September 15, 2017

Mr. Alfred Artinger
Reid's Heritage Homes
6783 Wellington Road 34, RR#22
Cambridge, Ontario N3C 2V4

Subject: Soil Infiltration Testing
19-59 Lowes Road
Guelph, Ontario
Our Ref.: 160-P-0010233-0-07-304-HD-L-0001-00

Dear Sir;

EnGlobe Corp. (Englobe) is pleased to submit this summary of our in-situ infiltration testing at the locations shown on the attached Drawing 1. In addition to this infiltration testing program, previous investigations of the property have been conducted, including the following:

- Geotechnical Investigation Report – Proposed Residential Development, Lowes Road, Guelph, Ontario, May 24, 2016. Englobe Reference Number 160-P-0010233-0-01-100-HD-R-0001-00
- Scoped Hydrogeology Study, Lowes Road, Guelph, Ontario May 30, 2017. Englobe Reference Number 160-P-0010233-0-02-300-HD-R-0001-01
- Long Term Monitoring Program. On-going. Englobe Reference Number 160-P-0010233-0-05-302

This letter report supplements the information and data previously provided in the above-referenced Geotechnical Investigation and Scoped Hydrogeology Study, which should be read in conjunction with this letter.

The objectives of this letter report are to provide a summary of the infiltration properties of the soils at the locations of depicted on Drawing 1.

Infiltration Testing

Infiltration tests were performed using a Soil Moisture Equipment 2800K1 Guelph Permeameter at the locations shown on the attached Drawing 1. Water levels within the combined reservoir of the Guelph Permeameter were recorded at regular intervals in order to obtain time varying infiltration rates of the near-surface soil layer. Infiltration testing was completed in three (3) pre-determined locations provided to Englobe by Stantec at an elevation of approximately 331.64 mASL. This elevation is the proposed base of the infiltration gallery as it corresponds to 1.0 m above the highest on-site water level measured during the May 2016 to May 2017 Long Term Monitoring Program. As existing residences are still present on the properties the pre-determined locations were in close proximity to the proposed infiltration gallery and clean water collection system locations.

The approximate ground surface at test location GP-01-17 was approximately 332.4 mASL. Because the target elevation is at 331.64, the infiltration test elevation at this location was set at about 1.2 mBGS (4.0 fBGS). A flat base was achieved in the cobbly soil in order to complete the testing due to. In test locations GP-02-17 and GP-03-17 the proposed infiltration gallery base elevation of 331.64 mASL is above existing ground surface. In order to complete the infiltration testing the topsoil was stripped back to expose the inorganic native soils. The approximate testing elevation for GP-02-17 and GP-03-17 was 330.9 mASL.

The in-situ infiltration testing at GP-01-17 was completed on the underlying sand and gravel with some silt and occasional cobbles. The soil descriptions are based on visual inspection of the soils encountered at the time of excavation and Borehole Logs BH-02-16 and BH-03-16, appended. Soils encountered at GP-02-17 were sand with some silt and trace gravel to silty sand, trace gravel and topsoil material based on Borehole Logs BH-05-16 and BH-06-16 located within the vicinity of the testing location. Lastly soils encountered at GP-03-17 were silty sand, some gravel and trace topsoil to silty sand and gravel material based on Borehole Logs BH-08-16 and BH-10-16.

Infiltration rates were determined using the One-Head Analysis as described in the SoilMoisture Equipment Corp. 2800K1 Operating Instructions (Dec. 2008). This method is expressed by the following equation:

$$K_{fs} = \frac{C_1 Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi(H_1/\alpha)}$$

Where:

K_{fs} =Field saturated hydraulic conductivity (entrapped air present) (cm/sec)

C_1 = Shape factor

Q_1 = Discharge from combined reservoir (cm^3/min)

H_1 = Well height (cm)

a = Well radius (cm)

α = Soil texture (cm^{-1})

Infiltration Rates

Field saturated hydraulic conductivities have been indirectly measured using the Guelph Permeameter. Three trials at each test location were completed allowing for pre-soaking of the initially unsaturated soils encountered. This hydraulic conductivity is measured when ponded water is allowed to infiltrate into an initially unsaturated soil. It is assumed that some volume of air becomes entrapped within the soils by the infiltrating water can sometimes result in the field saturated hydraulic conductivity being less than a saturated hydraulic conductivity. However, the use of the field saturated hydraulic conductivity can be argued as the more appropriate value compared to the saturated hydraulic conductivity as most natural and man-made infiltration processes result in the entrapment of air within the soil (SoilMoisture Equipment Corp., 2008).

The estimated infiltration rate is based on recommendations found in the “Low Impact Development Stormwater Management Planning and Design Guide, Appendix C’’, published by the Toronto and Region (TRCA) and the Credit Valley (CVC) Conservation Authority, and the assumed relationship between hydraulic conductivity and infiltration rate.

It should be noted that hydraulic conductivity and infiltration rate are two different concepts and that conversion from one parameter to another has to account for the hydraulic gradient and consequently cannot be done through unit conversion. A factor of safety of 2.5 was applied to the approximate infiltration rate to account for soil variability, gradual accumulation of fine soil sediments during the lifespan of the facility, and compaction during construction. The field measured hydraulic conductivities and estimated factored infiltration rates assuming a favourable hydraulic gradient of 1 are summarized in Table 1 below. The estimated infiltration rates reflect an infiltration potential and are preliminary in nature. For design purposes infiltration rates should be substantiated with hydraulic calculations taking into account hydraulic gradients and filter areas perpendicular to the flow direction.

Table 1 Infiltration Rates

INFILTRATION LOCATION	APPROXIMATE TEST DEPTH (mBGS)	APPROXIMATE TEST ELEVATION (m)	SOIL TYPE	FIELD SATUATED K-VALUE (m/sec)	FACTORED INFILTRATION RATE (mm/hr)
GP-01-17	0.5	331.2	Sand and Gravel	4.50×10^{-4}	237
GP-02-17	0.5	330.9	Silty Sand	2.99×10^{-5}	115
GP-03-17	1.2	330.9	Silty Sand	2.78×10^{-5}	113

Based on the proposed location of the infiltration gallery we recommend that the infiltration results obtained from the Guelph Permeameter testing at test locations GP-02-17 and GP-03-17 be considered as the most appropriate field saturated hydraulic conductivities. As the hydraulic gradient flattens the estimated factored infiltration rates will be reduced.

We anticipate that the top silt layer encountered at these locations will hinder the infiltration into the underlying sand and gravel layers; therefore, we advise that this layer be properly stripped and filled with a more permeable material.

We trust that this report is suitable for your present requirements, and we thank you for this opportunity to have been of service. If you have any questions or require further hydrogeological consultation, please do not hesitate to contact our office.

Yours very truly,

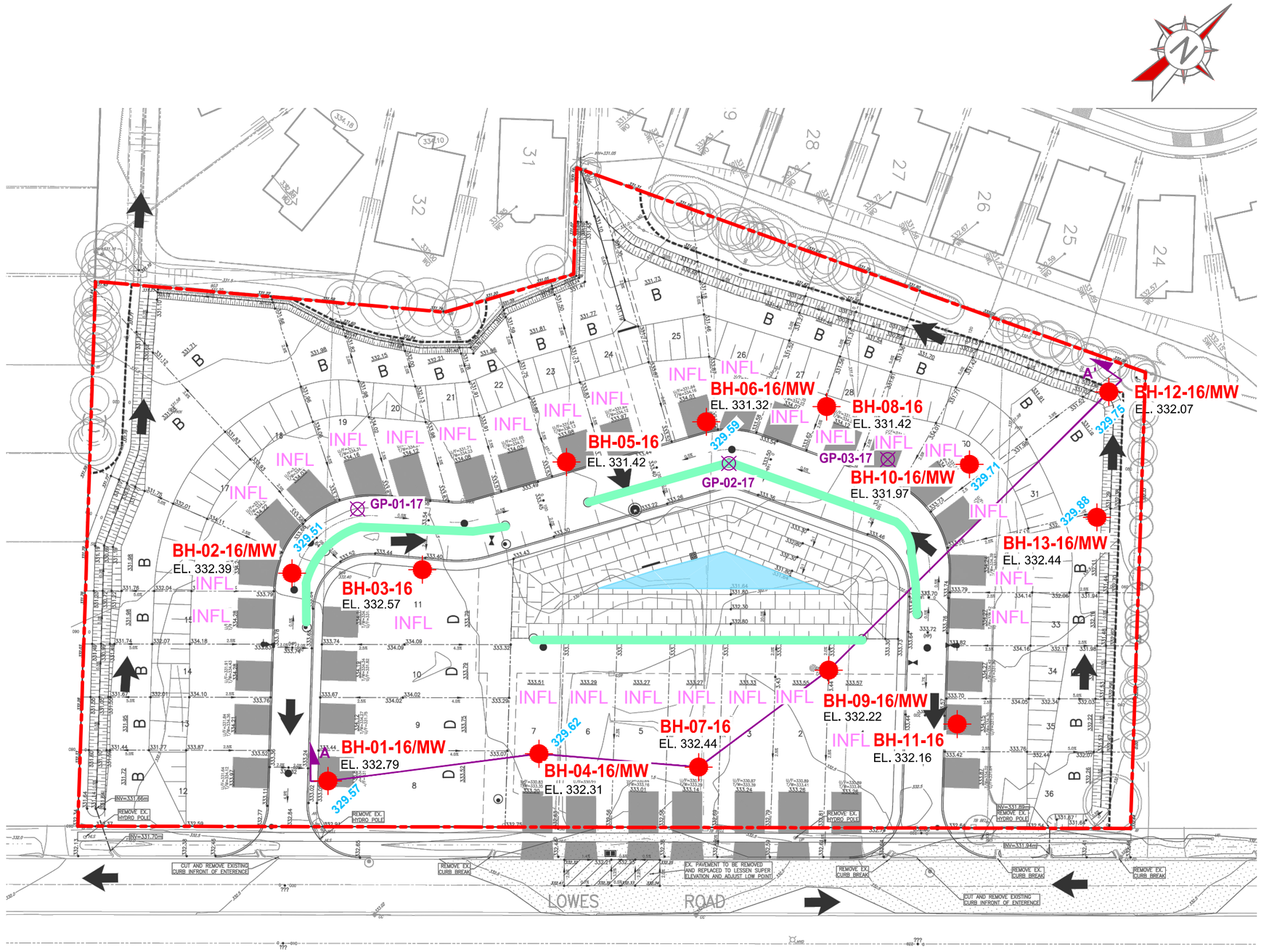
Elysha Brears, G.I.T., M.E.S.
Groundwater Technologist

Reinhard Zapata , P.Geo., Ph.D.
Senior Hydrogeologist

alc

Encl. Drawing 1 – Site Plan
Encl. BH-02-16, BH-03-16, BH-05-16, BH-06-16, BH-08-16 and BH-10-16

1ec: Mr. Peter Fitzgerald, Stantec
1ec: Ms. Astrid Clos, Planning Consultants



LEGEND :

- SITE OUTLINE
- BOREHOLE LOCATION
- EL. 331.32 — GROUND SURFACE ELEVATION (m)
- A — A' — CROSS SECTION (Refer to Drawing 3)
- INFILTRATION GALLERY
- CLEAN WATER COLLECTION SYSTEM
- INFL — INFILTRATION
- 329.51 — GROUNDWATER ELEVATION (mASL) (August 31, 2017)
- GUELPH PERMEAMETER TEST LOCATION

NOTES :

1-REFERENCES: STANTEC, Preliminary Grading Plan Site Plan Number, Drawing No.GP-1, August 2016..

2-Borehole coordinates and elevations based on Sokkia network data.

3-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

4-MW refers to monitoring well installed at borehole location.

Project

Lowes Road Development, Hydrogeology Study

Lowes Road, Guelph, Ontario

Title

SITE PLAN

Englobe Corp.
353, Bridge Street East
Kitchener (Ontario) N2K 2Y5
Telephone : 519.741.1313
Fax : 519.741.5422

Prepared	E.Ciochon	Discipline	HYDROGEOLOGY
Drawn	E.Ciochon	Scale	1:750
Checked	E.Brears	Date	2017-09-12
Project manager	E.Brears	Sequence no.	01 of 01

M. dept.	Project	Disc.	Dwg no.	Rev.
160	P-0010233-0-07-304	HD	001	00

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Englobe

Ground Elevation:	*332.39 m*	**Borehole Number:**	**BH-02-16**
Northing:	*4817500.03 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564840.49 m*	**Drill Date:**	*2016-05-02*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE			SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Initial / Remold / Shear Strength (FV) kPa	WP WL / Water Content (%)	Groundwater Observations and Standpipe Details
	Ground Elevation		332.39							
	FILL: loose brown silty sand and gravel, very moist		0.00 / 332.24	SS-1	5-5 3-3	8				flushmount cover and concrete
	loose dark brown silt, some topsoil, trace sand and organics, moist		0.15 / 332.11							
	brown sandy silt, trace gravel, very moist		0.28 / 331.48	SS-2	4-6 9-9	15				bentonite seal
1	***SAND AND GRAVEL:*** compact brown sand and gravel, some silt, occasional cobbles, moist		0.91 / 330.87	SS-3	18-20 30-26	50				
	very dense, numerous cobbles		1.52							
2				SS-4	46-23 21-16	44				el. 329.76 m 2016-05-12
	dense, wet		329.65 / 2.74							
3	compact, saturated		329.34 / 3.05	SS-5	13-14 14-12	28				sand pack
	very dense to dense		328.58 / 3.81	SS-6	27-30 35-30	65				50 mm pipe 3.05 m slotted screen
4										
5				SS-7	12-19 21-20	40				
	compact, occasional cobbles		327.06 / 5.33	SS-8	17-13 12-10	25				native cave
6	Borehole terminated 5.94 m		326.45 / 5.94							
7										
8										

Reviewed by: *K.Thrams* **Drafted by:** *E.Ciochon* **Sheet:** *1 of 1*

Notes:

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation:	*332.57 m*	**Borehole Number:**	**BH-03-16**
Northing:	*4817516.77 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564855.63 m*	**Drill Date:**	*2016-05-02*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE			SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
	Ground Elevation		332.57							
	FILL: dark brown silt (topsoil), trace gravel, moist		0.00 332.26	SS-1	2-2 4-6	6				
	SAND AND GRAVEL: dense brown sand and gravel, some silt, numerous cobbles, moist		0.30	SS-2	7-24 16-20	40				native backfill
	very dense		331.05 1.52	SS-3	17-60 /150 mm					
				SS-4	46-45 50	95				
	wet		329.67 2.90							native cave
	dense, occasional cobbles, saturated		329.52 3.05	SS-5	14-17 20-27	37				
	Borehole terminated at 3.66 m		328.91 3.66							At drilling completion, dry cave at 2.24 m.

Dynamic Cone / Std Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200 (Initial / Remold)

Water Content (%): WP WL; 10 20 30

Reviewed by: *K.Thrams* **Drafted by:** *E.Ciochon* **Sheet:** *1 of 1*

Notes:

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Englobe

Ground Elevation:	*331.42 m*	**Borehole Number:**	**BH-05-16**
Northing:	*4817547.70 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564859.41 m*	**Drill Date:**	*2016-05-02*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE			SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Initial / Remold / Shear Strength (FV) kPa	WP WL / Water Content (%)	Groundwater Observations and Standpipe Details
	Ground Elevation		331.42							
	FILL: loose dark brown silt (topsoil), trace sand and gravel, very moist		0.00 331.19 0.23	SS-1	1-2 3-5	5				native backfill
	SAND: loose brown sand, some silt, trace gravel, moist		330.66 0.76	SS-2	7-11 17-20	28				
1	***SAND AND GRAVEL:*** compact to dense brown sand and gravel, some silt, moist									bentonite seal
	dense, saturated		329.90 1.52	SS-3	10-14 21	35				
2										
	trace silt		329.13 2.29	SS-4	11-15 15	30				
3				SS-5	6-17 19	36				
4										native cave
	compact		326.85 4.57	SS-6	8-10 14	24				
5										
6				SS-7	7-8 9	17				
	Borehole terminated at 6.55 m		324.87 6.55							At drilling completion, dry cave at 2.13 m.
7										
8										

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Notes:

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation:	*331.32 m*	**Borehole Number:**	**BH-06-16**
Northing:	*4817570.01 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564871.12 m*	**Drill Date:**	*2016-05-03*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE			SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
	Ground Elevation		331.32							
	TOPSOIL: dark brown silt, moist		0.00 / 331.12							
	SAND: loose brown/dark brown silty sand, trace gravel and topsoil, very moist		0.20 / 330.56	SS-1	2-3 5-5	8				
1	compact, brown, some gravel, occasional cobbles, moist		0.76 / 329.80	SS-2	9-7 6-6	13				
	SAND AND GRAVEL: very dense grey/brown sand and gravel, trace silt, numerous cobbles, saturated		1.52 / 329.03	SS-3	16-24 39-20	63				
2	dense		2.29 / 328.27	SS-4	31-20 23-32	43				
3	compact		3.05 / 327.51	SS-5	12-13 14-16	27				
	very dense		3.81 / 326.75	SS-6	17-15 /75 mm					
4	compact, brown, occasional cobbles		4.57 / 326.14	SS-7	9-11 15-19	26				
5	Borehole terminated at 5.18 m		5.18							
6										
7										
8										

Dynamic Cone / Std Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200 — Initial / Remold

Water Content (%): WP WL — 10 20 30

Groundwater Observations and Standpipe Details:
- flushmount cover and concrete
- bentonite seal
- el. 329.86 m 2016-05-12
- sand pack
- 50 mm pipe
- 3.05 m slotted screen
- native cave

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Notes:

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Vertical Scale = 1 : 50.0

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Englobe

Ground Elevation:	*331.42 m*	**Borehole Number:**	**BH-08-16**
Northing:	*4817586.89 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564883.60 m*	**Drill Date:**	*2016-05-03*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE			SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Initial / Remold / Shear Strength (FV) kPa	Water Content (%)	Groundwater Observations and Standpipe Details
	Ground Elevation		331.42							
	TOPSOIL: loose dark brown silt, moist		0.00 / 331.22	SS-1	2-2 3	5				topsoil
	SAND: loose brown silty sand, some gravel, trace topsoil, moist		0.20 / 330.66							native backfill
1	***SAND AND GRAVEL:*** very dense brown sand and gravel, some silt, numerous cobbles, moist		0.76	SS-2	9-23 35	58				bentonite seal
	dense, saturated		329.90 / 1.52	SS-3	13-15 15	30				
2			329.13							
	very dense		2.29	SS-4	16-31 35	66				
3			328.37							
	dense		3.05	SS-5	16-18 24	42				
4										native cave
5				SS-6	14-17 20	37				
6				SS-7	8-14 17	31				
	Borehole terminated at 6.55 m		324.87 / 6.55							At drilling completion, wet cave at 1.52 m.
7										
8										

Dynamic Cone / Std Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200 — Initial, Remold

Water Content (%): WP, WL; 10 20 30

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation:	*331.97 m*	**Borehole Number:**	**BH-10-16**
Northing:	*4817597.87 m*	**Job N°:**	*P-0010233-0-01-100*
Easting:	*564907.94 m*	**Drill Date:**	*2016-05-03*
Project:	*Proposed Residential Development*	**Field Tech:**	*D.Souter*
Location:	*Lowes Road, Guelph, Ontario*	**Drill Method:**	*Hollow Stem Auger*

SOIL PROFILE		SAMPLE							
Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number	"Blows" /150 mm	SPT 'N' Value	Dynamic Cone / Std Penetration	Shear Strength (PP) kPa / Initial / Remold / Shear Strength (FV) kPa	Water Content (%) WP WL	Groundwater Observations and Standpipe Details
	Ground Elevation		331.97							
	TOPSOIL: dark brown silt, trace sand and gravel, occasional cobbles, moist		0.00 331.72 0.25							protective cover and concrete
1	***SAND AND GRAVEL:*** compact brown silty sand and gravel, trace topsoil, moist			SS-1	3-5 6	11				
	very dense, trace silt, numerous cobbles		330.45 1.52	SS-2	9-29 35	64				
2	saturated		329.68 2.29	SS-3	60 /150 mm					el. 330.00 m 2016-05-12
3	compact		328.92 3.05	SS-4	7-11 15	26				sand pack
4										50 mm pipe 1.52 m slotted screen
5				SS-5	8-10 12	22				
6	dense		325.87 6.10	SS-6	8-21 26	47				native cave
	Borehole terminated at 6.55 m		325.42 6.55							
7										
8										

Dynamic Cone / Std Penetration: 20 40 60 80

Shear Strength (PP) kPa / Shear Strength (FV) kPa: 50 100 150 200 — Initial, Remold

Water Content (%): 10 20 30

Reviewed by: *K.Thrams* **Drafted by:** *E.Ciochon* **Sheet:** *1 of 1*

Notes:

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011