WESTLANE DEVELOPMENT GROUP LTD.

STORMWATER MANAGEMENT REPORT

Brock Street and Nelkydd Lane, Township of Uxbridge

Project No.: 2018-0302

COLE

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Issues and Revisions Registry

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Final Report	August 2018	Issued for Zoning Approval
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Final Report	March 2021	Issued for Site Plan Application

Statement of Conditions

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1 Introduction

1.1 Background

Cole Engineering Group Ltd. (COLE) was retained by Westlane Development Group Ltd. to prepare a Stormwater Management Report in support of Site Plan Application for a proposed residential development located on the south side of Brock Street East, east of Nelkydd Lane within the Township of Uxbridge (the "Town"), in the Region of Durham (the "Region"). The proposed development is comprised of 60 townhouses. The purpose of this report is to provide site-specific information for the Town and the Region to review with respect to the infrastructure required to support the proposed development regarding storm drainage, water supply, and sanitary discharge. More specifically, the report will present the following:

- Evaluate on a preliminary basis the Stormwater Management (SWM) opportunities and constraints, including:
  - Calculation of allowable and proposed runoff rates for the development;
  - Evaluate suitable methods for attenuation and treatment of stormwater runoff;
  - Develop and propose on-site control measures and examine theoretical performance; and,
  - Demonstrate compliance of the proposed stormwater control measures with the Town, the conservation authorities, Ministry of Environment, Conservation and Parks (MECP and LSRCA's Technical Guidelines.

The following documents were reviewed during the preparation of this report:

- Stormwater Management Pond, Prepared by Vincent and Associates Ltd., Drawing Number S SW-1 and SW-2, dated July 2000;
- Geo Morphix Technical Design Brief: Tributary of Uxbridge Creek and Design Drawing GEO-1, XS-1, and DET-1, dated October 2020;
- Hydrogeological Assessment and Water Balance Study by WSP dated March, 2021;
- Summary of Infiltration Tests- Westlane Development Group Ltd. by WSP dated July 26, 2018; and,
- LSRCA Technical Guidelines for SWM Submissions, dated 2016.
- Road Stormwater Conveyance Report Brock Street and Herrema Boulevard, Township of Uxbridge, Prepared by Cole Engineering, dated September 2019 **[Stormwater Conveyance Report]**

1.2 Site Description

The subject site is located south of Brock Street East and east of Nelkydd Lane in the Town, within the Region. The existing site is approximately 2.61ha in size and is comprised of two (2) different properties, each occupied by a residential dwelling. The legal description is as follows: Part of Lot 30, Concession 7, and Part of Lots 55, 56, 57, 58, 59, 60 and Centre Street, Plan H50061, Township of Uxbridge.

A drainage ditch runs through each of the existing properties, carrying flows from the existing storm water management detention facility to the west, to a 1000 mm ø culvert on Brock Street East.

The site is bound by an open space area to the east, Brock Street East to the north, a wetland to the west, and a residential subdivision to the south. Refer to **Figures FIG 1** and **Figure FIG 2** following the report for location plan and aerial map of the site location.

2 Site Proposal

The proposed development consists of a townhouse and semi-detached development with a 10.0m wide and 15.0m wide headwater drainage feature. The development is approximately 2.33 ha in size. The access to the townhouses will be through a private entrance from Brock Street East. The headwater drainage feature is approximately 0.41ha in size and is comprised of a 10.0m wide headwater drainage feature along the south property line and a 15.0m headwater drainage feature along east property boundary. The proposed headwater drainage feature will carry flows from the existing storm water management detention facility to the west of the property, to a proposed 1200 mm ø culvert on Brock Street East. Refer to Site Plan in **Appendix A** for details.

3 Stormwater Management and Drainage

3.1 Design Criteria

As previously mentioned, the proposed SWM scheme is proposed to meet the MOECP SWMPD Manual (2003), LSRCA's Technical Guidelines and the Town standards. The following design criteria will be applied:

- Quality Control: Level 1 Enhanced Level protection, i.e., annually 80% TSS removal, as defined in the MOECP SWMPD Manual (2003);
- Quantity Control: Post- development peak flows for all storm events up to and including the 100-year event should be controlled to pre-development rates. The Town's IDF data to be used for analysis;
- Water Balance: Post-development to Pre-development water balance;
- Volume Control: Best efforts to achieve 25 mm and 5 mm minimum requirement for sites with restrictions; and,
- Phosphorus Removal: Minimum 80% Post-development phosphorus removal Lake Simcoe Phosphorus Offsetting Policy (LSPOP) and 90% or cash-in-lieu (Uxbridge Urban Area Stormwater Management Plan) for post-development. Best efforts to achieve 80% removal are encouraged and cash in lieu is required for any remaining phosphorus loading to Lake Simcoe. Any phosphorus load above zero phosphorus the developer or proponent shall be require to provide phosphorus offsetting to the LSRCA. Phosphorus offsetting will include the following:
  - Offset Ratio = 2.5:1
  - Offset Value – $35,000/kg/year
  - Offset Calculation = (ratio (2.5) x P deficit in kg x $ 35,000)

3.2 Existing Conditions

Under existing conditions, the subject site (2.61ha) is currently occupied by two (2) residential dwelling, 216 and 226 Brock Street East, in the Town. Major flows from the site are conveyed overland into a naturalized drainage ditch that runs the length of the site. The existing ditch currently conveys uncontrolled discharge from the subject site (A1 Pre) and external drainage area (EXT1) located to the south of the site. In addition, controlled discharge is conveyed within the drainage ditch from the existing Coral Creek Homes stormwater management pond located adjacent to the site (POND). Flow conveyed within the existing drainage ditch is outlet into the roadside ditch located parallel to Brock Street East before being conveyed downstream. The existing drainage area plan is illustrated in **Figure DAP-1** provided in **Appendix B.**

Composite runoff coefficients were calculated for each pre-development drainage area using runoff coefficients values of 0.25 for pervious and 0.95 for impervious land use types. A time of concertation of 13 minutes was calculated using the Uplands Method. Input parameters used to model the ore-development conditions are summarized in **Table 3.1**.

Table 3.1 Pre-Development Drainage Parameters

Catchment ID	Drainage Area (ha)	Runoff Coefficient ('C')	Tc (min)
A1 Pre	2.61	0.3	13
EXT1	0.6	0.45	10

Rational Method calculations were performed using the Town's Intensity-Duration-Frequency (IDF) data in order to determine the peak runoff rates resulting from the pre-development site conditions. Controlled release rates from the existing stormwater pond were provided on Drawing SW-1 by Vincent & Associates (July 2000). The peak runoff rates for Drainage Area A1 Pre provided in **Table 3.2** below will be used as the target release rates from the subject site during each storm event. Detailed pre-development flow calculations are included in **Appendix B**.

Table 3.2 Pre-Development Peak Flows

Catchment ID	Catchment Description	Discharge Location	Peak Flows (L/s)		
			2-Year Storm Event	5-Year Storm Event	100-Year Storm Event
A1 Pre	Proposed Site Development	Discharge into ditch along Brock Street East	140.9	196.4	458.3
EXT 1	Uncontrolled area from Coral Subdivision	Discharge into naturalized drainage feature	57.4	80	187.4
Pond	Controlled Flows from Coral Creek Homes Pond		70	160	860
Total Flow			**268.3**	**436.3**	**1505.7**

3.3 Proposed Storm Drainage System

Based on the proposed grading scheme of the site, the new development will comprise of a total of three (3) internal drainage areas. Drainage Area A1 Post will discharge uncontrolled into the proposed naturalized headwater drainage feature located along the eastern boundary of the site. Drainage Area A2 Post will also discharge at uncontrolled rate onto Brock Street East along the northern boundary of the development. The majority of the subject site, Drainage Area A3 Post, will be discharged at a controlled rate to a storm sewer under Brock Street East that drains to a naturalized channel to the north. The external drainage EXT1 and POND are not accounted for in the post-development storm drainage plans and calculations as peak flow contributions conveyed in the drainage feature to Brock Street East remain unchanged from these drainage areas in pre- and post-development conditions.

Composite runoff coefficients were calculated for each drainage area using a runoff coefficient of 0.95 for impervious areas and 0.25 for pervious areas. Post-development drainage areas and runoff coefficients are illustrated in **Figure DAP-2** found in **Appendix B**. The relevant drainage parameter of the post-development drainage areas are provided in **Table 3.3** on the following page.

Table 3.3 Post-Development Drainage Parameters

Catchment	Drainage Area (ha)	Discharge Location	Runoff Coefficient ('C')	Tc (min)
A1 Post	0.40	Uncontrolled to naturalized drainage feature along south and east boundary	0.25	10
A2 Post	0.11	Uncontrolled to Brock Street	0.50	10
A3 Post	2.10	Controlled discharge to the storm sewer crossing Brock Street	0.69	10
EXT 1	0.60	Uncontrolled to naturalized drainage feature along south boundary of Site	0.45	10
Pond	-	Controlled Flows from Coral Creek Homes Pond drains to naturalized drainage feature along south boundary of Site	-	-

3.4 Stormwater Management Controls

3.4.1 Quantity Controls

The post-development release rates to Brock Street East will be controlled to pre-development conditions as outlined in **Section 3.4.2**. On-site SWM controls will be required to ensure that quantity, quality, water balance, and minimum phosphorous removal criteria are met. Using the Town's intensity-duration-frequency (IDF) data, Modified Rational Method calculations were undertaken to determine the maximum storage and subsequent post-development release rates from the subject site. Results for the 2-, 5- and 100-year storm are provided in **Table 3.4** below. The detailed post-development quantity control calculations are provided in **Appendix B**.

Table 3.4 Post Development Peak Flows

Storm Event	Target Release Rate (L/s)	Uncontrolled Release Rate (L/s)	Controlled Release Rate (L/s)	Total Required Storage Volume (m^3)	Provided Storage Volume (m^3)	Total Site Release Rate (m^3)
2- Year	140.9	33.2	103.4	129	629.7	136.5
5- Year	196.4	46.2	115.5	207		161.7
100-Year	458.3	108.3	171.7	609		278.00

A 75mm ø orifice plate and 250mm ø orifice plate is proposed to be installed on the downstream invert of MH9 in order to control post development peak flows to the target pre-development rates prior to discharge to Brock Street S. Detailed orifice sizing calculations are provided in **Appendix B**. Onsite storage will be provided through the use of oversized box culverts, and pipe storage which will provide a at a minimum a total available storage volume of 604m^3. The above stormwater management strategy has been designed to over-control the captured areas of the site in order to compensate for the uncontrolled runoff from Drainage Area A2 Post to Brock Street South.

The proposed stormwater management system in conjunction with the proposed grading and servicing design retains enough runoff volume on site in order to reduce the post-development peak flows from the entire site to the pre-development peak flow targets. All detailed calculations related to quantity control can be found in **Appendix B**.

3.4.2 Stormwater Quality Control

Stormwater treatment must meet Enhanced (Level 1) Protection as defined by the Ministry of Environment, Conservations and Parks (MOECP) 2003 Stormwater Management Planning and Design (SWMPD) manual. Quality control is to be provided by a combination of rooftop and landscaped areas, in addition to a Jellyfish unit to treat flows from the asphalt areas prior to discharging into the culvert across Brock Street East. Runoff from rooftop and landscaped areas is considered inherently 'clean' as these do not contain oil and grit.

A Jellyfish Unit, JF8-8-2 (or approved equivalent) will be used to provide the required TSS removal in order to meet MOECP standards. Treatment unit sizing parameters are summarized in **Table 3.5** below and sizing results are provided in **Appendix B**.

Table 3.5 Additional Onsite Treatment Units

Drainage Area (ha)	Percent Impervious	Model	Effective TSS Removal
2.1	62.8	JF8-8-2	80%

The combination of clean rooftop and landscaped areas and the proposed Jellyfish Unit will provide an overall TSS removal of 80% for the subject site.

3.4.3 Water Balance

The LSRCA's Stormwater Management Guidelines require post-development infiltration volumes to best match pre-development levels on an annual basis. A water balance analysis has been completed by WSP in March 2021 and it was found the annual pre-development infiltration volume is 6,994m^3. The total on-site infiltration is reduced by approximately 20% or 1,385 m^3/year when compared to the pre-development scenario. Refer to the WSP report for detailed information found within **Appendix A**. Due to high groundwater levels the options for locations of infiltration are limited. In order to meet this requirement, a 7.5 m wide infiltration trench is proposed just to the south of Street B along the full length of the rear yards which will provide an annual infiltrated volume of 2200m^3/year. An infiltration test was completed by WSP in the area of the proposed trench resulting in a rate of 34.5mm/hr that has been used in designing the trench. This has a draw down of 8.7 hours (0.3 m/ 34.5 mm/hr = 8.7 hrs). The proposed infiltration trench will strictly receive runoff from inherently clean roof and landscaped areas therefore only clean water will be infiltrated. Groundwater elevations in this area are approximately at existing grade level. Thus, the site was filled and the trench was made very shallow, 0.3m of clear stone beneath the underdrain.

The online wet meadows have conservatively not been accounted for in the water balance but do provide some surface storage that can be infiltrated. Water balance assessment calculations are provided in **Appendix B**. In addition to the above top soil on all landscape areas will be increased as a best efforts approach.

Cash in lieu will be explored as a method to compensate for the infiltration deficit.

3.4.4 Volume Control

Best efforts have been pursued to implement volume control on site. Due to high groundwater levels LID locations are limited to the already proposed locations. As per LSRCA requirements for sites with restrictions, 5 mm retention is required per impervious area on site. The volume required for volume control is 68 m^3. The infiltration trench volume of 72 m^3. Therefore, minimum volume control requirements have been met. In addition to the above topsoil on all landscape areas will be increased to as a best efforts approach.

3.4.5 Phosphorous Loading

As required in the 2009 Lake Simcoe Protection Plan (LSPP) implemented by the LSRCA, new developments within the Lake Simcoe Watershed must adopt Best Management Practices (BMPs) and LID techniques in order to achieve sustainable development practices that will provide 80% phosphorus removal. The Uxbridge Urban Area Stormwater Management Plan requires 90% Phosphorous removal from the development or cash-in-lieu for any deficiency.

A phosphorous loading analysis was completed for the subject site using the MOECP Lake Simcoe Phosphorous Loading Development Tool. Pre-development conditions were simulated by applying a land use type of ‘Hay-Pasture’ for the large undeveloped field which makes up the majority of the site and ‘Low-intensity Development’ for the single residential lot located in the northeast corner.

The post-development conditions were simulated by applying a land use type of ‘High Intensity Development’ for the residential component of the site and ‘Open Water’ for the proposed headwater drainage feature located along the west boundary of the site. The post-development annual phosphorus loading was estimated to be 3.02kg/year. In applying the proposed LIDs for the subject site, which includes an enhanced headwater drainage feature and a treatment train approached including infiltration galleries, underground storage and a Jellyfish treatment unit, the mitigated annual phosphorous loading was significantly reduced by 66% to 1.03 kg/year in post-development conditions.

Maximum efforts have been made and due to stormwater management constraints on-site, a 100% removal cannot be achieved. As such, the owner will provide cash-in-lieu for the phosphorous removal deficiency.

3.4.6 Low Impact Development

In order to meet requirements for LSCRA, best management practices have been proposed. These design considerations include infiltration trenches and enhanced grassed swales.

3.4.7 100 Year Emergency Overland Flow Route

Critical Overland Flow route locations are shown on **Figure DAP3**. The locations have been evaluated to make sure that 100 year unattenuated overland flows can be conveyed through them. Calculations are provided in **Appendix B**.

3.4.8 100 Year Capture Analysis

A 100 year capture analysis was performed to ensure that 100 year flows are captured within the controlled drainage area A1 Post. Calculations are provided in **Appendix B** and **Figure DAP3** shows the 100 year capture areas.

4 Site Grading

4.1 Existing Grades

The existing site topography generally slopes towards Brook Street East.

The eastern and western drainage patterns slope towards a water drainage feature running though the centre of the site. The drainage feature runs from the south to north, conveying flows from the existing stormwater management facility to the west, towards an existing 1000 mm diameter culvert on Brock Street East. Flows are then conveyed to the existing stormwater management facility to the north.

4.2 Proposed Grades

The proposed grading of the site will match existing grades where possible and will provide an emergency overland flow route to Brook Street East located at the north end of the site, similar to the pre-development conditions. The site has been graded in accordance with Town Standards and adheres to road grades of 0.5% -5.0% and lot grades of 2.0% to 5.0% and has been designed such that as much drainage as possible from the townhouse blocks is controlled and conveyed to the proposed 1200 mm ø pipe on Brook Street East. Grading along the south limit of the site, will be governed by the proposed 10.0m wide headwater drainage feature which will match the grades of the existing residential development. The west property boundary will require grading to integrate the existing berm and match grades of the proposed development. To the west, proposed grades will match grades from the proposed 15.0 m wide headwater drainage feature designed by Geo Morphix. The headwater drainage feature will match existing grades along the east property boundary. To the extent practical, overland flows for events up to and including the 100-year storm design event, will be captured within the site. Overland flows for events exceeding the 100-year design event, will be directed to Brock Street East via the proposed laneways.

5 Design Details of Erosion and Sediment Control Measures

The erosion and sediment control measures will be implemented using several BMP measures. The erosion and sediment control measures are outlined below.

5.1 Sediment Control Fence/Construction Fence

The temporary sediment control silt fence will be erected around the entire proposed development perimeter as part of the overall ESC Plan as per **Drawing EC-02 and EC-03**.

5.2 Construction Mud Mat

Temporary construction access will be permitted only through Brock Street. Refer to **Drawing EC-02 and EC-03** for the location of the access route and Mud Mat.

5.3 Inlet Protection Devices

Nearby existing catch basins located along Brock Street will be fitted with inlet protection devices to reduce sediment load entering the existing storm system. Refer to **Drawing EC-02 and EC-03** for the location of the Inlet Protection Devices.

5.4 Rock Check Dams, Sediment Traps and Swales

Rock Check dams will be spaced every 0.5 m grade change along interceptor swales. Sediment traps will collect drainage less than 2 ha prior to out letting.

6 Record Keeping and Maintenance Procedures

Maintenance of record keeping for all the erosion and sediment control requirements will be conducted by COLE's field representative throughout the duration of the work program.

6.1 General Inspection and Maintenance

The minimum general inspection frequency during all construction stages is to be as follows:

- On a weekly basis during active construction;
- Before and after significant* rainfall events;
- After significant snowmelt events;
- After any extreme weather (e.g. wind storms) which could result in damage to ESC measures;
- Daily during extended rain or snowmelt periods;
- Monthly during inactive periods (> 30 days);
- During or immediately following any spill event;
- Before construction is shut down for the winter to ensure the site is ready for freezing conditions and thaws; and,
- At the end of construction *****A rainfall event should be considered significant when either of the following criteria are met:
  - An event during which ≥ 15 mm have been received within 24 hours; or
  - An event with an intensity of ≥ 5mm/hr and during which at least 10 mm have been received.

All damaged erosion and sediment control measures should be repaired and/or replaced within 48 hours of the inspection or immediately as required.

6.2 Silt Fence Inspection and Maintenance

- Inspect the entire length of sediment fence weekly and before and after significant rainfall (see definition in **Section 10.1.2**) or snowmelt events, and keep a record of the inspection;
- Inspect the fence to look for any signs of damage to the geotextile or compromising of the structural integrity of the fence. Ensure the fence has been properly installed as defined under "Design and Installation" section above;
- Remove and properly dispose of sediment before it reaches approximately 30% of the height of the fence, or sooner if not functioning as intended;
- A supply of sediment control fence materials should be kept on-site to allow for quick repairs or the installation of additional fencing as needed;
- Where fence continues to fail on an ongoing basis, consider reinforcing problem areas or replacing with an alternative sediment retention device. If failure is a result of concentrated flows being directed to the fence, consider re-designing surface water flow paths to reduce volumes being directed to the problem area; and,

- Any repair or maintenance needs identified should be repaired within 48 hours or sooner.

6.3 Inlet Protection Devices Inspection and Maintenance

- Inspect weekly and before and after significant rainfall or snowmelt events, and keep a record of the inspection;
- Look for any signs that runoff is undermining or otherwise by passing the sediment control measure and repair as needed;
- Remove any sediment accumulation that has reached approximately 30% of the height of the sediment retention barrier and ensure proper disposal;
- For below grade installations, like filter fabric sacks/bags, make sure that it is cleaned out at the frequency specified by the manufacturer/supplier and at a minimum when it reaches 50% accumulation. If there are signs of clogging causing impeded flow through and flooding, clean out immediately;
- Clean and/or replace the device if there is any evidence of clogging significantly impeding flow through and leading to flooding;
- Look for any signs of structural damage to the device. If it is being damaged due to vehicle traffic, consider substituting with a below grade device;
- Any repair or maintenance needs identified should be repaired within 48 hours or sooner; and,
- Ensure the inlet grate is not being unintentionally blocked by the protection device.

6.4 Mud Matt Inspection and Maintenance

- Inspect vehicle tracking controls weekly, and before and after significant rainfall or snowmelt events, and keep a record of the inspection;
- Inspect mud mats for excessive sediment accumulation. For rock pads look for signs that the voids have been filled with sediment and replace granular material as needed;
- Clean up any sediment tracked onto public roads at the end of each day;
- Ensure the installation of storm drain inlet protection for inlets in roads that will be subject to street sweeping, since this can sometimes cause additional sediment to be swept into storm drain inlets; and,
- Any repair or maintenance needs identified should be repaired within 48 hours or sooner.

An erosion and sediment control monitoring checklist has been included in **Appendix B**.

7 Construction Management

Drawing EC-02 and EC-03 identifies the access location for construction vehicles, parking and haulage routes in order to ensure minimal disturbance to the existing area.

7.1 Construction Vehicle Access

During the excavation and shoring works, the civil contractor's construction vehicles are permitted to enter and leave the development area using only the access to the proposed development via the Mud Matt's.

7.2 Street Cleaning

Municipal roads adjacent to the site and those roads that form the haulage route to and from the site shall be left in a broom swept condition at the end of each working day.

7.3 Health and Safety

The contractor will provide a comprehensive health and safety plan prior to construction. Everyone working on site shall abide by those health and safety regulations and applicable OHSA regulations.

8 Construction and Long Term Dewatering

Construction and long term dewatering is noted in the Hydogeological Report. Excerpts are included in **Appendix A**.

9 Conclusions and Recommendations

Based on our investigation, we conclude and recommend the following:

Stormwater Management

Based on the above analysis, storage provided within the proposed oversized box culverts and manholes in conjunction with a dual 75mm and 250 mm ø orifice plate is sufficient in order to control post-development peak flows to the corresponding pre-development target flows. Quality control will be provided via inherently ‘clean’ rooftop and landscaped areas in combination with a Jellyfish treatment unit (or approved equivalent) to achieve the minimum TSS removal of 80%. Water balance mitigation is to be achieved through the proposed infiltration gallery which will received clean runoff from the surrounding roof and landscaped areas in addition to small soak away pits located within the meanders of the naturalize headwater drainage feature. As best efforts extra topsoil will also be provided for all landscape areas. The required phosphorus removal requirements, as outlined in the LSRCA guidelines, will be achieved through the use of an enhanced headwater drainage feature and treatment train approach including underground storage, infiltration and treatment unit. Results of the analysis provided in this report indicate that the proposed measures will effectively meet the SWM criteria set forth by the City, LSRCA and MOECP.

Site Grading

The proposed grading of the site will match the existing grades where possible and maintain the existing overland flow routes. To the extent practical, overland flows for events up to and including the 100-year storm design event, will be captured within the site. Overland flows for events exceeding the 100-year design event, will be directed to Brook Street East via the proposed laneways.

APPENDIX A
Background Information

Appendix A1	**Conveyance Report Excerpts**
Appendix A2	**Conveyance Report Figure Excerpts**
Appendix A3	**WSP Hydrogeological Report Excerpts**
Appendix A4	**Geomorphix Report and Drawings**

APPENDIX A1
Conveyance Report Excerpts

EVENDALE DEVELOPMENTS LTD.

ROAD STORMWATER CONVEYANCE REPORT

Brock Street and Herrema Boulevard, Township of Uxbridge

Project No.: 2017-0569

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Final Report	January 2019	1st submission
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Statement of Conditions

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1.1 Background

Cole Engineering Group Ltd. (COLE) was retained by Evendale Developments Ltd. to prepare a Road Conveyance Report in support of the Plan of Subdivision Application: S-U-2017-03, in the Township of Uxbridge (the "Town"), within the Regional Municipality of Durham (the "Region"). The purpose of this report is to provide information for the Town to review with respect to stormsewer and overland flow conveyance. More specifically, the report will present the evaluation on the following:

- Overland Flow conveyance through Block 8
- Stormsewer and Overland Flow conveyance for Herrema Boulevard, and;
- Stormsewer conveyance along Brock Street.

The following documents were reviewed to complete this analysis and relevant excerpts are included in **Appendix A**:

- Stormwater Management Report for Barton Farm Plan of Subdivision 18T-87061, Prepared by G.M Sernas Associated Ltd. (December 1992) **(Barton Pond SWM Report)**;
- Drainage Area Plan Barton Farm Subdivision Figure 1, by G.M. Sernas & Associates Ltd. (1992) **(Barton Farm Subdivision Drainage Plan)**;
- Stormwater Management Report for Goldmanco Uxbridge Part of Lots 102 to 105 (Both Inclusive), Part of Park Street , Registered Plan H50061 and Part of Lot 31 Concession 7;
- Township of Uxbridge, Prepared by G.M Sernas (July 2008) **(Goldmanco SWM Report)**;
- Goldmanco Subdivision, Drawing OTT-1 dated August 2007 prepared by G.M Sernas Associates Ltd **(Goldmanco Drainage Plan)**;
- Coral Creek Homes, Storm Drainage Plan Drawing ST-1, Prepared by Vincent & Associates. (June 12 2001) **(Coral Creek Drainage Plan)**;
- Evendale Developments Ltd, Functional Servicing and Stormwater Management Report for Brock Street East Development, Township of Uxbridge, Prepared by Cole Engineering Ltd., Dated May 2018 **(Evendale FSR)**;
- Westlane Development Ltd, Functional Servicing and Stormwater Management Report for Brock Street and Nelkydd Lane, Township of Uxbridge, Prepared by Cole Engineering Ltd., Dated March 2019 **(Westlane FSR)**; and,
- Plan and Profile drawings provided by the Region.

1.2 Subdivision Description and General Assumptions

The study area as part of this analysis is shown on **Drawing STM-01** and **STM-02**. The Barton Pond SWM report set the overall drainage intent for stormwater draining towards the Barton SWM Pond located north along Herrema Boulevard at Barton Trail. The drainage plan from the Barton Pond SWM report has been included in **Appendix A**. Several developments have taken place or are planning to be developed since the Barton Pond SWM report and information from them has been compiled to perform the stormwater conveyance analysis. The proposed urbanization along Brock Street was included to set drainage areas in conjunction with assumptions from various reports listed below:

- The Evendale FSR includes information on future developments located north of Brock Street, refer to Evendale FSR drainage plan excerpts in **Appendix A**. This report was used to assume the original target controlled flows to the stormsewer network along Herrema Boulevard. It was also used to aid in assuming uncontrolled flows to Brock Street;
- The Westlane FSR includes information on future developments located south of Brock Street, refer to Westlane drainage plan excerpts in **Appendix A**. This report was used to assume controlled flows to MH20 and then to a naturalized channel;
- The Coral Creek Drainage Plan includes areas to the west of the Westlane developments and a portion of the road from the drainage plan was used in the stormwater conveyance analysis, refer to Coral Creek Drainage Plan excerpts in **Appendix A**; and,
- The Goldmanco Drainage Plan includes areas to the west of Evendale FSR development that were assumed to drain to Herrema Boulevard, refer to Goldmanco Drainage Plan excerpts in **Appendix A**. It should be noted that it cannot be verified where or how information for these drainage areas was determined, therefore it is uncertain on whether they are correct.

2 Stormwater Conveyance Design Criteria

- The storm sewers within the subdivision should be designed such that they can convey the minor flow, i.e., runoff based on the 5-year design storm.
- The overland Flow Route along Herrema Boulevard should be analyzed for conveyance of major flow, i.e., 100-year runoff minus 5-year runoff based design storms.

3 Brock Street Urbanization Changes to Stormwater Conditions

The urbanization of Brock Street ditches to storm sewers and removal of Donald Ln re-alignment of Herema Boulevard, results in an increase in paved surfaces and changes to drainage areas. Prior to discussion about stormsewer and overland flow capacity in this report, Quantity Control, Quality Control and Erosion Control have been analyzed for impacts and required mitigation measures. This analysis was done for both discharge points – flows to Barton Pond and flows towards the Natural Channel. It should be noted that both these discharge points ultimately drain to the same creek.

3.1 Quantity Control to Barton Pond

Figure 1 and **2** illustrates the existing and proposed minor and major storm drainage system not including the Evendale and Westlane development areas. A comparison of the existing and proposed 5 year and 100 year flows draining to the Pond are summarized in **Table 3-1** below using Visual OTTHYMO modeling**.** The 5.41 ha area A1 Pre minor and major is the drainage to Barton Pond under existing conditions, which includes some areas north and south of Brock Street and a portion of Brock Street as shown on **Figure 1**. The areas north of Brock Street within A1pre do not include Block 6, 7 and 8. Similarly A1 Post minor and A1 Post major are drainage areas towards the pond from some areas north and south of Brock Street and a portion of Brock Street and do not include Block 6, 7 and 8. The reason Block 6, 7 and 8 are not included on **Figures 1 and 2** is because this analysis shown in **Table 3-1** is to determine the change in flows as a result of the urbanization of Brock Street.

Table 3-1 Comparison of Increased Flows to Barton Pond from Brock Street Urbanization

Catchment ID/Description	Storm Event (yr)	Catchment Area (ha)	V05 Flow (L/s)	Increase in Flow (L/s)
A1 Pre Existing Minor System to Pond	5	5.41	680	-
A1 Pre Existing Major System to Pond	100	5.41	1,749	-
A1 Post Proposed Minor System to Pond	5	5.80	727	47
A1 Post Proposed Major System to Pond	100	5.43	1,789	40

Based on **Table 3-1** the urbanization of Brock Street will increase flows to Barton Pond. As a result, the Site Plan components of Evendale development (Blocks 6, 7 and 8, which are areas A5 Post and A15 post on **DWG STM-01**) will have their targets reduced. To determine the max pipe flow and overland flow from the Evendale Site Plans, the uncontrolled areas from Evendale development had to be approximated first. The approximate uncontrolled drainage area for Evandale developments to Barton Pond B1 Post is shown on **Figure 3** and a summary of the flows are shown on **Table 3-2** below.

Table 3-2 Estimated Uncontrolled Flow from Evendale Developments to Barton Farm

Catchment ID/Description	Storm Event (yr)	Catchment Area (ha)	V05 Flow (L/s)
B1 Post	5	0.92	119
B1 Post	100	0.92	306

The new Evendale development target flows to the storm sewer and overland are shown below in **Table 3-3** below.

Table 3-3 Target Flows and Estimated Design Flows from Evendale Developments

Storm Event	Original Total Target Flow (L/s)	Min Flow Decrease Required to Offset Increase in Flow (L/s)	New Total Target Flow Overl and and Pipe (L/s)	Uncontrolled Flow 119 L/s in Pipe the rest Overland (L/s)	New Control Target Flow Overland from Evendale Developments (L/s)	New Control Target Flow to Storm Sewer from Evendale Developments A5 + A15 (L/s)*	Total Estimated Design Flow (L/s)	Total Estimat ed Design Flow - Target Flow (L/s)
5	171	47	124	119	0	11	130	6
100	451	40	411	306	94	11	411	0

*Areas A5 and A15 are shown on Drawing STM-01

Based on **Table 3-3,** the 5 year total estimated design flow is higher than the target flow. This is unavoidable due to grading and servicing constraints that limit how much flow can be controlled on the

Evendale site plans. Low flow control structures have been assumed to potentially be placed within the Evendale Site plans that connect to the storm sewer under Herema Blvd. Low flow control structures typically can only control flows up to a minimum of 3.5 L/s. As there are 3 outlets to Herema from the Evendale Site Plan areas it has been assumed that the target flow for them can only be as low as 10.5 L/s. During detailed design of the Evendale development Site Plans, an ICD is recommended to be installed on one of the catch basins on Herema BLVD to lower the flow to the stormsewer by 6 L/s during the 5 year storm event. This is recommended to not exceed the assumed target flows to the storm sewer.

Table 3-4 below shows the 5 year % increase in flow compared to the original design of drainage area to Barton Pond. The % increase in flow to the pond is less than 0.5% and is anticipated to have a negligible impact on the downstream environment. It should also be noted that it is unlikely that the 6 L/s increase in flow will coincide with the same peak time as the peak flow towards the pond. Furthermore, **Section 3.2** below shows that flow to the natural channel are being reduced, which creates an overall net decrease in flow to the downstream creek. Refer to quantity control calculations in **Appendix B** and excerpts of the Original Pond Design in **Appendix A**. It should be noted that if uncontrolled flow areas from Evendale development are changed then the targets would have to change accordingly such that post to pre flows are maintained.

Table 3-4 Estimated Design Flows Impact on Barton Pond Flows

Storm Event	Total Drainage to Pond from Sernas Report	%Increase in Flow Towards the Pond Compared to Total Design Drainage to Pond from Sernas Report (Total Design Flow - Target Flow)/Total Drainage to Pond	Barton Farm Target Flows from Sernas Report (L/s)	Total Outflow from Pond from Sernas Report (L/s)	Outflow from Pond - Target Flow for Pond (L/s)	Max Outflow from Pond - Target Flow for Pond after Urbanization of Brock Street and Evendale Developments (L/s)
5	5,930	0.10%	2,000	980	-1,020	-1,014
100	16,200	0.00%	5,570	4,800	-770	-770

3.2 Quantity Control to the Natural Channel

Figure 1 and **2** illustrates the existing and proposed minor and major storm drainage system not including the Evendale and Westlane Site Plan development areas. A comparison of the existing and proposed 5 year and 100 year flows draining to the Pond are summarized in **Table 3-5** below using the rational method**.** Based on **Table 3-5** the flows towards the natural channel have decreased. Refer to quantity control calculations in **Appendix B.**

Table 3-5 Comparison of Flows to the Natural Channel from Brock Street Urbanization

Catchment ID/Description	Storm Event (yr)	Catchment Area (ha)	Rainfall Intensity (mm/hr)	Rational Method Flow (L/s)	Increase in Flow (L/s)

A2 Pre Existing Minor System to Channel	5	1.09	107.0	170	0
A2 Pre Existing Major System to Channel	100	1.09	200.6	398	0
A2 Post Proposed Minor System to Channel	5	0.7	107.0	116	-54
A2 Post Proposed Major System to Channel	100	1.07	200.6	395	-3

3.3 Quality and Erosion Control

As the developments and future developments indicated in the Evendale FSR utilize 80% TSS removal the TSS loading from these areas will mimic grass areas which is lower than the 35% imperviousness that was allotted for these areas draining to the Barton SWM Pond (refer to Table 2.1 of the Barton Pond SWM Report). This will offset the small ditch area on Brock Street draining towards the Barton Pond that is being filled and paved. Also, the ditch areas are being filled with sidewalks which are generally clean as they are for pedestrian traffic. As the total flow towards the pond will remain generally the same, it is anticipated that there will not be any significant impacts to erosion control.

Due to the Brock Street Urbanization the passive ditch treatment of stormwater for the road has been reduced to the natural channel. As discussed with the LSRCA and the Region, an OGS unit that is ETV certified has been agreed to be used to satisfy quality control as a result of the loss of the ditches. A Stormceptor OGS unit has been proposed. Refer to the **Servicing Drawing** for the location of the Stormceptor OGS unit and model type. Refer to ETV Certification and OGS to sizing calculations provided in **Appendix B**. As the total flow towards the channel are less than existing conditions as shown in **Section 3.2**, it is anticipated that there will not be any significant impacts to erosion control towards the natural channel.

4 Stormsewer Conveyance

To evaluate the storm sewer conveyance system performance, controlled and uncontrolled flows to various sections of the storm sewer network were analyzed.

The following drainage areas were analyzed as 5-year controlled flows draining into the storm sewer network with the following assumptions:

- A5 Post and A15 Post with flows of 3.5 L/s and 7 L/s respectively as per the Evendale FSR were modified to a total pipe target flow from both areas of 11 L/s. **Section 3.1** and calculations in **Appendix B** provide further information on how that target flow was calculated;
- A12 Post with 1505L/s 100-year flow as per the Westlane FSR;
- Due to limited information, A13 Post shown on **Drawing STM-01** was assumed to be controlled such that the effective runoff coefficient would be 0.37. The runoff coefficient of 0.75 from the ST-1 drawing for Coral Creek drainage plan was not used because it is unknown as to how much flow that area was required to control to and flows are required to be estimated for the storm sewer design sheet analysis. The runoff coefficient of 0.37 was determined by reviewing the Barton Pond SWM Report **Catchment Area 105**. According to the report approximately 4.2 ha from **Catchment Area 105** at an imperviousness of 35% (converted to a runoff coefficient of 0.48) was allowed to drain towards the pond from areas that include Brock Street and some areas to

the south of it (excerpts from Barton Pond SWM Report are included in **Appendix A**). Therefore a CxA value of 2.02 was allowed. To maintain this same total CxA value A13 Post C value must be 0.37 (refer to calculations provided in **Appendix B and Existing Drainage Plan Figure 1 in Appendix B**). The drainage area delineation for A13 post was estimated based upon plan and profiles provided by the Region, Barton Farm Subdivision Drainage Plan, Goldmanco Drainage Plan and Coral Creek Drainage Plan included in **Appendix A**. Please note that it is anticipated that this was a conservative approach applied under the conditions that limited information was available for review;

- The drainage area from Maunder Court lots near the outlet of the stormsewer to Herrema Boulevard, was assumed as per discussions with the Town (refer to correspondence in **Appendix A)**; and,
- 100 year flows from Area A18 will drain towards catchment area A5 and be captured and A5 and A18 together will be controlled to the target release rate for A5.

A 5-year storm sewer design sheet is provided on **Drawing STM-03**, which demonstrates that the sewers along Herrema Boulevard as well as Brock Street are of sufficient size to convey the minor system (5-year storm event). The design sheet has assumed that all drainage from the minor system is captured within the stormsewer network. It should be noted that the 5-year stormsewer design sheet and **Figures 1-4** and **Drawing STM-01**, **Drawing STM-02** and **Drawing STM-03** should be read in conjunction with this SWM Report as it provides context for several assumptions. It should be noted that due to limited information, the storm sewer design sheets only include drainage that extends as far as A19 Post to the headwall that drains to the natural channel going north of Brock Street.

Regarding the future developments along Herrema Boulevard, north of Brock Street, the target release rates for stormwater management controls, both minor flows discharged into the existing storm sewer system and the overland flows conveyed via the road network, shall be governed by this Conveyance Report and detailed in a Stormwater Management Report to support those submissions.

5 100 Year HGL

The 100 year HGL was calculated using the following assumptions:

- A5 Post 100 year controlled flows are 3.5 L/s as modified to account for Brock Street Urbanization (see **Section 3.1**);
- A15 Post 100 year controlled flows is 7 L/s modified to account for Brock Street Urbanization (see **Section 3.1**);
- A12 Post with 100-year flow of 1505L/s as per the Westlane FSR;
- All other flows captured in the storm sewer system are assumed to be up to the 10 year event; and,
- The downstream starting HGL at Maunder Court is 266.10 as per Drawing P-101.

A 100 Year HGL design sheet is included in **Appendix B**. The 100 Year HGL is shown on the Profile Drawings. As Brock Street was originally a ditch conveyance system it has been assumed that houses abutting Brock Street were using sump pumps to grade. The HGL is not contained on DICB2, however this is an interim DICB T/G condition as that area will be developed in the future and filled. Development along Low Boulevard will be sump pumped to grade. As can be seen on the Plan and Profile Drawings, overall the HGL levels are contained within the storm sewer system.

6 Critical Overland Flow Conveyance Routes

Several critical overland flow conveyance areas were assessed for this report. **Figure 4** illustrates drainage areas and critical overland flow sections.

Section A-A and Section B-B shown on **Figure 4** illustrates overland flow from drainage area C1 towards an easement located within Block 8. The overland flow route easement will be maintained by Block 8. Calculations shown in **Appendix B** show that these sections have sufficient capacity to convey flows from drainage areas C1 and C2. In the interim condition Block 8 will have a large swale and open area that will sheet flow towards the north east and spill towards Low Blvd. Refer to **Drawing GR-01, GR-02** for grading information. When development occurs for Block 8 this overland flow route will need to be reanalyzed and maintained by Block 8 to still convey the same drainage.

Section C-C shown on **Figure 4** illustrates overland flow towards Low Blvd from drainage areas C2 and C3. Calculations shown in **Appendix B** show that these sections have sufficient capacity to convey flows from drainage areas C2 and C3.

The roadway at the end of Herrema Boulevard **Section D-D** shown on **Figure 4** in **Appendix B**, was analyzed for overland flow conveyance. Due to limited information several assumptions were made. Key assumptions are listed below:

- Based on the **Goldmanco Drainage Plan**, an overland flow area of 1.05 ha at an imperviousness of 36% (runoff coefficient of 0.48) will drain through Low Boulevard and ultimately towards Barton SWM pond. It should be noted that this area is indicated as overland only on this drawing and has therefore been assumed not to be required to be conveyed through the storm sewer network draining east towards Herrema Boulevard;

- Conservatively, the total 100 year target flow for Evendale Developments (411 L/s) was assumed flowing overland only for the overland conveyance analysis
- Conservatively it has been assumed that Area A13 Post has no controls active
- The rational method was used and a scaling coefficient of 1.25 has been used for the 100 year storm event

The drainage area to Section D-D used was based upon A1 Post and B1 shown on **Figure 2** and **Figure 3**. Total 100-year flows and 5-year flows to Herrema Boulevard are provided in **Appendix B**. Flow master calculations provided in **Appendix B** verify that the 100 year flows minus the minor system flows (2,214L/s) are able to be conveyed within the ROW 3 m into the boulevards that have a capacity of 3,110 L/s. Refer to **Drawing GR-01, GR-02** for grading information and **Drawing GP-01, GP-02** for servicing information.

7 Development Area Target Flows

Based on the above, in order to avoid causing an impact to downstream conditions, the target flows to the Brock Street and Herema Blvd Storm Sewers from the Westlane and Evendale developments shown on **Drawing STM-01** and **Drawing STM-02** are as follows:

Evendale Developments 5 year Storm Sewer Target Flows:

- A5 Post 3.5 L/s; and,
- A15 Post 7 L/s.

Evendale Developments 100 year Storm Sewer Target Flows:

- A5 Post 3.5 L/s; and,
- A15 Post 7 L/s.

Westlane Development FSR 5 year Storm Sewer Target Flows:

- A12 Post 436 L/s

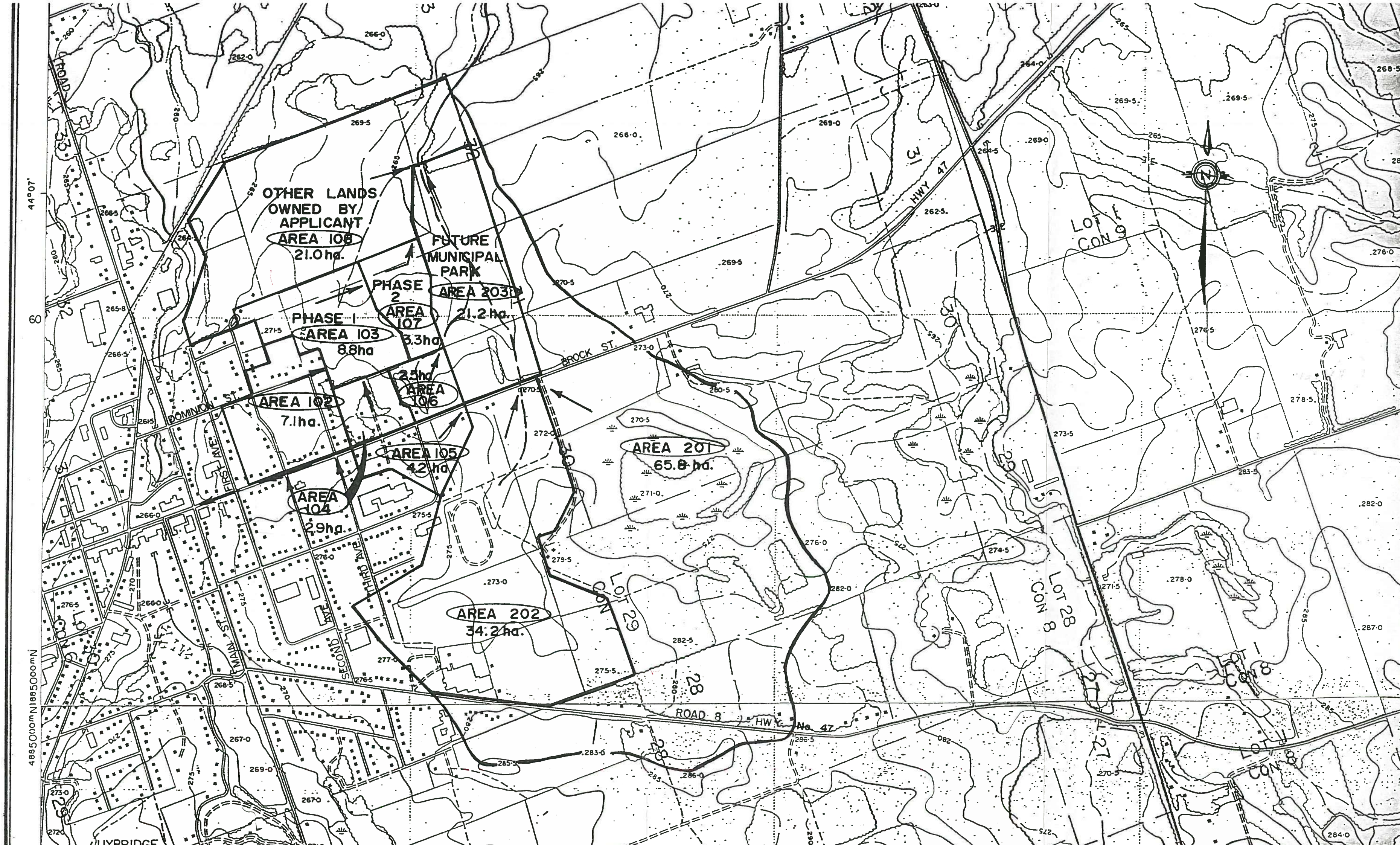
Westlane Development FSR 100 year Storm Sewer Target Flows:

- A12 Post 1505 L/s (includes external areas draining through Westlane Development

At detailed design these developments within catchment areas A5, A15 and A12 Post, will be required to control their flows to the storm sewer to the above mentioned targets.

8 Conclusions

Based on the above, the proposed stormsewer network has adequate capacity to convey the minor system North towards Herrema Boulevard and East along Brock Street up to the limits shown on the storm drainage plan **Drawing STM-01** and **STM-02**. The overland flow route along the roadway at the end of Herrema Boulevard has adequate capacity to convey the 100 year minus the minor system flows.

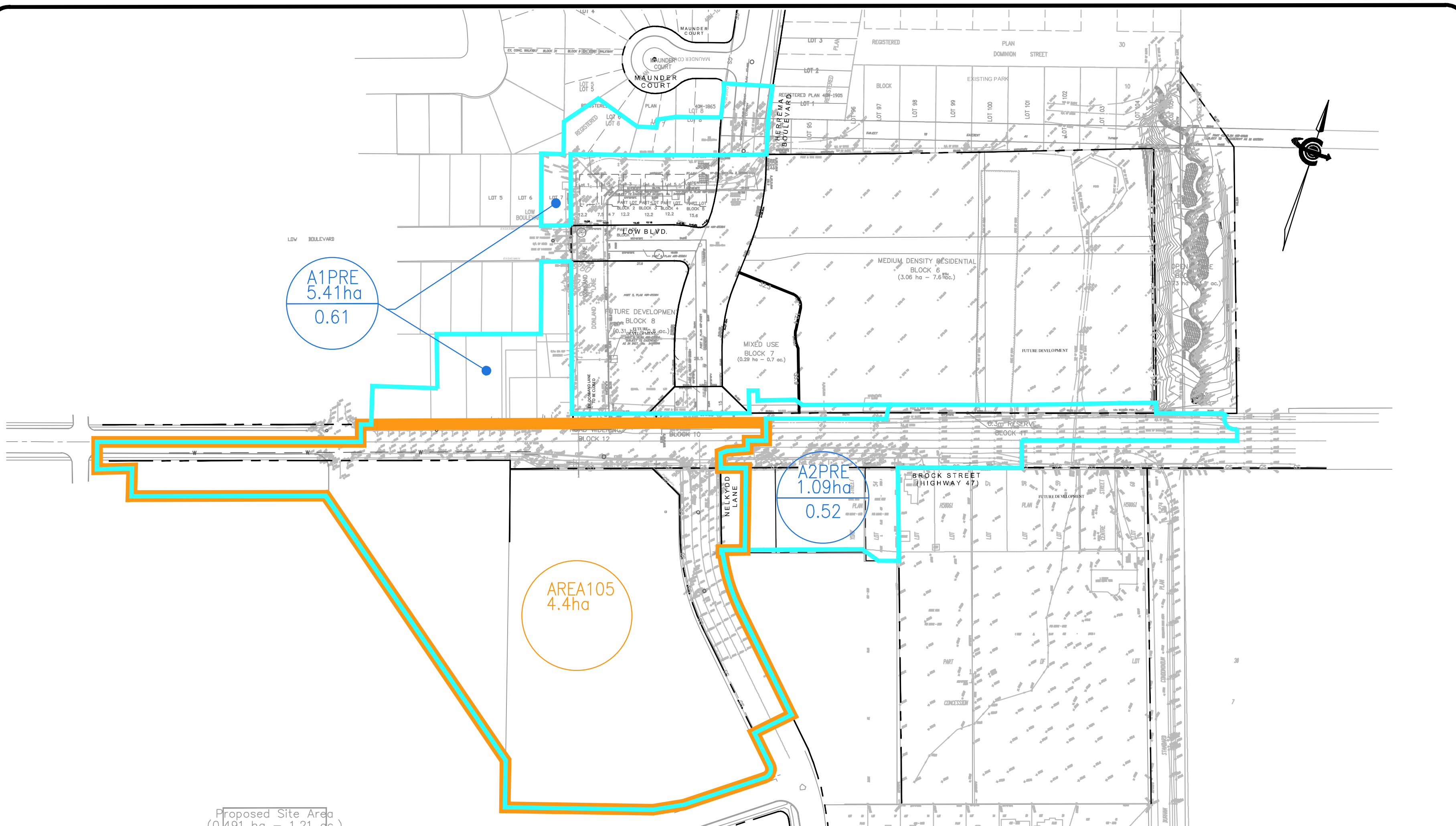


DRAINAGE AREA PLAN
BARTON FARM SUBDIVISION

G.M. Sernas & Associates Ltd.
Consulting Engineers & Planners
110 SCOTIA COURT UNIT 41
WHITBY, ONTARIO L1N 8Y7
TEL (416) 432-7878
FAX (416) 432-7877

DATE: DECEMBER 1992	DRAWN BY: A.H.	PROJECT No. 92061
	DESIGNED BY: R.P.S.	DRAWING No. FIG. 1
SCALE: 1:10,000	CHECKED BY: R.P.S.	

APPENDIX A2
Conveyance Report Figure Excerpts



COLE ENGINEERING

70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
T:416.987.6161 / 905.940.6161 F:905.940.2064

LEGEND

EXISTING MAJOR/MINOR DRAINAGE AREA

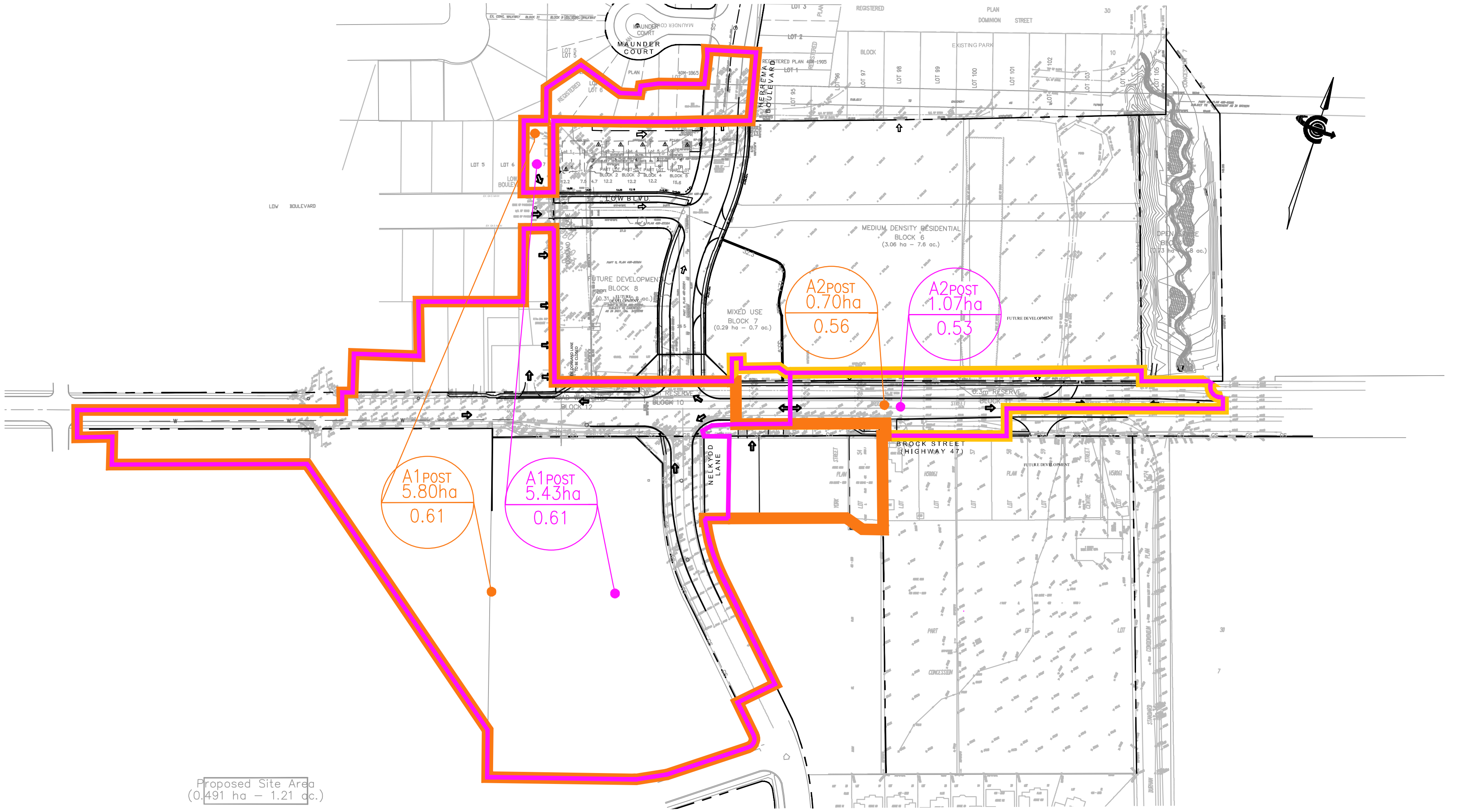
AREA 105

A1 PRE — STORM DRAINAGE AREA ID
0.12ha — DRAINAGE AREA (ha)
0.60 — RUNOFF COEFFICIENT

EXISTING STORM DRAINAGE AREA PLAN
EVANDALE DEVELOPMENTS LTD.
BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	SEPT 2019	PROJECT No.:	2017-0569
SCALE:	NTS	FIGURE No.:	FIG 1

P:\rm\2017\2017-0569 Evandale_BrockStreet_Uxbridge\300-Design-Engineering\312-Deliverables\Project\2019 Sept Conveyance Analysis\Figure\STM-03, STM-04.dwg (FIG 1)



COLE ENGINEERING

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LEGEND

MINOR SYSTEM DRAINAGE AREA	
MAJOR SYSTEM DRAINAGE AREA	

A1 POST — STORM DRAINAGE ID
0.12ha — DRAINAGE AREA (ha)
0.60 — RUNOFF COEFFICIENT

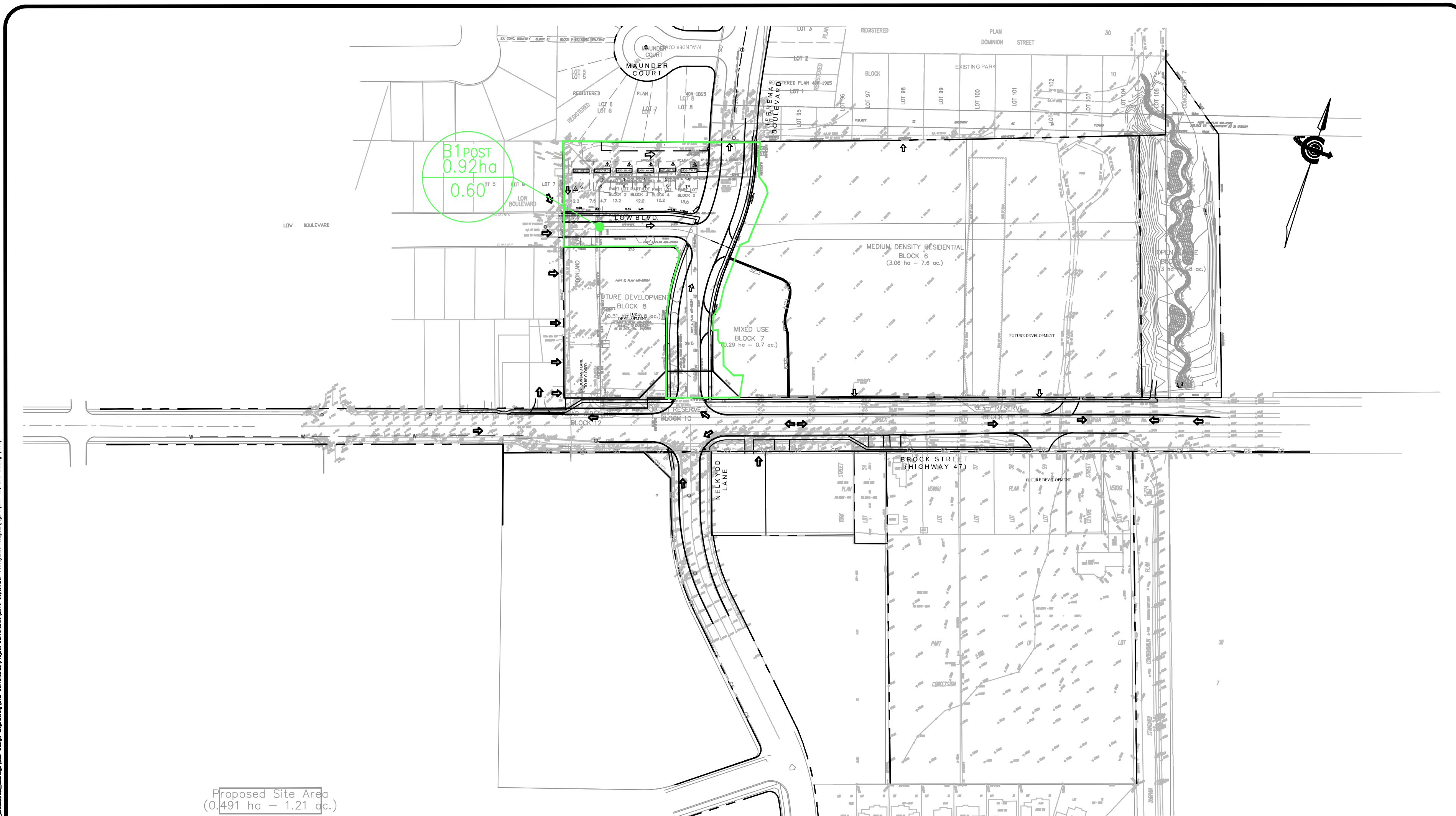
A1 POST — STORM DRAINAGE ID
0.12ha — DRAINAGE AREA (ha)
0.60 — RUNOFF COEFFICIENT

POST-STORM DRAINAGE AREA PLAN

EVANDALE DEVELOPMENTS LTD.
BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	SEPT 2019	PROJECT No.:	2017-0569
SCALE:	NTS	FIGURE No.:	FIG 2

P:\vmk\2017\2017-0569 Evandale_BrockStreet_Uxbridge\300-Design-Engineering\312-Deliverables\Project\2019 Sept Convergence Analysis\Figure\STM-03, STM-04.dwg (FIG 2)



COLE ENGINEERING

70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
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LEGEND

OVERLAND FLOW AREA

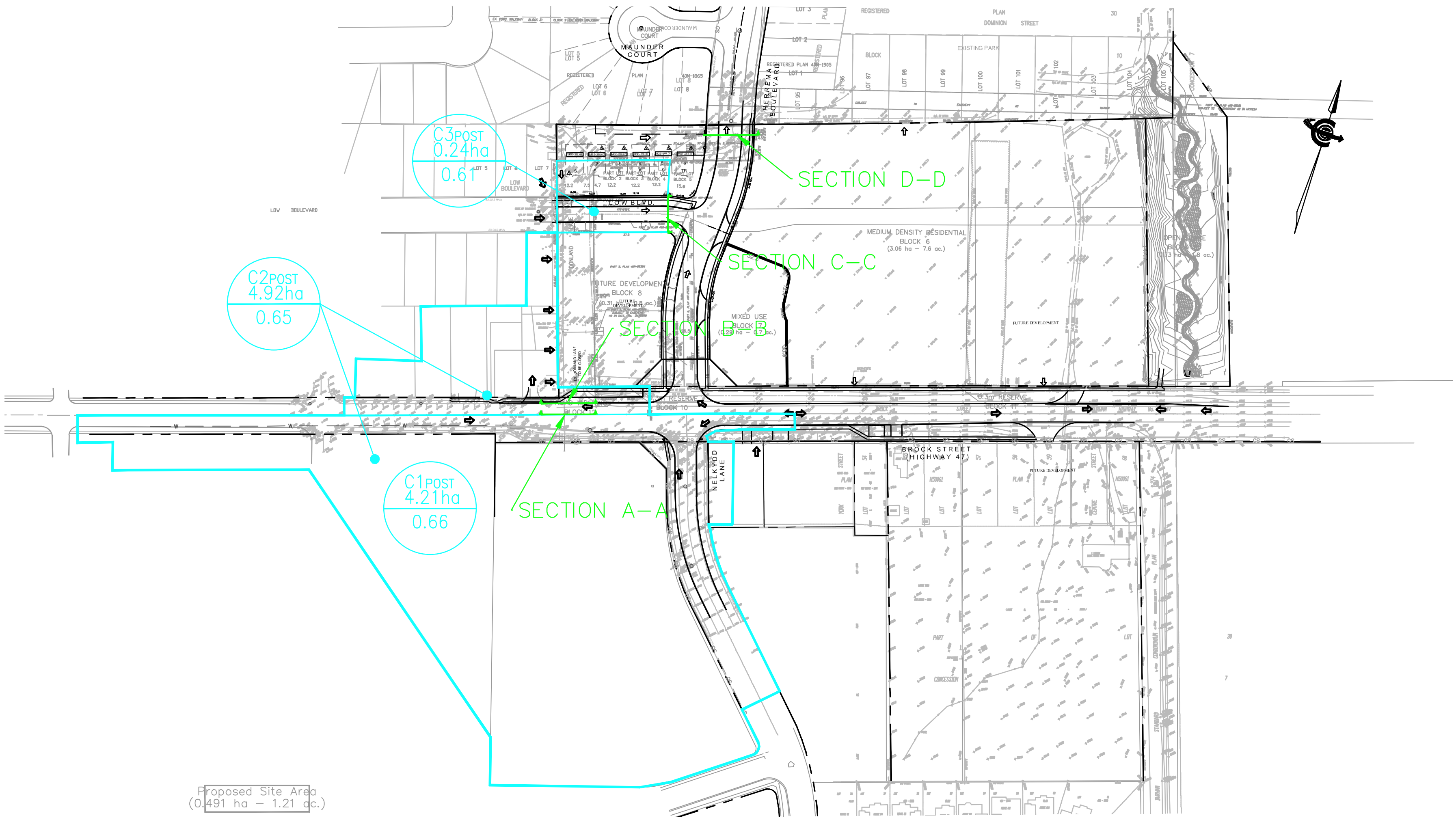
B1POST — STORM DRAINAGE ID
0.12ha — DRAINAGE AREA (ha)
0.60 — RUNOFF COEFFICIENT

ESTIMATED UNCONTROLLED AREAS TO BARTON POND FROM EVENDALE

EVANDALE DEVELOPMENTS LTD.
BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	SEPT 2019	PROJECT No.:	2017-0569
SCALE:	NTS	FIGURE No.:	FIG 3

S:\2017 Projects\C\2017-0569 Evendale_BrockStreet_Uxbridge\300-Design-Engineering\312-Deliverables\Project Deliverables\2019 September Conveyance Analysis\Figure\STM-03, STM-04.dwg (FIG3)



LEGEND

OVERLAND FLOW AREA	
C1POST 0.12ha 0.60	STORM DRAINAGE ID DRAINAGE AREA (ha) RUNOFF COEFFICIENT

COLE ENGINEERING
70 VALLEYWOOD DRIVE, MARKHAM, ON L3R 4T5
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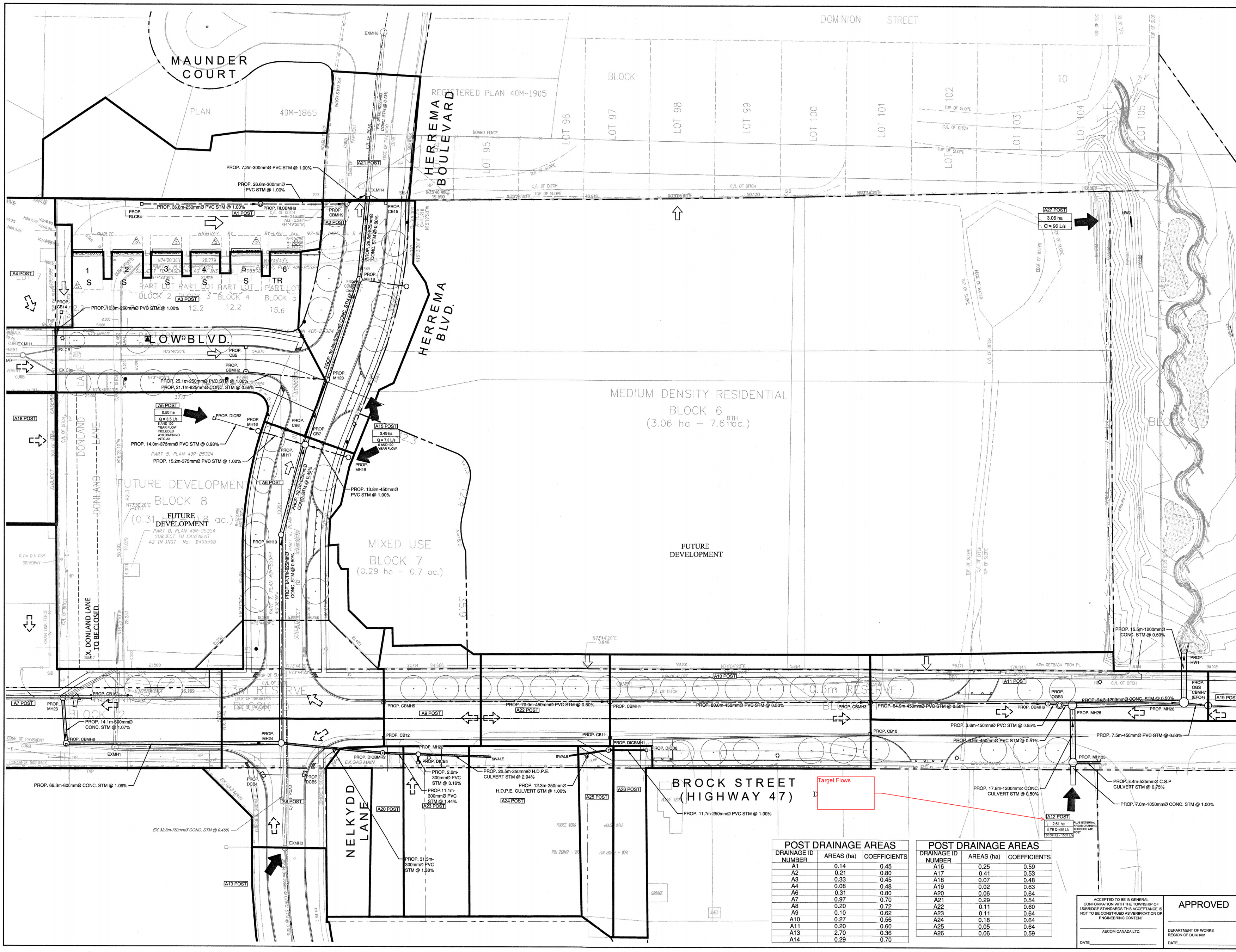
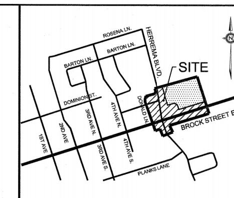
CRITICAL OVERLAND FLOW SECTIONS TO BARTON POND

EVANDALE DEVELOPMENTS LTD.
BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	SEPT 2019	PROJECT No.:	2017-0569
SCALE:	NTS	FIGURE No.:	FIG 4





LOCATION PLAN
N.T.S.

LEGEND

- PROPERTY LINE
- STORM DRAINAGE AREA
- STORM DRAINAGE ID — A24 POST
- STORM DRAINAGE AREA (ha) EXTERNAL — 2.61 ha
- STORM FLOW L/S — Q=164.3L/s
- MAJOR FLOW
- EXISTING MAJOR FLOW
- MINOR FLOW
- PROPOSED STORM MANHOLE
- PROPOSED STORM CATCH BASIN MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED DOUBLE CATCH BASIN
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- PROPOSED STORM SEWER
- EXISTING STORM SEWER

POST DRAINAGE AREAS

DRAINAGE ID NUMBER	AREAS (ha)	COEFFICIENTS
A1	0.14	0.45
A2	0.21	0.80
A3	0.33	0.45
A4	0.08	0.48
A6	0.31	0.80
A7	0.97	0.70
A8	0.20	0.72
A9	0.10	0.62
A10	0.27	0.56
A11	0.20	0.60
A13	2.70	0.36
A14	0.29	0.70

POST DRAINAGE AREAS

DRAINAGE ID NUMBER	AREAS (ha)	COEFFICIENTS
A16	0.25	0.59
A17	0.41	0.53
A18	0.07	0.48
A19	0.02	0.63
A20	0.06	0.64
A21	0.29	0.54
A22	0.11	0.60
A23	0.11	0.64
A24	0.18	0.64
A25	0.05	0.64
A26	0.06	0.59

SURVEYOR INFORMATION

JD BARNES LIMITED
110 SCOTIA COURT, #40
WHITBY, ON L1N 8Y7
PHONE: (905) 723-1212
FAX: (905) 723-4234

H.F. GRANDER Co. LIMITED
ONTARIO LAND SURVEYOR
1575 HIGHWAY 7A WEST, UNIT 2A
PORT PERRY, ON L9L 1A6
PHONE: (905) 985-3600
FAX: (905) 985-2347

BENCHMARK INFORMATION:
MINISTRY OF TRANSPORTATION OF ONTARIO PRECISE BENCHMARK N° 00819778487 (AKA 778487). TWO STOREY RED BRICK HOUSE ON SOUTH SIDE OF HIGHWAY 47 (BROCK STREET) IN THE TOWN OF UXBRIDGE, 118.9m EAST OF MARIETTA STREET, 18.4m WEST OF FRANKLIN STREET AND 15.9m SOUTH OF THE CENTRELINE OF HIGHWAY 47. TABLET IS SET HORIZONTALLY IN THE EAST FACE OF CONCRETE FOUNDATION, 3.9m SOUTH OF NORTHEAST CORNER, 30cm ABOVE GROUND LEVEL AND 34cm BELOW BRICKWORK. ELEVATION = 274.359m (GEODETIC)

NO.	REVISION	DATE	BY
6	REGION AND TOWNSHIP SUBMISSION	OCT 28, 2019	PS
5	LSRCA SUBMISSION	SEPT 13, 2019	PS
4	100% SUBMISSION	JUNE 28, 2019	PS
3	ISSUED FOR LSRCA APPROVAL	JUNE 20, 2019	PS
2	90% SUBMISSION	MAR 25, 2019	PS
1	60% SUBMISSION	JAN 11, 2019	PS

LICENSED PROFESSIONAL ENGINEER
R. J. ROBERTO
PROVINCE OF ONTARIO

THE REGIONAL MUNICIPALITY OF DURHAM

TOWN OF UXBRIDGE

COLE

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www.coleengineering.ca

EVENDALE DEVELOPMENTS LTD.
BROCK STREET DEVELOPMENT
UXBRIDGE, ONTARIO

STORM DRAINAGE AREA PLAN

DESIGNED BY: PS	DATE: JANUARY 2019	CHECKED BY: NG
DRAWN BY: PS	PROJECT No. 2017-0569	DRAWING No. STM-01
SCALE: 1:500		

ACCEPTED TO BE IN GENERAL CONFORMATION WITH THE TOWNSHIP OF UXBRIDGE STANDARDS THIS ACCEPTANCE IS NOT TO BE CONSTRUED AS VERIFICATION OF ENGINEERING CONTENT

AECOM CANADA LTD.

DATE

APPROVED

DEPARTMENT OF WORKS
REGION OF DURHAM

DATE

APPENDIX A3

WSP Hydrogeological Report Excerpts

5 WATER BUDGET ANALYSIS

The Water Budget Analysis is presented in the following sections. Section 5.1 describes the analysis of historical climate data to estimate annual average precipitation and potential evapotranspiration. Section 5.2 describes the Pre-Development Water Budget. Section 5.3 Describes the Post-Development Water Budget. Section 5.4 revisits the Post-Development Water Budget to consider the potential benefits of identified mitigation opportunities.

5.1 CLIMATE-BASED WATER BUDGET

The climate-based water budget calculations are included in Tables **D-1** to **D-4** (**Appendix D**) and are summarized in **Table 3**. The average annual precipitation for the thirty year normal data between 1981 and 2010 is about 886.2 mm/m^2/year (mm/year). The annual potential evapotranspiration is calculated in Table D-1 at 579.3 mm/year. This equates to a potential water surplus of 393.1 mm/year and a soil moisture deficit of 86.2 mm/year. Thus the net annual water surplus based on potential evapotranspiration is 306.9 mm/year.

The calculations were expanded to include the water holding capacity of the soil as presented in Tables D-2 to D-4. This will produce a total moisture surplus based on the calculated actual evapotranspiration. Three (3) combinations of soil type and vegetation type were identified on the Site for the Pre-Development and Post-Development scenarios. The majority of the surficial soil at the site is considered to be fine sandy loam. The land use classifications and the corresponding water holding capacities are:

— Fine Sandy Loam, Urban Lawn (75 mm/year);
— Fine Sandy Loam, Cultivated (150 mm/year);
— Fine Sandy Loam, Uncultivated (150 mm/year); and

Consideration of these factors produces a range of net annual moisture surplus between 283.8 and 341.1 mm/year as summarized in **Table 3**. The soils with higher water holding capacity effectively increase the water removed as evapotranspiration.

The calculated moisture surplus occurs during the winter, spring and fall months, and a water deficit occurs during the summer months. Much of the water surplus in the winter accumulates as snow. Snowmelt during the spring results in the runoff or infiltration of precipitation that is effectively equivalent to the winter and spring water surplus.

5.2 PRE-DEVELOPMENT WATER BUDGET

The Pre-Development Water Budget was developed based on topographic information provided by Ontario Base Mapping and the preliminary Site Grading Plan provided by *IBI*.

5.2.1 PRE-DEVELOPMENT CATCHMENTS

Figure 11 illustrates the delineation of drainage catchments and sub-catchments for the Site. The Site is represented by one (1) (on site) catchment area that is not considered to receive run-on from adjacent properties. The Pre-Development Drainage Plan prepared by *IBI* includes an external catchment to the south of the Site. *IBI* confirmed that the external catchment was included in their analysis to estimate the quantity of runoff from off-site to be conveyed through the headwater drainage feature. The water generated in the off-site catchment is considered to be conveyed through the site and does not contribute to on-Site infiltration. WSP did not include this off-site catchment in the pre-development water balance calculations.

The on-Site catchment areas have been further subdivided. The drainage sub-catchments are based on similar slopes, soils, and vegetation/land use. The drainage sub-catchments also include consideration of post-development drainage boundaries so that changes to drainage areas can be evaluated for the post-development conditions. The outlets for drainage of the identified Pre-Development catchments are as follows:

On-Site Catchments:

— **Pre-Development On-Site Catchment A:** Drains off-site through the north-eastern property boundary via overland flow (to the ditch along Brock Street East).

Table E-1 (**Appendix E**) provides a summary of the data attributes used to estimate the infiltration factor for each pre-development catchment and sub-catchment. The infiltration factor determined the proportion of the annual water surplus that would infiltrate or runoff within each sub-catchment.

Additional infiltration was attributed to Catchment A due to observed saturated conditions during the site visits. The water in the central area of the site appeared primarily to be standing water with minimum flow observed and is considered to provide an opportunity for enhanced infiltration in this area. An additional 25% of the runoff was allocated for infiltration in the pre-development scenario. This step is reflected in the water budget summary on **Table 4**, but not within the detailed water budget calculations (**Appendix E**).

5.2.2 PRE-DEVELOPMENT ANALYSIS

Properties associated with area, slope, soil type, and land cover were analyzed and assigned to each Pre-Development sub-catchment. The values assigned to each Pre-Development sub-catchment are provided in Table E-1. These values were used to estimate an Infiltration Factor. The Infiltration Factors were reviewed to confirm that they are appropriate and adjusted if necessary. Existing paved areas were assumed to be impervious and to generate runoff equivalent to the precipitation volume minus a 10% evaporative loss. Gravel areas were assumed to have a surplus equivalent to that of urban lawn areas.

Table E-1 includes the overall analysis of the total Study Area's infiltration and runoff. Table H-1 also documents the calculation of volumes associated with input and output parameters for the Pre-Development conditions. These volumes are also expressed in terms of the number of mm of water within each sub-catchment area.

A summary of the Pre-Development water budget calculations is provided in **Table 4**. These values will be used to assess the changes that proposed development will create relative to the pre-development conditions.

5.2.3 PRE-DEVELOPMENT INFILTRATION

The estimated total infiltration for the Site is 6,994 m^3/yr or an equivalent of 267.8 mm/year (mm/m^2/yr). The calculated infiltration represents approximately 30% of the annual precipitation (886.2 mm/yr) and 79% of the estimated annual water surplus (340.1 mm/yr).

5.2.4 PRE-DEVELOPMENT RUNOFF

The total runoff for the Site is 1,889 m^3/yr or an equivalent of 72.3 mm/year. The calculated runoff represents approximately 8% of the annual precipitation (886.2 mm/yr) and 21% of the estimated annual water surplus (340.1 mm/yr).

5.3 WATER BUDGET– POST-DEVELOPMENT CONDITIONS

The Post-Development Water Budget was based on the proposed concept plan presented in **Figure 3**. The Post-Development scenario introduces 60 townhomes, and new driveway and roadway areas. WSP understands that a naturalized drainage feature is to be constructed along the south and east side of this development area to convey water currently drained by the headwater drainage feature.

The Post-Development scenario presented by *IBI* in the Functional Servicing and Stormwater Management Report (IBI, 2021) includes the off-site catchment to the south as was included in Pre-Development. *IBI* has confirmed that the volume of water previously conveyed through the Site via the headwater drainage feature would now be directed to the proposed natural drainage feature along the south and east side of the property. The natural drainage features include a series of swales/soak away pits that have been designed to promote infiltration. *IBI* confirmed that the perimeter drainage feature is capable of promoting infiltration. WSP has accounted for this by increasing the soil infiltration factor within the drainage feature in detailed water budget calculations (**Appendix F**).

IBI also allowed for an infiltration trench to capture and infiltrate runoff from rooftops within the central area of the development. WSP also accounted for this infiltration in the detailed water budget calculations (**Appendix F**).

5.3.1 POST-DEVELOPMENT CATCHMENTS

Figure 12 illustrates the delineation of drainage catchments and sub-catchments for the Site under post-development conditions. The Site has been subdivided into six (6) on-site catchments. Sub-catchment delineations in Pre-Development conditions were maintained for the Post-Development analysis. The post-development catchments were prepared based on a preliminary grading plan and drainage area plan provided by *IBI*.

Under Post-Development conditions, a new naturalized drainage feature that drains off-site to the northwest is introduced in Catchment PF. Runoff from within the developed areas of the Site drains northwest via the on-site storm sewer system and rear lot catch basins, or directly to the offsite northwest via overland flow. WSP has assumed that the runoff from the upgradient properties (to the south and west) will be conveyed through the natural drainage feature. The outlets for each Catchment are summarized below:

<u>On-Site Catchments</u>:

- **Post-Development On-Site Catchment PA1:** Drains off-site to the northwest via overland flow.
- **Post-Development On-Site Catchment PA2:** Drains off-site to the northwest via overland flow.
- **Post-Development On-Site Catchment PB:** Drains off-site to the northwest via the on-site storm sewer system.
- **Post-Development On-Site Catchment PC:** Drains to the rear lot infiltration trench, which connects to the on-site storm system and subsequently flows off-site to the north.
- **Post-Development On-Site Catchment PD:** Drains to the rear lot catch basins which connect to the on-site storm sewer system and subsequently flows off-site to the north.
- **Post-Development On-Site Catchment PE:** Drains to the rear lot catch basins which connect to the on-site storm sewer system and subsequently flows off-site to the north.
- **Post-Development On-Site Catchment PF:** Drains to the proposed drainage swale which subsequently flows off-site to the north west via overland flow

Table F-1 (**Appendix F**) provides a summary of the data attributes used to estimate the infiltration factor for each post-development catchment and sub-catchment. The infiltration factor determined the proportion of the annual water surplus that would infiltrate or runoff within each sub-catchment. Runoff from the developed areas in on-site catchment areas will be affected by the creation of buildings and driveway areas.

WSP prepared the post-development catchments with input from *IBI* on split drainage from rooftops to rear lot catch basins. This results in some differences in catchment delineations between the *IBI* Post Development Drainage Area Plan (*IBI, 2021)* and the post-development site catchment areas in **Figure 12**. Catchment A1 in Post Development Drainage Area Plan (PDDAP) includes Catchment PF in **Figure 12.** Catchment A2 in the PDDAP includes Catchment PA1 and PA2 in **Figure 12.** Catchment A3 in the PDDAP includes Catchment PB, PC, PD and PE in **Figure 12.** The difference in catchment delineations is primarily due to the manner in which runoff is accounted for in stormwater management as opposed to the water balances.

5.3.2 POST-DEVELOPMENT ANALYSIS

Properties associated with area, slope, soil type, and land cover were analyzed and assigned to each Post-Development sub-catchment. The values assigned to each Post-Development sub-catchment are provided in

Table F-1 (**Appendix F**). These values were used to estimate an Infiltration Factor. The Infiltration Factors were reviewed to confirm that they are appropriate and adjusted if necessary.

Table F-1 includes the overall analysis of the total Study Area's infiltration and runoff. Table F-1 also documents the calculation of volumes associated with input and output parameters for the Post-Development condition. These volumes are also expressed in terms of the number of mm of water within each sub-catchment area. The volumes are summed by catchment and for the total property area.

Assumptions incorporated into the water budget for the Post-Development scenario included:

1) Impervious surfaces (roads, driveways and buildings) are assumed to have a 10% evaporative loss.
2) Runoff is assumed to be conveyed directly to the outlets and not infiltrated.
3) Runoff from external sub-catchments is conveyed through the Site and not infiltrated.
4) Infiltration through the naturalized drainage feature is included in the Water Budget Summary in **Table 4**.
5) Rooftop runoff from the entire roof area in Catchment PC will be redirected to the rear lawns, and 50% of the volumes are assumed to infiltrate.
6) Rooftop runoff from rear roof areas in Catchment PA1, PD and PE will be redirected to the rear lawns and 50% of the volumes are assumed to infiltrate.
7) The remaining rooftop runoff in Catchment PC and the runoff the from rear lawn areas will be captured by the infiltration trench in Catchment PC, with 80% of the volume received by the infiltration trench assumed to infiltrate.

A summary of the Post-Development water budget calculations is provided in **Table 4**.

5.3.3 POST-DEVELOPMENT INFILTRATION

In the post-development condition, the Site will contain approximately 13,574 m^2 of impervious surfaces. This would result in a net infiltration of 3,053 m^3/year or 117 mm/yr through natural pervious areas, including infiltration in the naturalized drainage area. A further 1,685 m^3/yr will infiltrate through the rear lawns by rooftop disconnect and 872 m^3/yr will infiltrate through the rear yard infiltration trench. This results in a net infiltration of 5,610 m^3/yr. The net infiltration would reflect approximately 24% of the precipitation (886.2 mm/yr).

5.3.4 POST-DEVELOPMENT RUNOFF

The introduction of impervious surfaces will increase the total runoff from the developed area. The total runoff generated by the proposed development area is11,939 m^3/yr or 457 mm/year. As mentioned above, 1,685 m^3/yr of this runoff will infiltrate through the rear lawns by rooftop disconnect and 872 m^3/yr will infiltrate through the central rear-lot infiltration trench. The net runoff generated in the post-development scenario if 9,382 m^3/yr. The total calculated net Post-Development runoff represents approximately 40.5% of the annual precipitation (886.2 mm/yr).

5.3.5 COMPARISON WITH PRE-DEVELOPMENT

Table 4 provides a comparison of the water budget estimates for the Pre-Development and Post-Development cases. The Post-Development scenario includes measures designed to enhance infiltration at the site. The total on-site infiltration is reduced by approximately 20% or 1,385 m^3/yr when compared to the Pre-Development Scenario. The introduction of additional impervious surfaces increases the total runoff by 7,493 m^3/yr. This increased runoff is managed by the stormwater management system.

Measures are proposed to re-direct front and rear roof-top runoff from the townhouse to the back lawns assumes that 50% of the redirected roof-top runoff will infiltrate into the lawns. The infiltration trench proposed in the rear lots of Catchment PC will have the ability to infiltrate runoff from the lawns. It is assumed that 80% of the volumes received are able to infiltrate back in the groundwater beneath the development site. The net infiltration is enhanced by 2,557 m^3/year through these actions. The primary goal of the water balance mitigation analysis is to determine whether the annual infiltration to groundwater beneath the development area can be maintained.

If other options for mitigation are preferred due to site area availability, it would also be possible to enhance infiltration by redirecting some of the runoff from driveways and other impervious surfaces. This can be accomplished by changing the infiltration characteristics of the pervious surfaces to allow for more infiltration.

5.4 WATER QUALITY

The water budget analysis must also consider potential changes to water quality that could be experienced in relation to the proposed development. The following sections describe the typical contaminants associated with the current and future land uses.

5.4.1 EXISTING CONDITIONS

The Site is currently vacant. As such, there are no activities present that could potentially impact groundwater quality at this time.

5.4.2 FUTURE CONDITIONS

The proposed Post-Development condition includes new driveway and roadway areas. These areas may be a future source of contamination to groundwater infiltration or surface water runoff by winter road de-icing agents. The most effective method of reducing potential impacts from salt or other winter road de-icing agents is to minimize the mass/volume of material applied through the use of Best Management Practices (BMPs). Any pervious areas used for winter snow storage may also become potential sources of contamination from winter road de-icing agents. BMPs recommend storing snow on impervious surfaces.

The driveway and roadway areas may also be a potential sources of petroleum hydrocarbons. These are typically contained in vehicles. The release of these substances will typically be the result of accidents. These potential releases could result in impairment of water quality by infiltrating into the groundwater. The risk of an accident occurring at the Site is low considering the only traffic will be the residents who occupy the building.

In pervious areas, soil-enrichment agents (i.e. fertilizers) and/or herbicides may also be a source of contamination. Application of these products should be minimized in order to reduce potential contamination.

7 DEWATERING ASSESSMENT

The potential requirements for dewatering in association with construction of the proposed residences, for long-term drainage from foundation drains and associated buried utilities (storm and sanitary sewers) is assessed below. The potential requirements for permitting associated with dewatering activities are as follows:

— Takings of less than 50,000 L/day at any one time do not require a permit;

— Takings of greater than 50,000 L/day but less than 400,000 L/day at any one time requires registration with the Environmental Activity and Sector Registry (EASR); or

— Takings of greater than 400,000 L/day at any one time for the project will require a Category 3 Permit to Take Water (PTTW).

WSP has prepared a preliminary assessment of the dewatering requirements and the associated impacts associated with construction and long-term drainage.

7.1 DEWATERING EQUATIONS AND ASSUMPTIONS

Given the subsurface conditions encountered in the study area, equations are used to account for excavations under unconfined groundwater conditions. For the purposes of these calculations, long narrow trench equations are assumed to be more appropriate to estimate flows for the foundation excavation, since the length to width ratio of the excavation is greater than 1.5.

LONG NARROW TRENCH EQUATION – UNCONFINED CONDITIONS

Dewatering volumes were estimated using the following equation from Powers (1992) for drainage trench of finite length with a length to width ratio of greater than 1.5 for an unconfined system:

$$Q = \frac{xK(H^2 - h^2)}{In\frac{R_o}{r_s}} + 2\left[\frac{xK(H^2 - h^2)}{2L}\right]$$

where Q is discharge (m^3/s), x is the trench sidewall length (m), K is hydraulic conductivity (m/s), H is initial water level (m), h is the required drawdown (m), R_0 is the equivalent radius of influence (m), and r_s is the equivalent well radius (m). For more details, please refer to Powers (1992). Using the equation for a long, narrow system provides a more conservative estimate for dewatering rates when compared with using the equation for a drainage trench from a line source.

DARCY'S LAW

Dewatering volumes for the calculation of seepage across the base of the excavation was estimated using the empirical Darcy's Law equation as described in Powers (1992):

$$Q = K_V A i$$

where Q is discharge (m^3/s), K_V is vertical hydraulic conductivity (m/s), A is cross-sectional area (m^2), and i is the hydraulic gradient.

EQUIVALENT RADIUS OF INFLUENCE (R_O)

The equivalent radius of influence R_0 is assumed to be equivalent to the zone of influence (ZOI). R_0 was estimated using the empirical Sichart equation as described in Powers (1992):

$$R_0 = 3000(H - h)\sqrt{K}$$

where R_0 is the equivalent radius of influence or ZOI (meters), H is the initial water level (meters), h is the required drawdown (meters), and K is hydraulic conductivity (meters/second).

7.2 ASSUMPTIONS

A number of assumptions were incorporated based on the site-specific data collected in site investigations and information about the proposed development. The assumptions related to construction dewatering are as follows:

- No measures are to be put in place to restrict flows into the excavations (e.g., sheet piling, caissons) to provide more conservative (overestimate) dewatering rates;
- The aquifer is uniform, continuous and of infinite extent;
- The proposed elevations of the building footings and storm and sanitary sewer inverts were provided by *IBI* in the Site Servicing Plan dated March 2019.
- The dimensions for each building used to estimate potential dewatering requirements are outlined below:
  - Building 1 – 29.4 x 13.3 m
  - Building 2 – 36.5 x 13.3 m
  - Building 3 – 35.4 x 14.2 m
  - Buildings 4 through 9 – 42.5 x 14.2 m
  - Buildings 10 and 11 – 54.4 x 16.2 m
- The Site Servicing plan showing the depths of building footings and depths of structures, pipe lengths and slopes are presented in **Appendix G.**
- Assumed hydraulic conductivity is based on the field saturated hydraulic conductivity estimated from the infiltration testing conducted at the Site by WSP (WSP, 2018). The field saturated hydraulic conductivity was observed to be 4.2 x 10^{-5} m/sec. This value is considered to be conservative for the observed soils.
- For the purposes of estimating flux across the base of the excavation, vertical hydraulic conductivity was used in the calculation using the Darcy equation. The vertical hydraulic conductivity is assumed to be an order of magnitude lower than the horizontal hydraulic conductivity (4.2 10^{-6} m/sec for the conservative dewatering rate)
- The vertical hydraulic gradient was assumed to be 0.1 m/m;
- Dewatering during construction is assumed to lower the water table by 0.5 m below the base of the building footing and 1.0 m below the base of the sewer inverts.
- Assumed seasonal high groundwater elevations for the Site is based on elevations measured in mid April and May of 2019 (**Table 1**).
- Groundwater elevation contours were used to prepare **Figure 17** to illustrate relative elevations of building foundations to the seasonally high groundwater elevations for use in the dewatering estimates.
- Groundwater elevation contours were used to prepare **Figure 18** to illustrate relative elevations of proposed utilities to the seasonally high groundwater elevations for use in the dewatering estimates. .
- Excavations for storm and sanitary sewers are assumed to not be any greater than 50 m trench segments.
- Precipitation entering the open excavations were estimated assuming a 10 mm rain storm event.
- A safety factor of 50% is applied to the dewatering estimates to account for fluctuations in groundwater elevations and variations in soil conditions.

The primary factors that will control the rate of seepage into the excavation or foundations are the hydraulic conductivity and the depth that the water table will be lowered.

This assessment does not represent an engineering design of a dewatering operation, but a preliminary hydrogeological analysis for assessment of dewatering volumes. The actual design of the dewatering operation will be the responsibility of the contractor.

7.3 DEWATERING CALCULATIONS

7.3.1 CONSTRUCTION DEWATERING FOR RESIDENTIAL FOUNDATIONS

The calculations of the estimated volumes of water that could enter the excavations during construction of each building lot are shown in **Table 5**. These calculations show the conservative dewatering rate that may be observed. Dewatering calculations are provided in **Appendix H1**.

Residential building foundations in the north-east portion of the Site (buildings 3, 4, 5, 8, 9 and 10) appear to above the seasonally high groundwater elevations assumed at the Site. Residential building foundations in the south-west potion of the Site (buildings 1, 2, 6, 7 and 11) have potential to be below the seasonally high groundwater elevations assumed at the Site.

The total volume that would potentially need to be dewatered to maintain all foundations open at the same time would be up to 313,000 L/day. Typical approaches for construction of these types of projects result in only a few individual building foundations being constructed at any one time. It was estimated that precipitation may contribute between 3,910 and 8,813 L/day for a single excavation, in addition to the estimated volumes listed above. The zone of hydraulic influence from building excavations would be less than 24 m. There is potential that hydraulic influence would extend off-site if multiple lots near the Site boundaries were constructed at the same time. Review of the conservatism in the estimates, the likelihood that construction will be carried out in stages, and the effects of seasonality on potential impacts, it is prudent to register the proposed dewatering activity for the subdivision on the EASR and to manage activities such that daily dewatering volumes are maintained below 400,000 L/day.

The following is a summary of the dewatering estimates for each building foundation with footings depths below the water table:

— **Building 1 with proposed footing depths plus 0.5m construction drawdown between 1.0 and 1.5 m below the water table:** The dewatering volumes entering across the walls and the floor of a single excavation is estimated to be up to 58,494 L/day, with an estimated zone of influence (ZOI) of up to 24m. It was estimated that precipitation may contribute up to 3,910 L/day for a single excavation, in addition to the estimated volumes listed above. Dewatering for the construction of the building foundation would likely require registering on the EASR. Registration is recommended based on the potential that the total rate of dewatering at the Site could be between 50,000 L and 400,000 L/day.

— **Building 2 with proposed footing depths plus 0.5m construction drawdown between 0.5 and 1.0 m below the water table:** The dewatering volumes entering across the walls and the floor of a single excavation is estimated to be up to 47,092 L/day, with an estimated zone of influence (ZOI) of up to 15m. It was estimated that precipitation may contribute up to 4,855 L/day for a single excavation, in addition to the estimated volumes listed above. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays.

— **Building 3 with proposed footing depths plus 0.5m construction drawdown between 1.0 and 1.5 m above the water table:** A comparison of the average groundwater elevation and proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays.

— **Building 4 with proposed footing depths plus 0.5m construction drawdown between 1.0 and 1.5 m above the water table:** A comparison of the average groundwater elevation and the proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays.

— **Building 5 with proposed footing depths plus 0.5m construction drawdown between 0.5 and 1.0 m above the water table:** A comparison of the average groundwater elevation and the proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays..

- **Building 6 with proposed footing depths plus 0.5m construction drawdown between 1.0 and 1.5 m below the water table:** The dewatering volumes entering across the walls and the floor of a single excavation is estimated to be up to 78,173 L/day, with an estimated zone of influence (ZOI) of up to 24m. It was estimated that precipitation may contribute up to 6,035 L/day for a single excavation, in addition to the estimated volumes listed above. Dewatering for the construction of the building foundation would likely require registering on the EASR. Registration is recommended based on the potential that the total rate of dewatering at the Site could be between 50,000 L and 400,000 L/day.
- **Building 7 with proposed footing depths plus 0.5m construction drawdown between 1.0 and 1.5 m below the water table:** The dewatering volumes entering across the walls and the floor of a single excavation is estimated to be up to 55,381 L/day, with an estimated zone of influence (ZOI) of up to 15m. It was estimated that precipitation may contribute up to 6,035 L/day for a single excavation, in addition to the estimated volumes listed above. Dewatering for the construction of the building foundation would likely require registering on the EASR. Registration is recommended based on the potential that the total rate of dewatering at the Site could be between 50,000 L and 400,000 L/day.
- **Building 8 with proposed footing depths plus 0.5m construction drawdown between 0.5 and 1.0 m above the water table:** A comparison of the average groundwater elevation and the proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays.
- **Building 9 with proposed footing depths plus 0.5m construction drawdown between 0.5 and 1.0 m above the water table:** A comparison of the average groundwater elevation and the proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays..
- **Building 10 with proposed footing depths plus 0.5m construction drawdown between 0 and 0.5 m above the water table:** A comparison of the average groundwater elevation and the proposed building foundation footing elevations indicates that the footings will be above the water table. These building foundations could potentially be constructed without registration on the EASR, but registration is prudent to minimize potential for delays..
- **Building 11 with proposed footing depths plus 0.5m construction drawdown between 0.5 and 1.0 m below the water table:** The dewatering volumes entering across the walls and the floor of a single excavation is estimated to be up to 73,962 L/day, with an estimated zone of influence (ZOI) of up to 15m. It was estimated that precipitation may contribute up to 8,813 L/day for a single excavation, in addition to the estimated volumes listed above. Dewatering for the construction of the building foundation would likely require registering on the EASR. Registration is recommended based on the potential that the total rate of dewatering at the Site could be between 50,000 L and 400,000 L/day.

The dewatering estimates provided herein address dewatering associated with construction of the building foundations and is intended to be conservative to reflect the maximum volume that could be experienced. These calculations only reflect dewatering requirements for construction of the building foundations. Additional dewatering may also be required to construct underground utilities. Ideally, work can be coordinated on the Site so that the combined daily flows from all dewatering can be managed to be less than 400,000 L/day such that a Permit To Take Water is not required.

This assessment does not represent an engineering design of a dewatering operation, but provides a preliminary hydrogeological analysis for assessment of dewatering volumes. The actual design of the dewatering operation will be the responsibility of the contractors.

7.3.2 LONG-TERM DRAINAGE

Based on the observed water table elevations in April and May 2019, some of the proposed building footings will require drainage to maintain dry foundations in seasonally high conditions. WSP understands that the footings are intended to drain by gravity to the storm sewers.

The conservative calculations of the estimated volumes of water that could enter the foundation drains for each building lot are shown in **Table 6**. These calculations show a conservative seepage rate that may be experienced during peak drainage conditions. Foundation seepage calculations are provided in **Appendix H2**.

For long term drainage, the potential requirements for permitting are assessed based on the daily volume that will be removed from a single building block.

The following is a summary of the dewatering estimates for each building block:

- **Building 1 with proposed footing depths between 0.5 and 1.0m below the water table:** The potential rate of seepage into the foundation for this building may be up to 39,785 L/day, with precipitation potentially contributing up to 3,910 L/day during a rain event. This estimated volume is below the threshold requirement for a Category 3 PTTW of 50,000 L/day.
- **Building 2 with proposed footing depths between 0 and 0.5m below the water table:** The potential rate of seepage into the foundation for this building may be up to 31,099 L/day, with precipitation potentially contributing up to 4,855 L/day during a rain event. This estimated volume is below the threshold requirement for a Category 3 PTTW of 50,000 L/day.
- **Building 3 with proposed footing depths between 1.0 and 1.5 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 4 with proposed footing depths between 1.0 and 1.5 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 5 with proposed footing depths between 0.5 and 1.0 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 6 with proposed footing depths between 0.5 and 1.0m below the water table:** The potential rate of seepage into the foundation for this building may be up to 55,381 L/day, with precipitation potentially contributing up to 6,035 L/day during a rain event. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the total rate of long term drainage for this building could be between 50,000 L and 400,000 L/day.
- **Building 7 with proposed footing depths between 0 and 0.5m below the water table:** The potential rate of seepage into the foundation for this building may be up to 37,950 L/day, with precipitation potentially contributing up to 6,035 L/day during a rain event. This estimated volume is below the threshold requirement for a Category 3 PTTW of 50,000 L/day.
- **Building 8 with proposed footing depths between 0.5 and 1.0 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 9 with proposed footing depths between 0.5 and 1.0 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 10 with proposed footing depths between 0 and 0.5 m above the water table:** Seepage into the foundation for this building is not anticipated.
- **Building 11 with proposed footing depths between 0 and 0.5 below the water table:** The potential rate of seepage into the foundation for this building may be up to 53,877 L/day, with precipitation potentially contributing up to 8,813 L/day during a rain event. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day.

7.3.3 CONSTRUCTION DEWATERING FOR INSTALLATION OF UTILITIES

The calculations of the estimated volumes of water that could enter the excavations during the installation of storm and sanitary sewers, watermain and lined filtration trenches are shown in **Table 7**. These calculations show the conservative estimate of the dewatering rate that may be observed per trench segment, ranging in lengths between 3 and 50 m. Dewatering calculations are provided in **Appendix H3**.

The following is a summary of the dewatering estimates for utility installations with similar maximum excavation depths below the water table:

- **Storm sewer (450 mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 1.0 and 1.5 m below the water table:** The dewatering volumes entering across the walls a single 7 m trench excavation is estimated to be up to 13,206 L/day, with an estimated zone of influence (ZOI) of up to 29m. It was estimated that precipitation may contribute up to 112 L/day, in addition to the estimated volumes listed above. There is one trench segment in this category. Individual trench segments within this category of sewers could be excavated and dewatered without registering on the EASR.
- **Storm sewer (1800mm x 900mm) trench with proposed pipe invert depths plus 1.0m construction drawdown between 2.0 and 2.5 m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 66,203 and 70,876 L/day, with an estimated zone of influence (ZOI) of up to 49m. It was estimated that precipitation may contribute up to 1,282 L/day, in addition to the estimated volumes listed above. There are two trench segments in this category, ranging in lengths between 41 and 46m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Storm sewer (250mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 2.5 and 3.0m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to be up to 54,065 L/day, with an estimated zone of influence (ZOI) of up to 58m. It was estimated that precipitation may contribute up to 244 L/day, in addition to the estimated volumes listed above. There is one trench segment in this category, with a trench length of 20m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Storm sewer (1800mm x 900mm.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 2.5 and 3.0m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to be up to 90,883 L/day, with an estimated zone of influence (ZOI) of up to 58m. It was estimated that precipitation may contribute up to 1,291 L/day, in addition to the estimated volumes listed above. There is one trench segment in this category, with a trench length of 46m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Storm sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 1.0 and 1.5m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 12,875 and 22,683 L/day, with an estimated zone of influence (ZOI) of up to 29m. It was estimated that precipitation may contribute up to 281L/day, in addition to the estimated volumes listed above. There are two trench segments in this category, ranging in lengths between 8 and 23m. Individual trench segments within this category of sewers could be excavated and dewatered without registering on the EASR.
- **Sanitary sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 2.0 and 2.5 below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 57,651and 66,614 L/day, with an estimated zone of influence (ZOI) of up to 49m. It was estimated that precipitation may contribute up to 539 L/day, in addition to the estimated volumes listed above. There are three trench segments in this category, ranging in lengths between 36 and 45m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration

is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.

- **Sanitary sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 2.5 and 3.0m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to be up to 90,612 L/day, with an estimated zone of influence (ZOI) of up to 58m. It was estimated that precipitation may contribute up to 600 L/day, in addition to the estimated volumes listed above. There is two trench segments in this category, with trench lengths ranging from 20 to 50m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Sanitary sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 3.5 and 4.0 below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 108,527 and 118,337 L/day, with an estimated zone of influence (ZOI) of up to 78m. It was estimated that precipitation may contribute up to 491 L/day, in addition to the estimated volumes listed above. There are two trench segments in this category, ranging in lengths between 35 and 41 m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Sanitary sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 4.5 and 5.0 m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 136,834 and 179,899 L/day, with an estimated zone of influence (ZOI) of up to 97m. It was estimated that precipitation may contribute up to 600 L/day, in addition to the estimated volumes listed above. There are four trench segments in this category, ranging in lengths between 16 and 50 m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.
- **Sanitary sewer (200mm dia.) trench with proposed pipe invert depths plus 1.0m construction drawdown between 5.0 and 5.5 m below the water table:** The dewatering volumes entering across the walls a single trench excavation is estimated to range between 131,903 and 157,233 L/day, with an estimated zone of influence (ZOI) of up to 107m. It was estimated that precipitation may contribute up to 213 L/day, in addition to the estimated volumes listed above. There are four trench segments in this category, ranging in lengths between 20 and 30 m. This estimated volume is above the threshold requirement for a Category 3 PTTW of 50,000 L/day. Registration is recommended based on the potential that the construction dewatering rate for these installations could be between 50,000 L and 400,000 L/day.

The dewatering estimates provided herein address dewatering associated with construction of the proposed utilities, and is intended to be conservative to reflect the maximum volume that could be experienced. These calculations only reflect dewatering requirements for construction of storm and sanitary sewers in up to 50m trench segments. Ideally, work can be coordinated on the Site so that the combined daily flows from all dewatering can be managed to be less than 400,000 L/day under a registered EASR, such that a Permit To Take Water is not required.

The utilities are to be constructed with low-permeability seals within the backfill below the seasonally high water table to minimize the potential for drainage of water or potential movement of contaminants within the excavated trenches.

This assessment does not represent an engineering design of a dewatering operation, but provides a preliminary hydrogeological analysis for assessment of dewatering volumes. The actual design of the dewatering operation will be the responsibility of the contractors.

7.4 DEWATERING SUMMARY

The conservative calculations of potential volumes of water that may require removal during construction or during long term use of the proposed residences are summarized in **Table 5, Table 6 and Table 7**.

There is potential that the volumes of water to be removed during construction dewatering may be greater than 50,000 L/day but will likely be less than 400,000 L/day. The proposed construction at the site is recommended to be registered as an activity on the EASR. Management may be required to coordinate construction activities such that daily dewatering volumes removed are maintained at less than 400,000 L/day. Records to demonstrate that daily volumes are less than 400,000 L/day for the Site will be a requirement of registration.

WSP notes that the water table is observed to vary by approximately 1.5 m in monitoring wells MW18-1 and MW18-2 during the course of the year, with higher values in the winter and spring and lower values in the summer and fall. Review of the water level data suggests that the foundation in buildings 1, 2, 6, 7 and 11 will be below the seasonally high water table. Water proofing of the foundations is recommended to reduce the potential that water is being removed and thereby complying with Policy DEMD-1 (see Section 6.1).

The potential capacity of the Region of Durham storm sewers to receive these flows has not been evaluated as part of this preliminary evaluation. The estimated rate of pumping to maintain dry foundations will likely exceed 50,000 L/day, and therefore the pumping activity will need to be registered on the EASR. An agreement with the Region of Durham will be required for discharge to be directed to the storm or sanitary sewers.

Review of the water level data suggests that the foundations for the proposed structures will be above the seasonally low water table and that foundation drainage would not occur year round, and may increase in response to precipitation events. Review of proposed foundation levels is recommended to confirm that they are above the seasonally low level.

8 CONCLUSIONS

1 WSP Canada Inc. (WSP) was retained by Westlane Development Group Ltd. to prepare a Hydrogeological Assessment and Water Balance Study for the proposed residential development located at 226 Brock Street East, Uxbridge, Ontario (Site).

2 The proposed development area lies within the Peterborough Drumlin Field physiographic region as defined by Chapman and Putnam (1984). The Peterborough Drumlin Field is typically characterized by rolling till plain. The area in and around the Site consist of clay plains.

3 The Site currently contains a headwater drainage feature that drains northerly across the site and discharges to a culvert beneath Brock Street. The development proposal includes a plan to incorporate the form and function of this headwater drainage feature in a naturalized drainage feature to be constructed along the east side of the property, pending approval of the LSRCA.

4 Based on the stratigraphy observed during the borehole drilling at the Site and well records from MECP Water Well Information System, the Site is predominantly underlain by alternating layers of sand and clay with isolated layers of silt, silty sand/sandy silt and silty clay observed in individual boreholes.

5 Groundwater elevations measured between May 2018 and May 2019 indicate that seasonally high groundwater levels are observed between February and May and also in the late fall, while groundwater levels are observed to be the lowest between July and October.

6 The apparent groundwater flow direction is to the north or northwest. The spacing of monitoring wells and the presence of the headwater drainage feature in the center of the site are factors to be considered in interpreting the groundwater flow direction from groundwater elevation data.

7 Representative groundwater samples were collected from the three (3) monitoring wells on June 21, 2018 and submitted for water quality analysis. The results of the test indicated that parameter concentrations are less than MECP Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for All Types of Property Use (Coarse Textured Soil).

8 The Climate-Based Water Budget indicates that average annual precipitation over the past 30 years is 886.2 mm/year. The available moisture surplus at the Site ranges between 327.1 mm/year to 341.1 mm/year year depending on the type of soil and vegetation cover. The moisture surplus will reflect the infiltration and runoff based on the soil properties, slopes, and vegetation within individual catchments.

9 Under existing conditions, the Site is considered to be one drainage catchment that drains to the ditch along the northern boundary of the site via overland flow.

10 The Pre-Development Water Budget reflects infiltration for the Site of approximately 6,994 m^3/yr and runoff from the Site of approximately 1,889 m^3/yr.

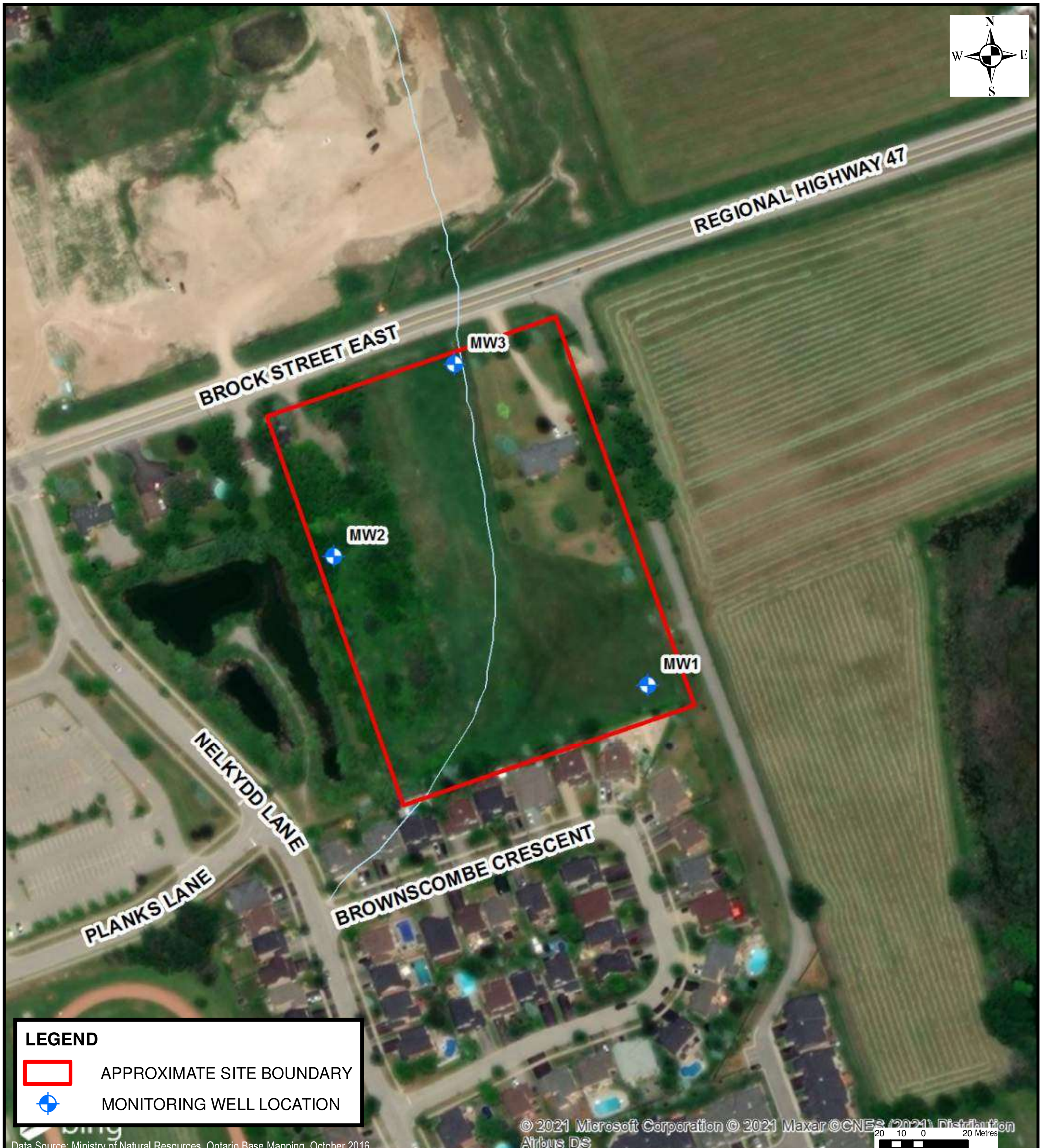
11 The Post-Development Water Budget reflects changes in land use to include increased areas of impervious surfaces (i.e. roads, buildings etc.) and re-grading. A naturalized drainage feature, with swales and soakaway pits is proposed to be constructed to replace the form and function of the headwater drainage feature. The proposed development conditions have been subdivided into six (6) on-site catchments. Runoff within the developed portion of the site is primarily captured by stormwater drainage systems.

12 The Stormwater Management Plan prepared by *IBI* incorporates Low Impact Development features in the form of an infiltration trench in the centre of the development to infiltrate runoff that is generated from rooftops and rear lots in the centre block of the development. The effect of these features is considered in the Post-Development Water Budget.

13 The Post-Development Water Budget predicts a net on-site infiltration of 5,610 m^3/yr. Approximately 2,557 m^3/yr of this infiltration is generated through the proposed LID measures. This reflects a net reduction of 1,385 m^3/yr or 20% relative to Pre-Development. Additional opportunities to further mitigate the infiltration deficit have not been identified.

14 The Post-Development Water Budget predicts a net runoff of 9,382 m^3/yr over the Site area. This is an increase of 7,493 m^3/yr (397%) relative to Pre-Development.

15 The Site lies within WHPA-Q1 and WHPA-Q2 for the Uxbridge Water Supply system with assigned stress levels of moderate. Source Protection Plan (SPP) policies for WHPA-Q1 apply to areas where activities that take water without returning it to the same source may be a threat. SPP policies for WHPA-Q2 apply to areas where activities that reduce recharge might be a threat. Based on the estimated volumes of water that may require removal during construction and long-term drainage of the residential condominium, the Site will need



126 DON HILLOCK DRIVE, UNIT 2
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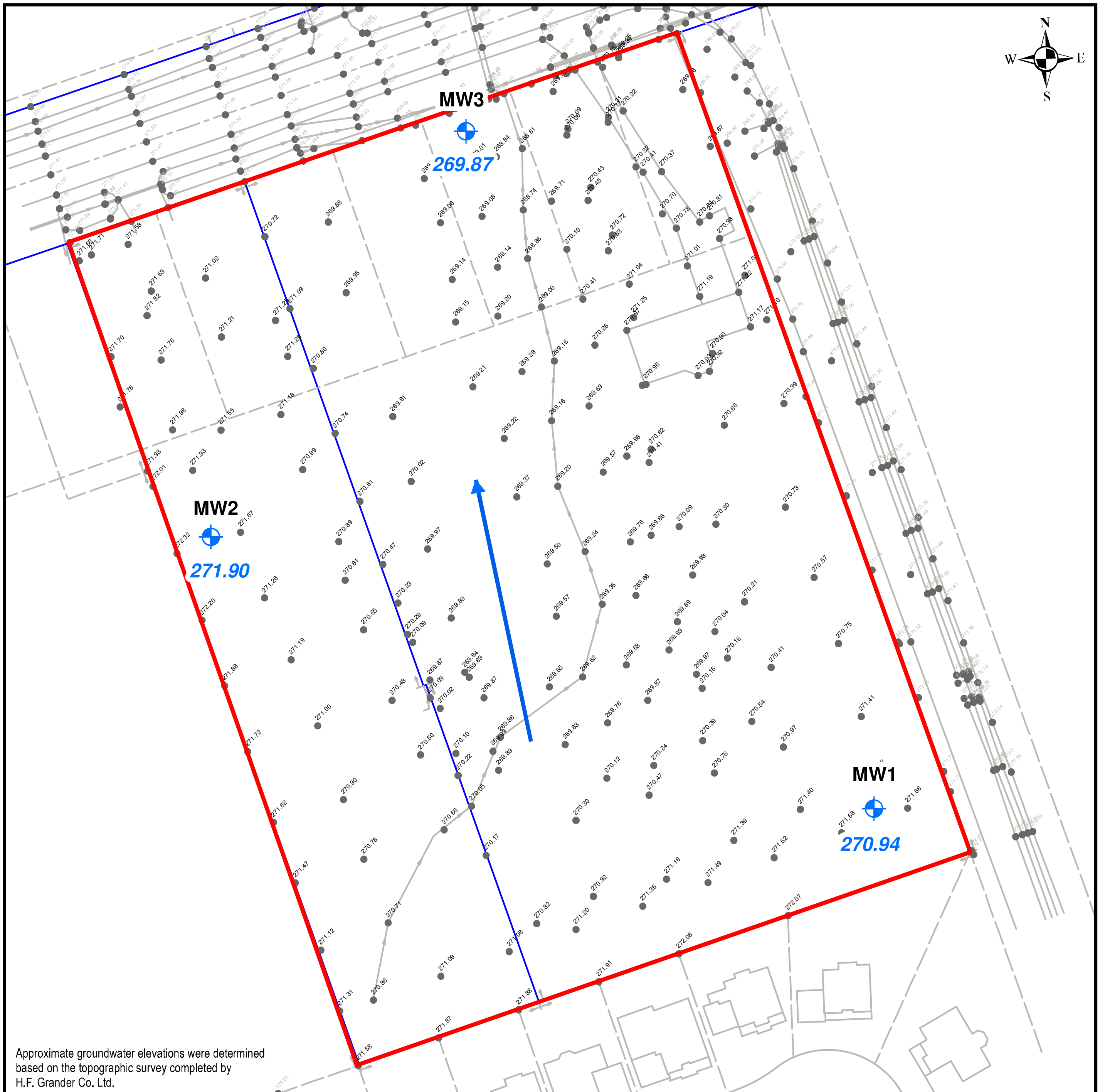
TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:2,500
	DRAWN BY: TP / CHECKED BY: LL
TITLE: EXISTING CONDITIONS	PROJECT NO: 181-06778-01
	DATE: MARCH 2021
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 2 / REV.: -

Document Path: D:\aProjects\181-06778-00\2020\MXD\181-06778-01 Figure 2 Existing Conditions.mxd



Approximate groundwater elevations were determined based on the topographic survey completed by H.F. Grander Co. Ltd.

LEGEND

- APPROXIMATE SITE BOUNDARY
- MONITORING WELL LOCATION
- *271.90* GROUNDWATER ELEVATION
- APPARENT GROUNDWATER FLOW DIRECTION

15 7.5 0 15 Metres

wsp 126 DON HILLOCK DRIVE, UNIT 2 AURORA, ONTARIO CANADA L4G 0G9 TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM	PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:1,250	
		DRAWN BY: TP	CHECKED BY: LL
	TITLE: SEASONAL HIGH WATER LEVELS	PROJECT NO: 181-06778-01	
		DATE: MARCH 2021	
	CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 10	REV.: -

Document Path: D:\aProjects\181-06778-00\2020\MXD\181-06778-01 Figure 10 GW Flow V2.mxd

TABLES

TABLE 1
GROUNDWATER ELEVATIONS
HYDROGEOLOGICAL STUDY AND WATER BALANCE ASSESSMENT
226 BROCK STREET
UXBRIDGE, ON

Monitor Designation	Elevation of T.O.P mASL	Elevation of Ground Surface mASL	PVC Casing Stick-up m	Measurement Date	Depth to Water m bmp	m bgl	Groundwater Elevation (local benchmark) m ASL	Approximate Ground Elevation m ASL	Approximate Groundwater Elevation m ASL
MW18-1	100.21	99.28	0.93	28-May-18	2.45	1.52	97.76	271.68	270.16
				21-Jun-18	2.78	1.85	97.43		269.83
				18-Jul-18	3.20	2.27	97.01		269.41
				9-Aug-18	2.49	1.56	97.72		270.12
				12-Sep-18	2.92	1.99	97.29		269.69
				19-Oct-18	2.97	2.04	97.23		269.64
				21-Nov-18	2.51	1.58	97.70		270.10
				18-Dec-19	2.28	1.35	97.93		270.33
				29-Jan-19	2.71	1.78	97.50		269.90
				15-Feb-19	2.79	1.86	97.42		269.82
				19-Mar-19	2.93	2.00	97.28		269.68
				22-Apr-19	1.84	0.91	98.37		270.77
				15-May-19	1.67	0.74	98.54		270.94
				19-Aug-20	3.13	2.20	97.08		269.48
MW18-2	100.09	99.08	1.02	28-May-18	1.97	0.95	98.13	271.99	271.04
				21-Jun-18	2.24	1.22	97.86		270.77
				18-Jul-18	2.46	1.44	97.63		270.55
				9-Aug-18	1.79	0.77	98.30		271.22
				12-Sep-18	2.07	1.06	98.02		270.93
				19-Oct-18	1.93	0.91	98.17		271.08
				21-Nov-18	1.64	0.62	98.46		271.37
				18-Dec-19	1.57	0.55	98.53		271.44
				29-Jan-19	1.80	0.78	98.29		271.21
				15-Feb-19	1.81	0.79	98.28		271.20
				19-Mar-19	1.70	0.68	98.39		271.31
				22-Apr-19	1.11	0.09	98.98		271.90
				15-May-19	1.20	0.18	98.89		271.81
				19-Aug-20	2.80	1.78	97.29		270.21
MW18-3	97.60	96.72	0.88	28-May-18	1.06	0.18	96.54	269.97	269.79
				21-Jun-18	1.09	0.20	96.52		269.77
				18-Jul-18	1.07	0.19	96.53		269.78
				9-Aug-18	1.00	0.12	96.60		269.85
				12-Sep-18	1.07	0.19	96.53		269.78
				19-Oct-18	1.14	0.25	96.47		269.72
				21-Nov-18	1.04	0.15	96.57		269.82
				18-Dec-19	-	-	-		-
				29-Jan-19	frozen @ 0.97	0.09	96.63		269.88
				15-Feb-19	frozen @ 0.97	0.09	96.63		269.88
				19-Mar-19	frozen @ 0.97	0.09	96.63		269.88
				22-Apr-19	0.99	0.10	96.62		269.87
				5-May-19	1.00	0.12	96.60		269.85
				19-Aug-20	1.18	0.30	96.42		269.67

Notes:

1) "m" indicates metres.
2) "m bmp" indicates metres below measurement point, which is the top of pipe (referred to as T.O.P.)
3) "m bgl" indicates metres below ground level.
4) "m ASL" indiciates metres above sea level.
5) Approximate ground and groundwater elevations were determined based on the topographic survey completed by H.F. Grander Co. Ltd.
6) Approximate groundwater elevations highlight represent seasonally high levels observed at the monitoring well location

Table 2
WATER QUALITY RESULTS
HYDROGEOLOGICAL STUDY AND WATER BALANCE ASSESSMENT
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Parameters	UNIT	Table 2 SCS (1)	MW18-1	MW18-2	MW18-3	DUP (MW18-3)
Sample Date			21-Jun-18	21-Jun-18	21-Jun-18	21-Jun-18
Calculated Parameters						
Anion Sum	me/L	-	3.56	8.3	12.0	11.8
Bicarb. Alkalinity (calc. as CaCO3)	mg/L	-	202	293	377	372
Calculated TDS	mg/L	-	224	506	712	706
Carb. Alkalinity (calc. as CaCO3)	mg/L	-	<10	<10	<10	<10
Cation Sum	me/L	-	4.70	10.00	13.60	13.50
Hardness (CaCO3)	mg/L	-	215	324	480	478
Ion Balance (% Difference)	%	-	132.00	121.00	113.00	114.00
Langelier Index (@ 4C)	N/A	-	0.500	1.000	0.600	0.700
Saturation pH (@ 4C)	N/A	-	7.21	6.95	6.73	6.74
Inorganics						
Total Ammonia-N	mg/L	-	0.13	0.113	0.296	0.354
Conductivity	umho/cm	-	383	878	1240	1230
Dissolved Organic Carbon	mg/L	-	2.0	3.4	3.8	4.7
Orthophosphate (P)	mg/L	-	<0.0030	<0.0030	<0.0030	<0.0030
pH	pH	-	7.74	7.94	7.31	7.39
Dissolved Sulphate (SO4)	mg/L	-	8.4	11.7	33.3	34
Alkalinity (Total as CaCO3)	mg/L	-	202	293	377	372
Dissolved Chloride (Cl)	mg/L	790	1	112	181	178
Nitrite (N)	mg/L	-	<0.010	<0.010	<0.010	<0.010
Nitrate (N)	mg/L	-	0.147	0.06	<0.020	<0.020
Nitrate + Nitrite (N)	mg/L	-	0.147	0.06	<0.022	<0.022
Metals						
Dissolved Aluminum (Al)	mg/L	-	0.0323	0.0098	<0.0050	<0.0050
Dissolved Antimony (Sb)	mg/L	0.006	0.00027	0.00013	<0.00010	0.00014
Dissolved Arsenic (As)	mg/L	0.025	0.00052	0.0008	0.00178	0.00375
Dissolved Barium (Ba)	mg/L	1	0.03	0.127	0.195	0.237
Dissolved Beryllium (Be)	mg/L	0.004	<0.00010	<0.00010	<0.00010	<0.00010
Dissolved Boron (B)	mg/L	5	0.024	0.022	0.031	0.033
Dissolved Cadmium (Cd)	mg/L	0.0027	<0.000010	<0.000010	<0.000010	<0.000010
Dissolved Calcium (Ca)	mg/L	-	79	113	161	160
Dissolved Chromium (Cr)	mg/L	0.05	0.00079	<0.00050	<0.00050	<0.00050
Dissolved Cobalt (Co)	mg/L	0.0038	<0.00010	0.00013	0.00072	0.00074
Dissolved Copper (Cu)	mg/L	0.087	0.00067	0.00537	0.00027	<0.00020
Dissolved Iron (Fe)	mg/L	-	0.035	0.023	1.88	0.47
Dissolved Lead (Pb)	mg/L	0.01	0.000053	0.000162	0.000055	<0.000050
Dissolved Magnesium (Mg)	mg/L	-	4	10	19	19
Dissolved Manganese (Mn)	mg/L	-	0.01	0.0332	3.3700	2.9100
Dissolved Molybdenum (Mo)	mg/L	0.07	0.0034	0.00122	0.000547	0.000814
Dissolved Nickel (Ni)	mg/L	0.1	<0.00050	0.00074	0.002	0.00226
Dissolved Phosphorus (P)	mg/L	-	<0.050	<0.050	<0.050	<0.050
Dissolved Potassium (K)	mg/L	-	0.6	2.3	1.2	1.4
Dissolved Selenium (Se)	mg/L	0.01	0.000501	0.000132	<0.000050	<0.000050
Dissolved Silicon (Si)	mg/L	-	4.9	5.2	8.6	8.4
Dissolved Silver (Ag)	mg/L	0.0015	<0.000050	<0.000050	<0.000050	<0.000050
Dissolved Sodium (Na)	mg/L	-	9	80	90	91
Dissolved Strontium (Sr)	mg/L	-	0.15	0.28	0.38	0.38
Dissolved Thallium (Tl)	mg/L	0.002	<0.000010	0.000013	<0.000010	<0.000010
Dissolved Titanium (Ti)	mg/L	-	0.00142	<0.00030	<0.00030	<0.00030
Dissolved Uranium (U)	mg/L	0.02	0.0007	0.00119	0.00033	0.00049
Dissolved Vanadium (V)	mg/L	0.0062	0.0007	0.00098	<0.00050	0.00134
Dissolved Zinc (Zn)	mg/L	1.1	0.0015	0.0115	0.0019	<0.0010

NOTES
1) Table 2 SCS = Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (April 2011).
2) Yellow shading indicates parameter reportable detection

TABLE 3
CLIMATIC WATER BUDGET SUMMARY TABLE
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Year of Climate Data Used	Total Adjusted Potential Evapotranspiration	Total Water Surplus	Total Precipitation	Soil Type	Land Use	Water Holding Capacity	Total Actual Evapotranspiration	Total Moisture Surplus used for Water Balance
	mm/yr	mm/yr	mm/yr			mm/yr	mm/yr	mm/yr
CLIMATE NORMAL 1981-2010	579.3	306.9	886.2	Fine Sandy Loam	Residential Lawn	75	545.1	341.1
					Cultivated	150	559.1	327.1
					Uncultivated	200	559.1	327.1

NOTES:
1) Water Holding Capacity obtained from Environmental Design Criteria of the SWM Planning and Design Manual published by the MOE in 2003.

TABLE 4 WATER BALANCE SUMMARY
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

A. OVERALL WATER BALANCE

Characteristics		Pre-development		Post-development (No Recharge mitigation)		Change	
		Volume (m^3/yr)	mm/yr	Volume (m^3/yr)	mm/yr	Volume (m^3/yr)	%
Input	Precipitation	23,146	886	23,146	886	0	0%
	Runon	0	0	0	0	0	0.0%
	Total In	**23,146**	**886**	**23,146**	**886**	**0**	**0.00%**
Output	Infiltration via Pervious Areas	6,365	244	3,053	117	-3,312	-52%
	Add: Additional Headwater Infiltration	630	24	0	0	-630	-100%
	Add: Infiltration via Rooftop Disconnect	0	0	1,685	65	1,685	>100%
	Add: Infiltration via Infiltration Trench	0	0	872	33	872	>100%
	Total Infiltration	6,994	268	5,610	215	-1,385	**-20%**
	Total Run-off	2,519	96	11,939	457	9,420	374.0%
	Less: Runoff Infiltrated by Headwater	-630	-24	0	0	630	-100.0%
	Less: Infiltration via Rooftop Disconnect	0	0	-1,685	-65	-1,685	-100.0%
	Less: Infiltration via Infiltration Trench	0	0	-872	-33	-872	-100.0%
	Net Runoff	1,889	72	9,382	359	7,493	396.6%
	Evapotranspiration	14,262	546	8,154	312	-6,108	-42.8%
	Total Out	**23,146**	**886**	**23,146**	**886**	**0**	**0.00%**

TABLE 5 CONSTRUCTION DEWATERING ESTIMATES SUMMARY - BUILDINGS

UPDATED HYDROGEOLOGICAL STUDY AND WATER BALANCE ASSESSMENT

226 BROCK STREET EAST

UXBRIDGE, ONTARIO

Building Number	Building Type	Length	Width	Area	Footing Depth Below Water Table	Footing Depth + 0.5m Below Water Table	Footing Depth Above Water Table	Construction Conservative Rate			Total Estimated Value	Precipitation Contribution Per Building
								Estimated Value	With Safety Factor	Maximum ZOI		
		(m)	(m)	(m^2)	(m)	(m)	(m)	(L/day)	(L/day)	(m)	(L/day)	(L/day)
1	A	29.4	13.3	391.0	0.5-1.0	1.0-1.5	NA	38,996	58,494	24	58,494	3,910
2	B	36.5	13.3	485.5	0-0.5	0.5-1.0	NA	31,395	47,092	15	47,092	4,855
3	C	35.4	14.2	502.7	NA	NA	1.0-1.5	NA	NA	NA	NA	5,027
4	D	42.5	14.2	603.5	NA	NA	1.0-1.5	NA	NA	NA	NA	6,035
5	D	42.5	14.2	603.5	NA	NA	0.5-1.0	NA	NA	NA	NA	6,035
6	D	42.5	14.2	603.5	0.5-1.0	1.0-1.5	NA	52,115	78,173	24	78,173	6,035
7	D	42.5	14.2	603.5	0-0.5	0.5-1.0	NA	36,921	55,381	15	55,381	6,035
8	D	42.5	14.2	603.5	NA	NA	0.5-1.0	NA	NA	NA	NA	6,035
9	D	42.5	14.2	603.5	NA	NA	0.5-1.0	NA	NA	NA	NA	6,035
10	E	54.4	16.2	881.3	NA	NA	0-0.5	NA	NA	NA	NA	8,813
11	E	54.4	16.2	881.3	0-0.5	0.5-1.0	NA	49,308	73,962	15	73,962	8,813
Total								**209,000**	**313,000**	**-**	**313,000**	**68,000**

Note: NA - Not Applicable

TABLE 6 DRAINAGE DEWATERING ESTIMATES SUMMARY - BUILDINGS
UPDATED HYDROGEOLOGICAL STUDY AND WATER BALANCE ASSESSMENT
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Building Number	Building Type	Length	Width	Area	Footing Depth Below Water Table	Footing Depth Above Water Table	Construction Conservative Rate			Total Estimated Value	Precipitation Contribution Per Building
							Estimated Value	With Safety Factor	Maximum ZOI		
		(m)	(m)	(m^2)	(m)	(m)	(L/day)	(L/day)	(m)	(L/day)	(L/day)
1	A	29.4	13.3	391.0	0.5-1.0	NA	26,524	39,785	15	39,785	3,910
2	B	36.5	13.3	485.5	0-0.5	NA	20,732	31,099	5	31,099	4,855
3	C	35.4	14.2	502.7	NA	1.0-1.5	NA	NA	NA	NA	5,027
4	D	42.5	14.2	603.5	NA	1.0-1.5	NA	NA	NA	NA	6,035
5	D	42.5	14.2	603.5	NA	0.5-1.0	NA	NA	NA	NA	6,035
6	D	42.5	14.2	603.5	0.5-1.0	NA	36,921	55,381	15	55,381	6,035
7	D	42.5	14.2	603.5	0-0.5	NA	25,300	37,950	5	37,950	6,035
8	D	42.5	14.2	603.5	NA	0.5-1.0	NA	NA	NA	NA	6,035
9	D	42.5	14.2	603.5	NA	0.5-1.0	NA	NA	NA	NA	6,035
10	E	54.4	16.2	881.3	NA	0-0.5	NA	NA	NA	NA	8,813
11	E	54.4	16.2	881.3	0-0.5	NA	35,918	53,877	5	53,877	8,813
						Total	**145,000**	**218,000**	**-**	**218,000**	**68,000**

Note: NA - Not Applicable

TABLE 7 CONSTRUCTION DEWATERING ESTIMATES SUMMARY - UTILITIES
UPDATED HYDROGEOLOGICAL STUDY AND WATER BALANCE ASSESSMENT
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Servicing Segment	Type of Servicing	Total Trench Length	Open Trench Length During Construction	No. of Trench Segments	Width	Sewer Depth Below Water Table	Sewer Depth + 1.0 m Below Water Table	Initial Elevation of Water Table	Sewer Depth Above Water Table	Construction Conservative Rate Estimated Value Per Trench	Construction Conservative Rate With Safety Factor	Construction Conservative Rate Maximum ZOI	Number of Trench Segments	Total Estimated Value	Precipitation Contribution Per Trench
		(m)	(m)	(m)	(m)	(m)	(m)	(m)	(m)	(L/day)	(L/day)	(m)		(L/day)	(L/day)
Between STM MH11 and MH12	Storm (450mm dia.)	16.7	16.7	1.0	1.5	NA	NA	NA	0.5-1.0	0	0	0	1.0	0	242
Between STM MH11 and MH12	Storm (450mm dia.)	16.8	16.8	1.0	1.5	NA	NA	NA	>1.0	0	0	0	1.0	0	244
Between STM MH10 nad MH11	Storm (450mm dia.)	5.2	5.2	1.0	1.5	NA	NA	NA	0.5-1.0	0	0	0	1.0	0	75
Between STM MH11 and Jellyfish	Storm (450mm dia.)	3.4	3.4	1.0	1.5	NA	NA	NA	0-0.5	0	0	0	1.0	0	49
Between STM MH10 and Jellyfish	Storm (450mm dia.)	3.3	3.3	1.0	1.5	NA	NA	NA	0-0.5	0	0	0	1.0	0	48
Between STM MH9 and MH10	Storm (450mm dia.)	7.7	7.7	1.0	1.5	0-0.5	1.0-1.5	1.5	NA	13,206	13,206	29	1.0	13,206	112
Between STM MH8 and MH9	Storm (450mm dia.)	15.9	15.9	1.0	1.5	NA	NA	NA	0-0.5	0	0	0	1.0	0	231
Between STM MH8 and MH9	Storm (450mm dia.)	15.7	15.7	1.0	1.5	NA	NA	NA	0.5-1.0	0	0	0	1.0	0	228
Between STM MH2 and MH8	Storm (1800mm x 900mm)	40.8	40.8	1.0	2.8	1.0-1.5	2.0-2.5	2.5	NA	66,203	66,203	49	1.0	66,203	1,142
Between STM MH2 and MH8	Storm (1800mm x 900mm)	40.8	40.8	1.0	2.8	NA	NA	NA	0-0.5	0	0	0	1.0	0	1,142
Between STM MH1 and MH2	Storm (250mm dia.)	19.5	19.5	1.0	1.3	1.5-2.0	2.5-3.0	3	NA	54,065	54,065	58	1.0	54,065	244
Between STM MH2 and MH3	Storm (1800mm x 900mm)	46.1	46.1	1.0	2.8	1.5-2.0	2.5-3.0	3	NA	90,883	90,883	58	1.0	90,883	1,291
Between STM MH2 and MH3	Storm (1800mm x 900mm)	45.8	45.8	1.0	2.8	1.0-1.5	2.0-2.5	2.5	NA	70,876	70,876	49	1.0	70,876	1,282
Between STM MH7 and MH8	Storm (1800mm x 900mm)	53.9	50.0	1.1	2.8	NA	NA	NA	0.5-1.0	0	0	0	1.1	0	1,400
East of CBMH1	Storm (250mm dia.)	4.8	4.8	1.0	1.3	NA	NA	NA	0.5-1.0	0	0	0	1.0	0	60
East of CBMH1	Storm (250mm dia.)	33.2	33.2	1.0	1.3	NA	NA	NA	>1.0	0	0	0	1.0	0	415
Between STM MH6 and MH7	Storm (1800mm x 900mm)	54.1	50.0	1.1	2.8	NA	NA	NA	0.5-1.0	0	0	0	1.1	0	1,400
Between STM MH5 and MH6	Storm (1800mm x 900mm)	29.2	29.2	1.0	2.8	NA	NA	NA	0-0.5	0	0	0	1.0	0	818
Between STM MH5 and MH13	Storm (200mm dia.)	7.6	7.6	1.0	1.2	NA	NA	NA	0-0.5	0	0	0	1.0	0	91
Between STM MH5 and MH13	Storm (200mm dia.)	7.6	7.6	1.0	1.2	0-0.5	1.0-1.5	1.5	NA	12,875	12,875	29	1.0	12,875	91
Between STM MH13 to RLCB8	Storm (200mm dia.)	23.4	23.4	1.0	1.2	0-0.5	1.0-1.5	1.5	NA	22,683	22,683	29	1.0	22,683	281
Between STM MH4 and MH6	Storm (1800mm x 900mm)	70.0	50.0	1.4	2.8	NA	NA	NA	0-0.5	0	0	0	1.4	0	1,400
Between STM MH4 and MH14	Storm (200mm dia.)	5.7	5.7	1.0	1.2	NA	NA	NA	0-0.5	0	0	0	1.0	0	68
Between STM MH14 and RLCB7	Storm (200mm dia.)	24.8	24.8	1.0	1.2	NA	NA	NA	0-0.5	0	0	0	1.0	0	298
North of STM CBMH4	Storm (300mm dia.)	30.7	30.7	1.0	1.3	NA	NA	NA	0-0.5	0	0	0	1.0	0	399
Between STM CBMH4 and RLCB6	Storm (200mm dia.)	47.9	47.9	1.0	1.2	NA	NA	NA	0-0.5	0	0	0	1.0	0	575
									Sub Total for Storm Sewers	**331,000**	**331,000**			**331,000**	**14,000**
Between SAN MH1A and MH2A	Sanitary (200mm dia.)	40.3	40.3	1.0	1.2	1.0-1.5	2.0-2.5	2.5	NA	62,264	62,264	49	1.0	62,264	484
Between SAN MH2A and MH4A	Sanitary (200mm dia.)	44.9	44.9	1.0	1.2	1.0-1.5	2.0-2.5	2.5	NA	66,614	66,614	49	1.0	66,614	539
etween SAN MH2A and MH4A, MH3A and MH4	Sanitary (200mm dia.)	69.4	50	1.4	1.2	1.5-2.0	2.5-3.0	3	NA	90,612	90,612	58	1.4	125,770	600
Between SAN MH4A and LIFT	Sanitary (200mm dia.)	40.9	40.9	1.0	1.2	2.5-3.0	3.5-4.0	4	NA	118,337	118,337	78	1.0	118,337	491
Between SAN MH4A and LIFT	Sanitary (200mm dia.)	40.3	40.3	1.0	1.2	3.5-4.0	4.5-5.0	5	NA	160,008	160,008	97	1.0	160,008	484
Between SAN LIFT and MH8A	Sanitary (75mm dia.)	19.8	19.8	1.0	1.1	4.0-4.5	5.0-5.5	5.5	NA	131,903	131,903	107	1.0	131,903	213
Between SAN LIFT and MH8A	Sanitary (75mm dia.)	19.8	19.8	1.0	1.1	NA	NA	NA	0-0.5	0	0	0	1.0	0	213
Between SAN LIFT and MH7A	Sanitary (200mm dia.)	29.4	29.4	1.0	1.2	4.0-4.5	5.0-5.5	5.5	NA	157,233	157,233	107	1.0	157,233	353
Between SAN LIFT and MH7A	Sanitary (200mm dia.)	29.4	29.4	1.0	1.2	3.5-4.0	4.5-5.0	5	NA	136,834	136,834	97	1.0	136,834	353
Between SAN MH6A and MH7A	Sanitary (200mm dia.)	56.0	50	1.1	1.2	3.5-4.0	4.5-5.0	5	NA	179,899	179,899	97	1.1	201,487	600
Between SAN MH5A and MH6A	Sanitary (200mm dia.)	34.9	34.9	1.0	1.2	2.5-3.0	3.5-4.0	4	NA	108,527	108,527	78	1.0	108,527	419
Between SAN MH5A and MH6A	Sanitary (200mm dia.)	35.5	35.5	1.0	1.2	1-1.5	2.0-2.5	2.5	NA	57,651	57,651	49	1.0	57,651	426
									Sub Total for Sanitary Sewers	**1,270,000**	**1,270,000**			**1,327,000**	**5,000**
									Total	**1,601,000**	**1,601,000**			**1,657,000**	**19,000**

Note: NA - Not Applicable

APPENDIX

E WATER BUDGET CALCULATIONS – PRE-DEVELOPMENT

TABLE E-1 PRE-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Subcatchment Designation	Post Dev Cat Delineation	Outlet	Area	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted MOE Infiltration Factor	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon		Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			(m^2)	Cover		Soil		Topography			(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(m^3/a)
Cat A-1	Cat PE-1	Offsite to the Northeast via overland flow	697.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	617.7	327.1	389.8	0	0	327.1	228.0	245.3	171.0	81.8	57.0	228.0
Cat A-2	Cat PD-2	Offsite to the Northeast via overland flow	261.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	231.4	327.1	146.0	0	0	327.1	85.4	245.3	64.0	81.8	21.3	85.4
Cat A-3	Cat PA1-3	Offsite to the Northeast via overland flow	184.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	163.4	327.1	103.1	0	0	327.1	60.3	245.3	45.2	81.8	15.1	60.3
Cat A-4	Cat PC-4	Offsite to the Northeast via overland flow	953.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	844.6	327.1	532.9	0	0	327.1	311.7	245.3	233.8	81.8	77.9	311.7
Cat A-5	Cat PA2-5	Offsite to the Northeast via overland flow	51.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	45.2	327.1	28.5	0	0	327.1	16.7	245.3	12.5	81.8	4.2	16.7
Cat A-6	Cat PF-6	Offsite to the Northeast via overland flow	227.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	201.7	327.1	127.3	0	0	327.1	74.5	245.3	55.8	81.8	18.6	74.5
Cat A-7	Cat PE-7	Offsite to the Northeast via overland flow	129.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	114.7	327.1	72.4	0	0	327.1	42.3	245.3	31.8	81.8	10.6	42.3
Cat A-8	Cat PE-8	Offsite to the Northeast via overland flow	395.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	350.1	327.1	220.9	0	0	327.1	129.2	245.3	96.9	81.8	32.3	129.2
Cat A-9	Cat PD-9	Offsite to the Northeast via overland flow	148.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	131.3	327.1	82.8	0	0	327.1	48.5	245.3	36.3	81.8	12.1	48.5
Cat A-10	Cat PA1-10	Offsite to the Northeast via overland flow	10.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	9.1	327.1	5.8	0	0	327.1	3.4	245.3	2.5	81.8	0.8	3.4
Cat A-11	Cat PA1-11	Offsite to the Northeast via overland flow	4.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	4.4	327.1	2.8	0	0	327.1	1.6	245.3	1.2	81.8	0.4	1.6
Cat A-12	Cat PA1-12	Offsite to the Northeast via overland flow	234.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	207.9	327.1	131.2	0	0	327.1	76.7	245.3	57.5	81.8	19.2	76.7
Cat A-13	Cat PA1-13	Offsite to the Northeast via overland flow	11.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	9.9	327.1	6.3	0	0	327.1	3.7	245.3	2.8	81.8	0.9	3.7
Cat A-14	Cat PA1-14	Offsite to the Northeast via overland flow	17.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	15.4	327.1	9.7	0	0	327.1	5.7	245.3	4.3	81.8	1.4	5.7
Cat A-15	Cat PC-15	Offsite to the Northeast via overland flow	571.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	506.5	327.1	319.6	0	0	327.1	186.9	245.3	140.2	81.8	46.7	186.9
Cat A-16	Cat PC-16	Offsite to the Northeast via overland flow	571.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	506.5	327.1	319.6	0	0	327.1	186.9	245.3	140.2	81.8	46.7	186.9
Cat A-17	Cat PB-17	Offsite to the Northeast via overland flow	157.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	139.9	327.1	88.3	0	0	327.1	51.6	245.3	38.7	81.8	12.9	51.6
Cat A-18	Cat PB-18	Offsite to the Northeast via overland flow	470.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	417.0	327.1	263.1	0	0	327.1	153.9	245.3	115.4	81.8	38.5	153.9
Cat A-19	Cat PB-19	Offsite to the Northeast via overland flow	10.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	9.1	327.1	5.8	0	0	327.1	3.4	245.3	2.5	81.8	0.8	3.4
Cat A-20	Cat PB-20	Offsite to the Northeast via overland flow	10.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	9.0	327.1	5.7	0	0	327.1	3.3	245.3	2.5	81.8	0.8	3.3
Cat A-21	Cat PB-21	Offsite to the Northeast via overland flow	9.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	8.7	327.1	5.5	0	0	327.1	3.2	245.3	2.4	81.8	0.8	3.2
Cat A-22	Cat PB-22	Offsite to the Northeast via overland flow	9.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	8.7	327.1	5.5	0	0	327.1	3.2	245.3	2.4	81.8	0.8	3.2
Cat A-23	Cat PB-23	Offsite to the Northeast via overland flow	10.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	8.9	327.1	5.6	0	0	327.1	3.3	245.3	2.5	81.8	0.8	3.3
Cat A-24	Cat PB-24	Offsite to the Northeast via overland flow	10.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	9.2	327.1	5.8	0	0	327.1	3.4	245.3	2.5	81.8	0.8	3.4
Cat A-25	Cat PB-25	Offsite to the Northeast via overland flow	3.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	3.4	327.1	2.2	0	0	327.1	1.3	245.3	0.9	81.8	0.3	1.3
Cat A-26	Cat PB-26	Offsite to the Northeast via overland flow	220.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	195.4	327.1	123.3	0	0	327.1	72.1	245.3	54.1	81.8	18.0	72.1
Cat A-27	Cat PB-27	Offsite to the Northeast via overland flow	221.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	196.1	327.1	123.7	0	0	327.1	72.4	245.3	54.3	81.8	18.1	72.4
Cat A-28	Cat PB-28	Offsite to the Northeast via overland flow	42.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	37.2	327.1	23.5	0	0	327.1	13.7	245.3	10.3	81.8	3.4	13.7
Cat A-29	Cat PB-29	Offsite to the Northeast via overland flow	43.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	38.2	327.1	24.1	0	0	327.1	14.1	245.3	10.6	81.8	3.5	14.1
Cat A-30	Cat PB-30	Offsite to the Northeast via overland flow	43.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	38.3	327.1	24.2	0	0	327.1	14.1	245.3	10.6	81.8	3.5	14.1
Cat A-31	Cat PB-31	Offsite to the Northeast via overland flow	42.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	37.7	327.1	23.8	0	0	327.1	13.9	245.3	10.4	81.8	3.5	13.9
Cat A-32	Cat PB-32	Offsite to the Northeast via overland flow	42.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	37.5	327.1	23.7	0	0	327.1	13.8	245.3	10.4	81.8	3.5	13.8
Cat A-33	Cat PB-33	Offsite to the Northeast via overland flow	39.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	35.2	327.1	22.2	0	0	327.1	13.0	245.3	9.8	81.8	3.3	13.0
Cat A-34	Cat PB-34	Offsite to the Northeast via overland flow	41.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	36.8	327.1	23.2	0	0	327.1	13.6	245.3	10.2	81.8	3.4	13.6
Cat A-35	Cat PB-35	Offsite to the Northeast via overland flow	37.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	32.9	327.1	20.8	0	0	327.1	12.2	245.3	9.1	81.8	3.0	12.2
Cat A-36	Cat PB-36	Offsite to the Northeast via overland flow	39.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	34.6	327.1	21.8	0	0	327.1	12.8	245.3	9.6	81.8	3.2	12.8
Cat A-37	Cat PB-37	Offsite to the Northeast via overland flow	39.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	35.1	327.1	22.1	0	0	327.1	12.9	245.3	9.7	81.8	3.2	12.9
Cat A-38	Cat PB-38	Offsite to the Northeast via overland flow	39.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	34.8	327.1	22.0	0	0	327.1	12.9	245.3	9.6	81.8	3.2	12.9
Cat A-39	Cat PB-39	Offsite to the Northeast via overland flow	39.7	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	35.2	327.1	22.2	0	0	327.1	13.0	245.3	9.7	81.8	3.2	13.0
Cat A-40	Cat PB-40	Offsite to the Northeast via overland flow	71.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.3	327.1	40.0	0	0	327.1	23.4	245.3	17.5	81.8	5.8	23.4
Cat A-41	Cat PB-41	Offsite to the Northeast via overland flow	71.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.4	327.1	40.0	0	0	327.1	23.4	245.3	17.5	81.8	5.8	23.4
Cat A-42	Cat PB-42	Offsite to the Northeast via overland flow	42.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	37.3	327.1	23.5	0	0	327.1	13.8	245.3	10.3	81.8	3.4	13.8
Cat A-43	Cat PB-43	Offsite to the Northeast via overland flow	3.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	3.2	327.1	2.0	0	0	327.1	1.2	245.3	0.9	81.8	0.3	1.2
Cat A-44	Cat PB-44	Offsite to the Northeast via overland flow	15.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	14.1	327.1	8.9	0	0	327.1	5.2	245.3	3.9	81.8	1.3	5.2
Cat A-45	Cat PB-45	Offsite to the Northeast via overland flow	16.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	14.2	327.1	9.0	0	0	327.1	5.2	245.3	3.9	81.8	1.3	5.2
Cat A-46	Cat PB-46	Offsite to the Northeast via overland flow	48.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	42.7	327.1	27.0	0	0	327.1	15.8	245.3	11.8	81.8	3.9	15.8
Cat A-47	Cat PB-47	Offsite to the Northeast via overland flow	73.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	64.7	327.1	40.8	0	0	327.1	23.9	245.3	17.9	81.8	6.0	23.9
Cat A-48	Cat PB-48	Offsite to the Northeast via overland flow	74.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	66.1	327.1	41.7	0	0	327.1	24.4	245.3	18.3	81.8	6.1	24.4
Cat A-49	Cat PB-49	Offsite to the Northeast via overland flow	71.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.1	327.1	39.8	0	0	327.1	23.3	245.3	17.5	81.8	5.8	23.3
Cat A-50	Cat PB-50	Offsite to the Northeast via overland flow	71.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.4	327.1	40.0	0	0	327.1	23.4	245.3	17.5	81.8	5.8	23.4
Cat A-51	Cat PB-51	Offsite to the Northeast via overland flow	72.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	64.4	327.1	40.6	0	0	327.1	23.8	245.3	17.8	81.8	5.9	23.8
Cat A-52	Cat PB-52	Offsite to the Northeast via overland flow	71.5	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.4	327.1	40.0	0	0	327.1	23.4	245.3	17.5	81.8	5.8	23.4
Cat A-53	Cat PB-53	Offsite to the Northeast via overland flow	176.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	156.2	327.1	98.5	0	0	327.1	57.6	245.3	43.2	81.8	14.4	57.6
Cat A-54	Cat PB-54	Offsite to the Northeast via overland flow	72.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	63.9	327.1	40.3	0	0	327.1	23.6	245.3	17.7	81.8	5.9	23.6
Cat A-55	Cat PB-55	Offsite to the Northeast via overland flow	2184.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	1935.4	327.1	1221.1	0	0	327.1	714.3	245.3	535.7	81.8	178.6	714.3
Cat A-56	Cat PB-56	Offsite to the Northeast via overland flow	58.3	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	51.6	327.1	32.6	0	0	327.1	19.1	245.3	14.3	81.8	4.8	19.1
Cat A-57	Cat PB-57	Offsite to the Northeast via overland flow	50.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	44.8	327.1	28.3	0	0	327.1	16.6	245.3	12.4	81.8	4.1	16.6
Cat A-58	Cat PB-58	Offsite to the Northeast via overland flow	19.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	17.4	327.1	11.0	0	0	327.1	6.4	245.3	4.8	81.8	1.6	6.4
Cat A-59	Cat PB-59	Offsite to the Northeast via overland flow	14.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	12.6	327.1	8.0	0	0	327.1	4.7	245.3	3.5	81.8	1.2	4.7
Cat A-60	Cat PB-60	Offsite to the Northeast via overland flow	3.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	2.7	327.1	1.7	0	0	327.1	1.0	245.3	0.8	81.8	0.3	1.0
Cat A-61	Cat PB-61	Offsite to the Northeast via overland flow	12.7	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	11.3	327.1	7.1	0	0	327.1	4.2	245.3	3.1	81.8	1.0	4.2
Cat A-62	Cat PB-62	Offsite to the Northeast via overland flow	1.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	1.6	327.1	1.0	0	0	327.1	0.6	245.3	0.4	81.8	0.1	0.6
Cat A-63	Cat PB-63	Offsite to the Northeast via overland flow	23.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	20.6	327.1	13.0	0	0	327.1	7.6	245.3	5.7	81.8	1.9	7.6
Cat A-64	Cat PB-64	Offsite to the Northeast via overland flow	2.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	2.5	327.1	1.6	0	0	327.1	0.9	245.3	0.7	81.8	0.2	0.9
Cat A-65	Cat PB-65	Offsite to the Northeast via overland flow	18.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	16.0	327.1	10.1	0	0	327.1	5.9	245.3	4.4	81.8	1.5	5.9
Cat A-66	Cat PB-66	Offsite to the Northeast via overland flow	185.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	164.7	327.1	103.9	0	0	327.1	60.8	245.3	45.6	81.8	15.2	60.8
Cat A-67	Cat PB-67	Offsite to the Northeast via overland flow	99.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	88.2	327.1	55.7	0	0	327.1	32.6	245.3	24.4	81.8	8.1	32.6
Cat A-68	Cat PB-68	Offsite to the Northeast via overland flow	96.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	85.3	327.1	53.8	0	0	327.1	31.5	245.3	23.6	81.8	7.9	31.5
Cat A-69	Cat PB-69	Offsite to the Northeast via overland flow	2.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	2.1	327.1	1.3	0	0	327.1	0.8	245.3	0.6	81.8	0.2	0.8
Cat A-70	Cat PB-70	Offsite to the Northeast via overland flow	168.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	148.9	327.1	93.9	0	0	327.1	55.0	245.3	41.2	81.8	13.7	55.0
Cat A-71	Cat PB-71	Offsite to the Northeast via overland flow	97.1	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	86.0	327.1	54.3	0	0	327.1	31.7	245.3	23.8	81.8	7.9	31.7
Cat A-72	Cat PB-72	Offsite to the Northeast via overland flow	97.8	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	86.7	327.1	54.7	0	0	327.1	32.0	245.3	24.0	81.8	8.0	32.0
Cat A-73	Cat PB-73	Offsite to the Northeast via overland flow	96.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	85.9	327.1	54.2	0	0	327.1	31.7	245.3	23.8	81.8	7.9	31.7
Cat A-74	Cat PB-74	Offsite to the Northeast via overland flow	95.7	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	84.8	327.1	53.5	0	0	327.1	31.3	245.3	23.5	81.8	7.8	31.3
Cat A-75	Cat PB-75	Offsite to the Northeast via overland flow	153.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	135.9	327.1	85.8	0	0	327.1	50.2	245.3	37.6	81.8	12.5	50.2
Cat A-76	Cat PB-76	Offsite to the Northeast via overland flow	128.0	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	113.4	327.1	71.6	0	0	327.1	41.9	245.3	31.4	81.8	10.5	41.9
Cat A-77	Cat PB-77	Offsite to the Northeast via overland flow	171.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	151.9	327.1	95.8	0	0	327.1	56.0	245.3	42.0	81.8	14.0	56.0
Cat A-78	Cat PB-78	Offsite to the Northeast via overland flow	27.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	24.1	327.1	15.2	0	0	327.1	8.9	245.3	6.7	81.8	2.2	8.9
Cat A-79	Cat PB-79	Offsite to the Northeast via overland flow	26.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	23.9	327.1	15.1	0	0	327.1	8.8	245.3	6.6	81.8	2.2	8.8
Cat A-80	Cat PB-80	Offsite to the Northeast via overland flow	26.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	23.4	327.1	14.8	0	0	327.1	8.6	245.3	6.5	81.8	2.2	8.6
Cat A-81	Cat PB-81	Offsite to the Northeast via overland flow	26.9	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	23.8	327.1	15.0	0	0	327.1	8.8	245.3	6.6	81.8	2.2	8.8
Cat A-82	Cat PB-82	Offsite to the Northeast via overland flow	36.2	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	32.1	327.1	20.2	0	0	327.1	11.8	245.3	8.9	81.8	3.0	11.8
Cat A-83	Cat PB-83	Offsite to the Northeast via overland flow	25.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	22.5	327.1	14.2	0	0	327.1	8.3	245.3	6.2	81.8	2.1	8.3
Cat A-84	Cat PB-84	Offsite to the Northeast via overland flow	6.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	5.7	327.1	3.6	0	0	327.1	2.1	245.3	1.6	81.8	0.5	2.1
Cat A-85	Cat PA1-85	Offsite to the Northeast via overland flow	7.2	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	6.4	797.6	0.6	0	0	797.6	5.7	0.0	0.0	797.6	5.7	5.7

TABLE E-1 PRE-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Subcatchment Designation	Post Dev Cat Delineation	Outlet	Area	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted MOE Infiltration Factor	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon		Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			(m^2)	Cover		Soil		Topography			(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(m^3/a)
Cat A-86	Cat PB-86	Offsite to the Northeast via overland flow	18.6	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	16.5	797.6	1.7	0	0	797.6	14.9	0.0	0.0	797.6	14.9	14.9
Cat A-87	Cat PB-87	Offsite to the Northeast via overland flow	53.8	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	47.7	797.6	4.8	0	0	797.6	42.9	0.0	0.0	797.6	42.9	42.9
Cat A-88	Cat PB-88	Offsite to the Northeast via overland flow	6.0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	5.3	797.6	0.5	0	0	797.6	4.8	0.0	0.0	797.6	4.8	4.8
Cat A-89	Cat PB-89	Offsite to the Northeast via overland flow	38.6	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	34.2	797.6	3.4	0	0	797.6	30.8	0.0	0.0	797.6	30.8	30.8
Cat A-90	Cat PB-90	Offsite to the Northeast via overland flow	7.1	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	6.3	797.6	0.6	0	0	797.6	5.7	0.0	0.0	797.6	5.7	5.7
Cat A-91	Cat PB-91	Offsite to the Northeast via overland flow	27.7	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	24.5	797.6	2.5	0	0	797.6	22.1	0.0	0.0	797.6	22.1	22.1
Cat A-92	Cat PB-92	Offsite to the Northeast via overland flow	69.5	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	61.6	797.6	6.2	0	0	797.6	55.4	0.0	0.0	797.6	55.4	55.4
Cat A-93	Cat PD-93	Offsite to the Northeast via overland flow	120.0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	106.4	797.6	10.6	0	0	797.6	95.7	0.0	0.0	797.6	95.7	95.7
Cat A-94	Cat PF-94	Offsite to the Northeast via overland flow	18.1	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	16.0	797.6	1.6	0	0	797.6	14.4	0.0	0.0	797.6	14.4	14.4
Cat A-95	Cat PD-95	Offsite to the Northeast via overland flow	78.2	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	69.3	797.6	6.9	0	0	797.6	62.3	0.0	0.0	797.6	62.3	62.3
Cat A-96	Cat PB-96	Offsite to the Northeast via overland flow	54.6	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	48.4	797.6	4.8	0	0	797.6	43.6	0.0	0.0	797.6	43.6	43.6
Cat A-97	Cat PD-97	Offsite to the Northeast via overland flow	86.5	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	76.7	341.1	47.2	0	0	341.1	29.5	238.7	20.7	102.3	8.9	29.5
Cat A-98	Cat PA2-98	Offsite to the Northeast via overland flow	19.2	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	17.1	341.1	10.5	0	0	341.1	6.6	238.7	4.6	102.3	2.0	6.6
Cat A-99	Cat PA1-99	Offsite to the Northeast via overland flow	15.2	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	13.4	341.1	8.3	0	0	341.1	5.2	238.7	3.6	102.3	1.6	5.2
Cat A-100	Cat PA1-100	Offsite to the Northeast via overland flow	6.4	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	5.6	341.1	3.5	0	0	341.1	2.2	238.7	1.5	102.3	0.7	2.2
Cat A-101	Cat PA1-101	Offsite to the Northeast via overland flow	37.7	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	33.4	341.1	20.6	0	0	341.1	12.9	238.7	9.0	102.3	3.9	12.9
Cat A-102	Cat PB-102	Offsite to the Northeast via overland flow	46.8	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	41.5	341.1	25.5	0	0	341.1	16.0	238.7	11.2	102.3	4.8	16.0
Cat A-103	Cat PB-103	Offsite to the Northeast via overland flow	13.5	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	11.9	341.1	7.3	0	0	341.1	4.6	238.7	3.2	102.3	1.4	4.6
Cat A-104	Cat PB-104	Offsite to the Northeast via overland flow	4.5	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	3.9	341.1	2.4	0	0	341.1	1.5	238.7	1.1	102.3	0.5	1.5
Cat A-105	Cat PB-105	Offsite to the Northeast via overland flow	0.7	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	0.6	341.1	0.4	0	0	341.1	0.2	238.7	0.2	102.3	0.1	0.2
Cat A-106	Cat PD-106	Offsite to the Northeast via overland flow	202.6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	179.6	341.1	110.5	0	0	341.1	69.1	238.7	48.4	102.3	20.7	69.1
Cat A-107	Cat PD-107	Offsite to the Northeast via overland flow	96.5	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	85.5	341.1	52.6	0	0	341.1	32.9	238.7	23.0	102.3	9.9	32.9
Cat A-108	Cat PB-108	Offsite to the Northeast via overland flow	272.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	241.6	341.1	148.6	0	0	341.1	93.0	238.7	65.1	102.3	27.9	93.0
Cat A-109	Cat PB-109	Offsite to the Northeast via overland flow	274.0	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	242.8	341.1	149.4	0	0	341.1	93.5	238.7	65.4	102.3	28.0	93.5
Cat A-110	Cat PB-110	Offsite to the Northeast via overland flow	106.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	94.3	341.1	58.0	0	0	341.1	36.3	238.7	25.4	102.3	10.9	36.3
Cat A-111	Cat PB-111	Offsite to the Northeast via overland flow	29.9	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	26.5	341.1	16.3	0	0	341.1	10.2	238.7	7.1	102.3	3.1	10.2
Cat A-112	Cat PB-112	Offsite to the Northeast via overland flow	71.6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	63.4	341.1	39.0	0	0	341.1	24.4	238.7	17.1	102.3	7.3	24.4
Cat A-113	Cat PB-113	Offsite to the Northeast via overland flow	74.6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	66.1	341.1	40.7	0	0	341.1	25.4	238.7	17.8	102.3	7.6	25.4
Cat A-114	Cat PB-114	Offsite to the Northeast via overland flow	67.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	59.8	341.1	36.8	0	0	341.1	23.0	238.7	16.1	102.3	6.9	23.0
Cat A-115	Cat PB-115	Offsite to the Northeast via overland flow	55.1	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	48.8	341.1	30.0	0	0	341.1	18.8	238.7	13.2	102.3	5.6	18.8
Cat A-116	Cat PB-116	Offsite to the Northeast via overland flow	20.0	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	17.7	341.1	10.9	0	0	341.1	6.8	238.7	4.8	102.3	2.0	6.8
Cat A-117	Cat PB-117	Offsite to the Northeast via overland flow	20.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	18.3	341.1	11.3	0	0	341.1	7.1	238.7	4.9	102.3	2.1	7.1
Cat A-118	Cat PB-118	Offsite to the Northeast via overland flow	82.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	73.0	341.1	44.9	0	0	341.1	28.1	238.7	19.7	102.3	8.4	28.1
Cat A-119	Cat PB-119	Offsite to the Northeast via overland flow	40.0	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	35.4	341.1	21.8	0	0	341.1	13.6	238.7	9.5	102.3	4.1	13.6
Cat A-120	Cat PB-120	Offsite to the Northeast via overland flow	46.8	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	41.4	341.1	25.5	0	0	341.1	15.9	238.7	11.2	102.3	4.8	15.9
Cat A-121	Cat PB-121	Offsite to the Northeast via overland flow	34.8	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	30.9	341.1	19.0	0	0	341.1	11.9	238.7	8.3	102.3	3.6	11.9
Cat A-122	Cat PB-122	Offsite to the Northeast via overland flow	115.3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	102.2	341.1	62.8	0	0	341.1	39.3	238.7	27.5	102.3	11.8	39.3
Cat A-123	Cat PB-123	Offsite to the Northeast via overland flow	96.0	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	85.1	341.1	52.3	0	0	341.1	32.7	238.7	22.9	102.3	9.8	32.7
Cat A-124	Cat PB-124	Offsite to the Northeast via overland flow	97.5	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	86.4	341.1	53.2	0	0	341.1	33.3	238.7	23.3	102.3	10.0	33.3
Cat A-125	Cat PB-125	Offsite to the Northeast via overland flow	132.3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	117.2	341.1	72.1	0	0	341.1	45.1	238.7	31.6	102.3	13.5	45.1
Cat A-126	Cat PB-126	Offsite to the Northeast via overland flow	1.0	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	0.9	341.1	0.5	0	0	341.1	0.3	238.7	0.2	102.3	0.1	0.3
Cat A-127	Cat PE-127	Offsite to the Northeast via overland flow	343.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	304.3	327.1	192.0	0	0	327.1	112.3	261.6	89.8	65.4	22.5	112.3
Cat A-128	Cat PC-128	Offsite to the Northeast via overland flow	785.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	696.1	327.1	439.2	0	0	327.1	256.9	261.6	205.5	65.4	51.4	256.9
Cat A-129	Cat PF-129	Offsite to the Northeast via overland flow	76.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	67.9	327.1	42.8	0	0	327.1	25.1	261.6	20.0	65.4	5.0	25.1
Cat A-130	Cat PE-130	Offsite to the Northeast via overland flow	257.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	228.5	327.1	144.2	0	0	327.1	84.3	261.6	67.5	65.4	16.9	84.3
Cat A-131	Cat PA1-131	Offsite to the Northeast via overland flow	10.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	9.6	327.1	6.0	0	0	327.1	3.5	261.6	2.8	65.4	0.7	3.5
Cat A-132	Cat PA1-132	Offsite to the Northeast via overland flow	12.7	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	11.2	327.1	7.1	0	0	327.1	4.2	261.6	3.3	65.4	0.8	4.2
Cat A-133	Cat PC-133	Offsite to the Northeast via overland flow	572.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	507.2	327.1	320.0	0	0	327.1	187.2	261.6	149.8	65.4	37.4	187.2
Cat A-134	Cat PC-134	Offsite to the Northeast via overland flow	572.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	507.2	327.1	320.0	0	0	327.1	187.2	261.6	149.8	65.4	37.4	187.2
Cat A-135	Cat PB-135	Offsite to the Northeast via overland flow	320.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	283.9	327.1	179.1	0	0	327.1	104.8	261.6	83.8	65.4	21.0	104.8
Cat A-136	Cat PB-136	Offsite to the Northeast via overland flow	9.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	8.7	327.1	5.5	0	0	327.1	3.2	261.6	2.6	65.4	0.6	3.2
Cat A-137	Cat PB-137	Offsite to the Northeast via overland flow	9.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	8.7	327.1	5.5	0	0	327.1	3.2	261.6	2.6	65.4	0.6	3.2
Cat A-138	Cat PB-138	Offsite to the Northeast via overland flow	5.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	5.2	327.1	3.3	0	0	327.1	1.9	261.6	1.5	65.4	0.4	1.9
Cat A-139	Cat PB-139	Offsite to the Northeast via overland flow	9.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	8.5	327.1	5.4	0	0	327.1	3.1	261.6	2.5	65.4	0.6	3.1
Cat A-140	Cat PB-140	Offsite to the Northeast via overland flow	12.0	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	10.6	327.1	6.7	0	0	327.1	3.9	261.6	3.1	65.4	0.8	3.9
Cat A-141	Cat PB-141	Offsite to the Northeast via overland flow	41.2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	36.5	327.1	23.0	0	0	327.1	13.5	261.6	10.8	65.4	2.7	13.5
Cat A-142	Cat PB-142	Offsite to the Northeast via overland flow	41.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	36.8	327.1	23.2	0	0	327.1	13.6	261.6	10.9	65.4	2.7	13.6
Cat A-143	Cat PB-143	Offsite to the Northeast via overland flow	42.2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	37.4	327.1	23.6	0	0	327.1	13.8	261.6	11.0	65.4	2.8	13.8
Cat A-144	Cat PB-144	Offsite to the Northeast via overland flow	25.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	22.9	327.1	14.4	0	0	327.1	8.4	261.6	6.7	65.4	1.7	8.4
Cat A-145	Cat PB-145	Offsite to the Northeast via overland flow	35.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	31.4	327.1	19.8	0	0	327.1	11.6	261.6	9.3	65.4	2.3	11.6
Cat A-146	Cat PB-146	Offsite to the Northeast via overland flow	40.1	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	35.6	327.1	22.4	0	0	327.1	13.1	261.6	10.5	65.4	2.6	13.1
Cat A-147	Cat PB-147	Offsite to the Northeast via overland flow	39.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	35.0	327.1	22.1	0	0	327.1	12.9	261.6	10.3	65.4	2.6	12.9
Cat A-148	Cat PB-148	Offsite to the Northeast via overland flow	69.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	61.6	327.1	38.9	0	0	327.1	22.7	261.6	18.2	65.4	4.5	22.7
Cat A-149	Cat PB-149	Offsite to the Northeast via overland flow	69.7	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	61.7	327.1	39.0	0	0	327.1	22.8	261.6	18.2	65.4	4.6	22.8
Cat A-150	Cat PB-150	Offsite to the Northeast via overland flow	69.3	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	61.4	327.1	38.7	0	0	327.1	22.7	261.6	18.1	65.4	4.5	22.7
Cat A-151	Cat PB-151	Offsite to the Northeast via overland flow	69.2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	61.3	327.1	38.7	0	0	327.1	22.6	261.6	18.1	65.4	4.5	22.6
Cat A-152	Cat PB-152	Offsite to the Northeast via overland flow	69.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	62.0	327.1	39.1	0	0	327.1	22.9	261.6	18.3	65.4	4.6	22.9
Cat A-153	Cat PB-153	Offsite to the Northeast via overland flow	68.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	61.0	327.1	38.5	0	0	327.1	22.5	261.6	18.0	65.4	4.5	22.5
Cat A-154	Cat PB-154	Offsite to the Northeast via overland flow	192.3	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	170.4	327.1	107.5	0	0	327.1	62.9	261.6	50.3	65.4	12.6	62.9
Cat A-155	Cat PB-155	Offsite to the Northeast via overland flow	56.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	50.3	327.1	31.7	0	0	327.1	18.6	261.6	14.9	65.4	3.7	18.6
Cat A-156	Cat PB-156	Offsite to the Northeast via overland flow	470.1	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	416.6	327.1	262.9	0	0	327.1	153.8	261.6	123.0	65.4	30.8	153.8
Cat A-157	Cat PB-157	Offsite to the Northeast via overland flow	3.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	3.2	327.1	2.0	0	0	327.1	1.2	261.6	0.9	65.4	0.2	1.2
Cat A-158	Cat PB-158	Offsite to the Northeast via overland flow	29.0	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	25.7	327.1	16.2	0	0	327.1	9.5	261.6	7.6	65.4	1.9	9.5
Cat A-159	Cat PB-159	Offsite to the Northeast via overland flow	184.2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	163.2	327.1	103.0	0	0	327.1	60.2	261.6	48.2	65.4	12.0	60.2
Cat A-160	Cat PB-160	Offsite to the Northeast via overland flow	25.2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	22.3	327.1	14.1	0	0	327.1	8.2	261.6	6.6	65.4	1.6	8.2
Cat A-161	Cat PB-161	Offsite to the Northeast via overland flow	2.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	2.4	327.1	1.5	0	0	327.1	0.9	261.6	0.7	65.4	0.2	0.9
Cat A-162	Cat PB-162	Offsite to the Northeast via overland flow	97.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	86.3	327.1	54.5	0	0	327.1	31.9	261.6	25.5	65.4	6.4	31.9
Cat A-163	Cat PB-163	Offsite to the Northeast via overland flow	95.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	84.7	327.1	53.4	0	0	327.1	31.3	261.6	25.0	65.4	6.3	31.3
Cat A-164	Cat PB-164	Offsite to the Northeast via overland flow	147.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	130.8	327.1	82.5	0	0	327.1	48.3	261.6	38.6	65.4	9.7	48.3
Cat A-165	Cat PB-165	Offsite to the Northeast via overland flow	96.0	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	85.1	327.1	53.7	0	0	327.1	31.4	261.6	25.1	65.4	6.3	31.4
Cat A-166	Cat PB-166	Offsite to the Northeast via overland flow	164.4	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	145.7	327.1	91.9	0	0	327.1	53.8	261.6	43.0	65.4	10.8	53.8
Cat A-167	Cat PB-167	Offsite to the Northeast via overland flow	96.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	85.9	327.1	54.2	0	0	327.1	31.7	261.6	25.4	65.4	6.3	31.7
Cat A-168	Cat PB-168	Offsite to the Northeast via overland flow	18.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	16.5	327.1	10.4	0	0	327.1	6.1	261.6	4.9	65.4	1.2	6.1
Cat A-169	Cat PB-169	Offsite to the Northeast via overland flow	25.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	22.6	327.1	14.2	0	0	327.1	8.3	261.6	6.7	65.4	1.7	8.3
Cat A-170	Cat PB-170	Offsite to the Northeast via overland flow	24.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	22.1	327.1	13.9	0	0	327.1	8.1	261.6	6.5	65.4	1.6	8.1

TABLE E-1 PRE-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Subcatchment Designation	Post Dev Cat Delineation	Outlet	Area	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted MOE Infiltration Factor	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon		Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			(m^2)	Cover		Soil		Topography			(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(m^3/a)
Cat A-171	Cat PF-171	Offsite to the Northeast via overland flow	817.4	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	724.4	327.1	457.1	0	0	327.1	267.4	245.3	200.5	81.8	66.8	267.4
Cat A-172	Cat PF-172	Offsite to the Northeast via overland flow	712.6	Cultivated	0.1	Open Sandy Loam	0.4	0.25	0.75	0.75	886.2	631.5	327.1	398.4	0	0	327.1	233.1	245.3	174.8	81.8	58.3	233.1
Cat A-173	Cat PF-173	Offsite to the Northeast via overland flow	77.5	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	68.7	797.6	6.9	0	0	797.6	61.8	0.0	0.0	797.6	61.8	61.8
Cat A-174	Cat PF-174	Offsite to the Northeast via overland flow	2.3	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	886.2	2.1	797.6	0.2	0	0	797.6	1.8	0.0	0.0	797.6	1.8	1.8
Cat A-175	Cat PF-175	Offsite to the Northeast via overland flow	152.5	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	135.2	341.1	83.2	0	0	341.1	52.0	238.7	36.4	102.3	15.6	52.0
Cat A-176	Cat PF-176	Offsite to the Northeast via overland flow	6.0	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	5.3	341.1	3.3	0	0	341.1	2.0	238.7	1.4	102.3	0.6	2.0
Cat A-177	Cat PF-177	Offsite to the Northeast via overland flow	5.2	Gravel	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	4.6	341.1	2.8	0	0	341.1	1.8	238.7	1.2	102.3	0.5	1.8
Cat A-178	Cat PF-178	Offsite to the Northeast via overland flow	840.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	744.7	341.1	458.1	0	0	341.1	286.6	238.7	200.6	102.3	86.0	286.6
Cat A-179	Cat PF-179	Offsite to the Northeast via overland flow	14.3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	12.7	341.1	7.8	0	0	341.1	4.9	238.7	3.4	102.3	1.5	4.9
Cat A-180	Cat PF-180	Offsite to the Northeast via overland flow	449.3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	398.2	341.1	245.0	0	0	341.1	153.3	238.7	107.3	102.3	46.0	153.3
Cat A-181	Cat PD-181	Offsite to the Northeast via overland flow	24.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	21.7	341.1	13.3	0	0	341.1	8.3	238.7	5.8	102.3	2.5	8.3
Cat A-182	Cat PD-182	Offsite to the Northeast via overland flow	331.4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	293.7	341.1	180.7	0	0	341.1	113.0	238.7	79.1	102.3	33.9	113.0
Cat A-183	Cat PD-183	Offsite to the Northeast via overland flow	375.3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	332.6	341.1	204.6	0	0	341.1	128.0	238.7	89.6	102.3	38.4	128.0
Cat A-184	Cat PA2-184	Offsite to the Northeast via overland flow	13.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	12.1	341.1	7.5	0	0	341.1	4.7	238.7	3.3	102.3	1.4	4.7
Cat A-185	Cat PA2-185	Offsite to the Northeast via overland flow	65.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	58.2	341.1	35.8	0	0	341.1	22.4	238.7	15.7	102.3	6.7	22.4
Cat A-186	Cat PF-186	Offsite to the Northeast via overland flow	106.6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	94.5	341.1	58.1	0	0	341.1	36.4	238.7	25.5	102.3	10.9	36.4
Cat A-187	Cat PF-187	Offsite to the Northeast via overland flow	24.1	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	21.3	341.1	13.1	0	0	341.1	8.2	238.7	5.8	102.3	2.5	8.2
Cat A-188	Cat PF-188	Offsite to the Northeast via overland flow	171.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	152.1	341.1	93.6	0	0	341.1	58.6	238.7	41.0	102.3	17.6	58.6
Cat A-189	Cat PD-189	Offsite to the Northeast via overland flow	59.8	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	53.0	341.1	32.6	0	0	341.1	20.4	238.7	14.3	102.3	6.1	20.4
Cat A-190	Cat PD-190	Offsite to the Northeast via overland flow	105.7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	886.2	93.7	341.1	57.6	0	0	341.1	36.0	238.7	25.2	102.3	10.8	36.0
Cat A-191	Cat PF-191	Offsite to the Northeast via overland flow	246.0	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	218.0	327.1	137.5	0	0	327.1	80.5	261.6	64.4	65.4	16.1	80.5
Cat A-192	Cat PF-192	Offsite to the Northeast via overland flow	181.8	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	161.1	327.1	101.6	0	0	327.1	59.4	261.6	47.6	65.4	11.9	59.4
Cat A-193	Cat PA1-193	Offsite to the Northeast via overland flow	143.6	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	127.2	327.1	80.3	0	0	327.1	47.0	261.6	37.6	65.4	9.4	47.0
Cat A-194	Cat PA1-194	Offsite to the Northeast via overland flow	47.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	42.5	327.1	26.8	0	0	327.1	15.7	261.6	12.5	65.4	3.1	15.7
Cat A-195	Cat PA1-195	Offsite to the Northeast via overland flow	4.3	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	3.8	327.1	2.4	0	0	327.1	1.4	261.6	1.1	65.4	0.3	1.4
Cat A-196	Cat PA1-196	Offsite to the Northeast via overland flow	150.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	133.4	327.1	84.2	0	0	327.1	49.2	261.6	39.4	65.4	9.8	49.2
Cat A-197	Cat PA1-197	Offsite to the Northeast via overland flow	27.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	24.7	327.1	15.6	0	0	327.1	9.1	261.6	7.3	65.4	1.8	9.1
Cat A-198	Cat PB-198	Offsite to the Northeast via overland flow	110.5	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	98.0	327.1	61.8	0	0	327.1	36.2	261.6	28.9	65.4	7.2	36.2
Cat A-199	Cat PB-199	Offsite to the Northeast via overland flow	13.7	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	12.1	327.1	7.7	0	0	327.1	4.5	261.6	3.6	65.4	0.9	4.5
Cat A-200	Cat PB-200	Offsite to the Northeast via overland flow	12.1	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	10.8	327.1	6.8	0	0	327.1	4.0	261.6	3.2	65.4	0.8	4.0
Cat A-201	Cat PB-201	Offsite to the Northeast via overland flow	61.3	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	54.3	327.1	34.3	0	0	327.1	20.0	261.6	16.0	65.4	4.0	20.0
Cat A-202	Cat PB-202	Offsite to the Northeast via overland flow	1682.9	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8	886.2	1491.4	327.1	941.0	0	0	327.1	550.4	261.6	440.3	65.4	110.1	550.4
Pre-Development Catchment A Total		**Offsite to the Northeast via overland flow**	**26,118**								**886.2**	**23,146**	**340.1**	**14,262**	**0**	**0**	**340.1**	**8,884**	**244**	**6,365**	**96**	**2,519**	**8,884**
SITE TOTAL			**26,118**								**886.2**	**23,146**	**340.1**	**14,262**	**0**	**0**	**340.1**	**8,884**	**244**	**6,365**	**96**	**2,519**	**8,884**

APPENDIX

F

WATER BUDGET CALCULATIONS – POST DEVELOPMENT

TABLE F-1 POST-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

ANNUAL PRECIPITATION	EVAPORATION AND EVAPOTRANSPIRATION FACTORS			
	Impervious Areas		Waterbody	
mm	%	mm	%	mm
886	10%	89	73%	646

On-Site Subcatchment Designation	Outlet	Total Area (m²)	Impervious: Total Impervious % of Total Area	Impervious: Total Impervious (m²)	Impervious: Assumed Buildings % of Impervious Area	Impervious: Assumed Buildings (m²)	Impervious: Assumed Road/ Parking/ Amenities % of Impervious Area	Impervious: Assumed Road/ Parking/ Amenities (m²)	Impervious: Other Impervious (m²)	Pervious: Total Pervious % of Total Area	Pervious: Total Pervious (m²)	MOE TABLE 2 Components: Cover		MOE TABLE 2 Components: Soil		MOE TABLE 2 Components: Topography	MOE Infiltration Factor	Adjusted MOE Infiltration Factor	Inputs: Precipitation Annual Average (m³/yr)	Inputs: Precipitation Surplus (Pervious) (m³/yr)	Inputs: Precipitation Surplus (Impervious) (m³/yr)	Inputs: Total Inputs (m³/yr)	Outputs: Evapotranspiration Pervious (m³/yr)	Outputs: Evapotranspiration Impervious (m³/yr)	Outputs: Total Evapotranspiration (m³/yr)	Outputs: Infiltration Pervious Areas (m³/yr)	Outputs: Infiltration Rooftop Discon (m³/yr)	Outputs: Infiltration Trenches (m³/yr)	Outputs: Total Infiltration (m³/yr)	Outputs: Runoff Pervious (m³/yr)	Outputs: Runoff Landscaped Area Redirected (m3/yr)	Outputs: Runoff Building (m³/yr)	Outputs: Runoff Road/ Driveway/ Amenities (m³/yr)	Outputs: Runoff Other Impervious (m³/yr)	Outputs: Runoff Total Impervious (m³/yr)	Outputs: Total Runoff (m³/yr)	Outputs: Rooftop Runoff Infiltrated (m³/yr)	Outputs: Infiltration Trenches (mm/yr)	Outputs: Infiltration Trenches (m³/yr)	Outputs: Net Runoff (mm/yr)	Outputs: Net Runoff (m³/yr)	Total Outputs (mm/yr)	Total Outputs (m³/yr)
Cat PA1-3	Offsite to the north via overland flow	184.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	184	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	163	63	0	163	101	0	101	44	0	0	44	19	0	0	0	0	0	19	0	0	0	102	19	886	163
Cat PA1-10	Offsite to the north via overland flow	10.3	100%	10.3	0%	0.0	100%	10.3	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PA1-11	Offsite to the north via overland flow	4.9	100%	4.9	0%	0.0	100%	4.9	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	4	0	4	4	0	0	0	0	0	0	0	0	0	0	4	0	4	4	0	0	0	798	4	886	4
Cat PA1-12	Offsite to the north via overland flow	234.6	100%	234.6	100%	234.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	208	0	187	208	0	21	21	0	94	0	94	0	0	187	0	0	187	187	-94	0	0	399	94	886	208
Cat PA1-13	Offsite to the north via overland flow	11.2	100%	11.2	0%	0.0	100%	11.2	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	10	0	9	10	0	1	1	0	0	0	0	0	0	0	9	0	9	9	0	0	0	798	9	886	10
Cat PA1-14	Offsite to the north via overland flow	17.4	100%	17.4	0%	0.0	100%	17.4	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	15	0	14	15	0	2	2	0	0	0	0	0	0	0	14	0	14	14	0	0	0	798	14	886	15
Cat PA1-85	Offsite to the north via overland flow	7.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	6	2	0	6	4	0	4	2	0	0	2	1	0	0	0	0	0	1	0	0	0	102	1	886	6
Cat PA1-99	Offsite to the north via overland flow	15.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	15	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	13	5	0	13	8	0	8	4	0	0	4	2	0	0	0	0	0	2	0	0	0	102	2	886	13
Cat PA1-100	Offsite to the north via overland flow	6.4	100%	6.4	0%	0.0	100%	6.4	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	6	0	5	6	0	1	1	0	0	0	0	0	0	0	5	0	5	5	0	0	0	798	5	886	6
Cat PA1-101	Offsite to the north via overland flow	37.7	100%	37.7	100%	37.7	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	33	0	30	33	0	3	3	0	15	0	15	0	0	30	0	0	30	30	-15	0	0	399	15	886	33
Cat PA1-131	Offsite to the north via overland flow	10.8	100%	10.8	0%	0.0	100%	10.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	10	0	9	10	0	1	1	0	0	0	0	0	0	0	9	0	9	9	0	0	0	798	9	886	10
Cat PA1-132	Offsite to the north via overland flow	12.7	100%	12.7	100%	12.7	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	11	0	10	11	0	1	1	0	5	0	5	0	0	10	0	0	10	10	-5	0	0	399	5	886	11
Cat PA1-193	Offsite to the north via overland flow	143.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	144	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	127	49	0	127	78	0	78	34	0	0	34	15	0	0	0	0	0	15	0	0	0	102	15	886	127
Cat PA1-194	Offsite to the north via overland flow	47.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	48	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	42	16	0	42	26	0	26	11	0	0	11	5	0	0	0	0	0	5	0	0	0	102	5	886	42
Cat PA1-195	Offsite to the north via overland flow	4.3	100%	4.3	0%	0.0	100%	4.3	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	4	0	3	4	0	0	0	0	0	0	0	0	0	0	3	0	3	3	0	0	0	798	3	886	4
Cat PA1-196	Offsite to the north via overland flow	150.5	100%	150.5	100%	150.5	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	133	0	120	133	0	13	13	0	60	0	60	0	0	120	0	0	120	120	-60	0	0	399	60	886	133
Cat PA1-197	Offsite to the north via overland flow	27.9	100%	27.9	100%	27.9	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	25	0	22	25	0	2	2	0	11	0	11	0	0	22	0	0	22	22	-11	0	0	399	11	886	25
Post-Development Catchment PA1 Total	**Offsite to the north via overland flow**	**927**	**57%**	**529**	**50%**	**463**	**7%**	**65**	**0**	**43%**	**398**								**821**		**422**	**821**	**217**	**47**	**264**	**95**	**185**	**0**	**280**	**41**	**0**	**370**	**52**	**0**	**422**	**462**	**-185**	**0**	**0**	**300**	**278**	**886**	**821**
Cat PA2-5	Offsite to the north via overland flow	51.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	51	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	45	17	0	45	28	0	28	12	0	0	12	5	0	0	0	0	0	5	0	0	0	102	5	886	45
Cat PA2-98	Offsite to the north via overland flow	19.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	19	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	17	7	0	17	10	0	10	5	0	0	5	2	0	0	0	0	0	2	0	0	0	102	2	886	17
Cat PA2-184	Offsite to the north via overland flow	13.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	14	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	12	5	0	12	7	0	7	3	0	0	3	1	0	0	0	0	0	1	0	0	0	102	1	886	12
Cat PA2-185	Offsite to the north via overland flow	65.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	66	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	58	22	0	58	36	0	36	16	0	0	16	7	0	0	0	0	0	7	0	0	0	102	7	886	58
Post-Development Catchment PA2 Total	**Offsite to the north via overland flow**	**150**	**0%**	**0**	**0%**	**0**	**0%**	**0**	**0**	**100%**	**150**								**133**		**0**	**133**	**82**	**0**	**82**	**36**	**0**	**0**	**36**	**15**	**0**	**0**	**0**	**0**	**0**	**15**	**0**	**0**	**0**	**102**	**15**	**886**	**133**
Cat PB-17	Offsite to the north via onsite catchbasins and stormsewers	157.9	100%	157.9	100%	157.9	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	140	0	126	140	0	14	14	0	0	0	0	0	0	126	0	0	126	126	0	0	0	798	126	886	140
Cat PB-18	Offsite to the north via onsite catchbasins and stormsewers	470.6	100%	470.6	100%	470.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	417	0	375	417	0	42	42	0	0	0	0	0	0	375	0	0	375	375	0	0	0	798	375	886	417
Cat PB-19	Offsite to the north via onsite catchbasins and stormsewers	10.3	100%	10.3	0%	0.0	100%	10.3	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-20	Offsite to the north via onsite catchbasins and stormsewers	10.1	100%	10.1	0%	0.0	100%	10.1	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-21	Offsite to the north via onsite catchbasins and stormsewers	9.8	100%	9.8	0%	0.0	100%	9.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-22	Offsite to the north via onsite catchbasins and stormsewers	9.8	100%	9.8	0%	0.0	100%	9.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-23	Offsite to the north via onsite catchbasins and stormsewers	10.1	100%	10.1	0%	0.0	100%	10.1	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-24	Offsite to the north via onsite catchbasins and stormsewers	10.3	100%	10.3	0%	0.0	100%	10.3	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-25	Offsite to the north via onsite catchbasins and stormsewers	3.8	100%	3.8	0%	0.0	100%	3.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	3	0	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	0	0	0	798	3	886	3
Cat PB-26	Offsite to the north via onsite catchbasins and stormsewers	220.5	100%	220.5	100%	220.5	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	195	0	176	195	0	20	20	0	0	0	0	0	0	176	0	0	176	176	0	0	0	798	176	886	195
Cat PB-27	Offsite to the north via onsite catchbasins and stormsewers	221.3	100%	221.3	100%	221.3	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	196	0	177	196	0	20	20	0	0	0	0	0	0	177	0	0	177	177	0	0	0	798	177	886	196
Cat PB-28	Offsite to the north via onsite catchbasins and stormsewers	42.0	100%	42.0	0%	0.0	100%	42.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	33	37	0	4	4	0	0	0	0	0	0	0	33	0	33	33	0	0	0	798	33	886	37
Cat PB-29	Offsite to the north via onsite catchbasins and stormsewers	43.1	100%	43.1	0%	0.0	100%	43.1	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	38	0	34	38	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	38
Cat PB-30	Offsite to the north via onsite catchbasins and stormsewers	43.2	100%	43.2	0%	0.0	100%	43.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	38	0	34	38	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	38
Cat PB-31	Offsite to the north via onsite catchbasins and stormsewers	42.5	100%	42.5	0%	0.0	100%	42.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	38	0	34	38	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	38
Cat PB-32	Offsite to the north via onsite catchbasins and stormsewers	42.3	100%	42.3	0%	0.0	100%	42.3	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	38	0	34	38	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	38
Cat PB-33	Offsite to the north via onsite catchbasins and stormsewers	39.8	100%	39.8	0%	0.0	100%	39.8	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	32	35	0	4	4	0	0	0	0	0	0	0	32	0	32	32	0	0	0	798	32	886	35
Cat PB-34	Offsite to the north via onsite catchbasins and stormsewers	41.5	100%	41.5	0%	0.0	100%	41.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	33	37	0	4	4	0	0	0	0	0	0	0	33	0	33	33	0	0	0	798	33	886	37
Cat PB-35	Offsite to the north via onsite catchbasins and stormsewers	37.2	100%	37.2	0%	0.0	100%	37.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	33	0	30	33	0	3	3	0	0	0	0	0	0	0	30	0	30	30	0	0	0	798	30	886	33
Cat PB-36	Offsite to the north via onsite catchbasins and stormsewers	39.0	100%	39.0	0%	0.0	100%	39.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	31	35	0	3	3	0	0	0	0	0	0	0	31	0	31	31	0	0	0	798	31	886	35
Cat PB-37	Offsite to the north via onsite catchbasins and stormsewers	39.6	100%	39.6	0%	0.0	100%	39.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	32	35	0	4	4	0	0	0	0	0	0	0	32	0	32	32	0	0	0	798	32	886	35
Cat PB-38	Offsite to the north via onsite catchbasins and stormsewers	39.3	100%	39.3	0%	0.0	100%	39.3	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	31	35	0	3	3	0	0	0	0	0	0	0	31	0	31	31	0	0	0	798	31	886	35
Cat PB-39	Offsite to the north via onsite catchbasins and stormsewers	39.7	100%	39.7	0%	0.0	100%	39.7	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	32	35	0	4	4	0	0	0	0	0	0	0	32	0	32	32	0	0	0	798	32	886	35
Cat PB-40	Offsite to the north via onsite catchbasins and stormsewers	71.5	100%	71.5	0%	0.0	100%	71.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-41	Offsite to the north via onsite catchbasins and stormsewers	71.5	100%	71.5	0%	0.0	100%	71.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-42	Offsite to the north via onsite catchbasins and stormsewers	42.0	100%	42.0	0%	0.0	100%	42.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	34	37	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	37
Cat PB-43	Offsite to the north via onsite catchbasins and stormsewers	3.6	100%	3.6	0%	0.0	100%	3.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	3	0	3	3	0	0	0	0	0	0	0	0	0	0	3	0	3	3	0	0	0	798	3	886	3
Cat PB-44	Offsite to the north via onsite catchbasins and stormsewers	15.9	100%	15.9	0%	0.0	100%	15.9	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	14	0	13	14	0	1	1	0	0	0	0	0	0	0	13	0	13	13	0	0	0	798	13	886	14
Cat PB-45	Offsite to the north via onsite catchbasins and stormsewers	16.0	100%	16.0	0%	0.0	100%	16.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	14	0	13	14	0	1	1	0	0	0	0	0	0	0	13	0	13	13	0	0	0	798	13	886	14
Cat PB-46	Offsite to the north via onsite catchbasins and stormsewers	48.2	100%	48.2	0%	0.0	100%	48.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	43	0	38	43	0	4	4	0	0	0	0	0	0	0	38	0	38	38	0	0	0	798	38	886	43
Cat PB-47	Offsite to the north via onsite catchbasins and stormsewers	73.0	100%	73.0	0%	0.0	100%	73.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	65	0	58	65	0	6	6	0	0	0	0	0	0	0	58	0	58	58	0	0	0	798	58	886	65
Cat PB-48	Offsite to the north via onsite catchbasins and stormsewers	74.6	100%	74.6	0%	0.0	100%	74.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	66	0	59	66	0	7	7	0	0	0	0	0	0	0	59	0	59	59	0	0	0	798	59	886	66
Cat PB-49	Offsite to the north via onsite catchbasins and stormsewers	71.1	100%	71.1	0%	0.0	100%	71.1	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-50	Offsite to the north via onsite catchbasins and stormsewers	71.5	100%	71.5	0%	0.0	100%	71.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-51	Offsite to the north via onsite catchbasins and stormsewers	72.6	100%	72.6	0%	0.0	100%	72.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	64	0	58	64	0	6	6	0	0	0	0	0	0	0	58	0	58	58	0	0	0	798	58	886	64
Cat PB-52	Offsite to the north via onsite catchbasins and stormsewers	71.5	100%	71.5	0%	0.0	100%	71.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-53	Offsite to the north via onsite catchbasins and stormsewers	176.3	100%	176.3	0%	0.0	100%	176.3	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	156	0	141	156	0	16	16	0	0	0	0	0	0	0	141	0	141	141	0	0	0	798	141	886	156
Cat PB-54	Offsite to the north via onsite catchbasins and stormsewers	72.1	100%	72.1	0%	0.0	100%	72.1	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	64	0	58	64	0	6	6	0	0	0	0	0	0	0	58	0	58	58	0	0	0	798	58	886	64
Cat PB-55	Offsite to the north via onsite catchbasins and stormsewers	2184.0	100%	2184.0	0%	0.0	100%	2184.0	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	1,935	0	1,742	1,935	0	194	194	0	0	0	0	0	0	0	1,742	0	1,742	1,742	0	0	0	798	1,742	886	1,935
Cat PB-56	Offsite to the north via onsite catchbasins and stormsewers	58.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	58	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	52	20	0	52	32	0	32	14	0	0	14	6	0	0	0	0	0	6	0	0	0	102	6	886	52
Cat PB-57	Offsite to the north via onsite catchbasins and stormsewers	50.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	51	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	45	17	0	45	28	0	28	12	0	0	12	5	0	0	0	0	0	5	0	0	0	102	5	886	45
Cat PB-58	Offsite to the north via onsite catchbasins and stormsewers	19.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	20	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	17	7	0	17	11	0	11	5	0	0	5	2	0	0	0	0	0	2	0	0	0	102	2	886	17
Cat PB-59	Offsite to the north via onsite catchbasins and stormsewers	14.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	14	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	13	5	0	13	8	0	8	3	0	0	3	1	0	0	0	0	0	1	0	0	0	102	1	886	13
Cat PB-60	Offsite to the north via onsite catchbasins and stormsewers	3.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	3	1	0	3	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	102	0	886	3
Cat PB-61	Offsite to the north via onsite catchbasins and stormsewers	12.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	13	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	11	4	0	11	7	0	7	3	0	0	3	1	0	0	0	0	0	1	0	0	0	102	1	886	11
Cat PB-62	Offsite to the north via onsite catchbasins and stormsewers	1.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	2	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	2	1	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	886	2
Cat PB-63	Offsite to the north via onsite catchbasins and stormsewers	23.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	23	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	21	8	0	21	13	0	13	6	0	0	6	2	0	0	0	0	0	2	0	0	0	102	2	886	21
Cat PB-64	Offsite to the north via onsite catchbasins and stormsewers	2.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	2	1	0	2	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	102	0	886	2
Cat PB-65	Offsite to the north via onsite catchbasins and stormsewers	18.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	18	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	16	6	0	16	10	0	10	4	0	0	4	2	0	0	0	0	0	2	0	0	0	102	2	886	16
Cat PB-66	Offsite to the north via onsite catchbasins and stormsewers	185.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	186	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	165	63	0	165	101	0	101	44	0	0	44	19	0	0	0	0	0	19	0	0	0	102	19	886	165
Cat PB-67	Offsite to the north via onsite catchbasins and stormsewers	99.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	100	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	88	34	0	88	54	0	54	24	0	0	24	10	0	0	0	0	0	10	0	0	0	102	10	886	88
Cat PB-68	Offsite to the north via onsite catchbasins and stormsewers	96.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	96	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	85	33	0	85	52	0	52	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	85
Cat PB-69	Offsite to the north via onsite catchbasins and stormsewers	2.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	2	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	2	1	0	2	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	102	0	886	2
Cat PB-70	Offsite to the north via onsite catchbasins and stormsewers	168.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	168	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	149	57	0	149	92	0	92	40	0	0	40	17	0	0	0	0	0	17	0	0	0	102	17	886	149
Cat PB-71	Offsite to the north via onsite catchbasins and stormsewers	97.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	97	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	86	33	0	86	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	86
Cat PB-72	Offsite to the north via onsite catchbasins and stormsewers	97.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	98	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	87	33	0	87	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	87
Cat PB-73	Offsite to the north via onsite catchbasins and stormsewers	96.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	97	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	86	33	0	86	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	86
Cat PB-74	Offsite to the north via onsite catchbasins and stormsewers	95.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	96	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	85	33	0	85	52	0	52	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	85
Cat PB-75	Offsite to the north via onsite catchbasins and stormsewers	153.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	153	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	136	52	0	136	84	0	84	37	0	0	37	16	0	0	0	0	0	16	0	0	0	102	16	886	136
Cat PB-76	Offsite to the north via onsite catchbasins and stormsewers	128.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	128	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	113	44	0	113	70	0	70	31	0	0	31	13	0	0	0	0	0	13	0	0	0	102	13	886	113
Cat PB-77	Offsite to the north via onsite catchbasins and stormsewers	171.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	171	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	152	58	0	152	93	0	93	41	0	0	41	18	0	0	0	0	0	18	0	0	0	102	18	886	152
Cat PB-78	Offsite to the north via onsite catchbasins and stormsewers	27.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	27	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	24	9	0	24	15	0	15	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	24
Cat PB-79	Offsite to the north via onsite catchbasins and stormsewers	26.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	27	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	24	9	0	24	15	0	15	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	24
Cat PB-80	Offsite to the north via onsite catchbasins and stormsewers	26.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	26	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	23	9	0	23	14	0	14	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	23
Cat PB-81	Offsite to the north via onsite catchbasins and stormsewers	26.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	27	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	24	9	0	24	15	0	15	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	24
Cat PB-82	Offsite to the north via onsite catchbasins and stormsewers	36.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	36	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	32	12	0	32	20	0	20	9	0	0	9	4	0	0	0	0	0	4	0	0	0	102	4	886	32
Cat PB-83	Offsite to the north via onsite catchbasins and stormsewers	25.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	25	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	22	9	0	22	14	0	14	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	22
Cat PB-84	Offsite to the north via onsite catchbasins and stormsewers	6.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	6	2	0	6	3	0	3	2	0	0	2	1	0	0	0	0	0	1	0	0	0	102	1	886	6
Cat PB-86	Offsite to the north via onsite catchbasins and stormsewers	18.6	100%	18.6	0%	0.0	100%	18.6	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	17	0	15	17	0	2	2	0	0	0	0	0	0	0	15	0	15	15	0	0	0	798	15	886	17
Cat PB-87	Offsite to the north via onsite catchbasins and stormsewers	53.8	100%	53.8	0%	0.0	100%	53.8	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	48	0	43	48	0	5	5	0	0	0	0	0	0	0	43	0	43	43	0	0	0	798	43	886	48
Cat PB-88	Offsite to the north via onsite catchbasins and stormsewers	6.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	6	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	5	2	0	5	3	0	3	1	0	0	1	1	0	0	0	0	0	1	0	0	0	102	1	886	5
Cat PB-89	Offsite to the north via onsite catchbasins and stormsewers	38.6	100%	38.6	0%	0.0	100%	38.6	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	34	0	31	34	0	3	3	0	0	0	0	0	0	0	31	0	31	31	0	0	0	798	31	886	34
Cat PB-90	Offsite to the north via onsite catchbasins and stormsewers	7.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	7	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	6	2	0	6	4	0	4	2	0	0	2	1	0	0	0	0	0	1	0	0	0	102	1	886	6
Cat PB-91	Offsite to the north via onsite catchbasins and stormsewers	27.7	100%	27.7	0%	0.0	100%	27.7	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	25	0	22	25	0	2	2	0	0	0	0	0	0	0	22	0	22	22	0	0	0	798	22	886	25
Cat PB-92	Offsite to the north via onsite catchbasins and stormsewers	69.5	100%	69.5	0%	0.0	100%	69.5	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	62	0	55	62	0	6	6	0	0	0	0	0	0	0	55	0	55	55	0	0	0	798	55	886	62
Cat PB-96	Offsite to the north via onsite catchbasins and stormsewers	54.6	100%	54.6	100%	54.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	48	0	44	48	0	5	5	0	0	0	0	0	0	44	0	0	44	44	0	0	0	798	44	886	48
Cat PB-102	Offsite to the north via onsite catchbasins and stormsewers	46.8	100%	46.8	100%	46.8	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	42	0	37	42	0	4	4	0	0	0	0	0	0	37	0	0	37	37	0	0	0	798	37	886	42
Cat PB-103	Offsite to the north via onsite catchbasins and stormsewers	13.5	100%	13.5	0%	0.0	100%	13.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	12	0	11	12	0	1	1	0	0	0	0	0	0	0	11	0	11	11	0	0	0	798	11	886	12
Cat PB-104	Offsite to the north via onsite catchbasins and stormsewers	4.5	100%	4.5	0%	0.0	100%	4.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	4	0	4	4	0	0	0	0	0	0	0	0	0	0	4	0	4	4	0	0	0	798	4	886	4
Cat PB-105	Offsite to the north via onsite catchbasins and stormsewers	0.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	1	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	886	1
Cat PB-108	Offsite to the north via onsite catchbasins and stormsewers	272.7	100%	272.7	100%	272.7	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	242	0	217	242	0	24	24	0	0	0	0	0	0	217	0	0	217	217	0	0	0	798	217	886	242
Cat PB-109	Offsite to the north via onsite catchbasins and stormsewers	274.0	100%	274.0	100%	274.0	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	243	0	219	243	0	24	24	0	0	0	0	0	0	219	0	0	219	219	0	0	0	798	219	886	243
Cat PB-110	Offsite to the north via onsite catchbasins and stormsewers	106.4	100%	106.4	100%	106.4	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	94	0	85	94	0	9	9	0	0	0	0	0	0	85	0	0	85	85	0	0	0	798	85	886	94
Cat PB-111	Offsite to the north via onsite catchbasins and stormsewers	29.9	100%	29.9	0%	0.0	100%	29.9	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	27	0	24	27	0	3	3	0	0	0	0	0	0	0	24	0	24	24	0	0	0	798	24	886	27

TABLE F-1 POST-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

ANNUAL PRECIPITATION	EVAPORATION AND EVAPOTRANSPIRATION FACTORS – Impervious Areas		Waterbody	
mm	%	mm	%	mm
886	10%	89	73%	646

On-Site Subcatchment Designation	Outlet	Total Area (m²)	Impervious – Total Impervious % of Total Area	Total Impervious (m²)	Assumed Buildings % of Impervious Area	Assumed Buildings (m²)	Assumed Road/ Parking/ Amenities % of Impervious Area	Assumed Road/ Parking/ Amenities (m²)	Other Impervious (m²)	Pervious – Total Pervious % of Total Area	Total Pervious (m²)	MOE TABLE 2 Components – Cover		Soil		Topography	MOE Infiltration Factor	Adjusted MOE Infiltration Factor	Inputs – Precipitation – Annual Average (m³/yr)	Surplus (Pervious) (m³/yr)	Surplus (Impervious) (m³/yr)	Total Inputs (m³/yr)	Outputs – Evapotranspiration – Pervious (m³/yr)	Impervious (m³/yr)	Total Evapotranspiration (m³/yr)	Infiltration – Pervious Areas (m³/yr)	Rooftop Discon (m³/yr)	Infiltration Trenches (m³/yr)	Total Infiltration (m³/yr)	Runoff – Pervious (m³/yr)	Landscaped Area Redirected (m3/yr)	Building (m³/yr)	Road/ Driveway/ Amenities (m³/yr)	Other Impervious (m³/yr)	Total Impervious (m³/yr)	Total Runoff (m³/yr)	Rooftop Runoff Infiltrated (m³/yr)	Infiltration Trenches (mm/yr)	Infiltration Trenches (m³/yr)	Net Runoff (mm/yr)	Net Runoff (m³/yr)	Total Outputs (mm/yr)	Total Outputs (m³/yr)
Cat PB-112	Offsite to the north via onsite catchbasins and stormsewers	71.6	100%	71.6	0%	0.0	100%	71.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	63	0	57	63	0	6	6	0	0	0	0	0	0	0	57	0	57	57	0	0	0	798	57	886	63
Cat PB-113	Offsite to the north via onsite catchbasins and stormsewers	74.6	100%	74.6	0%	0.0	100%	74.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	66	0	60	66	0	7	7	0	0	0	0	0	0	0	60	0	60	60	0	0	0	798	60	886	66
Cat PB-114	Offsite to the north via onsite catchbasins and stormsewers	67.4	100%	67.4	0%	0.0	100%	67.4	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	60	0	54	60	0	6	6	0	0	0	0	0	0	0	54	0	54	54	0	0	0	798	54	886	60
Cat PB-115	Offsite to the north via onsite catchbasins and stormsewers	55.1	100%	55.1	0%	0.0	100%	55.1	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	49	0	44	49	0	5	5	0	0	0	0	0	0	0	44	0	44	44	0	0	0	798	44	886	49
Cat PB-116	Offsite to the north via onsite catchbasins and stormsewers	20.0	100%	20.0	0%	0.0	100%	20.0	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	18	0	16	18	0	2	2	0	0	0	0	0	0	0	16	0	16	16	0	0	0	798	16	886	18
Cat PB-117	Offsite to the north via onsite catchbasins and stormsewers	20.7	100%	20.7	0%	0.0	100%	20.7	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	18	0	17	18	0	2	2	0	0	0	0	0	0	0	17	0	17	17	0	0	0	798	17	886	18
Cat PB-118	Offsite to the north via onsite catchbasins and stormsewers	82.4	100%	82.4	0%	0.0	100%	82.4	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	73	0	66	73	0	7	7	0	0	0	0	0	0	0	66	0	66	66	0	0	0	798	66	886	73
Cat PB-119	Offsite to the north via onsite catchbasins and stormsewers	40.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	40	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	35	14	0	35	22	0	22	10	0	0	10	4	0	0	0	0	0	4	0	0	0	102	4	886	35
Cat PB-120	Offsite to the north via onsite catchbasins and stormsewers	46.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	47	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	41	16	0	41	25	0	25	11	0	0	11	5	0	0	0	0	0	5	0	0	0	102	5	886	41
Cat PB-121	Offsite to the north via onsite catchbasins and stormsewers	34.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	35	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	31	12	0	31	19	0	19	8	0	0	8	4	0	0	0	0	0	4	0	0	0	102	4	886	31
Cat PB-122	Offsite to the north via onsite catchbasins and stormsewers	115.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	115	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	102	39	0	102	63	0	63	28	0	0	28	12	0	0	0	0	0	12	0	0	0	102	12	886	102
Cat PB-123	Offsite to the north via onsite catchbasins and stormsewers	96.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	96	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	85	33	0	85	52	0	52	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	85
Cat PB-124	Offsite to the north via onsite catchbasins and stormsewers	97.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	98	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	86	33	0	86	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	86
Cat PB-125	Offsite to the north via onsite catchbasins and stormsewers	132.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	132	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	117	45	0	117	72	0	72	32	0	0	32	14	0	0	0	0	0	14	0	0	0	102	14	886	117
Cat PB-126	Offsite to the north via onsite catchbasins and stormsewers	1.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	1	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	1	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102	0	886	1
Cat PB-135	Offsite to the north via onsite catchbasins and stormsewers	320.4	100%	320.4	100%	320.4	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	284	0	256	284	0	28	28	0	0	0	0	0	0	256	0	0	256	256	0	0	0	798	256	886	284
Cat PB-136	Offsite to the north via onsite catchbasins and stormsewers	9.8	100%	9.8	0%	0.0	100%	9.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-137	Offsite to the north via onsite catchbasins and stormsewers	9.8	100%	9.8	0%	0.0	100%	9.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-138	Offsite to the north via onsite catchbasins and stormsewers	5.8	100%	5.8	0%	0.0	100%	5.8	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	5	0	5	5	0	1	1	0	0	0	0	0	0	0	5	0	5	5	0	0	0	798	5	886	5
Cat PB-139	Offsite to the north via onsite catchbasins and stormsewers	9.6	100%	9.6	0%	0.0	100%	9.6	0.0	0%	0	Porch	0	Open Sandy Loam	0.4	0.25	0.65	0	9	0	8	9	0	1	1	0	0	0	0	0	0	0	8	0	8	8	0	0	0	798	8	886	9
Cat PB-140	Offsite to the north via onsite catchbasins and stormsewers	12.0	100%	12.0	100%	12.0	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	11	0	10	11	0	1	1	0	0	0	0	0	0	10	0	0	10	10	0	0	0	798	10	886	11
Cat PB-141	Offsite to the north via onsite catchbasins and stormsewers	41.2	100%	41.2	0%	0.0	100%	41.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	33	37	0	4	4	0	0	0	0	0	0	0	33	0	33	33	0	0	0	798	33	886	37
Cat PB-142	Offsite to the north via onsite catchbasins and stormsewers	41.5	100%	41.5	0%	0.0	100%	41.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	33	37	0	4	4	0	0	0	0	0	0	0	33	0	33	33	0	0	0	798	33	886	37
Cat PB-143	Offsite to the north via onsite catchbasins and stormsewers	42.2	100%	42.2	0%	0.0	100%	42.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	37	0	34	37	0	4	4	0	0	0	0	0	0	0	34	0	34	34	0	0	0	798	34	886	37
Cat PB-144	Offsite to the north via onsite catchbasins and stormsewers	25.8	100%	25.8	0%	0.0	100%	25.8	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	23	0	21	23	0	2	2	0	0	0	0	0	0	0	21	0	21	21	0	0	0	798	21	886	23
Cat PB-145	Offsite to the north via onsite catchbasins and stormsewers	35.5	100%	35.5	0%	0.0	100%	35.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	31	0	28	31	0	3	3	0	0	0	0	0	0	0	28	0	28	28	0	0	0	798	28	886	31
Cat PB-146	Offsite to the north via onsite catchbasins and stormsewers	40.1	100%	40.1	0%	0.0	100%	40.1	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	36	0	32	36	0	4	4	0	0	0	0	0	0	0	32	0	32	32	0	0	0	798	32	886	36
Cat PB-147	Offsite to the north via onsite catchbasins and stormsewers	39.5	100%	39.5	0%	0.0	100%	39.5	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	35	0	31	35	0	3	3	0	0	0	0	0	0	0	31	0	31	31	0	0	0	798	31	886	35
Cat PB-148	Offsite to the north via onsite catchbasins and stormsewers	69.6	100%	69.6	0%	0.0	100%	69.6	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	62	0	55	62	0	6	6	0	0	0	0	0	0	0	55	0	55	55	0	0	0	798	55	886	62
Cat PB-149	Offsite to the north via onsite catchbasins and stormsewers	69.7	100%	69.7	0%	0.0	100%	69.7	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	62	0	56	62	0	6	6	0	0	0	0	0	0	0	56	0	56	56	0	0	0	798	56	886	62
Cat PB-150	Offsite to the north via onsite catchbasins and stormsewers	69.3	100%	69.3	0%	0.0	100%	69.3	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	61	0	55	61	0	6	6	0	0	0	0	0	0	0	55	0	55	55	0	0	0	798	55	886	61
Cat PB-151	Offsite to the north via onsite catchbasins and stormsewers	69.2	100%	69.2	0%	0.0	100%	69.2	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	61	0	55	61	0	6	6	0	0	0	0	0	0	0	55	0	55	55	0	0	0	798	55	886	61
Cat PB-152	Offsite to the north via onsite catchbasins and stormsewers	69.9	100%	69.9	0%	0.0	100%	69.9	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	62	0	56	62	0	6	6	0	0	0	0	0	0	0	56	0	56	56	0	0	0	798	56	886	62
Cat PB-153	Offsite to the north via onsite catchbasins and stormsewers	68.9	100%	68.9	0%	0.0	100%	68.9	0.0	0%	0	Driveway	0	Open Sandy Loam	0.4	0.25	0.65	0	61	0	55	61	0	6	6	0	0	0	0	0	0	0	55	0	55	55	0	0	0	798	55	886	61
Cat PB-154	Offsite to the north via onsite catchbasins and stormsewers	192.3	100%	192.3	0%	0.0	100%	192.3	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	170	0	153	170	0	17	17	0	0	0	0	0	0	0	153	0	153	153	0	0	0	798	153	886	170
Cat PB-155	Offsite to the north via onsite catchbasins and stormsewers	56.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	57	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	50	19	0	50	31	0	31	14	0	0	14	6	0	0	0	0	0	6	0	0	0	102	6	886	50
Cat PB-156	Offsite to the north via onsite catchbasins and stormsewers	470.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	470	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	417	160	0	417	256	0	256	112	0	0	112	48	0	0	0	0	0	48	0	0	0	102	48	886	417
Cat PB-157	Offsite to the north via onsite catchbasins and stormsewers	3.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	4	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	3	1	0	3	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	102	0	886	3
Cat PB-158	Offsite to the north via onsite catchbasins and stormsewers	29.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	29	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	26	10	0	26	16	0	16	7	0	0	7	3	0	0	0	0	0	3	0	0	0	102	3	886	26
Cat PB-159	Offsite to the north via onsite catchbasins and stormsewers	184.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	184	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	163	63	0	163	100	0	100	44	0	0	44	19	0	0	0	0	0	19	0	0	0	102	19	886	163
Cat PB-160	Offsite to the north via onsite catchbasins and stormsewers	25.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	25	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	22	9	0	22	14	0	14	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	22
Cat PB-161	Offsite to the north via onsite catchbasins and stormsewers	2.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	3	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	2	1	0	2	2	0	2	1	0	0	1	0	0	0	0	0	0	0	0	0	0	102	0	886	2
Cat PB-162	Offsite to the north via onsite catchbasins and stormsewers	97.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	97	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	86	33	0	86	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	86
Cat PB-163	Offsite to the north via onsite catchbasins and stormsewers	95.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	96	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	85	33	0	85	52	0	52	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	85
Cat PB-164	Offsite to the north via onsite catchbasins and stormsewers	147.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	148	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	131	50	0	131	80	0	80	35	0	0	35	15	0	0	0	0	0	15	0	0	0	102	15	886	131
Cat PB-165	Offsite to the north via onsite catchbasins and stormsewers	96.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	96	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	85	33	0	85	52	0	52	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	85
Cat PB-166	Offsite to the north via onsite catchbasins and stormsewers	164.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	164	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	146	56	0	146	90	0	90	39	0	0	39	17	0	0	0	0	0	17	0	0	0	102	17	886	146
Cat PB-167	Offsite to the north via onsite catchbasins and stormsewers	96.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	97	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	86	33	0	86	53	0	53	23	0	0	23	10	0	0	0	0	0	10	0	0	0	102	10	886	86
Cat PB-168	Offsite to the north via onsite catchbasins and stormsewers	18.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	19	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	17	6	0	17	10	0	10	4	0	0	4	2	0	0	0	0	0	2	0	0	0	102	2	886	17
Cat PB-169	Offsite to the north via onsite catchbasins and stormsewers	25.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	25	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	23	9	0	23	14	0	14	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	23
Cat PB-170	Offsite to the north via onsite catchbasins and stormsewers	24.9	0%	0.0	0%	0.0	0%	0.0	0.0	100%	25	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	22	8	0	22	14	0	14	6	0	0	6	3	0	0	0	0	0	3	0	0	0	102	3	886	22
Cat PB-198	Offsite to the north via onsite catchbasins and stormsewers	110.5	100%	110.5	100%	110.5	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	98	0	88	98	0	10	10	0	0	0	0	0	0	88	0	0	88	88	0	0	0	798	88	886	98
Cat PB-199	Offsite to the north via onsite catchbasins and stormsewers	13.7	100%	13.7	100%	13.7	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	12	0	11	12	0	1	1	0	0	0	0	0	0	11	0	0	11	11	0	0	0	798	11	886	12
Cat PB-200	Offsite to the north via onsite catchbasins and stormsewers	12.1	100%	12.1	0%	0.0	100%	12.1	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	11	0	10	11	0	1	1	0	0	0	0	0	0	0	10	0	10	10	0	0	0	798	10	886	11
Cat PB-201	Offsite to the north via onsite catchbasins and stormsewers	61.3	100%	61.3	0%	0.0	100%	61.3	0.0	0%	0	Sidewalk	0	Open Sandy Loam	0.4	0.25	0.65	0	54	0	49	54	0	5	5	0	0	0	0	0	0	0	49	0	49	49	0	0	0	798	49	886	54
Cat PB-202	Offsite to the north via onsite catchbasins and stormsewers	1682.9	100%	1682.9	0%	0.0	100%	1682.9	0.0	0%	0	Road	0	Open Sandy Loam	0.4	0.25	0.65	0	1,491	0	1,342	1,491	0	149	149	0	0	0	0	0	0	0	1,342	0	1,342	1,342	0	0	0	798	1,342	886	1,491
Post-Development Catchment PBTotal	**Offsite to the north via onsite catchbasins and stormsewers**	**13,172**	**70%**	**9,284**	**17%**	**2,282**	**53%**	**7,003**	**0**	**30%**	**3,888**								**11,673**		**7,405**	**11,673**	**2,120**	**823**	**2,942**	**928**	**0**	**0**	**928**	**398**	**0**	**1,820**	**5,585**	**0**	**7,405**	**7,803**	**0**	**0**	**0**	**592**	**7,803**	**886**	**11,673**
Cat PC-4	Infiltration Trench	953.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	953	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	845	325	0	845	520	0	520	228	0	78	306	98	0	0	0	0	0	98	0	-82	-78	20	20	886	845
Cat PC-15	Infiltration Trench	571.6	100%	571.6	100%	571.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	507	0	456	507	0	51	51	0	228	182	410	0	0	456	0	0	456	456	-228	-191	-182	80	46	886	507
Cat PC-16	Infiltration Trench	571.6	100%	571.6	100%	571.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	507	0	456	507	0	51	51	0	228	182	410	0	0	456	0	0	456	456	-228	-191	-182	80	46	886	507
Cat PC-128	Infiltration Trench	785.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	785	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	696	268	0	696	428	0	428	188	0	64	252	80	0	0	0	0	0	80	0	-82	-64	20	16	886	696
Cat PC-133	Infiltration Trench	572.4	100%	572.4	100%	572.4	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	507	0	456	507	0	51	51	0	228	183	411	0	0	456	0	0	456	456	-228	-232	-183	80	46	886	507
Cat PC-134	Infiltration Trench	572.4	100%	572.4	100%	572.4	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	507	0	456	507	0	51	51	0	228	183	411	0	0	456	0	0	456	456	-228	-232	-183	80	46	886	507
Post-Development Catchment PCTotal	**Infiltration Trench**	**4,026**	**57%**	**2,288**	**57%**	**2,288**	**0%**	**0**	**0**	**43%**	**1,739**								**3,568**	**593**	**1,825**	**3,568**	**948**	**203**	**1,150**	**415**	**912**	**872**	**2,200**	**178**	**0**	**1,825**	**0**	**0**	**1,825**	**2,003**	**-912**	**-217**	**-872**	**54**	**218**	**886**	**3,568**
Cat PD-2	Off-site via swales and rearlot catchbasins	261.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	261	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	231	89	0	231	142	0	142	62	0	0	62	27	0	0	0	0	0	27	0	0	0	102	27	886	231
Cat PD-9	Off-site via swales and rearlot catchbasins	148.1	100%	148.1	100%	148.1	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	131	0	118	131	0	13	13	0	59	0	59	0	0	118	0	0	118	118	-59	0	0	399	59	886	131
Cat PD-93	Off-site via swales and rearlot catchbasins	120.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	120	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	106	41	0	106	65	0	65	29	0	0	29	12	0	0	0	0	0	12	0	0	0	102	12	886	106
Cat PD-95	Off-site via swales and rearlot catchbasins	78.2	100%	78.2	100%	78.2	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	69	0	62	69	0	7	7	0	31	0	31	0	0	62	0	0	62	62	-31	0	0	399	31	886	69
Cat PD-97	Off-site via swales and rearlot catchbasins	86.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	87	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	77	30	0	77	47	0	47	21	0	0	21	9	0	0	0	0	0	9	0	0	0	102	9	886	77
Cat PD-106	Off-site via swales and rearlot catchbasins	202.6	100%	202.6	100%	202.6	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	180	0	162	180	0	18	18	0	81	0	81	0	0	162	0	0	162	162	-81	0	0	399	81	886	180
Cat PD-107	Off-site via swales and rearlot catchbasins	96.5	100%	96.5	100%	96.5	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	85	0	77	85	0	9	9	0	38	0	38	0	0	77	0	0	77	77	-38	0	0	399	38	886	85
Cat PD-181	Off-site via swales and rearlot catchbasins	24.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	24	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	22	8	0	22	13	0	13	6	0	0	6	2	0	0	0	0	0	2	0	0	0	102	2	886	22
Cat PD-182	Off-site via swales and rearlot catchbasins	331.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	331	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	294	113	0	294	181	0	181	79	0	0	79	34	0	0	0	0	0	34	0	0	0	102	34	886	294
Cat PD-183	Off-site via swales and rearlot catchbasins	375.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	375	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	333	128	0	333	205	0	205	90	0	0	90	38	0	0	0	0	0	38	0	0	0	102	38	886	333
Cat PD-189	Off-site via swales and rearlot catchbasins	59.8	100%	59.8	100%	59.8	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	53	0	48	53	0	5	5	0	24	0	24	0	0	48	0	0	48	48	-24	0	0	399	24	886	53
Cat PD-190	Off-site via swales and rearlot catchbasins	105.7	100%	105.7	100%	105.7	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	94	0	84	94	0	9	9	0	42	0	42	0	0	84	0	0	84	84	-42	0	0	399	42	886	94
Post-Development Catchment PD Total	**Off-site via swales and rearlot catchbasins**	**1,890**	**37%**	**691**	**37%**	**691**	**0%**	**0**	**0**	**63%**	**1,199**								**1,675**	**409**	**551**	**1,675**	**653**	**61**	**715**	**286**	**276**	**0**	**562**	**123**	**0**	**551**	**0**	**0**	**551**	**674**	**-276**	**0**	**0**	**211**	**398**	**886**	**1,675**
Cat PE-1	Off-site via rearlot catchbasins and PF drainage feature	697.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	697	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	618	238	0	618	380	0	380	166	0	0	166	71	0	0	0	0	0	71	0	0	0	102	71	886	618
Cat PE-7	Off-site via rearlot catchbasins and PF drainage feature	129.5	100%	129.5	100%	129.5	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	115	0	103	115	0	11	11	0	52	0	52	0	0	103	0	0	103	103	-52	0	0	399	52	886	115
Cat PE-8	Off-site via rearlot catchbasins and PF drainage feature	395.0	100%	395.0	100%	395.0	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	350	0	315	350	0	35	35	0	158	0	158	0	0	315	0	0	315	315	-158	0	0	399	158	886	350
Cat PE-127	Off-site via rearlot catchbasins and PF drainage feature	343.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	343	Lawns	0.05	Open Sandy Loam	0.4	0.25	0.7	0.7	304	117	0	304	187	0	187	82	0	0	82	35	0	0	0	0	0	35	0	0	0	102	35	886	304
Cat PE-130	Off-site via rearlot catchbasins and PF drainage feature	257.8	100%	257.8	100%	257.8	0%	0.0	0.0	0%	0	Building	0	Open Sandy Loam	0.4	0.25	0.65	0	228	0	206	228	0	23	23	0	103	0	103	0	0	206	0	0	206	206	-103	0	0	399	103	886	228
Post-Development Catchment PE Total	**Off-site via rearlot catchbasins and PF drainage feature**	**1,823**	**43%**	**782**	**43%**	**782**	**0%**	**0**	**0**	**57%**	**1,040**								**1,615**	**355**	**624**	**1,615**	**567**	**69**	**637**	**248**	**312**	**0**	**560**	**106**	**0**	**624**	**0**	**0**	**624**	**730**	**-312**	**0**	**0**	**230**	**418**	**886**	**1,615**

TABLE F-1 POST-DEVELOPMENT WATER BUDGET (BY CATCHMENT)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

ANNUAL PRECIPITATION	EVAPORATION AND EVAPOTRANSPIRATION FACTORS			
	Impervious Areas		Waterbody	
mm	%	mm	%	mm
886	10%	89	73%	646

On-Site Subcatchment Designation	Outlet	Total Area	Impervious							Pervious		MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted MOE Infiltration Factor
			Total Impervious		Assumed Buildings		Assumed Road/ Parking/ Amenities		Other Impervious	Total Pervious								
		(m^2)	% of Total Area	(m^2)	% of Impervious Area	(m^2)	% of Impervious Area	(m^2)	(m^2)	% of Total Area	(m^2)	Cover		Soil		Topography		
Cat PF-6	Off-site to the north	227.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	228	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-94	Off-site to the north	18.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	18	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-129	Off-site to the north	76.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	77	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-171	Off-site to the north	817.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	817	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-172	Off-site to the north	712.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	713	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-173	Off-site to the north	77.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	78	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-174	Off-site to the north	2.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	2	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-175	Off-site to the north	152.5	0%	0.0	0%	0.0	0%	0.0	0.0	100%	153	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-176	Off-site to the north	6.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	6	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-177	Off-site to the north	5.2	0%	0.0	0%	0.0	0%	0.0	0.0	100%	5	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-178	Off-site to the north	840.4	0%	0.0	0%	0.0	0%	0.0	0.0	100%	840	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-179	Off-site to the north	14.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	14	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-180	Off-site to the north	449.3	0%	0.0	0%	0.0	0%	0.0	0.0	100%	449	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-186	Off-site to the north	106.6	0%	0.0	0%	0.0	0%	0.0	0.0	100%	107	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-187	Off-site to the north	24.1	0%	0.0	0%	0.0	0%	0.0	0.0	100%	24	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-188	Off-site to the north	171.7	0%	0.0	0%	0.0	0%	0.0	0.0	100%	172	Drainage Feature	0.2	Open Sandy Loam	0.4	0.25	0.85	0.85
Cat PF-191	Off-site to the north	246.0	0%	0.0	0%	0.0	0%	0.0	0.0	100%	246	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Cat PF-192	Off-site to the north	181.8	0%	0.0	0%	0.0	0%	0.0	0.0	100%	182	Uncultivated	0.15	Open Sandy Loam	0.4	0.25	0.8	0.8
Post-Development Catchment PF Total	**Off-site to the north**	**4,130**	**0%**	**0**	**0%**	**0**	**0%**	**0**	**0**	**100%**	**4,130**							
Total Site		**26,118**	**52%**	**13,574**	**25%**	**6,506**	**27%**	**7,068**	**0**	**48%**	**12,544**							

On-Site Subcatchment Designation	Inputs				Outputs						
	Precipitation			Total Inputs	Evapotranspiration			Infiltration			
	Annual Average	Surplus (Pervious)	Surplus (Impervious)		Pervious	Impervious	Total Evapotranspiration	Pervious Areas	Rooftop Discon	Infiltration Trenches	Total Infiltration
	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)
Cat PF-6	202	55	0	202	147	0	147	46	0	0	46
Cat PF-94	16	4	0	16	12	0	12	4	0	0	4
Cat PF-129	68	18	0	68	49	0	49	16	0	0	16
Cat PF-171	724	267	0	724	457	0	457	214	0	0	214
Cat PF-172	631	233	0	631	398	0	398	186	0	0	186
Cat PF-173	69	25	0	69	43	0	43	20	0	0	20
Cat PF-174	2	1	0	2	1	0	1	1	0	0	1
Cat PF-175	135	50	0	135	85	0	85	40	0	0	40
Cat PF-176	5	1	0	5	4	0	4	1	0	0	1
Cat PF-177	5	1	0	5	3	0	3	1	0	0	1
Cat PF-178	745	275	0	745	470	0	470	220	0	0	220
Cat PF-179	13	5	0	13	8	0	8	4	0	0	4
Cat PF-180	398	147	0	398	251	0	251	118	0	0	118
Cat PF-186	95	26	0	95	69	0	69	22	0	0	22
Cat PF-187	21	6	0	21	16	0	16	5	0	0	5
Cat PF-188	152	41	0	152	111	0	111	35	0	0	35
Cat PF-191	218	80	0	218	138	0	138	64	0	0	64
Cat PF-192	161	59	0	161	102	0	102	48	0	0	48
Post-Development Catchment PF Total	**3,660**	**1,296**	**0**	**3,660**	**2,365**	**0**	**2,365**	**1,044**	**0**	**0**	**1,044**
Total Site	**23,146**	**2,652**	**10,826**	**23,146**	**6,951**	**1,203**	**8,154**	**3,053**	**1,685**	**872**	**5,610**

On-Site Subcatchment Designation	Outputs													
	Runoff												Total Outputs	
	Pervious	Landscaped Area Redirecte	Building	Road/ Driveway/ Amenities	Other Impervious	Total Impervious	Total Runoff	Rooftop Runoff Infiltrated	Infiltration Trenches		Net Runoff			
	(m^3/yr)	(m3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
Cat PF-6	8	0	0	0	0	0	8	0	0	0	36	8	886	202
Cat PF-94	1	0	0	0	0	0	1	0	0	0	36	1	886	16
Cat PF-129	3	0	0	0	0	0	3	0	0	0	36	3	886	68
Cat PF-171	53	0	0	0	0	0	53	0	0	0	65	53	886	724
Cat PF-172	47	0	0	0	0	0	47	0	0	0	65	47	886	631
Cat PF-173	5	0	0	0	0	0	5	0	0	0	65	5	886	69
Cat PF-174	0	0	0	0	0	0	0	0	0	0	65	0	886	2
Cat PF-175	10	0	0	0	0	0	10	0	0	0	65	10	886	135
Cat PF-176	0	0	0	0	0	0	0	0	0	0	36	0	886	5
Cat PF-177	0	0	0	0	0	0	0	0	0	0	36	0	886	5
Cat PF-178	55	0	0	0	0	0	55	0	0	0	65	55	886	745
Cat PF-179	1	0	0	0	0	0	1	0	0	0	65	1	886	13
Cat PF-180	29	0	0	0	0	0	29	0	0	0	65	29	886	398
Cat PF-186	4	0	0	0	0	0	4	0	0	0	36	4	886	95
Cat PF-187	1	0	0	0	0	0	1	0	0	0	36	1	886	21
Cat PF-188	6	0	0	0	0	0	6	0	0	0	36	6	886	152
Cat PF-191	16	0	0	0	0	0	16	0	0	0	65	16	886	218
Cat PF-192	12	0	0	0	0	0	12	0	0	0	65	12	886	161
Post-Development Catchment PF Total	**251**	**0**	**0**	**0**	**0**	**0**	**251**	**0**	**0**	**0**	**61**	**251**	**886**	**3,660**
Total Site	**1,112**	**0**	**5,189**	**5,637**	**0**	**10,826**	**11,939**	**-1,685**	**-33**	**-872**	**359**	**9,382**	**886**	**23,146**

APPENDIX A4
GEOMORPHIX REPORT

Technical Design Brief: Tributary of Uxbridge Creek

Town of Uxbridge, Ontario

Prepared for:
Westlane Development Group Ltd.
2 Farr Avenue
Sharon, Ontario L0G 1V0

October 27, 2020
PN20094

GEO MORPHIX
Geomorphology
Earth Science
Observations

Report Prepared by:	GEO Morphix Ltd. 36 Main Street North, PO Box 205 Campbellville, ON L0P 1B0
Report Title:	Technical Design Brief: Tributary of Uxbridge Creek Town of Uxbridge, Ontario
Project Number:	PN20094
Status:	Final
Version:	1.0
First Submission Date:	October 27, 2020
Revision Date:	--
Prepared by:	Lindsay Davis, M. Sc., P.Geo., CAN-CISEC, Ben Miller, B. Sc., CAN-CISEC
Approved by:	Paul Villard, Ph.D., P.Geo., CAN-CISEC, EP, CERP
Approval Date:	October 27, 2020

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List of Tables

Appendices

1 Introduction

This design brief provides design recommendations for a bioswale design as part of the proposed 226 Brock Street residential development in the Town of Uxbridge, Ontario. The design serves to convey flows from the SWM Pond to the downstream tie in at Brock Street. A site map is provided in **Appendix A**. The bioswale design serves to improve form and function for this headwater drainage feature, enhance terrestrial diversity and the provision of organics, as well as enhance the retention and detention of flow and sediments.

In developing the design, the following activities were completed:

- A review of the available background materials, including the Conceptual Technical Design Brief (GEO Morphix Ltd., 2018)
- Provide details for the bioswale design including planform, cross sections, and necessary bioengineering details
- Hydraulic sizing of the bioswale materials
- Define corridor requirements
- Recommendations for design implementation including construction timing, and best management practices
- Development of a post-construction monitoring plan

This design brief is provided to facilitate review of the design, which outlines the current geomorphological condition of **Reach UCT1** and design considerations, provides technical details and recommendations for implementation, and monitoring of the proposed design.

2 Existing Conditions

Headwater drainage feature morphology and planform are largely governed by the flow regime and the availability and type of sediments (i.e., surficial geology) within the feature corridor. Physiography, riparian vegetation and land use also physically influence the headwater drainage feature. These factors are explored as they not only offer insight into what governs feature geomorphology, but also potential changes that could be expected in the future as they relate to a proposed activity. Field observations provide us with an in-depth understanding of the factors that impact feature geomorphology within the study area.

2.1 Geology

The study area is within the Peterborough Drumlin Field physiographic region, which is characterized as a drumlin field of various morphologies and orientation (OGS, 2010). The surficial geology is comprised of fine-textured glaciolacustrine deposits and ice-contact stratified deposits. The fine-textured glaciolacustrine deposits are located on the north side of the property and consist mainly of silt and clay with minor sand and gravel present. The ice contact stratified deposits are located at the south end of the property and consist of sand-gravel and minor silt, with clay and till present (OGS, 2003).

2.2 Field Observations

Field observations of **Reach UCT1** were completed on April 10, May 28, and July 19, 2018 previously as part of the conceptual design. The conceptual report recommended under the OSAP Headwater Drainage Assessment that *no management* was required for the reach based on the limited hydrology of the swale feature. However, the proponent wishes to retain the feature on the landscape as an enhanced bioswale. Given the feature has limited morphological variability as noted in the Conceptual Design Brief (GEO Morphix Ltd., 2018) restoration of the feature provides an opportunity to improve form and function and increase habitat and morphological variability.

3 Natural Bioswale Design

3.1 Design Objectives

As previously mentioned, the headwater drainage feature has limited morphology and degraded physical instream habitat conditions. The conceptual design has been reviewed previously by Lake Simcoe Region Conservation Authority and has been generally accepted. The below recommendation are consistent with those provided in the Conceptual Design Brief (GEO Morphix Ltd., 2018).

The proposed design will be a stable bioswale to provide a naturalized form and function. Headwater features like this reach provide detention and retention functions with regards to both flow and sediment. To maintain and enhance these functions, the design needs to provide good communication with the floodplain, as well as diversity in morphology. As such, online wet meadow features will be constructed throughout the corridor. These features enhance terrestrial habitat by increasing diversity and providing a more natural floodplain form. They also provide functional benefits by storing and discharging water over longer attenuated periods.

From a habitat perspective, the important contributions of the headwater drainage feature include organic inputs to the system, and provision of a complex valley system with elements that have a wide range of hydroperiods. The inclusion of a shallow and deep undulation typology with online wet meadow features provides a wide range of hydroperiods.

The primary objectives of the design, therefore, are to:

- Convey flows from the SWMP to the downstream channel
- Improve the function of the headwater drainage feature as well as its interaction with the floodplain
- Improve water quality by extending detention of water through online wet meadow features
- Improve riparian habitat by installing woody plantings and floodplain features

3.2 Bioswale Geometries

A bioswale containing shallow and deep undulations will convey flows along the south of the property into an enhanced bioswale feature with online wet meadows that flows along the east of the property. This feature will provide significant improvements to the headwater drainage feature, as it essentially replicates a natural system. When it is assessed to be an appropriate feature, a bioswale system offers numerous benefits, namely:

- Bed relief for flow variability
- Improve the function of the headwater drainage feature as well as its interaction with the floodplain
- Improve water quality by extending detention of water through online wet meadow features and providing infiltration
- Provide organic inputs through vegetation establishment

Bioswale dimensions are determined by bankfull discharge, as this represents what is generally considered the feature-forming discharge. Back-calculation of discharge from a reference reach, along with support from hydrological modelling, is usually the most appropriate. Due to the lack of a defined feature, and historical impacts to the headwater drainage feature because of agricultural activities, the computed discharge could not be considered accurate or reliable. Additionally, due to changes in hydrology likely to occur as a result of the development, a more appropriate discharge based on hydrological modelling was determined for the reach. Vincent & Associates (2000) completed hydrologic modelling upon review of post-development conditions and computed a bankfull discharge of 0.07 m^3/s. This discharge outlets from the Block 57 stormwater management (SWM) pond and is based on the 2-year storm event (Vincent & Associates, 2000).

Shallow and deep undulation geometries, as well as anticipated bankfull flow conditions, are provided in **Table 1.** A simple Manning's approach was used to size the bioswale dimensions. Since deep undulations contain dead space, this model overpredicts the amount of discharge that they convey. The modelled values for the shallow undulations give a better prediction of the bioswale capacity. The bioswale design comprises of a single reach, which begins as a straight bioswale within a narrow corridor extending 136 m before entering a wider corridor where the bioswale extends 173 m and contains online wetland features. The entire bioswale design is characterized by a constant bankfull gradient of 0.54% and has a total length of 312 m. The bankfull width and depth range from 1.20 m to 1.40 m and 0.15 m to 0.25 m for the shallow and deep undulations, respectively.

Table 1. Bankfull parameters of the proposed bioswale

Bioswale parameter	Bioswale Geometries	
	Shallow Undulation	Deep Undulation
Bankfull width (m)†	1.20	1.40
Average bankfull depth (m)†	0.11	0.14
Maximum bankfull depth (m)†	0.15	0.25
Bankfull width-to-depth ratio	8.00	5.60
Bioswale gradient (%)	1.8	0.54
Bankfull gradient (%)	0.54	0.54
Manning's roughness coefficient, *n*	0.04	0.03
Mean bankfull velocity (m/s) *	0.67	0.63
Bankfull discharge (m^3/s) *	0.09	0.13
Discharge to accommodate (m^3/s)	0.07	0.07
Tractive force at bankfull (N/m^2)††	26.48	14.71
Stream power (W/m)††	15.19	7.48
Unit stream power (W/m^2)††	14.47	7.87
Maximum grain size entrained (m) **	0.03	0.02
Mean grain size entrained **	0.02	0.01

† Based on bankfull gradient
†† Based on riffle gradient
* Based on Manning's equation; as pools contain ineffective space, the velocity and discharge conveyed in them are not presented
** Based on Shields equation, assuming Shields parameter equals 0.06 (gravel)

The sizing of proposed substrate materials was guided by a review of hydraulic conditions in the typical headwater drainage feature cross sections. To provide for a stable bed and level of sorting, native material is proposed for the shallow and deep undulations. A mix of topsoil and granular 'b' is proposed for the online wet meadows to provide for a stable bed and level of sorting, while still maintaining the character of the native material and providing slightly higher stability and opportunity for sediment sorting. Granular 'b' consists of a mix of stone where approximately 20% - 50% of the stone is greater than 0.005 m in diameter, but nothing larger than 0.15 m in diameter. These materials will always have a core of sediment that is not entrained under bankfull flow conditions. A mix of relatively larger substrate (0.15 – 0.20 m diameter riverstone) and granular 'b' is proposed for the stone core wetland, located immediately downstream of the SWM pond headwall. These materials will provide higher stability and will always have a core of sediment that is not entrained under larger storm events (i.e., 100-yr).

The bioswale banks and online wet meadows will be restored using native plant species. This includes appropriate species for the various seed mixes as well as woody vegetation. The plantings are intended to enhance the terrestrial habitat through the provision of habitat diversity, increase floodplain soil stability, and increase floodplain roughness and sedimentation. A tree compensation plan has been completed by Cosburn Nauboris Ltd. Landscape Architects to provide compensation for the trees being removed along the southern property limit. Additional plantings for the remainder of the corridor are provided on drawing RES-1 completed by GEO Morphix Ltd.

3.3 Bioswale Corridor

The bioswale is expected to fully vegetated and have intermittent flows. Given the limited energy and vegetation control, the feature is unlikely to migrate or adjust its planform resulting in no erosion hazard associated with the feature. The valley walls are less than 2.5 m in height, therefore it is not considered a confined system and does not require an erosion setback.

Online wet meadow features will be constructed in addition to the bioswale. These features provide functional benefits such as short-term water retention and sediment banking. Additionally, these features enhance local recharge by allowing for infiltration. Mounds are to be included within the wet meadows to provide added morphological variation.

3.4 Natural Erosion Control

Newly constructed features can be vulnerable to erosion. This is particularly true before vegetation has established along the bioswale banks. While low-flow events should not intensify erosion, the concern for erosion occurs when there are high flows or precipitation events during construction.

For immediate erosion protection, mechanical stabilization in the form of biodegradable erosion control blankets (i.e., coir cloth, jute mat, etc.) should be used. As the blankets will biodegrade over time, this serves as a short-term stabilization measure.

For long-term stability, implementation of a planting plan is recommended. This includes deep rooting native grasses and other herbaceous species seeded along and within bioswale sections, prescription of flood tolerant native shrub and tree species, and use of seed banks within the local soil. Shrubs should be planted close to the bioswale margins to provided maximum benefit with respect to stabilization and bioswale cover.

Potential erosion locations (i.e., along the outside meander bends, immediately downstream of wet meadow features, etc.) should be anticipated, and should be reflected in the planting plan. Live staking and shrub stock should be used adjacent to the bioswale bank to provide immediate benefit as well as long-term infilling. If appropriate live staking methods are followed, this method should provide greater benefits than simple potted or bare root shrub plating. This is because of the potential for higher densities with live staking.

4 Design Implementation

4.1 Construction Timing

Based on resident fish species and their respective life cycles, in-stream work will be restricted to July 1st to March 31st, unless otherwise directed by the Ministry of Natural Resources and Forestry (MNRF).

Vegetation removals associated with clearing, site access and staging should occur outside the key breeding bird period for migratory birds, identified by Environment Canada, to ensure compliance with the Migratory Birds Convention Act (MBCA), 1994 and Migratory Bird Regulations. The breeding season for migratory birds in this part of the country typically extends from as early as March 1 to as late as September 15. Should tree removals be required during the key breeding bird season, a qualified biologist should inspect those trees to ensure that they do not contain nesting birds. It is understood that the MBCA is not restricted to cutting woody vegetation, but also applies to topsoil stripping and grubbing activities, as there are ground nesting bird species that are protected under the Act.

4.2 Best Management Practices

Site inspection should be performed by an inspector with experience overseeing natural feature construction works, as this type of work differs considerably from engineering projects. An experienced inspector will be able to provide quick and appropriate response to issues that may arise and ensure that construction proceeds in accordance with the approved design and contract.

The limits of construction will be delineated to prevent unanticipated impacts to natural surroundings, including trees and the headwater drainage feature. Most of the bioswale can be constructed without interference to the existing headwater drainage feature. To complete the connection with the existing feature, flows will be conveyed around the work area using cofferdams and bypass pumping such that the bioswale can be constructed fully isolated from the active flow area.

All isolated work areas will be dewatered to perform work under dry conditions. Water will be pumped to a sediment filtration system located at least 30 m from the receiving headwater drainage feature and be allowed to naturally flow over a well-vegetation surface and ultimately return to the headwater drainage feature downstream of the work area. This will allow particles to settle before reaching the headwater drainage feature.

All materials and equipment will be stored and operated in such a manner that prevents any deleterious substances from entering the water. Vehicle and equipment re-fuelling and/or maintenance will be conducted away from the headwater drainage feature and be free of fluid leaks and externally cleaned/degreased to prevent the release of deleterious substances.

4.3 Post-Construction Monitoring

A post-construction monitoring program is recommended to assess the performance of the implemented design. Monitoring observations can also be used to determine the need for remedial works. Monitoring is recommended for two full calendar years following the year of construction.

The following monitoring and reporting activities are proposed:

- General observations of the bioswale works should be documented after construction and after the first large flooding event to identify any potential areas of erosion concern
- Collection of a photographic record of site conditions
- Total station as-built survey of the bioswale planform, longitudinal profile and cross sections just after construction to obtain reference data for the following two years
- A general vegetation survey in the spring of each year
- Re-survey of the longitudinal profile and monumented cross sections for two years following construction

- A yearly report for the first year, with a final report at the end of the two-year period

The monitoring would commence immediately after construction and sites would be reviewed annually to identify natural variability of the system. Reporting would be provided annually, with a summary report at the end of each year.

We trust this report meets your requirements. Should you have any questions, please contact us.

Respectfully submitted,

Paul Villard Ph.D., P.Geo., CAN-CISEC, EP, CERP
Director, Principal Geomorphologist

Lindsay Davis, M.Sc., P.Geo., CAN-CISEC
Geomorphologist

5 References

GEO Morphix Ltd. 2018. Conceptual Design Brief: Tributary of Uxbridge Creek. Town of Uxbridge, Ontario. Project No.: 18072.

Ontario Geological Survey (OGS). 2003. Surficial Geology of Southern Ontario.

Stanfield, L. (editor). 2013. Ontario Stream Assessment Protocol. Version 9.0. Fisheries Policy Section. Ontario Ministry of Natural Resources. Peterborough, Ontario. 505 Pages.

Toronto and Region Conservation Authority and Credit Valley Conservation (TRCA/CVC). 2014. Evaluation, Classification and Management of Headwater Drainage Features Guidelines

Vincent & Associates. 2000. Coral Creek Homes Stormwater Management Detention Facility. Drawing No. SW-1

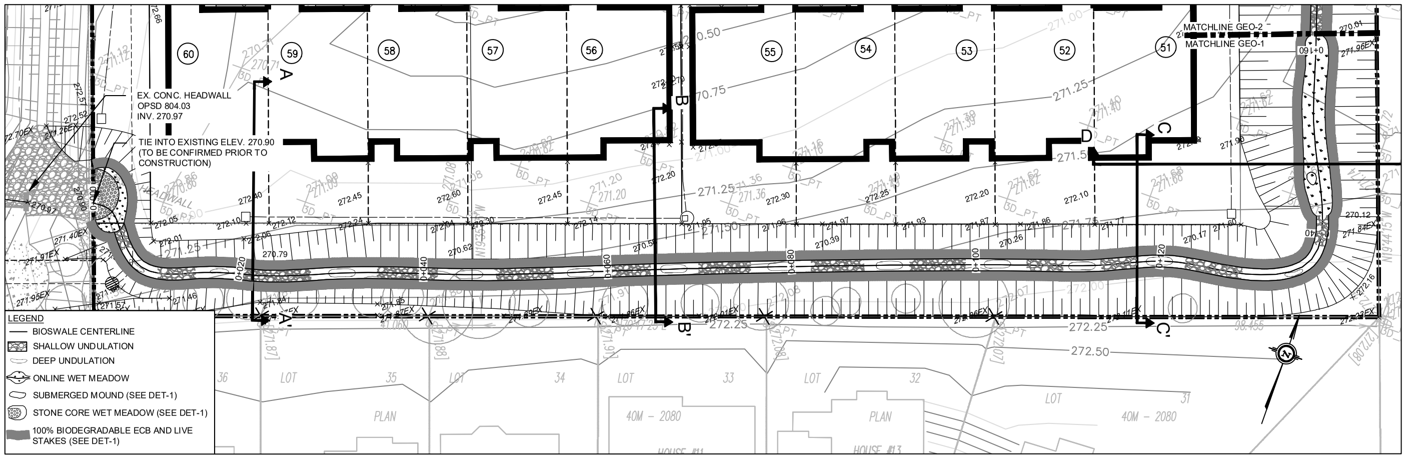
Appendix A
Site Map

GEO MORPHIX

Tributary of Uxbridge Creek

226 Brock Street,
Town of Uxbridge

Westlane Development Group Ltd.



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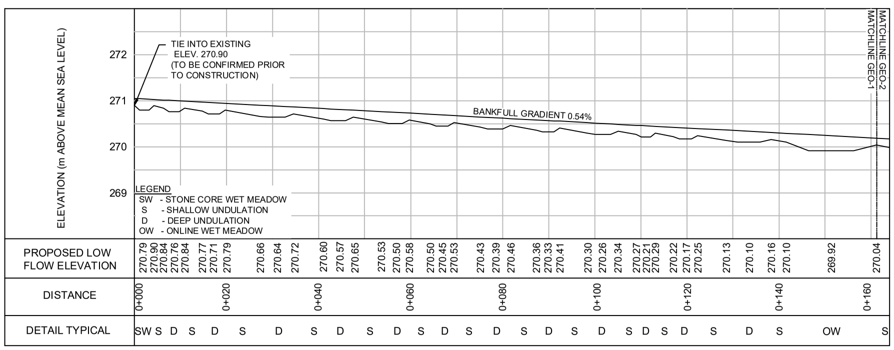

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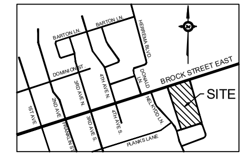

KEY MAP
N.T.S.

GENERAL NOTES

1. ALL CONTRACT DRAWINGS, SPECIFICATIONS AND APPLICABLE PERMITS MUST BE KEPT ON SITE DURING CONSTRUCTION FOR REFERENCE.
2. THE CONTRACTOR MUST NOTIFY THE CONTRACT ADMINISTRATOR AND CONSERVATION AUTHORITY OF THE INTENT TO COMMENCE WORK AT LEAST 48 HOURS IN ADVANCE.
3. THE CONTRACTOR IS RESPONSIBLE FOR ALL UTILITY LOCATES.
4. LAYOUT MUST BE REVIEWED AND APPROVED BY THE CONTRACT ADMINISTRATOR.
5. DESIGNER OR REPRESENTATIVE SHALL BE PRESENT DURING CONSTRUCTION TO PROVIDE GUIDANCE ON INSTALLATION OF THE FEATURES.

TIMING OF WORKS

1. WORKS SHALL BE COMPLETED BETWEEN JULY 1ST TO MARCH 31ST.
2. TREE CLEARING SHOULD BE COMPLETED OUTSIDE THE BIRD NESTING SEASON TO COMPLY WITH THE FEDERAL MIGRATORY BIRDS CONVENTION ACT. ANY TREES THAT REQUIRE REMOVAL OUTSIDE OF THIS TIMING WINDOW MUST FIRST BE INSPECTED BY A QUALIFIED BIOLOGIST TO DETERMINE THE PRESENCE OF NESTING BIRDS.
3. THE WEATHER FORECAST SHOULD BE CONTINUALLY MONITORED TO ENSURE THAT WORKS ARE UNDERTAKEN ONLY DURING FAVOURABLE WEATHER CONDITIONS.
4. COMPLETE THE WORKS WITH MINIMAL AVOIDABLE INTERRUPTIONS ONCE THEY COMMENCE.

SITE AND MATERIAL MANAGEMENT

1. ALL CONSTRUCTION EQUIPMENT AND MATERIALS (IMPORTED OR EXCAVATED) MUST BE STORED AT LEAST 30 m AWAY FROM ANY WATERBODY IN A STABLE AREA ABOVE THE ACTIVE FLOODPLAIN, OR IN A DESIGNATED STAGING/STORAGE AREA.
2. IN THE EVENT OF AN UNEXPECTED STORM, ALL UNFIXED ITEMS THAT HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW MUST BE MOVED A STABLE AREA ABOVE ACTIVE FLOODPLAIN.
3. STOCKPILES MUST BE LOCATED OUTSIDE THE ISOLATED WORK AREAS.
4. STABILIZE STOCKPILED SOILS THAT ARE STORED FOR PROLONGED PERIODS WITH THE APPLICATION OF A NURSE CROP AT A RATE OF 60 kg/ha.
5. STABILIZE, TEMPORARILY OR PERMANENTLY, ANY DISTURBED AREAS AS WORK PROGRESSES, OR SOON AS CONDITIONS ALLOW. ON SOILS THAT WILL BE EXPOSED FOR PROLONG PERIODS, TEMPORARILY INSTALL A BIODEGRADABLE EROSION CONTROL BLANKET ON EXPOSED SOILS, OR APPLY A NURSE CROP AT A RATE OF 60 KG/HA.
6. MINIMIZE THE AREA OF DISTURBANCE TO THE EXTENT POSSIBLE.
7. ALL VEGETATION, ADJACENT TO THE WORK AREA, MUST BE PROTECTED AND DELINEATED WITH CONSTRUCTION FENCING OR TREE PROTECTION BARRIERS.
8. ALL GRADES IN THE AREA REGULATED BY THE CONSERVATION AUTHORITY MUST BE MAINTAINED OR MATCHED, UNLESS OTHERWISE AUTHORIZED IN THE APPLICABLE PERMIT.

EROSION AND SEDIMENT CONTROL

1. ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES MUST BE INSTALLED PRIOR TO START OF WORKS.
2. SEDIMENT CONTROLS MUST BE INSPECTED DAILY TO ENSURE THAT THEY ARE IN GOOD REPAIR AND FUNCTIONING AS INTENDED.
3. EROSION AND SEDIMENT CONTROLS MUST BE MAINTAINED DURING CONSTRUCTION, AND ANY REQUIRED REPAIRS OR REPLACEMENTS MUST BE COMPLETED WITHIN 24 HOURS AFTER THEY HAVE BEEN IDENTIFIED DURING THE MONITORING.
4. EROSION AND SEDIMENT CONTROLS MAY REQUIRE PERIODIC ADJUSTMENTS TO REFLECT CHANGING SITE CONDITIONS. THE CONTRACTOR WILL BE RESPONSIBLE FOR THESE ADJUSTMENTS TO ENSURE PROPER FUNCTION.
5. ANY CHANGES TO THE EROSION AND SEDIMENT CONTROL PLAN BEYOND MINOR ADJUSTMENTS MUST BE APPROVED BY THE CONTRACT ADMINISTRATOR.
6. ADDITIONAL EROSION AND SEDIMENT CONTROL SUPPLIES MUST BE KEPT ON SITE IN ORDER TO FACILITATE IMMEDIATE REPAIRS AND/OR UPGRADES AS NEEDED.
7. ALL TEMPORARY SEDIMENT CONTROLS MUST BE REMOVED AFTER THE CONTRACT ADMINISTRATOR DEEMS THE SITE TO BE STABLE.

DELETERIOUS SUBSTANCE CONTROL/SPILL MANAGEMENT

1. PREVENT THE RELEASE OF SEDIMENT, SEDIMENT-LADEN WATER, RAW CONCRETE, CONCRETE LEACHATE OR ANY OTHER DELETERIOUS SUBSTANCES INTO ANY WATERBODY, RAVINE OR STORM SEWER SYSTEM.
2. ENSURE EQUIPMENT AND MACHINERY ARE IN GOOD OPERATING CONDITION (POWER WASHED), FREE OF LEAKS, EXCESS OIL, AND GREASE.
3. NO EQUIPMENT REFUELLING OR SERVICING SHOULD BE UNDERTAKEN WITHIN 30 m OF ANY WATERCOURSE OR SURFACE WATER DRAINAGE.
4. A SPILL CONTAINMENT KIT MUST BE READILY ACCESSIBLE ON SITE IN THE EVENT OF A RELEASE OF A DELETERIOUS SUBSTANCE TO THE ENVIRONMENT. ONSITE STAFF MUST BE TRAINED IN ITS USE.
5. THE CONTRACT ADMINISTRATOR MUST BE NOTIFIED IMMEDIATELY IN THE EVENT OF A SPILL OF DELETERIOUS SUBSTANCE.

WORK AREA ISOLATION

1. ALL WORK IN ISOLATED WORK AREAS MUST BE COMPLETED IN THE DRY. AN ADEQUATE NUMBER OF PUMPS MUST BE USED FOR UNWATERING.
2. THE UNWATERING DISCHARGE LOCATION MUST BE LOCATED AT LEAST 30 M FROM ANY WATERCOURSE OR WETLAND IN AN AREA WITH DENSE VEGETATIVE GROUNDCOVER, AND WHERE THE DISCHARGE CAN RETURN TO THE WATERBODY DOWNSTREAM OF THE WORK AREA OVER THE GROUNDCOVER.

	DATE	BY	REVISIONS
3.	20/10/27	LD	FIRST DETAILED DESIGN SUBMISSION TO LSRCA
2.	MARCH 2019	LD	SECOND SUBMISSION LSRCA
1.	AUGUST 2018	LD	FIRST SUBMISSION LSRCA

DESIGNED BY: PV	CHECKED BY: PV
DRAWN BY: LD / BM	DATE: OCTOBER 27, 2020

PROFESSIONAL GEOSCIENTIST
PAUL V. VILLARD
PRACTISING MEMBER
0957
ONTARIO
20/10/27

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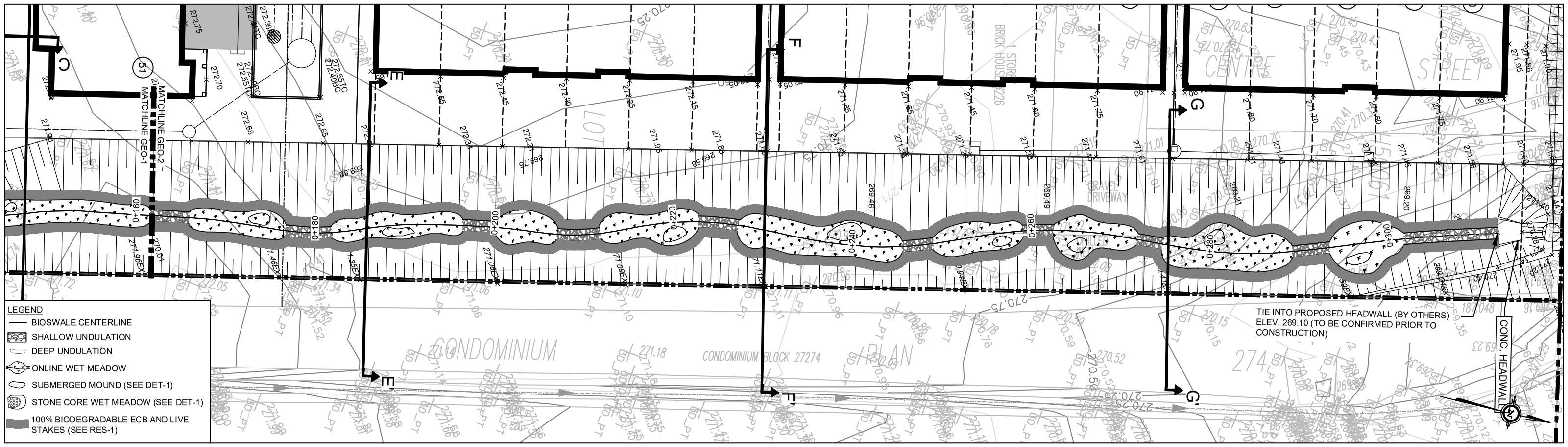
Observations
36 Main Street North, PO Box 205
Campbellville, Ontario L0P 1B0
T: 416.920.0926
www.geomorphix.com

226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
PLANFORM AND PROFILE

NOT FOR CONSTRUCTION

PROJECT No.: 20094	DRAWING No.: GEO-1
SCALE: AS NOTED	SHEET 1 OF 6



PLANFORM
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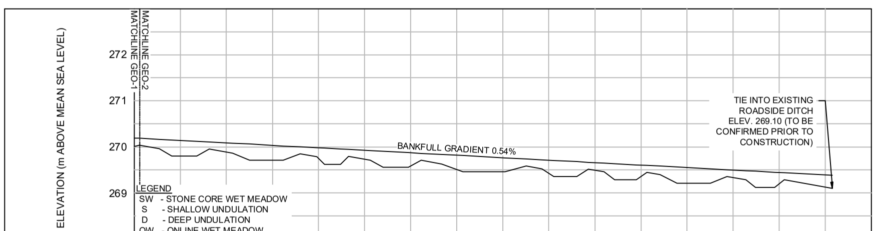

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DISTANCE	0+160, 0+180, 0+200, 0+220, 0+240, 0+260, 0+280, 0+300
DETAIL TYPICAL	S, OW, S, OW, S, OW, S, OW, S, OW, S, OW, S, OW, S, OW, S, OW, S

PROFILE
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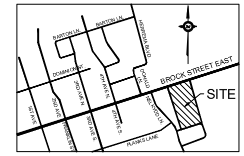
NOT FOR CONSTRUCTION



KEY MAP
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1. ALL CONSTRUCTION EQUIPMENT AND MATERIALS (IMPORTED OR EXCAVATED) MUST BE STORED AT LEAST 30 m AWAY FROM ANY WATERBODY IN A STABLE AREA ABOVE THE ACTIVE FLOODPLAIN, OR IN A DESIGNATED STAGING/STORAGE AREA.
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3. STOCKPILES MUST BE LOCATED OUTSIDE THE ISOLATED WORK AREAS.
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2. SEDIMENT CONTROLS MUST BE INSPECTED DAILY TO ENSURE THAT THEY ARE IN GOOD REPAIR AND FUNCTIONING AS INTENDED.
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DESIGNED BY: PV | CHECKED BY: PV
DRAWN BY: LD / BM | DATE: OCTOBER 27, 2020

PROFESSIONAL GEOSCIENTIST
PAUL V. VILLARD
PRACTISING MEMBER
0957
ONTARIO
20/10/27

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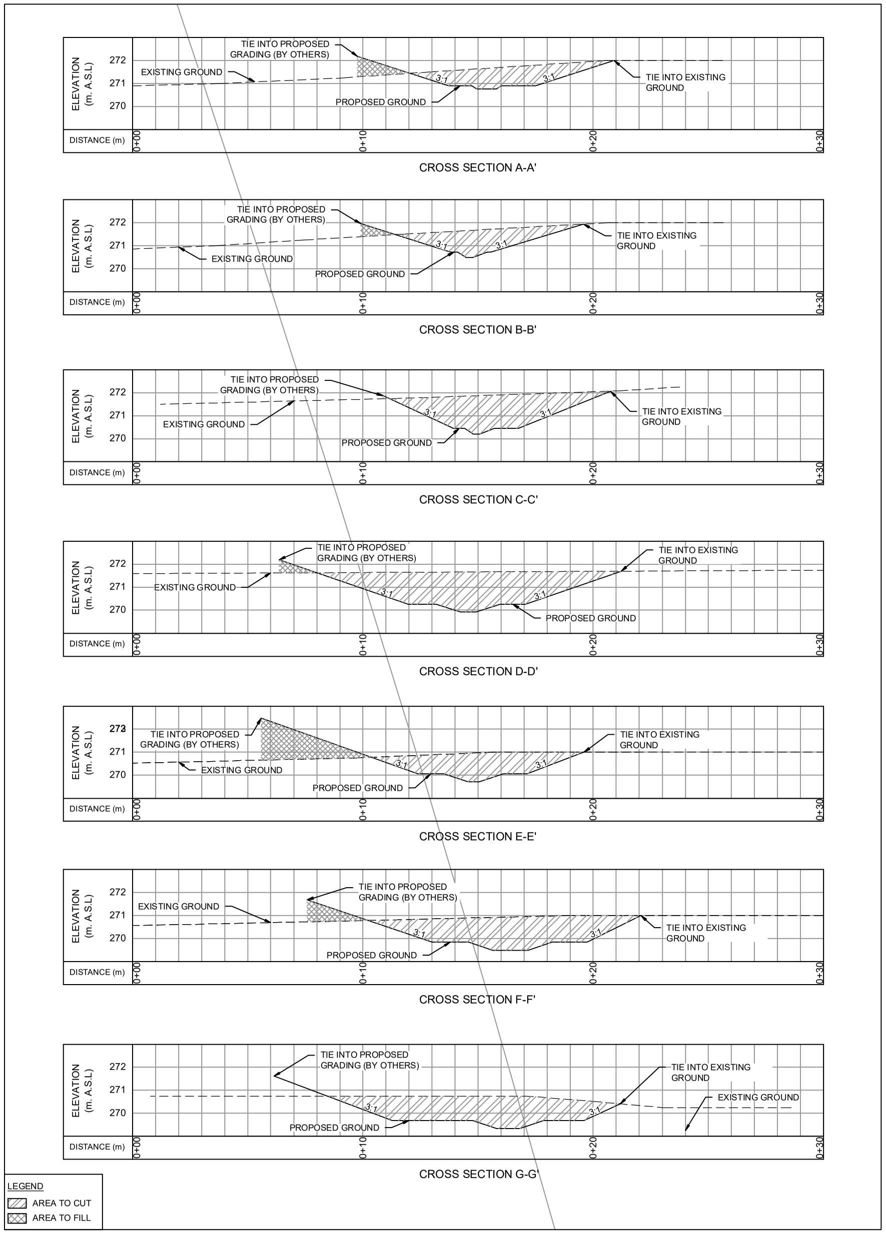
226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
PLANFORM AND PROFILE

PROJECT No.: 20094 | DRAWING No.: GEO-2
SCALE: AS NOTED | SHEET 2 OF 6



CROSS SECTIONS
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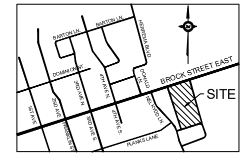

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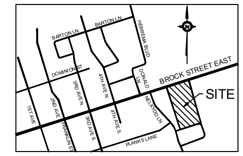
BIOSWALE DESIGN
CROSS SECTIONS

PROJECT No.: 20094	DRAWING No.: XS-1
SCALE: AS NOTED	SHEET 3 OF 6



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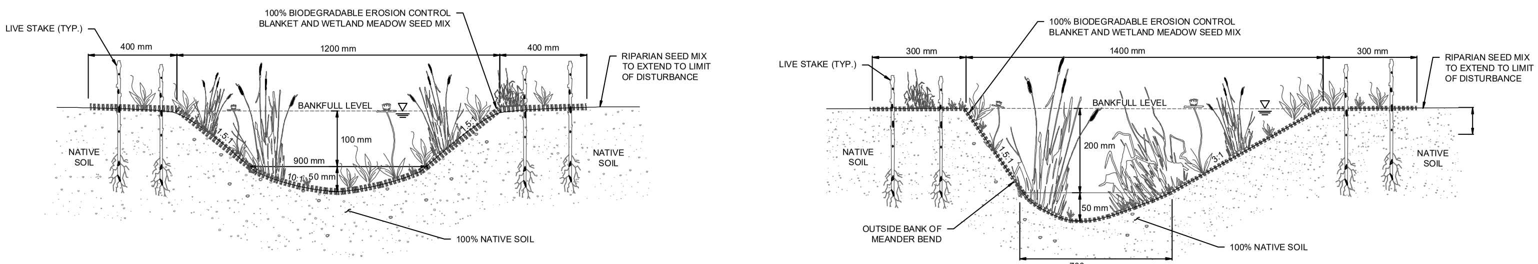
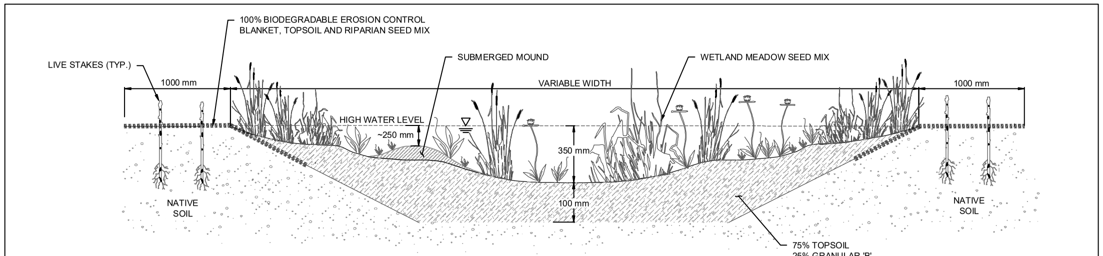


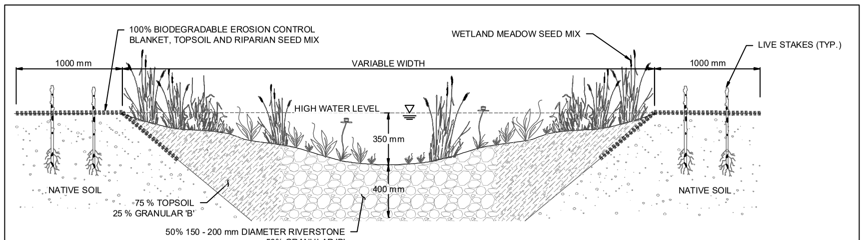
TYPICAL SHALLOW UNDULATION

TYPICAL DEEP UNDULATION

BIOSWALE FEATURES
N.T.S.



ONLINE WET MEADOW
N.T.S.



STONE CORE WET MEADOW
N.T.S.

NOT FOR CONSTRUCTION

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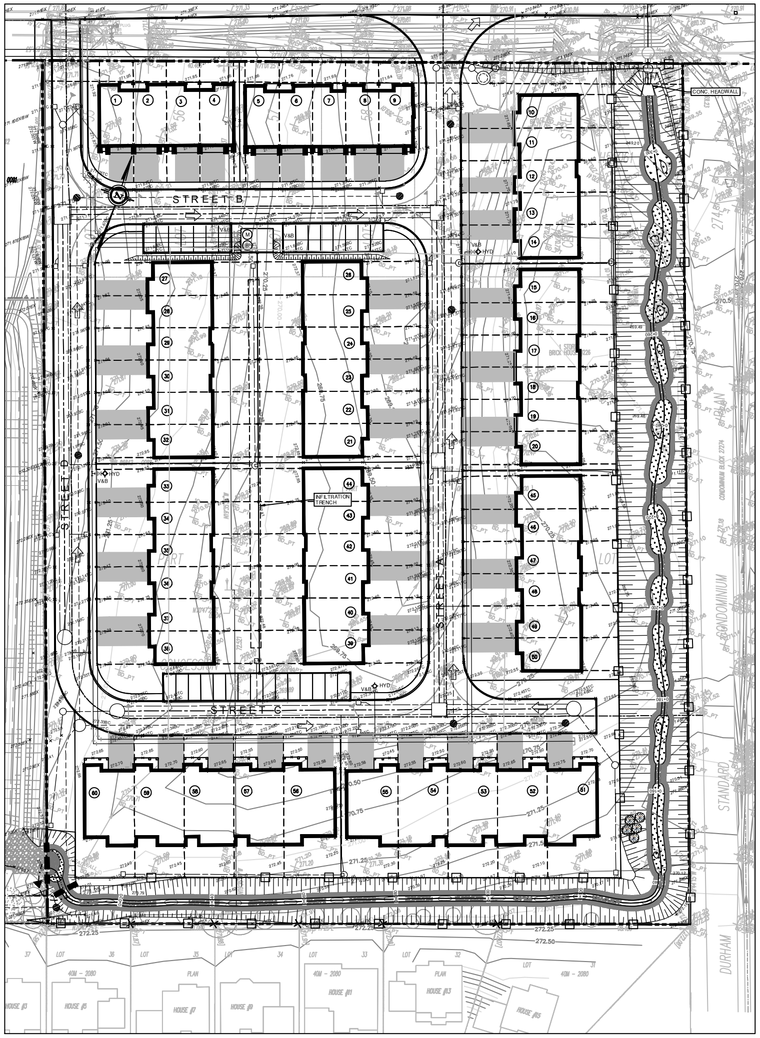
BIOSWALE DESIGN
RESTORATION DETAILS

PROJECT No.: 20094 | DRAWING No.: DET-1
SCALE: AS NOTED | SHEET 4 OF 6



PLANFORM
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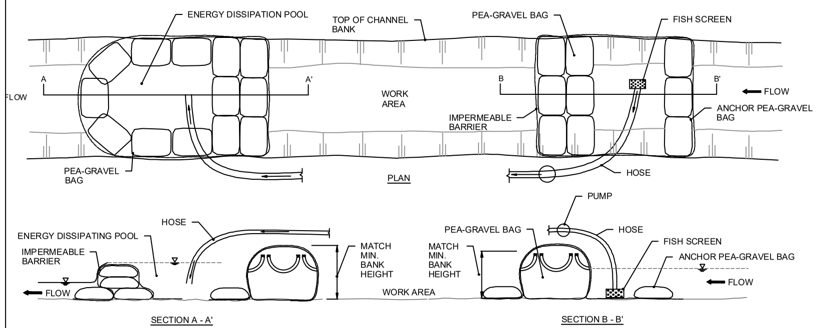
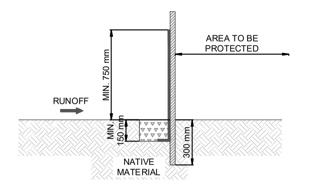


NOTES
1. PUMPING RATE MUST MATCH WORKING FLOW CONDITIONS.
2. IMPERMEABLE BARRIER (PLASTIC SHEET) TO COVER THE BAGS TO LIMIT SEEPAGE INTO WORK AREA.
3. BAGS TO BE FILLED WITH PEA-GRAVEL.
4. PEA-GRAVEL TO BE DISTRIBUTED IN CHANNEL AFTER WORKS ARE COMPLETE AT THE DISCRETION OF CONSTRUCTION CONTRACT ADMIN.
5. BACKUP PUMP AND HOSE SHALL BE KEPT ONSITE TO ADDRESS FAILURES AND HIGH FLOW CONDITIONS.

PEA-GRAVEL BAG COFFERDAM AND BYPASS PUMPING
N.T.S.



NOTE: MAX. 2 m T-BAR SPACING

SILT FENCE
N.T.S.

SUGGESTED SEQUENCE OF CONSTRUCTION

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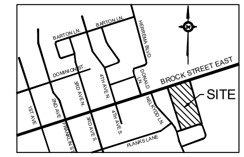
2. CONSTRUCTION CONTRACT ADMINISTRATOR TO REVIEW SITE CONDITIONS PRIOR TO COMMENCEMENT OF WORK.
3. MONITORING WEATHER TO ENSURE IN-WATER WORKS IS COMPLETED UNDER LOW-FLOW CONDITIONS.
4. INSTALL SILT FENCE TO ISOLATE THE WORK AREA.
5. CONSTRUCT AS MUCH AS ENHANCED BIOSWALE AS POSSIBLE WITHOUT INTERFERENCE TO THE EXISTING FEATURE., INCLUDING DOWNSTREAM TIE-IN.
6. STABILIZE ANY DISTURBED AREA WITH SEED AND 100% BIODEGRADABLE EROSION CONTROL BLANKET (BioNET C125BN OR APPROVED EQUIVALENT).
7. INSTALL COFFERDAMS AND PUMP FLOWS AROUND WORK ARE TO COMPLETE TIE-IN WITH EXISTING FEATURE AT THE UPSTREAM EXTENT.
8. INTRODUCE FLOWS TO THE FEATUREVONCE THE SITE HAS BEEN DEEMED STABLE BY THE DESIGNER OR REPRESENTATIVE.
9. REMOVE EROSION AND SEDIMENT CONTROL MEASURES ONCE AREA IS DEEMED STABLE BY THE DESIGNER OR REPRESENTATIVE.



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3. EROSION AND SEDIMENT CONTROLS MUST BE MAINTAINED DURING CONSTRUCTION, AND ANY REQUIRED REPAIRS OR REPLACEMENTS MUST BE COMPLETED WITHIN 24 HOURS AFTER THEY HAVE BEEN IDENTIFIED DURING THE MONITORING.
4. EROSION AND SEDIMENT CONTROLS MAY REQUIRE PERIODIC ADJUSTMENTS TO REFLECT CHANGING SITE CONDITIONS. THE CONTRACTOR WILL BE RESPONSIBLE FOR THESE ADJUSTMENTS TO ENSURE PROPER FUNCTION.
5. ANY CHANGES TO THE EROSION AND SEDIMENT CONTROL PLAN BEYOND MINOR ADJUSTMENTS MUST BE APPROVED BY THE CONTRACT ADMINISTRATOR.
6. ADDITIONAL EROSION AND SEDIMENT CONTROL SUPPLIES MUST BE KEPT ON SITE IN ORDER TO FACILITATE IMMEDIATE REPAIRS AND/OR UPGRADES AS NEEDED.
7. ALL TEMPORARY SEDIMENT CONTROLS MUST BE REMOVED AFTER THE CONTRACT ADMINISTRATOR DEEMS THE SITE TO BE STABLE.

DELETERIOUS SUBSTANCE CONTROL/SPILL MANAGEMENT

1. PREVENT THE RELEASE OF SEDIMENT, SEDIMENT-LADEN WATER, RAW CONCRETE, CONCRETE LEACHATE OR ANY OTHER DELETERIOUS SUBSTANCES INTO ANY WATERBODY, RAVINE OR STORM SEWER SYSTEM.
2. ENSURE EQUIPMENT AND MACHINERY ARE IN GOOD OPERATING CONDITION (POWER WASHED), FREE OF LEAKS, EXCESS OIL, AND GREASE.
3. NO EQUIPMENT REFUELLING OR SERVICING SHOULD BE UNDERTAKEN WITHIN 30 m OF ANY WATERCOURSE OR SURFACE WATER DRAINAGE.
4. A SPILL CONTAINMENT KIT MUST BE READILY ACCESSIBLE ON SITE IN THE EVENT OF A RELEASE OF A DELETERIOUS SUBSTANCE TO THE ENVIRONMENT. ONSITE STAFF MUST BE TRAINED IN ITS USE.
5. THE CONTRACT ADMINISTRATOR MUST BE NOTIFIED IMMEDIATELY IN THE EVENT OF A SPILL OF DELETERIOUS SUBSTANCE.

WORK AREA ISOLATION

1. ALL WORK IN ISOLATED WORK AREAS MUST BE COMPLETED IN THE DRY. AN ADEQUATE NUMBER OF PUMPS MUST BE USED FOR UNWATERING.
2. THE UNWATERING DISCHARGE LOCATION MUST BE LOCATED AT LEAST 30M FROM ANY WATERCOURSE OR WETLAND IN AN AREA WITH DENSE VEGETATIVE GROUNDCOVER, AND WHERE THE DISCHARGE CAN RETURN TO THE WATERBODY DOWNSTREAM OF THE WORK AREA OVER THE GROUNDCOVER.

	DATE	BY	REVISIONS
3.	20/10/27	LD	FIRST DETAILED DESIGN SUBMISSION TO LSRCA
2.	MARCH 2019	LD	SECOND SUBMISSION LSRCA
1.	AUGUST 2018	LD	FIRST SUBMISSION LSRCA

DESIGNED BY: PV | CHECKED BY: PV
DRAWN BY: LD / BM | DATE: OCTOBER 27, 2020

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20/10/27

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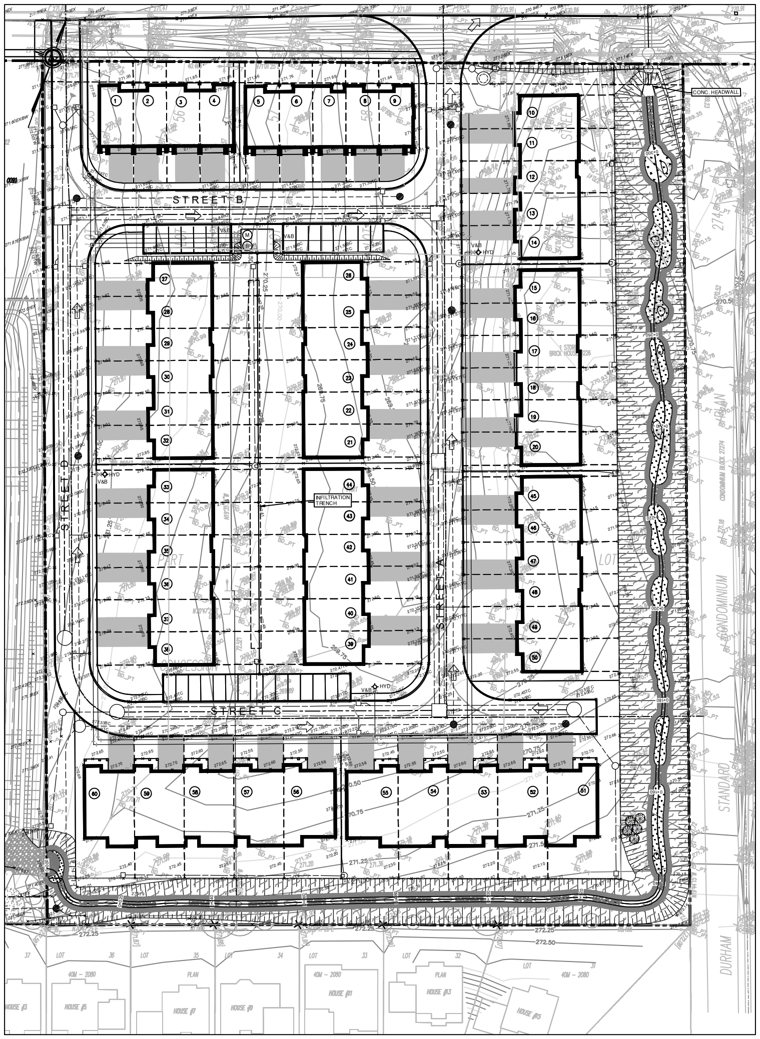
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
PHASING AND EROSION AND SEDIMENT CONTROL PLAN

NOT FOR CONSTRUCTION

PROJECT No.: 20094 | DRAWING No.: PESC-1
SCALE: AS NOTED | SHEET 5 OF 6



PLANFORM
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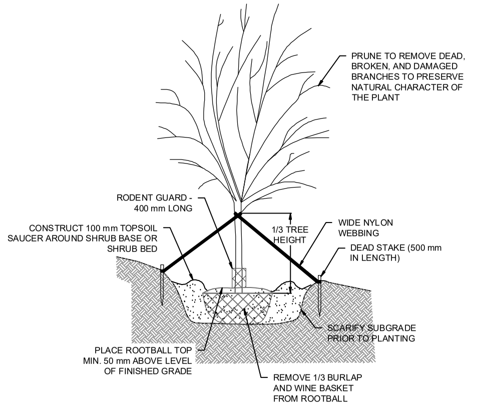
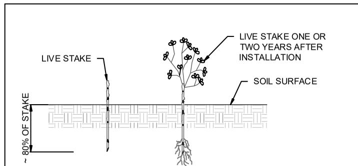


SPECIES AND QUANTITIES

I.D.	COMMON NAME	SPECIES	QTY	CONDITION / SIZE
Jc	BUTTERNUT	*Juglans cinerea*	5	60 mm CAL., B&B

NOTE:
ANY TREES FOUND TO BE DEAD, DEFECTIVE OR NOT IN A HEALTHY GROWING CONDITION WITHIN 2 YEARS OF PLANTING SHALL BE REPLACED AND RE-GUARANTEED FOR AN ADDITIONAL YEAR FROM THE DATE OF REPLACEMENT.

TREE PLANTING
N.T.S



SPECIES AND QUANTITIES

COMMON NAME	SPECIES	QUANTITY	CONDITION
RED OSIER DOGWOOD	*Cornus stolonifera*	325	1 m ht. BARE ROOT
PUSSY WILLOW	*Salix discolor*	325	1 m ht. BARE ROOT
SANDBAR WILLOW	*Salix exigua*	325	1 m ht. BARE ROOT

NOTES
1. QUANTITY TO BE DETERMINED BASED ON AREA OF DISTURBANCE TO BE RESTORED
2. LIVE STAKES SHOULD BE FROM AT MINIMUM 2-YEAR OLD STOCK.
3. LIVE STAKES ARE TO BE INSTALLED AT A DENSITY OF 1.5 STAKES PER LINEAR METRE.
4. LIVE STAKES SHOULD BE PRE-SOAKED (SUBMERGED IN WATER) FOR AT LEAST 24 HOURS AFTER HARVESTING AND IMMEDIATELY BEFORE INSTALLATION.
5. LIVE STAKES SHOULD NOT BE STORED FOR A PERIOD LONGER THAN 2 DAYS, UNLESS THEY ARE BEING SOAKED.
6. THE CONTRACTOR SHALL PROTECT PLANT MATERIALS FROM DRYING FROM THE TIME OF HARVEST UNTIL INSTALLED.
7. LIVE STAKES ARE TO BE A MINIMUM OF 25 mm IN DIAMETER AND CUT TO A LENGTH OF 1000 mm.
8. CUT ANGLE AT THE BOTTOM OF THE STAKE AND FLAT ON THE TOP.
9. TRIM ALL SIDE BRANCHES WHILE TAKING CARE NOT TO DAMAGE THE BARK.
10. INSTALL STAKES WITH BUDS POINTING UPWARDS AND THICKER STEM IN THE BED.
11. LIVE STAKES SHOULD BE INSTALLED USING A LARGE RUBBER MALLET.
12. 80% OF THE STAKE IS TO BE BELOW SURFACE.
13. TAMP THE LIVE STAKE INTO THE GROUND AT RIGHT ANGLE TO THE SURFACE.
14. IN COMPACT SOIL A PILOT HOLE SHOULD BE USED TO LIMIT DAMAGE TO THE STAKES.
15. IF USING A PILOT HOLE REPACK SOIL AROUND THE LIVE STAKE.
16. LIVE STAKES SHOULD STAND FIRM FROM THE SOIL FOLLOWING INSTALLATION.
17. ALL STAKES NOT PLANTED TO THE SPECIFICATIONS ABOVE WILL BE REPLACED AT THE CONTRACTOR'S EXPENSE.

LIVE STAKE
N.T.S.

RIPARIAN SEED MIX

COMMON NAME	SPECIES	% OF MIX
BLUE VERVAIN	*Verbana hastata*	3
BLUNT BROOM SEDGE	*Carex scoparia*	5
FOX SEDGE	*Carex vulpinoidea*	30
GREEN BULRUSH	*Scirpus atrovirens*	10
PURPLE STEMMED ASTER	*Aster puniceus*	5
SPOTTED JOE PYE WEED	*Eupatorium maculatum*	2
SWAMP MILKWEED	*Asclepias incarnate*	10
SWEET FLAG	*Acorus americana*	5
VIRGINIA WILD RYE	*Elymus virginicus*	30

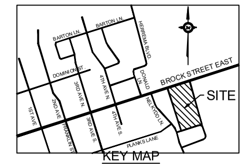
NOTES
1. APPLY SEED MIX AT A RATE OF 30 kg PER HECTARE.
2. SEEDING SHALL OVERLAP ADJACENT GROUND COVER BY 300 mm.
3. APPLY OAT OR RYE NURSE CROP AT A RATE OF 25 kg PER HECTARE.
4. WATER SOIL AFTER SEED APPLICATION.

WETLAND MEADOW SEED MIX

COMMON NAME	SPECIES	% OF MIX
BEBB'S SEDGE	*Carex bebbii*	1
BLUE LOBELIA	*Lobelia siphilitica*	1
BLUE VERVAIN	*Verbena hastata*	10
BONESET	*Eupatorium perfoliatum*	1
DARK GREEN BULRUSH	*Scirpus atrovirens*	1
FOWL BLUEGRASS	*Poa palustris*	20
FOX SEDGE	*Carex vulpinoidea*	27
NEW ENGLAND ASTER	*Aster novae-angliae*	2
PURPLE STEMMED ASTER	*Aster puniceus*	1
SOFT RUSH	*Juncus effusus*	2
SPOTTED JOE PYE WEED	*Eupatorium maculatum*	1
SQUARE STEMMED MONKEY FLOWER	*Mimulus ringens*	2
SWAMP MILKWEED	*Asclepias incarnata*	1
TALL MANNAGRASS	*Glyceria grandis*	2
VIRGINIA WILD RYE	*Elymus virginicus*	27
WOOLGRASS	*Scirpus cyperinus*	1

NOTES
1. APPLY SEED MIX AT A RATE OF 25 kg PER HECTARE WITHIN WETLANDS (SEE WETLAND DETAIL).
2. SEEDING SHALL OVERLAP ADJACENT GROUND COVER BY 300 mm.
3. APPLY COMMON OAT (*Avena sativa*) NURSE CROP AT A RATE OF 25 kg PER HECTARE.

NOT FOR CONSTRUCTION



KEY MAP
N.T.S.

GENERAL NOTES

1. ALL CONTRACT DRAWINGS, SPECIFICATIONS AND APPLICABLE PERMITS MUST BE KEPT ON SITE DURING CONSTRUCTION FOR REFERENCE.
2. THE CONTRACTOR MUST NOTIFY THE CONTRACT ADMINISTRATOR AND CONSERVATION AUTHORITY OF THE INTENT TO COMMENCE WORK AT LEAST 48 HOURS IN ADVANCE.
3. THE CONTRACTOR IS RESPONSIBLE FOR ALL UTILITY LOCATES.
4. LAYOUT MUST BE REVIEWED AND APPROVED BY THE CONTRACT ADMINISTRATOR.
5. DESIGNER OR REPRESENTATIVE SHALL BE PRESENT DURING CONSTRUCTION TO PROVIDE GUIDANCE ON INSTALLATION OF THE FEATURES.

TIMING OF WORKS

1. WORKS SHALL BE COMPLETED BETWEEN JULY 1ST TO MARCH 31ST.
2. TREE CLEARING SHOULD BE COMPLETED OUTSIDE THE BIRD NESTING SEASON TO COMPLY WITH THE FEDERAL MIGRATORY BIRDS CONVENTION ACT. ANY TREES THAT REQUIRE REMOVAL OUTSIDE OF THIS TIMING WINDOW MUST FIRST BE INSPECTED BY A QUALIFIED BIOLOGIST TO DETERMINE THE PRESENCE OF NESTING BIRDS.
3. THE WEATHER FORECAST SHOULD BE CONTINUALLY MONITORED TO ENSURE THAT WORKS ARE UNDERTAKEN ONLY DURING FAVOURABLE WEATHER CONDITIONS.
4. COMPLETE THE WORKS WITH MINIMAL AVOIDABLE INTERRUPTIONS ONCE THEY COMMENCE.

SITE AND MATERIAL MANAGEMENT

1. ALL CONSTRUCTION EQUIPMENT AND MATERIALS (IMPORTED OR EXCAVATED) MUST BE STORED AT LEAST 30 m AWAY FROM ANY WATERBODY IN A STABLE AREA ABOVE THE ACTIVE FLOODPLAIN, OR IN A DESIGNATED STAGING/STORAGE AREA.
2. IN THE EVENT OF AN UNEXPECTED STORM, ALL UNFIXED ITEMS THAT HAVE THE POTENTIAL TO CAUSE A SPILL OR AN OBSTRUCTION TO FLOW MUST BE MOVED A STABLE AREA ABOVE ACTIVE FLOODPLAIN.
3. STOCKPILES MUST BE LOCATED OUTSIDE THE ISOLATED WORK AREAS.
4. STABILIZE STOCKPILED SOILS THAT ARE STORED FOR PROLONGED PERIODS WITH THE APPLICATION OF A NURSE CROP AT A RATE OF 60 kg/ha.
5. STABILIZE, TEMPORARILY OR PERMANENTLY, ANY DISTURBED AREAS AS WORK PROGRESSES, OR SOON AS CONDITIONS ALLOW. ON SOILS THAT WILL BE EXPOSED FOR PROLONG PERIODS, TEMPORARILY INSTALL A BIODEGRADABLE EROSION CONTROL BLANKET ON EXPOSED SOILS, OR APPLY A NURSE CROP AT A RATE OF 60 KG/HA.
6. MINIMIZE THE AREA OF DISTURBANCE TO THE EXTENT POSSIBLE.
7. ALL VEGETATION, ADJACENT TO THE WORK AREA, MUST BE PROTECTED AND DELINEATED WITH CONSTRUCTION FENCING OR TREE PROTECTION BARRIERS.
8. ALL GRADES IN THE AREA REGULATED BY THE CONSERVATION AUTHORITY MUST BE MAINTAINED OR MATCHED, UNLESS OTHERWISE AUTHORIZED IN THE APPLICABLE PERMIT.

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	DATE	BY	REVISIONS
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2.	MARCH 2019	LD	SECOND SUBMISSION LSRCA
1.	AUGUST 2018	LD	FIRST SUBMISSION LSRCA

DESIGNED BY: PV | CHECKED BY: PV

DRAWN BY: LD / BM | DATE: OCTOBER 27, 2020

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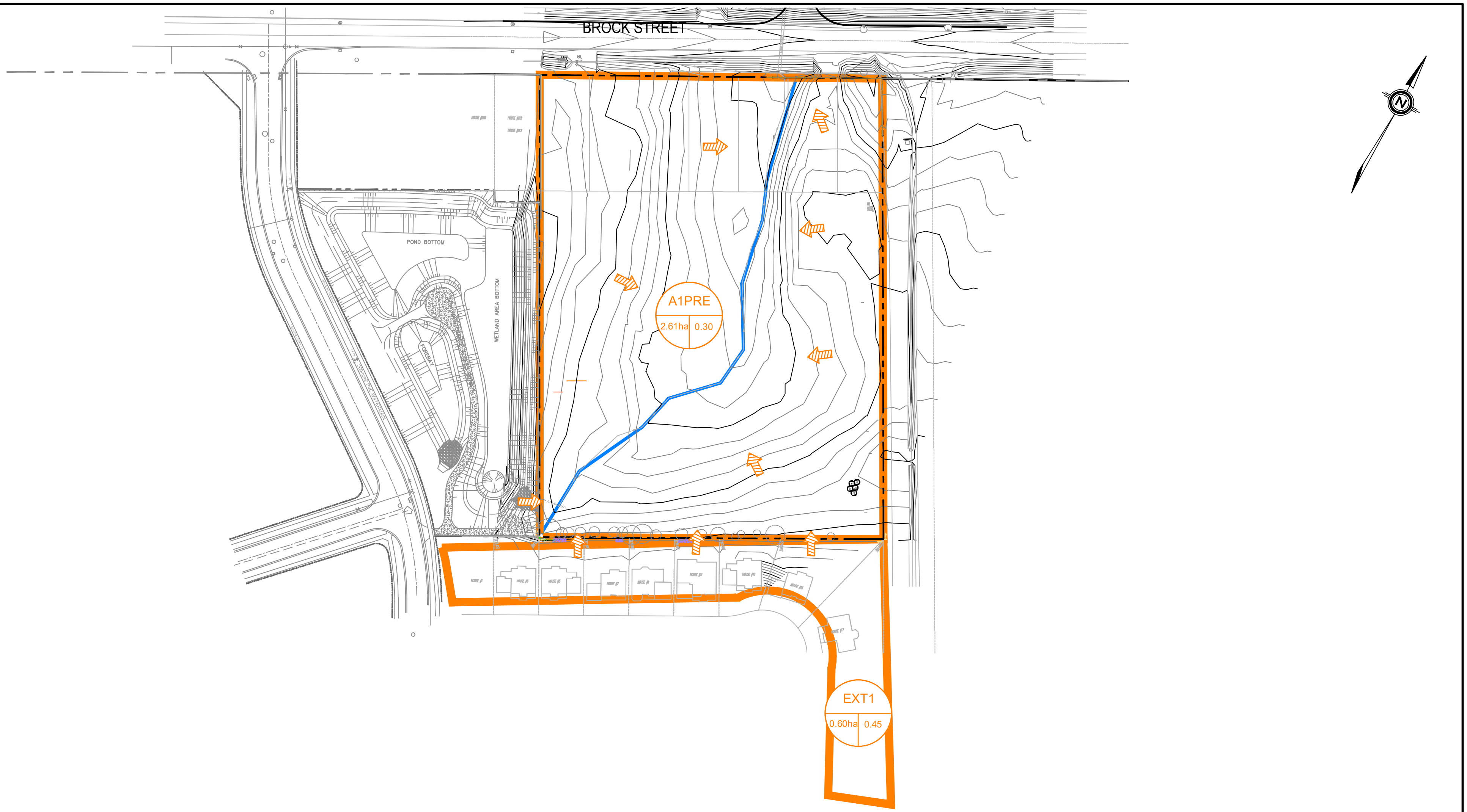
226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
RESTORATION PLAN AND DETAILS

PROJECT No.: 20094 | DRAWING No.: RES-1

SCALE: AS NOTED | SHEET 6 OF 6

APPENDIX B
Stormwater Data Analysis



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70 Valleywood Drive,
Markham, ON L3R 4T5
T. 416 987 6161 | 905 940 6161
www.coleengineering.ca

LEGEND

PROPERTY LINE
EXISTING STORM DRAINAGE AREA BOUNDARY
EXISTING OVERLAND FLOW DIRECTION

A1PRE
0.74ha
0.50
STORM DRAINAGE AREA NUMBER
DRAINAGE AREA IN HECTARES
RUNOFF COEFFICIENT

PRE DEVELOPMENT DRAINAGE AREA PLAN
WESTLANE DEVELOPMENTS LTD.
SOUTH BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	JANUARY 2021	PROJECT No.:	2018-0302
SCALE:	1:1500	FIGURE No.:	DAP-1

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COLE

Prepared By Tim Ng

Pre- Development Composite Runoff Coefficient

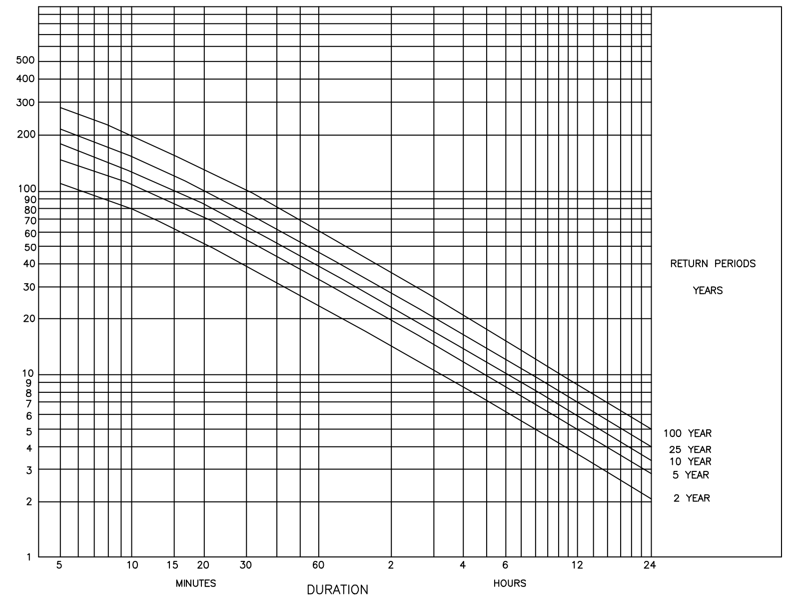
South Brock Street Development
File No. 2018-0302
Date: February 2021

Drainage Area A1 Pre

	(ha)		
Total Area:	2.61		
Impervious:	0.17	Coefficient:	0.95
Landscaping:	2.44	Coefficient:	0.25
Composite C:	0.30		
Percent Impervious	6.52%		

Drainage Area EXT. 1 External Drainage (Uncontrolled Area from Coral Subdivision)

	(ha)		
Total Area:	0.60		
Impervious:	0.17	Coefficient:	0.95
Landscaping:	0.43	Coefficient:	0.25
Composite C:	0.45		
Percent Impervious	28.33%		



1. EQUATION FOR TYPICAL INTENSITY–DURATION–FREQUENCY CURVES: T–TIME(MINUTES)
   I – INTENSITY (mm/hr)

$I_2 \quad \frac{645}{(T+5)^{0.786}} \qquad I_5 \quad \frac{904}{(T+5)^{0.788}} \qquad I_{10} \quad \frac{1065}{(T+5)^{0.788}} \qquad I_{25} \quad \frac{1234}{(T+4)^{0.787}} \qquad I_{100} \quad \frac{1799}{(T+5)^{0.810}}$

2. THE ABOVE EQUATION ARE ONLY VALID FOR T=10 MINUTES TO 1440 MINUTES

APPROVED	TOWNSHIP OF UXBRIDGE	DATE OF ISSUE MARCH 1989
REVISION	RAINFALL INTENSITY DURATION CURVES	DRAWING No. US–600
DATE OF REVISION		

COLE

Prepared By Tim Ng

Peak Time Calculations
Pre Development

South Brock Street Development

File No. 2018-0302

Date: February 2021

Area Number	Area	Runoff Coefficient	Length	Change in Elevation	Slope	Log Slope
-	(ha)	-	(m)	-	%	%
A1 Pre	2.61	0.30	228	2.66	1.2	0.07

Uplands Method

		Velocity	Time to peak (hour)	Time of Concentration (min)
Forest & Hay Meadow	A1 Pre	0.08	0.52	47
	0	0.08	0.00	0
Woodland, & Fallow	A1 Pre	0.16	0.26	24
	0	0.15	0.00	0
Pasture	A1 Pre	0.23	0.19	17
	0	0.21	0.00	0
Cultivated Straight Row	A1 Pre	0.29	0.15	13
	0	0.27	0.00	0
Bare Soil	A1 Pre	0.32	0.13	12
	0	0.29	0.00	0
Grassed Waterway	A1 Pre	0.48	0.09	8
	0	0.45	0.00	0
Upland Gullies & Paved Areas	A1 Pre	0.65	0.07	6
	0	0.60	0.00	0

COLE

Prepared By Tim Ng

Rational Method
Pre-Development Flow Calculation

South Brock Street Development
File No. 2018-0302
Date: February 2021

Input Parameters

Area Number	Area	C	Tc
	(ha)		(min.)
A1 Pre	2.61	0.30	13
EXT. 1	0.60	0.45	10

Formula: $I = a(T+b)^{-c}$

	a,b,c	Constants
	T	Time of concentration
	I	Rainfall intensity

Rational Method Calculations

IDF Data Set: Town of Uxbridge
Event **2-Year**
a = 645.0
b = 5.0
c = 0.786

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Pre	2.61	0.30	0.77	13	65.8	0.141	140.9
EXT. 1	0.60	0.45	0.27	10	76.8	0.057	57.4

IDF Data Set: Town of Uxbridge
Event **5-Year**
a = 904.0
b = 5.0
c = 0.788

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Pre	2.61	0.30	0.77	13	91.7	0.196	196.4
EXT. 1	0.60	0.45	0.27	10	107.0	0.080	80.0

IDF Data Set: Town of Uxbridge
Event **10-Year**
a = 1065.0
b = 5.0
c = 0.788

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Pre	2.61	0.30	0.77	13	108.0	0.231	231.4
EXT. 1	0.60	0.45	0.27	10	126.1	0.094	94.2

IDF Data Set: Town of Uxbridge
Event **25-Year**
a = 1234.0
b = 4.0
c = 0.787

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Pre	2.61	0.33	0.85	13	131.2	0.309	309.1
EXT. 1	0.60	0.49	0.30	10	154.6	0.127	127.1

IDF Data Set: Town of Uxbridge
Event **100-Year**
a = 1799.0
b = 5.0
c = 0.810

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Pre	2.61	0.37	0.96	13	171.1	0.458	458.3
EXT. 1	0.60	0.56	0.34	10	200.6	0.187	187.4

COLE

Prepared By Tim Ng

Existing Flows to Channel Summary

South Brock Street Development
File No. 2018-0302
Date: February 2021

Coral Creek Homes Pond Design

Return Period	2 year	5 year	10 year	25 year	100 year
External Drainage (Uncontrolled Area from Coral Subdivision)	57.4	80.0	94.2	127.1	**187.4 L/s**

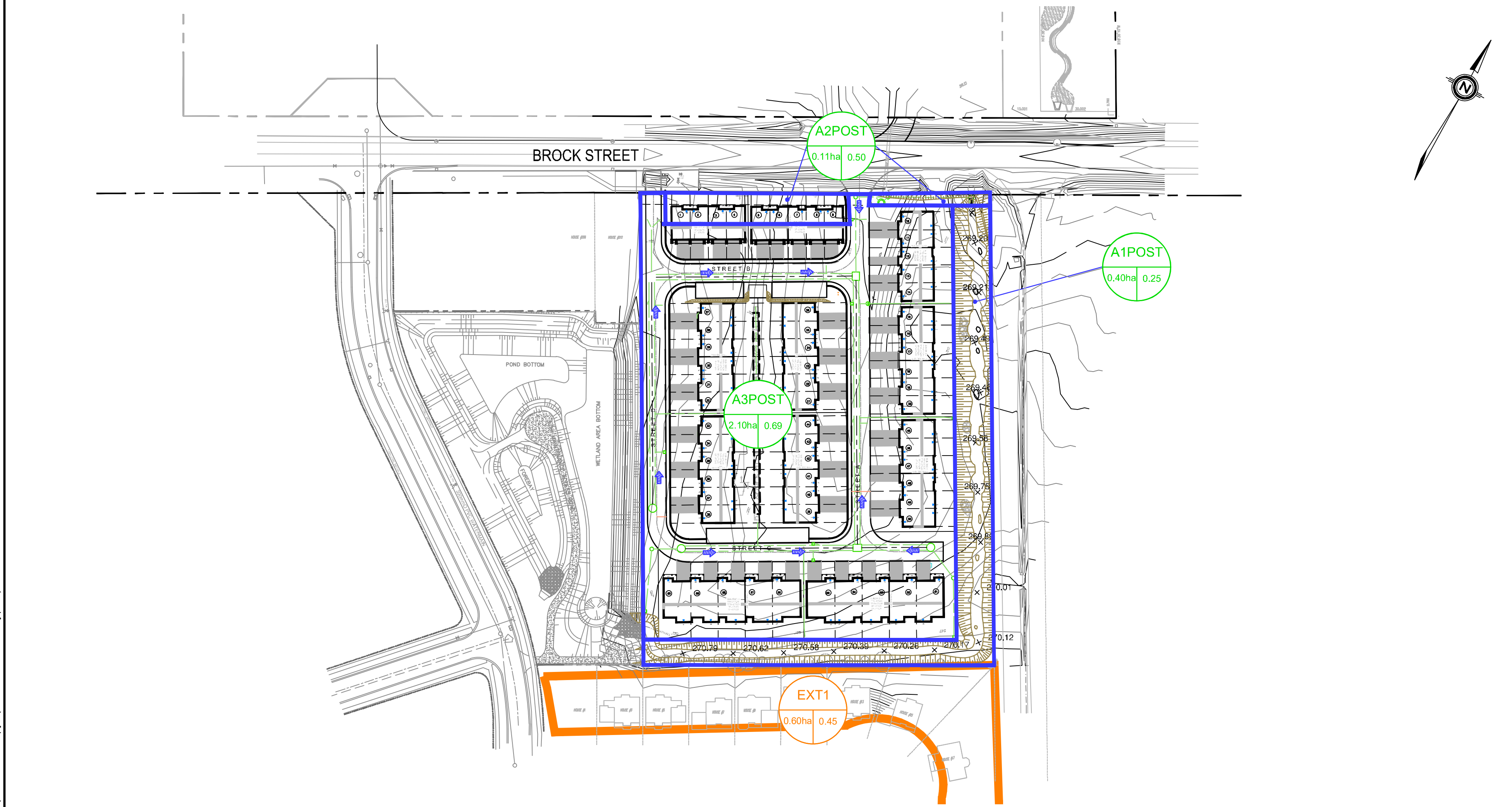
Existing Development

Return Period	2 year	5 year	10 year	25 year	100 year
A1 Pre	140.9	196.4	231.4	309.1	**458.3 L/s**

Coral Creek Homes Pond Flows

Return Period	2 year	5 year	10 year	25 year	100 year
Pre Development	210	350	460	620	880 L/s
Controlled Outflow (Ultimate)	70	160	290	500	**860** L/s
Controlled Outflow (Interim)	30	50	80	190	390 L/s

Return Period	2 year	5 year	10 year	25 year	100 year
Total Flow (L/s)	268.3	436.3	615.6	936.2	**1505.7 L/s**



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LEGEND

PROPERTY LINE
PROPOSED STORM DRAINAGE AREA BOUNDARY
PROPOSED OVERLAND FLOW DIRECTION

A1POST
0.25ha 0.50
STORM DRAINAGE AREA NUMBER
DRAINAGE AREA IN HECTARES
RUNOFF COEFFICIENT

POST DEVELOPMENT DRAINAGE AREA PLAN

WESTLANE DEVELOPMENTS LTD.
SOUTH BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	MARCH 2021	PROJECT No.:	2018-0302
SCALE:	1:1500	FIGURE No.:	DAP-2

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COLE	Rational Method **A1 Post Flow Calculation**
Prepared By Tim Ng	South Brock Street Development File No. 2018-0302 Date: February 2021

Input Parameters

Area Number	Area	C	Tc
	(ha)		(min.)
A1 Post	0.40	0.25	10

Formula:	$I = a(T+b)^{-c}$	
	a,b,c	Constants
	T	Time of concentration
	I	Rainfall intensity

Rational Method Calculations

IDF Data Set: Town of Uxbridge
Event **2-Year**
a = 645.0
b = 5.0
c = 0.786

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Post	0.40	0.25	0.10	10	76.8	0.021	21.3

IDF Data Set: Town of Uxbridge
Event **5-Year**
a = 904.0
b = 5.0
c = 0.788

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Post	0.40	0.25	0.10	10	107.0	0.030	29.7

IDF Data Set: Town of Uxbridge
Event **10-Year**
a = 1065.0
b = 5.0
c = 0.788

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Post	0.40	0.25	0.10	10	126.1	0.035	35.0

IDF Data Set: Town of Uxbridge
Event **25-Year**
a = 1234.0
b = 4.0
c = 0.787

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Post	0.40	0.28	0.11	10	154.6	0.047	47.3

IDF Data Set: Town of Uxbridge
Event **100-Year**
a = 1799.0
b = 5.0
c = 0.810

Area Number	A (ha)	C	AC	Tc (min.)	I (mm/h)	Q (m^3/s)	Q (L/s)
A1 Post	0.40	0.31	0.13	10	200.6	0.070	69.7

COLE	Proposed Natural Channel Flow Summary
Prepared By Tim Ng	South Brock Street Development File No. 2018-0302 Date: February 2021

Coral Creek Homes Pond Design

Return Period	2 year	5 year	10 year	25 year	100 year
External Drainage (Uncontrolled Area from Coral Subdivision)	57.4	80.0	94.2	127.1	**187.4 L/s**

Existing Development

Return Period	2 year	5 year	10 year	25 year	100 year
A1 Post	21.3	29.7	35.0	47.3	**69.7 L/s**

Coral Creek Homes Pond Flows

Return Period	2 year	5 year	10 year	25 year	100 year
Pre Development	210	350	460	620	880 L/s
Controlled Outflow (Ultimate)	70	160	290	500	**860** L/s
Controlled Outflow (Interim)	30	50	80	190	390 L/s

Return Period	2 year	5 year	10 year	25 year	100 year
Total Flow (L/s)	148.7	269.7	419.2	674.4	**1117.1 L/s**

COLE

Prepared By Tim Ng

Post Development Composite Runoff Coefficient

South Brock Street Development
File No. 2018-0302
Date: February 2021

Drainage Area A1 Post Uncontrolled- Naturalized Swale

	(ha)		
Total Area:	0.40		
Impervious:	0.00	Coefficient:	0.95
Landscaping:	0.40	Coefficient:	0.25
Composite C:	0.25		
Percent Impervious	0.0%		

Drainage Area A2 Post Uncontrolled to North

	(ha)		
Total Area:	0.11		
Impervious:	0.04	Coefficient:	0.95
Landscaping:	0.07	Coefficient:	0.25
Composite C:	0.50		
Percent Impervious	36.36%		

Drainage Area A3 Post Controlled to Ditch

	(ha)		
Total Area:	2.10		
Impervious:	1.32	Coefficient:	0.95
Landscaping:	0.79	Coefficient:	0.25
Composite C:	0.69		
Percent Impervious	62.6%		

COLE

Prepared By Tim Ng

Modified Rational Method - Two Year Storm
Site Flow and Storage Summary
South Brock Street Development
File No. 2018-0302
Date: February 2021

2-Year Design Storm

A=	645.0
B=	5.0
C=	0.786
I =	I = A/(T+B)^C

Uncontrolled- Natural Swale

Drainage Areas	A1 Post	
Area =	**0.40**	ha
"C" =	**0.25**	
AC1 =	**0.10**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**21.3**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.11**	ha
"C" =	**0.50**	
AC2 =	**0.06**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**11.8**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.69**	
AC3 =	**1.45**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**103.4**	L/s
Max. Required Storage Volume =	**128.2**	m^3
Max. Storage Available =	**128.6**	m^3

Uncontrolled Release Rate =	**33.2 L/s**
Controlled Release Rate =	**103.4 L/s**
Total Release Rate =	**136.5 L/s**
Target Release Rate (2 Yr Pre) =	**140.9 L/s**

(1) Time (min)	(2) Rainfall Intensity (mm/hr)	(3) Storm Runoff (m^3/s)	(4) Runoff Volume (m^3)	(5) Storm Runoff (m^3/s)	(6) Runoff Volume (m^3)	(7) Storm Runoff (m^3/s)	(8) Runoff Volume (m^3)	(9) Allowable Released Volume (m^3)	(10) Storage Volume (m^3)
	I = A(T+B)^C	**(3) = [(2)*AC1] / 360**	**(4) = (3)*(1)*60**	**(5) = [(2)*AC2] / 360**	**(6) = (5)*(1)*60**	**(7) = [(2)*AC3] / 360**	**(8) = (7)*(1)*60**	**(9) = [(R3) / 1000]*(1)*60**	**(10) = (8)-(9)**
10.0	76.8	0.021	12.8	0.012	7.1	0.308	184.9	62.0	122.9
15.0	61.2	0.017	15.3	0.009	8.5	0.246	221.3	93.1	128.2
20.0	51.4	0.014	17.1	0.008	9.5	0.206	247.6	124.1	123.5
25.0	44.5	0.012	18.5	0.007	10.3	0.179	268.1	155.1	113.0
30.0	39.4	0.011	19.7	0.006	10.9	0.158	285.0	186.1	98.9
35.0	35.5	0.010	20.7	0.005	11.5	0.143	299.4	217.1	82.3
40.0	32.4	0.009	21.6	0.005	12.0	0.130	311.9	248.1	63.8
45.0	29.8	0.008	22.3	0.005	12.4	0.120	323.0	279.2	43.9
50.0	27.6	0.008	23.0	0.004	12.8	0.111	333.0	310.2	22.8
55.0	25.8	0.007	23.7	0.004	13.1	0.104	342.1	341.2	0.9
60.0	24.2	0.007	24.2	0.004	13.5	0.097	350.5	372.2	0.0
65.0	22.9	0.006	24.8	0.004	13.8	0.092	358.2	403.2	0.0
70.0	21.7	0.006	25.3	0.003	14.0	0.087	365.4	434.2	0.0
75.0	20.6	0.006	25.7	0.003	14.3	0.083	372.1	465.3	0.0
80.0	19.6	0.005	26.2	0.003	14.5	0.079	378.4	496.3	0.0
85.0	18.8	0.005	26.6	0.003	14.8	0.075	384.4	527.3	0.0
90.0	18.0	0.005	27.0	0.003	15.0	0.072	390.1	558.3	0.0
95.0	17.3	0.005	27.4	0.003	15.2	0.069	395.5	589.3	0.0
100.0	16.6	0.005	27.7	0.003	15.4	0.067	400.7	620.3	0.0
105.0	16.0	0.004	28.1	0.002	15.6	0.064	405.6	651.4	0.0
110.0	15.5	0.004	28.4	0.002	15.8	0.062	410.3	682.4	0.0
115.0	15.0	0.004	28.7	0.002	15.9	0.060	414.8	713.4	0.0
120.0	14.5	0.004	29.0	0.002	16.1	0.058	419.2	744.4	0.0
125.0	14.1	0.004	29.3	0.002	16.3	0.056	423.4	775.4	0.0
130.0	13.6	0.004	29.6	0.002	16.4	0.055	427.5	806.5	0.0
135.0	13.3	0.004	29.8	0.002	16.6	0.053	431.4	837.5	0.0
140.0	12.9	0.004	30.1	0.002	16.7	0.052	435.2	868.5	0.0
145.0	12.6	0.003	30.4	0.002	16.9	0.050	438.9	899.5	0.0
150.0	12.2	0.003	30.6	0.002	17.0	0.049	442.5	930.5	0.0
155.0	11.9	0.003	30.9	0.002	17.1	0.048	446.0	961.5	0.0
160.0	11.7	0.003	31.1	0.002	17.3	0.047	449.4	992.6	0.0
165.0	11.4	0.003	31.3	0.002	17.4	0.046	452.7	1023.6	0.0

COLE

Prepared By Tim Ng

Modified Rational Method - Five Year Storm
Site Flow and Storage Summary

South Brock Street Development
File No. 2018-0302
Date: February 2021

Uncontrolled- Natural Swale

Drainage Areas	A1 Post	
Area =	**0.40**	ha
"C" =	**0.25**	
AC1 =	**0.10**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**29.7**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.11**	ha
"C" =	**0.50**	
AC2 =	**0.06**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**16.5**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.69**	
AC3 =	**1.45**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**115.5**	L/s
Max. Required Storage Volume =	**206.2**	m^3
Max. Storage Available =	**206.7**	m^3

Uncontrolled Release Rate =	**46.2 L/s**
Controlled Release Rate =	**115.5 L/s**
Total Release Rate =	**161.7 L/s**
Target Release Rate (5 Yr Pre) =	**196.4 L/s**

5-Year Design Storm

A=	904.0
B=	5.0
C=	0.788
I =	I = A/(T+B)^C

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Time (min)	**Rainfall Intensity (mm/hr)**	**Storm Runoff (m^3/s)**	**Runoff Volume (m^3)**	**Storm Runoff (m^3/s)**	**Runoff Volume (m^3)**	**Storm Runoff (m^3/s)**	**Runoff Volume (m^3)**	**Allowable Released Volume (m^3)**	**Storage Volume (m^3)**
	I = A(T+B)^C	**(3) = [(2)*AC1] / 360**	**(4) = (3)*(1)*60**	**(5) = [(2)*AC2] / 360**	**(6) = (5)*(1)*60**	**(7) = [(2)*AC3] / 360**	**(8) = (7)*(1)*60**	**(9) = [(R3) / 1000]*(1)*60**	**(10) = (8)-(9)**
10.0	107.0	0.030	17.8	0.016	9.9	0.430	257.8	69.3	188.5
15.0	85.3	0.024	21.3	0.013	11.8	0.343	308.3	103.9	204.3
20.0	71.5	0.020	23.8	0.011	13.2	0.287	344.7	138.6	206.2
25.0	62.0	0.017	25.8	0.010	14.3	0.249	373.3	173.2	200.0
30.0	54.9	0.015	27.4	0.008	15.2	0.220	396.7	207.9	188.8
35.0	49.4	0.014	28.8	0.008	16.0	0.198	416.6	242.5	174.1
40.0	45.0	0.013	30.0	0.007	16.7	0.181	433.9	277.2	156.7
45.0	41.4	0.012	31.1	0.006	17.2	0.166	449.2	311.8	137.4
50.0	38.4	0.011	32.0	0.006	17.8	0.154	463.0	346.4	116.6
55.0	35.9	0.010	32.9	0.006	18.3	0.144	475.6	381.1	94.5
60.0	33.7	0.009	33.7	0.005	18.7	0.135	487.1	415.7	71.4
65.0	31.8	0.009	34.4	0.005	19.1	0.128	497.8	450.4	47.4
70.0	30.1	0.008	35.1	0.005	19.5	0.121	507.7	485.0	22.6
75.0	28.6	0.008	35.8	0.004	19.8	0.115	517.0	519.7	0.0
80.0	27.3	0.008	36.4	0.004	20.2	0.110	525.7	554.3	0.0
85.0	26.1	0.007	36.9	0.004	20.5	0.105	534.0	589.0	0.0
90.0	25.0	0.007	37.5	0.004	20.8	0.100	541.8	623.6	0.0
95.0	24.0	0.007	38.0	0.004	21.1	0.096	549.2	658.2	0.0
100.0	23.1	0.006	38.5	0.004	21.4	0.093	556.3	692.9	0.0
105.0	22.3	0.006	39.0	0.003	21.6	0.089	563.1	727.5	0.0
110.0	21.5	0.006	39.4	0.003	21.9	0.086	569.6	762.2	0.0
115.0	20.8	0.006	39.8	0.003	22.1	0.083	575.9	796.8	0.0
120.0	20.1	0.006	40.3	0.003	22.3	0.081	581.9	831.5	0.0
125.0	19.5	0.005	40.7	0.003	22.6	0.078	587.7	866.1	0.0
130.0	18.9	0.005	41.0	0.003	22.8	0.076	593.3	900.8	0.0
135.0	18.4	0.005	41.4	0.003	23.0	0.074	598.7	935.4	0.0
140.0	17.9	0.005	41.8	0.003	23.2	0.072	604.0	970.0	0.0
145.0	17.4	0.005	42.1	0.003	23.4	0.070	609.0	1004.7	0.0
150.0	17.0	0.005	42.5	0.003	23.6	0.068	614.0	1039.3	0.0
155.0	16.6	0.005	42.8	0.003	23.8	0.067	618.8	1074.0	0.0
160.0	16.2	0.004	43.1	0.002	23.9	0.065	623.4	1108.6	0.0
165.0	15.8	0.004	43.4	0.002	24.1	0.063	628.0	1143.3	0.0

COLE

Prepared By Tim Ng

Modified Rational Method - Hundred Year Storm
Site Flow and Storage Summary

South Brock Street Development
File No. 2018-0302
Date: February 2021

100-Year Design Storm

A=	1799.0
B=	5.0
C=	0.810
I =	I = A/(T+B)^C

Uncontrolled- Natural Swale

Drainage Areas	A1 Post	
Area =	**0.40**	ha
"C" =	**0.31**	
AC1 =	**0.13**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**69.7**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.11**	ha
"C" =	**0.63**	
AC2 =	**0.07**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**38.7**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.86**	
AC3 =	**1.81**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**171.7**	L/s
Max. Required Storage Volume =	**604.0**	m^3
Max. Storage Available =	**604.0**	m^3

Uncontrolled Release Rate =	**108.3 L/s**
Controlled Release Rate =	**171.7 L/s**
Total Release Rate =	**280.0 L/s**
Target Release Rate (100 Yr Pre) =	**458.3 L/s**

(1) Time (min)	(2) Rainfall Intensity (mm/hr)	(3) Storm Runoff (m^3/s)	(4) Runoff Volume (m^3)	(5) Storm Runoff (m^3/s)	(6) Runoff Volume (m^3)	(7) Storm Runoff (m^3/s)	(8) Runoff Volume (m^3)	(9) Allowable Released Volume (m^3)	(10) Storage Volume (m^3)
	I = A(T+B)^C	(3) = [(2)*AC1] / 360	(4) = (3)*(1)*60	(5) = [(2)*AC2] / 360	(6) = (5)*(1)*60	(7) = [(2)*AC3] / 360	(8) = (7)*(1)*60	(9) = [(R3) / 1000]*(1)*60	(10) = (8)-(9)
10.0	200.6	0.070	41.8	0.039	23.2	1.007	604.2	103.0	501.2
15.0	158.9	0.055	49.7	0.031	27.6	0.798	717.9	154.5	563.4
20.0	132.6	0.046	55.3	0.026	30.7	0.666	798.9	206.0	592.9
25.0	114.4	0.040	59.6	0.022	33.1	0.574	861.5	257.5	604.0
30.0	101.0	0.035	63.1	0.019	35.0	0.507	912.5	309.0	603.5
35.0	90.6	0.031	66.1	0.017	36.7	0.455	955.4	360.5	594.9
40.0	82.4	0.029	68.7	0.016	38.1	0.414	992.6	412.0	580.5
45.0	75.7	0.026	70.9	0.015	39.4	0.380	1025.3	463.5	561.8
50.0	70.0	0.024	73.0	0.013	40.5	0.352	1054.6	515.0	539.5
55.0	65.3	0.023	74.8	0.013	41.5	0.328	1081.1	566.6	514.6
60.0	61.2	0.021	76.5	0.012	42.4	0.307	1105.3	618.1	487.3
65.0	57.6	0.020	78.0	0.011	43.3	0.289	1127.7	669.6	458.1
70.0	54.5	0.019	79.4	0.010	44.1	0.273	1148.4	721.1	427.4
75.0	51.7	0.018	80.8	0.010	44.8	0.260	1167.8	772.6	395.2
80.0	49.2	0.017	82.0	0.009	45.5	0.247	1186.0	824.1	361.9
85.0	47.0	0.016	83.2	0.009	46.2	0.236	1203.1	875.6	327.5
90.0	45.0	0.016	84.3	0.009	46.8	0.226	1219.3	927.1	292.2
95.0	43.2	0.015	85.4	0.008	47.4	0.217	1234.6	978.6	256.0
100.0	41.5	0.014	86.4	0.008	48.0	0.208	1249.2	1030.1	219.1
105.0	39.9	0.014	87.4	0.008	48.5	0.201	1263.2	1081.6	181.6
110.0	38.5	0.013	88.3	0.007	49.0	0.193	1276.5	1133.1	143.4
115.0	37.2	0.013	89.2	0.007	49.5	0.187	1289.3	1184.6	104.7
120.0	36.0	0.013	90.0	0.007	50.0	0.181	1301.6	1236.1	65.5
125.0	34.9	0.012	90.9	0.007	50.4	0.175	1313.5	1287.6	25.9
130.0	33.8	0.012	91.7	0.007	50.9	0.170	1324.9	1339.1	0.0
135.0	32.9	0.011	92.4	0.006	51.3	0.165	1335.9	1390.6	0.0
140.0	31.9	0.011	93.2	0.006	51.7	0.160	1346.6	1442.1	0.0
145.0	31.1	0.011	93.9	0.006	52.1	0.156	1356.9	1493.6	0.0
150.0	30.3	0.011	94.6	0.006	52.5	0.152	1366.9	1545.1	0.0
155.0	29.5	0.010	95.2	0.006	52.9	0.148	1376.6	1596.6	0.0
160.0	28.8	0.010	95.9	0.006	53.2	0.144	1386.0	1648.2	0.0
165.0	28.1	0.010	96.5	0.005	53.6	0.141	1395.2	1699.7	0.0

COLE

Prepared By Tim Ng

Orifice Control

South Brock Street Development
File No. 2018-0302
Date: February 2021

Orifice Equation

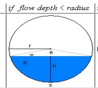
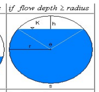
$$Q = C \times A \times \sqrt{2 \times g \times h}$$

Storm Event	Drainage Area ID	Orifice Location	Water Elevation	Orifice Coefficient	Diameter of Orifice	Orifice 1 Invert	Total Head	Area of Orifice	Orifice 1 Flow	Orifice Obvert	Orifice Coefficient	Diameter of Orifice	Orifice 2 Invert	Total Head	Area of Orifice	Orifice 2 Flow	Orifice 2 Obvert	Total Release Rate
			(m)									(mm)	(m)	(m)	(m^2)			(L/s)
2-Year	A3 Post	Outlet to Creek	270.21	0.60	75	269.41	0.77	0.004	10	269.49	0.60	250	269.58	0.51	0.049	93	269.83	103.4
5-Year	A3 Post	Outlet to Creek	270.34	0.60	75	269.41	0.90	0.004	11	269.49	0.60	250	269.58	0.64	0.049	104	269.83	115.5
100-Year	A3 Post	Outlet to Creek	271.14	0.60	75	269.41	1.69	0.004	15	269.49	0.60	250	269.58	1.44	0.049	156	269.83	171.7

COLE

Partially Filled Pipes Calculations
Two Year Event

Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.
Full pipes are calculated by taking the full end area of the pipe multiplied by the length of the pipe and method 1 and 2 calculations are ignored.
The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
The wetted length is predominantly useful in the calculations for when only one end of the pipe is submerged.
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0, therefore neither Method 1 nor Method 2 would be applicable.

	Method 1	Method 2
solve for	if flow depth < radius	if flow depth ≥ radius
		
circular segment height	$h = d$	$h = 2r - d$
central angle	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$
circular segment area	$K = \frac{r^2(\theta - \sin\theta)}{2}$	$K = \frac{r^2(\theta - \sin\theta)}{2}$
arc length	$s = r \times \theta$	$s = r \times \theta$
flow area	$A = K$	$A = \pi r^2 - K$
wetted perimeter	$P_W = s$	$P_W = 2\pi r - s$
hydraulic radius	$R_h = \frac{A}{P_W}$	$R_h = \frac{A}{P_W}$

Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 270.21 m

Pipe Storage

Pipe Start and End Locations	MH#	Pipe Diameter (m)	Radius (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth > 0 (IF NO then following calculations are not applicable)	Water Depth Type (Method 1 flow depth <radius, Method 2 Flow Depth >= radius, Full (full pipe), Empty (N/A))	h	θ	K	s	A	Pw	Rk	Wetted End Area (m2)	Upstream and Downstream Wetted Average Area (m2)	Horizontal Wetted Length (m)	Actual Volume (m3)
Upstream Manhole	8	0.25	0.13	269.66	269.91					0.55	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05			
Downstream Manhole	9	0.25	0.13	269.50	269.75					0.71	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.05			
						32.00	32.00	0.50	0.005												0.05	32.00	1.57

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume 1.57

Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.

The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
The wetted length is predominantly useful in the calculations for when only one end of the pipe is submerged.
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0

Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 270.21 m

Box Pipe Storage

Pipe Start and End Locations	MH#	Pipe Width (m)	Height (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth > 0 (IF NO then following calculations are not applicable)	Pipe End Empty, Partially Full or Full	Wetted End Area (m^2)	Upstream and Downstream Wetted Average Area (m^2)	Horizontal Wetted Length (m)	Full Wetted Length (m) Only applicable if pipe is full	Actual Volume (m^3)
Upstream Manhole	2	1.8	0.90	269.99	270.89					0.22	YES	Partially Full	0.40				
Downstream Manhole	8	1.8	0.90	269.75	270.65					0.46	YES	Partially Full	0.84				
						80.00	80.00	0.30	0.003					0.62	80.00	80.00	49.59
Upstream Manhole	3	1.8	0.90	270.36	271.26					0.00	NO	EMPTY	FALSE				
Downstream Manhole	2	1.8	0.90	270.08	270.98					0.13	YES	Partially Full	0.24				
						92.00	92.00	0.30	0.003					0.12	44.79	92.00	5.42
Upstream Manhole	7	1.8	0.90	269.85	270.75					0.36	YES	Partially Full	0.65				
Downstream Manhole	8	1.8	0.90	269.69	270.59					0.52	YES	Partially Full	0.94				
						54.00	54.00	0.30	0.003					0.80	54.00	54.00	43.10
Upstream Manhole	6	1.8	0.90	270.04	270.94					0.17	YES	Partially Full	0.31				
Downstream Manhole	7	1.8	0.90	269.88	270.78					0.33	YES	Partially Full	0.60				
						54.00	54.00	0.30	0.003					0.46	54.00	54.00	24.63
Upstream Manhole	5	1.8	0.90	270.22	271.12					0.00	NO	EMPTY	FALSE				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.08	YES	Partially Full	0.15				
						29.33	29.33	0.30	0.003					0.08	28.13	29.33	2.14
Upstream Manhole	4	1.8	0.90	270.34	271.24					0.00	NO	EMPTY	FALSE				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.08	YES	Partially Full	0.15				
						70.00	70.00	0.30	0.003					0.08	28.13	70.00	2.14

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume (m^3) 127.01

Partially Filled Pipes Calculations
Five Year Event

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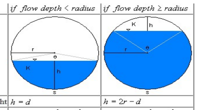
Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.
Full pipes are calculated by taking the full end area of the pipe multiplied by the length of the pipe and method 1 and 2 calculations are ignored.
The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
The wetted length is predominantly useful in the calculations for when only one end of the pipe is submerged.
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0, therefore neither Method 1 nor Method 2 would be applicable.



	Method 1	Method 2
solve for	*if flow depth < radius*	*if flow depth ≥ radius*
circular segment height	$h = d$	$h = 2r - d$
central angle	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$
circular segment area	$K = \frac{r^2(\theta - \sin\theta)}{2}$	$K = \frac{r^2(\theta - \sin\theta)}{2}$
arc length	$s = r \times \theta$	$s = r \times \theta$
flow area	$A = K$	$A = \pi r^2 - K$
wetted perimeter	$P_W = s$	$P_W = 2\pi r - s$
hydraulic radius	$R_h = \frac{A}{P_W}$	$R_h = \frac{A}{P_W}$

Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 270.34 m

Pipe Storage

Pipe Start and End Locations	MH#	Pipe Diameter (m)	Radius (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth > 0 (IF NO then following calculations are not applicable)	Water Depth Type (Method 1 flow depth <radius, Method 2 Flow Depth >= radius, Full (full pipe), Empty (N/A))	h	θ	K	s	A	Pw	Rk	Wetted End Area (m2)	Upstream and Downstream Wetted Average Area (m2)	Horizontal Wetted Length (m)	Actual Volume (m3)
Upstream Manhole	8	0.45	0.23	269.66	270.11					0.68	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16			
Downstream Manhole	9	0.45	0.23	269.50	269.95	2				0.84	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16			
						8	8.00	0.50	0.005												0.16	8.00	1.27

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume 1.27

Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.

The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
The wetted length is predominantly useful in the calculations for when only one end of the pipe is submerged.
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0

Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 270.34 m

Box Pipe Storage

Pipe Start and End Locations	MH#	Pipe Width (m)	Height (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth > 0 (IF NO then following calculations are not applicable)	Pipe End Empty, Partially Full or Full	Wetted End Area (m^2)	Upstream and Downstream Wetted Average Area (m^2)	Horizontal Wetted Length (m)	Full Wetted Length (m) Only applicable if pipe is full	Actual Volume (m^3)
Upstream Manhole	2	1.8	0.90	269.99	270.89					0.35	YES	PartiallyFull	0.64				
Downstream Manhole	8	1.8	0.90	269.75	270.65					0.59	YES	PartiallyFull	1.07				
						80.00	80.00	0.30	0.003					0.85	80.00	80.00	68.39
Upstream Manhole	3	1.8	0.90	270.36	271.26					0.00	NO	EMPTY	FALSE				
Downstream Manhole	2	1.8	0.90	270.08	270.98					0.26	YES	PartiallyFull	0.48				
						92.00	92.00	0.30	0.003					0.24	88.30	92.00	21.05
Upstream Manhole	7	1.8	0.90	269.85	270.75					0.49	YES	PartiallyFull	0.89				
Downstream Manhole	8	1.8	0.90	269.69	270.59					0.65	YES	PartiallyFull	1.18				
						54.00	54.00	0.30	0.003					1.03	54.00	54.00	55.78
Upstream Manhole	6	1.8	0.90	270.04	270.94					0.30	YES	PartiallyFull	0.55				
Downstream Manhole	7	1.8	0.90	269.88	270.78					0.46	YES	PartiallyFull	0.84				
						54.00	54.00	0.30	0.003					0.69	54.00	54.00	37.32
Upstream Manhole	5	1.8	0.90	270.22	271.12					0.13	YES	PartiallyFull	0.23				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.21	YES	PartiallyFull	0.39				
						29.33	29.33	0.30	0.003					0.31	29.33	29.33	9.02
Upstream Manhole	4	1.8	0.90	270.34	271.24					0.00	YES	PartiallyFull	0.01				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.21	YES	PartiallyFull	0.39				
						70.00	70.00	0.30	0.003					0.20	70.00	70.00	13.85

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume (m 205.42

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Partially Filled Pipes Calculations
For One Hundred Year Event

Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.
Full pipes are calculated by taking the full end area of the pipe multiplied by the length of the pipe and method 1 and 2 calculations are ignored.
The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
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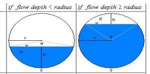
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0, therefore neither Method 1 nor Method 2 would be applicable.

	Method 1	Method 2
solve for	*if flow depth < radius*	*if flow depth ≥ radius*
		
circular segment height	$h = d$	$h = 2r - d$
central angle	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$	$\theta = 2\arccos\left(\frac{r-h}{r}\right)$
circular segment area	$K = \frac{r^2(\theta - \sin\theta)}{2}$	$K = \frac{r^2(\theta - \sin\theta)}{2}$
arc length	$s = r \times \theta$	$s = r \times \theta$
flow area	$A = K$	$A = \pi r^2 - K$
wetted perimeter	$P_W = s$	$P_W = 2\pi r - s$
hydraulic radius	$R_h = \frac{A}{P_W}$	$R_h = \frac{A}{P_W}$

Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 271.14 m

Pipe Storage

Pipe Start and End Locations	MH#	Pipe Diameter (m)	Radius (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth >0 (IF NO then following calculations are not applicable)	Water Depth Type (Method 1 flow depth <radius, Method 2 Flow Depth >= radius, Full (full pipe), Empty (N/A))	h	θ	K	s	A	Pw	Rk	Wetted End Area (m2)	Upstream and Downstream Wetted Average Area (m2)	Horizontal Wetted Length (m)	Actual Volume (m3)
Upstream Manhole	8	0.45	0.23	269.66	270.11					1.48	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16			
Downstream Manhole	9	0.45	0.23	269.50	269.95					1.64	YES	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.16			
						32.00	32.00	0.50	0.005												0.16	32.00	5.09

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume 5.09

Partially Filled Pipes are Calculated using the End Area Method
The average area of each end of the filled pipe is multiplied by the wetted length to give the volume.

The horizontal wetted length of the pipe is calculated by taking the flow depth at the downstream end up to a maximum of the upstream invert and dividing by the slope.
The wetted length is predominantly useful in the calculations for when only one end of the pipe is submerged.
If the flow depth at one manhole end is equal to or higher than the pipe diameter it is considered full at that end
If the flow depth at one manhole end is 0 or negative then that pipe diameter is considered empty at that end and has a wetted end area of 0

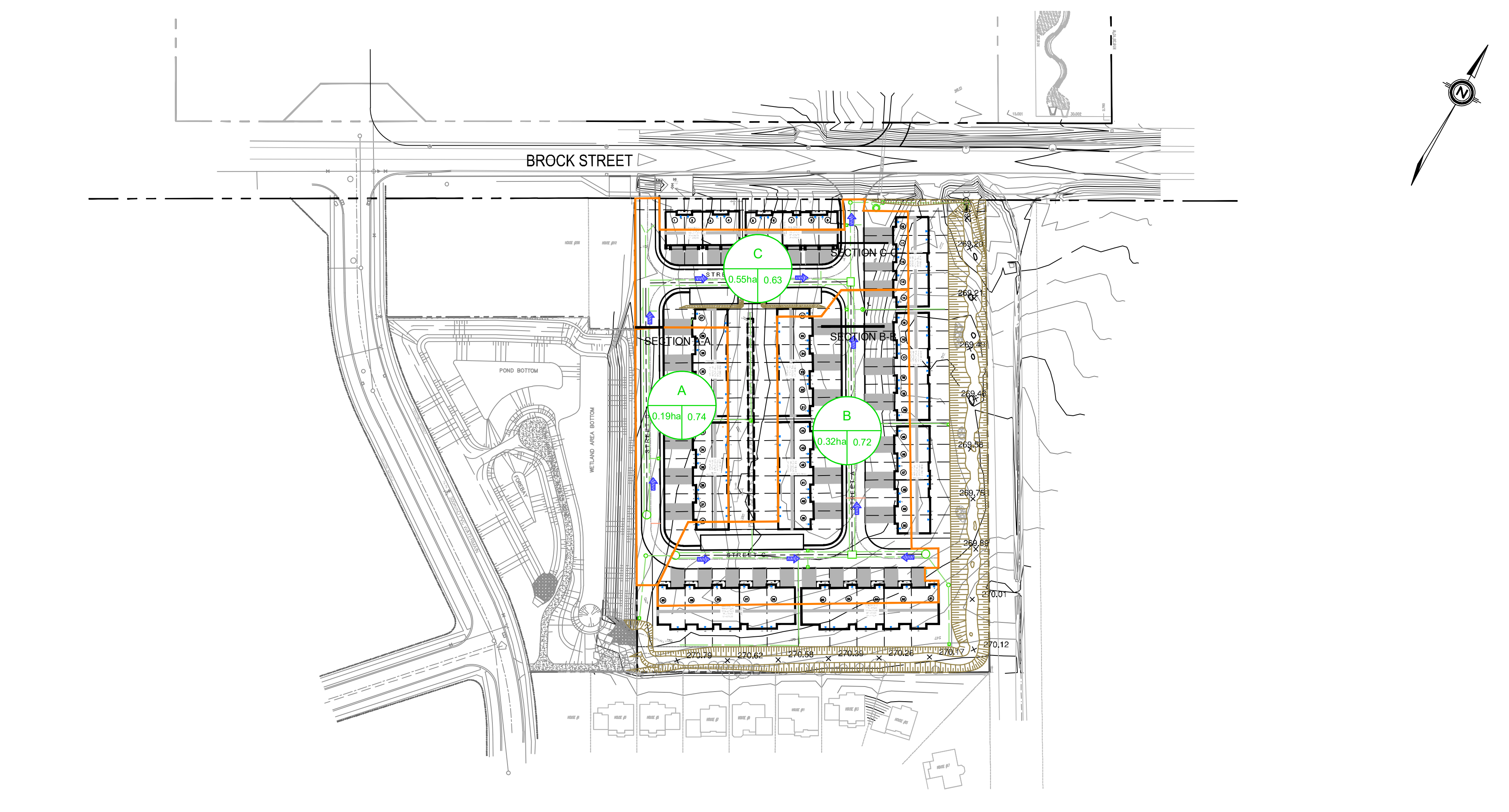
Volume of Stored Water = Upstream and Downstream Wetted Average Area x Length of Pipe
Water Elevation 271.14 m

Box Pipe Storage

Pipe Start and End Locations	MH#	Pipe Width (m)	Height (m)	Pipe Invert (m)	Pipe Obvert(m)	Flat/Horizontal Length of Pipe (m)	Full Length of Pipe (Accounts for Slope)	Slope %	Slope (m/m)	Flow Depth Above Pipe Invert(d)	Check Flow Depth >0 (IF NO then following calculations are not applicable)	Pipe End Empty, Partially Full or Full	Wetted End Area (m^2)	Upstream and Downstream Wetted Average Area (m^2)	Horizontal Wetted Length (m)	Full Wetted Length (m) Only applicable if pipe is full	Actual Volume (m^3)
Upstream Manhole	2	1.8	0.90	269.99	270.89					0.90	YES	FULL	1.62				
Downstream Manhole	8	1.8	0.90	269.75	270.65					0.90	YES	FULL	1.62				
						80.00	80.00	0.30	0.003					1.62	80.00	80.00	129.60
Upstream Manhole	3	1.8	0.90	270.36	271.26					0.79	YES	PartiallyFull	1.42				
Downstream Manhole	2	1.8	0.90	270.08	270.98					0.90	YES	FULL	1.62				
						92.00	92.00	0.30	0.003					1.52	92.00	92.00	139.62
Upstream Manhole	7	1.8	0.90	269.85	270.75					0.90	YES	FULL	1.62				
Downstream Manhole	8	1.8	0.90	269.69	270.59					0.90	YES	FULL	1.62				
						54.00	54.00	0.30	0.003					1.62	54.00	54.00	87.48
Upstream Manhole	6	1.8	0.90	270.04	270.94					0.90	YES	FULL	1.62				
Downstream Manhole	7	1.8	0.90	269.88	270.78					0.90	YES	FULL	1.62				
						54.00	54.00	0.30	0.003					1.62	54.00	54.00	87.48
Upstream Manhole	5	1.8	0.90	270.22	271.12					0.90	YES	FULL	1.62				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.90	YES	FULL	1.62				
						29.33	29.33	0.30	0.003					1.62	29.33	29.33	47.52
Upstream Manhole	4	1.8	0.90	270.34	271.24					0.80	YES	PartiallyFull	1.44				
Downstream Manhole	6	1.8	0.90	270.13	271.03					0.90	YES	FULL	1.62				
						70.00	70.00	0.30	0.003					1.53	70.00	70.00	107.24

Note Full Pipe Lengths are lower than Servicing Drawing Lengths because they are measured from End to End

Total Pipe Volume (m^3) 598.94



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LEGEND

PROPERTY LINE
PROPOSED STORM DRAINAGE AREA BOUNDARY
PROPOSED OVERLAND FLOW DIRECTION

A1POST — STORM DRAINAGE AREA NUMBER
0.25ha — DRAINAGE AREA IN HECTARES
0.50 — RUNOFF COEFFICIENT

EMERGENCY OVERLAND FLOW AREAS

WESTLANE DEVELOPMENTS LTD.
SOUTH BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	MARCH 2021	PROJECT No.:	2018-0302
SCALE:	1:1500	FIGURE No.:	DAP-3

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COLE ENGINEERING

Overland Flow Analysis Section A-A

South Brock Street Development

File No. 2018-0302

Date: February 2021

Surface Type Coefficients		
Coefficient:	0.9	Paved
Coefficient:	0.25	Grass

Storm Event	Catchment Area (ha)	Paved Area (ha)	Landscape Area (ha)	Composite C Scaled for 100 Year Event	Percent Impervious	Tc (min)	Rainfall Intensity	Flow (L/s)
100	0.79	0.60	0.19	0.93	76%	10	200.6	409

COLE ENGINEERING

Overland Flow Analysis Section B-B

South Brock Street Development

File No. 2018-0302

Date: February 2021

Surface Type Coefficients		
Coefficient:	0.9	Paved
Coefficient:	0.25	Grass

Storm Event	Catchment Area (ha)	Paved Area (ha)	Landscape Area (ha)	Composite C Scaled for 100 Year Event	Percent Impervious	Tc (min)	Rainfall Intensity	Flow (L/s)
100	0.32	0.23	0.09	0.90	72%	10	200.6	158

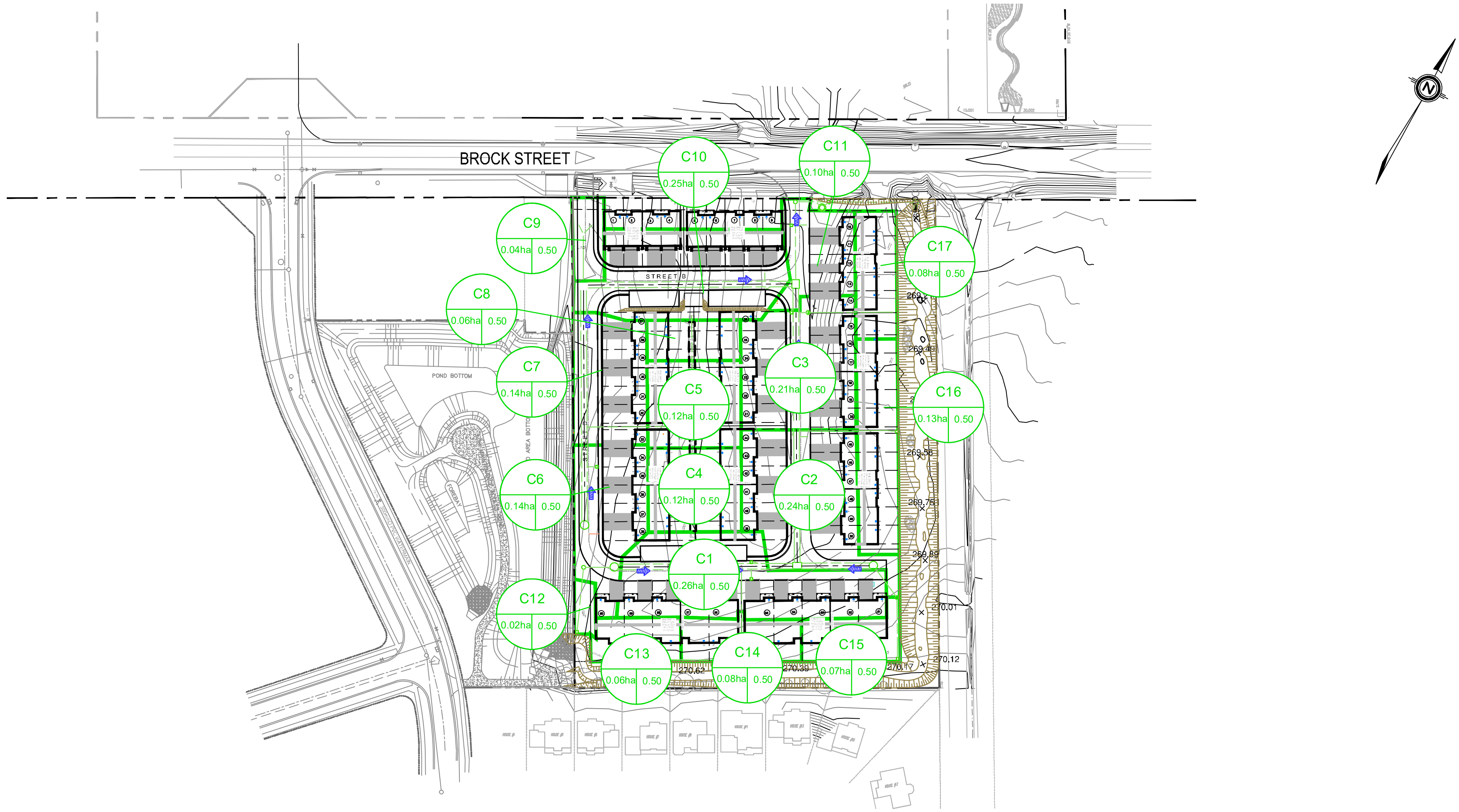
COLE ENGINEERING	Prepared By: Tim Ng	**Overland Flow Analysis Section C-C** South Brock Street Development File No. 2018-0302 Date: February 2021

Surface Type Coefficients		
Coefficient:	0.9	Paved
Coefficient:	0.25	Grass

Storm Event	Catchment Area (ha)	Paved Area (ha)	Landscape Area (ha)	Composite C Scaled for 100 Year Event	Percent Impervious	Tc (min)	Rainfall Intensity	Flow (L/s)
100	1.66	1.15	0.51	0.87	69%	10	200.6	808

Rectangle Weir (above the roadway)		
Height	0.20	Building Entrance elevation minus the high point on the road (271.65-271.44)
Length	7.1	
C	1.65	
Q Capacity (L/s)	**1048**	

Rectangle Weir (boulevard)		
Height	0.20	Building Entrance elevation minus the high point on the road (271.65-271.44)
Length	6.03	Half boulevadrd length because these weirs are triangular
C	1.65	
Q Capacity (L/s)	**890**	



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LEGEND

PROPERTY LINE

PROPOSED STORM DRAINAGE AREA BOUNDARY

PROPOSED OVERLAND FLOW DIRECTION

A1POST 0.25ha 0.50

STORM DRAINAGE AREA NUMBER

DRAINAGE AREA IN HECTARES

RUNOFF COEFFICIENT

100 YEAR CAPTURE AREA PLAN

WESTLANE DEVELOPMENTS LTD.
SOUTH BROCK STREET DEVELOPMENT
TOWN OF UXBRIDGE
REGIONAL MUNICIPALITY OF DURHAM

DATE:	MARCH 2021	PROJECT No.:	2018-0302
SCALE:	1:1500	FIGURE No.:	DAP-4

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100-Year Capture Analysis

Brock Street South
2018-0302
Mar-21

Drainage Area ID	# of CB Type	Single CB (in Sag), Double CB (in Sag), Gutter CB or Area Drain	High Capacity Grates	Total Area (ha)	Runoff Coefficent 'C'	100 Year Rainfall Intensity (mm/hr)	Gutter Slope (%)	Ponding Depth (m)	Open Flow Area m^2 (72% opening for high capacity grate)	Area Drain Open Area (m^2)	Cross Slope (%)	T Value	Gutter Flow Capacity Per CB	Direct Flow In (L/s)	Overflow In (L/s)	Total Flow In (L/s)	Flow Capture Capacity (L/s)	Blockage Factor	Flow Capture Capacity Assuming Blockage (L/s)	Overflow (L/s)	Overflow Location
C1	2	Single CB	Yes	0.26	0.86	200.60	-	0.02	0.52	-	-	-	-	125	0	125	195	50%	97	28	C2
C2	2	Gutter CB	No	0.24	0.86	200.60	0.75	-	-	-	2.00	2.50	45.00	115	28	143	90	50%	45	98	C3
C3	2	Gutter CB	No	0.21	0.86	200.60	0.75	-	-	-	2.00	2.50	45.00	101	98	199	90	50%	45	154	C11
C4	1	Single CB	No	0.12	0.86	200.60	-	0.30	-	-	-	-	-	58	0	58	204	50%	102	0	C3
C5	1	Single CB	No	0.12	0.86	200.60	-	0.30	-	-	-	-	-	58	0	58	204	50%	102	0	C8
C6	2	Gutter CB	No	0.14	0.86	200.60	1.00	-	-	-	2.00	2.50	48.00	67	0	67	96	50%	48	19	C7
C7	2	Gutter CB	No	0.14	0.86	200.60	0.50	-	-	-	2.00	2.50	40.00	67	19	87	80	50%	40	47	C8
C8	1	Single CB	Yes	0.06	0.86	200.60	-	0.01	0.26	-	-	-	-	29	47	75	69	50%	34	41	C10
C9	2	Single CB	No	0.04	0.86	200.60	-	0.09	-	-	-	-	-	19	0	19	44	50%	22	0	C10
C10	2	Single CB	Yes	0.25	0.86	200.60	-	0.09	0.52	-	-	-	-	120	41	161	413	50%	207	0	C11
C11	2	Double CB	Yes	0.10	0.86	200.60	-	0.10	1.04	-	-	-	-	48	154	202	871	50%	436	0	N/A
C12	1	Single CB	No	0.02	0.86	200.60	-	0.15	0.26	-	-	-	-	10	0	10	120	50%	60	0	N/A
C13	1	Single CB	No	0.06	0.86	200.60	-	0.15	0.26	-	-	-	-	29	0	29	120	50%	60	0	N/A
C14	1	Single CB	No	0.08	0.86	200.60	-	0.15	0.26	-	-	-	-	38	0	38	120	50%	60	0	N/A
C15	1	Single CB	No	0.07	0.86	200.60	-	0.15	0.26	-	-	-	-	34	0	34	120	50%	60	0	N/A
C16	1	Single CB	Yes	0.13	0.86	200.60	-	0.15	0.26	-	-	-	-	62	0	62	267	50%	133	0	N/A
C17	1	Single CB	No	0.08	0.86	200.60	-	0.15	0.26	-	-	-	-	38	0	38	120	50%	60	0	N/A

COLE

Prepared By Tim Ng

Water Quality Calculations

South Brock Street Development
File No. 2018-0302
Date: July 2018

Catchment	Surface	Treatment	Effective TSS	Area (ha)	% Area of Site	Overall TSS Removal
A1 Post	Landscape	Inherent	80%	0.40	15%	12%
A2 Post	Landscape	Inherent	80%	0.07	3%	2%
	Rooftop	Inherent	80%	0.04	2%	1%
A3 Post	Asphalt/Impervious Area	Jellyfish Unit	80%	0.72	27%	22%
	Landscape	Inherent	80%	0.79	30%	24%
	Rooftop	Inherent	80%	0.60	23%	18%
Total	**-**	**-**	**-**	**2.61**	**100.0%**	**80%**

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Tuesday, January 29, 2019
Project Name	Brock St. S
Project Number	2018-0302
Location	Uxbridge

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.
Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF8-8-2 is recommended to meet the water quality objective by treating a flow of 45.4 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 512 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF8-8-2	8	2	2.4	45.4	512

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

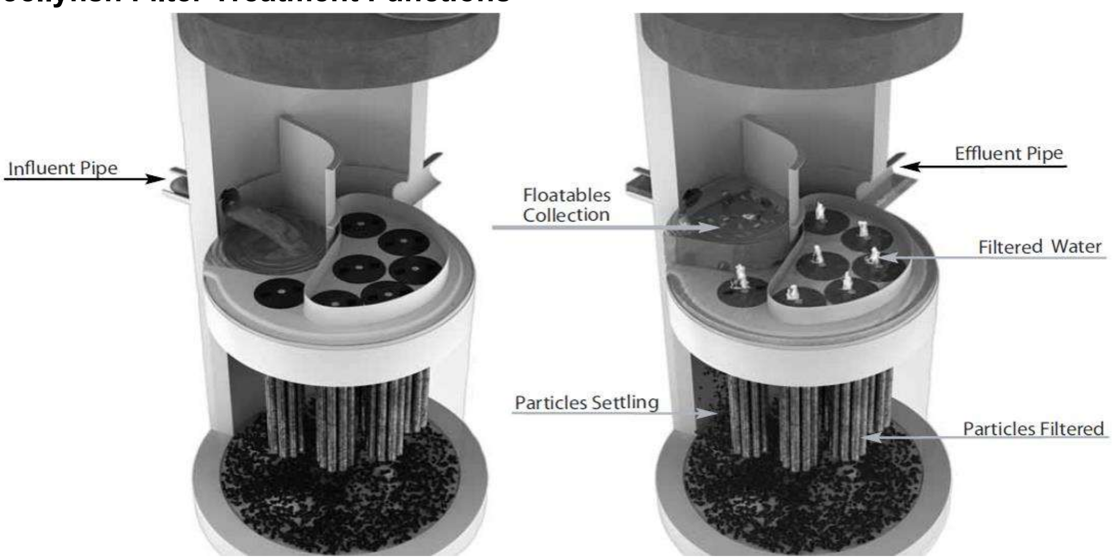
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 59%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Tuesday, January 29, 2019
Project Name:	Brock St. S
Project Number:	2018-0302
Location:	Uxbridge

Designer Information

Company:	Cole Engineering Group Ltd.
Contact:	Tim Ng
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	2.1 ha
Imperviousness:	64.7%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**35.8 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 8107 m³, with a suspended sediment concentration of 60 mg/L.	**486 kg***

* *Indicates that sediment loading is the limiting parameter in the sizing of this Jellyfish system*

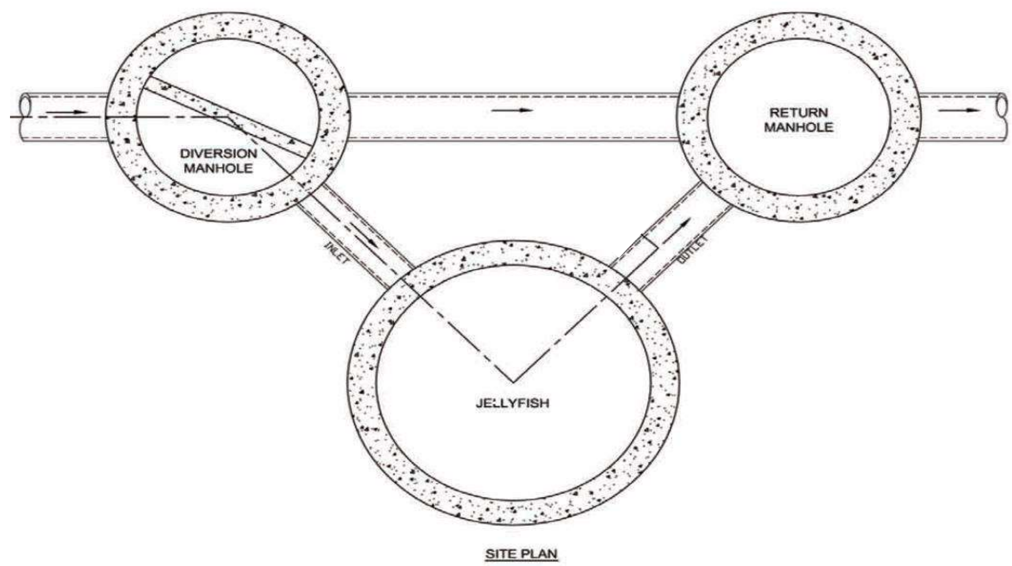
Recommendation

The Jellyfish Filter model JF8-8-2 is recommended to meet the water quality objective by treating a flow of 45.4 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 512 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	**8**	**2**	**2.4**	**9252**	**1.42**	**1469**	**45.4**	**512**
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	59º	200	250
2.4	**52º**	**250**	**300**
3.0	48º	300	450
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891:	Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478:	Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443:	Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101:	Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 <u>GENERAL</u>

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	**Minimum Filtration Membrane Surface Area (ft2 / m2)**	**Maximum Filter Cartridge Dry Weight (lbs / kg)**
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft^2 (0.142 lps/m^2).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

COLE	**5 mm Volume Control Retention Calculation** **Block 6** **2017-0569** **Date: February 2021**

Land Use	**Area (ha)**		**m^3**
Paved	1.36		
Landscape	1.26		
5 mm retention per impervious area =			**68**
	Area (m^2)	**Ponding/storage Depth (mm)**	
Infiltration Trenches	600	300	**72**
Total			**72**

COLE		Infiltration Trench Calculations
		South Brock Street Development File No. 2018-0302 Date: February 2021

Refer to Water Balance Calculations based on Hydrogeological Assessment and Water Balance Study performed by WSP March 2021 for Actual Infiltration into the Trench. Trenches have conservatively been sized with the total volume provided above the infiltration values from the WSP Report.

Proposed Infiltration							
Total Roof Area directed to infiltration trenches (m2)	Total landscaped areas directed to infiltration trenches	Total Area	Total Max Volume Provided for Infiltration (m^3)/year	Max Provided Depth to be infiltrated (mm/year)	Average rainfall (mm/year)	% of Annual rainfall	Depth retained (mm)
2288	1739	4027	2200	546	886	62%	6

Infiltration Trench ID	Contributing Drainage Area	Rainfall Depth to be infiltrated	Stone Porosity	Runoff Volume for Infiltration[1]	Infiltration rate[3]	Required Drawdown Time	Maximum Allowable Trench Depth[4]	Proposed Trench Depth[5]	Minimum Footprint Area for Infiltration[6]	Proposed Trench Width	Proposed Trench Length	Actual Footprint Area for Infiltration
	(m^2)	(mm)		(m^3)	(mm/hr)	(hr)	(m)		(m^2)	(m)	(m)	(m^2)
Trench Central	4027	6	0.40	24	34.5	48	4.14	0.30	201	7.50	80	600
	4027			24								

CVC & TRCA Low Impact Development Stormwater Planning & Design Manual
Used to calculate maximum LID depth for infiltration (Pg 4-57)

$$d_{max} = \frac{i \times T}{Vr}$$

d = Maximum stone depth of soakaway pit/infiltration trench (mm)
i = Infiltration Rate (mm/hr)
T = Drawdown time (48 hrs max.) (hr)
Vr= Void Space Ratio (typically 0.40 for 50mm clear stone)

CVC & TRCA Low Impact Development Stormwater Planning & Design Manual
Used to calculate the minimum footprint area for infiltration (Pg 4-58)

where;
A = Bottom area of soakaway pit/infiltration trench (m^2)
WQV = runoff volume to be infiltrated (m^3)
d = Maximum stone depth of soakaway pit/infiltration trench (m)
Vr = Void Space Ratio (typically 0.40 for 50mm clear stone)

$$A = \frac{WQV}{d \times Vr}$$

Notes:
1 - Volume of runoff based on 2mm of rain across the drainage area. See Water Balance Calculation for details.
2 - Safety factor from TRCA Stormwater Management Criteria Appendix C: Water Balance and Recharge (Table C 3)
3 - Infiltration rate based on WSP Report. See report in Appendix A.
4 - Max depth for a 48 hour draw down time see equation above
5 - Proposed depth for soakaway pit/infiltration trench
6 - Minimum trench bottom area, see equation 4.3 above

Infiltration Trench Details

Highest Observed Existing Grade Near Swale	Water Table	Max. Elevation of Infiltration System	Lowest Grade at Infiltration System	Available Depth	Proposed Depth of stone
(m)	(m)	(m)	(m)	(m)	(m)
270.74	270.74	271.74	272.18	0.44	0.30

COLE

Phosphorus Removal Calculations

South Brock Street Development
2018-0302
January 20201

Existing Phosphorus Loading Calculation

Land Use	Area	P Coef (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency (%)	BMP P (kg/yr)	Notes
Hay Pasture	2.36	0.06	0.14	None	0	0.14	
Low Intensity Development	0.25	0.13	0.03	None	0	0.03	
	2.61					0.17	

Proposed Phosphorus Loading Calculation with BMP

Land Use	Area	P Coef (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency (%)	BMP P (kg/yr)	Notes
High Intensity Residential	1.81	1.32	2.39	Storage, Jellyfsh Filter	69%	0.73	
High Intensity Residential	0.11	1.32	0.15	None	0%	0.15	
Open Water	0.4	0.26	0.10	Infiltration Trench for Roofs and Backyards	88%	0.01	
High Intensity Residential	0.29	1.32	0.38	Storage, Jellyfish Filter, Infiltration Trench	65%	0.13	
	2.61					**1.03**	

Proposed Phosphorus Loading Calculation without BMP

Land Use	Area	P Coef (kg/ha/yr)	P Load (kg/yr)	BMP	Efficiency (%)	BMP P (kg/yr)	Notes
High Intensity Residential	1.81	1.32	2.39	None	0%	2.39	
High Intensity Residential	0.11	1.32	0.15	None	0%	0.15	
Open Water	0.40	0.26	0.10	None	0%	0.10	
High Intensity Residential	0.29	1.32	0.38	None	0%	0.38	
	2.61					**3.02**	Total Phosphorus Load without BMP
						1.99	Total Phosphorus Removed with BMP
						66%	Phosphorus removal

$$R = A + B - [(A \times B) / 100] \quad \text{(Equation 4-1)}$$

Where:

R = Total TSS Removal Rate
A = TSS Removal Rate of the First or Upstream BMP
B = TSS Removal Rate of the Second or Downstream BMP

Underground Storage	=	**25**	% Phosphorus Removal
Jellyfish Treatment (as per ETTV results)	=	**59**	% Phosphorus Removal
Open Channel Treatment	=	**25**	% Phosphorus Removal
Infiltration Trench	=	**60**	% Phosphorus Removal
Jellyfish in Combination with Underground Storage R=59+25-[(59x25)/100]	=	**69**	% Phosphorus Removal
Jellyfish in Combination with Underground Storage and Infiltration Trenchl R=69+60-[(69x60)/100]	=	**88**	% Phosphorus Removal

Phosphorus Loading Summary		
Existing Conditions	0.17	kg/year
Proposed Conditions with no BMP	3.02	kg/year
Proposed Conditions with BMP	1.03	kg/year
Post Development % Phosphorus Removal	**66%**	

PHOSPHORUS EXPORT COEFFICIENTS

Updated: September 2011

Land-Use Specific Phorphorus Export Coefficients for Lake Simcoe Watersheds

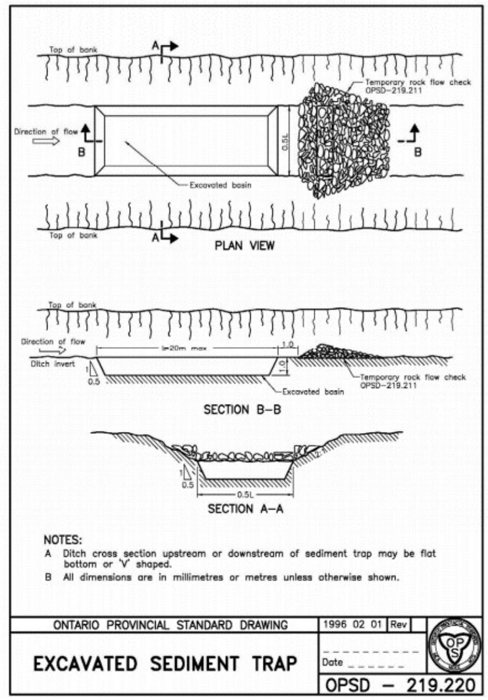
Subwatershed		Annual Phosphorus Load (kg/ha/year)											
		Agricultural			Urban			Natural Heritage		Other			
		HayPasture	Cropland	Sod Farm / Golf Course	Low Intensity Developmen t	High Intensity Comm/Ind	High Intensity Residential	Forest	Wetland	Quarry	Unpaved Road	Transition	Open Water
Monitored	Beaver River	0.04	0.22	0.01	0.19	1.82	1.32	0.02	0.02	0.16	0.83	0.04	0.26
	Black River	0.08	0.23	0.02	0.17	1.82	1.32	0.05	0.04	0.15	0.83	0.06	0.26
	East Holland	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.18	0.83	0.16	0.26
	Hawkestone Creek	0.10	0.19	0.06	0.09	1.82	1.32	0.03	0.03	0.10	0.83	0.04	0.26
	Lovers Creek	0.07	0.16	0.17	0.07	1.82	1.32	0.06	0.05	0.06	0.83	0.06	0.26
	Pefferlaw-Uxbridge Brook	0.06	0.11	0.02	0.13	1.82	1.32	0.03	0.04	0.04	0.83	0.04	0.26
	Whites Creek	0.10	0.23	0.42	0.15	1.82	1.32	0.10	0.09	0.08	0.83	0.11	0.26
Unmonitored	Barrie Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Georgina Creeks	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.08	0.83	0.16	0.26
	Hewitts Creek	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Innisfil Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Maskinonge River	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Oro Creeks North	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.10	0.08	0.83	0.16	0.26
	Oro Creeks South	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Ramara Creeks	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.05	0.08	0.83	0.06	0.26
	Talbot/Upper Talbot River	0.07	0.19	0.12	0.13	1.82	1.32	0.05	0.10	0.08	0.83	0.06	0.26
	West Holland	0.12	0.36	0.24	0.13	1.82	1.32	0.10	0.05	0.08	0.83	0.16	0.26

Summary for 17 sub-watersheds

Min	0.04	0.11	0.01	0.07	1.82	1.32	0.02	0.02	0.04	0.83	0.04	0.26
Max	0.12	0.36	0.42	0.19	1.82	1.32	0.10	0.10	0.18	0.83	0.16	0.26
Average	0.084	0.230	0.147	0.131	1.820	1.320	0.061	0.060	0.092	0.830	0.083	0.260
Standard deviation	0.025	0.079	0.104	0.026	0.000	0.000	0.028	0.027	0.036	0.000	0.047	0.000

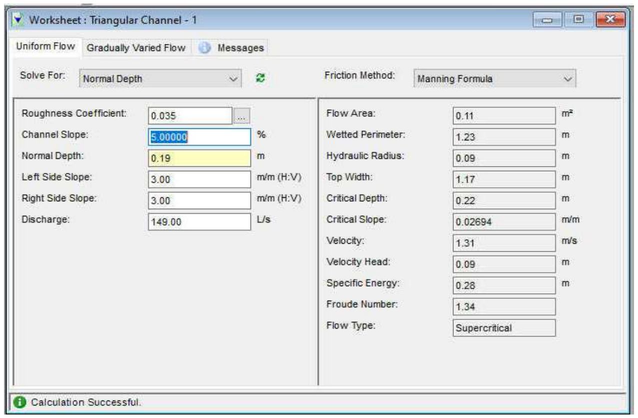
COLE ENGINEERING	**Sediment Trap Calculations Stage 1**
	Brock Street South File No. 2018-0302 March 1, 2021

Drainage Area	2
Volume Required per ha	125
Volume Required (m^3)	250
Length Provided (m)	20
Width Provided (m)	10.0
Depth (m)	1.4
Volume Provided (m)	252
Length <20 m	OK
Width < 0.5L	OK
Volume Provided> Required	OK



COLE ENGINEERING	**Rip Rap Sizing Calculations** Brock Street South File No.2018-0302 March 1, 2021

Max Drainage Area to Swale	2
Coefficient	0.25
5 Year Flow	149

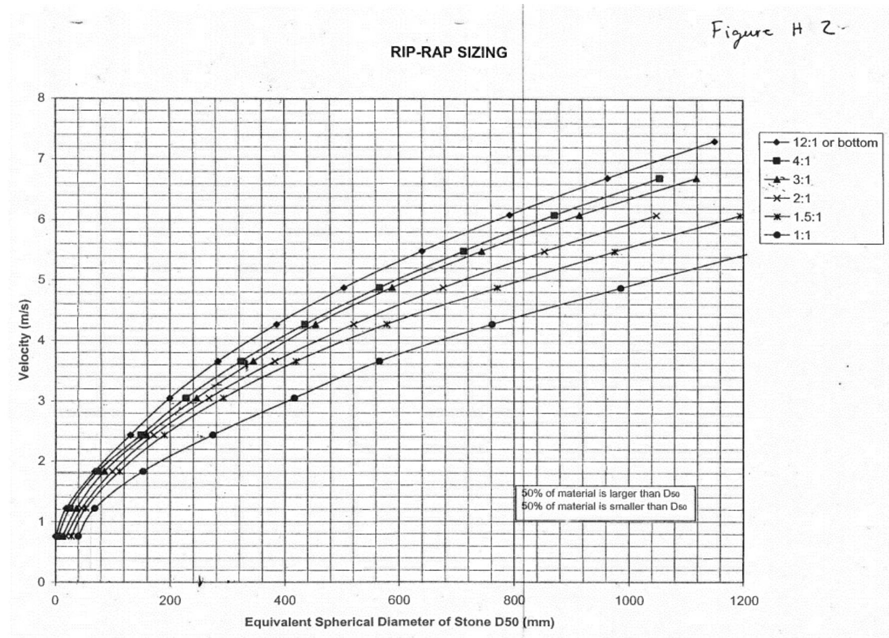

Worksheet : Triangular Channel - 1
Uniform Flow | Gradually Varied Flow | Messages
Solve For: Normal Depth
Friction Method: Manning Formula

Roughness Coefficient:	0.035	
Channel Slope:	5.00000	%
Normal Depth:	0.19	m
Left Side Slope:	3.00	m/m (H:V)
Right Side Slope:	3.00	m/m (H:V)
Discharge:	149.00	L/s

Flow Area:	0.11	m²
Wetted Perimeter:	1.23	m
Hydraulic Radius:	0.09	m
Top Width:	1.17	m
Critical Depth:	0.22	m
Critical Slope:	0.02694	m/m
Velocity:	1.31	m/s
Velocity Head:	0.09	m
Specific Energy:	0.28	m
Froude Number:	1.34	
Flow Type:	Supercritical	

Calculation Successful.

Velocity is approximately 1.3 m/s on the steepest swale which has a d50 close to 0 therefore **no riprap is required.**



COLE ENGINEERING

Rock Check Dam Spacing

Brock Street South
File No. 2018-0302
March 17 2021

*Rock Check Dams Spaced Every 0.5 m along swales

Slope of Swale (%)	Rock Check Dam Spacing (m)
0.1	500
0.2	250
0.3	167
0.4	125
0.5	100
0.6	83
0.7	71
0.8	63
0.9	56
1.0	50
1.1	45
1.2	42
1.3	38
1.4	36
1.5	33
1.6	31
1.7	29
1.8	28
1.9	26
2.0	25
2.1	24
2.2	23
2.3	22
2.4	21
2.5	20
2.6	19
2.7	19
2.8	18
2.9	17
3.0	17
3.1	16
3.2	16
3.3	15
3.4	15
3.5	14
3.6	14
3.7	14
3.8	13
3.9	13
4.0	13
4.1	12
4.2	12
4.3	12
4.4	11
4.5	11
4.6	11
4.7	11
4.8	10
4.9	10
5.0	10

COLE ENGINEERING

Weekly Erosion, Sediment, Pre Topsoil Stripping, Earthworks Report

		REPORT NO:	______________
PROJECT NAME:	______________	DATE AND TIME:	______________
PROJECT NO.:	______________	CIVIL CONSULTANTS:	______________
TOWN PROJECT NO.:	______________	CONTRACTOR:	______________
TOWN INSPECTOR(S):	______________	INSPECTOR(S):	______________

FENCING (SILT, SNOW, TREE PRESERVATION):

- Fences are located and installed as per Town of Markham Standards and the Sediment and Erosion Control Drawing — Yes ☐ No ☐
- Fences require remedial action in the following areas:______________________________

____

TEMPORARY SEDIMENT CONTROL PONDS/SWALES:

- Required temporary sediment control ponds/swales are located as per the Sediment and Erosion Control Drawing — Yes ☐ No ☐
- Required temporary sediment control ponds/swales are functioning as per the Sediment and Erosion Control Drawing — Yes ☐ No ☐
- Temporary sediment control ponds/swales require remedial action in the following areas:______________________________

____

CHECK DAMS:

- Required Check Dams are located and constructed as per Town of Markham Standards and the Sediment and Erosion Control Drawing — Yes ☐ No ☐
- Required Check Dams are functioning properly and are free of sediment build-up — Yes ☐ No ☐
- Check Dams require remedial actions in the following areas:______________________________

____

MUD MAT/ACCESS:

- The Mud Mat/Access is located and constructed as per Town of Markham Standards, the Sediment and Erosion Control Drawing and the roadway is clean — Yes ☐ No ☐
- The Mud Mat/Access is functioning properly and is free of excessive sediment build-up — Yes ☐ No ☐
- The required traffic control signage is present around the Construction Access — Yes ☐ No ☐
- The Mud Mat/Access requires the following remedial action:______________________________

____

TREE PRESERVATION:

- Tree Preservation Fences are located and installed as per Town of Markham Standards and the Sediment and Erosion Control Drawing — Yes ☐ No ☐
- Tree Preservation Fences require remedial action:______________________________

____

DUST CONTROL/ROAD CLEANING:

- Dust Control Plan and Strategy is communicated with the Town of Markham and the Contractor — Yes ☐ No ☐
- Road Cleaning Plan and Strategy is communicated with the Town of Markham and the Contractor — Yes ☐ No ☐

COMMENTS:

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APPENDIXC

Statement of Limiting Conditions and Assumptions

Statement of Limiting Conditions and Assumptions

1. This Report/Study (the "Work") has been prepared at the request of, and for the exclusive use of, the Owner, and its affiliates (the "Intended Users"). No one other than the Intended Users has the right to use and rely on the Work without first obtaining the written authorization of Cole Engineering Group Ltd. (Cole Engineering) and its Owner.
2. Cole Engineering expressly excludes liability to any party except the Intended Users for any use of, and/or reliance upon, the Work.
3. Cole Engineering notes that the following assumptions were made in completing the Work:
   a) the land use description(s) supplied to us are correct;
   b) the surveys and data supplied to Cole Engineering by the Owner are accurate;
   c) market timing, approval delivery and secondary source information is within the control of Parties other than Cole Engineering; and
   d) there are no encroachments, leases, covenants, binding agreements, restrictions, pledges, charges, liens or special assessments outstanding, or encumbrances which would significantly affect the use or servicing.

   Investigations have not been carried out to verify these assumptions. Cole Engineering deems the sources of data and statistical information contained herein to be reliable, but we extend no guarantee of accuracy in these respects.
4. Cole Engineering accepts no responsibility for legal interpretations, questions of survey, opinion of title, hidden or inconspicuous conditions of the property, toxic wastes or contaminated materials, soil or sub-soil conditions, environmental, engineering or other factual and technical matters disclosed by the Owner, the Client, or any public agency, which by their nature, may change the outcome of the Work. Such factors, beyond the scope of this Work, could affect the findings, conclusions and opinions rendered in the Work. We have made disclosure of related potential problems that have come to our attention. Responsibility for diligence with respect to all matters of fact reported herein rests with the Intended Users.
5. Cole Engineering practices engineering in the general areas of infrastructure and transportation. It is not qualified to and is not providing legal or planning advice in this Work.
6. The legal description of the property and the area of the site were based upon surveys and data supplied to us by the Owner. The plans, photographs, and sketches contained in this report are included solely to aide in visualizing the location of the property, the configuration and boundaries of the site, and the relative position of the improvements on the said lands.
7. We have made investigations from secondary sources as documented in the Work, but we have not checked for compliance with by-laws, codes, agency and governmental regulations, etc., unless specifically noted in the Work.
8. Because conditions, including capacity, allocation, economic, social, and political factors change rapidly and, on occasion, without notice or warning, the findings of the Work expressed herein, are as of the date of the Work and cannot necessarily be relied upon as of any other date without subsequent advice from Cole Engineering.
9. The value of proposed improvements should be applied only with regard to the purpose and function of the Work, as outlined in the body of this Work. Any cost estimates set out in the Work are based on construction averages and subject to change.
10. Neither possession of the Work, nor a copy of it, carries the right of publication. All copyright in the Work is reserved to Cole Engineering. The Work shall not be disclosed, produced or reproduced, quoted from, or referred to, in whole or in part, or published in any manner, without the express written consent of Cole Engineering and the Owner.
11. The Work is only valid if it bears the professional engineer's seal and original signature of the author, and if considered in its entirety. Responsibility for unauthorized alteration to the Work is denied.

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