MEMO

TO: Tony Miele, Michler Holdings Ltd.

FROM: Lloyd Lemon, M.Sc., P.Geo. Senior Project Geoscientist

SUBJECT: **Summary of Infiltration Test – Michler Holdings Ltd, 440 Veterans Way, Barrie, Ontario**

DATE: **November 3, 2020**

This memorandum summarizes infiltration testing performed at the Michler Holdings Ltd. property at 440 Veterans Way, Barrie, Ontario, as requested by Tony Miele on behalf of Michler Holdings Ltd.

APPROACH

The infiltration testing program included the following tasks:

1. Coordinate testing with Michler Holdings Ltd.
2. Stake the proposed test location in the field. The test location is shown in **Figure 1**.
3. Obtain public utility clearances from Ontario OneCall for the Site and coordinate with a private locator to provide clearance of underground utilities beneath each proposed test location.
4. Work with the excavation contractor to open a shallow test pit at the proposed location. The infiltration test was carried out at a depth of 1.5 m. The test location was restored to original condition on completion of field test (except as noted).
5. Conduct one (1) infiltration test in the shallow excavation using a 4" Pask Permeameter to measure the rate at which water is taken into the soil. A graphical method was then used to estimate the percolation rate or infiltration rate associated with the soils.
6. Prepare a technical memo report to document the methods, test locations, observations, calculated test values and the range of observed infiltration rates. A design infiltration rate is proposed for each facility location, including a factor of safety to ensure that the infiltration rate can be maintained.

FIELD WORK

The field work for the infiltration testing was carried out on October 17, 2020. One test pit was excavated to a depth of 1.5 m by a representative from Michler Holdings Ltd. The testing depths were predetermined based on existing topography data and design information on the proposed Low Impact Development (LID) infiltration system provided by Pearson Engineering Ltd. The LID design calls for placement of permeable pavers.

During testing, records were maintained of the soil profile encountered and the depth to water (if observed). Upon completion of testing, the test pits were back-filled and restored to the original condition.

TEST LOCATIONS AND DEPTHS

The testing location and depth was based on information contained within the drawing set provided by *Pearson Engineering Ltd.* The test location was selected based on the proposed location of the permeable pavers and is illustrated on **Figure 1.** The testing depths were determined based on existing topography, proposed grades, and LID design information contained within the drawing set. The test depth is summarized in **Table 1.**

OBSERVED CONDITIONS

SOIL

The soils at the Site were observed to consist of a 70 mm layer of topsoil underlain by a layer of gravelly sand (fill) that extends to a maximum depth of 0.41 m below ground surface (bgs). Below this lies a layer of silty sand to sandy silt till which extends to at least 1.47 m bgs (the point of test pit termination). These observations were consistent with the subsurface conditions noted in the Geospec Engineering (GEL)/SPL Consultants Limited (SPL) geotechnical investigation in October 2014.

WATER TABLE

Evidence of a water table was not observed within the test pit TP20-1 to a maximum depth of 1.5 bgs. Groundwater was not observed in the previous GEL/SPL geotechnical investigations, which consisted of three (3) boreholes advanced to a maximum depth of 5.5 mbgs.

INFILTRATION TEST RESULTS

The calculated field saturated hydraulic conductivity using the observed rate of fall and an applicable soil factor is presented in **Table 2.** The results of the infiltration testing are summarized in **Table 1**. The results are also presented graphically in **Figure 2**.

Figure 2 shows the observed field saturated hydraulic conductivity estimates and uses relationships published by the "Ministry of Municipal Affairs and Housing – Building Development Branch" to relate the test values to "infiltration rate" (in mm/hour) or "percolation time" (in mins/cm). As can be seen on **Figure 2** – these concepts are inversely related (a low value in one is high for the other).

The field saturated hydraulic conductivity was observed to be approximately 1.3×10^{-6} m/sec. This value is reasonably within the expected range observed for silty-sand soils. The test correlates to an infiltration rate of 52 mm/hr.

A safety correction factor is typically incorporated into the LID design to ensure that the sufficient conservatism is incorporated to account for variability in field conditions. The typical factor of safety to be used can range between 2 and 3. Typically, a higher factor of safety would require a larger footprint to provide an equivalent volume of infiltration. The infiltration rate for design purposes that accounts for the factor of safety of 2 and 3 would be 26 mm/hour and 17 mm/hour, respectively.

CONCLUSION

Testing shows that the on-site soils in the vicinity of the proposed permeable pavers are medium grained. Evidence of a water table was not observed during test pit excavation, with similar dry conditions observed during the GEL/SPL Geotechnical Investigation (October ,2014).

The infiltration test conducted in the vicinity of the proposed location of permeable pavers showed a field saturated hydraulic conductivity value consistent with the observed soils. These soils are considered to be capable of supporting a design infiltration rate of **26 mm/hour**, with **a factor of safety of 2**, or **17 mm/hour**, with a **factor of safety of 3**.

Attachments:
Figure 1 – Infiltration Test Locations
Figure 2 – Infiltration Test Results
Table 1- Infiltration Test Summary
Table 2 – TP20-1 Infiltration Test Calculation Sheet

wsp

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LEGEND

- APPROXIMATE SITE LOCATION
- PERMEABLE PAVERS
- TEST PIT LOCATION

N
W E
S

4 2 0 4 Metres

Data Source: Ministry of Natural Resources, Ontario Base Mapping, October 2019.
Imagery, Simcoe County, 2018

CLIENT:

MICHLER HOLDINGS LTD.

PROJECT:

440 VETERANS DRIVE
BARRIE, ONTARIO

PROJECT NO:	DATE:
201-06884-00	OCTOBER 2020

DESIGNED BY: -

DRAWN BY: T.P.

CHECKED BY: -

FIGURE NO:	SCALE:
1	1:400

TITLE:

INFILTRATION TEST LOCATIONS

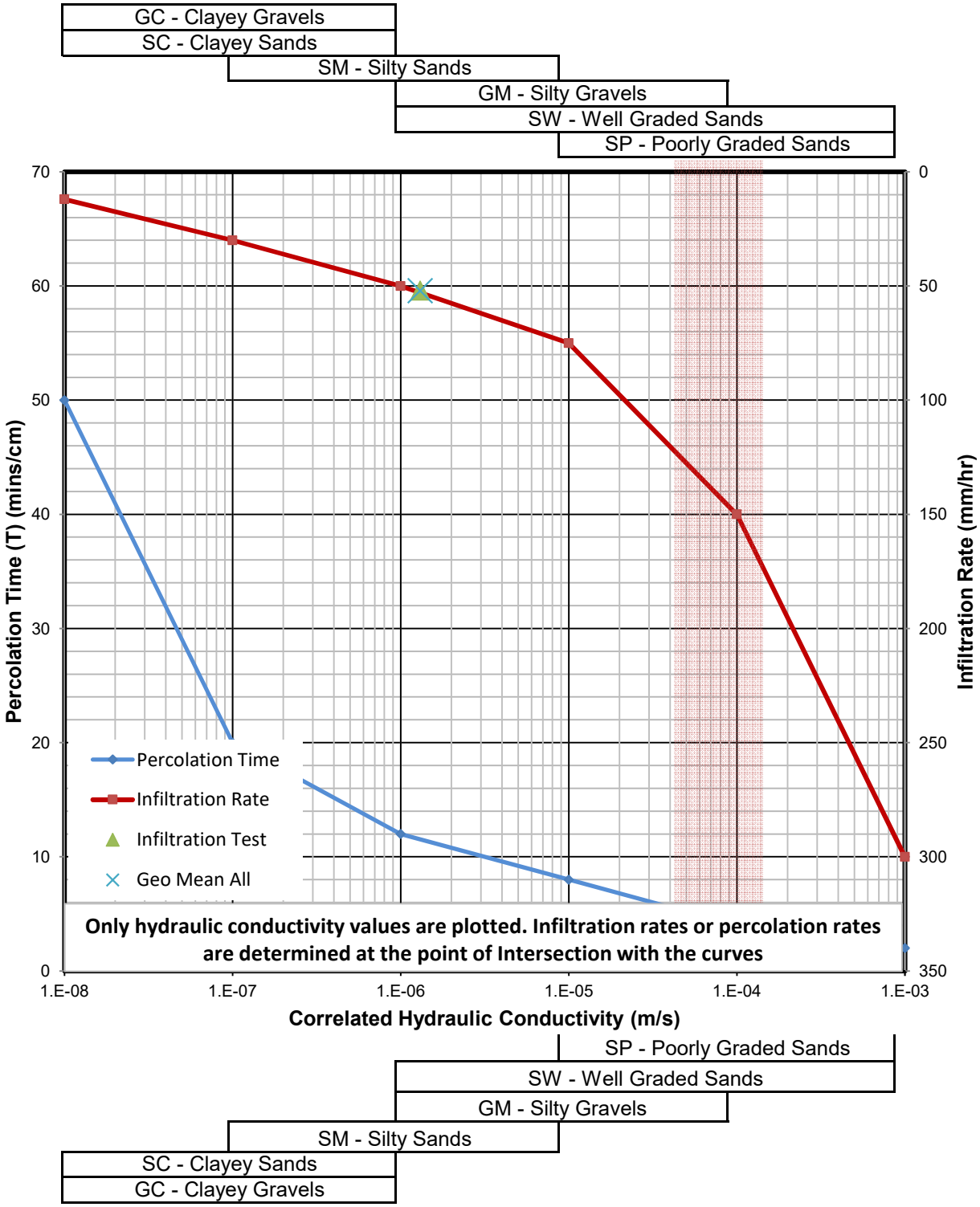
DISCIPLINE:

ENVIRONMENT

ISSUE:	REV.:
-	-

Document Path: D:\aProjects\201-06884-00\MXD\201-06884-00 Figure 1 Test Locations.mxd

Figure 2 - Infiltration Test Results - 440 Veterans Way, Barrie, ON



Relationships Derived From: "Approximate Relationships of Soil Types to Permeability and Percolation Time - Table 2 - Page SG 6-3 - Supplementary Guidelines to the 1997 Ontario Building Code/Code and Guide for Sewage Systems 1997 - September 20, 2004 Update. Ministry of Municipal Affairs and Housing Building and Development Branch

TABLE 1: INFILTRATION TESTS SUMMARY
440 Veterans Way, Barrie, ON
Project #: 201-06884-00

Test Number	Test Pit	Soil Type	Depth (mbgs)	Soil Factor	Stable Rate of Fall	Field Saturated Hydraulic Conductivity (K_fs)			Area of Hole		Q								Infiltration Rate	Infiltration Rate With Factor of Safety of 2	Infiltration Rate With Factor of Safety of 3
					(cm/min)	(mm/day)	(m/s)	(m/day)	(cm^2)	(m^2)	cm^3/min	L/s	m^3/s	m^3/year	$m^3/s/m^2$	m/year	cm/hr	min/cm	mm/hr	mm/hr	mm/hr
1	TP20-1	Silty sand / sandy silt	1.47	56.3	0.20	112.6	1.3E-06	0.11	495.90	0.0496	8.84	1.47E-04	1.47E-07	4.64	3.0E-06	93.6	1.1	56.1	52.0	26	17

NOTES:

1) Field observations and calculations summary provided in Table 2

2) "m bgs" = metres below ground surface

3) Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

TABLE 2: TP20-1 INFILTRATION TEST
440 Veterans Way, Barrie, ON
201-06884-00

Project Name: 440 Veterans Way	**Project No.:** 201-06884-00
Location of Test: TP20-1	**Weather:** overcast, rain
Start Date: October 17, 2020	**Infiltration Test Method:** Nova Scotia Permeameter - Falling Head
Supervised By: KMT	

PERMEAMETER DETAILS

Auger Hole Diameter (cm):	7	**Height of Air Inlet Hole (cm):**	20.8	**Soil Factor:**	56.3

Stable Rate of Fall of Water in Permeameter Reservoir (cm/min):	0.20

ELASPED TIME (min)	WATER LEVEL READING (cm)	RATE OF FALL (cm/min)	COMMENTS	
0	51.3	(-)	**Soil:**	Silty sand / sandy silt
0.5	51.3	0		
1	51.3	0		
1.5	51.2	0.2	**Excavated Depth (m) :**	1.57
2	51.1	0.2	**Sample Depth (m):**	1.57
2.5	51.1	0	**Auger Hole Depth (m):**	0.32
3	51	0.2	**Screen Zone (m):**	1.47
3.5	50.9	0.2	**Total Depth (m):**	1.57
4	50.8	0.2	**Additional Remarks:**	
4.5	50.7	0.2	**0-0.07: Topsoil / Rootlets**	
5	50.6	0.2	**0.07-0.41:** Fill / gravelly sand	
5.5	50.5	0.2	**0.41-1.47:** Brown silty sand / sandy silt till, moist	
6	50.5	0		
			No groundwater observed during test pit excavation.	
			Rate of Fall (cm/min): **0.20**	

CALCULATIONS

Saturated Field Hydraulic Conductivity

K_fs (mm/day) = Stable Rate of Fall x CSS Soil Factor*

K_fs (mm/day) = 112.60

	Auger Hole Diameter							
Soil Factor	**7**	**7.5**	**8**	**8.5**	**9**	**9.5**	**10**	**10.5**
Coarse Sands (CS)	72	69.8	67.3	65.1	62.2	58.9	58.7	55.5
Structured Soils (SS)	56.3	54.5	52.5	50.8	47.2	46.2	45.3	44
Clays (US)	32.4	31.4	30.5	29.5	28	27.4	26.3	25.9

Note: * = Soil Factors were calculated by Canadian Sewage Solutions Inc. based on research from Mooers, J.D., and D.H. Waller, 1993 ON-Site Wastewater Disposal in Nova Scotia, Final Report, On-Site Wastewater Research Program Phase 2 1990-1993. Technical University of Nova Scotia.

*Soil factors presented are used to convert the measured rate of fall in cm/min to a saturated field hydraulic conductivity(K_fs) in cm/day. The K_fs is then multiplied by 10 to present the value as mm/day.