BEACON ENVIRONMENTAL

GUIDING SOLUTIONS IN THE NATURAL ENVIRONMENT

Water Balance and Catchment-Based Water Balance Assessments Report

51, 53, 55, & 75 Bradford St. and 20 Checkley St., Barrie, Ontario

Preliminary Report

Prepared For:

Barrie Lakeshore Developments

Prepared By:

Beacon Environmental Limited

Date: *Project:*

August 2020 **219403.7**

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1. Introduction

This report includes the preliminary findings of the Global Site Water Balance ("Water Balance"), and Catchment-Based Water Balance (also known as a Feature-Based Water Balance) assessments, being carried out by Beacon Environmental Limited (Beacon) for the property located at 51, 53, 55, 75 Bradford Street and 20 Checkley Street, Barrie, Ontario (hereafter referred to as the "subject property"). The work has been undertaken in accordance with the proposed work plans approved by Barrie Lakeshore Developments.

The purpose of these water balance assessments is to provide further information regarding the proposed development of the subject property at two stages of development: Phase One and Phase Ultimate Conditions. Phase One Conditions describe the theoretical conditions at an interim stage of construction, which is summarized to include the construction of a tower building structure (Tower 1), located in the northeast part of the property, and interim parking located in the southwest part of the property. Phase Ultimate Conditions describe the theoretical conditions at the final proposed stage of development, which is summarized to include a further three tower building structures (Tower 2, Tower 3, and Tower 4), located on the west part of the property. Proposed development plans available at the time of this reporting are provided in **Appendix A**. The scope of this work is limited to a Water Balance and Catchment-Based Water Balance of Phase One and Phase Ultimate Conditions.

This report is preliminary and based on information collected between May and August of 2020. A revised report will be forthcoming which includes the findings of ongoing monitoring being carried out at the water channel and wetland.

2. Site and Area Physical Context

The subject property is approximately 3.5 ha (approximately 35,000 m^2) in area, and located in the City of Barrie, Ontario. As shown on **Figure 1,** the subject property is irregularly shaped and is roughly bounded to the north and south by Simcoe Street and Bunker Creek, respectively. The subject property is generally adjacent to Bradford Street to the west, and Lakeshore drive to the east.

The site is generally fallow grass meadow containing an existing building structure and paved parking area on the west part of the property.

2.1 Topography and Drainage

The subject property is located approximately 60 m from the Lake Simcoe shoreline, and is situated within the jurisdiction of Lake Simcoe Region Conservation Authority (LSRCA) and the Lake Simcoe and Couchiching/Black River Source Protection Area (SPA) in the City of Barrie. Available Ministry of the Environment, Conservation and Parks (MECP) mapping indicates that parts of the subject property are classified as Wellhead Protection Area B (WHPA-B) for water quality. The subject property overlies a Tier 2 Significant Ground Subwatershed, and the north part of the property overlies a Highly Vulnerable Aquifer.

The topography is summarized as highest in the northwest part of the subject property, with a general gradient downward towards the south toward Bunker Creek and wetland features. Topographic elevations for the subject property range from approximately 225 metres above sea level (masl) to 219 masl (approximately equivalent to the mean surface of Lake Simcoe).

A reconnaissance of the subject property was carried out by a Professional Hydrogeologist (P.Geo.) on June 4, 2020. Within the subject property, no obvious groundwater-dependent features or seepage areas were observed. Baseflow to Bunker Creek or the wetland could not be ascertained without the full monitoring dataset, and will be addressed further in the forthcoming revised report.

2.2 Physiography and Geology

The subject property is located on sand plains and glacio-lacustrine deposits characterized as sand, gravelly sand and gravel, nearshore and beach deposits. This deposit cross-cuts a glaciofluvial ice deposit, now existing to the north and south, characterized by gravel and sand, with minor till (OGS 2000; MRD128, 2010; MRD228, 2007).

The bedrock beneath the described overburden is reported to be composed of limestone, dolostone and shale (MRD126 2011). Bedrock units were not encountered during this investigation or during the drilling operations required to install the groundwater monitoring wells.

3. Water Balance

A comparative water budget assessment was carried out for the subject property. Estimates for existing conditions, proposed conditions, and proposed conditions with low impact development methods are compared below.

3.1 Methods

Pre-development and post-development groundwater recharge (infiltration) and surface water run-off were estimated at monthly resolutions to characterize the hydrological and hydrogeological dynamics of the subject property. The estimates take into account the following seven components:

"Inputs"	(P) Precipitation
	(S_i) Surface water inflow
	(G_i) Groundwater inflow
"Outputs"	(So) Surface water outflow
	(Go) Groundwater outflow
	(ET) Evapotranspiration
Available Storage	(SMC) soil moisture holding capacity

The basic water balance for a particular area can be expressed as:

$$P = Qs + ET + RE + \Delta S$$
(Thornthwaite and Mather 1955)

where,

P = Precipitation (rain and snow)
Qs = Runoff
ET = Evapotranspiration
RE = Recharge
ΔS = Change in Storage (assumed to be zero under steady state conditions)

Climate data was sourced from historical Environment Canada data available for Shanty Bay weather station, located approximately 5 km northeast of the subject property, and operated by the co-operative climate network (CCN), using an average of three years (2017 through 2019) for the estimates. Local solar radiation, incoming solar radiation, sunset hour angles, and solar declination conditions used to estimate the evapotranspiration rate were sourced from the National Aeronautical and Space Administration Langley Research Center (NASA 2018). An average of 20 years was used for the solar information. Standard soil water holding capacities and infiltration coefficients used were provided in the *Stormwater Management Planning and Design Manual* (MOECC 2003).

Table 1 summarizes the pre-development water-holding capacities assigned in the calculations based on the above descriptions and assumptions, as well as proposed conditions.

Table 1. Summary of Soil Type, Land Use, and Assigned Water Holding Capacity

Soil Type	Vegetation Community Type (see Map 3)	Assigned Water Holding Capacity (mm/m^2)
Silty Loam	Fallow grasses	125
Organic Wetland Soils		900
Fine Sandy Loam	Urban lawn/shallow rooted crops	75

The infiltration coefficients used in the estimate calculations were based on the sum of topography, surficial soil classification and cover factors, provided in the *Stormwater Management Planning and Design Manual* (MOECC 2003). The general topography of the catchment area was assigned a topographic factor of 0.2 based on visual observation. The surficial soil classification was considered 'Silty Loam' or 'Fine Sandy Loam' and assigned a soil factor of 0.2. The cover was considered "cultivated land" based on the general root depth of the vegetation observed and assigned a cover factor of 0.1. The cover of the existing wetland was provided an infiltration coefficient of 0.2, based on general root depth of the vegetation observed. Based on the above sums, the total infiltration coefficient used in the estimate calculations was 0.5, with a coefficient of 0.6 in the wetland.

3.2 Global Site Water Balance

Pre-Development Constraints

The existing pre-development conditions of the subject property includes one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements,

and building structures, as summarized in **Table 2.** The area of the subject property used in the calculations was 35047.1 m^2 in area, which includes approximately 7,923 m^2 of impermeable area.

Table 2. Existing Pre-Development Conditions Comparison of Pervious to Impervious Land Area

Existing Land Use	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – (including existing structure and paved parking area)	22,178.7	7,923
Wetland Areas	4,945.4	-
Total Areas	**27,124.1**	**7,923**

Post-Development Constraints – Phase One Conditions (without mitigation measures)

Post-development conditions for Phase One Conditions were based on drawings provided to Beacon, dated August 2020 (Figure 4.4; **Appendix A**), and surface area values provided by Turner Fleischer (August 10, 2020). The proposed conditions of the subject property include one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements, and building structures, as summarized in **Table 3.** The proposed subject property remains approximately 35047.1 m^2 in area, including approximately 11,758.3 m^2 of impermeable area.

Table 3. Proposed Post-Development Conditions – Phase One Conditions Comparison of Pervious to Impervious Land Area

Proposed Land Uses [1]	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – Grassed and Developed (including Tower 1, associated impermeable areas, and interim parking area)	18342.9	11,397.2
Wetland Areas (including wetland area, and associated asphalt areas – footpaths)	4945.4	361.1
Total	**23288.8**	**11,758.3**

[1] Based on provided information (Turner Fleischer, August 10, 2020)

Post-Development Constraints – Ultimate Conditions (without mitigation measures)

Post-development conditions for Ultimate Conditions were based on drawings provided to Beacon, dated August 2020 (Figure 2.5; **Appendix A**), and surface area values provided by Turner Fleischer (August 10, 2020). The proposed conditions of the subject property include one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements, and building structures, as summarized in **Table 4.** The proposed subject property remains

approximately 35047.1 m^2 in area. Ultimate Conditions include approximately 11,758.3 m^2 of impermeable area.

Table 4. Proposed Post-Development Conditions – Ultimate Conditions Comparison of Pervious to Impervious Land Area

Proposed Land Uses	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – (including Tower 1, Tower 2, Tower 3, and Tower 3, and associated impermeable areas)	4,194.9	25,545.5
Wetland Areas (including wetland area, and associated asphalt areas)	4,699.3	607.4
Total	**8,894.2**	**26,152.9**

[1] Based on provided information (Turner Fleischer, August 10, 2020)

Post-Development Mitigation Measures

Mitigation measure designs are effectively shared between Phase One Conditions and Phase Ultimate Conditions. Provided design plans for Phase One Conditions (**Appendix B**), include five infiltration trenches, designated Infiltration Trench A through Infiltration Trench E. Provided design plans for Phase Ultimate Conditions (**Appendix B**), include the five infiltration trenches, designate Infiltration Trench A through Infiltration Trench E, with an additional infiltration trench designated Infiltration Trench F for the purposes of infiltrating the water from Tower 2 through Tower 4.

The purpose of the infiltration systems is to provide a point of entry for runoff water to be infiltration into the ground, thereby mitigating the volume of infiltrated water 'lost' as a result of the proposed increase in impermeable surface area. **Table 5** summarizes the approximately catchment areas for which runoff areas, such as building structure roof surface, is converted to infiltrated groundwater for each infiltration trench.

Table 5. Infiltration Trench Specifications

Infiltration Trench	Approximate Catchment Area for Infiltration Trench (m^2)
Infiltration Trench A	1,100
Infiltration Trench B	600
Infiltration Trench C	2,800
Infiltration Trench D	700
Infiltration Trench E	6,900
Infiltration Trench F (only operational in Phase Ultimate Conditions)	7,100
Total Runoff Surface Area Converted to Infiltration	**19,200**

[1] Based on provided information (SCS)

The remaining catchment areas are provided filtration and directed to the Eco-Pond using two channel features or are directed off-site. Further infiltration trench information and specification may be found under separate cover in [SCS 2020].

3.3 Comparison of Pre-Development and Post-Development Water Balance Conditions

The pre-development hydrologic budget for the subject property was estimated based on the existing catchment conditions summarized above, and the post-development hydrologic budgets were estimated based on the Post-Development Drainage Plan and related mitigation measures, summarized above. The estimated pre-development conditions and post-development conditions for Phase One conditions are summarized in **Table 6,** below. The estimated pre-development conditions and post-development conditions for Phase Ultimate conditions are summarized in **Table 7**, below.

Table 6. Theoretical Average Annual Water Budgets – Phase One Conditions

Component	Pre-Development	Phase One Conditions (without mitigation)		Phase One Conditions (including mitigation*)	
	(m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)
(P) Precipitation	35,688	35,688	-	35,688	-
(ET) Evapotranspiration	10,758	9,252	1,506 (-14%)	9,237	2,107 (-18.5%)
(Q_G) Infiltration	11,344	9,795	1549 (-14%)	22,458	11,114 (+98%)
(Q_S) Run-off	20,893	25,218	4,325 (+21%)	12,584	8,309 (-40%)

* Mitigation measures considered as part of this estimate include:
- Infiltration Trench A through Infiltration Trench E.

Based on the summary of analyses provided in **Table 6,** it is noted that the proposed mitigated changes to the subject property are anticipated to result in an annual infiltration increase of approximately 11,114 m^3, and an annual runoff decrease of approximately 8,309 m^3 in comparison to existing conditions.

Table 7. Theoretical Average Annual Water Budgets – Phase Ultimate Conditions

Component	Pre-Development	Phase Ultimate Conditions (without mitigation)		Phase Ultimate Conditions (including mitigation*)	
	(m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development m^3 per annum (percentage)	(m^3 per annum)	Relative Difference from Pre-Development m^3 per annum (percentage)
(P) Precipitation	35,688	35,688	-	35,688	-
(ET) Evapotranspiration	10,758	3,528	7,320 (-67%)	3,528	7,320 (-67%)
(Q_G) Infiltration	11,344	3,879	7,465 (-65%)	20,642	9,298 (+82%)
(Q_S) Run-off	20,893	41,702	20,809 (-100%)	24,938	4,045 (+19%)

* Mitigation measures considered as part of this estimate include:
- Infiltration Trench A through Infiltration Trench F.

Based on the summary of analyses provided in **Table 7,** it is noted that the proposed mitigated changes to the subject property during Phase Ultimate conditions are anticipated to result in an annual infiltration increase of approximately 9,298 m^3 of infiltration, and an annual runoff increase of approximately 4,045 m^3 in comparison to existing conditions.

It is acknowledged that the values and coefficients presented above are standardized estimates. It is important to understand that infiltration rates and water holding capacities are dependent upon the effective porosity and hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the resulting run-off and infiltration estimates inherit potentially large margins of error. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post- development conditions.

3.4 Catchment-Based Water Balance

A water balance assessment was carried out, limited to the catchment area belonging to the Feature of Interest (FOI). The size of the catchment directing water to the FOI changes with grading and with areas dedicated to catchments for the Infiltration Trenches. The purpose of the catchment-based water balance assessment is to compare the hydrological conditions of the proposed development conditions on the surface water reaching/'feeding' the FOI. For the purposes of this assessment, the FOI is defined as the wetland and Bunker Creek.

Pre-Development Constraints – FOI Catchment

The existing pre-development conditions of the subject property includes one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements, and building structures, as summarized in **Table 8.** The existing area of the subject property dedicated to surface water catchment for the Feature of Interest used in the calculations was 31,942 m^2 in area, which includes approximately 7,923 m^2 of impermeable area.

Table 8. Existing Pre-Development Conditions – Catchment to Feature of Interest Comparison of Pervious to Impervious Land Area in FOI Catchment

Existing Catchment Land Use	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – (including existing structure and paved parking area)	19,073.6	7,923
Wetland Areas	4,945.4	-
Total Areas	**14,019**	**7,923**

Post-Development Constraints – Phase One Conditions – FOI Catchment (without mitigation measures)

Post-development conditions in the FOI Catchment for Phase One Conditions were based on drawings provided to Beacon, dated August 2020 (Figure 4.4; **Appendix A**), and surface area values provided by Turner Fleischer (August 10, 2020). The proposed conditions of the subject property include one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements, and building structures, as summarized in **Table 9.** The proposed catchment for the FOI under proposed Phase One conditions is approximately 25,706.7 m^2 in area, including approximately 5,619.2 m^2 of impermeable area.

Table 9. Proposed Post-Development Conditions – Phase One Conditions Comparison of Pervious to Impervious Land Area in FOI Catchment

Proposed Land Uses [1]	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – Grassed and Developed (including Tower 1, associated impermeable areas, and interim parking area)	15,142	5,258
Wetland Areas (including wetland area, and associated asphalt areas – footpaths)	4,945.5	361.2
Total	**20,087.5**	**5,619.2**

[1] Based on provided information (Turner Fleischer, August 10, 2020)

Post-Development Constraints – Phase Ultimate Conditions – FOI Catchment (without mitigation measures)

Post-development conditions in the FOI Catchment for Ultimate Conditions were based on drawings provided to Beacon, dated August 2020 (Figure 2.5; **Appendix A**), and surface area values provided by Turner Fleischer (August 10, 2020). The proposed conditions of the subject property include one general vegetation type (gentrified grasses), as well as impervious lands comprised of concrete pavements, asphalt pavements, and building structures, as summarized in **Table 10.** The proposed catchment for the FOI under proposed Phase Ultimate conditions is approximately 20,006 m^2 in area. Ultimate Conditions include approximately 9,145 m^2 of impermeable area as part of the FOI Catchment.

Table 10. Proposed Post-Development Conditions – Ultimate Conditions Comparison of Pervious to Impervious Land Area in FOI Catchment

Proposed Land Uses	Approximate Pervious Land Area (m^2)	Approximate Impervious Land Area (m^2)
Principle Area – (including Tower 1, Tower 2, Tower 3, and Tower 3, and associated impermeable areas)	6,162	8,538
Wetland Areas (including wetland area, and associated asphalt areas)	4,699.3	607.4
Total	**10,861.3**	**9,145**

[1] Based on provided information (Turner Fleischer, August 10, 2020)

Post-Development Mitigation Measures - Catchment

Mitigation measure designs are effectively shared between Phase One Conditions and Phase Ultimate Conditions. Provided design plans for Phase One Conditions (Appendix B), include five infiltration trenches, designated Infiltration Trench A through Infiltration Trench E. Provided design plans for Phase Ultimate Conditions (Appendix B), include the five infiltration trenches, designate Infiltration Trench A through Infiltration Trench E, with an additional infiltration trench designated Infiltration Trench F for the purposes of infiltrating the water from Tower 2 through Tower 4.

The purpose of the infiltration systems is to provide a point of entry for runoff water to be infiltration into the ground, thereby mitigating the volume of infiltrated water 'lost' as a result of the proposed increase in impermeable surface area. **Table 5** summarizes the approximately catchment areas for which runoff areas, such as building structure roof surface, is converted to infiltrated groundwater for each infiltration trench.

Table 11. Infiltration Trench Specifications

Infiltration Trench	Approximate Catchment Area for Infiltration Trench (m^2)
Infiltration Trench A	1,100
Infiltration Trench B	600
Infiltration Trench C	2,800
Infiltration Trench D	700
Infiltration Trench E	6,900
Infiltration Trench F (only operational in Phase Ultimate Conditions)	7,100
Total Runoff Surface Area Converted to Infiltration	**19,200**

[1] Based on provided information (SCS)

The remaining catchment areas are provided filtration and directed to the Eco-Pond using two channel features, or are directed off-site. Further infiltration trench information and specification may be found under separate cover [SCS 2020].

As summarized in **Appendix C**, infiltration trenches appear to be most effective during the freshet periods of April to May, and again in October.

3.5 Comparison of Pre-Development and Post-Development Catchment-Based Water Balance Conditions

The pre-development hydrologic budget for the subject property was estimated based on the existing catchment conditions summarized above, and the post-development hydrologic budgets were estimated based on the Post-Development Drainage Plan and related mitigation measures, summarized above. The estimated pre-development conditions and post-development conditions for Phase One conditions are summarized in **Table 6,** below. The estimated pre-development conditions and post-development conditions for Phase Ultimate conditions are summarized in **Table 7**, below. A monthly breakdown of the values summarized in **Table 12** is provided in **Appendix C**.

Table 12. Theoretical Average Catchment-Based Water Budgets – Phase One Conditions – FOI Catchment

Component	Pre-Development FOI Catchment [1]	Phase One Conditions [2] (without mitigation)		Phase One Conditions [2] (including mitigation*)	
	(m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)
(P) Precipitation	32,527	Not comparable [1 and 2]		Not comparable [1 and 2]	
(ET) Evapotranspiration	9,527	Not comparable [1 and 2]		Not comparable [1 and 2]	
(Q_G) Infiltration	10,075	8,467	1,608 (-16%)	17,789	7,714 (+76%)
(Q_S) Run-off	19,805	14,992	4,813 (-24%)	6,241	4,813 (-24%)

1 Pre-development FOI Catchment is interpreted to be approximately 31,942 m^2 in area

2 Phase One FOI Catchment is interpreted to be approximately 25,706.7 m^2 in area

* Mitigation measures considered as part of this estimate include:

- Infiltration Trench A through Infiltration Trench E.

Based on the summary of analyses provided in **Table 12,** it is noted that the proposed mitigated changes to the subject property during Phase One conditions are anticipated to result in an annual increase of infiltration in the FOI Catchment by approximately 7,714 m^3, and an annual decrease of runoff reaching the FOI by approximately 4,813 m^3 in comparison to existing conditions.

As shown in **Appendix C**, monthly volumes of infiltration and run-off have the greatest variation during the freshet period of April to May. The largest variation in infiltration appears to be from 1,272 m^3 to 3,364 m^3 in April. The largest variation in run-off to the FOI appears to be from 2,373 m^3 to 282 m^3 in April.

Table 13. Theoretical Average Catchment-Based Water Budgets – Phase Ultimate Conditions – FOI Catchment

Component	Pre-Development FOI Catchment [1]	Phase Ultimate FOI Catchment Conditions [2] (without mitigation)		Phase Ultimate FOI Catchment Conditions [2] (including mitigation*)	
	(m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)	(m^3 per annum)	Relative Difference from Pre-Development (m^3 per annum)
(P) Precipitation	32,527	Not comparable [1 and 2]		Not comparable [1 and 2]	
(ET) Evapotranspiration	9,527	Not comparable [1 and 2]		Not comparable [1 and 2]	
(Q_G) Infiltration	10,075	4,683	5,392 (-54%)	21,447	11,372 (+113%)
(Q_S) Run-off	19,805	17,037	2,768 (-14%)	4,043	15,762 (-80%)

[1] Pre-development FOI Catchment is interpreted to be approximately 31,942 m^2 in area

[2] Phase Ultimate FOI Catchment is interpreted to be approximately 25,706.7 m^2 in area

* Mitigation measures considered as part of this estimate include:

- Infiltration Trench A through Infiltration Trench F.

Based on the summary of analyses provided in **Table 12,** it is noted that the proposed mitigated changes to the subject property during Phase One conditions are anticipated to result in an annual increase of infiltration in the FOI Catchment by approximately 11,372 m^3, and an annual decrease of runoff reaching the FOI by approximately 15,762 m^3 in comparison to existing conditions.

As shown **Appendix C**, monthly volumes of infiltration and run-off have the greatest variation during the freshet period of April to May. The largest variation in infiltration appears to be from 698 m^3 to 4,579 m^3 (+3,881 m^3) in April. The largest variation in run-off to the FOI appears to be from 2,794 m^3 to 0 m^3 (- 2,794 m^3) in April.

It is acknowledged that the values and coefficients presented above are standardized estimates. It is important to understand that infiltration rates and water holding capacities are dependent upon the effective porosity and hydraulic conductivity of the surficial soils which may vary over several orders of magnitude. As such, the resulting run-off and infiltration estimates inherit potentially large margins of error. These margins of error are recognized, but for the purposes of this assessment, the numbers used in the water balance calculations are considered reasonable estimates based on the site-specific conditions and useful for comparison of pre- to post- development conditions.

4. Summary and Discussion

In summary, this report finds that:

Water Balance Assessment

Phase One Conditions

Proposed mitigated changes to the subject property are anticipated to result in an annual infiltration increase of approximately 11,114 m^3, and an annual runoff decrease of approximately 8,309 m^3 in comparison to existing conditions.

Phase Ultimate Conditions

Proposed mitigated changes to the subject property during Phase Ultimate conditions are anticipated to result in an annual infiltration increase of approximately 9,298 m^3 of infiltration, and an annual runoff increase of approximately 4,045 m^3 in comparison to existing conditions.

Catchment-Based Water Balance Assessment

Phase One Conditions

Proposed mitigated changes to the subject property during Phase One conditions are anticipated to result in an annual increase of infiltration in the FOI Catchment by approximately 11,372 m^3, and an annual decrease of runoff reaching the FOI by approximately 15,762 m^3 in comparison to existing conditions.

An assessment of monthly estimates shows that the greatest variation from existing catchment run-off to the FOI is during April, when the infiltration trenches are most effective. The greatest run-off variation is estimated to be approximately -2,206 m^3 for the month of April.

Phase Ultimate Conditions

Proposed mitigated changes to the subject property during Phase One conditions are anticipated to result in an annual increase of infiltration in the FOI Catchment by approximately 7,714 m^3, and an annual decrease of runoff reaching the FOI by approximately 4,813 m^3 in comparison to existing conditions.

An assessment of monthly estimates shows that the greatest variation from existing catchment run-off to the FOI is during April, when the infiltration trenches are most effective. The greatest run-off variation is estimated to be approximately -3,881 m^3 for the month of April.

Discussion

Theoretical Site Water Balance

The findings of the theoretical Water Balance Assessment for Phase Ultimate conditions appears to show that runoff is reasonably preserved (+19%) with an increase in infiltration (+82%). This is interpreted to hinge on the trade of vegetated areas in favour of impermeable structures and paved

areas. The reduction of evapotranspiration on the proposed subject property means that 7,730 m^3 of additional water is directed to other outputs such as infiltration or run-off each year.

Theoretical Catchment-Based Water Balance

The findings of the theoretical Catchment-Based Water Balance for Phase Ultimate conditions appear to show that runoff to the FOI is reduced from existing conditions month to month. Infiltration volumes limited to the FOI Catchment area is increased by approximately 11,372 m^3 per year, with highest variation in April – a trend seen in the global site water balance estimate. It is understood that the purpose of this is to prioritize phosphorous removal.

Based on information under separate cover (Beacon 2020), it is understood that at the downstream extent of the subject property (at Lakeshore Drive), Bunker Creek has a catchment area of approximately 3.3 km^2 (~3,300,000 m^2). As such, the FOI catchment located on the subject property is understood to represent approximately 0.96% of the catchment input area to Bunker Creek. With this in mind, the opinion is submitted that the reduction of phosphorous into the creek (and nearby lake) be provided priority of importance over a runoff deficit to the FOI, which provides relatively little to Bunker Creek respective to the catchment area.

We trust that this meets your immediate needs. As indicated above, this report will be revised to include salt contamination assessment findings.

Prepared by:
Beacon Environmental

Zen Keizars, P.Geo.
Senior Hydrogeologist, Practice Lead

5. Sources Cited

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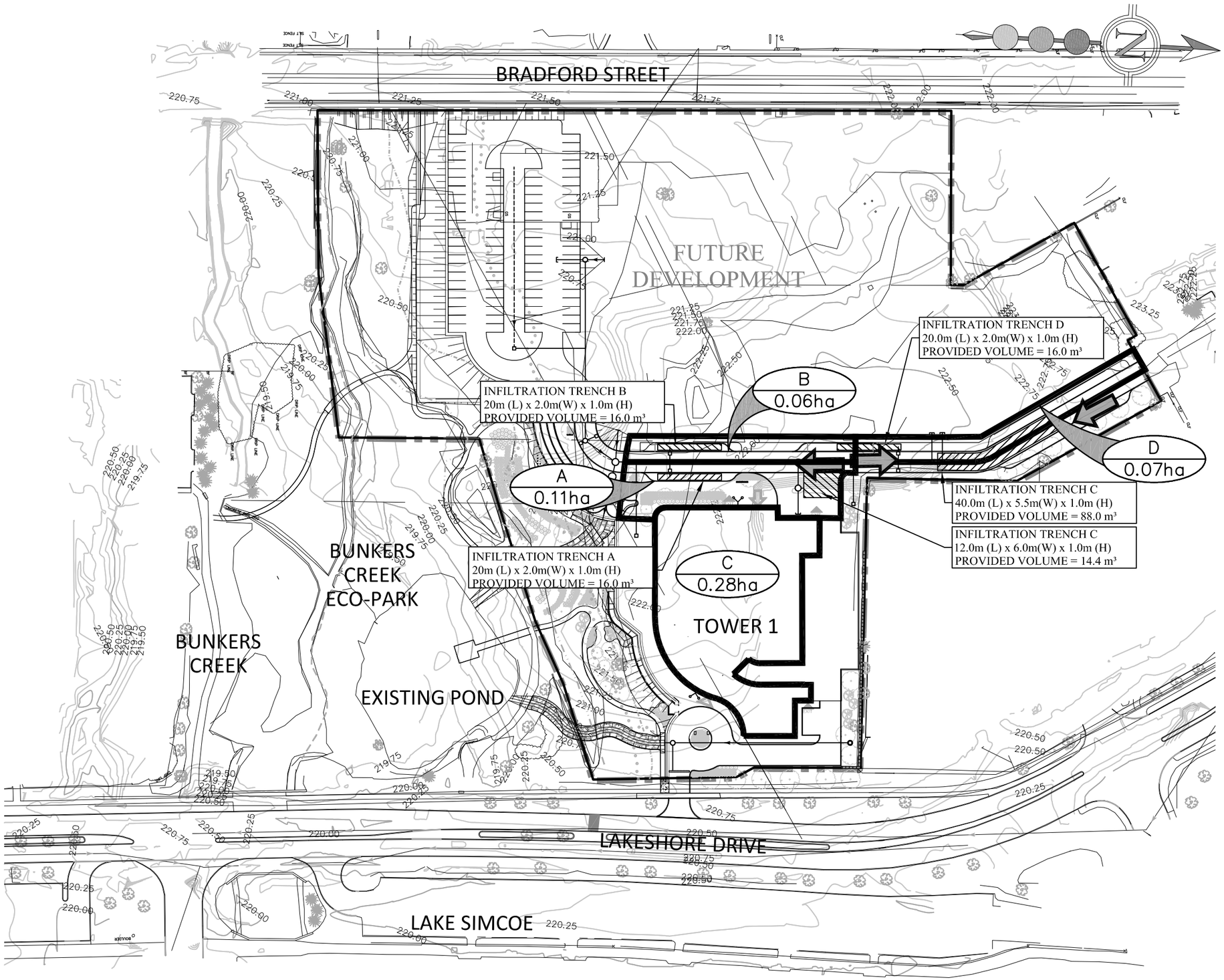
Figures

Site Location	Figure 1
51 Bradford Street, Barrie	
BEACON ENVIRONMENTAL	Project: 219403.7 Last Revised: July, 2020
Client: Barrie Lakeshore Developments	Prepared by: DU Checked by: SG
N 1:5,000	Inset Map:1:50,000

C:\Dropbox\Dropbox (Beacon)\All GIS Projects\2019\219403 51-57 Bradford Street Barrie EIS NHS\MXD\2020-07-27_Figure01_SiteLocation_219403_2.mxd

Appendix A

Design Plan Drawings Provided to Beacon



LEGEND:

- PROPERTY BOUNDARY
- PROPOSED LID MEASURE DRAINAGE BOUNDARY
- 270.25 — EXISTING CONTOUR AND ELEVATION
- A / 0.11ha — CATCHMENT ID; DRAINAGE AREA (HECTARES)
- MAJOR SYSTEM - OVERLAND FLOW
- PROPOSED INFILTRATION TRENCH

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

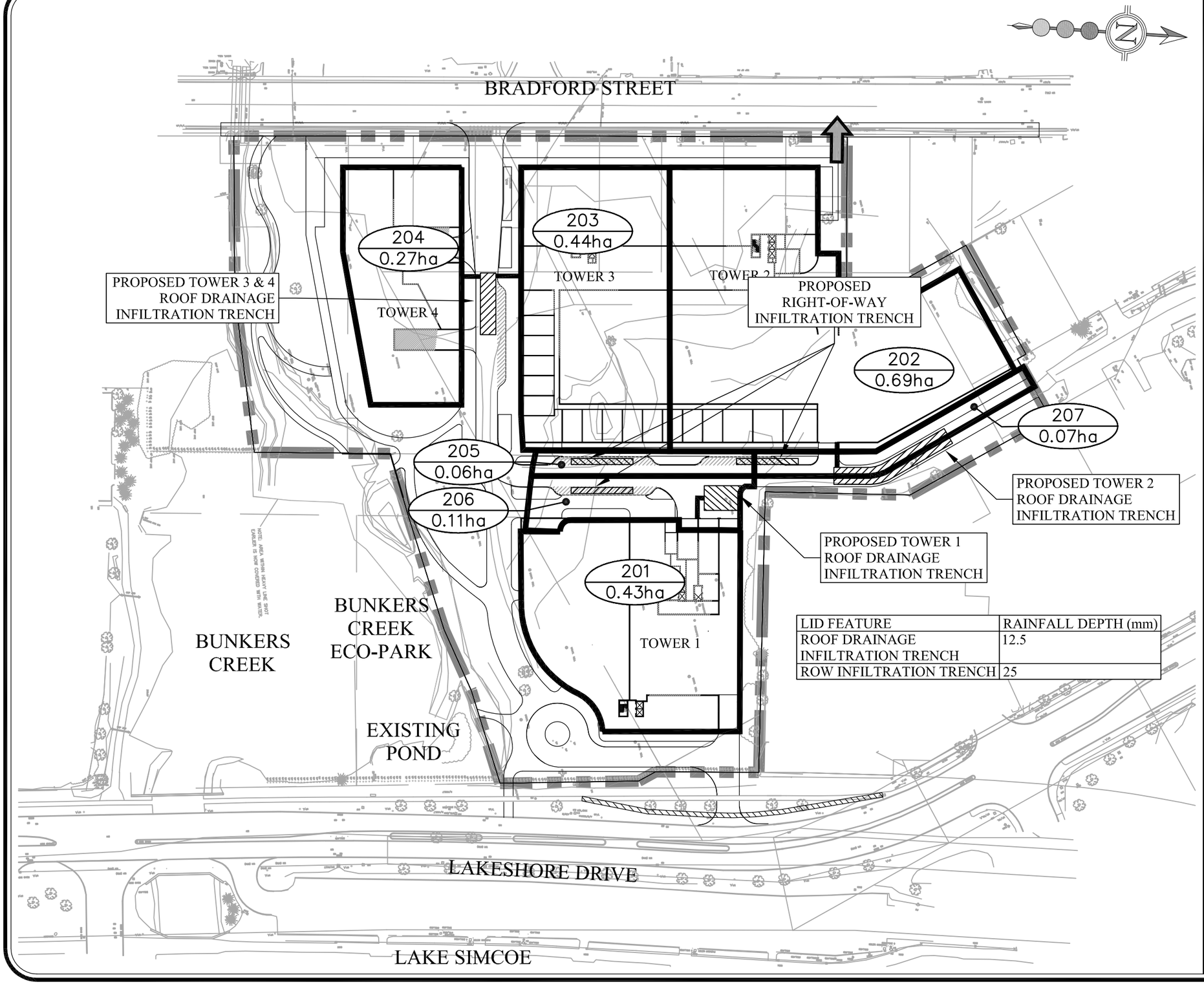
BARRIE LAKESHORE DEVELOPMENTS - PHASE 1

51, 53, 55 AND 75 BRADFORD STREET AND 20 CHECKLEY STREET - BARRIE

PROPOSED LOW IMPACT DEVELOPMENT PLAN

DESIGNED BY:	C.M.	CHECKED BY:	P.A.T.
SCALE:	1:1250	DATE:	AUGUST 2020
PROJECT No:	2196	FIGURE No:	4.4

File: P:\2196 51-75 Bradford Street\Drawings\Phase 1\Swm\Report Figures\2196D-STRM-PROP-LIDS-3.4.dwg - Revised by <PTURCHET> : Thu, Aug 06 2020 - 9:58pm



LID FEATURE	RAINFALL DEPTH (mm)
ROOF DRAINAGE INFILTRATION TRENCH	12.5
ROW INFILTRATION TRENCH	25

LEGEND:

- PROPERTY BOUNDARY
- PROPOSED LID FEATURE DRAINAGE BOUNDARY
- 270.25 — EXISTING CONTOUR AND ELEVATION
- 201 / 2.60ha — CATCHMENT ID; DRAINAGE AREA (HECTARES)
- PROPOSED INFILTRATION TRENCH

SCS consulting group ltd
30 CENTURIAN DRIVE, SUITE 100
MARKHAM, ONTARIO L3R 8B8
TEL: (905) 475-1900
FAX: (905) 475-8335

BARRIE LAKESHORE DEVELOPMENTS

51, 53, 55 & 75 BRADFORD STREET
AND 20 CHECKLEY STREET- BARRIE

PROPOSED LOW IMPACT DEVELOPMENT FIGURE

DESIGNED BY: C.M.	CHECKED BY: P.A.T..
SCALE: 1:1250	DATE: AUGUST 2020
PROJECT No: 2196	FIGURE No: 2.5

File: P:\2196 51-75 Bradford Street\Drawings\FSP\Fig\Report Figures\2196P-STRM-PROP-LID-2.5.dwg - Revised by <PTURCHET> : Thu, Aug 06 2020 - 10:00pm

Appendix B

Theoretical Global Site Water Balance Analyses

BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

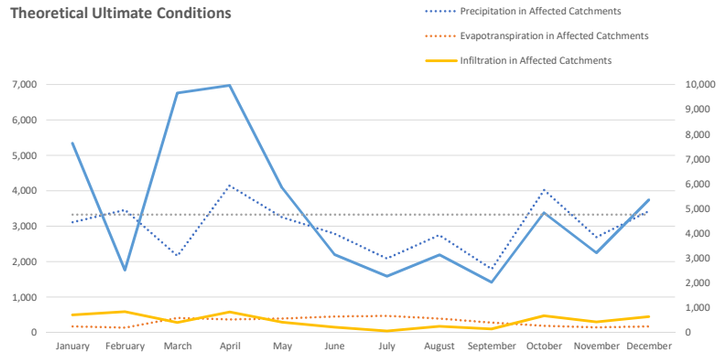
Project: 51-57 Bradford Street, Barrie, Ontario
Phase One Conditions with Mitigations

Project Number: 219403.7
For: Barrie Lakeshore Developments

Date: 11-Aug-20
Reviewed By: ZK

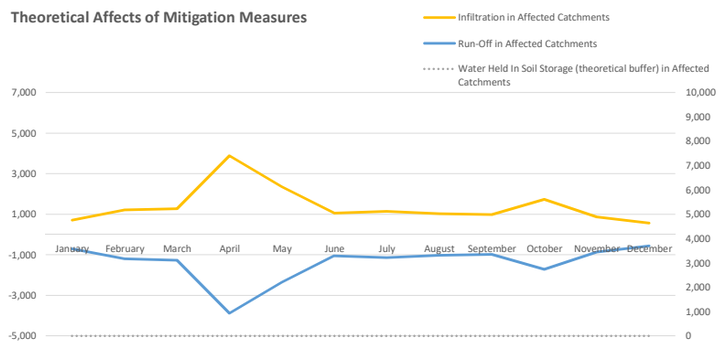
Theoretical Ultimate Conditions Before Mitigations

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	171	4,754	494	5,345
February	3,463	135	4,754	589	1,762
March	2,159	405	4,754	276	6,766
April	4,145	365	4,754	576	6,982
May	3,252	388	4,754	287	4,086
June	2,792	447	4,754	145	2,201
July	2,089	465	4,754	36	1,588
August	2,748	386	4,754	172	2,189
September	1,787	279	4,754	97	1,412
October	4,025	180	4,754	465	3,379
November	2,687	140	4,754	299	2,247
December	3,430	167	4,754	444	3,744
Minimum (Monthly)	1,787	135	4,754	36	1,412
Maximum (Monthly)	4,145	465	4,754	589	6,982
Average Monthly	2,974	294	4,754	323	3,475
Per Annum	35,688	3,528	-	3,879	41,702



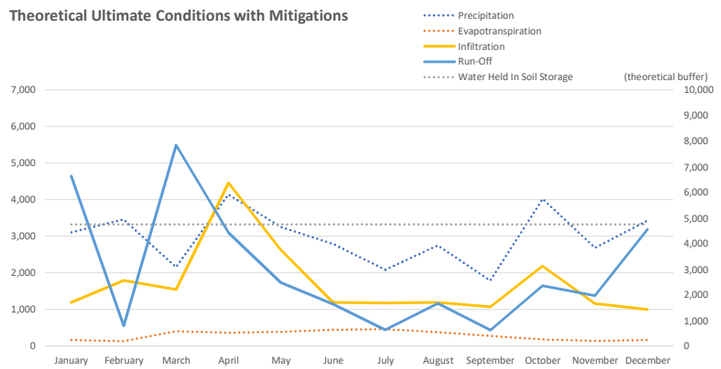
Theoretical Affects of Mitigation Measures

	Precipitation in Affected Catchments (m^3/month)	Evapotranspiration in Affected Catchments (m^3/month)	Water Held In Soil Storage (theoretical buffer) in Affected Catchments (m^3/month)	Infiltration in Affected Catchments (m^3/month)	Run-Off in Affected Catchments (m^3/month)
January	1,705	-	-	702	-702
February	1,897	-	-	1,206	-1,206
March	1,183	-	-	1,275	-1,275
April	2,271	-	-	3,881	-3,881
May	1,782	-	-	2,349	-2,349
June	1,530	-	-	1,050	-1,050
July	1,144	-	-	1,144	-1,144
August	1,505	-	-	1,025	-1,025
September	979	-	-	979	-979
October	2,205	-	-	1,725	-1,725
November	1,472	-	-	867	-867
December	1,879	-	-	561	-561
Minimum (Monthly)	979	-	-	561	-3,881
Maximum (Monthly)	2,271	-	-	3,881	-561
Average Monthly	1,629	-	-	1,397	-1,397
Per Annum	19,551	-	-	16,763	-16,763



Resulting Ultimate Conditions with Mitigations

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	171	4,754	1,196	4,643
February	3,463	135	4,754	1,794	557
March	2,159	405	4,754	1,550	5,491
April	4,145	365	4,754	4,457	3,100
May	3,252	388	4,754	2,636	1,738
June	2,792	447	4,754	1,194	1,151
July	2,089	465	4,754	1,181	444
August	2,748	386	4,754	1,197	1,164
September	1,787	279	4,754	1,076	433
October	4,025	180	4,754	2,190	1,655
November	2,687	140	4,754	1,166	1,380
December	3,430	167	4,754	1,004	3,183
Minimum (Monthly)	1,787	135	4,754	1,004	433
Maximum (Monthly)	4,145	465	4,754	4,457	5,491
Average Monthly	2,974	294	4,754	1,720	2,078
Per Annum	35,688	3,528 -		20,642	24,938



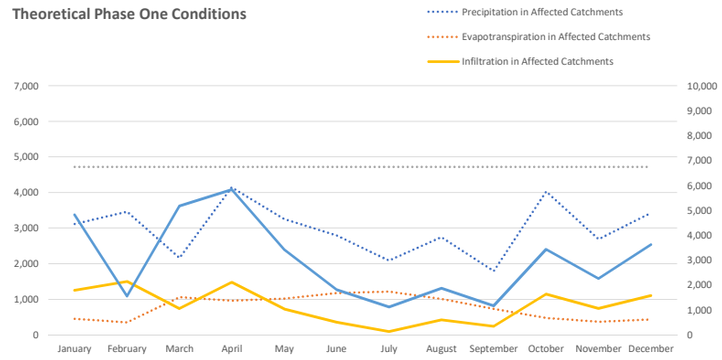
BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Phase One Conditions with Mitigations	**Project Number:**	219403.7	**Date:**	11-Aug-20
		For:	Barrie Lakeshore Developments	**Reviewed By:**	ZK

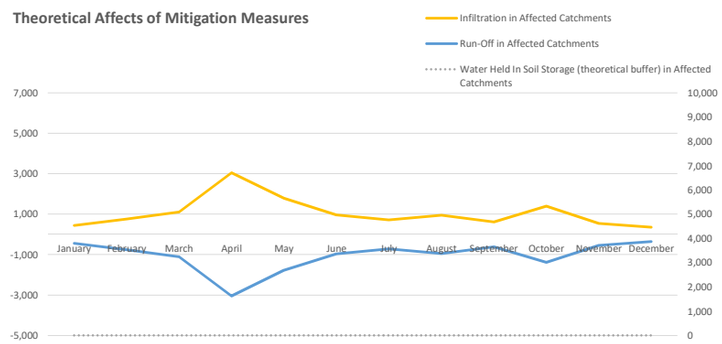
Theoretical Phase One Conditions Before Mitigations

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	448	6,744	1,251	3,377
February	3,463	352	6,744	1,497	1,084
March	2,159	1,060	6,744	731	3,621
April	4,145	957	6,744	1,473	4,085
May	3,252	1,016	6,744	722	2,397
June	2,792	1,170	6,744	357	1,265
July	2,089	1,217	6,744	89	783
August	2,748	1,012	6,744	424	1,312
September	1,787	730	6,744	239	819
October	4,025	472	6,744	1,148	2,405
November	2,687	367	6,744	739	1,580
December	3,430	437	6,744	1,105	2,538
Minimum (Monthly)	1,787	352	6,744	89	783
Maximum (Monthly)	4,145	1,217	6,744	1,497	4,085
Average Monthly	2,974	770	6,744	815	2,106
Per Annum	35,688	9,237	-	9,776	25,266



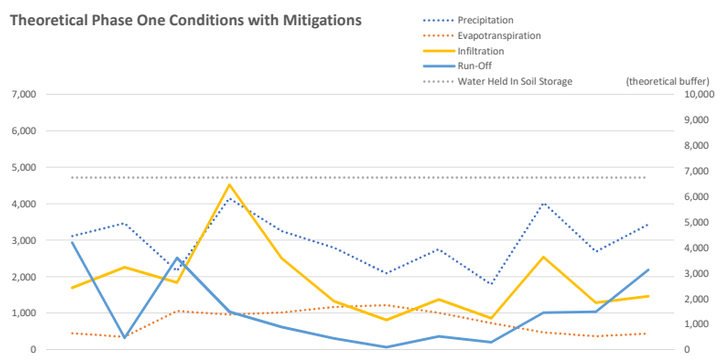
Theoretical Affects of Mitigation Measures

	Precipitation in Affected Catchments (m^3/month)	Evapotranspiration in Affected Catchments (m^3/month)	Water Held In Soil Storage (theoretical buffer) in Affected Catchments (m^3/month)	Infiltration in Affected Catchments (m^3/month)	Run-Off in Affected Catchments (m^3/month)
January	1,074	-	-	443	-443
February	1,195	-	-	760	-760
March	745	-	-	1,106	-1,106
April	1,431	-	-	3,051	-3,051
May	1,123	-	-	1,783	-1,783
June	964	-	-	964	-964
July	721	-	-	721	-721
August	949	-	-	949	-949
September	617	-	-	617	-617
October	1,389	-	-	1,389	-1,389
November	928	-	-	546	-546
December	1,184	-	-	354	-354
		-	-		
Minimum (Monthly)	617	-	-	354	-3,051
Maximum (Monthly)	1,431	-	-	3,051	-354
Average Monthly	1,027	-	-	1,057	-1,057
Per Annum	12,321	-	-	12,682	-12,682



Resulting Phase One Conditions with Mitigations

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	448	6,744	1,694	2,935
February	3,463	352	6,744	2,257	324
March	2,159	1,060	6,744	1,837	2,515
April	4,145	957	6,744	4,524	1,034
May	3,252	1,016	6,744	2,504	615
June	2,792	1,170	6,744	1,321	301
July	2,089	1,217	6,744	811	62
August	2,748	1,012	6,744	1,373	363
September	1,787	730	6,744	856	202
October	4,025	472	6,744	2,537	1,015
November	2,687	367	6,744	1,285	1,034
December	3,430	437	6,744	1,458	2,185
	0	0	0		
Minimum (Monthly)	1,787	352	6,744	811	62
Maximum (Monthly)	4,145	1,217	6,744	4,524	2,935
Average Monthly	2,974	770	6,744	1,871	1,049
Per Annum	35,688	9,237 -		22,458	12,584



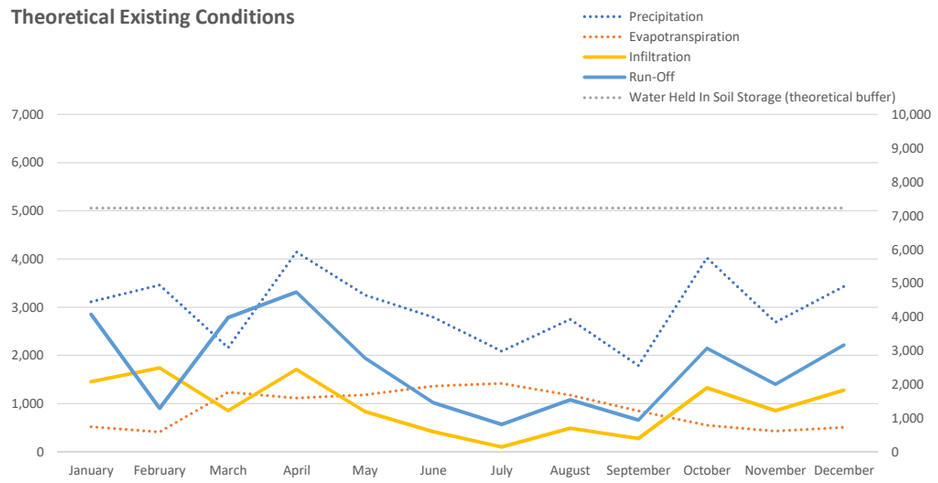
BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Phase One Conditions	**Project Number:**	219403.7	**Date:**	11-Aug-20
		For:	Barrie Lakeshore Developments	**Reviewed By:**	ZK

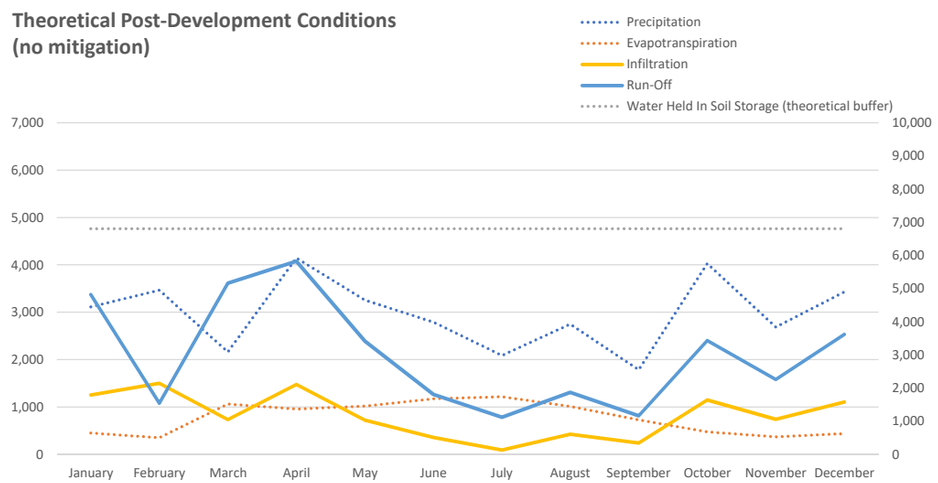
Theoretical Existing Conditions

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	522	7,223	1,453	2,854
February	3,463	410	7,223	1,739	904
March	2,159	1,234	7,223	853	2,783
April	4,145	1,115	7,223	1,711	3,314
May	3,252	1,184	7,223	837	1,948
June	2,792	1,362	7,223	414	1,016
July	2,089	1,417	7,223	103	568
August	2,748	1,178	7,223	491	1,078
September	1,787	850	7,223	276	661
October	4,025	549	7,223	1,329	2,146
November	2,687	428	7,223	856	1,403
December	3,430	508	7,223	1,281	2,218
Minimum (Monthly)	1,787	410	7,223	103	568
Maximum (Monthly)	4,145	1,417	7,223	1,739	3,314
Average Monthly	2,974	897	7,223	945	1,741
Per Annum	35,688	10,758	-	11,344	20,893



Theoretical Post-Development Conditions (no mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	449	6,802	1,254	3,371
February	3,463	353	6,802	1,500	1,082
March	2,159	1,061	6,802	732	3,612
April	4,145	959	6,802	1,475	4,076
May	3,252	1,018	6,802	723	2,393
June	2,792	1,171	6,802	358	1,262
July	2,089	1,219	6,802	90	781
August	2,748	1,013	6,802	425	1,309
September	1,787	731	6,802	239	817
October	4,025	473	6,802	1,150	2,402
November	2,687	368	6,802	741	1,578
December	3,430	437	6,802	1,107	2,534
Minimum (Monthly)	1,787	353	6,802	90	781
Maximum (Monthly)	4,145	1,219	6,802	1,500	4,076
Average Monthly	2,974	771	6,802	816	2,102
Per Annum	35,688	9,252	-	9,795	25,218



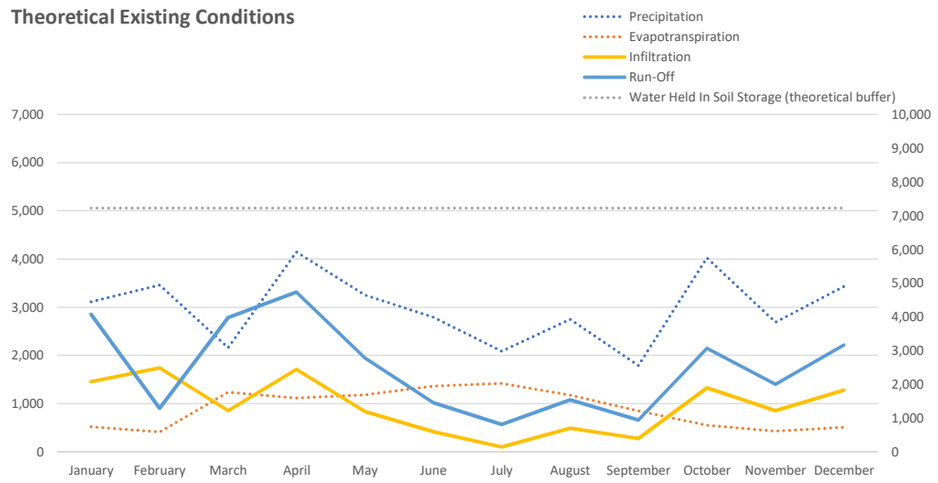
BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Phase One Conditions	**Project Number:**	219403.7	**Date:**	11-Aug-20
		For:	Barrie Lakeshore Developments	**Reviewed By:**	ZK

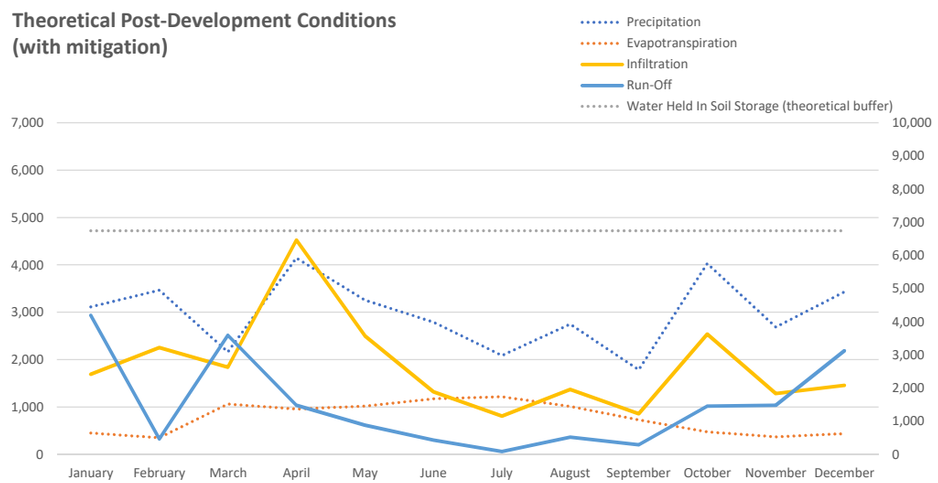
Theoretical Existing Conditions

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	522	7,223	1,453	2,854
February	3,463	410	7,223	1,739	904
March	2,159	1,234	7,223	853	2,783
April	4,145	1,115	7,223	1,711	3,314
May	3,252	1,184	7,223	837	1,948
June	2,792	1,362	7,223	414	1,016
July	2,089	1,417	7,223	103	568
August	2,748	1,178	7,223	491	1,078
September	1,787	850	7,223	276	661
October	4,025	549	7,223	1,329	2,146
November	2,687	428	7,223	856	1,403
December	3,430	508	7,223	1,281	2,218
Minimum (Monthly)	1,787	410	7,223	103	568
Maximum (Monthly)	4,145	1,417	7,223	1,739	3,314
Average Monthly	2,974	897	7,223	945	1,741
Per Annum	35,688	10,758	-	11,344	20,893



Theoretical Post-Development Conditions (with mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	448	6,744	1,694	2,935
February	3,463	352	6,744	2,257	324
March	2,159	1,060	6,744	1,837	2,515
April	4,145	957	6,744	4,524	1,034
May	3,252	1,016	6,744	2,504	615
June	2,792	1,170	6,744	1,321	301
July	2,089	1,217	6,744	811	62
August	2,748	1,012	6,744	1,373	363
September	1,787	730	6,744	856	202
October	4,025	472	6,744	2,537	1,015
November	2,687	367	6,744	1,285	1,034
December	3,430	437	6,744	1,458	2,185
	0	0	0		
Minimum (Monthly)	1,787	352	6,744	811	62
Maximum (Monthly)	4,145	1,217	6,744	4,524	2,935
Average Monthly	2,974	770	6,744	1,871	1,049
Per Annum	35,688	9,237	-	22,458	12,584



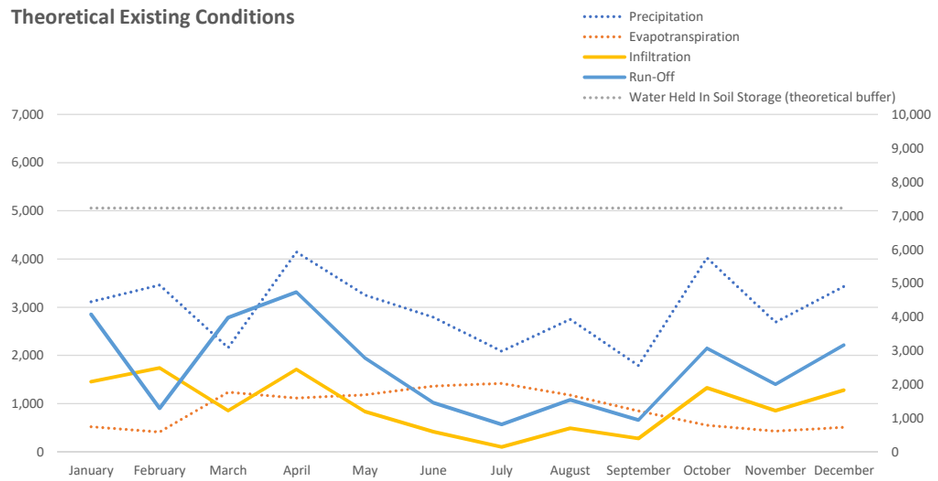
BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario	**Project Number:**	219403.7	**Date:**	24-Jul-20
	Ultimate Conditions	**For:**	Barrie Lakeshore Developments	**Reviewed By:**	ZK

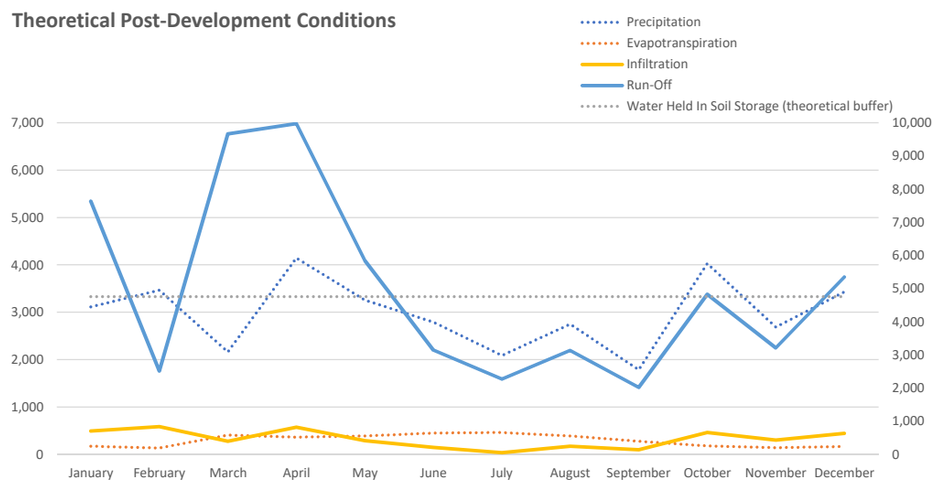
Theoretical Existing Conditions

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	522	7,223	1,453	2,854
February	3,463	410	7,223	1,739	904
March	2,159	1,234	7,223	853	2,783
April	4,145	1,115	7,223	1,711	3,314
May	3,252	1,184	7,223	837	1,948
June	2,792	1,362	7,223	414	1,016
July	2,089	1,417	7,223	103	568
August	2,748	1,178	7,223	491	1,078
September	1,787	850	7,223	276	661
October	4,025	549	7,223	1,329	2,146
November	2,687	428	7,223	856	1,403
December	3,430	508	7,223	1,281	2,218
Minimum (Monthly)	1,787	410	7,223	103	568
Maximum (Monthly)	4,145	1,417	7,223	1,739	3,314
Average Monthly	2,974	897	7,223	945	1,741
Per Annum	35,688	10,758	-	11,344	20,893



Theoretical Post-Development Conditions (no mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	171	4,754	494	5,345
February	3,463	135	4,754	589	1,762
March	2,159	405	4,754	276	6,766
April	4,145	365	4,754	576	6,982
May	3,252	388	4,754	287	4,086
June	2,792	447	4,754	145	2,201
July	2,089	465	4,754	36	1,588
August	2,748	386	4,754	172	2,189
September	1,787	279	4,754	97	1,412
October	4,025	180	4,754	465	3,379
November	2,687	140	4,754	299	2,247
December	3,430	167	4,754	444	3,744
Minimum (Monthly)	1,787	135	4,754	36	1,412
Maximum (Monthly)	4,145	465	4,754	589	6,982
Average Monthly	2,974	294	4,754	323	3,475
Per Annum	35,688	3,528	-	3,879	41,702



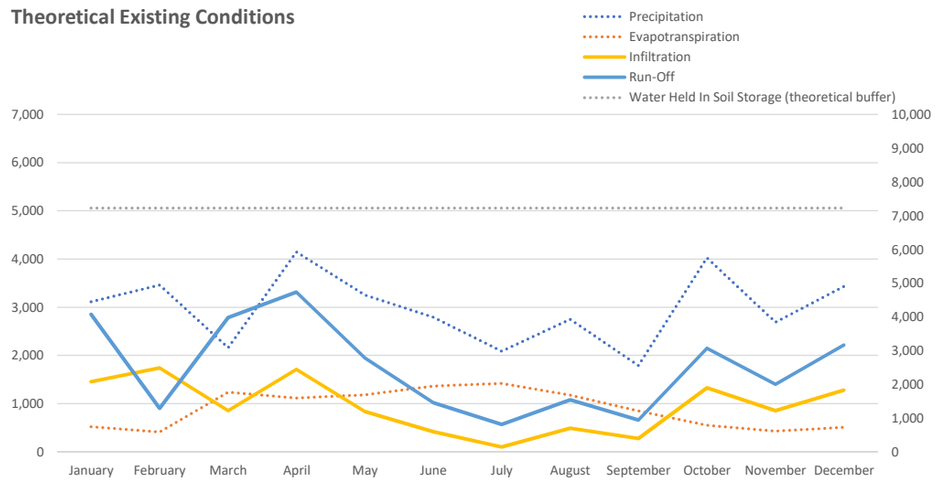
BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Ultimate Conditions	**Project Number:**	219403.7	**Date:**	11-Aug-20
		For:	Barrie Lakeshore Developments	**Reviewed By:**	ZK

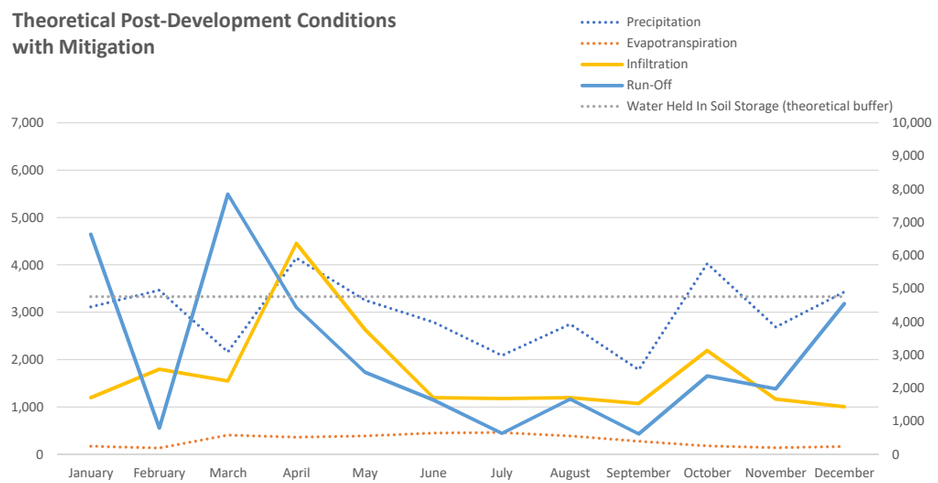
Theoretical Existing Conditions

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	522	7,223	1,453	2,854
February	3,463	410	7,223	1,739	904
March	2,159	1,234	7,223	853	2,783
April	4,145	1,115	7,223	1,711	3,314
May	3,252	1,184	7,223	837	1,948
June	2,792	1,362	7,223	414	1,016
July	2,089	1,417	7,223	103	568
August	2,748	1,178	7,223	491	1,078
September	1,787	850	7,223	276	661
October	4,025	549	7,223	1,329	2,146
November	2,687	428	7,223	856	1,403
December	3,430	508	7,223	1,281	2,218
Minimum (Monthly)	1,787	410	7,223	103	568
Maximum (Monthly)	4,145	1,417	7,223	1,739	3,314
Average Monthly	2,974	897	7,223	945	1,741
Per Annum	35,688	10,758	-	11,344	20,893



Theoretical Post-Development Conditions (with mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	171	4,754	1,196	4,643
February	3,463	135	4,754	1,794	557
March	2,159	405	4,754	1,550	5,491
April	4,145	365	4,754	4,457	3,100
May	3,252	388	4,754	2,636	1,738
June	2,792	447	4,754	1,194	1,151
July	2,089	465	4,754	1,181	444
August	2,748	386	4,754	1,197	1,164
September	1,787	279	4,754	1,076	433
October	4,025	180	4,754	2,190	1,655
November	2,687	140	4,754	1,166	1,380
December	3,430	167	4,754	1,004	3,183
Minimum (Monthly)	1,787	135	4,754	1,004	433
Maximum (Monthly)	4,145	465	4,754	4,457	5,491
Average Monthly	2,974	294	4,754	1,720	2,078
Per Annum	35,688	3,528	-	20,642	24,938



Appendix C

Theoretical Catchment-Based Water Balance Analyses

BEACON ENVIRONMENTAL

THEORETICAL FEATURE-BASED WATER BALANCE ASSESSMENT - DRAFT

Project: 51-57 Bradford Street, Barrie, Ontario
Effect of Mitigations on Phase One Conditions

Project Number: 219403.7
For: Barrie Lakeshore Developments

Date: 11-Aug-20
Reviewed By: ZK

Theoretical Phase One Conditions Before Mitigations

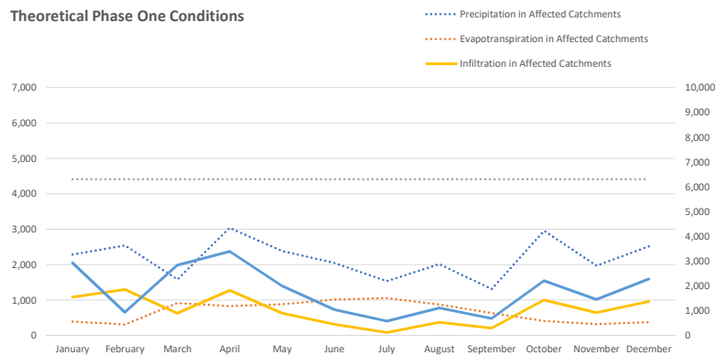
	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	2,283	387	6,304	1,083	2,049
February	2,540	304	6,304	1,295	648
March	1,584	914	6,304	630	1,985
April	3,040	825	6,304	1,273	2,373
May	2,386	877	6,304	625	1,397
June	2,048	1,009	6,304	310	729
July	1,532	1,049	6,304	78	405
August	2,015	873	6,304	368	774
September	1,311	629	6,304	207	474
October	2,952	407	6,304	997	1,548
November	1,971	317	6,304	642	1,012
December	2,516	377	6,304	958	1,597
Minimum (Monthly)	1,311	304	6,304	78	405
Maximum (Monthly)	3,040	1,049	6,304	1,295	2,373
Average Monthly	2,181	664	6,304	706	1,249
Per Annum	26,177	7,967	-	8,467	14,992

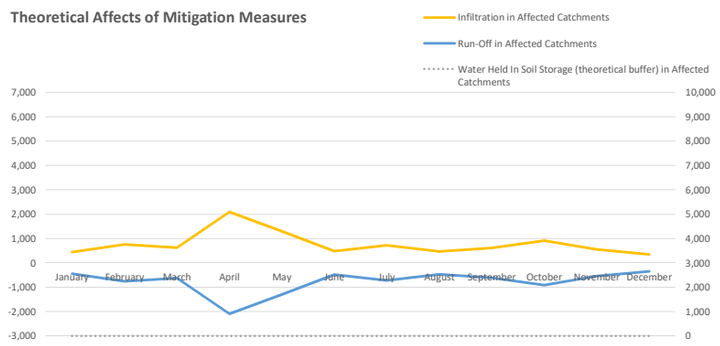
Theoretical Affects of Mitigation Measures

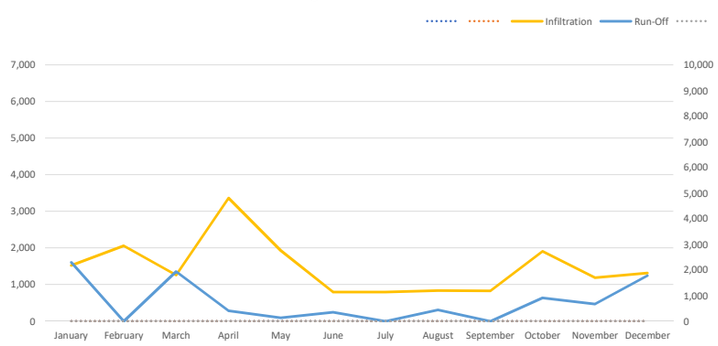
	Precipitation in Affected Catchments (m^3/month)	Evapotranspiration in Affected Catchments (m^3/month)	Water Held In Soil Storage (theoretical buffer) in Affected Catchments (m^3/month)	Infiltration in Affected Catchments (m^3/month)	Run-Off in Affected Catchments (m^3/month)
January	-	-	-	443	-443
February	-	-	-	760	-760
March	-	-	-	626	-626
April	-	-	-	2,091	-2,091
May	-	-	-	1,303	-1,303
June	-	-	-	484	-484
July	-	-	-	721	-721
August	-	-	-	469	-469
September	-	-	-	617	-617
October	-	-	-	909	-909
November	-	-	-	546	-546
December	-	-	-	354	-354
Minimum (Monthly)	-	-	-	354	-2,091
Maximum (Monthly)	-	-	-	2,091	-354
Average Monthly	-	-	-	777	-777
Per Annum	-	-	-	9,322	-9,322

Resulting Phase One Conditions with Mitigations

				Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	1,526	1,607
February	-	-	-	2,055	0
March	-	-	-	1,256	1,359
April	-	-	-	3,364	282
May	-	-	-	1,928	94
June	-	-	-	794	245
July	-	-	-	799	0
August	-	-	-	837	306
September	-	-	-	824	0
October	-	-	-	1,906	639
November	-	-	-	1,188	466
December	-	-	-	1,312	1,244
Minimum (Monthly)	-	-	-	794	0
Maximum (Monthly)	-	-	-	3,364	1,607
Average Monthly	-	-	-	1,482	520
Per Annum	-	-	-	17,789	6,241







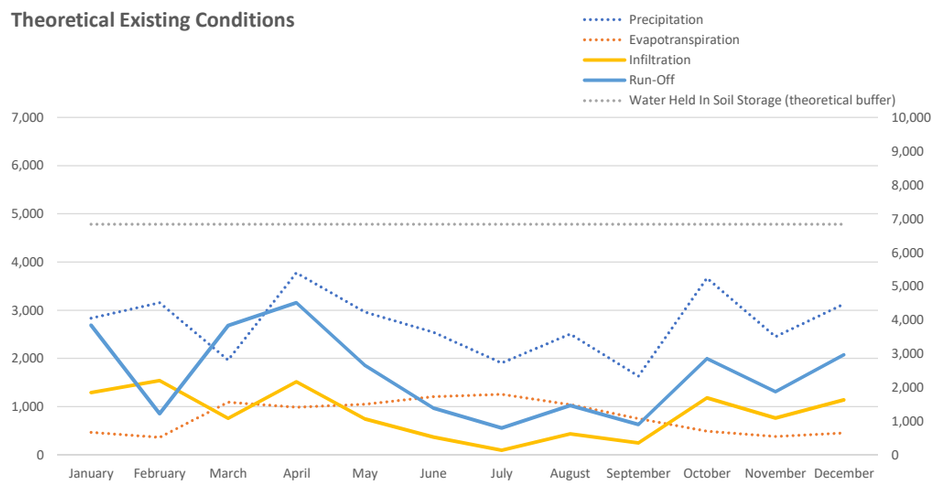
BEACON ENVIRONMENTAL

THEORETICAL FEATURE-BASED WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario	**Project Number:**	219403.7	**Date:**	12-Aug-20
	Phase One Conditions (without mitigations)	**For:**	Barrie Lakeshore Developments	**Reviewed By:**	ZK

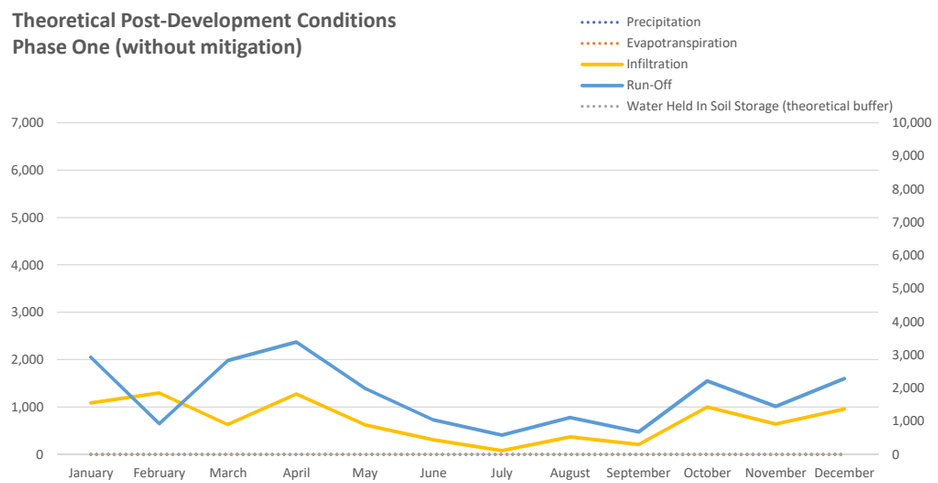
Theoretical Existing Conditions for Feature Catchment

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	2,836	462	6,835	1,290	2,691
February	3,156	363	6,835	1,543	855
March	1,968	1,093	6,835	754	2,685
April	3,778	987	6,835	1,518	3,155
May	2,964	1,048	6,835	744	1,854
June	2,545	1,206	6,835	368	970
July	1,904	1,255	6,835	92	557
August	2,504	1,043	6,835	437	1,024
September	1,629	753	6,835	246	631
October	3,668	487	6,835	1,183	1,999
November	2,449	379	6,835	761	1,309
December	3,126	450	6,835	1,138	2,075
Minimum (Monthly)	1,629	363	6,835	92	557
Maximum (Monthly)	3,778	1,255	6,835	1,543	3,155
Average Monthly	2,711	794	6,835	840	1,650
Per Annum	32,527	9,527	-	10,075	19,805



Theoretical Post-Development Conditions - Phase One (without mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	1,083	2,049
February	-	-	-	1,295	648
March	-	-	-	630	1,985
April	-	-	-	1,273	2,373
May	-	-	-	625	1,397
June	-	-	-	310	729
July	-	-	-	78	405
August	-	-	-	368	774
September	-	-	-	207	474
October	-	-	-	997	1,548
November	-	-	-	642	1,012
December	-	-	-	958	1,597
	-	-	-		
Minimum (Monthly)	-	-	-	78	405
Maximum (Monthly)	-	-	-	1,295	2,373
Average Monthly	-	-	-	706	1,249
Per Annum	-	-	-	8,467	14,992



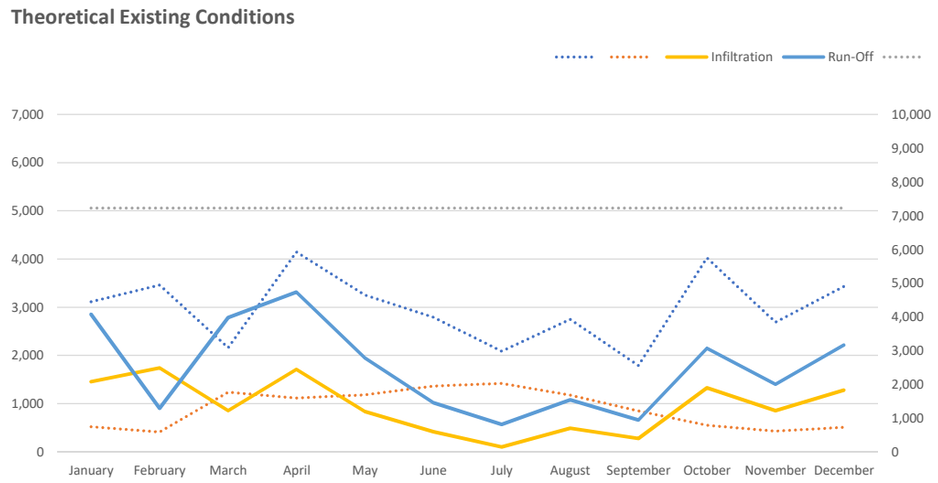
BEACON ENVIRONMENTAL

THEORETICAL FEATURE-BASED WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Phase One Conditions (with mitigations)	**Project Number:** **For:**	219403.7 Barrie Lakeshore Developments	**Date:** **Reviewed By:**	12-Aug-20 ZK

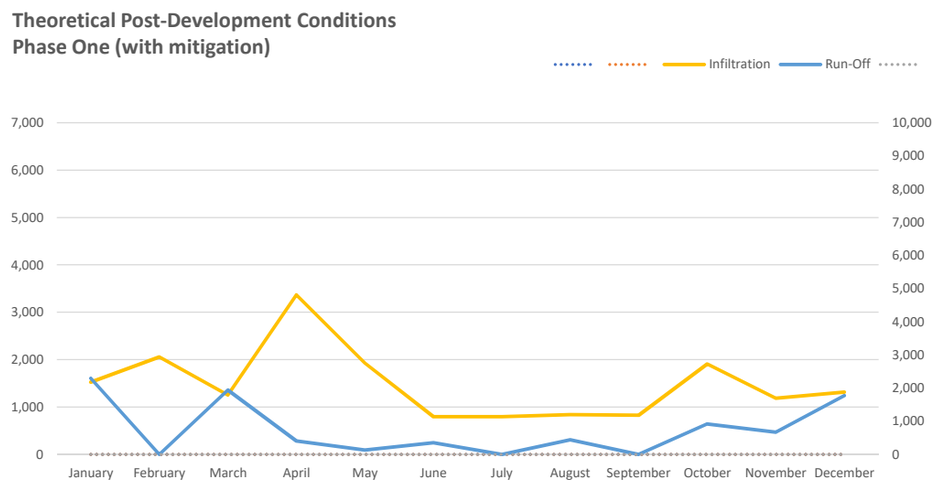
Theoretical Existing Conditions for Catchment

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	3,112	522	7,223	1,453	2,854
February	3,463	410	7,223	1,739	904
March	2,159	1,234	7,223	853	2,783
April	4,145	1,115	7,223	1,711	3,314
May	3,252	1,184	7,223	837	1,948
June	2,792	1,362	7,223	414	1,016
July	2,089	1,417	7,223	103	568
August	2,748	1,178	7,223	491	1,078
September	1,787	850	7,223	276	661
October	4,025	549	7,223	1,329	2,146
November	2,687	428	7,223	856	1,403
December	3,430	508	7,223	1,281	2,218
Minimum (Monthly)	1,787	410	7,223	103	568
Maximum (Monthly)	4,145	1,417	7,223	1,739	3,314
Average Monthly	2,974	897	7,223	945	1,741
Per Annum	35,688	10,758	-	11,344	20,893



Theoretical Post-Development Conditions - Phase One (with mitigation)

				Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	1,526	1,607
February	-	-	-	2,055	0
March	-	-	-	1,256	1,359
April	-	-	-	3,364	282
May	-	-	-	1,928	94
June	-	-	-	794	245
July	-	-	-	799	0
August	-	-	-	837	306
September	-	-	-	824	0
October	-	-	-	1,906	639
November	-	-	-	1,188	466
December	-	-	-	1,312	1,244
	-	-	-		
Minimum (Monthly)	-	-	-	794	0
Maximum (Monthly)	-	-	-	3,364	1,607
Average Monthly	-	-	-	1,482	520
Per Annum	-	-	-	17,789	6,241



BEACON ENVIRONMENTAL

THEORETICAL GLOBAL SITE WATER BALANCE ASSESSMENT - DRAFT

Project: 51-57 Bradford Street, Barrie, Ontario
Effects of Mitigation on Ultimate Conditions

Project Number: 219403.7
For: Barrie Lakeshore Developments

Date: 12-Aug-20
Reviewed By: ZK

Theoretical Ultimate Conditions Before Mitigations

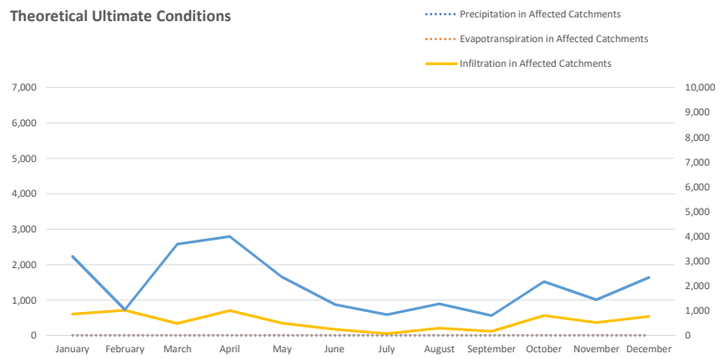
	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	597	2,234
February	-	-	-	713	725
March	-	-	-	338	2,577
April	-	-	-	698	2,794
May	-	-	-	347	1,640
June	-	-	-	174	875
July	-	-	-	43	582
August	-	-	-	206	890
September	-	-	-	116	564
October	-	-	-	558	1,519
November	-	-	-	359	1,003
December	-	-	-	534	1,633
	-	-	-		
Minimum (Monthly)	-	-	-	43	564
Maximum (Monthly)	-	-	-	713	2,794
Average Monthly	-	-	-	390	1,420
Per Annum	-	-	-	4,683	17,037

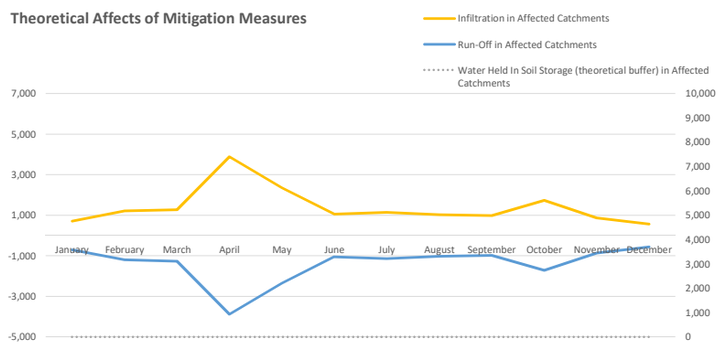
Theoretical Affects of Mitigation Measures

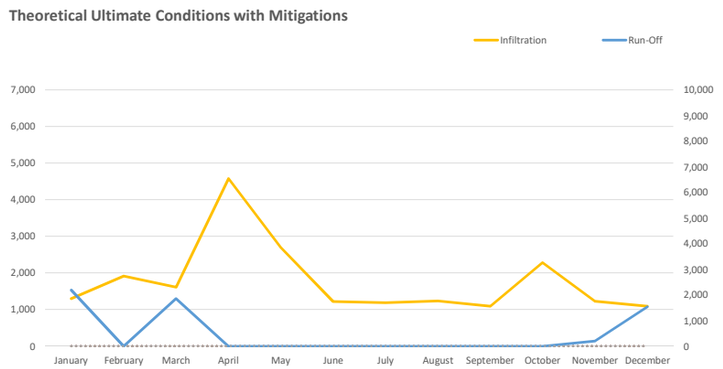
	Precipitation in Affected Catchments (m^3/month)	Evapotranspiration in Affected Catchments (m^3/month)	Water Held In Soil Storage (theoretical buffer) in Affected Catchments (m^3/month)	Infiltration in Affected Catchments (m^3/month)	Run-Off in Affected Catchments (m^3/month)
January	1,705	-	-	702	-702
February	1,897	-	-	1,206	-1,206
March	1,183	-	-	1,275	-1,275
April	2,271	-	-	3,881	-3,881
May	1,782	-	-	2,349	-2,349
June	1,530	-	-	1,050	-1,050
July	1,144	-	-	1,144	-1,144
August	1,505	-	-	1,025	-1,025
September	979	-	-	979	-979
October	2,205	-	-	1,725	-1,725
November	1,472	-	-	867	-867
December	1,879	-	-	561	-561
Minimum (Monthly)	979	-	-	561	-3,881
Maximum (Monthly)	2,271	-	-	3,881	-561
Average Monthly	1,629	-	-	1,397	-1,397
Per Annum	19,551	-	-	16,763	-16,763

Resulting Ultimate Conditions with Mitigations

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	1,300	1,532
February	-	-	-	1,918	0
March	-	-	-	1,613	1,302
April	-	-	-	4,579	0
May	-	-	-	2,695	0
June	-	-	-	1,223	0
July	-	-	-	1,188	0
August	-	-	-	1,232	0
September	-	-	-	1,095	0
October	-	-	-	2,283	0
November	-	-	-	1,226	136
December	-	-	-	1,095	1,072
Minimum (Monthly)	-	-	-	1,095	0
Maximum (Monthly)	-	-	-	4,579	1,532
Average Monthly	-	-	-	1,787	337
Per Annum	-	-	-	21,447	4,043







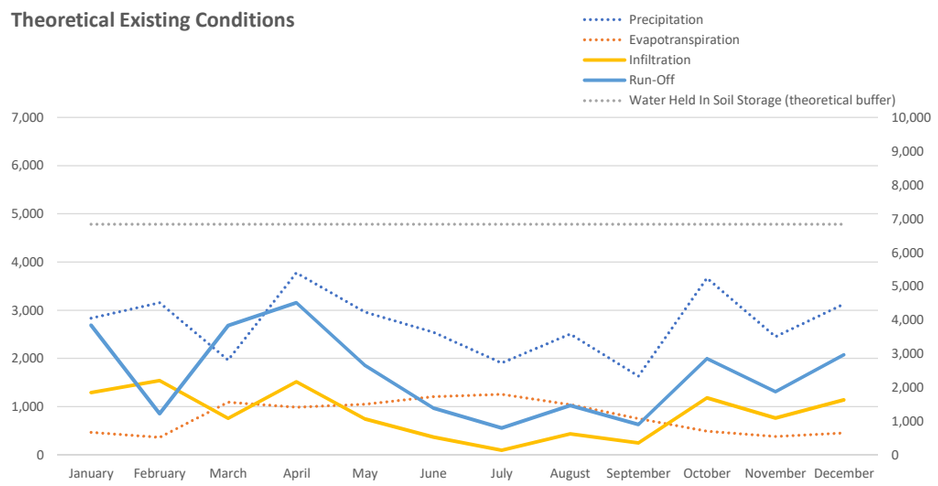
BEACON ENVIRONMENTAL

THEORETICAL FEATURE-BASED WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario	**Project Number:**	219403.7	**Date:**	12-Aug-20
	Ultimate Conditions (without mitigation)	**For:**	Barrie Lakeshore Developments	**Reviewed By:**	ZK

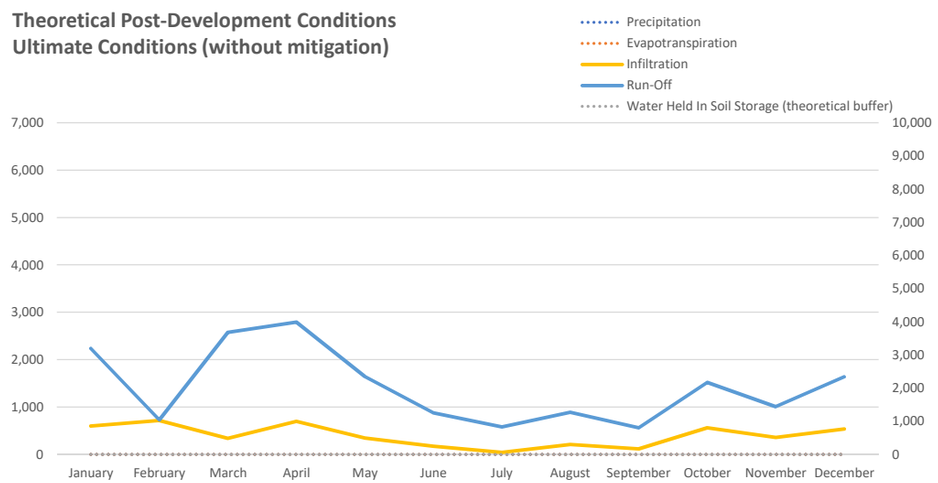
Theoretical Existing Conditions for Feature Catchment

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	2,836	462	6,835	1,290	2,691
February	3,156	363	6,835	1,543	855
March	1,968	1,093	6,835	754	2,685
April	3,778	987	6,835	1,518	3,155
May	2,964	1,048	6,835	744	1,854
June	2,545	1,206	6,835	368	970
July	1,904	1,255	6,835	92	557
August	2,504	1,043	6,835	437	1,024
September	1,629	753	6,835	246	631
October	3,668	487	6,835	1,183	1,999
November	2,449	379	6,835	761	1,309
December	3,126	450	6,835	1,138	2,075
Minimum (Monthly)	1,629	363	6,835	92	557
Maximum (Monthly)	3,778	1,255	6,835	1,543	3,155
Average Monthly	2,711	794	6,835	840	1,650
Per Annum	32,527	9,527	-	10,075	19,805



Theoretical Post-Development Conditions - Ultimate Conditions (without mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	597	2,234
February	-	-	-	713	725
March	-	-	-	338	2,577
April	-	-	-	698	2,794
May	-	-	-	347	1,640
June	-	-	-	174	875
July	-	-	-	43	582
August	-	-	-	206	890
September	-	-	-	116	564
October	-	-	-	558	1,519
November	-	-	-	359	1,003
December	-	-	-	534	1,633
	-	-	-		
Minimum (Monthly)	-	-	-	43	564
Maximum (Monthly)	-	-	-	713	2,794
Average Monthly	-	-	-	390	1,420
Per Annum	-	-	-	4,683	17,037



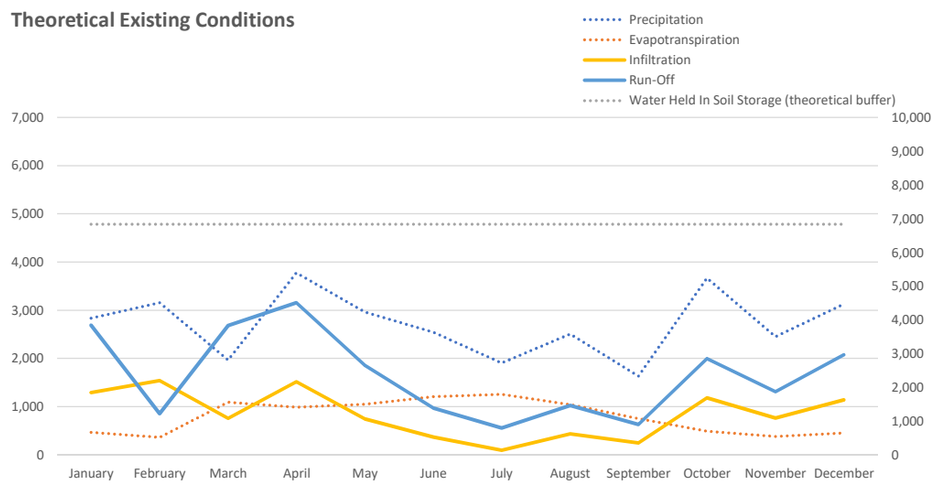
BEACON ENVIRONMENTAL

THEORETICAL FEATURE-BASED WATER BALANCE ASSESSMENT - DRAFT

Project:	51-57 Bradford Street, Barrie, Ontario Ultimate Conditions (with mitigation)	**Project Number:** **For:**	219403.7 Barrie Lakeshore Developments	**Date:** **Reviewed By:**	12-Aug-20 ZK

Theoretical Existing Conditions for Feature Catchment

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	2,836	462	6,835	1,290	2,691
February	3,156	363	6,835	1,543	855
March	1,968	1,093	6,835	754	2,685
April	3,778	987	6,835	1,518	3,155
May	2,964	1,048	6,835	744	1,854
June	2,545	1,206	6,835	368	970
July	1,904	1,255	6,835	92	557
August	2,504	1,043	6,835	437	1,024
September	1,629	753	6,835	246	631
October	3,668	487	6,835	1,183	1,999
November	2,449	379	6,835	761	1,309
December	3,126	450	6,835	1,138	2,075
Minimum (Monthly)	1,629	363	6,835	92	557
Maximum (Monthly)	3,778	1,255	6,835	1,543	3,155
Average Monthly	2,711	794	6,835	840	1,650
Per Annum	32,527	9,527	-	10,075	19,805



Theoretical Post-Development Conditions - Ultimate Conditions (with mitigation)

	Precipitation (m^3/month)	Evapotranspiration (m^3/month)	Water Held In Soil Storage (theoretical buffer) (m^3/month)	Infiltration (m^3/month)	Run-Off (m^3/month)
January	-	-	-	1,300	1,532
February	-	-	-	1,918	0
March	-	-	-	1,613	1,302
April	-	-	-	4,579	0
May	-	-	-	2,695	0
June	-	-	-	1,223	0
July	-	-	-	1,188	0
August	-	-	-	1,232	0
September	-	-	-	1,095	0
October	-	-	-	2,283	0
November	-	-	-	1,226	136
December	-	-	-	1,095	1,072
Minimum (Monthly)	-	-	-	1,095	0
Maximum (Monthly)	-	-	-	4,579	1,532
Average Monthly	-	-	-	1,787	337
Per Annum	-	-	-	21,447	4,043