TECHNICAL MEMORANDUM

DATE February 5, 2018 **PROJECT NO.** 1784392-2000

TO 1384341 Ontario Ltd.

FROM Loren Bekeris and Brian Byerley **EMAIL** Loren_Bekeris@golder.com; Brian_Byerlery@golder.com

DESKTOP HYDROGEOLOGICAL ASSESSMENT
PROPOSED RESIDENTIAL SUBDIVISION
5969 FERNBANK ROAD, OTTAWA, ONTARIO

This report presents the results of a desktop hydrogeological assessment carried out for the proposed residential development site at 5969 Fernbank Road in Stittsville (Ottawa), Ontario. It is understood that the hydrogeological assessment is required for draft plan approval.

The purpose of this hydrogeological assessment was to determine the general soil and groundwater conditions across this site, by means of existing data from on-site test pits, and to address possible construction-related impacts to private water supply wells. The on-site information was enhanced with published mapping and publicly available information. The water well records in the Ministry of the Environment and Climate Change (MOECC) Water Well Information System (WWIS) for nearby water wells were used to provide further information regarding hydrogeological conditions in the area and identify where nearby water well users are taking their water.

1.0 DESCRIPTION OF PROJECT AND SITE

Plans are being prepared to construct a residential development to be located at 5969 Fernbank Road in Stittsville (Ottawa), Ontario. The project limits for the proposed development are shown on Figure 1.

The following is known about the site and proposed development:

- The property is roughly rectangular in shape with a maximum length and width of approximately 810 and 290 metres, respectively.
- The site has a relatively flat to gently sloping topography, from about elevation 118 metres above sea level (masl) at the northwestern corner of the site to 107 masl at the southeastern corner.
- The site is bounded to the west by existing urban residential development, to the north by the Goulbourn Recreation Complex, to the east by Shea Road, and to the south by Fernbank Road.
- The site primarily consists of undeveloped vacant land, with some rows of trees.
- The property is to be developed as a residential subdivision.
- A stormwater management pond will be located at southeast corner of the site (Block 165).
- A City park will be located within the central portion of the site (Block 164).
- A school (which is not part of this current investigation) will be located at the northeast corner of the site (Block 163).

2.0 GEOLOGY AND HYDROGEOLOGY

The following sections describe the published local geology and hydrogeology in the vicinity of the site.

2.1 Surficial Geology

Based on published mapping (Figure 2), the surficial geology at the site is interpreted to consist of organic deposits in the northwest corner, shallow bedrock in the northern half, glacial till in the southern half, and fine to medium sand in the southeastern corner. Published mapping indicates the bedrock surface to be at depths in the range of 1 to 5 metres below the ground surface across the site (Figure 3).

2.2 Bedrock Geology

The Ontario Geological Survey bedrock geology mapping indicates that the site is underlain by the Gull River Formation, consisting of interbedded limestone and silty dolostone with shale and sandstone partings.

2.3 Hydrogeology

2.3.1 Overburden Aquifer

The shallow overburden deposits in the area are generally not capable of supplying sufficient quantities of groundwater to be considered an aquifer. As a result, the principal water supply aquifer within the vicinity of the site is considered to be the underlying bedrock formations.

2.3.2 Bedrock Aquifers

The Gull River formation is generally considered to provide a poor to moderate yield of potable water due to the shale content of the bedrock. Well yields in this formation have been reported from less than 10 to 15 L/min. Generally, the Gull River formation is capable of providing sufficient yields for domestic water supplies. Groundwater flow in the Gull River formation is controlled predominantly by fractures or sandstone interbeds, as the massive crystalline limestone layers generally provide little to no water.

3.0 SITE SPECIFIC GEOLOGY AND HYDROGEOLOGY

3.1 General

Golder Associates completed a geotechnical investigation at this site in 2017, which included 15 test pits advanced across the site.

Based on a review of the geotechnical investigation results and published geological mapping, the subsurface conditions at the site are interpreted to consist of deposits of silts and sands over glacial till over limestone bedrock. The Record of Test Pits is included as Table 1, and test pit locations are indicated on Figure 1.

3.2 Site Specific Geology

Topsoil and Fill

Topsoil exists at the ground surface at all of the test pit locations, except at test pit 17-05, where 0.5 metres of sand and brush fill is located above the topsoil, and at test pit 17-09, where neither topsoil nor fill was encountered. Where encountered, the topsoil and peat ranges from about 100 to 750 millimetres in thickness. A layer of fill was encountered below the topsoil at test pit 17-06. The fill consists of sand and gravel containing cobbles, and extends down to a depth of about 1.2 metres below the existing ground surface.

Sand and Silt

Discontinuous deposits of sand, silt, silty sand to sandy silt exist below the topsoil and fill in test pits 17-01, 17-03, 17-04, and 17-07 to 17-15. The sand and silt deposits were not fully penetrated in all of the test pits, but were proven to extend to depths ranging from about 0.2 to 4.2 metres below the existing ground surface.

Glacial Till

A discontinuous deposit of glacial till was encountered below the sand and silt layers in test pits 17-02, 17-05, 17-06, 17-07, 17-11, 17-14, and 17-15. The glacial till generally consists of a heterogeneous mixture of gravel, cobbles, and boulders in a soil matrix of silty sand to sandy silt. The glacial till was not fully penetrated in all the test pits but was proven to depths ranging from 1.1 to 4.5 metres below the existing ground surface.

Bedrock

Refusal to excavating was encountered at all of the test pit locations, except test pit 17-12 and 17-14, at depths ranging from about 0.2 to 3.3 metres below the existing ground surface.

The following table summarizes the ground surface, depth to refusal, and refusal elevations as encountered at the test pit locations.

Test Pit Number	Ground Surface Elevation (masl)	Refusal Depth (mbgs)	Refusal Elevation (masl)
17-01	111.1	0.9	110.2
17-02	109.5	1.1	108.4
17-03	111.8	1.1	110.7
17-04	112.0	1.3	110.7
17-05	113.6	1.6	112.0
17-06	111.3	1.5	109.8
17-07	108.9	1.8	107.1
17-08	109.5	0.4	109.1
17-09	111.9	0.2	111.7
17-10	110.9	1.9	109.0
17-11	109.7	2.1	107.6
17-13	105.9	3.3	102.6
17-15	108.6	3.4	105.2

Notes: masl: metres above sea level; mbgs: metres below ground surface

3.3 Hydrogeology

Groundwater seepage was observed in test pits 17-04, 17-12, 17-13 and 17-14 at depths of about 1.3 to 3.4 metres below the existing ground surface. Based on the materials encountered in the test pits, the water table is interpreted to lie in the glacial till, sandy silt or underlying bedrock.

It should be noted that groundwater levels are expected to fluctuate seasonally. Higher groundwater levels are expected during wet periods of the year, such as spring.

4.0 POTENTIAL IMPACTS TO EXISTING GROUNDWATER USERS

The maximum depth of the proposed infrastructure (sewer and watermain) is assumed to be approximately 5 metres below ground surface. The water table was found to be at an average of 2.5 metres below ground surface; therefore, dewatering during construction of site services will require approximately 2.5 metres of dewatering. Assuming the maximum hydraulic conductivity of the dewatered glacial till, sandy silt or underlying bedrock is 10^{-5} metres/second, the maximum radius of influence associated with this dewatering is approximately 30 metres (at a distance of 30 metres, less than 0.1 metre of water level drawdown would occur after 14 days of dewatering). To ensure a conservative assessment of potential impacts to groundwater users, existing groundwater users within 100 metres of the site were considered.

4.1 Nearby Groundwater Supply Wells

There are a total of three wells in the WWIS database that were constructed as water supply wells, located within 100 metres of the site (see Figure 1). Based on aerial photographs, there do not appear to be residences or buildings in the vicinity of the wells along Fernbank Road with Well ID 1513784 and 1511566. It is interpreted that these well records have inaccurate or incorrect location data in the WWIS or that the wells are no longer in use. The remaining well record within 100 metres of the site is Well ID 1522590, which appears to correspond to the residence located at 5957 Fernbank Road. Details regarding that water supply well (based on information in the WWIS) are presented in the following table:

Well ID	Depth of Well (mbgs)	Depth to Static Water Level (mbgs)	Depth to Water Found (mbgs)	Available Drawdown (metres)	Type of Well
1522590	48.8	0.6	7.0 and 18.9	48.2	Bedrock

Notes: mbgs: metres below ground surface

The available drawdown in this well, calculated as the difference between the static water level and the depth of the well, is 48.2 metres. A temporary drawdown in the water table, due to construction dewatering for the installation of services, would affect groundwater levels within the overburden or bedrock within 5 metres of ground surface. It could also temporarily reduce the available drawdown in the water supply well, but not likely to the degree that could negatively impact water supply. The “depth to water found” (7.0 and 18.9 mbgs) and the available drawdown (48.2 metres) indicate that construction of site services would not likely impact the water supply well. It is understood that there are no structures or land uses planned for the site that would permanently lower the groundwater levels in the area surrounding the site (i.e., deep drained foundations).

4.2 Recommended Monitoring Program

Prior to construction at the site, it is recommended that a well survey be completed at the residence at 5957 Fernbank Road. Information to be collected during the well survey could include the depth of the well, type of pump, and static water level. Water quality samples could be collected and analyzed for a typical suite of parameters (i.e. the 'subdivision package' as per MOECC Procedure D-5-5).

5.0 LIMITATIONS AND USE OF MEMORANDUM

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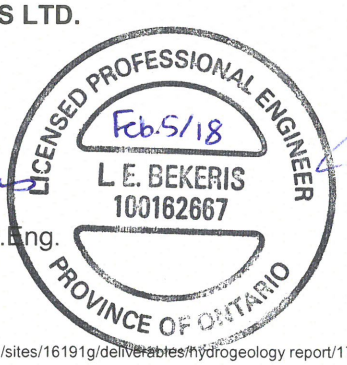
6.0 CLOSURE

We trust this submission satisfies the requirements for a desktop hydrogeological assessment of the proposed residential subdivision development at 5969 Fernbank Road, in Ottawa, Ontario. If you have any questions regarding this report, please contact the undersigned.

GOLDER ASSOCIATES LTD.



Loren Bekeris, M.Sc., P.Eng.
Environmental Engineer

Brian Byerley, M.Sc., P.Eng.
Senior Hydrogeologist / Principal

LEB/BTB/sg
https://golderassociates.sharepoint.com/sites/16191g/deliverables/hydrogeology report/1784392-tm-rev 1-hydrogeology assessment_5feb2018.docx

Attachments: Table 1 – Record of Test Pits
Figure 1 – Site Plan
Figure 2 – Surficial Geology
Figure 3 – Drift Thickness

RECORD OF TEST PITS

Test Pit Number Elevation (Metres)	**Depth (metres)**	**Description**
17-01 (111.09 metres)	0.00 – 0.25	TOPSOIL – (ML) Sandy SILT; non-cohesive, dark brown, moist
	0.25 – 0.92	(ML) Sandy SILT, brown; non-cohesive, moist
	0.92	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 0.30 – 0.75
17-02 (109.47 metres)	0.00 – 0.30	TOPSOIL – (SM) Sandy SILT; non-cohesive, dark brown, moist
	0.30 – 1.05	(SM) Sandy SILT, some gravel; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist
	1.05	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 0.04 – 1.00
17-03 (111.80 metres)	0.00 – 0.30	TOPSOIL – (ML) Sandy SILT; brown; non-cohesive, moist
	0.30 – 1.05	(SP) SAND, some non-plastic fines and gravel; grey, non-cohesive, moist
	1.30	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 0.10 – 0.25
		Sample 2 Depth (m) 0.50 – 1.25
17-04 (112.01 metres)	0.00 – 0.25	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.25 – 1.30	(SM) SILTY SAND, trace gravel; brown; non-cohesive, moist
	1.30	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Water seepage at 1.3 metres depth

RECORD OF TEST PITS

Test Pit Number Elevation (Metres)	**Depth (metres)**	**Description**
		Sample 1 Depth (m) 0.30 – 0.50
17-05 (113.55 metres)	0.00 – 0.50	FILL – (SP) SAND; brown, contains brush (WIND ROW); non-cohesive, moist
	0.50 – 0.70	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive moist
	0.70 – 1.60	(SM) SILTY SAND, some gravel; grey, contains cobbles and boulders (GLACIAL TILL), non-cohesive, moist
	1.60	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 1.00 – 1.50
17-06 (111.29 metres)	0.00 – 0.20	FILL/TOPSOIL – (ML) Sandy SILT; brown; non-cohesive, moist
	0.20 – 1.20	FILL – (SP/GP) SAND and GRAVEL; brown, contains cobbles (BLAST ROCK); non-cohesive, moist
	1.20 – 1.50	(ML) Sandy SILT, some gravel; grey (GLACIAL TILL); non-cohesive, moist
	1.50	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 1.30 – 1.50
17-07 (108.94 metres)	0.00 – 0.25	TOPSOIL – (SM) SILTY SAND; dark brown; non-cohesive, moist
	0.25 – 1.10	(SM) SILTY SAND; brown; non-cohesive, moist
	1.10 – 1.80	(SM) SILTY SAND; brown; contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist
	1.80	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 0.50 – 1.00
		Sample 2 Depth (m) 1.25 – 1.75

RECORD OF TEST PITS

Test Pit Number Elevation (Metres)	**Depth (metres)**	**Description**
17-08 (109.50 metres)	0.00 – 0.10	TOPSOIL – (SM) SILTY SAND; dark brown; non-cohesive, moist
	0.10 – 0.40	(SM) SILTY SAND; brown; non-cohesive, moist
	0.40	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 — Depth (m) 0.10 – 0.40
17-09 (111.92 metres)	0.00 – 0.15	(SP) SAND, some non-plastic fines, trace gravel; brown; non-cohesive, moist
	0.15	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 — Depth (m) 0.00 – 0.15
17-10 (110.93 metres)	0.00 – 0.15	TOPSOIL (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.15 – 1.85	(SP) SAND, some non-plastic fines, trace gravel; grey; non-cohesive, moist
	1.85	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 — Depth (m) 0.30 – 0.65
		Sample 2 — Depth (m) 1.50 – 1.75

RECORD OF TEST PITS

Test Pit Number Elevation (Metres)	Depth (metres)	Description
17-11 (109.72 metres)	0.00 – 0.40	TOPSOIL (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.40 – 1.10	(SM) SILTY SAND; brown; non-cohesive, moist
	1.10 – 2.10	(SM) SILTY SAND, trace gravel; grey, (GLACIAL TILL); non-cohesive, moist
	2.10	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry upon completion
		Sample 1 Depth (m) 0.50 – 1.00
		Sample 2 Depth (m) 1.25 – 1.75
17-12 (107.17 metres)	0.00 – 0.35	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.35 – 1.20	(ML) Sandy SILT; brown; non-cohesive, moist
	1.20 – 4.20	(ML) Sandy SILT; grey-brown, non-cohesive, wet
	4.20	END OF TEST PIT
		NOTE: Water seepage causing side walls to collapse
		Sample 1 Depth (m) 0.50 – 1.00
		Sample 2 Depth (m) 1.50 – 2.50
TP 17-13 (105.91 metres)	0.00 – 0.30	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.30 – 0.85	(SP/ML) SAND and SILT; brown; non-cohesive, moist
	0.85 – 2.95	(ML) Sandy SILT; grey-brown, non-cohesive, moist
	2.95 – 3.30	(ML) SILT, trace sand; grey; non-cohesive, moist
	3.30	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Water seepage at 3.0 metres depth
		Sample 1 Depth (m) 0.40 – 0.60
		Sample 2 Depth (m) 0.95 – 1.30
		Sample 3 Depth (m) 3.00 – 3.30

RECORD OF TEST PITS

Test Pit Number Elevation (Metres)	**Depth (metres)**	**Description**
TP 17-14 (106.80 metres)	0.00 – 0.20	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.20 – 1.50	(SM) SILTY SAND; brown; non-cohesive, moist
	1.50 – 4.50	(SM) SILTY SAND, some gravel; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, wet
	4.50	END OF TEST PIT
		NOTE: Water seepage at 3.4 metres depth Water seepage causing side walls to collapse
		Sample 1 Depth (m) 0.30 – 1.25
		Sample 2 Depth (m) 2.00 – 2.50
TP 17-15 (108.58 metres)	0.00 – 0.75	TOPSOIL – (ML) Sandy SILT; dark brown; non-cohesive, moist
	0.75 – 1.25	(SM) SILTY SAND, brown, non-cohesive, moist
	1.25 – 1.60	(SM) SILTY SAND, some gravel; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, moist
	1.60	END OF TEST PIT – Refusal to excavation on bedrock
		NOTE: Test pit dry
		Sample 1 Depth (m) 0.50 – 1.00
		Sample 2 Depth (m) 1.30 – 1.55

KEY MAP

SCALE 1:100,000

LEGEND

- APPROXIMATE TEST PIT LOCATION
- MOECC LISTED WATER WELLS
- SITE BOUNDARY
- 100m BUFFER FROM SITE BOUDNARY

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: UTM ZONE 18, VERTICAL DATUM: CGVD28

0 50 100 200

1:5,000 METRES

CLIENT
1384341 ONTARIO LTD.

PROJECT
HYDROGEOLOGICAL ASSESSMENT; PROPOSED RESIDENTIAL DEVELOPMENT; 5969 FERNBANK ROAD, OTTAWA, ONTARIO

TITLE
SITE PLAN

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-01-31
DESIGNED	----
PREPARED	ABD
REVIEWED	LEB
APPROVED	BTB

PROJECT NO.	CONTROL	REV.	FIGURE
1784392	0002	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: 25mm 0

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351000

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STITT ST E

EVELYN ST

CARIBOU AVE

CARLETON CATHCART ST

BASSWOOD AVE

SAMUEL MANN AVE

TRAFALGAR CRES

LIARD ST

SUNRAY CRES

SPINDLEWAY

CHERRY DR

MORNINGSUN CRES

SONIA CRT

JOHN SIDNEY CRES

SHEA RD

FERNBANK RD

7

r2

3

1a

5b

2

KEY MAP

SCALE 1:100,000

LEGEND

- ROADWAY
- WATERMAIN
- 100m BUFFER FROM SITE BOUDNARY
- SITE BOUNDARY
- 7 *7. ORGANIC DEPOSITS: MUCK & PEAT*
- 5b *5b: NEARSHORE SEDIMENTS: FINE TO MEDIUM GRAINED SAND*
- 3 *3. OFFSHORE MARINE DEPOSITS: CLAY, SILTY CLAY & SILT*
- 2 *2. ICE CONTACT STRATIFIED DRIFT: GRAVEL & SAND*
- 1a *1a. TILL, PLAIN WITH LOCAL RELIEF <5 m*
- r2 *r2. BEDROCK: LIMESTONE, DOLOMITE, SANDSTONE & LOCAL SHALE*

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: UTM ZONE 18, VERTICAL DATUM: CGVD28
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. BÉLANGER, J. R. 2008 URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE 5311, 1 DVD.

0 50 100 200

1:5,000 METRES

CLIENT

1384341 ONTARIO LTD.

PROJECT

HYDROGEOLOGICAL ASSESSMENT; PROPOSED RESIDENTIAL DEVELOPMENT; 5969 FERNBANK ROAD, OTTAWA, ONTARIO

TITLE

SURFICIAL GEOLOGY

CONSULTANT

Golder Associates

YYYY-MM-DD	2018-02-05
DESIGNED	----
PREPARED	ABD
REVIEWED	LEB
APPROVED	BTB

PROJECT NO.	CONTROL	REV.	FIGURE
1784392	0002	0	**2**

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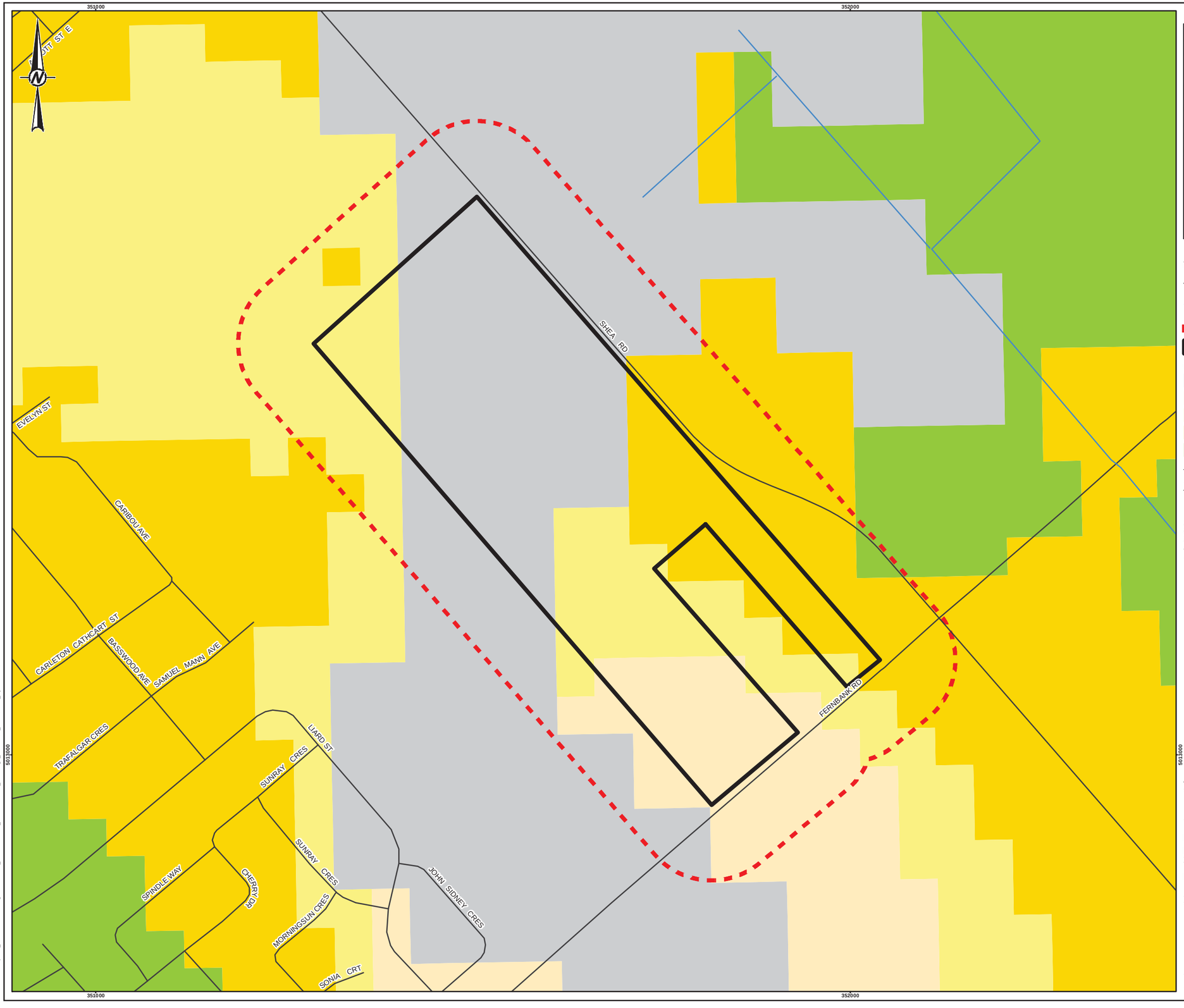

KEY MAP

SCALE 1:100,000

LEGEND

- ROADWAY
- WATERMAIN
- 100m BUFFER FROM SITE BOUDNARY
- SITE BOUNDARY

GSC TREND IN DEPTH TO BEDROCK (METRES)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 5
- 5 to 10

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. LAND INFORMATION ONTARIO (LIO) DATA PRODUCED BY GOLDER ASSOCIATES LTD. UNDER LICENCE FROM ONTARIO MINISTRY OF NATURAL RESOURCES, © QUEENS PRINTER 2014
2. PROJECTION: TRANSVERSE MERCATOR, DATUM: NAD 83, COORDINATE SYSTEM: UTM ZONE 18, VERTICAL DATUM: CGVD28
3. SERVICE LAYER CREDITS: © OPENSTREETMAP (AND) CONTRIBUTORS, CC-BY-SA
4. 2010 BÉLANGER, J. R., URBAN GEOLOGY OF THE NATIONAL CAPITAL AREA, GEOLOGICAL SURVEY OF CANADA, OPEN FILE D3256, 2001

0 50 100 200
1:5,000 METRES

CLIENT
1384341 ONTARIO LTD.

PROJECT
HYDROGEOLOGICAL ASSESSMENT; PROPOSED RESIDENTIAL DEVELOPMENT; 5969 FERNBANK ROAD, OTTAWA, ONTARIO

TITLE
DRIFT THICKNESS

CONSULTANT
Golder Associates

YYYY-MM-DD	2018-02-05
DESIGNED	----
PREPARED	ABD
REVIEWED	LEB
APPROVED	BTB

PROJECT NO.	CONTROL	REV.	FIGURE
1784392	0002	0	3