Appendix B.2
Hydrogeology and Contaminated Soil

Draft Technical Report
Hamilton LRT – B Line
Updated Hydrogeological Report

Report to

City of Hamilton

April 2011

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Draft for Comment

SNC♦LAVALIN Environment Inc.

SNC·LAVALIN

CLIENT: City of Hamilton

PROJECT: Hamilton LRT – B Line, Draft Updated Hydrogeological Report

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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 Hamilton is planning to implement a Rapid Transit System, with a focus on Light Rail Transit (LRT). Rapid transit can contribute to a reduction in single occupancy vehicle use and vehicle-kilometres traveled, and is viewed as a potential economic generator and community re-building tool. It is planned that the LRT will consist of at-grade rails and facilities

Two main corridors were identified as potential routes within the City (the A-Line and B-Line). The proposed B-Line route extends along the King/Main/Queenston corridor between University Plaza and Centennial Parkway (as shown in Figure 1)

A prior hydrogeological report had been prepared for this project in 2009, however, subsequent changes in alignment and design have rendered it outdated. This report is therefore intended to update the prior Dillon Hydrogeology Study.

The purposes of this hydrogeological report update are to:

- Provide a detailed hydrogeological description for the proposed B-Line route where it deviates from the 2009 Dillon report;
- Identify areas of potential concern;
- Evaluate the potential impact of the construction activities along the B-line 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.

2.0 PHYSICAL SETTING

The majority of the study area is heavily urbanized with significant building structures along the central corridor (Dillon, 2009). Generally, few natural areas occur along the proposed B-Line route. The three main areas of natural features are Coldwater Creek, Chedoke Creek, and Red Hill Creek. Coldwater Creek and Chedoke Creek drain from north and south, respectively, into Cootes Paradise. To the east, Red Hill Creek drains from the high lands above the Niagara Escarpment directly to the Lake Ontario.

2.1 Topography

The topography of the study area is typically flat (Dillon, 2009), sloping gently down towards Lake Ontario with the exception of Coldwater Creek (at the west end of the proposed B-Line route); Chedoke Creek (near the Highway 403 corridor); and Red Hill Creek (at the east end of the proposed B-Line route). The valleys generally run south to north through the study area. The lower portion of the Red Hill Valley watershed slopes gently down to Lake Ontario from the base of the Escarpment with a change in grade of approximately 30 m. The Red Hill Creek Valley is relatively steep and the creek is cut 5 m to 15 m below ground surface (m bgs).

2.2 Physiography

The study area is located in the Iroquois Plain, as described by Chapman and Putnam (1966). The Iroquois Plain resulted from the inundation of the area in late Pleistocene times by glacial Lake Iroquois. The Iroquois Plain consists of lacustrine deposits and lake-bottom sediments that have been smoothed by wave action and which extend around the western end of Lake Ontario and as far east as the Trent River. The width of this plain varies from a few hundred metres to 13 kilometres but is usually about 3 kilometres wide within the City of Hamilton. This is the youngest, large lake plain within the Regional Municipality of Hamilton Wentworth (RMHW) and also occurs at the lowest elevation. Between Lake Ontario and the Niagara Escarpment, the plain is cut by a number of creeks, with lagoons or marshes at their outlet to the lake.

2.3 Geology

2.3.1 Quaternary Geology

As interpreted from SNC, 2006 (Figure 2.2C), the proposed B-Line traverses through, from west to east, the glaciolacustrine deposits of the Iroquois Plain (glaciolacustrine sand and silt, and beach gravel), Paleozoic bedrock (shale and dolomite), Halton Till (silty to clayey till), and a narrow tract of modern alluvial deposits.

The overburden varies in thickness along the proposed B-Line route ranging from a few meters to approximately 30 m.

2.3.2 Paleozoic Geology

As interpreted from SNC, 2006 (Figure 2.3C), bedrock along the proposed B-Line route consists of the Queenston Formation (from Upper Ordovician age), which is predominantly red shale with green siltstone

bands. The formation thickness is estimated as being a minimum of 300 m, with the upper surface of the formation described as weathered in various geotechnical reports (Teleford, Bond, and Liberty, 1976; Liberty, B.A., 1976). The bedrock elevation along the B-Line route is relatively flat, between approximately 76 m above mean sea level (m amsl) and 91 m amsl, except in the Coldwater Creek (at the west end of the proposed B-Line route); Chedoke Creek (near the Highway 403 corridor); and Red Hill Creek (at the east end of the B-Line route).

The Georgian Bay Formation, also from the Ordovician age, underlies the Queenston Formation. The Ordovician formations have a low westward dip and show little sign of disturbance other than some stress-relief features. The Georgian Bay Formation does not outcrop within the RMHW.

3.0 HYDROGEOLOGY

3.1 Regional Hydrogeology

As interpreted from SNC, 2006 (Figure 2.7), there are two types of regional aquifers within the RMHW: overburden aquifer and bedrock aquifer. The overburden aquifers consist of granular deposits within the shallow overburden, and those present in thicker overburden found along bedrock valleys such as the Dundas Valley. A sand and gravel aquifer is located at the west end of the B-Line. No regional aquifers are identified in the rest of the study area.

3.2 Local Hydrogeology

As interpreted from SNC, 2006 (Figure 3.12C), the general direction of groundwater flow is from the southern highlands toward Hamilton Harbour and Lake Ontario. The presence of deep infrastructure, sewers, tunnels and other linear corridors will affect local groundwater flow within local areas, but the general trend will continue to be toward the lake.

3.2.1 Shallow Groundwater Conditions

As interpreted from SNC, 2006 (Figure 3.12C) and Dillon, 2006 (borehole logs), the near surface water table along the proposed B-Line route occurs in wells installed at a depth less than 15 m bgs and ranges from approximately 80 m amsl to 90 m amsl (or about 2 m bgs to 16 m bgs). The water table is relatively deeper to the west of the Highway 403 corridor, ranging from approximately 2 m bgs to 16 m bgs. The water table to the east of the Highway 403 corridor ranges from approximately 2 m bgs to 9 m bgs. A perched water table at approximately 1 m bgs may be present at various locations along the central west portion of the proposed B-Line route.

3.2.2 Deeper Groundwater Conditions

As interpreted from SNC, 2006 (Figure 3.13C), groundwater elevations (or potentiometric surface) in wells installed 15 m or more bgs range from approximately 80 m amsl to 110 m amsl along the proposed B-Line route. The general trend of the potentiometric surface is similar to the water table described in Section 3.2.1.

3.2.3 Recharge and Discharge Areas

As interpreted from SNC, 2006 (Fig 3.14C), the west and middle sections of the proposed B-Line route are groundwater discharge areas where groundwater flow is upwards towards the ground surface. The east section of the route, mainly in the Red Hill Valley, is a recharge area where groundwater flow is downwards from the ground surface. A small part of the west section is also a discharge area.

Groundwater recharge and discharge areas are associated with the potential for groundwater contamination. For instance, in a recharge area, contaminants that infiltrate to the water table will be transported with downward flowing groundwater and may impact an underlying aquifer. In contrast, in discharge areas, groundwater contamination of 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.

3.2.4 Areas Vulnerable to Groundwater Contamination

As interpreted from SNC, 2006 (Figure 3.24), groundwater along the proposed B-Line route has medium to high contaminant vulnerability, except in the west end in the Dundas Valley which has low vulnerability.

Groundwater vulnerability is related to several factors: (1) the water table is shallow, (2) the overburden is either very thin or absent in much of this area and (3) the predominant aquifer is fractured bedrock. The combination of these conditions results in the groundwater being considered as having medium to highly vulnerability to contamination.

In the vicinity of the Dundas Valley, the groundwater vulnerability is low because the water table is greater than 10 m bgs and the predominantly clayey surficial deposits limit downward infiltration of potential contaminants.

3.2.5 Potential for Soil and Groundwater Contamination

As discussed in Dillon, 2009 (Figure 2), there are several contaminated sites situated along the proposed B-Line route. As a result, it is likely that contaminated soil and groundwater will be encountered during construction of the proposed B-Line route. The site locations with actual or potential contamination, where environmental investigation reports were identified by Dillon, 2009, are summarized in Table 1. It is anticipated that there are potentially other contaminated sites along the proposed B-Line route that are not identified in Table 1.

Table 1: Location of Sites with Actual or Potential Contamination

Nearest Major Intersection	Geotechnical Report Number	Report Reference Information	Actual/Potential Contamination Investigation and/or Type
King Street & Gage Avenue	517[1]	Sitest Engineering, 1989. Geotechnical Investigation, Proposed Sanitary Sewers, King Street (Gage to Glendale), Hamilton, Ontario. File No. 8903.	Gasoline
King Street & Ottawa Street	646[1]	Mountainview Geotechnical Ltd., 1992. Geotechnical Investigation, Proposed Sewer Installations, City of Hamilton. Project No. S0220.	Petroleum hydrocarbons
Main Street West & Cootes Drive	684[1]	Trow Consulting Engineers Ltd., 1993. Phase I Geo-Environmental Assessment, Cootes Drive Rail Lands, Hamilton, Ontario. Project: H02917-E.	Phase I Investigation
Main Street West & Cootes Drive	693[1]	Trow Consulting Engineers Ltd., 1993. Follow-up Environmental Testing, CP Rail Right-of-Way Adjacent to Cootes Drive, Hamilton Ontario. Project: H02917-E.	Follow-up to Phase I (684[1]), to investigation potential PAH impacts in soil and groundwater.
Main Street, King Street & Highway 403	695[1]	Peto MacCallum Ltd., 1993. Geotechnical Investigation King/Main Street Storage Tank, Hamilton, Ontario. Job No. 93HF100	Refuse fill (historical landfill)
Main Street East & Sherman Avenue	ESA1_29[1]	Jacques Whitford, 2008. Soil Analytical Results – Northern and Western Property Lines, Former Sunoco Retail Outlet No. 5995. 790 Main Street East, Hamilton, Ontario. Project No. 102865	Petroleum hydrocarbons

Nearest Major Intersection	Geotechnical Report Number	Report Reference Information	Actual/Potential Contamination Investigation and/or Type
Main Street West & Cootes Drive	ESA1_33[1]	WESA, 2008. Phase I Environmental Site Assessment of City of Hamilton Rail Trail Corridor, Hamilton, Ontario. File: WB5247-00.	Phase I Investigation
Main Street East & Gage Avenue	ESA1_34[1]	AMEC Earth & Environmental, 2007. Phase I Environmental Site Assessment, Commercial Property, 979 Main Street East & 56 East Bend Avenue South, Hamilton, Ontario. TB71002.	Phase I Investigation
Main Street East & Gage Avenue	ESA2_13[1]	Peto MacCallum Ltd., 2008. Phase II Environmental Site Assessment 979 Main Street East and 56 East Bend Road South, Hamilton, Ontario. PML Ref.: 08HX011.	Phase II Investigation – includes petroleum hydrocarbons

4.0 EXISTING GROUNDWATER USAGE AND SOURCE WATER PROTECTION

Halton-Hamilton Source Protection Committee (2010) summarized groundwater usage, wellhead protection area and recommended groundwater protection action plan. This chapter summarizes those parts which directly relates to the proposed B-Line route project.

4.1 Source Water Protection

Halton-Hamilton Source Protection Committee (2010) proposes Sources Water Protection Areas for the current surface and groundwater usages within the greater Hamilton region. Based on this report, Source Water Protection Area does not exist along the proposed B-Line route.

4.1.1 Well Head Protection Areas

Wellhead Protection Areas (WHPA) are the total area of land which contributes water to a municipal well to the capacity of the *municipal drinking-water supply systems*, as well as the length of time groundwater within the WHSA will take to reach the municipal drinking-water supply well. The closest Wellhead Protection Area (Greensville well field) is located approximately 5 km northwest of the western portion of the proposed B-Line route (see Halton-Hamilton Source Protection Committee (2010) Figure 4.4).

4.1.2 GUDI Wells

Groundwater under the direct influence of surface water (GUDI) wells draw groundwater that is directly connected to, and dependent upon, surface water. The closest GUDI well (Greensville) which is located approximately 5 km northwest of the western portion of the proposed B-Line route.

4.2 Existing Groundwater Usage

Halton-Hamilton Source Protection Committee (2010) summarized the existing groundwater usage using the MOE Permit To Take Water (PTTW) database. The closest PTTW for the purpose of groundwater remediation is located at a site near the western inner Hamilton Harbour (see Halton-Hamilton Source Protection Committee (2010) Figure 5.4). This PTTW is located approximately 1 km north of the proposed B-Line route in the vicinity of the intersection of King and Queen Streets.

5.0 POTENTIAL IMPACT AND MITIGATION MEASURES

Based on current information and planned at-grade construction of the proposed B-Line LRT route, no significant hydrogeological issues are anticipated. But, local disturbance is expected during the construction period. Nevertheless, the following comments or observations are provided:

a) Shallow groundwater levels may occur along the proposed route. During construction, dewatering of parts of the proposed route may be required.
b) During construction excavation, it is likely that contaminated soil and groundwater may be encountered at some locations.
c) Mitigation plans to address these issues should be developed based on final route selection, completion of geotechnical testing along the final route, and an update of potential and actual sources of contaminated sites along the final route.
d) Mitigation plans during construction should also minimize the potential for soil and groundwater contaminations from construction equipment and/or unanticipated spills.

6.0 REFERENCES

1) Dillon Consulting Limited (Dillon), 2009. City of Hamilton Rapid Transit Initiative Hydrogeology Report – Final. Report to City of Hamilton. March 2009.

2) SNC-Lavalin Inc. (SNC), 2006. Hamilton Groundwater Resources Characterization and Wellhead Protection Partnership Study. Report to City of Hamilton. April 2006.

3) Chapman, L.J and D.F. Chapman, 1966. The Physiography of Southern Ontario. Published for the Ontario Research Council by The University of Toronto Press.

4) Regional Municipality of Hamilton-Wentworth, 2005. Towards a Sustainable Region. Hamilton-Wentworth Official Plan. June 2005.

5) Halton-Hamilton Source Protection Committee, 2010. Proposed Assessment Report, Hamilton Region, Source Protection Area. November 2010.

Figures

Figure 1: Proposed B-Line Route