City of Oshawa

Municipality of Clarington

LANGMAID RD

WINCHESTER RD E

TOWNLINE RD N

CONCESSION RD 7

hydro one

inergi

Produced By: Inergi LP, GIS Services
Date: July 23, 2013
Fig3-4_Map12-02_ClaringtonTS_EcologicalLandClassification

Source for Future Highway 407 - Municipality of Clarington, 2012

230 kV Junctions

Transmission Lines

44 kV

230 kV

500 kV

Roads

Future Highway 407

Project Area

Watercourses

Water

Wetlands

Municipal Boundary

AG

CUM

CUM1/CUT1

CUM1/THDM4

CUW

FOD5-1

FODM4-4

Hedgerow

MAM2-2

MAMM1-2

SWD4-1

SWT2-2

SWT2-5

CUT

Clarington TS - Ecological Land Classification

Figure 3-4

1:5,000

0 0.1 0.2 km

Forty-six (46) butternut trees were identified in the ELC vegetative inventory within the woodland and western riparian valley along a tributary of the Harmony Creek. In May and June 2012 a Butternut Assessment was conducted in accordance with the protocol provided in the Butternut Health Assessment in Ontario (FGCA, 2008). This assessment identified 35 butternut trees that were considered retainable (Category 2) and 11 butternut trees which were considered not retainable (Category 1). In October 2012, DNA testing was conducted on a number of retainable butternut trees in project area which were deemed to be incompatible with the proposed facilities. The results of the DNA testing showed that one of the butternut originally classified as retainable (Category 2) is not a genetically pure butternut but is in fact a hybrid and therefore is classified as not retainable (Category 1).

On July 1, 2013, changes to the *Endangered Species Act* came into effect which expanded the possible categorization of butternut trees to include an additional category for trees which are considered to have potential resistance to the Butternut Canker and are therefore considered genetically archivable (Category 3). A subsequent re-assessment of the Butternut trees in the project area conducted in October 2013 found that there are two Butternut in the project area which meet the requirements of the archivable (Category 3) designation.

A search of the Natural Heritage Information Centre (NHIC, 2010a) database indicated that no other plant species at risk (SAR) have been observed in the general proximity of the project area. Also no recent (post-1989) observations of any plant species tracked by the NHIC have been recorded in the general proximity of the project area. This was supported by the ELC and the vascular plant survey.

3.1.3 Hydrology and Hydrogeology

Surface Hydrology

The Harmony Creek watershed is primarily located on the glaciolacustrine Iroquois Plain and arises to the north in the South Slope till plain. The headwaters are intermittent exhibiting zero to low summer stream flow. The lower reaches of Harmony Creek are surrounded by an urban area and as a result function mainly to convey urban drainage.

The Farewell Creek drainage basin also extends beyond the Iroquois Plain into the till plain but just south of the Oak Ridges Moraine. The major area of the watershed occupies the Iroquois Plain which has its greatest breadth in this area. Downstream of the headwaters in the till plain, the extensive occurrence of high water table and wetland areas ensures year-round flow in the middle reaches of Farewell Creek and its major tributary, Black Creek. The headwaters are intermittent exhibiting zero to low summer stream flow.

The Farewell Creek and Harmony Creek converge downstream and discharge into Lake Ontario. Historical hydrological data are available from Water Survey of Canada stream flow gauge locations for each of the watercourses (**Table 3-1**). These data indicate that the greatest stream flows occur during the spring freshet in March and April, with lowest flows occurring during the summer.

Table 3-1: Monthly Mean Discharge Data for the Harmony Creek and Farewell Creek[1]

	January	February	March	April	May	June	July	August	September	October	November	December	Annual Mean
Harmony Creek at Oshawa[2]													
Mean (m3/s)	0.491	0.685	0.868	0.732	0.395	0.322	0.263	0.191	0.258	0.264	0.421	0.523	0.443
Minimum (m3/s)	0.065	0.059	0.256	0.195	0.108	0.069	0.044	0.048	0.046	0.061	0.115	0.078	0.267
Maximum (m3/s)	2.31	1.77	1.87	1.69	1.05	2.13	1.35	0.896	1.28	1.14	1.11	1.34	0.853
Farewell Creek at Oshawa[3]													
Mean (m3/s)	0.556	1.27	1.57	1.75	0.573	0.350	0.194	0.211	0.401	0.371	0.726	0.755	0.705
Minimum (m3/s)	0.150	0.126	0.633	0.458	0.145	0.141	0.079	0.063	0.086	0.140	0.314	0.260	0.486
Maximum (m3/s)	1.56	3.03	2.48	4.95	1.13	1.32	0.48	0.758	1.60	0.642	2.14	1.51	1.04

1 Source: http://www.wsc.ec.gc.ca/applications/H2O/index-eng.cfm

2 Station O2HD013; Latitude: 43°53'19"N, Longitude: 78°49'29"W; Gross Drainage area: 41.60 km^2; Period of record: 1980-2010.

3 Station O2HD014; Latitude: 43°53'18"N, Longitude: 78°49'16"W; Gross Drainage area: 58.50 km^2; Period of record: 1980-1993.

These gauge locations are downstream from the project area and do not adequately reflect the water flows in these onsite tributaries. Based on field investigations (2012), the Harmony Creek tributary was dry from May onward and the Farewell Creek tributary was dry from July onward.

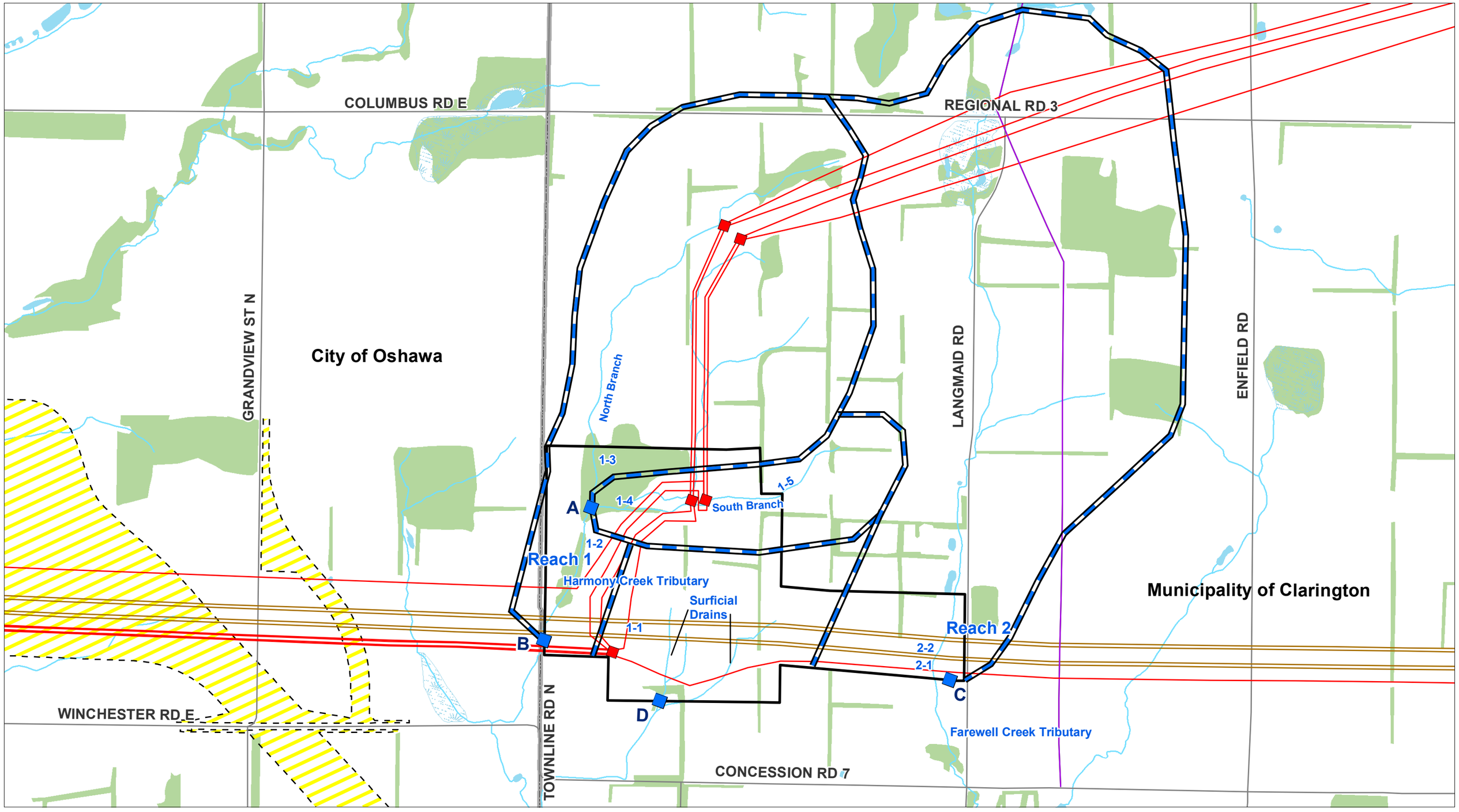
There are four points of defined surface water discharge from the site boundaries, including two intermittent watercourses. Of the two watercourses located within the project area, one is a multi-branched tributary to the Harmony Creek, located within the woodlot north and the valleyland west of the project area, and the second is a tributary to Farewell Creek on the eastern limit of the project area just west of Langmaid Road. In addition, two low-lying surficial drainage features with no defined watercourse attributes (i.e., bed and banks) drain to the south from the middle of the project area, confluencing immediately downstream at Concession Road 7 and flow into the Harmony Creek system. The four catchment areas associated with these discharge points are shown in **Figure 3-5** where they are denoted as catchments A, B, C and D with respective sizes of 24, 78, 142 and 23 ha.

A hydrologic model was created to provide quantitative estimates of the flows to and across the site using the Stormwater Management Hydrologic Model (SWMHYMO) and return-period rainfall events (1:2-year, 1:5-year and 1:100-year). The rainfall events were derived from Intensity-Duration-Frequency data applicable to the Burketon McLaughlin rainfall gauge located approximately 7 km from the site. Six- and 24-hour storm durations were used to understand the hydrologic characteristics under a range of conditions. **Table 3-2** presents a summary of the input rainfall depth and durations.

Table 3-2 Design Rainfall Parameters – Burketon McLaughlin Gauge

Return Period	6-hr Storm Event Depth (mm)	24-Hr Storm Event Depth (mm)
2-year	37.9	47.1
5-Year	50.0	59.2
100-Year	83.1	92.4

To reflect the existing site hydrologic conditions and using CLOCA detailed recommendations for the SWMHYMO model development, the peak flows and runoff



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Produced By: Inergi LP, GIS Services
Date: July 23, 2013
Fig3-5_Map12-02_ClaringtonTS_WatercourseCatchmentAreas

Source for Future Highway 407 - Municipality of Clarington, 2012

230 kV Junctions

Transmission Lines
- 44 kV
- 230 kV
- 500 kV

Roads
Future Highway 407
Project Area
Wooded Area
Watercourses
Water
Wetlands
Municipal Boundary
Key Flow Points (A-D)
Drainage Catchment
1.x - 2.x Reach Inventory Points

Clarington TS - Watercourses and Catchment Areas

Figure 3-5

1:10,000

0 0.25 0.5 km

volumes for the storm durations and events were calculated for each of the catchment areas (**Table 3-3**).

Table 3-3: Existing Conditions Hydrologic Model Results

Subcatchment Area	Storm Duration (hrs)	Storm Event Return Period					
		2-Year		5-Year		100-Year	
		Peak Flow (m3/s)	Runoff Volume (m3)	Peak Flow (m3/s)	Runoff Volume (m3)	Peak Flow (m3/s)	Runoff Volume (m3)
A	6	0.25	1700	0.46	3020	1.22	7700
B	6	0.93	7670	1.69	13560	4.41	34290
C	6	1.06	10760	1.90	19170	4.92	48370
D	6	0.33	1760	0.61	3110	1.59	7830
A	24	0.29	2680	0.46	4190	1.06	9250
B	24	1.07	12040	1.71	18740	3.86	40970
C	24	1.21	17040	1.93	26470	4.34	57740
D	24	0.39	2760	0.61	4300	1.38	9350

The existing conditions model results for peak flow discharges provide considerations that should be taken into account for development designs related to drainage.

Based on field investigations associated with the aquatic survey (**Section 3.1.5**), it was found that the creek systems had no apparent support from ground seepage. The dry nature of the tributaries indicated that they are not supported by groundwater, but rely upon overland flow.

Groundwater Hydrology

The project area lies within the South Slope physiographic region, characterized by till plains with long thin drumlins pointing upslope (Chapman and Putnam, 1984). This large area of gently sloping ground occurs between the highlands of the Oak Ridges Interlobate Moraine to the north and the lowland Iroquois Plain bordering Lake Ontario to the south. The South Slope is primarily underlain by a dense and competent glacial till material, known as

Newmarket Till. As such, this landform and its materials have very little sensitivity relating to human activities (Gartner Lee, 1978).

The core Oak Ridges Moraine physiographic region is located approximately 6 km to the north. It is a terminal moraine composed mainly of sands and gravels with till layers present throughout. The ORM consists of quaternary deposits up to 200 m thick grouped into the following five (5) general classifications as generally described by Geological Survey of Canada (2001) and presented from oldest to youngest:

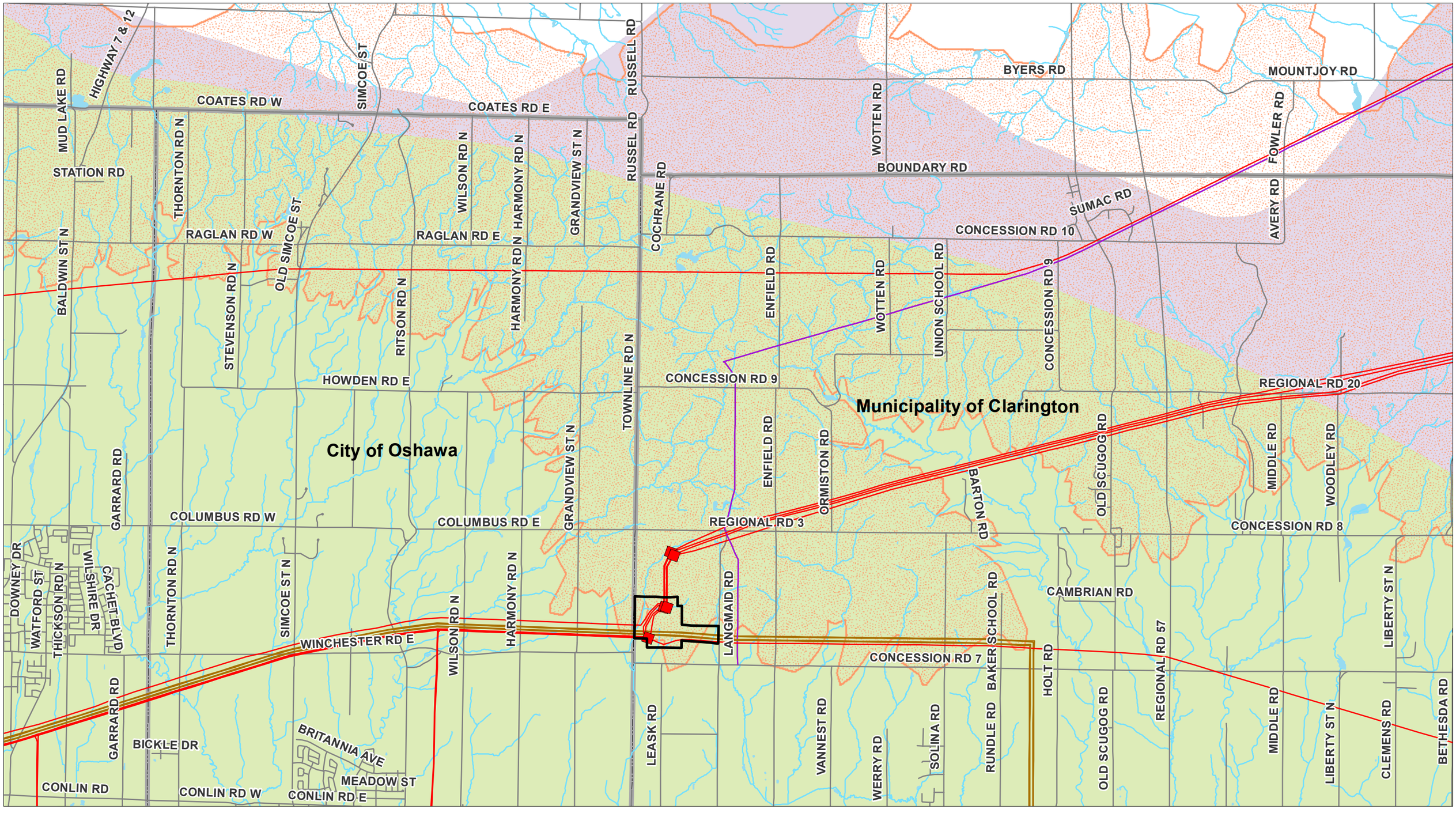
- Lower deposits (tills) which directly overly the bedrock and consist of interbedded layers of sand, silt, clay and till material;
- Newmarket Till described as sandy till with some gravel extending up to 50 m in thickness;
- A regional unconformity that forms the upper drumlinized and channelized surface of the Newmarket Till. Tunnel channels oriented in a north-northeast to south – southwest direction extend throughout the Newmarket Till and may extend to the bedrock. The channels may be 10's of kilometers long, < 4 km wide and up to 150 m deep. The channels primarily contain sandy sediments related to the ORM sediment but may also contain gravel material;
- Oak Ridges Moraine Sediments described as interbedded silt and fine sand with local gravel material, and
- Halton or Kettleby Till overly portions of the ORM and are predominately composed of clayey silt and silt till with interbedded sand and silt material.

Groundwater recharge occurs within the surficial sand and gravel deposits of the Oak Ridges Moraine Sediments and is discharged within seeps and springs towards the lower slopes of the moraine.

An interpretative schematic of the ORM which shows these general classifications, as well as, the relative location of the site in provided in **Figure 3-6.** As identified in this schematic, the site is located well below the ORM Sediments and lies primarily within the surficial Newmarket Till sandy to sandy silt deposits with intermittent Halton Till deposits also being

noted. These till deposits make up the South Slope physiographic region on which the project is located (Chapman and Putnam, 1984).

It should be noted that the ORMCP boundary was delineated on 250 m contours and consequently differs from the actual physiographic units. **Figure 3 – 7** shows the boundaries for the ORM and South Slope physiographic regions and ORMCP. This figure clearly illustrates the difference between the ORM physical and ORMCP boundaries



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Produced By: Inergi LP, GIS Services
Date: Oct 1, 2013
Map12-02_ClaringtonTS_Physiographic

Source for Future Highway 407 - Municipality of Clarington, 2012

- 230 kV Junctions

Transmission Lines

- 44 kV
- 230 kV
- 500 kV

- Roads
- Watercourses
- Water
- Municipal Boundary
- Project Area
- Oak Ridges Moraine Planning Boundary

Physiographic Regions (Chapman and Putnam 1984)

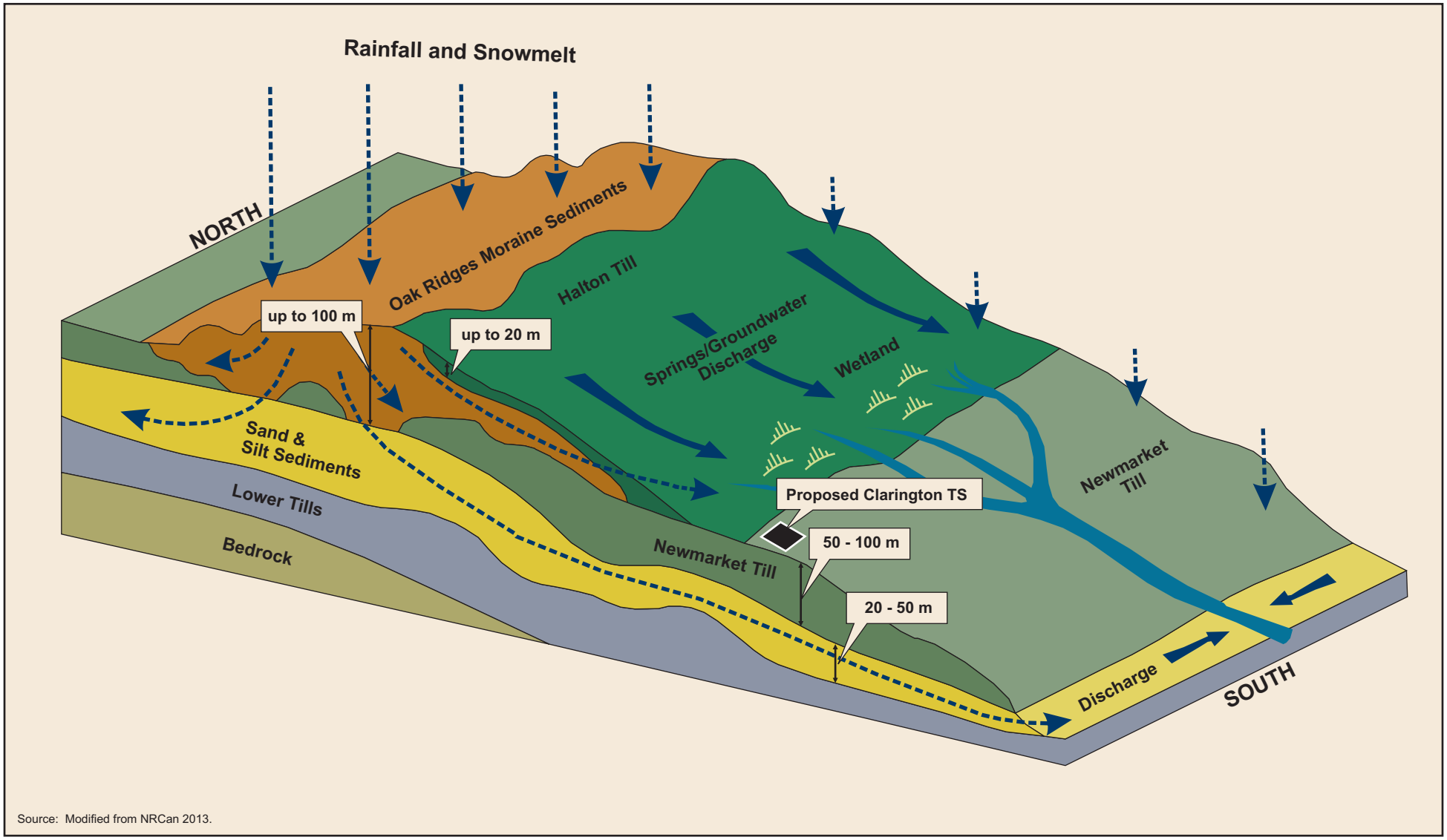
- Oak Ridges Moraine
- South Slope

Figure 3-6

Clarington TS

Study Area Physiography and the Oak Ridges Moraine Conservation Plan Boundary

1:50,000 0 1 2 km



Source: Modified from NRCan 2013.

Filepath: \\cd1220-f02101609\active\60960745\drawing\Corel\ORM_schematic\60960745_ORMschematic_20130321_CEW.cdr

March 2013
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Figure 3-7

Client/Project
Hydro One Networks Inc.
Hydrogeologic and Hydrologic Assessment Report
Clarington, Ontario

Figure No.
3

Title
Schematic of Oak Ridges Moraine

A geotechnical investigation within the project area (Geo-Canada Ltd, 2012) reported that between the overlying topsoil and the borehole depth of about 14 metres, there are two deposits of dense to very dense sandy silt till with isolated seams (lenses) of very dense, saturated silty fine sand/fine sandy silt about 3.2 metres thick. Both deposits of sandy silt till contain wet seams, as well as occasional boulders and cobbles. The layer of silty sand/sandy silt occurs at 5.5 metres below ground surface (BGS) and extends to a depth of 8.3 metres BGS. Additional information from geotechnical investigations undertaken in the project area (exp. 2012, Inspec-Sol 2013) confirms these findings showing a consistent overburden comprised of sandy silt till with isolated lenses of silty sand and sand at similar depth approximating 5 to 10 metres BGS. Profile locations and profiles of the overburden are shown in **Figures 3-8** to **3-10**.

It is expected that these isolated sand lenses, may be the water source for the shallow wells in the area and seepage areas noted by local residents. Generally, the sandy silt till extends from ground surface (within 30 centimetres) to the base of the boreholes at 10 to 15 metres BGS. The sandy silt till retards water penetration and is referred to as an "aquitard." This supports the Gartner Lee (1978) findings stated above and CLOCA's (2011) findings which indicate that the lands upon which the project area is located are not considered areas of Significant Groundwater Recharge, nor within an Intake Protection Zone (CLOCA, 2011).

Aquifer vulnerability is a measure of a groundwater system's intrinsic susceptibility, as a function of the thickness and permeability of overlying layers, to contamination from both human and natural impacts (MAH, 2002). Permeability is the ability of the material to allow water to flow through it. Layers of low permeability material, such as the clayey till material identified in MOE water well records (see below) and the Newmarket till characterizing the project area (geotechnical investigations) act as an aquitard which restricts the upward or downward movement of water and, therefore, decrease the vulnerability of the aquifer to contamination (CLOCA, 2011). Although portions of the surrounding area are categorized by CLOCA as having medium or high aquifer vulnerability, the entirety of the land occupied by the station is considered to have low aquifer vulnerability (**Figure 3-3**). Further, there are no well head protection areas (WHPAs) within the CLOCA Source Protection Area (CLOSPA) as all municipal drinking water supplies for the CLOSPA jurisdiction come from

Lake Ontario. Therefore, the Clarington TS study area does not fall within any well head protection areas.

CLOCA (2011) mapping indicates that no potential groundwater discharge areas (i.e., areas where the interpreted water table surface occurs within 1 metre of the ground surface) have been identified within the project area. One area of potential groundwater discharge and of high volume recharge is located south of the intersection of Townline Road North and Concession Road 7.