Appendix B.2

Hydrogeology Report
Hydrogeology Report

508956-3120-4ERA-0001-02

5 June 2014
CLIENT: City of Mississauga and City of Brampton

PROJECT: HMLRT – Hydrogeology Report

Prepared By: Jennifer Etherington, M.Sc., P.Geo.  Fabienne Etienne, B.Sc.

Signature: ____________________________  ____________________________
Date: June 5, 2014  Date: June 5, 2014

Reviewed and Approved By: Thom Kewen, P.Geo.

Signature: ____________________________
Date: June 5, 2014

ISSUE/REVISION INDEX

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Issue Codes:  RC = Released for Construction, RD = Released for Design, RF = Released for Fabrication, RI = Released for Information, RP = Released for Purchase, RQ = Released for Quotation, RR = Released for Review and Comments.
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1.0 INTRODUCTION

The City of Mississauga (COM), City of Brampton (COB) and Metrolinx are planning to implement a Rapid Transit System including a Light Rail Transit (LRT) Corridor. Rapid transit can contribute to a reduction in single occupancy vehicle use and vehicle-kilometres traveled, and are viewed as a potential economic generator and community re-building tool. It is planned that the LRT will consist of an at-grade transit way (road and rails) and facilities with the following possible cross-sections:

- Existing roadway mixed with traffic converting Hurontario from six-lane cross-section to four-lanes for auto use and two-lane reserved for transit; and,
- Existing roadway in shared lanes with four-traffic lanes such as in Mineola and Main St. South Heritage in South Brampton.

This report will concentrate only on the proposed preferred transit route extending solely within Hurontario-Main Street, hereafter referred to as the HMLRT. The proposed route is approximately 21 km in length between Port Credit in south Mississauga to downtown Brampton in the north. The proposed route also travels through the Mississauga City Centre, and passes mixed density urban neighbourhoods, beginning at the waterfront in the south and terminating at the Brampton GO Station downtown Brampton in the north (as shown in Figure 1).

The purposes of this hydrogeological report are to:

- Summarize available detailed hydrogeological description for the proposed HMLRT route;
- Identify areas of potential concern;
- Evaluate the potential impact of the construction activities along the HMLRT route on the groundwater regime; and,
- Recommend mitigation measures to address the potential impacts.

For these purposes, available information pertaining to the local geology, hydrogeology and infrastructure were reviewed, in conjunction with the proposed construction methods.
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Figure 1: Proposed HMLRT Alignment
2.0 PROPOSED CONSTRUCTION WORKS

A review of the Preliminary Structural Assessment Report (SNC-Lavalin, October, 2013) and the five Preliminary Foundation Investigation and Design Reports (Golder, a,b,c,d,e, 2013) were used to identify potential areas where dewatering may be required for proposed construction. The proposed construction structures are shown in Figure 2.

The HMLRT is proposed to be constructed within the median of Hurontario Street and Main Street along the alignment. Only locations where proposed bridge upgrades/replacements or culvert replacements have been proposed will be discussed further.
Port Credit Go Station:
The HMLRT will be constructed just west of the existing Hurontario Street Subway at GO Transit-Metrolinx. In order to accommodate the LRT guideway, a new bridge will be constructed immediately west of the existing bridge. Retaining walls are required north and south of the new bridge.

Mary Fix Creek Crossing at Eaglewood Boulevard Extension:
As part of the roadway modifications for this project, Eaglewood Boulevard will be extended to Oriole Avenue (west of Hurontario Street). In addition, the existing bridge to the north which carries Inglewood Drive/Old River Road over the creek will be abandoned, and the existing pedestrian bridge to the south will be removed. A new bridge will carry the Eaglewood Boulevard Extension over the Mary Fix Creek.

Queen Elizabeth Way (QEW) Crossing:
The HMLRT will be constructed below the existing QEW Overpass of Hurontario Street. The northbound lanes of Hurontario Street will be relocated to the east of the existing bridge. In order to accommodate the northbound lanes, a new bridge will be constructed.

Canadian Pacific (CP) Crossing:
The HMLRT will be constructed in the median of Hurontario Street, with the northbound and southbound tracks on either side of the pier of the existing Hurontario Street Subway at CP Rail. No structural work is required in order to construct the HMLRT in this location.

Rathburn Road Crossing:
The HMLRT will be constructed in the median of Hurontario Street at this location. The existing Hurontario Street Overpass of Rathburn Road will be modified to carry the LRT guideway.

Cooksville Creek Crossing:
The HMLRT will cross the Cooksville Creek in two locations: at an existing culvert below Hurontario Street and at a new crossing location west of Hurontario Street. No structural work is required to construct the HMLRT above the existing culvert. A new bridge will be constructed at the new crossing location.

Highway 403 Crossing:
The HMLRT will be constructed in the median of Hurontario Street at this location. The existing Highway 403 Underpass of Hurontario Street will be widened to the west in order to accommodate additional lanes along Hurontario Street.

Highway 401 Crossing:
The HMLRT will be constructed in the median of Hurontario Street at this location. The existing Highway 401 Underpass of Hurontario Street and Hurontario Street Overpass of Whittle Road will be modified to carry the LRT guideway.
Highway 407 Crossing:
The HMLRT will be constructed in the median of Hurontario Street at this location. The existing Highway 407 Underpass of Hurontario Street will be modified to carry the LRT guideway.

Etobicoke Creek Crossing (South):
The HMLRT will be constructed in the median of Main Street at this location. The superstructure of the existing Main Street Bridge over Etobicoke Creek (South) will be replaced.

Etobicoke Creek Crossing (North):
The HMLRT will be constructed in the median of Main Street at this location. The superstructure of the existing Main Street Bridge over Etobicoke Creek (North) will be replaced.

Canadian National Rail (CN) Crossing:
The HMLRT will be constructed along Hurontario Street, under the existing Main Street Subway at CN Rail. No structural work is required in order to construct the HMLRT in this location.
3.0 PHYSICAL SETTING

The proposed HMLRT alignment is surrounded by fully developed areas consisting of high-medium density commercial and residential areas throughout Mississauga and portions of the downtown Brampton area. Few natural areas occur along the preferred route within Mississauga with the exception of undeveloped land along the west side of Hurontario between Ambassador and Derry Rd and agricultural lands between Bristol Rd and Matheson Blvd in Mississauga. The preferred alignment in Brampton passes several green space areas exist including: the naturalized Etobicoke Creek valley which alternates from the East to the West side of Main St. between Bartley Run to Harold St. and crosses the preferred alignment just north of Charolais Blvd. and crosses again just north of Nanwood Dr.

3.1 Topography

The topography of the study area is typically flat, and slopes gently from northwest to southeast towards Lake Ontario. The topographic elevation ranges from 220 meters above sea level (masl) at the north end of the study area and slopes gently to approximately 80 masl near Lake Ontario. Localized areas of creek valleys slope towards the creek (NRC, 2012). The study area does not cross any deep creek or river valleys, with the exception of the Etobicoke Creek valley.

3.2 Physiography

The physiography of the study area was formed and influenced by glacial activities and lacustrine processes, and is dominated by till plains and sand deposits from Wisconsin glaciers and the former Lake Iroquois.

The proposed HMLRT corridor runs southwards across the Peel Plain throughout Brampton and Mississauga (which is cut by a strip of the South Slope) and meets the Iroquois sand plain closer to present day Lake Ontario in the Port Credit area (Chapman and Putnam, 1996). Each area has been significantly influenced by Quaternary or Pleistocene glaciations that occurred roughly 100,000 to 12,000 years ago.

The Peel Plain consists of level to undulating clay and silt soils that gradually slope towards Lake Ontario. Many large rivers including the Credit, Humber, Don and Rouge cut deep valleys within the Plain providing drainage into Lake Ontario. Streams including Bronte, Oakville, and Etobicoke Creeks also provide drainage of this clay plain. The surface elevation of this regional area ranges from 150 to 230 masl. The South Slope is described as the southern slope of the Oak Ridges Moraine and includes a strip south of the Peel Plain that consists of ground moraine deposits with irregular knolls or hills. The Iroquois Plain consists of gravelly sand deposits from the former Lake Iroquois shoreline. In the Clarkson area, the Iroquois Plain is cut by grey shale bedrock exposed at surface.
Lake Iroquois was formed within the present day Lake Ontario basin by the retreat of the Wisconsin glacier between 12,500 and 12,000 years ago. The shoreline of Lake Iroquois formed a prominent ridge and lies across the lower portion of the study area which parallels the present day Lake Ontario shoreline. This ridge provides separation of the clay rich silty soils to the north from the sandy lake deposits to the south.

3.3 Geology

The geological setting of the Cities of Mississauga and Brampton consists of Quaternary or Pleistocene geologic deposits that overly older Paleozoic bedrock. The overburden geologic deposits located in the study area either resulted from or were influenced by glacial processes during the Wisconsin glaciation which retreated 10,000 to 12,000 years ago.

3.3.1 Quaternary Geology

The preferred HMLRT alignment is underlain primarily by the Halton Till consisting of fine grain silty clay to silt materials that are stone poor (Karrow, 2005). Glaciolacustrine deposits from the former Lake Iroquois exist from just north of the CP rail line to the present day shoreline of Lake Ontario. These deposits are comprised of sand and gravelly sand and silty sand. Beach gravel of the former Lake Iroquois shoreline is located just north of the CP rail line closer to downtown Mississauga.

Preliminary foundation and geotechnical investigations were completed in May 2013 (Golder, a,b,c,d,e). The subsoil conditions vary between and beyond the borehole locations and do not represent the alignment path as a whole.

**Port Credit GO Station and CPR/Hurontario Street Underpass**

Information for the Port Credit GO Station and CPR Hurontario Street underpass subsurface conditions was collected (Golder, 2013a) and is summarized as follows:

The subsurface conditions at this location consist of:

*Cohesive Fill*
A layer of cohesive fill comprised of silty clay to clayey silt to sandy silty clay was encountered. The top of this deposit ranged from elevations of 83.8 m to 84.2 m with thickness ranging from 0.6 to 0.8 m.

*Sandy Silt to Sand*
A layer of sandy silt, trace clay was encountered below the cohesive fill layer with a thickness of 0.9 m.
Clayey Silt to Silty Clay
Underlying the fill deposit was a clayey silty to silty clay layer, trace to some sand. The thickness was 0.8 to 0.9 m and corresponded to elevations of 82.4 and 82.2 m.

Cohesive Glacial Till
A glacial till deposit consisting of cohesive sandy silty clay and some gravel was encountered in all boreholes. The top of the till deposit ranged from elevations of 83.2 to 81.0 m. All boreholes were completed within the cohesive glacial till layer; however an underlying deposit also glacially derived is expected.

Hurontario and QEW Crossing

Information for the QEW crossing subsurface conditions was collected (Golder, 2013b) and is summarized as follows:

Fill
The fill material encountered predominantly consisted of sand and silt to gravelly sand. The fill layer thickness ranged from 0.8 m to 4.4 m.

Sand to Sand and Silt
A deposit of sand to sand and silt was encountered underlying the fill materials. The top of this layer was encountered between approximate elevations of 97.0 m and 98.7 m.

Clayey Silt to Silty Clay Till
Below the sand and silt layer a deposit of clayey silt till, trace sand and gravel was encountered. The top of this deposit was encountered between approximate elevations of 92.7 m and 95.3 m.

Hurontario and Highway 403 Crossing

Boreholes from several geotechnical investigations were previously completed by the Ministry of Transportation and supplemental boreholes were advanced in May 2013 (Golder, 2013c). Subsurface conditions are summarized as:

Topsoil
Approximately 0.1 m of topsoil was encountered in borehole 13-2. In previous investigations, approximately 0.6 m of topsoil was encountered in borehole 69-7 and 69-9.
Clayey Silt to Silty Clay Fill
Approximately 0.8 m to 1.1 m of fill comprised of brown to grey sandy silty clay was encountered at the ground surface or below the topsoil in boreholes 13-1 and 13-2, respectively. The fill layer generally contains rootlets and trace of organics. In previous investigations, a layer of brown clayey silt with some sand to gravel was encountered in boreholes 67-26, 69-1, 6903 and 69-5. The top of clayey silt layer elevation ranges from 159.8 to 159.2 m with thickness of the layer ranging from 0.5 to 1.5 m.

Clayey Silt to Silty Clay Till
In previous investigations, a deposit of clayey silt to silty clay till with sand and gravel was encountered at the then existing ground surface in boreholes 67-2, 67-6 and 67-1D to 67-3D. The top of the deposit ranges from approximate elevations 160.1 m to 159.5 m and the deposit thickness ranges from 1.0 to 1.5 m.

Main St. and Etobicoke Creek Crossing
Supplemental boreholes were advanced in May 2013 (Golder, 2013d). Subsurface conditions are summarized as:

Fill
Granular portions of fill were encountered in all boreholes comprising of silty sand, gravelly silty sand to sand extending below a surficial asphalt layer to elevations of 203.2 to 199.4 m and varied in thickness from 4.3 to 7.0 m.

Silty Sand
A layer of silty sand, some gravel was encountered in borehole 13-EC3 at the South Bridge (Charolais Blvd.) site. The surface of sand soil was encountered at a depth of 5.3 m corresponding to an elevation of 200.4 m.

Clayey Silt Till
A 4.9 m to 5.0 m thick deposit of till consisting of clayey silt, some sand and gravel was encountered below the fill in boreholes 13-EC1 and 13-EC2. This till was encountered at depths of 4.6 to 7.0 m below ground surface corresponding to elevations of 204.8 to 200.8 m.

Main St. and Proposed Brampton GO Station Platform
Two boreholes were advanced in May 2013 at this location (Golder, 2013e). Subsurface conditions encountered are summarized as:
Approximately 0.1 m thick asphalt layer was encountered at both boreholes, underlain by 1.8 to 2.6 m of heterogeneous fill material corresponding to elevations of 215.4 to 214.7 m. The fill consists of upper non-cohesive and lower cohesive layers. The non-cohesive fill varies from sand containing trace to some gravel and trace silt, to gravelly sand containing trace silt. The cohesive portion of fill varies in composition from sandy silty clay to clayey silt containing some gravel and also contained organics, asphalt and brick fragments.

**Silty Clay Till**
Underlying fill materials a deposit of cohesive glacial till was encountered in both boreholes. The till deposit consisted of sandy silty clay containing some gravel. The surface of the till deposit was encountered at approximate depths ranging from 1.9 to 2.7 m below ground surface, corresponding to Elevations of 215.4 to 214.7 m. The deposit thickness ranged from 3.5 to 3.7 m.

### 3.3.2 Bedrock Geology

The bedrock along the preferred HMLRT alignment consists of shale of Ordovician age that is interbedded with limestone in some areas, and is known as the Georgian Bay Formation in the south and central portions of the alignment. In many places, this shallow gray to blue-gray shale has been weathered. Exposures of limestone deposits exist within the Port Credit area and closer to downtown Mississauga (Karrow, 2005), although were not observed during the windshield study of the preferred alignment completed by SNC-Lavalin staff in June 2012. In the northern part of the alignment, the bedrock consists of a reddish coloured shale known as the Queenston Formation. Bedrock encountered in boreholes advanced for the preliminary geotechnical investigations in key areas are summarized below (Golder, 2013a,b,c,d,e).

**Port Credit GO Station and CPR/Hurontario Street Underpass**

Grey shale bedrock was encountered at elevations about 73.9 and 75.5 m. Limestone with grey shale interbeds was also noted.

**Hurontario and QEW Crossing**

Shale bedrock was encountered approximately 2.3 m and 10.7 m below existing ground surface corresponding to elevations of 91.3 to 93.7 m. No coring was completed. The shale was anticipated to be slightly weathered to fresh, laminated, grey and containing strong to very strong limestone interbeds and clay seams.
Hurontario and Highway 403 Crossing

Bedrock was cored in borehole 13-1 with cored depths ranging from 2.0 to 7.6 m. The bedrock encountered consists of grey shale with grey limestone interbeds. The surface of the bedrock occurs at elevations of about 159.3 m to 159.9 m and is classified as slightly to moderately weathered, thinly to medium bedded, fine grained, faintly porous, very weak to weak shale of the Georgian Bay Formation with slightly weathered, thinly bedded, fine grained, faintly porous, medium strong limestone interbeds.

Main St. and Etobicoke Creek Crossing

Red Shale bedrock of the Queenston Formation was encountered at all four recently drilled boreholes corresponding to elevations of 197.4 m in the North (Nanwood Blvd.) to 199.4 m in the south (Charolais Blvd.). The samples consist of highly to moderately weathered to fresh, thinly laminated, very weak to weak red with trace grey layers of shale bedrock with interbeds of strong to very strong limestone. A clay seam was noted in core samples in borehole 13-EC2 at the borehole base (3.0 m).

Main St. and Proposed Brampton GO Station Platform

Shale bedrock of the Queenston Formation was encountered in both boreholes at this location. The approximate depth to bedrock was 5.6 to 6.2 m corresponding to elevations of 211.7 to 211.2 m in boreholes 13-B1 and 13.B2 respectively.
4.0 HYDROGEOLOGY

4.1 Regional Hydrogeology

The thin overburden materials and dense till layer include few thick sand units and result in little to no overburden aquifers. The shallow shale bedrock and silty-clay till deposits prevent deep groundwater recharge to underlying materials.

In the Brampton area, the Oak Ridges Aquifer complex lies north of Mayfield Road and north of the study area. As interpreted from the TRCA (2011), some of the hydrostratigraphic units which are considered to influence groundwater flow within the Etobicoke Creek watersheds and may be present in the study area are:

Layer 1: Surficial Aquifer (recent deposits and weathered Halton Till)
Layer 2: Halton Aquitard
Layer 3: Oak Ridges Aquifer (or equivalent) Complex / Mackinaw Interstadial (ORAC)
Layer 4: Newmarket Aquitard
Layer 5: Thorncliffe Aquifer Complex (TAC)
Layer 6: Sunnybrook Aquitard
Layer 7: Scarborough Aquifer Complex (SAC)
Layer 8: Weathered Bedrock

4.2 Local Hydrogeology

There were no large aquifer units encountered below the preferred HMLRT alignment. As interpreted from previous geotechnical studies (Terraprobe, 1996; MNA, 1997; Trow, 2000, Golder, 2013a,b,c,d,e) within City of Mississauga and City of Brampton, shallow groundwater exists within the upper weathered shale bedrock and/or perched groundwater in upper sand lenses and till layers. The general direction of shallow groundwater flow mimics bedrock topography and is southeasterly to southerly towards Lake Ontario, and is locally influenced by creeks (such as Etobicoke Creek that ultimately outlet to Lake Ontario).

Shallow Groundwater Conditions

As interpreted from previous studies by others, groundwater within the study area in the City of Mississauga ranges from 3.3 meters below grade (mbg) near the CP Rail overpass (Terraprobe, 1996), to between 3.4 to 6.1 mbgs near Courtney Park Boulevard (Trow, 2000). Groundwater may be present in sand lenses within the glacial till or Lake Iroquois sand deposits, however, is not expected to provide enough water for water supply based on a review of the available Ministry of the Environment water well records.
As interpreted from the TRCA (2010), the Halton Till is known to exist below the area of the proposed route. This near surface till layer is considered to be an aquitard, and provides little groundwater supply and prevents deeper recharge.

**Local Groundwater Conditions**

At the time of the Preliminary Foundation Design field work (Golder, 2013a,b,c,d,e), the groundwater conditions within the project area were assessed by observing the water levels in open boreholes and piezometers installed in select locations. Groundwater was identified in most boreholes at completion, however, these groundwater level measurements provide limited information on the baseline water conditions at each site and do not necessarily represent static groundwater levels at the time, nor do they consider seasonal changes in groundwater elevations. As such, additional groundwater level measurements should be made prior to completion of design and prior to the start of construction. Table 1 summarized observed groundwater levels taken at borehole completion (where available).

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<td>Open Borehole</td>
</tr>
<tr>
<td>(Charolais Blvd.)</td>
<td>13-EC4</td>
<td>205.5</td>
<td>5.3</td>
<td>200.2</td>
<td>May 16, 2013</td>
<td>Piezometer</td>
</tr>
<tr>
<td>Brampton GO Station</td>
<td>13-B1</td>
<td>217.3</td>
<td>7.3</td>
<td>210.0</td>
<td>May 12, 2013</td>
<td>Open Borehole,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>after soil drilling</td>
</tr>
<tr>
<td></td>
<td>13-B2</td>
<td>217.4</td>
<td>Dry</td>
<td>Dry</td>
<td>May 12, 2013</td>
<td>Open Borehole</td>
</tr>
</tbody>
</table>

*It should be noted that many groundwater levels were recorded over 8 years ago and groundwater conditions may have changed over time (Golder, 2013b).

The groundwater conditions have likely changed over the last 50 years and historical groundwater levels have not been provided in Table 1. At Highway 403 and Hurontario, the two boreholes advanced were dry upon completion, however, previous investigations in 1973 indicated that groundwater levels were generally at or close to ground surface, with a maximum depth of about 2.6 m below the then existing ground surface, corresponding to groundwater elevations of 159.8 and 157 m (Golder, May 2013c).
At the Etobicoke Creek crossing, it is anticipated that groundwater levels are similar to the creek water levels and may be influenced by creek level seasonal fluctuations.

**Deeper Groundwater Conditions**

As interpreted from CVC (2011), groundwater levels in wells installed more than 25 m deep range from 90 to 160 masl along the preferred alignment from Port Credit to Highway 403. The general flow direction was interpreted to be in a southerly direction towards Lake Ontario.

The deeper groundwater conditions along the proposed alignment have not been investigated in detail by CVC (2011); however, based on the TRCA (2010) study, they are expected to reflect deeper hydrostratigraphic units including the ORM Aquifer, ORM aquitard, Thorncliffe and Scarborough Formations throughout the alignment length. Based on a review of MOE water well records, approximately 21 wells were installed over 25 m deep, prior to the 1970s and within 100 m of the alignment for domestic, livestock and commercial purposes. This suggests that a deep aquifer may exist below the alignment.

### 4.2.1 Recharge and Discharge Areas

Groundwater recharge and discharge areas may affect groundwater contamination or distribution. For instance, in a recharge area, contaminants that infiltrate to the water table with downward flowing groundwater may impact an underlying aquifer. In contrast, in discharge areas, groundwater contamination at the water table may still occur but downward migration is minimal, and hence potential impacts on an underlying aquifer will be less pronounced, if any.

As interpreted from CVC (2011), groundwater recharge is expected to occur within the gravelly sand deposits of former Lake Iroquois, however, due to the underlying shale or clay rich till materials minimal recharge to underlying aquifers is anticipated to occur. Recharge in the Brampton area is also expected to be low as interpreted from TRCA (2010) based on the clay rich till materials of the Halton Till. The HMLRT alignment does not lie in a significant recharge area as per the CTC studies (2012a,b).

Groundwater discharge areas are not well studied within the HMLRT study area; however, groundwater is expected to discharge to creeks and rivers where permeable deposits exist. In some cases, it is expected that groundwater discharge provides seasonal base flow to some watercourses. Presently, groundwater discharge has been monitored (TRCA, 2010) outside of the proposed alignment area along the Etobicoke Creek to the north and east of the alignment.
4.2.2 Preliminary Assessment for Construction Dewatering

Sites with construction activities to be conducted below ground surface such as culvert placement/widening, bridge adjustments, creek alterations and/or relocation of subsurface utilities may require construction dewatering. Dewatering of greater than 50,000 L per day will require a MOE Permit to Take Water (PTTW) and accompanying detailed Hydrogeological study to be completed by a qualified person during the detailed design stage. The Permits are issued by the Ministry of the Environment and applications can take up to 90 days to be approved.

Port Credit:
Port Credit GO may require additional hydrologic and hydrogeological investigations to further assess and mitigate flooding if below ground construction to the bridge underpass is conducted.

Downtown Mississauga:
Proposed construction of the widening of the existing bridge to cross Highway 403, the modification of the existing Hurontario Street Overpass of Rathburn Road to carry the LRT guideway and the construction of the new bridge for the new Cooksville Creek Crossing may require dewatering for rehabilitation/placement of bridge footings. A detailed hydrogeological investigation will be required and based on the findings of this investigation, a PTTW may be required at this location.

Brampton Etobicoke Creek:
At this time, the preliminary design proposes that the LRT alignment is to run along the center of Main St. and the existing travelled lanes will be rerouted/shared to accommodate both the LRT and automobile traffic. A full bridge replacement and new foundations will not be required at the bridge locations crossing Etobicoke Creek. No groundwater impacts are anticipated at this time and a PTTW is unlikely to be required for the proposed construction works.

4.2.3 Areas Vulnerable to Groundwater Contamination

As interpreted from CTC (2012a,b) Source Protection Studies, the proposed route at the CN bridge underpass and the route south of Highway 403 has high groundwater vulnerability due to shallow overburden sandy soils. Areas to the north of Highway 401 have moderate to low vulnerability.

The proposed LRT is a surficial route which will not cause significant environmental concern with respect to soils/groundwater along the majority of the alignment. The current development and existing structures in both Brampton and Mississauga are not known to affect current groundwater conditions. Potential for environmental impacts to groundwater from construction activities and potential contamination from certain business activities are considered to be minimal. Groundwater vulnerability is related to several factors where:
• The water table is shallow;
• The overburden is either very thin or absent in much of the area; and,
• Limited areas of shallow low permeability confining layers.

A moderate to high groundwater vulnerability exists where construction encounters shallow sands of the Iroquois Plain in the Port Credit area and the sandy surficial soils at Highway QEW. In other parts of the alignment, the silty clay till overburden and shallow weathered shale bedrock limit downward infiltration of contaminants resulting in low groundwater vulnerability due to proposed construction activities. All other preferred route options outlined in Design Workbook2 are considered to have low impacts to groundwater conditions.

4.2.4 Potential for Soil and Groundwater Contamination

Contaminated soil is often found on highway verges and adjacent lands, particularly those adjacent to activities such as gas stations, repair shops and scrap yards. Soil can be contaminated with petroleum hydrocarbons from spills and leaks from vehicles and fuel storage tanks. Metals-contaminated soil is occasionally encountered on or adjacent to properties associated with industrial processes or dump sites. A list of Potentially Contaminating Activities is identified in Table 2 of Ontario Reg. 153/04 amended 511/09.

4.2.5 EcoLog ERIS Database Search

EcoLog ERIS specializes in providing environmental and historical information compiled from government and private source records. An EcoLog ERIS database search was commissioned in order to identify actual or potential environmental concerns in the vicinity of the study area. The EcoLog ERIS Report (Project No. 20110509034) is available upon request.

The EcoLog ERIS database search did not identify potential environmental concerns directly within the study area. Relevant information pertaining to potential environmental concerns within a 250 m radius of the preferred alignment is summarized in the table below.

Table 2: EcoLog ERIS Actual or Potential Contaminated Site

<table>
<thead>
<tr>
<th>Database</th>
<th>Mississauga</th>
<th>Brampton</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial Fuel Oil Tanks</td>
<td>5</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Chemical Register</td>
<td>6</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>List of TSSA Expired Facilities</td>
<td>122</td>
<td>91</td>
<td>213</td>
</tr>
<tr>
<td>Contaminated Sites on Federal land</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
For surrounding properties, the findings in the EcoLog ERIS report indicated that the preferred HMLRT alignment is located within an area of commercial businesses that are or were registered generators of subject waste. Among the five hundred and eight (508) properties registered generators of subject waste, subject wastes generated include Paint/Pigment/Coating Residues (Waste Code 145), Aromatic Solvents (Waste Code 211), Waste Oils and Lubricants (Waste Code 252), Oil Skimmings & Sludges (Waste Code 251), Waste Oils / Sludges (Waste Code 251), Emulsified Oils (Waste Code 253), Petroleum Distillates (Waste Code 213) and Light Fuels (Waste Code 221).

The report also identified the locations of one hundred and twenty eight (128) retail fuel storage tanks/fuel storage tanks within a 250 m radius of the alignment. These tanks have capacity ranging from 2,200 L to 150,000 L. These properties are listed as gasoline stations or others business including Bell Canada. The Private and Retail Fuel Storage Tanks database identifies forty nine (49) tanks ranging from 2,000 L to 180,000 L owned by several different companies. These fuel storage tanks are located within approximately 250 m of the alignment.

The Ontario Spill Database indicated that one hundred and ninety eight (198) oil spills ranging from 1 L to 1,850 L occurred with a 250 m radius of the alignment. A 1,850 L spill of furnace oil occurred at the Mississauga Hospital (100 Queensway West) located within 150 m west of the site on April 26, 2004. Environmental impact due to this spill was considered possible.

Within a 250 m radius of the alignment, two hundred and seventy three (273) properties are listed in the Scott’s Manufacturing Directory.

The Water Well Information System (WWIS) database identified two hundred and nine (209) wells (domestic, commercial and observation wells).
4.2.6 **Aerial Photographs Review**

A review of aerial photographs from the National Aerial Collection (supplied by National Air Photo Library to Ecolog) was completed for the years 1960, 1976, 1988 and 2009 for the preferred alignment and surrounding areas. These years were selected for review to investigate previous land use and site development history. These photos were all taken at high altitude and the scale of the photographs precludes a detailed interpretation. Copies of portions of the aerial photographs for the selected years are provided in Appendix A. Overall interpretations are summarized below:

**Table 3: Historical Aerial Photographs**

<table>
<thead>
<tr>
<th>Year</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td><strong>SITE</strong> Mississauga: Hurontario Street is developed as well as the Queen Elizabeth Way (QEW), the Highway 401 including the interchanges and the major intersections. Brampton: Steeles Avenue West, Main and Queen Street West are developed. The rail road track is built.</td>
</tr>
<tr>
<td></td>
<td><strong>SURROUNDING AREA</strong> Mississauga: The area south of the QEW is developed and appears of residential/commercial uses. Port Credit River is visible west of the alignment. The rail road track is built north of Dundas Street West. The area north of the QEW and south of these tracks is lightly developed and appears of residential/commercial and agricultural uses. North of the tracks, the area is not developed and/or is of agricultural use. Brampton: Fletcher and Etobicoke Creeks are visible in the proximity of the alignment. From Derry Road East to Nanwood Drive, the area is not developed and/or is of agricultural use. North of Nanwood Drive to the end of the alignment, the area is developed and appears of residential/commercial uses.</td>
</tr>
</tbody>
</table>
### Year | Observations
--- | ---
1976 | **SITE** Similar to the 1960 aerial photo.  
**SURROUNDING AREA** Mississauga: The residential/commercial area extends to Burnhamthorpe Road West. The commencement of Square One shopping centre development is noticeable.  
Brampton: The residential/commercial area extends to Steeles Avenue West.

1988 | **SITE** Mississauga: Highway 403 and the interchange are built.  
**SURROUNDING AREA** Mississauga: The residential/commercial development area extends to Eglinton Avenue West and Highway 401 on the west and east side of Hurontario Street.  
Brampton: The residential/commercial development continues and extends to just north of the future Highway 407 Right of Way.

2009 | **SITE** Brampton: Highway 407 and the interchange are built.  
**SURROUNDING AREA** Mississauga & Brampton: The residential/commercial development continues and extends to each city’s limit. Hydro One utility corridor and sub-station is noted south of Highway 407.

### 4.2.7 MOE Freedom of Information (FOI)

Two requests were submitted to the MOE under the FOI Act on behalf of the Cities of Mississauga and Brampton for information regarding orders, spills, investigations/prosecutions, waste generator numbers/classes and Certificates of Approval. One request was submitted for the properties located on or beneath the roadway for Main Street South between Steeles Avenue West and Railroad Street in Brampton. The second request was submitted for the properties located on or beneath the roadway for Hurontario Street between Lakeshore Rd East and Steeles Avenue West in Mississauga. MOE response dated January 18, 2013 indicates that the Ministry could not process both requests as properties owners and/or tenants names were required. A copy of the MOE response letter is provided in Appendix B.

### 4.2.8 Windshield Survey

A windshield survey was conducted by an SNC-Lavalin Site Inspector on May 23, 2012. The purpose of the windshield survey was to identify actual or potential contamination within the study area, or in adjacent areas with the potential to migrate onto the preferred HMLRT alignment. The assessment was conducted with a drive along the alignment. Site photographs were taken and are included in Appendix C.
Key observations made during the field visit are described below and summarized in Table 2:

- The land use within and adjacent to the study area is predominantly residential and commercial;
- No property located directly on the proposed alignment was identified as an environmental concern for the study area; and,
- Several gas stations, auto repairs shop and/or dry cleaners were noted on adjacent properties of the alignment and could possibly represent an environmental concern for the study area.

Table 4: Potential Business Activities of Concern Identified

<table>
<thead>
<tr>
<th>Activities</th>
<th>Mississauga</th>
<th>Brampton</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas Stations</td>
<td>13</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>Repair Shops</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Dry Cleaners</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
<td><strong>6</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

Based on the findings above, the potential for adverse environmental impacts directly within the study area is considered low. There are localized areas of concern adjacent to the alignment with sources of contamination, which may have the potential for impacts to adjacent sites, including the alignment lands, in the event of leaks or spills. During proposed construction activities, excavations will be undertaken; therefore, contaminated soil and groundwater may be encountered. The likelihood of encountering contaminated material will depend on the actual land takings for the project.

4.2.9 Land Intakes

During construction, it is anticipated that land intake will occur on 136 properties. Based on review of the Ecolog Eris report and the findings of an updated windshield survey conducted in October 2013, SNC-Lavalin has determined that thirteen properties will require a Phase II Environmental Site Assessment (ESA) (limited to the land that is being taken). The Phase II’s are required to confirm the presence of contamination during the detailed design phase, either because of the presence of a source of contamination at the property (such as gas station or dry cleaner) or proximity to such a property.
5.0 EXISTING GROUNDWATER USAGE AND SOURCE WATER PROTECTION

The CTC Source Protection Committee (2012) evaluated the Credit Valley Source Protection Area (CVSP), the Toronto & Region Source Protection Area (TRSP) and the Central Lake Ontario Source Protection Area (CLOSP) and summarized groundwater usage, wellhead protection areas and recommended groundwater protection plans for all areas within these areas. The proposed HMLRT alignment passes through the jurisdiction of both the CVSP and the TRSP. The following sections summarize relevant information that relate to the preferred HMLRT alignment.

5.1 Source Water Protection

The HMLRT alignment lies within the jurisdiction of both the CVSP and TRSP areas as identified by the Clean Water Act (2012).

5.1.1 Well Head Protection Areas

Wellhead Protection Areas (WHPA) consider the total area of land which contributes water to a municipal drinking-water supply well, as well as the length of time groundwater within the WHPA will take to reach the municipal drinking-water supply well. Both the City of Mississauga and the City of Brampton obtain municipal drinking water from Lake Ontario. Neither City relies on groundwater for municipal water supply along the study area. No WHPAs were identified by either City or by the CTC (2012a, 2012b).

5.1.2 GUDI Wells

Groundwater under the direct influence of surface water (GUDI) wells draw groundwater that is directly connected to, and dependent upon, surface water. No GUDI wells were identified within the study area (CVC, 2011; CTC, 2012a, 2012b).

5.2 Existing Groundwater Usage

Both the City of Brampton and the City of Mississauga obtain their drinking water supply from Lake Ontario. It is anticipated that local golf courses and some industries in the study area may rely on local groundwater supply wells. A review of the CVC Hydrogeology Report (2011) confirmed that no overburden wells lie within the study area south of Highway 401. The TRSP (2012) identified several water well records within the study area along Main St., however, no further investigation as to their exact locations or use was provided.
5.2.1 MOE Water Well Records

The Ontario MOE was contacted to obtain information regarding water wells on-site and in the vicinity of the site to investigate potable water use in the area.

A review of MOE water well records reportedly identified three hundred and seventy five (375) wells within 250 m of the alignment. Of these wells, one hundred and fifty four (154) are located within 100 m of the corridor. Use and status of these wells are generally reported as domestic, commercial, abandoned and dewatering. The wells were installed between 1949 and 2012. It is expected that most of the domestic water wells identified are no longer in use due to municipal supply services; any wells identified in areas of anticipated dewatering should be further evaluated during the detailed design stage. The approximate locations of the identified wells within 100 m of the alignment are provided in Appendix D.
6.0 PROJECT ENVIRONMENTAL EFFECTS, MITIGATION AND MONITORING

6.1 Natural Environment

6.1.1 Hydrogeology and Groundwater

The proposed HMLRT alignment runs through various soil types including Iroquois Plain glaciolacustrine deposits (clay and silt, some find sand), and Halton Till (silty to clayey till). Palaeozoic shale bedrock lies below these overburden deposits.

For the most part, the proposed HMLRT construction will involve widening of the existing roadway with minor cut and fill site grading operations, possible storm/sewer adjustments, the widening of the existing bridge to cross Highway 403, the modification of the existing Hurontario Street Overpass of Rathburn Road to carry the LRT guideway and the construction of the new bridge for the new Cooksville Crossing. No extensive soil or groundwater impacts are anticipated.

Construction/Operations Impacts

The following localized impacts may occur during construction:

- Shallow groundwater levels may be temporarily affected if dewatering is required for excavation of culverts or bridge footings. If required, a Permit to Take Water application will be prepared and submitted to the MOE for approval in accordance with Ontario Regulation 387/04 (Ontario Water Resources Act), as amended. The application document will include appropriate evaluation of geological and hydrogeological conditions of the subject area;
- Some contaminated soil and groundwater may be encountered and will require proper handling in accordance with applicable environmental regulations including Ontario Regulation 347 (General Waste Management); and,
- Soil or groundwater contamination may occur from excavation (leaching of contaminants into groundwater), construction equipment and/or associated spills.

Mitigation Measures and Net Effects

Mitigation plans to address the above mentioned construction impacts will be developed based on construction methods developed in the detailed design phase, completion of geotechnical testing along the route, and an update of potential and actual sources of contaminated sites along the route during detailed design. Construction equipment should be maintained in good working order with appropriate safety and emergency measures. Contingency plans will be developed to minimize potential soil or groundwater contamination and/or associated spills.
Monitoring

An overall monitoring plan is not required based on assumed localized construction dewatering requirements. Temporary or localized plans can be prepared based on the detailed design for the alignment. Where groundwater may impact surface water, a hydrologist will be consulted for input to these plans (such as proximity to Etobicoke Creek).

6.1.2 Contaminated Property

Contaminated Soils

The windshield survey conducted by SNC-Lavalin in May 2012 and the historical records indicated that several properties adjacent to the proposed alignment including several gas stations have the potential to contribute to environmental contamination.

Potential impacts associated with disturbance of contaminated soils include runoff of contaminated materials into watercourses, the airborne transmission of fine contaminated particulates, leaching of contaminants into groundwater and disposal of contaminated soil removed during construction. Ontario Regulation 153/04, as amended will be applied with respect to the removal and/or movement of soils to minimize the potential impacts. If contaminated sites are positively identified in or adjacent to the construction area, the MOE District Office will be contacted.

Construction/Operations Impacts

Based on the findings of the windshield survey and historical records, the potential for adverse environmental impacts directly within the study area is considered low. There are localized areas of concern adjacent to the alignment with sources of contamination, which may have the potential for impacts to adjacent sites, including the alignment lands, in the event of leaks or spills. During proposed construction activities, excavations will be undertaken; therefore, contaminated soil and groundwater may be encountered. Phase II ESAs are recommended at thirteen properties, which will provide information on soil and groundwater at these properties.

It is anticipated that no Records of Site Condition (RSC) will be filed for any of the properties and therefore Phase II ESAs will be in accordance with the Canadian Standard Association (CSA).

Ontario Regulation 153/04, as amended, will be applied with respect to the removal and/or movement of contaminated soils. Impacts to construction activities can be mitigated by including special provisions in the contract documents if contaminated soil is encountered. If contaminated sites are positively identified in or adjacent to the construction area, the MOE District Office will be contacted.
Mitigation Measures and Net Effects

Impacts to construction activities can be mitigated by including special provisions in the contract documents if contaminated soil is encountered. Where removal of potentially contaminated soil and/or contaminated water must take place, contractors will be required to test soils and/or water for those chemicals that may have been used or deposited within the area. Contaminated soil or groundwater will be handled in accordance with Ontario Regulation 153/04 (as amended) and Part XV.I of the Environmental Protection Act (EPA).

Monitoring

Regular and routine inspections will be conducted during construction by the Engineer to ensure that contract specifications are implemented and the Project’s environmental commitments are fulfilled. Contractors will be responsible for implementing all environmental protection measures specified in their contract, including any required laboratory analyses of soil and/or groundwater prior to disposal.
7.0 REFERENCES


Appendix A

Historical Aerial Photographs
Appendix B

MOE – Freedom of Information
January 18, 2013

Fabienne Etienne
SNC-Lavalin Inc.
20 DeBoers Drive, Suite 200
Toronto, Ontario, M3K 2B4

RE: Freedom of Information and Protection of Privacy Act Request

Thank you for your request(s) for access to records under the Freedom of Information and Protection of Privacy Act. Based on the information provided, we are unable to process your request at this time and are returning your application. If you wish to resubmit please include the following details missing from your current request(s):

✗ Property owner and tenant name. Note: for a complete search all former property owner and tenant names for years requested are required.

NOTE: Both the Investigations/Prosecutions Branch (IEB) and the Environmental Assessment and Approvals Branch (EAAB) file records by the owner and/or tenant.

You may submit your request without owner and tenant information, however DO NOT OPT for the two search parameters, investigations/prosecutions or Certificates of Approvals.

✗ Municipal address / Lot and Concession - If the property is located within a municipality, it is absolutely essential that you provide us with the municipal address. If no municipal address exists then you must provide the lot and concession information. If in doubt on the type of information you should provide us with, please contact us, otherwise you risk possible time delays due to clarification. (Provide any historical address information – only if it is in the form of either a municipal address or lot and concession)

NOTE: The Ministry of the Environment does not file records by Pin, Block, or Registered Plan numbers and cannot accept intersections or descriptions in relation to other properties as valid search parameters.

One site per request – you may only submit multiple addresses if the properties are considered one site and are adjacent to each other without crossing a street and have the same current owner.

The changes indicated above need to be made to every application that was submitted in this package.

When remitting your request please send to:
Ministry of the Environment
Freedom of information and Protection of Privacy Office
40 St. Clair Avenue West, 12th Floor
Toronto, Ontario
M4V 1M2
Fax: 416.314-4285

If you have any questions regarding the above mentioned requirements do not hesitate to contact Liz Mico at (416) 212-0559. Please find your original incomplete request enclosed.

Yours truly,

Liz Mico
FOI Office Clerk
Information Management and Access Branch Encl.
Appendix C

Site Photographs
Photograph 1: Study Area – Looking north on Hurontario

Photograph 2: Shell Gas Station at Main and Church Street, Brampton
Photograph 3: Olde Town Auto Repair at 10 Nelson Street East, Brampton

Photograph 4: Dry Cleaner at 6 Nelson Street East, Brampton
Photograph 5: Husky Gas Station at Main Street and Steeles Avenue, Brampton

Photograph 6: Petro Canada Gas Station at Hurontario Street and Britannia Road, Mississauga
Photograph 7: Daniel Auto Repair Shop/Petro Canada Gas Station at Hurontario Street and Burnhamthorpe Road, Mississauga

Photograph 8: Fine Auto Repair Shop at Hurontario and John Street, Mississauga
Appendix D

MOE – Water Well Locations