Appendix G

Geotechnical Inventory Report

Terraprobe

Consulting Geotechnical & Environmental Engineering
Construction Materials Inspection & Testing

GEOTECHNICAL INVENTORY REPORT
BRACEBRIDGE NORTH TRANSPORTATION CORRIDOR
BRACEBRIDGE
DISTRICT MUNICIPALITY OF MUSKOKA, ONTARIO

Prepared for: AECOM Canada Ltd.
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Bracebridge, Ontario
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Attention: Mr. Chris Stilwell, P. Eng.

File No. 33-12-8014
August 30, 2012

Distribution:

3 cc: AECOM Canada Ltd.
1 cc: Terraprobe Inc.

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1.0 INTRODUCTION

This report presents a Geotechnical Inventory compiled for the Class Environmental Assessment Study for the proposed Bracebridge North Transportation Corridor, Bracebridge, Ontario.

Authorization to proceed with the work was provided by Mr. Chris Stilwell, P. Eng. of AECOM Canada Ltd. (AECOM).

This report presents the Geotechnical Inventory for the study area. Results of the environmental components are beyond the scope of this assessment.

2.0 PROPOSED DEVELOPMENT

It is understood that the District Municipality of Muskoka has identified a need to address the short and longer term transportation requirements of the Town of Bracebridge. Currently there is limited access around the northwest quadrant of the Community of Bracebridge (ie: connecting Hwy 118 to Hwy 11).

It has been suggested that the preferred solution to the future transportation requirements would be the construction of a new connection between Hwy 118 west of Bracebridge and Hwy 11 north of Bracebridge.

The limits of the study area for this Geotechnical Inventory are shown on the drawings by AECOM in Appendix A.

3.0 SCOPE OF WORK

The scope of work for this Geotechnical Inventory included the following:

- Compile a Desktop Geotechnical Inventory of the study area assessing:
  - Surficial Geology;
  - Groundwater constraints;
  - Overburden Thickness and;
  - Bedrock Geology;

- Carry out a site reconnaissance to confirm site conditions revealed in the Desktop Study and further identify site features;

- Prepare a Geotechnical Inventory Report outlining the field observations and site conditions within the study area and identifying major constraints presented by the geotechnical conditions for the anticipated construction project.

4.0 METHOD OF INVESTIGATION

4.1 Desktop Study

The Desktop Study included reviewing existing available geotechnical reports, MOE water well records, geological and geotechnical data obtained from the Geological Survey of Canada and the Ontario Geological Survey, aerial photographs and other sources. A reference list is provided in Section 9.

4.2 Site Reconnaissance

A site visit that included car traverses through the entire study area was carried out on May 23, 2012. Representative photographs were taken throughout the study area (see Appendix B).

4.3 Mapping

Maps were reviewed based on regional information and data gathered from borehole/water well records as well as site observations. For the purposes of this report, the surficial soil at a particular location is defined as the material anticipated at depth 1m below ground surface.

5.0 GEOTECHNICAL INVENTORY RESULTS

5.1 Site Description

The study area for this Geotechnical Inventory includes about 200 to 500m either side of S. Monck Drive as well as the area between and slightly beyond S. Monck Drive to Hwy 11 and Falkenburg Road to Nichols/High Falls Road. The location of the study area is shown on the first drawing in Appendix A. Representative Photographs of the study are provided in Appendix B.

Physiography

Based on the Physiography of Southern Ontario by Chapman and Putnam (1984) the study area is generally situated in the region known as the Number 11 Strip. Its origin is as sediment deposited just below the shoreline of glacial Lake Algonquin. The predominant glaciofluvial outwash and glaciolacustrine deposits of sand to gravelly sand are interrupted by frequent outcrops of igneous and metamorphic Precambrian bedrock. Localized recent peat and/or muck deposits are also anticipated in the study area.

Topography

The study area generally has rolling/undulating terrain. Elevations of the ground surface vary from about 240m to 335m throughout the area. Bedrock outcrops define steeper sections while sediment deposits and/or recent organics fill in low-lying bowls. Drainage is anticipated to vary throughout most of the study area with run-off directed largely by the bedrock surface. Poorer drainage in the vicinity of a number of swampy areas in the northern portion of the study area is noted.

5.2 Subsurface Information

The soils in the Bracebridge area were generally deposited in the following stratigraphic sequence: bedrock is overlain by glaciofluvial outwash deposits overlain by glaciolacustrine deposits; overlain by the more recent post-glacial alluvium and organic deposits.

A summary of the anticipated subsurface conditions is provided below.

5.2.1 Surficial Geology

Shallow Bedrock

Shallow or exposed bedrock was noted at numerous locations across the study area. Additional information on the bedrock is provided in Section 5.2.3 below.

Glaciofluvial Deposits

Glaciofluvial deposits, generally consisting of gravelly sand or sand material, cover much of the study area. According to Chapman and Putnam (1984), the glaciofluvial deposits are generally not considered to be suitable as aggregate sources for commercial uses.

Glaciolacustrine Deposits

Glaciolacustrine sediments are noted in bands/pockets across the study area. This deposit consists of sand to gravelly sand and silt and is likely of limited depth as well as area.

Organic Deposits

Organic deposits are noted at several locations within the study area. They are usually associated with poorly drained areas and are likely indicative of bedrock near surface. The materials include peat and muck.

5.2.2 Overburden Thickness

Water well records obtained from the Ministry of the Environment of Ontario were used to estimate the depth to bedrock within the study area. It is noted that the water well records can be inaccurate and the information provided from them must be treated with caution. Experience in this area would suggest overburden/drift thickness of about 0 to 10m over the undulating bedrock surface.

5.2.3 Bedrock Geology

Based on Geology Map No. 2254 published by the Ontario Division of Mines, the bedrock in the entire study area consists of Precambrian metamorphic and igneous rocks.

5.2.4 Groundwater

From the review of online well data and our site reconnaissance visit, the depth to groundwater is frequently less than 5m where bedrock outcrop is not present. Groundwater was noted at shallower depths at other locations.

5.3 Earth Science ANSI’s

No Earth Science ANSI’s were noted within the study area according to the Ministry of Natural Resources of Ontario’s Natural Heritage Information Centre.

6.0 SUMMARY OF ALTERNATIVE ALIGNMENT CONDITIONS

Based on the variability of the topography and geology in the area as described above, we anticipate that each of the proposed alignment options will encounter bedrock outcrop as well as many if not all of the geological deposits previously discussed.

No discernable difference from a geotechnical perspective is observed between potential alternative alignments with respect to the documents reviewed and our site visit.

7.0 GEOTECHNICAL ASSESSMENT

The geotechnical conditions identified in the geotechnical inventory have been reviewed with respect to how they may impact the design and construction of the proposed road alignment. The implications of the ground conditions on factors such as suitable structure foundation types, pavement designs, embankment stability and settlement and potential construction concerns are discussed in the sections that follow.

7.1 Foundation Types

Shallow bedrock is present throughout the study area. Foundations for bridge abutments and piers in areas with shallow bedrock are likely to consist of spread footings as the bedrock offers a high bearing resistance. Some rock excavation is likely to be required to remove loose and weathered rock from beneath foundations and in order to provide a level bearing surface.

The surficial soil conditions where bedrock outcrop is not encountered consist of glaciofluvial sand and gravel and post glacial alluvial sand and gravel. These deposits offer low to moderate bearing resistance for shallow foundations, depending on the density of the deposits at the foundation locations. Driven steel piles are also a feasible foundation option, and may prove to be the preferred foundation option, for structures located in areas underlain by sand and gravel deposits. The use of driven steel piles would allow for a design that incorporates integral abutments.

The soil and bedrock conditions at the proposed foundation locations will need to be assessed in detail as part of the final design. This would include assessment of the bedrock profile.

7.2 Soft Ground

The presence of swampy areas with organic soils and/or soft cohesive soils is likely to be encountered in localized areas along the alignment.

If the final alignment crosses a swampy area, the soft organic soils would need to be removed from beneath road embankments and structures and replaced with compactable granular material as well as potentially geosynthetic support materials.

7.3 Pavement Design

Variable subgrade conditions should be anticipated for the alternative alignments. Increased granular thicknesses and/or geosynthetic materials may be required in order to create a stable pavement structure. Additional geotechnical investigation will be required along the selected route during the design phases.

7.4 Embankment Settlements/Stability

The proposed road alignments are within areas with shallow bedrock and sand and gravel deposits. These materials are generally quite competent and settlement due to embankment loading typically occurs rapidly (i.e. during the construction period). As a result, these deposits do not present any restrictions on design grades. In addition, stability of embankments over these materials is typically not a concern under static conditions.

There is the potential for liquefaction of loose to compact sand and gravel deposits located below the groundwater level under seismic design loads. This is generally not a concern for at-grade roads but may be a concern if high approach fills are required. The potential for liquefaction will need to be verified as part of the design stage. The risk of liquefaction can be managed by densification of the sand and gravel prior to embankment construction. New fills will experience excessive and long-term settlement if they are placed over existing organic materials.

7.5 Excavation Support and Dewatering

The sand and gravel deposits are typically characterized by moderate to high hydraulic conductivity. As a result, significant groundwater inflow should be expected for any excavations that extend below the groundwater level. Water seepage from excavation walls also has a detrimental impact on the stability of excavation side slopes. Excavations within the sand and gravel deposits can likely be made with excavation side slopes of 1H:1V where they are carried out above the groundwater level. Excavations that extend below the groundwater level will likely require excavation support (e.g. sheet piles) and dewatering.

8.0 SUMMARY

This geotechnical inventory, based only a cursory review, characterizes the proposed corridor alignment as similar across the study area. Shallow overburden deposits above precambrian bedrock are expected combined with poor drainage captured above bedrock and localized muck and peat deposits.

Bedrock will be the primary founding strata for road/bridge infrastructure. Importation of granular materials would be expected for construction.

We trust that the foregoing information will satisfy your present requirements. If you should have any questions, or if we can be of further assistance, please do not hesitate to contact the undersigned.

Sincerely,
Terraprobe Inc.

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Associate

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9.0 REFERENCES

Chapman, L.J., and Putnam, D.F. The Physiography of Southern Ontario; Ontario Geological Survey, Special Volume 2. Toronto: Ontario Research Foundation, Ontario Geological Survey, 1984.

Ontario Division of Mines, Palezoic Geology of Southern Ontario. Ontario Geological Survey Map 2254.

Ministry of Northern Development and Mines, Quaternary Geology of Ontario, Southern Sheet. Ontario Geological Survey Map 2556.

Ministry of Natural Resources of Ontario Natural Heritage Information Centre Website: http://www.biodiversityexplorer.mnr.gov.on.ca/nhicWEB/main.jsp.

APPENDIX A

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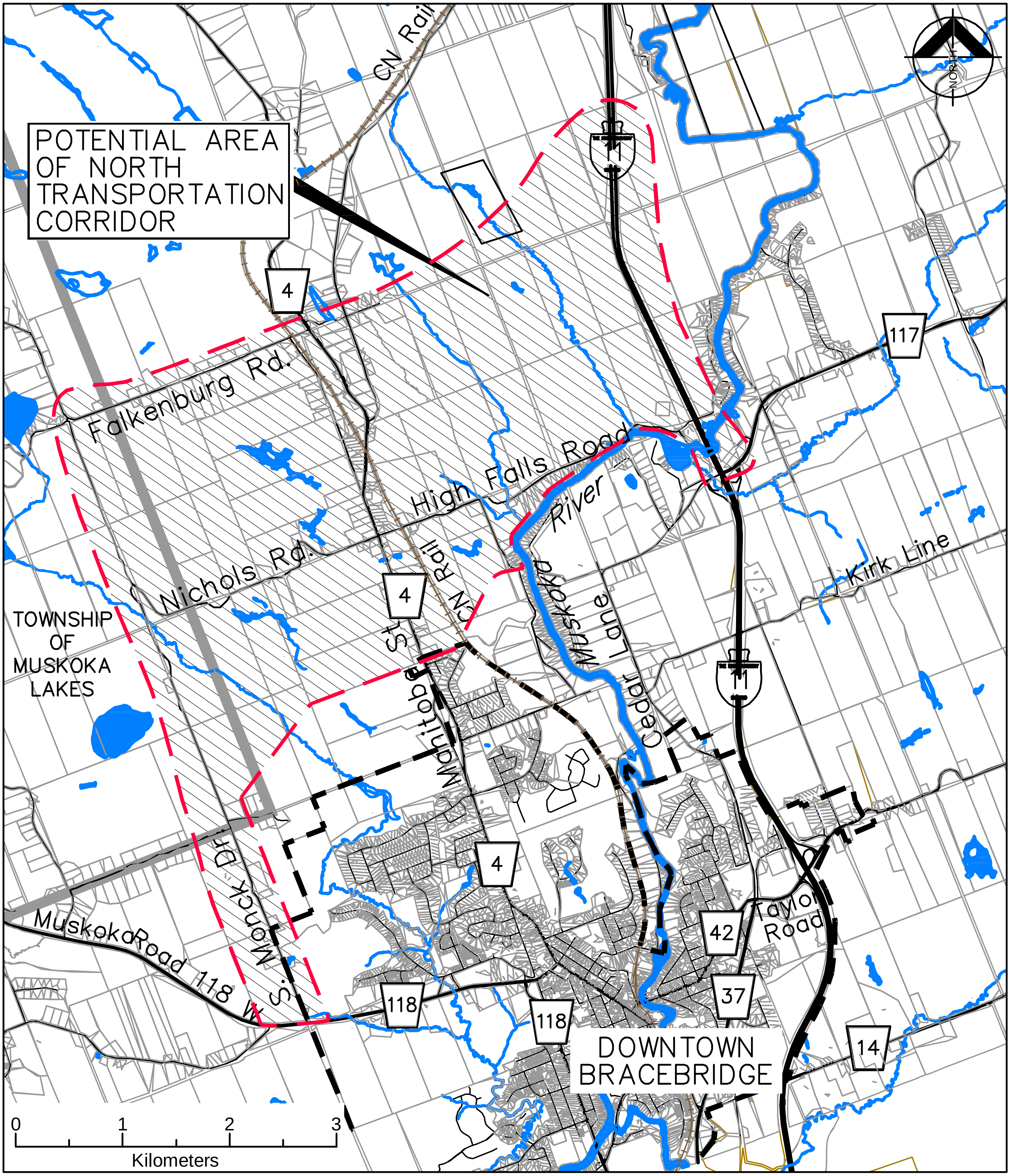
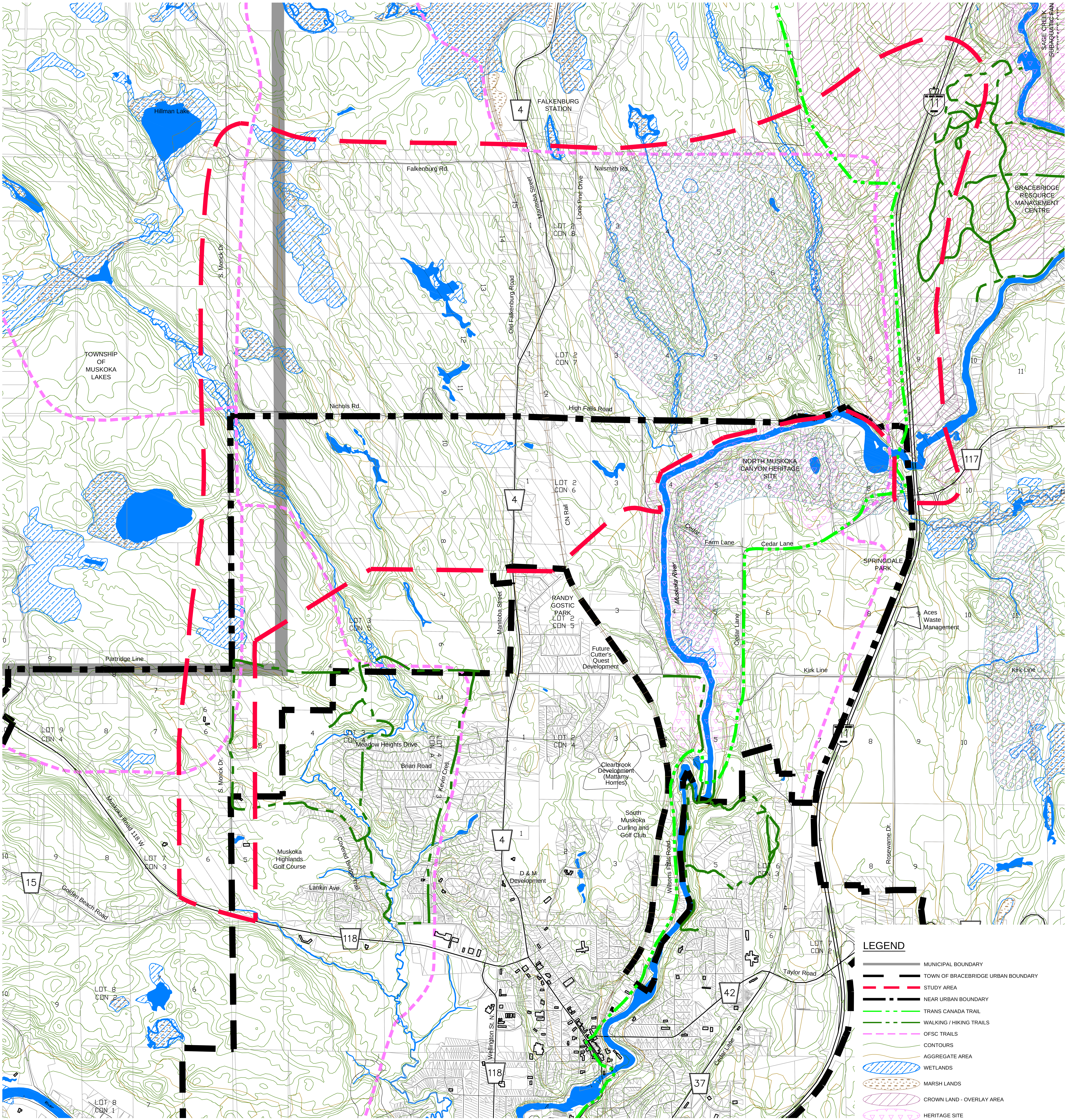


LEGEND

MUNICIPAL BOUNDARY

TOWN OF BRACEBRIDGE URBAN BOUNDARY

STUDY AREA



BRACEBRIDGE NORTH TRANSPORTATION CORRIDOR EA

District Municipality of Muskoka

ENVIRONMENTAL CONSTRAINTS

AECOM

August, 2012

Scale: 1:10,000

THE DISTRICT MUNICIPALITY OF MUSKOKA

APPENDIX B

Terraprobe Inc.

MAY 2012

SITE PHOTOGRAPHS

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