

November 13, 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-0001-03

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 reviewed in consultation with this letter.

The objectives of this letter report are to provide a summary of the infiltration properties of the soils at the locations 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 m above the highest measured water level on-site 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; therefore, the infiltration test elevation at this location was about 1.2 mBGS (4.0 fBGS) in order to achieve a flat base to complete the testing due to the cobbly nature of the soil. In test locations GP-02-17 and GP-03-17 elevation 331.64 mASL is above existing ground surface; therefore, 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 BH08-16 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) in cm/sec

$C_1$  = Shape factor

$Q_1$  = Discharge from combined reservoir

$H_1$  = Well height (cm)

$a$  = well radius (cm)

$\alpha$  = soil texture (cm<sup>-1</sup>)

## Infiltration Rates

Field saturated hydraulic conductivities have been calculated using the results of the Guelph Permeameter testing. 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 which 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).

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The estimated design 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 Authorities, and the approximate 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 favourably high hydraulic gradients ( $> 0.2$ ) are summarized in Table 1 below. The field measured results and corresponding infiltration rates are summarized in Table 1 below.

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	1.2	331.2	Sand and Gravel	$4.50 \times 10^{-4}$	95
GP-02-17	0.5	330.9	Silty Sand	$2.99 \times 10^{-5}$	46
GP-03-17	0.5	330.9	Silty Sand	$2.78 \times 10^{-5}$	45

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 and infiltration rates. 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

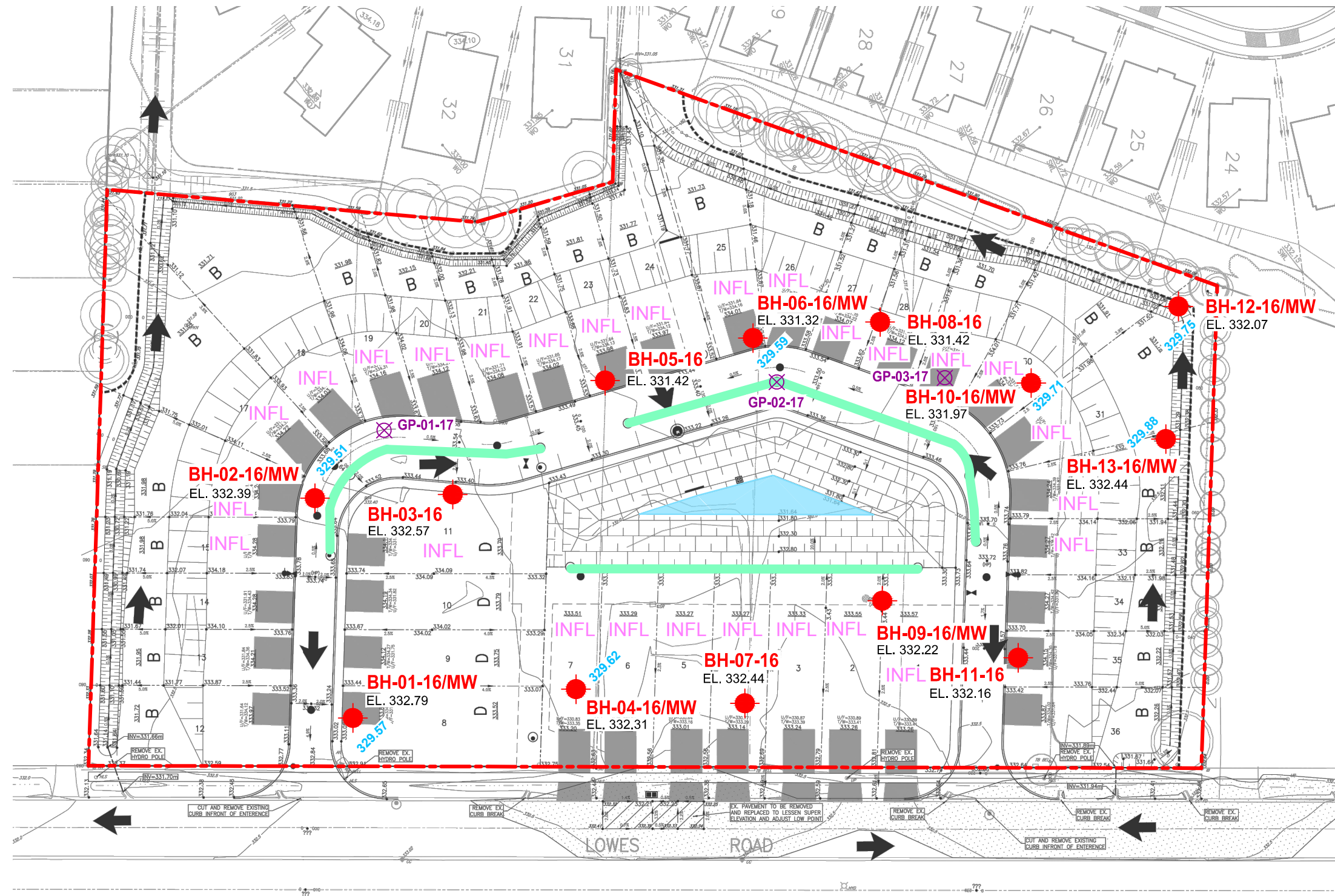
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Encl. Drawing 1 – Site Plan  
Encl. Borehole Logs BH-02-16, BH-03-16, BH-05-16, BH-06-16, BH-08-16 and BH-10-16

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

Kelvin Antoniuk, P. Geo., B.Sc.  
Senior Geoscientist

10 cm  
5  
4  
3  
2  
1  
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**LEGEND :**

- - - SITE OUTLINE
- BOREHOLE LOCATION
- EL. 331.32 GROUND SURFACE ELEVATION (m)
- 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

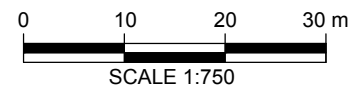
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Title

### SITE PLAN

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

Prepared <b>E.Ciochon</b> Drawn <b>E.Ciochon</b> Checked <b>E.Brears</b>	Discipline <b>HYDROGEOLOGY</b> Scale <b>1:750</b> Date <b>2017-11-10</b>
Project manager <b>E.Brears</b>	Sequence no. <b>01 of 01</b>
M. dept. <b>160</b> Project <b>P-0010233-0-07-304</b>	Disc. <b>HD</b> Dwg no. <b>001</b> Rev. <b>03</b>



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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

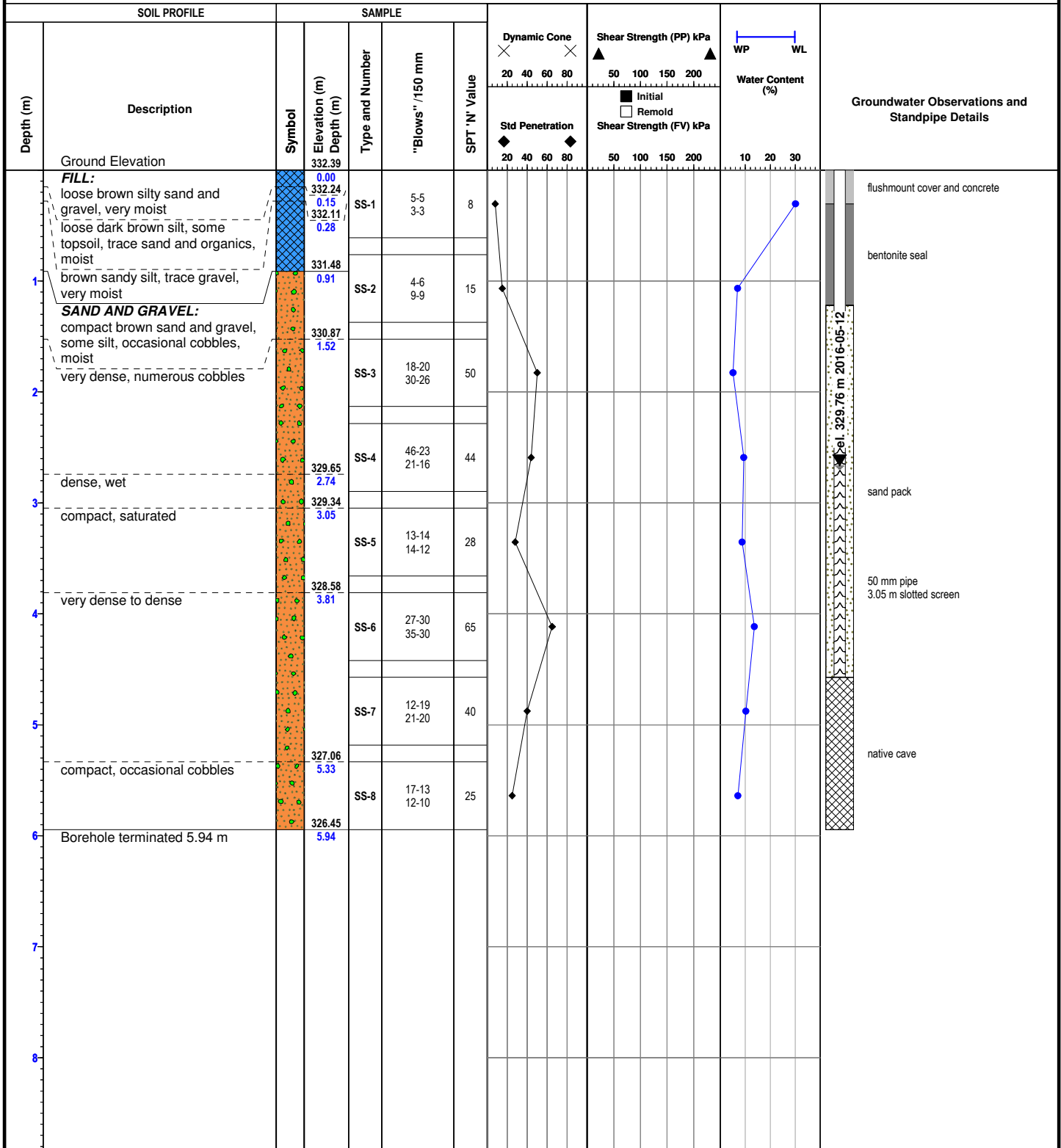
Location: Lowes Road, Guelph, Ontario

Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



Reviewed by: K.Thrams

Drafted by: E.Ciochon

Sheet: 1 of 1

Notes:



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

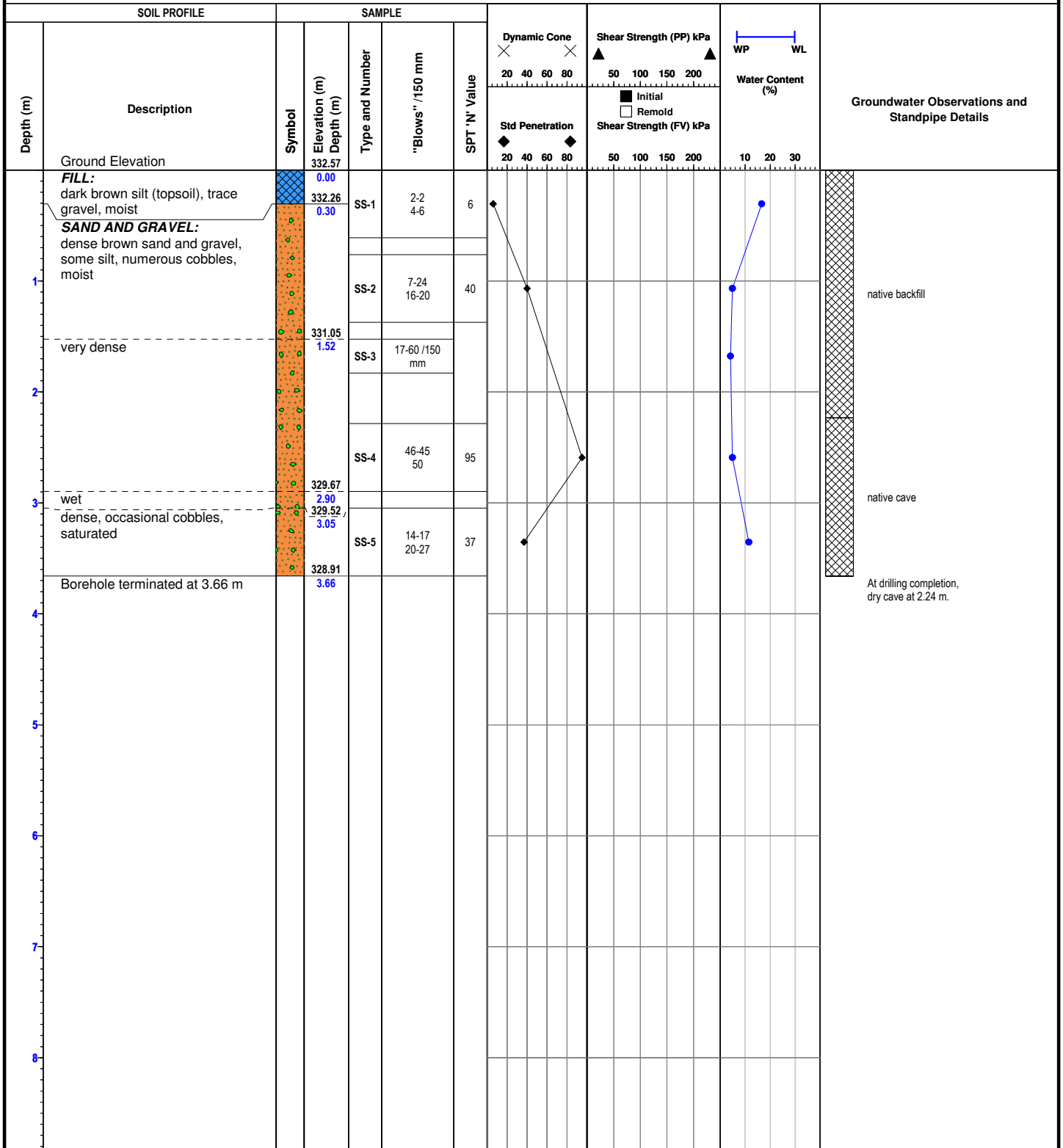
Location: Lowes Road, Guelph, Ontario

Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



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Drafted by: E.Ciochon

Sheet: 1 of 1

Notes:



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

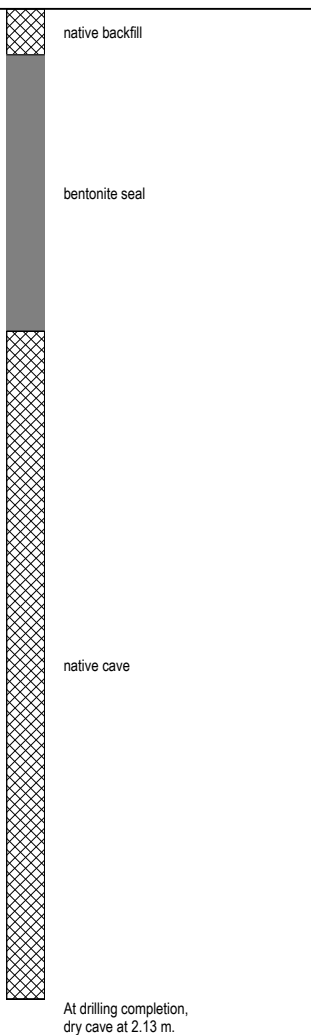
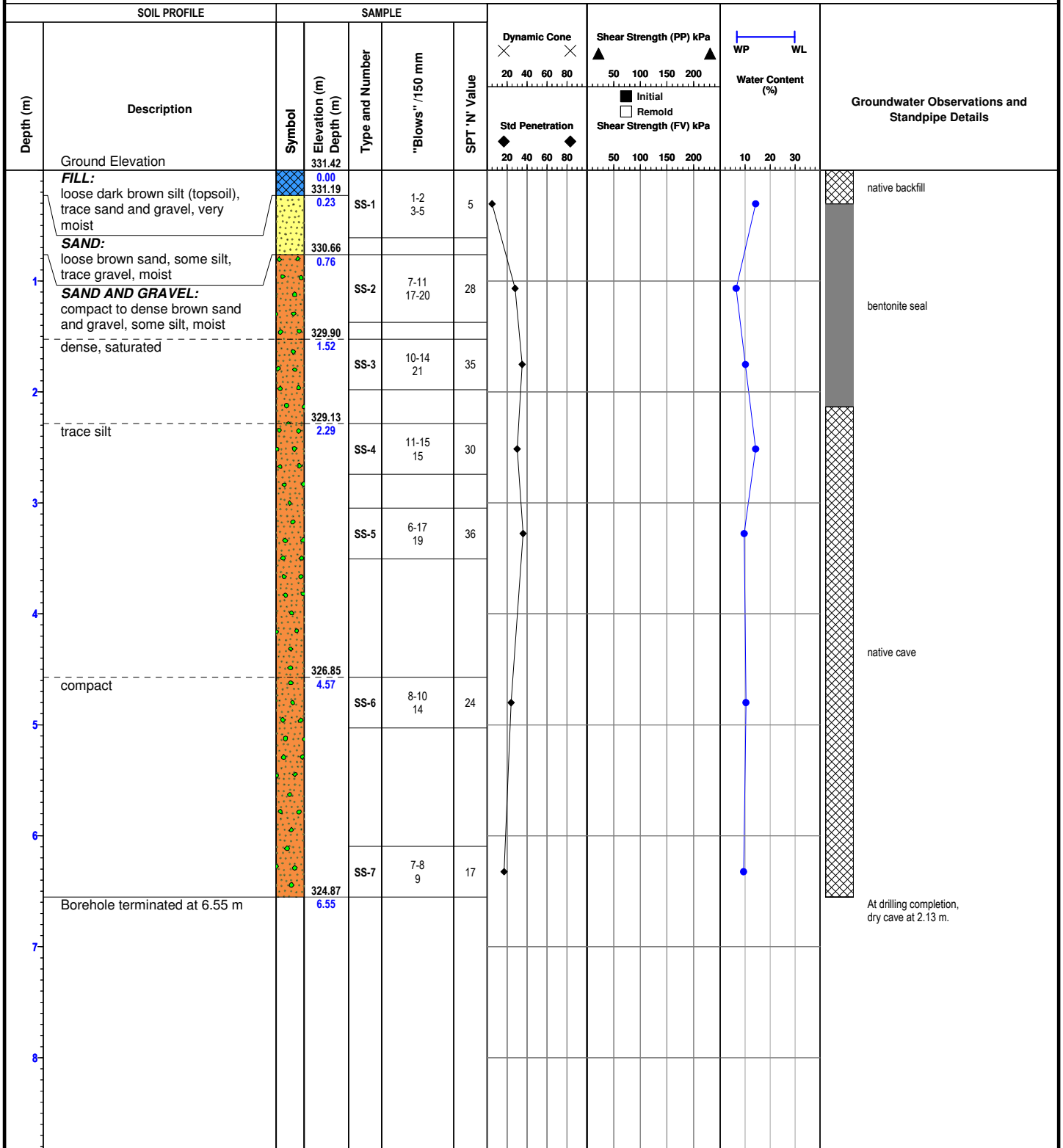
Location: Lowes Road, Guelph, Ontario

Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



Reviewed by: K.Thrams

Drafted by: E.Ciochon

Sheet: 1 of 1

Notes:



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

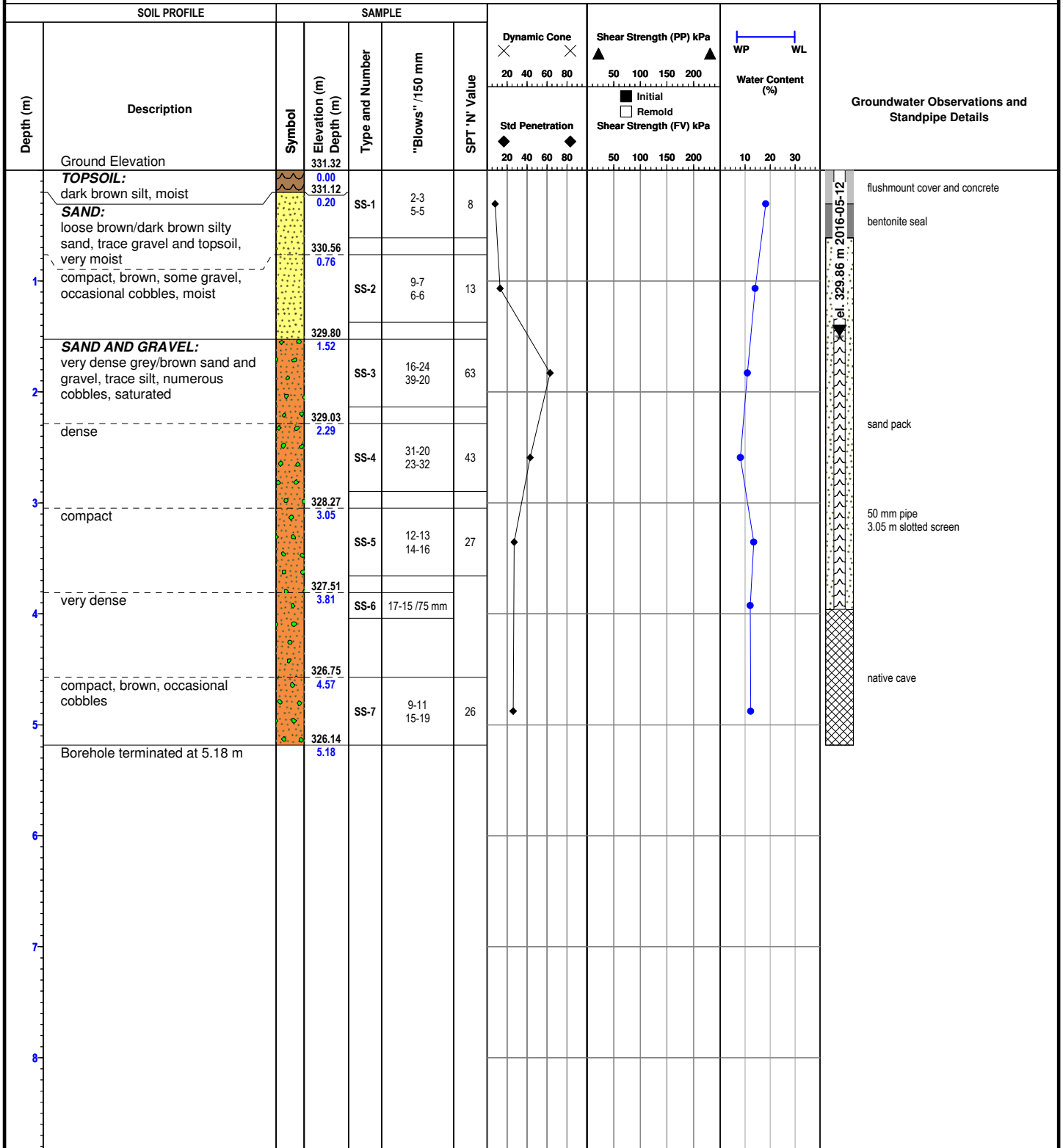
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Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



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Sheet: 1 of 1

Notes:





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

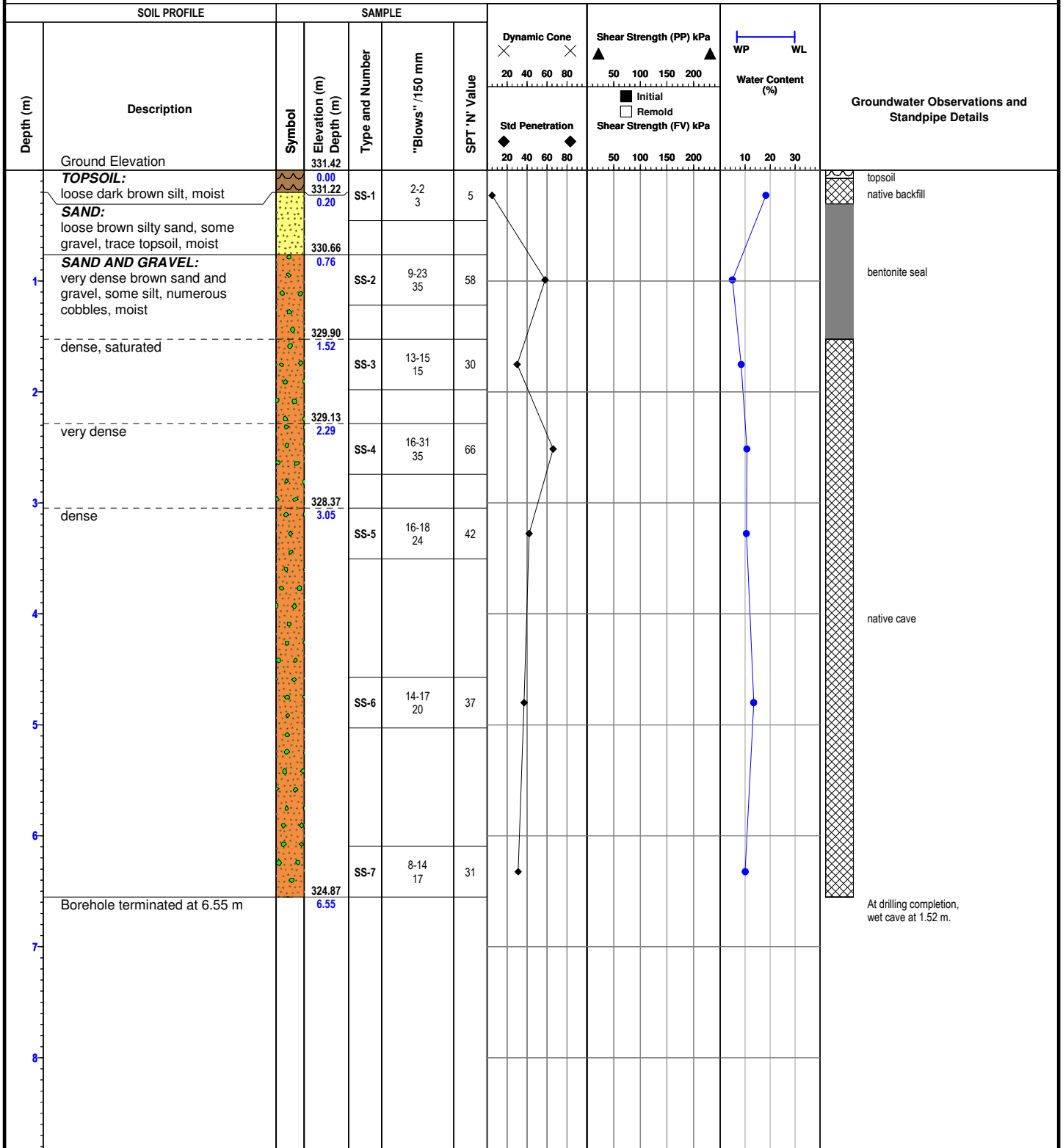
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Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



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Sheet: 1 of 1

Notes:



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

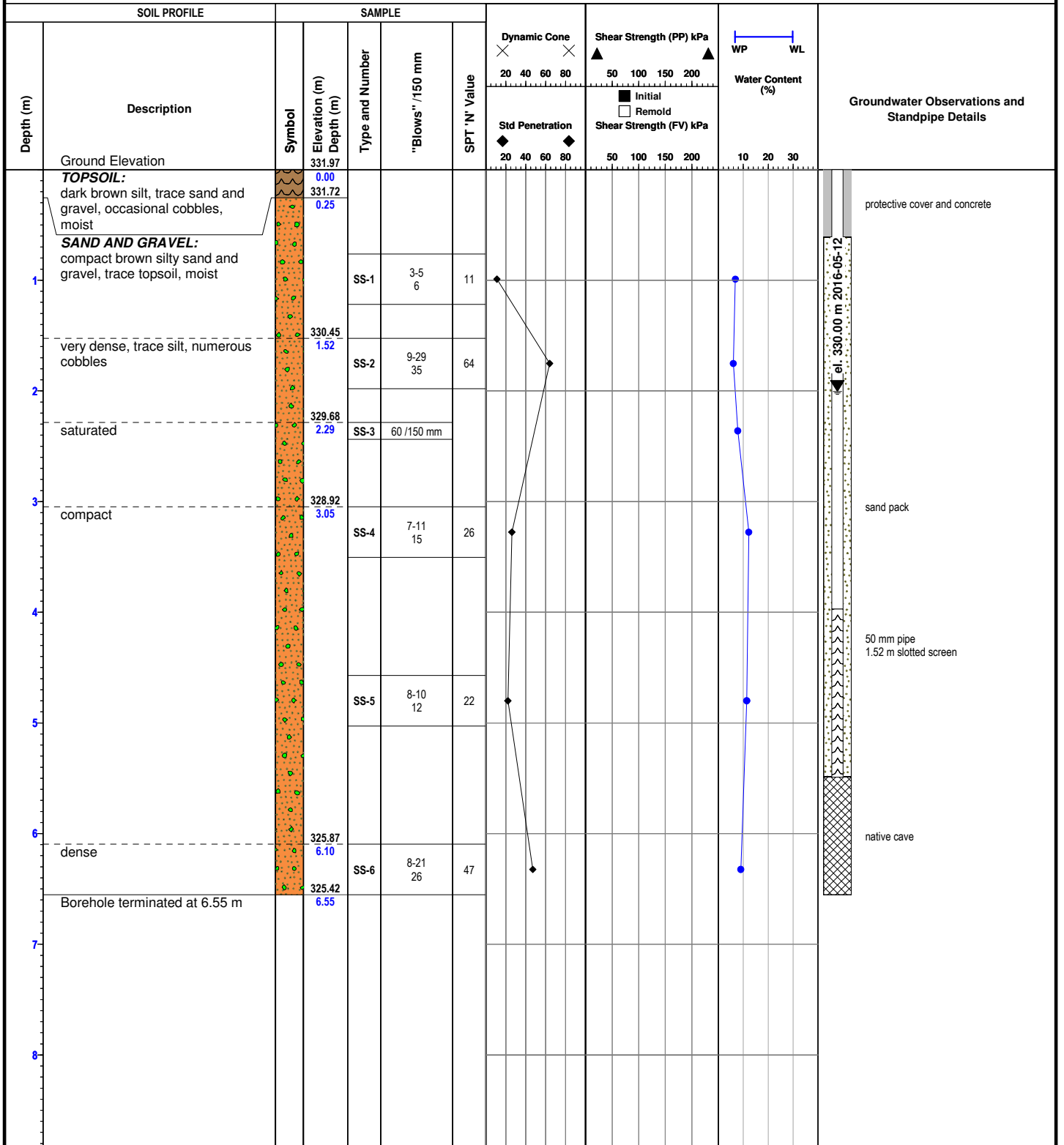
Location: Lowes Road, Guelph, Ontario

Drill Method: Hollow Stem Auger

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Vertical Scale = 1 : 50.0

EQ-09-Ge-72 R.1 18.02.2011



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Drafted by: E.Ciochon

Sheet: 1 of 1

Notes: