STORMWATER MANAGEMENT REPORT

750 MAPLEVIEW DRIVE EAST
PROPOSED RESIDENTIAL DEVELOPMENT

CITY OF BARRIE

PROJECT: 2019-4867 OCTOBER, 2021

Revision	Description	Prepared		Checked	
		By	Date	By	Date
0.	First Submission	N.Kamran	October 2021	K. Shahbikian	October 2021

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1. INTRODUCTION

1.1 Objective and Location

This Stormwater Management Report is prepared in support of the detailed design for the proposed residential development, located at 750 Mapleview Drive East, in the City of Barrie. The subject site is rectangular and covers a total area of approximately 1.39 hectares. The property is located on the north side of Mapleview Drive East, approximately 500 m east of Yonge Street, between St. Paul's Crescent to the west and Royal Jubilee Drive to the east. The proposed development is surrounded by the 700 Mapleview Drive East residential subdivision to the north, east, and west (see Figure 1).

This report will establish how the subject site can be serviced by stormwater management infrastructure. The following sections present a stormwater management servicing plan for the proposed development.

1.2 Existing Conditions

The proposed development covers a total area of 1.39 ha and is mainly located within the Hewitt's Creek Watershed in the City of Barrie. Under pre-development conditions, the subject site is primarily forested/grassy land. The site is relatively flat and grades down towards the northeast part of the site. The topography of the property ranges from 251.5 m above sea level (masl) in the southwest corner of the property to 247.00 m masl in the northeast corner of the property. (see Drawing STM-1 in Appendix E). The developable area of the site after including all applicable setbacks is 1.08 ha (approximately 78% of the site area). There is an existing residential dwelling, located on the property that has a footprint of approximately 204 m^2, which will be demolished before the development of the subject site.

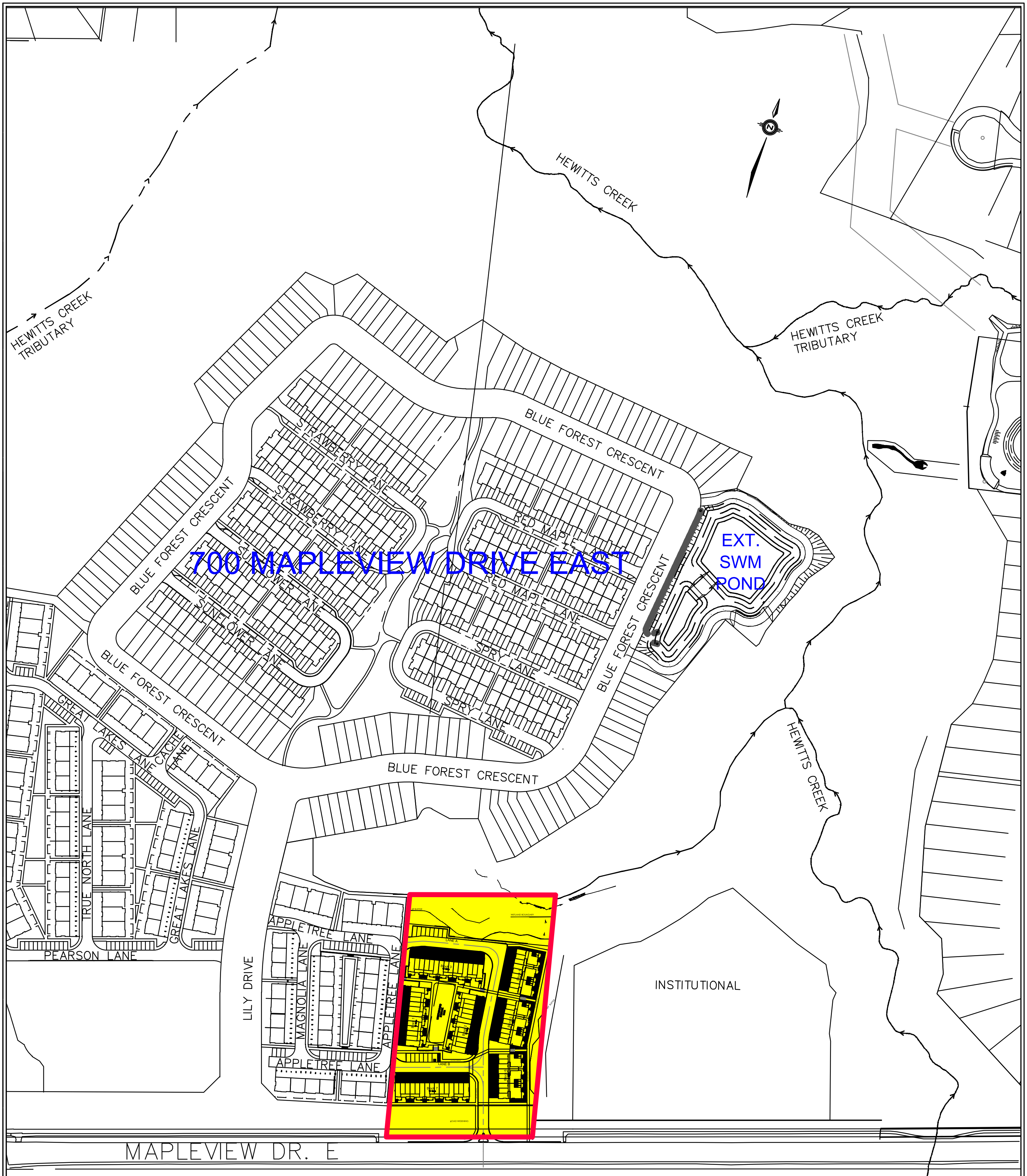
1.3 Proposed Development Plan

According to the Site Plan for the proposed development, prepared by R.N Design, dated September 22, 2020, last revised on June 6, 2021, 81 residential units and Amenity Area based on 8 m^2/unit are proposed. Please refer to Figure 2 and the Site Plan for the proposed development, provided in Appendix A. The site is legally described as Part of the South Half of Lot 16, Concession 12, City of Barrie, and County of Simcoe.

1.4 Background Information

The following reports and technical documents were reviewed in the preparation of this report:

- *Stormwater Management Report, 700 Mapleview Drive East Proposed Residential Subdivision, City of Barrie, by Schaeffers Consulting Engineers, Last Revised March 2020;*
- *Preliminary Geotechnical Investigation, 750 Mapleview Drive East, Barrie, Ontario, by EXP, dated July 23, 2020;*
- *Phase I Environmental Site Assessment (ESA), 750 Mapleview Drive East, Barrie, Ontario, by EXP, dated February 28, 2020;*
- *INNIS_SHORE Planning Area Master Servicing Report, by R.G Robinson and Associates (Barrie) Ltd. Consulting Engineers and Planners, Revised August 1998;*
- *MOECC Stormwater Management Planning and Design Manual (March 2003);*
- *LSRCA Technical Guidelines for Stormwater Management Submissions (Sept. 1, 2016)*;
- *Lake Simcoe Protection Plan (July 2009);*
- *The City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, updated August 11, 2020.*



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LEGEND
SITE LOCATION

FIGURE 1
LOCATION PLAN

2019-4867 | AUGUST 2021 | SCALE: N.T.S.

2. STORMWATER MANAGEMENT

The proposed development is located within the Hewitt's Creek Subwatershed. The proposed SWM plan for the subject site follows the guidelines outlined in the MOECC Stormwater Management Planning and Design Manual (March 2003), City of Barrie design criteria, and the Lake Simcoe Region Conservation Authority (LSCRA) design guidelines. More details of the SWM plan for the proposed residential subdivision will be discussed in the sections below. A presentation was conducted by Schaeffers Consulting Engineers in a charrette meeting to develop a collaborative and comprehensive stormwater management plan for the subject site. Due to high groundwater elevation, low infiltration rate, and limited opportunities for implementation of volume reduction techniques within the subject site, Schaeffers Consulting Engineers proposed a Sand Filtration Bed in the north part of the site as a rate control LID to fulfill the LSRCA requirement for retaining 25 mm volume of water from the impervious area of the proposed development. The Sand Filter Bed close to the existing environmental features was not accepted by LSRCA and the flexible treatment alternative for sites with restrictions, according to LSRCA Technical Guidelines(Sept. 1, 2016) was recommended. It was agreed in the meeting to follow the criteria in INNIS-SHORE Planning Area Master Servicing Report for quantity control.

2.1 Existing Infrastructure

Consistent with the pre-development drainage pattern, the proposed development will mainly discharge into a tributary of Hewitt's Creek at the northeast part of the subject site. (See Drawing STM-1 and Drawing TA-1 in Appendix E). There are existing storm sewers in Block 8 of the 700 Mapleview Drive East Subdivision, immediately west of the subject site which will receive the post-development stormwater runoff from 0.03 ha area, located along the west side of the subject site. The existing sewers in Block 8 will convey the captured runoff to an existing SWM Pond, constructed to provide water quality, erosion, and quantity controls for the stormwater runoff from its drainage area plus the 0.03 ha area from the proposed development. The Visual OTTHYMO modeling results provided in Appendix C and updated Storm Sewers Design Sheets for 700 Mapleview Drive East Subdivision, provided in Appendix B, demonstrate that the existing downstream storm sewers and the exiting SWM Pond in 700 Mapleview Drive East Subdivision have the required capacity to accommodate flows from the 0.03 ha area of the subject site. The remaining parts of the site will be serviced by the proposed stormwater management infrastructure.

2.2 Stormwater Management Design Criteria

The stormwater quality and quantity control criteria for the subject site are based on the MOECC 2003 Stormwater Management Practices Planning and Design manual. Additional SWM design criteria as recommended by the City of Barrie and the Lake Simcoe Region Conservation Authority (LSRCA) have been integrated into the overall design. A summary of the stormwater management design criteria is provided as follows:

- Enhanced water quality control is required;
- According to Innis-Shore Planning Area, Master Servicing Report, and agreement in charrette meeting, only post-development 2-year storm event flow is required to be controlled to 2-year storm event pre-development flow as per the Andrew Bodie Master Drainage Plan. The flows generated by higher storm events are allowed to discharge uncontrolled.
- Storm sewers shall be designed to convey, as a minimum, the 1:5-year design storm
- For the quantity control modeling, design storms SCS Type II (6 hours, 12 hours, and 24 hours duration) and City of Barrie 4-hour Chicago design storm should be used;
- To determine the critical design storm, the SCS Type II (6-hour, 12-hour, and 24-hour durations), as well as 4-hour Chicago storm distribution for the 1:2 year through the 1: 100-year return periods shall be applied.
- All storm sewers shall be designed using the Rational Formula where:

  Q = (C) (I) (A)/360, where:

  Q = the design flow in (m^3/s)

  C = the site-specific runoff coefficient

  A = the drainage area (ha)

  The rainfall intensity shall be calculated per the "*Table 3.1: Barrie WPCC IDF Curve*

Parameters - Adjusted to Account for Climate Change" and the following equation:

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

I = the rainfall intensity (mm/hr)

t = Time of concentration (minutes)

A, B, C = function of the local intensity-duration data.

- The post-development annual infiltration volume is required to be equal to or to exceed the pre-development annual infiltration volume.
- Lake Simcoe Phosphorus Offsetting Program (LSPOP) requires that all new developments must control 100% of phosphorus from leaving their property (Zero Export Target)
- As per Section 2.2.2.1 (Stormwater Volume Control Requirements) of the LSRCA Technical Guidelines (Sept. 1, 2016), for new, nonlinear developments that create more than 0.5 hectares of new impervious surface on sites without restrictions, stormwater runoff volumes will be controlled and the post-construction runoff volume shall be captured and retained/treated on-site from a 25 mm rainfall event from the total impervious area
- If full compliance is not possible due to any of the factors listed below, the site would be considered a "site with restrictions" and as such, the Flexible Treatment Alternatives, according to Section 2.2.2.2 of the LSRCA Guidelines will apply.

Factors to be considered for each alternative:

i. Karst geology;
ii. Shallow bedrock;
iii. High groundwater;
iv. Hotspots or contaminated soils;
v. Areas with high chloride concentrations;
vi. Significant Groundwater Recharge Area and Wellhead Protection Areas or Intake Protection Zones or within 15 meters of a drilled drinking water well (within 30 meters of a dug well);
vii. Zoning, setbacks, or other land use requirements;

viii. Property or infrastructure restrictions;
ix. Excessive cost;
x. Poor soils (infiltration rates that are too low or too high, problematic urban soils, such as soils that are highly compacted or altered); and
xi. Highly vulnerable aquifer.

- As per Section 2.2.2.2 (***Flexible Treatment Alternative for Sites with Restrictions***), if site constraints or restrictions limit the full treatment requirement, The flexible treatment alternatives shall be used as described below:

  Alternative #1:

  i. Retain runoff from a 12.5 mm event from all impervious surfaces if the site is new development or from the new and/or fully reconstructed impervious surfaces for redevelopment or linear development site.
  ii. Options considered and presented shall examine the merits of relocating project elements to address, varying soil conditions and other constraints across the site.

  Alternative #2

  i. Achieve volume reduction to the maximum extent practicable (minimum 5 mm from all impervious surfaces).
  ii. Options considered and presented shall examine the merits of relocating project elements to address, varying soil conditions and other constraints across the site.

  Alternative #3

  i. Mitigation equivalent to the performance of 25 mm of volume reduction for new ***development, redevelopment, or*** linear ***development*** as described above in this section can be performed off-site to protect the receiving water body. Off-site treatment shall be achieved in areas selected in the following order of preference:
     a. Locations immediately upstream or downstream of the proposed construction activity on the same tributary

b. Locations that yield benefits to the same tributary that receives runoff from the original construction activity
c. Locations within the same LSRCA catchment area as the original construction activity

The proponent shall document the flexible treatment alternatives sequence starting with Alternative #1. If Alternative #1 cannot be met, then Alternative #2 shall be analyzed. Proponents must document the specific reasons why Alternative #1 cannot be met based on the factors listed above. If Alternative #2 cannot be met then Alternative #3 shall be met. Proponents must document the specific reasons why Alternative #2 cannot be met.

2.3 Proposed Stormwater Management Plan

The proposed stormwater management plan for the subject site follows the design criteria mentioned in Section 2.2. The post-development SWM plan for the subject site will consist of a dual drainage system designed based on the MOECC, LSRCA, and City of Barrie design criteria and guidelines. Up to and including the 5-year storm event runoff will be captured and conveyed by the minor system, which will be comprised of storm sewers and catchbasins. The major system will capture and convey all runoff, which is not captured by the minor system (up to and including the 100-year storm event) and will consist of roadways and overland flow routes (see grading plan Drawing GR-1 and Strom Tributary Area Plan, Drawing TA-1 in Appendix E).

The proposed stormwater management plan for the subject site includes a treatment train approach to provide enhanced water quality control for the stormwater runoff from the subject site, fulfill infiltration, volume control, and phosphorus load reduction requirements to the extent possible. Considering the size of the subject site, a JellyFish unit is proposed to provide enhanced water quality control. According to the Environmental Technology Verification (ETV), provided in Appendix D, the proposed JellyFish units will provide enhanced water quality control for the flows from its drainage area.

The post-development drainage plan for the subject site is consistent with the pre-development drainage pattern. As shown in Figure 2 and Drawing STM - TA-1, provided in

Appendix E, the flows from the subject site will discharge to a single outlet, proposed at the northeast part of the subject site. The subject site is located in Hewitt's Creek Watershed and the flows from the site discharge into a tributary of Hewitt's Creek, close to the northeast corner of the site.

Due to the size of the proposed development, onsite quantity control storages are proposed to control the post-development up to and including the 2-year storm event flow to the corresponding pre-development flow. Please note that based on excerpts from Innis-Shore Planning Area Master Servicing Report, provided in Appendix D, only post-development flows generated by up to and including 2-year storm events are required to be controlled to corresponding pre-development flows. Flows from the proposed development, generated by higher storm events are allowed to discharge to the watercourse uncontrolled. Due to grading constraints, three onsite storage are proposed to provide the required quantity control for the post-development flows from the subject site as follows:

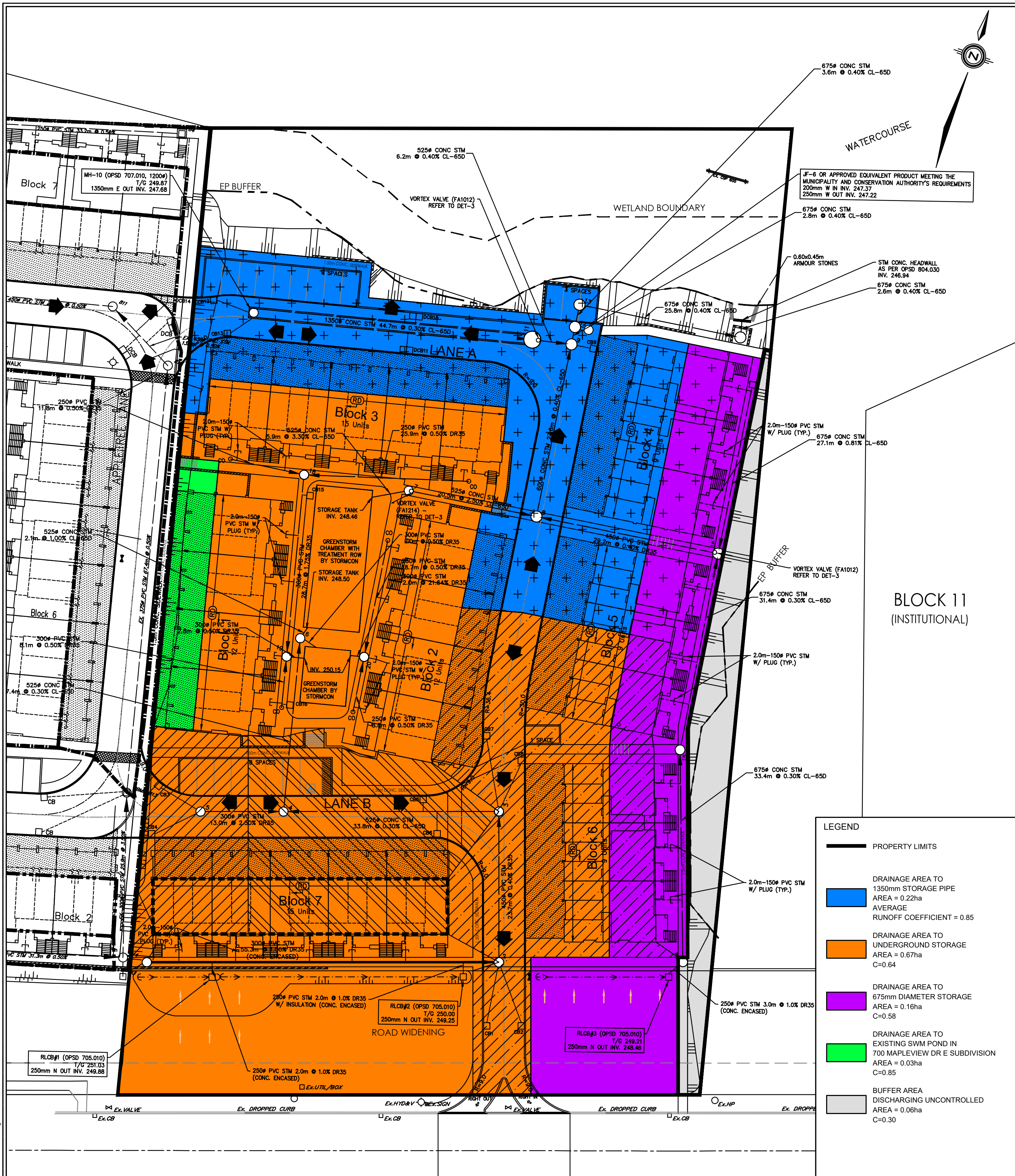
- As shown in Figure 2, GreenStorm underground storage, a product of Stormcon Products Inc. is proposed in Amenity Area. The proposed storage will provide quantity control for the 2-year storm event flow from 0.67 ha drainage area;
- A 1350 mm diameter concrete storm sewer, proposed along Lane A, located at the northwest part of the site will provide quantity control for the 2-year storm event from the 0.22 ha drainage area;
- The proposed 675 mm diameter concrete storm sewer along the east side of the subject site will provide quantity control for the 2-year storm event flow from the 0.16 ha drainage area along the east side of the subject site.

As part of the treatment train approach and in addition to the onsite storage volumes for quantity control as mentioned above underground GreenSorm storage, which will receive clean water from the roof and landscaped areas is proposed at the south part of the Amenity Area to fulfill water balance requirements and help volume control. More detailed information is provided in the following sections.

2.3.1 Post-development Drainage Plan

As shown in Figure 2 and Drawing STM-TA-1, provided in Appendix E, the post-development drainage plan for the subject site is consistent with the pre-development drainage pattern. Consistent with the pre-development drainage pattern a single stormwater outlet for the subject site is proposed at the northeast corner of the proposed development. As shown in Figure 2, the post-development drainage area has been divided into six catchments as follows:

- Due to grading constraints, a small drainage area (0.03 ha, C = 0.85) along the west side of the subject site is proposed to discharge to the existing stormwater infrastructure in Block 8 of the 700 Mapleview Drive East Residential Subdivision, located immediately west of the subject site. The updated Storm Sewers Design Sheets, provided in Appendix B, and the updated Visual OTTTHYMO modeling results, provided in Appendix C demonstrate that the downstream storm sewers and the existing SWM Pond have the required capacity to accommodate the flows from this area;
- The stormwater runoff from the 0.67 ha drainage area with a runoff coefficient of 0.64 will discharge to the proposed GreenStorm underground storage tank for 2-year storm event quantity control;
- The runoff from the 0.22 ha drainage area at the northwest part of the site, with a runoff coefficient of 0.85 will discharge into the proposed 1350 mm diameter superpipe storage which will provide 2-year storm event quantity control for the flows from its drainage area;
- The 0.16 ha drainage area along the east side of the subject site will drain into a proposed 675 mm diameter which will provide 2-year storm event water quantity control for the flows from its drainage area;
- The flows from the 0.06 ha buffer area along the east side of the subject site will discharge to the valley lands as an uncontrolled sheet flow. The flows will be from the vegetated area and will not require quality control;
- The 0.25 ha area at the north side of the site, which includes environmental features will not be developed and the post-development drainage pattern will remain the same as the pre-development drainage pattern.



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LEGEND
(AS SHOWN ABOVE)

FIGURE 2
STORMWATER DRAINAGE PLAN

2019-4867	AUGUST 2021	SCALE: N.T.S.

2.3.2 Quality Control

A JellyFish Units is proposed at the north part of the site, close to the site outlet, to provide water quality control for the stormwater runoff from the 1.05 ha drainage area of the subject site (see Figure 2). As per the Jellyfish Filter Sizing Report by Imbrium, provided in Appendix D the Jellyfish Filter Model JF6-4-1 is recommended to meet the water quality objective by treating 22.7 l/s, which exceeds 90% of the average annual rainfall-runoff volume based on 36 years of Barrie WPCC rainfall data for the subject site (19.9 l/s). This model has a sediment capacity of 256 kg, which exceeds the estimated annual sediment load of 126 kg/year. According to a copy of the Environmental Technology Verification (ETV), provided in Appendix D, the proposed JellyFish Unit will capture 89.8% of the Total Suspended Solids (TSS), 60.1 % total phosphorus, and 100% oil and grease. The stormwater runoff from the 1.05 ha drainage area, after passing through the Jellyfish Unit will discharge to the outlet at the northeast part of the subject site (see Figure 2 and drawings in Appendix E).

As mentioned earlier, due to grading constraints the stormwater runoff from a small drainage area (0.03 ha) along the west side of the subject site will discharge to the existing stormwater infrastructure in 700 Mapleview Drive East Residential Subdivision, where the existing SWM Pond will provide water quality and quantity controls for the 0.03 ha area of the subject site. The Visual OTTHYMO modeling results, provided in Appendix C, and Storm Sewers Design Sheets in Appendix B demonstrate that the existing stormwater management infrastructures in 700 Mapleview Drive East Subdivision have the required capacity to accommodate the flows from the 0.03 ha area of the subject site.

2.3.3 Quantity Control

Considering the size of the proposed development, three onsite storages are proposed to provide water quantity control for the stormwater runoff from the proposed development. Underground GreenStorm Stormwater Chamber, a product of Stormcon is proposed in Amenity Area to provide quantity control for the stormwater runoff from the 0.67 ha drainage area along the east side of the subject site (see Figure 2). The storage includes a servicing row to be used during maintenance works (see Sheet No. 4 by Stormcon in Appendix E). The storage has been sized to control the post-development 2-year storm event flow from its drainage area to the corresponding pre-development 2-year storm event flow from the same drainage area. As mentioned earlier, based on background information, the flows generated by higher storm events are allowed to discharge uncontrolled. The target release rates (2-year storm event pre-development flows) are low and even the minimum allowable size of the orifice plate (75 mm) will convey more than the target release rates, therefore, the post-development 2-year storm event flow from this area will be controlled to the pre-development 2-year storm event flow by a proposed Vortex Valve FA1214 w/ 108 mm in MH 7. The Visual OTTHYMO modeling results in Appendix C show that the 24-hour SCS Type II storm will require more storage volume, therefore, it will be the governing design storm. The pre-development 2-year storm event flow from this area generated by the 12-hour and 24-hour SCS Type II storms are 8 l/s & 9 l/s respectively (see the pre-development VO modeling results in Appendix C). As per the Vortex Valve Model FA1214 head-discharge curve, provided in Appendix B, the maximum 2-year post-development flow from this area at a maximum head of 0.84 m is = 7.93 l/s, which is less than the pre-development 2-year storm event flows generated by 12-hour and 24-hour SCS Type II design storms. Please note that the 0.84 m head is calculated based on storage tank top elevation (249.07 m) and the invert elevation of the Vortex Valve (248.23 m). A summary of the pre and post-development 2-year storm event flows from this area is provided in Table 2-1 as follows:

Table 2-1: Pre and Post-development flows from 0.67 ha Area

Storm Event	Area (ha)	Elevation (m)		Head (m)	Valve Model	Flow (l/s)	
		Upstream	Downstream			Pre-dev	Post-dev
2-year	0.67	249.07	248.23	0.84	FA1214	9	7.9

The required and provided storage volumes for this area are summarized in Table 2-2 as follows:

Table 2-2: GreenStorm Storage at Amenity Area (Drainage Area = 0.67 ha)

Storm Event	Required Storage Volume (m^3)				Provided Volume (m^3)
	4-hr Chicago	6-hr SCS	12-hr SCS	24-hr SCS	
2-year	106	110	107	111	124.9

Please refer to Sheet No. 5, by Stormcon in Appendix E for calculation of the provided storage volume.

Table 2-2 shows that the provided storage volume is more than the required storage volume, therefore, the storage volume capacity constraints will not be expected. The table shows that the 24-hour SCS Type II requires more storage volume therefore, will be considered as governing design storm.

The quantity control for the 2-year storm event flows from the 0.22 ha drainage area at the northwest part of the site is proposed to be provided by a 1350 mm diameter superpipe along Lane A (see Figure 2) and a Vortex Valve FA1012 w/64 mm proposed downstream of the storage pipe at the upstream end of the 300 mm diameter storm sewer in BH2. The maximum head for the Vortex Valve is calculated based on the upstream obvert (249.03 m) and the downstream invert (247.55 m) elevations of the 1350 mm diameter storage pipe. According to the VO modeling results in Appendix C, the pre-development 2-year storm event flow from this area is 2 l/s generated by 4-hour Chicago Storm, 3 l/s generated by 6-hour and 12-hour SCS Type II storms, and 4 l/s generated by 24-hour SCS Type II design storm. As per the Vortex Valve Model 1012 head-discharge curve, by Contech Engineering Solutions, provided in Appendix B, the post-development 2-year storm event flow from this area will be 3 l/s. A summary of the pre and post-development 2-year storm event flows from this area is provided in Table 2-3 as follows:

Table 2-3: Pre and Post-development flows from 0.22 ha Area

Storm Event	Area (ha)	Elevation (m)		Head (m)	Valve Model	Flow (l/s)	
		Upstream	Downstream			Pre-dev	Post-dev
2-year	0.22	249.03	247.55	0.48	FA1012	4	3

The required and provided storage volumes for this area are summarized in Table 2-4 as follows:

Table 2-4: 1350 mm Superpipe Storage at Lane A (Drainage Area = 0.22 ha)

Storm Event	Required Storage Volume (m^3)				Provided Volume (m^3)
	4-hr Chicago	6-hr SCS	12-hr SCS	24-hr SCS	
2-year	58	61	61	58	64

The provided storage volume is more than the required storage volume, therefore the storage volume capacity constraints will not be expected.

The provided storage volume calculation is summarized in Table 2-5 as follows:

Table 2-5: Summary of the Provided Storage Volume Calculation

Diameter	Area	Length	Volume	Maximum Storage Used
(mm)	(m^2)	(m)	(m^3)	(m^3)
1350	1.431	44.7	64.0	61

The quantity control for the 2-year storm event flow from the 0.16 ha drainage area along the east side of the subject site is proposed to be provided by 675 mm diameter storm sewers along the east side of the subject site (see Figure 2) and a Vortex Valve FA1012 w/57 mm proposed in MH16. The maximum head for the Vortex Valve is calculated based on the upstream obvert (248.735 m) and the downstream invert (247.84 m) elevations of the 375 mm diameter storage pipe. According to the VO modeling results in Appendix C, the pre-development 2-year storm event flow from this area is 2 l/s generated by 6-hour and 12-hour and 24-hour SCS Type II storms. As per the Vortex Valve Model FA1012 w/57 mm head-discharge curve, by Contech Engineering Solutions, provided in Appendix B, the post-development 2-year storm event flow from this area will be 1.8 l/s. A summary of the pre and post-development 2-year storm event flows from this area is provided in Table 2-6 as follows:

Table 2-6: Pre and Post-development flows from 0.16 ha Area

Storm Event	Area (ha)	Elevation (m)		Head (m)	Valve Model	Flow (l/s)	
		Upstream	Downstream			Pre-dev	Post-dev
2-year	0.16	248.735	247.84	0.895	FA1012	2	1.78

The required and provided storage volumes for this area are summarized in Table 2-7 as follows:

Table 2-7: Summary of the Provided Storage Volume Calculation

Storm Event	Required Storage Volume (m^3)				Provided Volume (m^3)
	4-hr Chicago	6-hr SCS	12-hr SCS	24-hr SCS	
2-year	25	25	25	26	33

The provided storage volume is more than the required storage volume, therefore the storage volume capacity constraints will not be expected.

The provided storage volume calculation is summarized in Table 2-8 as follows:

Table 2-8: Summary of the Provided Storage Volume Calculation

Diameter	Area	Length	Volume	Maximum Storage Used
(mm)	(m^2)	(m)	(m^3)	(m^3)
675	0.358	91.9	32.9	26

Quantity control for the stormwater runoff from the proposed development is calculated based on matching the predevelopment flows, generated by up to and including the 2-year storm event. According to page 22 of the Innis-Shore Planning Area Master Servicing Report by R.G. Robinson and Associates (Barrie) Ltd. Consulting Engineers and Planners, Revised August 1998, provided in Appendix D, *"For Zones 2 to 5, quantity control is only proposed up to the 2-year event as per the Andrew Brodie Master Drainage Plan"*. As per Innis Shore Secondary Plan Area, Storm Drainage, Drawing No. 3, excerpted from the report mentioned above, the proposed development is located in Zone 3, therefore, up to and including 2-year storm event flows are required to be controlled to the corresponding pre-development flows. Flows generated by higher storm events are not required to be controlled and allowed to discharge to the watercourse uncontrolled.

The Visual OTTHYMO Modeling Software was used to calculate the pre and post-development flow from the subject site. According to the *"Preliminary Geotechnical*

Investigation – 750 Mapleveiw Drive East, Barrie, Ontario", by EXP, dated July 2020, the soil stratigraphy, as revealed in the boreholes, generally comprised of surficial topsoil or fill, over a local peat layer, over native deposits of silty sand till, silty fine sand and silty clay. These characteristics indicated that the soil in the subject site corresponds to SCS Group B.

Based on the soil type SCS Group B and Tables 7.4 of the City of Barrie Storm Drainage and Stormwater Management Policies and Design Guidelines, the CN (AMC II) for wooded or forest land with good cover is 55. The pre-development CN*(AMC II), calculated based on CN (AMC II) = 55, is = 48, which has been used in pre-development Visual OTTHYMO modeling. In the same way, according to Table 7.4, the post-development curve number for lawns and soil type B is CN (AMC II) = 61. The post-development modified curve number calculated based on CN (AMC II) = 61 is, CN* (AMC II) = 56. The detailed calculations for pre and post-development modified curve numbers are provided in Appendix B. The Calculated CN* (AMC II) values for pre and post-development conditions, 48, 56, respectively, have been used in Visual OTTHYMO modeling software to calculate pre and post-development flows. The calculation for Time to Peak, used in pre-development Visual OTTHYMO modeling is provided in Appendix B and summarized in Table 2-9 as follows:

Table 2-9: Summary of Time to Peak Calculation

Area	NHYD	overland Flow				Time to Peak
(ha)	No.	S (%)	C	L (m)	T_{co} (hr)	$T_{P\ (hr)}$
0.67	1	1.99	0.30	121	0.38	0.25
0.22	2	2.58	0.30	75	0.28	0.18
0.16	3	1.78	0.3	93	0.35	0.23

The Visual OTTHYMO modeling results are provided in Appendix C and a summary of the pre and post-development 2-year storm event flows at the site outlet is provided in Table 2-10 as follows:

Table 2-10: Summary of the Pre and Post-development 2-year Storm Event Flows

S.N	Area (ha)	Release Rates (l/s)							
		Chicago Storm		6-hour SCS		12-hour SCS		24-hour SCS	
		Pre-de	Post-dev	Pre-de	Post-dev	Pre-de	Post-dev	Pre-de	Post-dev
1	0.67	4	3	7	6	8	7	9	7
2	0.22	2	2	3	3	3	3	4	4
3	0.16	1	1	2	2	2	2	2	2
4	0.06	1	1	1	1	1	1	1	1
Outlet	1.11	**8**	**6**	**13**	**11**	**14**	**12**	**16**	**13**

As mentioned earlier, the post-development stormwater runoff from the proposed development, generated by any storm event higher than the 2-year storm event is not required to be controlled and is allowed to discharge to the watercourse uncontrolled. A Summary of the pre and post-development 5-year to 100-year storm event flows from the subject site are provided in Table 2-11 and Table 2-12 as follows:

Table 2-11: Pre-development 5-year – 100-year Storm Event Flows at the Outlet

Storm Event	Chicago Storm	6-hr SCS Storm	12-hr SCS Storm	24 hr SCS Storm	AddHyd No.	Area (ha)
5-year	0.016	0.027	0.028	0.033	4	1.11
10-eyar	0.023	0.040	0.039	0.046	4	1.11
25-year	0.033	0.058	0.056	0.064	4	1.11
50-year	0.041	0.073	0.070	0.080	4	1.11
100-year	0.050	0.089	0.084	0.097	4	1.11

Table 2-12: Post-development Uncontrolled Flows at the Outlet

Storm Event	Chicago Storm	6-hr SCS Storm	12-hr SCS Storm	24 hr SCS Storm	AddHyd No.	Area (ha)
5-year	0.228	0.183	0.168	0.170	7	1.11
10-eyar	0.273	0.224	0.206	0.209	7	1.11
25-year	0.326	0.281	0.256	0.260	7	1.11
50-year	0.369	0.324	0.239	0.299	7	1.11
100-year	0.412	0.370	0.331	0.338	7	1.11

A stormwater outlet in each control manhole, at invert elevation equal to the maximum head for each Vortex Valve, is proposed to convey the uncontrolled flows to the outlet (see Plan and Profile drawings in Appendix E). These outlets will convey flows generated by storm events higher than the 2-year storm event and will have no flow during storm events lower than the 2-year storm event.

2.3.4 Minor System

As per the City of Barrie Design Criteria, all minor system pipes were designed to capture and convey the 5-year Design Storm flows under un-surcharged conditions (flows in sewers/full flow capacity < 1). Please refer to the storm sewer design sheets provided in Appendix B.

As shown in Figure 2 and Drawing STM-TA-1 in Appendix E, the minor system flows from the subject site will be captured by proposed catchbasins on roads and will be conveyed by proposed storm sewers to the proposed onsite storages. After receiving quantity control by proposed onsite storages and passing through a Jellyfish unit for quality control, the flows captured by the minor system will discharge to the outlet.

2.3.5 Major System

As per the City of Barrie design criteria, the major system has been designed to safely convey the flows not captured by the minor system including the 100-yr storm event runoff. The major system consisting of roads and overland flow routes are designed to convey the overland flows from the subject site to the approved outlet safely without flooding the private property. The flows exceeding the capacities of the proposed catchbasins on roads and not captured by the minor system will be conveyed by the major system as overland flow. The direction of the overland flow is shown on Drawing TA-1 and Grading Plan, provided in Appendix E. The overland flow routes are designed such that the 100-year storm event flow depth will not exceed the allowable depth of 0.30 m and the private properties will not be flooded during a 100-year storm event.

To prevent the discharge of uncontrolled flows from the subject site to Mapleveiw Drive East, the 100-year storm event overland flow from 0.23 ha drainage area at the southeast part of the site, as shown on Drawing STM-TA-1 in Appendix E will be fully captured by the proposed catchbasins at a low on the road north of Mapleview Drive East. The post-development 100-year storm event flow from this area is calculated to be 0.115 m^3/s (see 100-year Storm Event flow at Full Capture Location in Appendix B), while the capacity of the proposed catchbasins is 0.145 m^3/s (see Inlet Capacity at Road Sag in Appendix B).

To prevent the discharge of uncontrolled overland flow from the subject site to the existing Block 8 in 700 Mapleview Drive East Subdivision, Zurn Trench Drains are proposed at the west ends of Lane A and Lane B. The 100-year storm event overland flow at these locations will be captured by the proposed trench drains and directed to the minor system. As shown on Drawing STM TA-1, the tributary areas to the proposed trench drains on Land A and Lane B are 0.03 ha and 0.04 ha respectively. The 100-year storm event flows at trench drain locations on Lane A and Lane B are 0.015 m^3/s and 0.020 m^3/s, respectively, while the capacity of the proposed trench drain (8201), according to the manufacturer document provided in Appendix B is 35 l/s.

2.4 Water Balance and Stormwater Volume Control

A water balance calculation for the proposed development was performed to determine the pre and post-development annual infiltration volumes. Generally, the objective of water balance analysis is to ensure that the level of post-development infiltration within the subdivision meets the pre-development levels. LID measures including, roof leader disconnection, soil amendment, and infiltration storage are proposed. Roof areas will discharge into pervious landscape areas and the proposed 300 mm depth of topsoil in landscape areas will enhance the infiltration in these areas.

A Water Balance Assessment for the proposed development has been completed by EXP Services Inc. as part of the*"750 Mapleview Drive East, Barrie, Ontario, Proposed Development Complex, Hydrogeological Investigation, and Water Balance Assessment, dated July 2, 2021.* A copy of the report is provided in Appendix D. A digital copy of the complete report is provided as well. According to Section 4.1.2 of the hydrogeological report, metrological data including average monthly precipitation and average temperatures were obtained from the National Climate Data and Archive (Environment Canada) for the City of Barrie (Station ID No. 6110557). Thornthwaite and Mather Method was used to estimate pre-development evapotranspiration (ET) and surplus as summarized in Table 2-13 below:

Table 2-13: Summary of Pre-development Climate Water Balance Analysis

Soil Moisture Storage (mm)	**Precipitation** (mm/year)	**Potential ET** (mm/year)	**Actual ET** (mm/year)	**Surplus** (mm/year)
200 mm (Clayey Sandy Silt/Sand and Silt)	**933.0**	**566.7**	**556.3**	**376.7**

The pre-development site area and area available for infiltration have been calculated to be, 13,400 m^2 and 13,100 m^2, respectively. The pre-development water balance analysis has been summarized in Table 2-14 as follows:

Table 2-14: Summary of Pre-development Water Balance Results

Location	Site Area (m^2)	Pervious Area (m^2)	Precipitation (m^3/year)	Actual ET (m^3/year)	Run-off (m^3/year)	Infiltration (m^3/year)
Total Site	13,400	13,100	12,502	7,288	2,910	2,305
Percentage Precipitation (%)			100%	58%	23%	18%

Based on the proposed development plan, the total area of impervious surfaces under post-development conditions is approximately 6,400 m^2, representing approximately 48% of the site area (site area = 13,400 m^2). The post-development water balance analysis has been summarized in Table 2-15 as follows:

Table 2-15: Summary of Post-development Water Balance Results

Location	Site Area (m^2)	Pervious Area (m^2)	Precipitation (m^3/year)	Actual ET (m^3/year)	Run-off (m^3/year)	Infiltration (m^3/year)
Total Site	13,400	7,000	12,502	3,894	7,501	1,107
Percentage Precipitation (%)			100%	31%	60%	9%

To mitigate the infiltration deficit of approximately 1,197 m^3/year, within development limits, which is approximately 90.5% of total precipitation, in post-development conditions, mitigation measures should be implemented to maintain these infiltration levels.

To meet pre-development annual infiltration, GreenStorm storage chambers are proposed in Amenity Area. Clean water from 0.23 ha roof and landscaped areas are directed to the proposed infiltration storage. The proposed infiltration storage is equipped with an overflow pipe at the top of the storage and the flows exceeding the capacity of the storage will discharge to the quantity control GreenStorm Chambers in Amenity Area (see Drawing STM-TA-1 and Sheet No. 2 by Stormcon in Appendix E).

As shown in Figure 3 and Drawing STM-TA-1, clean water from 0.23 ha area (roof and landscaped area) with a runoff coefficient of 0.57 (imperviousness = 0.53) will discharge into the proposed infiltration storage. Based on imperviousness the drainage area can be split into

1,216 m^2 impervious and 1,084 m^2 pervious drainage areas. The annual volume of water discharging into infiltration storage from the impervious area (assuming 10% evaporation) is:

= 1,216 x (933/1000) x 0.90 = 1,021 m^3/year

From Table 2-13, the surplus on the pervious area which will discharge into the proposed infiltration storage is = 377 mm and the annual volume of water from the pervious area discharging into infiltration storage is = 1.084 x (377/1000) = 409 m^3/year. The total annual volume of clean water directed to the proposed infiltration storage is = 1,021 + 409 = 1,430 m^3/year. The total post-development annual infiltration is = 1,430 + 1,107 = 2,537 m^3/year which exceeds the pre-development infiltration (2,305 m^3/year). A summary of the water balance calculation is provided in Table 2-16 as follows:

Table 2-16: Summary of Water Balance Calculatlion

Pre-development Infiltration	**2,305**	(m^3/year)
Post-development Infiltration (No Mitigation)	1,107	(m^3/year)
Annual Infiltration Deficit (No Mitigation)	1,198	(m^3/year)
Required Roof Area to meet the deficit	1,427	(m^2)
Roof Area discharging to infiltration Storage	**1,216**	(m^2)
Pervious Area Discharging to infiltration storage	**1,084**	(m^2)
Annual total precipitation	933	mm
Annual Evaporation on Roof (10%)	93	mm
Annual precipitation discharging to infiltration storage	840	mm
The volume of Water from roof Discharging to storage	1,021	(m^3/year)
Annual Evapotranspiration on pervious area	556	mm
Annual Surplus on pervious area	377	mm
Annual Volume of water from pervious area	409	(m^3/year)
Total annual volume of water to infiltration storage	1,430	(m^3/year)
Annual Infiltration (with Mitigation)	**2,537**	(m^3/year)
Annual Surplus (with mitigation)	**232**	(m^3/year)

The infiltration storage has been sized to store and infiltrate the 25 mm rainfall from its drainage area (0.23 ha), which will cover approximately 95% of the annual rainfall events. Assuming 10% evaporation in impervious drainage area (roof area), the volume of water from the impervious area during a 25 mm storm event, discharging into infiltration storage is:

1,216 x 25/1000 x 0.9 = 27.36 m^3/event

The evapotranspiration from pervious area during a 25 mm storm event can be calculated as:

= (556/933) x 25 = 14.9 mm. Surplus = 25 – 14.9 = 10.1 mm/event

The volume of water from the pervious area during a 25 mm storm event, discharging into infiltration storage is = 1,084 x (10.1/1000) = 10.95 m^3/event.

Total volume of water discharging into infiltration storage during a 25 mm storm event is:

= 27.36 + 10.95 = 38.30 m^3/event

Provided storage volume in infiltration storage = 40.14 m^3/event (see the calculation on Sheet 3, by Stormcon, provided in Appendix E). A summary of the storage sizing calculation is provided in Table 2-17 as follows:

Table 2-17: Infiltration Storage Sizing Calculation (25 mm Storm)

Depth of the rainfall	25	mm/event
Evaporation on roof area (10%)	2.5	mm/event
Depth of the rainfall from roof available for infiltration	22.5	mm/event
The volume of water from the roof (25 mm storm)	**27.36**	(m^3/event)
Evapotranspiration on pervious area (556/933 x 25)	14.90	mm/event
Depth of rainfall from pervious area available for infiltration	10.10	mm/event
The volume of water from pervious area (25 mm storm)	**10.95**	(m^3/event)
The total volume of water from the 25 mm storm event	**38.31**	(m^3/event)
Provided Infiltration storage Volume	**40.14**	(m^3/event)

According to Sheet No. 2 by Stormcon, provided in Appendix E, the bottom elevation of the infiltration storage is 249.78 m. The groundwater elevation as per Figure 6 of the Hydrogeology Report, provided in Appendix B, is 248.07 m and the distance between the bottom of the storage to the groundwater is 249.78 – 248.07 = 1.71 m > 1.0 m required.

Based on Section 4.1.8 of the Hydrogeology Report, the design infiltration rate for the subject site is 4.0 mm/hour. The depth of the storage according to Sheet 2 by Stormcon is 0.66 m = 660 mm. The drawdown time is = 660/4 = 165 hours.

The LSRCA requires the retention of 25mm of runoff from the impervious area of a Major Developments as per the LSRCA Technical Guidelines for Stormwater Management Submission, September 1, 2016, and Lake Simcoe Protection Plan (LSPP), dated July 2009. A major development is defined by the LSPP as; the creation of four or more lots, the construction of a building or buildings within a ground floor area of 500m^2 or more, or the establishment of major recreational use, further defined in the LSRCA SWM Guidelines as; compliant with the definition of the LSPP or a development that results in new construction or reconstruction of at least 0.5ha of impervious area. To meet this criterion, water must be retained on-site to be infiltrated, filtrated, evaporated, or re-used whilst still being able to capture the next rainfall event.

As mentioned earlier, a presentation was conducted by Schaeffers Consulting Engineers in a charrette meeting to develop a collaborative and comprehensive stormwater management plan for the subject site. Due to high groundwater elevation, low infiltration rate (4 mm/hour), and limited opportunities for implementation of volume reduction techniques within the subject site, Schaeffers Consulting Engineers proposed a Sand Filtration Bed in the north part of the site as a rate control LID to fulfill the LSRCA requirement for filtrating 25 mm volume of water from the impervious area of the proposed development. The Sand Filter Bed proposed close to the existing environmental features was not accepted by LSRCA and implementing the flexible treatment alternative for sites with restrictions, according to LSRCA Technical Guidelines for Stormwater Management Submissions (Sept. 1, 2016) was recommended. A summary of the volume control calculation for different alternatives is provided in Table 2-18 as follows:

Table 2-18: Volume Control Calculation

Site Developable Area	1.14	ha
Average Imperviousness	66	%
Impervious area	0.75	ha
25 mm volume from impervious area	188	m^3/event
12.5 mm volume from impervious area	94	m^3/event
5 mm volume from impervious area	**38**	m^3/event

According to Table 2-18, the required volumes of water required to be retained to meet 25 mm and 12.5 mm requirements are 188 m^3/year and 94 m^3/year, respectively. Referring to the "*factors to be considered for each alternative"*, provided in Section 2.2 of the report, the following factors seem to apply to the subject site:

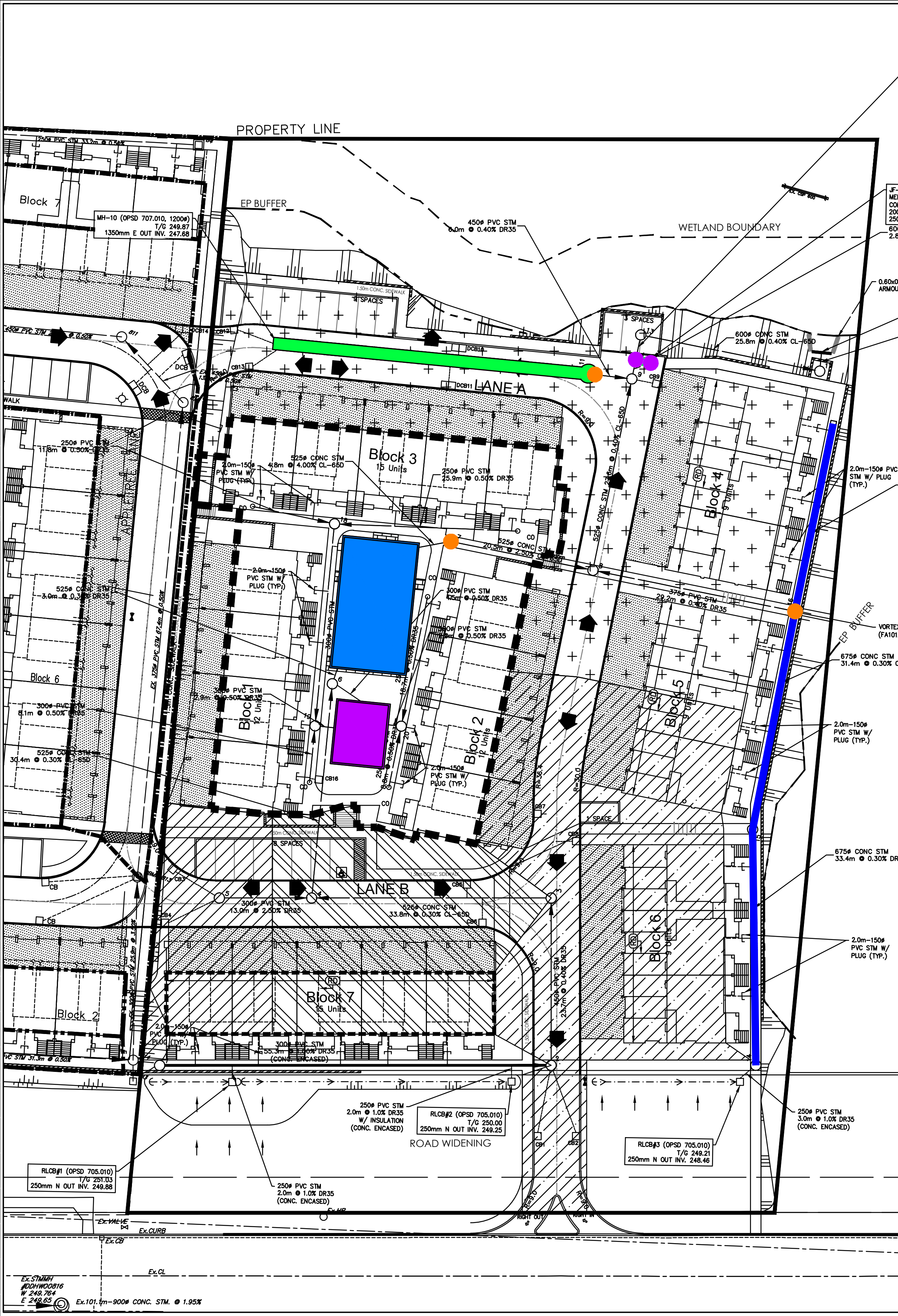
- High groundwater;
- Poor soils (infiltration rates that are too low or too high, problematic urban soils, such as soils that are highly compacted altered); and
- Property or infrastructure restrictions

According to the LSRCA Guidelines, if full compliance is not possible due to any of the factors listed in Section 2.2.2.2 of the LSRCA Guidelines (copied in Section 2.2 of the report), the site would be considered a "site with restrictions" and the Flexible Treatment Alternatives according to Section 2.2.2.2 of the LSRCA Guidelines will apply.

As mentioned above the groundwater is high which is a challenge for implementing infiltration galleries. At the same time, the design infiltration according to the Hydrogeology Report by EXP is very low (4 mm/hour) and the drawdown time is too long. The existence of the environmental features at the north part of the site can be considered as a site restriction for implementing LIDs. The environmental features are located close to the outlet of the site, where sufficient flow is available. This area could have been a suitable area for the implementation of a filtration system if the environmental features were not there. As mentioned earlier, we tried this option which was not accepted by LSRCA in the charrette meeting. The calculations show that we will be able to meet the requirements for Alternative #2 and achieve volume reduction to the maximum extent possible (5 mm from all impervious surfaces).

Table 2-18 shows that the 5 mm volume of water from the impervious area of the subject site is = 38 m^3. According to Table 2-17, the volume of water available for infiltration is 38.31 m^3/event. As such, the minimum requirement for the volume control, which is 5 mm from the impervious area of a major development will be met.

Please note that the 0.25 ha area, at the north part of the property, which includes environmental features will not be developed. This area will remain untouched.



LEGEND

(thick dashed line)	DRAINAGE AREA TO INFILTRATION STORAGE AREA = 0.23ha C=0.57
(blue box)	UNDERGROUND QUANTITY CONTROL STORAGE (GREENSTORM MODULES, PRODUCT OF STORMCON)
(purple box)	UNDERGROUND INFILTRATION STORAE (GREENSTORM MODULES, PRODUCT OF STORMCON)
(green line)	1350mm DIAMETER STORAGE PIPE
(blue line)	675mm DIAMETER STORAGE PIPE
(purple dot)	JELLFISH MODED JF-6 OR APPROVED EQUIVALENT
(orange dot)	VORTEX VALVES FOR QUNITIY CONTROL

750 MAPLEVIEW DRIVE EAST
CITY OF BARRIE

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LEGEND
(AS SHOWN ABOVE)

FIGURE 3
WATER BALANCE,
QUANTITY & QUALITY CONTROL PLAN

2019-4867 | AUGUST 2021 | SCALE: N.T.S.

2.5 Phosphorus Loading Requirements

The Lake Simcoe Protection Plan states the following:

4.8-DP An application for ***major development*** *shall be accompanied by a stormwater management plan that demonstrates:*

e. through an evaluation of anticipated changes in phosphorous loadings between pre-development and post-development, how the loadings shall be minimized.

The Lake Simcoe Technical Guidelines for Stormwater Management Submissions, dated September 1st, 2016, states the following:

Section 2.3.2 An area load method is to be utilized to compare existing load under ***pre-development*** *conditions versus the total* ***post-development*** *load with/without quality controls:*

In addition to the above, the removal of 80% of the annual Total Phosphorus (TP) load from all ***major development*** *areas will be required.*

Lake Simcoe Phosphorus Offsetting Policy (LSPOP), dated September 2017 states:

"*LSPOP requires that all new development must control 100% of the phosphorus from leaving their property. This is referred to as the Zero Export Target, a key component of the LSPOP that ensures new development or redevelopment activities do not continue to contribute to phosphorus loading to Lake Simcoe. Any remaining stormwater phosphorus load that cannot be controlled would trigger the need for an offset to achieve a net-zero target. An offset ratio of 2.5:1 would be applied meaning that 2.5 kg of phosphorus per year would be removed for every 1 kg required to be offset".*

The following phosphorus loading analysis has been prepared to fulfill the requirements discussed above on a subdivision level.

2.6 Phosphorus Loading Analysis

A phosphorous budget analysis was conducted for the subject site based on the developable area of the subject site. The total pre and post-development drainage areas considered in pre and post-development phosphorus loading calculation is 1.14 ha. As mentioned earlier, under post-development conditions the runoff from 0.03 ha drainage area will discharge to the existing SWM Pond in 700 Mapleview Drive East Subdivision. Post-development runoff from 0.67 ha, 0.22 ha, and 0.16 ha drainage areas discharge to onsite storages for quantity control and after passing through a Jellyfish unit for quality control, discharge to the site outlet. There is a buffer area (0.06 ha) along the east side of the subject site which will discharge to the valley uncontrolled with no mitigation measures. The clean water from the 0.23 ha area is directed to infiltration storage and the runoff exceeding the capacity of the storage will discharge to the quantity control storage. The proposed mitigation measures are underground storage, infiltration, and the Jellyfish unit.

2.6.1 Pre-development Phosphorus Loading Analysis

The proposed development is located within the Hewitt's Creek Subwatershed and is an undeveloped wooded marsh/wetland. The total phosphorus removal rates provided in the *"MOECC Lake Simcoe Phosphorus Loading Development Tool"* (January 2012) were used to determine the pre-development annual phosphorous loads. The MOECC phosphorus loading rate of 0.05 kg/ha/yr for woodlands/wetlands, yielded a pre-development phosphorus loading rate of 0.06 kg/yr for the entire developable part of the property as follows:

$TP_{\text{Total Site}}$ = 1.14 ha x 0.05 kg/yr/ha = 0.06 kg/yr.

2.6.2 Post-development Phosphorus Loading Analysis (With No Mitigation)

Based on the MOECC Phosphorous Tool, a post-development phosphorus loading rate of 1.32 kg/yr/ha was used to calculate the annual post-development phosphorous load for the subject site. The resulting mass-based loading rate for the subject site is as follows:

$TP_{\text{Total Site}}$ = 1.08 ha x 1.32 kg/yr/ha + 0.06 ha (buffer) x 0.07 (hay-pasture) = 1.43 kg/year.

2.6.3 Post-development With Mitigation Measures

A treatment train approach is considered for the 0.23 ha drainage area, which discharges into proposed infiltration storage (phosphorus reduction factor of 60%) in Amenity Area and the surcharge spills over to the quantity control underground storage (phosphorus reduction factor 25%). The flows from the underground storage will discharge to the outlet after passing through the Jellyfish unit (phosphorus reduction factor 50%), proposed for quality control. The combined reduction factor for this area is = 0.85 (0.6 + 0.25 – 0.6 x 0.25 = 0.70, 0.70 + 0.5 – 0.70 x 0.5 = 0.85). Phosphorus load from this area leaving the site is = 0.23 x 1.32 x (1 – 0.85) = **0.05** kg/year. The remaining 0.44 ha area tributary to the underground quantity control storage will discharge to the outlet after passing through the proposed Jellyfish. The reduction measures for this area are underground storage (25%) and Jellyfish (50%). The combined factor is = 0.25 + 0.50 – 0.25 x 0.50 = 0.63. The phosphorus load leaving the site from this area is = 0.44 x 1.32 x (1 – 0.63) = **0.21** kg/year. The flows from 0.38 ha drainage area, tributary to the proposed pipe storages will discharge to the outlet after passing through the proposed Jellyfish. The phosphorus load from this area leaving the site is = 0.38 x 1.32 x (1 - 0.50) = **0.25** kg/year. The flows from 0.03 ha drainage area along the west side of the site ultimately discharge into the existing pond in 700 Mapleview Drive East Subdivision. The phosphorus loading from this area leaving the area is = 0.03 x 1.32 x (1 – 0.63) = **0.01** kg/year. Total post-development phosphorus load leaving the site after mitigation is = 0.05 + 0.21 + 0.25 + 0.01 = **0.53** kg/year.

Lake Simcoe Phosphorus Offsetting Program (LSPOP) requires that all new developments must control 100% of phosphorus from leaving their property (Zero Export Target), otherwise, a compensation cost is required to be paid. As per the LSPOP the compensation cost is = 0.53 x 2.5 x $35,000.00 = $46,375.00.

3. Erosion and Sediment Control

Erosion and sediment control measures are generally used to minimize the soil particle detachment, transport, and deposit of the detached soil particles. Construction activities commonly alter the landscapes where they are located, exacerbating these natural processes. One of the most significant alterations encountered during construction is the removal of the trees and vegetation that stabilize the subsoil. Efforts are required to minimize the extent of the disturbance and stabilize the disturbed areas. The following procedures and control measures will be used:

- Erosion protection at the source, which will minimize sediment detachment at the source;
- Phasing construction work and minimizing the extent of the disturbance;
- Erosion protection and stabilization of the critical areas and topsoil stockpiles;
- Using rock check dams and DitchChexx to reduce flow velocities in conveyance swales and channels, and create ponding opportunities;
- Stabilizing the conveyance swales and channels before directing flows to these channels;
- Using environmental fences to isolate the work area and create upstream ponding, which allows soil particles to settle down, thereby reducing the amount of soil particles leaving a disturbed area ;
- Construction of temporary siltation control pond during the construction phase;
- Regular inspection and monitoring;
- Updating the erosion and sediment control measures according to the site conditions and;
- Repair/replacement of deficient parts within 24 hours;

The following discussion provides a summary of potential erosion and sediment control measures that can be implemented during the construction stages of the project. The environmental features, watercourses, and associated valley lands adjacent to the site are the most critical features that are to be protected. Please note that required erosion and sediment control measures according to the siltation control plans provided in Appendix E, have been proposed. Some of the proposed erosion and sediment control measures are explained in more detail as follows:

Phasing

In terms of erosion and sediment control, phasing is advantageous as it reduces the limits of construction at a given point and time, as opposed to developing the entire area at once. As a result, disturbed or bare earth areas, which are a large source of erosion and sediment release are also reduced.

Topsoil Stockpiles

Grading for construction requires the top layer of soil (topsoil), which contains nutrients and organic matter necessary for plant growth, to be removed. The topsoil is put into piles and stored for later use on site. Measures will be taken to prevent erosion of stockpiles, keeping sediment, nutrients, and organic matter from entering the waterways.

To ensure the stockpile is effective, it is proposed to stabilize stockpiles immediately. Seeding or mulching can be used to stabilize the stockpile. Another option is to cover it with erosion control blankets to protect it from rainfall. Given the size of the site, topsoil will likely be removed from the site.

Rock Check Dams

Rock check dams (RCD) provide ponding opportunities and slow down the flow velocity. They maintain sheet flow and promote sediment settling. Some storage capacity is created on the upstream side of the RCD. During construction activities, RCDs are anticipated to be used within stormwater drainage ditches as part of the sediment and erosion control plan.

Environmental Fencing

Environmental fencing is a type of barrier used to physically separate construction areas from adjacent properties. In general, environmental fencing should be installed around the limits of construction and topsoil stockpiles. Double row environment fences with straw bales in between are proposed to protect the existing environmental features at the north part of the subject site. Single row environmental fences are proposed along the south, east and west sides of the subject site. It is recommended that all proposed erosion and sediment control measures be inspected weekly and after every significant rainfall event. The subject site is located within Hewitt's Creek Subwatershed at a close distance to Hewitt's Creek tributaries. Therefore, intensive erosion and sediment control measures are required. Regular inspections are to be scheduled to ensure that sediment from the subject site will not be released to the receiving watercourse (a tributary of Hewitt's Creek).

Monitoring

It is essential to ensure that the sediment and erosion control measures are properly installed and well maintained. They should be monitored on daily basis to ensure that they function as intended. The ESC plan should provide the framework for the inspection, maintenance, and record-keeping procedures for all stages of construction. The deficient parts are to be repaired/replaced as soon as they are detected. Please refer to the Erosion and Sediment Control Drawings SC-1 to SC-4 in Appendix E.

3. SUMMARY

This Stormwater Management Report outlines the stormwater servicing plan for the 750 Mapleview Drive East Proposed Residential Development in the City of Barrie.

The proposed stormwater management plan for the subject site consists of a dual drainage system designed based on the MOECC, LSRCA, and City of Barrie design criteria and guidelines.

Up to and including the 5-year storm event, the runoff will be captured and conveyed by the minor system, which will be comprised of storm sewers and catchbasins. The major system will convey all runoff that is not captured by the minor system. Consistent with the pre-development drainage pattern, the post-development flows from the subject site will discharge to a single outlet at the northeast part of the site.

As per “Innis-Shore Planning Area Master Servicing Report” only post-development 2-year storm event flow is required to be controlled to 2-year storm event pre-development flow as per the Andrew Bodie Master Drainage Plan. The flows generated by higher storm events are allowed to discharge uncontrolled. Three onsite control storages are proposed to provide quantity control for the flows from the subject site. Stormwater runoff from 0.67 ha drainage area is directed to an underground GreenStorm Chambers. A 1350 mm diameter pipe storage is proposed to provide quantity control for flows from the 0.22 ha drainage area of the subject site. Quantity control for the runoff from the 0.16 ha drainage area of the subject site is proposed to be provided by a 675 mm diameter storm sewer along the east side of the subject site. Since the 2-year storm event pre-development flows from the drainage areas mentioned above are low, the flow through the minimum allowable orifice plate (75 mm) will exceed the target flow, therefore, a Vortex Valve associated with each storage is proposed to attenuate post-development 2-year storm event flows from each quantity control storage to the 2-year pre-development storm event flow. A stormwater outlet in each control manhole, at invert elevation equal to the maximum head for each Vortex Valve, is proposed to convey the uncontrolled flows to the outlet (see engineering drawings in Appendix E).

A treatment train approach, consisting of onsite storages, infiltration, and Jellyfish Unit at the site outlet are proposed to provide quality control for the flows from the subject site. As per the Jellyfish Filter Sizing Report by Imbrium, provided in Appendix D the Jellyfish Filter Model JF6-4-1 is recommended to meet the water quality objective. This model has a sediment capacity of 256 kg, which exceeds the estimated annual sediment load of 126 kg/year. According to a copy of the Environmental Technology Verification (ETV), provided in Appendix D, the proposed JellyFish Unit will capture 89.8% of the Total Suspended Solids (TSS), 60.1 % total phosphorus, and 100% oil and grease.

The clean water from 0.23 ha roof and landscape areas is proposed to be stored in an underground GreenStorm Chamber and infiltrate. The pre and post-development annual infiltration volumes, calculated in Hydrogeology Report by EXP are 2305 m^3/year and 1107 m^3/year, respectively. The annual volume of clean water from the roof and landscape area directed to the infiltration storage is = 1430 m^3/year. The total post-development annual infiltration volume is = 1107 + 1430 = 2537 m^3/year, which exceeds the pre-development annual infiltration. As per Table 2-17, the volume of clean water from the 0.23 ha drainage area, during a 25 mm storm event, which covers 95% of the annual rainfall events, is = 38.31 m^3/event and the provided storage according to Sheet No. 3, by Stormcon is = 40.14 m^3/event According to Sheet No. 2 by Stormcon, provided in Appendix E, the bottom elevation of the infiltration storage is 249.78 m. The groundwater elevation as per Figure 6 of the Hydrogeology Report, provided in Appendix B, is 248.07 m and the distance between the bottom of the storage to the groundwater is 249.78 – 248.07 = 1.71 m > 1.0 m required.

Due to high groundwater elevation, low infiltration rate and site restrictions for volume control the subject site will be considered as the site with restriction as defined in Section 2.2.2.2 of the LSRCA Guidelines. A presentation was conducted by Schaeffers Consulting Engineers in a charrette meeting to develop a collaborative and comprehensive stormwater management plan for the subject site. Due to high groundwater elevation, low infiltration rate, and limited opportunities for implementation of volume reduction techniques within the subject site, Schaeffers Consulting Engineers proposed a Sand Filtration Bed in the north part of the site as a rate control LID to fulfill the LSRCA requirement for retaining 25 mm volume of water from the impervious area of the proposed development. The Sand Filter Bed close to the existing environmental features was not accepted by LSRCA and the flexible treatment alternative for sites with restrictions, according to LSRCA Technical Guidelines for Stormwater Management Submissions (Sept. 1, 2016) was recommended. According to Table 2-18, the 5 mm volume of water from the impervious area of the subject site is = 38 m^3, and based on Table 2-17, the volume of water available for infiltration is 38.31 m^3/event. As such, Alternative #2 requirement for the volume control, which is 5 mm from the impervious area of a major development will be met.

The pre-development annual phosphorus loading from 1.14 ha developable area of the site, calculated using *"MOECC Lake Simcoe Phosphorus Loading Development Tool"* (January 2012) is = 0.06 kg/year. The post-development annual loading with mitigation, leaving the site is = 0.53 kg/year. As per Lake Simcoe Phosphorus Offsetting Program (LSPOP) all new development must control 100% of the phosphorus from leaving their property. Any remaining stormwater phosphorus load that cannot be controlled would trigger the need for an offset to achieve a net-zero target. As per the LSPOP, the compensation cost is =
0.53 x 2.5 x $35,000.00 = $46,375.00.

We trust that you will find the contents of this report satisfactory. Please contact us if you have any questions or concerns.

Respectfully Submitted,

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