WYCLIFFE THORNRIDGE SHARON CORNERS LIMITED

NORTHWEST CORNER OF MOUNT ALBERT ROAD AND LESLIE STREET

SOURCE WATER IMPACT ASSESSMENT AND MITIGATION PLAN (SWIAMP)

MARCH 29, 2019

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SOURCE WATER IMPACT ASSESSMENT AND MITIGATION PLAN (SWIAMP)

WYCLIFFE THORNRIDGE SHARON CORNERS LIMITED

PROJECT NO.: 17M-00407-00
DATE: MARCH 2019

WSP
582 LANCASTER STREET WEST
KITCHENER, ON, CANADA N2K 1M3

FAX: +1 519 743-8778
WSP.COM

March 29, 2019

Wycliffe Thornridge Sharon Corners Limited
34 Doncaster Avenue, Suite 201
Thornhill, Ontario L3T 4S1

Attention: Mr. Gary Bensky

Dear Mr. Bensky:

WSP Canada Group Limited (WSP) was retained by Wycliffe Thornridge Sharon Corners Limited, to prepare a Source Water Impact Assessment and Mitigation Plan (SWIAMP) for their property located at the northwest corner of Mount Albert Road and Leslie Street in the Town of East Gwillimbury, Ontario (former Village of Sharon).

Under York Region's Official Plan, SWIAMPs are required for proposed developments found within wellhead protection areas. The SWIAMP serves as the framework to develop a plan to manage the risk of potential impacts to the groundwater supply that may result from the proposed future land use.

This SWIAMP report has been structured to meet the York Region Source Protection Guidance for Proposed Developments in Wellhead Protection Areas in the Regional Municipality of York dated October 2014.

Yours sincerely,

Peter Hayes, P.Geo.
Senior Hydrogeologist / Environmental Specialist

Emily Stephenson, B.Sc., G.I.T.
Environmental Scientist

WSP ref.: 17M-00407-00

582 Lancaster Street West
Kitchener, ON, Canada N2K 1M3

Fax: +1 519 743-8778
wsp.com

SIGNATURES

PREPARED BY

Emily Stephenson, B.Sc., G.I.T.
Environmental Scientist

REVIEWED BY

Peter Hayes, P.Geo.
Senior Hydrogeologist / Environmental Specialist

REVIEWED BY

Andrew Kulin, M.A.Sc., M.B.A., P.Eng.
Senior Hydrogeologist / Geological Engineer

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APPENDICES

1 INTRODUCTION

The project site is located at the northwest corner of Mount Albert Road and Leslie Street (1420 Mount Albert Road to 1484 Mount Albert Road and 19180 Leslie Street) in the Town of East Gwillimbury and the Regional Municipality of York as shown on **Figure 1** (showing existing conditions). The site is located within Part of Lot 12, Concession 2 and has an approximate center coordinate of UTM Zone 17 624550 meters East and 4884845 meters North.

The contact information for the land owner is as follows:

Mr. Gary Bensky

Wycliffe Thornridge Sharon Corners Limited

34 Doncaster Avenue, Suite 201

Thornhill, Ontario L3T 4S1

1.1 SUMMARY OF OBJECTIVES AND PURPOSE OF THE PLAN

This Source Water Impact Assessment and Mitigation Plan (SWIAMP) will review available background information for the site, identify vulnerable areas and transport pathways, summarizes potential impacts and present risk management measures for the site to prevent any adverse water quality or quantity effects. The site is subject to the source water protection policies in the York Region Official Plan (ROP, 2010) and Regional Official Plan Amendment 5 (ROPA 5, 2013).

1.2 SITE SETTING

The site is located on the edge of an urban area with land use currently including seven residential homes and an undeveloped area. The site is bordered to the northwest by a watercourse and wetlands, to the east by a hydro transformer station and two existing homes along Leslie Street (future redevelopment blocks owned by others) and Mount Albert Road and new residential subdivision developments to the south. The proposed development will include a seven-storey retirement residence with one level of underground parking, a seven-storey apartment building, a mixed-use building and sixty-eight condominium townhouse units in twelve buildings as shown on **Figure 2**. The total site area is approximately 30,771 square meters and the following **Table 1** provides a breakdown of approximate existing and proposed development areas at the site.

Table 1: Current and Proposed Areas of Site Development

CATERGORY	EXISTING SITE		PROPOSED SITE	
	AREA (M^2)	PERCENT (%)	AREA (M^2)	PERCENT (%)
Developed Areas (Impervious)	2,539	8.25	22,384	72.74
Undeveloped Areas (Pervious)	28,232	91.75	8,387	27.26

The site is located in the Schomberg Clay Plains as per Chapman and Putman (1984), which is defined as a deep stratified clay and silt deposits with rolling relief. The surficial geology of the site is fine textured glaciolacustrine deposits composed of silt and clay (massive to well laminated). Surficial geology and topography contours are shown on attached **Figure 3**.

The area was historically serviced with water wells and septic tanks; however, the area has been municipally serviced for ten plus years, with some water wells remaining as secondary sources for private residents in the area.

2 IDENTIFICATION OF VULNERABLE AREAS

As per the Municipality of York Region's Source Water Protection mapping the site is in Wellhead Protection Area D (WHPA-D) (time of travel 10 to 25 years) for the Queensville wells as shown on **Figure 4** and the WHPA-D has a vulnerability score ranging from 2 to 4 (low) as shown on **Figure 5** (South Georgian Bay Lake Simcoe Protection Region (SGBLSPR), 2015). Vulnerability scoring is based on distance from well or intake, aquifer permeability, and transport pathways. The site is located in a recharge management area (WHPA-Q) with moderate stress (SGBLSPR, 2015).

The site is also located in the Intake Protection Zone - 3 (IPZ - 3) (area of water and land that may lead to contaminants reaching an intake during an extreme events e.g. 1 in 100 year rainfall) for the Keswick Surface Water Intake (the closest surface water intake on Lake Simcoe) and potentially the other ten (10) surface water intakes on Lake Simcoe. The IPZ-3 has a vulnerability score of 6.3 (moderate) at the site (SGBLSPR, 2015).

A high aquifer vulnerability area (aquifer more susceptible to contamination because of location, soil texture (sand and gravel or fractured rock near ground surface) and a shallow water table) is located 125 meters west of the site as shown on attached **Figure 4**. No Significant groundwater recharge areas (sand and gravel soils that maintain water levels in an aquifer which supplies a community or a cold water ecosystem) are located in the site vicinity (SGBLSPR, 2015). The site is not located in the Oak Ridges Moraine Conservation Plan.

2.1 ANTHROPOGENIC TRANSPORT PATHWAYS

Four MOECC water well records are located at the site, all for domestic supply wells with depths from 13.1 to 16.5 meter below ground surface. These wells were completed in a blue clay to sandy clay unit with static water levels ranging from 3.7 to 7.0 meters below ground surface. Pumping tests completed on the wells recommended a pump depth between 12.2 to 15.5 meters below ground surface with a pumping rate of 0.5 to 1 gallon per minute. The complete water well records are included in **Appendix A** (6900120, 6900121, 6900122 and 6900123) and locations are shown on **Figure 6**. Additional water well records are present in the site-vicinity. Two private water wells were surveyed at the property from a prior private water well survey in the area and are understood to be used as secondary water sources (i.e. for lawn watering etc.) these water well locations are also shown on attached **Figure 6**. Thirteen boreholes plus three monitoring wells are located on the site as shown on **Figure 6.** The complete borehole logs are provided in **Appendix B**.

2.2 SUMMARY OF DRINKING WATER QUALITY IMPACTS AND THREATS

As per the Municipality of York Region Guidance document (2014) the Upper Thames River Conservation Authority Threat Analysis Tool was utilized and it was found that there are no applicable Clean Water Act (2006) prescribed drinking water threats that would apply to this property based on the WHPA-D with a score of 2 and 4. Based on the IPZ-3 with a score of 6.3 and a North American Industry Classification System (NAICS) code for Residential Building Construction (236110), a number of low risk chemical threats exist for the handling and storage of organic solvent and fuel and the establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act, all of which are summarized in attached **Table 2**. Additionally, the Source Protection Pre-Consultation Correspondence with York Region is provided in **Appendix C**.

A SWIAMP is required when any of the following storage or manufacturing activities will occur on a site within a WHPA or IPZ:

- Petroleum-based fuels and or solvents;
- Pesticides, herbicides, fungicides or fertilizers;
- Construction equipment;
- Inorganic chemicals;
- Road salt and contaminants as identified by the Province;
- The generation and storage of hazardous waste or liquid industrial waste, and a waste disposal sites and facilities;
- Organic soil conditioning sites and the storage and application of agricultural and non-agricultural source organic materials; and
- Snow storage and disposal facilities.

The above activities, with the exception of on going winter road salt use, will not be undertaken at this proposed residential development.

3 RISK MANAGEMENT MEASURES

The following recommended risk management measures are based on the anticipated work, the attached **Table 2,** and on previous experience:

1. Best Management Practices are recommended for the handling and storage of fuel, fertilizer and chemicals at the site.
2. It is recommended that the primary contractor be certified by Smart About Salt.
3. Compensation is proposed to be established elsewhere within the Lake Simcoe watershed, as the site is located in a recharge management area and must adhere to the South Georgian Bay Lake Simcoe Source Protection Plan water quality recharge maintenance policy Land Use Planning – 12 (LUP-12).
4. A Dewatering Monitoring and Mitigation Plan will need to be prepared for all construction period dewatering, including any excavations.

Any sanitary sewers will have to be designed, constructed and tested as per the York Region Sanitary Sewer System Inspection, Testing and Acceptance Guideline (October 2011) and as per the York Region Construction Design Guidelines and Standards.

3.1 MONITORING

Based on the anticipated construction and the finding of this report a Best Management Practises program is required for this work.

3.2 COMMUNICATION AND IMPLEMENTATION PLAN

A Communication and Implementation Plan will be developed prior to the start of construction and will be updated during construction to identify Best Management Practises and emergency contacts (i.e. owner, operator, spills hotline and bylaw officers). The emergency contacts should include the Regional Municipality of York Risk Management Official at 1-877-464-9675x75050.

3.3 EMERGENCY RESPONSE PLAN

An Emergency Response Plan will be developed prior to the start of construction and will be updated during construction.

3.4 TERMINATION OF PLAN

If Wycliffe Thornridge Sharon Corners Limited choses to move or transfer the ownership of this property the Regional Municipality of York will be informed of the change of addresses and / or ownership.

3.5 RELIANCE STATEMENT

A reliance letter is provided in **Appendix D**.

4 STANDARDS AND LIMITATIONS

This Report was prepared for the Client, solely for their exclusive use to provide an Assessment of current environmental conditions in association with the Site. WSP will not be responsible for any use of this report by any other party, for any decisions to be made based on it, or for the consequences thereof, unless written reliance is granted by WSP.

The Report summarizes WSP's review of available data in accordance with the principal components of the stated regulations, standards and guidelines and the scope, terms and conditions of the contract or proposal to which the Assignment was conducted. No other warranties are either expressed or implied with respect to the professional services provided under the terms of the contract or proposal and represented in this Report. Conditions may exist which were not detected given the nature of the inquiry WSP was retained to undertake with respect to the Site. Additional environmental studies and actions may be recommended.

The Report is based on data and information collected at the time of this Assessment, as stated in the Report. Site use or conditions change and the information and conclusions in the Report may no longer apply following the date of this Report. If any conditions become apparent that differ significantly from that presented in this Report, we request that we be notified to reassess the conclusions and recommendations provided herein. WSP disclaims any obligation to update this Report for conditions that may be identified after the date of this Report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

In evaluating the Site, WSP has relied in good faith on information provided by others, as noted in the Report. WSP has assumed that the information provided is correct and WSP assumes no responsibility for the accuracy, completeness or workmanship of any such information.

The Report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions are based on the Site conditions observed by WSP at the time the work was performed and may include information obtained at specific testing and/or sampling locations. It is recognized that overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

The conclusions presented in this Report are based on Work undertaken by trained professional and technical staff and the reasonable and professional interpretation of the information considered. Conclusions presented in this report should not be construed as legal advice. WSP makes no other representations whatsoever, including those concerning the legal significance of its findings, or as to other legal matters touched on in the Report, including, but not limited to, ownership of any property, or the application of any law to the findings of the Assessment.

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- York Region, 2011. Sanitary Sewer System Inspection, testing and Acceptance Guideline.

TABLES

Table 2: Clean Water Act (2006) Prescribed Drinking Water Threats
Northwest Corner of Mount Albert Road and Leslie Street
Source Water Impact Assessment and Mitigation Plan (SWIAMP)

IPZ on the Property	Vulnerability Score	Identified Prescribed Drinking Water Threat	Short Form Name	Type of Threat	Chemical Of Concern	Chemical Quantity Circumstance	Chemical Circumstance	Reference Numbers	CWA Rating of the Drinking Water Threat
IPZ-3	6.3	The establishment, operation or maintenance of a waste disposal site within the meaning of Part V of the Environmental Protection Act.	Waste Disposal Site - Storage of wastes described in clauses (p), (q), (r), (s), (t) or (u) of the definition of hazardous waste	Chemical	Arsenic or one or more of its compounds containing Arsenic	Not registered as a Hazardous Waste Disposal Site by MOE - Not regulated by O.Reg.347 - General Waste Management	Storage of hazardous waste or liquid industrial waste at or above grade at waste disposal sites.	1914, 1924 and 1934	Low
					Barium			1915 and 1935	
					Cadmium or one or more of its compounds containing Cadmium			1916, 1926 and 1936	
					Chromium VI			1917, 1927 and 1937	
					Dichlorophenoxy Acetic Acid (D-2,4)			1918 and 1938	
					Lead or one or more of its compounds containing Lead			1919 and 1939	
					Mercury or one or more of its compounds containing Mercury			1920, 1930 and 1940	
					Selenium or one or more of its compounds containing Selenium			1921 and 1941	
					Silver or one or more of its compounds containing Silver			1922 and 1942	
					Trichlorophenoxyacetic acid-2,4,5			1923 and 1943	
		The handling and storage of an organic solvent.	Storage Of An Organic Solvent		Carbon Tetrachloride	where the quantity stored is <25 L	Where an organic solvent is stored at or above grade.	1225 and 1345	
							Where an organic solvent is stored partially below grade.	1233 and 1353	
						where the quantity stored is 25-250 L	Where an organic solvent is stored at or above grade.	1237 and 1357	
							Where an organic solvent is stored partially below grade.	1245 and 1365	
						where the quantity stored is >250-2500 L	Where an organic solvent is stored at or above grade.	1249 and 1369	
							Where an organic solvent is stored completely below grade.	1253 and 1373	
							Where an organic solvent is stored partially below grade.	1257 and 1377	
						where the quantity stored is >2500 L	Where an organic solvent is stored at or above grade.	1261 and 1381	
							Where an organic solvent is stored completely below grade.	1265 and 1385	
							Where an organic solvent is stored partially below grade.	1269 and 1389	
					Chloroform	where the quantity stored is 25-250 L	Where an organic solvent is stored at or above grade.	1238 and 1358	
							Where an organic solvent is stored partially below grade.	1246 and 1366	
						where the quantity stored is >250-2500 L	Where an organic solvent is stored at or above grade.	1250 and 1370	
							Where an organic solvent is stored partially below grade.	1258 and 1378	
						where the quantity stored is >2500 L	Where an organic solvent is stored at or above grade.	1262 and 1382	
							Where an organic solvent is stored completely below grade.	1266 and 1386	
							Where an organic solvent is stored partially below grade.	1270 and 1390	
					Methylene Chloride (Dichloromethane)	where the quantity stored is 25-250 L	Where an organic solvent is stored at or above grade.	1239 and 1359	
							Where an organic solvent is stored partially below grade.	1247 and 1367	
						where the quantity stored is >250-2500 L	Where an organic solvent is stored at or above grade.	1251 and 1371	
							Where an organic solvent is stored partially below grade.	1259 and 1379	
						where the quantity stored is >2500 L	Where an organic solvent is stored at or above grade.	1263 and 1383	
							Where an organic solvent is stored completely below grade.	1267 and 1387	
							Where an organic solvent is stored partially below grade.	1271 and 1391	
					Pentachlorophenol	where the quantity stored is 25-250 L	Where an organic solvent is stored at or above grade.	1240 and 1360	
							Where an organic solvent is stored partially below grade.	1248 and 1368	
						where the quantity stored is >250-2500 L	Where an organic solvent is stored at or above grade.	1252 and 1372	
							Where an organic solvent is stored partially below grade.	1260 and 1380	
						where the quantity stored is >2500 L	Where an organic solvent is stored at or above grade.	1264 and 1384	
							Where an organic solvent is stored completely below grade.	1268 and 1388	
							Where an organic solvent is stored partially below grade.	1272 and 1392	
		The handling and storage of fuel.	Storage Of Fuel		BTEX	where the quantity stored is 25-250 L	Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1324 and 242	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1339	
						where the quantity stored is >250-2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1349 and 267	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1354 and 272	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1369, 1374 and 292	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1374, 1369 and 287	
						where the quantity stored is >2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1379 and 297	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1384 and 302	
							Where liquid fuel is stored completely below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1389, 1394 and 312	
							Where liquid fuel is stored completely below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1394, 1389 and 307	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1399, 1404 and 322	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1404, 1399 and 317	

Note:
All threats are based on the North American Industry Classification System (NAICS) code for Residential Building Construction.
Reference:
Upper Thames River Conservation Authority. Threats Analysis Tool. URL: https://apps.thamesriver.on.ca/SWPThreats/default.aspx

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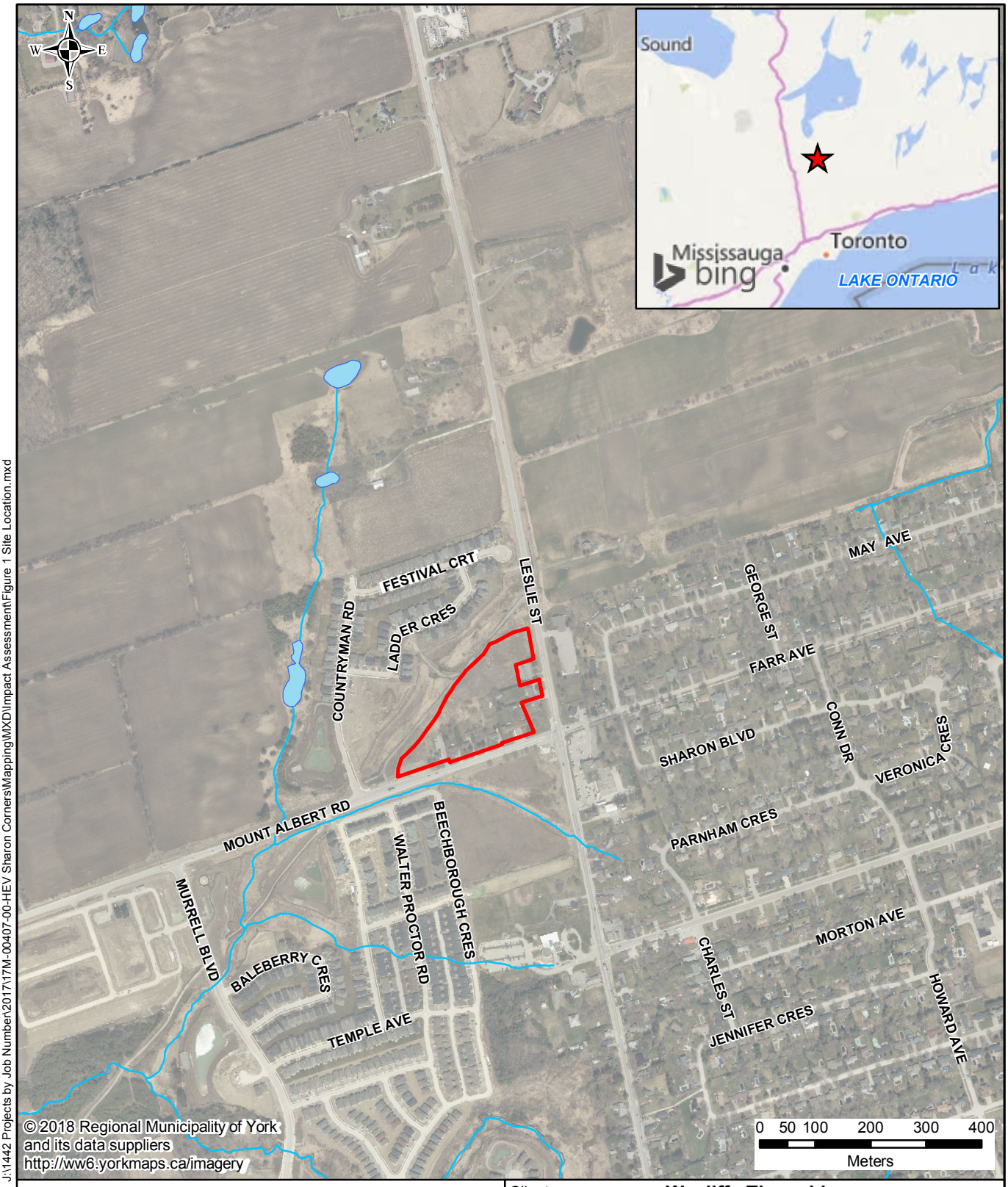
IPZ on the Property	Vulnerability Score	Identified Prescribed Drinking Water Threat	Short Form Name	Type of Threat	Chemical Of Concern	Chemical Quantity Circumstance	Chemical Circumstance	Reference Numbers	CWA Rating of the Drinking Water Threat
IPZ-3	6.3	The handling and storage of fuel.	Storage Of Fuel	Chemical	Petroleum Hydrocarbons F1 (nC6-nC10)	where the quantity stored is 25-250 L	Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1325 and 243	Low
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1340	
						where the quantity stored is >250-2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1350 and 268	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1355 and 273	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1370, 1375 and 293	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1375, 1370 and 288	
						where the quantity stored is >2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1380 and 298	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1385 and 303	
							Where liquid fuel is stored completely below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1390, 1395 and 313	
							Where liquid fuel is stored completely below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1395, 1390 and 308	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1400, 1405 and 323	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1405, 1400 and 318	
					Petroleum Hydrocarbons F2 (>nC10-nC16)	where the quantity stored is >250-2500 L	Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1357 and 275	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1372	
						where the quantity stored is >2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1382 and 300	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1387 and 305	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1402, 1407 and 325	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1407, 1402 and 320	
					Petroleum Hydrocarbons F3 (>nC16-nC34)	where the quantity stored is >250-2500 L	Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1358 and 276	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1373	
						where the quantity stored is >2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1383 and 301	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1388 and 306	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1403, 1408 and 326	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1408, 1403 and 321	
					Petroleum Hydrocarbons F4 (>nC34)	where the quantity stored is >250-2500 L	Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1356 and 274	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1371	
						where the quantity stored is >2500 L	Where liquid fuel is stored at or above grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1381 and 299	
							Where liquid fuel is stored at or above grade in tanks at permanent or mobile small facilities or a facility defined under O Reg 213.	1386 and 304	
							Where liquid fuel is stored partially below grade in tanks at a facility under O Reg 213, or a facility under O Reg 217, but not a bulk plant.	1401, 1406 and 324	
							Where liquid fuel is stored partially below grade in tanks at bulk plants under O.Reg 217, fuel manufacturers, or refineries.	1406, 1401 and 319	

Note:
All threats are based on the North American Industry Classification System (NAICS) code for Residential Building Construction.
Reference:
Upper Thames River Conservation Authority. Threats Analysis Tool. URL: https://apps.thamesriver.on.ca/SWPThreats/default.aspx

FIGURES



J:\1442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 1 Site Location.mxd

Legend

- Site Location
- Property Boundary
- Watercourses
- Waterbodies

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Site Location**
Prepared By:	WSP
17M-00407-00	Scale as Shown / Review: ANK
Date: March 2019	**Figure: 1**
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Legend

- A - Pre-Approved Lands
- B - Remainder of Site
- Watercourses

Proposed Land Uses

- Lawn / Greenspace
- Impervious
- Roof
- Road

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Proposed Development Plan**
Prepared By:	WSP
17M-00407-00	Scale as Shown | Review: ANK
Date: March 2019	**Figure: 2**
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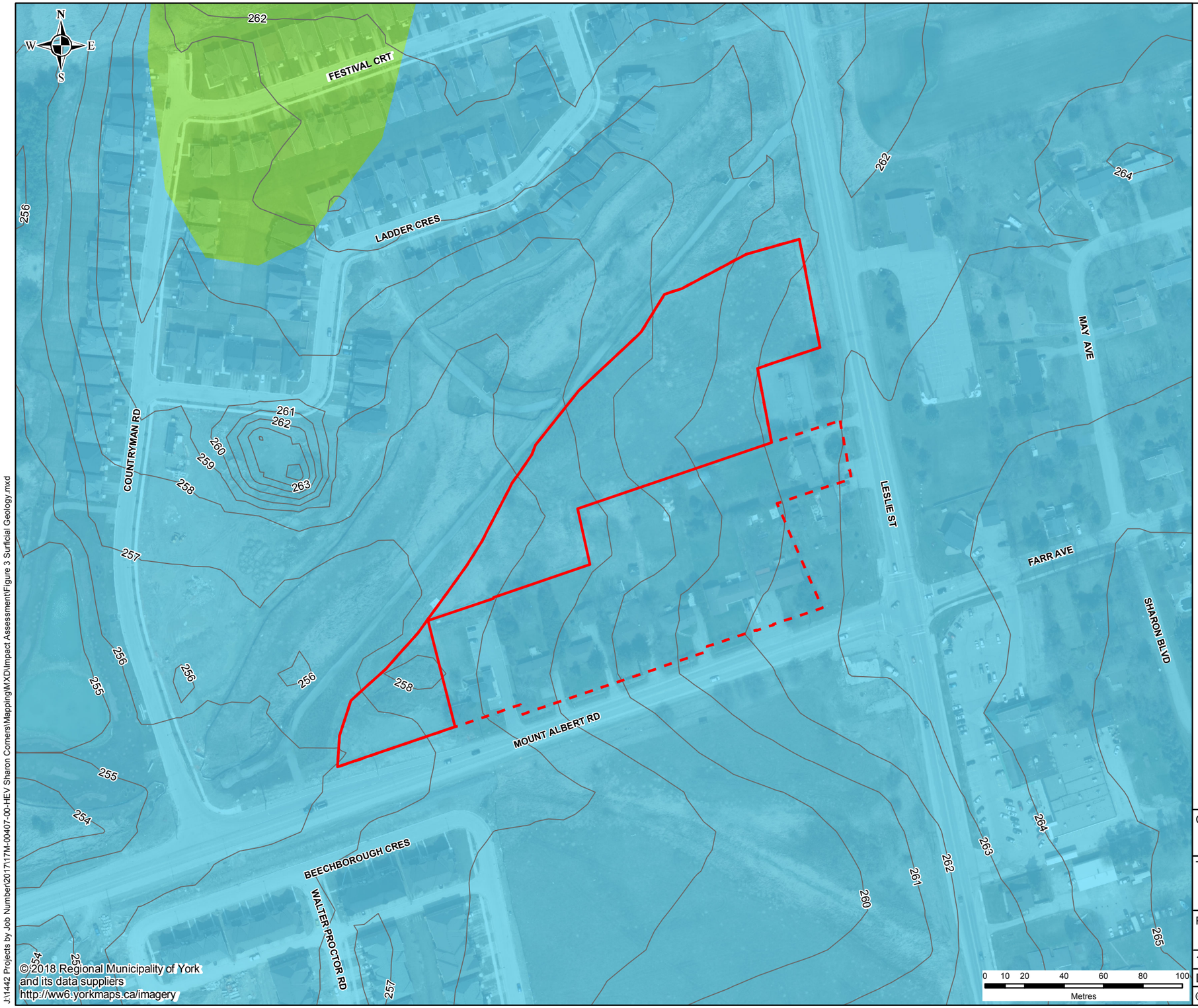
J:\1442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 2 Proposed Development Plan.mxd



J:\1442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 3 Surficial Geology.mxd

Legend

- A - Pre-Approved Lands
- B - Remainder of Site
- Topographic Contours

Surficial Geology

- Sandy silt to Silty sand (Newmarket Till)
- Silt and Clay

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Surficial Geology**
Prepared By:	WSP
17M-00407-00	Scale as Shown | Review: ANK
Date: March 2019	**Figure: 3**
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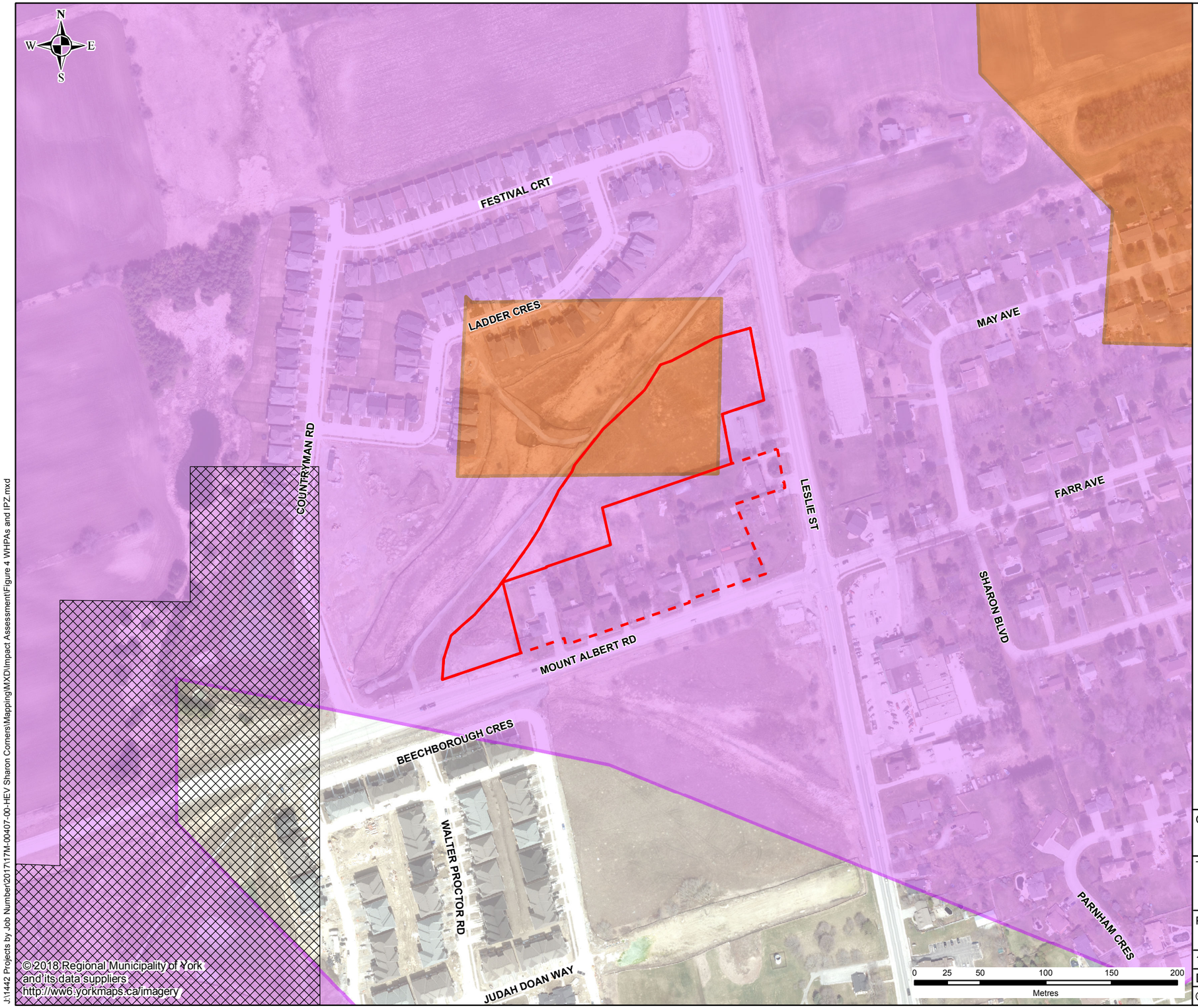


Legend

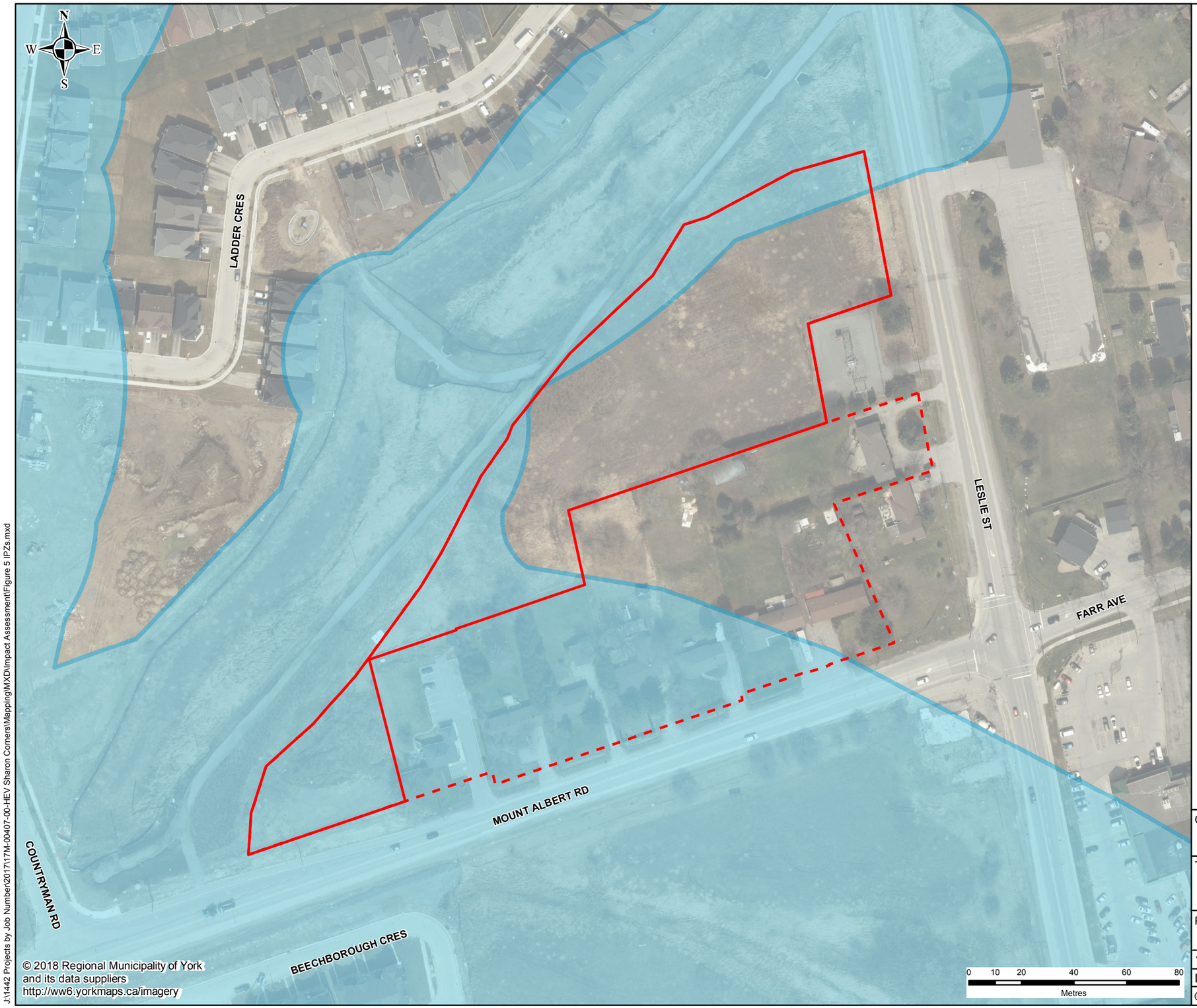
- A - Pre-Approved Lands
- B - Remainder of Site
- Highly Vulnerable Aquifers

Wellhead Protection Areas

- Queensville Wellhead Protection Area-D
- Vulnerability Score - 2 (Low)
- Vulnerability Score - 4 (Low)

J:\1442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 4 WHPAs and IPZ.mxd

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Wellhead Protection Areas**
Prepared By:	WSP
17M-00407-00	Scale as Shown | Review: ANK
Date: March 2019	**Figure: 4**



Legend

- A - Pre-Approved Lands
- B - Remainder of Site
- Keswick and Georgina Surface Water Intake Protection Zone – 3 with Vulnerability Score - 6.3 (Moderate)

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Intake Protection Zones**
Prepared By:	WSP
17M-00407-00	Scale as Shown | Review: ANK
Date: March 2019	**Figure: 5**
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J:\17442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 5 IPZs.mxd

J:\1442 Projects by Job Number\2017\17M-00407-00-HEV Sharon Corners\Mapping\MXD\Impact Assessment\Figure 6 Monitoring Locations.mxd

Legend

- A - Pre-Approved Lands
- B - Remainder of Site
- MOECC Water Well Records
- Private Wells
- Borehole (Soil Eng)
- Monitoring Well (WSP)

Notes:
1. Borehole locations are approximate and were taken from Soil Eng's Borehole Location Plan. Monitoring well locations are based on GPS coordinates obtained by WSP using a hand-held GPS unit.

Client:	**Wycliffe Thornridge Sharon Corners Limited**
Title:	**Borehole and Monitoring Well Location Plan**
Prepared By:	WSP
17M-00407-00	Scale as Shown | Review: ANK
Date: March 2019	**Figure: 6**
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APPENDIX

A WATER WELL RECORDS

Record No. 6900120

62

31034

B

UTM 17 Z 624489 E

17 R 488458 N

Con. 11

Elev. 17 R 10853

Lot 12

Basin 22 4

WATER WELL RECORD

The Ontario Water Resources Commission Act

GROUND WATER BRANCH
JAN 20 1964
ONTARIO WATER RESOURCES COMMISSION

69 NW 120

County or District York Township, Village, Town or City East Gwillimbury

Con. 2 Lot 12 Date completed 2 (day) Dec (month) 1963 (year)

[redacted] ress Sharon, Ont

Casing and Screen Record

Inside diameter of casing 30 inches

Total length of casing 45 ft

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 30 inches

Pumping Test

Static level 23 ft

Test-pumping rate ½ G.P.M.

Pumping level

Duration of test pumping

Water clear or cloudy at end of test Clear

Recommended pumping rate ½ G.P.M.

with pump setting of 40' HD feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Top soil	0	1	42	fresh
Clay	1	19		
Blue Clay	19	40		
Sandy Clay	40	45		

For what purpose(s) is the water to be used? House

Is well on upland, in valley, or on hillside? upland

~~Drilling~~ or Boring Firm John D. Hitchins & Son

Address Holland Landing Box 20 Ont

Licence Number 28

Name of ~~Driller~~ or Borer Grant Hitchins

Address Sharon Ont

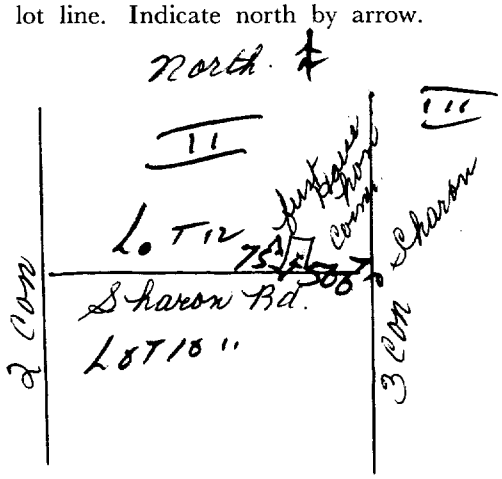
Date Dec 31 1963

Grant Hitchins

(Signature of Licensed Drilling or Boring Contractor)

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Form 7 15M-60-4138

OWRC COPY

CSS.S8

Record No. 6900121

163

31039

B

121

WATER RESOURCES DIVISION
69 No
OCT 15 1965
ONTARIO WATER RESOURCES COMMISSION

UTM 17 Z 624515 E
5 R 4884584 N
Elev. 5 R 0853

The Ontario Water Resources Commission Act

WATER WELL RECORD

Basin 22 York
County or District

Lot 12

Township, Village, Town or City East Gwillimbury

Con. 2 Lot 12

Date completed 18 (day) June (month) 1965 (year)

[redacted] ress Sharon Ont.

Casing and Screen Record

Inside diameter of casing 30 inches
Total length of casing 48 ft
Type of screen
Length of screen
Depth to top of screen
Diameter of finished hole 30 inches

Pumping Test

Static level 23 ft
Test-pumping rate 1/2 G.P.M.
Pumping level
Duration of test pumping
Water clear or cloudy at end of test Clear
Recommended pumping rate 1/2 G.P.M.
with pump setting of 46' feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Top soil	0	1	42	fresh
Clay	1	19		
Blue Clay	19	40		
Sandy Clay.	40	48		

For what purpose(s) is the water to be used? house

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm John D. Hitching & Son

Address Holland Landing Box 20. Ont.

Licence Number 77

Name of Driller or Borer Grant Hitching

Address Sharon Ont

Date Sept. 18, 1965

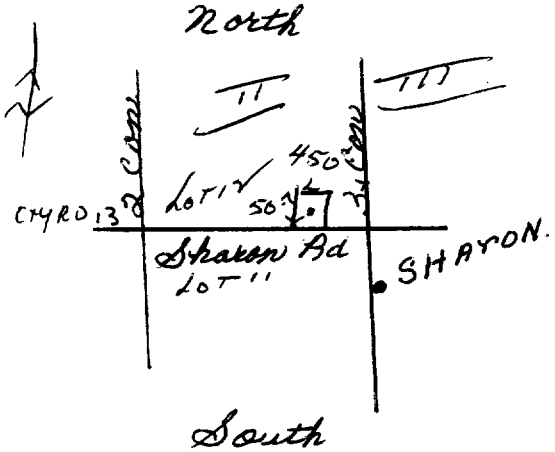
Grant Hitching
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS 58

200 - Record No. 6900122

31D3d

UTM 17 Z 6 2 4 5 5 0 E

5 8 4 6 1 1 2 N

Elev. 8 5 5

Basin 24

69 № 122

The Ontario Water Resources Commission Act

WATER WELL RECORD

County or District York Township, Village, Town or City East Gwillimbury

Con. 2 Lot 12 Date completed 23 (day) Feb. (month) 1966 (year)

[redacted]ress SHARON, Ontario.

Casing and Screen Record

Inside diameter of casing 30 inches

Total length of casing 53 ft.

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 30 inches

Pumping Test

Static level 12 ft.

Test-pumping rate 1 G.P.M.

Pumping level

Duration of test pumping

Water clear or cloudy at end of test clear

Recommended pumping rate 1 G.P.M.

with pump setting of 51 feet below ground surface

Well Log / Water Record

Overburden and Bedrock Record	From ft.	To ft.	Depth(s) at which water(s) found	Kind of water (fresh, salty, sulphur)
			42 ft.	fresh
top soil	0	2		
brown clay	2	26		
blue clay	26	53		

For what purpose(s) is the water to be used? House

Is well on upland, in valley, or on hillside? upland

Drilling or Boring Firm J.F. Kitching & Son Ltd.

Address HOLLAND LANDING, Box 20, Ontario.

Licence Number 96

Name of Driller or Borer Dave Draper,

Address KESWICK, Ontario.

Date March 22, 1966

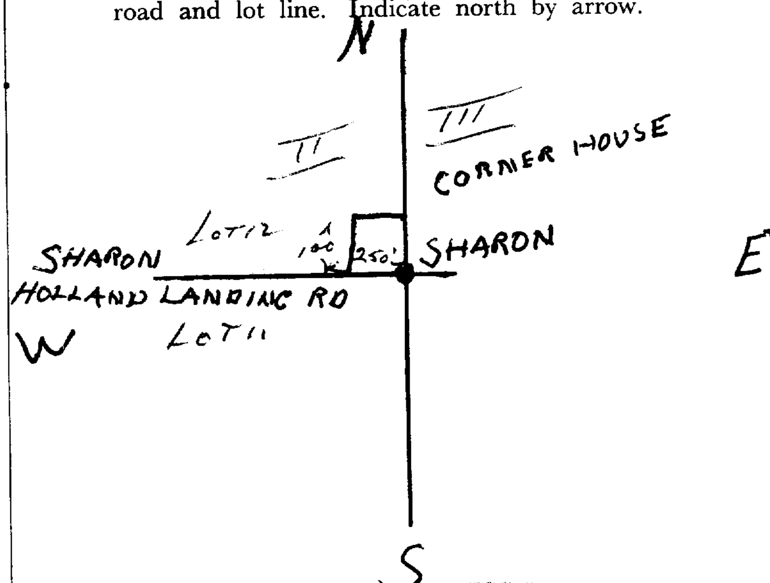
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

OWRC COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



Record No. 6900123

31039

UTM 17 | 6 | 2 | 4 | 5 | 1 | 6 E
5 R | 4 | 8 | 8 | 4 | 5 | 9 | 5 N

Elev. 5 R | 0 | 8 | 5 | 4

Basin 2 | 2

The Ontario Water Resources Commission Act

WATER WELL RECORD

W 69 No. 123

JAN 17 1967

County or District York, Township, Village, Town or City East Gwillimbury

Con. 2 Lot 12 Date completed 28 (day) Oct. (month) 1966 (year)

[redacted] ress SHARON, Ontario.

Casing and Screen Record

Inside diameter of casing 30 inches

Total length of casing 54 ft.

Type of screen

Length of screen

Depth to top of screen

Diameter of finished hole 30 inches

Pumping Test

Static level 12 ft.

Test-pumping rate 1 G.P.M.

Pumping level

Duration of test pumping

Water clear or cloudy at end of test clear

Recommended pumping rate 1 G.P.M.

with pump setting of 52 feet below ground surface

Well Log

Overburden and Bedrock Record	From ft.	To ft.	Water Record: Depth(s) at which water(s) found	Water Record: Kind of water (fresh, salty, sulphur)
Top soil	0	2	45	fresh
brown clay	2	16		
Blue clay	16	54		

For what purpose(s) is the water to be used? House

Is well on upland, in valley, or on hillside? upland

~~Drilling~~ or Boring Firm J.F. Kitching & Son Ltd.,

Address HOLLAND LANDING, Box 20, Ont.

Licence Number 96

Name of ~~Driller~~ or Borer Dave Draper,

Address KESWICK, Ontario.

Date Nov. 30, 1966

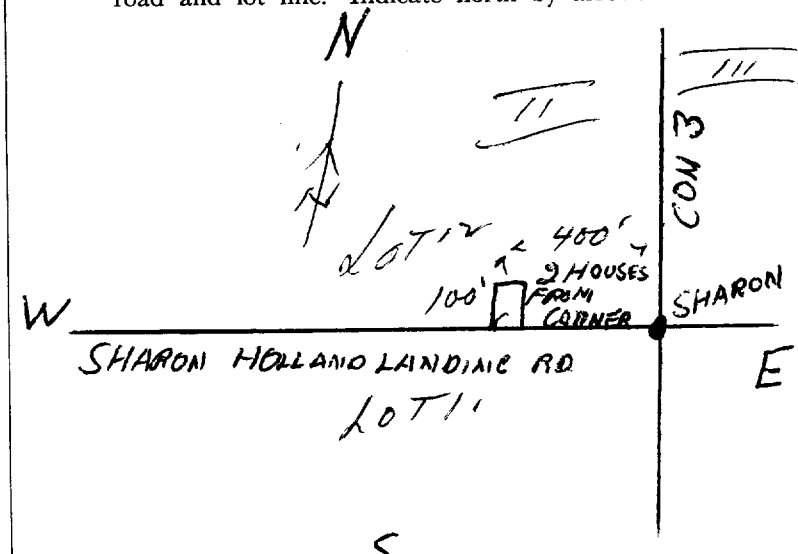
Grad Kitching
(Signature of Licensed Drilling or Boring Contractor)

Form 7 15M-60-4138

O W R C COPY

Location of Well

In diagram below show distances of well from road and lot line. Indicate north by arrow.



CSS.S8

APPENDIX

B BOREHOLE LOGS

Figure No. _____

LOG OF MONITORING WELL MW1

Project No. 17M-00407-00-HEV
Project: Sharon Corners - Wycliffe Homes
Location: Sharon, Ontario
Co-ordinates: 624404E, 4884755N
Date Drilled: September 25, 2017
Datum: UTM NAD 83 Zone 17
Drill Type: B-45 HD
Logged By: D. N.
Drilling Contractor: Profile Drilling Inc.
Checked By: A. K.

DEPTH (mbgs)	DEPTH (masl)	LITHOLOGY	SOIL DESCRIPTION	WELL	INSTALLATION DETAILS	SAMPLE ID	RECOVERY (%)	SPT Value
	255.7							
			SILTY SAND, some clay, trace gravel - brown, some orange oxidation, compact, moist		Concrete Enviroplug Bentonite	SS1	100%	14
0.69	255.01							
			SILT, trace to some sand and clay - brown mottled, stiff, moist			SS2	100%	11
1.36	254.34							
1.52	254.18		**SILT TILL,** trace to some clay, trace sand and gravel - brown, compact, damp to moist			SS3	100%	7
						SS4	92%	20
2.90	252.8		- No sample due to rock in spoon tip					
						No Recovery	0%	30
3.81	251.89							
			SILT TILL, some clay, trace to some sand, trace gravel - brown, compact, damp to moist			SS5	92%	21
						SS6	100%	22
5.26	250.44							
			SILT, trace to some clay, trace sand - grey, stiff to very stiff, moist to wet			SS7	83%	20
			- clay content decreasing with depth		Sand #10 Slotted PVC Screen	SS8	100%	15
						SS9	67%	26
7.62	248.08							
			End of borehole at 7.62 mbgs		Water measured on Sept. 26, 2017 masl 1.36 mbgs Well Diameter: 50.8 mm Well Material: Schedule 40 PVC			

Figure No. _____

LOG OF MONITORING WELL MW2

Project No. 17M-00407-00-HEV
Project: Sharon Corners - Wycliffe Homes
Location: Sharon, Ontario
Co-ordinates: 624605E, 4844998N
Date Drilled: September 26, 2017
Datum: UTM NAD 83 Zone 17
Drill Type: B-45 HD
Logged By: D. N.
Drilling Contractor: Profile Drilling Inc.
Checked By: A. K.

DEPTH (mbgs)	DEPTH (masl)	LITHOLOGY	SOIL DESCRIPTION	WELL	INSTALLATION DETAILS	SAMPLE ID	RECOVERY (%)	SPT Value
	261.2							
0.33	260.87		**TOPSOIL**		Concrete			
			SILT, trace to some clay, trace sand - brown mottled, firm to stiff, moist		Enviroplug Bentonite	SS1	54%	6
						SS2	100%	5
						SS3	50%	13
2.21	258.99		**SILT TILL,** trace to some clay, trace gravel - brown mottled, stiff, moist - orange oxidation staining on fractures			SS4	100%	11
2.97	258.23		**CLAYEY SILT** - grey mottled, firm to stiff - some oxidation along fractures in upper part of the deposit			SS5	83%	11
						SS6	100%	6
4.42	256.78		- No sample due to rock in spoon tip		Sand			
						No Recovery	0%	19
5.33	255.87		**CLAYEY SILT** - grey, stiff, wet		#10 Slotted PVC Screen	SS7	100%	10
6.34	254.86					SS8	100%	9
6.71	254.49		End of borehole at 6.71 mbgs		Water measured on Sept. 26, 2017 masl 6.34 mbgs Well Diameter: 50.8 mm Well Material: Schedule 40 PVC			

WSP MW REPORT VER.3 BH LOGS - SHARON CORNERS.GPJ GINT STD CANADA LAB.GDT 11/10/17

Figure No. _____

LOG OF MONITORING WELL MW3

Project No. 17M-00407-00-HEV
Project: Sharon Corners - Wycliffe Homes
Location: Sharon, Ontario
Co-ordinates: 624545E, 4884792N
Date Drilled: September 26, 2017
Datum: UTM NAD 83 Zone 17
Drill Type: B-45 HD
Logged By: D. N.
Drilling Contractor: Profile Drilling Inc.
Checked By: A. K.

DEPTH (mbgs)	(masl)	LITHOLOGY	SOIL DESCRIPTION	WELL	INSTALLATION DETAILS	SAMPLE ID	RECOVERY (%)	SPT Value
	260.5							
0.05	260.45		**SAND AND GRAVEL FILL** - brown, loose, moist		Concrete			
			SILT, trace to some clay, trace sand - brown, firm to stiff - some orange oxidation staining		Enviroplug Bentonite	SS1	25%	5
						SS2	83%	7
						SS3	88%	13
2.21	258.29		**SILT,** some sand, trace clay - brown, loose, wet			SS4	100%	5
2.74	257.76		**SILT,** trace to some clay, trace sand - brown, firm, wet - orange oxidation staining visible at fractures			SS5	83%	7
3.73	256.77		**SILT TILL,** some sand and clay, trace gravel - grey, stiff, wet			SS6	100%	9
					Sand #10 Slotted PVC Screen	SS7	100%	8
5.26	255.24		**SILT,** trace sand and clay - grey, very stiff, wet			SS8	100%	28
6.10	254.4		End of borehole at 6.10 mbgs Monitoring well was dry upon completion.		Water measured on Sept. 26, 2017 masl mbgs Well Diameter: 50.8 mm Well Material: Schedule 40 PVC			

WSP MW REPORT VER.3 BH LOGS - SHARON CORNERS.GPJ GINT STD CANADA LAB.GDT 11/10/17

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 12

FIGURE NO.: 12

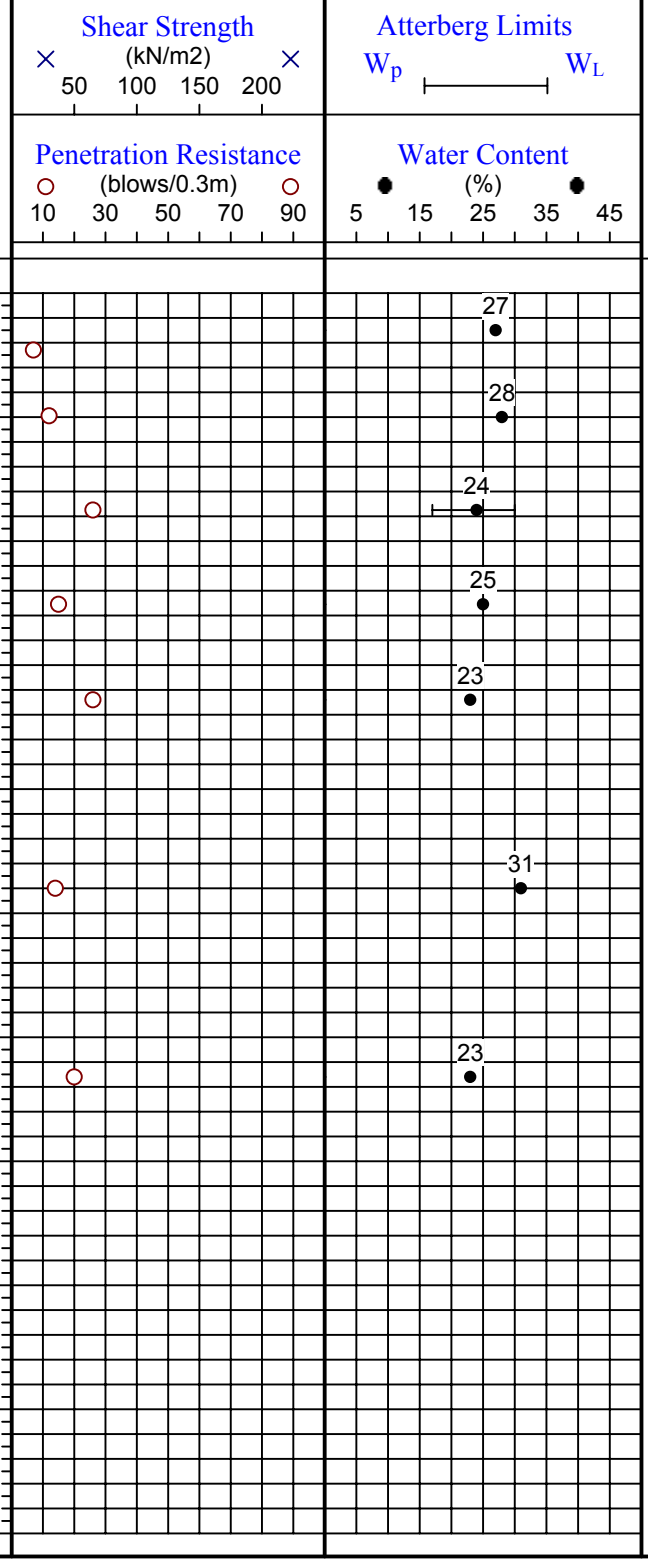
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: January 24, 2008

Elev. / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
261.4 / 0.0	Ground Surface			
	23cm TOPSOIL			
	Firm to very stiff — weathered	1	DO	7
		2	DO	12
	SILTY CLAY			
		3	DO	26
		4	DO	15
	a trace of sand occ. wet sand and silt seams and layers			
		5	DO	26
	brown grey			
		6	DO	14
254.8 / 6.6		7	DO	20
	END OF BOREHOLE			



WATER LEVEL

W.L. @ El. 256.8 m on completion

Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 13

FIGURE NO.: 13

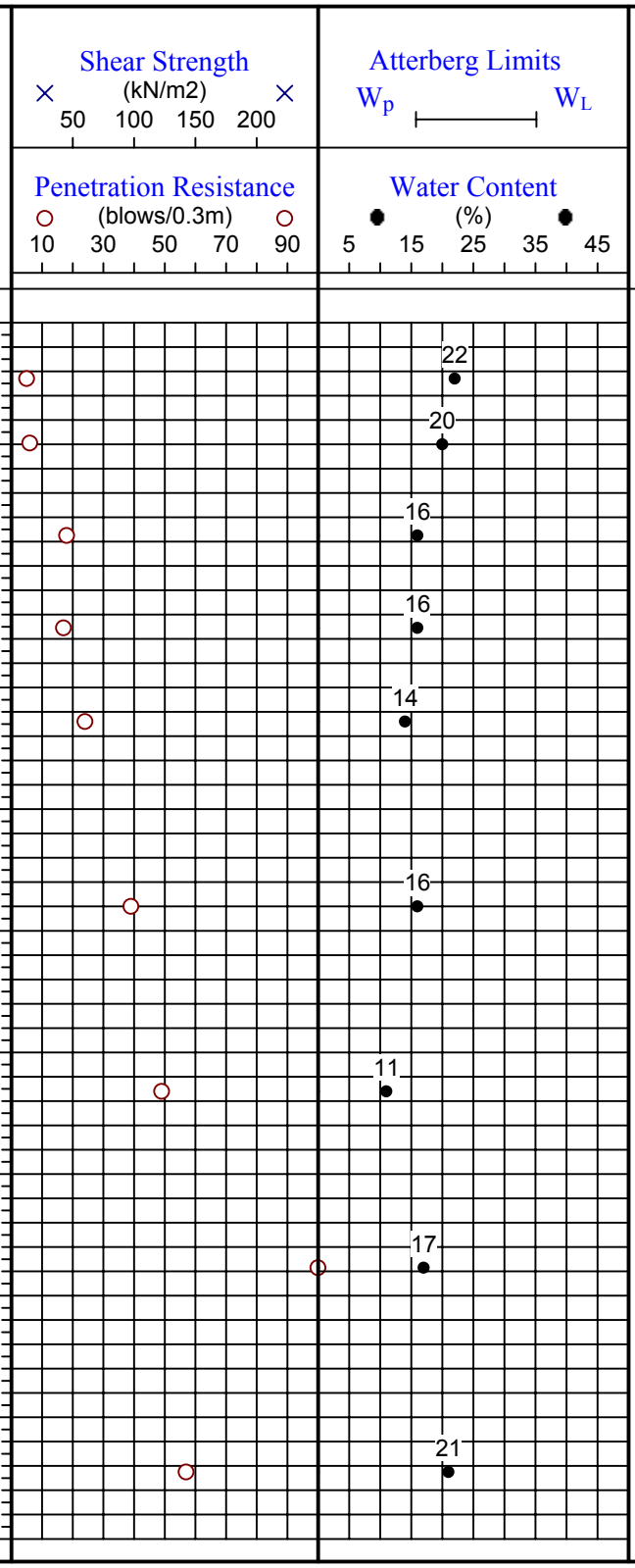
JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: January 24, 2008

Elev. / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
257.9 / 0.0	Ground Surface			
	25cm TOPSOIL			
	Brown, firm to very stiff **SILTY CLAY** a trace of sand occ. wet sand and silt seams and layers	1	DO	5
		2	DO	6
	weathered			
		3	DO	18
255.8 / 2.1	Very stiff to hard brown grey	4	DO	17
		5	DO	24
	SILTY CLAY, Till sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	6	DO	39
		7	DO	49
		8	DO	100+
249.4 / 8.5	Grey, very dense **SILT** a trace to some sand some clay, a trace of gravel occ. wet sand and clay seams and layers	9	DO	57
248.3 / 9.6	**END OF BOREHOLE**			



Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1

JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value
260.2 / 0.0	Ground Surface			
	51cm TOPSOIL			
	Firm to stiff	1A	DO	-
		1B	DO	4
	SILTY CLAY weathered	2	DO	6
	a trace of sand occ. wet sand and silt seams and layers (varved structure)	3	DO	10
	SILT LAYER brown grey	4	DO	11
		5	DO	14
		6	DO	13
254.6 / 5.6	Grey, stiff to very stiff			
	SILTY CLAY, Till	7	DO	15
	sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	8	DO	16
		9	DO	21
250.2 / 10.0	Cont'd on Fig.1A			

Depth Scale (m): 0 1 2 3 4 5 6 7 8 9 10

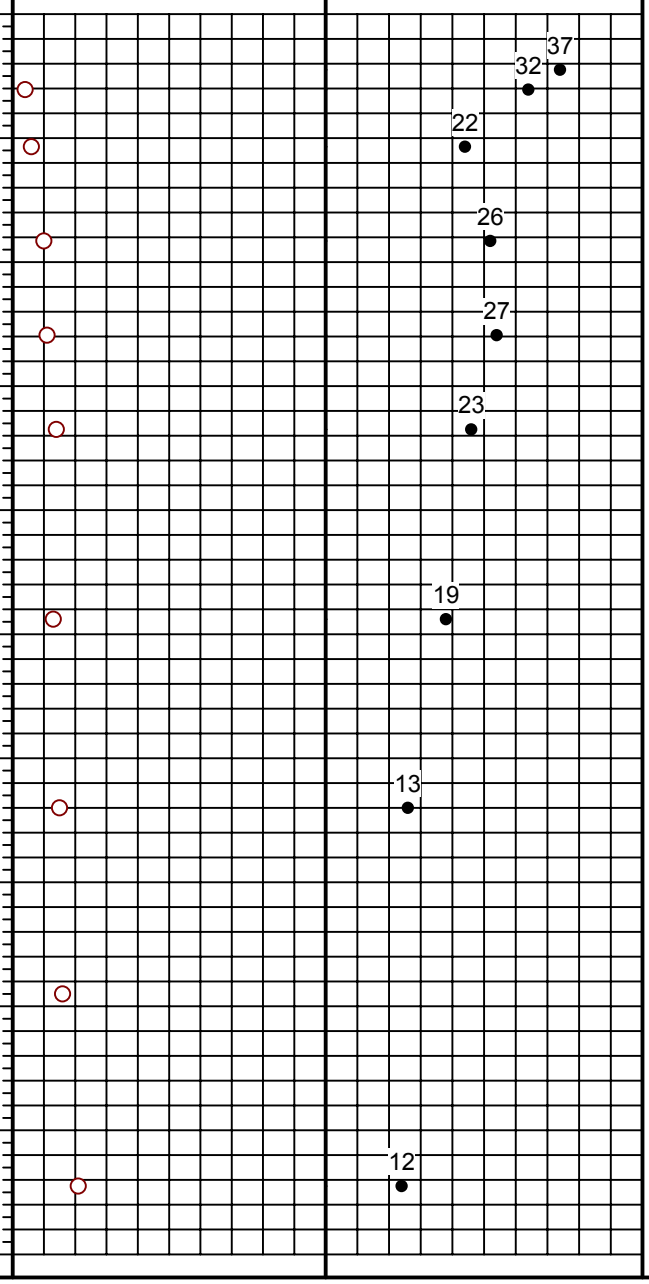
Shear Strength (kN/m2): × 50 100 150 200 ×

Penetration Resistance (blows/0.3m): ○ 10 30 50 70 90 ○

Atterberg Limits: W_P ⊢——⊣ W_L

Water Content (%): ● 5 15 25 35 45 ●

Water Level: Surface flooded



Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1 A

JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Shear Strength (kN/m2) 50 100 150 200 / Penetration Resistance (blows/0.3m) 10 30 50 70 90	Atterberg Limits W_P W_L / Water Content (%) 5 15 25 35 45	WATER LEVEL
250.2	Cont'd							
10.0	Grey, very stiff **SILTY CLAY** a trace of sand occ. wet sand and silt seams and layers (varved structure)	10	DO	21	11		20	
248.5								
11.7	Grey, compact **SILT** some clay, a trace of sand occ. silty clay layers	11	DO	19	12		20	
247.0								
13.2	Grey, very stiff **SILTY CLAY, Till** sandy, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	12	DO	16	13 14		19	
244.0		13	DO	18	15		19	
16.2	Grey, compact to dense **SANDY SILT, Till** some clay, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	14	DO	11	16 17		12	
		15	DO	45	18		9	
240.2	Cont'd on Fig. 1B	16	DO	42	19 20		11	
20.0								

Soil Engineers Ltd.

JOB NO.: 0710-S131

LOG OF BOREHOLE NO.: 101

FIGURE NO.: 1 B

JOB DESCRIPTION: Proposed Residential Subdivision

JOB LOCATION: Leslie St./Mount Albert Rd.
Town of East Gwillimbury

METHOD OF BORING: Flight-Auger

DATE: April 2, 2008

Elev. / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Shear Strength (kN/m2) 50 100 150 200 / Penetration Resistance (blows/0.3m) 10 30 50 70 90	Atterberg Limits W_p W_L / Water Content (%) 5 15 25 35 45	WATER LEVEL
240.2	Cont'd							
20.0	Grey, dense **SANDY SILT, Till** some clay, a trace of gravel occ. wet sand and silt seams and layers, cobbles and boulders	17	DO	42	21			
238.4								
21.8	**END OF BOREHOLE**				22			
					23			
					24			
					25			
					26			
					27			
					28			
					29			
					30			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 6, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
263.0	Ground Surface							
0.0	Loose to compact, wet **SILT** some clay a trace of sand	1	DO	4	0		23	
	weathered	2	DO	11	1		25	
		3	DO	13	2		22	
		4	DO	14			28	
		5	DO	16	3		26	
	brown grey	6	DO	6	4		20	
256.9					5			
6.1	Grey, compact **SANDY SILT TILL** some clay to clayey a trace of gravel	7	DO	11	6		14	
		8	DO	14	7		13	
255.0					8			

W.L. @ El. 258.4 m upon completion
Cave-In @ El. 258.1 m upon completion

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 201

FIGURE NO.: 1

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 6, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	SAMPLES Type	SAMPLES N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Grey, compact **SANDY SILT TILL** some clay to clayey a trace of gravel				8			
		9	DO	20	9	○	● 9	
253.4 9.6	**END OF BOREHOLE**				10			
					11			
					12			
					13			
					14			
					15			
					16			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
262.2	Ground Surface							
0.0	**15cm TOPSOIL**				0			
	Brown, loose to compact, wet	1	DO	6			19	
	SILT							
	some clay weathered							
	a trace of sand	2	DO	14	1		24	
		3	DO	11			20	
					2			
		4	DO	11			21	
					3			
		5	DO	8			25	
257.6					4			
4.6	Grey, compact	6	DO	13			13	
	SANDY SILT TILL				5			
	some clay to clayey a trace of gravel							
					6			
		7	DO	15			14	
					7			
		8	DO	18	8		18	
254.2								

W.L. @ El. 260.4 m upon completion
Cave-In @ El. 260.1 m upon completion

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Grey, compact				8			
253.1	**SANDY SILT TILL** some clay to clayey a trace of gravel				9			
9.1	Grey, compact to dense, wet	9	DO	33			26	
	SILT some clay to clayey occ. clay layers				10			
		10	DO	10	11		27	
		11	DO	10	12		25	
248.0		12	DO	18	13			
14.2	**NO SAMPLING** **DYNAMIC CONE**				14		17	
246.2					15			
					16			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 202

FIGURE NO.: 2

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES: Number	SAMPLES: Type	SAMPLES: N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
16.0	**NO SAMPLING DYNAMIC CONE**				16			
					17			
					18			
244.0 18.2	**END OF BOREHOLE**							
					19			
					20			
					21			
					22			
					23			
					24			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
263.4	Ground Surface							
0.0	**50 mm ASPHALTIC CONCRETE** **300 mm GRANULAR FILL** Loose to compact, wet **SILT** some clay a trace of sand	1	DO	13	0		16	
		2	DO	13	1		17	
		3	DO	7	2		27	
		4	DO	9	3		28	
		5	DO	11	4		25	
	brown / grey	6	DO	18	5		30	
		7	DO	22	6		28	
255.4		8	DO	13	8		21	W.L. @ El. 258.5 m upon completion @ El. 257.3 m upon completion

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 203

FIGURE NO.: 3

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Loose to compact, wet				8			Cave-In
	SILT							
	some clay a trace of sand							
254.3					9			
9.1	Grey, compact to dense	9	DO	28			8	
	SANDY SILT TILL							
	some clay a trace of gravel occ. cobbles				10			
		10	DO	22			14	
					11			
					12			
		11	DO	44			13	
					13			
		12	DO	25	14		13	
249.2								
14.2	**END OF BOREHOLE**				15			
					16			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 204

FIGURE NO.: 4

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 10, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
261.9	Ground Surface							
0.0	**18 cm TOPSOIL**				0			
	Loose to compact, wet	1	DO	6			26	
	SILT							
	a trace of sand occ. clay layers — weathered	2	DO	9	1		26	
		3	DO	12	2		25	
		4	DO	20			21	
		5	DO	16	3		22	
	— brown grey	6	DO	17	4		22	
		7	DO	22	5		16	
255.3					6			
6.6	**END OF BOREHOLE**				7			
					8			

W.L. @ El. 260.4 m upon completion

Cave-In @ El. 257.0 m upon completion

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 19, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
260.9	Ground Surface							
0.0	**15cm TOPSOIL**				0			
	Very loose to compact, wet	1	DO	1			29	
	SILT							
	some clay							
	weathered	2	DO	8	1		21	
		3	DO	10			21	
					2			
		4	DO	10			22	
	brown grey	5	DO	9	3		20	
257.1								
3.8	Grey, loose to compact	6	DO	10	4		13	
	SANDY SILT TILL							
	some clay to clayey a trace of gravel	7	DO	11			12	
					5			
					6			
		8	DO	8			13	
					7			
252.9		9	DO	16	8		11	

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 19, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Grey, loose to compact				8			
	SANDY SILT TILL							
	some clay to clayey a trace of gravel							
	wet silt layer	10	DO	9	9		24	
					10			
		11	DO	12	11		11	
					12			
248.3		12	DO	13				
12.6	**NO SAMPLING** **DYNAMIC CONE**				13			
					14			
					15			
244.9					16			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 205

FIGURE NO.: 5

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 19, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES: Number	SAMPLES: Type	SAMPLES: N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
16.0	**NO SAMPLING DYNAMIC CONE**				16			
					17			
					18			
					19			
240.9 / 20.0	**END OF BOREHOLE**				20			
					21			
					22			
					23			
					24			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 206

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 12, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
259.0	Ground Surface							
0.0	**23 cm TOPSOIL**				0			
	Brown, loose, wet **SILT** traces of clay and sand	1	DO	5			18	
		2	DO	6	1		23	
257.5	weathered							
1.5	Compact to dense **SANDY SILT TILL** some clay to clayey a trace of gravel occ. sand seams	3	DO	14	2		14	
		4	DO	10			13	
		5	DO	16	3		17	
	brown grey	6	DO	17	4		12	
		7	DO	27	5		12	
	boulders and cobbles	8	DO	36	6		11	
251.0					7			
					8			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 206

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 12, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Compact to dense				8			
	SANDY SILT TILL							
	some clay to clayey a trace of gravel occ. sand seams							
249.9					9			
9.1	Grey, compact, wet	9	DO	28			18	
	SILT							
	some clay				10			
		10	DO	13			19	
					11			
					12			
		11	DO	12			22	
245.9					13			
13.1	Grey, loose							
	SANDY SILT TILL							
	some clay to clayey a trace of gravel	12	DO	6	14		12	
					15			
		13	DO	7			11	
243.0					16			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 206

FIGURE NO.: 6

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 12, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES: Number	SAMPLES: Type	SAMPLES: N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
16.0	**NO SAMPLING DYNAMIC CONE**				16			
					17			
					18			
					19			
					20			
238.6								
20.4	**END OF BOREHOLE**				21			
					22			
					23			
					24			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 207

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 16, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
260.0	Ground Surface							
0.0	**20 cm TOPSOIL**				0			
	Brown, very loose to loose, wet	1	DO	5			29	
	SILT							
	some clay to clayey a trace of sand — weathered	2	DO	9	1		24	
		3	DO	2	2		31	
		4	DO	7			25	
256.9					3			
3.1	Compact	5	DO	10			10	
	SANDY SILT TILL				4			
	some clay a trace of gravel occ. sand seams or layers							
	— brown grey	6	DO	20	5		17	
		7	DO	20	6		12	
					7			
252.0		8	DO	23	8		12	

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 207

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 16, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Compact				8			
	SANDY SILT TILL some clay a trace of gravel occ. sand seams or layers				9			
		9	DO	30		○	25	
					10			
249.3								
10.7	Grey, loose to compact, wet	10	DO	6		○	25	
	SILT some clay				11			
					12			
		11	DO	15		○	19	
246.9					13			
13.1	Grey, very loose to compact							
	SANDY SILT TILL some clay a trace of gravel							
		12	DO	13	14	○	10	
					15			▽ completion
	wet silt layer	13	DO	2		○	13	
244.0					16			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 207

FIGURE NO.: 7

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 16, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
16.0	Grey, very loose to compact				16			W.L. @ El. 244.8 m upon
	SANDY SILT TILL							
	some clay a trace of gravel							
242.8		14	DO	7	17	○	12 ●	
17.2	**NO SAMPLING DYNAMIC CONE**				18			
					19			
					20			
					21			
					22			
237.5								
22.5	**END OF BOREHOLE**				23			
					24			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 208

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street, Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
261.0	Ground Surface							
0.0	**80 mm ASPHALTIC CONCRETE** **250 mm GRANULAR FILL** Brown, loose to compact, wet **SILT** a trace to some clay occ. clay seams or layers — weathered	1	DO	7	0		20	
		2	DO	11	1		21	
		3	DO	10	2		23	
		4	DO	22	3		22	
257.7		5	DO	18			20	
3.3	Compact to dense **SANDY SILT TILL** some clay a trace of gravel — brown grey	6	DO	15	4 5		13	W.L. @ El. 256.4 m upon completion
		7	DO	33	6 7		16	
253.0		8	DO	47	8		12	

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 208

FIGURE NO.: 8

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 8, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Compact to dense				8			
	SANDY SILT TILL							
	some clay a trace of gravel							
251.9					9			
9.1	Grey, loose to dense, wet	9	DO	32			15	
	SILT							
	some clay				10			
		10	DO	9			23	
					11			
					12			
		11	DO	7			25	
247.9					13			
13.1	Grey, loose to compact							
	SANDY SILT TILL							
	some clay a trace of gravel	12	DO	12	14		18	
					15			
		13	DO	8			12	
245.3								
15.7	**END OF BOREHOLE**				16			

Soil Engineers Ltd.

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 209

FIGURE NO.: 9

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 9, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
259.7	Ground Surface							
0.0	**50 mm ASPHALTIC CONCRETE** **380 mm GRANULAR FILL**	1	DO	10	0		22	
	EARTH FILL brown silty clay	2	DO	7	1		21	
258.2								
1.5	Brown, loose to compact, wet **SILT** coarse sand layer some clay occ. gravel	3	DO	9	2		17	
		4	DO	11			24	
256.5					3			
3.2	Grey, compact to dense — boulder **SANDY SILT TILL** some clay a trace of gravel	5	DO	42				
		6	DO	21	4		12	
		7	DO	15	5		10	
		8	DO	26	6		10	
251.7					7			
					8			

W.L. @ El. 255.7 m upon completion

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 209

FIGURE NO.: 9

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 9, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)	Dynamic Cone (blows/30 cm) 10 30 50 70 90 / Shear Strength (kN/m²) 50 100 150 200 / Penetration Resistance (blows/30 cm) 10 30 50 70 90	Atterberg Limits PL LL / Moisture Content (%) 10 20 30 40	WATER LEVEL
8.0	Grey, compact to dense				8			
	SANDY SILT TILL							
	some clay a trace of gravel							
250.6					9			
9.1	Grey, compact to dense, wet	9	DO	32			19	
	SILT							
	some clay				10			
		10	DO	12			22	
					11			
					12			
		11	DO	21			18	
					13			
246.0								
13.7	Grey, loose to compact	12	DO	11	14		18	
	SANDY SILT TILL							
	some clay a trace of gravel				15			
		13	DO	9			12	
244.0								
15.7	**END OF BOREHOLE**				16			

JOB NO.: 1704-S065

LOG OF BOREHOLE NO.: 210

FIGURE NO.: 10

PROJECT DESCRIPTION: Proposed Residential Development

METHOD OF BORING: Flight Auger

PROJECT LOCATION: Northwest Corner of Mount Albert Road and Leslie Street
Town of East Gwillimbury

DRILLING DATE: May 9, 2017

El. (m) / Depth (m)	SOIL DESCRIPTION	SAMPLES Number	Type	N-Value	Depth Scale (m)
258.0	Ground Surface				
0.0	**EARTH FILL**				0
257.7 / 0.3	brown silty clay traces of sand and gravel Brown, loose to compact	1	DO	18	
	SANDY SILT TILL				
	some clay a trace of gravel	2	DO	10	1
		3	DO	8	
					2
		4	DO	13	
					3
		5	DO	18	
					4
		6	DO	31	
252.5 / 5.5	Grey, compact, wet				5
	SILT				
	some clay and sand	7	DO	25	6
251.4 / 6.6	**END OF BOREHOLE**				7
					8

Dynamic Cone (blows/30 cm) 10 30 50 70 90

Shear Strength (kN/m²) 50 100 150 200

Penetration Resistance (blows/30 cm) 10 30 50 70 90

Atterberg Limits PL LL

Moisture Content (%) 10 20 30 40

Depth (m)	Moisture Content (%)
0.3	20
1.5	15
2.0	15
2.5	15
3.3	12
4.8	15
6.3	21

WATER LEVEL

W.L. @ El. 256.2 m upon completion

Soil Engineers Ltd.

APPENDIX

C YORK REGION CORRESPONDANCE

From:	Berg, David <David.Berg@york.ca>
Sent:	October-12-17 1:15 PM
To:	Stephenson, Emily
Cc:	Masotti, Angelika
Subject:	Source Protection Pre-Consultation for the North West Corner of Mount Albert Road and Leslie Street
Attachments:	20160922-Water Balance Tables.pdf; HydroAssessmentGuidelines-20130610-FINAL.PDF; YORK-#7903654-v1-Figure_2_-_VS-NWCornerMtAlbertLeslieSt-11-OCT-2017.PDF; YORK-#7903653-v1-Figure_1_-_WHPA-NWCornerMtAlbertLeslieSt-11-OCT-2017.PDF

Hi Emily,

Please find attached Source Protection related mapping for the site and summary of applicable Source Protection Policies. Based on my understanding, the proposed development is for two 6-storey apartment buildings and townhouse complexes.

The property is located within the South Georgian Bay Lake Simcoe Source Protection Region (the corresponding Conservation Authority is Lake Simcoe and Region Conservation Authority (LSRCA)). The site is within Wellhead Protection Area D (WHPA-D) with Vulnerability Scores of 4 and 2, and Wellhead Protection Area Q (WHPA-Q or the Recharge Management Area).

Source Protection Plan and Regional Official Plan Policies

Regional Official Plan and ROPA 5 Applicability

As the property is subject to source protection policies in the York Region Official Plan (ROP, 2010) and Regional Official Plan Amendment 5 (ROPA 5, 2013). Prior to Development Application approval, the Owner shall conduct and submit a Source Water Impact and Assessment Mitigation Plan (SWIAMP), to the satisfaction of the Region, to identify and address any potential water quality and water quantity threats to the municipal groundwater supplies. The SWIAMP shall be prepared by a qualified professional, to the satisfaction of Regional Environmental Services staff in the Water Resources group. The SWIAMP must follow the York Region document Guidance for Proposed Developments in Wellhead Protection Areas in York Region (October 2014). A SWIAMP is required for any of the activities listed below if they will occur on the site for the storage or manufacture of:

- petroleum-based fuels and or solvents;
- pesticides, herbicides, fungicides or fertilizers;
- construction equipment;
- inorganic chemicals;
- road salt and contaminants as identified by the Province;
- the generation and storage of hazardous waste or liquid industrial waste, and waste disposal sites and facilities;
- organic soil conditioning sites and the storage and application of agricultural and non-agricultural source organic materials; and,
- snow storage and disposal facilities.

If a SWIAMP is not required, a letter prepared by a qualified professional will be required in its place stating that the above noted activities will not be occurring.

We do have SWIAMP templates available and a guidance document can be found at: http://www.york.ca/wps/wcm/connect/yorkpublic/b50badd9-9523-439f-a65a-ff61ba162b22/Guidance_for_proposed_developments_in_WHPAs_Oct2014.pdf?MOD=AJPERES

As the site is within a wellhead protection area, Water Resources does encourage the use of best management practices during construction and post construction with respect to the handling and storage of chemicals on site. It is strongly recommended that Risk Management Measures are put in place with respect to chemical use and storage including spill kits, secondary containment, a spill response plan and training.

With respect to the use of **salt** on the property, Water Resources recommends the use of a contractor who is certified by Smart About Salt, and use of best management practices identified in the TAC Synthesis of Best Management Practices for Salt and Snow are followed: http://tac-atc.ca/en/bookstore-and-resources/free-resources-and-tools/syntheses-practice .

Recharge Management Area (WHPA-Q)

The site is within WHPA-Q and as such the South Georgian Bay Lake Simcoe Source Protection Plan water quantity recharge maintenance policy (LUP-12) will apply and demonstration of recharge maintenance will be required through a hydrogeological study that shows the existing (i.e. pre proposed development) water balance can be maintained in the future (i.e. post proposed development). As such, the site is subject to a hydrogeological study and water balance under the source protection plan policies if the total **new** impervious area is **500 m2 or greater**. Although this is similar to LSPP requirements the source protection plan policies go one step further and requires off-site compensation if pre-development infiltration cannot be maintained through the use of LIDs. Please contact Shelly Cuddy (S.Cuddy@lsrca.on.ca) for more information.

Low Impact Development:

The owner is to be advised that Low Impact Development (LID) measures are encouraged to be applied to the site. As per York Region Official Plan policy 2.3.37, developments should maximize infiltration through integrated treatment approach techniques to minimize stormwater volume and contaminant loads. This should include, but not be limited to, techniques such as rainwater harvesting, phosphorus reduction, constructed wetlands, bioretention swales, green roofs, permeable surfaces, clean water collection systems, and the preservation and enhancement of native vegetation cover. The use of the following resource is encouraged: Low Impact Development Stormwater Management Planning and Design Guide and is available using the following link: http://www.creditvalleyca.ca/low-impact-development/low-impact-development-support/stormwater-management-lid-guidance-documents/low-impact-development-stormwater-management-planning-and-design-guide/

Dewatering Considerations

Given the proximity of the site to York Region's municipal drinking water wells construction activities, such as deep excavation, (typically associated with underground parking and installation of water, sanitary and stormwater services) that may require significant dewatering or groundwater depressurization, have the potential to interfere with the quantity of groundwater available for municipal supply. Water Resources recommends that should significant dewatering be required, a dewatering plan shall be prepared by a qualified person and submitted by the proponent to the Region for approval prior to excavation. Also, please note that the Sewer Use By-law group should be contacted for a dewatering discharge permit, if required. LSRCA would also need to be contacted.

If you have any questions, please let me know.

Thanks,
David

David Berg | Source Protection Project Assistant, Water Resources, Environmental Services
---
The Regional Municipality of York | 17250 Yonge Street | Newmarket, ON L3Y 6Z1
O: 1-877-464-9675 ext. 77619 | David.Berg@york.ca | york.ca
*Our Values: **I**ntegrity, **C**ommitment, **A**ccountability, **R**espect, **E**xcellence*

From: Stephenson, Emily [mailto:Emily.Stephenson@wsp.com]
Sent: Thursday, October 12, 2017 10:50 AM
To: Masotti, Angelika
Cc: Berg, David
Subject: RE: SWP Report NW corner of Mt. Albert Rd. and Leslie St. in Sharon

Hi Angelika,

The development is anticipated to include two six storey apartment buildings and a number of townhouse complexes.

Let me know if you need any further information for the mapping and summary.

Thanks-you,

Emily Stephenson, B. Sc., G.I.T.
T +1 519-904-1747

From: Masotti, Angelika [mailto:Angelika.Masotti@york.ca]
Sent: October-12-17 9:21 AM
To: Stephenson, Emily <Emily.Stephenson@wsp.com>
Cc: Berg, David <David.Berg@york.ca>
Subject: RE: SWP Report NW corner of Mt. Albert Rd. and Leslie St. in Sharon

Hi Emily,
David will be responding with the mapping and a summary of any vulnerable areas and policy requirements associated with it for you. In order for us to provide a complete response would you be

able to share what the development is that is going in as with Source Water the policies are activity based.
Thanks,
Angelika

Angelika Masotti | Risk Management Inspector, Program Coordinator, Water Resources, Environmental Promotion and Protection, Environmental Services
---
The Regional Municipality of York
Mailing Address: The Regional Municipality of York| 17250 Yonge Street | Newmarket, ON L3Y 6Z1
Office/Courier Address: 145 Harry Walker Parkway| Newmarket, ON
O: 1-877-464-9675 ext. 75128 | **C:** 905-806-0512 | angelika.masotti@york.ca | www.york.ca
*Our Values: **I**ntegrity, **C**ommitment, **A**ccountability, **R**espect, **E**xcellence*

From: Stephenson, Emily [mailto:Emily.Stephenson@wsp.com]
Sent: Wednesday, October 11, 2017 2:06 PM
To: Masotti, Angelika
Subject: SWP Report NW corner of Mt. Albert Rd. and Leslie St. in Sharon

Hello Angelika,

Andrew Kulin advised that you can provide a source water protection report for study areas, as per the attached email. Could you provided a source water protection report the Northwest corner of Mt. Albert Rd. and Leslie St. in Sharon (location show on attached screenshot)?

Thank-you,

Emily Stephenson, B. Sc., G.I.T.
Environmental Scientist
Environment / Environmental Management

T+ 1 519-904-1747

582 Lancaster Street West
Kitchener, Ontario,
N2K 1M3 Canada

wsp.com

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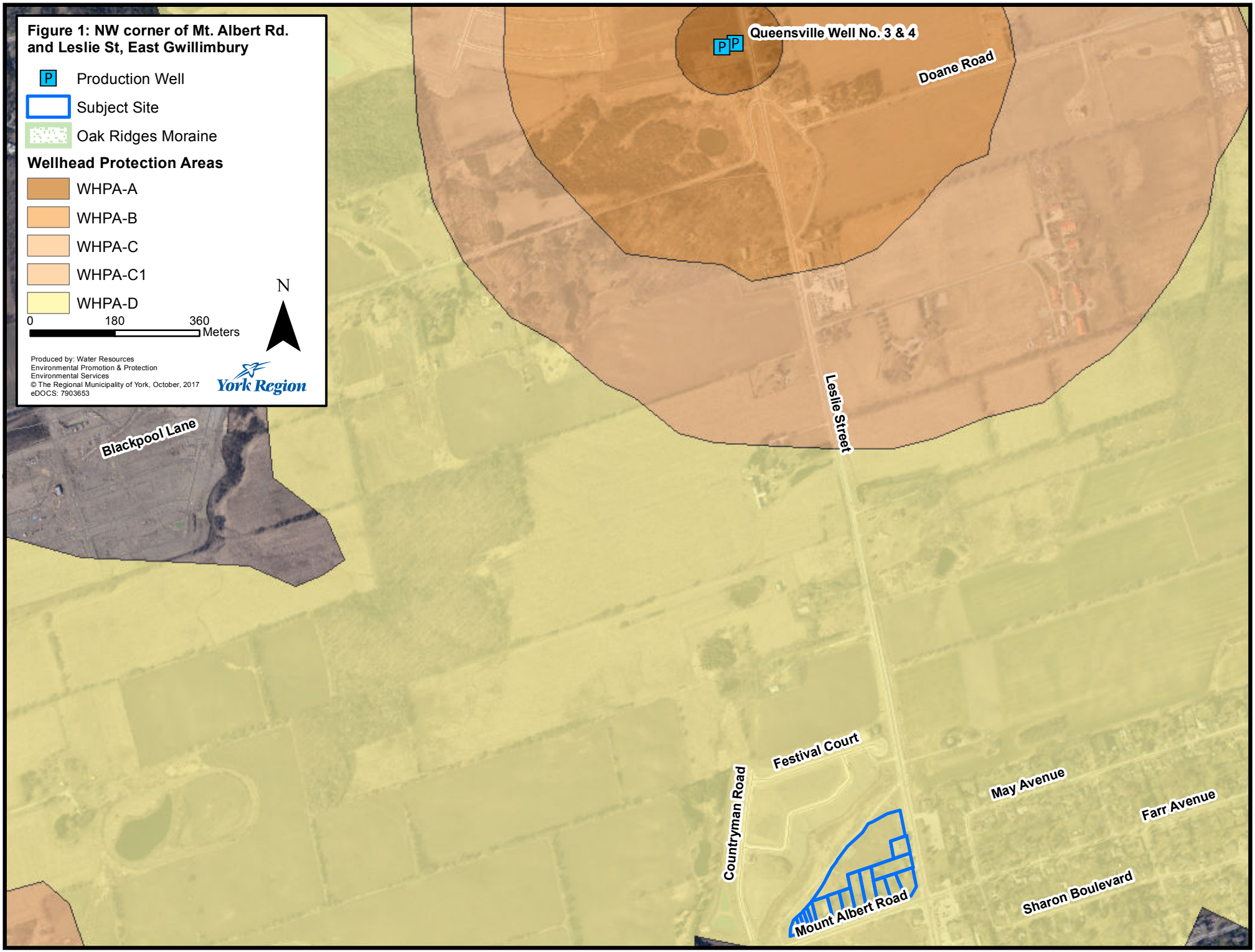
Figure 1: NW corner of Mt. Albert Rd. and Leslie St, East Gwillimbury
Production Well
Subject Site
Oak Ridges Moraine
Wellhead Protection Areas
WHPA-A
WHPA-B
WHPA-C
WHPA-C1
WHPA-D
0
180
360
Meters
N
Produced by: Water Resources
Environmental Promotion & Protection
Environmental Services
© The Regional Municipality of York, October, 2017
eDOCS: 7903653
York Region
Queensville Well No. 3 & 4
Doane Road
Leslie Street
Blackpool Lane
Festival Court
Countryman Road
May Avenue
Farr Avenue
Sharon Boulevard
Mount Albert Road

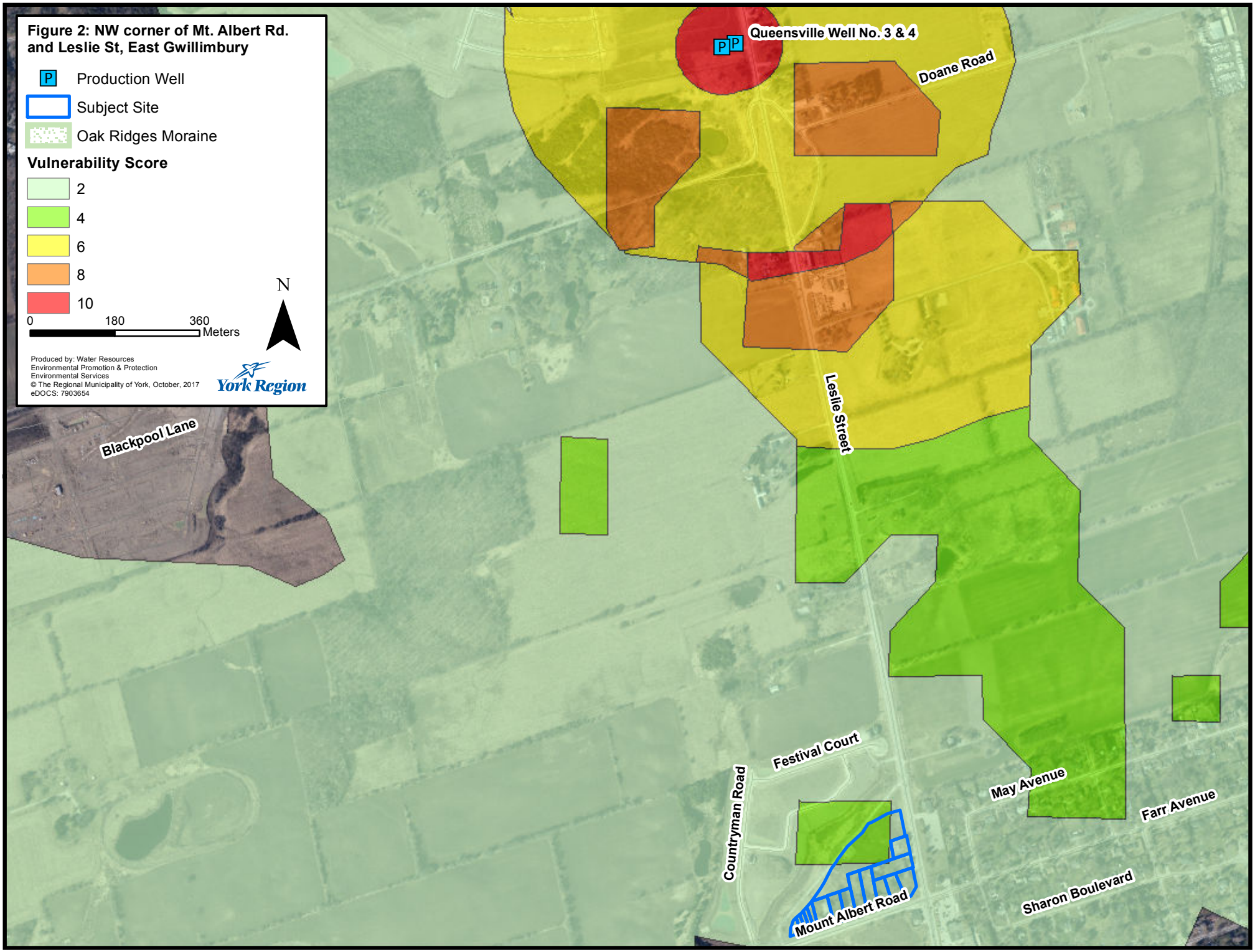
Figure 2: NW corner of Mt. Albert Rd. and Leslie St, East Gwillimbury
Production Well
Subject Site
Oak Ridges Moraine
Vulnerability Score
2
4
6
8
10
0
180
360
Meters
N
Produced by: Water Resources
Environmental Promotion & Protection
Environmental Services
© The Regional Municipality of York, October, 2017
eDOCS: 7903654
York Region
Queensville Well No. 3 & 4
Doane Road
Leslie Street
Blackpool Lane
Festival Court
Countryman Road
May Avenue
Farr Avenue
Sharon Boulevard
Mount Albert Road

Lake Simcoe Region
conservation authority

Climate Data for Water Balance Studies to Support Land Development Applications within the Lake Simcoe Watershed

October, 2016

Disclaimer: *This document has been provided in an attempt to standardize and aid in evaluation of water balance assessments completed to support development applications reviewed by the Lake Simcoe Region Conservation Authority and should be referred to for this purpose only. The data contained within this document are results from the Lake Simcoe PRMS model developed by Earthfx (2010) and published in the Lake Simcoe and Couchiching-Black River Source Protection Area Approved Assessment Report (2015) which should be referred to for more information.*

Users must exercise judgment and flexibly to adapt the data provided when considering specific site conditions and when new information or data becomes available. It is not the intent of the Lake Simcoe Region Conservation Authority to proscribe the methodology nor the data used to undertake water balance assessments, rather it is intended to provide responsible estimates based on current knowledge and evaluation of the conditions within each subwatershed. Where the Qualified Person can show that alternate approaches/data can produce the desired results or even better, such methods and data should be considered. The Qualified Person is solely responsible for the water balance assessments provided to the Lake Simcoe Conservation Authority supporting Land Development Applications for any given site. This document should be used with other established manuals and practices.

Introduction

Water balance methods are an appropriate means for predicting the changes to the hydrologic cycle that results from urban development. They can be used to determine amounts of water that should be infiltrated to compensate for reductions cause by large paved areas or changes to vegetation.

The maintenance of pre-development 'recharge' is a general requirement in the Oak Ridges Moraine Conservation Plan (ORMCP), Lake Simcoe Protection Plan (LSPP), the South Georgian Bay Lake Simcoe (SGBLS) Source Protection Plan and the Provincial Policy Statement (PPS) that is often captured in municipal Official Plans. Groundwater frequently supports significant watershed features that are necessary components to the maintenance of a healthy watershed. As a result, a water balance analysis is required to estimate the pre-development and post-development infiltration and runoff for most development applications within the Lake Simcoe Region Conservation Authority as outlined in Table 1.

This document aims at providing a standard dataset for land development applicants and their consultants to use when completing water balance analysis. Qualified Persons (QP) should exercise professional judgment and flexibly to adapt the data provided when considering specific site conditions and when new information or data becomes available. It is not the intent of the Lake Simcoe Region Conservation Authority to proscribe the methodology or the data used; rather it is intended to provide responsible estimates based on current knowledge and evaluation of the conditions within each subwatershed. Where there is an alternate approach or data available that can produce the desired results or even better, such methods and data should be considered.

Table 1: Legislation requirements for water balance assessments within the Lake Simcoe Region Conservation Authority

Legislative Authority:	**Policy Requirements:**
Oak Ridges Moraine	Hydrogeological assessment, pre and post- development water balance required for all major development.
Lake Simcoe Protection Plan – 4.8 Designated Policy	Pre and post- development water balance required for all major development and show how such changes shall be minimized.
Lake Simcoe Protection Plan – 6.40 Designated Policy	Outside of the Oak Ridges Moraine area, an application for major development within a significant groundwater recharge area (SGRA) shall be accompanied by an environmental impact study that demonstrates that the quality and quantity of groundwater in these areas and the function of the recharge areas will be protected, improved or restored.

South Georgian Bay Lake Simcoe Source Protection Plan – Policy LUP-12	For Planning Act applications within the WHPA-Q2 a hydrogeological study is required to show that the existing water balance can be maintained through the use of best management practices. Where necessary implementation and maximization of off-site recharge enhancement within the same WHPA-Q2 may be used to compensate for any predicted loss of recharge from the development. *excludes single detached residential, barns and non-commercial structures that are accessory to an agricultural operation.
Notes: *Major development for ORMCP and LSPP includes any site which has a proposed building footprint of 500 square metres or greater. Major development for SGBLS SPP includes any site which has a proposed impervious footprint of 500 square metres or greater.*	

Water Balance Methodology

The purpose of the water balance analysis is to reasonably estimate the current infiltration rates to the subsurface and to then determine how much this rate will change as a result of the proposed development. It is recognized that site specific water balances are difficult to accurately estimate, the goal should be to assess the difference between pre-development and post development conditions and to mitigate for impacts on infiltration.

The terms 'infiltration' and 'recharge' are commonly used interchangeably in development application supporting documents. Infiltration relates to the capacity for the soil to allow water to enter the subsurface. Some of this infiltration results in lateral movement in the shallow unsaturated zone where interflow may predominate and some of the infiltration is directed downward to the deeper aquifer system. Recharge is considered to be primarily water that reaches the saturated zone of the aquifer and becomes part of the regional groundwater flow system. The maintenance of infiltration rates is essential to the sustainability of the groundwater flow system which may support local significant ecological features. In addition, infiltration may move to a regional deeper flow system that may be important at a regional scale from either an ecological or water supply perspective.

It is common practice and an accepted method to provide estimates of surplus using a Thornthwaite and Mather approach where surplus is estimated based on precipitation minus evapotranspiration (Steenhuis and Van Der Molen, 1986). Infiltration portion of the surplus can be estimated by applying the infiltration factors provided in the Ministry of the Environment and Energy Hydrogeological Technical Information Requirements for Land Development Applications (1995). These factors consider slope, vegetation and soils. The remainder of surplus is considered to be runoff.

With the recent completion of technical studies required under The Clean Water Act, 2006, numerical models were utilized to estimate, interception, evaporation, potential and actual evapotranspiration, snowmelt, runoff, infiltration, interflow, and groundwater recharge. Many of

these model estimates are based on soils, surficial geology and land use mapping products but may also consider detailed vegetation attributes as well as hydrological cycle functions. These modelling output data are available and consultants are encouraged to use them completing site specific water balance assessments.

The water balance tables provided in this document are results from the numerical modelling undertaken by Earthfx (2010) required under the Clean Water Act, 2006. The resulting water balance parameters are categorized by various vegetation covers in different soil types for each subwatershed within the Lake Simcoe Basin. Infiltration factors can then be applied based on specific site conditions – vegetation, soil and topography, per the above mentioned MOE methodology.

This document is meant to summarize the PRMS modelling results (Earthfx, 2010) and not to provide detailed water balance methodology. For additional information on completing hydrogeological water balance assessments please refer to The Ontario Ministry of the Environment Stormwater Planning and Design Manual (2003), Ministry of the Environment and Energy Hydrogeological Technical Information Requirements for Land Development Applications (1995) or the Hydrogeological Assessment Submissions – Conservation Authority Guidelines for Development Applications (2013). In addition, pre-consultation with the Lake Simcoe Region Conservation Authority is strongly recommended to determine the policy context and the scope of your study.

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.74	952	525	427
Fine Sandy Loam	B		952	539	413
Silt Loam	C		952	573	380
Clay	D		952	643	310
Forest					
Fine Sand	A	4.12	952	521	431
Fine Sandy Loam	B		952	540	412
Silt Loam	C		952	434	518
Clay	D		952	598	354
Pasture & Shrubs					
Fine Sand	A	0.40	952	565	387
Fine Sandy Loam	B		952	546	406
Silt Loam	C		952	558	394
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	0.92	952	528	424
Fine Sandy Loam	B		952	636	316
Silt Loam	C		-	-	-
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	0.43	952	556	396
Fine Sandy Loam	B		952	532	420
Silt Loam	C		-	-	-
Clay	D		-	-	-
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.62	952	471	481
Fine Sandy Loam	B		952	456	496
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**952**	**446**	**506**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.41	905	582	323
Fine Sandy Loam	B		905	594	311
Silt Loam	C		905	589	316
Clay	D		-	-	-
Forest					
Fine Sand	A	27.16	905	561	344
Fine Sandy Loam	B		905	629	276
Silt Loam	C		905	610	295
Clay	D		905	643	262
Pasture & Shrubs					
Fine Sand	A	6.88	905	550	355
Fine Sandy Loam	B		905	620	285
Silt Loam	C		905	613	292
Clay	D		905	584	321
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	106.22	905	584	321
Fine Sandy Loam	B		905	647	258
Silt Loam	C		905	649	256
Clay	D		905	636	269
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	96.36	905	569	336
Fine Sandy Loam	B		905	653	252
Silt Loam	C		905	649	256
Clay	D		905	656	249
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	4.39	905	477	428
Fine Sandy Loam	B		905	515	390
Silt Loam	C		905	495	410
Clay	D		-	-	-
Mean Annual			**905**	**610**	**295**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	3.13	895	564	331
Fine Sandy Loam	B		895	579	316
Silt Loam	C		895	569	326
Clay	D		895	596	299
Forest					
Fine Sand	A	73.90	895	578	317
Fine Sandy Loam	B		895	605	290
Silt Loam	C		895	589	306
Clay	D		895	632	263
Pasture & Shrubs					
Fine Sand	A	14.32	895	581	314
Fine Sandy Loam	B		895	605	290
Silt Loam	C		895	591	304
Clay	D		895	607	288
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	57.67	895	581	314
Fine Sandy Loam	B		895	603	292
Silt Loam	C		895	624	271
Clay	D		895	601	294
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	86.23	895	585	310
Fine Sandy Loam	B		895	615	280
Silt Loam	C		895	620	275
Clay	D		895	652	243
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	3.53	895	486	409
Fine Sandy Loam	B		895	509	386
Silt Loam	C		895	485	410
Clay	D		-	-	-
Mean Annual			**895**	**574**	**320**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	10.04	878	579	299
Fine Sandy Loam	B		878	638	240
Silt Loam	C		878	594	283
Clay	D		878	613	265
Forest					
Fine Sand	A	39.28	878	608	270
Fine Sandy Loam	B		878	624	253
Silt Loam	C		878	600	278
Clay	D		878	618	260
Pasture & Shrubs					
Fine Sand	A	11.08	878	601	276
Fine Sandy Loam	B		878	621	256
Silt Loam	C		878	606	272
Clay	D		878	594	283
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	24.28	878	622	256
Fine Sandy Loam	B		878	649	229
Silt Loam	C		878	632	246
Clay	D		878	619	259
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	48.80	878	601	276
Fine Sandy Loam	B		878	646	231
Silt Loam	C		878	648	230
Clay	D		878	647	231
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	24.28	878	508	371
Fine Sandy Loam	B		878	532	346
Silt Loam	C		878	462	417
Clay	D		-	-	-
Mean Annual			**878**	**567**	**311**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.19	907	550	357
Fine Sandy Loam	B		907	568	339
Silt Loam	C		907	664	243
Clay	D		907	593	314
Forest					
Fine Sand	A	9.69	907	575	332
Fine Sandy Loam	B		907	594	313
Silt Loam	C		907	594	313
Clay	D		907	643	264
Pasture & Shrubs					
Fine Sand	A	1.02	907	592	315
Fine Sandy Loam	B		907	612	295
Silt Loam	C		907	585	322
Clay	D		907	651	257
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	2.59	907	649	258
Fine Sandy Loam	B		907	624	283
Silt Loam	C		907	640	267
Clay	D		907	610	297
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	12.98	907	616	291
Fine Sandy Loam	B		907	642	265
Silt Loam	C		907	640	267
Clay	D		907	647	260
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**907**	**576**	**331**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.37	-	-	-
Fine Sandy Loam	B		973	656	317
Silt Loam	C		-	-	-
Clay	D		-	-	-
Forest					
Fine Sand	A	13.95	973	551	422
Fine Sandy Loam	B		973	629	344
Silt Loam	C		973	588	385
Clay	D		973	671	303
Pasture & Shrubs					
Fine Sand	A	1.25	973	551	422
Fine Sandy Loam	B		973	620	353
Silt Loam	C		973	644	329
Clay	D		973	647	326
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	10.50	973	586	387
Fine Sandy Loam	B		973	643	330
Silt Loam	C		973	617	356
Clay	D		973	653	320
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	5.83	973	601	372
Fine Sandy Loam	B		973	647	326
Silt Loam	C		973	608	365
Clay	D		973	667	306
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.97	973	478	495
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**973**	**589**	**385**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.20	939	654	285
Fine Sandy Loam	B		939	539	401
Silt Loam	C		-	-	-
Clay	D		-	-	-
Forest					
Fine Sand	A	1.48	939	547	392
Fine Sandy Loam	B		939	586	353
Silt Loam	C		939	649	290
Clay	D		-	-	-
Pasture & Shrubs					
Fine Sand	A	0.41	939	498	441
Fine Sandy Loam	B		939	640	299
Silt Loam	C		939	662	278
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	1.58	939	566	373
Fine Sandy Loam	B		939	618	321
Silt Loam	C		939	621	318
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	7.47	939	613	326
Fine Sandy Loam	B		939	624	315
Silt Loam	C		939	641	298
Clay	D		-	-	-
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**939**	**567**	**372**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.44	909	538	371
Fine Sandy Loam	B		909	578	331
Silt Loam	C		909	549	360
Clay	D		-	-	-
Forest					
Fine Sand	A	18.24	909	534	375
Fine Sandy Loam	B		909	575	334
Silt Loam	C		909	584	325
Clay	D		909	571	338
Pasture & Shrubs					
Fine Sand	A	1.71	909	572	337
Fine Sandy Loam	B		909	596	313
Silt Loam	C		909	585	324
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	17.89	909	627	282
Fine Sandy Loam	B		909	625	284
Silt Loam	C		909	655	254
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	29.78	909	606	303
Fine Sandy Loam	B		909	625	284
Silt Loam	C		909	674	235
Clay	D		909	664	245
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.56	909	462	447
Fine Sandy Loam	B		909	454	455
Silt Loam	C		909	456	453
Clay	D		-	-	-
Mean Annual			**909**	**571**	**339**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.69	914	537	377
Fine Sandy Loam	B		914	571	343
Silt Loam	C		914	585	329
Clay	D		-	-	-
Forest					
Fine Sand	A	8.05	914	574	340
Fine Sandy Loam	B		914	557	357
Silt Loam	C		914	593	321
Clay	D		914	560	354
Pasture & Shrubs					
Fine Sand	A	1.66	914	566	348
Fine Sandy Loam	B		914	582	332
Silt Loam	C		914	658	256
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	3.89	914	571	343
Fine Sandy Loam	B		914	608	306
Silt Loam	C		914	650	264
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	16.20	914	589	325
Fine Sandy Loam	B		914	623	291
Silt Loam	C		914	646	268
Clay	D		914	523	391
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.20	914	493	421
Fine Sandy Loam	B		914	529	385
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**914**	**545**	**369**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.04	-	-	-
Fine Sandy Loam	B		893	432	461
Silt Loam	C		-	-	-
Clay	D		-	-	-
Forest					
Fine Sand	A	5.78	893	583	310
Fine Sandy Loam	B		893	626	267
Silt Loam	C		893	587	306
Clay	D		893	584	309
Pasture & Shrubs					
Fine Sand	A	1.09	893	596	297
Fine Sandy Loam	B		893	632	261
Silt Loam	C		893	596	297
Clay	D		893	537	356
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	8.93	893	606	287
Fine Sandy Loam	B		893	634	259
Silt Loam	C		893	615	278
Clay	D		893	629	264
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	35.46	893	603	290
Fine Sandy Loam	B		893	635	258
Silt Loam	C		893	592	301
Clay	D		893	574	319
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**893**	**599**	**293**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.50	990	509	482
Fine Sandy Loam	B		990	572	418
Silt Loam	C		990	586	404
Clay	D		-	-	-
Forest					
Fine Sand	A	19.74	990	561	429
Fine Sandy Loam	B		990	606	385
Silt Loam	C		990	602	388
Clay	D		990	654	336
Pasture & Shrubs					
Fine Sand	A	2.04	990	553	437
Fine Sandy Loam	B		990	618	373
Silt Loam	C		990	621	369
Clay	D		990	588	402
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	18.06	990	570	420
Fine Sandy Loam	B		990	623	368
Silt Loam	C		990	626	364
Clay	D		990	659	332
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	7.32	990	568	423
Fine Sandy Loam	B		990	631	360
Silt Loam	C		990	652	339
Clay	D		990	619	372
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	1.50	990	476	515
Fine Sandy Loam	B		-	-	-
Silt Loam	C		990	490	500
Clay	D		-	-	-
Mean Annual			**990**	**562**	**427**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.64	961	622	339
Fine Sandy Loam	B		961	574	387
Silt Loam	C		-	-	-
Clay	D		-	-	-
Forest					
Fine Sand	A	16.66	961	591	370
Fine Sandy Loam	B		961	626	335
Silt Loam	C		961	603	359
Clay	D		-	-	-
Pasture & Shrubs					
Fine Sand	A	0.83	961	608	354
Fine Sandy Loam	B		961	635	326
Silt Loam	C		961	640	321
Clay	D		-	-	-
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	11.52	961	584	378
Fine Sandy Loam	B		961	650	312
Silt Loam	C		961	640	321
Clay	D		-	-	-
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	10.44	961	582	379
Fine Sandy Loam	B		961	652	309
Silt Loam	C		961	650	312
Clay	D		-	-	-
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**961**	**608**	**354**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	5.06	897	529	368
Fine Sandy Loam	B		897	551	346
Silt Loam	C		897	601	296
Clay	D		897	608	289
Forest					
Fine Sand	A	54.17	897	552	345
Fine Sandy Loam	B		897	611	286
Silt Loam	C		897	596	301
Clay	D		897	651	246
Pasture & Shrubs					
Fine Sand	A	8.73	897	552	345
Fine Sandy Loam	B		897	582	315
Silt Loam	C		897	584	313
Clay	D		897	611	286
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	59.27	897	574	323
Fine Sandy Loam	B		897	634	263
Silt Loam	C		897	649	248
Clay	D		897	637	260
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	57.79	897	570	327
Fine Sandy Loam	B		897	624	273
Silt Loam	C		897	650	247
Clay	D		897	652	245
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	8.10	897	432	465
Fine Sandy Loam	B		897	448	449
Silt Loam	C		897	671	226
Clay	D		-	-	-
Mean Annual			**897**	**572**	**325**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.10	966	576	390
Fine Sandy Loam	B		966	653	313
Silt Loam	C		966	638	328
Clay	D		966	676	290
Forest					
Fine Sand	A	13.12	966	565	401
Fine Sandy Loam	B		966	614	352
Silt Loam	C		966	599	367
Clay	D		966	657	309
Pasture & Shrubs					
Fine Sand	A	3.09	966	546	420
Fine Sandy Loam	B		966	625	341
Silt Loam	C		966	612	354
Clay	D		966	627	339
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	54.65	966	591	375
Fine Sandy Loam	B		966	652	314
Silt Loam	C		966	661	305
Clay	D		966	654	312
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	14.65	966	581	385
Fine Sandy Loam	B		966	663	303
Silt Loam	C		966	663	303
Clay	D		966	639	327
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.43	-	-	-
Fine Sandy Loam	B		966	525	441
Silt Loam	C		966	502	464
Clay	D		966	540	426
Mean Annual			**966**	**605**	**361**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.29	940	533	407
Fine Sandy Loam	B		940	546	394
Silt Loam	C		940	639	301
Clay	D		-	-	-
Forest					
Fine Sand	A	9.47	940	566	374
Fine Sandy Loam	B		940	579	361
Silt Loam	C		940	580	360
Clay	D		940	587	353
Pasture & Shrubs					
Fine Sand	A	2.79	940	595	345
Fine Sandy Loam	B		940	607	333
Silt Loam	C		940	583	357
Clay	D		940	537	403
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	29.21	940	593	347
Fine Sandy Loam	B		940	608	332
Silt Loam	C		940	623	317
Clay	D		940	628	312
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	7.82	940	572	368
Fine Sandy Loam	B		940	618	322
Silt Loam	C		940	586	354
Clay	D		940	652	288
Open Alvar					
Fine Sand	A	0.06	-	-	-
Fine Sandy Loam	B		940	506	434
Silt Loam	C		940	503	437
Clay	D		-	-	-
Aggregates					
Fine Sand	A	1.39	940	490	450
Fine Sandy Loam	B		940	507	433
Silt Loam	C		940	468	472
Clay	D		940	453	487
Mean Annual			**940**	**587**	**353**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.43	952	479	474
Fine Sandy Loam	B		952	517	435
Silt Loam	C		-	-	-
Clay	D		952	612	340
Forest					
Fine Sand	A	70.50	952	557	395
Fine Sandy Loam	B		952	586	366
Silt Loam	C		952	596	356
Clay	D		952	556	396
Pasture & Shrubs					
Fine Sand	A	37.78	952	546	406
Fine Sandy Loam	B		952	581	371
Silt Loam	C		952	544	408
Clay	D		952	583	369
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	9.56	952	538	414
Fine Sandy Loam	B		952	562	390
Silt Loam	C		952	575	377
Clay	D		952	588	364
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	26.17	952	528	424
Fine Sandy Loam	B		952	599	353
Silt Loam	C		952	629	323
Clay	D		952	559	393
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	1.70	952	474	478
Fine Sandy Loam	B		952	549	403
Silt Loam	C		952	493	459
Clay	D		-	-	-
Mean Annual			**952**	**568**	**384**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	1.74	892	532	360
Fine Sandy Loam	B		892	560	332
Silt Loam	C		892	616	276
Clay	D		-	-	-
Forest					
Fine Sand	A	30.46	892	551	341
Fine Sandy Loam	B		892	606	286
Silt Loam	C		892	591	301
Clay	D		892	531	361
Pasture & Shrubs					
Fine Sand	A	5.20	892	548	344
Fine Sandy Loam	B		892	591	301
Silt Loam	C		892	613	279
Clay	D		892	508	385
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	35.79	892	561	331
Fine Sandy Loam	B		892	625	267
Silt Loam	C		892	624	268
Clay	D		892	569	323
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	43.40	892	585	307
Fine Sandy Loam	B		892	627	265
Silt Loam	C		892	627	265
Clay	D		892	525	367
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	1.75	892	433	459
Fine Sandy Loam	B		892	416	476
Silt Loam	C		892	490	402
Clay	D		-	-	-
Mean Annual			**892**	**574**	**317**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	4.38	868	537	331
Fine Sandy Loam	B		868	613	255
Silt Loam	C		868	598	270
Clay	D		-	-	-
Forest					
Fine Sand	A	47.88	868	559	309
Fine Sandy Loam	B		868	614	254
Silt Loam	C		868	647	221
Clay	D		868	634	234
Pasture & Shrubs					
Fine Sand	A	12.54	868	586	282
Fine Sandy Loam	B		868	610	258
Silt Loam	C		868	640	228
Clay	D		868	645	223
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	46.19	868	581	287
Fine Sandy Loam	B		868	618	250
Silt Loam	C		868	663	205
Clay	D		868	665	203
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	153.92	868	576	292
Fine Sandy Loam	B		868	606	262
Silt Loam	C		868	659	209
Clay	D		868	660	208
Open Alvar					
Fine Sand	A	-	-	-	-
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.07	868	496	372
Fine Sandy Loam	B		868	506	362
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**868**	**605**	**264**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

	Hydrologic Soil Group	Subwatershed Area (km^2)	Mean Annual Precipitation (mm/yr.)	Actual Evapotranspiration (mm/yr.)	Precipitation Surplus (mm/yr.)
Urban Lawns/Golf Courses					
Fine Sand	A	0.12	925	538	387
Fine Sandy Loam	B		925	408	517
Silt Loam	C		925	636	289
Clay	D		-	-	-
Forest					
Fine Sand	A	8.37	925	577	348
Fine Sandy Loam	B		925	603	322
Silt Loam	C		925	589	336
Clay	D		925	612	313
Pasture & Shrubs					
Fine Sand	A	3.34	925	569	356
Fine Sandy Loam	B		925	612	313
Silt Loam	C		925	579	346
Clay	D		925	570	355
Non-Intensive Agriculture (e.g. Hay)					
Fine Sand	A	40.79	925	599	327
Fine Sandy Loam	B		925	637	288
Silt Loam	C		925	622	303
Clay	D		925	641	284
Intensive Agriculture (e.g. Row crop)					
Fine Sand	A	21.31	925	579	346
Fine Sandy Loam	B		925	642	283
Silt Loam	C		925	621	304
Clay	D		925	643	282
Open Alvar					
Fine Sand	A	0.19	-	-	-
Fine Sandy Loam	B		925	528	397
Silt Loam	C		925	534	391
Clay	D		-	-	-
Aggregates					
Fine Sand	A	0.15	925	493	432
Fine Sandy Loam	B		-	-	-
Silt Loam	C		-	-	-
Clay	D		-	-	-
Mean Annual			**925**	**602**	**323**

Notes: Precipitation and Actual Evapotranspiration values are the AVERAGE ANNUAL estimates obtained from the Lake Simcoe PRMS model (Earthfx, 2010).

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Hydrogeological Assessment Submissions

Conservation Authority Guidelines for Development Applications

June, 2013

Note to Reader: This document has been provided in an attempt to standardize the hydrogeological study requirements to support development applications reviewed by Conservation Authorities and should be referred to for guidance purposes only. It is not a legal document and should not be used as such. In addition, this document has not been endorsed by all Conservation Authorities. This document has been drafted to satisfy specific requirements applicable to hydrogeologic studies that meet the needs of most Conservation Authorities and for that reason, not all content of the document may be appropriate for your hydrogeologic study or Conservation Authority. Therefore, while this document may serve as an excellent starting point for undertaking hydrogeologic studies, independent judgment and pre-consultation with your Conservation Authority and municipality is strongly recommended to determine the scope of your study.

Acknowledgements

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1 INTRODUCTION

This guidance document has been developed by the Conservation Authorities Geoscience Group which is made up of Conservation Authority hydrogeologists. The main purpose of this document is to provide information and guidance material to Conservation Authorities, their municipalities and consultant hydrogeologists related to hydrogeological assessment requirements that can be used to ensure comprehensive evaluations of potential impacts associated with development on natural ecological features and functions that are supported by groundwater resources. The intent is that it be used as a resource to promote consistency amongst Conservation Authorities in the development of terms of reference and the Conservation Authority review of the resulting technical studies. The document may also be used as a resource to assist the consulting community in the understanding of the Conservation Authority perspective regarding potential watershed impacts and serve to increase efficiencies and reduce approval timelines.

This guidance document provides a list of recommended requirements for hydrogeological investigations. The checklist outlines specific study requirements depending on the type of development application. Short descriptions of report expectations, report components, as well as some of the resources available have also been provided. Where a Conservation Authority has adopted these guidelines, the scope of the investigation and report requirements should follow this guidance document unless otherwise agreed upon during pre-consultation with Conservation Authority staff. It should be noted, however, that this is a guideline document aimed at consistency and not a legally binding instrument. A municipality and their Conservation Authority may choose to change the scope of the analyses required within their jurisdiction.

In carrying out plan review and regulation responsibilities, Conservation Authorities can be involved in the review of hydrological assessments addressing matters such as:

1. groundwater infiltration and recharge;
2. groundwater discharge and baseflow (supporting streams and wetlands);
3. coldwater fisheries supported by groundwater discharge;
4. water quality and temperature (wetland species/fisheries);

5. groundwater elevations and flow paths (potential to divert flow, cause flooding, divert shallow flow causing impacts on shallow rooted vegetation and wetland features); and
6. cumulative watershed impacts.

In summary, this guidance document may assist Conservation Authority involvement in requirements for hydrogeological submission by:

1. establishing a consistent approach in the review of studies;
2. clarifying upfront the information that should be included in hydrogeological studies;
3. providing a clearer understanding of potential hydrogeological issues and concerns;
4. providing minimum information requirements and best management practices in the preparation of hydrogeological reports;

As indicated earlier, this document attempts to satisfy specific requirements applicable to hydrogeological studies that meet the needs of most Conservation Authorities. The guidance information is not intended to be prescriptive or to replace professional judgment and is based upon a review of current practices for hydrogeologic reviews at Conservation Authorities. Therefore, while this document may serve as an excellent starting point for undertaking hydrogeologic studies, independent judgment and pre-consultation is strongly recommended to determine the scope of a hydrogeological submission.

Where applicable, this document takes into consideration existing provincial (e.g. Oak Ridges Moraine Conservation Plan, Niagara Escarpment Plan, Lake Simcoe Protection Plan, etc.), municipal and Conservation Authority policies and guidelines for information requirements for land development applications. Information contained within this document was drawn from Ministry of Environment and Energy (MOEE) Hydrogeological Technical Information Requirements for Land Development Applications (MOEE, 1995) but simplified and focused on watershed and ecological impacts associated with development.

2 HYDROGEOLOGICAL ASSESSMENT CONTENT AND REQUIREMENTS

It is strongly recommended, that prior to the commencement of any study, the proponent and their consultant(s) undertake pre-consultation with Conservation Authority staff to confirm the scope of the required technical study.

Hydrogeological studies will vary in scope, level of detail, and methodologies depending upon project scale and the study objectives. Sufficient detail should be provided to facilitate a review of the hydrogeological analysis and conclusions.

This guidance document provides a list of recommended requirements for hydrogeological investigations. The checklist (Table 1 in Section 2.2) outlines specific study requirements depending on the type of development application. Section 3 provides a short description of report expectations, report components, as well as some of the resources available. Where a Conservation Authority has adopted these guidelines, the scope of the investigation and report requirements should follow this guidance document unless otherwise agreed upon during pre-consultation with Conservation Authority staff. It should be noted, however, that this is a guideline document aimed at consistency and not a legally binding instrument. A municipality and their Conservation Authority may choose to change the scope of the analyses required within their jurisdiction. Further, where this guideline is adopted, a staged study approach may be taken whereby a preliminary phase of a study may be initially required followed in sequence by secondary, more detailed phases over a period of time. A broader scale of investigation is generally undertaken for larger scale developments such as supporting documentation for secondary plans.

The studies are expected to provide new or updated sources of data, particularly on a local, site-specific scale and identify potential changes in environmental conditions. Data provided should be of a qualitative and a quantitative nature and be suitable to identify a linkage between impact on recharge/discharge capability, long- and short-term watershed planning and environmental quality. The information provided should be sufficient to identify areas of concern. Additionally, it will give the opportunity for developers to indicate where potential concerns can

be mitigated or avoided. In this respect, developments can be accurately assessed from a site specific and broader watershed development impact perspective.

It is strongly recommended that, prior to the commencement of any study, the proponent and their consultant(s) undertake pre-consultation with Conservation Authority staff to confirm the scope of the required technical study (ies).

2.1 QUALIFICATIONS

Proponents of development applications will be required to submit reports which summarize the work completed. These reports shall be prepared by Qualified Persons (QPs). A QP is a licensed Professional Geoscientist or an exempted Professional Engineer as set out in the *Professional Geoscientists Act of Ontario.*

2.2 STUDY CHECK LIST

The general purpose of a planning application hydrogeological study is to evaluate whether the proposed application is likely to result in adverse/negative impacts to the aquifer, existing groundwater users or natural functions of the ecosystem relying on groundwater. As such, the level of detail required in the hydrogeological study is normally expected to correspond with the level of risk posed to the ground and surface water resources, and the level of uncertainty associated with the available information. Where there is a low risk of negative impacts, a QP may be able to complete their report by qualitatively applying hydrogeological principles to existing information, such as in the form of a desk-top study. Where there is a high risk of negative impacts, a detailed site investigation and monitoring program may be required.

Table 1 has been developed to serve as an easy reference resource to identify hydrogeological study requirements in support of planning applications at the Conservation Authority. Table 1 outlines the type of planning application and general requirements most commonly required by Conservation Authorities in the review of different types and scales of Hydrogeological Assessments. However, it should be noted that Table 1 is not a complete list of all types of applications dealt with by each Conservation Authority, nor are all components of the checklist appropriate for every development type/situation. The following checklist represents recommended minimum requirements. Additional information may be required in some cases.

The table is not intended to replace professional judgment. Individual Conservation Authorities should be consulted for additional specific study requirements or conversely where study components may not be required. A description of the guidance checklist components is provided in more detail within Section 3 of this document.

The expected content of a hydrogeological assessment is broken out into three sections:

1) Existing Conditions;
2) Impact Assessment; and
3) Mitigation.

Table 1: Hydrogeological Assessment Check List intended to Support Development Applications

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
1. EXISTING CONDITIONS:							
Introduction and background	☐	☐	☐	☐	☐	☐	☐
Site location and description	☐	☐	☐	☐	☐	☐	☐
Description of: • Topography & Drainage • Physiography • Geology & Soils	☐	☐	☐	☐	☐	☐	☐
Test pits/Boreholes	☐	☐	☐	☐	☐	GNR	☐
Monitoring Wells	☐	☐	☐	☐	☐	GNR	☐
Private Well Survey	☐	☐	☐	☐	☐	GNR	☐
Hydrostratigraphy/Hydrogeology: • Aquifer properties • Groundwater Levels • Groundwater flow direction	☐	☐	☐	☐	☐	☐	☐
Description of surface water features and functions	☐	☐	☐	☐	☐	☐	☐
Water Taking Permit details	GNR	GNR	GNR	GNR	GNR	GNR	☐
Water Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-5 (Water Supply)	GNR	GNR	GNR	GNR	☐	GNR	GNR

Groundwater Assessment	Master Environmental Servicing Plan or Equivalent	Environmental Assessment (EA)	Site Plan Commercial, Institutional, or Industrial	Subdivision or Condominium Development		Single lot Residential	Dewatering
				Municipal Servicing	Private Servicing		
2. IMPACT ASSESSMENT:							
Groundwater Levels	☐	☐	☐	☐	☐	GNR	☐
Pumping Tests*	☐	☐	GNR	GNR	☐	GNR	☐
Groundwater Discharge (Baseflow)	☐	☐	☐	☐	☐	GNR	☐
Water Balance	☐	☐	☐	☐	☐	GNR	GNR
Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
D-5-4 (Onsite Sewage Systems)	GNR	GNR	GNR	GNR	☐	GNR	GNR
3. MITIGATION MEASURES:							
Maintenance of Infiltration/Recharge	☐	☐	☐	☐	☐	GNR	GNR
Maintenance Groundwater Quality	☐	☐	☐	☐	☐	GNR	☐
Monitoring Program	☐	☐	☐	☐	☐	GNR	☐
Contingency Plans**	GNR	GNR	GNR	☐	☐	GNR	☐

NOTES: This table outlines the type of planning application and associated requirements most commonly required by Conservation Authorities in the review of Hydrogeological Assessments. This table is not a complete list of all types of applications dealt with by each Conservation Authority nor is the checklist appropriate for every development situation. Individual Conservation Authorities should be consulted with for specific requirements.

☐ - *Recommended*
GNR – Generally Not Required
** Where development is municipally serviced, these tests will be necessary on a case by case basis (sensitive aquifer/ aquatic considerations).*
***May be scoped, Contingency Plans will not be needed in most cases.*

3 HYDROGEOLOGICAL ASSESSMENT REPORT REQUIREMENTS

This section outlines the minimum requirements that should be provided in a report format for review by Conservation Authority staff. The technical requirements are based on the type of planning application as outlined in Table 1. This section should be used along with Table 1 to ensure all application study recommended requirements are being met.

3.1 EXISTING CONDITIONS

3.1.1 Introduction & Background

The following introductory information should be provided within the report:

- Description of the planning context and relevant policies
- Outline of the scope of the assessment and the specific issues
- Contact information for the landowner and/or person engaged in the activity or land use, if they are different people (e.g. tenant versus landlord)

3.1.2 Site Location & Description

Identification of the site location should include the following information:

- Site location including street address, UTM (or northing and easting, NAD83),
- Township/municipality, lot, concession, size of property, area to be developed/disturbed
- Description of the proposed undertaking or development (size and purpose)
- Identification of the type of site servicing
- Description of construction/site disturbance activities
- Provision of the development plan or draft plan
- Land use designations of the Official Plan(s) and permitted uses in the zoning of the site
- Present land use of the site and adjacent lands
- Regional map
- Local map showing the site, major/minor roads, environmentally sensitive areas, wetland and watercourse features within 500 metres of the site or the area of influence; whichever is greater

3.1.3 Topography & Drainage

The report should include the following information with respect to topography and drainage conditions on the site:

- Description and figure of existing surface topography and drainage patterns of the site
- Description and figure of the proposed site alteration that clearly outlines ground elevations and change in drainage patterns

3.1.4 Physiography

A description of the physiography of the study area should be presented within the report. Its purpose is to provide background information regarding the landscape and the type of landforms present.

- Description of study area physiography
- Regional (watershed or larger) physiography map of the study area showing the site

3.1.5 Geology and Soils

The description of the geology should include both regional and site-specific descriptions. This discussion should contain a description of the overburden and bedrock materials including thickness. Features such as bedrock valleys, karst, and tunnel channels should be noted where known/relevant. The consultant should reference existing relevant regional studies e.g. the Ontario Geologic Survey maps and reports, Ontario Ministry of Agriculture and Foods soils maps, Ecological Land Classification data, Watershed Management reports and Assessment Reports prepared under the Clean Water Act, 2006. An overview of the regional stratigraphy including thicknesses of the formations, and unit name is expected. This description should also include an assessment of soils and infiltration properties inferred from grain size analyses from on-site test pits/boreholes where completed.

The report should also contain a minimum of two cross-sections (along perpendicular lines) to support discussions on geology, stratigraphy and flow patterns. Ideally, the cross-sections will be oriented along the groundwater flow path and across the groundwater flow path. In some cases, the cross-sections will be constructed based on the available data (regional sections along roads, etc.). Borehole logs should be shown on the cross sections with an interpretation of geologic units encountered. For shallow construction, test pit data may be correlated where possible.

- Description of surficial and bedrock material

- Summary of on-site borehole information
- Characterization of soil stratigraphy
- Provision of detailed cross sections showing boreholes and interpolation (a min. of 2 sections are highly recommended).
- Figures:
    - Surficial and bedrock geology
    - Soils
    - Cross sections with plan

3.1.6 Test Pits and Boreholes

On-site investigations comprised of excavation of test pits with a backhoe, or shallow boreholes, are advised to determine surficial geologic and hydro-geologic conditions. While no minimum number of test pits is stipulated, the consultant is expected to construct as many test pits as required by the geo-technical regulations and to use professional judgment to determine the number and location of test pits required to adequately assess the soils and overburden materials present on the site.

Boreholes may be constructed in place of test pits and may be finished as monitoring wells. Like test pits, boreholes should be installed at strategic locations across the site so that potential impacts to sensitive groundwater dependent features can be adequately assessed.

Test pits/boreholes should be advanced to a depth to correspond with the engineering plans associated with planned development. Test pit/borehole locations should be provided on a figure and all data should be provided in an Appendix. Each test pit or borehole record should show the date of excavation and data collection. Ground elevation (masl) must be provided for each pit.

Representative soil samples shall be analysed in the laboratory to determine grain size distribution and an estimate of material percolation rates provided.

- Description of test pits/boreholes on site including date of construction/abandonment
- Grain size analysis and logs are required within the appendix of the report
- Figures:
    - Site test pit/borehole location map including historic boreholes

3.1.7 Monitoring Wells

Monitoring wells provide access to groundwater and may be required to assess short and long term changes in water levels, aquifer properties, hydraulic gradients, groundwater flow direction, connection to surface water features and impacts from dewatering.

It is recommended that a representative number of monitoring wells are constructed onsite and water levels be recorded upon well installation and at least two other occasions to determine stabilized water levels, seasonal influences and the seasonally highest (spring) and seasonally low (fall) water table elevation. A field survey should be conducted to establish reference elevations for each monitoring point and used to provide consistent elevations of soil contacts and groundwater elevations.

It may be necessary to install piezometers instead of monitoring wells where shallow groundwater levels need to be obtained and an area that is not accessible to drill rigs due to the proximity to a sensitive feature(s).

- Description of monitoring wells/piezometers on site including date of construction/abandonment
- Grain size analysis and logs are required within the appendix of the report
- Figures:
    - Site test monitoring wells/piezometers location map including historic boreholes
    - Water levels (with sample dates) and hydrographs if available

3.1.8 Private Well Surveys

In addition to boreholes installed on the site, well data from wells within 500m of site should be used to characterize the groundwater conditions. If used, all relevant/supporting information should be provided within the report.

A house-to-house water well survey within 500 m of the site should be completed to obtain well location, construction details and water levels where possible. In addition, Ministry of the Environment (MOE) water well data within 500 m of the site should be obtained to supplement and confirm the data collected through the house-to-house survey.

- Well data for private wells within 500 m of the site is to be used for the impact assessment

- Figure of the well locations Hydrogeology/Hydrostratigraphy

Hydraulic conductivity (K) of each geologic unit should be characterized or estimated. The proponent may refer to published reports regarding typical hydraulic conductivity properties for the geologic units or utilize data from field tests (single well response tests) conducted on monitoring or test wells on the site. Both K_h and K_v estimates should be provided where available.

To characterize the groundwater conditions at the site, both groundwater levels and flow patterns should be discussed along with the appropriate documentation. This should include: 1) a description of groundwater levels and seasonal fluctuations; 2) direction of groundwater flow; and 3) areas of groundwater discharge along with estimated volumes. A description of both shallow and deep (where appropriate) groundwater flow systems should be provided along with a contour plan showing flow direction. Flow system attributes such as the average horizontal hydraulic gradient, and vertical gradients between hydrogeological units should be included. An indication of seasonal fluctuations and highest seasonal water table is expected over a period of time. Where site grade alterations are anticipated, the water table should be discussed in relation to both pre-development and the finished grade.

Field work should be carried out to assess the potential impacts of the proposed development on sensitive groundwater dependent features such as surface water and wetlands. In addition, the consultant should also provide a description of regional groundwater conditions that can be summarized from regional monitoring well data (where available) and water well records within the vicinity of the site (range and average well depth, range and average pumping rate, shallowest/deepest well, any flowing well conditions, etc.) to supplement site specific data.

- Identification and characterization of hydrostratigraphic units, including local and regional aquifers
- A summary of infiltration and recharge rates associated with the site materials
- Description and characterization of hydraulic conductivity and hydraulic gradients
- General description of surface water/groundwater relationships
- Water well characteristics that may be useful in characterization of the system (well depth, pumping rate, water level, types of wells, flowing conditions etc.)
- Summary of groundwater levels, including seasonal fluctuations and highest water table evaluation

- Groundwater flow characteristics
- Characterization of hydraulic gradients
- General description of surface water/groundwater relationships
- Figures:
    - Water table figure showing shallow groundwater flow direction
    - Piezometeric surface for deeper aquifers showing groundwater flow direction (if applicable to the study)

3.1.9 Description of Surface Water Features

A description of the study area should include all stream orders (Strahler, 1952) and other surface water features (e.g. wetlands) on/or bounding the site.

Surface and groundwater interactions and associated features should be noted. Areas of groundwater discharge should be noted where anticipated; either through water table elevations generated from water well records mapped above or near ground surface elevation or observed in the field. Where groundwater models exist, figures showing simulated groundwater discharge within the gauged reach may be provided. Where tile drainage is known to exist, it should be noted.

- General description of surface water features on or near the site and their relationship to groundwater discharge and location to the water table
- Figure of watercourses and wetlands (provincially and locally significant) on or near the site

3.1.10 Water Taking Permit Details

Where a Permit to Take Water (PTTW) is required from the MOE, the proponent should provide the Conservation Authority with the supporting PTTW information as provided to the MOE (if available). This should include permitted and actual planned taking details as well as special conditions of the permit, where applicable.

- Permit to Take Water application material should to be provided

3.1.11 Water Quality

A description of water quality (ground and surface) should be provided. This is to establish a baseline to assess potential future impacts. The consultant should request monitoring data

where such data are available, and comment on anticipated impacts from the development to both ground and surface water bodies in the area. Where impacts are anticipated, the consultant should suggest ways to mitigate these impacts. Even where these impacts may be unavoidable or necessary to ensure human safety (such as impacts from road salting), such considerations would allow a holistic approach to the maintenance of watershed health.

- A description of surface and groundwater quality

3.1.12 D-5-5 (Water Supply)

Where a planned development is to establish a private water supply, the Ministry of Environment D-5-5 (*Technical Guideline for Private Wells: Water Supply Assessment, 1996*) is the provincial technical guideline that a proponent is generally required to adhere to. It is noted that the health and public works departments of some Ontario municipalities set their own requirements for applications for private servicing. Per the D-5-5 guideline, the capability of the aquifer to supply a sufficient quantity of water in accordance with the requirements of Regional `Guidelines for Small Groundwater Supply Systems August 1987' (MOE, 1995) must be demonstrated. Pumping tests are required as part of the guideline and details for the number of test wells required as well as the duration of the pumping test are outlined.

D-5-5 stipulates the minimum number of test wells as well as other considerations for a given size of property and a survey of private wells within a minimum of 500m of the site. Where there are private water wells in the vicinity of the development, information should be obtained where possible to establish pre-development conditions and to assess impacts during pumping tests. Where possible, new subdivision water supply wells should be developed in deeper confined aquifers to provide protection from surface activities. In locations where a protective aquitard does not exist, or it is limited in vertical thickness and extent, recommendations and decisions associated with the location of wells should take into consideration potential sources of off-site and on-site contamination such as septic leaching beds, farming operations, industrial operations, etc., recognizing, where appropriate, the potential formation of contaminant plumes from these sources.

Regardless of the aquifer chosen for the water supply, the water quality of the upper shallow aquifer, if applicable, should be determined. The shallow aquifer assessment will also include the potential impact of the development to the overall groundwater flow system which could lead

to potential impacts on nearby groundwater dependent features such as wetlands and watercourses.

3.2 IMPACT ASSESSMENT

Developments typically result in impacts including: increased runoff, reduction in infiltration potentially leading to reduced interflow and baseflow discharge, raised or lowered water levels in shallow aquifers, changes in shallow groundwater flow direction, and creation of preferential pathways that may increase susceptibility of contamination in the subsurface. Impacts may be cumulative in areas where intensive development is planned.

The proponent must provide an assessment of potential impacts. The impact assessment will vary depending on the trigger of the hydrogeological assessment (e.g. a significant recharge area may require a water balance). Therefore, each Conservation Authority should be consulted to determine specific policies and associated requirements. In addition, acceptable impacts and appropriate mitigation will require the input of a qualified ecologist and/or biologist.

The assessment of potential development impacts may include, but is not limited to, a description of the following potential impacts:

- Changes to water table elevation (including seasonal fluctuations)
- Changes in groundwater flow direction
- Reduction to infiltration/recharge/discharge rates and volumes on varying time scales (i.e., daily to annual depending upon proximal environmental features)
- Reduction in baseflow
- Impacts on water quality
- Impacts to nearby receiving surface waters (wetlands, watercourses or other significant features)
- Impacts to environmental features

The impact assessment should demonstrate a degree of understanding of site conditions such that the potential impact of the proposed development is recognized and discussed. In addition, the assessment should evaluate the potential changes to existing conditions of the recharge/discharge features and functions resulting from the proposed development. This should include a description of the estimated post-development change from existing conditions

as assessed and the direct and indirect effects over short-term and long-term periods should be described. A pre-development and post-development water balance is expected for most, though not all, development applications (see Table 1). The impact assessment should discuss how pre-development infiltration, evapotranspiration, runoff and flow paths can be maintained. Groundwater quantity, quality, water level patterns (duration, frequency and spatial distribution) and the link to nearby wetlands/watercourses should all be considered.

3.2.1 Groundwater Levels

Where the pre-development shallow groundwater levels are shown to support natural features (wetland and/or discharge to another surface water feature), and where the proposed development will require dewatering or is anticipated to result in a change in the volume and/or alteration to infiltration or recharge rates, an impact assessment of the groundwater levels must be included in the report. The following information should be included:

- Where the proposed development will result in a change in the infiltration/recharge rate, information on how and where water levels will be changed (i.e. increased or decreased)
- Anticipated impacts to sensitive groundwater-dependent features (wetland and watercourse) - mitigation plans to address the impacts (see Section 3.3 Mitigation)

3.2.2 Pumping Tests

Where the proposed development requires a dewatering pumping test, the design and interpretation of the test should be done by a qualified professional. The following information should be provided:

- Rate and duration of pumping test water level data in the form of hydrographs from observation wells used to measure impacts (i.e. shallow and deep aquifer units, mini-piezometers in surface water features, nearby private wells)
- Documentation of the test and interpretations should be provided (i.e. data and output from a manual analysis or from a commercially available software e.g. AquiferTest)

3.2.3 Groundwater Discharge (Baseflow)

As part of their mandate, Conservation Authorities are concerned with the potential impact of development on groundwater contribution to baseflow. In many areas in the province, baseflow represents between 50 and 90% of summer flow in many creeks with established aquatic life

and watershed species dependencies. Dewatering and tile drain or large pipe installations can significantly reduce the volume of baseflow contributions from the subsurface. Changes to shallow groundwater flow patterns induced through development have also been linked to flooding and resulting damage to private property. It is recommended that the proponent ensure that the impact assessment considers and either avoids, or sufficiently mitigates, impacts to baseflow.

- Estimate/quantify reduction to baseflow

3.2.4 Water Balance Analysis

A water balance analysis is required to estimate the pre-development and post-development infiltration and runoff for most development applications as outlined in Table 1. Many Conservation Authorities have policies related to maintaining infiltration. The maintenance of pre-development 'recharge' is a general requirement in the Oak Ridges Moraine Conservation Plan, Lake Simcoe Protection Plan and the Provincial Policy Statement that is often captured in municipal Official Plans. Groundwater frequently supports significant watershed features that are necessary components to the maintenance of a healthy watershed. The purpose of the water budget analysis is to reasonably estimate the current infiltration rates to the subsurface and to then determine how much this rate will change as a result of the proposed development. It is recognized that site specific water budgets are difficult to accurately estimate, the goal should be to assess the difference between pre-development and post development conditions and to mitigate for impacts on infiltration. Please see Section 3.3 for more information on mitigation measures and the example in APPENDIX A: Water Balance Example.

The terms 'infiltration' and 'recharge' are commonly used interchangeably in development application supporting documents. Infiltration relates to the capacity for the soil to allow water to enter the subsurface. Some of this infiltration results in lateral movement in the shallow unsaturated zone where interflow may predominate and some of the infiltration is directed downward to the deeper aquifer system. Recharge is considered to be primarily water that reaches the saturated zone of the aquifer and becomes part of the regional groundwater flow system. The maintenance of infiltration rates is essential to the sustainability of the groundwater flow system which may support local significant ecological features. In addition, infiltration may

move to a regional deeper flow system that may be important at a regional scale from either an ecological or water supply perspective.

It is common practice and an accepted method (by most Conservation Authorities) to provide estimates of surplus using a Thornthwaite and Mather approach where surplus is estimated based on precipitation minus evapotranspiration (Steenhuis and Van Der Molen, 1986). Infiltration portion of the surplus can be estimated by applying the infiltration factors provided in the Ministry of the Environment and Energy Hydrogeological Technical Information Requirements for Land Development Applications (1995). These factors consider slope, vegetation and soils. The remainder of surplus is considered to be runoff.

The Ontario Ministry of the Environment Stormwater Planning and Design Manual (2003) provides representative values for evapotranspiration in Ontario and provides guidance for factors to be used (based on MOEE, 1995 guidance) in determining recharge and runoff. It should be noted that the MOE Stormwater Manual (2003) provides examples only and where possible, local estimates of evapotranspiration and water surplus are to be provided using the Thornthwaite and Mather approach and data obtained from a local climatic station.

The water balance should be prepared by subdividing the development site into zones that reflect drainage outlets. In a simple case, there would be one catchment and one drainage outlet, whereas a more detailed case may have multiple stream catchments and several outlets. These catchments would be further subdivided by similar infiltration properties (i.e. grades, soils and vegetations). Pre-development and post-development water balances may have different catchments depending on the change in drainage patterns, grading, soil and vegetation as a result of the development. These changes should be clearly documented in the report and within a figure.

In most cases, one surplus value may be calculated for the entire site however, it may be requested that the surplus is calculated for each catchment for both pre- and post-development.

Post-development infiltration calculations/estimations should account for changes in imperviousness, vegetation, soil conditions, grading and site design by using adjusted infiltration factors based on these changes. These calculations should take into account the change in

surplus (i.e. decrease in evapotranspiration) in areas where there will be impervious surfaces (e.g. roadways, driveways and rooftops). Where an amount of evaporation is assumed to occur on impervious surfaces these assumptions should be documented and supported accordingly. Generally, a 10-20% loss of precipitation is acceptable for these areas and is highly dependant on the drainage of the site.

With the recent completion of technical studies required under The Clean Water Act, 2006, many of the Conservation Authorities now utilize numerical models to estimate, interception, evaporation, potential and actual evapotranspiration, snowmelt, runoff, infiltration, interflow, and groundwater recharge. Many of these model estimates are based on soils, surficial geology and land use mapping products but may also consider detailed vegetation attributes as well as hydrological cycle functions. These modelling output data may be available from the Conservation Authority and consultants are encouraged to liaise with staff for access to the information.

Regardless of the water balance method applied, site-specific data and estimates should be incorporated as appropriate. The water balance should provide monthly calculations based on Thronthwaite and Mather to show Potential ET, Actual ET, and then use these to determine the annual surplus. However, a monthly water balance may be requested to take into account short-term or seasonal scale in addition to long-term or annual scale effects.

As much as possible, calculations should estimate the amount of infiltration necessary to maintain pre-development conditions. Detailed information on the proposed mitigation measures should be provided to account the loss of infiltration. These details should include location of enhanced infiltration (e.g. infiltration trench), the volume/rate and condition of the soils to support water being infiltrated. Mitigation is discussed further in Section 3.3.1.

At a minimum, the following are required when conducting a water balance analysis:

- Obtain precipitation values from a reliable source such as Environment Canada Meteorological Services for the area (utilize closest station with adequate data)
- Estimate of local values for major water balance components (evapotranspiration, surplus, runoff, and infiltration) for pre-development, post-development and post-development with mitigation conditions

- Calculations of impervious areas that reflect actual conditions based on the proposed site plan or a reasonable range of impervious areas used in those cases where only a conceptual development plan is provided
- Runoff coefficients consistent with generally accepted numbers (e.g. MOE guidelines)
- The water balance is required to take into account the changes to grading/topography and land cover.
- Grain size analysis for both the fill material and on-site soils to confirm fill material is similar to existing soil conditions (maybe recommended).
- Appropriate catchments should be used within the analysis (i.e. delineate catchments based on drainage, grades, vegetation, soils and show how infiltration and runoff will change within these zones for both pre- and post-development).
- Figure of catchments used within the pre- and post-development water balance.
- All calculations should be provided in a table format which clearly demonstrates that inputs (precipitation, additional runoff, water from municipal wells, etc.) are equal to outputs (i.e. infiltration, runoff, water use).

3.2.5 Groundwater Quality

The impact of the proposed development on groundwater quality should be assessed. This may include impacts to a surface water feature from road maintenance, landscaping practices and/or chemical processing or storage. In addition, water quality should be assessed as it relates to:

- Private water supply servicing
- Discharge water as a result of dewatering activities
- Activities that can be undertaken in areas that are delineated as Highly Vulnerable Aquifers (HVAs) and Significant Groundwater Recharge Areas (SGRAs), completed as part of the Assessment Report required in support of The Clean Water Act, 2006.

The existing water quality will need to be determined by sampling and testing of the water source to understand baseline conditions. The parameters analyzed should include general chemistry, bacteriological parameters, and site specific parameters of concern relating to past, existing and proposed land use. Based on the type of proposed development, an appropriate guideline (e.g. Ontario Drinking Water Quality Standards or Provincial Water Quality Objectives) should be selected from which to compare the test results. Other water quality guidelines may be considered for comparison on a case by case basis. Regardless of the aquifer chosen for the water supply, the water quality, and the potential impacts that might arise from the proposed development, within the upper shallow aquifer, if applicable, must be assessed. This

assessment will include the potential water quality impacts to the shallow groundwater flow system as well as to any sensitive groundwater dependent features such as wetlands or watercourses.

3.2.6 D-5-4 Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment 1996 - Septic System Suitability Evaluation

Where a planned development is to establish individual on-site sewage systems, the Ministry of Environment D-5-4 (Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment, *1996*) is the provincial technical guideline that a proponent is generally required to adhere to. The septic system study should be consistent with the minimum requirements of the MOE Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems and any Regional Health Unit and Public Works Departments Guidelines.

The evaluation should take into consideration the hydrogeological conditions of the site and groundwater resource evaluation and integrate these with septic effluent disposal issues.

The septic system suitability evaluation will require soils investigations to determine soil profiles and to estimate percolation for each lot across the site. Soil profiles to a minimum depth of 2 meters are required for each surficial geologic material on the property. The percolation times can be determined by the following methods:

- Grain size analysis of representative soil samples, and/or
- In-situ Percolation tests, and/or
- Guelph permeameter tests

Any one method can be used to determine percolation times but it is recommended that more than one method be used to provide comparative results. Representative percolation times are required for all soil types on the property. Lot specific testing will be required prior to draft approval for the design of private sewage systems.

Percolation times will be used to determine the design of the septic system according to the details given by MOE's Manual of Policy, Procedures and Guidelines for Private Sewage Disposal Systems, and Regional Health Services and Public Works Departments guidelines. All of the limiting factors such as depth to the water table, thickness of acceptable soils, range of percolation times, and distances to wells and surface water, as set out in the MOE and Regional

Guidelines, must be considered in the design. Based on the septic system design and the design sewage flow, the hydraulic loading to the groundwater must be assessed. In determining the hydraulic loading, consideration must be given to the hydraulic properties of the soil materials in which the septic systems will be placed as well as the underlying materials. The loading must be calculated on a lot-by- lot basis as well as in consideration of the development as a whole.

Using all of the information described above, provision of a diagram(s) showing the typical lot plan, building and leaching bed envelopes is recommended for each leaching bed design. Each leaching bed must be designed specific to the conditions on each lot.

3.3 MITIGATION REQUIREMENTS

The majority of development application studies should include recommendation(s) for actions to mitigate potential impacts identified through the hydrogeological studies. Specific measures should be described to mitigate the potential impacts identified in Section 3.2. Mitigation recommendations shall address both the anticipated long-term and short-term impacts. To this end, a monitoring program to address potential impacts prior to, during and post-development may be requested by the Conservation Authority at its discretion. In this case a contingency plan may also be required (see contingency plans).

Mitigation measures might include, but are not limited to:

- Recharge or infiltration basins for urban runoff
- Preservation of setbacks (buffer areas) from recharge/discharge areas
- Sedimentation control plans to prevent siltation of recharge/discharge areas
- Spill Control Plans
- Re-vegetation plans for disturbed areas
- Re-orientation of local surface water drainage
- Provisions for land use and site control plans (e.g., tree cutting restrictions, prohibition of use or storage of specified contaminants, access restrictions, etc.)

3.3.1 Maintenance of Infiltration

The maintenance of infiltration and interflow hydraulic functions is a key target to ensure that discharge to ecological features in close proximity will not be impacted and that the overall

watershed health is sustained. It is recommended that especially in areas delineated as High Volume Recharge Areas, Significant Groundwater Recharge Areas, and Ecologically Significant Recharge Areas, pre-development infiltration should be matched in the post-development scenarios utilizing low impact development solutions. In other areas, professional judgement should prevail.

There are various approaches to mitigating the impacts through Low Impact Development (LID) measures. The proponent is encouraged to plan for such measures, even in areas with low infiltration (i.e. low permeability materials) given that the cumulative impact of development even on these areas can be significant over time. Any recommended approaches should be feasible/practical given the site's surficial native soils. Please refer to the Low Impact Development Stormwater Management Planning and Design Guide, Version 1.0 for some more information (Toronto and Region Conservation Authority and Credit Valley Conservation Authority, 2011).

It should be noted that promoting infiltration from paved surfaces, such as parking lots, roadways, etc. will generally not be approved unless the water has been pre-treated to prevent groundwater contamination.

Another consideration in recommending enhanced infiltration techniques is thermal considerations. Thermal impacts are important to aquatic life in areas where shallow discharge to streams is significant. Where proposed mitigation measures to increase infiltration are identified, these can also be beneficial to creeks with cold water thermal regimes by buffering them from prolonged spikes in air temperatures or inputs of hot urban stormwater. Cold water fish community assemblages have limits to the water temperatures they can tolerate. If these limits are surpassed frequently or for prolonged periods of time, then degradation in the health and the makeup of the fish community can be expected. As such, mitigation measures that promote stormwater infiltration can be of great benefit to enhancing groundwater contributions to cold water creeks thereby protecting and enhancing the thermal stability of these fish communities.

Green infrastructure may include downspouts connected to rain water cisterns, rain gardens, green roofs, vegetated filter strips, dry and bio swales, perforated pipe, infiltration trenches, and permeable pavement. Different approaches may be combined depending on the available

space, configuration, topography and soil types associated with the development. These mitigation approaches are intended to move from the more conventional approach of "pipe and convey" to one that maintains the hydrologic cycle and mitigates water quality impacts. The above is not a complete list of current approaches being applied to development. Technical documents should be reviewed for the details on appropriate approaches that may be recommended for any particular site.

Clean water (roof, walkways, parking lot and road runoff with adequate treatment) may be infiltrated through infiltration trenches that may be modular in design. Enhanced infiltration measures should not receive runoff from high traffic areas where large amounts of de-icing salts are used nor areas where there are several or large sources of pollutants. Site topography and the location of the seasonally high water table are additional considerations.

Where a proposed mitigation measure to increase infiltration has been identified, the following points should be presented/discussed:

- the mitigation method(s) selected;
- location of mitigation measures on site plan
- impacts to groundwater and surface water quality;
- the amount (or range) of the annual enhanced infiltration estimated (based on available literature for each mitigation method recommended);
- limitations - practical matters need to be considered (such as the nature of the native soil and its capacity to allow enhanced infiltration);
- the long term expected success of the measures, for example clogging or siltation of infiltration facilities is a common issue that needs to be addressed;
- long term maintenance of the measure should be discussed (i.e. will maintenance be required and who will undertake such maintenance)
- post-development monitoring - often recommended but it is uncertain whether the monitoring actually occurs and to whom the data is being provided.

The current practice of simply increasing the infiltration factor where a form of mitigation is recommended with no documentation or breakdown calculation on the expected enhancement values for each individual method or how these methods will be evaluated is unacceptable.

It is understood that some developers and or their consultants do work with municipal or Conservation Authority staff in designing and monitoring LIDs but this is not common across the province.

3.3.2 Maintenance of Groundwater Quality

The mitigation measures should address not only water quantity, but also the potential for water quality impacts on groundwater and surface water resources as a result of the development. Depending on the zoned use of the site, water quality concerns will vary. For example, in the case where shallow groundwater flow discharging to nearby streams is significant, potential temperature changes are also relevant, as aquatic life may be impacted. A discussion of potential impacts to sensitive features (i.e. wetlands, watercourses, etc.), along with recommendations for mitigation of the impacts, should be provided.

3.3.3 Monitoring Program

Pre-Development monitoring program:

A monitoring program will need to be implemented prior to development in order to assess existing conditions and to undertake an impact assessment as outlined in Section 3.2. Pre-development monitoring may also assist in addressing public concerns that could arise in the future. The proposed monitoring program should outline the following:

- Location of the proposed monitoring stations;
- Description of the monitoring locations (well type, depth and conditions, wetland, reservoir, stream, etc);
- Frequency of specific data collection;
- Chemical and other parameters to be monitored as well as frequency of monitoring.

Development monitoring program:

In certain cases where an impact assessment indicates that potential impacts may arise during construction, the developer may be required by the Conservation Authority to monitor the impact of development during construction activities. In certain situations a contingency plan may also be required to mitigate observed impacts (see below). The monitoring program would be designed to assess water levels and/or water quality impacts during development activities. Where the MOE has required a monitoring program as a condition of a Permit to Take Water (PTTW) application, these results may also be requested by the Conservation Authority.

In certain cases where an impact assessment indicates that potential impacts may arise during construction, the developer may be required by the Conservation Authority to monitor the impact of development during construction activities. In certain situations a contingency plan may also be required to mitigate observed impacts (see below). The monitoring program would be designed to assess water levels and/or water quality impacts during development activities. Where the MOE has required a monitoring program as a condition of a Permit to Take Water (PTTW) application, these results may also be requested by the Conservation Authority.

Both up gradient and down gradient monitoring wells may be required for baseline data and information. Any required monitoring program would be designed in co-operation with the Conservation Authority to meet their concerns. The program would address:

- rationale for location of the proposed monitoring well(s);
- source of water supply (i.e. communal vs. individual wells);
- zone(s) to be monitored (i.e. depth of well, aquifer receiving effluent, aquifer supplying water, receptors);
- frequency of monitoring;
- necessary parameters to be monitored (e.g. nitrate, bacteria)

Monitoring results will be provided to the Conservation Authority (and municipality) at a pre-determined interval

Post-development monitoring program:

Post-development monitoring will not be required in most cases. In some circumstances the Conservation Authority may request that the development monitoring program (above) continue for a pre-determined amount of time following development activities to assess delayed impacts to groundwater resources.

3.3.4 Contingency Plans

Where determined during pre-consultation or review of the proposed development, a contingency plan may be required. This requirement would come into effect if significant impacts are anticipated from the proposed development. This could include for example, situations where large quantities or long duration of de-watering are expected, where a significant reduction in recharge is possible, or where degradation to water quality might be anticipated.

The report must include contingency plans to address such potential impacts. Contingency plans can be requested to address short and long term impacts depending on the duration and complexity of the development and the potentiality of impacts.

3.4 SUMMARY AND RECOMMENDATIONS

Each report will summarize the study findings and provide recommendations to minimize negative impacts to the groundwater-dependent features and their functions.

3.5 FIGURES

The report should include appropriately scaled figure(s) sufficient to describe the subject property in the context of the environmental resources under discussion. Sections 3.1 through 3.3 outline the suggested minimum recommended figures to be included within the report.

- Figures as outlined in Sections 3.1 through 3.3

3.6 REFERENCES

- List references

3.7 APPENDICES

- Well records and borehole logs
- Pumping test and associated water level information
- In-situ hydraulic conductivity testing results
- Soil analysis results
- Water balance calculations – Table format
- Laboratory water quality results
- Copies of relevant planning policies, agency guidelines

4 REFERENCES

Low Impact Development Stormwater Management Planning and Design Guide, Version 1, Toronto and Region and Credit Valley Conservation, 2010.

Ministry of Environment and Energy. 1995, MOEE Hydrogeological Technical Information Requirements for Land Development Applications.

Ministry of Environment and Energy. 1995, MOEE Hydrogeological Technical Information Requirements for Land Development Applications. Appendix C2: D-5-5 Technical Guideline for Private Wells: Water Supply Assessment, 1996.

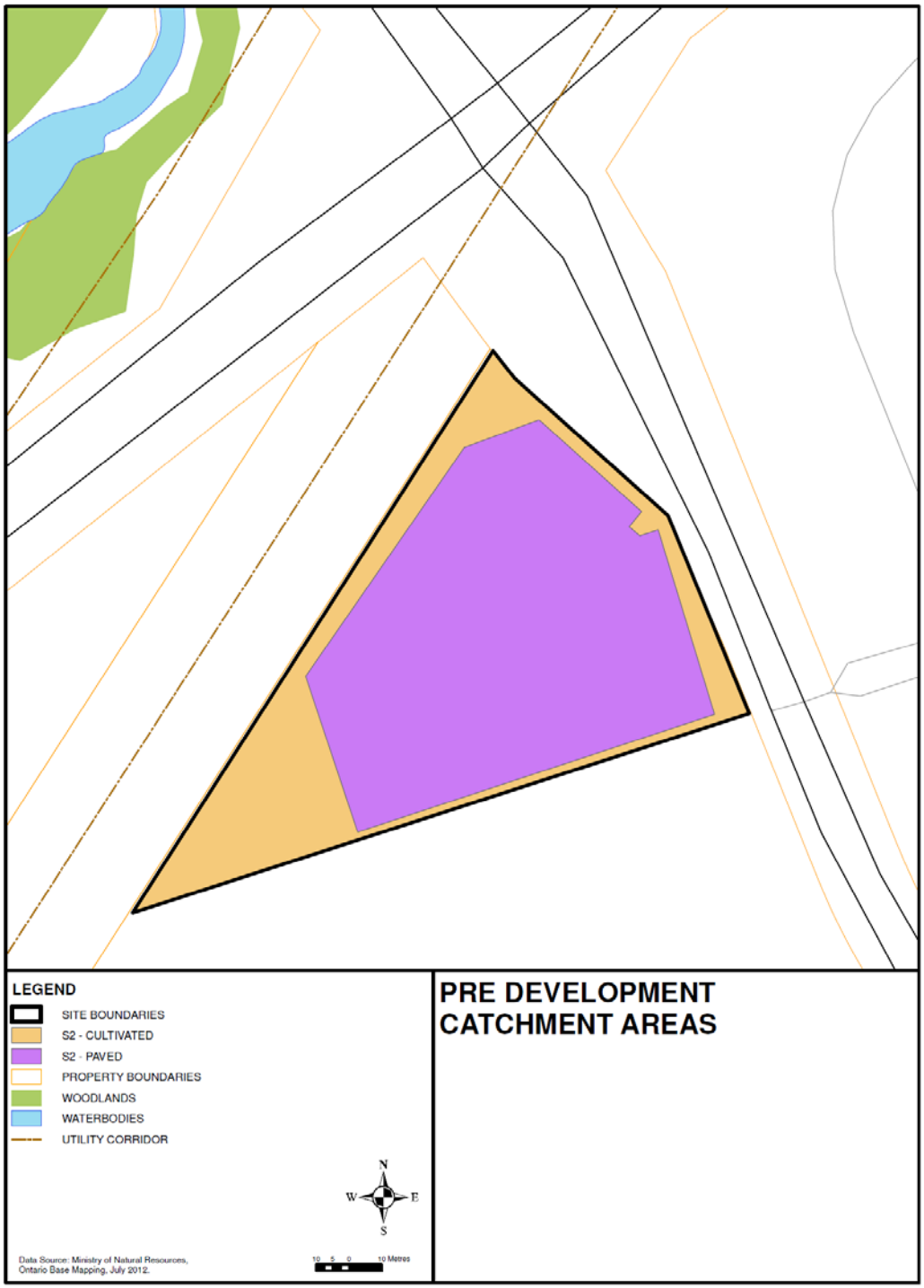
Ministry of Environment and Energy. 1995, MOEE Hydrogeological Technical Information Requirements for Land Development Applications. Appendix C3: D-5-4 Technical Guideline for Individual On-Site Sewage Systems: Water Quality Impact Risk Assessment, 1996.

Strahler, A. N. (1952). "Dynamic basis of geomorphology". Geological Society of America Bulletin 63: 923–938.

Strahler, A. N. (1952). "Hypsometric (Area-Altitude) analysis of erosional topography". Geological Society of America Bulletin 63: 1117–1142

T.S. Steenhuis, W.H. Van Der Molen, The Thornthwaite-Mather procedure as a simple engineering method to predict recharge, Journal of Hydrology, Volume 84, Issues 3–4, 30 May 1986, Pages 221-229, ISSN 0022-1694, 10.1016/0022-1694(86)90124-1

APPENDIX A: Water Balance Example



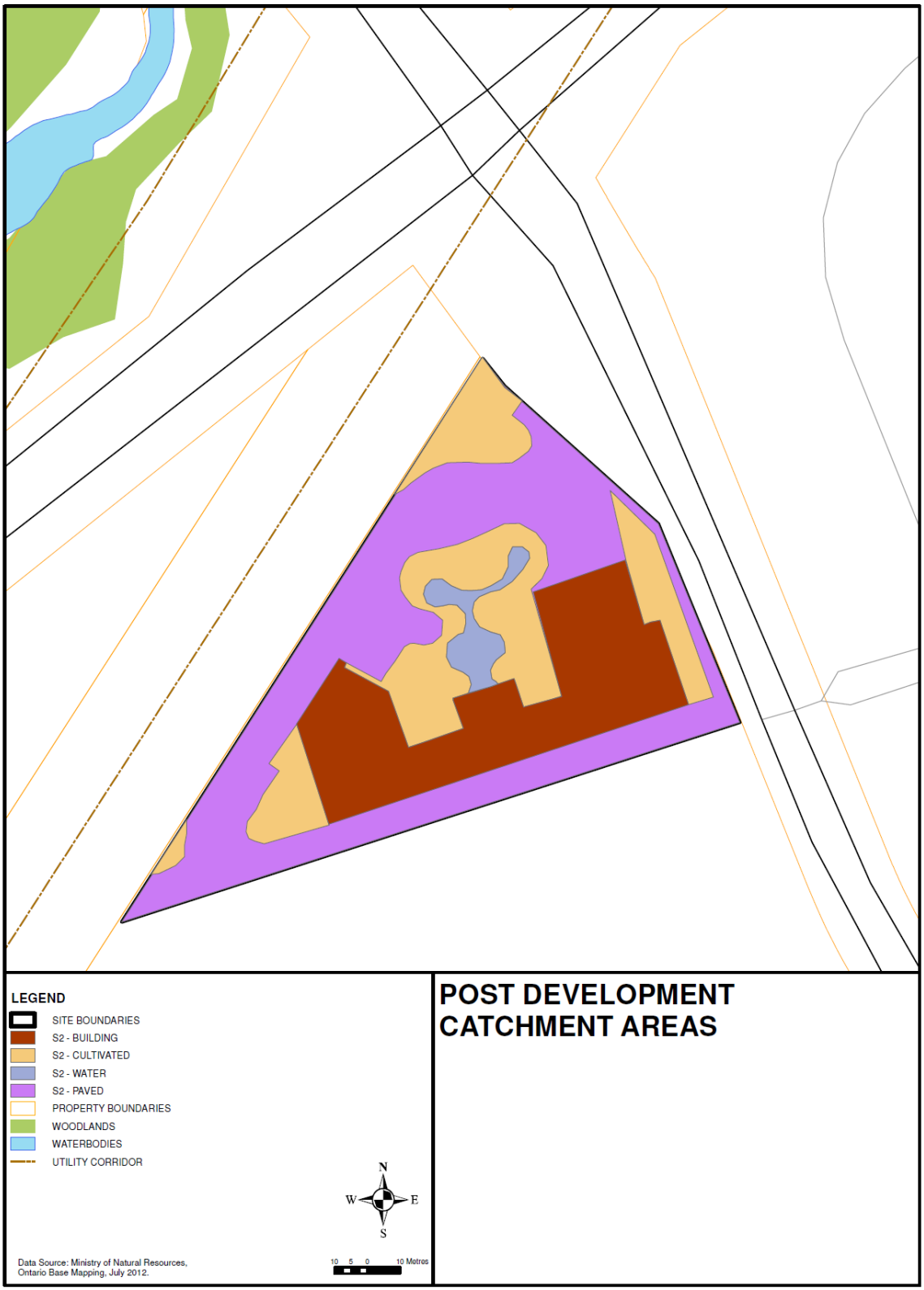

LEGEND
SITE BOUNDARIES
S2 - BUILDING
S2 - CULTIVATED
S2 - WATER
S2 - PAVED
PROPERTY BOUNDARIES
WOODLANDS
WATERBODIES
UTILITY CORRIDOR
N
W
E
S
Data Source: Ministry of Natural Resources, Ontario Base Mapping, July 2012.
10 5 0 10 Metres
POST DEVELOPMENT CATCHMENT AREAS

TABLE 1
CLIMATIC WATER BUDGET: CLIMATE NORMAL 1971-2000 (TORONTO LESTER B. PEARSON INT'L AIRPORT)
Potential Evapotranspiration
TRILLIUM HEALTH CENTRE

	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	-6.3	0.0	0.0	0.81	0.0	52.2	52.2	0.0
February	-5.4	0.0	0.0	0.81	0.0	42.6	42.6	0.0
March	-0.4	0.0	0.0	1.02	0.0	57.1	57.1	0.0
April	6.3	1.4	28.4	1.12	31.8	68.4	36.6	0.0
May	12.9	4.2	61.8	1.27	78.5	72.5	0.0	6.0
June	17.8	6.8	87.7	1.29	113.1	74.2	0.0	38.9
July	20.8	8.7	103.8	1.30	134.9	74.4	0.0	60.5
August	19.9	8.1	98.9	1.20	118.7	79.6	0.0	39.1
September	15.3	5.4	74.4	1.04	77.4	77.5	0.1	0.0
October	8.9	2.4	41.3	0.95	39.3	64.1	24.8	0.0
November	3.2	0.5	13.6	0.80	10.9	69.3	58.4	0.0
December	-2.9	0.0	0.0	0.74	0.0	60.9	60.9	0.0
TOTALS		37.5			604.6	792.8	332.8	144.6

TOTAL WATER SURPLUS **188.2** **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 Toronto Lester B. Pearson Int'l Airport located at latitude 43°40'38.0" N, longitude 79°37'50.0" W, elevation 173.40 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 for 2007 and 2008.

TABLE 2
WATER BUDGET - PRE-DEVELOPMENT
WATER BALANCE/ WATER BUDGET ASSESSMENT

Catchment Designation	Site		
	S2 - Cultivated	S2 - Paved	S2 - Totals
Area (m^2)	4,229	9,427	13,656
Pervious Area (m^2)	4,229	9,427	13,656
Impervious Area (m^2)	4,229	9,427	13,656
Infiltration Factors			
Topography Infiltration Factor	0.15	0.15	
Soil Infiltration Factor	0.1	0.1	
Land Cover Infiltration Factor	0.1	0	
MOE Infiltration Factor	0.35	0	
Actual Infiltration Factor	0.35	0	
Run-Off Coefficient	0.65	1	
Runoff from Impervious Surfaces*	0	0.8	
Inputs (per Unit Area)			
Precipition (mm/yr)	793	793	793
Run-On (mm/yr)	0	0	0
Other Inputs (mm/yr)	0	0	0
Total Inputs (mm/yr)	**793**	**793**	**793**
Outputs (per Unit Area)			
Precipitation Surplus (mm/yr)	188	634	496
Net Surplus (mm/yr)	188	634	496
Evapotranspiration (mm/yr)	605	159	297
Infiltration (mm/yr)	66	0	20
Rooftop Infiltration (mm/yr)	0	0	0
Total Infiltration (mm/yr)	66	0	20
Runoff Pervious Areas	122	0	122
Runoff Impervious Areas	0	634	1,413
Total Runoff (mm/yr)	122	634	476
Total Outputs (mm/yr)	**793**	**793**	**793**
Difference (Inputs - Outputs)	**0**	**0**	**0**
Inputs (Volumes)			
Precipition (m^3/yr)	3,354	7,476	10,829
Run-On (m^3/yr)	0	0	0
Other Inputs (m^3/yr)	0	0	0
Total Inputs (m^3/yr)	**3,354**	**7,476**	**10,829**
Outputs (Volumes)			
Precipitation Surplus (m^3/yr)	795	5,977	6,772
Net Surplus (m^3/yr)	795	5,977	6,772
Evapotranspiration (m^3/yr)	2,559	1,499	4,057
Infiltration (m^3/yr)	278	0	278
Rooftop Infiltration (m^3/yr)	0	0	0
Total Infiltration (m^3/yr)	278	0	278
Runoff Pervious Areas (m^3/yr)	517	0	517
Runoff Impervious Areas (m^3/yr)	0	5,977	5,977
Total Runoff (m^3/yr)	517	5,977	6,494
Total Outputs (m^3/yr)	**3,354**	**7,476**	**10,829**
Difference (Inputs - Outputs)	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 20% of precipitation

TABLE 3
WATER BUDGET, POST-DEVELOPMENT
WATER BALANCE/ WATER BUDGET ASSESSMENT

Catchment Designation	Site				
	S2 - Cultivated	S2 - Paved	S2 - Building	S2 - Water	S2 - Totals
Area (m^2)	3,609	5,977	3,655	415	13,656
Pervious Area (m^2)	3,609	0	0	0	3,609
Impervious Area (m^2)	0	5,977	3,655	415	10,047
Infiltration Factors					
Topography Infiltration Factor	0.15	0.15	0.15	0.15	
Soil Infiltration Factor	0.1	0.1	0.1	0.1	
Land Cover Infiltration Factor	0.1	0	0	1	
MOE Infiltration Factor	0.35	0	0	0	
Actual Infiltration Factor	0.35	0	0	0	
Run-Off Coefficient	0.65	1	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0.8	
Inputs (per Unit Area)					
Precipition (mm/yr)	793	793	793	793	793
Run-On (mm/yr)	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0
Total Inputs (mm/yr)	**793**	**793**	**793**	**793**	**793**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	188	634	634	634	516
Net Surplus (mm/yr)	188	634	634	634	516
Evapotranspiration (mm/yr)	605	159	159	159	277
Infiltration (mm/yr)	66	0	0	0	17
Rooftop Infiltration (mm/yr)	0	0	0	0	0
Total Infiltration (mm/yr)	66	0	0	0	17
Runoff Pervious Areas	122	0	0	0	122
Runoff Impervious Areas	0	634	634	634	1,765
Total Runoff (mm/yr)	122	634	634	634	499
Total Outputs (mm/yr)	**793**	**793**	**793**	**793**	**793**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipition (m^3/yr)	2,862	4,740	2,898	329	10,829
Run-On (m^3/yr)	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0
Total Inputs (m^3/yr)	**2,862**	**4,740**	**2,898**	**329**	**10,829**
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	678	3,789	2,317	263	7,048
Net Surplus (m^3/yr)	678	3,789	2,317	263	7,048
Evapotranspiration (m^3/yr)	2,183	950	581	66	3,781
Infiltration (m^3/yr)	237	0	0	0	237
Rooftop Infiltration (m^3/yr)	0	0	0	0	0
Total Infiltration (m^3/yr)	237	0	0	0	237
Runoff Pervious Areas (m^3/yr)	441	0	0	0	441
Runoff Impervious Areas (m^3/yr)	0	3,789	2,317	263	6,370
Total Runoff (m^3/yr)	441	3,789	2,317	263	6,811
Total Outputs (m^3/yr)	**2,862**	**4,740**	**2,898**	**329**	**10,829**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 20% of precipitation

TABLE 4
WATER BUDGET, POST-DEVELOPMENT WITH MITIGATION
WATER BALANCE/ WATER BUDGET ASSESSMENT

Catchment Designation	Site				
	S2 - Cultivated	S2 - Paved	S2 - Building	S2 - Water	S2 - Totals
Area ($m^{2)}$	3,609	5,977	3,655	415	13,656
Pervious Area (m^2)	3,609	0	0	0	3,609
Impervious Area (m^2)	0	5,977	3,655	415	10,047
Infiltration Factors					
Topography Infiltration Factor	0.15	0.15	0.15	0.15	
Soil Infiltration Factor	0.1	0.1	0.1	0.1	
Land Cover Infiltration Factor	0.1	0	0	1	
MOE Infiltration Factor	0.35	0	0	0	
Actual Infiltration Factor	0.35	0	0	0	
Run-Off Coefficient	0.65	1	1	1	
Runoff from Impervious Surfaces*	0	0.8	0.8	0.8	
Inputs (per Unit Area)					
Precipition (mm/yr)	793	793	793	793	793
Run-On (mm/yr)	0	0	0	0	0
Other Inputs (mm/yr)	0	0	0	0	0
Total Inputs (mm/yr)	**793**	**793**	**793**	**793**	**793**
Outputs (per Unit Area)					
Precipitation Surplus (mm/yr)	188	634	634	634	516
Net Surplus (mm/yr)	188	634	634	634	516
Evapotranspiration (mm/yr)	605	159	159	159	277
Infiltration (mm/yr)	66	0	0	0	17
Rooftop Infiltration (mm/yr)	0	0	10	0	3
Total Infiltration (mm/yr)	66	0	10	0	20
Runoff Pervious Areas	122	0	0	0	122
Runoff Impervious Areas	0	634	624	634	1,755
Total Runoff (mm/yr)	122	634	624	634	496
Total Outputs (mm/yr)	**793**	**793**	**793**	**793**	**793**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**
Inputs (Volumes)					
Precipition (m^3/yr)	2,862	4,740	2,898	329	10,829
Run-On (m^3/yr)	0	0	0	0	0
Other Inputs (m^3/yr)	0	0	0	0	0
Total Inputs (m^3/yr)	**2,862**	**4,740**	**2,898**	**329**	**10,829**
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	678	3,789	2,317	263	7,048
Net Surplus (m^3/yr)	678	3,789	2,317	263	7,048
Evapotranspiration (m^3/yr)	2,183	950	581	66	3,781
Infiltration (m^3/yr)	237	0	0	0	237
Rooftop Infiltration (m^3/yr)	0	0	37	0	37
Total Infiltration (m^3/yr)	237	0	37	0	274
Runoff Pervious Areas (m^3/yr)	441	0	0	0	441
Runoff Impervious Areas (m^3/yr)	0	3,789	2,281	263	6,333
Total Runoff (m^3/yr)	441	3,789	2,281	263	6,774
Total Outputs (m^3/yr)	**2,862**	**4,740**	**2,898**	**329**	**10,829**
Difference (Inputs - Outputs)	**0**	**0**	**0**	**0**	**0**

* Evaporation from impervious areas was assumed to be 20% of precipitation
Approximately 6% of total roof runoff is to be infiltrated to match pre-development infiltration

TABLE 5
WATER BUDGET SUMMARY
WATER BALANCE/ WATER BUDGET ASSESSMENT

Characteristic	Site				
	Pre-Development	Post-Development	Change (Pre- to Post-)	Post-Development with Mitigation	Change (Pre- to Post- with Mitigation
Inputs (Volumes)					
Precipition (m^3/yr)	10,829	10,829	0.0%	10,829	0.0%
Run-On (m^3/yr)	0	0	0.0%	0	0.0%
Other Inputs (m^3/yr)	0	0	0.0%	0	0.0%
Total Inputs (m^3/yr)	**10,829**	**10,829**	**0.0%**	**10,829**	**0.0%**
Outputs (Volumes)					
Precipitation Surplus (m^3/yr)	6,772	7,048	4.1%	7,048	4.1%
Net Surplus (m^3/yr)	6,772	7,048	4.1%	7,048	4.1%
Evapotranspiration (m^3/yr)	4,057	3,781	-6.8%	3,781	-6.8%
Infiltration (m^3/yr)	278	237	-14.7%	237	-14.7%
Rooftop Infiltration (m^3/yr)	0	0	0.0%	37	0.0%
Total Infiltration (m^3/yr)	278	237	-14.7%	274	-1.5%
Runoff Pervious Areas (m^3/yr)	517	441	-14.7%	441	-14.7%
Runoff Impervious Areas (m^3/yr)	5,977	6,370	6.6%	6,333	6.0%
Total Runoff (m^3/yr)	6,494	6,811	4.9%	6,774	4.3%
Total Outputs (m^3/yr)	**10,829**	**10,829**	**0.0%**	**10,829**	**0.0%**

APPENDIX

D RELIANCE LETTER

March 29, 2019

Confidential

The Regional Municipality of York
17250 Yonge Street
Newmarket, ON L3Y 6Z1

Attention: Angelika Masotti

Dear Ms. Masotti:

WSP Canada Group Limited has prepared the following report on behalf of Wycliffe Thornridge Sharon Corners Limited:

— Northwest Corner of Mount Albert Road and Leslie Street SWIAMP, July 2018.

We confirm the above-noted report including the representations, assumptions, findings, opinions and recommendations contained in the report, can be relied on by The Regional Municipality of York.

The report was prepared, developed and performed in a manner consistent with the accepted level of skill and care ordinarily exercised by a reasonable environmental professional under similar conditions, and the report was prepared in general accordance with the recommendations listed in York Region's Source Protection Guidance for Proposed Developments in Wellhead Protection Areas in the Regional Municipality of York (dated October 2014).

Yours sincerely,

Peter Hayes, P.Geo.
Senior Hydrogeologist / Environmental Specialist

Emily Stephenson, B.Sc., G.I.T.
Environmental Scientist

cc: Mr. Gary Bensky, Wycliffe Thornridge Sharon Corners Limited
WSP ref.: 17M-00407-00

582 Lancaster Street West
Kitchener, ON, Canada N2K 1M3

Fax: +1 519 743-8778

T: +1 519 743-8778
F: +1 519 743-8778
wsp.com