WESTLANE DEVELOPMENT GROUP LTD.

FUNCTIONAL SERVICING AND STORMWATER MANAGEMENT REPORT

Brock Street and Nelkydd Lane, Township of Uxbridge

Project No.: 2018-0302

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1 Introduction

1.1 Background

Cole Engineering Group Ltd. (COLE) was retained by Evendale Developments Ltd. to prepare a Functional Servicing and Stormwater Management Report in support of Zoning By-law amendment 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 64 townhouses. The purpose of this report is to provide site-specific information for the Township and 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:

- Identify sanitary servicing opportunities and constraints, including:
  - Calculation of existing and proposed sanitary flows;
  - Review the capacity of the existing sanitary service connections; and,
  - Ensure that there is enough capacity within the receiving Regional sewers to accommodate the additional sanitary flows from the proposed development.
- Evaluate the existing Regional water system, including:
  - Calculation of the proposed domestic water and firefighting supply needs; and,
  - Confirm adequate flow exists to meet the additional required domestic and fire flow demands for the proposed development.
- 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 Township, the conservation authorities, Ministry of Environment, Conservation and Parks (MOECPand 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 NumberS SW-1 and SW-2, dated July 2000;
- Geo Morphix Design Drawing GEO-1, XS-1, and DET-1;
- Hydrogeological Assessment and Water Balance Study by WSP dated July 19, 2018;
- Summary of Infiltration Tests- Westlane Development Group Ltd. by WSP dated July 26, 2018; and,
- LSRCA Technical Guidelines for SWM Submissions, dated 2016.

1.2 Site Description

The subject site is located south of Brock Street East and east of Nelkydd Lane in the Township of Uxbridge, Regional Municipality of Durham. The existing site is approximately 2.61ha in size and is comprised of two 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 (the "Town").

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 a residential subdivision 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 development and a 20.0m wide headwater drainage feature. The Townhouse Development is approximately 2.33 ha in size, composed of 12 townhouse blocks consisting of 64 Townhouse units. The access to the townhouses will be through a private entrance from Brock Street East. The headwater drainage feature is approximately 0.28ha in size and is comprised of a 20.0m wide headwater drainage feature along the west property line. The proposed headwater drainage feature will carry flows from the existing storm water management detention facility to the west of the property, to an existing 1000 mm ø culvert on Brock Street East. Refer to **Appendix A** for details.

3 Terms of Reference and Methodology

3.1 Terms of Reference

Design criteria for the municipal services will be in accordance with the Region, the Town, and MOECP:

- Post-development peak flows for all events from the site should be controlled to the peak flow resulting from the pre-development conditions;
- Stormwater should be treated to Enhanced Protection (Level 1) as defined in the MOECP Stormwater Management Planning & Design (SWMPD) Manual (2003); and,
- The Township's intensity-duration-frequency (IDF) data was used for the quantity control analysis.

3.2 Methodology: Stormwater Drainage and Management

The SWM portion of this report demonstrates that the required SWM controls will be achieved as per the provincial, conservation authority and municipal standards. The SWM standards applied are summarized below.

Water Quality

As per MOECP SWMPD Manual (2003), Level 1 (enhanced) quality control (i.e. long-term average removal of 80% of the total suspended solids (TSS) on an annual loading basis) shall be achieved.

Water Quantity

Post- to Pre-peak flow attenuation up to and including the 100-year storm shall be achieved to the ditch discharge location at Brock Street South through the use of underground storage and a flow regulation device.

Water Balance

Post- to Pre- water balance shall be achieved as per the Lake Simcoe Region Conservation Authority (LSRCA)'s Stormwater Management Guidelines.

Phosphorous Removal

80% Post-development phosphorus removal is required for the subject property as per the Lake Simcoe Region Conservation Authority (LSRCA)'s Stormwater Management Guidelines. The Uxbridge Urban Area Stormwater Management Plan requires 90% Phosphorous removal from the development or provide cash-in-lieu for any phosphorous removal deficiency at the current rate .

3.3 Methodology: Sanitary Discharge

The sanitary sewage discharge from the proposed site was determined using sanitary sewer design sheets based on Region's Design Standards that consider the land use and building statistics as supplied by the design team. The calculated values provide peak sanitary flow discharge with infiltration considerations.

The estimated sanitary discharge flows from the existing site as well as the proposed site will be calculated based on the criteria shown in **Table 3.1** below.

Table 3.1 Sanitary Flows

Usage	Design Flow	Units	Persons
Existing Residential	364	Litres / person / day	Single Family Dwelling: 3.5 Persons / Unit
Residential	364	Litres / person / day	Single & Semi: 3.5 Persons / Unit Townhouses 3.0 Persons / Unit 1 bedroom Apartment: 1.5 Persons / Unit 2 bedroom Apartment: 2.5 Persons / Unit
Commercial	180,000	Litres / ha / day	86 Persons / ha

Based on the calculated peak flows, the adequacy of the existing infrastructure to support the proposed development will be discussed.

3.4 Methodology: Water Usage

The proposed watermain system will be designed in accordance with the following guidelines and standards:

- Region of Durham's Design Specifications, dated April 2014;
- The MOECP Design Guidelines for Drinking-Water Systems, dated 2008; and,
- Fire Underwriters Survey (FUS), Water Supply for Public Fire Protection, dated 1999.

The system design pressure and demand requirements for the subject development are summarized in **Table 3.2** below.

Table 3.2 Water Supply Design Criteria

Design Criteria	Requirement
Domestic Demand	Average daily demand of 364 litres / capita / day
Residential Population Density	3.5 persons per unit (ppu) for single family and semi-detached; 3.0 persons per unit (ppu) for townhouses; 2.5 ppu for 2 bedroom apartment units; and, 1.5 ppu for 1 bedroom apartment units.
Peaking Factor	Maximum Day = 2.75 and Peak Hour = 4.13 for population less than 1,000 for the subject development (MOECP, 2008)
Fire Flow	Calculated as per Water Supply for Public Fire Protection (FUS, 1999)
System Pressure	Minimum Pressure = 275kPa (40 psi) under normal operating condition; Minimum Pressure = 140kPa (20 psi) during Maximum Day + Fire Flow; and, Maximum Pressure = 700kPa (100 psi) under any flow scenario.
Pipeline Sizing	Minimum size of 150 mm ø in residential areas; 300 mm ø in commercial, industrial and institutional areas.
"C" Factor	C=100 for 150 mm ø watermain; C=110 for 200 to 300 mm ø watermain; and, C=120 for 350 to 600 mm ø watermain.

Fire suppression flow calculations were undertaken in accordance with Region Fire Suppression Standards. This requirement will be compared to the existing conditions to determine the adequacy of the water infrastructure to support the proposed development.

4 Stormwater Management and Drainage

4.1 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 Township's IDF data to be used for analysis;
- Water Balance: Post-development to Pre-development water balance; and,
- Phosphorus Removal: Minimum 80% Post-development phosphorus removal (LSRCA) and 90% or cash-in-lieu (Uxbridge Urban Area Stormwater Managemnet Plan) for post-development.

4.2 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 4.1**.

Table 4.1 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 4.2** 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 4.2 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	366.6
EXT 1	Uncontrolled area from Coral Subdivision	Discharge into naturalized drainage feature	57.4	80	149.9
Pond	Controlled Flows from Coral Creek Homes Pond		70	160	860
Total Flow			**268.3**	**436.3**	**1376.5**

4.3 Proposed Storm Drainage System

The proposed site will consist of 64 townhouse units and private driveways and multiple laneways. 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 western boundary of the site. Drainage Area A2 Post will also discharge at uncontrolled rate into the ditch parallel to Brock Street S 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 the ditch along Brock Street East. 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 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 4.3**Table 4.3** on the following page.

Table 4.3 Post-Development Drainage Parameters

Catchment	Drainage Area (ha)	Discharge Location	Runoff Coefficient ('C')	Tc (min)
A1 Post	0.38	Uncontrolled to naturalized drainage feature along west boundary	0.25	10
A2 Post	0.13	Uncontrolled to ditch along Brock St S.	0.61	10
A3 Post	2.10	Controlled discharge to ditch along Brock St S.	0.7	10

4.4 Stormwater Management Controls

4.4.1 Quantity Controls

The post-development release rates to the ditch located along Brock Street East will be controlled to pre-development conditions as outlined in **Section 4.4.2**. 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 4.4** below. The detailed post-development quantity control calculations are provided in **Appendix B**.

Table 4.4 Post Development Peak Flows

<table>
<tr><th>Storm Event</th><th>Target Release Rate (L/s)</th><th>Uncontrolled Release Rate (L/s)</th><th>Controlled Release Rate (m³)</th><th>Total Required Storage Volume (m³)</th><th>Provided Storage Volume (m³)</th><th>Total Site Release Rate (m³)</th></tr>
<tr><td>2- Year</td><td>140.9</td><td>37.0</td><td>101.9</td><td>132.4</td><td rowspan="3">496.56</td><td>138.9</td></tr>
<tr><td>5- Year</td><td>196.4</td><td>51.6</td><td>112.7</td><td>214</td><td>164.3</td></tr>
<tr><td>100-Year</td><td>366.6</td><td>96.7</td><td>140.1</td><td>488.1</td><td>496.56</td></tr>
</table>

A 225mm ø orifice plate is proposed to be installed on the downstream invert of CBMH3 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 manholes which will provide a total available storage volume of 496.56m^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 stromwater 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**.

4.4.2 Stormwater Quality Control

Stormwater treatment must meet Enhanced (Level 1) Protection as defined by the Ministry of Environment, Convseravations 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 4.5** below and sizing results are provided in **Appendix B**.

Table 4.5 Additional Onsite Treatment Units

Drainage Area (ha)	Percent Impervious	Model	Effective TSS Removal
2.1	64.1%	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.

4.4.3 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 July 2018 and it was found the annual pre-development infiltration volume is 6,994m^3. The initial abstraction from pervious areas was found to be 2864m^3, resulting in a required infiltration volume of 4130m^3 under post-development conditions. Refer to the WSP report for detailed information found within **Appendix B**. In order to meet this requirement, a 2m wide infiltration trench in proposed along the full length of the rear yards of Blocks 5-8 which will provide an annual infiltrated volume of 1988m^3. 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. 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 2.0m below the proposed infiltration trench.

In addition, small soakaway pits are proposed within the meanders along the proposed headwater drainage feature located along the west of the site. The proposed pits are to be filled with clear stone and have a total combined area of 60m^2. The proposed soakaway pits are to receive clean water from the downstream pond and surrounding uncontrolled vegetative area therefore only clean water to be infiltrated. The proposed pits will provide additional annual infiltration of 2,980m^3 resulting in a total annual infiltration of 4969m^3 therefore exceeding the minimum infiltration volume of 4,130m^3. Water balance assessment calculations are provided in **Appendix B**.

4.4.4 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 3.04kg/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 80% to 0.64 kg/year in post-development conditions.

Maximum efforts have been made and due to stormwater management constraints on-site, a 90% removal cannot be achieved. As such, the owner will provide cash-in-lieu for the phosphorous removal deficiency at the then current rate.

4.4.5 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.

5 Sanitary Drainage System

5.1 Existing System

According to the plan and profile drawings from the Town and the Region, there is an existing 200 mm ø sanitary sewer on Nelkydd Lane, located west of the subject site. The existing two (2) dwellings on the site currently make use of septic systems and are not connected to the Town's sanitary network.

5.2 Existing Sanitary Flows

According to the reviewed information, the current land is occupied by two (2) residential dwellings. Both dwellings rely on septic systems and therefore do not contribute sanitary flows to the existing sanitary system.

5.3 Proposed Sanitary Flows

The proposed sanitary discharge flows from the site were calculated based on the proposed site statistics, using the criteria listed in **Section 3.3**. Peaking factors were applied using the Harmon Peaking Factor as per the Region of Durham standards. The number of proposed residential units was considered in the analysis in order to evaluate the adequacy of the existing municipal infrastructure. The design inputs for the site is shown in Table 5.1**Table 5.1** below.

Table 5.1 Equivalent Population Calculations (Residential)

Unit Size	Number of Units	Persons (ppu)	Total Persons
Townhouse Units	64 units	3	192

This development consists of 12 townhouse blocks, with 64 townhouse units. The sanitary discharge flow was calculated using the Region's guidelines as detailed in **Section 3.3, Table 3.1.** Total maximum sanitary flows of 3.68L/s were calculated for the proposed development (Refer to **Sanitary Calculations** in **Appendix C**). According to the Region, there is adequate capacity downstream in the existing sanitary sewers to permit minimum sanitary flows of 3.68L/s from the proposed development. Refer to correspondence in **Appendix C**.

5.3.1 Townhouse Blocks

A 200 mm ø sanitary sewer connection and control manhole shall be provided at the southwest corner of the development which will connect to the existing 200 mm ø sanitary sewer Nelkydd Ln through a proposed 6.0m wide easement located south of the existing stormwater management facility to the west of the site. Internal to the Townhouse block, the sanitary sewer configuration shall have a minimum diameter of 200 mm ø. Individual house service connections shall be 100 mm ø as per the Region of Durham standards. A lift station will be installed at the southwest corner of the property to pump sanitary flows from the development to the control manhole (MH10A), as grading constraints on site do not allow for gravity discharge directly to the control manhole. However, sanitary discharge will gravity flow from the control manhole (MH10A) to the existing 200 mm ø sanitary sewer on Nelkydd Ln. Refer to Preliminary Site Servicing Drawing (**Dwg. SS-01**) in **Appendix E** for the layout of the proposed sanitary sewers.

6 Water Supply System

6.1 Existing Water System

Based on the review of the Region's water supply system, the subject site is located within the pressure Zone 1 of the Uxbridge Water System. The water supply is from two (2) municipal wells (Wells No. 5 and No. 6). The existing Quaker Hill reservoir provides water storage and maintains system pressure for the Zone 1 water system. The reservoir is located at Concession Road 6, south of Bolton Drive. The Top Water Level (TWL) in the existing reservoir is 331m and Low Water Level (LWL) is assumed 328m, approximately 0.65 above the bottom of the reservoir.

According to the reviewed information (Region of Durham Water supply system map), the existing municipal infrastructure does not extend to the proposed development. The closest existing watermain is a 300 mmø on Nelkydd Lane, west of the property.

For the purpose of confirming general supply and water pressure in the vicinity of the site, a hydrant flow tests was performed on-site on July 25, 2018 by COLE.

The results of the test on Nelkydd Ln. indicates that 199L/s (3,150 USGPM) are available at a pressure of 140kPa (20PSI).

6.2 Proposed Water Supply Requirements

The estimated water consumption for the proposed development was calculated based on the occupancy rates shown in **Table 3.1**, based on the City's Design Criteria for Sewers and Watermain revised in November 2009 and the Ontario Building Code. The Water Supply for Public Fire Protection was calculated based on the guidelines provided by the FUS, to demonstrate that the existing flows and pressure are adequate to meet the minimum requirement for fire suppression outlined in the FUS.

The average domestic water consumption rates for the proposed development are anticipated to be approximately 141,300.00L/d (1.64L/s), a maximum daily consumption of 409,770.00 L/d, a minimum hourly demand of 2,310.00L/hr and a peak hourly demand of 25,316.25 L/hr. Detailed calculations are provided in **Appendix D** and summarized in **Table 6.1** below. According to our calculations, a minimum fire suppression flow of approximately 11,000L/min (2,910 USGPM) at a pressure of 140kPa (20PSI) will be required for the proposed site. Refer to the detailed calculations found in **Appendix D**. The results from the hydrant flow test taken within the vicinity of the proposed development on Nelkydd Lane shows an available flow rate of 3,150 USGPM from the system and pressure is in the area of 140kPa (20PSI). Based on the above, there are sufficient flows and pressures within the existing municipal water distribution system to accommodate the proposed development.

Table 6.1 Water Demand

Flow	Townhouse Block
Average Day (L/d)	141,300
Average Day (L/s)	1.64
Max. Day (L/min)	248.56
Peak Hour (L/hr)	25,316.25
Peak Hour (L/s)	7.03

6.3 Proposed Watermain Connections

A total of 64 townhouse units are proposed. Water servicing of the site will be made through the proposed 6.0m wide easement located south of the existing pond to the west. A connection will be made to the existing 300 mm ø on the west side of Nelkydd Lane. The connection shall be in accordance with Region of Durham standards and be monitored through a water meter room equipped with back flow preventers. Internal to the site, the development will be provided with domestic and fire services. Townhouses shall have individual connections for each unit per Region standards. Refer to the Preliminary Site Servicing Plan (**Dwg. SS-01** in **Appendix E**).

7 Site Grading

7.1 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 ø culvert on Brock Street East. Flows are then conveyed to the existing stormwater management facility to the north.

7.2 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 existing 1000 mm ø culvert on Brook Street East. Grading along the south limit of the site, will be governed by existing residential development and will be coordinated to match the existing grades. The East property will require the construction of a retaining wall given that the existing vacant lot is lower than the proposed site. To the west, proposed grades will match grades from the proposed 20.0 m wide headwater drainage feature designed by Geo Morphix.

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.

8 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 225 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 located between Blocks 5-8 which will received clean runoff from the surrounding roof and landscaped areas in addition to small soakaway pits located within the meanders of the naturalize headwater drainage feature. 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.

Sanitary Sewers

A total net design flow of 3.68L/s was calculated for the proposed development. The sanitary servicing of this site shall be provided by the existing 200 mm ø sanitary sewer located in the municipal right of way of Nelkydd Ln. According to the Region, there is adequate capacity in the existing sanitary sewer to permit the proposed development.

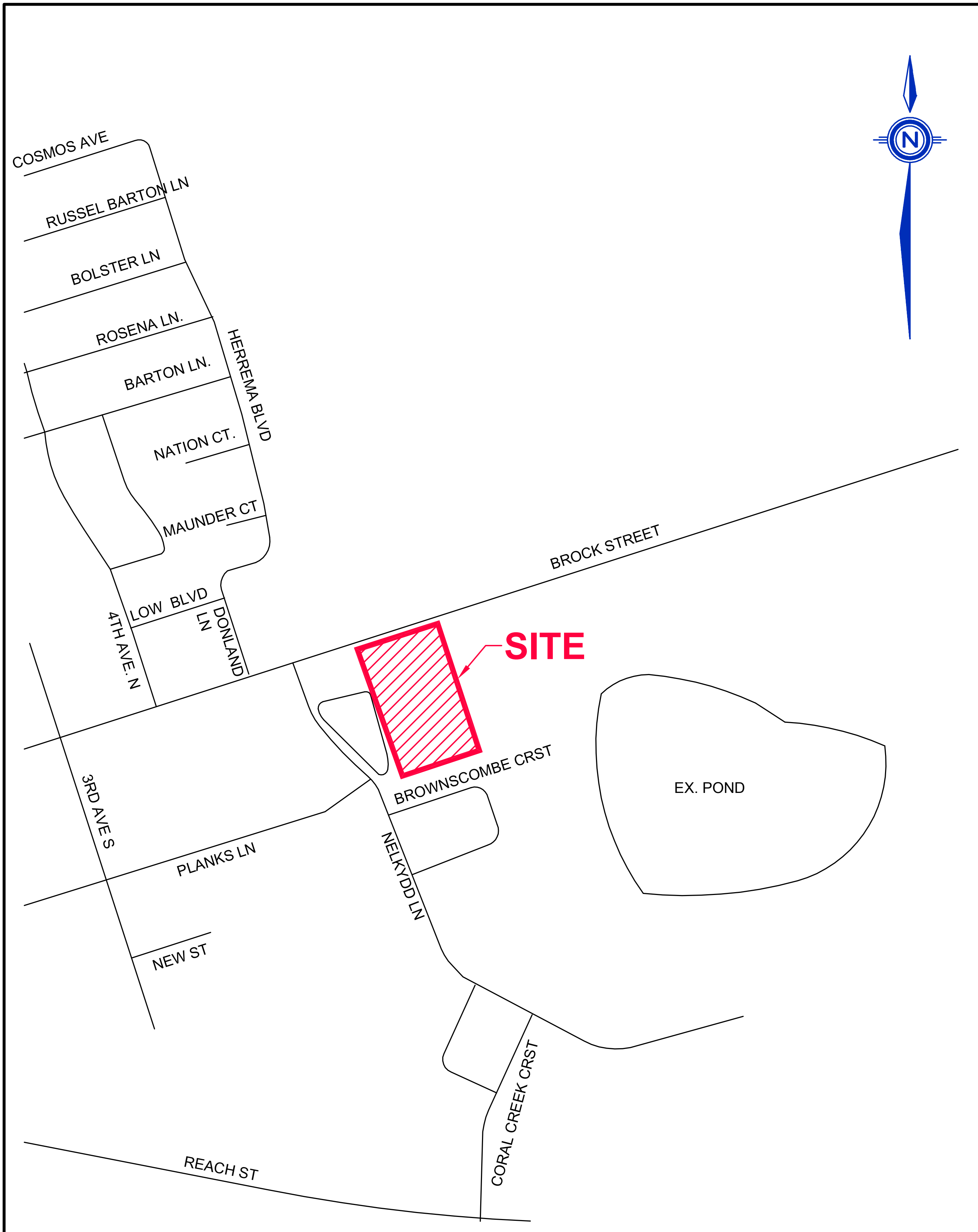
Water Supply

Water supply for the site will be provided by a connection made to the existing 300 mm Ø watermain on Nelkydd Ln. The average domestic water consumption rates anticipated to be drawn from the existing 300 mm Ø watermain are approximately 141,300 L/d (1.64 L/s), a maximum daily consumption of 409,770 L/d, a minimum hourly demand of 2,310 L/hr and a peak hourly demand of 25,316.25 L/hr. The site requires a minimum flow rate of 11,000 L/min (2,910 USGPM) at a pressure of 150 kPa (20 PSI) to account for fire flows. The hydrant results show 3,150 USGPM of water supply available in the watermain system. No improvements are required to the existing municipal watermain system.

According to the Region, the subject property is located within the Zone 1 water supply system for the Township of Uxbridge. The estimated static water pressure for this area is approximately 594 kpa (86 psi). The estimated static water pressure exceeds the maximum allowance of 550 kpa (80 psi). Therefore, private pressure reducing valves will be provided.

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.



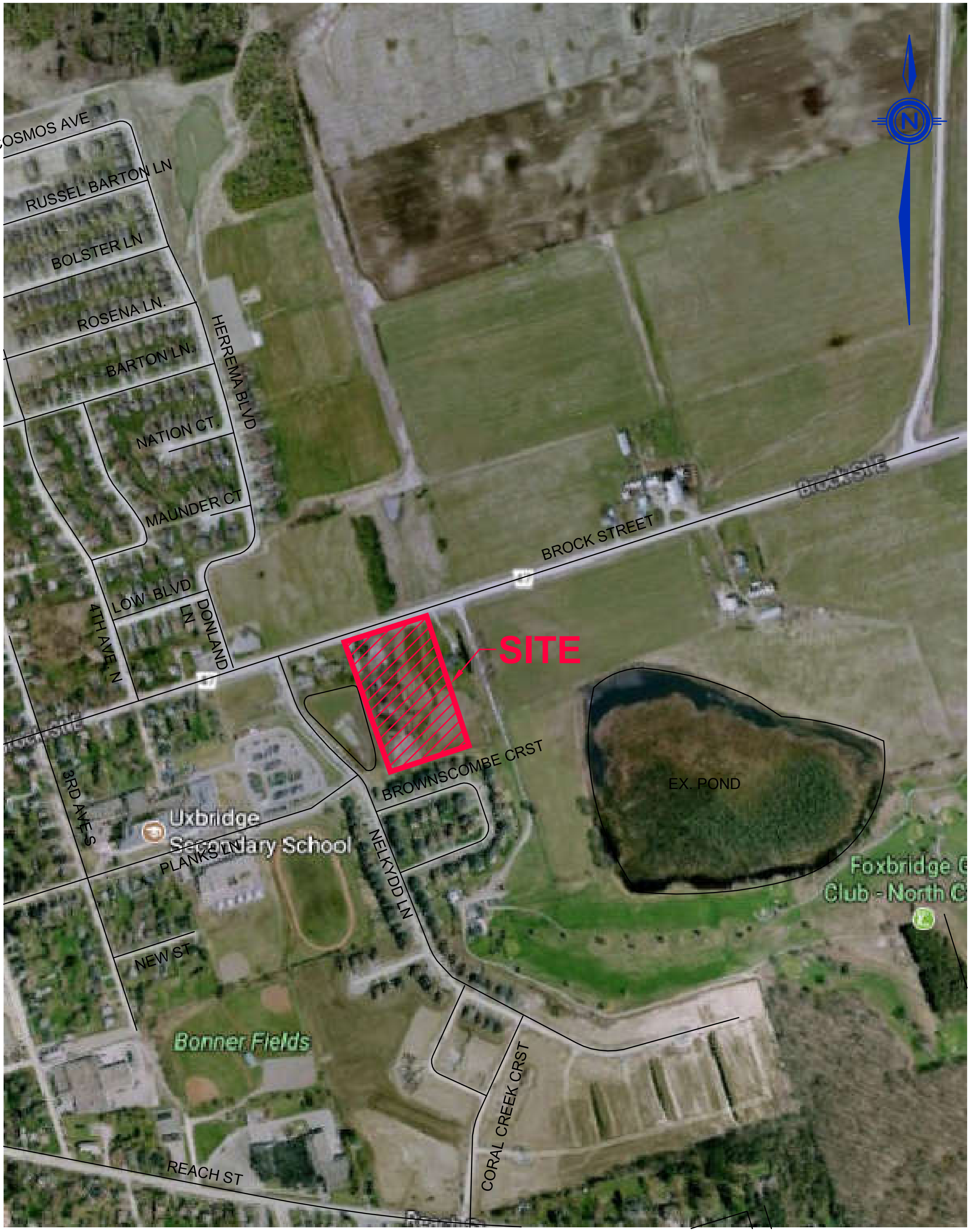
COLE

LOCATION PLAN

EVANDALE DEVELOPMENTS INC.
SOUTH BROCK STREET DEVELOPMENT
UXBRIDGE, ONTARIO

DATE:	AUGUST 2018	PROJECT No.:	2018-0302
SCALE:	N.T.S.	FIGURE No.:	FIG-1

P:\mrk\2018\2018-0302\400_Tchncl\70_Rprts\FSR SWM July 2018\Figures\FSR Fig 1-2.dwg (Location Plan)



P:\mrk\2018\2018-0302\400_Tchncl\70_Rprts\FSR SWM July 2018\Figures\FSR Fig 1-2.dwg (Aerial Plan)

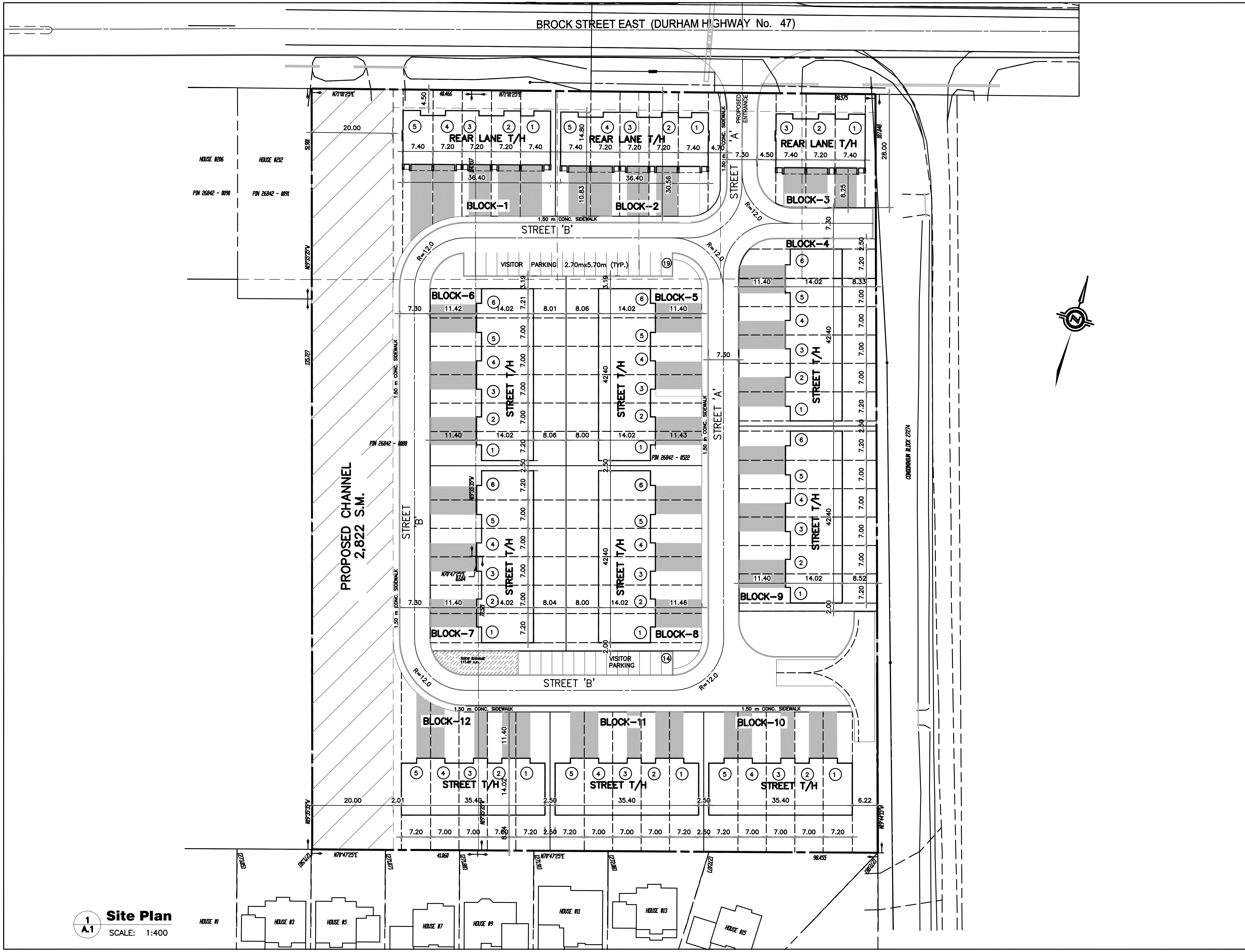
COLE

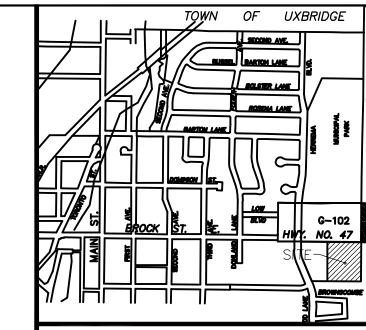
AERIAL PLAN

EVANDALE DEVELOPMENTS INC.
SOUTH BROCK STREET DEVELOPMENT
UXBRIDGE, ONTARIO

DATE:	AUGUST 2018	PROJECT No.:	2018-0302
SCALE:	N.T.S.	FIGURE No.:	FIG-2

APPENDIX A
Background Information





KEY MAP-Uxbridge N.T.S.

SITE STATISTICS:

LOT AREA:	26,091.12 S.M.	6.45Ac	2.61 Ha
PROPOSED CHANNEL:	2,822.00 S.M.	0.70Ac	2.82 Ha
LANDSCAPE AREA:			
BUILDING COVERAGE:			
AMENITY SPACE:	854.0 S.M.		

PAVED AREA:

DRIVEWAYS	3,080 S.M.
ROADWAY	4,190 s.m.
SNOW STORAGE AREA:	

TOWNHOUSES:

13 - 7.2 M (23'-8") REAR LANE TOWNS W/ 2 CAR GARAGE, 2 CAR DRIVEWAY
51 - 7.0 M (23'-0") REAR LANE TOWNS W/ 1 CAR GARAGE, 2 CAR DRIVEWAY
64 - TOTAL UNITS

PARKING:

VISITOR PARKING	32 PROVIDED (50.0%)
MIN. PARKING DIMENSIONS	2.70x5.70 OUTSIDE PARKING

DATE	REVISIONS

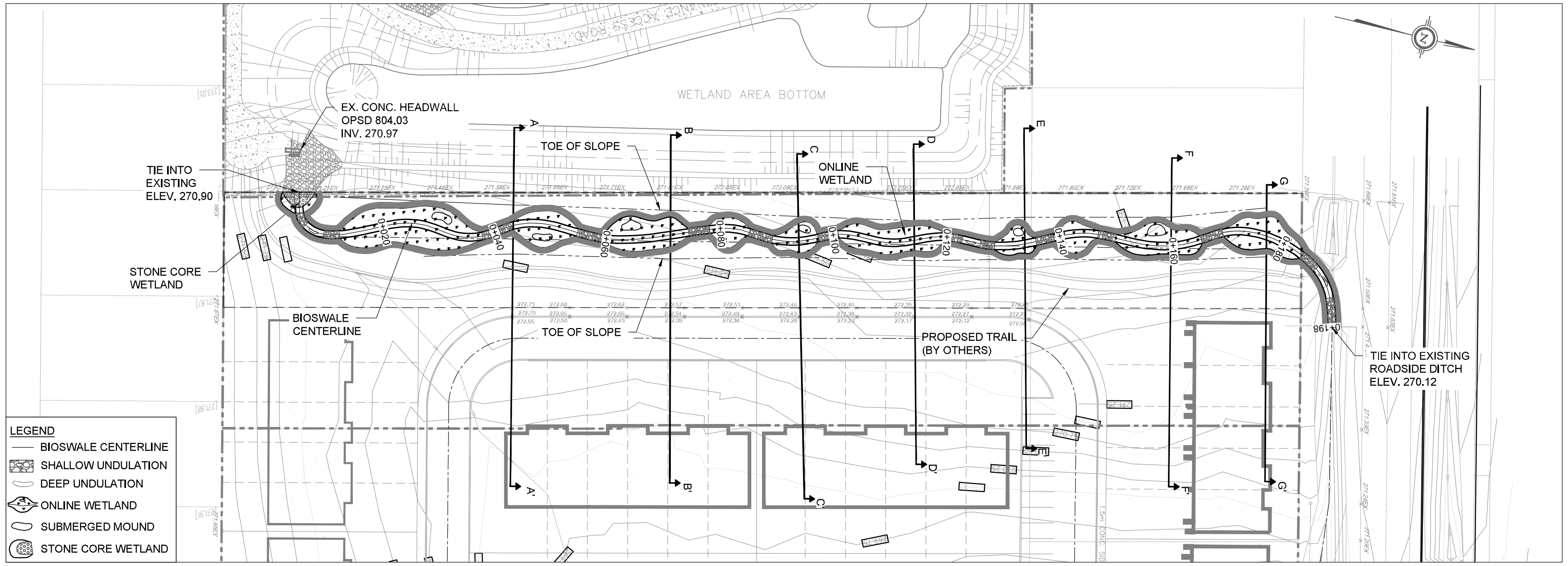
ICR Associates Incorporated
12 Sandbourne Crescent
Toronto Ontario M2J 3A6
Tel.(416) 499-9427
E Mail = icr.des@gmail.com

West Lane Developments Ltd
BROCK STREET DEVELOPMENT
UXBRIDGE, ONTARIO

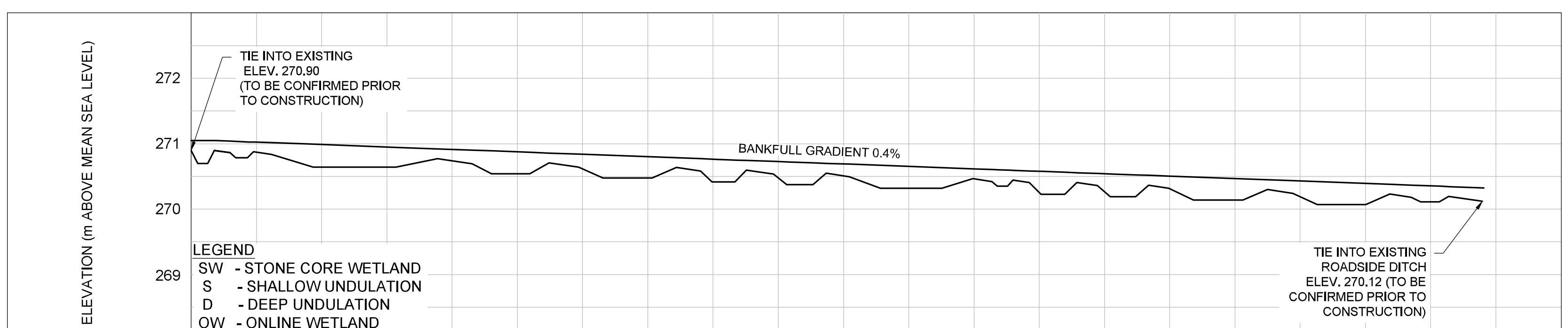
Proposed
226 Brock Street Developmen

DATE	AUG. 2017
SCALE	1:500
DRAWN BY	B.M.
JOB NO	217-000

A.1

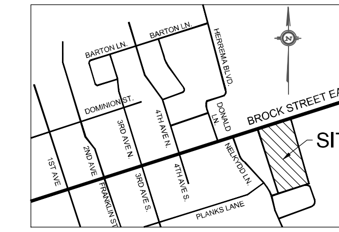


PLANFORM
1:500



PROPOSED LOW FLOW ELEVATION	270.70 270.90 270.86 270.79 270.88 270.84 270.64 270.77 270.69 270.54 270.71 270.64 270.48 270.64 270.58 270.42 270.60 270.53 270.37 270.55 270.50 270.32 270.47 270.42 270.35 270.45 270.41 270.23 270.41 270.36 270.19 270.37 270.32 270.14 270.30 270.24 270.07 270.23 270.18 270.11 270.20 270.12
DISTANCE	0+000 0+020 0+040 0+060 0+080 0+100 0+120 0+140 0+160 0+180 0+200
DETAIL TYPICAL	SW S D S OW S OW S OW S OW S OW S OW S D S OW S OW S OW S OW S D S

PROFILE
H = 1:500; V=1:50



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.

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.
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EROSION AND SEDIMENT CONTROL

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DATE	BY	REVISIONS

DESIGNED BY: P.V.	CHECKED BY: P.V.
DRAWN BY: L.D. / B.M.	DATE: AUGUST 2018

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Milton, Ontario L9T 6P4
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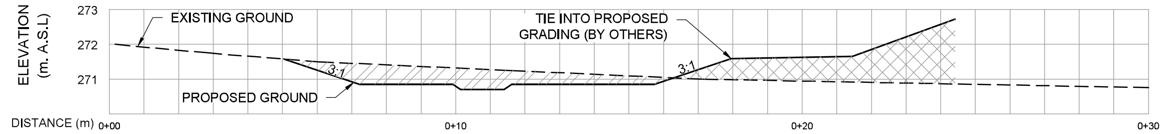
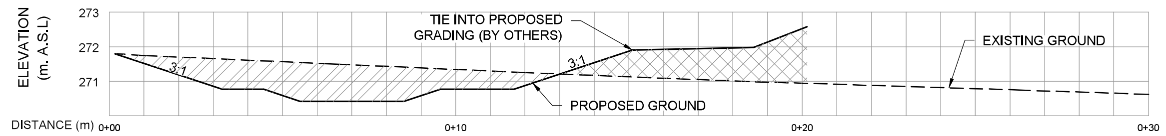
226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
PLANFORM AND PROFILE

PROJECT No.: 18072	DRAWING No.: GEO-1
SCALE: AS NOTED	SHEET 1 OF 3



CROSS SECTION A-A'



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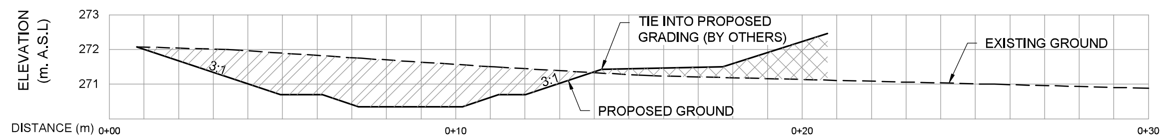

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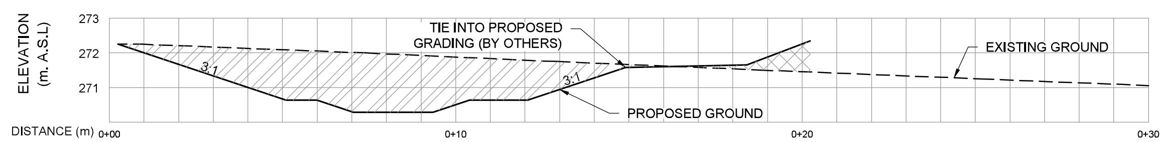

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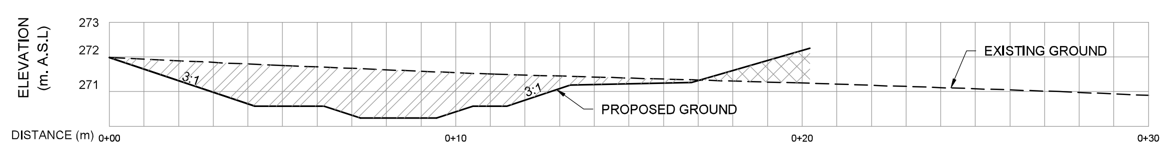

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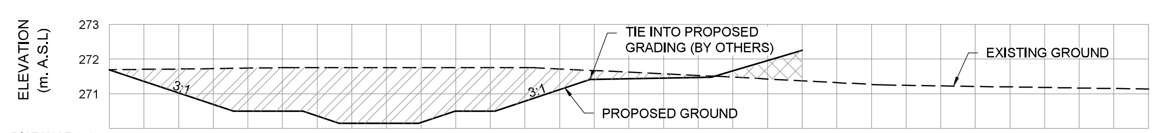

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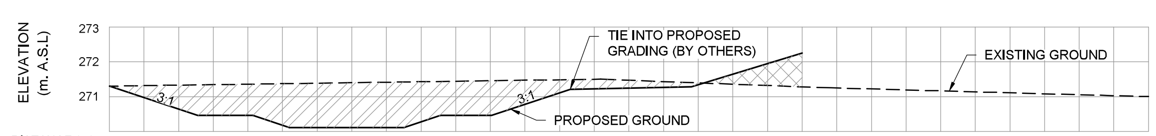

CROSS SECTION G-G'

LEGEND

AREA TO CUT
AREA TO FILL

CROSS SECTIONS
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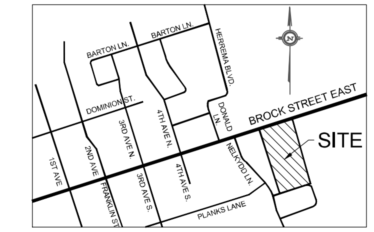

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	DATE	BY	REVISIONS

DESIGNED BY: P.V.	CHECKED BY: P.V.
DRAWN BY: L.D. / B.M.	DATE: AUGUST 2018

2800 High Point Drive, Suite 100a
Milton, Ontario L9T 6P4
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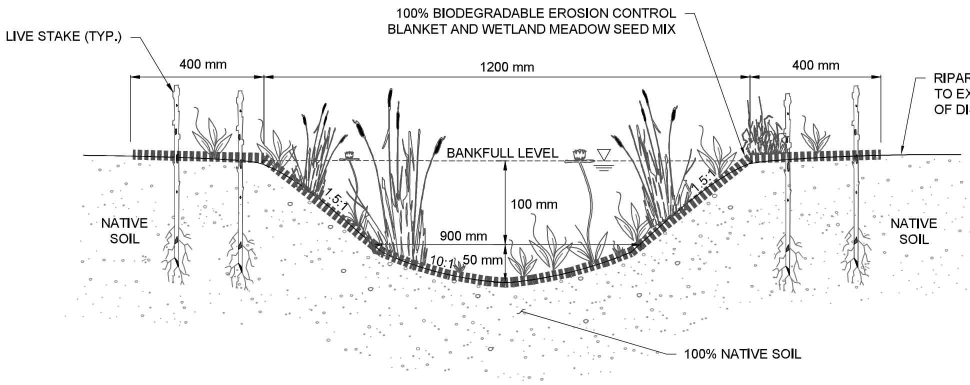
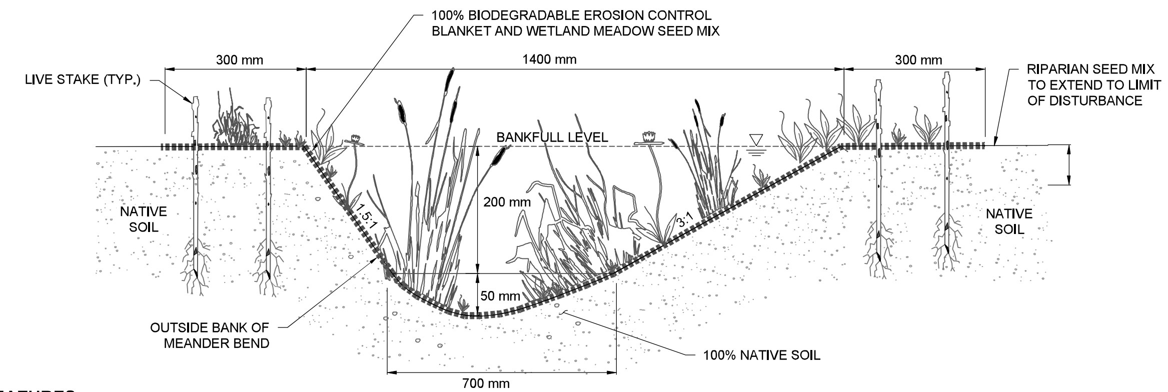
226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
CROSS SECTIONS

PROJECT No.: 18072	DRAWING No.: XS-1
SCALE: AS NOTED	SHEET 2 OF 3

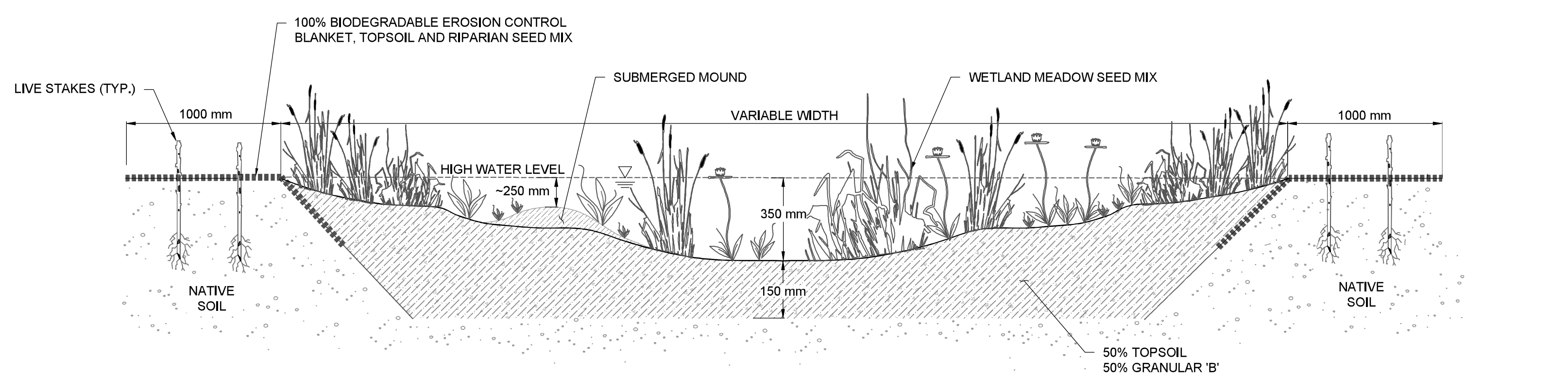


TYPICAL SHALLOW UNDULATION

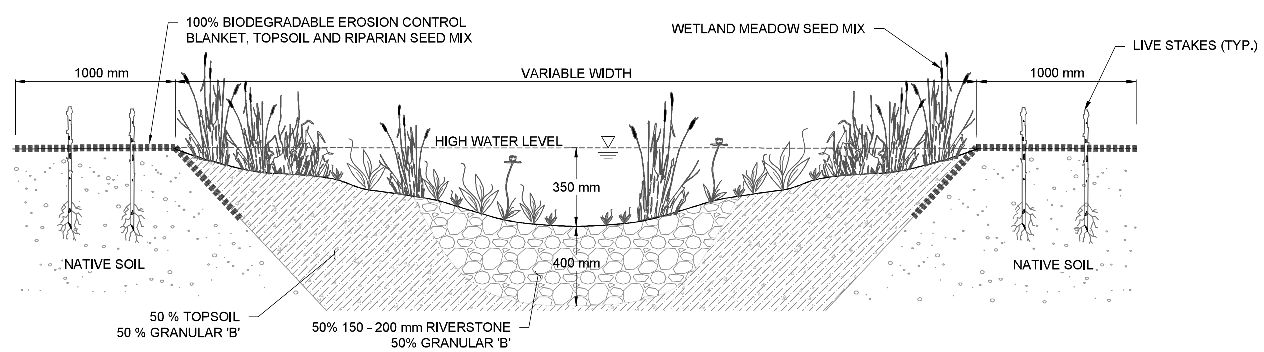


TYPICAL DEEP UNDULATION

BIOSWALE FEATURES
N.T.S.



ONLINE WETLAND
N.T.S.



STONE CORE WETLAND
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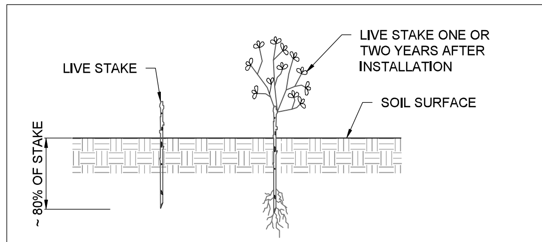


SPECIES AND QUANTITIES

COMMON NAME	SPECIES	QUANTITY	CONDITION
RED OSIER DOGWOOD	*Cornus stolonifera*	425	1 m ht. BARE ROOT
PUSSY WILLOW	*Salix discolor*	425	1 m ht. BARE ROOT
SANDBAR WILLOW	*Salix exigua*	425	1 m ht. BARE ROOT

NOTES
1. QUANTITY TO BE DETERMINED BASED ON AREA OF DISTURBANCE TO BE RESTORED
2. LIVE SHOULD BE FROM AT MINIMUM 2-YEAR OLD STOCK.
3. LIVE STAKES ARE TO BE INSTALLED AT A DENSITY OF 3 STAKES PER SQUARE 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

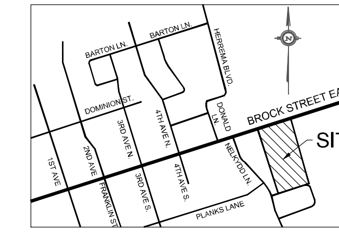
COMMON NAME	SPECIES	% OF MIX
BLUE VERVAIN	*Verbena hastata*	3
BLUNT BROOM SEDGE	*Carex scoparia*	5
FOX SEDGE	*Carex vulpinoidea*	30
GREEN BULRUSH	*Scirpus atrovirens*	10
PURPLE STEMMED ASTER	*Aster puniceus*	5
SPOTTED JOE PYE WEED	*Eupatorium maculatum*	2
SWAMP MILKWEED	*Asclepias incarnate*	10
SWEET 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.



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.

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.
3. FISH MUST BE REMOVED FROM THE WORK AREA ONCE ISOLATED. FISH SALVAGE MUST BE COMPLETED BY A QUALIFIED TECHNICIAN WITH A LICENSE FROM THE ONTARIO MINISTRY OF NATURAL RESOURCES AND FORESTRY.

DATE	BY	REVISIONS

DESIGNED BY: P.V.	CHECKED BY: P.V.
DRAWN BY: L.D. / B.M.	DATE: AUGUST 2018

GEO MORPHIX
Geomorphology Earth Science Observations
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226 BROCK STREET EAST
WESTLANE DEVELOPMENT GROUP LTD.

BIOSWALE DESIGN
RESTORATION DETAILS

PROJECT No.: 18072	DRAWING No.: DET-1
SCALE: AS NOTED	SHEET 3 OF 3

MEMO

TO: David Sud, Westlane Development Group Ltd.

Pouya Haghshenas, P.Eng., Cole Engineering Group Ltd.

FROM: Lloyd Lemon, M.Sc., P.Geo. Senior Project Geoscientist

SUBJECT: **Summary of Infiltration Tests – Westlane Development Group Ltd. 226 Brock Street East, Uxbridge, Ontario**

DATE: **July 26, 2018**

This memorandum summarizes infiltration testing performed at the Westlane Development Group Ltd. property at 226 Brock Street East, Uxbridge, Ontario as outlined in the WSP Canada Inc. (WSP) work plan submitted on May 10, 2018 and approved by David Sud on behalf of Westlane Development Group Ltd.

APPROACH

The infiltration testing program included the following tasks:

1. Coordinate testing with Westlane Development Group Ltd.
2. Stake the proposed test locations in the field. Four (4) locations were proposed as shown in **Figure 1**.
3. Obtain public utility clearances from Ontario OneCall for the Site and coordinate with a private locator to provide clearance of underground utilities beneath each proposed test location.
4. Work with the excavation contractor to open shallow test pits at the proposed locations. The successful test was carried out at a depth of 0.95 m. Test locations were restored to original condition on completion of field tests.
5. Conduct three (3) infiltration test in each shallow excavation using a 4” Pask Permeameter to measure the rate at which water is taken into the soil. A graphical method was then used to estimate the percolation rate or infiltration rate associated with the soils.
6. Prepare a technical memo report to document the methods, test locations, observations, calculated test values and the range of observed infiltration rates. A design infiltration rate is proposed for each facility location, including a factor of safety to ensure that the infiltration rate can be maintained. Information from previous field investigations regarding observed water table conditions and descriptions of soil formations will be incorporated into this memo.

FIELD WORK

The field work for the infiltration testing was carried out on Wednesday July 18, 2018 between 8:15am and 12:30pm. Upon arrival, the WSP technician investigated the feasibility of excavating in the areas of the predetermined test locations. Due to presence of a very shallow water table and saturated soils at the Site, the test locations were adjusted slightly to ensure that test results were meaningful and defensible.

Four (4) test pits were planned and six (6) test pits were excavated by a representative from *Complete Septic Systems.* Within each test pit, the WSP field technician attempted to conduct two (2) infiltration tests at a shallow depth and one (1) test at a deep depth for a total of twelve (12) tests. The purpose of conducting tests at multiple depths is to determine an appropriate safety correction factor that is incorporated into the design infiltration rate as per Appendix C of the Low Impact Development (LID) Stormwater Management Planning and Design Guide. The testing depths were predetermined based on the Preliminary Grading Plan provide by *Cole Engineering Group Limited* and the topographic survey completed by *H.F. Grander and Co. Ltd.*

The excavations below the topsoil at the locations on the north side of the property all resulted in seepage of groundwater at a very shallow depth. Only one infiltration test could be performed at a shallow depth at the location along the southern property boundary.

During testing, records were maintained of the soil profile encountered and the depth to water (if observed). Upon completion of testing, the test pits were back-filled and restored to the original condition.

TEST LOCATIONS AND DEPTHS

Testing locations and depths were based on information contained within the preliminary grading plan provided by *Cole Engineering Group Ltd*. The test locations were selected based on the proposed locations of the infiltration galleries. The test locations are illustrated on **Figure 1.** The testing depths were determined based on existing topography, and proposed grades information contained within the preliminary grading plan. Test depths are summarized in **Table 1.**

OBSERVED CONDITIONS

SOIL

Based on the stratigraphy observed within the test pits, the soils at the Site generally consist of a 200mm to 700mm layer of topsoil underlain by a layer of fine sand or silty sand with some clay that extends to at least 2.20 m bgs (the point of test pit termination). The soil conditions appeared to be consistent across the Site.

The soil conditions observed within the test pits are generally consistent with the stratigraphy observed within the boreholes drilled as part of the concurrent Hydrogeological Assessment and Water Balance Study (WSP, 2018). Based on the deeper soil conditions observed within the boreholes, it is interpreted that the surficial soils observed within the test pits are underlain by a layer of silty clay and/or clay. The lower permeability clay layer was not observed during the shallow test pit excavations and therefore was not tested.

Borehole logs from the concurrent Hydrogeological Investigation are included at the end of this memo.

WATER TABLE

Evidence of a water table was observed during all test pit excavations between 0.70 and 2.55 m bgs during testing. Exact groundwater levels within the test pits were difficult to determine given the amount of soil saturation observed at the time of testing. WSP has based the estimates on observed groundwater seepage levels and in some cases, moisture content and evidence of staining as a result of groundwater. Groundwater levels and approximate elevations within each test pit are summarized below:

- TP18-1: 0.70 m bgs (~268.45 mASL)
- TP18-2: 0.75 m bgs (~269.18 mASL)
- TP18-3: 0.78 m bgs (~270.06 mASL)
- TP18-4: 0.90 m bgs (~271.40 mASL)

Ongoing groundwater level monitoring at the monitoring wells installed as part of the concurrent Hydrogeological Investigation indicates a high water level of 0.18 m bgs in the area of MW18-3. The groundwater level information collected to date is appended at the end of this memo.

INFILTRATION TEST RESULTS

The results of the infiltration testing are summarized in **Table 1**. Only one test was carried out successfully in the shallow excavation at TP18-4. The results are also presented graphically in **Figure 2**.

Figure 2 shows the field saturated hydraulic conductivity estimate and uses relationships published by the “Ministry of Municipal Affairs and Housing – Building Development Branch” to relate the test values to “infiltration rate” (in mm/hour) or “percolation time” (in mins/cm). As can be seen on **Figure 2 –** these concepts are inversely related (a low value in one is high for the other).

The field saturated hydraulic conductivity was observed to be 4.2 x 10^{-5} m/sec. This value is reasonably consistent with the expected range for the observed soils. This test correlates to an infiltration rate of 121 mm/hr.

A safety correction factor is typically incorporated into the LID design to ensure that the sufficient conservatism is incorporated to account for variability in field conditions. The factor of safety is determined based on the ratio of the infiltration rates proposed bottom depth of the LID to the infiltration rate at the slowest horizon within 1.5 m below the proposed bottom depth. Given that a deep test was not completed as a result of saturated conditions, WSP has incorporated a safety correction factor of 3.5 to produce a design infiltration rate. The safety factor, in part, reflects the potential presence of the deeper clay layer which is assumed to have a slower infiltration rate than the soils that were tested. The infiltration rate for design purposes that accounts for the factor of safety for available test data would be 34.5 mm/hour.

CONCLUSION

Testing shows that the on-site generally consist of a 200mm to 700mm layer of topsoil underlain by a layer of fine sand or silty sand with some clay that extends to at least 2.2 m bgs. The soils are considered to be generally consistent across the Site. Evidence of a water table was observed during all test pit excavations between 0.75 and 1.0 m bgs. Ongoing groundwater level monitoring indicates a high water table at 0.18 m bgs in the northern area of the Site.

The tested infiltration rate in the southern area of the Site was 121 mm/hour. This corresponds to a relatively higher than typical value of field saturated hydraulic conductivity. Based on this testing, this area is considered to be capable of supporting a design infiltration rate of 34.5 mm/hour. This design infiltration rate reflects a factor of safety of 3.5 which was assumed based on soil conditions observed during infiltration testing and in the monitoring wells which were installed as part of the concurrent Hydrogeological Investigation (WSP, 2018).

KDH/nah

WSP ref.: 181-06778-00
\\caaur1dat01.gcg.local\vol1\Data\Proj\18\06778-00\1001 Analysis And Reporting\Wp\181-06778-00 226 Brock St Infiltration Test Summary - KDH.docx

ATTACHMENTS

FIGURES

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016. Imagery,Simcoe County, 2016.

wsp

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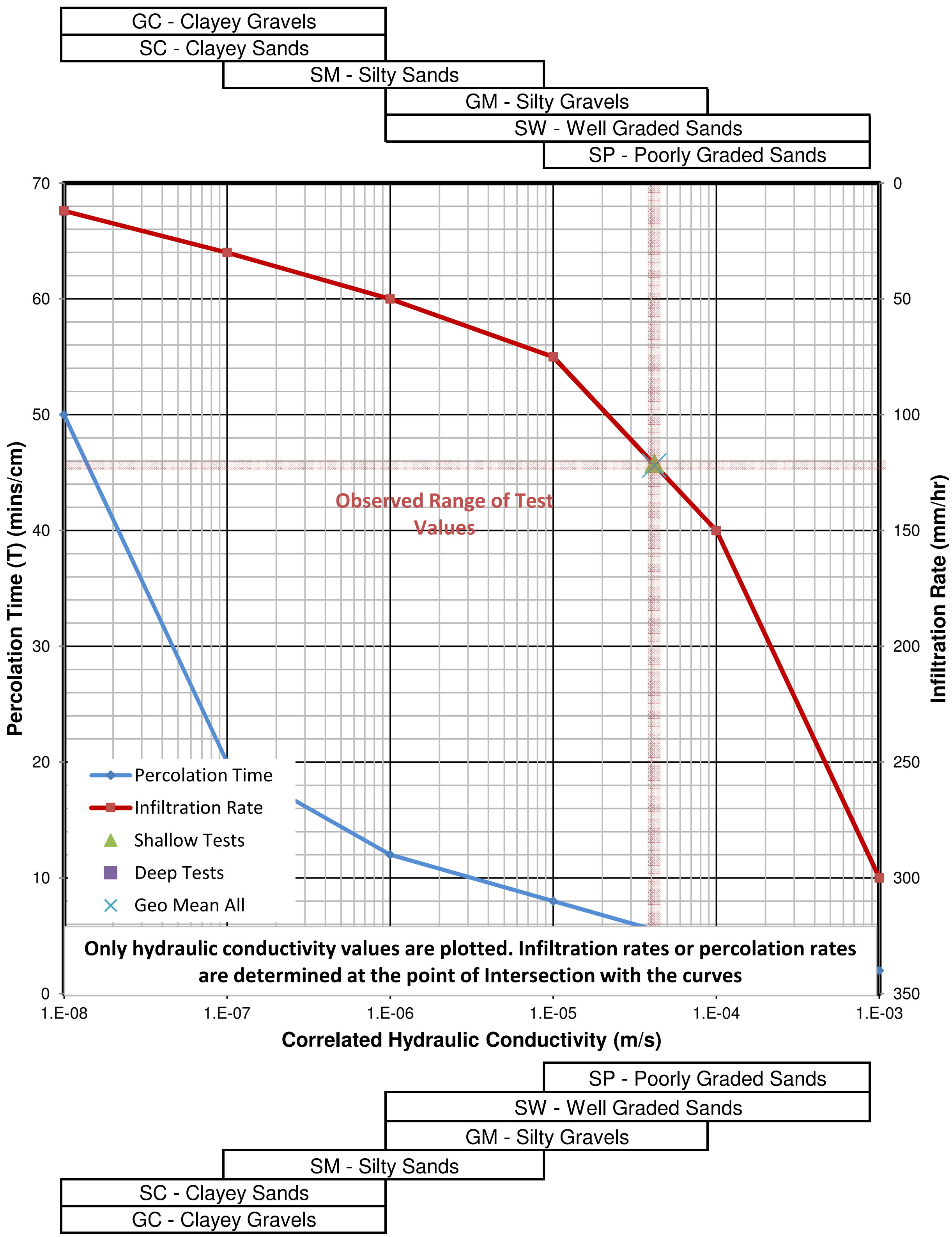
TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

PROJECT: HYDROGEOLOGICAL AND WATER BALANCE ASSESSMENT 226 BROCK STREET EAST UXBRIDGE, ONTARIO	SCALE: 1:1,500
	DRAWN BY: TP / CHECKED BY: -
TITLE: TEST LOCATIONS	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 1 / REV.: -

Figure 2 - Infiltration Test Results - 226 Brock Street East, Uxbridge, ON



Relationships Derived From: "Approximate Relationships of Soil Types to Permeability and Percolation Time - Table 2 - Page SG 6-3 - Supplementary Guidelines to the 1997 Ontario Building Code/Code and Guide for Sewage Systems 1997 - September 20, 2004 Update. Ministry of Municipal Affairs and Housing Building and Development Branch

TABLES

TABLE 1: INFILTRATION TESTS SUMMARY
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Test Number	Test Pit	Soil Type	Depth	Soil Factor	Stable Rate of Fall	Field Saturated Hydraulic Conductivity (K_fs)			Area of Hole		Q								Infiltration Rate	Assumed Afety Correction Factor
					(cm/min)	(mm/day)	(m/s)	(m/day)	(cm^2)	(m^2)	cm^3/min	L/s	m^3/s	m^3/year	$m^3/s/m^2$	m/year	cm/hr	min/cm	mm/hr	
-	TP18-1 (1-A) - Deep	Light Brown fine sand trace clay, wet	2.20 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-1 (1-B) - Shallow	Light Brown fine sand trace clay, wet	0.60 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-1 (1-C) - Shallow	Light brown, silty clay, some sand, moist	0.77 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-2 (1-1) - Shallow	Light grey fine sand, trace silt, some orange stainging, moist	0.75 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-2 (1-2) - Shallow	Grey silty sand, some clay, moist	1.50 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-3 (1-1) - Shallow	Grey silty sand, some clay, moist	1.08 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-3 (1-2) - Shallow	Grey silty sand, some clay, moist	1.08 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	TP18-3 (1-3) - Deep	Grey silty sand, trace to some clay, very moist to wet	2.20 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	TP18-4 (1-1) - Shallow	Light brown, fine to medium sand, moist, loose	0.95 m bgs	44	8.20	3608.00	4.2E-05	3.61	772.71	0.0773	362.26	6.04E-03	6.04E-06	190.41	7.8E-05	2464.1	28.1	2.1	121.0	3.5
-	TP18-4 (1-2) - Deep	Light grey fine sand, some silt, some orange staining, wet to very wet	2.55 m bgs	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
						Maximum (m/s)	**4.2E-05**												**121.0**	
						Minimum (m/s)	**4.2E-05**												**121.0**	
						Geometric Mean [All Tests] (m/s)	**4.2E-05**												**121.0**	

NOTES:

1) Field observations and calculations summary provided in Tables 2-1 through 2-10.
2) "m bgs" = metres below ground surface
3) Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-1: TP18-1 (1-A) INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-1 (1-A) - Deep

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
			Soil:	Light Brown fine sand trace clay, wet
			Excavated Depth (m) :	2.20 m bgs
			Sample Depth:	0.60 m bgs (SS1)
			Auger Hole Depth (m):	-
			Screen Zone (m):	-
			Total Depth (m)	2.20 m bgs
			Additional Remarks:	
			0.00-0.70: Dark brown topsoil, some fines, some roots, very wet	
			0.70-2.2: Light brown, fine sand trace clay, wet (SS2 taken at 0.9 m bgs)	
			Wet and caving conditions observed during test pit excavation.	
			Groundwater seepage observed at 2 m bgs.	
			Surface water flow into the pit.	
			Test abandoned due to surface flow and unsafe conditions.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-2: TP18-1 (1-B) INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-1 (1-B) - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
			Soil:	Light Brown fine sand trace clay, wet
			Excavated Depth (m) :	0.60 m bgs
			Sample Depth (m):	-
			Auger Hole Depth (m):	-
			Screen Zone (m):	-
			Total Depth (m):	0.60 m bgs
			Additional Remarks:	
			0.00-0.20: Dark brown topsoil, some fines, some roots, moist	
			0.20-0.60: Light brown fine sand, trace clay, wet	
			Open and wet conditions observed during test pit excavation.	
			Groundwater seepage observed.	
			Surface water flow into the pit.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-3: TP18-1 (1-C) INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-1 (1-C) - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-
Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-				

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
			Soil:	Light brown, silty clay, some sand, moist
			Excavated Depth (m) :	0.40 m bgs
			Sample Depth (m):	0.40 m bgs (SS2)
			Auger Hole Depth (m):	0.37 m bgs
			Screen Zone (m):	0.77 - 0.56m bgs
			Total Depth (m):	0.77 m bgs
			Additional Remarks:	
			0.00-0.10: Dark brown topsoil, some fines, some roots, moist	
			0.10-0.40: Light brown silty clay, some sand, moist	
			Open and wet conditions observed during test pit excavation.	
			Groundwater seepage observed at 0.7 in auger hole.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-4: TP18-2 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-2 (1-1) - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	**Height of Air Inlet Hole (cm):**	20.8	**Soil Factor:**	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
0	39	16.8	**Soil:**	Light grey fine sand, trace silt, some orange stainging, moist
0.25	34.8	16		
0.5	30.8	12.4		
0.75	27.7	12	**Excavated Depth (m) :**	0.40 m bgs
1	24.7	6	**Sample Depth (m):**	0.70 m bgs (SS1)
1.5	20	9.4	**Auger Hole Depth (m):**	0.35 m bgs
2	Test fail due to auger hole overflow		**Screen Zone (m):**	0.75 - 0.54 m bgs
2.5			**Total Depth (m):**	0.75 m bgs
			Additional Remarks:	
			0-0.40: Dark brown topsoil, some roots, moist	
			0.40-0.75: Light grey fine sand, trace silt, some orange staining, moist	
			Wet and caving conditions observed during test pit excavation.	
			Groundwater seepage at 1 m bgs.	
			Surface flow at auger hole.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-5: TP18-2 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East
Project No.: 181-06778-00
Location of Test: TP18-2 (1-2) - Shallow
Weather: Sunny, 25°C
Start Date: July 18, 2018
Infiltration Test Method: Nova Scotia Permeameter - Constant Head
Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
			Soil:	Light grey sandy silt, trace cobbles, some orange staining
			Excavated Depth (m) :	1.50 m bgs
			Sample Depth (m):	1.10 m bgs (SS2)
			Auger Hole Depth (m):	-
			Screen Zone (m):	-
			Total Depth (m):	1.50 m bgs
			Additional Remarks:	
			0.00-0.40: Dark brown topsoil, some roots, moist	
			0.40-1.00: Light grey fine sand, trace silt, some orange staining, moist,	
			1.00-1.50: Light grey sandy silt, trace cobbles, some orange staining	
			Wet and Caving conditions observed during test pit excavation	
			Groundwater seepage at 1 m bgs.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-6: TP18-3 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-3 - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
0	35	(-)	Soil:	Grey silty sand, some clay, moist
0.5	29	12		
1	Test fail due to auger hole overflow			
			Excavated Depth (m) :	0.78 m bgs
			Sample Depth (m):	0.40 m bgs (SS1)
			Auger Hole Depth (m):	0.30 m bgs
			Screen Zone (m):	1.08 - 0.87 m bgs
			Total Depth (m):	1.08 m bgs
			Additional Remarks:	
			0.00-0.20: Dark brown topsoil, some roots, moist	
			0.20-0.80: Light brown silty sand	
			0.80-1.08: Grey silty sand, some clay, moist	
			Surface flow at auger hole.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	7	7.5	8	8.5	9	9.5	10	10.5
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-7: TP18-3 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-3 (1-2) - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
0	46.6	(-)	Soil:	Grey silty sand, some clay, moist
0.5	44.8	3.6		
1	42.8	4		
1.5	40.9	3.8	Excavated Depth (m) :	0.78 m bgs
2	Test fail due to auger hole overflow		Sample Depth (m):	1.08 m bgs (SS2)
			Auger Hole Depth (m):	0.30 m bgs
			Screen Zone (m):	1.08 - 0.87 m bgs
			Total Depth (m):	1.08 m bgs
			Additional Remarks:	
			0.00-0.20: Dark brown topsoil, some roots, moist	
			0.20-0.80: Light brown silty sand	
			0.80-1.08: Grey silty sand, some clay, moist	
			Surface flow at auger hole.	
			Test abandoned.	
			Auger hole did not drain until penetrated with excavator.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-8: TP18-3 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-3 (1-3) - Deep

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-
Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-				

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
			Soil:	Grey silty sand, trace to some clay, very moist to wet
			Excavated Depth (m) :	2.20 m bgs
			Sample Depth (m):	2.20 m bgs (SS3)
			Auger Hole Depth (m):	-
			Screen Zone (m):	-
			Total Depth (m):	2.20 m bgs
			Additional Remarks:	
			0.00-0.20: Dark brown topsoil, some roots, moist	
			0.20-0.80: Light brown silty sand to sandy silt	
			0.80-2.20: Grey silty sand, trace to some clay, very moist to wet	
			Groundwater seepage observed at 2.1m.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-9: TP18-4 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East

Project No.: 181-06778-00

Location of Test: TP18-4 (1-1) - Shallow

Weather: Sunny, 25°C

Start Date: July 18, 2018

Infiltration Test Method: Nova Scotia Permeameter - Constant Head

Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	44

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	8.20

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
0	44.7	(-)	Soil:	Light brown, fine to medium sand, moist, loose
0.25	42	10.8		
0.5	39	12		
0.75	35.4	14.4	Excavated Depth (m) :	0.65 m bgs
1	32.6	11.2	Sample Depth (m):	0.50 m bgs (SS1)
1.5	28.1	9	Auger Hole Depth (m):	0.30 m bgs
2	22.2	11.8	Screen Zone (m):	0.95 - 0.74 m bgs
2.5	18.1	8.2	Total Depth (m):	0.95 m bgs
3	13.4	9.4	Additional Remarks:	
3.5	9.3	**8.2**	**0.00-0.20:** Dark brown topsoil, some fines, some rootlets, moist	
4	5.2	**8.2**	**0.20-0.90:** Light brown fine to medium sand, moist, loose,	
4.5	1.1	**8.2**		
			Rate of Fall (cm/min):	**8.20**

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = 3608.00

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2-10: TP18-4 INFILTRATION TEST
226 Brock Street East, Uxbridge, ON
Project #: 181-06778-00 100

Project Name: 226 Brock Street East
Project No.: 181-06778-00
Location of Test: TP18-4 (1-2) - Deep
Weather: Sunny, 25°C
Start Date: July 18, 2018
Infiltration Test Method: Nova Scotia Permeameter - Constant Head
Supervised By: KDH, PLM

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	10.5	Height of Air Inlet Hole (cm):	20.8	Soil Factor:	-
Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	-				

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
		(-)	Soil:	Light grey fine sand, some silt, some orange staining, wet to very wet
			Excavated Depth (m) :	2.20 m bgs
			Sample Depth (m):	2.20 m bgs (SS2)
			Auger Hole Depth (m):	0.35 m bgs
			Screen Zone (m):	2.55 - 2.34 m bgs
			Total Depth (m):	2.55 m bgs
			Additional Remarks:	
			0.00-0.20: Dark brown topsoil, some fines, roots, moist	
			0.20-0.90: Light brown fine to medium sand, moist, loose,	
			0.90-2.20: Light grey fine sand, some silt, some orange staining, wet to very wet	
			Groundwater seepage observed at 2.55 m.	
			Test pit observed to be wet and caving.	
			Test abandoned.	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*
K_fs (mm/day) = -

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 3
OBSERVED GROUNDWATER LEVELS
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
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
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

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.

BOREHOLE LOGS

WSP

BOREHOLE NO. MW18-1

PROJECT NAME: 226 BROCK STREET

PROJECT NO.: 181-06778-00

CLIENT: OXFORD HOMES

DATE COMPLETED: May 16, 2018

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER

SUPERVISOR: JSW

GROUND ELEVATION: NOT DETERMINED

REVIEWER: LAL

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0		**TOPSOIL:** Dark brown, trace sand, some rootlets, moist.						**UTM CO-ORDINATES** UTM Zone: NAD: Easting: Northing:
0.2		**SAND:** Orangey brown, moist.	SS1	4		50		
0.8		**SILTY SAND:** Brown, silty sand, very wet to saturated, loose.	SS2	6		58		
		- Brown to orangy brown	SS3	12		46		
2.3		**SILT:** Brown to orangy brown, some sand, saturated.	SS4	13		63		
3.0		**SANDY SILT:** Brown, trace clay, saturated.						
3.3		**SILTY CLAY:** Silty clay, trace sand, wet to very wet.	SS5	13		75		
			SS6	8				
4.6		Borehole terminated at 4.6 m in **SILTY CLAY**						

Column headings: STRATIGRAPHY; MONITOR DETAILS; CONE PENETRATION "N" VALUE 10 20 30, SHEAR STRENGTH; WATER CONTENT % 10 20 30, W_P W_L.

WSP GEOLOGIC (METRIC) WITH MASL 181-06778-00 LOGS.GPJ WSP_ENV_V1.GDT 6/20/18

BOREHOLE NO. MW18-2

PROJECT NAME: 226 BROCK STREET
PROJECT NO.: 181-06778-00
CLIENT: OXFORD HOMES
DATE COMPLETED: May 17, 2018
BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER
SUPERVISOR: JSW
GROUND ELEVATION: NOT DETERMINED
REVIEWER: LAL

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0		**TOPSOIL:** Dark brown, some silt, some rootlets, very moist.						
0.1		**SILTY SAND:** Light brown, orange mottling, very moist.	SS1	13		88		
0.8		**SAND:** Light brown to orange mottling, wet, very wet in last 5.1 cm.	SS2	15		60		
		- Very wet to saturated	SS3	19		88		
2.3		**CLAY:** Light grey, trace cobble, moist to wet.	SS4	13		69		
3.0		Borehole terminated at 3.0 m in **CLAY**.						

CONE PENETRATION: "N" VALUE 10 20 30; SHEAR STRENGTH

WATER CONTENT %: 10 20 30; W_P W_L

UTM CO-ORDINATES
UTM Zone: NAD:
Easting:
Northing:

BOREHOLE NO. MW18-3

PROJECT NAME: 226 BROCK STREET
PROJECT NO.: 181-06778-00
CLIENT: OXFORD HOMES
DATE COMPLETED: May 16, 2018
BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER
SUPERVISOR: JSW
GROUND ELEVATION: NOT DETERMINED
REVIEWER: LAL

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0		**SILTY TOPSOIL:** Dark brown, some rootlets, trace orange mottling, wet.	SS1	2		79		
0.8		**SANDY SILT TO SILTY SAND:** light brown, fine. - Light brown to grey, trace clay, orange stains throughout, very wet.	SS2	7		79		
1.5		**SILTY CLAY:** Grey, trace sand, orange staining, wet to saturated.	SS3	4		79		
2.2		**SILTY SAND TO SAND:** GREY TO greyish brown, trace clay, saturated.						
2.5		**CLAY:** Grey, some silt, trace sand, saturated.	SS4	14		83		
		- Interbedded with seams of sand, saturated.	SS5	8				
3.8		Borehole terminated at 3.8 m in **CLAY**						

STRATIGRAPHY | MONITOR DETAILS | CONE PENETRATION "N" VALUE 10 20 30 / SHEAR STRENGTH | WATER CONTENT % 10 20 30 W_P W_L

UTM CO-ORDINATES
UTM Zone: NAD:
Easting:
Northing:

WSP GEOLOGIC (METRIC) WITH MASL 181-06778-00 LOGS.GPJ WSP_ENV_V1.GDT 6/20/18

WESTLANE DEVELOPMENT GROUP LTD.

HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY

226 BROCK STREET EAST, UXBRIDGE, ONTARIO

AUGUST 10, 2018

HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY

226 BROCK STREET EAST, UXBRIDGE, ONTARIO

WESTLANE DEVELOPMENT GROUP LTD.

PROJECT NO.: 181-06778-00 100
DATE: AUGUST 10, 2018

WSP
UNIT 2
126 DON HILLOCK DRIVE
AURORA, ON, CANADA L4G 0G9

T: +1 905 750-3080
F: +1 905 727-0463
WSP.COM

August 10, 2018

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

Attention: David Sud

Dear David,

Subject: Hydrogeological Assessment and Water Balance Study
226 Brock Street East, Uxbridge, Ontario

WSP Canada Inc. (WSP) is pleased to submit the attached report to document the Hydrogeological Assessment and Water Balance Study prepared for a proposed subdivision development at 226 Brock Street East, Uxbridge, Ontario.

The report provides an assessment of the existing hydrogeological conditions beneath the Site as well as water budgets for existing and future conditions to illustrate the likely changes in water balance that would be expected due to the proposed development. This report has been prepared to reflect planned low impact development measures as described in concurrent work and reporting prepared by Cole Engineering Group Limited.

Thank you for the opportunity to carry out this study on your behalf. We trust that this information is sufficient for your current needs. If you have any questions or require further information, please contact us.

Yours truly,

Lloyd Lemon, M.Sc., P.Geo.
Senior Project Geoscientist

JSW/LAL/nah

WSP ref.: 181-06778-00 100
H:\Data\Proj\18\06778-00\1001 Analysis And Reporting\Tech\Report\JSW - Hydrogeological Study and Water Balance Assessment - Final_DLW.docx

UNIT 2
126 DON HILLOCK DRIVE
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T: +1 905 750-3080
F: +1 905 727-0463
wsp.com

EXECUTIVE SUMMARY

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). A draft of this report was provided to Cole Engineering Group Limited for use in designing infiltration measures as part of the Stormwater Management Plan.

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.

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 west side of the property, pending approval of the LSRCA.

Based on the stratigraphy observed during the borehole drilling at the Site and well records from Ministry of the Environment, Conservation and Parks (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.

Groundwater elevations measured in June 2018 support the observation that groundwater is relatively shallow beneath the Site and that 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.

Representative groundwater samples were collected from the three (3) monitoring wells on June 21, 2018. 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).

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/yr to 341.1 mm/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.

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.

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.

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. Under the proposed development conditions there are seven (7) on-site catchments. Runoff within the developed portion of the site is primarily captured by stormwater drainage systems.

The Stormwater Management Plan prepared by *Cole* incorporates Low Impact Development features in the form of an infiltration trench and soakaway pits to infiltrate runoff that is generated at the Site. The effect of these features is considered in the Post-Development Water Budget.

The Post-Development Water Budget predicts a net on-site infiltration of 7,831 m^3/yr. Approximately 4,968 m^3/yr (71% of pre-development) of this infiltration is generated through the proposed LID measures. At this time, no additional mitigation measures are required as the introduction of LID features enhances the infiltration rate relative to pre-development conditions.

The Post-Development Water Budget predicts a net runoff of 7,524 m^3/yr over the Site area. This is an increase of 5,636 m^3/yr (398%) relative to Pre-Development.

The Site lies within an area designated as WHPA-Q, where policies in the Lakes Simcoe and Couchiching Source Protection Plan require recharge to be maintained or enhanced. The water balance assessment demonstrates that the proposed mitigation enhance recharge from pre-development levels.

The Site lies within Intake Protection Zone 3 (IPZ-3) for water supplies that draw from Lake Simcoe. The proposed residential activities at the Site are not considered to present an increased risk to water quality for these water supplies.

The Site is mapped as a Highly Vulnerable Aquifer in the Assessment Report for the Lakes Simcoe and Couchiching Source Protection Area. The proposed land use as residential is expected to have minimal potential to affect underlying groundwater resources.

The majority of the Site is mapped as an SGRA. The water balance assessment demonstrates that the proposed mitigation enhance recharge from pre-development levels.

SIGNATURES

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APPENDICES

1 INTRODUCTION

WSP Canada Inc. (WSP) was retained by Westlane Development Group Ltd. to prepare a Hydrogeological Assessment and Water Balance Study for the proposed subdivision development located at 226 Brock Street East, Uxbridge, Ontario, herein referred to as the Site. The location of the Site is shown on **Figure 1**.

The Site is located approximately south of Brock Street E and approximately 100 meters east of Nelkydd Lane in Uxbridge, Ontario. The Site is approximately 2.61 hectares in size, rectangular in shape, and is currently occupied by agricultural fields, uncultivated areas, two (2) residential dwellings (now vacant), gravel roads and lawns. The existing conditions at the Site are shown in **Figure 2** and the development plans provided to WSP are presented in **Figure 3**. Under post-development conditions, the Site is proposed to include 64 residential lots.

This report documents the work performed to provide an understanding of the hydrogeological conditions at the Site, to prepare a water balance analysis, and to provide preliminary recommendations for Site design and construction.

1.1 OBJECTIVES AND SCOPE

The need for a Hydrogeological Assessment and Water Balance Study was identified to help support the development application process and to quantify changes in Site runoff, infiltration and evapotranspiration between the pre- and post-development conditions for the development plan.

The Hydrogeological Assessment and Water Balance Study has been designed to:

- Review historical information and integrate findings.
- Identify the inventory of groundwater users within 500 m of the property.
- Confirm groundwater flow directions and patterns.
- Confirm and identify potential watershed divides, if any, which control groundwater flow.
- Characterize the water quality of the shallow groundwater.
- Characterize the relationships between on-site groundwater flow systems and adjacent surface water bodies.
- Create an annual water budget for the existing conditions at the property for use as a baseline.
- Determine a future annual water budget for the proposed development scenario.
- Identify significant changes to the water balance or to the form and function of the groundwater or surface water systems that might result from future plans and provide recommendations for mitigative measures to address these changes.
- Prepare a project report.

1.2 ANALYSIS AND DOCUMENTATION

The following published information and mapping was reviewed and considered in our analysis of the Site:

- Hydrogeological Assessments - Conservation Authority Guidelines to Support Development Applications, April 2013.
- Assessment Report, South Georgian Bay Lake Simcoe Source Protection Region, Part 1 (Lake Simcoe, May 2015 update). Approved Lakes Simcoe and Couchiching Source Protection Plan.
- Ministry of Environment, Conservation and Parks Water Well Information System (MECP WWIS);
- Other sources of information as listed in Section 8.0.

2 REGIONAL SETTING

2.1 PHYSIOGRAPHY

The regional physiography for the Site area is shown in **Figure 4**. The proposed development area lies within the Peterborough Drumlin Field physiographic region as defined by Chapman and Putnam (1984). The Peterborough Drumlin Field consists of a rolling till plain. The landforms in the area within and surrounding the Site consist of clay plains.

2.2 DRAINAGE

Regional topography is illustrated on **Figure 5**. The topography of the Site generally slopes gently toward the centre of the property at an approximate elevation of 280 metres above sea level (m asl).

The Site is located approximately 3.5 km northwest of the divide between the Lake Simcoe Watershed (draining to North) and the Kawartha-Haliburton Watershed (draining locally to northeast) and approximately 9 km north of the Duffins Creek Watershed (draining to South).

The Site currently contains a headwater drainage feature that drains northerly across the site and discharges to a culvert beneath Brock Street. The headwater drainage feature is within the area regulated by the LSRCA under O.Reg. 179/06. The development proposal includes a plan to incorporate the form and function of this headwater drainage feature in a bioswale to be constructed along the west side of the property, pending approval of the LSRCA.

2.3 REGIONAL GEOLOGY

The near surface soils are the top unit in a layered sequence of glacial and interglacial sediments that comprise the stratigraphic profile overlying bedrock beneath the Lake Simcoe region. The distribution of surficial soil types in and around the Site are shown on **Figure 6**. The surficial soils at the Site are predominantly characterized by sand deposits with some silt deposits in the north of the property. The deposits and stratigraphy for the regional area are described in a series of papers and posters prepared by the Geological Survey of Canada under the direction of Dr. David Sharpe.

The stratigraphic profile beneath Oak Ridges Moraine area typically includes the following layers, from youngest to oldest:

1) Recent deposits.
2) Oak Ridges Moraine (ORM) Sediments
3) Newmarket Till.
4) Thorncliffe Formation.
5) Sunnybrook Drift.
6) Scarborough Formation.
7) Don Formation.
8) York Till.
9) Bedrock.

The Site area is not located within the ORM and some of these deposits may not all be observed at this location. The Site is close to the ORM (approximately 1 km), and is expected to present a similar stratigraphic profile.

The ORM sediments are a complex package of granular sediments deposited in the meltwater at the later stages of the last glacial period, which serve as the topographic and groundwater divide between Lake Simcoe and Lake Ontario. These deposits generally become finer, and typically become thinner and eventually pinch out away from the original outlets of meltwater. Certain areas with the ORM sediments may be overlain by a thin layer of Halton Till.

The Newmarket Till represents a regionally extensive stratum that is associated with the most recent period of glaciation. This till is typically dense to very hard and sandy to silty in texture with relatively low gravel content.

The stratigraphic layers between the Newmarket Till and the underlying bedrock are commonly grouped as the Lower Sediments. The Lower Sediments are considered to have been formed by similar cycles of earlier glacial advances and retreats and associated meltwater events that resulted in the deposition of the Newmarket Till and Oak Ridges Moraine sediments. Five (5) stratigraphic layers that constitute the Lower Sediments are described below, although not all are interpreted to occur below the study area.

- The Thorncliffe Formation is a complex of stratified glaciofluvial and glaciolacustrine deposits. The texture of the Thorncliffe Formation is highly variable and is best described as fine-grained, with interbedded coarse-grained material capable of yielding notable amounts of water.
- The Sunnybrook Drift is a fine-grained material deposited in glacial and proglacial lacustrine depositional environments (diamicton). The advance of the ice sheet blocked the main drainage from the regional basin, which caused water levels to rise and form a deep lacustrine environment with deposits including varved clays.
- The Scarborough Formation is a coarsening upward sequence of sediment that ranges from clay/silt rythmites (fine-grained) to channelized cross-bedded sands (coarse-grained). The coarser fractions of this delta are a potential source of groundwater.
- The Don Formation is only rarely preserved within southern Ontario and consists of alternating beds of fossiliferous sand and mud.
- The York Till was deposited immediately overlying the bedrock by the preceding Illinoian glaciation. This till occurs only sporadically within the study area and is believed to be preserved in lows upon the bedrock surface. The till is dark grey with a sandy silt matrix and includes clusters of the underlying shale.

The bedrock in the study area is mapped as shale/limestone/dolostone/siltstone of the Blue Mountain Formation (Ontario Geological Survey, 2011) as illustrated on **Figure 7**. The depth to bedrock is estimated to be between 80 to 90 metres below ground surface, based on bedrock topography mapping and topographic mapping of the ground surface (Gao, et. al., 2006). A map of overburden thickness is provided in **Figure 8**. The thickness of overburden is typically greatest along the crest of the Oak Ridges Moraine or in areas where there are topographic lows in the underlying bedrock surface.

2.4 REGIONAL HYDROGEOLOGY

The movement of groundwater through the subsurface is controlled by the hydraulic gradients and the relative distribution of coarse and fine-grained sediments. In general, water will move laterally through coarse-grained sediments (sands and gravels) and vertically through fine-grained sediments (silts and clays). As such, the geologic units are typically grouped into hydrostratigraphic units that reflect the capacity of the geologic units to transmit water. Hydrostratigraphic units are considered to be either aquifers (with good capacity to transmit water) or aquitards (which typically impede transmission of water). Ultimately the distribution and interconnection of aquifers and aquitards are responsible for observed groundwater movement.

Earthfx Inc. (2006) grouped the regional stratigraphic profile into a seven-layer hydrostratigraphic profile as follows:

1) Recent Deposits
2) Oak Ridges Aquifer Complex (ORAC).

3) Newmarket Aquitard.
4) Thorncliffe Aquifer Complex.
5) Sunnybrook Aquitard.
6) Scarborough Aquifer Complex.
7) Bedrock.

The Oak Ridges Aquifer Complex is a regional aquifer system in Ontario that corresponds to the area where the Oak Ridges Sediments are deposited. The aquifer is a significant source of groundwater for domestic, commercial, industrial, institutional, agricultural, and municipal water supplies. The ORAC provides baseflow to the headwaters of creeks and rivers where the Halton Aquitard is absent. The shallow water table will typically be observed within this layer. The ORAC may be present at the Site.

The Newmarket Aquitard consists of the Newmarket Till and low permeability deposits that are known to infill the erosional channels. The Newmarket Aquitard is considered to be a leaky confining layer that provides protection from contamination to aquifers within the underlying hydrostratigraphic units. The Newmarket Aquitard may be present at ground surface beneath the southern part of the Site.

The Thorncliffe Aquifer Complex consists of fine to coarse-grained sediments of the Thorncliffe Formation. Local sand and gravel deposits within the Thorncliffe Aquifer Complex provide high yield wells. Groundwater in this layer is typically under pressure and in areas to the south of Aurora, the groundwater is under artesian pressure which can result in flowing wells.

The Sunnybrook Aquitard separates the Thorncliffe and Scarborough Aquifer Complexes. This aquitard demonstrates low permeability, provides some resistance to vertical groundwater movement, and protects the underlying aquifer from potential contaminant movement.

The Scarborough Aquifer Complex consists of fine to coarse-grained sediments associated with the Scarborough Formation. In general, these sediments tend to be coarse-grained and thicker where they fill topographic lows and valleys in the underlying bedrock surface. Groundwater within the Scarborough Aquifer Complex is typically under pressure, but only local artesian conditions occur. Locally, the Scarborough Aquifer Complex produces high well yields suitable for municipal or commercial wells. Due to its depth and presence of shallower aquifers, the Scarborough Aquifer Complex is not exploited extensively for private water supplies.

2.4.1 REGIONAL GROUNDWATER MOVEMENT

In general terms, precipitation infiltrates vertically into the surficial sand/gravel soil units. Groundwater will primarily move downward to the water table within the upper aquifer or aquitard unit. Groundwater will then tend to flow up or down through the aquitard units and laterally within the aquifers. Groundwater flow patterns can be influenced by established watercourses where there is potential for groundwater discharge to supply baseflow into the watercourses. The rate of groundwater discharge is controlled by the relative permeability of the recent deposits at the base of the streams. Discharge as baseflow is typically low through fine-grained base soils and higher where the streams have eroded down into coarser aquifers.

The horizontal groundwater movement through the subsurface aquifers tends to reflect the ground surface topography and the presence of stream channels.

3 WORK PERFORMED

The work program for the Hydrogeological Assessment and Water Balance Study included the following activities:

1) Description of the natural Site conditions: surface features, surface topography, soil types and stratigraphy.
2) Identification of current users of groundwater within 500 m of the subject property through the review of the Ministry of Environment, Conservation and Parks (MECP) Water Well Information System.
3) Installation of three (3) groundwater monitoring wells at various locations throughout the Site.
4) Measurement of groundwater elevations in the monitoring well network.
5) Development of the wells to a silt free condition.
6) Collection of representative samples from the monitoring well network for groundwater quality analysis.
7) Preparation of an annual climatic water budget and Site-specific water balance for Pre and Post-Development conditions.

3.1 BACKGROUND REVIEW OF GEOLOGICAL CONDITIONS

The geologic conditions beneath the proposed development were reviewed using published map sources, records from work on adjacent properties, and the WWIS database as maintained by the MECP.

Water well records within a 500-metre radius of the Site were reviewed to obtain information on existing wells and to provide information on the geology of the area. A summary of the well record search is provided in Table A-1, **Appendix A** and water well record locations are plotted on **Figure 9**.

3.2 BOREHOLE DRILLING

Ontario One Call was consulted to identify where existing public utilities entered the Site boundaries prior to initiating on-site activities. In addition, given that the Site is a private property, WSP retained the services of a private utility locator to clear the specific borehole and test pit locations from potential interference with private utilities.

The borehole drilling and monitoring well installation was carried out between May 16 and May 17, 2018. Drilling and excavation services were provided by Orbit Garant Drilling Inc. of Sharon, Ontario. A CME 750 Rubber Tire ATV-mounted auger drill was used for borehole drilling and monitoring well installation. A WSP technician was on-site to supervise the drilling, monitor installation.

The borehole and test pit locations are shown on **Figure 2**. The drilling program consisted of installing three (3) monitoring wells, designated as MW18-1 to MW18-3, to depths ranging from 3.0 m and 4.6 m below ground surface (bgs). Records of the observed stratigraphy in the boreholes and test pits are provided in **Appendix B**.

3.3 MONITORING WELL INSTALLATION

The positions of the monitoring well screens in MW18-1 to MW18-3 were determined based on the observed soil profile and were targeted to correspond with identified sandy or wet and more permeable layers of the soil within the upper 7 m of ground surface. This depth was determined based on observations from past investigations in the area.

The monitoring wells were constructed upon reaching the target depth in the direct push boreholes. The wells were constructed in individual boreholes using 52 mm (2 inch) inside nominal diameter (ID), schedule 40, environmental grade PVC riser pipes and well screens. The well screens are factory slotted with No. 10 slot size, and are 3.05 m (10 feet) long. The wells were constructed to leave the PVC riser pipe between 0.84 and 0.88 m above ground surface.

The borehole annulus around the well screens were filled with No. 2 silica sand to approximately 0.6 m above the top of the well screen to provide a filter pack. A low-permeability seal was placed above the filter pack using bentonite pellets. A 1.5 m long, lockable, steel, protective casing was placed over the PVC riser pipe.

The monitoring well installations were completed to O. Reg. 903 standards and a well tag was submitted to the MOE by the licensed driller for each individual well. The monitoring well construction details are summarized in on borehole records provided in **Appendix B**.

3.4 GROUNDWATER LEVEL MEASUREMENTS

Observations during the drilling MW18-1 to MW18-3 confirmed that the water table is relatively shallow beneath the Site. The well screen intervals were placed at depth in stratigraphic positions that were considered to have potential to yield water.

The depth to groundwater was measured in monitoring wells. Static groundwater elevations were estimated by subtracting the measured water depth from the determined reference elevation at each monitoring well. The groundwater elevations in MW18-1 to MW18-3 were measured after construction on June 21, 2018.

A summary of groundwater elevations is provided in **Table 1**. A site plan showing the measured groundwater elevations is presented as **Figure 10**.

3.5 WELL DEVELOPMENT

The monitoring wells were developed after installation to remove silt and sediment. The purpose of development is to ensure that representative formation water is obtained for water quality analysis.

The volume of water in the well casing was estimated based on the static groundwater level measurement. A dedicated Waterra™ Inertial pump was installed in the monitoring well and used to remove water from the well. Standing water was observed in all three (3) monitoring wells.

3.6 WATER QUALITY SAMPLING

Representative samples of groundwater were collected from the three (3) monitoring wells on June 21, 2018. A duplicate sample was taken for QA/QC purposes. Samples were collected via the dedicated Waterra™ inertial pump placed in the monitoring well. Field measurements of temperature, electrical conductivity, and pH were recorded at the time of sample collection. The water samples were collected in sample bottles prepared by and provided by ALS Environmental Laboratories (ALS) located in Waterloo, Ontario.

The water quality samples were submitted to determine concentrations of:

- General water quality parameters (major cations, major anions, pH)
- Dissolved Metals
- Dissolved Organic Carbon
- Nutrients.

The Certificates of Analysis provided by ALS are provided in **Appendix C**.

The water quality results were reviewed with respect to Table 2: Full Depth Generic Site Condition Standards in a Potable Ground Water Condition for All Types of Property Use (Coarse Textured Soil), hereinto referred to as the “MECP Table 2 SCS”, as outlined in the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act (April 15, 2011). This table was selected as it provides a conservative assessment of potential water quality concerns in groundwater as the area surrounding the Site is serviced by municipal water supplies.

3.7 WATER BUDGET ANALYSIS

A Water Budget provides an accounting of the water inputs and water outputs within a defined area. In this case, the area of the proposed development is used to estimate the water budgets in the existing condition (Pre-Development) and in the future condition (Post-Development).

The basic assumption of a water budget analysis is that there is a balance between water inputs and outputs, unless there is a clear understanding that water is being removed from storage within the system. The water budget is typically represented in a simple form as:

Water In = Water Out

P + EI = ET + IR + RO + EO

Where:

P	=	Precipitation
EI	=	External Inputs (including run-on, irrigation, and vertical/lateral transfers)
ET	=	Evapotranspiration
IR	=	Infiltration Recharge
RO	=	Runoff
EO	=	External Outputs (including water taking, and vertical/lateral transfers)

In more complex scenarios, lateral inputs through groundwater and surface water, movement between subsurface aquifer layers, and removal from storage can also be considered.

The objectives of the Water Budget Analysis are to:

a) quantify the water budget equation for the existing conditions;
b) quantify the water budget equation for proposed future conditions; and
c) illustrate that there is either no significant change (i.e. a water balance) between the existing or future conditions, or that mitigation methods can be employed to minimize the estimated change.

The Water Budget Analysis was completed in four main steps:

Step 1) Analysis of Climatic Data;

Step 2) Pre-Development Water Budget;

Step 3) Post-Development Water Budget; and

Step 4) Post-Development Water Budget (not including mitigation).

A previous iteration of the Water Balance Study identified potential infiltration deficits that were subsequently addressed by the current stormwater management plan. In this case, Steps 3 and 4 were combined. The water budget analysis has been completed using methods outlined in “Hydrogeological Technical Information Requirements for Land Development Applications” (MECP, 1995).

3.7.1 ANALYSIS OF CLIMATE DATA

Climate data available from on-line resources maintained by the Meteorological Service of Canada (Environmental Canada) were obtained and analyzed to determine the appropriate values for annual average precipitation and evapotranspiration. The surplus left over after subtraction of the evapotranspiration from the average precipitation is considered to represent the quantity of water available for infiltration and runoff under existing conditions.

Climate data was obtained for the Udora Climate Station for the period from 1981 until 2010. These data are provided in Table G-1, **Appendix D**. Mean monthly temperatures were calculated by averaging mean monthly minimum and maximum temperatures. Temperature data were derived from the 30-year (1981-2010) climate data summaries.

The Thornthwaite-Mather method was used to estimate potential and actual evapotranspiration on a monthly basis. The Thornthwaite-Mather method is based on an empirical relationship between potential evapotranspiration and mean air temperature. The method also takes into account the water holding capacity for the soil to compute the actual evapotranspiration and the resulting moisture surplus that is available for infiltration and runoff.

The water holding capacity of the soil depends on two different factors – the soil type and structure, and the type of vegetation growing on the surface. Different types of soil hold different amounts of moisture storage capacity, while different species of vegetation will send roots into the soil to different depths and therefore retain varying amounts of moisture. The water holding capacity for each soil type/vegetation type combination found on the Site was determined from the Environmental Design Criteria of the Storm Water Management Planning and Design Manual published by the Ontario Ministry of the Environment, Conservation and Parks ("MECP") in 2003.

The monthly estimates were used to calculate an annual average for precipitation, potential evapotranspiration, actual evapotranspiration, and available moisture surplus for each combination of soil and vegetation type found on-site. The moisture surplus represents the quantity of water available for infiltration and runoff on an annual average basis. Tables that document the details of the Thornthwaite-Mather analysis for the combinations of soil type and land use are provided in **Appendix D.**

3.7.2 PRE-DEVELOPMENT WATER BUDGET

The Pre-Development Water Budget was estimated using the approach recommended in Table 2 of the "Hydrogeological Technical Information Requirements for Land Development Applications" (MECP, 1995). The steps taken to estimate the Pre-Development Water Budget included:

1) Identify sensitive features and to observe existing topography, soil types, and other controls on infiltration and runoff.
2) Delineating drainage catchments and sub-catchments based on observed drainage outlets and physical characteristics as described below.
3) Estimating the quantities of infiltration and runoff for each of the sub-catchment areas and preparing summary estimates for catchments related to identified drainage outlets and for the proposed development area.

The drainage catchments and sub-catchments were defined by considering the following factors:

- Existing elevations;
- Existing property boundaries;
- Post-development features and property boundaries;
- Natural topographical features;
- Slope ratio; and
- Land cover, and
- Land use.

The sub-catchments defined for the Pre-Development Water Budget also considered the proposed development areas and future drainage considerations for the proposed development. This was incorporated into the analysis to be able to demonstrate changes in drainage to the identified outlets and infiltration beneath the development area. The defined sub-catchments for the Pre-Development Water Budget are shown on **Figure 11** and in Table E-1, **Appendix E**.

The Infiltration Factor for each Pre-Development sub-catchment was estimated by adding the sub-factors for topography, soil type, and land cover as recommended in the MECP methodology. A geographic information system (GIS) was used to evaluate the topography, soil type and land use for each of the Pre-Development, Current Condition, and Post-Development scenarios and to generate a set of sub-catchments that can be used in analysis of each scenario. Section 6 provides a characterization of the Site in terms of the topography, soil type, and land use as input into the water budget analysis. The calculated infiltration factor for each catchment was reviewed and updated manually, as a confirmation that they reflect actual conditions. Assumptions applied to the Pre-Development water budget scenario are described in Section 6.2.

The volume of Pre-Development Infiltration was estimated as the product of [sub-catchment area] x [moisture surplus] x [Infiltration factor]. The Pre-Development Runoff was estimated by subtracting the volume of infiltration from the total volume of moisture surplus for each sub-catchment. A detailed table to document the calculations of the Pre-development Water Budget is provided in **Appendix E**.

3.7.3 POST-DEVELOPMENT WATER BUDGET

The Post-Development Water Budget was estimated using a similar approach as outlined for the Pre-Development case. The proposed development plan and future drainage plan were used to establish new drainage sub-catchments that relate to the outlets identified in the Pre-Development case. Within each drainage sub-catchment, the area of pervious soils and impervious development (roads, driveways, amenities, and roofs) were estimated based on preliminary Site plans and grading plans as provided by *Cole Engineering Group Ltd*. (*Cole*). A draft of the post-development water budget was provided to *Cole* for use in finalizing stormwater management plans and in preparing designs for systems to infiltrate runoff to balance recharge. The Post-Development Water Budget calculations were revisited to be consistent with the documentation prepared by *Cole*.

For the pervious areas, the quantity of infiltration was calculated using the [pervious area] x [precipitation surplus] x [Infiltration Factor]. The Infiltration Factors were reviewed to correspond to the Post-Development conditions. The runoff for the pervious areas was estimated by subtracting the volume of infiltration from the total volume of precipitation surplus for the pervious area in each sub-catchment.

The volume of runoff from the impervious surfaces was estimated using the area of impervious surfaces and the volume of precipitation. A factor of 10% was considered to represent some evaporation in the course of runoff. This value is consistent with assumptions made on adjacent lands.

The Site will be municipally serviced for water and sewage. The Post-Development Water Budget reflects this.

The Post-Development Water Budget was compared to the Pre-Development Water Budget to evaluate the effects of the proposed development. The Post-Development Water Budget takes into consideration mitigation measures to address a potential infiltration deficit that was identified in the initial draft the water balance. The findings of the initial draft water balance analysis were used by *Cole* in the design of Low Impact Development measures to maintain pre-development recharge.

Details of the Post-Development Water Budget calculations are provided in **Appendix F**.

4 OBSERVATIONS

The information obtained during previous site studies was reviewed and analyzed to characterize the soil profile and the groundwater system at the Site.

4.1 SOIL PROFILE

Based on the stratigraphy observed during the borehole drilling and test pit excavations, 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 certain boreholes.

A layer of topsoil ranging from 100 – 800 mm in depth was observed in BH18-1 to BH18-3. The topsoil was underlain by different soil types depending on location and these included: sand, sandy silt, and silty sand. The first layer of stratigraphy typically extended to a depth of 0.8 – 1.5 m bgs. Below this level, the stratigraphy predominantly consisted of alternating layers of sand and clay or combinations of both down to a maximum depth of 4.6 m bgs.

The stratigraphy observed during the borehole investigation is generally consistent with the stratigraphy information reported in the water well records obtained through the MECP borehole logs. Table A-1 in **Appendix A** provides a list of water well records. Borehole logs are provided in **Appendix B**.

4.2 GROUNDWATER ELEVATIONS

Upon development of the wells, the water level within each monitoring well was observed and recorded. The water levels ranged from 1.1 m bgs to 2.8 m bgs on June 21, 2018. Water levels at the Site are recorded on a monthly basis and are summarized in **Table 1.**

Figure 10 presents a map illustrating groundwater elevations at the Site. The apparent groundwater flow direction is inferred to be in a northerly direction based on observations of active flow in the central headwater drainage feature on June 21, 2018. This inferred groundwater flow direction generally consistent with the topography observed at the Site. The monitoring well locations were chosen near the corners of the property and this may not reflect the influence of topography and surface water drainage in the center of the Site.

The Site's location to the north of the regional groundwater divide indicates that the local groundwater flow feeds the regional groundwater system to the north.

4.3 WATER USE

The two (2) residential dwellings located on the Site obtain water from on-site wells and have private individual sewage systems. The proposed development will be municipally serviced for water and sewage.

4.3.1 MECP WATER WELL SEARCH

A list of MECP water well records within 500 m of the Site is provided in **Appendix A**. **Figure 9** illustrates the locations of wells located within 500 m of the Site property as per the MECP WWIS. The well record database includes seventy-three (73) water well records within a 500-metre radius of the Site. Of the well records, 11 are water supply wells for domestic, irrigation, livestock, industrial and municipal purposes, 36 are test holes or monitoring wells, 19) are abandoned, one (1) is for dewatering purposes, and six (6) are for other purposes.

Of the 11 water supply wells, five (5) draw water from sand and gravel lenses at a depth less than 20 m, seven (7) draw water from sand and gravel lenses at depths ranging between 20 and 40 m, and three (3) draw water from silt, stone and sand lenses greater than 40 m. WSP understands that much of the search area is now municipally serviced for water supply. This is reflected by the relatively high proportion of reported abandoned wells. It is likely that some of the identified of the domestic water supply wells have also been removed from active use, but are not documented in the MECP WWIS.

It is possible that the MECP WWIS database includes other wells that are incorrectly located and there may be some wells for which well records are not on file at the MECP.

4.4 WATER QUALITY

The results of water quality testing at the three (3) on-site monitoring wells are summarized in **Table 2**. The water quality analysis reports as provided by ALS are presented in **Appendix C**.

The concentrations of the parameters tested are less than the relevant MECP Table 2 Site Condition Standard (SCS) values.

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 property 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 *Cole*.

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 *Cole* includes an external catchment to the south of the Site. *Cole* 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 64 residential dwellings, and new driveway and roadway areas. WSP understands that a naturalized drainage feature is to be constructed along the west side of this development area to convey water currently drained by the headwater drainage feature.

The Post-Development scenario presented by *Cole* in the Functional Servicing and Stormwater Management Report (*Cole*, 2018) does not include a delineated off-site catchment to the south as was included in Pre-Development.

Cole 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 west side of the property. The natural drainage features include a series of swales/soak away pits that have been designed to promote infiltration. *Cole* provided estimates of the annual volumes of runoff that are to be infiltrated through this system of swales. WSP accounted for this infiltration in the water budget summary on **Table 4**, but not within the detailed water budget calculations (**Appendix F**).

Cole also allowed for infiltration trenches to capture and infiltrate runoff from rooftops within the central area of the development. WSP also accounted for this infiltration in the water budget summary on **Table 4**, but not within 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. Under post-development conditions, the Site comprises seven (7) 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 provided by *Cole*.

Under Post-Development conditions, a new naturalized drainage feature that drains off-site to the northwest is introduced in Catchment A. 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 property (to the south) 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 A:** Drains to the proposed drainage swale which subsequently flows off-site to the north west via overland flow.

— **Post-Development On-Site Catchment B:** Drains off-site to the northwest via overland flow.

— **Post-Development On-Site Catchment C:** Drains off-site to the northwest via overland flow.

— **Post-Development On-Site Catchment D:** Drains off-site to the northwest via the on-site storm sewer system.

— **Post-Development On-Site Catchment E:** 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 F:** 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 G:** Drains to the rear lot catch basins which connect to the on-site storm sewer system and subsequently flows off-site to the north.

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.

Cole prepared the stormwater management plan with input from a draft Hydrogeological Assessment and Water Balance Study. This results in some differences in catchment delineations between the two analyses. Catchment A1 in the Post Development Drainage Plan (PDDP) (*Cole*, 2018) is the same as Catchment A in **Figure 12**. Catchment A2 in the PDDP includes Catchments B and C in **Figure 12**; and Catchment A3 in the PDDP includes Catchments D, E, F and G 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. The Hydrogeological Assessment and Water Balance Study was reviewed by *Cole* and no revisions to the catchment areas were required.

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 not accounted for in the detailed water budget analysis (Appendix F) but is included in the Water Budget Summary in **Table 4**.

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 14,124 m^2 of impervious surfaces. This would result in a net infiltration of 2,864 m^3/year or 109.6 mm/yr through natural pervious areas. An additional 2,980 m^3/yr is considered to infiltrate through the soak away pits in the naturalized drainage area. A further 1,988 m^3/yr will infiltrate through the infiltration trench. This results in a net infiltration of 7,831 m^3/yr. The net infiltration would reflect approximately 34% 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 is 12,492 m^3/yr or 478.3 mm/year. As mentioned above, 2,980 m^3/yr of this runoff is infiltrated in the soak away pits and 1,988 m^3/yr is infiltrated through the infiltration trench. The total calculated net Post-Development runoff represents approximately 33% 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. As the Post-Development scenario includes measures designed to enhance and maintain infiltration, the total on-site infiltration is increased by approximately 837 m^3/yr, or 12% relative to pre-development. The introduction of additional impervious surfaces and the above mitigation measures increases total runoff by 5,636 m^3/yr or 298%. This increased runoff is managed by the stormwater management system.

The incorporation of LID measures as part of the stormwater management system has demonstrated an ability to practically enhance the pre-development recharge and to manage the generated stormwater to be released through the natural system.

At this time, additional mitigation measures are not required as an infiltration surplus exists based on the proposed mitigation measures, however, other strategies that can be employed further enhance infiltration at the Site are available. These include:

a) reduction of impervious areas;
b) use of more pervious pavement materials (particularly for driveways, sidewalks, and other decorative areas);
c) enhancement of infiltration capacity in pervious areas through use of materials with increased permeability or grading.
d) consideration of other water inputs in addition to precipitation (for example irrigation of lawn and garden areas using municipal water sources).

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.

6 POLICY AREAS

6.1 WELLHEAD PROTECTION AREAS

The Wellhead Protection Areas (WHPA) for the Uxbridge municipal water are illustrated on **Figure 13**. The WHPA and vulnerability scores were obtained from the Assessment Report for the Lakes Simcoe and Couchiching Source Protection Area. The Site does not lie within delineated WHPA-A to -D for the Uxbridge municipal wells.

Figure 13 illustrates that the entire Site lies within an area designated as WHPA-Q. In this case, WHPA-Q reflects the combined effects of groundwater taking in York and Durham Region. Policies in the Lakes Simcoe and Couchiching Source Protection Plan for WHPA-Q require that recharge be maintained or enhanced. The water balance calculations presented herein demonstrate that the proposed mitigation measures enhance pre-development infiltration rates.

6.2 INTAKE PROTECTION ZONE

Intake Protection Zones (IPZ) refer to areas on the water and land surrounding a municipal surface water intake. **Figure 14** illustrates that the Site lies within an IPZ-3 as delineated for municipal water supplies that draw water from Lake Simcoe. IPZ-3 includes areas that can be delineated if modelling demonstrates that spills from a specific activity, that is located outside IPZ-1 and IPZ-2, may be transported to a water supply intake and result in a deterioration of the water quality at an intake. In this case, there is potential for contaminants at the Site to be transported northward to Lake Simcoe. The vulnerability score associated with IPZ-3 is relatively low and reflects that activities on this Site would have a relatively low likelihood of affecting the water quality in a surface water intake in Lake Simcoe. The mitigation measures proposed in the Functional Servicing and Stormwater Management Report (*Cole*, 2018) enhance the pre-development rate of infiltration/recharge.

6.3 HIGHLY VULNERABLE AQUIFERS

The Source Protection Plan for the Lakes Simcoe and Couchiching Source Protection Area contains policies that apply to Highly Vulnerable Aquifers. **Figure 15** presents the mapping of Highly Vulnerable Aquifers (HVA) from the Assessment Report for the Lakes Simcoe and Couchiching Source Protection Area. HVA are considered susceptible to contamination of groundwater from activities on the surface or shallow subsurface. The Site is mapped as a Highly Vulnerable Aquifer. The proposed land use as residential is expected to have minimal potential to affect underlying groundwater resources.

6.4 SIGNIFICANT GROUNDWATER RECHARGE AREAS

Policies 6.36 DP through 6.40 DP of the Lake Simcoe Protection Plan address Significant Groundwater Recharge Areas (SGRA).

The Assessment Report for the Lakes Simcoe and Couchiching Source Protection Area contains mapping of Significant Groundwater Recharge Areas (SGRA). SGRA are regional areas that receive more than the average estimated recharge for a watershed area.

Most of the Site is within a mapped SGRA as shown on **Figure 16**. More than half of the Site including the central portion and the portions in the southeast corner are shown to have high sensitivity.

The mitigation measures proposed in the Functional Servicing and Stormwater Management Report (*Cole*, 2018) enhance the pre-development rate of infiltration/recharge.

7 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). A draft of this report was provided to Cole Engineering Group Limited for use in designing infiltration measures as part of the Stormwater Management Plan.

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 west 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 in June 2018 support the observation that groundwater is relatively shallow beneath the Site and that 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.

6 Representative groundwater samples were collected from the three (3) monitoring wells on June 21, 2018. 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).

7 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/yr to 341.1 mm/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.

8 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.

9 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.

10 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. Under the proposed development conditions there are seven (7) on-site catchments. Runoff within the developed portion of the site is primarily captured by stormwater drainage systems.

11 The Stormwater Management Plan prepared by *Cole* incorporates Low Impact Development features in the form of an infiltration trench and soakaway pits to infiltrate runoff that is generated at the Site. The effect of these features is considered in the Post-Development Water Budget.

12 The Post-Development Water Budget predicts a net on-site infiltration of 7,831 m^3/yr. Approximately 4,968 m^3/yr (71% of pre-development) of this infiltration is generated through the proposed LID measures. At this time, no additional mitigation measures are required as the introduction of LID features enhances the infiltration rate relative to pre-development conditions.

13 The Post-Development Water Budget predicts a net runoff of 7,524 m^3/yr over the Site area. This is an increase of 5,636 m^3/yr (398%) relative to Pre-Development.

14 The Site lies within an area designated as WHPA-Q, where policies in the Lakes Simcoe and Couchiching Source Protection Plan require recharge to be maintained or enhanced. The water balance assessment demonstrates that the proposed mitigation enhance recharge from pre-development levels.

15 The Site lies within Intake Protection Zone 3 (IPZ-3) for water supplies that draw from Lake Simcoe. The proposed residential activities at the Site are not considered to present an increased risk to water quality for these water supplies.

16 The Site is mapped as a Highly Vulnerable Aquifer in the Assessment Report for the Lakes Simcoe and Couchiching Source Protection Area. The proposed land use as residential is expected to have minimal potential to affect underlying groundwater resources.

17 The majority of the Site is mapped as an SGRA. The water balance assessment demonstrates that the proposed mitigation enhance recharge from pre-development levels.

This concludes the Hydrogeological Assessment and Water Balance Study. We trust that this report satisfies your requirements. If you have any questions or concerns regarding this report, do not hesitate to contact our office.

8 REFERENCES

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TABLES

TABLE 1
OBSERVED GROUNDWATER LEVELS
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
MW18-1	100.21	99.28	0.93	28-May-18	2.45	1.52	97.76
				21-Jun-18	2.78	1.85	97.43
				18-Jul-18	3.20	2.27	97.01
				9-Aug-18	2.49	1.56	97.72
MW18-2	100.09	99.08	1.02	28-May-18	1.97	0.95	98.13
				21-Jun-18	2.24	1.22	97.86
				18-Jul-18	2.46	1.44	97.63
				9-Aug-18	1.79	0.77	98.30
MW18-3	97.60	96.72	0.88	28-May-18	1.06	0.18	96.54
				21-Jun-18	1.09	0.20	96.52
				18-Jul-18	1.07	0.19	96.53
				9-Aug-18	1.00	0.12	96.60

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.

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 limit exceeds Table 2 SCS.

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	150	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 can be found in Appendix B)

two (2) internal (on-site) and one (1) external (off-site) catchment areas

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

Characteristics		Pre-development		Post-development		Change	
		Volume (m^3/yr)	mm/yr	Volume (m^3/yr)	mm/yr	Volume (m^3/yr)	%
Input	Precipitation	23,146	886.2	23,146	886.2	0	0%
	Run-on	0	0.0	0	0.0	0	0%
	Total In	**23,146**	**886.2**	**23,146**	**886.2**	**0**	**0.0%**
swales and soakaway pits	*Infiltration via Pervious Areas*	6,365	243.7	2,864	109.6	-3,501	-55%
	Add: Additional Headwater Infiltration	630	24.1	0	0.0	-630	>100%
	Add: Infiltration via Infiltration Trench	0	0.0	1,988	76.1	1,988	>100%
	Add: Infiltration via Soakaway Pits	0	0.0	2,980	114.1	2,980	>100%
	Total Infiltration	6,994	267.8	7,831	299.8	837	12%
	Runoff	2,519	96.4	12,492	478.3	9,974	396%
	Less: Runoff Infiltrated by Headwater	-630	-24.1	0	0.0	630	<-100%
	Less: Runoff Infiltrated by Infiltration Trench	0	0.0	-1,988	-76.1	-1,988	<-100%
	Less: Runoff Infiltrated by Soakaway Pits	0	0.0	-2,980	-114.1	-2,980	<-100%
	Total Runoff	1,889	72.3	7,524	288.1	5,636	298%
	Evapotranspiration	14,262	546.1	7,790	298.3	-6,472	-45%
	Total Out	**23,146**	**886.2**	**23,146**	**886.2**	**0**	**0.0%**

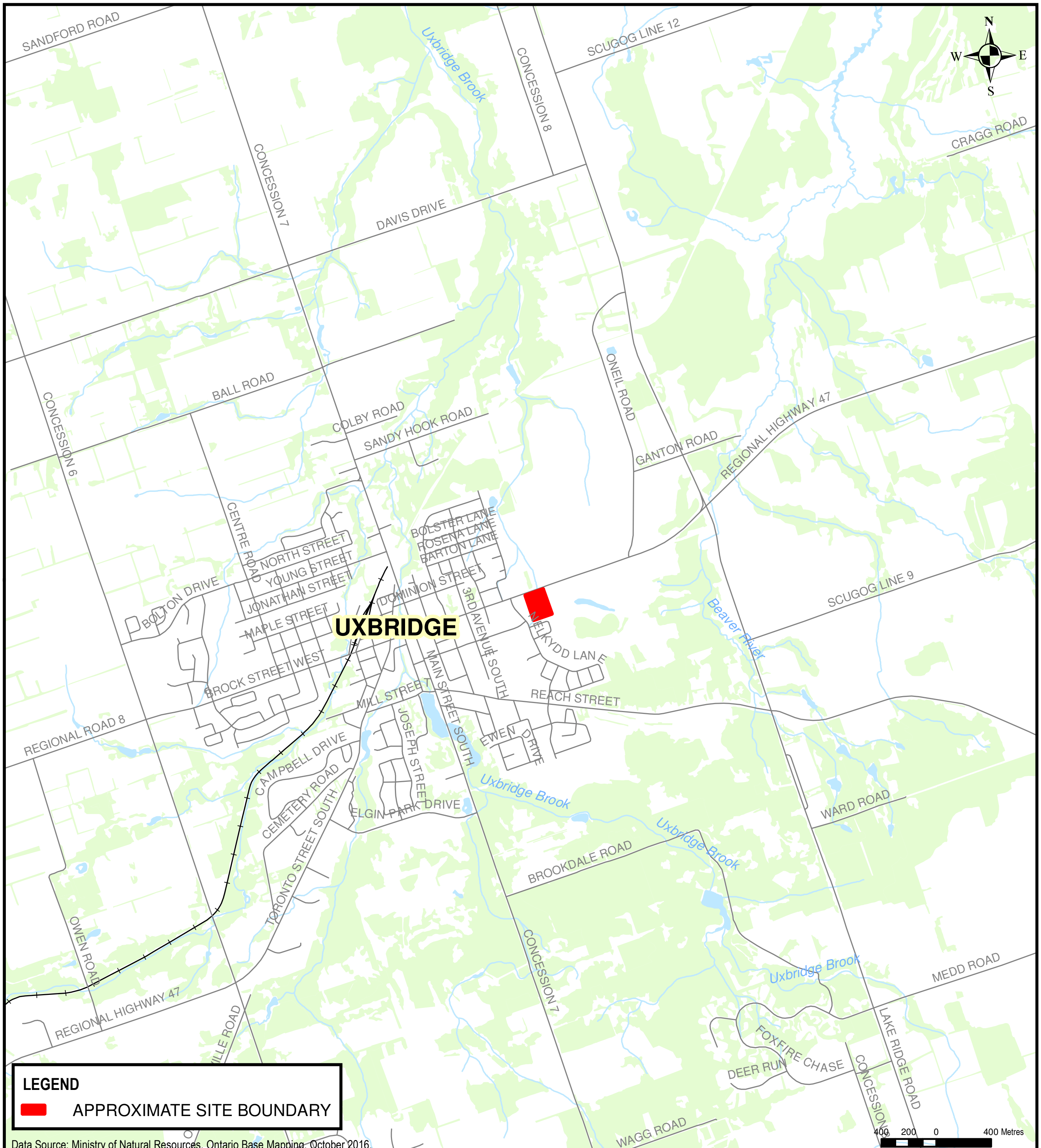
Off-Site Runoff Change - By Outlet

Outlet	Description	Contributing Catchments - Pre-Development	Contributing Catchments - Post-Development	Pre-Development		Post-Development		Runoff Change*	
				Area	Volume	Area	Volume		
				m^2	m^3	m^2	m^3	m^3	%
Off-Site Northwest (Storm Sewers)	Flows off-site to the northwest via the on-site storm sewer system.	None	D	0	0	15,016	9,270	9,270	>100%
Off-Site Northwest (RLCB and Storm Sewers)	Flows to the rear lot catch basins which connect to the on-site storm sewer system and subsequently flows off-site to the north.	None	E, F, G	0	0	5,898	2,230	2,230	>100%
Off-Site Northwest (Overland Flow)	Flows off-site to the northwest via overland flow.	A	B, C	26,118	1,889	1,373	600	-897	-48%
Off-Site Northwest (Swale)	Flows to the on-site drainage channel which subsequently flows off-site to the north west via overland flow.	None	A			3,830	392		
Total				**26,118**	**1,889**	**26,118**	**12,492**	**10,603**	**561%**

Breakdown of Post-Development Run-Off by Land Use

Land Use	Description	Post-Development		Runoff
		Area	Volume	
		m^2	m^3	m^3
Total Buildings	Includes residential homes.	6,136	4,894	4,894
Paved Areas	Includes roads, sidewalks and driveways.	7,988	6,371	6,371
Impervious Areas		**14,124**	**11,265**	**11,265**
Pervious Areas	Includes residential lawns, uncultivated areas and gravel.	11,994	1,227	1,227
Pervious Areas		**11,994**	**1,227**	**1,227**
TOTAL RUN-OFF		**26,118**	**12,492**	**12,492**

FIGURES



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: 1:40,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: SITE LOCATION MAP	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 1 / REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 1 Location Map.mxd

126 DON HILLOCK DRIVE, UNIT 2
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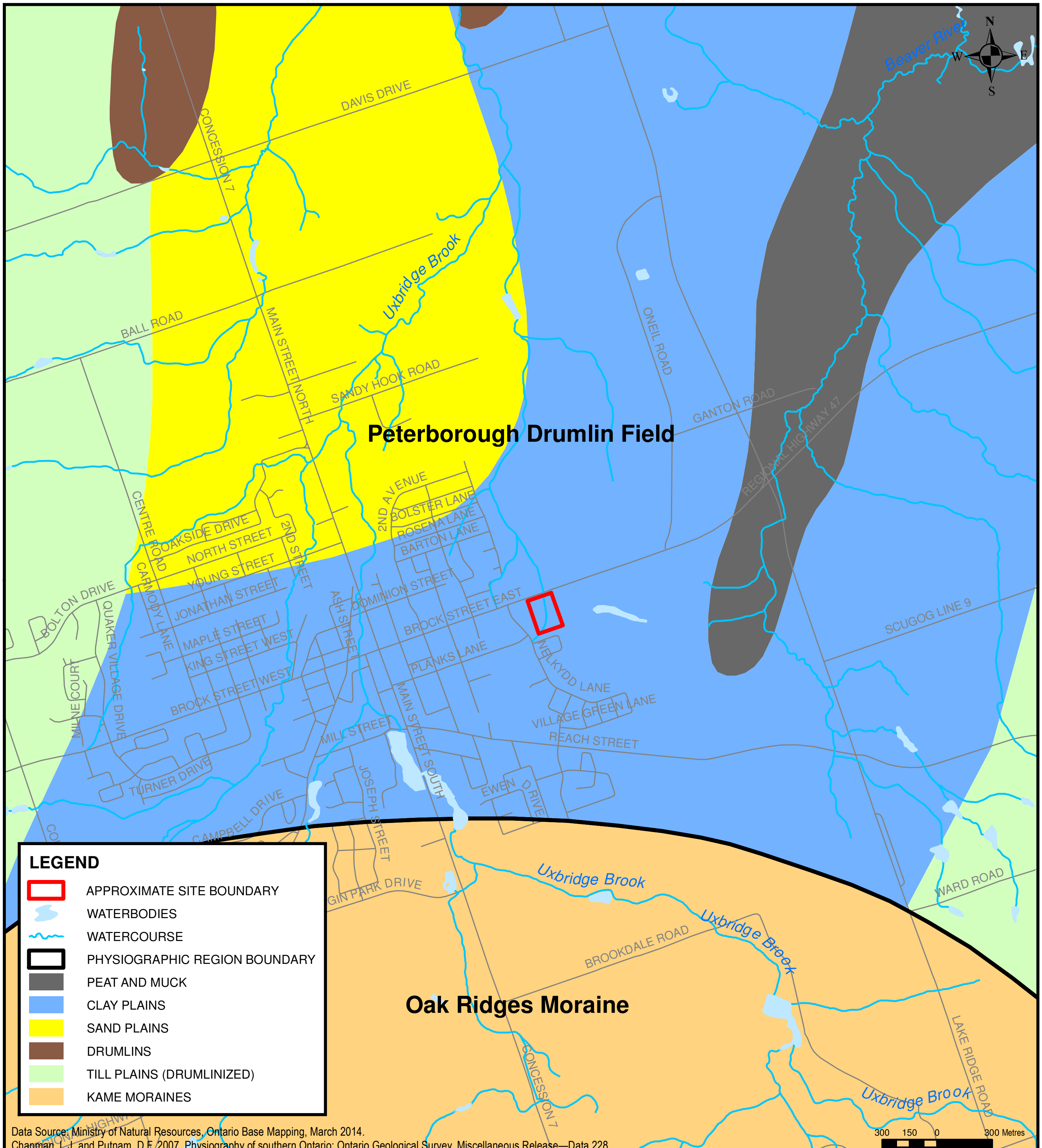
PROJECT:	HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO
SCALE:	1:2,500
DRAWN BY:	TP
CHECKED BY:	LL
TITLE:	EXISTING CONDITIONS
PROJECT NO:	181-06778-00 100
DATE:	JULY 2018
CLIENT:	WESTLANE DEVELOPMENT GROUP LTD.
FIGURE NO:	2
REV.:	-

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 2 Existing Conditions.mxd

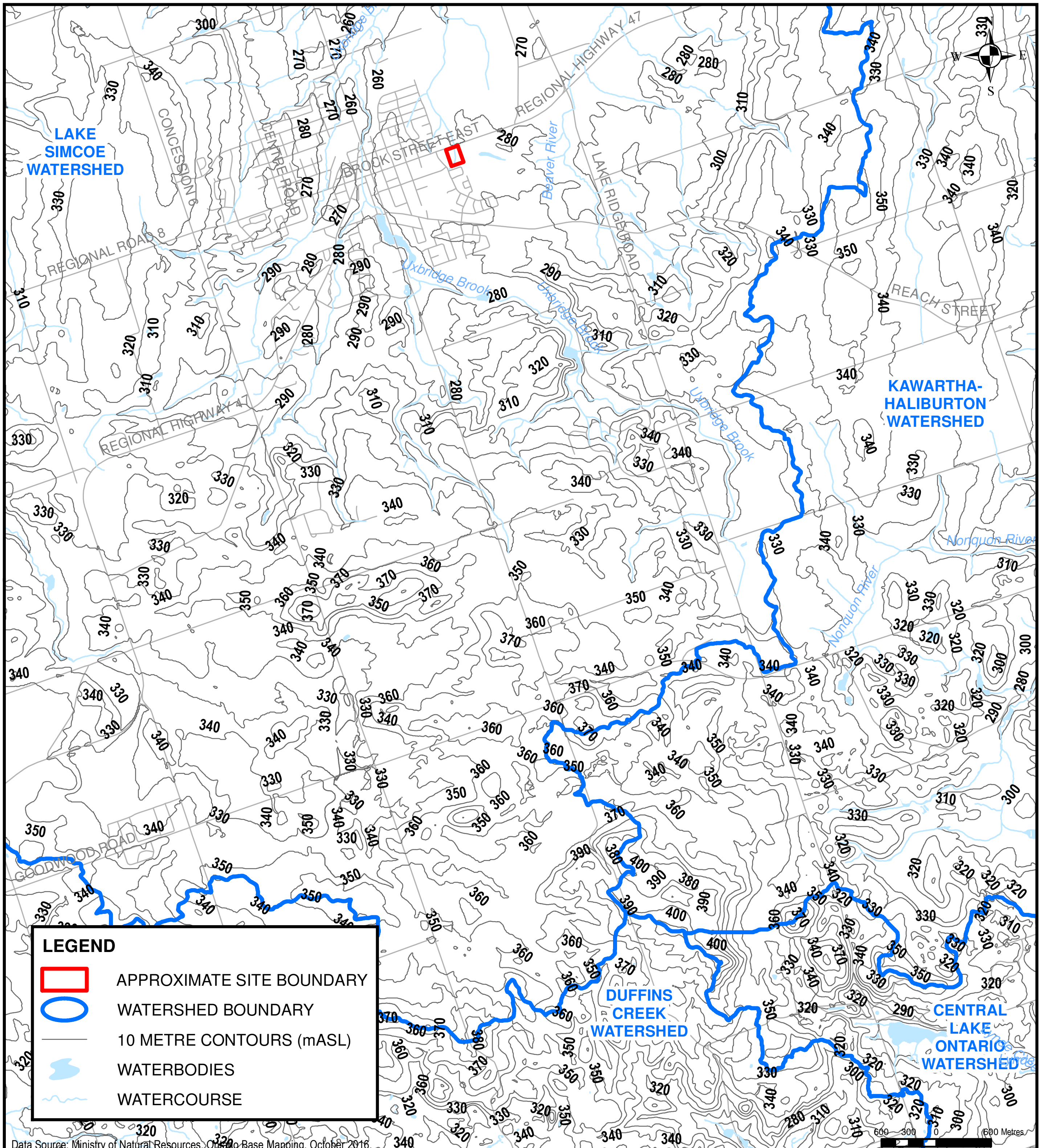
wsp 126 DON HILLOCK DRIVE, UNIT 2 AURORA, ONTARIO CANADA L4G 0G9 TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM	PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:1,500	
		DRAWN BY: TP	CHECKED BY: LL
	TITLE: PROPOSED DEVELOPMENT	PROJECT NO: 181-06778-00 100	
		DATE: JULY 2018	
	CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 3	REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 3 Proposed Development.mxd



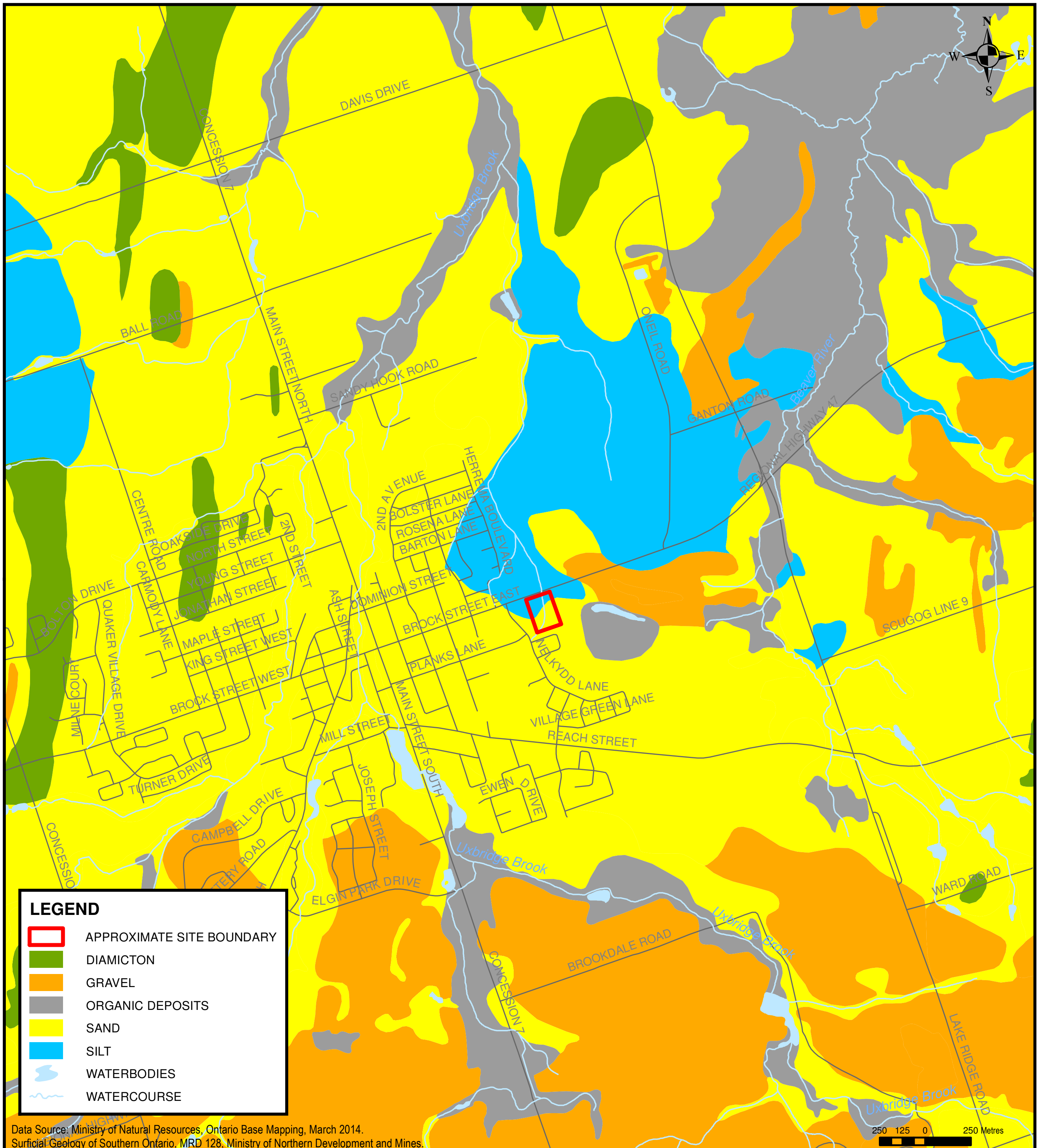
wsp 126 DON HILLOCK DRIVE, UNIT 2 AURORA, ONTARIO CANADA L4G 0G9 TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM	PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:30,000 DRAWN BY: TP CHECKED BY: LL
	TITLE: REGIONAL PHYSIOGRAPHY	PROJECT NO: 181-06778-00 100 DATE: JULY 2018
	CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 4 REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 4 Physiography.mxd



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: 1:60,000 DRAWN BY: TP CHECKED BY: LL
	TITLE: REGIONAL TOPOGRAPHY AND DRAINAGE	PROJECT NO: 181-06778-00 100 DATE: JULY 2018
	CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 5 REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 5 Drainage.mxd



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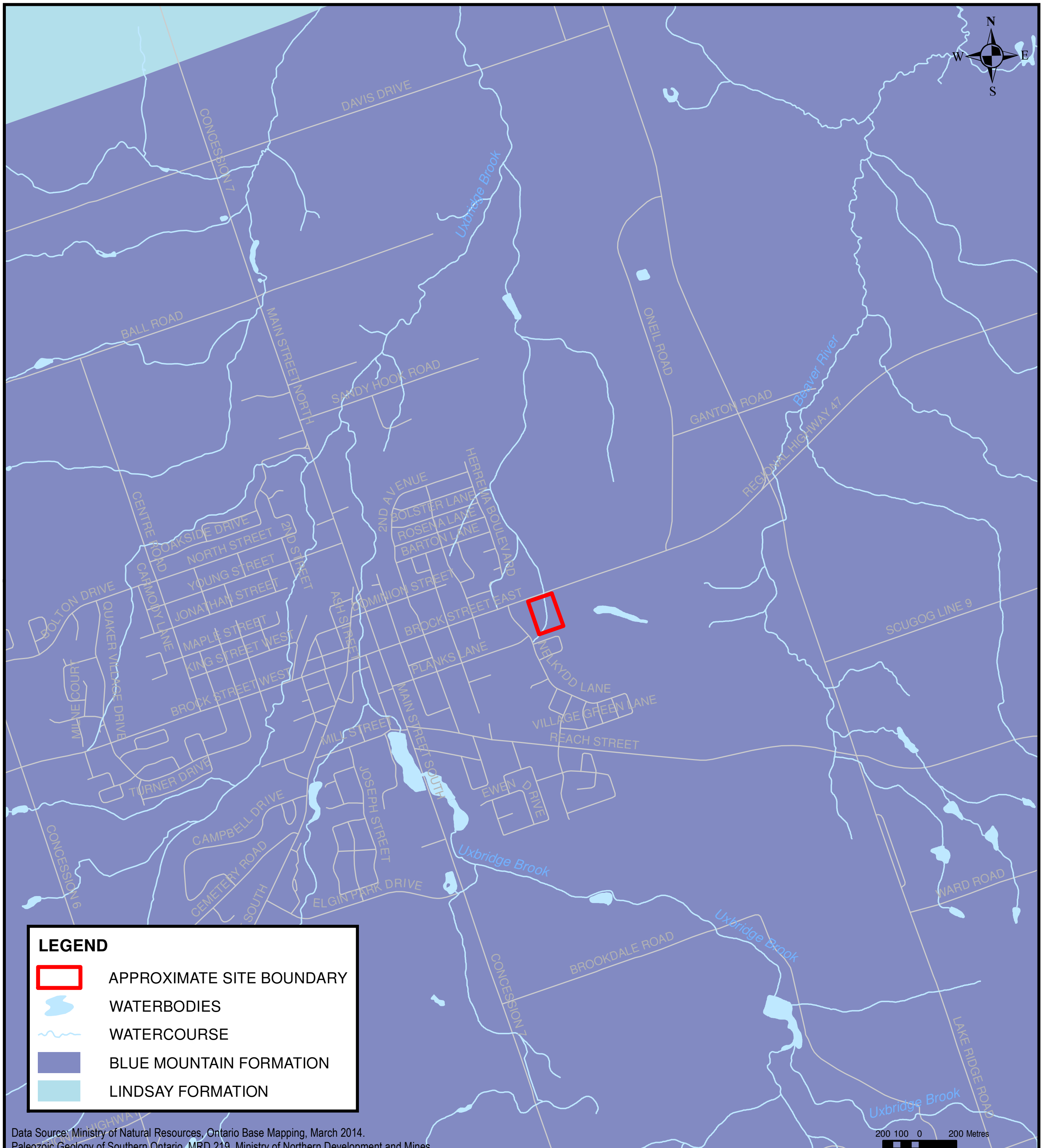
TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:30,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: SURFICIAL GEOLOGY	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 6 / REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 6 Surficial Geology.mxd



Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.
Paleozoic Geology of Southern Ontario, MRD 219, Ministry of Northern Development and Mines.

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PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:30,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: BEDROCK GEOLOGY	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 7 / REV.: -

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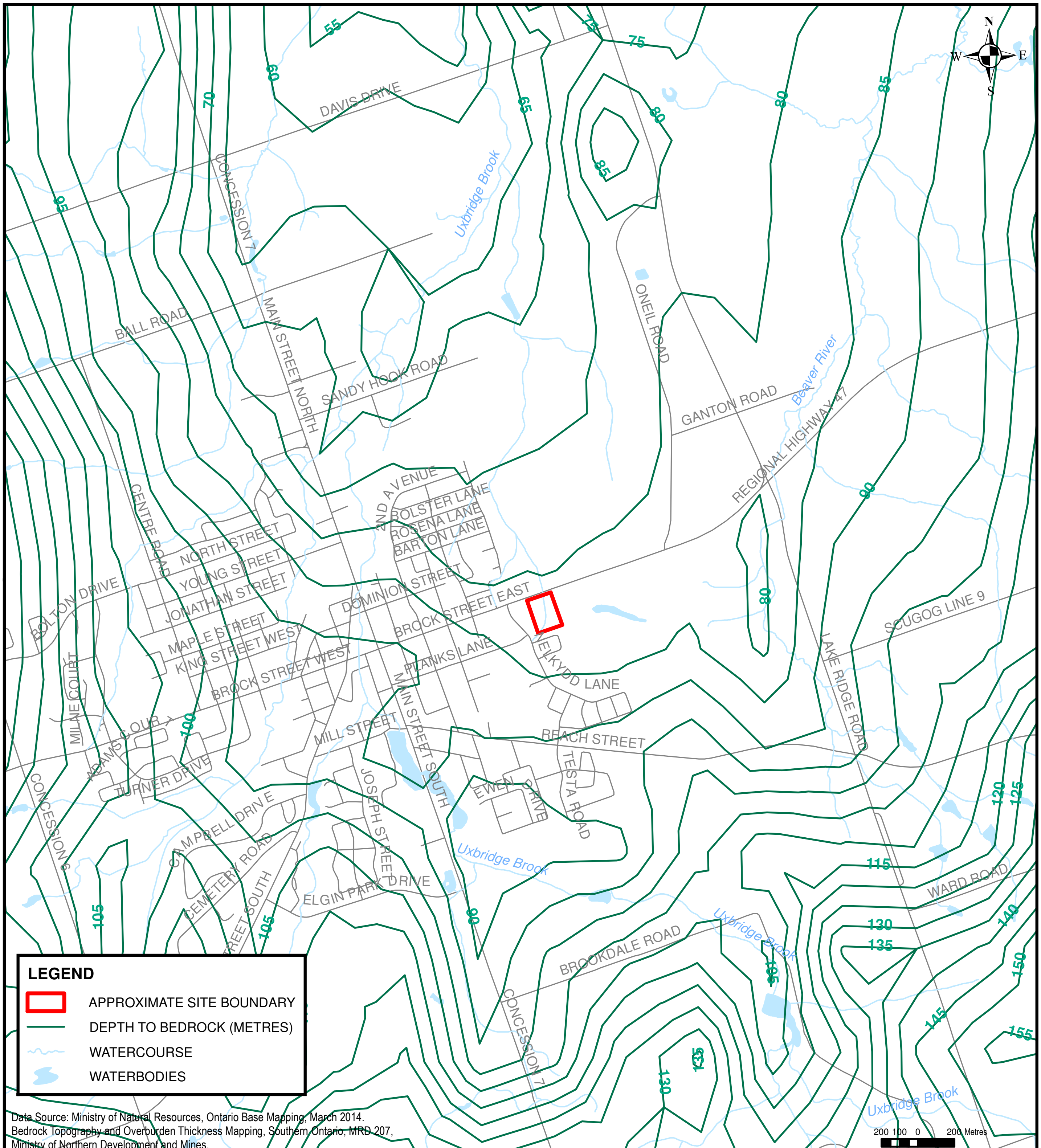

LEGEND

APPROXIMATE SITE BOUNDARY

DEPTH TO BEDROCK (METRES)

WATERCOURSE

WATERBODIES

Data Source: Ministry of Natural Resources, Ontario Base Mapping, March 2014.
Bedrock Topography and Overburden Thickness Mapping, Southern Ontario, MRD 207, Ministry of Northern Development and Mines.

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PROJECT:
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST, UXBRIDGE, ONTARIO

TITLE:
OVERBURDEN THICKNESS

CLIENT:
WESTLANE DEVELOPMENT GROUP LTD.

SCALE: 1:30,000

DRAWN BY: TP

CHECKED BY: LL

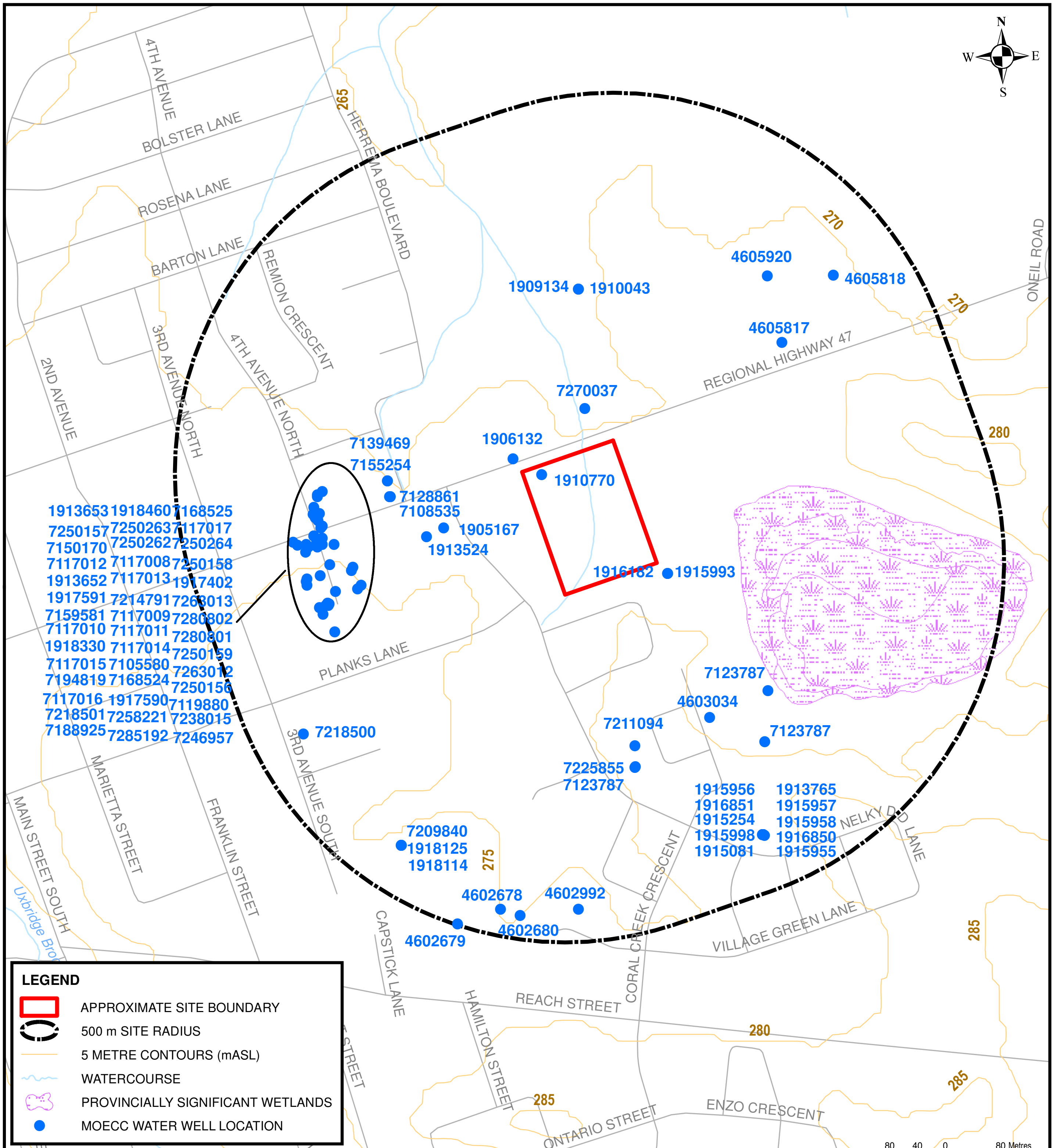
PROJECT NO: 181-06778-00 100

DATE: JULY 2018

FIGURE NO: 8

REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 8 Overburden Thickness.mxd



Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

wsp

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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: 1:8,000
	DRAWN BY: TP — CHECKED BY: LL
TITLE: MOECC WATER WELLS	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 9 — REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 9 MOECC Wells.mxd

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AURORA, ONTARIO CANADA L4G 0G9
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LEGEND

- PRE DEVELOPMENT CATCHMENT AREAS
- BUILDING
- CULTIVATED
- GRAVEL
- LAWNS
- UNCULTIVATED
- PRE DEVELOPMENT FLOW DIRECTION

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	
PROJECT: HYDROGEOLOGICAL AND WATER BALANCE ASSESSMENT 226 BROCK STREET EAST UXBRIDGE, ONTARIO	
PROJECT NO: 181-06778-00 100	DATE: JULY 2018
DESIGNED BY: -	
DRAWN BY: T.P.	
CHECKED BY: -	
FIGURE NO: 9	SCALE: 1:1,000
TITLE: PRE DEVELOPMENT SITE CATCHMENT AREAS	
DISCIPLINE: ENVIRONMENT	
ISSUE: -	REV.: -

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:	1:1,500
DRAWN BY:	TP
CHECKED BY:	LL
TITLE:	GROUNDWATER ELEVATIONS
PROJECT NO:	181-06778-00 100
DATE:	JULY 2018
CLIENT:	WESTLANE DEVELOPMENT GROUP LTD.
FIGURE NO:	10
REV.:	-

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 10 GW Flow.mxd

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AURORA, ONTARIO CANADA L4G 0G9
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LEGEND

- PRE DEVELOPMENT CATCHMENT AREAS
- BUILDING
- CULTIVATED
- GRAVEL
- LAWNS
- UNCULTIVATED
- PRE DEVELOPMENT FLOW DIRECTION

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

CLIENT:
WESTLANE DEVELOPMENT GROUP LTD.

PROJECT:
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST, UXBRIDGE, ONTARIO

PROJECT NO:	DATE:
181-06778-00 100	JULY 2018

DESIGNED BY: -

DRAWN BY: T.P.

CHECKED BY: LL

FIGURE NO:	SCALE:
11	1:1,000

TITLE:
PRE DEVELOPMENT SITE CATCHMENT AREAS

DISCIPLINE:
ENVIRONMENT

ISSUE:	REV.:
-	-

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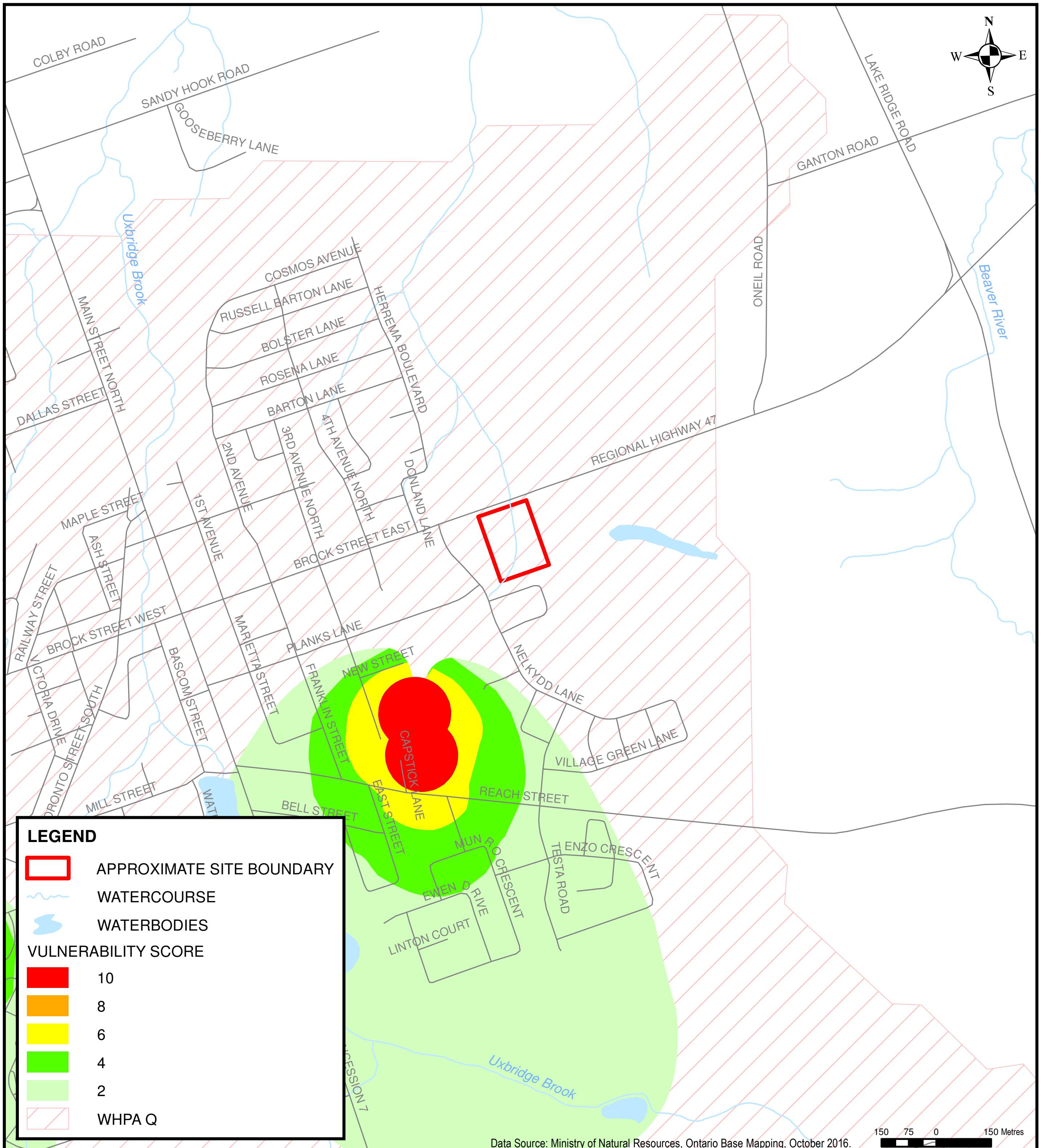
LEGEND

- POST DEVELOPMENT CATCHMENT AREAS
- BUILDING
- CULTIVATED
- DRIVEWAY
- GRAVEL
- LAWNS
- ROAD
- SIDEWALK
- UNCULTIVATED
- POST DEVELOPMENT FLOW DIRECTION

N W E S

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	
PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST UXBRIDGE, ONTARIO	
PROJECT NO: 181-06778-00 100	DATE: JULY 2018
DESIGNED BY: -	
DRAWN BY: T.P.	
CHECKED BY: LL	
FIGURE NO: 12	SCALE: 1:1,000
TITLE: POST DEVELOPMENT SITE CATCHMENT AREAS	
DISCIPLINE: ENVIRONMENT	
ISSUE: -	REV.: -



LEGEND

APPROXIMATE SITE BOUNDARY
WATERCOURSE
WATERBODIES

VULNERABILITY SCORE

10
8
6
4
2
WHPA Q

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2016.

150 75 0 150 Metres

wsp
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TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

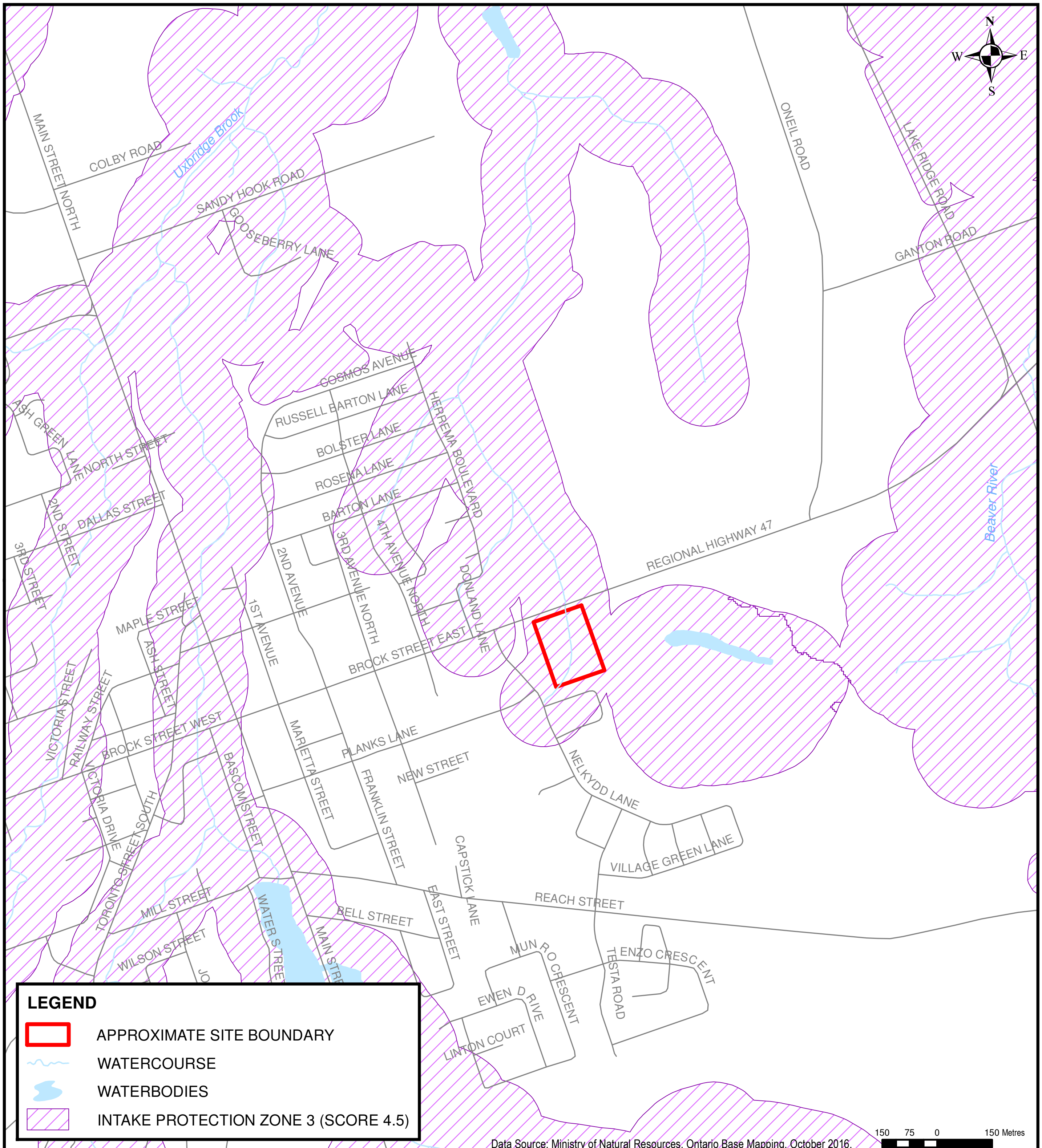
PROJECT:
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST, UXBRIDGE, ONTARIO

TITLE:
WELLHEAD PROTECTION AREAS

CLIENT:
WESTLANE DEVELOPMENT GROUP LTD.

SCALE: 1:15,000	
DRAWN BY: TP	CHECKED BY: LL
PROJECT NO: 181-06778-00 100	
DATE: JULY 2018	
FIGURE NO: 13	REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 13 WHPA.mxd

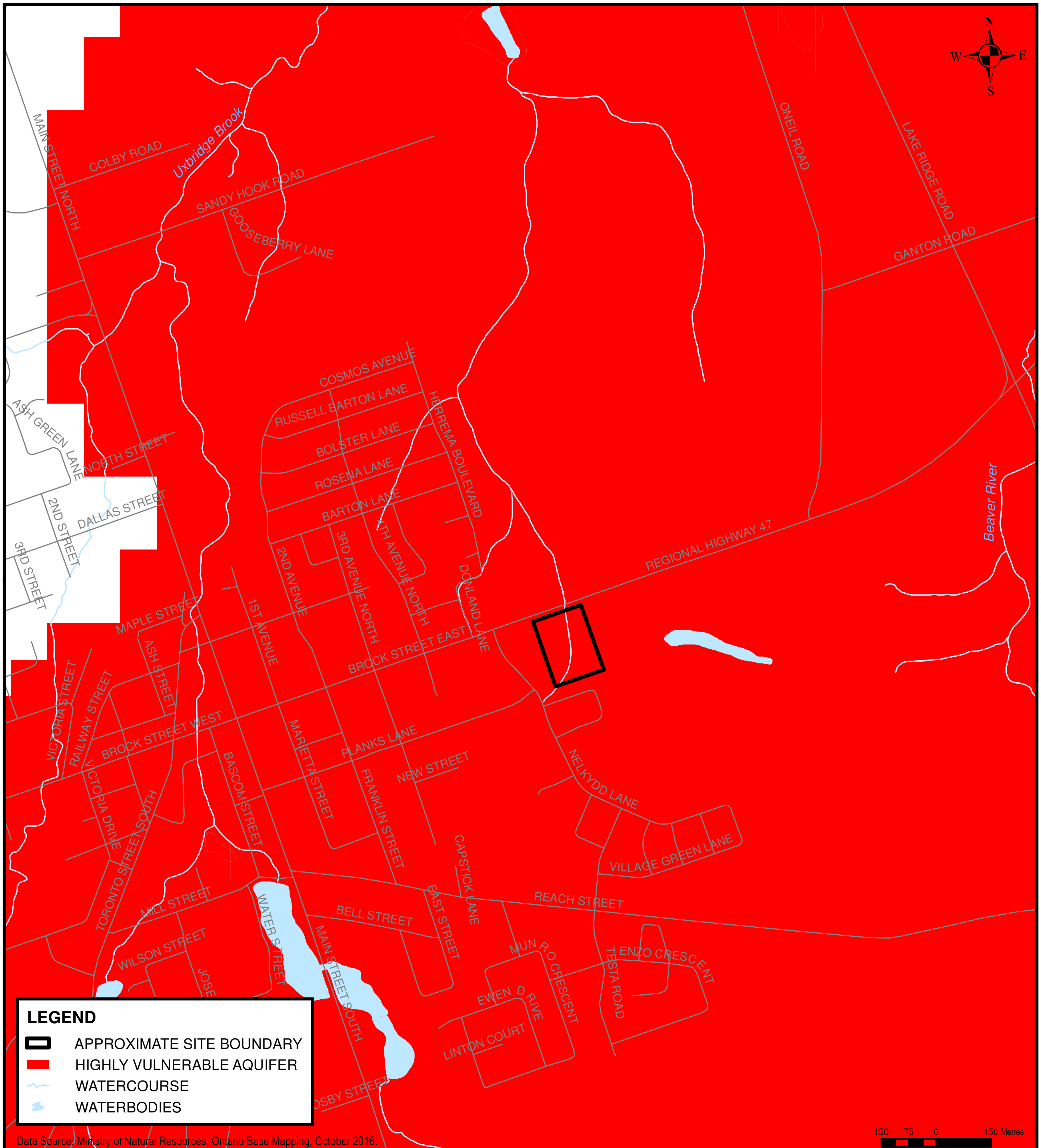


wsp

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: 1:15,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: INTAKE PROTECTION ZONES	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 14 / REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 14 IPZ.mxd



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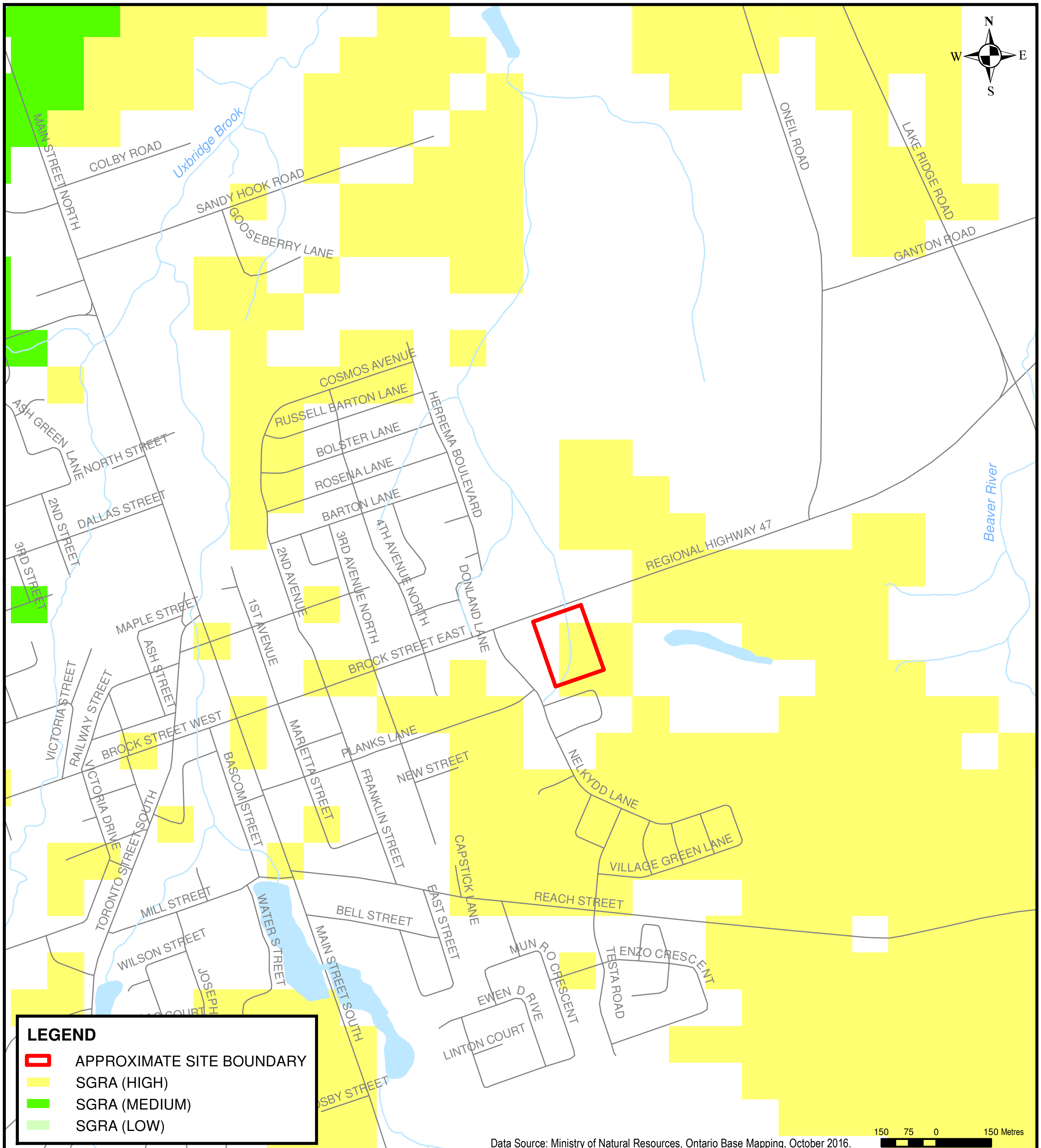
TEL.: 905-750-3080 | FAX: 905-727-0463 | WWW.WSP.COM

PROJECT: HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY 226 BROCK STREET EAST, UXBRIDGE, ONTARIO	SCALE: 1:15,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: HIGHLY VULNERABLE AQUIFERS	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 15 / REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 15 HVA.mxd



wsp

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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: 1:15,000
	DRAWN BY: TP / CHECKED BY: LL
TITLE: SIGNIFICANT GROUNDWATER RECHARGE AREAS	PROJECT NO: 181-06778-00 100
	DATE: JULY 2018
CLIENT: WESTLANE DEVELOPMENT GROUP LTD.	FIGURE NO: 16 / REV.: -

Document Path: T:\181-06778-00\MXD\181-06778-00 100 Figure 16 SGRA.mxd

APPENDIX

A

MECP WATER WELL RECORDS

Appendix A - Summary of MOECC Water Well Records within 500 m
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

Well ID	X	Y	Elevation (m)	Well Depth (m)	Construction Method	Water Level (m)	Water Yield	Units of Measurement	Water Use	Water Status	Formation Depth (m)	Material Colour	Material 1	Material 2	Material 3
1905167	651114.9	4885923	272.593658	4.87680006	Boring	3.048000097		GPM	Domestic	Water Supply	0.6		TOPSOIL		
											3.0	BROWN	CLAY	STONEY	
											4.9		COARSE SAND		
1906132	651214.9	4886023	271.525054	31.69919968	Cable Tool	25.90800095	20	GPM	Domestic	Water Supply	0.6	BLACK	TOPSOIL		
											5.2	BROWN	CLAY	SOFT	
											25.9	BLUE	CLAY	SOFT	
											29.0	BROWN	SAND	SILT	DIRTY
											31.7	BROWN	COARSE SAND		
1909134	651308.9	4886267	269.258789	22.86000061	Rotary (Convent.)	22.86000061	8	GPM	Domestic	Water Supply	16.5	BROWN	GRAVEL	CLAY	BOULDERS
											20.4	GREY	CLAY	BOULDERS	HARD
											22.9	GREY	SAND	CLEAN	
1910043	651308.9	4886267	269.258789	11.27760029	Rotary (Air)	11.27760029	6	GPM	Domestic	Water Supply	3.0	BROWN	CLAY	DENSE	
											4.6	BROWN	SAND	FINE SAND	
											11.3	GREY	SAND	FINE SAND	
1910770	651255.9	4886000	271.236328	24.38400078	Rotary (Air)	24.38400078	12	GPM	Domestic	Water Supply	3.7	BROWN	CLAY	SOFT	
											5.2	GREY	CLAY	SOFT	
											17.4	BLUE	SILT	SOFT	
											21.3	BROWN	SAND	MEDIUM SAND	
											24.4	BROWN	SAND	MEDIUM SAND	CLEAN
1913524	651090	4885911	272.539215	23.46960068	Rotary (Air)	23.46960068	40	GPM	Domestic	Water Supply	4.6	BROWN	SAND	PACKED	
											12.2	GREY	CLAY	SOFT	
											17.1	GREY	SILT	SOFT	
											23.5	BROWN	SAND	GRAVEL	COARSE-GRAINED
4603034	651497.9	4885651	274.356475	28.34640121	Cable Tool	28.34640121	9	GPM	Irrigation	Water Supply	9.1		PREVIOUSLY DUG		
											15.8		CLAY	MEDIUM SAND	
											18.6	RED	FINE SAND		
											25.0	BLUE	MEDIUM SAND		
											28.3	BLACK	MEDIUM SAND		
4605817	651601.9	4886190	272.364318	10.66800022	Boring	6.705600262	0	GPM	Livestock	Water Supply	1.2		CLAY		
											5.5		SAND		
											6.4		SANDSTONE		
											9.4		QUICKSAND		
											10.7		COARSE SAND		
4605818	651675.9	4886287	270.361145	10.66800022	Boring	7.924799919		GPM	Livestock	Water Supply	3.7		CLAY		
											6.7		SAND		
											9.1		SANDSTONE		
											10.7		SAND	GRAVEL	
4605920	651580.9	4886286	270.920379	27.43200111	Rotary (Convent.)	27.43200111	9	GPM	Livestock	Water Supply	7.6	BROWN	SAND	CLAY	
											27.4	BROWN	SAND		
7105580	650938	4885870	275.0	4.2	Auger	2.4			Not Used	Other Status	4.2	BROWN	MEDIUM SAND		
1913652	650932	4885903	274.26773							Test Hole	4.572000027	BROWN	SAND	SILT	LOOSE
1913653	650928	4885912	274.034484							Test Hole	5.486400127	BROWN	SAND	SILT	LOOSE
1915993	651437.2	4885858	273.423126							Abandoned-Other					
1916182	651437.2	4885858	273.423126							Abandoned-Other					
1917402	650928	4885912	274.034484							Observation Wells	1.22	BROWN	SAND		
											4.28	BROWN	SAND	WATER-BEARING	
1917590	650959	4885832	275.415618							Observation Wells	0.15	BROWN	GRAVEL		
											4.5	BROWN	SAND		
1917591	650957	4885900	274.293457							Observation Wells	3	BROWN	SAND	DRY	
											4.5	BROWN	SAND		
1918330	650940	4885900	274.353515							Observation Wells	2.4	BROWN	MEDIUM SAND	GRAVEL	
											3.6	BROWN	MEDIUM SAND	GRAVEL	
1918460	651037	4885968	270.425231						Not Used	Test Hole	0.1				
											0.3		GRAVEL	SANDY	FILL
											2	BROWN	SAND	SILT	
											2.3	BROWN	SILT	SAND	
											6	BROWN	SAND	SILT	
7108535	651038	4885968	270.408782							Abandoned-Other					
7117008	650934	4885934	273.390747						Test Hole	Test Hole	1.2	BROWN	SAND		MEDIUM-GRAINED
											3	BROWN	SAND	SILT	
											5.1	BROWN	SAND	SILT	COARSE-GRAINED
7117009	650898	4885903	274.189971							7258221	1.2	BROWN	SAND		MEDIUM-GRAINED
											1.8	BROWN	SAND	SILT	MEDIUM-GRAINED
											4.5	BROWN	SAND	SILT	WATER-BEARING
7117010	650940	4885909	274.099853						Test Hole	Test Hole	0.6	BROWN	SAND		COARSE-GRAINED
											1.8	BROWN	SAND	SILT	MEDIUM-GRAINED
											4.5	BROWN	SAND	SILT	WATER-BEARING
7117011	650933	4885896	274.444671						Test Hole	Test Hole	0.6	BROWN	SAND	GRAVEL	COARSE-GRAINED
											1.8	BROWN	SAND	SILT	FINE-GRAINED
											4.2	BROWN	SAND	SILT	WATER-BEARING
											4.6	GREY	SILT	SAND	WATER-BEARING
7117012	650904	4885899	274.299011						Test Hole	Test Hole	1.8	BROWN	SAND		FINE-GRAINED
											3	BROWN	SAND	SILT	
											4.5	BROWN	SAND	SILT	MEDIUM-GRAINED
7117013	650951	4885871	275.050262						Test Hole	Test Hole	1.5	BROWN	SAND	MEDIUM GRAVEL	
											2.8	BROWN	SAND	SILT	
											3.6	BROWN	SAND	CLAY	SILT
											4.8	BROWN	SAND	SILT	CLAY
											5.1	BROWN	SILT	CLAY	WATER-BEARING
											5.9	BROWN	CLAY	SILT	WATER-BEARING
7117014	650917	4885846	275.190399						Test Hole	Test Hole	1.8	BROWN	SAND		FINE-GRAINED
											3	BROWN	SAND	SILTY	WATER-BEARING
											4.5	BROWN	SAND		WATER-BEARING
7117015	650984	4885867	274.794677						Test Hole	Test Hole	0.3	BROWN	TOPSOIL		
											3.8	BROWN	SAND		WATER-BEARING
7117016	650991	4885836	275.18045						Test Hole	Test Hole	1.5	BROWN	SAND		MEDIUM-GRAINED
											5.3	BROWN	SAND	SILT	CLAY
											5.9	GREY	CLAY		WATER-BEARING
7117017	650958	4885774	275.578857						Test Hole	Test Hole	1.2	BROWN	SAND	MEDIUM-GRAINED	
											3.6	BROWN	SAND	SILT	MEDIUM-GRAINED
											5.4	BROWN	SAND	SILT	WATER-BEARING
7119880	650950	4885814	275.5						Test Hole	Test Hole	3.8	BROWN	SAND		SOFT
											4.4	BROWN	CLAY		SOFT
											5.2	BROWN	SAND		SOFT
7123787	651582	4885689	273.245361						Monitoring and Test	Test Hole	10	BROWN	SAND	SILT	WATER-BEARING
											15	GREY	SAND	SILT	WATER-BEARING
7128861	651038	4885968	270.408782							Abandoned-Other					

7139469	651034	4885991	270.067626						Not Used	Test Hole	0.9	GREY	STONES	GRAVEL	
											3.05	BROWN	SAND	SILT	SILTY
7150170	650938	4885903	274.272674							Abandoned-Other					
7155254	651034	4885991													
7159581	650920	4885896							Test Hole	Test Hole	3	BROWN	FILL	SAND	LOOSE
											7	BROWN	FILL	SAND	GRAVEL
											15	BROWN	FILL	SAND	WATER-BEARING
7168524	650916	4885889								Abandoned-Other					
7168525	650982	4885862								Abandoned-Other					
7188925	650996	4885841													
7194819	650937	4885855							Test Hole	Test Hole	3.657599926	BROWN	FILL		LOOSE
											4.572000027	BROWN	MEDIUM SAND		WATER-BEARING
7211094	651390	4885610								Abandoned-Other					
7214791	650918	4885850								Abandoned Monitoring and Test Hole					
7218500	650913	4885627							Test Hole	Test Hole	0.304800004	BROWN	TOPSOIL	HARD	DENSE
											3.96239996	YELLOW	SAND	SILT	
											4.572000027	YELLOW	SAND	CLAY	WATER-BEARING
7218501	650918	4885841							Test Hole	Test Hole	0.304800004	BROWN	TOPSOIL	HARD	DENSE
											3.96239996	YELLOW	SAND	SILT	
											4.572000027	YELLOW	SAND	CLAY	WATER-BEARING
7225855	651390	4885579							Not Used	Abandoned-Other					
7238015	650948	4885815													
7246957	650949	4885812							Test Hole	Test Hole	2.43840003	BROWN	SAND		
											4.572000027	BROWN	SAND		WATER-BEARING
7250156	650927	4885943							Test Hole	Observation Wells	1	BROWN	TOPSOIL	LOOSE	
											5	BROWN	FILL	LOOSE	
											17.5	GREY	SILT	CLAY	SOFT
7250157	650930	4885938							Test Hole	Observation Wells	1	BROWN	TOPSOIL	LOOSE	
											5	BROWN	FILL	LOOSE	
											17.5	GREY	SILT	CLAY	SOFT
7250158	650928	4885953							Test Hole	Observation Wells	1	BROWN	TOPSOIL	SOFT	
											5	BROWN	SAND	SILT	SOFT
											15	GREY	SILT	CLAY	SOFT
7250159	650936	4885944							Test Hole	Observation Wells	1	BROWN	TOPSOIL	SOFT	
											5	BROWN	SAND	SILT	SOFT
											15	GREY	SILT	CLAY	SOFT
7250262	650933	4885968							Test Hole	Observation Wells	0.152400002	BROWN	TOPSOIL	LOOSE	
											0.304800004	BROWN	SAND	SILT	LOOSE
											2.743200064	BROWN	SILT	CLAY	LOOSE
											4.572000027	GREY	SILT	CLAY	LOOSE
7250263	650933	4885971							Test Hole	Observation Wells	0.152400002	BROWN	TOPSOIL	LOOSE	
											0.304800004	BROWN	SAND	SILT	LOOSE
											2.743200064	BROWN	SILT	CLAY	LOOSE
											4.572000027	GREY	SILT	CLAY	LOOSE
7250264	650940	4885976							Test Hole	Observation Wells	0.152400002	BROWN	TOPSOIL	LOOSE	
											0.304800004	BROWN	SAND	SILT	LOOSE
											2.743200064	BROWN	SILT	CLAY	LOOSE
											4.572000027	GREY	SILT	CLAY	LOOSE
7258221	650941	4885799							Monitoring	Observation Wells	0.300000012	BROWN	TOPSOIL		TOPSOIL
											2.440000057	BROWN	SAND		SOFT
											4.570000172	BROWN	SAND		WATER-BEARING
7263012	650940	4885926													
7263013	650938	4885923													
1915081	651574.7	4885482	278.811401	21.33600044	Rotary (Air)	21.33600044	10	GPM	Domestic	Water Supply	3.657599926	BROWN	SAND	PACKED	
											17.37360001	GREY	CLAY	SOFT	
											21.33600044	BROWN	FINE SAND		
1915998	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	49.37760162		GPM	Irrigation	Water Supply	3.657599926	BLACK	SAND		
											7.924799919	BROWN	CLAY	STONES	
											19.81200027	GREY	CLAY	STONES	
											24.99360085		COARSE SAND	STONES	
											40.23360062	GREY	CLAY	STONES	
											49.37760162		COARSE SAND	STONES	
1916850	651575.2	4885482	278.82492	72.23760223	Rotary (Convent.)	61.26480103	200	GPM	Not Used		0.304800004	BLACK	TOPSOIL		
											1.828799963	BROWN	SAND	GRAVEL	
											4.572000027	BROWN	CLAY	SANDY	GRAVEL
											7.924799919	GREY	CLAY	SANDY	GRAVEL
											13.10640049	BROWN	SAND	SILTY	CLAY
											16.45919991	BROWN	SILT	SAND	WATER-BEARING
											19.50720024	GREY	SILT	SAND	CLAY
											24.99360085	GREY	SAND	SILTY	WATER-BEARING
											30.78479958	GREY	CLAY	SILTY	GRAVEL
											33.52799988	GREY	CLAY	SILTY	GRAVEL
											36.88080215	GREY	CLAY	SILTY	SAND
											41.45280075	GREY	CLAY	SANDY	SILT
											51.81600189	GREY	SAND	SILT	WATER-BEARING
											58.21680069	GREY	FINE SAND	SILT	WATER-BEARING
											59.43600082	GREY	SAND	GRAVEL	WATER-BEARING
											62.48400116	GREY	SAND	GRAVEL	WATER-BEARING
											64.00800323	GREY	SAND	GRAVEL	WATER-BEARING
											68.58000183	GREY	SAND	GRAVEL	WATER-BEARING
											70.40879822	GREY	SAND	GRAVEL	WATER-BEARING
											72.23760223	GREY	CLAY	SANDY	GRAVEL
1916851	651575.2	4885482	278.82492	84.42960358	Rotary (Air)	78.02880096	49	GPM	Not Used		0.304800004	BLACK	TOPSOIL		
											2.133599997	BROWN	SAND	SILTY	
											6.400800228	BROWN	CLAY	SILT	
											7.619999886	BROWN	CLAY	SILT	SAND
											12.19200039	BROWN	CLAY	SANDY	SILT
											18.28800011	BROWN	FINE SAND	SILT	
											19.20240021	BROWN	CLAY	SILTY	
											19.81200027	GREY	CLAY	SILTY	
											24.99360085	BROWN	FINE SAND	SILT	WATER-BEARING
											26.21280098	BROWN	SAND	GRAVEL	WATER-BEARING
											28.65120125	GREY	CLAY	SANDY	GRAVEL
											31.08959961	GREY	SAND	GRAVEL	WATER-BEARING
											33.52799988	GREY	CLAY	SILTY	SAND
											39.62400055	GREY	SILT	CLAY	WATER-BEARING
											41.45280075	GREY	CLAY	SANDY	SILT
											43.58639908	GREY	CLAY	SILT	WATER-BEARING
											45.72000122	GREY	CLAY	SANDY	SILT
											51.81600189	GREY	SILT	SANDY	WATER-BEARING
											54.25440216	GREY	SAND	GRAVEL	WATER-BEARING
											61.26480103	GREY	FINE SAND	WATER-BEARING	
											62.78879929	GREY	SAND	GRAVEL	WATER-BEARING
											64.00800323	GREY	SAND	GRAVEL	WATER-BEARING
											65.83679962	GREY	SAND	WATER-BEARING	
											84.42960358	BLACK	SHALE		

1918125	651054	4885467	275.167114	71.59999847	Rotary (Air)	38		GPM	Municipal	Water Supply	0.899999976	BROWN	TOPSOIL		
											2.099999905		SAND	SILT	
											6.099999905	GREY	CLAY	SILT	
											25	GREY	SAND	SILT	
											27.39999962	GREY	CLAY		
											30.5	GREY	SILT		
											38	GREY	CLAY	SILT	
											42.70000076	GREY	SILT	SAND	
											59.40000153	GREY	SAND	SILT	
											61	GREY	GRAVEL	SAND	
											64	GREY	SAND	SILT	
											65.5	GREY	GRAVEL	SAND	
											71.59999847	GREY	SAND	SILT	
4602678	651196.9	4885375	274.979156	85.34400177	Rotary (Convent.)	57.91200256	33	GPM	Not Used	Test Hole	0.304800004		TOPSOIL		
											1.219200015		MEDIUM SAND	CLAY	
											2.743200064		MEDIUM SAND	GRAVEL	
											27.43200111		CLAY		
											37.79520035		CLAY	GRAVEL	
											41.14799881		CLAY	MEDIUM SAND	
											45.72000122		FINE SAND	SILT	
											52.42560196		FINE SAND	GRAVEL	
											55.16880035		MEDIUM SAND	GRAVEL	CLAY
											56.99760056		FINE SAND	GRAVEL	
											57.3024025	BROWN	CLAY	GRAVEL	
											57.91200256		FINE SAND	GRAVEL	
											62.48400116		MEDIUM SAND	GRAVEL	
											77.11440277		MEDIUM SAND	GRAVEL	CLAY
											85.34400177		CLAY	MEDIUM SAND	GRAVEL
4602679	651134.9	4885354	276.160461	77.11440277	Cable Tool	45.72000122	220	GPM	Industrial	Water Supply	0.304800004		TOPSOIL		
											0.914399981		CLAY	MEDIUM SAND	
											7.010400295	BROWN	CLAY	STONES	
											15.5447998		MEDIUM SAND	SILT	CLAY
											16.76399994		MEDIUM SAND	SILT	
											20.42160034		MEDIUM SAND	SILT	CLAY
											21.94560051		COARSE SAND		
											25.29840088		FINE SAND		
											31.69919968		CLAY	GRAVEL	
											45.72000122		FINE SAND	SILT	GRAVEL
											54.25440216		FINE SAND	GRAVEL	CLAY
											59.74079895		FINE SAND	GRAVEL	SILT
											68.88480377		MEDIUM SAND	GRAVEL	BOULDERS
											70.71360016		MEDIUM SAND	GRAVEL	SILT
											76.80960083		MEDIUM SAND	GRAVEL	
											77.11440277		MEDIUM SAND	GRAVEL	BOULDERS
4602680	651224.9	4885366	274.987609	78.02880096	Rotary (Convent.)	61.26480103	32	GPM	Not Used	Test Hole	0.304800004		TOPSOIL		
											0.914399981		MEDIUM SAND	CLAY	
											5.791200161		CLAY		
											19.50720024		CLAY	MEDIUM SAND	
											21.64080048		MEDIUM SAND	GRAVEL	CLAY
											23.77440071		FINE SAND	CLAY	
											32.00400162	GREY	CLAY		
											36.88080215		SILT	MEDIUM SAND	
											51.81600189		FINE SAND	GRAVEL	SILT
											56.38800049		CLAY	MEDIUM SAND	GRAVEL
											61.26480103		MEDIUM SAND	GRAVEL	CLAY
											67.05599976		GRAVEL	MEDIUM SAND	CLAY
											68.27519989		MEDIUM SAND	GRAVEL	BOULDERS
											70.10400391		BOULDERS	MEDIUM SAND	GRAVEL
											71.32320404		MEDIUM SAND	GRAVEL	CLAY
											76.20000458		MEDIUM SAND	GRAVEL	CLAY
											77.41920471		BOULDERS	MEDIUM SAND	GRAVEL
											78.02880096		FINE SAND	CLAY	GRAVEL
4602992	651308.9	4885375	275.827636	77.72399902	Rotary (Convent.)	53.64480209		GPM	Not Used	Test Hole	0.304800004		TOPSOIL		
											0.914399981		MEDIUM SAND	CLAY	
											4.572000027	GREY	CLAY		
											23.77440071		FINE SAND	CLAY	GRAVEL
											25.60320091		MEDIUM SAND	GRAVEL	CLAY
											38.10000229	GREY	CLAY	GRAVEL	
											48.46319962		FINE SAND	CLAY	GRAVEL
											53.64480209		CLAY	MEDIUM SAND	GRAVEL
											56.69280243		FINE SAND	GRAVEL	
											61.87440109		FINE SAND	GRAVEL	CLAY
											65.83679962		CLAY	MEDIUM SAND	
											69.18959808	GREY	CLAY	GRAVEL	
											72.54240417		GRAVEL	MEDIUM SAND	CLAY
											74.98080444		GRAVEL	MEDIUM SAND	CLAY
											77.72399902	GREY	CLAY	GRAVEL	
1913765	651576.9	4885481	278.858917		Not Known					Abandoned-Other					
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	0.609600008	BLACK	TOPSOIL		
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	2.43840003	BROWN	SAND	SILTY	
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	3.657599926	BROWN	CLAY		
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	7.924799919	GREY	CLAY		
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	12.19200039	BROWN	CLAY	SANDY	
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	39.62400055	GREY	CLAY	GRAVEL	
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	47.85359955	GREY	SAND	GRAVEL	
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	60.95999908	GREY	SAND	GRAVEL	CLAY
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	75.89520264	GREY	COARSE SAND	COARSE GRAVEL	WATER-BEARING
1915254	651575.2	4885482	278.82492	78.33360291	Rotary (Convent.)					Observation Wells	78.33360291	GREY	GRAVEL	SANDY	CLAY
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	3.048000097	BLACK	SAND		
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	11.27760029	BROWN	CLAY	STONES	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	15.84959984	GREY	CLAY	STONES	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	19.20240021	BROWN	FINE SAND		
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	28.34640121	GREY	CLAY	STONES	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	30.17519951		GRAVEL	CEMENTED	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	31.08959961	GREY	CLAY	STONES	

1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	34.13759995		GRAVEL	CEMENTED	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	89.91600037	GREY	CLAY	STONES	
1915955	651574.2	4885482	278.797729	92.04959869	Rotary (Convent.)					Abandoned-Supply	92.04959869	BLACK	SHALE		
1915956	651574.2	4885482	278.797729	46.32960129	Rotary (Convent.)					Abandoned-Supply	3.657599926	BLACK	SAND		
1915956	651574.2	4885482	278.797729	46.32960129	Rotary (Convent.)					Abandoned-Supply	7.924799919	BROWN	CLAY	STONES	
1915956	651574.2	4885482	278.797729	46.32960129	Rotary (Convent.)					Abandoned-Supply	19.81200027	GREY	CLAY	STONES	
1915956	651574.2	4885482	278.797729	46.32960129	Rotary (Convent.)					Abandoned-Supply	24.99360085		COARSE SAND	STONES	
1915956	651574.2	4885482	278.797729	46.32960129	Rotary (Convent.)					Abandoned-Supply	46.32960129	GREY	CLAY	STONES	
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	3.657599926	BLACK	SAND		
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	7.924799919	BROWN	CLAY	STONES	
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	19.81200027	GREY	CLAY	STONES	
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	24.99360085		COARSE SAND	STONES	
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	40.23360062	GREY	CLAY	STONES	
1915957	651574.2	4885482	278.797729	49.37760162	Rotary (Convent.)	40.23360062				Observation Wells	49.37760162		COARSE SAND	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	3.657599926	BLACK	SAND		
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	9.753600121	BROWN	CLAY		
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	19.50720024		CLAY	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	24.99360085		COARSE SAND	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	40.23360062	GREY	CLAY	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	49.37760162		COARSE SAND	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	79.2480011	GREY	CLAY	STONES	
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	90.52560425	GREY	CLAY		
1915958	651574.2	4885482	278.797729	95.09760284	Rotary (Convent.)					Abandoned-Supply	95.09760284	BLACK	SHALE		
1918114	651054	4885467	275.167114		Rotary (Air)					Abandoned-Other					
7209840	651054	4885467	275.166687						Municipal	Water Supply					

APPENDIX

B BOREHOLE LOGS

BOREHOLE NO. MW18-1

PROJECT NAME: 226 BROCK STREET
PROJECT NO.: 181-06778-00
CLIENT: OXFORD HOMES
DATE COMPLETED: May 16, 2018
BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER
SUPERVISOR: JSW
GROUND ELEVATION: NOT DETERMINED
REVIEWER: LAL

UTM CO-ORDINATES
UTM Zone: NAD:
Easting:
Northing:

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0		**TOPSOIL:** Dark brown, trace sand, some rootlets, moist.						
0.2		**SAND:** Orangey brown, moist.	SS1	4		50		
0.8		**SILTY SAND:** Brown, silty sand, very wet to saturated, loose.	SS2	6		58		
		- Brown to orangy brown	SS3	12		46		
2.3		**SILT:** Brown to orangy brown, some sand, saturated.	SS4	13		63		
3.0		**SANDY SILT:** Brown, trace clay, saturated.						
3.3		**SILTY CLAY:** Silty clay, trace sand, wet to very wet.	SS5	13		75		
			SS6	8				
4.6		Borehole terminated at 4.6 m in **SILTY CLAY**						

Column headings: STRATIGRAPHY; MONITOR DETAILS; CONE PENETRATION "N" VALUE 10 20 30, SHEAR STRENGTH; WATER CONTENT % 10 20 30, W_P W_L

WSP

BOREHOLE NO. MW18-2

PROJECT NAME: 226 BROCK STREET

PROJECT NO.: 181-06778-00

CLIENT: OXFORD HOMES

DATE COMPLETED: May 17, 2018

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER

SUPERVISOR: JSW

GROUND ELEVATION: NOT DETERMINED

REVIEWER: LAL

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)	REMARKS
0.0		**TOPSOIL:** Dark brown, some silt, some rootlets, very moist.						
0.1		**SILTY SAND:** Light brown, orange mottling, very moist.	SS1	13		88		
0.8		**SAND:** Light brown to orange mottling, wet, very wet in last 5.1 cm.	SS2	15		60		
		- Very wet to saturated	SS3	19		88		
2.3		**CLAY:** Light grey, trace cobble, moist to wet.	SS4	13		69		
3.0		Borehole terminated at 3.0 m in **CLAY**.						

Column headings: STRATIGRAPHY; MONITOR DETAILS; SAMPLE; CONE PENETRATION "N" VALUE 10 20 30, SHEAR STRENGTH; WATER CONTENT % 10 20 30, W_P W_L

UTM CO-ORDINATES
UTM Zone: NAD:
Easting:
Northing:

BOREHOLE NO. MW18-3

PROJECT NAME: 226 BROCK STREET **PROJECT NO.:** 181-06778-00

CLIENT: OXFORD HOMES **DATE COMPLETED:** May 16, 2018

BOREHOLE TYPE: 210 mm HOLLOW STEM AUGER **SUPERVISOR:** JSW

GROUND ELEVATION: NOT DETERMINED **REVIEWER:** LAL

DEPTH (m)	ELEV (mASL)	STRATIGRAPHIC DESCRIPTION	SAMPLE TYPE	N VALUE	% WATER	% RECOVERY	RQD (%)
0.0		**SILTY TOPSOIL:** Dark brown, some rootlets, trace orange mottling, wet.	SS1	2		79	
0.8		**SANDY SILT TO SILTY SAND:** light brown, fine. - Light brown to grey, trace clay, orange stains throughout, very wet.	SS2	7		79	
1.5		**SILTY CLAY:** Grey, trace sand, orange staining, wet to saturated.	SS3	4		79	
2.2		**SILTY SAND TO SAND:** GREY TO greyish brown, trace clay, saturated.					
2.5		**CLAY:** Grey, some silt, trace sand, saturated.	SS4	14		83	
		- Interbedded with seams of sand, saturated.	SS5	8			
3.8		Borehole terminated at 3.8 m in **CLAY**					

Column headings: STRATIGRAPHY; MONITOR DETAILS; CONE PENETRATION "N" VALUE (10 20 30), SHEAR STRENGTH; WATER CONTENT % (10 20 30), W_P W_L; REMARKS

UTM CO-ORDINATES
UTM Zone: NAD:
Easting:
Northing:

APPENDIX

C WATER QUALITY

WSP Canada Inc. (Aurora)
ATTN: Jake Whittamore
126 Don Hilock Drive
Unit 2
Aurora ON L4G 0G9

Date Received: 22-JUN-18
Report Date: 29-JUN-18 10:05 (MT)
Version: FINAL

Client Phone: 289-984-0418

Certificate of Analysis

Lab Work Order #: L2117286

Project P.O. #:	NOT SUBMITTED
Job Reference:	181-06778-00/100/1003
C of C Numbers:	17-624360
Legal Site Desc:	

Mary-Lynn Pike
Client Services Supervisor

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-1 MW 18-1 Sampled By: CLIENT on 21-JUN-18 @ 11:20 Matrix: WATER							
Physical Tests							
Colour, Apparent	87.8		2.0	CU		25-JUN-18	R4096736
Conductivity	383		3.0	umhos/cm		23-JUN-18	R4096667
pH	7.74		0.10	pH units		23-JUN-18	R4096667
Total Dissolved Solids	272	DLDS	20	mg/L		27-JUN-18	R4099427
Turbidity	>4000		0.10	NTU		22-JUN-18	R4095398
Anions and Nutrients							
Alkalinity, Bicarbonate (as CaCO3)	202		10	mg/L		27-JUN-18	R4098480
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Total (as CaCO3)	202		10	mg/L		27-JUN-18	R4098480
Ammonia, Total (as N)	0.127		0.020	mg/L		25-JUN-18	R4096446
Bromide (Br)	<0.10		0.10	mg/L		26-JUN-18	R4098230
Chloride (Cl)	1.25		0.50	mg/L		26-JUN-18	R4098230
Computed Conductivity	373			uS/cm		28-JUN-18	
Conductivity % Difference	-2.6			%		28-JUN-18	
Fluoride (F)	0.048		0.020	mg/L		26-JUN-18	R4098230
Hardness (as CaCO3)	215			mg/L		28-JUN-18	
Ion Balance	132			%		28-JUN-18	
Langelier Index	0.5					28-JUN-18	
Nitrate and Nitrite as N	0.147		0.022	mg/L		27-JUN-18	
Nitrate (as N)	0.147		0.020	mg/L		26-JUN-18	R4098230
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-18	R4098230
Saturation pH	7.21			pH		28-JUN-18	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		25-JUN-18	R4096504
TDS (Calculated)	224			mg/L		28-JUN-18	
Sulfate (SO4)	8.39		0.30	mg/L		26-JUN-18	R4098230
Anion Sum	3.56			me/L		28-JUN-18	
Cation Sum	4.70			me/L		28-JUN-18	
Cation - Anion Balance	13.9			%		28-JUN-18	
Organic / Inorganic Carbon							
Dissolved Organic Carbon	2.0		1.0	mg/L		28-JUN-18	R4102418
Inorganic Parameters							
Silica	10.5		0.11	mg/L		26-JUN-18	
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					25-JUN-18	R4096104
Aluminum (Al)-Dissolved	0.0323		0.0050	mg/L	25-JUN-18	25-JUN-18	R4097078
Antimony (Sb)-Dissolved	0.00027		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Arsenic (As)-Dissolved	0.00052		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Barium (Ba)-Dissolved	0.0343		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Boron (B)-Dissolved	0.024		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-1 MW 18-1 Sampled By: CLIENT on 21-JUN-18 @ 11:20 Matrix: WATER							
Dissolved Metals							
Cadmium (Cd)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Calcium (Ca)-Dissolved	78.8		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Chromium (Cr)-Dissolved	0.00079		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Cobalt (Co)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Copper (Cu)-Dissolved	0.00067		0.00020	mg/L	25-JUN-18	25-JUN-18	R4097078
Iron (Fe)-Dissolved	0.035		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Lead (Pb)-Dissolved	0.000053		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Magnesium (Mg)-Dissolved	4.42		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Manganese (Mn)-Dissolved	0.00505		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Molybdenum (Mo)-Dissolved	0.00335		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Nickel (Ni)-Dissolved	<0.00050		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Potassium (K)-Dissolved	0.637		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Selenium (Se)-Dissolved	0.000501		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silicon (Si)-Dissolved	4.92		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Sodium (Na)-Dissolved	8.72		0.50	mg/L	25-JUN-18	25-JUN-18	R4097078
Strontium (Sr)-Dissolved	0.152		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Sulfur (S)-Dissolved	<5.0		5.0	mg/L	25-JUN-18	25-JUN-18	R4097078
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Titanium (Ti)-Dissolved	0.00142		0.00030	mg/L	25-JUN-18	25-JUN-18	R4097078
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Uranium (U)-Dissolved	0.000727		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Vanadium (V)-Dissolved	0.00074		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Zinc (Zn)-Dissolved	0.0015		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	26-JUN-18	R4097078
L2117286-2 MW 18-2 Sampled By: CLIENT on 21-JUN-18 @ 11:35 Matrix: WATER							
Physical Tests							
Colour, Apparent	96.6		2.0	CU		25-JUN-18	R4096736
Conductivity	878		3.0	umhos/cm		23-JUN-18	R4096667
pH	7.94		0.10	pH units		23-JUN-18	R4096667
Total Dissolved Solids	528	DLDS	20	mg/L		27-JUN-18	R4099427
Turbidity	339		0.10	NTU		22-JUN-18	R4095398
Anions and Nutrients							
Alkalinity, Bicarbonate (as CaCO3)	293		10	mg/L		27-JUN-18	R4098480
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Total (as CaCO3)	293		10	mg/L		27-JUN-18	R4098480
Ammonia, Total (as N)	0.113		0.020	mg/L		25-JUN-18	R4096446

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-2 MW 18-2							
Sampled By: CLIENT on 21-JUN-18 @ 11:35							
Matrix: WATER							
Anions and Nutrients							
Bromide (Br)	<0.10		0.10	mg/L		26-JUN-18	R4098230
Chloride (Cl)	112		0.50	mg/L		26-JUN-18	R4098230
Computed Conductivity	829			uS/cm		28-JUN-18	
Conductivity % Difference	-5.7			%		28-JUN-18	
Fluoride (F)	0.043		0.020	mg/L		26-JUN-18	R4098230
Hardness (as CaCO3)	324			mg/L		28-JUN-18	
Ion Balance	121			%		28-JUN-18	
Langelier Index	1.0					28-JUN-18	
Nitrate and Nitrite as N	0.061		0.022	mg/L		27-JUN-18	
Nitrate (as N)	0.061		0.020	mg/L		26-JUN-18	R4098230
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-18	R4098230
Saturation pH	6.95			pH		28-JUN-18	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		25-JUN-18	R4096504
TDS (Calculated)	506			mg/L		28-JUN-18	
Sulfate (SO4)	11.7		0.30	mg/L		26-JUN-18	R4098230
Anion Sum	8.26			me/L		28-JUN-18	
Cation Sum	10.0			me/L		28-JUN-18	
Cation - Anion Balance	9.7			%		28-JUN-18	
Organic / Inorganic Carbon							
Dissolved Organic Carbon	3.4		1.0	mg/L		28-JUN-18	R4102418
Inorganic Parameters							
Silica	11.1		0.11	mg/L		26-JUN-18	
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					25-JUN-18	R4096104
Aluminum (Al)-Dissolved	0.0098		0.0050	mg/L	25-JUN-18	25-JUN-18	R4097078
Antimony (Sb)-Dissolved	0.00013		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Arsenic (As)-Dissolved	0.00080		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Barium (Ba)-Dissolved	0.127		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Boron (B)-Dissolved	0.022		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Cadmium (Cd)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Calcium (Ca)-Dissolved	113		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Chromium (Cr)-Dissolved	<0.00050		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Cobalt (Co)-Dissolved	0.00013		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Copper (Cu)-Dissolved	0.00537		0.00020	mg/L	25-JUN-18	25-JUN-18	R4097078
Iron (Fe)-Dissolved	0.023		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Lead (Pb)-Dissolved	0.000162		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Magnesium (Mg)-Dissolved	9.83		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Manganese (Mn)-Dissolved	0.0332		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Molybdenum (Mo)-Dissolved	0.00122		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Nickel (Ni)-Dissolved	0.00074		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-2 MW 18-2 Sampled By: CLIENT on 21-JUN-18 @ 11:35 Matrix: WATER							
Dissolved Metals							
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Potassium (K)-Dissolved	2.28		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Selenium (Se)-Dissolved	0.000132		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silicon (Si)-Dissolved	5.21		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Sodium (Na)-Dissolved	80.4		0.50	mg/L	25-JUN-18	25-JUN-18	R4097078
Strontium (Sr)-Dissolved	0.282		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Sulfur (S)-Dissolved	<5.0		5.0	mg/L	25-JUN-18	25-JUN-18	R4097078
Thallium (Tl)-Dissolved	0.000013		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Tin (Sn)-Dissolved	0.00067		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	25-JUN-18	R4097078
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Uranium (U)-Dissolved	0.00119		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Vanadium (V)-Dissolved	0.00098		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Zinc (Zn)-Dissolved	0.0115		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	26-JUN-18	R4097078
L2117286-3 MW 18-3 Sampled By: CLIENT on 21-JUN-18 @ 10:40 Matrix: WATER							
Physical Tests							
Colour, Apparent	95.0		2.0	CU		25-JUN-18	R4096736
Conductivity	1240		3.0	umhos/cm		23-JUN-18	R4096667
pH	7.31		0.10	pH units		23-JUN-18	R4096667
Total Dissolved Solids	853	DLDS	20	mg/L		27-JUN-18	R4099427
Turbidity	>4000		0.10	NTU		22-JUN-18	R4095398
Anions and Nutrients							
Alkalinity, Bicarbonate (as CaCO3)	377		10	mg/L		27-JUN-18	R4098480
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Total (as CaCO3)	377		10	mg/L		27-JUN-18	R4098480
Ammonia, Total (as N)	0.296		0.020	mg/L		25-JUN-18	R4096446
Bromide (Br)	<0.10		0.10	mg/L		26-JUN-18	R4098230
Chloride (Cl)	181		0.50	mg/L		26-JUN-18	R4098230
Computed Conductivity	1140			uS/cm		28-JUN-18	
Conductivity % Difference	-8.3			%		28-JUN-18	
Fluoride (F)	0.037		0.020	mg/L		26-JUN-18	R4098230
Hardness (as CaCO3)	480			mg/L		28-JUN-18	
Ion Balance	113			%		28-JUN-18	
Langelier Index	0.6					28-JUN-18	
Nitrate and Nitrite as N	<0.022		0.022	mg/L		27-JUN-18	
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-18	R4098230
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-18	R4098230

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-3 MW 18-3							
Sampled By: CLIENT on 21-JUN-18 @ 10:40							
Matrix: WATER							
Anions and Nutrients							
Saturation pH	6.73			pH		28-JUN-18	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		25-JUN-18	R4096504
TDS (Calculated)	712			mg/L		28-JUN-18	
Sulfate (SO4)	33.3		0.30	mg/L		26-JUN-18	R4098230
Anion Sum	12.0			me/L		28-JUN-18	
Cation Sum	13.6			me/L		28-JUN-18	
Cation - Anion Balance	6.2			%		28-JUN-18	
Organic / Inorganic Carbon							
Dissolved Organic Carbon	3.8		1.0	mg/L		28-JUN-18	R4102418
Inorganic Parameters							
Silica	18.4		0.11	mg/L		26-JUN-18	
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					25-JUN-18	R4096104
Aluminum (Al)-Dissolved	<0.0050		0.0050	mg/L	25-JUN-18	25-JUN-18	R4097078
Antimony (Sb)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Arsenic (As)-Dissolved	0.00178		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Barium (Ba)-Dissolved	0.195		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Boron (B)-Dissolved	0.031		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Cadmium (Cd)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Calcium (Ca)-Dissolved	161		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Chromium (Cr)-Dissolved	<0.00050		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Cobalt (Co)-Dissolved	0.00072		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Copper (Cu)-Dissolved	0.00027		0.00020	mg/L	25-JUN-18	25-JUN-18	R4097078
Iron (Fe)-Dissolved	1.88		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Lead (Pb)-Dissolved	0.000055		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Magnesium (Mg)-Dissolved	18.7		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Manganese (Mn)-Dissolved	3.37	DLHC	0.0050	mg/L	25-JUN-18	26-JUN-18	R4097078
Molybdenum (Mo)-Dissolved	0.000547		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Nickel (Ni)-Dissolved	0.00200		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Potassium (K)-Dissolved	1.17		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Selenium (Se)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silicon (Si)-Dissolved	8.58		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Sodium (Na)-Dissolved	90.4		0.50	mg/L	25-JUN-18	25-JUN-18	R4097078
Strontium (Sr)-Dissolved	0.383		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Sulfur (S)-Dissolved	13.1		5.0	mg/L	25-JUN-18	25-JUN-18	R4097078
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	25-JUN-18	R4097078

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-3 MW 18-3							
Sampled By: CLIENT on 21-JUN-18 @ 10:40							
Matrix: WATER							
Dissolved Metals							
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Uranium (U)-Dissolved	0.000327		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Vanadium (V)-Dissolved	<0.00050		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Zinc (Zn)-Dissolved	0.0019		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	26-JUN-18	R4097078
L2117286-4 DUP							
Sampled By: CLIENT on 21-JUN-18 @ 10:50							
Matrix: WATER							
Physical Tests							
Colour, Apparent	61.7		2.0	CU		25-JUN-18	R4096736
Conductivity	1230		3.0	umhos/cm		23-JUN-18	R4096667
pH	7.39		0.10	pH units		23-JUN-18	R4096667
Total Dissolved Solids	796	DLDS	20	mg/L		27-JUN-18	R4099427
Turbidity	>4000		0.10	NTU		22-JUN-18	R4095398
Anions and Nutrients							
Alkalinity, Bicarbonate (as CaCO3)	372		10	mg/L		27-JUN-18	R4098480
Alkalinity, Carbonate (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Hydroxide (as CaCO3)	<10		10	mg/L		27-JUN-18	R4098480
Alkalinity, Total (as CaCO3)	372		10	mg/L		27-JUN-18	R4098480
Ammonia, Total (as N)	0.354		0.020	mg/L		25-JUN-18	R4096446
Bromide (Br)	<0.10		0.10	mg/L		26-JUN-18	R4098230
Chloride (Cl)	178		0.50	mg/L		26-JUN-18	R4098230
Computed Conductivity	1130			uS/cm		28-JUN-18	
Conductivity % Difference	-8.3			%		28-JUN-18	
Fluoride (F)	0.045		0.020	mg/L		26-JUN-18	R4098230
Hardness (as CaCO3)	478			mg/L		28-JUN-18	
Ion Balance	114			%		28-JUN-18	
Langelier Index	0.7					28-JUN-18	
Nitrate and Nitrite as N	<0.022		0.022	mg/L		27-JUN-18	
Nitrate (as N)	<0.020		0.020	mg/L		26-JUN-18	R4098230
Nitrite (as N)	<0.010		0.010	mg/L		26-JUN-18	R4098230
Saturation pH	6.74			pH		28-JUN-18	
Orthophosphate-Dissolved (as P)	<0.0030		0.0030	mg/L		25-JUN-18	R4096504
TDS (Calculated)	706			mg/L		28-JUN-18	
Sulfate (SO4)	34.3		0.30	mg/L		26-JUN-18	R4098230
Anion Sum	11.8			me/L		28-JUN-18	
Cation Sum	13.5			me/L		28-JUN-18	
Cation - Anion Balance	6.7			%		28-JUN-18	
Organic / Inorganic Carbon							
Dissolved Organic Carbon	4.7		1.0	mg/L		28-JUN-18	R4102418
Inorganic Parameters							
Silica	18.0		0.11	mg/L		26-JUN-18	

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2117286-4 DUP Sampled By: CLIENT on 21-JUN-18 @ 10:50 Matrix: WATER							
Inorganic Parameters							
Dissolved Metals							
Dissolved Metals Filtration Location	FIELD					25-JUN-18	R4096104
Aluminum (Al)-Dissolved	<0.0050		0.0050	mg/L	25-JUN-18	25-JUN-18	R4097078
Antimony (Sb)-Dissolved	0.00014		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Arsenic (As)-Dissolved	0.00375		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Barium (Ba)-Dissolved	0.237		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Beryllium (Be)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Bismuth (Bi)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Boron (B)-Dissolved	0.033		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Cadmium (Cd)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Calcium (Ca)-Dissolved	160		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Chromium (Cr)-Dissolved	<0.00050		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Cobalt (Co)-Dissolved	0.00074		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Copper (Cu)-Dissolved	<0.00020		0.00020	mg/L	25-JUN-18	25-JUN-18	R4097078
Iron (Fe)-Dissolved	0.470		0.010	mg/L	25-JUN-18	25-JUN-18	R4097078
Lead (Pb)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Magnesium (Mg)-Dissolved	19.1		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Manganese (Mn)-Dissolved	2.91	DLHC	0.0050	mg/L	25-JUN-18	26-JUN-18	R4097078
Molybdenum (Mo)-Dissolved	0.000814		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Nickel (Ni)-Dissolved	0.00226		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Phosphorus (P)-Dissolved	<0.050		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Potassium (K)-Dissolved	1.40		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Selenium (Se)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silicon (Si)-Dissolved	8.42		0.050	mg/L	25-JUN-18	25-JUN-18	R4097078
Silver (Ag)-Dissolved	<0.000050		0.000050	mg/L	25-JUN-18	25-JUN-18	R4097078
Sodium (Na)-Dissolved	90.7		0.50	mg/L	25-JUN-18	25-JUN-18	R4097078
Strontium (Sr)-Dissolved	0.383		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Sulfur (S)-Dissolved	12.7		5.0	mg/L	25-JUN-18	25-JUN-18	R4097078
Thallium (Tl)-Dissolved	<0.000010		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Tin (Sn)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Titanium (Ti)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	25-JUN-18	R4097078
Tungsten (W)-Dissolved	<0.00010		0.00010	mg/L	25-JUN-18	25-JUN-18	R4097078
Uranium (U)-Dissolved	0.000492		0.000010	mg/L	25-JUN-18	25-JUN-18	R4097078
Vanadium (V)-Dissolved	0.00134		0.00050	mg/L	25-JUN-18	25-JUN-18	R4097078
Zinc (Zn)-Dissolved	<0.0010		0.0010	mg/L	25-JUN-18	25-JUN-18	R4097078
Zirconium (Zr)-Dissolved	<0.00030		0.00030	mg/L	25-JUN-18	26-JUN-18	R4097078

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Chloride (Cl)	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Sulfur (S)-Dissolved	MS-B	L2117286-1, -2, -3, -4
Matrix Spike	Uranium (U)-Dissolved	MS-B	L2117286-1, -2, -3, -4

Sample Parameter Qualifier key listed:

Qualifier	Description
DLDS	Detection Limit Raised: Dilution required due to high Dissolved Solids / Electrical Conductivity.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-AUTO-WT	Water	Automated Speciated Alkalinity	EPA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-SPECIATED-WT	Water	pH Measurement for Spec. Alk	APHA 4500 H-Electrode

Water samples are analyzed directly by a calibrated pH meter.

ALS Test Code	Matrix	Test Description	Method Reference**
BR-IC-N-WT	Water	Bromide in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
C-DIS-ORG-WT	Water	Dissolved Organic Carbon	APHA 5310B

Sample is filtered through a 0.45um filter, then injected into a heated reaction chamber which is packed with an oxidative catalyst. The water is vaporized and the organic carbon is oxidized to carbon dioxide. The carbon dioxide is transported in a carrier gas and is measured by a non-dispersive infrared detector.

ALS Test Code	Matrix	Test Description	Method Reference**
CL-IC-N-WT	Water	Chloride by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

ALS Test Code	Matrix	Test Description	Method Reference**
COLOUR-APPARENT-WT	Water	Colour	APHA 2120

Apparent Colour is measured spectrophotometrically by comparison to platinum-cobalt standards using the single wavelength method after sample decanting. Colour measurements can be highly pH dependent, and apply to the pH of the sample as received (at time of testing), without pH adjustment. Concurrent measurement of sample pH is recommended.

ALS Test Code	Matrix	Test Description	Method Reference**
EC-WT	Water	Conductivity	APHA 2510 B

Water samples can be measured directly by immersing the conductivity cell into the sample.

ALS Test Code	Matrix	Test Description	Method Reference**
ETL-N2N3-WT	Water	Calculate from NO2 + NO3	APHA 4110 B
ETL-SILICA-CALC-WT	Water	Calculate from SI-TOT-WT	EPA 200.8
F-IC-N-WT	Water	Fluoride in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

ALS Test Code	Matrix	Test Description	Method Reference**
IONBALANCE-OP03-WT	Water	Detailed Ion Balance Calculation	APHA 1030E, 2330B, 2510A
MET-D-CCMS-WT	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030B/6020A (mod)

Water samples are filtered (0.45 um), preserved with nitric acid, and analyzed by CRC ICPMS.

Method Limitation (re: Sulfur): Sulfide and volatile sulfur species may not be recovered by this method.

Reference Information

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

NH3-WT	Water	Ammonia, Total as N	EPA 350.1

Sample is measured colorimetrically. When sample is turbid a distillation step is required, sample is distilled into a solution of boric acid and measured colorimetrically.

NO2-IC-WT	Water	Nitrite in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

NO3-IC-WT	Water	Nitrate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

PO4-DO-COL-WT	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P PHOSPHORUS

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

SO4-IC-N-WT	Water	Sulfate in Water by IC	EPA 300.1 (mod)

Inorganic anions are analyzed by Ion Chromatography with conductivity and/or UV detection.

SOLIDS-TDS-WT	Water	Total Dissolved Solids	APHA 2540C

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-WT	Water	Turbidity	APHA 2130 B

Sample result is based on a comparison of the intensity of the light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. Sample readings are obtained from a Nephelometer.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	**Laboratory Location**
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

17-624360

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9

Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-AUTO-WT	**Water**							
Batch R4098480								
WG2808519-3 CRM		**WT-ALK-CRM**						
Alkalinity, Total (as CaCO3)			95.4		%		80-120	27-JUN-18
WG2808519-4 DUP		**L2118034-1**						
Alkalinity, Total (as CaCO3)		107	108		mg/L	0.8	20	27-JUN-18
WG2808519-2 LCS								
Alkalinity, Total (as CaCO3)			94.4		%		85-115	27-JUN-18
WG2808519-1 MB								
Alkalinity, Total (as CaCO3)			<10		mg/L		10	27-JUN-18
ALK-SPECIATED-WT	**Water**							
Batch R4096667								
WG2805161-4 DUP		**WG2805161-3**						
pH		7.78	7.80	J	pH units	0.03	0.2	23-JUN-18
WG2805161-2 LCS								
pH			6.98		pH units		6.9-7.1	23-JUN-18
BR-IC-N-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Bromide (Br)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	26-JUN-18
WG2807031-7 LCS								
Bromide (Br)			99.7		%		85-115	26-JUN-18
WG2807031-6 MB								
Bromide (Br)			<0.10		mg/L		0.1	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Bromide (Br)			91.6		%		75-125	26-JUN-18
C-DIS-ORG-WT	**Water**							
Batch R4102418								
WG2810133-3 DUP		**L2117612-2**						
Dissolved Organic Carbon		4.9	3.3	J	mg/L	1.6	2	28-JUN-18
WG2810133-2 LCS								
Dissolved Organic Carbon			98.0		%		80-120	28-JUN-18
WG2810133-1 MB								
Dissolved Organic Carbon			<1.0		mg/L		1	28-JUN-18
WG2810133-4 MS		**L2117612-2**						
Dissolved Organic Carbon			82.2		%		70-130	28-JUN-18
CL-IC-N-WT	**Water**							

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9

Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CL-IC-N-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Chloride (Cl)		178	177		mg/L	0.5	20	26-JUN-18
WG2807031-7 LCS								
Chloride (Cl)			102.3		%		90-110	26-JUN-18
WG2807031-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Chloride (Cl)			N/A	MS-B	%		-	26-JUN-18
COLOUR-APPARENT-WT	**Water**							
Batch R4096736								
WG2804951-3 DUP		**L2117286-1**						
Colour, Apparent		87.8	85.1		CU	3.1	20	25-JUN-18
WG2804951-2 LCS								
Colour, Apparent			107.5		%		85-115	25-JUN-18
WG2804951-1 MB								
Colour, Apparent			<2.0		CU		2	25-JUN-18
EC-WT	**Water**							
Batch R4096667								
WG2805161-4 DUP		**WG2805161-3**						
Conductivity		82.3	80.0		umhos/cm	2.8	10	23-JUN-18
WG2805161-2 LCS								
Conductivity			96.6		%		90-110	23-JUN-18
WG2805161-1 MB								
Conductivity			<3.0		umhos/cm		3	23-JUN-18
F-IC-N-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Fluoride (F)		0.045	0.046		mg/L	3.6	20	26-JUN-18
WG2807031-7 LCS								
Fluoride (F)			102.2		%		90-110	26-JUN-18
WG2807031-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Fluoride (F)			99.9		%		75-125	26-JUN-18
MET-D-CCMS-WT	**Water**							

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4097078								
WG2805781-4 DUP		**WG2805781-3**						
Aluminum (Al)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	26-JUN-18
Antimony (Sb)-Dissolved		0.00112	0.00113		mg/L	0.3	20	26-JUN-18
Arsenic (As)-Dissolved		0.00437	0.00427		mg/L	2.3	20	26-JUN-18
Barium (Ba)-Dissolved		0.135	0.139		mg/L	2.4	20	26-JUN-18
Beryllium (Be)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	26-JUN-18
Bismuth (Bi)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	26-JUN-18
Boron (B)-Dissolved		0.199	0.211		mg/L	6.1	20	26-JUN-18
Cadmium (Cd)-Dissolved		<0.0000050	<0.0000050	RPD-NA	mg/L	N/A	20	26-JUN-18
Calcium (Ca)-Dissolved		30.7	30.6		mg/L	0.1	20	26-JUN-18
Chromium (Cr)-Dissolved		<0.00050	<0.00050	RPD-NA	mg/L	N/A	20	26-JUN-18
Cobalt (Co)-Dissolved		0.00016	0.00016		mg/L	4.2	20	26-JUN-18
Copper (Cu)-Dissolved		0.00059	0.00059		mg/L	0.2	20	26-JUN-18
Iron (Fe)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	26-JUN-18
Lead (Pb)-Dissolved		0.000193	0.000191		mg/L	0.9	20	26-JUN-18
Magnesium (Mg)-Dissolved		79.2	81.0		mg/L	2.2	20	26-JUN-18
Manganese (Mn)-Dissolved		0.0594	0.0602		mg/L	1.3	20	26-JUN-18
Molybdenum (Mo)-Dissolved		0.00905	0.00913		mg/L	0.9	20	26-JUN-18
Nickel (Ni)-Dissolved		0.00080	0.00081		mg/L	1.6	20	26-JUN-18
Phosphorus (P)-Dissolved		0.150	0.132		mg/L	13	20	26-JUN-18
Potassium (K)-Dissolved		11.8	12.0		mg/L	1.7	20	26-JUN-18
Selenium (Se)-Dissolved		0.000481	0.000478		mg/L	0.5	20	26-JUN-18
Silicon (Si)-Dissolved		5.66	5.57		mg/L	1.7	20	26-JUN-18
Silver (Ag)-Dissolved		<0.000050	<0.000050	RPD-NA	mg/L	N/A	20	26-JUN-18
Sodium (Na)-Dissolved		259	258		mg/L	0.2	20	25-JUN-18
Strontium (Sr)-Dissolved		0.368	0.375		mg/L	1.9	20	26-JUN-18
Sulfur (S)-Dissolved		31.7	31.6		mg/L	0.3	20	26-JUN-18
Thallium (Tl)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	26-JUN-18
Tin (Sn)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	26-JUN-18
Titanium (Ti)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	26-JUN-18
Tungsten (W)-Dissolved		0.00197	0.00194		mg/L	1.5	20	26-JUN-18
Uranium (U)-Dissolved		0.000509	0.000486		mg/L	4.7	20	26-JUN-18
Vanadium (V)-Dissolved		0.00171	0.00171		mg/L	0.0	20	26-JUN-18
Zinc (Zn)-Dissolved		0.0021	0.0017		mg/L			26-JUN-18

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4097078								
WG2805781-4 DUP		**WG2805781-3**						
Zinc (Zn)-Dissolved		0.0021	0.0017	J	mg/L	0.0004	0.002	26-JUN-18
Zirconium (Zr)-Dissolved		<0.00030	<0.00030	RPD-NA	mg/L	N/A	20	26-JUN-18
WG2805781-2 LCS								
Aluminum (Al)-Dissolved			103.8		%		80-120	25-JUN-18
Antimony (Sb)-Dissolved			102.2		%		80-120	25-JUN-18
Arsenic (As)-Dissolved			103.2		%		80-120	25-JUN-18
Barium (Ba)-Dissolved			99.5		%		80-120	25-JUN-18
Beryllium (Be)-Dissolved			103.0		%		80-120	25-JUN-18
Bismuth (Bi)-Dissolved			103.8		%		80-120	25-JUN-18
Boron (B)-Dissolved			101.3		%		80-120	25-JUN-18
Cadmium (Cd)-Dissolved			96.9		%		80-120	25-JUN-18
Calcium (Ca)-Dissolved			100.5		%		80-120	25-JUN-18
Chromium (Cr)-Dissolved			100.5		%		80-120	25-JUN-18
Cobalt (Co)-Dissolved			101.1		%		80-120	25-JUN-18
Copper (Cu)-Dissolved			100.9		%		80-120	25-JUN-18
Iron (Fe)-Dissolved			104.4		%		80-120	25-JUN-18
Lead (Pb)-Dissolved			98.7		%		80-120	25-JUN-18
Magnesium (Mg)-Dissolved			109.1		%		80-120	25-JUN-18
Manganese (Mn)-Dissolved			107.9		%		80-120	25-JUN-18
Molybdenum (Mo)-Dissolved			99.5		%		80-120	25-JUN-18
Nickel (Ni)-Dissolved			100.7		%		80-120	25-JUN-18
Phosphorus (P)-Dissolved			106.8		%		80-120	25-JUN-18
Potassium (K)-Dissolved			107.9		%		80-120	25-JUN-18
Selenium (Se)-Dissolved			104.2		%		80-120	25-JUN-18
Silicon (Si)-Dissolved			106.4		%		60-140	25-JUN-18
Silver (Ag)-Dissolved			96.6		%		80-120	25-JUN-18
Sodium (Na)-Dissolved			110.2		%		80-120	25-JUN-18
Strontium (Sr)-Dissolved			98.1		%		80-120	25-JUN-18
Sulfur (S)-Dissolved			108.4		%		80-120	25-JUN-18
Thallium (Tl)-Dissolved			106.2		%		80-120	25-JUN-18
Tin (Sn)-Dissolved			96.7		%		80-120	25-JUN-18
Titanium (Ti)-Dissolved			99.7		%		80-120	25-JUN-18
Tungsten (W)-Dissolved			99.9		%		80-120	25-JUN-18
Uranium (U)-Dissolved			99.7		%		80-120	25-JUN-18

ALS Environmental

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9

Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4097078								
WG2805781-2 LCS								
Vanadium (V)-Dissolved			104.3		%		80-120	25-JUN-18
Zinc (Zn)-Dissolved			96.3		%		80-120	25-JUN-18
Zirconium (Zr)-Dissolved			96.0		%		80-120	25-JUN-18
WG2805781-1 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	25-JUN-18
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Barium (Ba)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Beryllium (Be)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Bismuth (Bi)-Dissolved			<0.000050		mg/L		0.00005	25-JUN-18
Boron (B)-Dissolved			<0.010		mg/L		0.01	25-JUN-18
Cadmium (Cd)-Dissolved			<0.0000050		mg/L		0.000005	25-JUN-18
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	25-JUN-18
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	25-JUN-18
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Copper (Cu)-Dissolved			<0.00020		mg/L		0.0002	25-JUN-18
Iron (Fe)-Dissolved			<0.010		mg/L		0.01	25-JUN-18
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	25-JUN-18
Magnesium (Mg)-Dissolved			<0.0050		mg/L		0.005	25-JUN-18
Manganese (Mn)-Dissolved			<0.00050		mg/L		0.0005	25-JUN-18
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	25-JUN-18
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	25-JUN-18
Phosphorus (P)-Dissolved			<0.050		mg/L		0.05	25-JUN-18
Potassium (K)-Dissolved			<0.050		mg/L		0.05	25-JUN-18
Selenium (Se)-Dissolved			<0.000050		mg/L		0.00005	25-JUN-18
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	25-JUN-18
Silver (Ag)-Dissolved			<0.000050		mg/L		0.00005	25-JUN-18
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	25-JUN-18
Strontium (Sr)-Dissolved			<0.0010		mg/L		0.001	25-JUN-18
Sulfur (S)-Dissolved			<0.50		mg/L		0.5	25-JUN-18
Thallium (Tl)-Dissolved			<0.000010		mg/L		0.00001	25-JUN-18
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18
Titanium (Ti)-Dissolved			<0.00030		mg/L		0.0003	25-JUN-18
Tungsten (W)-Dissolved			<0.00010		mg/L		0.0001	25-JUN-18

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4097078								
WG2805781-1 MB								
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	25-JUN-18
Vanadium (V)-Dissolved			<0.00050		mg/L		0.0005	25-JUN-18
Zinc (Zn)-Dissolved			<0.0010		mg/L		0.001	25-JUN-18
Zirconium (Zr)-Dissolved			<0.00030		mg/L		0.0003	25-JUN-18
WG2805781-5 MS		**WG2805781-3**						
Aluminum (Al)-Dissolved			105.5		%		70-130	26-JUN-18
Antimony (Sb)-Dissolved			92.0		%		70-130	26-JUN-18
Arsenic (As)-Dissolved			100.9		%		70-130	26-JUN-18
Barium (Ba)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Beryllium (Be)-Dissolved			100.8		%		70-130	26-JUN-18
Bismuth (Bi)-Dissolved			89.2		%		70-130	26-JUN-18
Boron (B)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Cadmium (Cd)-Dissolved			95.8		%		70-130	26-JUN-18
Calcium (Ca)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Chromium (Cr)-Dissolved			95.6		%		70-130	26-JUN-18
Cobalt (Co)-Dissolved			92.9		%		70-130	26-JUN-18
Copper (Cu)-Dissolved			90.7		%		70-130	26-JUN-18
Iron (Fe)-Dissolved			91.5		%		70-130	26-JUN-18
Lead (Pb)-Dissolved			99.0		%		70-130	26-JUN-18
Magnesium (Mg)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Manganese (Mn)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Molybdenum (Mo)-Dissolved			96.2		%		70-130	26-JUN-18
Nickel (Ni)-Dissolved			89.3		%		70-130	26-JUN-18
Phosphorus (P)-Dissolved			104.2		%		70-130	26-JUN-18
Potassium (K)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Selenium (Se)-Dissolved			100.3		%		70-130	26-JUN-18
Silicon (Si)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Silver (Ag)-Dissolved			93.4		%		70-130	26-JUN-18
Sodium (Na)-Dissolved			N/A	MS-B	%		-	25-JUN-18
Strontium (Sr)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Sulfur (S)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Thallium (Tl)-Dissolved			92.3		%		70-130	26-JUN-18
Tin (Sn)-Dissolved			97.0		%		70-130	26-JUN-18
Titanium (Ti)-Dissolved			98.8		%		70-130	26-JUN-18

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-WT	**Water**							
Batch R4097078								
WG2805781-5 MS		**WG2805781-3**						
Tungsten (W)-Dissolved			103.5		%		70-130	26-JUN-18
Uranium (U)-Dissolved			N/A	MS-B	%		-	26-JUN-18
Vanadium (V)-Dissolved			100.6		%		70-130	26-JUN-18
Zinc (Zn)-Dissolved			96.8		%		70-130	26-JUN-18
Zirconium (Zr)-Dissolved			98.0		%		70-130	26-JUN-18
NH3-WT	**Water**							
Batch R4096446								
WG2805816-3 DUP		**L2117300-1**						
Ammonia, Total (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	25-JUN-18
WG2805816-2 LCS								
Ammonia, Total (as N)			99.96		%		85-115	25-JUN-18
WG2805816-1 MB								
Ammonia, Total (as N)			<0.020		mg/L		0.02	25-JUN-18
WG2805816-4 MS		**L2117300-1**						
Ammonia, Total (as N)			94.1		%		75-125	25-JUN-18
NO2-IC-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Nitrite (as N)		<0.010	<0.010	RPD-NA	mg/L	N/A	25	26-JUN-18
WG2807031-7 LCS								
Nitrite (as N)			101.9		%		70-130	26-JUN-18
WG2807031-6 MB								
Nitrite (as N)			<0.010		mg/L		0.01	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Nitrite (as N)			92.6		%		70-130	26-JUN-18
NO3-IC-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Nitrate (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	25	26-JUN-18
WG2807031-7 LCS								
Nitrate (as N)			101.6		%		70-130	26-JUN-18
WG2807031-6 MB								
Nitrate (as N)			<0.020		mg/L		0.02	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Nitrate (as N)			100.2		%		70-130	26-JUN-18
PO4-DO-COL-WT	**Water**							

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4-DO-COL-WT	**Water**							
Batch R4096504								
WG2805871-3 DUP		**L2116343-1**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	30	25-JUN-18
WG2805871-7 DUP		**L2117286-1**						
Orthophosphate-Dissolved (as P)		<0.0030	<0.0030	RPD-NA	mg/L	N/A	30	25-JUN-18
WG2805871-2 LCS								
Orthophosphate-Dissolved (as P)			102.9		%		70-130	25-JUN-18
WG2805871-6 LCS								
Orthophosphate-Dissolved (as P)			108.6		%		70-130	25-JUN-18
WG2805871-1 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	25-JUN-18
WG2805871-5 MB								
Orthophosphate-Dissolved (as P)			<0.0030		mg/L		0.003	25-JUN-18
WG2805871-4 MS		**L2116343-1**						
Orthophosphate-Dissolved (as P)			100.7		%		70-130	25-JUN-18
WG2805871-8 MS		**L2117286-1**						
Orthophosphate-Dissolved (as P)			109.8		%		70-130	25-JUN-18
SO4-IC-N-WT	**Water**							
Batch R4098230								
WG2807031-10 DUP		**L2117286-4**						
Sulfate (SO4)		34.3	34.2		mg/L	0.1	20	26-JUN-18
WG2807031-7 LCS								
Sulfate (SO4)			103.0		%		90-110	26-JUN-18
WG2807031-6 MB								
Sulfate (SO4)			<0.30		mg/L		0.3	26-JUN-18
WG2807031-9 MS		**L2117286-4**						
Sulfate (SO4)			105.1		%		75-125	26-JUN-18
SOLIDS-TDS-WT	**Water**							
Batch R4099427								
WG2807086-3 DUP		**L2117148-1**						
Total Dissolved Solids		119	123		mg/L	2.9	20	27-JUN-18
WG2807086-2 LCS								
Total Dissolved Solids			94.1		%		85-115	27-JUN-18
WG2807086-1 MB								
Total Dissolved Solids			<10		mg/L		10	27-JUN-18
TURBIDITY-WT	**Water**							

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9

Contact: Jake Whittamore

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-WT	**Water**							
Batch R4095398								
WG2804812-3 DUP		**L2117286-2**						
Turbidity		339	344		NTU	1.5	15	22-JUN-18
WG2804812-2 LCS								
Turbidity			105.0		%		85-115	22-JUN-18
WG2804812-1 MB								
Turbidity			<0.10		NTU		0.1	22-JUN-18

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9

Contact: Jake Whittamore

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
J	Duplicate results and limits are expressed in terms of absolute difference.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Client: WSP Canada Inc. (Aurora)
126 Don Hilock Drive Unit 2
Aurora ON L4G 0G9
Contact: Jake Whittamore

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Colour							
	1	21-JUN-18 11:20	25-JUN-18 00:00	48	85	hours	EHTL
	2	21-JUN-18 11:35	25-JUN-18 00:00	48	84	hours	EHTL
	3	21-JUN-18 10:40	25-JUN-18 00:00	48	85	hours	EHTL
	4	21-JUN-18 10:50	25-JUN-18 00:00	48	85	hours	EHTL

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2117286 were received on 22-JUN-18 12:05.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L2117286-COFC

COC Number: 17 - 624360

Page of

Report To	Contact and company name below will appear on the final report
Company:	WSP Canada Inc.
Contact:	Jake Whittemore
Phone:	289-552-1022
	Company address below will appear on the final report
Street:	126 Don Hillock Dr
City/Province:	Aurora, ON
Postal Code:	L4G 0G9

Invoice To		
Same as Report To	☒ YES	☐ NO
Copy of Invoice with Report	☒ YES	☐ NO
Company:		
Contact:		

Report Format / Distribution

Select Report Format: ☒ PDF ☒ EXCEL ☐ EDD (DIGITAL)

Quality Control (QC) Report with Report ☒ YES ☐ NO

☐ Compare Results to Criteria on Report - provide details below if box checked

Select Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: jake.whittemore@gmail.com

Email 2

Email 3

Invoice Distribution

Select Invoice Distribution: ☒ EMAIL ☐ MAIL ☐ FAX

Email 1 or Fax: jake.whittemore@gmail.com

Email 2: payables.ontario@wsp.com

Select Service Level Below - Contact your AM to confirm all E&P TATs (surcharges may apply)

Regular [R] ☒ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4-20%] ☐ 3 day [P3-25%] ☐ 2 day [P2-50%] ☐

EMERGENCY: 1 Business day [E-100%] ☐ Same Day, Weekend or Statutory holiday [E2-200% (Laboratory opening fees may apply)] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Project Information

ALS Account # / Quote #: As per company pricing agreement

Job #: 181-06776-00/100/1003

PO / AFE:

LSD:

Oil and Gas Required Fields (client use)

AFE/Cost Center: PO#

Major/Minor Code: Routing Code:

Requisitioner:

Location:

ALS Lab Work Order # (lab use only): L2117286 RK 22B

ALS Contact: ML

Sampler:

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	GENCHEM 3	DOC	Metals (F/P)	NH3 (P)	SAMPLES ON HOLD	Sample is hazardous (please provide further details)	NUMBER OF CONTAINERS
1	MW18-1	21-Jun-18	11:20	GW	X	X	X	X			4
2	MW18-2	↓	11:35	GW	X	X	X	X			4
3	MW18-3	↓	10:40	GW	X	X	X	X			4
4	DUP	↓	10:50	GW	X	X	X	X			4

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ YES ☒ NO

Are samples for human consumption/ use? ☐ YES ☒ NO

Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C

FINAL COOLER TEMPERATURES °C: 4.8

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)	
Released by: Jake Whittemore	Date: 06/21/18	Time: 14:30	Received by:	Date:	Time:	Received by:	Date: JUNE 22/18

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX

D

CLIMATE BASED WATER BUDGET

TABLE D-1
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1981-2010 (UDORA CLIMATE STATION)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

	Thornthwaite (1948)							
Month	**Mean Temperature (°C)**	**Heat Index**	**Potential Evapo-transpiration (mm)**	**Daylight Correction Value**	**Adjusted Potential Evapo-transpiration (mm)**	**Total Precipitation (mm)**	**Surplus (mm)**	**Deficit (mm)**
January	-7.0	0.0	0.0	0.7839	0.00	64.9	64.9	0.0
February	-6.6	0.0	0.0	0.8679	0.00	45.9	45.9	0.0
March	-1.3	0.0	0.0	0.9871	0.00	53.1	53.1	0.0
April	5.7	1.2	26.5	1.1200	29.70	67.9	38.2	0.0
May	12.2	3.9	59.4	1.2290	72.97	82.1	9.1	0.0
June	18.0	7.0	89.6	1.2900	115.62	106.6	0.0	9.0
July	19.9	8.1	99.7	1.2581	125.40	86.4	0.0	39.0
August	19.3	7.7	96.5	1.1613	112.06	73.9	0.0	38.2
September	15.1	5.3	74.4	1.0400	77.39	87.3	9.9	0.0
October	8.6	2.3	41.0	0.9194	37.69	74.9	37.2	0.0
November	2.4	0.3	10.6	0.8000	8.49	83.2	74.7	0.0
December	-4.0	0.0	0.0	0.7355	0.00	60.0	60.0	0.0
TOTALS		**35.8**			**579.3**	**886.2**	**393.1**	**86.2**

TOTAL WATER SURPLUS **306.9** **mm**

NOTES:

1) Water budget adjusted for latitude and daylight.
2) (°C) - Represents calculated mean of daily temperatures for the month.
3) Precipitation and Temperature data from the Udora Climate Station located at latitude 44°15'45.000" N, longitude 79°09'41.004" W, elevation 262.0 m.
4) Total Water Surplus (Thornthwaite, 1948) is calculated as total precipitation minus adjusted potential evapotranspiration.
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

TABLE D-2
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1981-2010 (UDORA CLIMATE STATION)
FINE SANDY LOAM, URBAN LAWN (75 mm HOLDING CAPACITY)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

	Thornthwaite (1948)									Thornthwaite and Mather (1957)					
Month	Mean Temperature (°C)	Heat Index	Potential Evapo-transpiration (mm)	Daylight Correction Value	Adjusted Potential Evapo-transpiration (mm)	Total Precipitation (mm)	Surplus (mm)	Deficit (mm)	TP - PET (mm)	Accumulated Potential Water Loss (mm)	Soil Moisture (mm)	Change in Soil Moisture (mm) (delta S)	Actual Evapo-transpiration (mm)	Moisture Deficit (mm)	Unadjusted Moisture Surplus (mm)
January	-7.0	0.0	0.0	0.7839	0.00	64.9	64.9	0.0	64.9	0.0	75.0	0.0	0.0	0.0	64.9
February	-6.6	0.0	0.0	0.8679	0.00	45.9	45.9	0.0	45.9	0.0	75.0	0.0	0.0	0.0	45.9
March	-1.3	0.0	0.0	0.9871	0.00	53.1	53.1	0.0	53.1	0.0	75.0	0.0	0.0	0.0	53.1
April	5.7	1.2	26.5	1.1200	29.70	67.9	38.2	0.0	38.2	0.0	75.0	0.0	29.7	0.0	38.2
May	12.2	3.9	59.4	1.2290	72.97	82.1	9.1	0.0	9.1	0.0	75.0	0.0	73.0	0.0	9.1
June	18.0	7.0	89.6	1.2900	115.62	106.6	0.0	9.0	-9.0	-9.0	66.0	-9.0	115.6	0.0	0.0
July	19.9	8.1	99.7	1.2581	125.40	86.4	0.0	39.0	-39.0	-48.0	38.0	-28.0	114.4	11.0	0.0
August	19.3	7.7	96.5	1.1613	112.06	73.9	0.0	38.2	-38.2	-86.2	23.0	-15.0	88.9	23.2	0.0
September	15.1	5.3	74.4	1.0400	77.39	87.3	9.9	0.0	9.9	0.0	32.9	9.9	77.4	0.0	0.0
October	8.6	2.3	41.0	0.9194	37.69	74.9	37.2	0.0	37.2	0.0	70.1	37.2	37.7	0.0	0.0
November	2.4	0.3	10.6	0.8000	8.49	83.2	74.7	0.0	74.7	0.0	75.0	4.9	8.5	0.0	69.8
December	-4.0	0.0	0.0	0.7355	0.00	60.0	60.0	0.0	60.0	0.0	75.0	0.0	0.0	0.0	60.0
TOTALS		**35.8**			**579.3**	**886.2**	**393.1**	**86.2**	**306.9**	**-86.2**	**755.0**	**0.0**	**545.1**	**34.2**	**341.1**

TOTAL WATER SURPLUS **306.9** **mm**

TOTAL MOISTURE SURPLUS **341.1** **mm**

NOTES:

1) Water budget adjusted for latitude and daylight.
2) (°C) - Represents calculated mean of daily temperatures for the month.
3) Precipitation and Temperature data from the Udora Climate Station located at latitude 44°15'45.000" N, longitude 79°09'41.004" W, elevation 262.0 m.
4) Total Water Surplus (Thornthwaite, 1948) is calculated as total precipitation minus adjusted potential evapotranspiration.
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

TABLE D-3
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1981-2010 (UDORA CLIMATE STATION)
FINE SANDY LOAM, CULTIVATED (150 mm HOLDING CAPACITY)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

	Thornthwaite (1948)									Thornthwaite and Mather (1957)					
Month	Mean Temperature (°C)	Heat Index	Potential Evapo-transpiration (mm)	Daylight Correction Value	Adjusted Potential Evapo-transpiration (mm)	Total Precipitation (mm)	Surplus (mm)	Deficit (mm)	TP - PET (mm)	Accumulated Potential Water Loss (mm)	Soil Moisture (mm)	Change in Soil Moisture (mm) (delta S)	Actual Evapo-transpiration (mm)	Moisture Deficit (mm)	Unadjusted Moisture Surplus (mm)
January	-7.0	0.0	0.0	0.7839	0.00	64.9	64.9	0.0	64.9	0.0	150.0	0.0	0.0	0.0	64.9
February	-6.6	0.0	0.0	0.8679	0.00	45.9	45.9	0.0	45.9	0.0	150.0	0.0	0.0	0.0	45.9
March	-1.3	0.0	0.0	0.9871	0.00	53.1	53.1	0.0	53.1	0.0	150.0	0.0	0.0	0.0	53.1
April	5.7	1.2	26.5	1.1200	29.70	67.9	38.2	0.0	38.2	0.0	150.0	0.0	29.7	0.0	38.2
May	12.2	3.9	59.4	1.2290	72.97	82.1	9.1	0.0	9.1	0.0	150.0	0.0	73.0	0.0	9.1
June	18.0	7.0	89.6	1.2900	115.62	106.6	0.0	9.0	-9.0	-9.0	141.0	-9.0	115.6	0.0	0.0
July	19.9	8.1	99.7	1.2581	125.40	86.4	0.0	39.0	-39.0	-48.0	108.0	-33.0	119.4	6.0	0.0
August	19.3	7.7	96.5	1.1613	112.06	73.9	0.0	38.2	-38.2	-86.2	84.0	-24.0	97.9	14.2	0.0
September	15.1	5.3	74.4	1.0400	77.39	87.3	9.9	0.0	9.9	0.0	93.9	9.9	77.4	0.0	0.0
October	8.6	2.3	41.0	0.9194	37.69	74.9	37.2	0.0	37.2	0.0	131.1	37.2	37.7	0.0	0.0
November	2.4	0.3	10.6	0.8000	8.49	83.2	74.7	0.0	74.7	0.0	150.0	18.9	8.5	0.0	55.8
December	-4.0	0.0	0.0	0.7355	0.00	60.0	60.0	0.0	60.0	0.0	150.0	0.0	0.0	0.0	60.0
TOTALS		**35.8**			**579.3**	**886.2**	**393.1**	**86.2**	**306.9**	**-86.2**	**1608.0**	**0.0**	**559.1**	**20.2**	**327.1**

TOTAL WATER SURPLUS **306.9** **mm**

TOTAL MOISTURE SURPLUS **327.1** **mm**

NOTES:

1) Water budget adjusted for latitude and daylight.
2) (°C) - Represents calculated mean of daily temperatures for the month.
3) Precipitation and Temperature data from the Udora Climate Station located at latitude 44°15'45.000" N, longitude 79°09'41.004" W, elevation 262.0 m.
4) Total Water Surplus (Thornthwaite, 1948) is calculated as total precipitation minus adjusted potential evapotranspiration.
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

TABLE D-4
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1981-2010 (UDORA CLIMATE STATION)
FINE SANDY LOAM, UNCULTIVATED (150 mm HOLDING CAPACITY)
HYDROGEOLOGICAL ASSESSMENT AND WATER BALANCE STUDY
226 BROCK STREET EAST
UXBRIDGE, ONTARIO

	Thornthwaite (1948)									Thornthwaite and Mather (1957)					
Month	Mean Temperature (°C)	Heat Index	Potential Evapo-transpiration (mm)	Daylight Correction Value	Adjusted Potential Evapo-transpiration (mm)	Total Precipitation (mm)	Surplus (mm)	Deficit (mm)	TP - PET (mm)	Accumulated Potential Water Loss (mm)	Soil Moisture (mm)	Change in Soil Moisture (mm) (delta S)	Actual Evapo-transpiration (mm)	Moisture Deficit (mm)	Unadjusted Moisture Surplus (mm)
January	-7.0	0.0	0.0	0.7839	0.00	64.9	64.9	0.0	64.9	0.0	150.0	0.0	0.0	0.0	64.9
February	-6.6	0.0	0.0	0.8679	0.00	45.9	45.9	0.0	45.9	0.0	150.0	0.0	0.0	0.0	45.9
March	-1.3	0.0	0.0	0.9871	0.00	53.1	53.1	0.0	53.1	0.0	150.0	0.0	0.0	0.0	53.1
April	5.7	1.2	26.5	1.1200	29.70	67.9	38.2	0.0	38.2	0.0	150.0	0.0	29.7	0.0	38.2
May	12.2	3.9	59.4	1.2290	72.97	82.1	9.1	0.0	9.1	0.0	150.0	0.0	73.0	0.0	9.1
June	18.0	7.0	89.6	1.2900	115.62	106.6	0.0	9.0	-9.0	-9.0	141.0	-9.0	115.6	0.0	0.0
July	19.9	8.1	99.7	1.2581	125.40	86.4	0.0	39.0	-39.0	-48.0	108.0	-33.0	119.4	6.0	0.0
August	19.3	7.7	96.5	1.1613	112.06	73.9	0.0	38.2	-38.2	-86.2	84.0	-24.0	97.9	14.2	0.0
September	15.1	5.3	74.4	1.0400	77.39	87.3	9.9	0.0	9.9	0.0	93.9	9.9	77.4	0.0	0.0
October	8.6	2.3	41.0	0.9194	37.69	74.9	37.2	0.0	37.2	0.0	131.1	37.2	37.7	0.0	0.0
November	2.4	0.3	10.6	0.8000	8.49	83.2	74.7	0.0	74.7	0.0	150.0	18.9	8.5	0.0	55.8
December	-4.0	0.0	0.0	0.7355	0.00	60.0	60.0	0.0	60.0	0.0	150.0	0.0	0.0	0.0	60.0
TOTALS		**35.8**			**579.3**	**886.2**	**393.1**	**86.2**	**306.9**	**-86.2**	**1608.0**	**0.0**	**559.1**	**20.2**	**327.1**

TOTAL WATER SURPLUS **306.9** **mm**

TOTAL MOISTURE SURPLUS **327.1** **mm**

NOTES:

1) Water budget adjusted for latitude and daylight.
2) (°C) - Represents calculated mean of daily temperatures for the month.
3) Precipitation and Temperature data from the Udora Climate Station located at latitude 44°15'45.000" N, longitude 79°09'41.004" W, elevation 262.0 m.
4) Total Water Surplus (Thornthwaite, 1948) is calculated as total precipitation minus adjusted potential evapotranspiration.
5) Total Moisture Surplus (Thornthwaite and Mather, 1957) is calculated as total precipitation minus actual evapotranspiration.

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	On/Off-Site	Outlet	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted Infiltration Factor	Area	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon	Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			Topography	Soil		Cover		Factor	Factor	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(mm/a)	(m^3/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
A-1	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	334.6	886.2	296.5	327.1	187.1	0.0	327.1	109.4	82.1	245.3	27.4	81.8	109.4
A-10	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	219.5	886.2	194.6	327.1	122.8	0.0	327.1	71.8	53.9	245.3	18.0	81.8	71.8
A-109	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	418.2	886.2	370.6	341.1	228.0	0.0	341.1	142.6	99.8	238.7	42.8	102.3	142.6
A-11	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	153.4	886.2	136.0	327.1	85.8	0.0	327.1	50.2	37.6	245.3	12.5	81.8	50.2
A-110	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	205.1	886.2	181.8	341.1	111.8	0.0	341.1	70.0	49.0	238.7	21.0	102.3	70.0
A-111	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	20.8	886.2	18.4	341.1	11.3	0.0	341.1	7.1	5.0	238.7	2.1	102.3	7.1
A-112	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	169.4	886.2	150.1	341.1	92.3	0.0	341.1	57.8	40.4	238.7	17.3	102.3	57.8
A-113	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	2.5	886.2	2.2	341.1	1.4	0.0	341.1	0.9	0.6	238.7	0.3	102.3	0.9
A-114	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	75.0	886.2	66.5	341.1	40.9	0.0	341.1	25.6	17.9	238.7	7.7	102.3	25.6
A-115	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	2.4	886.2	2.1	341.1	1.3	0.0	341.1	0.8	0.6	238.7	0.2	102.3	0.8
A-116	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	26.5	886.2	23.5	341.1	14.4	0.0	341.1	9.0	6.3	238.7	2.7	102.3	9.0
A-117	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	29.4	886.2	26.1	341.1	16.0	0.0	341.1	10.0	7.0	238.7	3.0	102.3	10.0
A-118	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	68.3	886.2	60.5	341.1	37.2	0.0	341.1	23.3	16.3	238.7	7.0	102.3	23.3
A-119	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	11.8	886.2	10.5	341.1	6.5	0.0	341.1	4.0	2.8	238.7	1.2	102.3	4.0
A-12	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.6	886.2	69.7	327.1	44.0	0.0	327.1	25.7	19.3	245.3	6.4	81.8	25.7
A-120	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	232.9	886.2	206.4	341.1	127.0	0.0	341.1	79.4	55.6	238.7	23.8	102.3	79.4
A-121	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	111.5	886.2	98.8	341.1	60.8	0.0	341.1	38.0	26.6	238.7	11.4	102.3	38.0
A-122	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	90.2	886.2	80.0	341.1	49.2	0.0	341.1	30.8	21.5	238.7	9.2	102.3	30.8
A-123	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	9.9	886.2	8.7	341.1	5.4	0.0	341.1	3.4	2.4	238.7	1.0	102.3	3.4
A-124	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	40.7	886.2	36.1	341.1	22.2	0.0	341.1	13.9	9.7	238.7	4.2	102.3	13.9
A-125	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	57.9	886.2	51.3	341.1	31.5	0.0	341.1	19.7	13.8	238.7	5.9	102.3	19.7
A-126	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	61.1	886.2	54.2	341.1	33.3	0.0	341.1	20.9	14.6	238.7	6.3	102.3	20.9
A-127	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	75.4	886.2	66.8	341.1	41.1	0.0	341.1	25.7	18.0	238.7	7.7	102.3	25.7
A-128	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	12.724196	886.2	11.3	341.1	6.9	0.0	341.1	4.3	3.0	238.7	1.3	102.3	4.3
A-129	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	79.26702	886.2	70.2	341.1	43.2	0.0	341.1	27.0	18.9	238.7	8.1	102.3	27.0
A-13	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	163.8	886.2	145.1	327.1	91.6	0.0	327.1	53.6	40.2	245.3	13.4	81.8	53.6
A-130	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	4.7	886.2	4.2	341.1	2.6	0.0	341.1	1.6	1.1	238.7	0.5	102.3	1.6
A-131	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	54.2	886.2	48.0	341.1	29.5	0.0	341.1	18.5	12.9	238.7	5.5	102.3	18.5
A-132	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	82.5	886.2	73.1	341.1	45.0	0.0	341.1	28.1	19.7	238.7	8.4	102.3	28.1
A-133	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	36.4	886.2	32.2	341.1	19.8	0.0	341.1	12.4	8.7	238.7	3.7	102.3	12.4
A-134	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	6.4	886.2	5.7	341.1	3.5	0.0	341.1	2.2	1.5	238.7	0.7	102.3	2.2
A-135	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	50.1	886.2	44.4	341.1	27.3	0.0	341.1	17.1	11.9	238.7	5.1	102.3	17.1
A-136	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	90.7	886.2	80.4	341.1	49.4	0.0	341.1	30.9	21.7	238.7	9.3	102.3	30.9
A-137	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	71.3	886.2	63.2	341.1	38.9	0.0	341.1	24.3	17.0	238.7	7.3	102.3	24.3
A-138	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	115.4	886.2	102.3	341.1	62.9	0.0	341.1	39.4	27.5	238.7	11.8	102.3	39.4
A-139	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	33.3	886.2	29.5	341.1	18.1	0.0	341.1	11.3	7.9	238.7	3.4	102.3	11.3
A-14	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	162.0	886.2	143.5	327.1	90.6	0.0	327.1	53.0	39.7	245.3	13.2	81.8	53.0
A-140	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	115.0	886.2	101.9	341.1	62.7	0.0	341.1	39.2	27.4	238.7	11.8	102.3	39.2
A-141	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	27.6	886.2	24.4	341.1	15.0	0.0	341.1	9.4	6.6	238.7	2.8	102.3	9.4
A-142	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	69.8	886.2	61.8	341.1	38.0	0.0	341.1	23.8	16.7	238.7	7.1	102.3	23.8
A-143	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	73.6	886.2	65.2	341.1	40.1	0.0	341.1	25.1	17.6	238.7	7.5	102.3	25.1
A-144	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	83.4	886.2	73.9	341.1	45.5	0.0	341.1	28.4	19.9	238.7	8.5	102.3	28.4
A-145	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	154.4	886.2	136.9	327.1	86.3	0.0	327.1	50.5	40.4	261.6	10.1	65.4	50.5
A-146	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	153.6	886.2	136.1	327.1	85.9	0.0	327.1	50.2	40.2	261.6	10.0	65.4	50.2
A-147	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	21.0	886.2	18.6	327.1	11.7	0.0	327.1	6.9	5.5	261.6	1.4	65.4	6.9
A-148	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	160.2	886.2	142.0	327.1	89.6	0.0	327.1	52.4	41.9	261.6	10.5	65.4	52.4
A-149	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	147.9	886.2	131.1	327.1	82.7	0.0	327.1	48.4	38.7	261.6	9.7	65.4	48.4
A-15	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	37.9	886.2	33.6	327.1	21.2	0.0	327.1	12.4	9.3	245.3	3.1	81.8	12.4
A-150	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	151.1	886.2	133.9	327.1	84.5	0.0	327.1	49.4	39.5	261.6	9.9	65.4	49.4
A-151	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	78.7	886.2	69.7	327.1	44.0	0.0	327.1	25.7	20.6	261.6	5.1	65.4	25.7
A-152	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	78.5	886.2	69.5	327.1	43.9	0.0	327.1	25.7	20.5	261.6	5.1	65.4	25.7
A-153	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	78.8	886.2	69.8	327.1	44.1	0.0	327.1	25.8	20.6	261.6	5.2	65.4	25.8
A-154	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	4.7	886.2	4.2	327.1	2.6	0.0	327.1	1.5	1.2	261.6	0.3	65.4	1.5
A-155	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	78.4	886.2	69.4	327.1	43.8	0.0	327.1	25.6	20.5	261.6	5.1	65.4	25.6
A-156	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	587.7	886.2	520.8	327.1	328.6	0.0	327.1	192.2	153.8	261.6	38.4	65.4	192.2
A-157	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	49.9	886.2	44.3	327.1	27.9	0.0	327.1	16.3	13.1	261.6	3.3	65.4	16.3
A-158	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	105.3	886.2	93.4	327.1	58.9	0.0	327.1	34.5	27.6	261.6	6.9	65.4	34.5
A-159	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	90.0	886.2	79.7	327.1	50.3	0.0	327.1	29.4	23.5	261.6	5.9	65.4	29.4
A-16	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	20.8	886.2	18.5	327.1	11.6	0.0	327.1	6.8	5.1	245.3	1.7	81.8	6.8
A-160	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	89.9	886.2	79.7	327.1	50.3	0.0	327.1	29.4	23.5	261.6	5.9	65.4	29.4
A-161	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	128.6	886.2	113.9	327.1	71.9	0.0	327.1	42.0	33.6	261.6	8.4	65.4	42.0
A-162	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	17.3	886.2	15.3	327.1	9.7	0.0	327.1	5.6	4.5	261.6	1.1	65.4	5.6
A-163	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	1970.0	886.2	1745.8	327.1	1101.5	0.0	327.1	644.3	515.5	261.6	128.9	65.4	644.3
A-164	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	203.4	886.2	180.3	327.1	113.7	0.0	327.1	66.5	53.2	261.6	13.3	65.4	66.5
A-165	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	143.7	886.2	127.3	327.1	80.3	0.0	327.1	47.0	37.6	261.6	9.4	65.4	47.0
A-166	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	119.5	886.2	105.9	327.1	66.8	0.0	327.1	39.1	31.3	261.6	7.8	65.4	39.1
A-167	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	152.1	886.2	134.8	327.1	85.0	0.0	327.1	49.7	39.8	261.6	9.9	65.4	49.7
A-168	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	73.7	886.2	65.3	327.1	41.2	0.0	327.1	24.1	19.3	261.6	4.8	65.4	24.1
A-169	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	79.5	886.2	70.5	327.1	44.5	0.0	327.1	26.0	20.8	261.6	5.2	65.4	26.0
A-17	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	17.9	886.2	15.8	327.1	10.0	0.0	327.1	5.8	4.4	245.3	1.5	81.8	5.8
A-170	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	78.8	886.2	69.8	327.1	44.1	0.0	327.1	25.8	20.6	261.6	5.2	65.4	25.8
A-171	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	91.9	886.2	81.4	327.1	51.4	0.0	327.1	30.1	24.0	261.6	6.0	65.4	30.1
A-172	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	39.0	886.2	34.6	327.1	21.8	0.0	327.1	12.8	10.2	261.6	2.6	65.4	12.8

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

Subcatchment Designation	On/Off-Site	Outlet	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted Infiltration Factor	Area	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon	Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			Topography	Soil		Cover		Factor	Factor	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(mm/a)	(m^3/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
A-173	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	109.0	886.2	96.6	327.1	60.9	0.0	327.1	35.6	28.5	261.6	7.1	65.4	35.6
A-174	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	505.6	886.2	448.1	327.1	282.7	0.0	327.1	165.4	132.3	261.6	33.1	65.4	165.4
A-175	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	5.6	886.2	5.0	327.1	3.1	0.0	327.1	1.8	1.5	261.6	0.4	65.4	1.8
A-176	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	90.0	886.2	79.8	327.1	50.3	0.0	327.1	29.4	23.5	261.6	5.9	65.4	29.4
A-177	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	88.9	886.2	78.8	327.1	49.7	0.0	327.1	29.1	23.3	261.6	5.8	65.4	29.1
A-178	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	122.9	886.2	108.9	327.1	68.7	0.0	327.1	40.2	32.2	261.6	8.0	65.4	40.2
A-179	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	141.7	886.2	125.6	327.1	79.2	0.0	327.1	46.3	37.1	261.6	9.3	65.4	46.3
A-18	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	29.2	886.2	25.9	327.1	16.3	0.0	327.1	9.5	7.2	245.3	2.4	81.8	9.5
A-180	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	3.4	886.2	3.0	327.1	1.9	0.0	327.1	1.1	0.9	261.6	0.2	65.4	1.1
A-181	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	90.6	886.2	80.3	327.1	50.7	0.0	327.1	29.6	23.7	261.6	5.9	65.4	29.6
A-182	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	4.6	886.2	4.1	327.1	2.6	0.0	327.1	1.5	1.1	245.3	0.4	81.8	1.5
A-183	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	71.9	886.2	63.7	327.1	40.2	0.0	327.1	23.5	17.6	245.3	5.9	81.8	23.5
A-184	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	3.4	886.2	3.1	327.1	1.9	0.0	327.1	1.1	0.8	245.3	0.3	81.8	1.1
A-185	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	3.2	886.2	2.9	327.1	1.8	0.0	327.1	1.1	0.8	245.3	0.3	81.8	1.1
A-186	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	621.5	886.2	550.7	327.1	347.5	0.0	327.1	203.3	152.4	245.3	50.8	81.8	203.3
A-187	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	2.5	886.2	2.2	327.1	1.4	0.0	327.1	0.8	0.6	245.3	0.2	81.8	0.8
A-188	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	6.3	886.2	5.6	327.1	3.5	0.0	327.1	2.0	1.5	245.3	0.5	81.8	2.0
A-189	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	115.6	886.2	102.4	341.1	63.0	0.0	341.1	39.4	27.6	238.7	11.8	102.3	39.4
A-19	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	70.4	886.2	62.3	327.1	39.3	0.0	327.1	23.0	17.3	245.3	5.8	81.8	23.0
A-190	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	65.5	886.2	58.1	341.1	35.7	0.0	341.1	22.3	15.6	238.7	6.7	102.3	22.3
A-191	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	102.7	886.2	91.0	341.1	56.0	0.0	341.1	35.0	24.5	238.7	10.5	102.3	35.0
A-192	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	26.4	886.2	23.4	341.1	14.4	0.0	341.1	9.0	6.3	238.7	2.7	102.3	9.0
A-193	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	84.2	886.2	74.6	341.1	45.9	0.0	341.1	28.7	20.1	238.7	8.6	102.3	28.7
A-194	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	31.0	886.2	27.5	341.1	16.9	0.0	341.1	10.6	7.4	238.7	3.2	102.3	10.6
A-195	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	27.6	886.2	24.4	341.1	15.0	0.0	341.1	9.4	6.6	238.7	2.8	102.3	9.4
A-196	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	87.4	886.2	77.5	341.1	47.7	0.0	341.1	29.8	20.9	238.7	8.9	102.3	29.8
A-197	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	67.1	886.2	59.5	341.1	36.6	0.0	341.1	22.9	16.0	238.7	6.9	102.3	22.9
A-198	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	1599.2	886.2	1417.2	327.1	894.2	0.0	327.1	523.1	418.4	261.6	104.6	65.4	523.1
A-199	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	14.8	886.2	13.1	327.1	8.3	0.0	327.1	4.8	3.9	261.6	1.0	65.4	4.8
A-2	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	988.4	886.2	875.9	327.1	552.6	0.0	327.1	323.3	242.4	245.3	80.8	81.8	323.3
A-20	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	287.3	886.2	254.6	327.1	160.6	0.0	327.1	94.0	70.5	245.3	23.5	81.8	94.0
A-200	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	90.0	886.2	79.7	327.1	50.3	0.0	327.1	29.4	23.5	261.6	5.9	65.4	29.4
A-201	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Uncultivated	0.15	0.80	0.80	103.8	886.2	92.0	327.1	58.0	0.0	327.1	33.9	27.2	261.6	6.8	65.4	33.9
A-202	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	126.8	886.2	112.3	341.1	69.1	0.0	341.1	43.2	30.3	238.7	13.0	102.3	43.2
A-203	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	78.9	886.2	69.9	341.1	43.0	0.0	341.1	26.9	18.8	238.7	8.1	102.3	26.9
A-204	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Lawns	0.05	0.70	0.70	999.3	886.2	885.6	341.1	544.8	0.0	341.1	340.8	238.6	238.7	102.3	102.3	340.8
A-21	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	57.6	886.2	51.1	327.1	32.2	0.0	327.1	18.8	14.1	245.3	4.7	81.8	18.8
A-22	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	283.2	886.2	250.9	327.1	158.3	0.0	327.1	92.6	69.5	245.3	23.2	81.8	92.6
A-23	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	63.1	886.2	55.9	327.1	35.3	0.0	327.1	20.6	15.5	245.3	5.2	81.8	20.6
A-24	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	40.1	886.2	35.5	327.1	22.4	0.0	327.1	13.1	9.8	245.3	3.3	81.8	13.1
A-25	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	6.4	886.2	5.7	327.1	3.6	0.0	327.1	2.1	1.6	245.3	0.5	81.8	2.1
A-26	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	18.8	886.2	16.7	327.1	10.5	0.0	327.1	6.2	4.6	245.3	1.5	81.8	6.2
A-27	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	109.0	886.2	96.6	327.1	60.9	0.0	327.1	35.6	26.7	245.3	8.9	81.8	35.6
A-28	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	7.9	886.2	7.0	327.1	4.4	0.0	327.1	2.6	1.9	245.3	0.6	81.8	2.6
A-29	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	28.0	886.2	24.8	327.1	15.6	0.0	327.1	9.2	6.9	245.3	2.3	81.8	9.2
A-3	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	95.2	886.2	84.4	327.1	53.2	0.0	327.1	31.1	23.4	245.3	7.8	81.8	31.1
A-30	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	107.5	886.2	95.3	327.1	60.1	0.0	327.1	35.2	26.4	245.3	8.8	81.8	35.2
A-31	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	50.5	886.2	44.7	327.1	28.2	0.0	327.1	16.5	12.4	245.3	4.1	81.8	16.5
A-32	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	10.8	886.2	9.5	327.1	6.0	0.0	327.1	3.5	2.6	245.3	0.9	81.8	3.5
A-33	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	858.0	886.2	760.4	327.1	479.7	0.0	327.1	280.6	210.5	245.3	70.2	81.8	280.6
A-34	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	115.2	886.2	102.1	327.1	64.4	0.0	327.1	37.7	28.3	245.3	9.4	81.8	37.7
A-35	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	692.8	886.2	614.0	327.1	387.4	0.0	327.1	226.6	169.9	245.3	56.6	81.8	226.6
A-36	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	93.9	886.2	83.2	327.1	52.5	0.0	327.1	30.7	23.0	245.3	7.7	81.8	30.7
A-37	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	229.6	886.2	203.5	327.1	128.4	0.0	327.1	75.1	56.3	245.3	18.8	81.8	75.1
A-38	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	221.5	886.2	196.3	327.1	123.8	0.0	327.1	72.4	54.3	245.3	18.1	81.8	72.4
A-39	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	63.9	886.2	56.6	327.1	35.7	0.0	327.1	20.9	15.7	245.3	5.2	81.8	20.9
A-4	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	258.8	886.2	229.4	327.1	144.7	0.0	327.1	84.7	63.5	245.3	21.2	81.8	84.7
A-40	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	130.7	886.2	115.8	327.1	73.1	0.0	327.1	42.7	32.1	245.3	10.7	81.8	42.7
A-41	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	223.5	886.2	198.1	327.1	125.0	0.0	327.1	73.1	54.8	245.3	18.3	81.8	73.1
A-42	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	125.9	886.2	111.6	327.1	70.4	0.0	327.1	41.2	30.9	245.3	10.3	81.8	41.2
A-43	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	101.6	886.2	90.0	327.1	56.8	0.0	327.1	33.2	24.9	245.3	8.3	81.8	33.2
A-44	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	261.9	886.2	232.1	327.1	146.4	0.0	327.1	85.7	64.2	245.3	21.4	81.8	85.7
A-45	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	270	886.2	239.3	327.1	151.0	0.0	327.1	88.3	66.2	245.3	22.1	81.8	88.3
A-46	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	49.3	886.2	43.7	327.1	27.6	0.0	327.1	16.1	12.1	245.3	4.0	81.8	16.1
A-47	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.7	886.2	69.7	327.1	44.0	0.0	327.1	25.7	19.3	245.3	6.4	81.8	25.7
A-48	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.1	886.2	69.2	327.1	43.7	0.0	327.1	25.5	19.2	245.3	6.4	81.8	25.5
A-49	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	76.9	886.2	68.1	327.1	43.0	0.0	327.1	25.2	18.9	245.3	6.3	81.8	25.2
A-5	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	62.4	886.2	55.3	327.1	34.9	0.0	327.1	20.4	15.3	245.3	5.1	81.8	20.4
A-50	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	79.2	886.2	70.2	327.1	44.3	0.0	327.1	25.9	19.4	245.3	6.5	81.8	25.9
A-51	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	77.6	886.2	68.8	327.1	43.4	0.0	327.1	25.4	19.0	245.3	6.3	81.8	25.4
A-52	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.0	886.2	69.1	327.1	43.6	0.0	327.1	25.5	19.1	245.3	6.4	81.8	25.5
A-53	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.1	886.2	69.2	327.1	43.7	0.0	327.1	25.5	19.2	245.3	6.4	81.8	25.5
A-54	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.5	886.2	69.6	327.1	43.9	0.0	327.1	25.7	19.3	245.3	6.4	81.8	25.7

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

Subcatchment Designation	On/Off-Site	Outlet	MOE TABLE 2 Components					MOE Infiltration Factor	Adjusted Infiltration Factor	Area	Precipitation	Precipitation Total	Precipitation Surplus	Evapotranspiration	Runon	Net Surplus		Infiltration		Runoff*		Total Infiltration + Runoff
			Topography	Soil		Cover		Factor	Factor	(m^2)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(mm/a)	(m^3/a)	(m^3/a)	(mm/a)	(m^3/a)	(mm/a)	(m^3/a)
A-55	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	78.7	886.2	69.7	327.1	44.0	0.0	327.1	25.7	19.3	245.3	6.4	81.8	25.7
A-56	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	38.0	886.2	33.7	327.1	21.2	0.0	327.1	12.4	9.3	245.3	3.1	81.8	12.4
A-57	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	38.5	886.2	34.1	327.1	21.5	0.0	327.1	12.6	9.4	245.3	3.1	81.8	12.6
A-58	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	130.3	886.2	115.5	327.1	72.9	0.0	327.1	42.6	32.0	245.3	10.7	81.8	42.6
A-59	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	72.7	886.2	64.4	327.1	40.6	0.0	327.1	23.8	17.8	245.3	5.9	81.8	23.8
A-6	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	281.8	886.2	249.8	327.1	157.6	0.0	327.1	92.2	69.1	245.3	23.0	81.8	92.2
A-60	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	212.9	886.2	188.7	327.1	119.0	0.0	327.1	69.6	52.2	245.3	17.4	81.8	69.6
A-61	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	222.1	886.2	196.8	327.1	124.2	0.0	327.1	72.6	54.5	245.3	18.2	81.8	72.6
A-62	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	1342.1	886.2	1189.4	327.1	750.4	0.0	327.1	439.0	329.2	245.3	109.7	81.8	439.0
A-63	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	22.8	886.2	20.2	327.1	12.7	0.0	327.1	7.5	5.6	245.3	1.9	81.8	7.5
A-64	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	90.2	886.2	79.9	327.1	50.4	0.0	327.1	29.5	22.1	245.3	7.4	81.8	29.5
A-65	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	90.6	886.2	80.3	327.1	50.7	0.0	327.1	29.6	22.2	245.3	7.4	81.8	29.6
A-66	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	90.1	886.2	79.8	327.1	50.4	0.0	327.1	29.5	22.1	245.3	7.4	81.8	29.5
A-67	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	189.6	886.2	168.0	327.1	106.0	0.0	327.1	62.0	46.5	245.3	15.5	81.8	62.0
A-68	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	146.3	886.2	129.7	327.1	81.8	0.0	327.1	47.8	35.9	245.3	12.0	81.8	47.8
A-69	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	90.0	886.2	79.8	327.1	50.3	0.0	327.1	29.4	22.1	245.3	7.4	81.8	29.4
A-7	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	23.1	886.2	20.4	327.1	12.9	0.0	327.1	7.5	5.7	245.3	1.9	81.8	7.5
A-70	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	44.5	886.2	39.4	327.1	24.9	0.0	327.1	14.6	10.9	245.3	3.6	81.8	14.6
A-71	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	89.3	886.2	79.1	327.1	49.9	0.0	327.1	29.2	21.9	245.3	7.3	81.8	29.2
A-72	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	142.3	886.2	126.1	327.1	79.6	0.0	327.1	46.5	34.9	245.3	11.6	81.8	46.5
A-73	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	24.5	886.2	21.7	327.1	13.7	0.0	327.1	8.0	6.0	245.3	2.0	81.8	8.0
A-74	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	45.3	886.2	40.1	327.1	25.3	0.0	327.1	14.8	11.1	245.3	3.7	81.8	14.8
A-75	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	90.1	886.2	79.8	327.1	50.4	0.0	327.1	29.5	22.1	245.3	7.4	81.8	29.5
A-76	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	143.1	886.2	126.8	327.1	80.0	0.0	327.1	46.8	35.1	245.3	11.7	81.8	46.8
A-77	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	42.1	886.2	37.3	327.1	23.5	0.0	327.1	13.8	10.3	245.3	3.4	81.8	13.8
A-78	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	85.6	886.2	75.8	797.6	7.6	0.0	797.6	68.3	0.0	0.0	68.3	797.6	68.3
A-79	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	45.8	886.2	40.6	797.6	4.1	0.0	797.6	36.5	0.0	0.0	36.5	797.6	36.5
A-8	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	125.7	886.2	111.4	327.1	70.3	0.0	327.1	41.1	30.8	245.3	10.3	81.8	41.1
A-80	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	28.1	886.2	24.9	797.6	2.5	0.0	797.6	22.4	0.0	0.0	22.4	797.6	22.4
A-81	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	35.3	886.2	31.3	797.6	3.1	0.0	797.6	28.2	0.0	0.0	28.2	797.6	28.2
A-82	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	9.6	886.2	8.5	797.6	0.9	0.0	797.6	7.7	0.0	0.0	7.7	797.6	7.7
A-83	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	24.6	886.2	21.8	797.6	2.2	0.0	797.6	19.6	0.0	0.0	19.6	797.6	19.6
A-84	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	23.5	886.2	20.8	797.6	2.1	0.0	797.6	18.7	0.0	0.0	18.7	797.6	18.7
A-85	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	58.6	886.2	51.9	797.6	5.2	0.0	797.6	46.7	0.0	0.0	46.7	797.6	46.7
A-86	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	111.4	886.2	98.8	797.6	9.9	0.0	797.6	88.9	0.0	0.0	88.9	797.6	88.9
A-87	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	4.3	886.2	3.8	797.6	0.4	0.0	797.6	3.4	0.0	0.0	3.4	797.6	3.4
A-88	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	67.1	886.2	59.5	797.6	5.9	0.0	797.6	53.5	0.0	0.0	53.5	797.6	53.5
A-89	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Building	0	0.65	0.00	84.8	886.2	75.1	797.6	7.5	0.0	797.6	67.6	0.0	0.0	67.6	797.6	67.6
A-9	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Cultivated	0.1	0.75	0.75	83.0	886.2	73.5	327.1	46.4	0.0	327.1	27.1	20.4	245.3	6.8	81.8	27.1
A-90	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	24.3	886.2	21.5	341.1	13.3	0.0	341.1	8.3	5.8	238.7	2.5	102.3	8.3
A-91	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	26.2	886.2	23.2	341.1	14.3	0.0	341.1	8.9	6.3	238.7	2.7	102.3	8.9
A-92	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	23.7	886.2	21.0	341.1	12.9	0.0	341.1	8.1	5.7	238.7	2.4	102.3	8.1
A-93	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	57.7	886.2	51.1	341.1	31.5	0.0	341.1	19.7	13.8	238.7	5.9	102.3	19.7
A-94	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	21.4	886.2	19.0	341.1	11.7	0.0	341.1	7.3	5.1	238.7	2.2	102.3	7.3
A-95	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	64.1	886.2	56.8	341.1	35.0	0.0	341.1	21.9	15.3	238.7	6.6	102.3	21.9
A-96	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	46.4	886.2	41.1	341.1	25.3	0.0	341.1	15.8	11.1	238.7	4.7	102.3	15.8
A-97	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	101.7	886.2	90.1	341.1	55.4	0.0	341.1	34.7	24.3	238.7	10.4	102.3	34.7
A-98	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	6.2	886.2	5.5	341.1	3.4	0.0	341.1	2.1	1.5	238.7	0.6	102.3	2.1
A-99	On Site	Offsite to the Northeast via overland flow	0.25	Open Sandy Loam	0.4	Gravel	0.05	0.70	0.70	18.2	886.2	16.1	341.1	9.9	0.0	341.1	6.2	4.3	238.7	1.9	102.3	6.2
Subtotal Catchment A										**26,118**	**886.2**	**23,146**	**340**	**14,262**	**0**	**340**	**8,883**	**6,365**	**244**	**2,519**	**96**	**8,883**
TOTAL SITE										**26,118**	**886.2**	**23,146**	**340.1**	**14,262**	**0.0**	**340.1**	**8,883**	**6,365**	**243.7**	**2,519**	**96.4**	**8,883**

Total of On-Site Infiltration* 6,365 (m^3/a)
Total of On-Site Runoff 2,519 (m^3/a)

NOTES: 1) Subcatchment areas were delineated using the development plans provided by Cole Engineering.
2) "*" Infiltration factors components are based on land use information provided by Ontario Base Mapping.

APPENDIX

F

WATER BUDGET CALCULATIONS – POST DEVELOPMENT

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

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

On-site Subcatchments	Area (m^2)	Outlet	Total Impervious (m^2)	Total Pervious (m^2)	Infiltration Factor Components*: Topography	Soil		Cover		MOE Infiltration Factor	Adjusted Infiltration Factor	Inputs: Precipitation: Annual Average (mm/yr)	(m^3/yr)	Surplus (mm/yr)	(m^3/yr)	Run-on (mm/yr)	(m^3/yr)	Total Inputs (mm/yr)	(m^3/yr)	Outputs: Evapotranspiration: Pervious (mm/yr)	(m^3/yr)	Impervious (mm/yr)	(m^3/yr)	Total Evapotranspiration (mm/yr)	(m^3/yr)	Infiltration: Pervious Areas (mm/yr)	(m^3/yr)	Total Infiltration (mm/yr)	(m^3/yr)	Runoff: Pervious (mm/yr)	(m^3/yr)	Total Impervious (mm/yr)	(m^3/yr)	Total Runoff (mm/yr)	(m^3/yr)	Total Outputs (mm/yr)	(m^3/yr)
A-78	85.6	Off-site via Swale	0	86	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	75.8	341.1	29.2	0.0	0	886.2	75.8	545.1	46.7	0.0	0.0	545.1	46.7	238.7	20.4	238.7	20.4	102.3	8.8	0.0	0.0	102.3	8.8	886.2	75.8
A-79	45.8	Off-site via Swale	0	46	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	40.6	341.1	15.6	0.0	0	886.2	40.6	545.1	25.0	0.0	0.0	545.1	25.0	238.7	10.9	238.7	10.9	102.3	4.7	0.0	0.0	102.3	4.7	886.2	40.6
A-80	28.1	Off-site via Swale	0	28	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	24.9	341.1	9.6	0.0	0	886.2	24.9	545.1	15.3	0.0	0.0	545.1	15.3	238.7	6.7	238.7	6.7	102.3	2.9	0.0	0.0	102.3	2.9	886.2	24.9
A-97	101.7	Off-site via Swale	0	102	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	90.1	341.1	34.7	0.0	0	886.2	90.1	545.1	55.4	0.0	0.0	545.1	55.4	238.7	24.3	238.7	24.3	102.3	10.4	0.0	0.0	102.3	10.4	886.2	90.1
A-163	1970.0	Off-site via Swale	0	1,970	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	1745.8	341.1	671.9	0.0	0	886.2	1745.8	545.1	1073.9	0.0	0.0	545.1	1073.9	238.7	470.3	238.7	470.3	102.3	201.6	0.0	0.0	102.3	201.6	886.2	1745.8
A-198	1599.2	Off-site via Swale	0	1,599	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	1417.2	341.1	545.4	0.0	0	886.2	1417.2	545.1	871.8	0.0	0.0	545.1	871.8	238.7	381.8	238.7	381.8	102.3	163.6	0.0	0.0	102.3	163.6	886.2	1417.2
Catchment A Total	**3,830**		**0**	**3,830**								**886**	**3,394**	**341.1**	**1,306**	**0**	**0**	**886**	**3,394**	**545**	**2,088**	**0**	**0**	**545**	**2,088**	**239**	**914**	**239**	**914**	**102**	**392**	**0**	**0**	**102**	**392**	**886**	**3,394**
B-1	334.6	Off-site North West via Overland Flow	0	335	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	296.5	341.1	114.1	0.0	0	886.2	296.5	545.1	182.4	0.0	0.0	545.1	182.4	238.7	79.9	238.7	79.9	102.3	34.2	0.0	0.0	102.3	34.2	886.2	296.5
B-3	95.2	Off-site North West via Overland Flow	95	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	84.4	797.6	75.9	0.0	0	886.2	84.4	0.0	0.0	88.6	8.4	88.6	8.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	75.9	797.6	75.9	886.2	84.4
B-4	258.8	Off-site North West via Overland Flow	259	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	229.4	797.6	206.4	0.0	0	886.2	229.4	0.0	0.0	88.6	22.9	88.6	22.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	206.4	797.6	206.4	886.2	229.4
B-98	6.2	Off-site North West via Overland Flow	0	6	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	5.5	341.1	2.1	0.0	0	886.2	5.5	545.1	3.4	0.0	0.0	545.1	3.4	238.7	1.5	238.7	1.5	102.3	0.6	0.0	0.0	102.3	0.6	886.2	5.5
B-119	11.8	Off-site North West via Overland Flow	0	12	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	10.5	341.1	4.0	0.0	0	886.2	10.5	545.1	6.5	0.0	0.0	545.1	6.5	238.7	2.8	238.7	2.8	102.3	1.2	0.0	0.0	102.3	1.2	886.2	10.5
B-145	154.4	Off-site North West via Overland Flow	0	154	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	136.9	341.1	52.7	0.0	0	886.2	136.9	545.1	84.2	0.0	0.0	545.1	84.2	238.7	36.9	238.7	36.9	102.3	15.8	0.0	0.0	102.3	15.8	886.2	136.9
B-146	153.6	Off-site North West via Overland Flow	154	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	136.1	797.6	122.5	0.0	0	886.2	136.1	0.0	0.0	88.6	13.6	88.6	13.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	122.5	797.6	122.5	886.2	136.1
Catchment B Total	**1,015**		**508**	**507**								**886**	**899**	**569.4**	**578**	**0**	**0**	**886**	**899**	**272**	**276**	**44**	**45**	**317**	**321**	**119**	**121**	**119**	**121**	**51**	**52**	**399**	**405**	**450**	**457**	**886**	**899**
C-90	24.3	Off-site North West via Overland Flow	0	24	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	21.5	341.1	8.3	0.0	0	886.2	21.5	545.1	13.3	0.0	0.0	545.1	13.3	238.7	5.8	238.7	5.8	102.3	2.5	0.0	0.0	102.3	2.5	886.2	21.5
C-92	23.7	Off-site North West via Overland Flow	24	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	21.0	797.6	18.9	0.0	0	886.2	21.0	0.0	0.0	88.6	2.1	88.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	18.9	797.6	18.9	886.2	21.0
C-189	115.6	Off-site North West via Overland Flow	0	116	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	102.4	341.1	39.4	0.0	0	886.2	102.4	545.1	63.0	0.0	0.0	545.1	63.0	238.7	27.6	238.7	27.6	102.3	11.8	0.0	0.0	102.3	11.8	886.2	102.4
C-190	65.5	Off-site North West via Overland Flow	0	66	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	58.1	341.1	22.3	0.0	0	886.2	58.1	545.1	35.7	0.0	0.0	545.1	35.7	238.7	15.6	238.7	15.6	102.3	6.7	0.0	0.0	102.3	6.7	886.2	58.1
C-191	102.7	Off-site North West via Overland Flow	103	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	91.0	797.6	81.9	0.0	0	886.2	91.0	0.0	0.0	88.6	9.1	88.6	9.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	81.9	797.6	81.9	886.2	91.0
C-192	26.4	Off-site North West via Overland Flow	26	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	23.4	797.6	21.1	0.0	0	886.2	23.4	0.0	0.0	88.6	2.3	88.6	2.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	21.1	797.6	21.1	886.2	23.4
Catchment C Total	**358**		**153**	**205**								**886**	**317**	**535.8**	**192**	**0**	**0**	**886**	**317**	**313**	**112**	**38**	**14**	**350**	**126**	**137**	**49**	**137**	**49**	**59**	**21**	**340**	**122**	**399**	**143**	**886**	**317**
D-5	62.4	Infiltration Trench	62	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	55.3	797.6	49.8	0.0	0	886.2	55.3	0.0	0.0	88.6	5.5	88.6	5.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	49.8	797.6	49.8	886.2	55.3
D-6	281.8	Infiltration Trench	282	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	249.8	797.6	224.8	0.0	0	886.2	249.8	0.0	0.0	88.6	25.0	88.6	25.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	224.8	797.6	224.8	886.2	249.8
D-7	23.1	Infiltration Trench	23	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	20.4	797.6	18.4	0.0	0	886.2	20.4	0.0	0.0	88.6	2.0	88.6	2.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	18.4	797.6	18.4	886.2	20.4
D-8	125.7	Infiltration Trench	126	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	111.4	797.6	100.3	0.0	0	886.2	111.4	0.0	0.0	88.6	11.1	88.6	11.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	100.3	797.6	100.3	886.2	111.4
D-9	83.0	Off-Site Northwest via Storm Sewers	83	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	73.5	797.6	66.2	0.0	0	886.2	73.5	0.0	0.0	88.6	7.4	88.6	7.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	66.2	797.6	66.2	886.2	73.5
D-10	219.5	Off-Site Northwest via Storm Sewers	220	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	194.6	797.6	175.1	0.0	0	886.2	194.6	0.0	0.0	88.6	19.5	88.6	19.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	175.1	797.6	175.1	886.2	194.6
D-11	153.4	Off-Site Northwest via Storm Sewers	153	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	136.0	797.6	122.4	0.0	0	886.2	136.0	0.0	0.0	88.6	13.6	88.6	13.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	122.4	797.6	122.4	886.2	136.0
D-12	78.6	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.7	797.6	62.7	0.0	0	886.2	69.7	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.7	797.6	62.7	886.2	69.7
D-13	163.8	Off-Site Northwest via Storm Sewers	164	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	145.1	797.6	130.6	0.0	0	886.2	145.1	0.0	0.0	88.6	14.5	88.6	14.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	130.6	797.6	130.6	886.2	145.1
D-14	162.0	Off-Site Northwest via Storm Sewers	162	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	143.5	797.6	129.2	0.0	0	886.2	143.5	0.0	0.0	88.6	14.4	88.6	14.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	129.2	797.6	129.2	886.2	143.5
D-15	37.9	Off-Site Northwest via Storm Sewers	38	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	33.6	797.6	30.2	0.0	0	886.2	33.6	0.0	0.0	88.6	3.4	88.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	30.2	797.6	30.2	886.2	33.6
D-16	20.8	Off-Site Northwest via Storm Sewers	21	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	18.5	797.6	16.6	0.0	0	886.2	18.5	0.0	0.0	88.6	1.8	88.6	1.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	16.6	797.6	16.6	886.2	18.5
D-17	17.9	Off-Site Northwest via Storm Sewers	18	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	15.8	797.6	14.2	0.0	0	886.2	15.8	0.0	0.0	88.6	1.6	88.6	1.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	14.2	797.6	14.2	886.2	15.8
D-18	29.2	Off-Site Northwest via Storm Sewers	29	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	25.9	797.6	23.3	0.0	0	886.2	25.9	0.0	0.0	88.6	2.6	88.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	23.3	797.6	23.3	886.2	25.9
D-23	63.1	Off-Site Northwest via Storm Sewers	0	63	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	55.9	341.1	21.5	0.0	0	886.2	55.9	545.1	34.4	0.0	0.0	545.1	34.4	238.7	15.1	238.7	15.1	102.3	6.5	0.0	0.0	102.3	6.5	886.2	55.9
D-24	40.1	Off-Site Northwest via Storm Sewers	0	40	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	35.5	341.1	13.7	0.0	0	886.2	35.5	545.1	21.9	0.0	0.0	545.1	21.9	238.7	9.6	238.7	9.6	102.3	4.1	0.0	0.0	102.3	4.1	886.2	35.5
D-25	6.4	Off-Site Northwest via Storm Sewers	0	6	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	5.7	341.1	2.2	0.0	0	886.2	5.7	545.1	3.5	0.0	0.0	545.1	3.5	238.7	1.5	238.7	1.5	102.3	0.7	0.0	0.0	102.3	0.7	886.2	5.7
D-26	18.8	Off-Site Northwest via Storm Sewers	0	19	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	16.7	341.1	6.4	0.0	0	886.2	16.7	545.1	10.3	0.0	0.0	545.1	10.3	238.7	4.5	238.7	4.5	102.3	1.9	0.0	0.0	102.3	1.9	886.2	16.7
D-27	109.0	Off-Site Northwest via Storm Sewers	0	109	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	96.6	341.1	37.2	0.0	0	886.2	96.6	545.1	59.4	0.0	0.0	545.1	59.4	238.7	26.0	238.7	26.0	102.3	11.1	0.0	0.0	102.3	11.1	886.2	96.6
D-28	7.9	Off-Site Northwest via Storm Sewers	0	8	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	7.0	341.1	2.7	0.0	0	886.2	7.0	545.1	4.3	0.0	0.0	545.1	4.3	238.7	1.9	238.7	1.9	102.3	0.8	0.0	0.0	102.3	0.8	886.2	7.0
D-29	28.0	Off-Site Northwest via Storm Sewers	0	28	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	24.8	341.1	9.5	0.0	0	886.2	24.8	545.1	15.3	0.0	0.0	545.1	15.3	238.7	6.7	238.7	6.7	102.3	2.9	0.0	0.0	102.3	2.9	886.2	24.8
D-30	107.5	Off-Site Northwest via Storm Sewers	0	107	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	95.3	341.1	36.7	0.0	0	886.2	95.3	545.1	58.6	0.0	0.0	545.1	58.6	238.7	25.7	238.7	25.7	102.3	11.0	0.0	0.0	102.3	11.0	886.2	95.3
D-31	50.5	Off-Site Northwest via Storm Sewers	0	50	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	44.7	341.1	17.2	0.0	0	886.2	44.7	545.1	27.5	0.0	0.0	545.1	27.5	238.7	12.0	238.7	12.0	102.3	5.2	0.0	0.0	102.3	5.2	886.2	44.7
D-32	10.8	Off-Site Northwest via Storm Sewers	0	11	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	9.5	341.1	3.7	0.0	0	886.2	9.5	545.1	5.9	0.0	0.0	545.1	5.9	238.7	2.6	238.7	2.6	102.3	1.1	0.0	0.0	102.3	1.1	886.2	9.5
D-40	130.7	Off-Site Northwest via Storm Sewers	131	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	115.8	797.6	104.3	0.0	0	886.2	115.8	0.0	0.0	88.6	11.6	88.6	11.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	104.3	797.6	104.3	886.2	115.8
D-41	223.5	Infiltration Trench	223	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	198.0	797.6	178.2	0.0	0	886.2	198.0	0.0	0.0	88.6	19.8	88.6	19.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	178.2	797.6	178.2	886.2	198.0
D-42	125.9	Infiltration Trench	126	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	111.5	797.6	100.4	0.0	0	886.2	111.5	0.0	0.0	88.6	11.2	88.6	11.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	100.4	797.6	100.4	886.2	111.5
D-43	101.6	Off-Site Northwest via Storm Sewers	102	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	90.1	797.6	81.1	0.0	0	886.2	90.1	0.0	0.0	88.6	9.0	88.6	9.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	81.1	797.6	81.1	886.2	90.1
D-44	261.9	Off-Site Northwest via Storm Sewers	262	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	232.1	797.6	208.9	0.0	0	886.2	232.1	0.0	0.0	88.6	23.2	88.6	23.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	208.9	797.6	208.9	886.2	232.1
D-45	270.0	Off-Site Northwest via Storm Sewers	270	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	239.3	797.6	215.3	0.0	0	886.2	239.3	0.0	0.0	88.6	23.9	88.6	23.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	215.3	797.6	215.3	886.2	239.3
D-46	49.3	Off-Site Northwest via Storm Sewers	49	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	43.7	797.6	39.4	0.0	0	886.2	43.7	0.0	0.0	88.6	4.4	88.6	4.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	39.4	797.6	39.4	886.2	43.7
D-47	78.7	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.7	797.6	62.7	0.0	0	886.2	69.7	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.7	797.6	62.7	886.2	69.7
D-48	78.1	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.2	797.6	62.3	0.0	0	886.2	69.2	0.0	0.0	88.6	6.9	88.6	6.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.3	797.6	62.3	886.2	69.2
D-49	76.9	Off-Site Northwest via Storm Sewers	77	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	68.2	797.6	61.4	0.0	0	886.2	68.2	0.0	0.0	88.6	6.8	88.6	6.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	61.4	797.6	61.4	886.2	68.2
D-50	79.2	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	70.2	797.6	63.2	0.0	0	886.2	70.2	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	63.2	797.6	63.2	886.2	70.2
D-51	77.6	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	68.8	797.6	61.9	0.0	0	886.2	68.8	0.0	0.0	88.6	6.9	88.6	6.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	61.9	797.6	61.9	886.2	68.8
D-52	78.0	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.1	797.6	62.2	0.0	0	886.2	69.1	0.0	0.0	88.6	6.9	88.6	6.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.2	797.6	62.2	886.2	69.1
D-53	78.1	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.2	797.6	62.3	0.0	0	886.2	69.2	0.0	0.0	88.6	6.9	88.6	6.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.3	797.6	62.3	886.2	69.2
D-54	78.5	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.6	797.6	62.6	0.0	0	886.2	69.6	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.6	797.6	62.6	886.2	69.6
D-55	78.7	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.7	797.6	62.7	0.0	0	886.2	69.7	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.7	797.6	62.7	886.2	69.7
D-56	38.0	Off-Site Northwest via Storm Sewers	38	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	33.7	797.6	30.3	0.0	0	886.2	33.7	0.0	0.0	88.6	3.4	88.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	30.3	797.6	30.3	886.2	33.7
D-57	38.5	Off-Site Northwest via Storm Sewers	39	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	34.2	797.6	30.7	0.0	0	886.2	34.2	0.0	0.0	88.6	3.4	88.6	3.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	30.7	797.6	30.7	886.2	34.2
D-58	130.3	Off-Site Northwest via Storm Sewers	130	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	115.5	797.6	103.9	0.0	0	886.2	115.5	0.0	0.0	88.6	11.5	88.6	11.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	103.9	797.6	103.9	886.2	115.5
D-59	72.7	Off-Site Northwest via Storm Sewers	73	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	64.4	797.6	58.0	0.0	0	886.2	64.4	0.0	0.0	88.6	6.4	88.6	6.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	58.0	797.6	58.0	886.2	64.4
D-62	1342.1	Off-Site Northwest via Storm Sewers	1,342	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	1189.4	797.6	1070.4	0.0	0	886.2	1189.4	0.0	0.0	88.6	118.9	88.6	118.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	1070.4	797.6	1070.4	886.2	1189.4
D-63	22.8	Off-Site Northwest via Storm Sewers	0	23	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	20.2	341.1	7.8	0.0	0	886.2	20.2	545.1	12.4	0.0	0.0	545.1	12.4	238.7	5.4	238.7	5.4	102.3	2.3	0.0	0.0	102.3	2.3	886.2	20.2
D-64	90.2	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.9	341.1	30.8	0.0	0	886.2	79.9	545.1	49.2	0.0	0.0	545.1	49.2	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.9
D-65	90.6	Off-Site Northwest via Storm Sewers	0	91	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	80.3	341.1	30.9	0.0	0	886.2	80.3	545.1	49.4	0.0	0.0	545.1	49.4	238.7	21.6	238.7	21.6	102.3	9.3	0.0	0.0	102.3	9.3	886.2	80.3
D-66	90.1	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.9	341.1	30.7	0.0	0	886.2	79.9	545.1	49.1	0.0	0.0	545.1	49.1	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.9
D-67	189.6	Off-Site Northwest via Storm Sewers	0	190	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	168.0	341.1	64.7	0.0	0	886.2	168.0	545.1	103.4	0.0	0.0	545.1	103.4	238.7	45.3	238.7	45.3	102.3	19.4	0.0	0.0	102.3	19.4	886.2	168.0
D-68	146.3	Off-Site Northwest via Storm Sewers	0	146	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	129.6	341.1	49.9	0.0	0	886.2	129.6	545.1	79.7	0.0	0.0	545.1	79.7	238.7	34.9	238.7	34.9	102.3	15.0	0.0	0.0	102.3	15.0	886.2	129.6
D-69	90.0	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.7	341.1	30.7	0.0	0	886.2	79.7	545.1	49.0	0.0	0.0	545.1	49.0	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.7
D-70	44.5	Off-Site Northwest via Storm Sewers	0	44	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	39.4	341.1	15.2	0.0	0	886.2	39.4	545.1	24.2	0.0	0.0	545.1	24.2	238.7	10.6	238.7	10.6	102.3	4.6	0.0	0.0	102.3	4.6	886.2	39.4
D-71	89.3	Off-Site Northwest via Storm Sewers	0	89	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.1	341.1	30.4	0.0	0	886.2	79.1	545.1	48.7	0.0	0.0	545.1	48.7	238.7	21.3	238.7	21.3	102.3	9.1	0.0	0.0	102.3	9.1	886.2	79.1
D-72	142.3	Off-Site Northwest via Storm Sewers	0	142	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	126.1	341.1	48.5	0.0	0	886.2	126.1	545.1	77.6	0.0	0.0	545.1	77.6	238.7	34.0	238.7	34.0	102.3	14.6	0.0	0.0	102.3	14.6	886.2	126.1
D-73	24.5	Off-Site Northwest via Storm Sewers	0	25	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	21.7	341.1	8.4	0.0	0	886.2	21.7	545.1	13.4	0.0	0.0	545.1	13.4	238.7	5.9	238.7	5.9	102.3	2.5	0.0	0.0	102.3	2.5	886.2	21.7
D-74	45.3	Off-Site Northwest via Storm Sewers	0	45	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	40.1	341.1	15.4	0.0	0	886.2	40.1	545.1	24.7	0.0	0.0	545.1	24.7	238.7	10.8	238.7	10.8	102.3	4.6	0.0	0.0	102.3	4.6	886.2	40.1
D-75	90.1	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.8	341.1	30.7	0.0	0	886.2	79.8	545.1	49.1	0.0	0.0	545.1	49.1	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.8
D-76	143.1	Off-Site Northwest via Storm Sewers	0	143	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	126.8	341.1	48.8	0.0	0	886.2	126.8	545.1	78.0	0.0	0.0	545.1	78.0	238.7	34.2	238.7	34.2	102.3	14.6	0.0	0.0	102.3	14.6	886.2	126.8
D-77	42.1	Off-Site Northwest via Storm Sewers	0	42	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	37.3	341.1	14.4	0.0	0	886.2	37.3	545.1	23.0	0.0	0.0	545.1	23.0	238.7	10.1	238.7	10.1	102.3	4.3	0.0	0.0	102.3	4.3	886.2	37.3
D-81	35.3	Off-Site Northwest via Storm Sewers	35	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	31.3	797.6	28.2	0.0	0	886.2	31.3	0.0	0.0	88.6	3.1	88.6	3.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	28.2	797.6	28.2	886.2	31.3
D-82	9.6	Off-Site Northwest via Storm Sewers	10	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	8.5	797.6	7.7	0.0	0	886.2	8.5	0.0	0.0	88.6	0.9	88.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	7.7	797.6	7.7	886.2	8.5
D-83	24.6	Off-Site Northwest via Storm Sewers	25	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	21.8	797.6	19.6	0.0	0	886.2	21.8	0.0	0.0	88.6	2.2	88.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	19.6	797.6	19.6	886.2	21.8
D-86	111.4	Off-Site Northwest via Storm Sewers	111	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	98.8	797.6	88.9	0.0	0	886.2	98.8	0.0	0.0	88.6	9.9	88.6	9.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	88.9	797.6	88.9	886.2	98.8
D-87	4.3	Off-Site Northwest via Storm Sewers	4	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	3.8	797.6	3.4	0.0	0	886.2	3.8	0.0	0.0	88.6	0.4	88.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	3.4	797.6	3.4	886.2	3.8
D-88	67.1	Off-Site Northwest via Storm Sewers	67	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	59.5	797.6	53.5	0.0	0	886.2	59.5	0.0	0.0	88.6	5.9	88.6	5.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	53.5	797.6	53.5	886.2	59.5
D-89	84.8	Off-Site Northwest via Storm Sewers	0	85	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	75.1	341.1	28.9	0.0	0	886.2	75.1	545.1	46.2	0.0	0.0	545.1	46.2	238.7	20.2	238.7	20.2	102.3	8.7	0.0	0.0	102.3	8.7	886.2	75.1
D-94	21.4	Off-Site Northwest via Storm Sewers	21	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	19.0	797.6	17.1	0.0	0	886.2	19.0	0.0	0.0	88.6	1.9	88.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	17.1	797.6	17.1	886.2	19.0
D-95	64.1	Off-Site Northwest via Storm Sewers	64	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	56.8	797.6	51.1	0.0	0	886.2	56.8	0.0	0.0	88.6	5.7	88.6	5.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	51.1	797.6	51.1	886.2	56.8
D-96	46.4	Off-Site Northwest via Storm Sewers	46	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	41.1	797.6	37.0	0.0	0	886.2	41.1	0.0	0.0	88.6	4.1	88.6	4.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	37.0	797.6	37.0	886.2	41.1
D-99	18.2	Off-Site Northwest via Storm Sewers	0	18	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	16.1	341.1	6.2	0.0	0	886.2	16.1	545.1	9.9	0.0	0.0	545.1	9.9	238.7	4.3	238.7	4.3	102.3	1.9	0.0	0.0	102.3	1.9	886.2	16.1
D-112	169.4	Off-Site Northwest via Storm Sewers	169	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	150.1	797.6	135.1	0.0	0	886.2	150.1	0.0	0.0	88.6	15.0	88.6	15.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	135.1	797.6	135.1	886.2	150.1
D-113	2.5	Off-Site Northwest via Storm Sewers	3	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	2.3	797.6	2.0	0.0	0	886.2	2.3	0.0	0.0	88.6	0.2	88.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	2.0	797.6	2.0	886.2	2.3
D-114	75.0	Off-Site Northwest via Storm Sewers	75	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	66.5	797.6	59.8	0.0	0	886.2	66.5	0.0	0.0	88.6	6.6	88.6	6.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	59.8	797.6	59.8	886.2	66.5
D-115	2.4	Off-Site Northwest via Storm Sewers	2	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	2.1	797.6	1.9	0.0	0	886.2	2.1	0.0	0.0	88.6	0.2	88.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	1.9	797.6	1.9	886.2	2.1
D-116	26.5	Off-Site Northwest via Storm Sewers	26	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	23.5	797.6	21.1	0.0	0	886.2	23.5	0.0	0.0	88.6	2.3	88.6	2.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	21.1	797.6	21.1	886.2	23.5
D-117	29.4	Off-Site Northwest via Storm Sewers	0	29	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	26.1	341.1	10.0	0.0	0	886.2	26.1	545.1	16.0	0.0	0.0	545.1	16.0	238.7	7.0	238.7	7.0	102.3	3.0	0.0	0.0	102.3	3.0	886.2	26.1
D-118	68.3	Off-Site Northwest via Storm Sewers	0	68	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	60.6	341.1	23.3	0.0	0	886.2	60.6	545.1	37.2	0.0	0.0	545.1	37.2	238.7	16.3	238.7	16.3	102.3	7.0	0.0	0.0	102.3	7.0	886.2	60.6
D-122	90.2	Off-Site Northwest via Storm Sewers	90	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	80.0	797.6	72.0	0.0	0	886.2	80.0	0.0	0.0	88.6	8.0	88.6	8.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	72.0	797.6	72.0	886.2	80.0
D-123	9.9	Off-Site Northwest via Storm Sewers	10	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	8.7	797.6	7.9	0.0	0	886.2	8.7	0.0	0.0	88.6	0.9	88.6	0.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	7.9	797.6	7.9	886.2	8.7
D-124	40.7	Off-Site Northwest via Storm Sewers	41	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	36.1	797.6	32.5	0.0	0	886.2	36.1	0.0	0.0	88.6	3.6	88.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	32.5	797.6	32.5	886.2	36.1
D-125	57.9	Off-Site Northwest via Storm Sewers	58	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	51.3	797.6	46.1	0.0	0	886.2	51.3	0.0	0.0	88.6	5.1	88.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	46.1	797.6	46.1	886.2	51.3
D-126	61.1	Off-Site Northwest via Storm Sewers	61	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	54.2	797.6	48.8	0.0	0	886.2	54.2	0.0	0.0	88.6	5.4	88.6	5.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	48.8	797.6	48.8	886.2	54.2
D-127	75.4	Off-Site Northwest via Storm Sewers	75	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	66.8	797.6	60.2	0.0	0	886.2	66.8	0.0	0.0	88.6	6.7	88.6	6.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	60.2	797.6	60.2	886.2	66.8
D-128	12.7	Off-Site Northwest via Storm Sewers	13	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	11.3	797.6	10.1	0.0	0	886.2	11.3	0.0	0.0	88.6	1.1	88.6	1.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	10.1	797.6	10.1	886.2	11.3
D-129	79.3	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	70.2	797.6	63.2	0.0	0	886.2	70.2	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	63.2	797.6	63.2	886.2	70.2
D-130	4.7	Off-Site Northwest via Storm Sewers	5	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	4.2	797.6	3.8	0.0	0	886.2	4.2	0.0	0.0	88.6	0.4	88.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	3.8	797.6	3.8	886.2	4.2
D-131	54.2	Off-Site Northwest via Storm Sewers	54	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	48.0	797.6	43.2	0.0	0	886.2	48.0	0.0	0.0	88.6	4.8	88.6	4.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	43.2	797.6	43.2	886.2	48.0
D-132	82.5	Off-Site Northwest via Storm Sewers	82	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	73.1	797.6	65.8	0.0	0	886.2	73.1	0.0	0.0	88.6	7.3	88.6	7.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	65.8	797.6	65.8	886.2	73.1
D-133	36.4	Off-Site Northwest via Storm Sewers	0	36	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	32.2	341.1	12.4	0.0	0	886.2	32.2	545.1	19.8	0.0	0.0	545.1	19.8	238.7	8.7	238.7	8.7	102.3	3.7	0.0	0.0	102.3	3.7	886.2	32.2
D-134	6.4	Off-Site Northwest via Storm Sewers	0	6	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	5.7	341.1	2.2	0.0	0	886.2	5.7	545.1	3.5	0.0	0.0	545.1	3.5	238.7	1.5	238.7	1.5	102.3	0.7	0.0	0.0	102.3	0.7	886.2	5.7

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

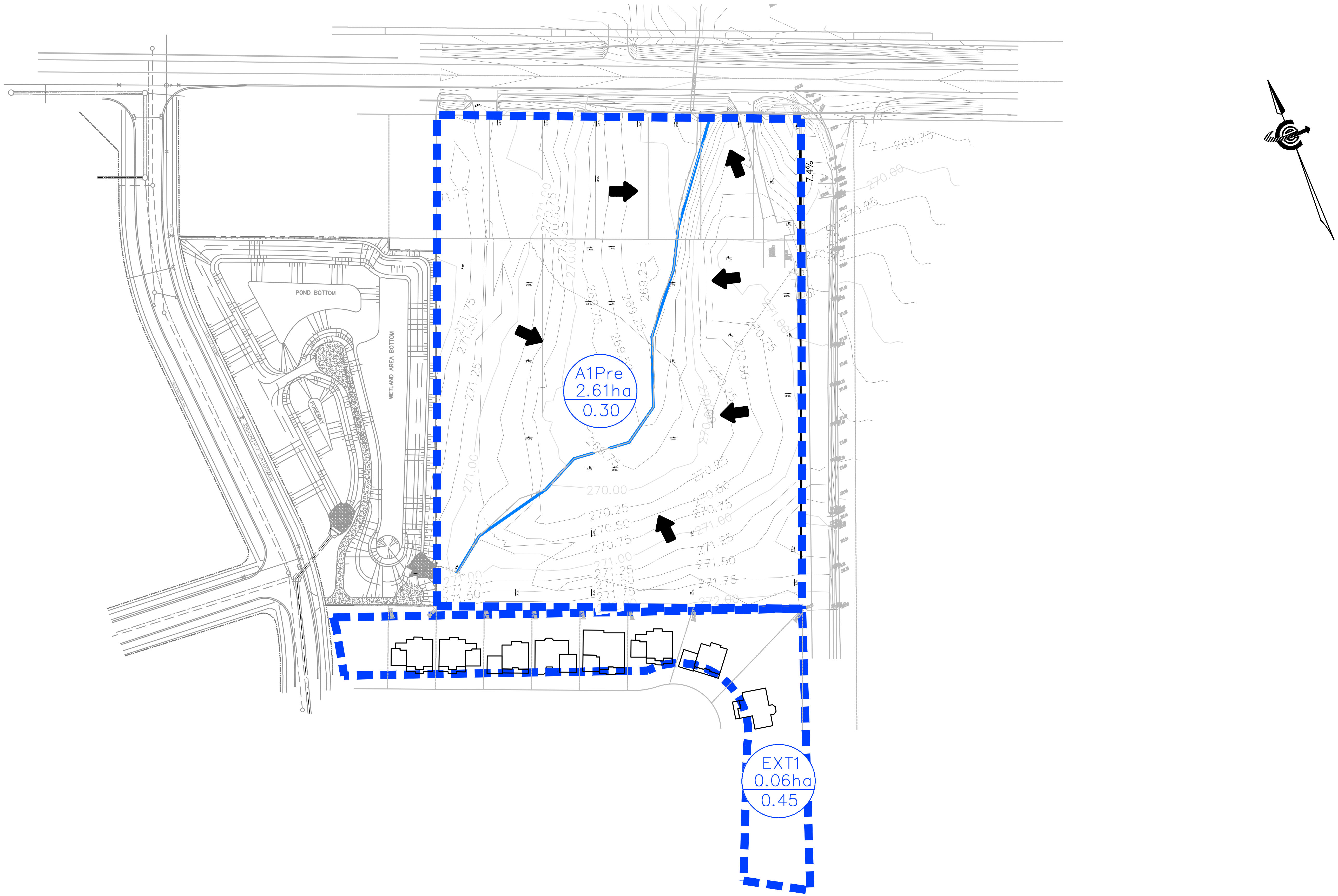
ANNUAL PRECIPITATION	EVAPORATION AND EVAPOTRANSPIRATION FACTORS			
	Impervious Areas		Ponds	
mm	%	mm	%	mm
886	10%	89	73%	646

On-site Subcatchments	Area (m^2)	Outlet	Total Impervious (m^2)	Total Pervious (m^2)	Infiltration Factor Components*					MOE Infiltration Factor	Adjusted Infiltration Factor	Inputs								Outputs																	
					Topography	Soil		Cover				Precipitation				Run-on		Total Inputs		Evapotranspiration						Infiltration				Runoff						Total Outputs	
												Annual Average		Surplus						Pervious		Impervious		Total Evapotranspiration		Pervious Areas		Total Infiltration		Pervious		Total Impervious		Total Runoff			
												(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)	(mm/yr)	(m^3/yr)
D-135	50.1	Off-Site Northwest via Storm Sewers	0	50	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	44.4	341.1	17.1	0.0	0	886.2	44.4	545.1	27.3	0.0	0.0	545.1	27.3	238.7	11.9	238.7	11.9	102.3	5.1	0.0	0.0	102.3	5.1	886.2	44.4
D-136	90.7	Off-Site Northwest via Storm Sewers	0	91	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	80.4	341.1	30.9	0.0	0	886.2	80.4	545.1	49.4	0.0	0.0	545.1	49.4	238.7	21.7	238.7	21.7	102.3	9.3	0.0	0.0	102.3	9.3	886.2	80.4
D-137	71.3	Off-Site Northwest via Storm Sewers	0	71	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	63.2	341.1	24.3	0.0	0	886.2	63.2	545.1	38.9	0.0	0.0	545.1	38.9	238.7	17.0	238.7	17.0	102.3	7.3	0.0	0.0	102.3	7.3	886.2	63.2
D-138	115.4	Off-Site Northwest via Storm Sewers	0	115	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	102.3	341.1	39.4	0.0	0	886.2	102.3	545.1	62.9	0.0	0.0	545.1	62.9	238.7	27.5	238.7	27.5	102.3	11.8	0.0	0.0	102.3	11.8	886.2	102.3
D-139	33.3	Off-Site Northwest via Storm Sewers	0	33	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	29.5	341.1	11.3	0.0	0	886.2	29.5	545.1	18.1	0.0	0.0	545.1	18.1	238.7	7.9	238.7	7.9	102.3	3.4	0.0	0.0	102.3	3.4	886.2	29.5
D-140	115.0	Off-Site Northwest via Storm Sewers	0	115	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	101.9	341.1	39.2	0.0	0	886.2	101.9	545.1	62.7	0.0	0.0	545.1	62.7	238.7	27.4	238.7	27.4	102.3	11.8	0.0	0.0	102.3	11.8	886.2	101.9
D-141	27.6	Off-Site Northwest via Storm Sewers	0	28	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	24.4	341.1	9.4	0.0	0	886.2	24.4	545.1	15.0	0.0	0.0	545.1	15.0	238.7	6.6	238.7	6.6	102.3	2.8	0.0	0.0	102.3	2.8	886.2	24.4
D-142	69.8	Off-Site Northwest via Storm Sewers	0	70	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	61.8	341.1	23.8	0.0	0	886.2	61.8	545.1	38.0	0.0	0.0	545.1	38.0	238.7	16.7	238.7	16.7	102.3	7.1	0.0	0.0	102.3	7.1	886.2	61.8
D-143	73.6	Off-Site Northwest via Storm Sewers	0	74	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	65.2	341.1	25.1	0.0	0	886.2	65.2	545.1	40.1	0.0	0.0	545.1	40.1	238.7	17.6	238.7	17.6	102.3	7.5	0.0	0.0	102.3	7.5	886.2	65.2
D-144	83.4	Off-Site Northwest via Storm Sewers	0	83	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	73.9	341.1	28.4	0.0	0	886.2	73.9	545.1	45.5	0.0	0.0	545.1	45.5	238.7	19.9	238.7	19.9	102.3	8.5	0.0	0.0	102.3	8.5	886.2	73.9
D-147	21.0	Infiltration Trench	21	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	18.6	797.6	16.7	0.0	0	886.2	18.6	0.0	0.0	88.6	1.9	88.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	16.7	797.6	16.7	886.2	18.6
D-148	160.2	Infiltration Trench	160	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	142.0	797.6	127.8	0.0	0	886.2	142.0	0.0	0.0	88.6	14.2	88.6	14.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	127.8	797.6	127.8	886.2	142.0
D-149	147.9	Off-Site Northwest via Storm Sewers	148	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	131.1	797.6	117.9	0.0	0	886.2	131.1	0.0	0.0	88.6	13.1	88.6	13.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	117.9	797.6	117.9	886.2	131.1
D-150	151.1	Off-Site Northwest via Storm Sewers	151	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	133.9	797.6	120.5	0.0	0	886.2	133.9	0.0	0.0	88.6	13.4	88.6	13.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	120.5	797.6	120.5	886.2	133.9
D-151	78.7	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.7	797.6	62.8	0.0	0	886.2	69.7	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.8	797.6	62.8	886.2	69.7
D-152	78.5	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.5	797.6	62.6	0.0	0	886.2	69.5	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.6	797.6	62.6	886.2	69.5
D-153	78.8	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.8	797.6	62.8	0.0	0	886.2	69.8	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.8	797.6	62.8	886.2	69.8
D-154	4.7	Off-Site Northwest via Storm Sewers	5	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	4.2	797.6	3.7	0.0	0	886.2	4.2	0.0	0.0	88.6	0.4	88.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	3.7	797.6	3.7	886.2	4.2
D-155	78.4	Off-Site Northwest via Storm Sewers	78	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.4	797.6	62.5	0.0	0	886.2	69.4	0.0	0.0	88.6	6.9	88.6	6.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.5	797.6	62.5	886.2	69.4
D-156	587.7	Off-Site Northwest via Storm Sewers	588	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	520.8	797.6	468.7	0.0	0	886.2	520.8	0.0	0.0	88.6	52.1	88.6	52.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	468.7	797.6	468.7	886.2	520.8
D-157	49.9	Off-Site Northwest via Storm Sewers	0	50	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	44.3	341.1	17.0	0.0	0	886.2	44.3	545.1	27.2	0.0	0.0	545.1	27.2	238.7	11.9	238.7	11.9	102.3	5.1	0.0	0.0	102.3	5.1	886.2	44.3
D-158	105.3	Off-Site Northwest via Storm Sewers	0	105	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	93.4	341.1	35.9	0.0	0	886.2	93.4	545.1	57.4	0.0	0.0	545.1	57.4	238.7	25.1	238.7	25.1	102.3	10.8	0.0	0.0	102.3	10.8	886.2	93.4
D-159	90.0	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.7	341.1	30.7	0.0	0	886.2	79.7	545.1	49.0	0.0	0.0	545.1	49.0	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.7
D-160	89.9	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.7	341.1	30.7	0.0	0	886.2	79.7	545.1	49.0	0.0	0.0	545.1	49.0	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.7
D-161	128.6	Off-Site Northwest via Storm Sewers	0	129	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	113.9	341.1	43.8	0.0	0	886.2	113.9	545.1	70.1	0.0	0.0	545.1	70.1	238.7	30.7	238.7	30.7	102.3	13.2	0.0	0.0	102.3	13.2	886.2	113.9
D-162	17.3	Off-Site Northwest via Storm Sewers	0	17	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	15.3	341.1	5.9	0.0	0	886.2	15.3	545.1	9.4	0.0	0.0	545.1	9.4	238.7	4.1	238.7	4.1	102.3	1.8	0.0	0.0	102.3	1.8	886.2	15.3
D-166	119.5	Infiltration Trench	119	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	105.9	797.6	95.3	0.0	0	886.2	105.9	0.0	0.0	88.6	10.6	88.6	10.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	95.3	797.6	95.3	886.2	105.9
D-167	152.1	Off-Site Northwest via Storm Sewers	152	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	134.8	797.6	121.3	0.0	0	886.2	134.8	0.0	0.0	88.6	13.5	88.6	13.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	121.3	797.6	121.3	886.2	134.8
D-168	73.7	Off-Site Northwest via Storm Sewers	74	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	65.3	797.6	58.8	0.0	0	886.2	65.3	0.0	0.0	88.6	6.5	88.6	6.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	58.8	797.6	58.8	886.2	65.3
D-169	79.5	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	70.5	797.6	63.4	0.0	0	886.2	70.5	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	63.4	797.6	63.4	886.2	70.5
D-170	78.8	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	69.8	797.6	62.8	0.0	0	886.2	69.8	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.8	797.6	62.8	886.2	69.8
D-171	91.9	Off-Site Northwest via Storm Sewers	92	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	81.4	797.6	73.3	0.0	0	886.2	81.4	0.0	0.0	88.6	8.1	88.6	8.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	73.3	797.6	73.3	886.2	81.4
D-172	39.0	Off-Site Northwest via Storm Sewers	39	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	34.6	797.6	31.1	0.0	0	886.2	34.6	0.0	0.0	88.6	3.5	88.6	3.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	31.1	797.6	31.1	886.2	34.6
D-173	109.0	Off-Site Northwest via Storm Sewers	109	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	96.6	797.6	86.9	0.0	0	886.2	96.6	0.0	0.0	88.6	9.7	88.6	9.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	86.9	797.6	86.9	886.2	96.6
D-174	505.6	Off-Site Northwest via Storm Sewers	506	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	448.1	797.6	403.3	0.0	0	886.2	448.1	0.0	0.0	88.6	44.8	88.6	44.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	403.3	797.6	403.3	886.2	448.1
D-175	5.6	Off-Site Northwest via Storm Sewers	0	6	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	5.0	341.1	1.9	0.0	0	886.2	5.0	545.1	3.1	0.0	0.0	545.1	3.1	238.7	1.3	238.7	1.3	102.3	0.6	0.0	0.0	102.3	0.6	886.2	5.0
D-176	90.0	Off-Site Northwest via Storm Sewers	0	90	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	79.7	341.1	30.7	0.0	0	886.2	79.7	545.1	49.0	0.0	0.0	545.1	49.0	238.7	21.5	238.7	21.5	102.3	9.2	0.0	0.0	102.3	9.2	886.2	79.7
D-177	88.9	Off-Site Northwest via Storm Sewers	0	89	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	78.8	341.1	30.3	0.0	0	886.2	78.8	545.1	48.5	0.0	0.0	545.1	48.5	238.7	21.2	238.7	21.2	102.3	9.1	0.0	0.0	102.3	9.1	886.2	78.8
D-178	122.9	Off-Site Northwest via Storm Sewers	0	123	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	108.9	341.1	41.9	0.0	0	886.2	108.9	545.1	67.0	0.0	0.0	545.1	67.0	238.7	29.3	238.7	29.3	102.3	12.6	0.0	0.0	102.3	12.6	886.2	108.9
D-179	141.7	Off-Site Northwest via Storm Sewers	0	142	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	125.6	341.1	48.3	0.0	0	886.2	125.6	545.1	77.2	0.0	0.0	545.1	77.2	238.7	33.8	238.7	33.8	102.3	14.5	0.0	0.0	102.3	14.5	886.2	125.6
D-180	3.4	Off-Site Northwest via Storm Sewers	0	3	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	3.0	341.1	1.2	0.0	0	886.2	3.0	545.1	1.9	0.0	0.0	545.1	1.9	238.7	0.8	238.7	0.8	102.3	0.4	0.0	0.0	102.3	0.4	886.2	3.0
D-181	90.6	Off-Site Northwest via Storm Sewers	0	91	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	80.2	341.1	30.9	0.0	0	886.2	80.2	545.1	49.4	0.0	0.0	545.1	49.4	238.7	21.6	238.7	21.6	102.3	9.3	0.0	0.0	102.3	9.3	886.2	80.2
D-182	4.6	Off-Site Northwest via Storm Sewers	5	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	4.1	797.6	3.7	0.0	0	886.2	4.1	0.0	0.0	88.6	0.4	88.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	3.7	797.6	3.7	886.2	4.1
D-183	71.9	Off-Site Northwest via Storm Sewers	72	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	63.7	797.6	57.3	0.0	0	886.2	63.7	0.0	0.0	88.6	6.4	88.6	6.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	57.3	797.6	57.3	886.2	63.7
D-184	3.4	Off-Site Northwest via Storm Sewers	3	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	3.1	797.6	2.7	0.0	0	886.2	3.1	0.0	0.0	88.6	0.3	88.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	2.7	797.6	2.7	886.2	3.1
D-185	3.2	Off-Site Northwest via Storm Sewers	3	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	2.9	797.6	2.6	0.0	0	886.2	2.9	0.0	0.0	88.6	0.3	88.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	2.6	797.6	2.6	886.2	2.9
D-186	621.5	Off-Site Northwest via Storm Sewers	621	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	550.7	797.6	495.7	0.0	0	886.2	550.7	0.0	0.0	88.6	55.1	88.6	55.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	495.7	797.6	495.7	886.2	550.7
D-187	2.5	Off-Site Northwest via Storm Sewers	0	2	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	2.2	341.1	0.8	0.0	0	886.2	2.2	545.1	1.4	0.0	0.0	545.1	1.4	238.7	0.6	238.7	0.6	102.3	0.3	0.0	0.0	102.3	0.3	886.2	2.2
D-188	6.3	Off-Site Northwest via Storm Sewers	0	6	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	5.6	341.1	2.1	0.0	0	886.2	5.6	545.1	3.4	0.0	0.0	545.1	3.4	238.7	1.5	238.7	1.5	102.3	0.6	0.0	0.0	102.3	0.6	886.2	5.6
D-193	84.2	Off-Site Northwest via Storm Sewers	84	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	74.6	797.6	67.2	0.0	0	886.2	74.6	0.0	0.0	88.6	7.5	88.6	7.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	67.2	797.6	67.2	886.2	74.6
D-194	31.0	Off-Site Northwest via Storm Sewers	31	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	27.5	797.6	24.7	0.0	0	886.2	27.5	0.0	0.0	88.6	2.7	88.6	2.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	24.7	797.6	24.7	886.2	27.5
D-195	27.6	Off-Site Northwest via Storm Sewers	28	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	24.4	797.6	22.0	0.0	0	886.2	24.4	0.0	0.0	88.6	2.4	88.6	2.4	0.0	0.0	0.0	0.0	0.0	0.0	797.6	22.0	797.6	22.0	886.2	24.4
D-196	87.4	Off-Site Northwest via Storm Sewers	87	0	0.25	Open Sandy Loam	0.40	Driveway	0	0.65	0	886.2	77.5	797.6	69.7	0.0	0	886.2	77.5	0.0	0.0	88.6	7.7	88.6	7.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	69.7	797.6	69.7	886.2	77.5
D-197	67.1	Off-Site Northwest via Storm Sewers	67	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	59.5	797.6	53.5	0.0	0	886.2	59.5	0.0	0.0	88.6	5.9	88.6	5.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	53.5	797.6	53.5	886.2	59.5
D-199	14.8	Off-Site Northwest via Storm Sewers	15	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	13.1	797.6	11.8	0.0	0	886.2	13.1	0.0	0.0	88.6	1.3	88.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	11.8	797.6	11.8	886.2	13.1
D-200	90.0	Off-Site Northwest via Storm Sewers	90	0	0.25	Open Sandy Loam	0.40	Sidewalk	0	0.65	0	886.2	79.7	797.6	71.7	0.0	0	886.2	79.7	0.0	0.0	88.6	8.0	88.6	8.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	71.7	797.6	71.7	886.2	79.7
D-201	103.8	Off-Site Northwest via Storm Sewers	0	104	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	92.0	341.1	35.4	0.0	0	886.2	92.0	545.1	56.6	0.0	0.0	545.1	56.6	238.7	24.8	238.7	24.8	102.3	10.6	0.0	0.0	102.3	10.6	886.2	92.0
D-202	126.8	Off-Site Northwest via Storm Sewers	127	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	112.3	797.6	101.1	0.0	0	886.2	112.3	0.0	0.0	88.6	11.2	88.6	11.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	101.1	797.6	101.1	886.2	112.3
D-203	78.9	Off-Site Northwest via Storm Sewers	79	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	69.9	797.6	62.9	0.0	0	886.2	69.9	0.0	0.0	88.6	7.0	88.6	7.0	0.0	0.0	0.0	0.0	0.0	0.0	797.6	62.9	797.6	62.9	886.2	69.9
D-204	999.3	Off-Site Northwest via Storm Sewers	999	0	0.25	Open Sandy Loam	0.40	Road	0	0.65	0	886.2	885.6	797.6	797.0	0.0	0	886.2	885.6	0.0	0.0	88.6	88.6	88.6	88.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	797.0	797.6	797.0	886.2	885.6
Catchment D Total	**15,016**		**11,124**	**3,893**								**886**	**13,308**	**679.2**	**10,200**	**0**	**0**	**886**	**13,308**	**141**	**2,122**	**66**	**986**	**207**	**3,108**	**62**	**929**	**62**	**929**	**27**	**398**	**591**	**8,872**	**617**	**9,270**	**886**	**13,308**
E-2	988.4	Off-site Northwest via RLCBs and Storm Sewers	0	988	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	875.9	341.1	337.1	0.0	0	886.2	875.9	545.1	538.8	0.0	0.0	545.1	538.8	238.7	236.0	238.7	236.0	102.3	101.1	0.0	0.0	102.3	101.1	886.2	875.9
E-19	70.4	Off-site Northwest via RLCBs and Storm Sewers	70	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	62.3	797.6	56.1	0.0	0	886.2	62.3	0.0	0.0	88.6	6.2	88.6	6.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	56.1	797.6	56.1	886.2	62.3
E-20	287.3	Off-site Northwest via RLCBs and Storm Sewers	287	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	254.6	797.6	229.1	0.0	0	886.2	254.6	0.0	0.0	88.6	25.5	88.6	25.5	0.0	0.0	0.0	0.0	0.0	0.0	797.6	229.1	797.6	229.1	886.2	254.6
E-21	57.6	Off-site Northwest via RLCBs and Storm Sewers	58	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	51.1	797.6	46.0	0.0	0	886.2	51.1	0.0	0.0	88.6	5.1	88.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	46.0	797.6	46.0	886.2	51.1
E-22	283.2	Off-site Northwest via RLCBs and Storm Sewers	283	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	250.9	797.6	225.9	0.0	0	886.2	250.9	0.0	0.0	88.6	25.1	88.6	25.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	225.9	797.6	225.9	886.2	250.9
E-35	692.8	Off-site Northwest via RLCBs and Storm Sewers	0	693	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	614.0	341.1	236.3	0.0	0	886.2	614.0	545.1	377.7	0.0	0.0	545.1	377.7	238.7	165.4	238.7	165.4	102.3	70.9	0.0	0.0	102.3	70.9	886.2	614.0
E-60	212.9	Off-site Northwest via RLCBs and Storm Sewers	213	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	188.6	797.6	169.8	0.0	0	886.2	188.6	0.0	0.0	88.6	18.9	88.6	18.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	169.8	797.6	169.8	886.2	188.6
E-61	222.1	Off-site Northwest via RLCBs and Storm Sewers	222	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	196.8	797.6	177.1	0.0	0	886.2	196.8	0.0	0.0	88.6	19.7	88.6	19.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	177.1	797.6	177.1	886.2	196.8
Catchment E Total	**2,815**		**1,133**	**1,681**								**886**	**2,494**	**524.9**	**1,477**	**0**	**0**	**886**	**2,494**	**326**	**916**	**36**	**100**	**361**	**1,017**	**143**	**401**	**143**	**401**	**61**	**172**	**321**	**904**	**382**	**1,076**	**886**	**2,494**
F-34	115.2	Off-Site via RLCBs and Storm Sewers	0	115	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	102.1	341.1	39.3	0.0	0	886.2	102.1	545.1	62.8	0.0	0.0	545.1	62.8	238.7	27.5	238.7	27.5	102.3	11.8	0.0	0.0	102.3	11.8	886.2	102.1
F-39	63.9	Off-Site via RLCBs and Storm Sewers	64	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	56.6	797.6	51.0	0.0	0	886.2	56.6	0.0	0.0	88.6	5.7	88.6	5.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	51.0	797.6	51.0	886.2	56.6
F-84	23.5	Off-Site via RLCBs and Storm Sewers	0	23	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	20.8	341.1	8.0	0.0	0	886.2	20.8	545.1	12.8	0.0	0.0	545.1	12.8	238.7	5.6	238.7	5.6	102.3	2.4	0.0	0.0	102.3	2.4	886.2	20.8
F-85	58.6	Off-Site via RLCBs and Storm Sewers	59	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	51.9	797.6	46.7	0.0	0	886.2	51.9	0.0	0.0	88.6	5.2	88.6	5.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	46.7	797.6	46.7	886.2	51.9
F-91	26.2	Off-Site via RLCBs and Storm Sewers	0	26	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	23.2	341.1	8.9	0.0	0	886.2	23.2	545.1	14.3	0.0	0.0	545.1	14.3	238.7	6.3	238.7	6.3	102.3	2.7	0.0	0.0	102.3	2.7	886.2	23.2
F-93	57.7	Off-Site via RLCBs and Storm Sewers	58	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	51.1	797.6	46.0	0.0	0	886.2	51.1	0.0	0.0	88.6	5.1	88.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	797.6	46.0	797.6	46.0	886.2	51.1
F-109	418.2	Off-Site via RLCBs and Storm Sewers	0	418	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	370.6	341.1	142.6	0.0	0	886.2	370.6	545.1	227.9	0.0	0.0	545.1	227.9	238.7	99.8	238.7	99.8	102.3	42.8	0.0	0.0	102.3	42.8	886.2	370.6
F-110	205.1	Off-Site via RLCBs and Storm Sewers	205	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	181.8	797.6	163.6	0.0	0	886.2	181.8	0.0	0.0	88.6	18.2	88.6	18.2	0.0	0.0	0.0	0.0	0.0	0.0	797.6	163.6	797.6	163.6	886.2	181.8
F-111	20.8	Off-Site via RLCBs and Storm Sewers	21	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	18.4	797.6	16.6	0.0	0	886.2	18.4	0.0	0.0	88.6	1.8	88.6	1.8	0.0	0.0	0.0	0.0	0.0	0.0	797.6	16.6	797.6	16.6	886.2	18.4
F-120	232.9	Off-Site via RLCBs and Storm Sewers	0	233	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	206.4	341.1	79.4	0.0	0	886.2	206.4	545.1	127.0	0.0	0.0	545.1	127.0	238.7	55.6	238.7	55.6	102.3	23.8	0.0	0.0	102.3	23.8	886.2	206.4
F-121	111.5	Off-Site via RLCBs and Storm Sewers	111	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	98.8	797.6	88.9	0.0	0	886.2	98.8	0.0	0.0	88.6	9.9	88.6	9.9	0.0	0.0	0.0	0.0	0.0	0.0	797.6	88.9	797.6	88.9	886.2	98.8
Catchment F Total	**1,334**		**518**	**816**								**886**	**1,182**	**518.3**	**691**	**0**	**0**	**886**	**1,182**	**334**	**445**	**34**	**46**	**368**	**491**	**146**	**195**	**146**	**195**	**63**	**83**	**310**	**413**	**372**	**496**	**886**	**1,182**
G-33	858.0	Off-Site via RLCBs and Storm Sewers	0	858	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	760.4	341.1	292.6	0.0	0	886.2	760.4	545.1	467.8	0.0	0.0	545.1	467.8	238.7	204.9	238.7	204.9	102.3	87.8	0.0	0.0	102.3	87.8	886.2	760.4
G-36	93.9	Off-Site via RLCBs and Storm Sewers	94	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	83.2	797.6	74.9	0.0	0	886.2	83.2	0.0	0.0	88.6	8.3	88.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	74.9	797.6	74.9	886.2	83.2
G-37	229.6	Off-Site via RLCBs and Storm Sewers	230	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	203.4	797.6	183.1	0.0	0	886.2	203.4	0.0	0.0	88.6	20.3	88.6	20.3	0.0	0.0	0.0	0.0	0.0	0.0	797.6	183.1	797.6	183.1	886.2	203.4
G-38	221.5	Off-Site via RLCBs and Storm Sewers	221	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	196.3	797.6	176.6	0.0	0	886.2	196.3	0.0	0.0	88.6	19.6	88.6	19.6	0.0	0.0	0.0	0.0	0.0	0.0	797.6	176.6	797.6	176.6	886.2	196.3
G-164	203.4	Off-Site via RLCBs and Storm Sewers	0	203	0.25	Open Sandy Loam	0.40	Lawns	0.05	0.7	0.7	886.2	180.2	341.1	69.4	0.0	0	886.2	180.2	545.1	110.9	0.0	0.0	545.1	110.9	238.7	48.6	238.7	48.6	102.3	20.8	0.0	0.0	102.3	20.8	886.2	180.2
G-165	143.7	Off-Site via RLCBs and Storm Sewers	144	0	0.25	Open Sandy Loam	0.40	Building	0	0.65	0	886.2	127.4	797.6	114.6	0.0	0	886.2	127.4	0.0	0.0	88.6	12.7	88.6	12.7	0.0	0.0	0.0	0.0	0.0	0.0	797.6	114.6	797.6	114.6	886.2	127.4
Catchment G Total	**1,750**		**689**	**1,061**								**886**	**1,551**	**520.7**	**911**	**0**	**0**	**886**	**1,551**	**331**	**579**	**35**	**61**	**365**	**640**	**145**	**253**	**145**	**253**	**62**	**109**	**314**	**549**	**376**	**658**	**886**	**1,551**
TOTAL SITE (before Mitigation)	**26,118**		**14,124**	**11,994**								**886**	**23,146**	**587.9**	**15,356**	**0.0**	**0**	**886.2**	**23,146**	**250.3**	**6,538**	**47.9**	**1,252**	**298.3**	**7,790**	**109.6**	**2,864**	**109.6**	**2,864**	**47.0**	**1,227**	**431.3**	**11,265**	**478.3**	**12,492**	**886.2**	**23,146**
Total Buildings	**6,136**		**6,136**	**0**								**886**	**5,437**	**797.6**	**4,894**	**0.0**	**0**	**886.2**	**5,437**	**0.0**	**0**	**88.6**	**544**	**88.6**	**544**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**797.6**	**4,894**	**797.6**	**4,894**	**886.2**	**5,437**
Paved Areas	**7,988**		**7,988**	**0**								**886**	**7,079**	**797.6**	**6,371**	**0.0**	**0**	**886.2**	**7,079**	**0.0**	**0**	**88.6**	**708**	**88.6**	**708**	**0.0**	**0**	**0.0**	**0**	**0.0**	**0**	**797.6**	**6,371**	**797.6**	**6,371**	**886.2**	**7,079**
Pervious Areas	**11,994**		**0**	**11,994**								**886**	**10,629**	**341.1**	**4,091**	**0.0**	**0**	**886.2**	**10,629**	**545.1**	**6,538**	**0.0**	**0**	**545.1**	**6,538**	**238.7**	**2,864**	**238.7**	**2,864**	**102.3**	**1,227**	**0.0**	**0**	**102.3**	**1,227**	**886.2**	**10,629**

NOTES:

1) Subcatchment areas were delineated using the development plans provided by WSP.
2) "*" Infiltration factors components are based land use information provided through Ontario Base Mapping.

APPENDIX B
Stormwater Data Analysis



COLE ENGINEERING

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

LEGEND

PRE-DEVELOPMENT STORM DRAINAGE AREA

EXISTING DRAINAGE DITCH

OVERLAND FLOW PATH

DRAINAGE AREA (ha)

EXT1
0.06ha
0.45

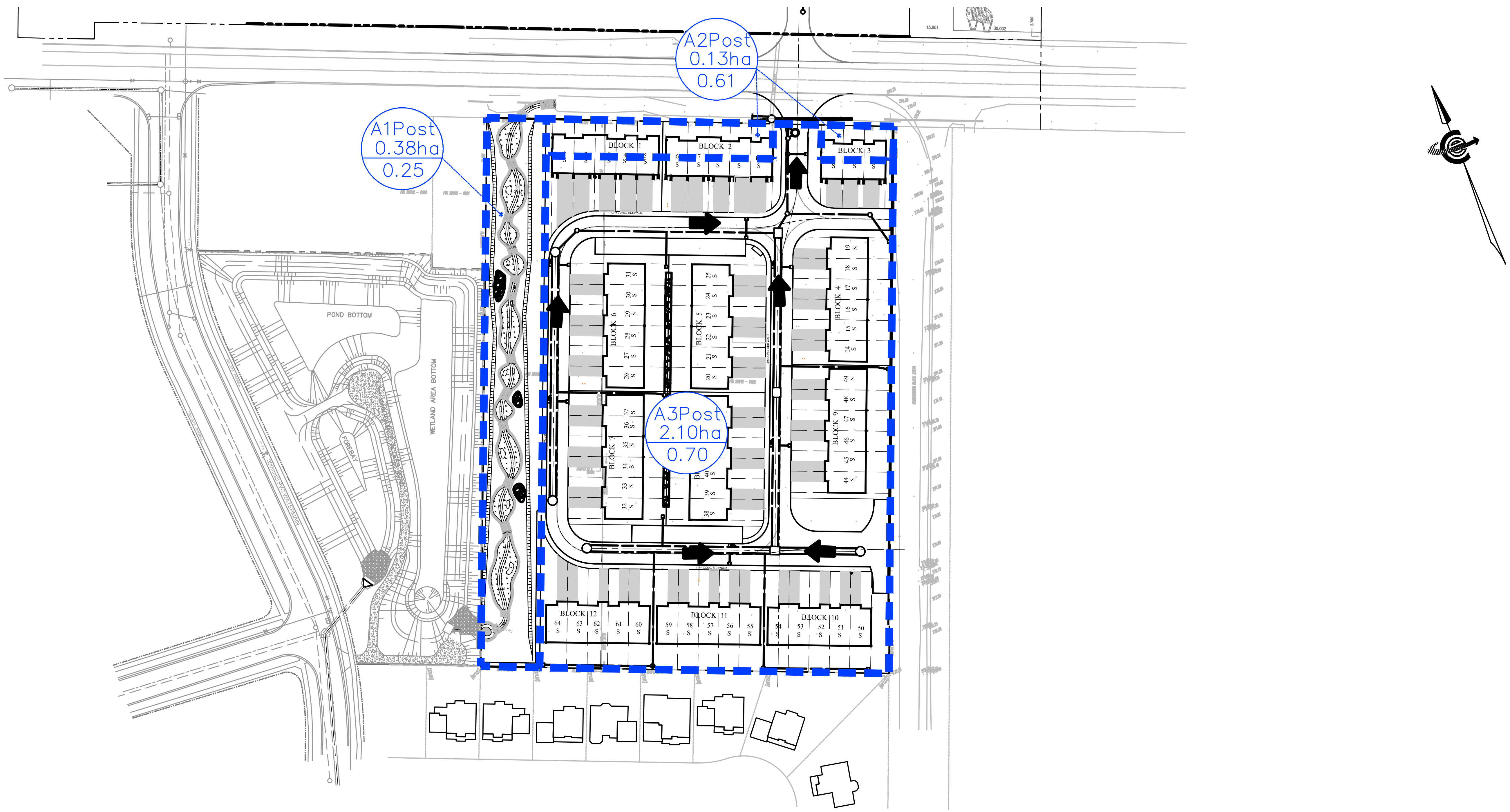
CATCHMENT ID

RUN-OFF COEFFICIENT

PRE DEVELOPMENT DRAINAGE PLAN

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

DATE:	AUGUST 2018	PROJECT No.:	2018-0302
SCALE:	1: 1500	FIGURE No.:	DAP-01



LEGEND

PRE-DEVELOPMENT STORM DRAINAGE AREA

EXISTING DRAINAGE DITCH

OVERLAND FLOW PATH

DRAINAGE AREA (ha)

EXT1
0.06ha
0.45

CATCHMENT ID

RUN-OFF COEFFICIENT

COLE ENGINEERING

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

POST DEVELOPMENT DRAINAGE PLAN

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

DATE:	AUGUST 2018	PROJECT No.:	2018-0302
SCALE:	1: 1500	FIGURE No.:	DAP-02

COLE

Prepared By S. Rayner, EIT

Pre- Development Composite Runoff Coefficient

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

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%		

COLE

Prepared By S. Rayner, EIT

Peak Time Calculations
Pre Development

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

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 S. Rayner, EIT

Rational Method
Pre-Development Flow Calculation

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

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	0.30	0.77	13	131.2	0.281	281.0
EXT. 1	0.60	0.45	0.27	10	154.6	0.116	115.5

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	0.30	0.77	13	171.1	0.367	366.6
EXT. 1	0.60	0.45	0.27	10	200.6	0.150	149.9

COLE

Prepared By S. Rayner, EIT

Existing Flows to Channel Summary

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

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	115.5	**149.9 L/s**

Existing Development

Return Period	2 year	5 year	10 year	25 year	100 year
A1 Pre	140.9	196.4	231.4	281.0	**366.6 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	896.6	**1376.5 L/s**

Prepared By S. Rayner, EIT

Post Development Composite Runoff Coefficient

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

Drainage Area A1 Post Uncontrolled- Naturalized Swale

	(ha)		
Total Area:	0.38		
Impervious:	0.00	Coefficient:	0.95
Landscaping:	0.38	Coefficient:	0.25
Composite C:	0.25		
Percent Impervious	0.0%		

Drainage Area A2 Post Uncontrolled to North

	(ha)		
Total Area:	0.13		
Impervious:	0.07	Coefficient:	0.95
Landscaping:	0.06	Coefficient:	0.25
Composite C:	0.61		
Percent Impervious	50.77%		

Drainage Area A3 Post Controlled to Ditch

	(ha)		
Total Area:	2.10		
Impervious:	1.34	Coefficient:	0.95
Landscaping:	0.75	Coefficient:	0.25
Composite C:	0.70		
Percent Impervious	64.1%		

COLE

Prepared By S. Rayner, EIT

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

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 =	**0.38**	ha
"C" =	**0.25**	
AC1 =	**0.09**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**20.2**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.13**	ha
"C" =	**0.61**	
AC2 =	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**16.8**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.70**	
AC3 =	**1.46**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**101.9**	L/s
Max. Required Storage Volume =	**132.4**	m^3
Max. Storage Available =	**496.56**	m^3

Uncontrolled Release Rate =	**37.0 L/s**
Controlled Release Rate =	**101.9 L/s**
Total Release Rate =	**138.9 L/s**
Target Release Rate (2 Yr Pre) =	**140.9 L/s**

(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	76.8	0.020	12.1	0.017	10.1	0.312	187.3	61.2	126.2
15.0	61.2	0.016	14.5	0.013	12.0	0.249	224.1	91.7	132.4
20.0	51.4	0.014	16.2	0.011	13.5	0.209	250.8	122.3	128.5
25.0	44.5	0.012	17.6	0.010	14.6	0.181	271.6	152.9	118.7
30.0	39.4	0.010	18.7	0.009	15.5	0.160	288.7	183.5	105.3
35.0	35.5	0.009	19.7	0.008	16.3	0.144	303.3	214.0	89.3
40.0	32.4	0.009	20.5	0.007	17.0	0.132	316.0	244.6	71.4
45.0	29.8	0.008	21.2	0.007	17.6	0.121	327.2	275.2	52.0
50.0	27.6	0.007	21.9	0.006	18.1	0.112	337.3	305.8	31.6
55.0	25.8	0.007	22.5	0.006	18.6	0.105	346.5	336.3	10.2
60.0	24.2	0.006	23.0	0.005	19.1	0.099	355.0	366.9	0.0
65.0	22.9	0.006	23.5	0.005	19.5	0.093	362.8	397.5	0.0
70.0	21.7	0.006	24.0	0.005	19.9	0.088	370.1	428.1	0.0
75.0	20.6	0.005	24.4	0.005	20.3	0.084	376.9	458.6	0.0
80.0	19.6	0.005	24.8	0.004	20.6	0.080	383.3	489.2	0.0
85.0	18.8	0.005	25.2	0.004	20.9	0.076	389.4	519.8	0.0
90.0	18.0	0.005	25.6	0.004	21.2	0.073	395.2	550.4	0.0
95.0	17.3	0.005	26.0	0.004	21.5	0.070	400.6	580.9	0.0
100.0	16.6	0.004	26.3	0.004	21.8	0.068	405.9	611.5	0.0
105.0	16.0	0.004	26.6	0.004	22.1	0.065	410.8	642.1	0.0
110.0	15.5	0.004	26.9	0.003	22.3	0.063	415.6	672.7	0.0
115.0	15.0	0.004	27.2	0.003	22.6	0.061	420.2	703.2	0.0
120.0	14.5	0.004	27.5	0.003	22.8	0.059	424.7	733.8	0.0
125.0	14.1	0.004	27.8	0.003	23.1	0.057	428.9	764.4	0.0
130.0	13.6	0.004	28.1	0.003	23.3	0.056	433.0	795.0	0.0
135.0	13.3	0.003	28.3	0.003	23.5	0.054	437.0	825.5	0.0
140.0	12.9	0.003	28.6	0.003	23.7	0.052	440.9	856.1	0.0
145.0	12.6	0.003	28.8	0.003	23.9	0.051	444.6	886.7	0.0
150.0	12.2	0.003	29.0	0.003	24.1	0.050	448.2	917.3	0.0
155.0	11.9	0.003	29.3	0.003	24.3	0.049	451.8	947.8	0.0
160.0	11.7	0.003	29.5	0.003	24.5	0.047	455.2	978.4	0.0
165.0	11.4	0.003	29.7	0.002	24.6	0.046	458.5	1009.0	0.0

COLE

Prepared By S. Rayner, EIT

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

Uncontrolled- Natural Swale

Drainage Areas	A1 Post	
Area =	**0.38**	ha
"C" =	**0.25**	
AC1 =	**0.09**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**28.2**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.13**	ha
"C" =	**0.61**	
AC2 =	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**23.4**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.70**	
AC3 =	**1.46**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**112.7**	L/s
Max. Required Storage Volume =	**214.0**	m^3
Max. Storage Available =	**496.56**	m^3

Uncontrolled Release Rate =	**51.6 L/s**
Controlled Release Rate =	**112.7 L/s**
Total Release Rate =	**164.3 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) 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	107.0	0.028	16.9	0.023	14.0	0.435	261.1	67.6	193.5
15.0	85.3	0.022	20.2	0.019	16.8	0.347	312.3	101.4	210.8
20.0	71.5	0.019	22.6	0.016	18.8	0.291	349.2	135.2	214.0
25.0	62.0	0.016	24.5	0.014	20.3	0.252	378.1	169.0	209.1
30.0	54.9	0.014	26.0	0.012	21.6	0.223	401.8	202.8	199.0
35.0	49.4	0.013	27.3	0.011	22.7	0.201	422.0	236.6	185.3
40.0	45.0	0.012	28.5	0.010	23.6	0.183	439.5	270.4	169.1
45.0	41.4	0.011	29.5	0.009	24.5	0.169	455.0	304.2	150.8
50.0	38.4	0.010	30.4	0.008	25.2	0.156	469.0	338.0	131.0
55.0	35.9	0.009	31.2	0.008	25.9	0.146	481.7	371.8	109.9
60.0	33.7	0.009	32.0	0.007	26.5	0.137	493.4	405.6	87.8
65.0	31.8	0.008	32.7	0.007	27.1	0.129	504.2	439.4	64.8
70.0	30.1	0.008	33.3	0.007	27.6	0.122	514.3	473.2	41.0
75.0	28.6	0.008	33.9	0.006	28.1	0.116	523.7	507.0	16.6
80.0	27.3	0.007	34.5	0.006	28.6	0.111	532.5	540.8	0.0
85.0	26.1	0.007	35.0	0.006	29.1	0.106	540.9	574.6	0.0
90.0	25.0	0.007	35.6	0.005	29.5	0.102	548.8	608.4	0.0
95.0	24.0	0.006	36.0	0.005	29.9	0.098	556.4	642.3	0.0
100.0	23.1	0.006	36.5	0.005	30.3	0.094	563.6	676.1	0.0
105.0	22.3	0.006	37.0	0.005	30.7	0.091	570.4	709.9	0.0
110.0	21.5	0.006	37.4	0.005	31.0	0.087	577.0	743.7	0.0
115.0	20.8	0.005	37.8	0.005	31.4	0.085	583.4	777.5	0.0
120.0	20.1	0.005	38.2	0.004	31.7	0.082	589.5	811.3	0.0
125.0	19.5	0.005	38.6	0.004	32.0	0.079	595.3	845.1	0.0
130.0	18.9	0.005	38.9	0.004	32.3	0.077	601.0	878.9	0.0
135.0	18.4	0.005	39.3	0.004	32.6	0.075	606.5	912.7	0.0
140.0	17.9	0.005	39.6	0.004	32.9	0.073	611.8	946.5	0.0
145.0	17.4	0.005	40.0	0.004	33.2	0.071	616.9	980.3	0.0
150.0	17.0	0.004	40.3	0.004	33.4	0.069	621.9	1014.1	0.0
155.0	16.6	0.004	40.6	0.004	33.7	0.067	626.8	1047.9	0.0
160.0	16.2	0.004	40.9	0.004	33.9	0.066	631.5	1081.7	0.0
165.0	15.8	0.004	41.2	0.003	34.2	0.064	636.1	1115.5	0.0

COLE

Prepared By S. Rayner, EIT

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

Uncontrolled- Natural Swale

Drainage Areas	A1 Post	
Area =	**0.38**	ha
"C" =	**0.25**	
AC1 =	**0.09**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R1) =	**52.9**	L/s

Uncontrolled- To Brock Street

Drainage Areas	A2 Post	
Area =	**0.13**	ha
"C" =	**0.61**	
AC2 =	**0.08**	
Tc =	**10.0**	min
Time Increment =	**5**	min
Release Rate (R2) =	**43.9**	L/s

Controlled- To Discharge into Creek

Drainage Areas	A3 Post	
Area =	**2.10**	ha
"C" =	**0.70**	
AC3 =	**1.46**	
Tc =	**10.0**	min
Time Increment =	**5.0**	min
Controlled Release Rate (R3) =	**140.1**	L/s
Max. Required Storage Volume =	**488.1**	m^3
Max. Storage Available =	**496.56**	m^3

Uncontrolled Release Rate =	**96.7 L/s**
Controlled Release Rate =	**140.1 L/s**
Total Release Rate =	**236.8 L/s**
Target Release Rate (100 Yr Pre) =	**366.6 L/s**

100-Year Design Storm

A=	1799.0
B=	5.0
C=	0.810
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	200.6	0.053	31.7	0.044	26.3	0.816	489.6	84.0	405.6
15.0	158.9	0.042	37.7	0.035	31.3	0.646	581.8	126.1	455.7
20.0	132.6	0.035	41.9	0.029	34.8	0.540	647.4	168.1	479.3
25.0	114.4	0.030	45.2	0.025	37.5	0.465	698.2	210.1	488.1
30.0	101.0	0.027	47.9	0.022	39.7	0.411	739.5	252.1	487.3
35.0	90.6	0.024	50.2	0.020	41.6	0.369	774.3	294.2	480.1
40.0	82.4	0.022	52.1	0.018	43.2	0.335	804.4	336.2	468.2
45.0	75.7	0.020	53.8	0.017	44.7	0.308	830.9	378.2	452.7
50.0	70.0	0.018	55.4	0.015	45.9	0.285	854.6	420.2	434.4
55.0	65.3	0.017	56.8	0.014	47.1	0.265	876.1	462.2	413.9
60.0	61.2	0.016	58.0	0.013	48.1	0.249	895.7	504.3	391.5
65.0	57.6	0.015	59.2	0.013	49.1	0.234	913.9	546.3	367.6
70.0	54.5	0.014	60.3	0.012	50.0	0.222	930.7	588.3	342.4
75.0	51.7	0.014	61.3	0.011	50.9	0.210	946.4	630.3	316.0
80.0	49.2	0.013	62.3	0.011	51.7	0.200	961.1	672.4	288.7
85.0	47.0	0.012	63.2	0.010	52.4	0.191	974.9	714.4	260.6
90.0	45.0	0.012	64.0	0.010	53.1	0.183	988.1	756.4	231.7
95.0	43.2	0.011	64.8	0.009	53.8	0.176	1000.5	798.4	202.1
100.0	41.5	0.011	65.6	0.009	54.4	0.169	1012.4	840.4	171.9
105.0	39.9	0.011	66.3	0.009	55.0	0.162	1023.7	882.5	141.2
110.0	38.5	0.010	67.0	0.008	55.6	0.157	1034.5	924.5	110.0
115.0	37.2	0.010	67.7	0.008	56.2	0.151	1044.9	966.5	78.3
120.0	36.0	0.009	68.3	0.008	56.7	0.147	1054.8	1008.5	46.3
125.0	34.9	0.009	69.0	0.008	57.2	0.142	1064.4	1050.6	13.9
130.0	33.8	0.009	69.6	0.007	57.7	0.138	1073.7	1092.6	0.0
135.0	32.9	0.009	70.1	0.007	58.2	0.134	1082.6	1134.6	0.0
140.0	31.9	0.008	70.7	0.007	58.7	0.130	1091.2	1176.6	0.0
145.0	31.1	0.008	71.2	0.007	59.1	0.126	1099.6	1218.6	0.0
150.0	30.3	0.008	71.8	0.007	59.5	0.123	1107.7	1260.7	0.0
155.0	29.5	0.008	72.3	0.006	60.0	0.120	1115.6	1302.7	0.0
160.0	28.8	0.008	72.8	0.006	60.4	0.117	1123.2	1344.7	0.0
165.0	28.1	0.007	73.3	0.006	60.8	0.114	1130.6	1386.7	0.0

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Prepared By S. Rayner, EIT

Orifice Control

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

Orifice Equation

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

Storm Event	Drainage Area ID	Orifice Location	Orifice Coefficient	Diameter of Orifice	Orifice Invert	Headwater Elevation	Total Head	Area of Orifice	Release Rate
				(mm)	(m)	(m)	(m)	(m^2)	(L/s)
2-Year	A3 Post	Outlet to Creek	0.61	225	269.52	270.42	0.90	0.040	101.9
5-Year	A3 Post	Outlet to Creek	0.61	225	269.52	270.62	1.10	0.040	112.7
100-Year	A3 Post	Outlet to Creek	0.61	225	269.52	271.22	1.70	0.040	140.1

COLE

Prepared By: S.Rayner, EIT

Stage- Storage- Discharge Table for Superpipes and MH

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

Orifice Invert (m)	Lowest CB Spill Point (m)
269.52	271.21

Super Pipe #1			Square MH along Superpipe #1			
Height (m)	Width (m)	Length (m)	Number of MH Used for Storage	Height Range (m)	Width (m)	Length (m)
0.9	1.8	206.348	3	1.9 - 2.4	2.5	3

Super Pipe #2			Circle MH along Superpipe #2		
Height (m)	Width (m)	Length (m)	Number of MH Used for Storage	Height Range (m)	Diameter
0.9	1.8	84.961	2	2.1 - 2.6	2.5

			Super Pipe #1		Square MH in Superpipe #1		Super Pipe #2		Circle MH in Superpipe #2		Total Storage
Description	Design Head	Elevation	Area in Superpipe	Storage in Superpipe	Area in Manhole	Storage in Manhole	Area in Superpipe	Storage in Superpipe	Area in Manhole	Storage in Manhole	
	(m)	(m)	(m)	(m^3)	(m)	(m^3)	(m)	(m^3)	(m)	(m^3)	(m)
	0.00	269.5	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00
	0.10	269.6	0.00	0.00	0.30	0.75	0.00	0.00	0.00	0.00	0.75
	0.20	269.7	0.00	0.00	0.60	1.50	0.00	0.00	0.00	0.00	1.50
	0.30	269.8	0.16	11.14	1.13	2.82	0.00	0.00	0.00	0.00	13.96
	0.40	269.9	0.34	23.52	1.73	4.32	0.00	0.00	0.00	0.00	27.84
	0.50	270.0	0.52	35.90	2.60	6.50	0.00	0.00	0.00	0.00	42.40
	0.60	270.1	0.70	48.29	3.48	8.70	0.00	0.00	0.10	0.71	57.69
	0.70	270.2	0.88	60.67	4.40	11.00	0.00	0.00	0.20	1.41	73.08
	0.80	270.3	1.17	80.48	5.30	13.25	0.14	6.12	0.30	2.12	101.96
2 Year	**0.90**	**270.4**	**1.60**	**110.19**	**6.20**	**15.50**	**0.32**	**13.76**	**0.48**	**3.39**	**142.84**
	1.00	270.5	2.14	147.33	7.10	17.75	0.56	23.70	0.66	4.67	193.45
5 Year	**1.10**	**270.6**	**2.68**	**184.48**	**8.00**	**20.00**	**0.92**	**39.00**	**0.84**	**5.94**	**249.40**
	1.20	270.7	3.06	210.47	8.90	22.25	1.28	54.29	1.02	7.21	294.22
	1.30	270.8	3.42	235.24	9.80	24.50	1.64	69.58	1.20	8.48	337.80
	1.40	270.9	3.78	260.00	10.70	26.75	2.00	84.88	1.38	9.75	381.37
	1.50	271.0	4.14	284.76	11.60	29.00	2.36	100.17	1.56	11.03	424.95
	1.60	271.1	4.50	309.52	12.50	31.25	2.72	115.46	1.74	12.30	468.53
100 Year	**1.70**	**271.2**	**4.73**	**325.62**	**13.40**	**33.50**	**2.92**	**123.87**	**1.92**	**13.57**	**496.56**

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Prepared By: S.Rayner, EIT

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%	0.38	15%	12%
A2 Post	Landscape	Inherent	80%	0.07	3%	2%
	Rooftop	Inherent	80%	0.06	2%	2%
A3 Post	Asphalt/Impervious Area	Jellyfish Unit	80%	0.80	31%	24%
	Landscape	Inherent	80%	0.76	29%	23%
	Rooftop	Inherent	80%	0.54	21%	17%
Total	**-**	**-**	**-**	**2.61**	**100.0%**	**80%**

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Wednesday, August 01, 2018
Project Name	Brock St.
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:

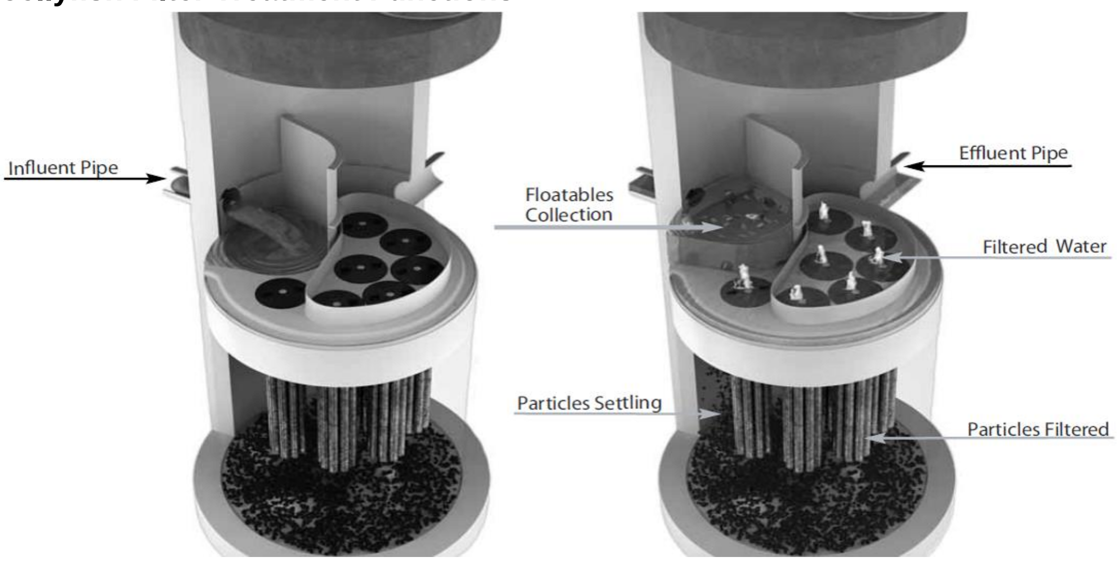
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 59% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash 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:	Wednesday, August 01, 2018
Project Name:	Brock St.
Project Number:	2018-0302
Location:	Uxbridge

Designer Information

Company:	Cole Engineering Group Ltd.
Contact:	Samantha Rayner
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:	64.1%

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:	**35.5 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 8033 m³, with a suspended sediment concentration of 60 mg/L.	**482 kg***

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

Recommendation

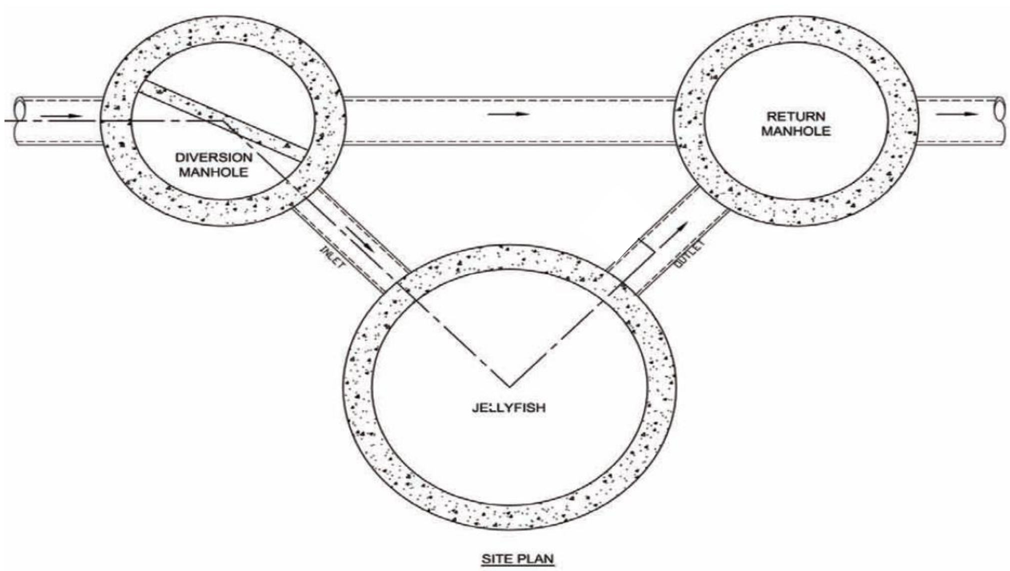
The Jellyfish Filter model JF8-8-2 is recommended to meet the water quality objective by treating a flow of 45.4 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 512 kg,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

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 GENERAL

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.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable 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.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

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

GENERAL NOTES:
1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. JELLYFISH STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE JELLYFISH SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR PROJECT BID DATE OR AS DIRECTED BY THE ENGINEER OF RECORD.

JELLYFISH STRUCTURE & DESIGN NOTES:
1. 762 MM Ø (30") MAINTENANCE ACCESS WALL TO BE USED FOR CLEANOUT AND ACCESS BELOW CARTRIDGE DECK.
2. CASTINGS OR DOORS OF THE JELLYFISH MANHOLE STRUCTURE TO EXTEND TO DESIGN FINISH GRADE. DEPTHS IN EXCESS OF 3.65 M (12') MAY REQUIRE THE DESIGN AND INSTALLATION OF INTERMEDIATE SAFETY GRATES OR OTHER STRUCTURAL ELEMENTS.
3. CASTINGS AND GRADE RINGS, OR DOORS AND DOOR RISERS, OR BOTH, SHALL BE GROUTED FOR WATERTIGHTNESS. STRUCTURE SHALL MEET AASHTO HS-20, ASSUMING EARTH COVER OF 0' - 3', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 LOAD RATING AND BE CAST WITH THE IMBRIUM LOGO.
4. ALL STRUCTURAL SECTIONS AND PARTS TO MEET OR EXCEED ASTM C-478, ASTM C-443, AND ASTM D-4097 CORRESPONDING TO AASHTO SPECIFICATIONS, AND ANY OTHER SITE OR LOCAL STANDARDS.
5. CONCRETE RISER SECTIONS FROM BOTTOM TO TOP WILL BE ADDED AS REQUIRED INCLUDING TRANSITION PIECES TO SMALLER DIAMETER RISERS FOR SURFACE ACCESSES WHERE WARRANTED BY SERVICING DEPTH.
6. IF MINIMUM DEPTH FROM TOP OF CARTRIDGE DECK TO BOTTOM OF STRUCTURAL TOP SLAB CANNOT BE ACHIEVED DUE TO PIPING INVERT ELEVATIONS OR OTHER SITE CONSTRAINTS. ALTERNATIVE HATCH CONFIGURATIONS MAY BE AVAILABLE. HATCH DOORS SHOULD BE SIZED TO PROVIDE FULL ACCESS ABOVE THE CARTRIDGES TO ACCOMMODATE MAINTENANCE.
7. STEPS TO BE APPROXIMATELY 330 MM (13") APART AND DIMENSIONS MUST MEET LOCAL STANDARDS. STEPS MUST BE INSTALLED AFTER CARTRIDGE DECK IS IN PLACE.
8. CONFIGURATION OF INLET AND OUTLET PIPE CAN VARY TO MEET SITE'S NEEDS.
9. IT IS THE RESPONSIBILITY OF OTHERS TO PROPERLY PROTECT THE TREATMENT DEVICE, AND KEEP THE DEVICE OFFLINE DURING CONSTRUCTION. FILTER CARTRIDGES SHALL NOT BE INSTALLED UNTIL THE PROJECT SITE IS CLEAN AND FREE OF DEBRIS, BY OTHERS. THE PROJECT SITE INCLUDES ANY SURFACE THAT CONTRIBUTES STORM DRAINAGE TO THE TREATMENT DEVICE. CARTRIDGES SHALL BE FURNISHED NEW, AT THE TIME OF FINAL ACCEPTANCE.
10. THIS DRAWING MUST BE VIEWED IN CONJUNCTION WITH THE STANDARD JELLYFISH SPECIFICATION, AND STORMWATER QUALITY FILTER TREATMENT JELLYFISH DOCUMENTS.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT CARTRIDGES FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. CARTRIDGE INSTALLATION, BY IMBRIUM, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE JELLYFISH UNIT IS CLEAN AND FREE OF DEBRIS. CONTACT IMBRIUM TO COORDINATE CARTRIDGE INSTALLATION WITH SITE STABILIZATION.

STANDARD OFFLINE JELLYFISH RECOMMENDED PIPE DIAMETERS

MODEL DIAMETER (m)	MINIMUM ANGLE INLET/OUTLET PIPES	MINIMUM INLET PIPE DIAMETER (mm)	MINIMUM OULTET PIPE DIAMETER (mm)
1.2	62	150	200
1.8	59	200	250
2.4	52	250	300
3.0	48	300	450
3.6	40	300	450
CONTACT IMBRIUM SYSTEMS FOR ALTERNATE PIPE DIAMETERS			

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL JELLYFISH FILTER REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE.

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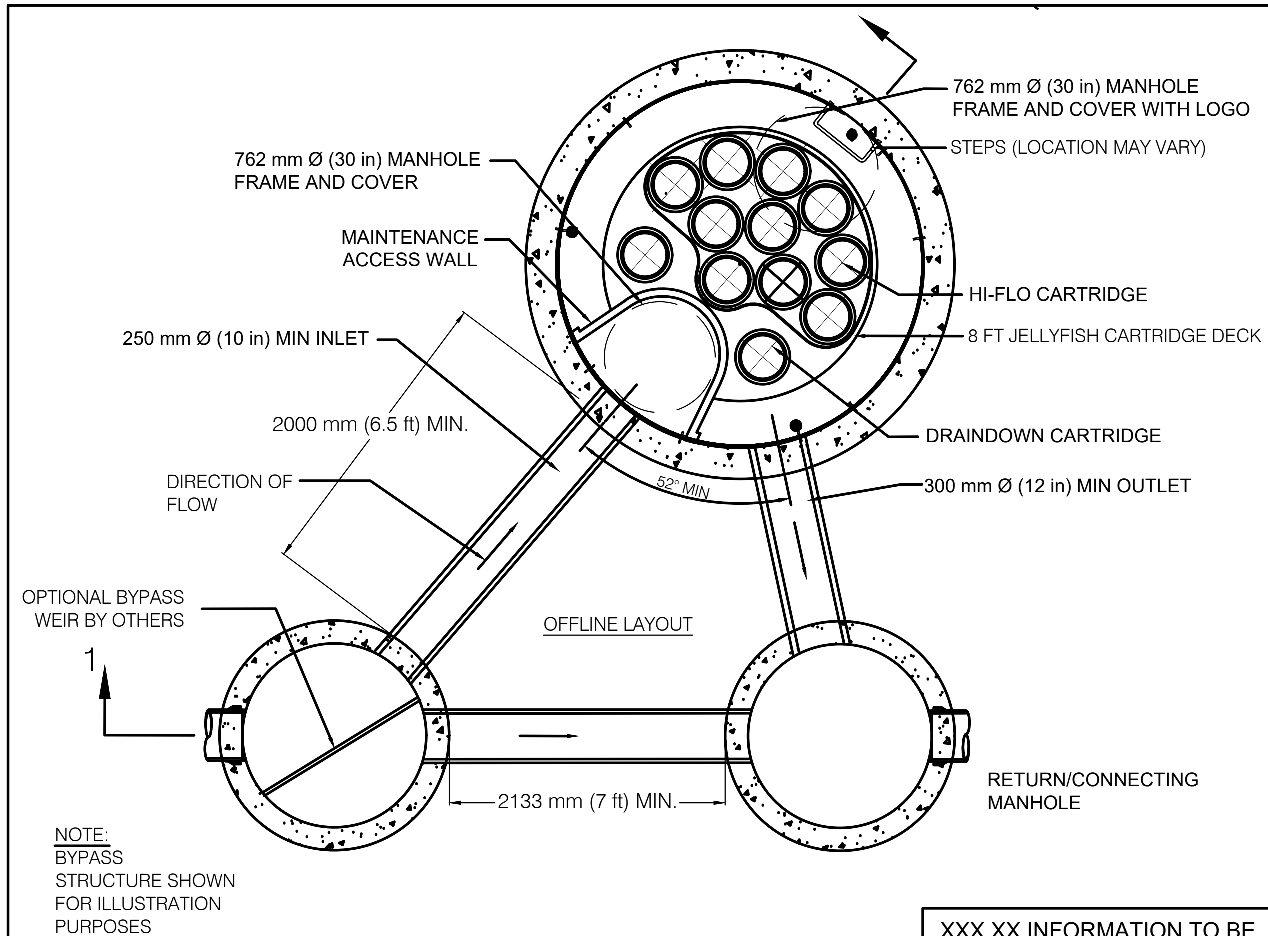
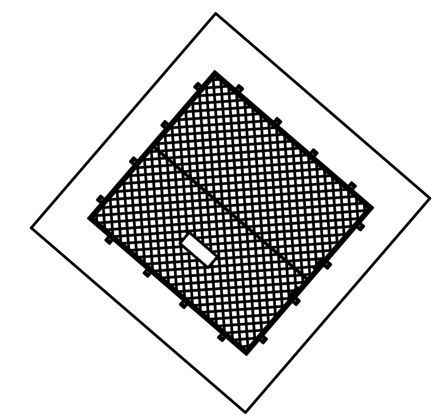
DRAWING NOT TO BE USED FOR CONSTRUCTION



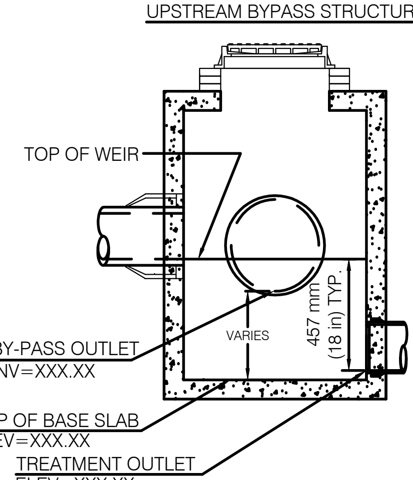


1829 mm x 1829 mm (72 in. x 72 in.)
OPTIONAL HATCH

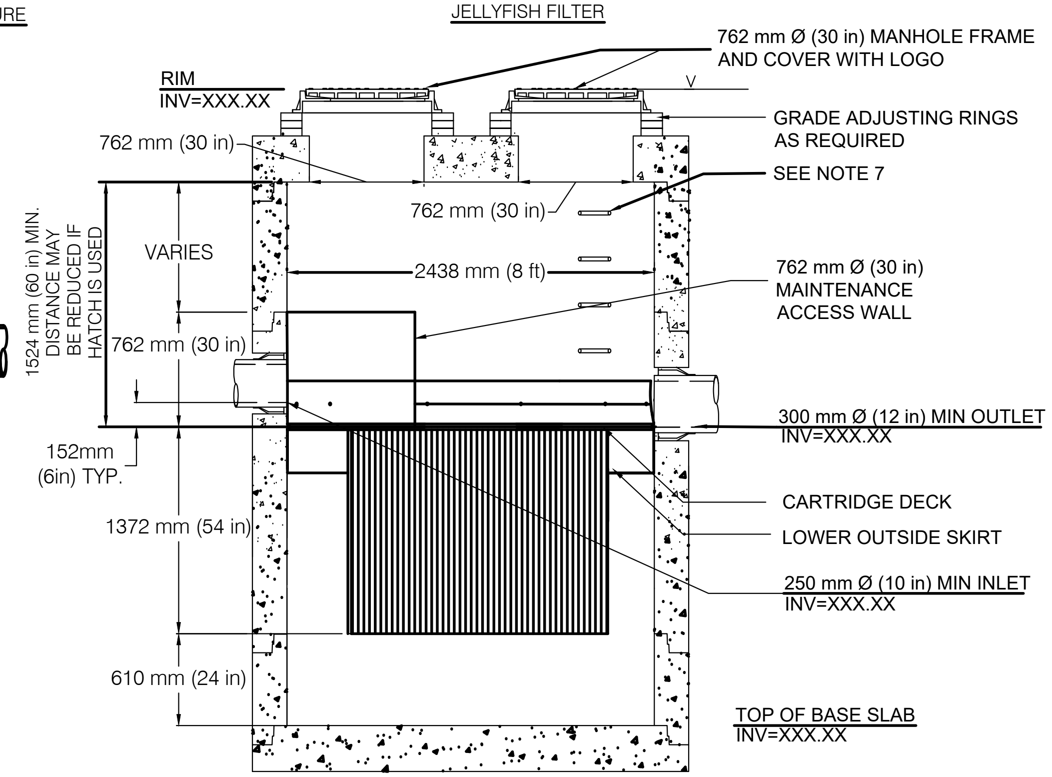
NOTE:
BYPASS STRUCTURE SHOWN FOR ILLUSTRATION PURPOSES

XXX.XX INFORMATION TO BE SUPPLIED BY ENGINEER OF RECORD

UPSTREAM BYPASS STRUCTURE



JELLYFISH FILTER



CROSS SECTION 1-1

JELLYFISH DESIGN NOTES

JELLYFISH TREATMENT CAPACITY IS A FUNCTION OF THE CARTRIDGE SELECTION AND THE NUMBER OF CARTRIDGES. THE STANDARD MANHOLE STYLE IS SHOWN. Ø2438 mm (96") MANHOLE JELLYFISH PEAK TREATMENT CAPACITY IS 55.5 L/s (1.96 CFS). TREATMENT FLOW RATE IS BASED ON 457 MM (18") OF HEAD PRESSURE.

CARTRIDGE SELECTION				
CARTRIDGE DEPTH	54"	40"	27"	15"
OUTLET INVERT TO STRUCTURE BASE SLAB	90"	76"	63"	51"
FLOW RATE HIGH-FLO / DRAINDOWN (L/s) (per cart)	5.09 / 2.55	3.68 / 1.84	2.55 / 1.27	1.41 / 0.71
SEDIMENT CAPACITY HIGH-FLO / DRAINDOWN (kg) (per cart)	57 / 28	42 / 21	28 / 14	16 / 8
MAX. CARTS HIGH-FLO/DRAINDOWN	10 / 2			
MAX. SEDIMENT CAPACITY (kg)	626	462	308	176
MAX. TREATMENT (L/s)	55.5	41.6	27.7	15.3

SITE SPECIFIC DATA REQUIREMENTS

JELLYFISH MODEL	*				
STRUCTURE ID					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
# OF CARTRIDGES REQUIRED (HF / DD)					*
CARTRIDGE SIZE (inches)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*
* PER ENGINEER OF RECORD					

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Jellyfish®
JF8 STANDARD
Scale = 1:50

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JELLYFISH® FILTER - SPECIFICATIONS

GENERAL

A. WORK INCLUDED: SPECIFIES REQUIREMENTS FOR CONSTRUCTION AND PERFORMANCE OF AN UNDERGROUND STORMWATER QUALITY, MEMBRANE FILTRATION, AND TREATMENT DEVICE THAT REMOVES POLLUTANTS FROM STORMWATER RUNOFF THROUGH THE UNIT OPERATIONS OF SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.

B. 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 990: SPECIFICATION FOR JOINTS FOR CONCRETE MANHOLES USING PREFORMED FLEXIBLE JOINT SEALANTS
ASTM D 4101: SPECIFICATION FOR COPOLYMER STEPS CONSTRUCTION

C. 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 PRECAST CONCRETE AND CALL OUT OR NOTE THE FIBERGLASS (FRP) INTERNALS/COMPONENTS.

D. 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.

E. HANDLING AND STORAGE: PREVENT DAMAGE TO MATERIALS DURING STORAGE AND HANDLING.

PRODUCTS

A. 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.

B. THE CYLINDRICAL CONCRETE DEVICE SHALL INCLUDE A FIBERGLASS CARTRIDGE DECK INSERT. THE RECTANGULAR CONCRETE DEVICE SHALL INCLUDE A COATED ALUMINUM INSERT. IN EITHER INSTANCE, THE INSERT SHALL BE BOLTED AND SEALED WATERTIGHT INSIDE THE PRECAST CONCRETE CHAMBER. THE INSERT 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); (D) A CONDUIT FOR CONVEYANCE OF TREATED WATER TO THE EFFLUENT PIPE.

C. MEMBRANE 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) OR GREATER 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 FLUX RATE SHALL BE 0.21 GPM/FT2 (0.142 LPS/M2). EACH MEMBRANE FILTER CARTRIDGE SHALL ALLOW FOR MANUAL INSTALLATION AND REMOVAL.

D. 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.

E. ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.

F. 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" MAY HAVE AN IMPACT ON THE TOTAL PERFORMANCE AND/OR LONGEVITY BETWEEN CARTRIDGE MAINTENANCE/REPLACEMENT OF THE DEVICE.

G. 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.

H. GASKETS AND/OR SEALANTS TO PROVIDE WATER TIGHT SEAL BETWEEN CONCRETE JOINTS. JOINTS SHALL BE SEALED WITH PREFORMED JOINT SEALING COMPOUND CONFORMING TO ASTM C 990.

I. 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.

J. DOOR AND HATCHES, IF PROVIDED SHALL MEET DESIGNATED LOADING REQUIREMENTS OR AT A MINIMUM FOR INCIDENTAL VEHICULAR TRAFFIC.

K. ALL CONCRETE COMPONENTS SHALL BE MANUFACTURED ACCORDING TO LOCAL SPECIFICATIONS AND SHALL MEET THE REQUIREMENTS OF ASTM C 478.

L. 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.

M. 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.

N. 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.

PERFORMANCE

A. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL FUNCTION TO REMOVE POLLUTANTS BY THE FOLLOWING UNIT TREATMENT PROCESSES; SEDIMENTATION, FLOATATION, AND MEMBRANE FILTRATION.

B. 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.

C. 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 PASS WATER OVER THE CARTRIDGE DECK, AND AVOID PASSAGE THROUGH THE SUMP AND/OR CARTRIDGE FILTRATION ZONE.

D. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL TREAT 100% OF THE REQUIRED WATER QUALITY TREATMENT FLOW BASED ON A MAXIMUM TREATMENT FLUX RATE (SURFACE LOADING RATE) ACROSS THE MEMBRANE FILTER CARTRIDGES NOT TO EXCEED 0.21 GPM/FT2 (0.142 LPS/M2).

E. AT A MINIMUM, THE STORMWATER QUALITY FILTER DEVICE SHALL HAVE BEEN FIELD TESTED AND VERIFIED WITH A MINIMUM 25 QUALIFYING STORM EVENTS AND FIELD MONITORING CONDUCTED ACCORDING TO THE TARP TIER II OR TAPE FIELD TEST PROTOCOL, AND HAVE RECEIVED NJCAT VERIFICATION.

F. 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%.

G. 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 D50 OF 15 MICRONS OR LOWER FOR ALL MONITORED STORM EVENTS, AND AN EFFLUENT TURBIDITY OF 15 NTUS OR LOWER.

H. 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%.

I. THE STORMWATER QUALITY FILTER TREATMENT DEVICE SHALL HAVE DEMONSTRATED A MINIMUM MEDIAN TOTAL ZINC REMOVAL OF 50%, AND A MINIMUM MEDIAN TOTAL COPPER REMOVAL OF 75%.

INSPECTION AND MAINTENANCE

A. 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.

B. 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).

C. 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.

D. SEDIMENT REMOVAL FROM THE FILTER TREATMENT DEVICE SHALL BE ABLE TO BE CONDUCTED USING A STANDARD MAINTENANCE TRUCK AND VACUUM APPARATUS, AND A MINIMUM ONE POINT OF ENTRY TO THE SUMP THAT IS UNOBSTRUCTED BY FILTER CARTRIDGES.

E. MAINTENANCE ACCESS SHALL HAVE A MINIMUM CLEAR HEIGHT OF 60" OVER ALL OF THE FILTER CARTRIDGES, OR BE ACCESSIBLE BY A HATCH OR OTHER MECHANISM THAT PROVIDES MINIMUM 60" 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.

F. FILTER CARTRIDGES SHALL BE ABLE TO BE MAINTAINED WITHOUT THE USE OF ADDITIONAL LIFTING EQUIPMENT.

EXECUTION

A. THE INSTALLATION OF A WATERTIGHT PRECAST CONCRETE DEVICE SHOULD CONFORM TO ASTM C 891 AND TO ANY STATE HIGHWAY, MUNICIPAL OR LOCAL SPECIFICATIONS FOR THE CONSTRUCTION OF MANHOLES, WHICHEVER IS MORE STRINGENT. SELECTED SECTIONS OF A GENERAL SPECIFICATION THAT ARE APPLICABLE ARE SUMMARIZED BELOW.

B. THE WATERTIGHT PRECAST CONCRETE DEVICE IS INSTALLED IN SECTIONS IN THE FOLLOWING SEQUENCE:

- AGGREGATE BASE
- BASE SLAB
- TREATMENT CHAMBER AND CARTRIDGE DECK RISER SECTION(S)
- BYPASS SECTION
- CONNECT INLET AND OUTLET PIPES
- CONCRETE RISER SECTION(S) AND/OR TRANSITION SLAB (IF REQUIRED)
- MAINTENANCE RISER SECTION(S) (IF REQUIRED)
- FRAME AND ACCESS COVER

C. 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.

D. 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.

E. 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.

F. FILTER CARTRIDGES SHALL BE INSTALLED IN THE CARTRIDGE DECK AFTER THE CONSTRUCTION SITE IS FULLY STABILIZED AND IN ACCORDANCE WITH THE MANUFACTURERS 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.

G. 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.

H. THE MANUFACTURER SHALL PROVIDE AN OWNER'S MANUAL UPON REQUEST.

I. 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.

J. 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

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JELLYFISH FILTER SPECIFICATIONS

Jellyfish

JF8 STANDARD

Scale = 1:50

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COLE

Prepared by: S. Rayner

Infiltration Trench Calculations

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

Water Balance Calculations based on Hydrogeological Assessment and Water Balance Study performed by WSP dated March 16 2018.
See Appendix for relevant information.

Pre Development Infiltration	6994	m3/year
Post Development Pervious Infiltration	2864	m3/year
Required Additional Infiltration	**4130**	m3/year
Total Infiltration Provided	**4969**	m3/year

Infiltration Trench

Contributing Area to Trench	Average Rainfall	Depth to be Retained	% of Annual Rainfall Depth	Total Infiltration	Total Volume to be Infiltrated	Stone Porosity	Runoff Volume for Infiltration[1]	Infiltration rate[2]	Required Drawdown Time	Maximum Allowable Trench Depth[3]	Proposed Trench Depth[4]	Minimum Footprint Area for Infiltration[5]	Proposed Trench Width	Proposed Trench Length	Actual Footprint Area for Infiltration
(m^3)	(mm/year)	(mm)	(%)	(mm)	(m^3/ year)		(m^3)	(mm/hr)	(hr)	(m)	(m)	(m^2)	(m)	(m)	(m^2)
3958	886	8	57%	502	1988	0.4	31.664	34.5	48	4.14	1.00	79.2	2.00	80	160

Trench Details

Observed Groundwater Level below Existing Grade	Observed Existing Grade	Water Table	Max. Elevation of Infiltration System	Lowest Grade at Infiltration System	Available Depth	Proposed Depth
(m)	(m)	(m)	(m)	(m)	(m)	(m)
0.75	269.93	269.18	270.18	272.18	2.00	1.00

Channel Soakway Pits

Total Area of Soakway Pits	Infiltration Rate	Time	Total Volume to be Infiltrated
(m^2)	(mm/hr)	(hr)	(m^3/ year)
60	34.5	1440	2980.8

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

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

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)

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

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)

Notes:
1 - Volume of runoff based on 15mm of rain across the drainage area.
2 - Infiltration rate based on WSP Report. See report in Appendix A.
3 - Max depth for a 48 hour draw down time see equation above
4 - Proposed depth for soakaway pit/infiltration trench
5 - Minimum trench bottom area, see equation 4.3 above

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 property 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 *Cole*.

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 *Cole* includes an external catchment to the south of the Site. *Cole* 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 64 residential dwellings, and new driveway and roadway areas. WSP understands that a naturalized drainage feature is to be constructed along the west side of this development area to convey water currently drained by the headwater drainage feature.

The Post-Development scenario presented by *Cole* in the Functional Servicing and Stormwater Management Report (*Cole*, 2018) does not include a delineated off-site catchment to the south as was included in Pre-Development.

Cole 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 west side of the property. The natural drainage features include a series of swales/soak away pits that have been designed to promote infiltration. *Cole* provided estimates of the annual volumes of runoff that are to be infiltrated through this system of swales. WSP accounted for this infiltration in the water budget summary on **Table 4**, but not within the detailed water budget calculations (**Appendix F**).

Cole also allowed for infiltration trenches to capture and infiltrate runoff from rooftops within the central area of the development. WSP also accounted for this infiltration in the water budget summary on **Table 4**, but not within 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. Under post-development conditions, the Site comprises seven (7) 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 provided by *Cole*.

Under Post-Development conditions, a new naturalized drainage feature that drains off-site to the northwest is introduced in Catchment A. 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 property (to the south) 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 A:** Drains to the proposed drainage swale which subsequently flows off-site to the north west via overland flow.

— **Post-Development On-Site Catchment B:** Drains off-site to the northwest via overland flow.

— **Post-Development On-Site Catchment C:** Drains off-site to the northwest via overland flow.

— **Post-Development On-Site Catchment D:** Drains off-site to the northwest via the on-site storm sewer system.

— **Post-Development On-Site Catchment E:** 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 F:** 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 G:** Drains to the rear lot catch basins which connect to the on-site storm sewer system and subsequently flows off-site to the north.

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.

Cole prepared the stormwater management plan with input from a draft Hydrogeological Assessment and Water Balance Study. This results in some differences in catchment delineations between the two analyses. Catchment A1 in the Post Development Drainage Plan (PDDP) (*Cole,* 2018) is the same as Catchment A in **Figure 12**. Catchment A2 in the PDDP includes Catchments B and C in **Figure 12**; and Catchment A3 in the PDDP includes Catchments D, E, F and G 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. The Hydrogeological Assessment and Water Balance Study was reviewed by *Cole* and no revisions to the catchment areas were required.

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 not accounted for in the detailed water budget analysis (Appendix F) but is included in the Water Budget Summary in **Table 4**.

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 14,124 m^2 of impervious surfaces. This would result in a net infiltration of 2,864 m^3/year or 109.6 mm/yr through natural pervious areas. An additional 2,980 m^3/yr is considered to infiltrate through the soak away pits in the naturalized drainage area. A further 1,988 m^3/yr will infiltrate through the infiltration trench. This results in a net infiltration of 7,831 m^3/yr. The net infiltration would reflect approximately 34% 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 is 12,492 m^3/yr or 478.3 mm/year. As mentioned above, 2,980 m^3/yr of this runoff is infiltrated in the soak away pits and 1,988 m^3/yr is infiltrated through the infiltration trench. The total calculated net Post-Development runoff represents approximately 33% 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. As the Post-Development scenario includes measures designed to enhance and maintain infiltration, the total on-site infiltration is increased by approximately 837 m^3/yr, or 12% relative to pre-development. The introduction of additional impervious surfaces and the above mitigation measures increases total runoff by 5,636 m^3/yr or 298%. This increased runoff is managed by the stormwater management system.

The incorporation of LID measures as part of the stormwater management system has demonstrated an ability to practically enhance the pre-development recharge and to manage the generated stormwater to be released through the natural system.

At this time, additional mitigation measures are not required as an infiltration surplus exists based on the proposed mitigation measures, however, other strategies that can be employed further enhance infiltration at the Site are available. These include:

a) reduction of impervious areas;
b) use of more pervious pavement materials (particularly for driveways, sidewalks, and other decorative areas);
c) enhancement of infiltration capacity in pervious areas through use of materials with increased permeability or grading.
d) consideration of other water inputs in addition to precipitation (for example irrigation of lawn and garden areas using municipal water sources).

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.

COLE

Prepared By: S.Rayner, EIT

Phosphorus Removal

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

Drainage Area	Method	Effective TP Removal	Area (ha)	% Area of Site	Overall TP Removal
A1 Post	Enhanced Swale	100%	0.38	15%	15%
A2 Post	Clean release solely from yards and residential roofs into roadside ditch	50%	0.13	5%	2%
A3 Post	Treatment Train: Infiltration + Underground storage + Jellyfish Filter	80%	2.10	80%	64%
Total			**2.61**		**81%**

Ontario
MINISTRY OF THE ENVIRONMENT

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

Project DEVELOPMENT Summary

DEVELOPMENT: **South Brock Street Development- Evansdale Development Ltd.**
Subwatershed: **Pefferlaw-Uxbridge Brook**

Total Pre-Development Area (ha):	**2.61**	Total Pre-Development Phosphorus Load (kg/yr):	**0.17**

Pre-Development Land Use	Area (ha)	P coeff. (kg/ha)	P Load (kg/yr)
Hay-Pasture	2.36	0.06	0.14
Low Intensity Development	0.25	0.13	0.03

POST-DEVELOPMENT LOAD

Post-Development Land Use	Area (ha)	P coeff. (kg/ha)	Best Management Practice applied with P Removal Efficiency		P Load (kg/yr)
High Intensity - Residential	2.1	1.32	Treatment Train Approach	80%	0.55
High Intensity - Residential	0.13	1.32	Other	50%	0.09
Open Water	0.38	0.26	Enhanced Grass/WQ Swales	**100%**	0.00

Treatment Train Approach- Controlled flows from A3 Post will be treated through infiltration trench, underground storage, and jellyfish unit

Uncontrolled Flow to Brock Street will be solely from clean rooftops and residential backyards and discharge into a grassed swale

Drainage Area A1- Enhanced Swale to treat uncontrolled runoff discharging to channel and discharge from adjacent pond

NOTE: BMP efficiency has been adjusted from the reference provided value by 100% (from 0% to 100%)

Post-Development Area Altered:	**2.61**
Total Pre-Development Area:	**2.61**
Unaffected Area:	**0**

	P Load (kg/yr)
Pre-Development:	**0.17**
Post-Development:	**3.04**
Change (Pre - Post):	**-2.87**
	1648% Net Increase in Load
Post-Development (with BMPs):	**0.64**
Change (Pre - Post):	**-0.47**
	267.72% Net Increase in Load

APPENDIX C
Sanitary Data Analysis

TOWNSHIP OF UXBRIDGE
Region of Durham
ENGINEERING AND PUBLIC WORKS DEPARTMENT
Sanitary Calculations
South Brock Street Development

Sheet: 1 of 1

Prepared By: LMV
Date: 02-Aug-18
Project No.: 2018-0302

Residential Population Density:
Single Family Dwelling, Semi-Detached: 3.5 Persons/unit
Townhouses: 3.0 Persons/Unit
1 Bedroom Apartment: 1.5 Persons/Unit
2 Bedroom Apartment: 2.5 Persons/Unit

Infiltration: 22,500 L/g/h/day
Commercial 180,000 L/floor ha/day

q = average daily flow per person 364 L/d

M = Peaking Factor (Residential)
M = 1 + 14/(4+P^.5)
where P = population in 1000's

Q (p) = peak population flow (L/s)
Q (I) = peak Infiltration flow (L/s)
Q (C) = peak flow from commercial area (L/s)
Q (d) = Total Peak flow (L/s)

Q(d) = Q(p) + Q(I) + Q(C)

LOCATION	SECTION AREA (ha.)	RESIDENTIAL: NUMBER OF UNITS: Single Family Dwelling @ 3.5 ppu	Townhouse units @ 3 ppu	Future Development Block	Residential units above Commercial Block @ 2.5 ppu	3 Bed Apts. @ 3.5 ppu	SECTION POP. (persons)	NON-RESIDENTIAL: Office (ha)	COMMERCIAL (ha.)	INSTIT. (ha.)	SCHOOL @ 86 p/ha (ha.)	SECTION AREA (ha.)	SECTION POP. (persons)	SANITARY FLOW: TOTAL ACCUM. POP. (persons)	AVERAGE RESIDENTIAL FLOW @ 364 L/person/d (L/s)	HARMON PEAKING FACTOR	RES. PEAK FLOW (L/s)	INFILT. @ 22,500 L / ha / day (L/s)	Total Residential Flow	Toal COMMERCIAL FLOW @ 180,000 L/ha/day (L/s)	TOTAL SANITARY FLOW (L/s)
Townhouse Units	2.330	0	64	0	0	0	192		0.000					192	0.81	3.8	3.07	0.61	3.68	0.00	**3.68**
Total																					**3.68**

*Note: Infiltration for the entire Townhouse Parcel, 2.330 ha, has been considered in the total infiltration calculations

Luis Vieira

Subject: FW: Brock Street Development - Sanitary Sewers

From: Jeff Almeida [mailto:Jeff.Almeida@Durham.ca]
Sent: Thursday, July 19, 2018 2:13 PM
To: Pouya Haghshenas <PHaghshenas@coleengineering.ca>
Cc: Joe Lasitz <jlasitz@coleengineering.ca>
Subject: RE: Brock Street Development - Sanitary Sewers

Pouya,

We have recently completed detailed analysis of the sanitary sewer system in the east Uxbridge area so there is no need for Cole Engineering to conduct the same exercise. The sanitary flows from Nelkydd Lane south of Brock Street will need to be conveyed as it stands now. The sanitary sewers on existing Herrema Drive do not have the capacity for the lands south of Brock Street on Nelkydd Lane.

In our review we also looked at the servicing of the two subject lots on the south side fronting Brock Street. We determined that if the two lots were to proceed with a low to medium density proposal that a sanitary sewer connection could potentially be extended across the storm pond on an easement from sanitary M.H. AG15-079 at the intersection of Planks Lane/Nelkydd Lane easterly to the subject property. You would be responsible for obtaining an easement across the storm pond for the sanitary sewer connection.

Jeff Almeida
Development Approvals Division
Works Department
Regional Municipality of Durham
605 Rossland Road East
Whitby, ON L1R 1W8
Phone: (905) 668-7711 ext. 3721
Fax: (905) 668-2051

From: Pouya Haghshenas [mailto:PHaghshenas@coleengineering.ca]
Sent: July-04-18 1:32 PM
To: Jeff Almeida
Cc: Joe Lasitz
Subject: Brock Street Development - Sanitary Sewers

Good afternoon Jeff,

Thank you for taking my call earlier this morning.

As discussed, in our efforts to provide a sanitary outlet for our client's new development site on the south side of Brock Street, we will need to extend the sanitary sewers along Brock Street and also on Herrema Boulevard from Brock Street to Low Boulevard.

There currently exists a shallow sanitary sewer system on Herrema Boulevard (from Brock St to Low Blvd.) and the above extension will require modifications to this sanitary sewer line as the Region permits only one (1) sanitary line within the future Herrema boulevard R.O.W.. Under the existing conditions, all flows from the south side of Brock St. are conveyed to the 200 mm sanitary sewer system on Barton Ln. / Remion Cr., through the shallow sewers on Herrema Blvd. and Low Blvd.

Considering the above information, it seems that the most preferred solution with the least impact to the existing sanitary sewer pipes would be to continue conveying the drainage to the 200 mm sanitary sewers on Barton Ln. / Remion Cr. with the exception that these flows are conveyed through the future sanitary sewer system on Herrema Blvd, which would eventually replace the existing shallow sanitary sewers on Herrema Boulevard. For this option to work, we must ensure that the existing sanitary sewers downstream have adequate capacity to support the existing flows, as well as future flows from our client's two (2) development sites.

Would you please review the attached marked up sketch and advise whether you can provide us with the following:

1) Sanitary flows being picked up by MH 021
2) Flows coming into MH 044 on Barton Lane, through Remion Court.

Once we have this information, we will do a detailed analysis (i.e. sanitary sewer design sheets) and verify whether the existing sanitary sewers on Herrema Boulevard would provide enough capacity for the above work.

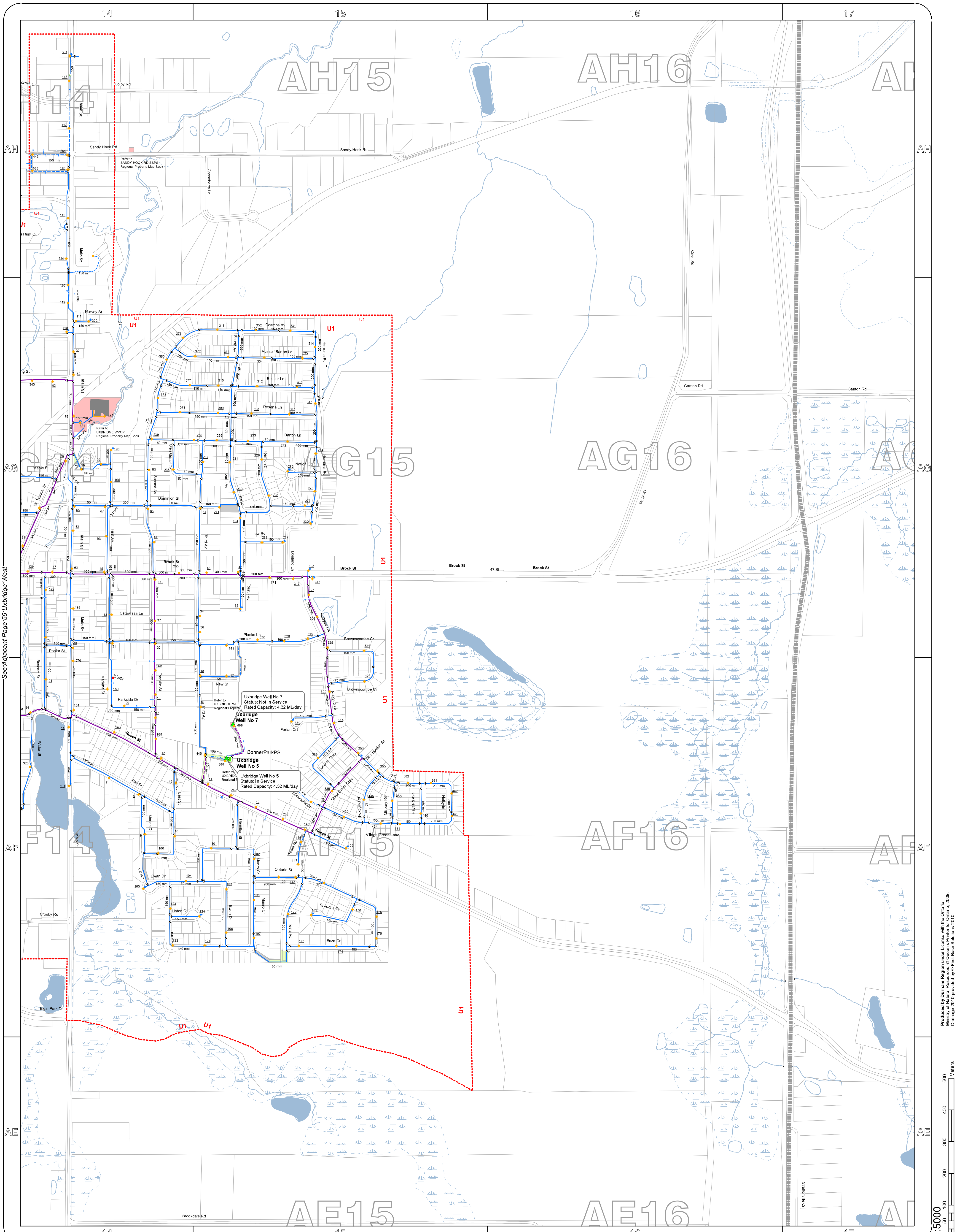
Would you please also advise if you would be in agreement with this approach should the system provide adequate capacity.

Best regards,

Pouya Haghshenas P.Eng.
Project Engineer
Urban Development (ICI)

Cole Engineering Group Ltd.
70 Valleywood Dr., Markham, ON L3R 4T5
T. 905-940-6161 Ext 315, Tor. Line: 416-987-6161
C. 416-427-9779
F: 905-940-2064
Email: phaghshenas@ColeEngineering.ca
Website: www.ColeEngineering.ca

APPENDIX D
Water Data Analysis



The Regional Municipality of Durham
Works Department
WATER SUPPLY SYSTEM

This map has been produced from a variety of sources. The Region of Durham does not make any representations concerning the accuracy, likely results, or reliability of the use of the materials. The Region hereby disclaims all representations and warranties.

Servicing Note: This map depicts proximity of services only. It is not to be used to determine individual site servicing or availability of capacity within the system. For detailed site servicing information please contact the development approvals section of the works department,

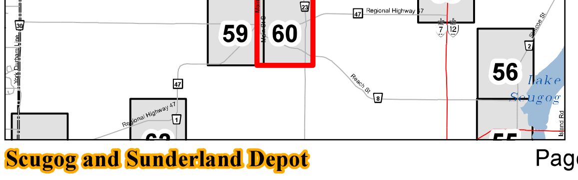
Township of Uxbridge
Uxbridge East

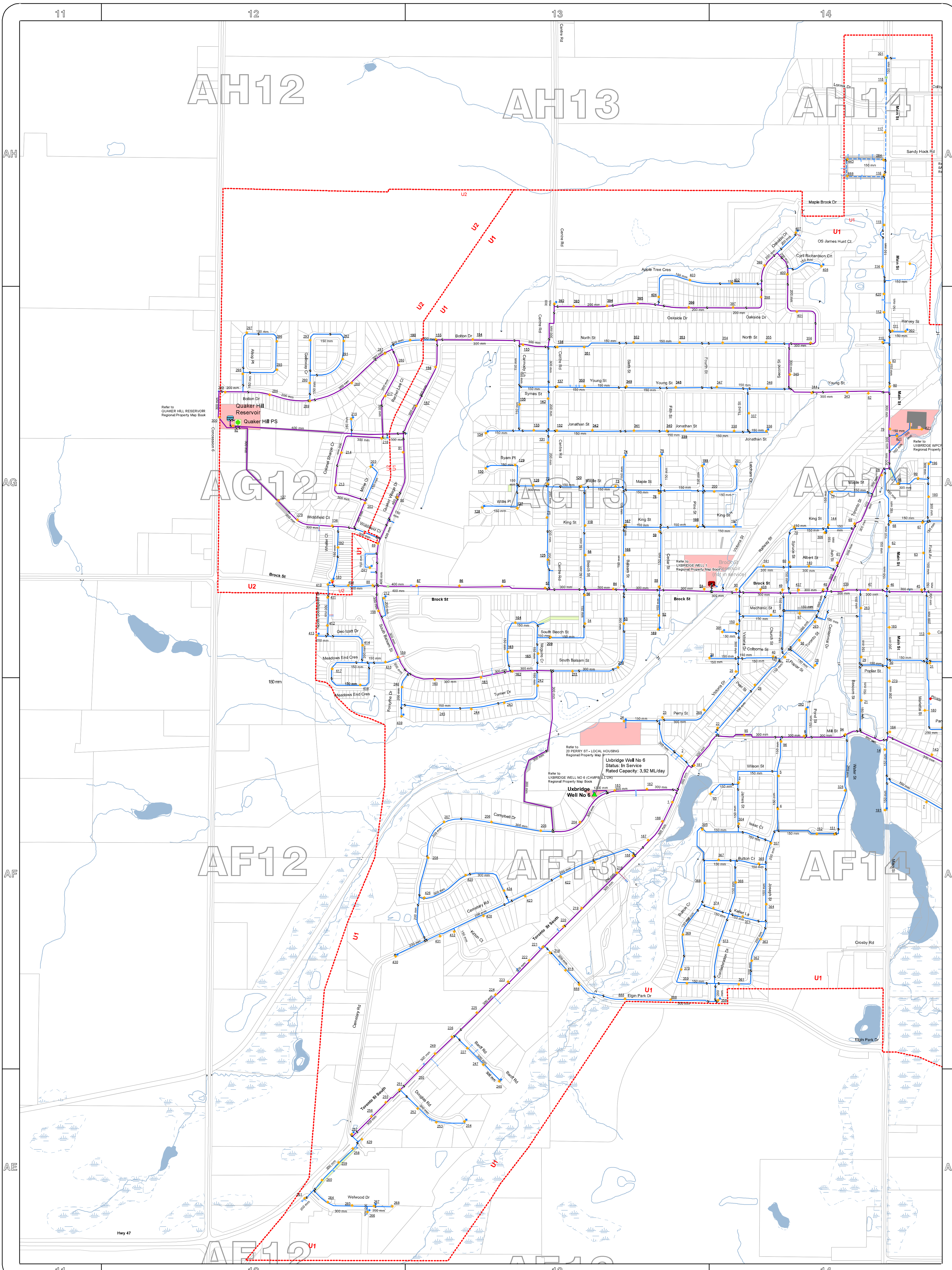
- Water Main - Assumed or In Service
- Water Main - Maintenance
- Water Main - Issued for Construction
- Water Main - Not In Service
- Feeder Main - Assumed or In Service
- Feeder Main - Maintenance
- Feeder Main - Issued for Construction
- Fireline
- Service
- Pressure Zone Edge
- Underground Pipelines
- Municipal Boundary

- Hydrant
- Flushing Hydrant
- Hydrant with Anti-tampering Device
- Flushing Hydrant with Anti-tampering Device
- Temporary Flushing Hydrant
- Temporary Flushing Hydrant with Anti-tampering Device
- Private Hydrant
- Water Pumping Station - Proposed
- Water Pumping Station - Not in Service
- Water Pumping Station - Not Applicable
- Water Pumping Station - Assumed/In Service/Maintenance
- Water Pumping Station - Abandoned

- Control Valve
- Curbstop Non Residential
- Zone Valve
- Blow Off
- Air Release, Check, Drain or Pressure Relief
- Municipal Well - In Service
- Municipal Well - Abandoned
- Municipal Well - Not in Service
- Municipal Well - Not Applicable
- Reservoir - In Service
- Reservoir - Not in Service
- Storage Tank - In Service
- Wet Well - Assumed

- Easement (Water)
- Easement (Combined)
- Regional Property





The Regional Municipality of Durham
Works Department
WATER SUPPLY SYSTEM

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DURHAM REGION

Township of Uxbridge
Uxbridge West

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- Water Pumping Station - Proposed
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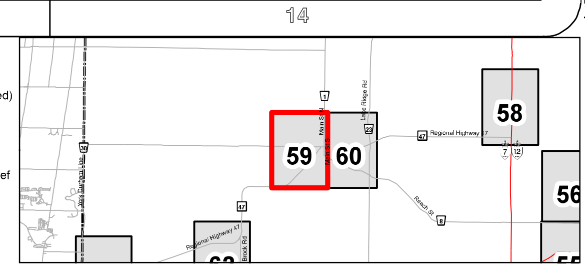
- Municipal Well - Not Applicable
- Reservoir - In Service
- Reservoir - Not in Service
- Storage Tank - In Service
- Wet Well - Assumed



Scugog and Sunderland Depot

Water_5000_D.mxd
printed May-18-16

DOMESTIC WATER DEMAND

COLE ENGINEERING
Experience Enhancing Excellence

Project:	Brock Street South Development	Proj. #	2018-0302
Date:	August 2018		
Calc'ed by:	LV		

Note:
Based on the Region of Durham Standards, Ministry of the Environment and Climate Change Design Guidelines for Drinking-Water Systems 2008 Table 3-3 .

	Site Component	Townhouses	Semi-Detached Units	Future Development Block	Commercial Block		
Residential Occupancy Data	Studio / 1 / 1+d bed units						
	People per unit	*1.5*	*1.5*	*1.5*	*1.5*		
	2 bed units / 2+D				**5**		
	People per unit	*2.5*	*2.5*	*2.5*	*2.5*		
	3 bed units						
	People per unit	*3.5*	*3.5*	*3.5*	*3.5*		
	Townhouse units	**64**					
	People per unit	*3.0*	*3.0*	*3.0*	*3.0*		
	Semi Detached or Single		**8**				
	Person per unit	*3.5*	*3.5*	*3.5*	*3.5*		
Commercial Occupancy Data	Commercial GFA (ha)				**0.060**		
	People per ha				*86.0*		
	blank						
	blank						

Unit Quantity by Site Component	Water Demand	Units	Equivalent Population (persons)					
Residential Occupancies								
Residential Occupancies	450	L/person/day	192.0	28.0	75.0	13.0	-	-
Commercial Occupancies			**Equivalent Poplutations (persons)**					
Commercial or Retail	450	L/person/day	-	-	-	6.0	-	-

Daily Flow Rate (L/d)								
Residential Occupancies								
Residential Occupancies		138,600.00	86,400.00	12,600.00	33,750.00	5,850.00	0	0
Commercial Occupancies								
Commercial Occupancies		2,700.00	0	0	0	2,700.00	0	0

	Total Flow						
Average day (L/d)	**141,300.00**	86,400.00	12,600.00	33,750.00	8,550.00	0.00	0.00
Average day (L/s)	**1.64**	1.00	0.15	0.39	0.10	0.00	0.00
Max. day (L/d)	**409,770.00**	250,560.00	36,540.00	97,875.00	24,795.00	0.00	0.00
Max. day (L/min)	**284.56**	174.00	25.38	67.97	17.22	0.00	0.00
Min. hour (L/hr)	**2,310.00**	1,440.00	210.00	562.50	97.50	0.00	0.00
Peak hour (L/hr)	**25,316.25**	15,480.00	2,257.50	6,046.88	1,531.88	0.00	0.00
Peak hour (L/s)	**7.03**	4.30	0.63	1.68	0.43	0.00	0.00

Peaking Factors

Land Use	Minimum Hour	Peak Hour	Maximum Day
Residential	0.4	4.30	2.90
Commercial / Retail	0.4	4.30	2.90

Population density (people per unit), and 'Volume (L)' is based on the Region of Durham Design Criteria & Standard Drawings.Residential unit count are based on the project statistics prepared by Architect.

\\coleengineering.ca\prj\mrk\2018\2018-0302\400_Tchncl\70_Rprts\FSR SWM July 2018\Appendix D - Water\[Water Domestic & Fire Demand.xlsx]1. Domestic Water Demand

FIRE FLOW CALCULATION

Project:	Brock Street South Development	Project #	2018-0302
Date:	Aug-18		
Calc'ed by:	LV		

Fire Resistive Construction:	NO	Site Component:	Largest Townhouse Block					
The following calculations are for the proposed townhouse development and are based on the largest townhouse area. The FUS requires that a minimum water supply source 'F' be provided at 150KPa. The minimum flow 'F' can be calculated as such:	**Total Floor Area** ***Basement Area has been excluded. 3-Storeys have been considered in the calculations**	*Largest Floor Area	1704.0	0.0	0.0	0.0		
		Area above (m2)		0.0	0.0	0.0		
		Area below (m2)		0.0	0.0	0.0		
		Total Floor Area (m2)	1704.0	0	0	0.0		
$F = 220C\sqrt{A}$	**Flow (F)**	C (dimensionless)	1.0	0.0	0.0	0.0		
		A (m2)	1704	0	0	0		
		F (L/min)	9000	0	0	0		
F = Required fire flow L/min	**Reduction Factor**	F (L/min)	9000	0	0	0		
C = Coefficient related to construction		f_1 (dimensionless)	0.85					
A = Total area in m^2		$F' = F \times f_f$ (L/min)	7650	0	0	0		
		f_1 = occupancy factor; ie, Residential, f_1 = 0.85; for Retail or Commercial, f_1 = 1.00						
	Sprinkler and Exposure Increase or Decrease	f_2 (sprinkler factor)	0%	0%	0%	0%		
		North Side	5%	0%	0%	0%		
		East Side	5%	0%	0%	0%		
		South Side	25%	0%	0%	0%		
'Calculations, formulas and factors are as per Fire Underwriter's Survey (FUS) Water Supply for Public Fire Protection		West Side	15%	0%	0%	0%		
		f_3	50%	0%	0%	0%		
		f_3 = Exposure factor not to exceed 75%, determined as per FUS Guide Item 4, page 18)						

F' (L/min)	**7650**	**0**	**0**	**0**		
S = F' * *f_2 (L/min)*	**0**	**0**	**0**	**0**		
E = F' * *f_3 (L/min)*	**3825**	**0**	**0**	**0**		

F''=F'-S+E (L/min) rounded to nearest 1,000	**11000**	**0**	**0**	**0**		
F''(L/s)	**183**	**0**	**0**	**0**		
F''(USGPM)	**2910**	**0**	**0**	**0**		

Table 1

Sprinkler Reduction Factor (f_2)		
No Sprkinkler System	Sprinklered	Sprink. + Supervised
0%	30%	50%

Table 2

Construction Type "C" Factor			
Wood Frame	Ordinary Construction	Non-Combustible	Fire Resistive
1.5	1	0.80	0.60

Table 3

Occupancy Factor (f_1)				
Rapid Burning	Free Burning	Combustible	Limited Combustible	Non-Combust.
25%	15%	0%	-15%	-25%

Table 4

Exposure Charge					
0 to 3m	3.1 to 10m	10.1 to 20m	20.1 to 30m	30.1 to 45m	> 45m
25%	20%	15%	10%	5%	0

HYDRANT FLOW TEST FORM

COLE ENGINEERING
Experience Enhancing Excellence

Project No: 2018-0302

Date: July 25, 2018

Site Location: 226 Brock St. E
Uxbridge, On.

Hydrants Opened by: Durham Water

Tested By: Andrew O; Meredith H

1) Required photos:

- [x] Site Id & Date
- [x] Location Overview
- [x] Other
- [x] Condition of Flow Hydrant
- [x] Condition of Residual Hydrant

2) Test Data

Time of Test: 1000

Location of Test: (Flow) 1st hydrant South of residual hydrant

(Residual) East side of Welkydal Rd, 1st hydrant North of Planks Lane.

Main Size: 300 mm

Static Pressure: 78 psi

	Number of Outlets & Orifice Size	Pitot Pressure	Flow (USGPM)	Residual Pressure
1	1 x 2.5"	45	1150	66
2	2 x 2.5"	25	1700	60
3				
4				

3) Calculations

$Q = 29.83\ cd^2\sqrt{p}$

Where c- cofficient of discharge (1 in smooth pipe)
d- pipe diameter (inches)
p- pitot reading (psi)
Q- flow (USGPM)

$Q_1 = (29.83)(0.9)(2.5")^2\sqrt{45}$
$= 1125.59$

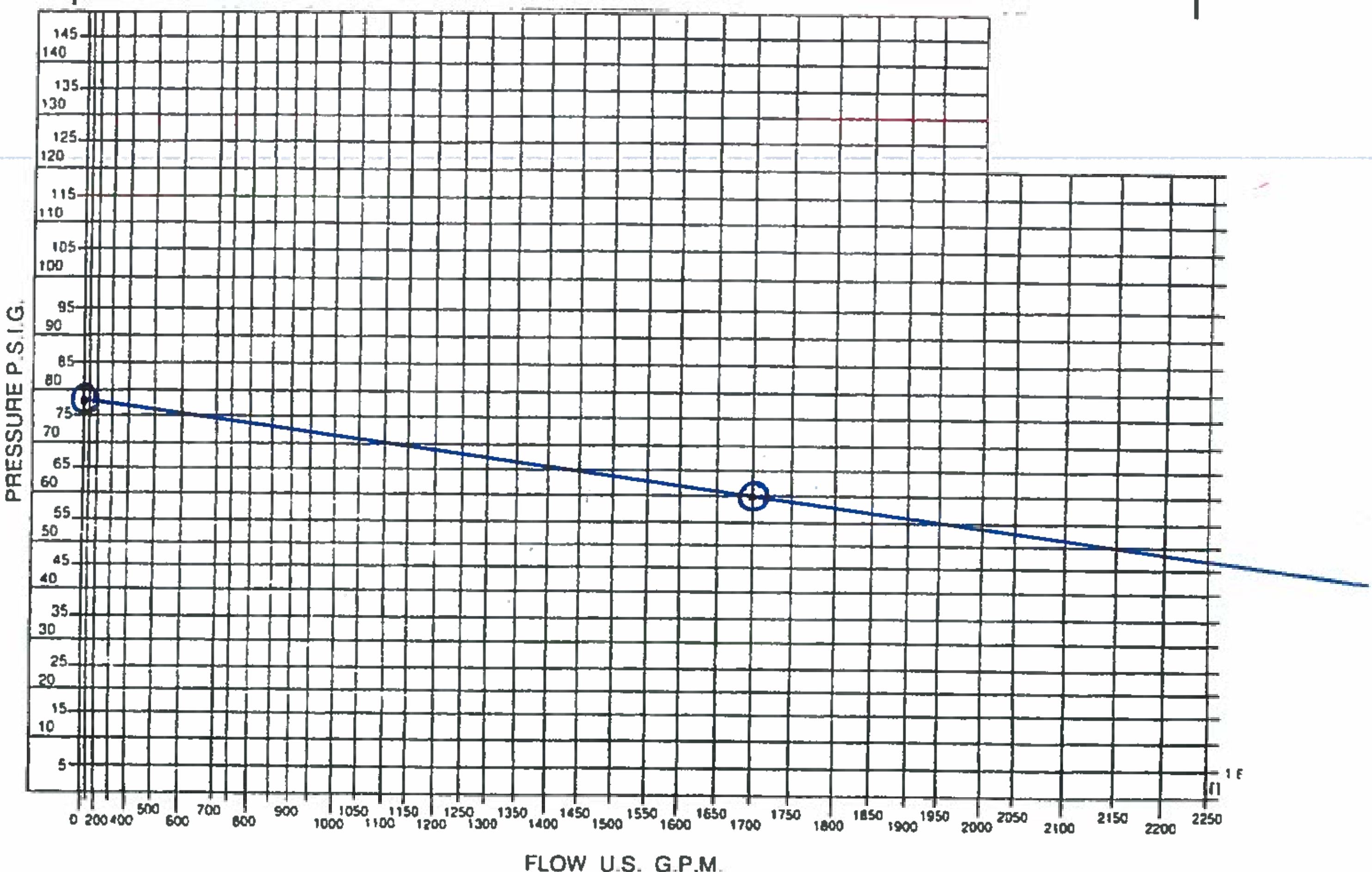
$\boxed{Q_1 = \sim 1150\ USGPM}$

$Q_T = 2(29.83)(0.9)(2.5")^2\sqrt{25}$
$= 1677.94$

$\boxed{Q_T = \sim 1700\ USGPM}$

Note: Hydrants tested according to NFPA 291: Recommended Practice for Fire Flow Testing and Marking of Hydrants

4) Plot



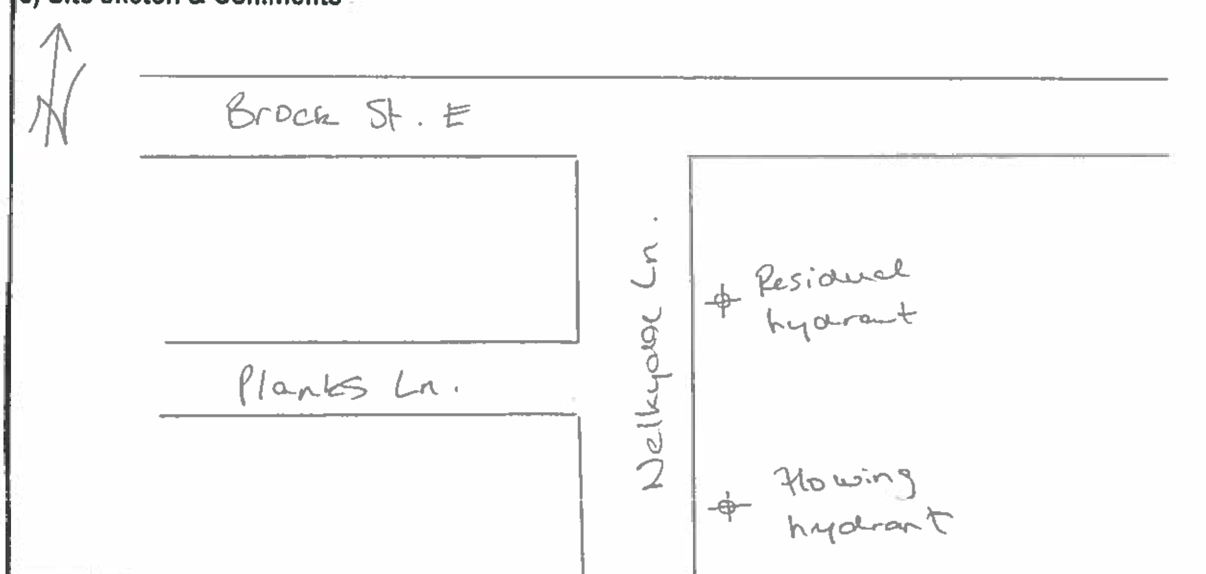
$$Q_{avail} @ 20\,psi = Q_F\left((P_S - P_A)/(P_S - P_R)\right)^{0.54}$$

$$= 1677.94\left((78-20)/(78-60)\right)^{0.54}$$

$$= 3156.31$$

$$\boxed{Q_{avail} = \sim 3150\ USGPM}$$

5) Site sketch & Comments



APPENDIX E
Conceptual Engineering Plans