Englobe
Soils Materials Environment

Fisheries and Oceans Canada

Storage Building
1527 Lake Road
Norfolk County, Ontario

Geotechnical Engineering Report

Date: November 22, 2016
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Fisheries and Oceans Canada

Storage Building
1527 Lake Road
Norfolk County, Ontario

Geotechnical Engineering Report | P-0011609-0-01-100-01

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Property and Confidentiality

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1219 Queen Street East
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REVISION AND PUBLICATION REGISTER		
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INTRODUCTION

Englobe Corp. (Englobe) has been retained to carry out a geotechnical investigation for the proposed storage building at 1527 Lake Road in Norfolk County, Ontario, at the location shown on Drawing 1, in Appendix 1. This work was authorized by Mr. Bhuwani Paudel, M.A. Sc., P. Eng., of Fisheries and Oceans Canada in purchase order F2311-160034 dated September 26, 2016.

The project involves the design and construction of a 37.16 m^2 single storey slab-on-grade storage building.

The purpose of the geotechnical investigation was to explore the subsurface soil and groundwater conditions at the site. Based on the findings, we have prepared this engineering report with geotechnical recommendations pertaining to foundation design, concrete slab on grade design, and excavations and dewatering.

1 INVESTIGATIVE PROCEDURE

1.1 FIELD PROGRAM

The fieldwork for this investigation was carried out on October 11, 2016, and involved the excavating of two test pits (Test Pits TP-01-16 and TP-02-16) to depths of 3.3 and 3.1 m in the area of the proposed storage building as shown on the Site Plan, Drawing 2 in Appendix 1. The test pits were advanced with a tracked hydraulic backhoe supplied and operated by a specialized excavating contractor.

Public utility companies were contacted prior to the start of excavating activities in order to demarcate underground utilities near the test pit locations.

Soil samples were recovered from the test pits at regular depth intervals throughout the depths explored.

The native soils in the test pits were hand probed with a 10 mm diameter steel rod to estimate the soil relative density. Observations made of the soil characteristics are provided on the test pit logs, in Appendix 2.

Groundwater observations and measurements were carried out in the open test pits during excavating. The observations are summarized on the test pit logs. The test pits were backfilled upon completion.

The fieldwork was observed by a member of our geotechnical engineering staff who documented the excavating and sampling procedures; probed the soils; documented the soil stratigraphies; recorded the groundwater observations; and cared for the recovered soil samples.

The test pit locations and ground surface elevations were surveyed by Englobe. The test pits were located relative to existing site features and property lines, and the ground surface elevations are referred to the following temporary benchmark (TBM):

TBM: Top of concrete well at Civic No. 1535 Lake Road as shown on Drawing 2.
Elevation: 100.00 m (assumed local datum)

1.2 LABORATORY TESTING

The soil samples secured during this investigation were returned to our laboratory for visual examination as well as moisture content tests. The moisture content test results are provided on the appended test pit logs.

The soil samples will be stored for a period of three months from the date of sampling. After this time, they will be discarded unless prior arrangements have been made for longer storage.

2 SUMMARIZED CONDITIONS

The storage building is planned to be constructed northeast of the house at 1535 Lake Road. The storage building will have a planned area of approximately 36 m^2. The location of the storage building is currently covered with field grasses and is generally level at the test pit locations.

Photographs of the site are provided in Appendix 3.

We refer to the appended test pit logs for soil descriptions and stratigraphies; moisture content profiles; and groundwater observations.

The subsurface stratigraphy at the site generally comprises topsoil overlying native sand and clayey silt. Descriptions of the soil deposits encountered are provided in the following paragraphs.

Topsoil was encountered surficially in both test pits excavated for this investigation. The topsoil is 200 mm thick and comprises sandy silt with organics. The topsoil is moist at the time of the investigation.

Sand was encountered beneath the topsoil in Test Pits TP-01-16 and TP-02-16 and is 1.5 and 1.3 m thick respectively. The sand contains some silt and is moist based on insitu moisture contents of 9%.

Silt was encountered below sand in Test Pits TP-01-16 and TP-02-16 at depths of 1.7 and 1.5 m respectively, and extends to the termination depth of both test pits. The texture of the silt comprises clayey silt with trace sand.

Insitu moisture contents of the silt range from 18 to 19% indicating the soils are drier than the plastic limit.

Groundwater observations and measurements carried out in the open test pits are provided on the appended test pit logs. No free groundwater was encountered in the test pits indicating the groundwater level is below the depth of exploration or 3.3 m. Seasonal fluctuations and local variations in the groundwater levels would be expected.

3 DISCUSSION AND RECOMMENDATIONS

The Department of Fisheries and Oceans – Sea Lamprey Contact Control Centre is proposing to build a 37.16 m^2 unheated slab-on-grade storage building on the property at 1527 Lake Road in Norfolk County.

3.1 FOUNDATION DESIGN

It is expected that exterior footings will be founded at conventional depth (1.5 m) in the native sand or silt.

Conventional spread footings founded on the undisturbed native sand or clayey silt at 1.5 m depth may be designed for a factored geotechnical bearing resistance at Ultimate Limit States of 175 kPa, and the soil bearing resistance at Serviceability Limit States of 100 kPa. Properly constructed footings within the native soil deposits are expected to undergo total settlements of less than 25 mm and differential settlements of less than 12 mm.

A Site Classification 'D' should be used or earthquake load and effects in accordance with Table 4.1.8.4.A of the Ontario Building Code (2012).

All exterior footings and those exposed to freezing should be provided with a minimum of 1.2 m of soil cover to provide protection from freezing. If construction extends into the winter months, all founding soil must be protected from freezing during construction.

In general, the native sand excavated from the foundation trench areas will be suitable for reuse as foundation wall backfill provided that the work is carried out during relatively dry weather. If the weather conditions are wet during construction, then imported granular material such as OPSS 1010 Granular 'B' should be used. The backfill should be placed in 300 mm thick lifts and compacted with a smooth drum roller to 95% SPMDD in the exterior of the footing, and to 98% SPMDD in the interior of the building. The backfill should be brought up evenly on both sides of walls not designed to resist lateral earth pressure. Over-compaction must be avoided since this could cause excessive lateral earth pressure.

3.2 CONCRETE SLAB-ON-GRADE

The floor slab for the proposed storage building may be constructed using conventional concrete slab-on-grade techniques following removal of the surficial topsoil. The subgrade soils should be proof-rolled and inspected by experienced geotechnical personnel.

Sand excavated from the foundation trenches is considered suitable for reuse as floor slab fill providing work is carried out during dry weather. If the weather conditions are wet or any additional material is required for floor slab fill should comprise granular materials such as OPSS Granular 'B' Type 1. The floor slab fill should be placed in 300 mm thick lifts and compacted to 98% SPMDD.

A minimum 150 mm thick layer of Granular 'A' material compacted to 100% SPMDD should be provided directly beneath the slab for levelling and uniform support purposes. This should be confirmed by the floor slab designer.

No special under floor drains are required provided the exterior grades are lower than the floor slab and positively sloped away from the building addition.

A modulus of subgrade reaction (k) of 35 MPa/m may be used for the design of the floor slab. The slab-on-grade floor should be independent of all load-bearing walls and columns.

The water to cement ratio and slump of the concrete utilized in the floor slab should be strictly controlled to minimize shrinkage of the slab. Control joints should be sawed into the slab at maximum 4 m spacing's within 12 hours of initial concrete placement in order to pre-locate shrinkage cracks. The saw-cut depths should be ¼ of the slab thickness.

During placement of concrete at the construction site, testing should be performed to determine the slump, temperature, and air entrainment of the concrete, and concrete cylinders should be cast for compressive strength testing.

3.3 EXCAVATION AND DEWATERING

Temporary excavations for foundation construction at this site must comply with O.Reg. 213/91 under the Ontario Occupational Health and Safety Act and Regulations for Construction Projects. The predominant soils encountered in the test pits would be classified as Type 3 soils (O.Reg. 213, s. 226(3)) and temporary side slopes must be trimmed back at about 1 horizontal to 1 vertical from the base of the excavation as per O.Reg. 213/91 s. 234(2) (exclusive of groundwater affects).

No major groundwater problems are envisaged for excavations above Elevation 97.1 m and any minor groundwater infiltration should be handled using conventional sump pumping techniques. Every excavation that a worker may be required to enter shall be kept reasonably free of water (O.Reg. 213/91, s. 230).

4 STATEMENT OF LIMITATIONS

The geotechnical recommendations provided in this report are applicable only to the project described in the text and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known at the time of report preparation, we recommend that we be retained during the final design stage to verify that the geotechnical recommendations have been correctly interpreted in the design. Also, if any further clarification and/or elaboration are needed concerning the geotechnical aspects of the project, Englobe Corp. (Englobe) should be contacted. We recommend that we be retained during construction to confirm that the subsurface conditions do not deviate materially from those encountered in the test holes and to ensure that our recommendations are properly understood. Quality assurance testing and inspection services during construction are a necessary part of the evaluation of the subsurface conditions.

The geotechnical recommendations provided in this report are intended for the use of the Client or its' agent and may not be used by a Third Party without the expressed written consent of Englobe and the Client. They are not intended as specifications or instructions to contractors. Any use which a contractor makes of this report, or decisions made based on it, are the responsibility of the contractor. The contractor must also accept the responsibility for means and methods of construction, seek additional information if required, and draw their own conclusions as to how the subsurface conditions may affect their work. Englobe accepts no responsibility and denies any liability whatsoever for any damages arising from improper or unauthorized use of the report or parts thereof.

It is important to note that the geotechnical assessment involves a limited sampling of the site gathered at specific test hole locations and the conclusions in this report are based on this information gathered and in accordance with normally accepted practices. The subsurface geotechnical, hydrogeological, environmental and geologic conditions between and beyond the test holes will differ from those encountered at the test holes. Also such conditions are not uniform and can vary over time. Should subsurface conditions be encountered which differ materially from those indicated at the test holes, we request that we be notified in order to assess the additional information and determine whether or not changes should be made as a result of the conditions. Englobe will not be responsible to any party for damages incurred as a result of failing to notify Englobe that differing site or subsurface conditions are present upon becoming aware of such conditions.

It must be recognized that the passage of time, natural occurrences and direct or indirect human intervention at or near the site have potential to alter the subsurface conditions. If during construction the soil, rock or groundwater is found not to be of the type or in the condition used in design and as indicated on the drawings, the design shall be reassessed by the designer. If during construction, climatic (i.e. rain, frost etc.) or any other conditions (i.e. seepage, excavations, chemical spills, etc.) have changed the properties of the soil, rock or groundwater, the design shall be reassessed by the designer.

The professional services provided for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise stated specifically in the report. The recommendations and opinions given in this report are based on our professional judgment and are for the guidance of the Client or its' Agent in the design of the specific project. No other warranties or guarantees, expressed or implied, are made.

Appendix 1 Drawings

Drawing 1: Location Plan
Drawing 2: Site Plan

NOTES :

1-REFERENCE : Ontario Road Atlas (2006), Page 10

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

0 2 4 6 8 10 km

SCALE 1:200,000

Project

NEW STORAGE SHED

1527 Lake Road, Norfolk County, Ontario

Title

LOCATION PLAN

Englobe

440, Hardy Road, Unit 3
Brantford (Ontario) N3T 5L8
Telephone : 519.720.0078
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Prepared	K. Staples	Discipline	Geotechnical	Project manager	T. Staples
Drawn	K. Staples	Scale	1 : 200,000	Sequence no.	01of 02
Checked	T. Staples	Date	2016-11-22		

M. dept.	Project	Disc.	Dwg no.	Rev.
162	P-0011609-0-01-100-01	GE	001	00

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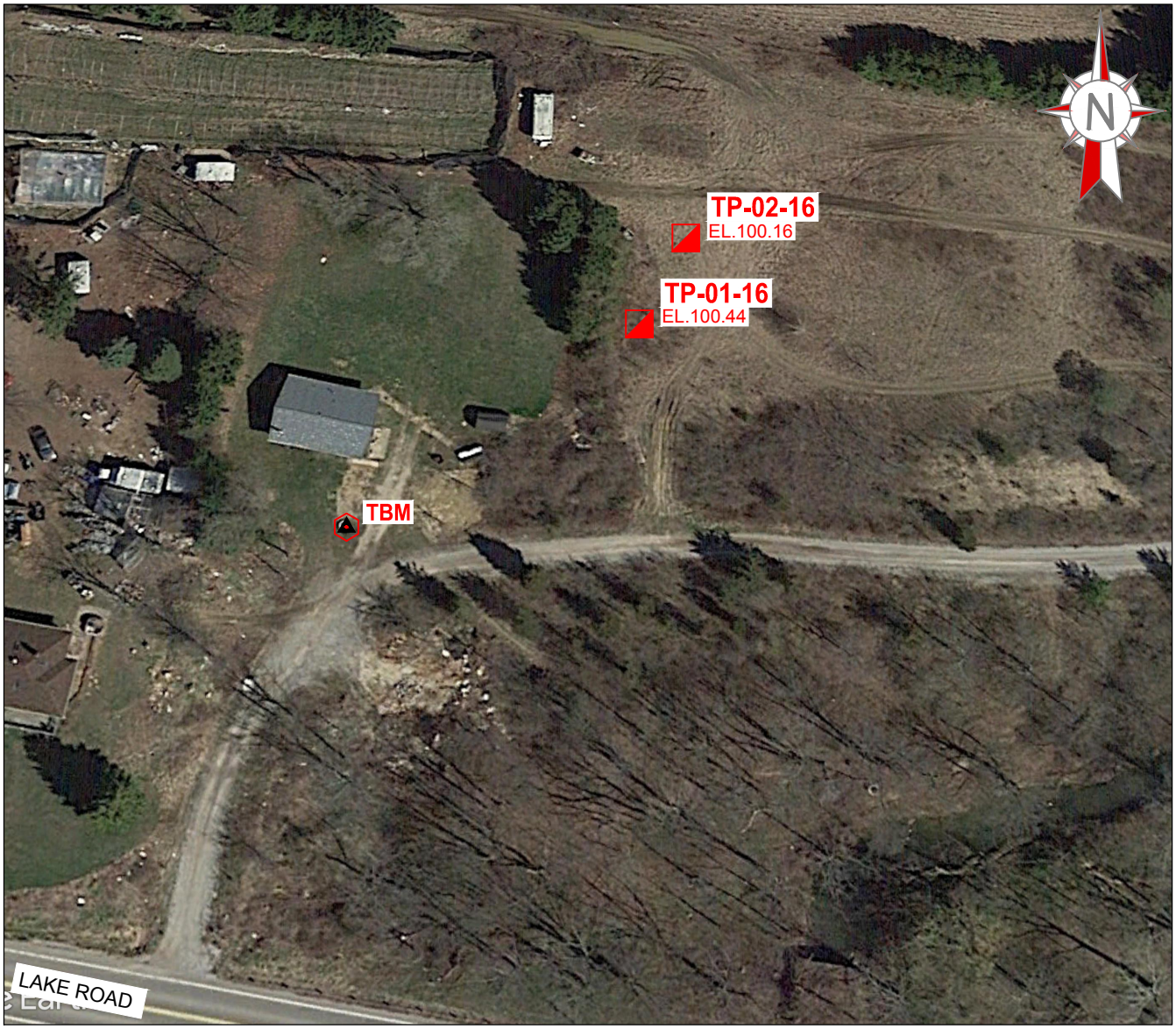

LEGEND :

	TEST PIT LOCATION
EL.100.44	GROUND SURFACE ELEVATION (m)
TBM	TEMPORARY BENCHMARK

NOTES :

1-REFERENCE : 2016 Aerial imagery from Google Earth (2016)
2-TEMPORARY BENCHMARK : Top of concrete on drilled well at Civic #1535 Lake Road. Elevation: 100.00 m (assumed local datum)
3-Drawing scale may be distorted due to file conversion and/or copying. Measurements taken from the drawing must be verified in the field.

0 10 20 30 m

SCALE 1:750

Project

NEW STORAGE SHED

1527 Lake Road, Norfolk County, Ontario

Title

SITE PLAN

Englobe
440, Hardy Road, Unit 3
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Telephone : 519.720.0078
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Checked	T. Staples	Date	2016-11-22		

M. dept.	Project	Disc.	Dwg no.	Rev.
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Appendix 2 Test Pit Logs

List of Abbreviations

Test Pit Logs – Test Pits TP-01-16 and TP-02-16

LIST OF ABBREVIATIONS

The abbreviations commonly employed on the borehole logs, on the figures, and in the text of the report, are as follows:

Sample Types		Soil Tests and Properties	
AS	Auger Sample	SPT	Standard Penetration Test
CS	Core Sample	UC	Unconfined Compression
RC	Rock Core	FV	Field Vane Test
SS	Split Spoon	ø	Angle of internal friction
TW	Thinwall, Open	γ	Unit weight
WS	Wash Sample	w_p	Plastic limit
BS	Bulk Sample	w	Water content
GS	Grab Sample	w_L	Liquid limit
WC	Water Content Sample	I_L	Liquidity index
TP	Thinwall, Piston	I_p	Plasticity index
		PP	Pocket penetrometer

Penetration Resistances	
Dynamic Penetration Resistance	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) diameter 60º cone a distance 300 mm (12 in.). The cone is attached to 'A' size drill rods and casing is not used.
Standard Penetration Resistance, N (ASTM D1586)	The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) required to drive a standard split spoon sampler 300 mm (12 in.)
WH	sampler advanced by static weight of hammer
PH	sampler advanced by hydraulic pressure
PM	sampler advanced by manual pressure

Soil Description		
Cohesionless Soils	**SPT N-Value**	**Relative Density (D_r)**
Compactness Condition	(blows per 0.3 m)	(%)
Very Loose	0 to 4	0 to 20
Loose	4 to 10	20 to 40
Compact	10 to 30	40 to 60
Dense	30 to 50	60 to 80
Very Dense	over 50	80 to 100
Cohesive Soils	**Undrained Shear Strength (C_u)**	
Consistency	**kPa**	**psf**
Very Soft	less than 12	less than 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1000
Stiff	50 to 100	1000 to 2000
Very Stiff	100 to 200	2000 to 4000
Hard	over 200	over 4000
DTPL	Drier than plastic limit	Low Plasticity, W_L <30
APL	About plastic limit	Medium Plasticity, 30 < W_L < 50
WTPL	Wetter than plastic limit	High Plasticity, W_L > 50

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Ground Elevation: *100.44 m*

Test Pit Number: **TP-01-16**

Job N°: *P-0011609-0-01-100-01*

Drill Date: *2016-10-11*

Project: *New Storage Shed*

Field Tech: *J. Marcos*

Location: *1527 Lake Road, Norfolk County, Ontario*

Excavation Method: *Backhoe*

SOIL PROFILE		SAMPLE						
Depth (m)	Description	Symbol	Elevation (m) Depth (m)	Type and Number	Shear Strength (PP) kPa / Shear Strength (FV) kPa (50, 100, 150, 200)	WP WL Water Content (%) (10, 20, 30)	Groundwater Observations and Standpipe Details
	Ground Elevation		100.44				
	TOPSOIL: dark brown sandy silt with organics, moist		0.00 100.24				
	SAND: light brown sand, some silt, moist		0.20 98.74	BS-1			native backfill
	SILT: brown clayey silt, trace sand, DTPL		1.70	BS-2			
	Test pit terminated at 3.30 m.		97.14 3.30				At completion of excavation, test pit sidewalls vertically stable. No free groundwater encountered.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes: *Soil was probed at 1.2 m and penetration was approximately 7 cm.*

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Vertical Scale = 1 : 30.0

EQ-09-Ge-72 R.1 18.02.2011

Englobe

Ground Elevation: *100.16 m*

Test Pit Number: **TP-02-16**

Job N°: *P-0011609-0-01-100-01*

Drill Date: *2016-10-11*

Project: *New Storage Shed*

Field Tech: *J. Marcos*

Location: *1527 Lake Road, Norfolk County, Ontario*

Excavation Method: *Backhoe*

Depth (m)	Description	Symbol	Elevation (m) / Depth (m)	Type and Number
	Ground Elevation		100.16	
	TOPSOIL: dark brown sandy silt with organics, moist		0.00 / 99.96	
	SAND: light brown sand, some silt, moist		0.20 / 98.66	BS-1
	SILT: brown clayey silt, trace sand, DTPL		1.50 / 97.06	BS-2
	Test pit terminated at 3.10 m.		3.10	

Shear Strength (PP) kPa: 50 100 150 200

Shear Strength (FV) kPa: 50 100 150 200

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

Groundwater Observations and Standpipe Details

native backfill

At completion of excavation, test pit sidewalls vertically stable.

No free groundwater encountered.

Reviewed by: *T. Staples*

Drafted by: *K. Staples*

Sheet: *1 of 1*

Notes: *Soil was probed at 1.2 m and penetration was approximately 6 cm.*

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Vertical Scale = 1 : 30.0

EQ-09-Ge-72 R.1 18.02.2011

Appendix 3 Site Photographs

Photographs 1 and 2

Photo 1 : Looking north from top of slope next to driveway.

Photo 2 : Looking southwest across location of proposed storage building.