.15	0.00%	400	0.4	9	0	0.00	0.5	0

Soil - *Texture Class Required for Filter Media (Loamy Sand)*

Thickness (mm)	Soil Texture Class	Porosity (frac)	Field Capacity (frac)	Wilting Point (frac)	Hydraulic Conductivity (mm / hr)	Conductivity Slope	Suction Head (mm)
550	Loamy Sand	0.35	0.062	0.024	120.34	5	49.02

Rerefences: **STEP Low Impact Development Stormwater Management Planning & Design Guide:** *https://wiki.sustainabletechnologies.ca/wiki/Main_Page*

Item	Page	Link
Eq.'s 1.1, 1.2, 2, 3	*Bioretention: Sizing*	*https://wiki.sustainabletechnologies.ca/wiki/Bioretention:_Sizing*
Eq. 4	*Flow Through Media*	*https://wiki.sustainabletechnologies.ca/wiki/Flow_through_media*
Eq. 5	*Flow Through Perforated Pipe*	*https://wiki.sustainabletechnologies.ca/wiki/Flow_through_perforated_pipe*

Elements Condominium
PCSWMM LID Performance Summary

CLIENT: Pratt Hansen Group Inc.

PROJECT: Elements Condominium Site Plan

FILE: PRA-19078 (50)

DATE: December 2021

DESIGN: MG

CHECKED: MF

25mm Event Performance

LID Name	LID Controls Editor Name	Subcatchment LID PCSWMM ID#	Names of Contributing Areas	Contributing Area (ha)	Total Runoff contributing (mm)	Total Runoff Volume (cu.m)	LID Catchment Area (ha)	Total Inflow (mm)	Infil Loss (mm)	Infiltration Volume (cu.m)	Surface Outflow (mm)	% of WQE Runoff Captured
Rain Garden #1	LID-1	LID-1	101	0.26	17.47	44.55	0.0256	173.97	152.82	39.12	0.00	87.8%
Rain Garden #2	LID-2	LID-2	201 - 205	0.67	16.57	110.55	0.0349	316.73	292.47	102.07	0.00	92.3%
Rain Garden #3	LID-3	LID-3	301 - 305	1.02	13.72	140.11	0.0554	252.88	229.52	127.15	0.00	90.8%
CB Shields & Up-Flo Filter	No LID	No LID	501 & 502	0.35	4.19	14.56	0.00	0.00	0.00	0.00	4.19	0.0%
Up-Flo Filter	No LID	No LID	503 & 504	0.16	17.62	29.05	0.00	0.00	0.00	0.00	17.62	0.0%
CB Shield	No LID	No LID	505	0.16	14.59	23.33	0.00	0.00	0.00	0.00	14.59	0.0%
No LID	No LID	No LID	506	0.06	3.12	1.75	0.00	0.00	0.00	0.00	3.12	0.0%
No LID	No LID	No LID	601 - 603	0.49	1.12	5.47	0.00	0.00	0.00	0.00	1.12	0.0%
			TOTALS:	**3.16**		**369.37**				**268.35**		**72.7%**

PERFORMANCE 15.45 mm

Continous Event Performance

LID Name	LID Controls Editor Name	Subcatchment LID PCSWMM ID#	Names of Contributing Areas	Contributing Area (ha)	Total Runoff contributing (mm)	Total Runoff Volume (cu.m)	LID Catchment Area (ha)	Total Inflow (mm)	Infil Loss (mm)	Infiltration Volume (cu.m)	Surface Outflow (mm)	Surface Outflow (cu.m)	% of annual Runoff Captured
Rain Garden #1	LID-1	LID-1	101	0.26	570.69	1455.26	0.0256	5684.57	5165.58	1322.39	0.00	0.00	90.9%
Rain Garden #2	LID-2	LID-2	201 - 205	0.67	558.25	3725.17	0.0349	10673.85	10139.19	3538.58	0.00	0.00	95.0%
Rain Garden #3	LID-3	LID-3	301 - 305	1.02	460.85	4705.69	0.0554	8494.04	7962.81	4411.40	0.00	0.00	93.7%
CB Shields & Up-Flo Filter	No LID	No LID	501 & 502	0.35	136.81	474.88	0.00	0.00	0.00	0.00	136.81	474.88	0.0%
Up-Flo Filter	No LID	No LID	503 & 504	0.16	751.09	1238.55	0.00	0.00	0.00	0.00	751.09	1238.55	0.0%
CB Shield	No LID	No LID	505	0.16	475.35	760.08	0.00	0.00	0.00	0.00	475.35	760.08	0.0%
No LID	No LID	No LID	506	0.06	138.88	78.05	0.00	0.00	0.00	0.00	138.88	78.05	0.0%
No LID	No LID	No LID	601 - 603	0.49	72.00	350.41	0.00	0.00	0.00	0.00	72.00	350.41	0.0%
			TOTALS:	**3.16**		**12788.11**				**9272.36**		**2902.0**	**72.5%**

A new Version 1.2.1 of the LID TTT has been updated with the following revised default Land Cover Event Mean Concentrations (EMCs), to sync better with local and regional data associated with these various land cover options and associated TSS and TP loadings generated from the tool.

The LID TTT provides the user with default land cover event mean concentrations (EMCs), along with an 'Other' land use option that provides flexibility for either additional land cover options, modifications to the land cover EMC defaults, and/or mixed land-use EMCs.

Land Cover EMCs

Land Cover	TSS (mg/L)	TP (mg/L)
Paved Surface [1.]	90	0.23
Roof [2.]	7	0.09
Landscaped Area [3.]	100	0.32
Row Crop [4.]	100	0.23
Open Space/Parkland [4.]	27	0.20
Forest [4.]	55	0.23
Wetland [4.]	13	0.81

Data sources:

1. STEP/TRCA and CVC water quality data from various public road and private parking lot sites in the Greater Toronto Area. A conservative value for asphalt would utilize the average of the 75th percentile values. These concentrations for TP and TSS are 0.23 and 90 mg/L, respectively, and are consistent with other northern US studies cited. Recommended for use with parking lots and/or arterial roadways.

2. STEP water quality data from four local roof runoff studies. Utilizing the 75th percentile values, conservative TP and TSS values for roof runoff in the LID TTT would be 0.09 and 7 mg/L respectively.

3. The landscaped area data are from experimental soil plots designed to evaluate feasible alternatives to standard topsoil management practice in new residential developments. As a conservative value, we recommend using the 75th percentile values for TP from a compost amended plot with the addition of 15% for potential synthetic fertilizer applications by property owners or landscape professionals. The TSS EMC default for this land cover has been assigned based on a general correlation only.

4. International Stormwater BMP Database (2018).

STEP anticipates providing additional land cover EMC recommendations and/or defaults by/before the next Version 2.0 release.

Water Quality Calculations - Mass Balance Approach (Annual)

CLIENT: Pratt Hansen Group Inc.
DATE: December 2021
PROJECT: Elements Condominium Site Plan
DESIGN: MG
FILE: PRA-19078 (50)
CHECKED: MF

TSS Quality Treatment Train Calculations - Elements Condominium

Sediment Bulk Density = 1600 kg/m³
Sediment Wet Density = 1230 kg/m³

Land Cover EMC values have been referenced from the LID Treatment Train Tool Help Guide.

Legend:
Catchment

T.T.		Cum. Area (ha)
TSS Out	mg / L	**% Rem.**
Flow Out	m3 OUT	
Mass Out	kg OUT	
Mass Ret.	kg RET	
Vol. Ret.	m3 RET	
Vol. Avail.	m3 Available	

C/O Freq. Yrs

**Yearly maintenance for the Up-Flo Filter is required per manufacturors specifications (Hydro International Operation and Maintenance Manual)

501 & 502

CB Shields	0.35
47.44 mg / L	**50%**
474.88 m3 OUT	
22.53 kg OUT	
22.53 kg RET	
0.018 m3 RET	
0.30 m3 Available	

16.4 Yrs

Weighted EMC	*94.9*	*mg/L*
Landscaped Area	*0.2693*	*ha*
Rooftop Area	*0.0120*	*ha*
Paved area	*0.0658*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

503 & 504

No Treatment	0.16
89.47 mg / L	**0%**
1238.55 m3 OUT	
110.82 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*89.5*	*mg/L*
Landscaped Area	*0.0245*	*ha*
Rooftop Area	*0.0040*	*ha*
Paved area	*0.1364*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

Up-Flo Filter**	0.51
14.55 mg / L	**81.3%**
1713.44 m3 OUT	
24.94 kg OUT	
108.41 kg RET	
0.088 m3 RET	
0.51 m3 Available	

5.8 Yrs

101

Rain Garden #1 - LID-1	0.26
0.00 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
133.00 kg RET	
0.108 m3 RET	
6.40 m3 Available	

59.2 Yrs

Weighted EMC	*91.4*	*mg/L*
Landscaped Area	*0.0512*	*ha*
Rooftop Area	*0.0019*	*ha*
Paved area	*0.2019*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

*No Outflow, therefore 100% TSS Removal

201 - 205

Rain Garden #2 - LID-2	0.67
0.00 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
216.59 kg RET	
0.176 m3 RET	
8.73 m3 Available	

49.5 Yrs

Weighted EMC	*58.1*	*mg/L*
Landscaped Area	*0.1524*	*ha*
Rooftop Area	*0.2745*	*ha*
Paved area	*0.2404*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

*No Outflow, therefore 100% TSS Removal

301 - 305

Rain Garden #3 - LID-3	1.02
0.00 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
299.47 kg RET	
0.243 m3 RET	
13.85 m3 Available	

56.9 Yrs

Weighted EMC	*63.6*	*mg/L*
Landscaped Area	*0.3652*	*ha*
Rooftop Area	*0.3683*	*ha*
Paved area	*0.2876*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

*No Outflow, therefore 100% TSS Removal

505

CB Shield	0.16
46.71 mg / L	**50%**
760.08 m3 OUT	
35.50 kg OUT	
35.50 kg RET	
0.029 m3 RET	
0.88 m3 Available	

30.3 Yrs

Weighted EMC	*93.4*	*mg/L*
Landscaped Area	*0.0547*	*ha*
Rooftop Area	*0.0000*	*ha*
Paved area	*0.1052*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

506

No LID	0.06
87.67 mg / L	**0%**
78.05 m3 OUT	
6.84 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*87.7*	*mg/L*
Landscaped Area	*0.0417*	*ha*
Rooftop Area	*0.0066*	*ha*
Paved area	*0.0079*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

Continued on next page

Water Quality Calculations - Mass Balance Approach (Annual)

CLIENT: Pratt Hansen Group Inc.

DATE: December 2021

PROJECT: Elements Condominium Site Plan

DESIGN: MG

FILE: PRA-19078 (50)

CHECKED: MF

TSS Quality Treatment Train Calculations - Elements Condominium

601 - 603

No LID-Uncontrolled	0.49
99.51 mg / L	**0%**
350.41 m3 OUT	
34.87 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*99.5*	*mg/L*
Landscaped Area	*0.4627*	*ha*
Rooftop Area	*0.0000*	*ha*
Paved area	*0.0240*	*ha*
EMC Landscape	*100*	*mg/L*
EMC Rooftop	*7*	*mg/L*
EMC Paved	*90*	*mg/L*

OF#7	3.16
35.20 mg / L	**0%**
2901.98 m3 OUT	
102.15 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Annual Mass In:	**984.23 kg**	**Annual Mass Out:**	**102.15 kg**	**Overall TSS Annual Removal:**	**89.6%**

Water Quality Calculations - Mass Balance Approach (Annual)

CLIENT: Pratt Hansen Group Inc.
DATE: December 2021
PROJECT: Elements Condominium Site Plan
DESIGN: MG
FILE: PRA-19078 (50)
CHECKED: MF

TP Quality Treatment Train Calculations - Elements Condominium

Sediment Bulk Density = 1600 kg/m³
Sediment Wet Density = 1230 kg/m³
EMC = 0.32 mg/L

Land Cover EMC values have been referenced from the LID Treatment Train Tool Help Guide.

Legend:
Catchment

T.T.		Cum. Area (ha)
TP Out	mg / L	***% Rem.***
Flow Out	m3 OUT	
Mass Out	kg OUT	
Mass Ret.	kg RET	
Vol. Ret.	m3 RET	

**Yearly maintenance for the Up-Flo Filter is required per manufacturors specifications (Hydro International Operation and Maintenance Manual)

501 & 502

CB Shields	0.35
0.295 mg / L	**0%**
474.88 m3 OUT	
0.14 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*0.295*	*mg/L*
Landscaped Area	*0.2693*	*ha*
Rooftop Area	*0.0120*	*ha*
Paved area	*0.0658*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

503 & 504

No Treatment	0.16
0.240 mg / L	**0%**
1238.55 m3 OUT	
0.30 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*0.240*	*mg/L*
Landscaped Area	*0.0245*	*ha*
Rooftop Area	*0.0040*	*ha*
Paved area	*0.1364*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

Up-Flow Filter**	0.51
0.133 mg / L	**48%**
1713.44 m3 OUT	
0.23 kg OUT	
0.21 kg RET	
0.000 m3 RET	

101

Rain Garden #1 - LID-1	0.26
0.000 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
0.36 kg RET	
0.000 m3 RET	

Weighted EMC	*0.247*	*mg/L*
Landscaped Area	*0.0512*	*ha*
Rooftop Area	*0.0019*	*ha*
Paved area	*0.2019*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

*No Outflow, therefore 100% TP Removal

201 - 205

Rain Garden #2 - LID-2	0.67
0.000 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
0.72 kg RET	
0.001 m3 RET	

Weighted EMC	*0.193*	*mg/L*
Landscaped Area	*0.1524*	*ha*
Rooftop Area	*0.2745*	*ha*
Paved area	*0.2404*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

*No Outflow, therefore 100% TP Removal

301 - 305

Rain Garden #3 - LID-3	1.02
0.000 mg / L	**100%**
0.00 m3 OUT*	
0.00 kg OUT	
1.00 kg RET	
0.001 m3 RET	

Weighted EMC	*0.212*	*mg/L*
Landscaped Area	*0.3652*	*ha*
Rooftop Area	*0.3683*	*ha*
Paved area	*0.2876*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

*No Outflow, therefore 100% TP Removal

505

CB Shield	0.16
0.261 mg / L	**0%**
760.08 m3 OUT	
0.20 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*0.261*	*mg/L*
Landscaped Area	*0.0547*	*ha*
Rooftop Area	*0.0000*	*ha*
Paved area	*0.1052*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

506

No LID	0.06
0.280 mg / L	**0%**
78.05 m3 OUT	
0.02 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*0.280*	*mg/L*
Landscaped Area	*0.0417*	*ha*
Rooftop Area	*0.0066*	*ha*
Paved area	*0.0079*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

Continued on next page

Water Quality Calculations - Mass Balance Approach (Annual)

CLIENT: Pratt Hansen Group Inc.

DATE: December 2021

PROJECT: Elements Condominium Site Plan

DESIGN: MG

FILE: PRA-19078 (50)

CHECKED: MF

TP Quality Treatment Train Calculations - Elements Condominium

601 - 603

No LID-Uncontrolled	0.49
0.316 mg / L	***0%***
350.41 m3 OUT	
0.11 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Weighted EMC	*0.316*	*mg/L*
Landscaped Area	*0.4627*	*ha*
Rooftop Area	*0.0000*	*ha*
Paved area	*0.0240*	*ha*
EMC Landscape	*0.32*	*mg/L*
EMC Rooftop	*0.09*	*mg/L*
EMC Paved	*0.23*	*mg/L*

OF#7	3.16
0.192 mg / L	***0%***
2901.98 m3 OUT	
0.56 kg OUT	
0.00 kg RET	
0.000 m3 RET	

Annual Mass In:	**3.081 kg**	**Annual Mass Out:**	**0.558 kg**	**Overall TP Annual Removal:**	**81.9%**

Elements Condominium
Water Quality Calculations - LID Facility Drawdown Time

CLIENT: Pratt Hansen Group Inc.
DATE: December 2021
PROJECT: Elements Condominium Site Plan
DESIGN: MG
FILE: PRA-19078 (50)
CHECKED: MF

25mm Event Drawdown Time for Rain Garden 1

From LID PCSWMM model Catchment LID-1		
Native soil infiltration rate:	11	mm/hr
Area of facility:	256	m²
Runon from upstream catchments:	173.97	mm

25mm event Runoff Volume	44.54	m³
Infiltration Flow Rate	0.000782	m³/s
Drawdown Time	15.82	hr

Infiltration Flow rate is an addaption of Equation 4.20 from MOE SWM Planning & Design Manual dated March 2003.

Drawdown Time Equation: $T_D = V_{(25mm)}/(Q \times 3600)$

where ; Td is detention time (hours)
V(25mm) is the 25mm event runoff volume (m³)
Q is infiltration flowrate (m³/s)

Runoff Volume Equation: $V_{(25mm)} = RO \times A_{LID} \times 10$

where ; RO is the runon from the upstream catchments taken at Catchment LID-10A_1 (mm)
A_{LID} is area of LID facility (ha)

Infiltration Flow Rate: $Q_i = (P \times A_{LID})/3600000$

where ; P is the Native Soil Infiltration Rate (mm/hr)
A_{LID} is area of the LID facility (m²)

25mm Event Drawdown Time for Rain Garden 2

From LID PCSWMM model Catchment LID-2		
Native soil infiltration rate:	11	mm/hr
Area of facility:	349	m²
Runon from upstream catchments:	316.73	mm

25mm event Runoff Volume	110.54	m³
Infiltration Flow Rate	0.0011	m³/s
Drawdown Time	28.79	hr

Infiltration Flow rate is an addaption of Equation 4.20 from MOE SWM Planning & Design Manual dated March 2003.

Drawdown Time Equation: $T_D = V_{(25mm)}/(Q_i \times 3600)$

where ; Td is detention time (hours)
V(25mm) is the 25mm event runoff volume (m³)
Q_i is infiltration flowrate (m³/s)

Runoff Volume Equation: $V_{(25mm)} = RO \times A_{LID} \times 10$

where ; RO is the runon from the upstream catchments taken at Catchment LID-10A_2 (mm)
A_{LID} is area of LID facility (ha)

Infiltration Flow Rate: $Q_i = (P \times A_{LID})/3600000$

where ; P is the Native Soil Infiltration Rate (mm/hr)
A_{LID} is area of the LID facility (m²)

25mm Event Drawdown Time for Rain Garden 3

From LID PCSWMM model Catchment LID-3		
Native soil infiltration rate:	9	mm/hr
Area of facility:	554	m²
Runon from upstream catchments:	252.88	mm

25mm event Runoff Volume	140.10	m³
Infiltration Flow Rate	0.0014	m³/s
Drawdown Time	28.10	hr

Infiltration Flow rate is an addaption of Equation 4.20 from MOE SWM Planning & Design Manual dated March 2003.

Drawdown Time Equation: $T_D = V_{(25mm)}/(Q_i \times 3600)$

where ; Td is detention time (hours)
V(25mm) is the 25mm event runoff volume (m³)
Q_i is infiltration flowrate (m³/s)

Runoff Volume Equation: $V_{(25mm)} = RO \times A_{LID} \times 10$

where ; RO is the runon from the upstream catchments taken at Catchment LID-10A_2 (mm)
A_{LID} is area of LID facility (ha)

Infiltration Flow Rate: $Q_i = (P \times A_{LID})/3600000$

where ; P is the Native Soil Infiltration Rate (mm/hr)
A_{LID} is area of the LID facility (m²)

Elements Condominum
LID Facility Estimation of Provided Storage Volume

CLIENT: Pratt Hansen Group Inc.

PROJECT: Elements Condomium Site Plan

FILE: PRA-19078 (50)

DATE: December 2021

DESIGN: MG

CHECKED: MF

Statistics Referenced from Detailed Land Use Breakdown in Appendix C	
Total Catchment Area	3.16 ha
Average Percent Impervious	54.88%

Calculated RVCT Volume	
Total Impervious Area	1.73 ha
25mm RVCT	433.3 m^3

Common LID Parameters	
Storage Layer Void Ratio	0.40
Soil Media Layer Void Ratio	0.35

LID parameters have been referenced from LID Design Notes in Appendix C

LID-1 Parameters	
A LID-1	256 m^2
storage depth	0.40 m
media depth	0.55 m

LID-2 Parameters	
A LID-2	349 m^2
storage depth	0.40 m
media depth	0.55 m

LID-3 Parameters	
A LID-3	554 m^2
storage depth	0.40 m
media depth	0.55 m

Subsurface Storage Volume Calculations	
LID-1 subsurface storage volume	90.2 m^3
LID-2 subsurface storage volume	123.0 m^3
LID-3 subsurface storage volume	195.3 m^3

Surface Storage Volume Calculations	
LID-1 surface storage volume	51.2 m^3
LID-2 surface storage volume	69.8 m^3
LID-3 surface storage volume	110.8 m^3

LID Specific Maximum Storage Volume	
LID-1 Total:	141.4 m^3
LID-2 Total:	192.8 m^3
LID-3 Total:	306.1 m^3

Total Underground Storage Volume: **408.5 m^3**
Total Surface Storage Volume: **231.8 m^3**

Total LID Storage Volume: **640.3 m^3**

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 3 2021

PRA-19078 - External Ditch Conveyance Metrolinx (Area 701 & 702)

Trapezoidal

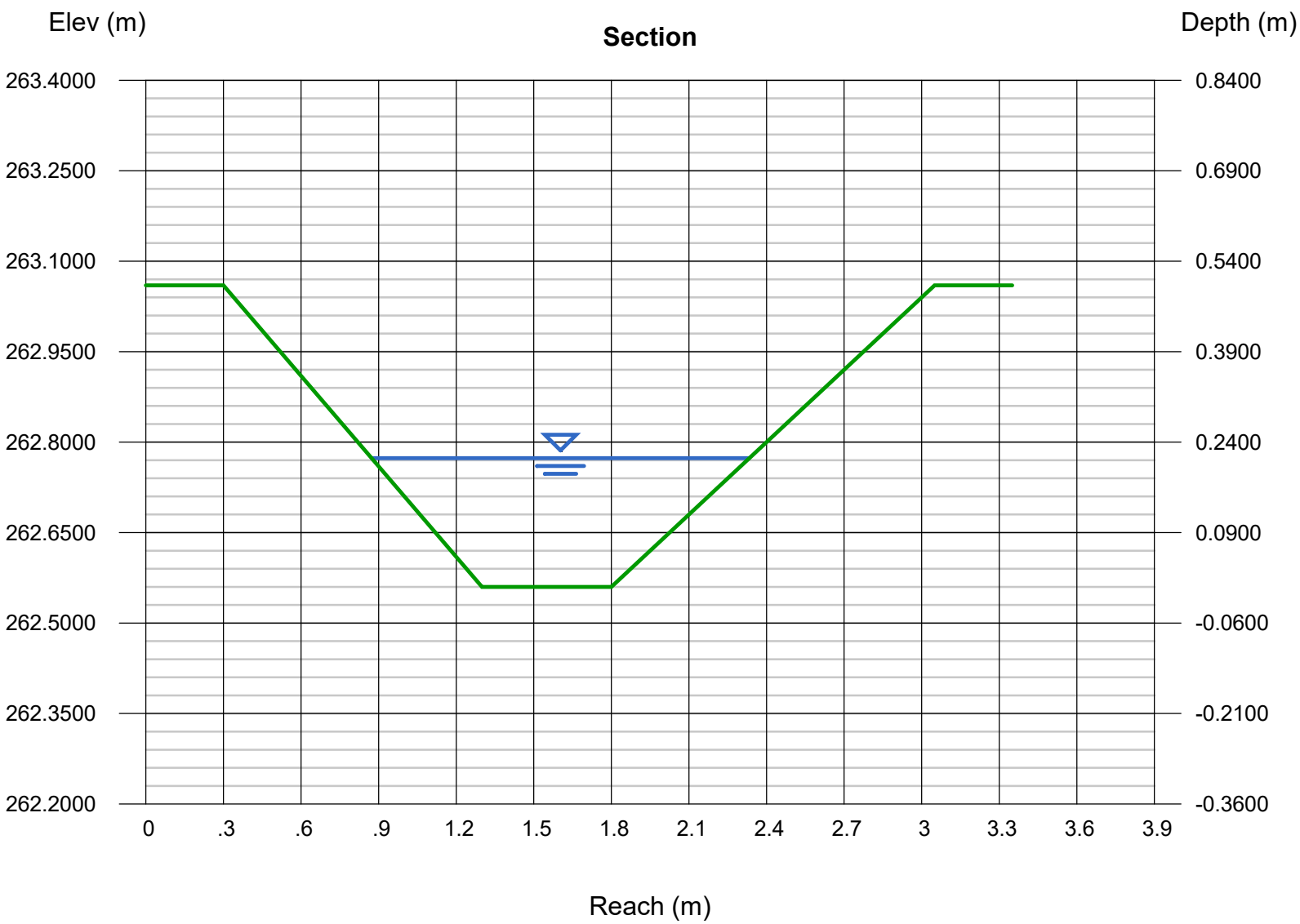
Bottom Width (m)	=	0.5000
Side Slopes (z:1)	=	2.0000, 2.5000
Total Depth (m)	=	0.5000
Invert Elev (m)	=	262.5600
Slope (%)	=	0.7720
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.1584

Highlighted

Depth (m)	=	0.2134
Q (cms)	=	0.158
Area (sqm)	=	0.2091
Velocity (m/s)	=	0.7575
Wetted Perim (m)	=	1.5516
Crit Depth, Yc (m)	=	0.1707
Top Width (m)	=	1.4601
EGL (m)	=	0.2426



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 3 2021

PRA-19078 - External Ditch Conveyance Metrolinx (Areas 701-703 & 601)

Trapezoidal

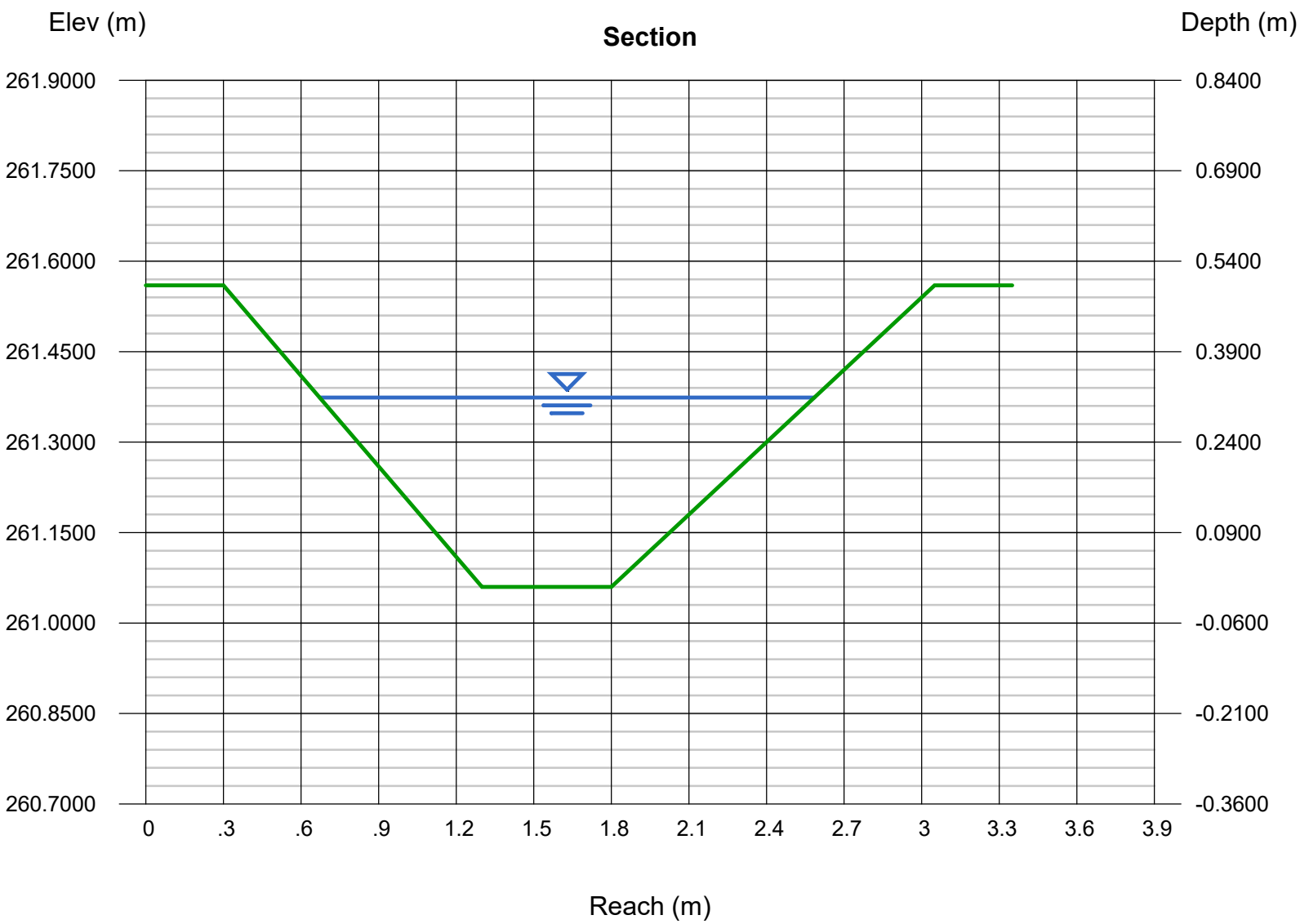
Bottom Width (m)	=	0.5000
Side Slopes (z:1)	=	2.0000, 2.5000
Total Depth (m)	=	0.5000
Invert Elev (m)	=	261.0600
Slope (%)	=	0.8490
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.3721

Highlighted

Depth (m)	=	0.3139
Q (cms)	=	0.3721
Area (sqm)	=	0.3787
Velocity (m/s)	=	0.9825
Wetted Perim (m)	=	2.0473
Crit Depth, Yc (m)	=	0.2652
Top Width (m)	=	1.9127
EGL (m)	=	0.3632



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 3 2021

PRA-19078 - Mapleview Drive East Ditch Conveyance (Areas 701-704, 601 & 602)

Trapezoidal

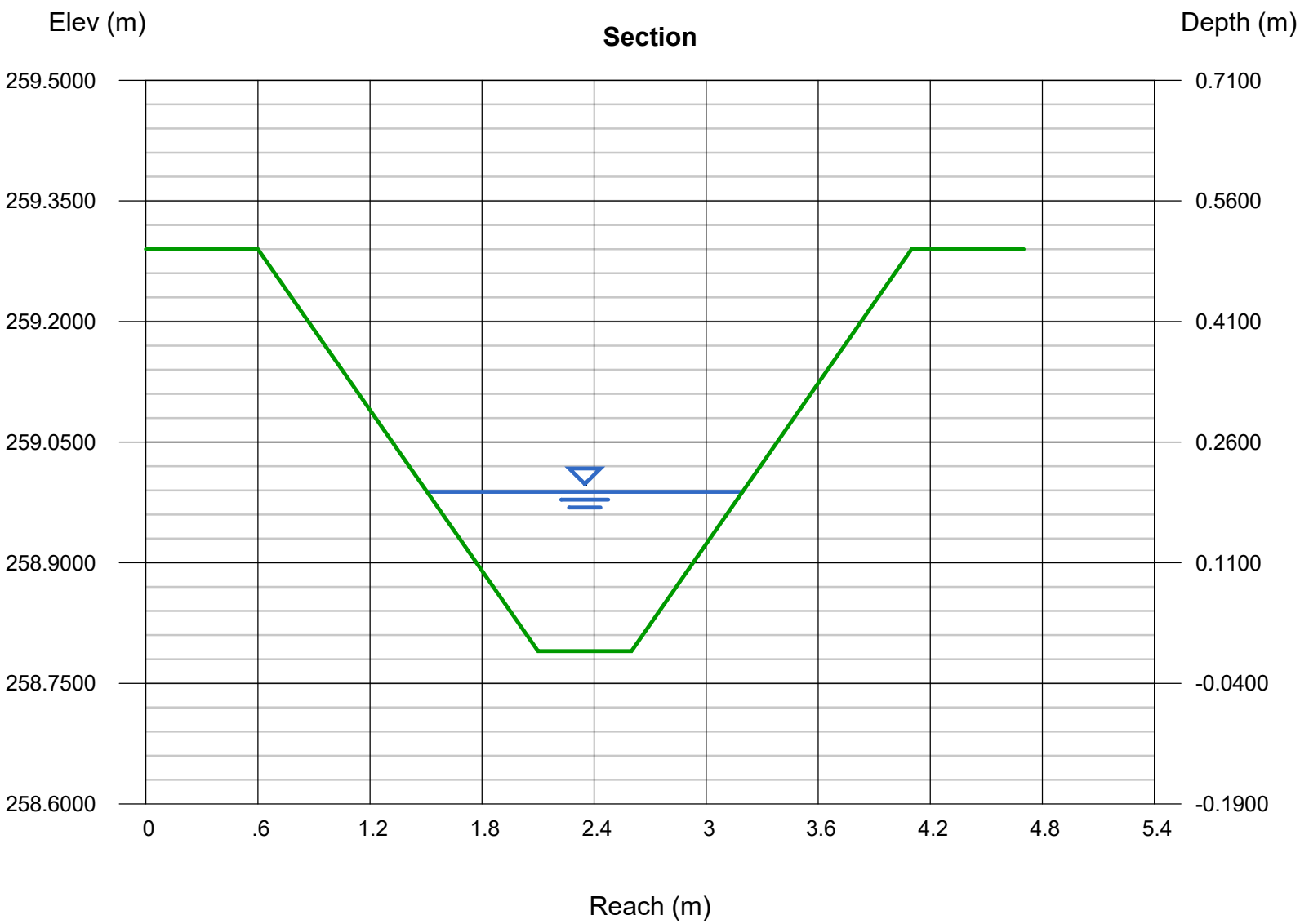
Bottom Width (m)	=	0.5000
Side Slopes (z:1)	=	3.0000, 3.0000
Total Depth (m)	=	0.5000
Invert Elev (m)	=	258.7900
Slope (%)	=	3.5190
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cms)	=	0.3336

Highlighted

Depth (m)	=	0.1981
Q (cms)	=	0.3336
Area (sqm)	=	0.2168
Velocity (m/s)	=	1.5386
Wetted Perim (m)	=	1.7530
Crit Depth, Yc (m)	=	0.2347
Top Width (m)	=	1.6887
EGL (m)	=	0.3189



◆ Verification Statement ◆ Verification Statement ◆ Verification Statement ◆

VERIFICATION STATEMENT

GLOBE Performance Solutions

Verifies the performance of

CB Shield® Stormwater Quality Device

Developed by CB Shield Inc.
Oakville, Ontario, Canada

Registration: GPS-ETV_VR2019-10-31

In accordance with

ISO 14034:2016

Environmental Management —
Environmental Technology Verification (ETV)

John D. Wiebe, PhD
Executive Chairman
GLOBE Performance Solutions

October 31, 2019
Vancouver, BC, Canada

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

Technology description and application

The CB Shield® technology provides an environmental benefit of controlling sediment wash off at upstream locations. A standard catch basin has a 1.2 m waterfall inflow that churns up sediment in the sump below causing a very poor rate of sediment retention. The CB Shield is a flow deflection device that is inserted into a standard catch basin. It contains a sloped plate to direct runoff to the back wall of the catch basin, thereby dissipating the energy of stormwater inflows. The dissipation of inflow energy allows time for settling of sediment in stormwater runoff, increasing capture and reducing scour/ re-suspension of previously deposited sediment. Installation involves lowering the unit into a standard sized catch basin, and adjusting the height of the unit to the height of the permanent pool in the sump. The unit is manufactured with durable fiberglass requiring little maintenance and is estimated to be operated on the same cleanout schedule set for the catch basin. Due to high rates of scour in a standard catch basin, they are seldom filled beyond 40% of sump capacity. Clean out routines and expenses are optimized when the CB Shield captures and retains more sediment within the sump.

In an urban setting, there are typically approximately 5 catch basins installed per hectare. Assuming an equal distribution of overland flow, the tested flow rates for the scour and capture tests are meaningful in the context of 78 L/s per hectare and 42 L/s per hectare, respectively. The CB Shield's scour prevention performance has been evaluated in a laboratory setting relative to a standard unshielded catch basin for flows of 1.2 to15.6 L/s. The device's sediment capture performance was evaluated for flows of 0.24 to 8.4 L/s. Hydraulically, the CB Shield has been tested to pass flows up to 60 L/s without any negative impacts (i.e., surcharging).

Performance conditions

<u>Claim 1: Capture test</u>

The capture test is carried out in a laboratory with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width). The catch basin was clean of any litter or debris. Capture performance was tested by comparing the mass of retained sediment with the influent sediment mass for each of six inflow rates: 0.24, 0.48, 1.20, 2.40, 6.00, and 8.40 L/s. The test sediment consisted of ground silica (1 – 1000 micron) with a specific gravity of 2.65, uniformly mixed to meet the particle size distribution specified in the *Procedure for Laboratory Testing of Oil Grit Separators (TRCA, 2014)*. Sediment was injected onto the street scape at a point just upstream of the catch basin to allow mixing prior to discharge while avoiding excessive buildup of sediment on the street scape. The sediment feed rate was adjusted for each flow rate to keep the influent concentrations consistent at 200 mg/L. The tests were conducted with a false floor set at 300 mm below the outlet invert simulating a catch basin that is filled to 50% of the manufacturer's recommended maximum sediment storage.

<u>Claim 2: Scour test</u>

The scour test was carried out in a laboratory on catch basins with and without the CB Shield® insert with a constructed simulated street scape (1 % slope along its 2.4 m (96 inch) length, 2 % slope along its 1.2 m (48 inch) width) and the catch basins clean of any litter or debris. A false floor was set in the catch basins at 254 mm below the outlet invert and preloaded with the test sediment (1- 1000 micron silica blend) test up to 150 mm below the outlet invert simulating a catch basin that is ¾ full of sediment. Water was filled to the effluent pipe and sediments were allowed to settle for 12-24 hours. Flows of 1.2, 4.8, 8.4, 12, and 15.6 L/s were tested on a continuous run with flow rates maintained at 5 minutes and a one minute transition time between flow rates. A minimum effluent grab sample of 500 mL was collected in 1000 mL jars by holding it under the entire effluent stream. A sample was taken at 30 seconds during the flow transitions to account for scour during the transition. Background samples were also taken at least once

every flow rate and effluent concentrations were corrected accordingly. Effluent flow was filtered using a 10µm filter and was recycled during the continuous 30 min test.

Performance claim(s)

Claim 1: Capture test

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

Claim 2: Scour test

For a catch basin filled to three quarters of the manufacturer's recommended maximum sediment storage depth, with the CB Shield® insert, scouring of test sediment is at most 8% of the control catch basin during a continuous 30 minute scour test run with 5 minute duration inflows of 1.2, 4.8, 8.4, 12.0, and 15.6 L/s.

Performance results

The test sediment used to evaluate the CB Shield® technology was the same as that required by CETV for the evaluation of Oil Grit Separators. The comparison of the average test sediment PSD to the CETV specified PSD in Figure 1 indicates that the test sediment was finer than the specified PSD, with a median particle size of approximately 50 microns.

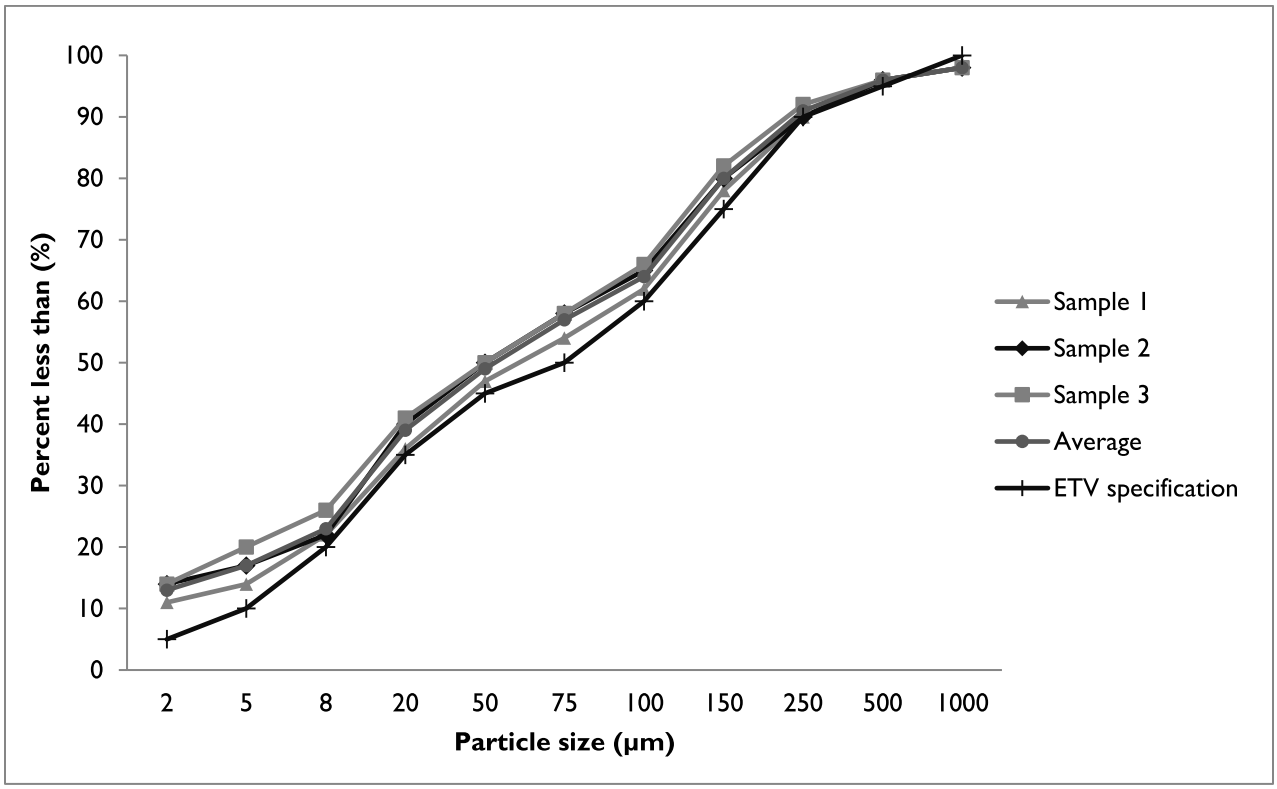


Figure 1. Test sediment particle size distribution (PSD) in relation to specified PSD.

The capacity of the device to retain sediment was determined at six surface loading rates using the modified mass balance method (see TRCA, 2014). During each of the tested flow rates, a known quantity

of sediment was injected at a constant rate onto a simulated street scape just upstream of the catch basin containing the CB Shield® technology. Based on these results, removal efficiencies were determined for each of the tested surface loading rates (Table 1).

Table 1. Removal efficiencies (%) based on modified mass balance results at specified surface loading rates.

Flow rate	**(L/s)**	0.24	0.48	1.20	2.40	6.00	8.40
Surface loading rate	**(L/min/m^2)**	40	80	200	400	1000	1400
Total mass added	**(kg)**	1.217	2.302	5.072	5.150	4.921	4.812
Total mass captured	**(kg)**	0.778	1.378	2.659	2.196	1.238	1.287
Removal efficiency	**(%)**	64.0	59.9	52.4	42.6	25.2	26.7

Table 2 shows the results of the sediment scour and re-suspension test. This test involved preloading fresh test sediment into the sedimentation area of two catch basins with and without the CB Shield technology, as described in Performance Conditions section above. Effluent samples were collected at one-minute sampling intervals and analyzed for Suspended Sediment Concentration (SSC). The mean sediment scour load of the catch basin with the CB shield insert was shown to be only 5% that of the control catch basin.

Table 2. Scour test effluent sediment concentration and loads.

Run	Flow rates (L/sec)	Surface loading rate (L/min/m²)	CB Shield®			Control		
			Run time (min)	Effluent suspended sediment concentration (mg/L)	Sediment load (g)	Run time (min)	Effluent suspended sediment concentration (mg/L)	Sediment load (g)
			1:00	17.7	1.3	1:00	129.2	9.7
			2:00	6.5	0.47	2:00	185.3	13.9
			3:00	2.7	0.19	3:00	206.0	15.5
			4:00	3.1	0.22	4:00	176.0	13.2
			5:00	4.6	0.33	5:00	523.6	39.4
			6:00	0.6	0.04	6:00	495.7	41.8
1	1.2	200	**Sum**		**2.6**	**Sum**		**133.5**
			7:00	8.2	2.4	7:00	7164.0	2069.0
			8:00	4	1.2	8:00	8094.0	2338.0
			9:00	0.6	0.2	9:00	6762.0	1950.0
			10:00	0.6	0.2	10:00	4842.0	1393.0
			11:00	1.7	0.5	11:00	5266.0	1517.0
			12:00	0.6	0.2	12:00	4768.0	1457.0
2	4.8	800	**Sum**		**4.7**	**Sum**		**10724.0**
			13:00	5.4	2.7	13:00	5429.0	2725.0
			14:00	10.0	5.0	14:00	6648.0	3332.0
			15:00	9.5	4.8	15:00	5025.0	2528.0
			16:00	10.0	5.0	16:00	5859.0	2939.0
			17:00	8.4	4.2	17:00	5019.0	2515.0
			18:00	8.2	4.1	18:00	3249.0	1628.0
3	8.4	1400	**Sum**		**25.8**	**Sum**		**15667.0**
			19:00	38.4	27.6	25:30	1886.0	1347.0
			20:00	79.4	57.2	26:30	1432.0	1027.0
			21:00	113.0	81.3	27:30	1167.0	844.0
			22:00	103.0	74.2	28:30	1508.0	1089.0
			23:00	114.0	82.1	29:30	1100.0	795.0
			24:00	92.3	66.5	30:30	708.0	512.0
4	12	2000	**Sum**		**388.9**	**Sum**		**5614.0**
			25:00	117.4	166.0	52:30	386.9	364.8
			26:00	211.6	198.1	53:30	252.7	237.8
			27:00	220.3	206.2	54:30	372.5	349.6
			28:00	187.8	175.8	55:30	332.4	311.7
			29:00	224.4	210.0	56:30	279.8	262.6
			30:00	199.2	186.5	57:30	310.2	290.9
5	15.6	2600	**Sum**		**1142.6**	**Sum**		**1817.4**
Total load					**1564.6**			**33956.0**

Potential sources of error

1. Background concentrations during the scour test were measured to be generally under 5 mg/L for both CB Shield® and Control treatments. However, background concentrations for the Control treatment at flow rates of 12.0 L/s and 15.6 L/s were substantially higher than the expected threshold of 20 mg/L as a result of inefficient recycling of water in the laboratory. Effluent samples were corrected based on the measured background concentrations since it was assumed that background sediments consisted of fine particles that were not captured in the device and flowed through as effluent concentration. If instead, some of the background sediments settled, the correction for all background sediments would bias against the relative performance of the CB Shield and therefore result in a more conservative evaluation of the CB Shield technology performance.

2. The reduction in scour at higher flow rates for the Control treatment suggested that the amount of preloaded sediment (10.2 cm depth) may have been insufficient to provide a continuous supply of fine particles for scour throughout the test. A similar decrease in scour at high flow rates was not observed for the CB Shield® treatment. This interpretation of the data implies that preloading both catch basins with additional sediment would likely have shown increased relative scour for the Control treatment, particularly at high flow rates. Although further testing would be required to verify this interpretation, it is reasonable to suggest that the test as conducted may have produced a smaller relative difference, resulting in a more conservative claim for the CB Shield technology.

Verification

This verification was first completed in October, 2016 and is considered valid for subsequent renewal periods every three (3) years thereafter. Data and information provided by CB Shield Inc. to support the performance claim included the following: Performance test report prepared by Good Harbour Laboratories of Mississauga, Ontario, dated 24 August 2016; the report was based on testing completed in accordance with the Procedure for Laboratory Testing of Oil-Grit Separators (Version 3.0, June 2014).

The original verification was completed by the Toronto and Region Conservation Authority, contracted by GLOBE Performance Solutions, using the Canadian ETV Program's General Verification Protocol (June 2012) and taking into account ISO/FDIS 14034:2015(E). This ETV renewal is considered to meet the equivalency of an ETV verification completed using the International Standard ***ISO 14034:2016 Environmental management -- Environmental technology verification (ETV)***.

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

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

For more information on the CB Shield® Stormwater Quality Device please contact:

CB Shield Inc.
39 Uplands Drive
Brantford, ON
N3R 6H5 Canada
Tel: 519-212-9161
info@cbshield.com
www.cbshield.com

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

GLOBE Performance Solutions
404 – 999 Canada Place
Vancouver, BC
V6C 3E2 Canada
Tel: 604-695-5018 / Toll Free: 1-855-695-5018
etv@globeperformance.com
www.globeperformance.com

Limitation of verification - Registration: GPS-ETV_VR2019-10-31
GLOBE Performance Solutions and the Verification Expert provide the verification services solely on the basis of the information supplied by the applicant or vendor and assume no liability thereafter. The responsibility for the information supplied remains solely with the applicant or vendor and the liability for the purchase, installation, and operation (whether consequential or otherwise) is not transferred to any other party as a result of the verification.

November 3, 2021

ADS UFF Sizing Summary

Project Name: Elements Condos

Consulting Engineer: Jones Engineering

Location: Barrie, ON

Sizing Completed By: Cody Neath **Email:** cody.neath@ads-pipe.com

Recommended Unit	
Recommended Model:	UFF-4
TSS Removal Percentage:	81.3%
Total Site Volume Treated:	90.4%

Site Details	
Site Area:	0.512 ha
% Impervious:	42.62%
Rational C:	0.56
Rainfall Station:	Barrie, ONT
Particle Size Distribution:	ETV / NJDEP
Peak Storm Flowrate:	---

Unit Specifications:	
Number of Filter Modules:	4
Maximum Treatment Flowrate:	6.4 L/s
Inlet - Outlet Drop:	240 mm*
Max. Pipe Diameter:	600 mm

* Drop across unit can be reduced when required.

Site Elevations:	
Rim Elevation:	100.00
Inlet Pipe Elevation:	99.00
Outlet Pipe Elevation:	98.76

Consult approved shop drawings for final elevations. Riser sections (and/or grade rings) may be required to reach final grade on site.

Rainfall Intensity(1)	Fraction of Rainfall(1)	Removal Efficiency(2)	Weighted Net-Annual Removal Efficiency
mm/hr	%	%	%
0.50	0.3%	92.2%	0.3%
1.00	25.7%	91.3%	23.5%
1.50	5.3%	90.3%	4.8%
2.00	13.4%	89.4%	11.9%
2.50	5.5%	88.4%	4.9%
3.00	3.7%	87.5%	3.3%
3.50	7.2%	86.5%	6.2%
4.00	3.4%	85.6%	2.9%
4.50	2.4%	84.6%	2.1%
5.00	4.3%	83.7%	3.6%
6.00	3.6%	81.8%	3.0%
7.00	4.3%	79.9%	3.5%
8.00	3.4%	77.9%	2.6%
9.00	1.6%	76.0%	1.2%
10.00	2.1%	74.1%	1.6%
20.00	8.9%	55.1%	4.9%
30.00	2.3%	36.0%	0.8%
40.00	1.0%	16.9%	0.2%
50.00	0.5%	0.0%	0.0%
100.00	0.7%	0.0%	0.0%
150.00	0.1%	0.0%	0.0%
Net Annual Treatment			**81.3%**
Total Runoff Volume Treated:			**90.4%**

Rainfall Data: 1978:2007, HLY03, Barrie, ONT, 6110557.

Notes:

Removal efficiencies are based on NJDEP Test Protocols and independently verified.

TSS removal based on ETV/NJDEP particle size distribution.

All units supplied by ADS have numerous local, provincial, and international certifications (copies of which can be provided upon request). The design engineer is responsible for ensuring compliance with applicable regulations.

Verification Statement

Hydro International Up-Flo® Filter with CPZ™ Media

Registration number: (V-2019-06-01)
Date of issue: (2020-May-13)

Technology type	Stormwater Filtration Device		
Application	Technology to remove sediment, nutrients and metals from stormwater runoff		
Company	Hydro International	**Website**	https://www.hydro-int.com
Address	94 Hutchins Drive, Portland, Maine USA 04102		
E-mail	TechSupport@hydro-int.com	**Phone**	+1 (207) 756 6200

This Verification Statement was prepared by VerifiGlobal to summarize the results reported in the Verification Report for the Hydro International Up-Flo® Filter with CPZ™ Media, dated November 26, 2019. The Verification Report was prepared by Good Harbour Laboratories Inc. (GHL) for VerifiGlobal in accordance with the requirements of the International Organization for Standardization (ISO) 14034 Environmental Technology Verification (ETV) standard and the VerifiGlobal Performance Verification Protocol. All the information provided in this Statement are based on the independent, third-party review and verification of technical information, performance test reports, performance data and specific performance claims documented in the Verification Report.

Technology Description

The Up-Flo® Filter with CPZ™ Media is a stormwater remedial device that incorporates gravitational separation of floating and settling materials, screening, and filtration of polluted stormwater to offer treatment train capabilities in a standalone device. Each Up-Flo® Filter consists of a highly configurable array of modules that are typically supplied as a complete system housed in a 4-ft (1.2 m) diameter manhole or precast vault. Manhole configurations consist of a single ring assembly containing one to six modules. Vaulted systems are highly configurable and may contain single or multiple arrays each consisting of one to 18 Filter Modules depending on availability of vault sizes.

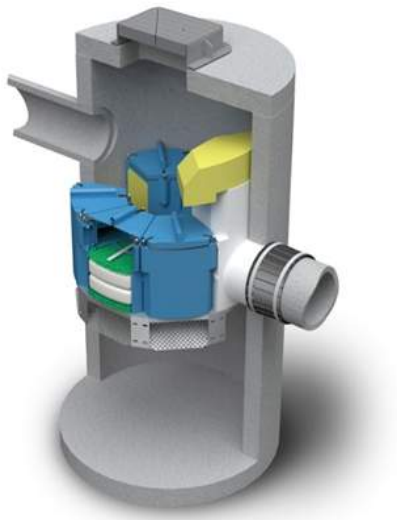


Figure 1: Up-Flo® Filter with CPZ™ Media

Verified Performance Claims

Verification of the Hydro International Up-Flo® Filter with CPZ™ Media is based on existing performance test data from two different locations with different rainfall characteristics, catchment areas and pollutant loadings. Supporting data were obtained from three independent perfomance monitoring studies. One was conducted by Engineering School of Sustainable Infrastructure and Environment (ESSIE) at the University of Florida (UF) under the supervision of Dr. John Sansalone and two were conducted by Department of Civil, Construction, and Environmental Engineering (CCEE) at the University of Alabama (UA) under the supervision of Dr. Bob Pitt.

All three studies performance monitoring studies were conducted following the requirements of the New Jersey Department of Environmental Protection (NJDEP) Technology Acceptance Reciprocity Partnership (TARP) Tier II Protocol for Stormwater Best Management Practice Demonstrations (2003) and its 2006 and 2009 amendments. In total, there were 66[1] storms assessed to verify that an Up-Flo® Filter with CPZ™ Media achieves the performance listed in Tables 1 and 2, when designed to the following parameters:

- System hydraulic loading rate of 25 gpm (1.58 L/s) per filter module, with bypass of higher flows.
- Filter flux rate of 22.7 gpm/ft2 (15.4 L/s/m2)
- Operating head of ≤30 in. (76.2 cm)
- Effective Sedimentation/ Filtration Treatment Area (ESA/EFTA) –12.6/6.6 (1.91)
- Maximum sediment storage volume of 16.8 ft3 (0.476 m3) at a sediment depth of 16 inches (0.41m).

Table 1. Up-Flo® Filter with CPZ™ Media – Verified Concentration Removal Efficiency

Constituent	Lower 95% Confidence Interval	Median	Upper 95% Confidence Interval
SSC *	85.9%	92.8%	94.7%
SSC **	73.9%	82.8%	86.3%
TSS *	79.0%	89.2%	91.0%
TSS **	72.0%	78.3%	85.2%
TN *	9.0%	28.5%	64.7%
TP *	33.8%	43.9%	50.9%
Zn **	39.4%	50.0%	62.1%
Cu **	72.6%	80.7%	85.2%
* Based on ESSIE (UF) Performance monitoring results ** Based on CCEE (UA) Performance monitoring results			

Table 2. Up-Flo® Filter with CPZ™ Media – Verified Flow Weighted Mass Removal Efficiency

Constituent	ESSIE (UF) Performance monitoring results		CCEE (UA) Performance monitoring results
	6-month	12-month	12-month
SSC	93%	92%	86%
TSS*	89%	87%	87%
TN **	68%	39%	***
TP **	48%	48%	***
Zn	***	***	59%
Cu	***	***	70%
* TSS results for UF are a function of SSC. ** TN and TP load data was time dependent after 6-months *** No data submitted			

[1]Of the total 66 storms (16 storms from UF and 50 storms from UA), 62 were identified as qualifying events having quality data for TSS, and 59 for SSC. Fewer events with metals detected in the runoff limited the metals data sets. There were a total of 28 and 17 storms for Zn and Cu, respectively, solely from the UA data. Total Nitrogen and Total Phosphorous claims were based on the 16 storms recorded solely from the UF data.

Description of Test Procedure

Table 3 shows the target criteria as outlined by the TARP and TAPE programs as well as the results achieved at the two locations. Table 4 provides a more detailed description of the observed operating conditions over the testing period. At the time of testing, the TARP and TAPE programs both allowed for field testing data to be used to obtain certification in participating states. They were the most widely used protocols and were generally accepted as industry standards. The TARP program has since stopped accepting field data, but the TAPE program remains in effect and is currently referenced to benchmark the quality of data obtained from stormwater monitoring programs.

Table 3. Up-Flo® Filter with CPZ™ Media Performance Testing - Specified TARP & TAPE criteria, and achieved results, for storm selection and sampling

Description	TARP Criteria	TAPE Criteria	Achieved value	
			ESSIE - UF	CCEE - UA
Total rainfall/storm	≥2.5 mm (0.1”)	≥3.81 mm (0.15”)	>2.5 mm (0.1")	≥4.6 mm (0.18”)
Minimum inter-event period	6 h	6 h	≥ 6 h	≥ 6 h
Minimum flow-weighted composite sample storm coverage	70% including as much of the first 20% of the storm	75% including as much of the first 20% of the storm	100%	87.6%
Minimum influent/effluent samples	10, but a minimum of 5 subsamples for composite samples	12, but a minimum of 10 subsamples for composite samples	5, whole manual samples	11
Total sampled rainfall	≥ 381 mm (15”)	NA	195 mm (7.66”)	765 mm (30.07”)
Total sampled storms	≥ 20	≥ 12	16	29

Table 4. Up-Flo® Filter with CPZ™ Media Performance Testing - Observed operational conditions for events monitored over each performance test period

Operating parameter	Observed range	
	ESSIE - UF	CCEE - UA Total*
Storm duration	0.35-5.78 h	0.67-64.7 h
Previous dry hours**	6-213	> 6 hrs for the 20 storms in 1st study and 12-632 hrs for 30 storms in second study
Rainfall depth	0.10-1.64 in	0.18-2.44 in
Runoff volume	223-4095 gal (0.84-15.5 m^3)	2,065-61,131 gal(7.82-231 m^3)
Peak rainfall intensity (5 min)	1.2-5.4 in/h (3.0-13.7 cm)	0.24-4.68 in/h (0.61-11.9 cm)
Peak runoff flow rate	27.7-233 gpm (1.75-14.7 L/s)	68-1023 gpm (4.29-64.5 L/s)
Event median flow rate	2.4-21.4 gpm (0.15-1.35 L/s)	28-175 gpm (1.75-11.0 L/s)

* The UA data ranges cover the storms for both studies; ranges for individual studies might be narrower.
** This is the same as the time period between events, or time since it last rained a qualifying event.

For the UF study, performance monitoring was conducted at the Reitz Union surface parking lot, which had a drainage area of 0.12-0.20 acres (0.049-0.081 ha),which was 76% impervious, depending on storm intensity and wind direction. The area generated a flow rate in excess of the 150 gpm (9.55 L/s) maximum treatment flow rate (MTFR) in 3 of the 16 storms. The 4-ft diameter (1.2 m) test unit was installed above ground in a temporary installation at the bottom of a hill sloping down from the lot. An inlet catch basin conveyed runoff from the parking lot through a Pashall flume into the filter. Monitoring occurred over a period of 12 months and the UF team recovered the captured mass at the end of the perfomance monitoring study. No maintenance was required or conducted during the year long monitoring period from 12 September 2015 through 1 September 2016.

The UA perfomance monitoring studies covered a total of 50 storms, but not all of them yielded useful data for all parameters. The site used in both cases was the Riverwalk parking lot near the Bama Belle in Tuscaloosa, Alabama. The drainage area was about 0.9 acres (0.36 ha), 68% impervious. The unit was installed in a 4 ft. (1.2 m) diameter below-grade catch basin inlet manhole on the site. Monitoring occurred in two stages of approximately 12 months each over a total of 32 months. The first round of testing occurred from July 16, 2010 to April 11, 2011 and the second from May 31st, 2012 to March 30th, 2013.

The UA perfomance monitoring study used autosamplers to generate the flow-weighted composite samples and the event mean concentration data. This data was used to calculate removal efficiencies. However, in the UF performance monitoring study, sediment removal performance was assessed by taking full cross section samples of the influent and effluent streams at regular intervals for the duration of the storm and combining the samples into flow-weighted composites. The data was converted into event mean concentrations for the purposes of calculating removals.

The following approved analytical methods were used:

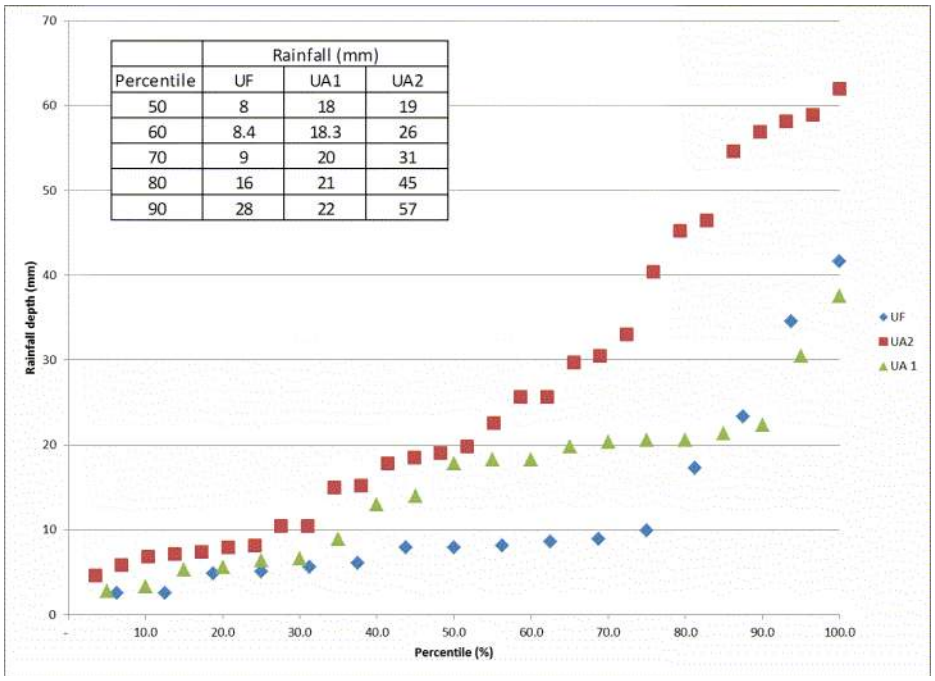
- TSS – ASTM D2540
- SSC – ASTM D3977-97(2013) Standard Test Methods for Determining Sediment Concentration in Water Samples
- PSD – ASTM D422 – 63 Standard Test Method for Particle-Size Analysis of Soils and ASTM C136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
- PSD – ASTM 2560- C, D (UF used 2560D laser diffraction or light-scattering method and UA used 2560C Coulter Counter or light-blocking method)
- TP – S.M.4500-P-B Acid Hydrolysis
- TN – Persulfate Digestion Method
- Cu – EPA 200.8 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry
- Zn - EPA 200.8 Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma – Mass Spectrometry

As part of the mass balance measurements, the UF team allowed all samples to sit for an hour and reported concentrations of suspended solids, measured using ASTM 2540D, as TSS, in addition to the usual SSC measurement using SM3977. In order to be able to report a TSS comparable to other perfomance monitoring studies, Dr. Sansalone developed a correlation equation for TSS* = f(SSC) as well as equations for the 95% confidence limits of TSS*.

Summary of Verification Results

The cumulative frequency of rainfall depths monitored during the three perfomance monitoring studies is presented in Figure 2. The median rainfall depths in the three perfomance monitoring studies were 0.31, 0.71, and 0.75 inches (8, 18 & 19 mm) while the 90th percentile rainfall depths were 1.1, 0.9 and 2.2 inches (28, 22 and 57 mm). Thus the data presented covers a comparatively wide range of rain events.

Figure 2. Rainfall depth frequency curves



	Rainfall (mm)		
Percentile	UF	UA1	UA2
50	8	18	19
60	8.4	18.3	26
70	9	20	31
80	16	21	45
90	28	22	57

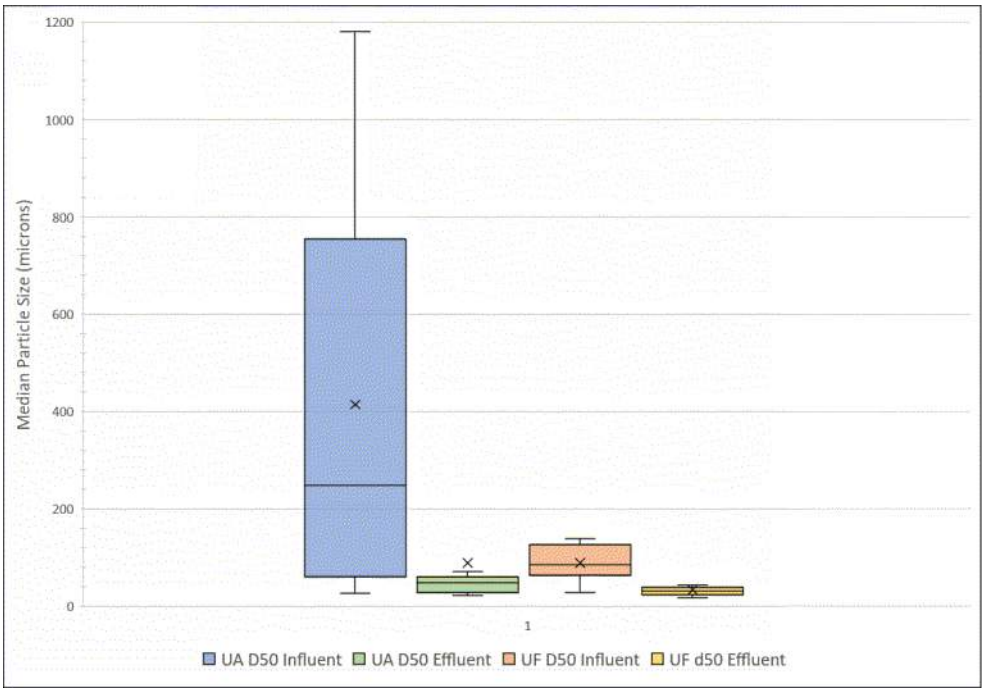
For UF monitoring, a total of 16 storm events, with varying rainfall intensity and runoff volume from event to event, were monitored. The cumulative rainfall depth was 7.66 inches (195 mm) and the cumulative influent runoff volume was 20,022 gallons (7.65 m^3). The entire volume was treated by the Up-Flo® Filter system. Of the 16 storms treated, three storms generated flow rates exceeding the MTFR of 150 gpm (9.55 L/s) but there was no bypass, because the excess was not sufficient to top the overflow weir, and all sampled flows passed through the filtration media. Median driving head difference for an event never exceeded 13.1 inches (33.3 cm) and peak driving head difference never exceeded 27.1 inches (68.8 cm), which indicates the media was not occluded.

For the UA site, all of the storm events from May 31st, 2012 to March 30th, 2013 were monitored for flow but only 30 events were sampled. The total rainfall depth for this period was 49 inches (124.5 cm) or 982,192 gal. (3,718 m^3) of runoff volume that was routed through the filter. Actual storm data from the monitoring period showed about 624,503 gal. (2,364 m^3) of runoff (from about 30 inches or 76.2 cm of rainfall) was treated by the media filter system. This included about 28.5 % of bypass flow volume, which was sampled and included in the performance results. Given that the total bypassed volume was almost three times the expected bypass volume at the UA site, the UA results are considered conservative.

Influent particle sizes varied considerably between the two monitored locations and between storm events. Catchment characteristics and available sources, sampling methods (auto sampling vs. grab sampling), storm intensities, duration and volumes all influence the particle size range. The particle size analyses were completed for just the median particle size for each storm. A comparison of statistical descriptive values for influent and effluent median particle sizes for the two monitored sites is illustrated with the Whisker-Box-Plot shown in Figure 3.

Due to larger storm events and curbside erosion, the median UA influent particle size range and d_{50} were substantially the larger of the two monitored sites. The interquartile range for the influent median particles sizes was 659 µm for UA compared to 59 µm for UF and the UA d50 was 247 µm compared to 85 µm for UF. However, despite the influent particle size differences between locations, the median UA and UF effluent particle size range and d50 were similar. The interquartile range for the effluent median particles sizes was 33 µm for UA compared to 13 µm for UF and the UA d50 was 48 µm compared to 30 µm for UF.

Figure 3. UF and UA Summary of Influent and Effluent Median Particle Sizes



Summary statistics for the influent and effluent concentration removal efficiencies as well as the overall mass load reductions are shown in Table 4 and Table 5 for UF and UA, respectively.

While the flow weighted removal efficiency for TP and TN were 48% and 39%, respectively, TP and TN reduction tended to decrease with the overall volume treated. Results showed that if the filter maintnenance cycle is limited to 6-8 months, the long-term load reduction for TP and TN would have been 50% and 70%, respectively.

Table 4: Up-Flo® Filter with CPZ™ Media Performance Testing - Summary statistics for influent and effluent event mean concentrations (EMCs) and the overall mass load reductions for selected constituents (UF Test)

Parameter	Sample Location	Min	Max	Median	SD	Mass Load Reduction
SSC	Influent	146	1584	487	360	92%
	Effluent	19.9	96.5	43.25	20.2	
TSS*	Influent	93.3	870	277	194	87%
	Effluent	25.0	66.4	37.6	10.9	
TP	Influent	0.79	6.05	1.9	1.70	48%
	Effluent	.56	2.19	1.1	0.56	
TN	Influent	.41	7.89	2.1	2.18	39%
	Effluent	.52	3.84	1.2	1.21	

Table 5. Up-Flo® Filter with CPZ™ Media Performance Testing - Summary statistics for influent and effluent event mean concentrations (EMCs) and the overall mass load reductions for selected constituents (UA Tests)

Parameter	Sample Location	Min	Max	Median	SD	Mass Load Reduction
SSC (mg/L)	Influent	23	879	88	166	86%
	Effluent	3	69	17	18	
TSS (mg/L)	Influent	11	571	89	128	87%
	Effluent	3	64	19	22	
Total Zn (µg/L)	Influent	7.0	157	22.0	0.71	59%
	Effluent	2.5*	72	14.0	0.68	
Total Cu (µg/L)	Influent	6	181	9	42	70%
	Effluent	1.3**	42	1.3	20.9	

* There was a single effluent value that was non-detect (ND). Since it was only 1 value ½ the detection limit 1.3 µg/L, was substituted when calculating statistics.
**The Cu data was highly censored (many non-detect, ND, effluents). Statistics were calculated by substituting ½ the detection limit, 1.3 µg/L, for all ND data then bootstrapping as usual.

As the independent third-party verifier, following the requirements of ISO 14034, GHL has confirmed that:

- The Hydro International Up-Flo® Filter with CPZ™ Media is based on sound scientific and engineering principles, providing a net environmental benefit.
- Performance testing of the Hydro International Up-Flo® Filter with CPZ™ Media was based on defined parameters and was conducted following the requirements of the NJDEP TARP Tier II Protocol for Stormwater Best Management Practice Demonstrations (2003) and its 2006 and 2009 amendments.
- Performance testing of the Hydro International Up-Flo® Filter with CPZ™ Media was performed by a qualified testing organization.
- Sample analyses were carried out as part of the test plan by a third-party analytical laboratory in a manner that meets the quality requirements of ISO 17025. Operating conditions and performance during each testing run were documented.
- Frequency of sampling and duration of each performance test were determined based on the specifications in a credible test plan and the requirements to produce sufficient data to support the performance claim at a 95% confidence level.
- Performance measurements and calculations were based on the technology application and relevant performance parameters as outlined in the Verification Plan.
- Performance calculations were done according to generally accepted test methods described in the test design, including the applicable mathematical and statistical principles and procedures.
- Data storage, transfer and control were adequate, carried out in accordance with the intent of ISO 9001 enabling control and retrieval of documents and records.
- Quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This confirmation included reviewing all data sheets and data downloads, as well as overall management of test system quality.

Quality Assurance

Performance testing and verification of the Hydro International Up-Flo® Filter with CPZ™ Media were performed in accordance with the requirements of ISO 14034:2016 and the VerifiGlobal Performance Verification Protocol. The verifier, Good Harbour Laboratories, has confirmed that quality assurance requirements were addressed throughout the performance testing process and in the generation of performance test results. This includes reviewing all data sheets and data downloads, as well as overall management of the test system, quality control and data integrity.

References

Technology Acceptance Reciprocity Partnership (TARP) Protocol and New Jersey Department of Environmental Protection (NJDEP amendments to the TARP Protocol, dated August 5, 2009 and Revised December 5th, 2009

"Development and Testing of Protocols for Evaluating Emerging Technologies for the treatment of Stormwater", Noboru Togawa, Dissertation, Department of Civil, Construction, Construction, and Environmental Engineering, Graduate School of the University Of Alabama, Tuscaloosa, Alabama, 2011.

"Up-Flo® Filter Verification Testing, Quality Assurance Project Plan, Bama Belle Field Verification Test Site", Tuscaloosa, AL, Hydro International, July 2012.

"Full-Scale Up-Flo® Filter Field Performance Verification Tests", Department of Civil, Construction, and Environmental Engineering University of Alabama, Tuscaloosa, AL 35487 USA - December 26, 2013.

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"Physical Model Testing and Monitoring of a Hydro International (HI) Up-Flo® Filter Subject to Rainfall-Runoff Loading Events", University of Florida Engineering School of Sustainable Infrastructure and Environment (ESSIE), University of Florida, Gainesville, FL 32611 USA - Version 7-12-17.

Particulate Matter Fraction Analyses. (Sansalone & Kim: Transport of Particulate Matter Fractions in Runoff, Journal of Environmental Quality • Volume 37 • September–October 2008)

New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device, January 2013

2009 Urban Stormwater BMP Performance Monitoring Guidelines
http://www.bmpdatabase.org/contacts.html

Description of Up-Flo® Filter

Up-Flo® Filter Design Manual https://www.hydroint.com/sites/default/files/uff_dg_nashville_f1504.pdf

Up-Flo® Filter Verification Brochure

ISO/IEC 14034, Environmental management – Environmental technology verification

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

ISO/IEC 9001, Quality Management Systems.

VerifiGlobal Performance Verification Protocol (Applying ISO 14034:2016)

VerifiGlobal Test Body Assessment – Guidance (2018)

What is ISO 14034?

The purpose of environmental technology verification is to provide a credible and impartial account of the performance of environmental technologies. Environmental technology verification is based on a number of principles to ensure that verifications are performed and reported accurately, clearly, unambiguously and objectively. The International Organization for Standardization (ISO) standard for environmental technology verification (ETV) is ISO 14034, which was published in November 2016.

Benefits of ETV

ETV contributes to protection and conservation of the environment by promoting and facilitating market uptake of innovative environmental technologies, especially those that perform better than relevant alternatives. ETV is particularly applicable to those environmental technologies whose innovative features or performance cannot be fully assessed using existing standards. Through the provision of objective evidence, ETV provides an independent and impartial confirmation of the performance of an environmental technology based on reliable test data. ETV aims to strengthen the credibility of new, innovative technologies by supporting informed decision-making among interested parties.

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Signed for Hydro International: *Original signed by:* *Phillip Taylor* Phillip Taylor Technical Product Manager, Americas Stormwater	Signed for VerifiGlobal: *Original signed by:* *Thomas Bruun* Thomas Bruun, Managing Director *Original signed by:* *John Neate* John Neate, Managing Director

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SANITARY SEWER DESIGN - LOCAL SEWER

Development Details Basis

DESIGN SHEET 1 of 1
FILE NO PRA-19078
CONTRACT / PROJECT Elements Condominium Plan - Pratt Hansen Group Inc.

n ≥ 0.013
M = 5/P^0.2 Babbit

Numbers in blue or text in red are equations

M=1+[14/(4+P^0.5)] Harmon (Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

Q_p = P*q*M/86.4 (Peak population flow where; q = 225 L/day/person; P = population in thousands) 225 litres/person/day

Q_i = I*A (Peak extraneous flow: I= 0.1L/s/ha over development area)

Q_{tot} = Q_p + Q_i (Total peak flow as the sum of peak population flow and peak extraneous flow)

STREET / AREA	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q_p (l/s)	AREA (ha)	AREA (ACC) (ha)	Q_i (l/s)	Q_{tot} (l/s)	L (m)	D (mm)	S (%)	Qf FULL (l/s)	d/D(2)	d/D(3) >0.5 or >0.7	Velocity FULL (m/s)	Velocity Partial(1) (m/s)	Velocity(4) > 0.6 (m/s)
Area 1 - Building C	BUILDING C	SAN01	96	96	1.67	160	160	7.211	4.182	7.211	3.010	0.17	0.17	0.017	3.027	11.7	200	2.00%	46.384	0.173	Ok	1.476	0.829	Ok
Area 2	SAN01	SAN02	0	96	0	0	160	7.211	4.182	7.211	3.010	0.16	0.33	0.033	3.044	25.6	250	2.00%	84.100	0.130	Ok	1.713	0.807	Ok
Area 3 - Building B (southern half)	BUILDING B	SAN02	78	78	1.67	130	130	7.516	4.210	7.516	2.550	0.14	0.14	0.014	2.564	14.4	200	2.00%	46.384	0.159	Ok	1.476	0.791	Ok
Area 4	SAN02	SAN03	0	174	0	0	291	6.402	4.084	6.402	4.845	0.09	0.56	0.056	4.901	31.4	250	2.00%	84.100	0.163	Ok	1.713	0.928	Ok
Area 5 - Building A	BUILDING A	SAN05	94	94	1.67	157	157	7.241	4.185	7.241	2.960	0.17	0.17	0.017	2.977	15.7	200	2.00%	46.384	0.171	Ok	1.476	0.827	Ok
Area 6	SAN05	SAN04	0	94	0	0	157	7.241	4.185	7.241	2.960	0.17	0.34	0.034	2.994	48.0	250	2.00%	84.100	0.129	Ok	1.713	0.803	Ok
Area 7 - Building B (northern half)	BUILDING B	SAN04	78	78	1.67	130	130	7.516	4.210	7.516	2.550	0.13	0.13	0.013	2.563	16.1	200	2.00%	46.384	0.159	Ok	1.476	0.791	Ok
Area 8	SAN04	SAN03	0	172	0	0	287	6.417	4.086	6.417	4.800	0.09	0.56	0.056	4.856	54.0	250	2.00%	84.100	0.163	Ok	1.713	0.928	Ok
Area 9	SAN03	SAH33492	0	346	0	0	578	5.580	3.941	5.580	8.396	0.13	1.25	0.125	8.521	57.2	250	2.00%	84.100	0.214	Ok	1.713	1.094	Ok

DATE: December 17th, 2021 CALCULATED BY: MG CHECKED BY: MF

* For sizing of the 375mmø Trunk Sewer on Kneeshaw Drive, refer to Sanitary Sewer Design - Trunk Sewer worksheet.

(1) without extraneous flow
(2) with extraneous flow
(3) d/D>0.5 for pipes 375 and less, d/D>0.85 for pipes greater than 375
(4) Velocity check based on the lesser of full flow or partial velocity

SANITARY SEWER DESIGN - TRUNK SEWER

Development Details Basis

DESIGN SHEET 1 of 1
FILE NO PRA-12160
CONTRACT / PROJECT Bistro 6 West Subdvision - Crisdawn Construction Inc.

n ≥ 0.013
M = 5/P^0.2 Babbit
M=1+[14/(4+P^0.5)] Harmon
Q_p = P*q*M/86.4
Q_i = I*A
Q_{tot} = Q_p + Q_i

Numbers in blue or text in red are equations
(Harmon or Babbitt peaking factor where; M ≥ 2), the greater of the two is used in the spreadsheet. Please refer to Section 3.3.1.1 of the Barrie Sanitary Design Guidelines for additional guidance on which peaking factor to use.

(Peak population flow where; q = 225 L/day/person; P = population in thousands) 225 litres/person/day
(Peak extraneous flow: I= 0.1L/s/ha over development area)
(Total peak flow as the sum of peak population flow and peak extraneous flow)

STREET / AREA	MAINTENANCE HOLE FROM	MAINTENANCE HOLE TO	DWELL UNITS	DWELL (ACC) UNITS	DENSITY P.P.U.	POP. (P)	POP. (ACC)	M PEAKING FACTOR BABBIT	M PEAKING FACTOR HARMON	Max PEAKING FACTOR	Q_p (L/s)	AREA (ha)	AREA (ACC) (ha)	Q_i (L/s)	Q_{tot} (L/s)	L (m)	D (mm)	S (%)	Qf FULL (L/s)	d/D(2)	d/D(3) >0.5 or >0.7	Velocity FULL (m/s)	Velocity Partial(1) (m/s)	Velocity(4) > 0.6 (m/s)
Mixed Use			Residential Multi-Density			3401	3401	3.914	3.396	3.914	34.668	24.59	24.59	2.459	37.127									
			Commercial 0.32 L/(s*ha)					2.000	2.000	2.000	3.187	4.98	4.98	0.498	3.685									
St. Paul's Development Area	SANMH57	SANMH25					3401	3.914	3.396	3.914	37.855	1.11	30.68	3.068	40.923		375	0.50%	123.977	0.395	Ok	1.123	0.986	Ok
EXT1 - Yonge St. - Institutional			Institutional 0.32 L/(s*ha)			0	0	2.000	2.000	2.000	3.680	5.75	5.75	0.575	4.255									
EXT2 - Yonge St. - Recreational Centre			Institutional 0.32 L/(s*ha)			0	0	2.000	2.000	2.000	4.659	7.28	13.03	1.303	5.962									
EXT3 - Yonge St. - Mixed Use Proposed			Residential 175 people/ha			655	655	5.442	3.911	5.442	17.615	3.74	16.77	1.677	19.292									
EXT4 - Yonge St. - Mixed Use Proposed			Residential 175 people/ha			1904	2559	4.144	3.500	4.144	35.947	10.88	27.65	2.765	38.712									
	YS STUB	FUT. SAN7				0	2559	4.144	3.500	4.144	35.947	0.00	27.65	2.765	38.712		300	1.00%	96.701	0.440	Ok	1.368	1.267	Ok
KNEESHAW DRIVE	SANMH1	SANMH7	Residential 147 people/ha			1227	1227	4.800	3.741	4.800	15.336	8.35	8.35	0.835	16.171		300	0.40%	61.159	0.351	Ok	0.865	0.719	Ok
Area 23 - KNEESHAW DRIVE (Trunk)	FUT. SAN10	FUT. SAN11					3786	3.831	3.355	3.831	46.108	0.70	36.70	3.670	49.778	15.0	375	0.40%	110.889	0.469	Ok	1.004	0.957	Ok
Area 24 - KNEESHAW DRIVE (Trunk)	FUT. SAN11	FUT. SAN12					3786	3.831	3.355	3.831	46.108	0.39	37.09	3.709	49.817	108.4	375	0.40%	110.889	0.469	Ok	1.004	0.957	Ok
Area 24 - KNEESHAW DRIVE (Local)	FUT. SAN11	FUT. SAN12	8	8	2.34	19	19	11.079	4.384	11.079	0.540				0.540	108.4	200	2.00%	46.384	0.075	Ok	1.476	0.493	Check
Area 25 - KNEESHAW DRIVE (Trunk)	FUT. SAN12	FUT. SAN13					3804	3.828	3.353	3.828	46.258	0.04	37.13	3.713	49.971	15.0	375	0.40%	110.889	0.470	Ok	1.004	0.958	Ok
Area 26 - KNEESHAW DRIVE (Trunk)	FUT. SAN13	FUT. SAN14					3804	3.828	3.353	3.828	46.258	0.15	37.28	3.728	49.986	43.7	375	0.40%	110.889	0.470	Ok	1.004	0.958	Ok
Area 26 - KNEESHAW DRIVE (Local)	FUT. SAN13	FUT. SAN14	3	3	2.34	7	7	13.480	4.428	13.480	0.246				0.246	43.7	200	2.00%	46.384	0.052	Ok	1.476	0.389	Check
Area 27 - KNEESHAW DRIVE (Trunk)	FUT. SAN14	FUT. SAN17					3811	3.826	3.352	3.826	46.314	0.22	37.50	3.750	50.064	61.1	375	0.40%	110.889	0.471	Ok	1.004	0.958	Ok
Area 27 - KNEESHAW DRIVE (Local)	FUT. SAN14	FUT. SAN17	5	5	2.34	12	12	12.171	4.408	12.171	0.371				0.371	61.1	200	2.00%	46.384	0.063	Ok	1.476	0.441	Check
Area 1 - FLAN BOULEVARD (Local)	FUT. SAN47	FUT. SAN31	24	24	2.34	56	56	8.894	4.304	8.894	1.301	0.88	0.88	0.088	1.389	100.9	200	1.70%	42.764	0.123	Ok	1.361	0.609	Ok
Area 28 - KNEESHAW DRIVE (local)	FUT. SAN31	FUT. SAN17	9	33	2.34	21	77	8.345	4.273	8.345	1.678	0.26	1.14	0.114	1.792	78.7	200	1.40%	38.808	0.146	Ok	1.235	0.614	Ok
Area 29 - KNEESHAW DRIVE (Trunk)	FUT. SAN17	SAH33482					3900	3.808	3.343	3.808	47.021	0.70	39.34	3.934	50.955	99.2	375	0.40%	110.889	0.475	Ok	1.004	0.962	Ok
Area 29 - KNEESHAW DRIVE (Local)	FUT. SAN17	SAH33482	14	14	3.13	44	44	9.346	4.326	9.346	1.067				1.067	99.2	200	2.00%	46.384	0.104	Ok	1.476	0.607	Ok
Area 30 - KNEESHAW DRIVE (Trunk)	SAH33482	SAH33483	16	30	3.13	50	3950	3.799	3.338	3.799	47.418	0.73	40.07	4.007	51.425	87.7	375	0.40%	110.889	0.478	Ok	1.004	0.964	Ok
Area 31 - KNEESHAW DRIVE (Trunk)	SAH33483	SAH33484	9	39	3.13	28	3978	3.793	3.335	3.793	47.640	0.42	40.49	4.049	51.689	55.7	375	0.40%	110.889	0.479	Ok	1.004	0.965	Ok
Refer to Interal Sanitary Sewer Design																								
****1** SHIRAZ TRAIL TOTAL**	SAH33488	SAH33484		108		19	307	6.331	4.074	6.331	5.065	0.31	4.41											
Area 32 - KNEESHAW DRIVE (Trunk)	SAH33484	SAH33481	4	151	3.13	13	4298	3.735	3.305	3.735	50.148	0.51	45.41	4.541	54.689	102.6	375	0.40%	110.889	0.495	Ok	1.004	0.978	Ok
Refer to Interal Sanitary Sewer Design																								
****2** FLAN BOULEVARD TOTAL**	SAH33480	SAH33481		93		236	236	6.675	4.121	6.675	4.099	0.30	3.88											
Area 33 - KNEESHAW DRIVE (Trunk)	SAH33481	SAH33491		283			4534	3.696	3.284	3.696	51.973	0.13	49.42	4.942	56.915	59.0	375	0.40%	110.889	0.507	Check	1.004	0.987	Ok
Area 34 - KNEESHAW DRIVE (Trunk)	SAH33491	SAH33492		283			4534	3.696	3.284	3.696	51.973	0.18	49.61	4.961	56.933	79.1	375	0.46%	118.915	0.487	Ok	1.077	1.040	Ok
Area 37 - BLK598 (High Density - 100units/ha)	BLK598	SAH33492	346	346	1.67	578	578	5.580	3.941	5.580	8.396	1.25	1.25	0.125	8.521	57.2	250	2.00%	84.100	0.214	Ok	1.713	1.094	Ok
Area 35 - KNEESHAW DRIVE (Trunk)	SAH33492	SAH33493					5112	3.608	3.236	3.608	56.367	0.27	51.12	5.112	61.480	97.1	375	1.58%	220.387	0.361	Ok	1.995	1.667	Ok
Area 36 - KNEESHAW DRIVE (Trunk)	SAH33493	SAH33494					5112	3.608	3.236	3.608	56.367	0.15	51.27	5.127	61.494	68.8	375	0.50%	123.977	0.497	Ok	1.123	1.096	Ok
Mapleview Drive East	SAH33494	SAH33495					8513	3.258	3.024	3.258	83.753	0.21	82.17	8.217	91.969	85.9	375	0.70%	146.692	0.573	Check	1.328	1.372	Ok
Mapleview Drive East	SAH33495	SAH33496					8513	3.258	3.024	3.258	83.753	0.18	82.34	8.234	91.987	61.3	375	0.70%	146.692	0.573	Check	1.328	1.372	Ok
EXT 5 - Mapleview Drive East	PLUG	SAH33496									3.700	0.91	0.91	0.091	3.791	24.5	250	2.00%	84.100	0.144	Ok	1.713	0.856	Ok
Area 38 - BLK597 (High Density - B6 Site Plan)	BLK597	SAH33496	440	440	1.67	735	735	5.318	3.882	5.318	10.176	4.51	4.51	0.451	10.627	24.7	250	4.95%	132.307	0.191	Ok	2.695	1.593	Ok
Mapleview Drive East	SAH33496	SAH33497					9248	3.205	2.988	3.205	92.399	0.37	88.13	8.813	101.212	110.0	375	0.80%	156.820	0.584	Check	1.420	1.478	Ok
Mapleview Drive East	SAH33497	SAH33498					9248	3.205	2.988	3.205	88.699	0.43	88.56	8.856	97.555	119.9	375	0.85%	161.646	0.560	Check	1.464	1.497	Ok
EXT 6 - Mapleview Drive East	PLUG	SAH33498									1.500	2.12	2.12	0.212	1.712	10.4	250	1.00%	59.468	0.116	Ok	1.211	0.513	Check
Mapleview Drive East	SAH33498	SAH33499					9248	3.205	2.988	3.205	90.199	0.34	91.02	9.102	99.301	87.3	375	2.10%	254.078	0.434	Ok	2.300	2.103	Ok

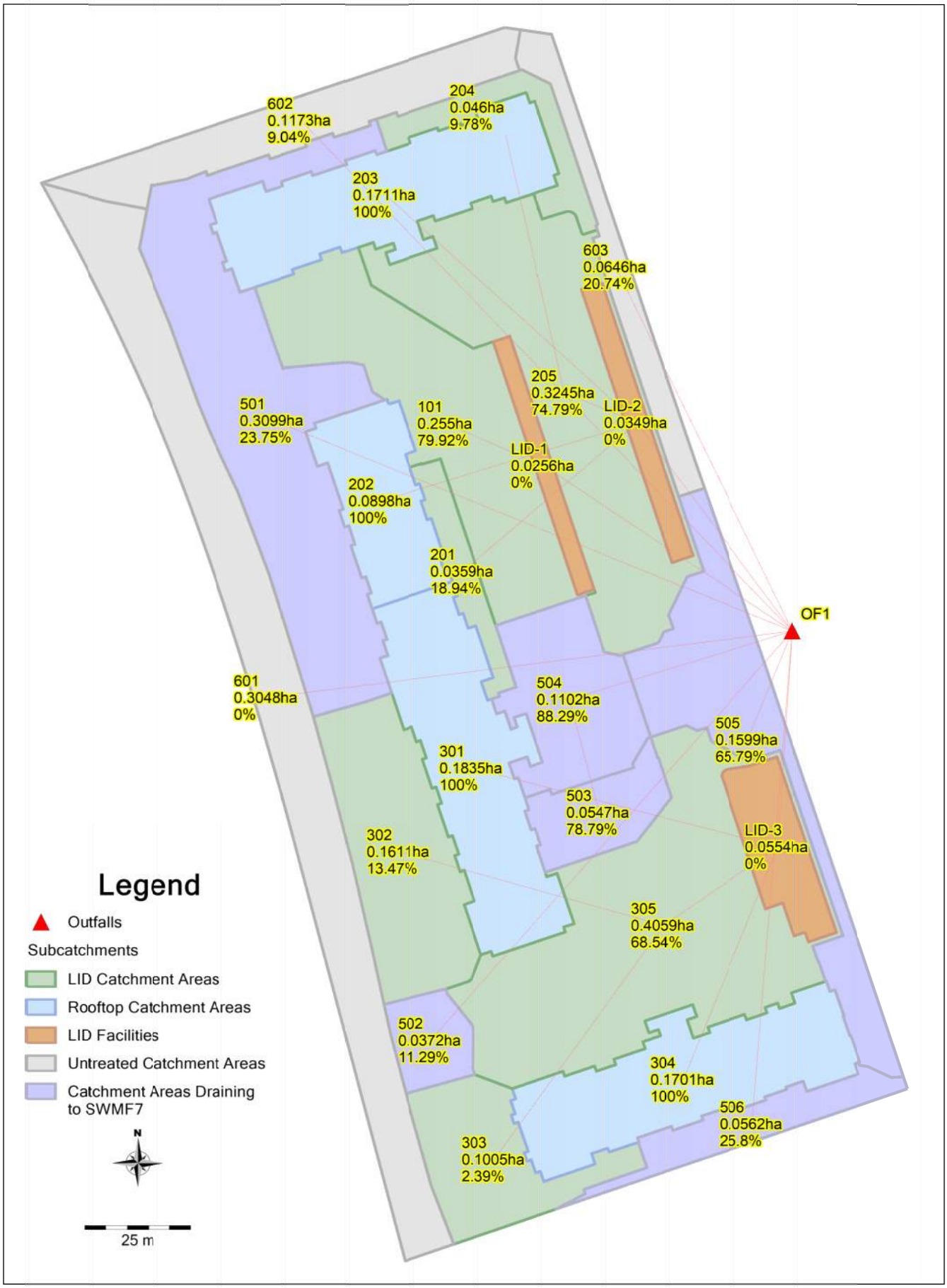
DATE: December 17th, 2021 CALCULATED BY: MG CHECKED BY: MF

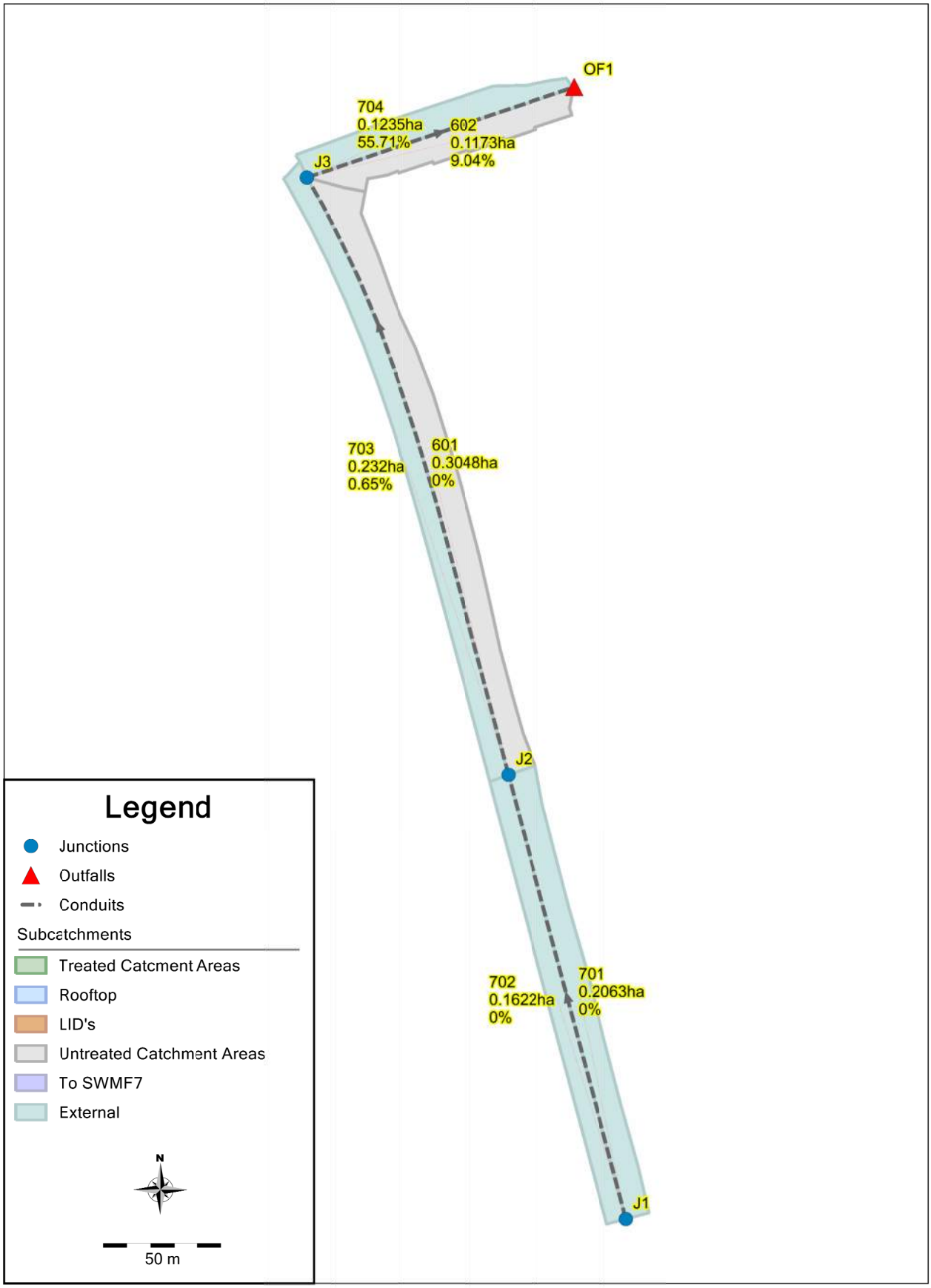
(1) without extraneous flow
(2) with extraneous flow
(3) d/D>0.5 for pipes 375 and less, d/D>0.7 for pipes greater than 375
(4) Velocity check based on the lesser of full flow or partial velocity

Appendix D

PCSWMM Schematics & Model Outputs

- PCSWMM Model Schematics
  - Post-Dev-LID
  - External
- PCSWMM Model Input Parameters
- PCSWMM Detailed Status Report
  - Post-Dev-LID - 25mm Status Report
  - Post-Dev-LID - Continuous Status Report
  - Post-Dev-LID - 100yr4hrCHI Status Report
  - Post-Dev-LID - 100yr6hrSCS Status Report
  - Post-Dev-LID - Hazel Status Report
  - External - 100yr6hrSCS Status Report
- Graphical Model Output
  - LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time – 25mm Simulation
  - LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time – 25mm Simulation
  - LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time – 25mm Simulation
  - LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time - Continuous Simulation
  - LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time - Continuous Simulation
  - LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time - Continuous Simulation
  - LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time – 100Yr6HrSCS
  - LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time – 100Yr4HrCHI
  - LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time – 100Yr4HrCHI
  - LID-1: Flow vs. Time – 100-Year & Hurricane Hazel Simulations
  - LID-2: Flow vs. Time – 100-Year & Hurricane Hazel Simulations
  - LID-3: Flow vs. Time – 100-Year & Hurricane Hazel Simulations
  - External: Flow vs. Time – 100-Year & Hurricane Hazel Simulations (J1, J2, J3 and OF1)
  - External: Hydraulic Grade Line Analysis – 100Yr6HrSCS Simulation
- Digital Modeling Files


602
0.1173ha
9.04%
204
0.046ha
9.78%
203
0.1711ha
100%
603
0.0646ha
20.74%
205
0.3245ha
74.79%
LID-2
0.0349ha
0%
501
0.3099ha
23.75%
101
0.255ha
79.92%
LID-1
0.0256ha
0%
202
0.0898ha
100%
201
0.0359ha
18.94%
OF1
601
0.3048ha
0%
504
0.1102ha
88.29%
505
0.1599ha
65.79%
301
0.1835ha
100%
503
0.0547ha
78.79%
LID-3
0.0554ha
0%
302
0.1611ha
13.47%
305
0.4059ha
68.54%
502
0.0372ha
11.29%
304
0.1701ha
100%
506
0.0562ha
25.8%
303
0.1005ha
2.39%
Legend
Outfalls
Subcatchments
LID Catchment Areas
Rooftop Catchment Areas
LID Facilities
Untreated Catchment Areas
Catchment Areas Draining to SWMF7
N
25 m


OF1
704
0.1235ha
55.71%
602
0.1173ha
9.04%
J3
703
0.232ha
0.65%
601
0.3048ha
0%
J2
702
0.1622ha
0%
701
0.2063ha
0%
J1
Legend
Junctions
Outfalls
Conduits
Subcatchments
Treated Catcment Areas
Rooftop
LID's
Untreated Catchment Areas
To SWMF7
External
N
50 m

Post-Dev-LID Subcatchment Parameters																					
Name	Tag	Rain Gage	Outlet	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)	Subarea Routing	Percent Routed (%)	Snow Pack	LID Controls	LID Names	Suction Head (mm)	Conductivity (mm/hr)	Initial Deficit (frac.)
101		25mm_Chicago_4h	LID-1	0.2550	85	30	1.5	79.92	0.013	0.15	2	5	0	PERVIOUS	0.93	Snowpack1	0		60.96	29.97	0.39
201		25mm_Chicago_4h	LID-2	0.0359	6.527	55	1	18.94	0.013	0.15	2	5	0	PERVIOUS	100	Snowpack1	0		60.96	29.97	0.39
202	Rooftop	25mm_Chicago_4h	LID-2	0.0898	59.867	15	0.5	100	0.013	0.15	2	5	0	PERVIOUS	100	Snowpack1	0		60.96	29.97	0.39
203	Rooftop	25mm_Chicago_4h	LID-2	0.1711	114.067	15	0.5	100	0.013	0.15	2	5	0	PERVIOUS	100	Snowpack1	0		60.96	29.97	0.39
204		25mm_Chicago_4h	205	0.0460	6.571	70	2	9.78	0.013	0.15	2	5	0	PERVIOUS	86.67	Snowpack1	0		60.96	29.97	0.39
205		25mm_Chicago_4h	LID-2	0.3245	129.8	25	1	74.79	0.013	0.15	2	5	0	PERVIOUS	1.19	Snowpack1	0		60.96	29.97	0.39
301	Rooftop	25mm_Chicago_4h	LID-3	0.1835	122.333	15	0.5	100	0.013	0.15	2	5	0	PERVIOUS	100	Snowpack1	0		60.96	29.97	0.39
302		25mm_Chicago_4h	305	0.1611	22.375	72	1	13.47	0.013	0.15	2	5	0	PERVIOUS	25.81	Snowpack1	0		60.96	29.97	0.39
303		25mm_Chicago_4h	305	0.1005	18.273	55	3.5	2.39	0.013	0.15	2	5	0	PERVIOUS	87.5	Snowpack1	0		60.96	29.97	0.39
304	Rooftop	25mm_Chicago_4h	LID-3	0.1701	113.4	15	0.5	100	0.013	0.15	2	5	0	PERVIOUS	100	Snowpack1	0		60.96	29.97	0.39
305		25mm_Chicago_4h	LID-3	0.4059	67.65	60	2	68.54	0.013	0.15	2	5	0	PERVIOUS	2.52	Snowpack1	0		60.96	29.97	0.39
501	SWMF7	25mm_Chicago_4h	OF1	0.3099	36.277	83	2	23.75	0.013	0.15	2	5	0	PERVIOUS	16.3	Snowpack1	0		60.96	29.97	0.39
502	SWMF7	25mm_Chicago_4h	OF1	0.0372	20.667	18	25	11.29	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
503	SWMF7	25mm_Chicago_4h	504	0.0547	32.176	17	3.1	78.79	0.013	0.15	2	5	0	PERVIOUS	6.5	Snowpack1	0		60.96	29.97	0.39
504	SWMF7	25mm_Chicago_4h	505	0.1102	42.385	26	5	88.29	0.013	0.15	2	5	0	PERVIOUS	1.23	Snowpack1	0		60.96	29.97	0.39
505	SWMF7	25mm_Chicago_4h	OF1	0.1599	63.96	25	5	65.79	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
506	SWMF7	25mm_Chicago_4h	OF1	0.0562	16.057	35	2	25.8	0.013	0.15	2	5	0	PERVIOUS	45.52	Snowpack1	0		60.96	29.97	0.39
601	Untreated	25mm_Chicago_4h	OF1	0.3048	254	12	35	0	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
602	Untreated	25mm_Chicago_4h	OF1	0.1173	117.3	10	33	9.04	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
603	Untreated	25mm_Chicago_4h	OF1	0.0646	107.667	6	33	20.74	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
LID-1	LID	NO_RAIN	OF1	0.0256	62.439	4.1	0.5	0	0.013	0.15	2	5	0	OUTLET	100		1	LID-1	60.96	29.97	0.39
LID-2	LID	NO_RAIN	OF1	0.0349	68.431	5.1	0.5	0	0.013	0.15	2	5	0	OUTLET	100		1	LID-2	60.96	29.97	0.39
LID-3	LID	NO_RAIN	OF1	0.0554	42.615	13	0.5	0	0.013	0.15	2	5	0	OUTLET	100		1	LID-3	60.96	29.97	0.39

External PCSWMM model Metrolinx & Mapleview Drive East Channel Subcatchment Parameters																					
Name	Tag	Rain Gage	Outlet	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)	Subarea Routing	Percent Routed (%)	Snow Pack	LID Controls	LID Names	Suction Head (mm)	Conductivity (mm/hr)	Initial Deficit (frac.)
601	Untreated	100yr_4h_Chicago	J2	0.3048	254	12	35	0.00	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
602	Untreated	100yr_4h_Chicago	J3	0.1173	117.3	10	33	9.04	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
701	External	100yr_4h_Chicago	J1	0.2063	187.545	11	35	0.00	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
702	External	100yr_4h_Chicago	J1	0.1622	190.824	8.5	15	0.00	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
703	External	100yr_4h_Chicago	J2	0.2320	272.941	8.5	15	0.65	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39
704	External	100yr_4h_Chicago	J3	0.1235	41.167	30	5	55.71	0.013	0.15	2	5	0	PERVIOUS	0	Snowpack1	0		60.96	29.97	0.39

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:

WARNING 09: time series interval greater than recording interval for Rain Gage 25mm_Chicago_4h

*************
Element Count
*************
Number of rain gages ...... 28
Number of subcatchments ... 23
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
-----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
10yr_12h_SCS_Type_II_76mm 10yr_12h_SCS_Type_II_76mm      INTENSITY    6 min.
10yr_24h_SCS_Type_II_89.9mm 10yr_24h_SCS_Type_II_89.9mm    INTENSITY    6 min.
10yr_4h_Chicago      10yr_4h_Chicago                INTENSITY    1 min.
10yr_6h_SCS_Type_II_70.8mm 10yr_6h_SCS_Type_II_70.8mm     INTENSITY    6 min.
25mm_Chicago_4h      Chicago_4h                     CUMULATIVE   1 min.
25yr_12h_SCS_Type_II_90.7mm 25yr_12h_SCS_Type_II_90.7mm    INTENSITY    6 min.
25yr_24h_SCS_Type_II_107.5mm 25yr_24h_SCS_Type_II_107.5mm   INTENSITY    6 min.
25yr_4h_Chicago      25yr_4h_Chicago                INTENSITY    1 min.
25yr_6H_SCS_Type_II_85.2mm 25yr_6H_SCS_Type_II_85.2mm     INTENSITY    6 min.
2yr_12h_SCS_Type_II_46.7mm 2yr_12h_SCS_Type_II_46.7mm     INTENSITY    6 min.
2yr_24h_SCS_Type_II_55mm 2yr_24h_SCS_Type_II_55mm       INTENSITY    6 min.
2yr_4h_Chicago       2yr_4h_Chicago                 INTENSITY    1 min.
2yr_6h_SCS_Type_II_42.3mm 2yr_6h_SCS_Type_II_42.3mm      INTENSITY    6 min.
```

```
50yr_12h_SCS_Type_II_101.7mm 50yr_12h_SCS_Type_II_101.7mm   INTENSITY    6 min.
50yr_24h_SCS_Type_II_120.6mm 50yr_24h_SCS_Type_II_120.6mm   INTENSITY    6 min.
50yr_4h_Chicago      50yr_4h_Chicago                INTENSITY    1 min.
50yr_6h_SCS_Type_II_95.9mm 50yr_6h_SCS_Type_II_95.9mm     INTENSITY    6 min.
5yr_12h_SCS_Type_II_64.3mm 5yr_12h_SCS_Type_II_64.3mm     INTENSITY    6 min.
5yr_24h_SCS_Type_II_76mm 5yr_24h_SCS_Type_II_76mm       INTENSITY    6 min.
5yr_4h_Chicago       5yr_4h_Chicago                 INTENSITY    1 min.
5yr_6h_SCS_Type_II_59.5mm 5yr_6h_SCS_Type_II_59.5mm      INTENSITY    6 min.
Continuous           Continuous                     INTENSITY   60 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.
NO_RAIN              NO_RAIN                        VOLUME       5 min.
```

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	0.26	85.00	79.92	1.5000	25mm_Chicago_4h	LID-1
201	0.04	6.53	18.94	1.0000	25mm_Chicago_4h	LID-2
202	0.09	59.87	100.00	0.5000	25mm_Chicago_4h	LID-2
203	0.17	114.07	100.00	0.5000	25mm_Chicago_4h	LID-2
204	0.05	6.57	9.78	2.0000	25mm_Chicago_4h	205
205	0.32	129.80	74.79	1.0000	25mm_Chicago_4h	LID-2
301	0.18	122.33	100.00	0.5000	25mm_Chicago_4h	LID-3
302	0.16	22.38	13.47	1.0000	25mm_Chicago_4h	305
303	0.10	18.27	2.39	3.5000	25mm_Chicago_4h	305
304	0.17	113.40	100.00	0.5000	25mm_Chicago_4h	LID-3
305	0.41	67.65	68.54	2.0000	25mm_Chicago_4h	LID-3
501	0.31	37.34	23.75	2.0000	25mm_Chicago_4h	OF1
502	0.04	20.67	11.29	25.0000	25mm_Chicago_4h	OF1
503	0.05	32.18	78.79	3.1000	25mm_Chicago_4h	504
504	0.11	42.38	88.29	5.0000	25mm_Chicago_4h	OF1
505	0.16	63.96	65.79	5.0000	25mm_Chicago_4h	OF1
506	0.06	16.06	25.80	2.0000	25mm_Chicago_4h	OF1
601	0.30	254.00	0.00	35.0000	25mm_Chicago_4h	OF1
602	0.12	117.30	9.04	33.0000	25mm_Chicago_4h	OF1
603	0.06	107.67	20.74	33.0000	25mm_Chicago_4h	OF1
LID-1	0.03	62.44	0.00	0.5000	NO_RAIN	OF1
LID-2	0.03	68.43	0.00	0.5000	NO_RAIN	OF1
LID-3	0.06	42.61	0.00	0.5000	NO_RAIN	OF1

****

LID Control Summary
****

Subcatchment	LID Control	No. of Units	Unit Area	Unit Width	% Area Covered	% Imperv Treated	% Perv Treated
LID-1	LID-1	1	256.00	4.10	100.00	0.00	0.00
LID-2	LID-2	1	349.00	5.10	100.00	0.00	0.00
LID-3	LID-3	1	554.00	13.00	100.00	0.00	0.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OF1	OUTFALL	251.98	0.00	0.0	

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... YES
  Groundwater ..... YES
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Surcharge Method ..... EXTRAN
Starting Date 06/01/2005 00:00:00
Ending Date 06/04/2005 00:00:00
Antecedent Dry Days 7.0
Report Time Step 00:00:15
Wet Time Step 00:00:15

```
Dry Time Step ........... 00:00:15


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.002         0.467
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         0.079        24.138
Evaporation Loss .........         0.007         2.166
Infiltration Loss ........         0.064        19.484
Surface Runoff ...........         0.007         2.265
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.002         0.727
Continuity Error (%) .....        -0.145


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........        17.051      5398.950
Infiltration .............         0.037        11.702
Upper Zone ET ............         0.022         6.845
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.000         0.097
Groundwater Flow .........         0.000         0.000
Final Storage ............        17.066      5403.710
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.007         0.074
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.007         0.074
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
```

```
Final Stored Volume ......          0.000          0.000
Continuity Error (%) .....          0.000
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	25.02	0.00	2.41	5.19	17.63	0.00	17.47	0.04	0.13	0.698
201	25.02	0.00	0.59	24.45	4.19	0.00	0.00	0.00	0.00	0.000
202	25.02	0.00	3.02	0.00	22.05	0.00	22.05	0.02	0.05	0.881
203	25.02	0.00	3.02	0.00	22.05	0.00	22.05	0.04	0.10	0.881
204	25.02	0.00	0.31	24.44	2.18	0.00	0.29	0.00	0.00	0.012
205	25.02	0.04	2.26	6.51	16.53	0.00	16.34	0.05	0.15	0.652
301	25.02	0.00	3.02	0.00	22.05	0.00	22.05	0.04	0.11	0.881
302	25.02	0.00	0.42	22.41	2.98	0.00	2.21	0.00	0.01	0.088
303	25.02	0.00	0.09	24.88	0.54	0.00	0.07	0.00	0.00	0.003
304	25.02	0.00	3.02	0.00	22.05	0.00	22.05	0.04	0.10	0.881
305	25.02	0.89	2.09	8.54	15.70	0.00	15.31	0.06	0.14	0.591
501	25.02	0.00	0.73	19.92	5.25	0.00	4.39	0.01	0.04	0.176
502	25.02	0.00	0.35	22.18	2.56	0.00	2.56	0.00	0.00	0.102
503	25.02	0.00	2.34	6.44	17.47	0.00	16.33	0.01	0.04	0.653
504	25.02	8.11	2.64	4.20	26.69	0.00	26.36	0.03	0.10	0.796
505	25.02	0.00	1.96	8.55	14.59	0.00	14.59	0.02	0.10	0.583
506	25.02	0.00	0.78	21.16	5.73	0.00	3.12	0.00	0.01	0.125
601	25.02	0.00	0.02	25.01	0.00	0.00	0.00	0.00	0.00	0.000
602	25.02	0.00	0.28	22.75	2.06	0.00	2.06	0.00	0.01	0.082
603	25.02	0.00	0.62	19.82	4.72	0.00	4.72	0.00	0.01	0.188
LID-1	0.01	173.97	15.72	152.82	0.00	0.00	0.00	0.00	0.00	0.000
LID-2	0.01	316.73	15.94	292.47	0.00	0.00	0.00	0.00	0.00	0.000
LID-3	0.01	252.88	15.81	229.52	0.00	0.00	0.00	0.00	0.00	0.000

****
LID Performance Summary
****

	Total	Evap	Infil	Surface	Drain	Initial	Final	Continuity

Subcatchment	LID Control	Inflow mm	Loss mm	Loss mm	Outflow mm	Outflow mm	Storage mm	Storage mm	Error %
LID-1	LID-1	173.98	15.72	152.82	0.00	0.00	13.20	18.65	-0.00
LID-2	LID-2	316.74	15.94	292.47	0.00	0.00	13.20	21.53	-0.00
LID-3	LID-3	252.88	15.81	229.52	0.00	0.00	13.20	20.76	-0.00

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m
101	5.19	2.72	0.12	0.00	0.00	0.30	246.25	0.30	246.25
201	24.45	12.36	0.12	0.00	0.00	0.31	246.25	0.31	246.25
202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
204	24.44	14.03	0.12	0.00	0.00	0.31	246.25	0.31	246.25
205	6.51	3.42	0.12	0.00	0.00	0.30	246.25	0.30	246.25
301	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	22.41	13.35	0.12	0.00	0.00	0.31	246.25	0.30	246.25
303	24.88	15.39	0.12	0.00	0.00	0.31	246.25	0.30	246.25
304	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
305	8.54	4.25	0.12	0.00	0.00	0.30	246.25	0.30	246.25
501	19.92	11.49	0.12	0.00	0.00	0.31	246.25	0.30	246.25
502	22.18	14.22	0.12	0.00	0.00	0.31	246.25	0.30	246.25
503	6.44	2.88	0.12	0.00	0.00	0.30	246.25	0.30	246.25
504	4.20	1.59	0.12	0.00	0.00	0.30	246.25	0.30	246.25
505	8.55	4.65	0.12	0.00	0.00	0.30	246.25	0.30	246.25
506	21.16	11.15	0.12	0.00	0.00	0.31	246.25	0.31	246.25
601	25.01	16.37	0.12	0.00	0.00	0.31	246.25	0.30	246.25
602	22.75	14.65	0.12	0.00	0.00	0.31	246.25	0.30	246.25
603	19.82	12.41	0.12	0.00	0.00	0.31	246.25	0.30	246.25

Analysis begun on: Wed Nov 3 14:41:00 2021
Analysis ended on: Wed Nov 3 14:41:52 2021
Total elapsed time: 00:00:52

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:


*************
Element Count
*************
Number of rain gages ...... 28
Number of subcatchments ... 23
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
-----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
10yr_12h_SCS_Type_II_76mm 10yr_12h_SCS_Type_II_76mm      INTENSITY    6 min.
10yr_24h_SCS_Type_II_89.9mm 10yr_24h_SCS_Type_II_89.9mm    INTENSITY    6 min.
10yr_4h_Chicago      10yr_4h_Chicago                INTENSITY    1 min.
10yr_6h_SCS_Type_II_70.8mm 10yr_6h_SCS_Type_II_70.8mm     INTENSITY    6 min.
25mm_Chicago_4h      Chicago_4h                     CUMULATIVE   1 min.
25yr_12h_SCS_Type_II_90.7mm 25yr_12h_SCS_Type_II_90.7mm    INTENSITY    6 min.
25yr_24h_SCS_Type_II_107.5mm 25yr_24h_SCS_Type_II_107.5mm   INTENSITY    6 min.
25yr_4h_Chicago      25yr_4h_Chicago                INTENSITY    1 min.
25yr_6H_SCS_Type_II_85.2mm 25yr_6H_SCS_Type_II_85.2mm     INTENSITY    6 min.
2yr_12h_SCS_Type_II_46.7mm 2yr_12h_SCS_Type_II_46.7mm     INTENSITY    6 min.
2yr_24h_SCS_Type_II_55mm 2yr_24h_SCS_Type_II_55mm       INTENSITY    6 min.
2yr_4h_Chicago       2yr_4h_Chicago                 INTENSITY    1 min.
2yr_6h_SCS_Type_II_42.3mm 2yr_6h_SCS_Type_II_42.3mm      INTENSITY    6 min.
50yr_12h_SCS_Type_II_101.7mm 50yr_12h_SCS_Type_II_101.7mm   INTENSITY    6 min.
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50yr_24h_SCS_Type_II_120.6mm 50yr_24h_SCS_Type_II_120.6mm   INTENSITY    6 min.
50yr_4h_Chicago      50yr_4h_Chicago                INTENSITY    1 min.
50yr_6h_SCS_Type_II_95.9mm 50yr_6h_SCS_Type_II_95.9mm     INTENSITY    6 min.
5yr_12h_SCS_Type_II_64.3mm 5yr_12h_SCS_Type_II_64.3mm     INTENSITY    6 min.
5yr_24h_SCS_Type_II_76mm 5yr_24h_SCS_Type_II_76mm       INTENSITY    6 min.
5yr_4h_Chicago       5yr_4h_Chicago                 INTENSITY    1 min.
5yr_6h_SCS_Type_II_59.5mm 5yr_6h_SCS_Type_II_59.5mm      INTENSITY    6 min.
Continuous           Continuous                     INTENSITY   60 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.
NO_RAIN              NO_RAIN                        VOLUME       5 min.
```

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	0.26	85.00	79.92	1.5000	Continuous	LID-1
201	0.04	6.53	18.94	1.0000	Continuous	LID-2
202	0.09	59.87	100.00	0.5000	Continuous	LID-2
203	0.17	114.07	100.00	0.5000	Continuous	LID-2
204	0.05	6.57	9.78	2.0000	Continuous	205
205	0.32	129.80	74.79	1.0000	Continuous	LID-2
301	0.18	122.33	100.00	0.5000	Continuous	LID-3
302	0.16	22.38	13.47	1.0000	Continuous	305
303	0.10	18.27	2.39	3.5000	Continuous	305
304	0.17	113.40	100.00	0.5000	Continuous	LID-3
305	0.41	67.65	68.54	2.0000	Continuous	LID-3
501	0.31	37.34	23.75	2.0000	Continuous	OF1
502	0.04	20.67	11.29	25.0000	Continuous	OF1
503	0.05	32.18	78.79	3.1000	Continuous	504
504	0.11	42.38	88.29	5.0000	Continuous	OF1
505	0.16	63.96	65.79	5.0000	Continuous	OF1
506	0.06	16.06	25.80	2.0000	Continuous	OF1
601	0.30	254.00	0.00	35.0000	Continuous	OF1
602	0.12	117.30	9.04	33.0000	Continuous	OF1
603	0.06	107.67	22.07	33.0000	Continuous	OF1
LID-1	0.03	62.44	0.00	0.5000	NO_RAIN	OF1
LID-2	0.03	68.43	0.00	0.5000	NO_RAIN	OF1
LID-3	0.06	42.61	0.00	0.5000	NO_RAIN	OF1

****
LID Control Summary

```
*******************
                                 No. of        Unit        Unit      % Area    % Imperv      % Perv
Subcatchment     LID Control      Units        Area       Width     Covered     Treated     Treated
-------------------------------------------------------------------------------------------------------
LID-1            LID-1                1      256.00        4.10      100.00        0.00        0.00
LID-2            LID-2                1      349.00        5.10      100.00        0.00        0.00
LID-3            LID-3                1      554.00       13.00      100.00        0.00        0.00


************
Node Summary
************
                                        Invert      Max.    Ponded    External
Name                 Type                Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
OF1                  OUTFALL            251.98      0.00       0.0


*********************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*********************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... YES
  Groundwater ............ YES
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Surcharge Method ......... EXTRAN
Starting Date ............ 06/01/2005 00:00:00
Ending Date .............. 05/31/2006 23:00:00
Antecedent Dry Days ...... 7.0
Report Time Step ......... 00:00:15
Wet Time Step ............ 00:00:15
Dry Time Step ............ 00:00:15
```

```
**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.002         0.467
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         3.109       949.457
Evaporation Loss .........         0.522       159.298
Infiltration Loss ........         2.324       709.887
Surface Runoff ...........         0.261        79.743
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.003         1.002
Continuity Error (%) .....        -0.001


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........        17.051      5398.950
Infiltration .............         1.397       442.343
Upper Zone ET ............         0.851       269.476
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.038        12.025
Groundwater Flow .........         0.000         0.000
Final Storage ............        17.559      5559.790
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.261         2.611
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.261         2.611
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
```

Continuity Error (%) 0.000

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	984.30	0.00	200.67	212.95	576.04	0.00	570.69	1.46	0.01	0.580
201	984.30	0.00	118.44	792.04	136.75	73.83	73.83	0.03	0.00	0.075
202	984.30	0.00	237.73	0.00	746.58	0.00	746.58	0.67	0.00	0.758
203	984.30	0.00	237.73	0.00	746.58	0.00	746.58	1.28	0.01	0.758
204	984.30	0.00	95.02	819.80	70.71	60.06	69.49	0.03	0.00	0.071
205	984.30	9.85	188.18	266.43	546.05	0.00	539.55	1.75	0.01	0.543
301	984.30	0.00	237.73	0.00	746.58	0.00	746.58	1.37	0.01	0.758
302	984.30	0.00	33.64	878.50	97.27	0.00	72.17	0.12	0.00	0.073
303	984.30	0.00	77.52	850.20	17.31	54.42	56.58	0.06	0.00	0.057
304	984.30	0.00	237.73	0.00	746.58	0.00	746.58	1.27	0.01	0.758
305	984.30	42.65	173.25	344.77	522.10	0.00	508.94	2.07	0.01	0.496
501	984.30	0.00	59.46	781.42	171.36	0.00	143.42	0.44	0.00	0.146
502	984.30	0.00	27.94	874.58	81.79	0.00	81.79	0.03	0.00	0.083
503	984.30	0.00	196.49	255.58	569.25	0.00	532.25	0.29	0.00	0.541
504	984.30	264.19	220.90	167.89	870.42	0.00	859.72	0.95	0.01	0.689
505	984.30	0.00	164.04	344.92	475.35	0.00	475.35	0.76	0.01	0.483
506	984.30	0.00	64.28	781.15	186.46	0.00	138.88	0.08	0.00	0.141
601	984.30	0.00	68.61	859.83	0.00	55.86	55.86	0.17	0.01	0.057
602	984.30	0.00	22.36	896.44	65.51	0.00	65.51	0.08	0.00	0.067
603	984.30	0.00	54.59	769.81	159.92	0.00	159.92	0.10	0.00	0.162
LID-1	0.01	5684.57	504.20	5165.58	0.00	0.00	0.00	0.00	0.00	0.000
LID-2	0.01	10673.85	519.13	10139.19	0.00	0.00	0.00	0.00	0.00	0.000
LID-3	0.01	8494.04	516.29	7962.81	0.00	0.00	0.00	0.00	0.00	0.000

****
LID Performance Summary
****

	Total Inflow	Evap Loss	Infil Loss	Surface Outflow	Drain Outflow	Initial Storage	Final Storage	Continuity Error

Subcatchment	LID Control	mm	mm	mm	mm	mm	mm	mm	%
LID-1	LID-1	5684.58	504.20	5165.59	0.00	0.00	13.20	27.99	-0.00
LID-2	LID-2	10673.86	519.13	10139.20	0.00	0.00	13.20	28.74	-0.00
LID-3	LID-3	8494.05	516.29	7962.81	0.00	0.00	13.20	28.15	-0.00

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m
101	212.95	132.05	14.61	0.00	0.00	0.31	246.21	0.34	246.17
201	792.04	427.53	15.45	0.00	0.00	0.32	246.79	0.25	248.20
202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
204	819.80	455.34	15.41	0.00	0.00	0.32	246.76	0.25	248.20
205	266.43	165.66	14.61	0.00	0.00	0.31	246.21	0.35	246.17
301	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	878.50	521.02	15.28	0.00	0.00	0.31	246.68	0.25	248.17
303	850.20	485.76	15.39	0.00	0.00	0.31	246.75	0.25	248.20
304	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
305	344.77	206.78	14.62	0.00	0.00	0.32	246.22	0.37	246.21
501	781.42	509.75	15.13	0.00	0.00	0.31	246.57	0.28	247.74
502	874.58	568.29	15.22	0.00	0.00	0.31	246.63	0.27	247.93
503	255.58	139.84	14.61	0.00	0.00	0.32	246.21	0.36	246.16
504	167.89	76.61	14.61	0.00	0.00	0.31	246.21	0.35	246.16
505	344.92	226.14	14.61	0.00	0.00	0.31	246.21	0.36	246.17
506	781.15	501.31	15.15	0.00	0.00	0.31	246.58	0.27	247.79
601	859.83	495.40	15.38	0.00	0.00	0.31	246.74	0.25	248.20
602	896.44	567.60	15.26	0.00	0.00	0.31	246.66	0.28	248.03
603	769.81	519.02	15.06	0.00	0.00	0.31	246.52	0.30	247.58

Analysis begun on: Wed Nov 3 15:57:13 2021
Analysis ended on: Wed Nov 3 17:04:13 2021
Total elapsed time: 01:07:00

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:


*************
Element Count
*************
Number of rain gages ...... 28
Number of subcatchments ... 23
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
-----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
10yr_12h_SCS_Type_II_76mm 10yr_12h_SCS_Type_II_76mm      INTENSITY    6 min.
10yr_24h_SCS_Type_II_89.9mm 10yr_24h_SCS_Type_II_89.9mm    INTENSITY    6 min.
10yr_4h_Chicago      10yr_4h_Chicago                INTENSITY    1 min.
10yr_6h_SCS_Type_II_70.8mm 10yr_6h_SCS_Type_II_70.8mm     INTENSITY    6 min.
25mm_Chicago_4h      Chicago_4h                     CUMULATIVE   1 min.
25yr_12h_SCS_Type_II_90.7mm 25yr_12h_SCS_Type_II_90.7mm    INTENSITY    6 min.
25yr_24h_SCS_Type_II_107.5mm 25yr_24h_SCS_Type_II_107.5mm   INTENSITY    6 min.
25yr_4h_Chicago      25yr_4h_Chicago                INTENSITY    1 min.
25yr_6H_SCS_Type_II_85.2mm 25yr_6H_SCS_Type_II_85.2mm     INTENSITY    6 min.
2yr_12h_SCS_Type_II_46.7mm 2yr_12h_SCS_Type_II_46.7mm     INTENSITY    6 min.
2yr_24h_SCS_Type_II_55mm 2yr_24h_SCS_Type_II_55mm       INTENSITY    6 min.
2yr_4h_Chicago       2yr_4h_Chicago                 INTENSITY    1 min.
2yr_6h_SCS_Type_II_42.3mm 2yr_6h_SCS_Type_II_42.3mm      INTENSITY    6 min.
50yr_12h_SCS_Type_II_101.7mm 50yr_12h_SCS_Type_II_101.7mm   INTENSITY    6 min.
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50yr_24h_SCS_Type_II_120.6mm 50yr_24h_SCS_Type_II_120.6mm   INTENSITY    6 min.
50yr_4h_Chicago      50yr_4h_Chicago                INTENSITY    1 min.
50yr_6h_SCS_Type_II_95.9mm 50yr_6h_SCS_Type_II_95.9mm     INTENSITY    6 min.
5yr_12h_SCS_Type_II_64.3mm 5yr_12h_SCS_Type_II_64.3mm     INTENSITY    6 min.
5yr_24h_SCS_Type_II_76mm 5yr_24h_SCS_Type_II_76mm       INTENSITY    6 min.
5yr_4h_Chicago       5yr_4h_Chicago                 INTENSITY    1 min.
5yr_6h_SCS_Type_II_59.5mm 5yr_6h_SCS_Type_II_59.5mm      INTENSITY    6 min.
Continuous           Continuous                     INTENSITY   60 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.
NO_RAIN              NO_RAIN                        VOLUME       5 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
-------------------------------------------------------------------------------------------------------
101                         0.26     85.00     79.92    1.5000 100yr_6h_SCS_Type_II_106.5mm LID-1
201                         0.04      6.53     18.94    1.0000 100yr_6h_SCS_Type_II_106.5mm LID-2
202                         0.09     59.87    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-2
203                         0.17    114.07    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-2
204                         0.05      6.57      9.78    2.0000 100yr_6h_SCS_Type_II_106.5mm 205
205                         0.32    129.80     74.79    1.0000 100yr_6h_SCS_Type_II_106.5mm LID-2
301                         0.18    122.33    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-3
302                         0.16     22.38     13.47    1.0000 100yr_6h_SCS_Type_II_106.5mm 305
303                         0.10     18.27      2.39    3.5000 100yr_6h_SCS_Type_II_106.5mm 305
304                         0.17    113.40    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-3
305                         0.41     67.65     68.54    2.0000 100yr_6h_SCS_Type_II_106.5mm LID-3
501                         0.31     37.34     23.75    2.0000 100yr_6h_SCS_Type_II_106.5mm OF1
502                         0.04     20.67     11.29   25.0000 100yr_6h_SCS_Type_II_106.5mm OF1
503                         0.05     32.18     78.79    3.1000 100yr_6h_SCS_Type_II_106.5mm 504
504                         0.11     42.38     88.29    5.0000 100yr_6h_SCS_Type_II_106.5mm OF1
505                         0.16     63.96     65.79    5.0000 100yr_6h_SCS_Type_II_106.5mm OF1
506                         0.06     16.06     25.80    2.0000 100yr_6h_SCS_Type_II_106.5mm OF1
601                         0.30    254.00      0.00   35.0000 100yr_6h_SCS_Type_II_106.5mm OF1
602                         0.12    117.30      9.04   33.0000 100yr_6h_SCS_Type_II_106.5mm OF1
603                         0.06    107.67     20.74   33.0000 100yr_6h_SCS_Type_II_106.5mm OF1
LID-1                       0.03     62.44      0.00    0.5000 NO_RAIN              OF1
LID-2                       0.03     68.43      0.00    0.5000 NO_RAIN              OF1
LID-3                       0.06     42.61      0.00    0.5000 NO_RAIN              OF1


******************
LID Control Summary
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Subcatchment	LID Control	No. of Units	Unit Area	Unit Width	% Area Covered	% Imperv Treated	% Perv Treated
LID-1	LID-1	1	256.00	4.10	100.00	0.00	0.00
LID-2	LID-2	1	349.00	5.10	100.00	0.00	0.00
LID-3	LID-3	1	554.00	13.00	100.00	0.00	0.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OF1	OUTFALL	251.98	0.00	0.0	

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... YES
  Groundwater ..... YES
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Surcharge Method ..... EXTRAN
Starting Date 06/01/2005 00:00:00
Ending Date 06/04/2005 00:00:00
Antecedent Dry Days 7.0
Report Time Step 00:00:15
Wet Time Step 00:00:15
Dry Time Step 00:00:15

```
**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.002         0.467
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         0.336       102.730
Evaporation Loss .........         0.008         2.511
Infiltration Loss ........         0.185        56.622
Surface Runoff ...........         0.141        43.110
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.003         0.960
Continuity Error (%) .....        -0.005


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........        17.051      5398.950
Infiltration .............         0.125        39.697
Upper Zone ET ............         0.021         6.500
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.000         0.097
Groundwater Flow .........         0.000         0.000
Final Storage ............        17.155      5432.050
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.141         1.411
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.141         1.411
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
```

Continuity Error (%) 0.000

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	106.50	0.00	2.83	17.07	82.32	5.05	86.60	0.22	0.14	0.813
201	106.50	0.00	0.88	81.38	19.52	24.24	24.24	0.01	0.01	0.228
202	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.09	0.05	0.967
203	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.18	0.10	0.967
204	106.50	0.00	0.56	85.56	10.08	19.04	20.38	0.01	0.01	0.191
205	106.50	2.89	2.66	21.76	79.20	6.71	84.97	0.28	0.18	0.777
301	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.19	0.11	0.967
302	106.50	0.00	0.69	81.54	13.88	13.98	24.28	0.04	0.03	0.228
303	106.50	0.00	0.29	87.37	2.46	18.54	18.84	0.02	0.02	0.177
304	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.18	0.10	0.967
305	106.50	14.30	2.50	28.92	80.38	11.04	89.39	0.36	0.23	0.740
501	106.50	0.00	1.01	70.87	24.47	14.14	34.62	0.11	0.07	0.325
502	106.50	0.00	0.53	73.34	11.64	21.00	32.64	0.01	0.02	0.306
503	106.50	0.00	2.76	19.57	81.20	8.26	84.18	0.05	0.03	0.790
504	106.50	41.79	3.09	11.86	127.86	7.05	133.35	0.15	0.09	0.899
505	106.50	0.00	2.32	28.37	67.81	8.01	75.81	0.12	0.08	0.712
506	106.50	0.00	1.06	69.26	26.59	21.70	36.19	0.02	0.02	0.340
601	106.50	0.00	0.16	82.15	0.00	24.21	24.21	0.07	0.13	0.227
602	106.50	0.00	0.45	74.51	9.32	22.23	31.56	0.04	0.05	0.296
603	106.50	0.00	0.82	64.55	21.39	19.76	41.14	0.03	0.03	0.386
LID-1	0.01	862.66	15.97	521.50	0.00	0.00	312.07	0.08	0.13	0.362
LID-2	0.01	1584.98	16.12	524.68	0.00	0.00	1031.04	0.36	0.32	0.651
LID-3	0.01	1312.34	16.06	511.77	0.00	0.00	769.75	0.43	0.41	0.587

****
LID Performance Summary
****

	Total Inflow	Evap Loss	Infil Loss	Surface Outflow	Drain Outflow	Initial Storage	Final Storage	Continuity Error

Subcatchment	LID Control	mm	mm	mm	mm	mm	mm	mm	%
LID-1	LID-1	862.67	15.97	521.50	312.07	0.00	13.20	26.33	-0.00
LID-2	LID-2	1584.98	16.12	524.68	1031.04	0.00	13.20	26.35	-0.00
LID-3	LID-3	1312.35	16.06	511.77	769.75	0.00	13.20	27.98	-0.00

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m
101	17.07	2.62	0.12	0.00	0.00	0.31	246.25	0.31	246.25
201	81.38	11.87	0.12	0.00	0.00	0.34	246.25	0.34	246.25
202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
204	85.56	13.46	0.12	0.00	0.00	0.34	246.25	0.34	246.25
205	21.76	3.29	0.12	0.00	0.00	0.31	246.25	0.31	246.25
301	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	81.54	12.81	0.12	0.00	0.00	0.34	246.25	0.34	246.25
303	87.37	14.77	0.12	0.00	0.00	0.34	246.25	0.34	246.25
304	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
305	28.92	4.10	0.12	0.00	0.00	0.31	246.25	0.31	246.25
501	70.87	11.03	0.12	0.00	0.00	0.33	246.25	0.33	246.25
502	73.34	13.25	0.12	0.00	0.00	0.33	246.25	0.33	246.25
503	19.57	2.78	0.12	0.00	0.00	0.31	246.25	0.31	246.25
504	11.86	1.53	0.12	0.00	0.00	0.31	246.25	0.31	246.25
505	28.37	4.49	0.12	0.00	0.00	0.31	246.25	0.31	246.25
506	69.26	10.71	0.12	0.00	0.00	0.33	246.25	0.33	246.25
601	82.15	15.19	0.12	0.00	0.00	0.34	246.25	0.33	246.25
602	74.51	13.64	0.12	0.00	0.00	0.33	246.25	0.33	246.25
603	64.55	11.63	0.12	0.00	0.00	0.33	246.25	0.33	246.25

Analysis begun on: Wed Nov 3 14:29:53 2021
Analysis ended on: Wed Nov 3 14:30:45 2021
Total elapsed time: 00:00:52

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EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:


*************
Element Count
*************
Number of rain gages ...... 28
Number of subcatchments ... 23
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
-----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
10yr_12h_SCS_Type_II_76mm 10yr_12h_SCS_Type_II_76mm      INTENSITY    6 min.
10yr_24h_SCS_Type_II_89.9mm 10yr_24h_SCS_Type_II_89.9mm    INTENSITY    6 min.
10yr_4h_Chicago      10yr_4h_Chicago                INTENSITY    1 min.
10yr_6h_SCS_Type_II_70.8mm 10yr_6h_SCS_Type_II_70.8mm     INTENSITY    6 min.
25mm_Chicago_4h      Chicago_4h                     CUMULATIVE   1 min.
25yr_12h_SCS_Type_II_90.7mm 25yr_12h_SCS_Type_II_90.7mm    INTENSITY    6 min.
25yr_24h_SCS_Type_II_107.5mm 25yr_24h_SCS_Type_II_107.5mm   INTENSITY    6 min.
25yr_4h_Chicago      25yr_4h_Chicago                INTENSITY    1 min.
25yr_6H_SCS_Type_II_85.2mm 25yr_6H_SCS_Type_II_85.2mm     INTENSITY    6 min.
2yr_12h_SCS_Type_II_46.7mm 2yr_12h_SCS_Type_II_46.7mm     INTENSITY    6 min.
2yr_24h_SCS_Type_II_55mm 2yr_24h_SCS_Type_II_55mm       INTENSITY    6 min.
2yr_4h_Chicago       2yr_4h_Chicago                 INTENSITY    1 min.
2yr_6h_SCS_Type_II_42.3mm 2yr_6h_SCS_Type_II_42.3mm      INTENSITY    6 min.
50yr_12h_SCS_Type_II_101.7mm 50yr_12h_SCS_Type_II_101.7mm   INTENSITY    6 min.
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50yr_24h_SCS_Type_II_120.6mm 50yr_24h_SCS_Type_II_120.6mm   INTENSITY    6 min.
50yr_4h_Chicago      50yr_4h_Chicago                INTENSITY    1 min.
50yr_6h_SCS_Type_II_95.9mm 50yr_6h_SCS_Type_II_95.9mm     INTENSITY    6 min.
5yr_12h_SCS_Type_II_64.3mm 5yr_12h_SCS_Type_II_64.3mm     INTENSITY    6 min.
5yr_24h_SCS_Type_II_76mm 5yr_24h_SCS_Type_II_76mm       INTENSITY    6 min.
5yr_4h_Chicago       5yr_4h_Chicago                 INTENSITY    1 min.
5yr_6h_SCS_Type_II_59.5mm 5yr_6h_SCS_Type_II_59.5mm      INTENSITY    6 min.
Continuous           Continuous                     INTENSITY   60 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.
NO_RAIN              NO_RAIN                        VOLUME       5 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
------------------------------------------------------------------------------------------------------
101                         0.26     85.00     79.92    1.5000 100yr_6h_SCS_Type_II_106.5mm LID-1
201                         0.04      6.53     18.94    1.0000 100yr_6h_SCS_Type_II_106.5mm LID-2
202                         0.09     59.87    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-2
203                         0.17    114.07    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-2
204                         0.05      6.57      9.78    2.0000 100yr_6h_SCS_Type_II_106.5mm 205
205                         0.32    129.80     74.79    1.0000 100yr_6h_SCS_Type_II_106.5mm LID-2
301                         0.18    122.33    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-3
302                         0.16     22.38     13.47    1.0000 100yr_6h_SCS_Type_II_106.5mm 305
303                         0.10     18.27      2.39    3.5000 100yr_6h_SCS_Type_II_106.5mm 305
304                         0.17    113.40    100.00    0.5000 100yr_6h_SCS_Type_II_106.5mm LID-3
305                         0.41     67.65     68.54    2.0000 100yr_6h_SCS_Type_II_106.5mm LID-3
501                         0.31     37.34     23.75    2.0000 100yr_6h_SCS_Type_II_106.5mm OF1
502                         0.04     20.67     11.29   25.0000 100yr_6h_SCS_Type_II_106.5mm OF1
503                         0.05     32.18     78.79    3.1000 100yr_6h_SCS_Type_II_106.5mm 504
504                         0.11     42.38     88.29    5.0000 100yr_6h_SCS_Type_II_106.5mm OF1
505                         0.16     63.96     65.79    5.0000 100yr_6h_SCS_Type_II_106.5mm OF1
506                         0.06     16.06     25.80    2.0000 100yr_6h_SCS_Type_II_106.5mm OF1
601                         0.30    254.00      0.00   35.0000 100yr_6h_SCS_Type_II_106.5mm OF1
602                         0.12    117.30      9.04   33.0000 100yr_6h_SCS_Type_II_106.5mm OF1
603                         0.06    107.67     20.74   33.0000 100yr_6h_SCS_Type_II_106.5mm OF1
LID-1                       0.03     62.44      0.00    0.5000 NO_RAIN              OF1
LID-2                       0.03     68.43      0.00    0.5000 NO_RAIN              OF1
LID-3                       0.06     42.61      0.00    0.5000 NO_RAIN              OF1


******************
LID Control Summary
```

****

Subcatchment	LID Control	No. of Units	Unit Area	Unit Width	% Area Covered	% Imperv Treated	% Perv Treated
LID-1	LID-1	1	256.00	4.10	100.00	0.00	0.00
LID-2	LID-2	1	349.00	5.10	100.00	0.00	0.00
LID-3	LID-3	1	554.00	13.00	100.00	0.00	0.00

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
OF1	OUTFALL	251.98	0.00	0.0	

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****

```
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... YES
  Groundwater ............ YES
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Surcharge Method ......... EXTRAN
Starting Date ............ 06/01/2005 00:00:00
Ending Date .............. 06/04/2005 00:00:00
Antecedent Dry Days ...... 7.0
Report Time Step ......... 00:00:15
Wet Time Step ............ 00:00:15
Dry Time Step ............ 00:00:15
```

```
**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.002         0.467
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         0.336       102.730
Evaporation Loss .........         0.008         2.511
Infiltration Loss ........         0.185        56.622
Surface Runoff ...........         0.141        43.110
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.003         0.960
Continuity Error (%) .....        -0.005


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........        17.051      5398.950
Infiltration .............         0.125        39.697
Upper Zone ET ............         0.021         6.500
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.000         0.097
Groundwater Flow .........         0.000         0.000
Final Storage ............        17.155      5432.050
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.141         1.411
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.141         1.411
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
```

Continuity Error (%) 0.000

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	106.50	0.00	2.83	17.07	82.32	5.05	86.60	0.22	0.14	0.813
201	106.50	0.00	0.88	81.38	19.52	24.24	24.24	0.01	0.01	0.228
202	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.09	0.05	0.967
203	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.18	0.10	0.967
204	106.50	0.00	0.56	85.56	10.08	19.04	20.38	0.01	0.01	0.191
205	106.50	2.89	2.66	21.76	79.20	6.71	84.97	0.28	0.18	0.777
301	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.19	0.11	0.967
302	106.50	0.00	0.69	81.54	13.88	13.98	24.28	0.04	0.03	0.228
303	106.50	0.00	0.29	87.37	2.46	18.54	18.84	0.02	0.02	0.177
304	106.50	0.00	3.51	0.00	103.00	0.00	103.00	0.18	0.10	0.967
305	106.50	14.30	2.50	28.92	80.38	11.04	89.39	0.36	0.23	0.740
501	106.50	0.00	1.01	70.87	24.47	14.14	34.62	0.11	0.07	0.325
502	106.50	0.00	0.53	73.34	11.64	21.00	32.64	0.01	0.02	0.306
503	106.50	0.00	2.76	19.57	81.20	8.26	84.18	0.05	0.03	0.790
504	106.50	41.79	3.09	11.86	127.86	7.05	133.35	0.15	0.09	0.899
505	106.50	0.00	2.32	28.37	67.81	8.01	75.81	0.12	0.08	0.712
506	106.50	0.00	1.06	69.26	26.59	21.70	36.19	0.02	0.02	0.340
601	106.50	0.00	0.16	82.15	0.00	24.21	24.21	0.07	0.13	0.227
602	106.50	0.00	0.45	74.51	9.32	22.23	31.56	0.04	0.05	0.296
603	106.50	0.00	0.82	64.55	21.39	19.76	41.14	0.03	0.03	0.386
LID-1	0.01	862.66	15.97	521.50	0.00	0.00	312.07	0.08	0.13	0.362
LID-2	0.01	1584.98	16.12	524.68	0.00	0.00	1031.04	0.36	0.32	0.651
LID-3	0.01	1312.34	16.06	511.77	0.00	0.00	769.75	0.43	0.41	0.587

****
LID Performance Summary
****

	Total Inflow	Evap Loss	Infil Loss	Surface Outflow	Drain Outflow	Initial Storage	Final Storage	Continuity Error

Subcatchment	LID Control	mm	mm	mm	mm	mm	mm	mm	%
LID-1	LID-1	862.67	15.97	521.50	312.07	0.00	13.20	26.33	-0.00
LID-2	LID-2	1584.98	16.12	524.68	1031.04	0.00	13.20	26.35	-0.00
LID-3	LID-3	1312.35	16.06	511.77	769.75	0.00	13.20	27.98	-0.00

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m
101	17.07	2.62	0.12	0.00	0.00	0.31	246.25	0.31	246.25
201	81.38	11.87	0.12	0.00	0.00	0.34	246.25	0.34	246.25
202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
204	85.56	13.46	0.12	0.00	0.00	0.34	246.25	0.34	246.25
205	21.76	3.29	0.12	0.00	0.00	0.31	246.25	0.31	246.25
301	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	81.54	12.81	0.12	0.00	0.00	0.34	246.25	0.34	246.25
303	87.37	14.77	0.12	0.00	0.00	0.34	246.25	0.34	246.25
304	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
305	28.92	4.10	0.12	0.00	0.00	0.31	246.25	0.31	246.25
501	70.87	11.03	0.12	0.00	0.00	0.33	246.25	0.33	246.25
502	73.34	13.25	0.12	0.00	0.00	0.33	246.25	0.33	246.25
503	19.57	2.78	0.12	0.00	0.00	0.31	246.25	0.31	246.25
504	11.86	1.53	0.12	0.00	0.00	0.31	246.25	0.31	246.25
505	28.37	4.49	0.12	0.00	0.00	0.31	246.25	0.31	246.25
506	69.26	10.71	0.12	0.00	0.00	0.33	246.25	0.33	246.25
601	82.15	15.19	0.12	0.00	0.00	0.34	246.25	0.33	246.25
602	74.51	13.64	0.12	0.00	0.00	0.33	246.25	0.33	246.25
603	64.55	11.63	0.12	0.00	0.00	0.33	246.25	0.33	246.25

Analysis begun on: Wed Nov 3 14:29:53 2021
Analysis ended on: Wed Nov 3 14:30:45 2021
Total elapsed time: 00:00:52

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:


*************
Element Count
*************
Number of rain gages ...... 28
Number of subcatchments ... 23
Number of nodes ........... 1
Number of links ........... 0
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
-----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
10yr_12h_SCS_Type_II_76mm 10yr_12h_SCS_Type_II_76mm      INTENSITY    6 min.
10yr_24h_SCS_Type_II_89.9mm 10yr_24h_SCS_Type_II_89.9mm    INTENSITY    6 min.
10yr_4h_Chicago      10yr_4h_Chicago                INTENSITY    1 min.
10yr_6h_SCS_Type_II_70.8mm 10yr_6h_SCS_Type_II_70.8mm     INTENSITY    6 min.
25mm_Chicago_4h      Chicago_4h                     CUMULATIVE   1 min.
25yr_12h_SCS_Type_II_90.7mm 25yr_12h_SCS_Type_II_90.7mm    INTENSITY    6 min.
25yr_24h_SCS_Type_II_107.5mm 25yr_24h_SCS_Type_II_107.5mm   INTENSITY    6 min.
25yr_4h_Chicago      25yr_4h_Chicago                INTENSITY    1 min.
25yr_6H_SCS_Type_II_85.2mm 25yr_6H_SCS_Type_II_85.2mm     INTENSITY    6 min.
2yr_12h_SCS_Type_II_46.7mm 2yr_12h_SCS_Type_II_46.7mm     INTENSITY    6 min.
2yr_24h_SCS_Type_II_55mm 2yr_24h_SCS_Type_II_55mm       INTENSITY    6 min.
2yr_4h_Chicago       2yr_4h_Chicago                 INTENSITY    1 min.
2yr_6h_SCS_Type_II_42.3mm 2yr_6h_SCS_Type_II_42.3mm      INTENSITY    6 min.
50yr_12h_SCS_Type_II_101.7mm 50yr_12h_SCS_Type_II_101.7mm   INTENSITY    6 min.
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50yr_24h_SCS_Type_II_120.6mm 50yr_24h_SCS_Type_II_120.6mm   INTENSITY    6 min.
50yr_4h_Chicago      50yr_4h_Chicago                INTENSITY    1 min.
50yr_6h_SCS_Type_II_95.9mm 50yr_6h_SCS_Type_II_95.9mm     INTENSITY    6 min.
5yr_12h_SCS_Type_II_64.3mm 5yr_12h_SCS_Type_II_64.3mm     INTENSITY    6 min.
5yr_24h_SCS_Type_II_76mm 5yr_24h_SCS_Type_II_76mm       INTENSITY    6 min.
5yr_4h_Chicago       5yr_4h_Chicago                 INTENSITY    1 min.
5yr_6h_SCS_Type_II_59.5mm 5yr_6h_SCS_Type_II_59.5mm      INTENSITY    6 min.
Continuous           Continuous                     INTENSITY   60 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.
NO_RAIN              NO_RAIN                        VOLUME       5 min.
```

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
101	0.26	85.00	79.92	1.5000	Hurricane_Hazel	LID-1
201	0.04	6.53	18.94	1.0000	Hurricane_Hazel	LID-2
202	0.09	59.87	100.00	0.5000	Hurricane_Hazel	LID-2
203	0.17	114.07	100.00	0.5000	Hurricane_Hazel	LID-2
204	0.05	6.57	9.78	2.0000	Hurricane_Hazel	205
205	0.32	129.80	74.79	1.0000	Hurricane_Hazel	LID-2
301	0.18	122.33	100.00	0.5000	Hurricane_Hazel	LID-3
302	0.16	22.38	13.47	1.0000	Hurricane_Hazel	305
303	0.10	18.27	2.39	3.5000	Hurricane_Hazel	305
304	0.17	113.40	100.00	0.5000	Hurricane_Hazel	LID-3
305	0.41	67.65	68.54	2.0000	Hurricane_Hazel	LID-3
501	0.31	37.34	23.75	2.0000	Hurricane_Hazel	OF1
502	0.04	20.67	11.29	25.0000	Hurricane_Hazel	OF1
503	0.05	32.18	78.79	3.1000	Hurricane_Hazel	504
504	0.11	42.38	88.29	5.0000	Hurricane_Hazel	OF1
505	0.16	63.96	65.79	5.0000	Hurricane_Hazel	OF1
506	0.06	16.06	25.80	2.0000	Hurricane_Hazel	OF1
601	0.30	254.00	0.00	35.0000	Hurricane_Hazel	OF1
602	0.12	117.30	9.04	33.0000	Hurricane_Hazel	OF1
603	0.06	107.67	20.74	33.0000	Hurricane_Hazel	OF1
LID-1	0.03	62.44	0.00	0.5000	NO_RAIN	OF1
LID-2	0.03	68.43	0.00	0.5000	NO_RAIN	OF1
LID-3	0.06	42.61	0.00	0.5000	NO_RAIN	OF1

****
LID Control Summary

```
*******************
                                 No. of        Unit        Unit      % Area    % Imperv      % Perv
Subcatchment     LID Control      Units        Area       Width     Covered     Treated     Treated
-----------------------------------------------------------------------------------------------------
LID-1            LID-1                1      256.00        4.10      100.00        0.00        0.00
LID-2            LID-2                1      349.00        5.10      100.00        0.00        0.00
LID-3            LID-3                1      554.00       13.00      100.00        0.00        0.00


************
Node Summary
************
                                        Invert      Max.    Ponded    External
Name                 Type                Elev.     Depth      Area    Inflow
-------------------------------------------------------------------------------
OF1                  OUTFALL            251.98      0.00       0.0


*******************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*******************************************************

****************
Analysis Options
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... YES
  Groundwater ............ YES
  Flow Routing ........... NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Surcharge Method ......... EXTRAN
Starting Date ............ 06/01/2005 00:00:00
Ending Date .............. 06/04/2005 00:00:00
Antecedent Dry Days ...... 7.0
Report Time Step ......... 00:00:15
Wet Time Step ............ 00:00:15
Dry Time Step ............ 00:00:15
```

```
**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial LID Storage ......         0.036        10.860
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         0.666       203.531
Evaporation Loss .........         0.011         3.420
Infiltration Loss ........         0.343       104.635
Surface Runoff ...........         0.345       105.328
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.003         1.010
Continuity Error (%) .....        -0.001


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........        17.051      5398.950
Infiltration .............         0.274        86.890
Upper Zone ET ............         0.019         5.880
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.000         0.097
Groundwater Flow .........         0.000         0.000
Final Storage ............        17.307      5479.863
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.345         3.449
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.345         3.449
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
```

Continuity Error (%) 0.000

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
101	211.00	0.00	4.01	38.29	164.73	5.50	168.70	0.43	0.03	0.800
201	211.00	0.00	1.43	176.74	39.05	32.84	32.84	0.01	0.00	0.156
202	211.00	0.00	4.89	0.00	206.11	0.00	206.11	0.19	0.01	0.977
203	211.00	0.00	4.89	0.00	206.11	0.00	206.11	0.35	0.02	0.977
204	211.00	0.00	1.01	181.47	20.17	25.83	28.52	0.01	0.00	0.135
205	211.00	4.04	3.79	48.19	157.18	7.76	163.07	0.53	0.04	0.758
301	211.00	0.00	4.89	0.00	206.11	0.00	206.11	0.38	0.03	0.977
302	211.00	0.00	1.17	169.30	27.77	19.92	40.52	0.07	0.01	0.192
303	211.00	0.00	0.67	186.52	4.93	23.19	23.81	0.02	0.01	0.113
304	211.00	0.00	4.89	0.00	206.11	0.00	206.11	0.35	0.02	0.977
305	211.00	21.98	3.56	62.86	156.31	14.19	166.56	0.68	0.06	0.715
501	211.00	0.00	1.60	149.34	48.96	19.07	60.05	0.19	0.02	0.285
502	211.00	0.00	1.01	165.02	23.29	21.69	44.97	0.02	0.00	0.213
503	211.00	0.00	3.92	45.41	162.45	9.78	161.67	0.09	0.01	0.766
504	211.00	80.25	4.39	28.43	252.86	8.68	258.43	0.28	0.02	0.887
505	211.00	0.00	3.36	63.67	135.65	8.33	143.97	0.23	0.02	0.682
506	211.00	0.00	1.67	153.36	53.20	26.99	55.97	0.03	0.00	0.265
601	211.00	0.00	0.53	185.81	0.00	24.66	24.66	0.08	0.02	0.117
602	211.00	0.00	0.91	168.93	18.65	22.52	41.16	0.05	0.01	0.195
603	211.00	0.00	1.40	147.05	42.78	19.77	62.55	0.04	0.01	0.296
LID-1	0.01	1680.41	16.52	599.98	0.00	0.00	1342.96	0.34	0.03	0.799
LID-2	0.01	3090.76	16.53	600.70	0.00	0.00	2752.56	0.96	0.08	0.891
LID-3	0.01	2535.87	16.53	574.83	0.00	0.00	2221.92	1.23	0.11	0.876

****
LID Performance Summary
****

	Total Inflow	Evap Loss	Infil Loss	Surface Outflow	Drain Outflow	Initial Storage	Final Storage	Continuity Error

Subcatchment	LID Control	mm	mm	mm	mm	mm	mm	mm	%
LID-1	LID-1	1680.41	16.52	599.98	1342.96	0.00	306.79	27.75	-0.00
LID-2	LID-2	3090.77	16.53	600.70	2752.56	0.00	306.79	27.77	-0.00
LID-3	LID-3	2535.87	16.53	574.83	2221.93	0.00	306.79	29.37	-0.00

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m
101	38.29	2.35	0.12	0.00	0.00	0.32	246.25	0.32	246.25
201	176.74	10.75	0.12	0.00	0.00	0.38	246.33	0.38	246.42
202	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
203	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
204	181.47	12.22	0.12	0.00	0.00	0.38	246.33	0.38	246.42
205	48.19	2.95	0.12	0.00	0.00	0.32	246.25	0.32	246.25
301	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
302	169.30	11.61	0.12	0.00	0.00	0.37	246.32	0.37	246.40
303	186.52	13.43	0.12	0.00	0.00	0.38	246.34	0.38	246.43
304	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
305	62.86	3.66	0.12	0.00	0.00	0.33	246.25	0.33	246.25
501	149.34	9.98	0.12	0.00	0.00	0.36	246.29	0.37	246.31
502	165.02	12.03	0.12	0.00	0.00	0.37	246.32	0.37	246.39
503	45.41	2.49	0.12	0.00	0.00	0.32	246.25	0.32	246.25
504	28.43	1.37	0.12	0.00	0.00	0.31	246.25	0.31	246.25
505	63.67	4.02	0.12	0.00	0.00	0.33	246.25	0.33	246.25
506	153.36	9.69	0.12	0.00	0.00	0.37	246.30	0.37	246.34
601	185.81	13.82	0.12	0.00	0.00	0.38	246.34	0.38	246.43
602	168.93	12.39	0.12	0.00	0.00	0.37	246.32	0.37	246.40
603	147.05	10.54	0.12	0.00	0.00	0.36	246.29	0.37	246.30

Analysis begun on: Wed Nov 3 14:20:09 2021
Analysis ended on: Wed Nov 3 14:21:02 2021
Total elapsed time: 00:00:53

```
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)
--------------------------------------------------------------

PROJECT MANAGER: MF
MODELLING COMPLETED BY: MG
WORK COMPLETED:


*************
Element Count
*************
Number of rain gages ...... 5
Number of subcatchments ... 6
Number of nodes ........... 4
Number of links ........... 3
Number of pollutants ...... 0
Number of land uses ....... 0


****************
Raingage Summary
****************
                                                    Data       Recording
Name                 Data Source                    Type       Interval
----------------------------------------------------------------------
100yr_12h_SCS_Type_II_112.5mm 100yr_12h_SCS_Type_II_112.5mm  INTENSITY    6 min.
100yr_24h_SCS_Type_II_133.6mm 100yr_24h_SCS_Type_II_133.6mm  INTENSITY    6 min.
100yr_4h_Chicago     100yr_4h_Chicago               INTENSITY    1 min.
100yr_6h_SCS_Type_II_106.5mm 100yr_6h_SCS_Type_II_106.5mm   INTENSITY    6 min.
Hurricane_Hazel      Hurricane_Hazel                INTENSITY   60 min.


********************
Subcatchment Summary
********************
Name                        Area     Width   %Imperv    %Slope Rain Gage            Outlet
------------------------------------------------------------------------------------------------
601                         0.30    254.00      0.00   35.0000 100yr_6h_SCS_Type_II_106.5mm J2
602                         0.12    117.30      9.04   33.0000 100yr_6h_SCS_Type_II_106.5mm J3
701                         0.21    187.54      0.00   35.0000 100yr_6h_SCS_Type_II_106.5mm J1
702                         0.16    190.82      0.00   15.0000 100yr_6h_SCS_Type_II_106.5mm J1
703                         0.23    272.94      0.65   15.0000 100yr_6h_SCS_Type_II_106.5mm J2
704                         0.12     41.17     55.71    5.0000 100yr_6h_SCS_Type_II_106.5mm J3
```

```
************
Node Summary
************
                                        Invert      Max.    Ponded    External
Name                 Type                Elev.     Depth      Area    Inflow
--------------------------------------------------------------------------------
J1                   JUNCTION           262.56      0.50       0.0
J2                   JUNCTION           261.06      0.50       0.0
J3                   JUNCTION           258.79      0.50       0.0
OF1                  OUTFALL            254.59      0.50       0.0


************
Link Summary
************
Name              From Node         To Node           Type             Length    %Slope Roughness
-----------------------------------------------------------------------------------------------------
C1                J1                J2                CONDUIT          194.2    0.7723    0.0300
C2                J3                OF1               CONDUIT          119.4    3.5194    0.0300
C3                J2                J3                CONDUIT          267.4    0.8489    0.0300


*********************
Cross Section Summary
*********************
                                      Full     Full     Hyd.     Max.   No. of     Full
Conduit           Shape              Depth     Area     Rad.    Width  Barrels     Flow
-----------------------------------------------------------------------------------------
C1                TRAPEZOIDAL         0.50     0.81     0.27     2.75        1     1.00
C2                TRAPEZOIDAL         0.50     1.00     0.27     3.50        1     2.63
C3                TRAPEZOIDAL         0.50     0.81     0.27     2.75        1     1.05


*******************************************************
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
*******************************************************

****************
Analysis Options
```

```
****************
Flow Units ............... CMS
Process Models:
  Rainfall/Runoff ........ YES
  RDII ................... NO
  Snowmelt ............... YES
  Groundwater ............ YES
  Flow Routing ........... YES
  Ponding Allowed ........ NO
  Water Quality .......... NO
Infiltration Method ...... GREEN_AMPT
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 06/01/2005 00:00:00
Ending Date .............. 06/04/2005 00:00:00
Antecedent Dry Days ...... 7.0
Report Time Step ......... 00:00:15
Wet Time Step ............ 00:00:15
Dry Time Step ............ 00:00:15
Routing Time Step ........ 5.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Initial Snow Cover .......         0.000         0.000
Total Precipitation ......         0.122       106.500
Evaporation Loss .........         0.000         0.389
Infiltration Loss ........         0.088        76.412
Surface Runoff ...........         0.034        29.710
Snow Removed .............         0.000         0.000
Final Snow Cover .........         0.000         0.000
Final Storage ............         0.000         0.000
Continuity Error (%) .....        -0.010


**************************        Volume         Depth
Groundwater Continuity         hectare-m            mm
**************************     ---------       -------
Initial Storage ..........         6.188      5398.950
```

```
Infiltration .............         0.088        76.412
Upper Zone ET ............         0.016        14.001
Lower Zone ET ............         0.000         0.000
Deep Percolation .........         0.000         0.121
Groundwater Flow .........         0.000         0.000
Final Storage ............         6.259      5461.240
Continuity Error (%) .....         0.000


**************************        Volume        Volume
Flow Routing Continuity        hectare-m      10^6 ltr
**************************     ---------     ---------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.034         0.341
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.034         0.340
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.000         0.000
Continuity Error (%) .....         0.000


*************************
Highest Continuity Errors
*************************
Node J2 (1.18%)


***************************
Time-Step Critical Elements
***************************
None


********************************
Highest Flow Instability Indexes
********************************
All links are stable.
```

```
*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     4.50 sec
Average Time Step           :     5.00 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00
Time Step Frequencies       :
    5.000 -  3.155 sec      :   100.00 %
    3.155 -  1.991 sec      :     0.00 %
    1.991 -  1.256 sec      :     0.00 %
    1.256 -  0.792 sec      :     0.00 %
    0.792 -  0.500 sec      :     0.00 %
```

****
Subcatchment Runoff Summary
****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
601	106.50	0.00	0.16	82.15	0.00	24.21	24.21	0.07	0.13	0.227
602	106.50	0.00	0.45	74.51	9.32	22.23	31.56	0.04	0.05	0.296
701	106.50	0.00	0.16	82.06	0.00	24.29	24.29	0.05	0.09	0.228
702	106.50	0.00	0.16	82.23	0.00	24.12	24.12	0.04	0.07	0.227
703	106.50	0.00	0.18	81.69	0.67	23.97	24.65	0.06	0.10	0.231
704	106.50	0.00	1.99	37.07	57.42	10.03	67.44	0.08	0.06	0.633

****
Groundwater Summary
****

Subcatchment	Total Infil mm	Total Evap mm	Total Lower Seepage mm	Total Lateral Outflow mm	Maximum Lateral Outflow CMS	Average Upper Moist.	Average Water Table m	Final Upper Moist.	Final Water Table m

601	82.15	15.19	0.12	0.00	0.00	0.34	246.25	0.33	246.25
602	74.51	13.64	0.12	0.00	0.00	0.33	246.25	0.33	246.25
701	82.06	15.19	0.12	0.00	0.00	0.34	246.25	0.33	246.25
702	82.23	15.19	0.12	0.00	0.00	0.34	246.25	0.33	246.25
703	81.69	15.08	0.12	0.00	0.00	0.34	246.25	0.33	246.25
704	37.07	5.81	0.12	0.00	0.00	0.32	246.25	0.32	246.25

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.00	0.20	262.76	0 03:00	0.20
J2	JUNCTION	0.00	0.29	261.35	0 03:03	0.29
J3	JUNCTION	0.00	0.20	258.99	0 03:06	0.20
OF1	OUTFALL	0.00	0.20	254.79	0 03:06	0.20

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.158	0.158	0 03:00	0.0892	0.0892	-2.808
J2	JUNCTION	0.231	0.372	0 03:00	0.131	0.223	1.198
J3	JUNCTION	0.112	0.338	0 03:03	0.12	0.34	-0.009
OF1	OUTFALL	0.000	0.334	0 03:06	0	0.34	0.000

****
Node Surcharge Summary
****

No nodes were surcharged.

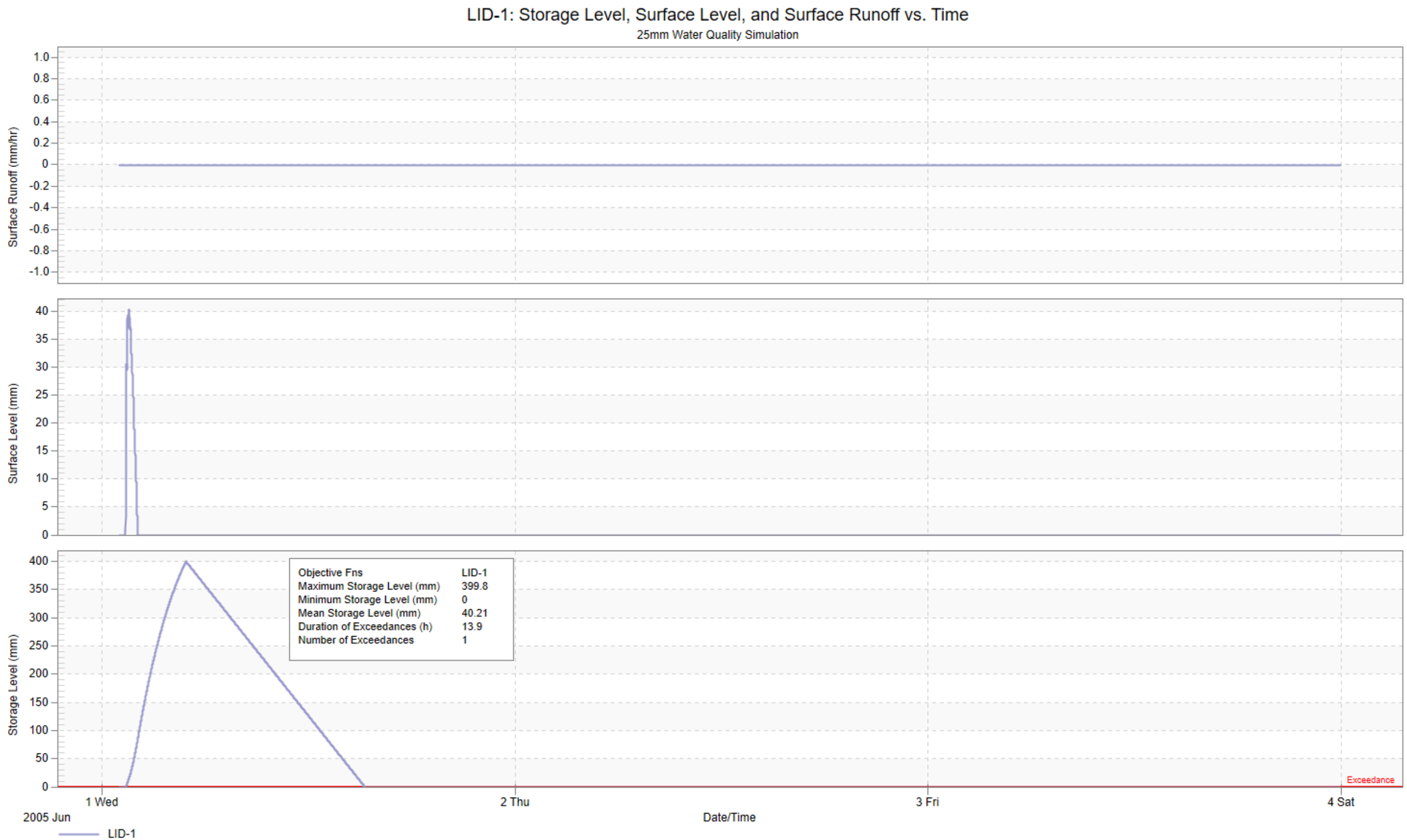
```
*********************
Node Flooding Summary
*********************

No nodes were flooded.


************************
Outfall Loading Summary
************************

-------------------------------------------------------------
                       Flow       Avg       Max       Total
                       Freq      Flow      Flow      Volume
Outfall Node           Pcnt       CMS       CMS    10^6 ltr
-------------------------------------------------------------
OF1                    9.37     0.014     0.334       0.340
-------------------------------------------------------------
System                 9.37     0.014     0.334       0.340


********************
Link Flow Summary
********************

-------------------------------------------------------------------------------
                                Maximum  Time of Max   Maximum    Max/    Max/
                                 |Flow|   Occurrence   |Veloc|    Full    Full
Link                  Type          CMS  days hr:min     m/sec    Flow   Depth
-------------------------------------------------------------------------------
C1                    CONDUIT     0.144     0  03:00      0.68    0.14    0.48
C2                    CONDUIT     0.334     0  03:06      1.55    0.13    0.39
C3                    CONDUIT     0.262     0  03:04      1.04    0.25    0.49


***************************
Flow Classification Summary
***************************

-------------------------------------------------------------------------------------
                     Adjusted    ---------- Fraction of Time in Flow Class ----------
                      /Actual         Up    Down  Sub   Sup   Up    Down  Norm  Inlet
```

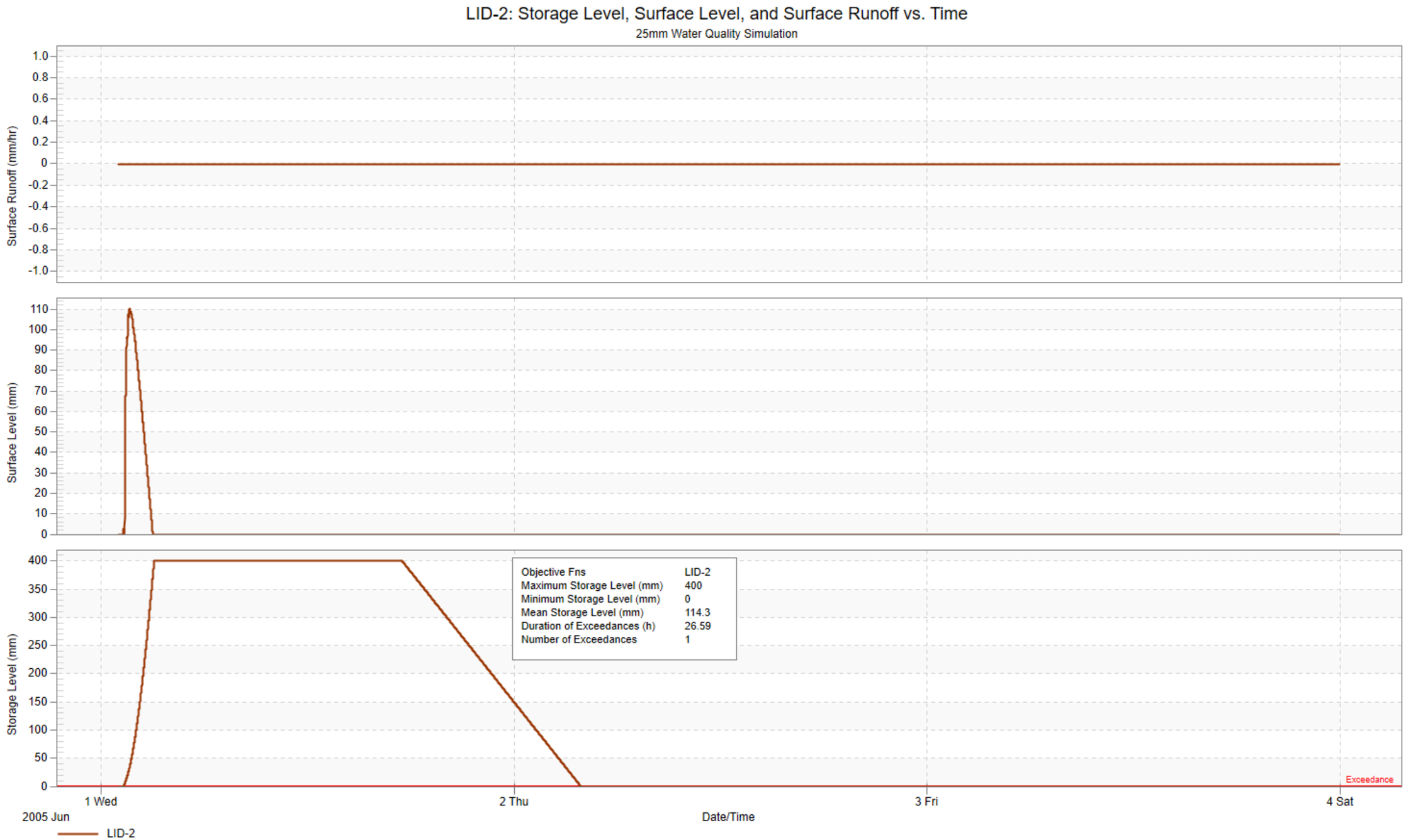
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
C1	1.00	0.69	0.20	0.00	0.11	0.00	0.00	0.00	0.96	0.00
C2	1.00	0.76	0.00	0.00	0.23	0.02	0.00	0.00	0.09	0.00
C3	1.00	0.69	0.00	0.00	0.31	0.00	0.00	0.00	0.17	0.00

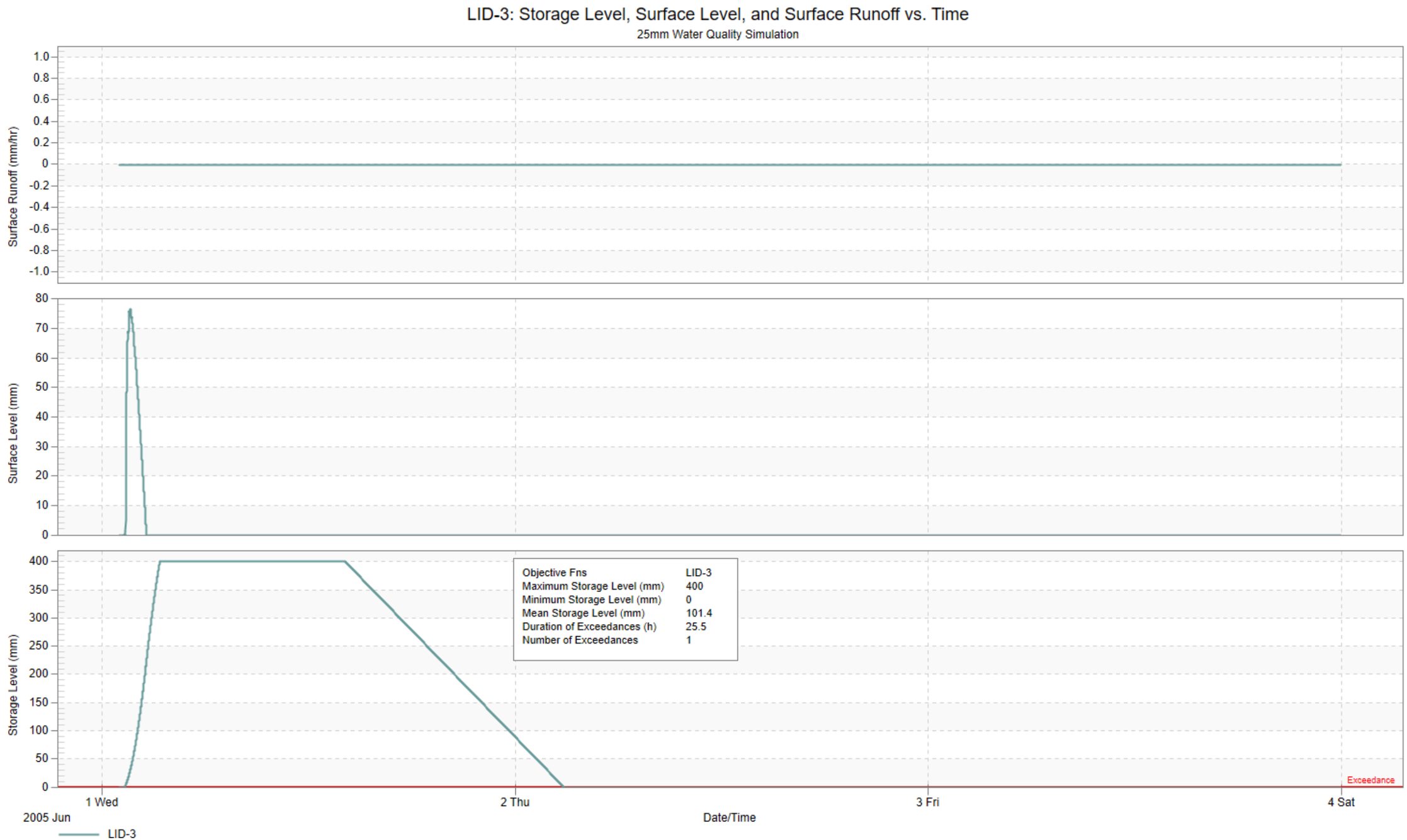
****
Conduit Surcharge Summary
****

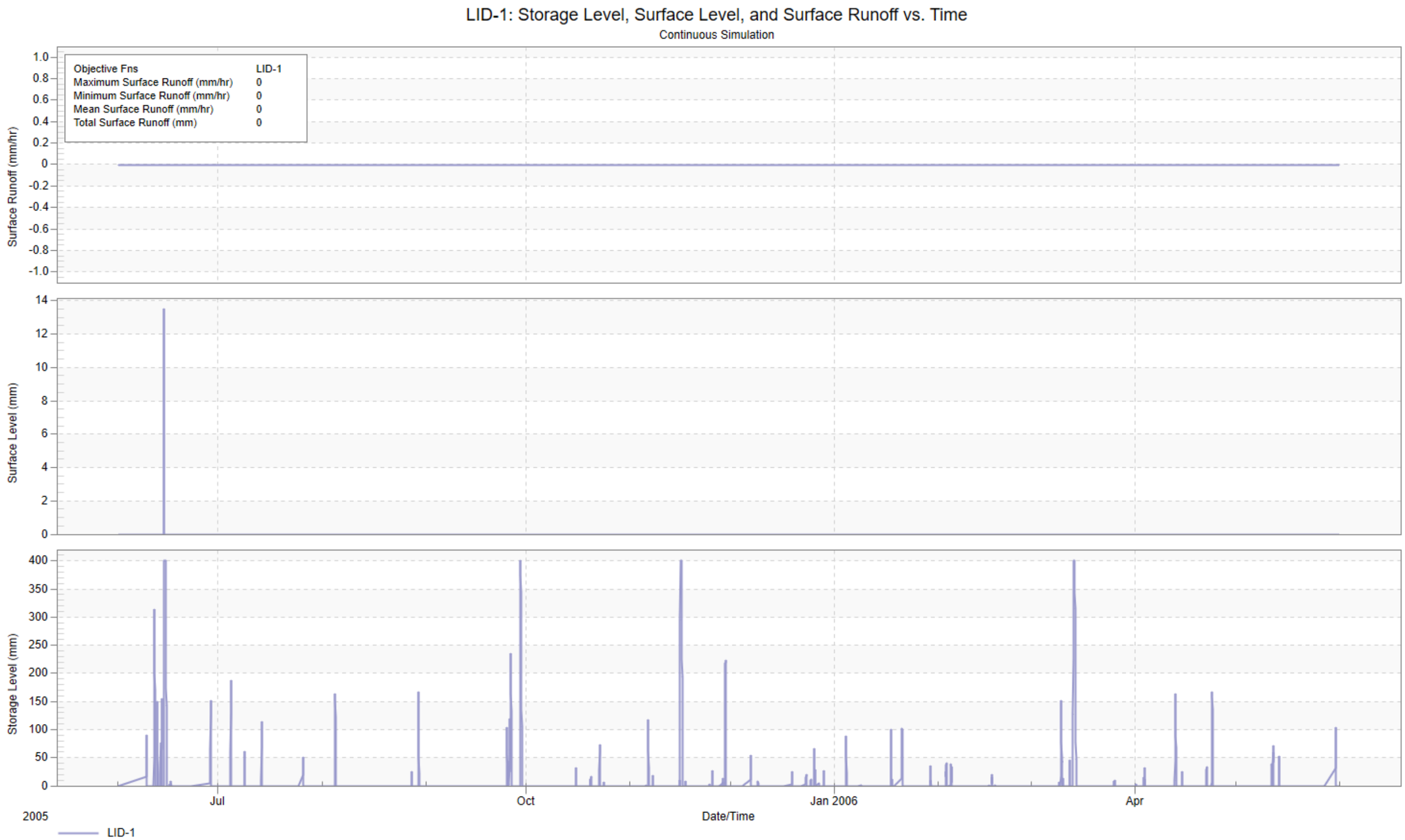
No conduits were surcharged.

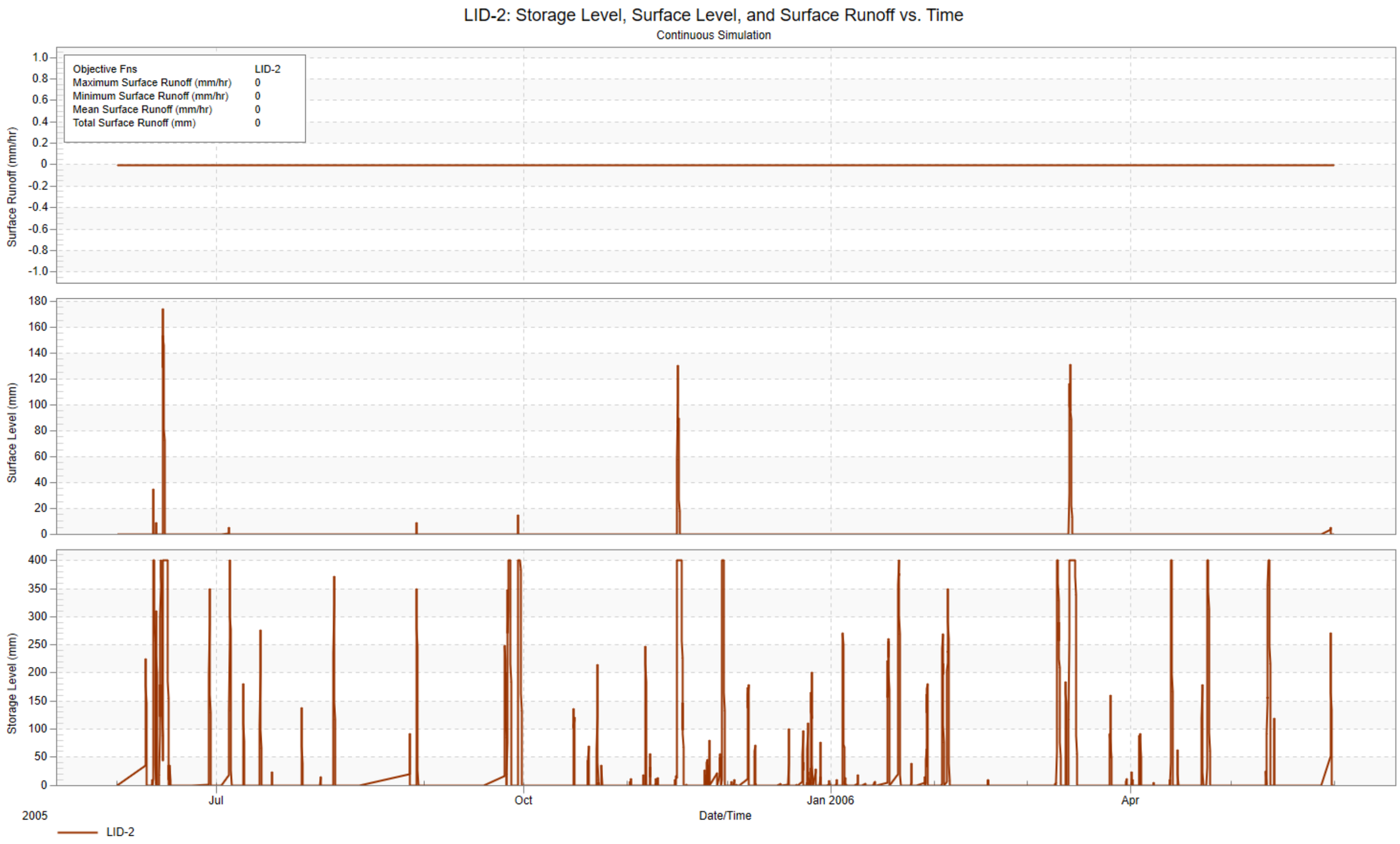
Analysis begun on: Mon Nov 1 12:18:53 2021
Analysis ended on: Mon Nov 1 12:18:53 2021
Total elapsed time: < 1 sec

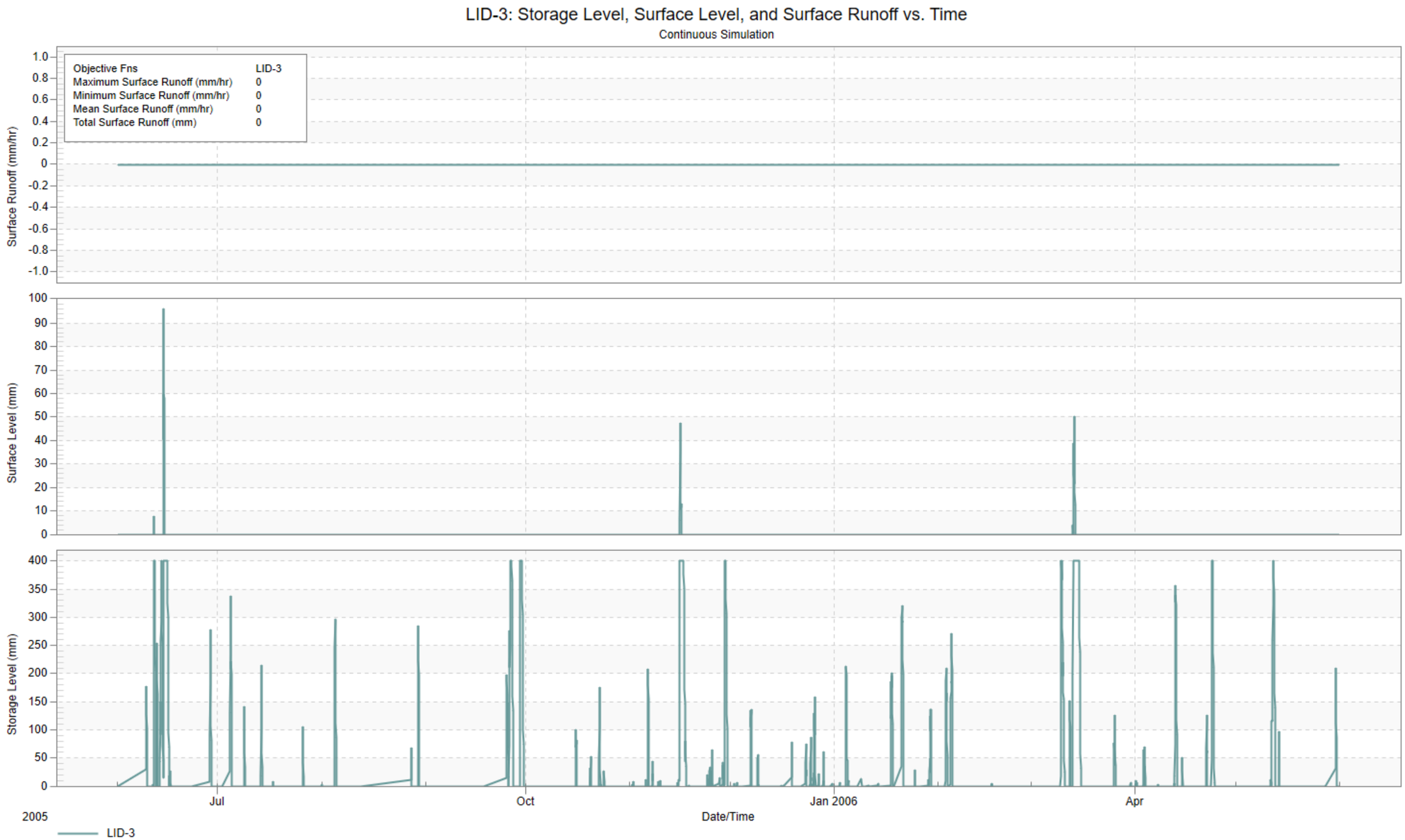

LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time
25mm Water Quality Simulation
Surface Runoff (mm/hr)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
Surface Level (mm)
40
35
30
25
20
15
10
5
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
Objective Fns LID-1
Maximum Storage Level (mm) 399.8
Minimum Storage Level (mm) 0
Mean Storage Level (mm) 40.21
Duration of Exceedances (h) 13.9
Number of Exceedances 1
Exceedance
1 Wed
2 Thu
3 Fri
4 Sat
2005 Jun
Date/Time
LID-1

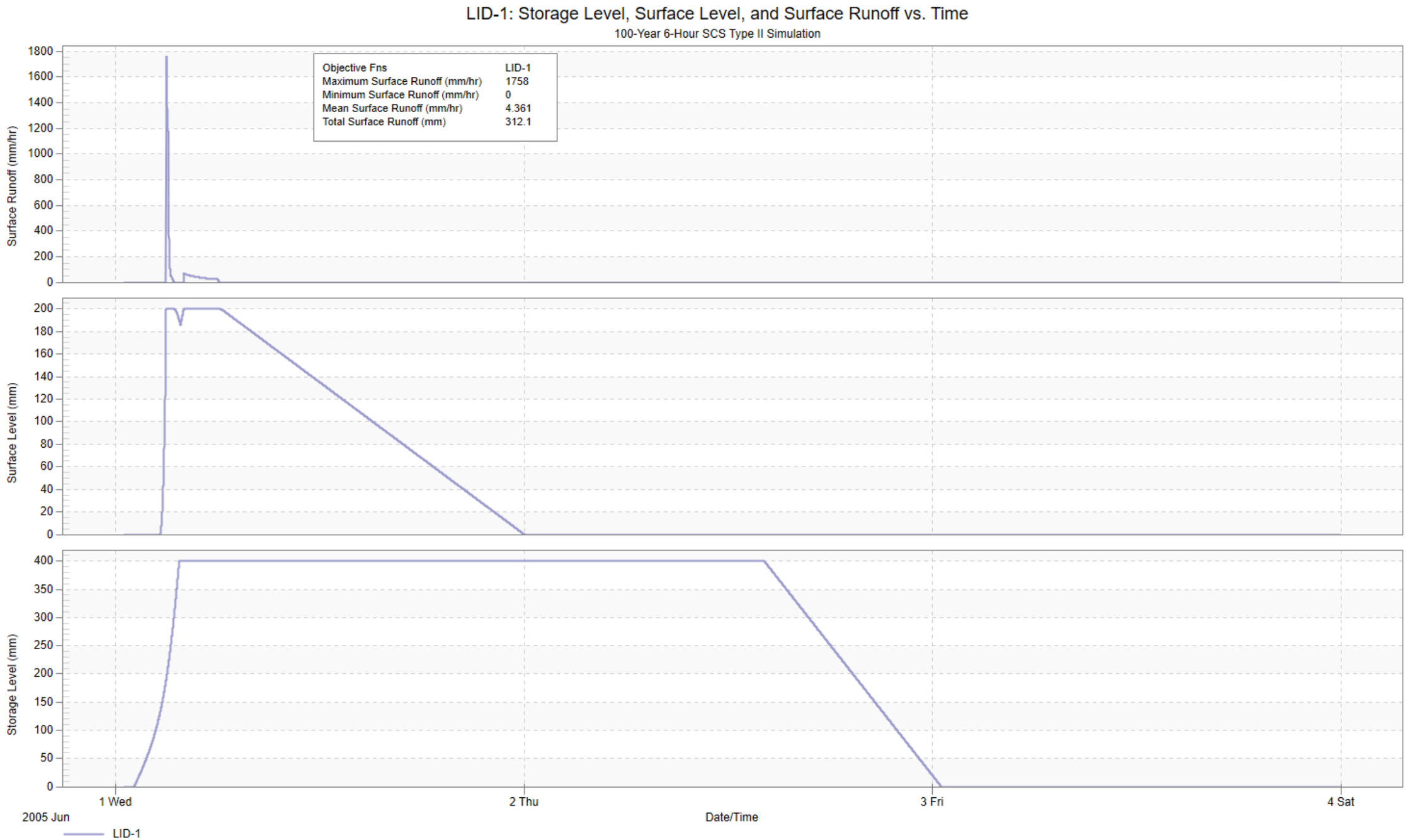

LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time
25mm Water Quality Simulation
Surface Runoff (mm/hr)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
Surface Level (mm)
110
100
90
80
70
60
50
40
30
20
10
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
Objective Fns LID-2
Maximum Storage Level (mm) 400
Minimum Storage Level (mm) 0
Mean Storage Level (mm) 114.3
Duration of Exceedances (h) 26.59
Number of Exceedances 1
Exceedance
1 Wed
2005 Jun
2 Thu
3 Fri
4 Sat
Date/Time
LID-2

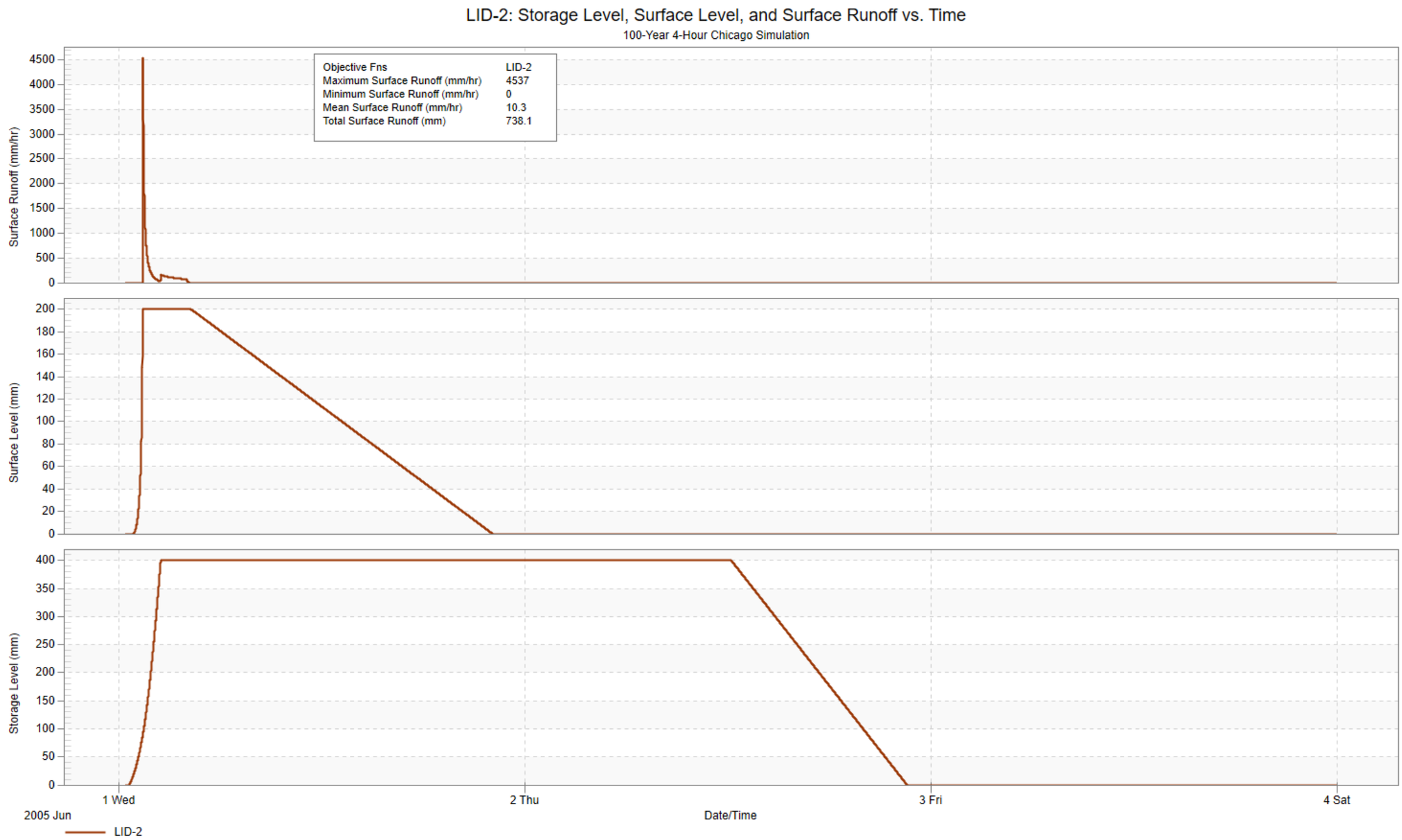

LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time
25mm Water Quality Simulation
Surface Runoff (mm/hr)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
Surface Level (mm)
80
70
60
50
40
30
20
10
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
Objective Fns LID-3
Maximum Storage Level (mm) 400
Minimum Storage Level (mm) 0
Mean Storage Level (mm) 101.4
Duration of Exceedances (h) 25.5
Number of Exceedances 1
Exceedance
1 Wed
2 Thu
3 Fri
4 Sat
2005 Jun
Date/Time
LID-3

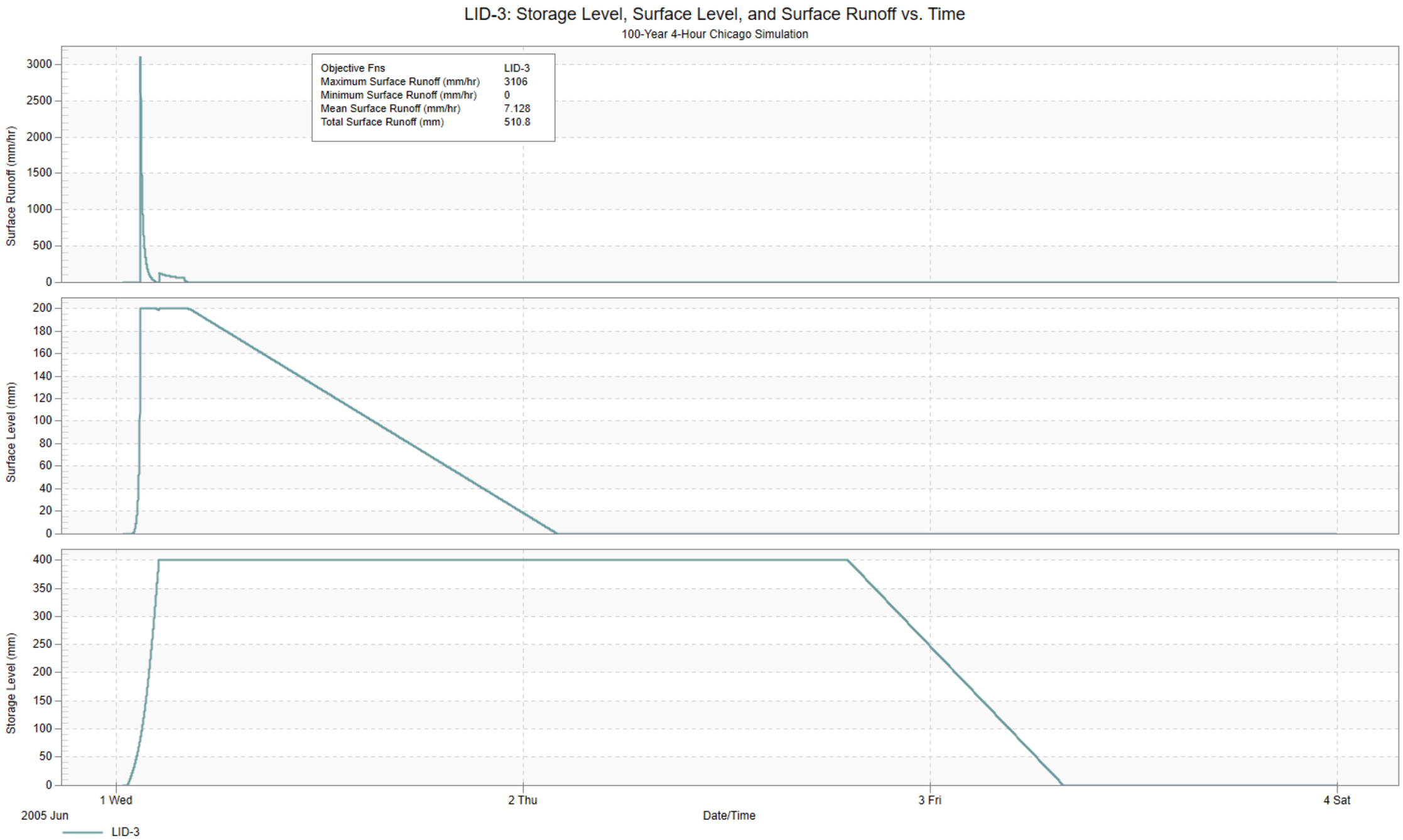

LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time
Continuous Simulation
Objective Fns LID-1
Maximum Surface Runoff (mm/hr) 0
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 0
Total Surface Runoff (mm) 0
Surface Runoff (mm/hr)
Surface Level (mm)
Storage Level (mm)
Jul
Oct
Jan 2006
Apr
2005
Date/Time
LID-1


LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time
Continuous Simulation
Objective Fns LID-2
Maximum Surface Runoff (mm/hr) 0
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 0
Total Surface Runoff (mm) 0
Surface Runoff (mm/hr)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
Surface Level (mm)
180
160
140
120
100
80
60
40
20
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
2005
Jul
Oct
Jan 2006
Apr
Date/Time
LID-2


LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time
Continuous Simulation
Objective Fns LID-3
Maximum Surface Runoff (mm/hr) 0
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 0
Total Surface Runoff (mm) 0
Surface Runoff (mm/hr)
1.0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1.0
Surface Level (mm)
100
90
80
70
60
50
40
30
20
10
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
2005
Jul
Oct
Jan 2006
Apr
Date/Time
LID-3

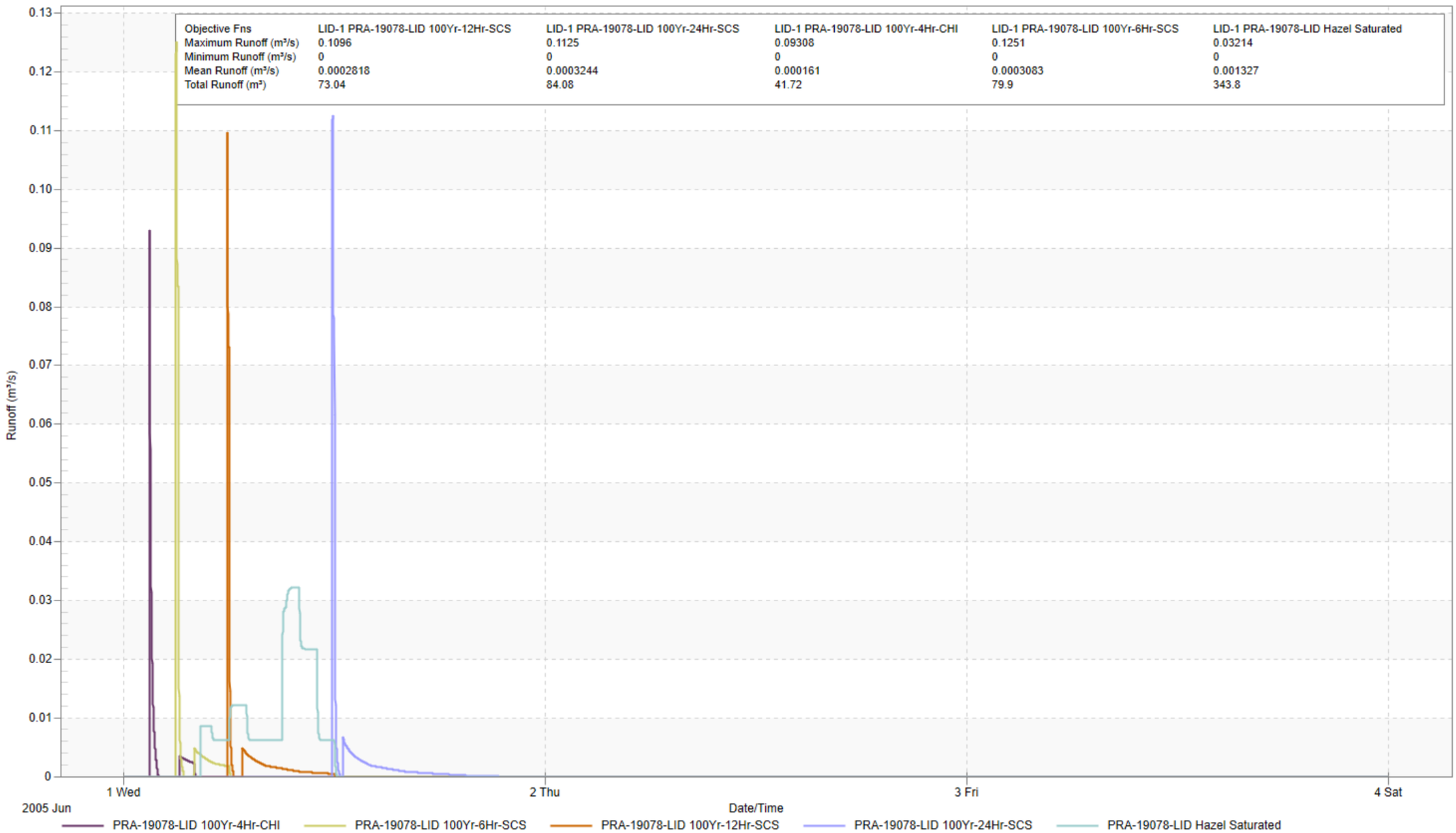

LID-1: Storage Level, Surface Level, and Surface Runoff vs. Time
100-Year 6-Hour SCS Type II Simulation
Objective Fns LID-1
Maximum Surface Runoff (mm/hr) 1758
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 4.361
Total Surface Runoff (mm) 312.1
Surface Runoff (mm/hr)
Surface Level (mm)
Storage Level (mm)
1 Wed
2 Thu
3 Fri
4 Sat
2005 Jun
Date/Time
LID-1


LID-2: Storage Level, Surface Level, and Surface Runoff vs. Time
100-Year 4-Hour Chicago Simulation
Objective Fns LID-2
Maximum Surface Runoff (mm/hr) 4537
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 10.3
Total Surface Runoff (mm) 738.1
Surface Runoff (mm/hr)
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Surface Level (mm)
200
180
160
140
120
100
80
60
40
20
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
1 Wed
2 Thu
3 Fri
4 Sat
2005 Jun
Date/Time
LID-2


LID-3: Storage Level, Surface Level, and Surface Runoff vs. Time
100-Year 4-Hour Chicago Simulation
Objective Fns LID-3
Maximum Surface Runoff (mm/hr) 3106
Minimum Surface Runoff (mm/hr) 0
Mean Surface Runoff (mm/hr) 7.128
Total Surface Runoff (mm) 510.8
Surface Runoff (mm/hr)
3000
2500
2000
1500
1000
500
0
Surface Level (mm)
200
180
160
140
120
100
80
60
40
20
0
Storage Level (mm)
400
350
300
250
200
150
100
50
0
1 Wed
2 Thu
3 Fri
4 Sat
2005 Jun
Date/Time
LID-3

Subcatchment LID-1

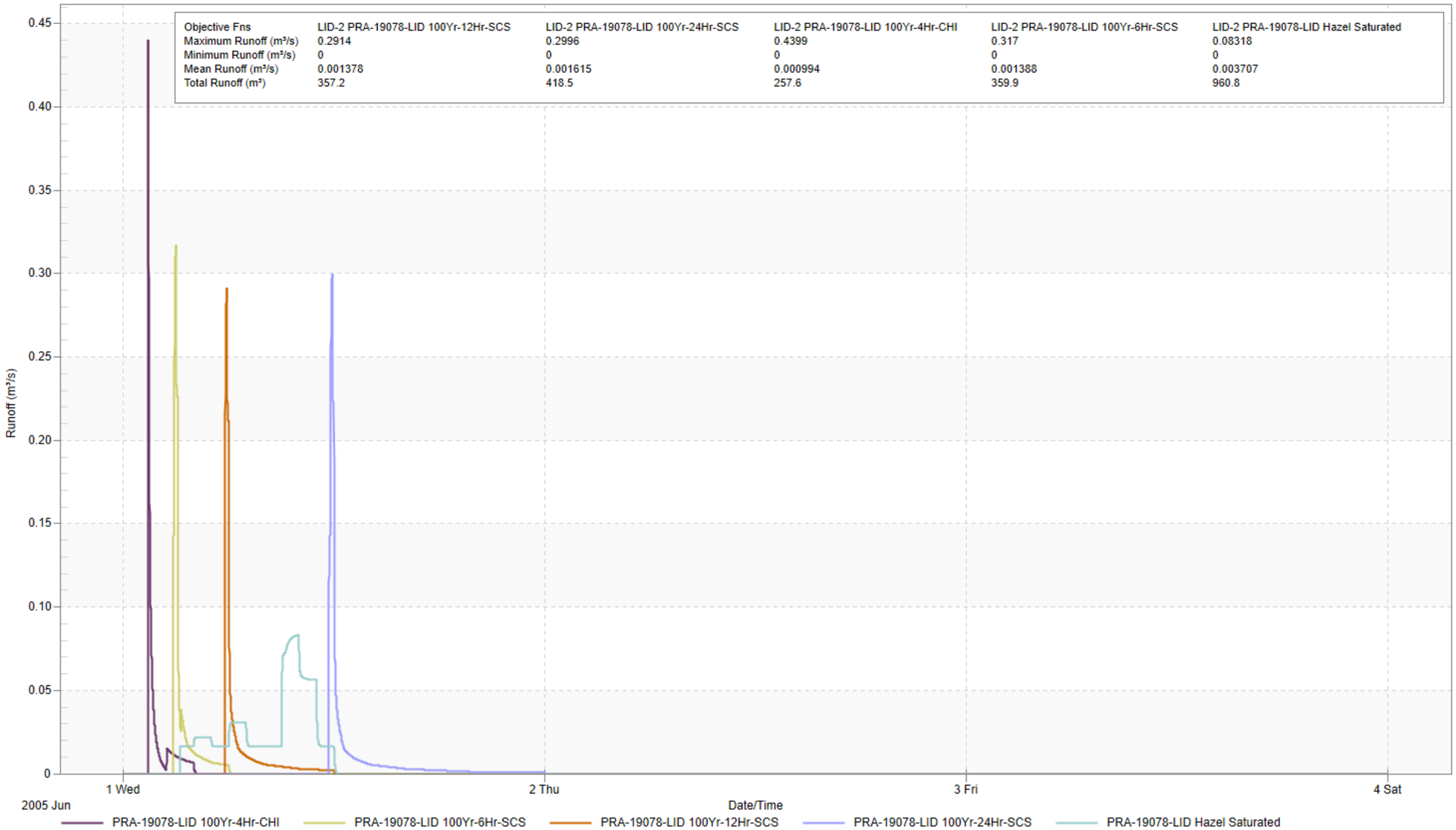
LID-1: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	LID-1 PRA-19078-LID 100Yr-12Hr-SCS	LID-1 PRA-19078-LID 100Yr-24Hr-SCS	LID-1 PRA-19078-LID 100Yr-4Hr-CHI	LID-1 PRA-19078-LID 100Yr-6Hr-SCS	LID-1 PRA-19078-LID Hazel Saturated
Maximum Runoff (m³/s)	0.1096	0.1125	0.09308	0.1251	0.03214
Minimum Runoff (m³/s)	0	0	0	0	0
Mean Runoff (m³/s)	0.0002818	0.0003244	0.000161	0.0003083	0.001327
Total Runoff (m³)	73.04	84.08	41.72	79.9	343.8

Subcatchment LID-2

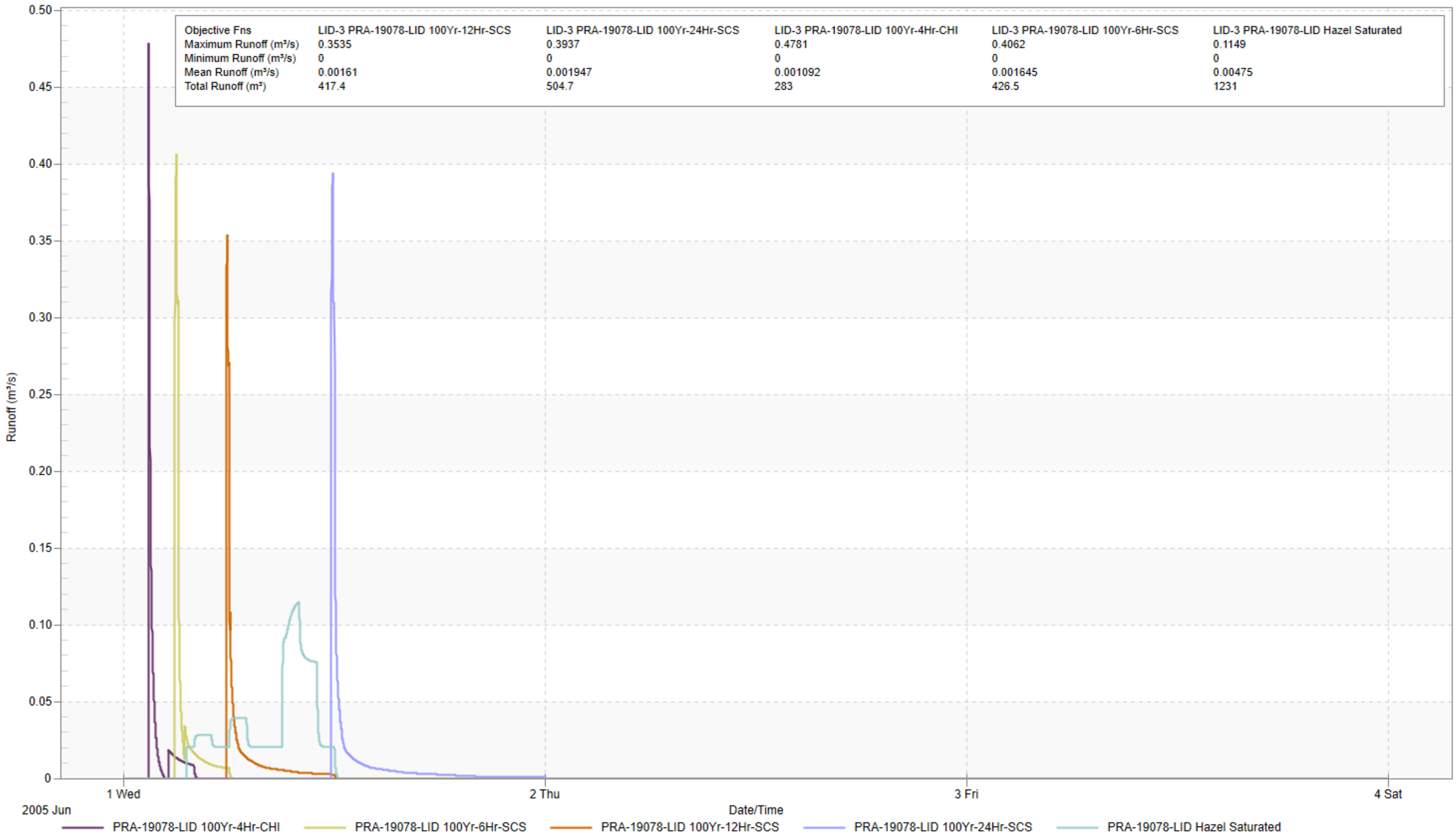
LID-2: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	LID-2 PRA-19078-LID 100Yr-12Hr-SCS	LID-2 PRA-19078-LID 100Yr-24Hr-SCS	LID-2 PRA-19078-LID 100Yr-4Hr-CHI	LID-2 PRA-19078-LID 100Yr-6Hr-SCS	LID-2 PRA-19078-LID Hazel Saturated
Maximum Runoff (m³/s)	0.2914	0.2996	0.4399	0.317	0.08318
Minimum Runoff (m³/s)	0	0	0	0	0
Mean Runoff (m³/s)	0.001378	0.001615	0.000994	0.001388	0.003707
Total Runoff (m³)	357.2	418.5	257.6	359.9	960.8

Subcatchment LID-3

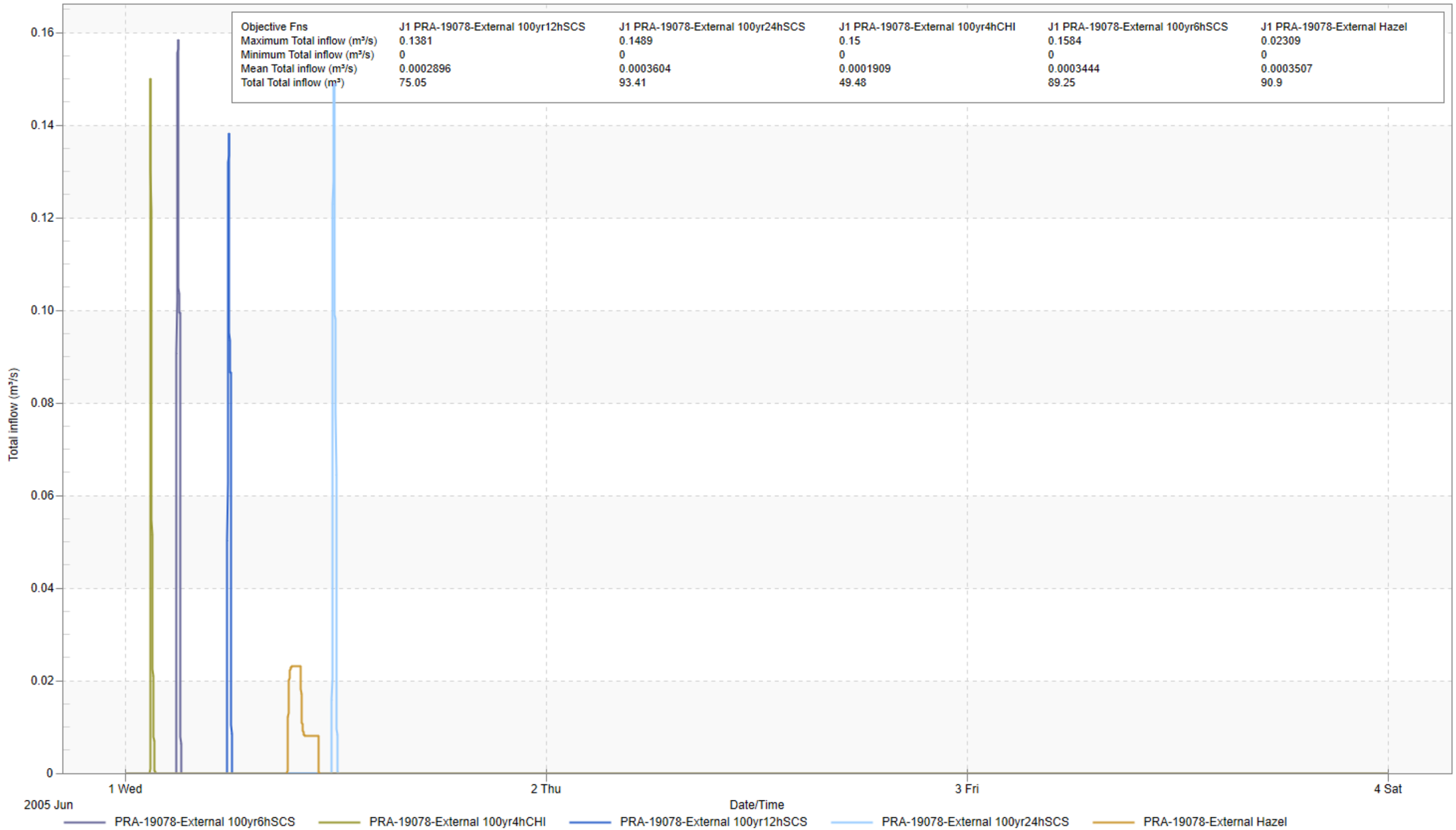
LID-3: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	LID-3 PRA-19078-LID 100Yr-12Hr-SCS	LID-3 PRA-19078-LID 100Yr-24Hr-SCS	LID-3 PRA-19078-LID 100Yr-4Hr-CHI	LID-3 PRA-19078-LID 100Yr-6Hr-SCS	LID-3 PRA-19078-LID Hazel Saturated
Maximum Runoff (m³/s)	0.3535	0.3937	0.4781	0.4062	0.1149
Minimum Runoff (m³/s)	0	0	0	0	0
Mean Runoff (m³/s)	0.00161	0.001947	0.001092	0.001645	0.00475
Total Runoff (m³)	417.4	504.7	283	426.5	1231

Node J1

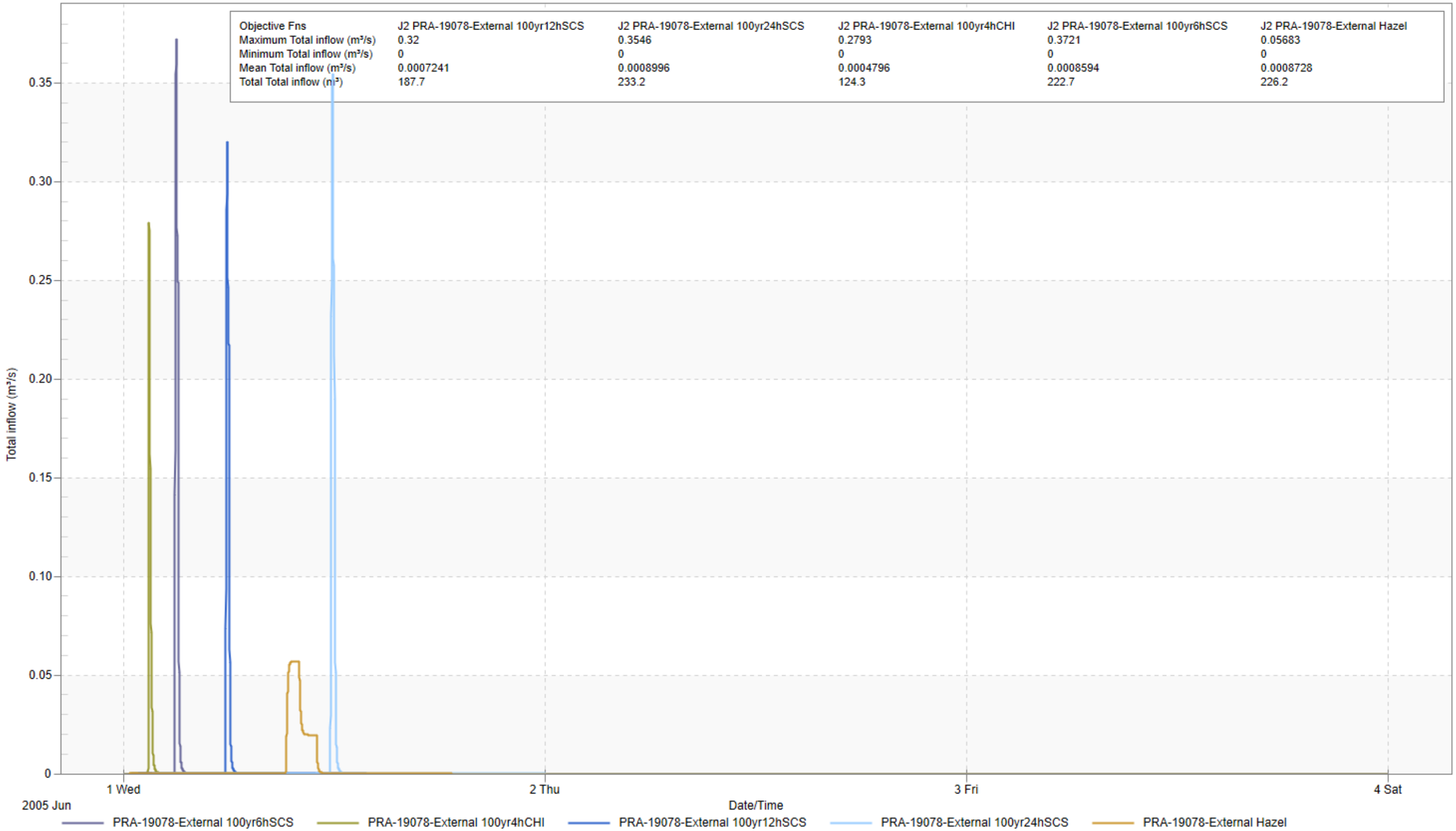
External: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	J1 PRA-19078-External 100yr12hSCS	J1 PRA-19078-External 100yr24hSCS	J1 PRA-19078-External 100yr4hCHI	J1 PRA-19078-External 100yr6hSCS	J1 PRA-19078-External Hazel
Maximum Total inflow (m³/s)	0.1381	0.1489	0.15	0.1584	0.02309
Minimum Total inflow (m³/s)	0	0	0	0	0
Mean Total inflow (m³/s)	0.0002896	0.0003604	0.0001909	0.0003444	0.0003507
Total Total inflow (m³)	75.05	93.41	49.48	89.25	90.9

Node J2

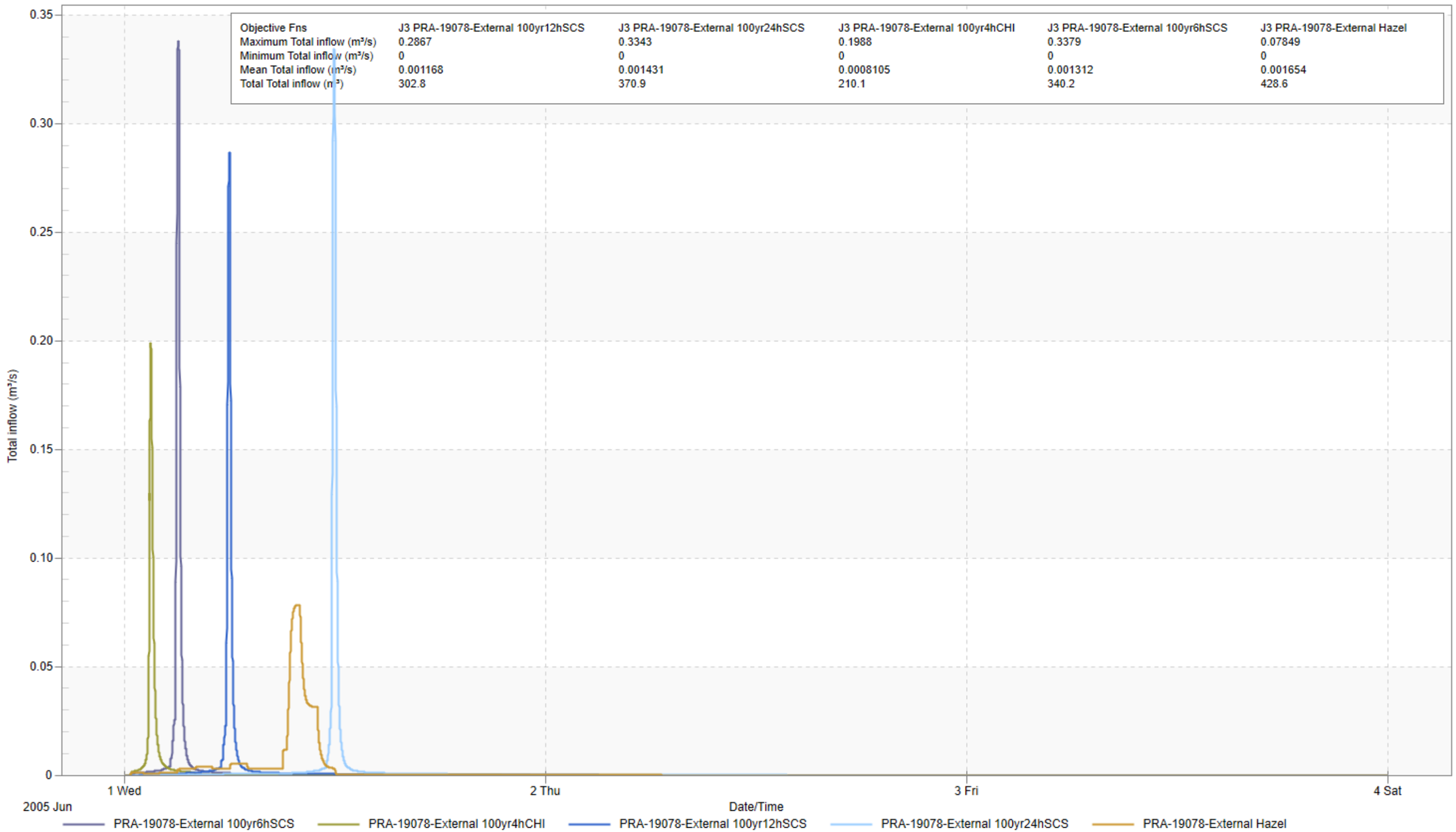
External: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	J2 PRA-19078-External 100yr12hSCS	J2 PRA-19078-External 100yr24hSCS	J2 PRA-19078-External 100yr4hCHI	J2 PRA-19078-External 100yr6hSCS	J2 PRA-19078-External Hazel
Maximum Total inflow (m³/s)	0.32	0.3546	0.2793	0.3721	0.05683
Minimum Total inflow (m³/s)	0	0	0	0	0
Mean Total inflow (m³/s)	0.0007241	0.0008996	0.0004796	0.0008594	0.0008728
Total Total inflow (m³)	187.7	233.2	124.3	222.7	226.2

Node J3

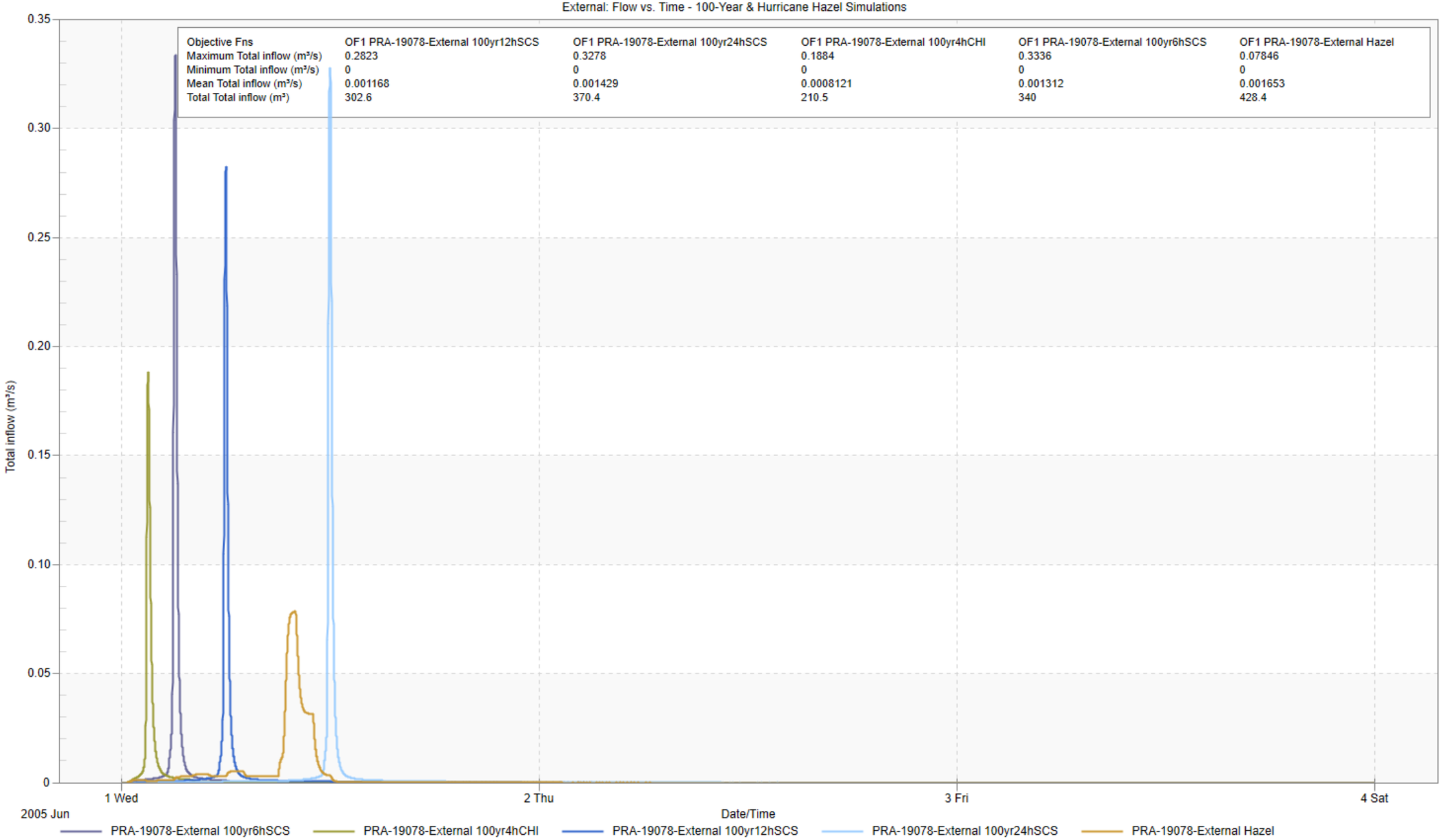
External: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



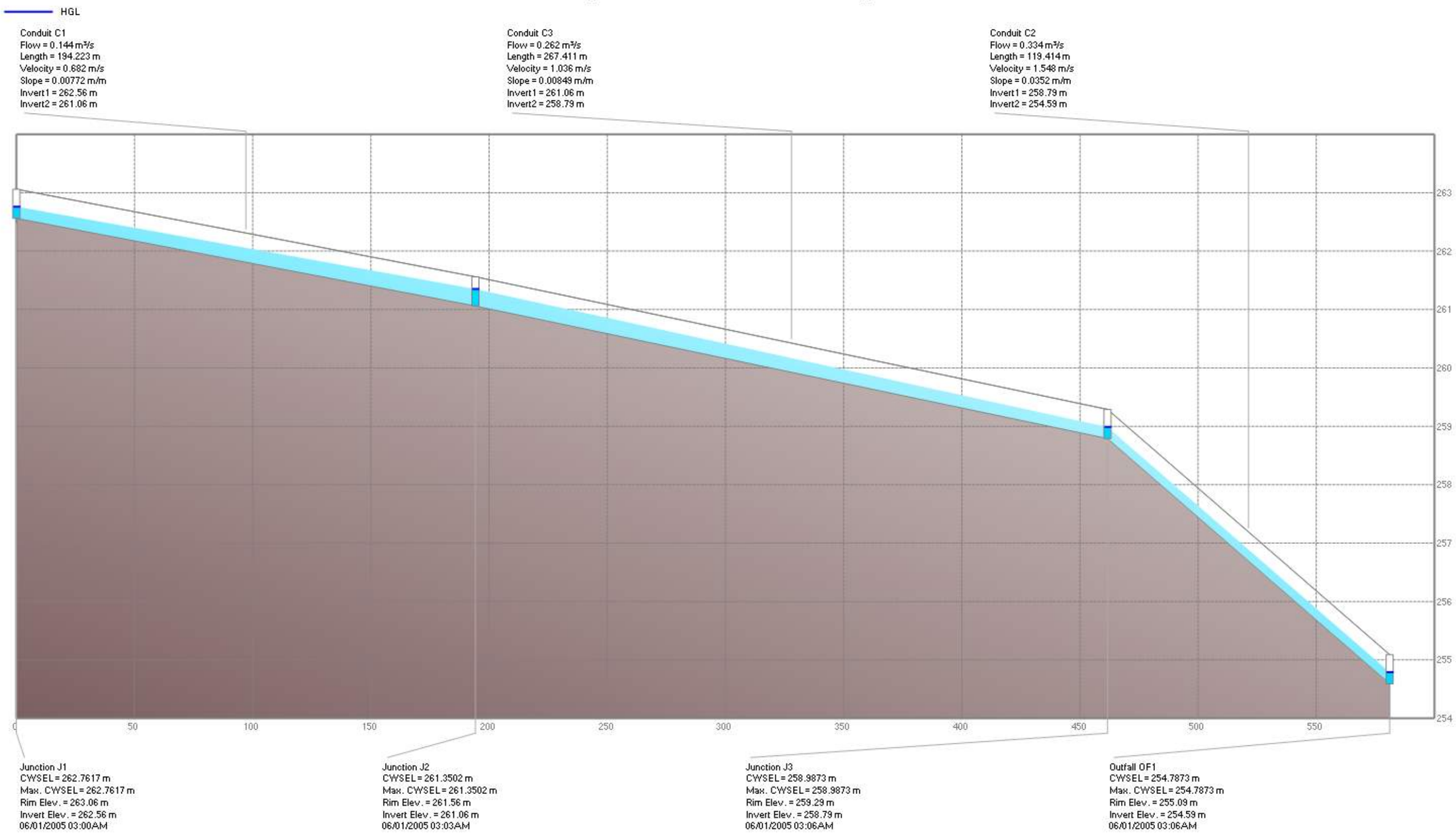
Objective Fns	J3 PRA-19078-External 100yr12hSCS	J3 PRA-19078-External 100yr24hSCS	J3 PRA-19078-External 100yr4hCHI	J3 PRA-19078-External 100yr6hSCS	J3 PRA-19078-External Hazel
Maximum Total inflow (m³/s)	0.2867	0.3343	0.1988	0.3379	0.07849
Minimum Total inflow (m³/s)	0	0	0	0	0
Mean Total inflow (m³/s)	0.001168	0.001431	0.0008105	0.001312	0.001654
Total Total inflow (m³)	302.8	370.9	210.1	340.2	428.6

Node OF1

External: Flow vs. Time - 100-Year & Hurricane Hazel Simulations



Objective Fns	OF1 PRA-19078-External 100yr12hSCS	OF1 PRA-19078-External 100yr24hSCS	OF1 PRA-19078-External 100yr4hCHI	OF1 PRA-19078-External 100yr6hSCS	OF1 PRA-19078-External Hazel
Maximum Total inflow (m³/s)	0.2823	0.3278	0.1884	0.3336	0.07846
Minimum Total inflow (m³/s)	0	0	0	0	0
Mean Total inflow (m³/s)	0.001168	0.001429	0.0008121	0.001312	0.001653
Total Total inflow (m³)	302.6	370.4	210.5	340	428.4

PRA-19078 - Metrolinx and Mapleview Drive East Conveyance Channel

Hydraulic Gradeline Assessment - 100 Year 6 Hour SCS Type II