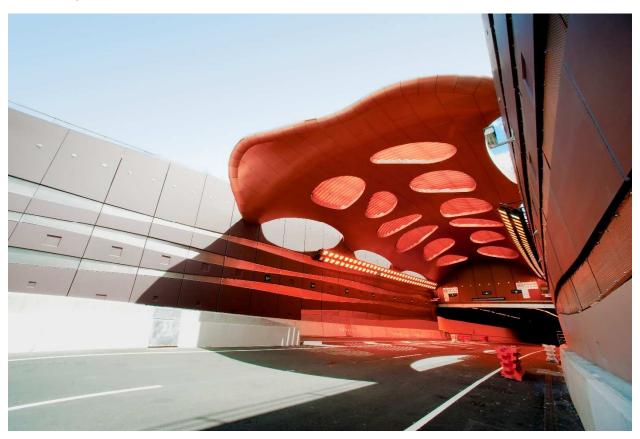
DELTINI COMMERCIAL DEVELOPMENTS

636040 PRINCE OF WALES RD., W. PRIMROSE, ON INFILTRATION STUDY

OCTOBER 29, 2018







636040 PRINCE OF WALES RD., W. PRIMROSE, ON INFILTRATION STUDY

DELTINI COMMERCIAL DEVELOPMENTS

PROJECT NO.: 181-01582-01 DATE: OCTOBER 29, 2018

WSP
UNIT 1
14 RONELL CRESCENT
COLLINGWOOD, ON, CANADA L9Y 4J7

T: +1 705 445-0064 F: +1 705 445-0067 WSP.COM



October 29, 2018

DELTINI COMMERCIAL DEVELOPMENTS 1350 Shawson Drive Mississauga, ON L4W 1C5

Attention: Ms. Marika Zigon

Dear Ms. Zigon,

Infiltration Study - 637040 Prince of Wales Rd., W. Primrose, ON **Subject:**

WSP Canada Inc. (WSP) was retained by Deltini Commercial Developments/1461125 Ontario Limited to complete an infiltration study of current site conditions for select locations at 636040 Prince of Wales Rd West in Primrose, Ontario. Figure 1 shows the site location. The work was completed to determine the infiltration potential of the varying soil conditions at the property for consideration of Low Impact Development (LID) techniques. The testing, methodology, calculations and data assessment are in accordance with the Low Impact Development Stormwater Management Planning and Design Guide issued by the Toronto Region Conservation Authority and Credit Valley Conservation (TRCA and CVC). The results of the testing are compared to the requirements established in the Stormwater Management Planning and Design Manual (MOE, March 2003).

Yours sincerely,

Nicole Collins

Vicole Colle

Environmental Technician

Gord Jarvis

Team Lead - Environment

GJ/ham

WSP ref.: 181-01582-01



TABLE OF CONTENTS

1	INTRODUCTION	. 1
2	IN-SITU TESTING	.2
3	GEOTECHNICAL INVESTIGATION	4



TABLES

TABLE 2-1 SUMMARY OF INFILTRATION TEST

RESULTS3

TABLE 2-2 GROUNDWATER LEVELS

OBSERVED IN MONITORING WELLS4

FIGURES

FIGURE 1: TEST PIT LOCATION MAP

APPENDICES

A INFILTRATION TEST DATA

B GRAIN SIZE DISTRIBUTION

C BOREHOLE LOGS

1 INTRODUCTION

The Site is located on the west side of Prince of Wales Road West and north of Highway 89 in a mixed-use area in the Town of Primrose, Ontario. The Site is currently agricultural with a total area of approximately $382,800 \text{ m}^2$ (94.6 acres).

The objectives of this investigation include:

- Evaluate the potential infiltration rate of native soils above the water table using in-situ infiltration testing; and,
- Collection of soil samples at the same depths as the tests to be submitted for grain-size analyses.

2 IN-SITU TESTING

WSP conducted the in-situ infiltration testing (IT) on September 24 & 25, 2018. A small excavator was required to dig to the target depths to perform the testing. The testing was conducted with a double-ring infiltrometer in the test-pits excavated to depths ranging between 0.5 to 1.6 m below ground surface (BGS). The in-situ infiltration testing was completed at seven locations (test pits) at the site, with eight (8) tests completed (IT1 to IT8) to determine the infiltration rate of the soils. The location of the infiltration tests is shown on *Figure 1* and the results are summarized in **Table 1** below, and in *Appendix A*.

Infiltration testing was completed by saturating the native soils and measuring the rate of water infiltration (mm/hr) at each location.

The testing was completed in the various soil conditions encountered at the site and have been compared to each other in the following categories; clayey silt and silt; and, silty sand, sand and gravelly sand.

The measured infiltration rates in the clayey silt and silt materials encountered at the site ranged from 5 to 28 mm/hr, with a geometric mean of 16 mm/hr, and permeability rates ranged from 2.5x10⁻⁸ to 1.5x10⁻⁵ cm/s. As per the LID guideline, a safety correction factor of 2.5 should be applied to the measured infiltration rates to calculate the design infiltration rate. The safety factor is required to account for site heterogeneity, potential reduction in soil permeability during construction and gradual accumulation of fine sediments over time. As such, the recommended design infiltration rate for the clayey silt and silt soils encountered at the site is 6 mm/hr.

The measured infiltration rates for the silty sand, sand and gravelly sand materials encountered at the site ranged from 61 to 212 mm/hr, with a geometric mean of 148 mm/hr, and permeability rates ranged from 2.8×10^{-4} to 3.0×10^{-2} cm/s. As per the LID guideline, a safety correction factor of 2.5 should be applied to the measured infiltration rates to calculate the design infiltration rate. The safety factor is required to account for site heterogeneity, potential reduction in soil permeability during construction and gradual accumulation of fine sediments over time. As such, the recommended design infiltration rate for the silty sand, sand and gravelly sand soils encountered at the site is 59 mm/hr.

In addition to the field testing for infiltration, grain size analyses of soil samples were completed. The grain size distribution chart is presented in *Appendix B*, along with the infiltration testing results. The results show that the clayey silt and silt soils consist of 0 to 5% gravel, 4 to 15% sand and 80 to 96% fines. The results show that the silty sand, sand and gravelly sand soils consist of 0 to 33% gravel, 54 to 90% sand and 6 to 30% fines. The hydraulic conductivity value (K) was estimated from particle size analyses using the Hazen method, which is an empirical relationship where:

$$K = C * d_{10}^2$$

Where:

C = constant, average value of 1.0, when D is in mm and K is in cm/s; d_{10} =diameter of the 10^{th} percentile grain size (mm).

Table 2-1 Summary of Infiltration Test Results

			INFILTE	RATION TEST - D INFILTROMET		ESTIMATED PERMEABILITY (K) (CM/S)	ESTIMATED PERMEABILITY
TEST #	TEST LOCATION	SOIL TYPE AT TEST DEPTH	Test Pit Depth (m)	Measured Infiltration Rate (mm/hr)	Calculated Percolation Time (T) (min/cm)	CALCULATED FROM INFILTRATION RATE	(K) (CM/S) CALCULATED FROM GRAIN SIZE ANALYSIS
IT1	TP1	Clayey Silt	1.0	5	120	2.5x10 ⁻⁸	<1.0x10 ⁻⁶
IT2	TP2	Silty Sand	1.6	61	10	2.8x10 ⁻⁴	2.7x10 ⁻³
IT3	TP3	Clayey Silt	1.0	28	21	1.5x10 ⁻⁵	<1.0x10 ⁻⁶
IT4	TP4	Sand	1.0	195	3	2.2 x10 ⁻²	7.5x10 ⁻²
IT5	TP5	Silt	1.2	19	32	3.6x10 ⁻⁶	1.8x10 ⁻³
IT6	TP5	Silty Sand	0.5	212	3	3.0x10 ⁻²	2.2x10 ⁻²
IT7	TP6	Gravelly Sand	1.0	189	3	1.9x10 ⁻²	1.4x10 ⁻¹
IT8	TP7	Silt	1.4	23	26	7.3x10 ⁻⁶	3.5×10^{-3}

3 GEOTECHNICAL INVESTIGATION

WSP also completed a geotechnical investigation drilling program at the site in February and March 2018. As part of this drilling program, groundwater monitoring wells were installed in seven borehole locations as shown on *Figure 1*. The borehole logs are included in *Appendix C*. The observations made of the groundwater conditions in some monitoring wells are summarized in **Table 2-2** below:

Table 3-1 Groundwater Levels Observed in Monitoring Wells

WELL ID	DATE OF WATER LEVEL MEASUREMENT	WELL DEPTH (M BGS)	DEPTH TO WATER (M BGS)
BH18-02	March 6, 2018	4.68	3.94
BH18-03	March 6, 2018	4.74	1.52
BH18-04	March 6, 2018	7.60	6.76
BH18-05	March 6, 2018	5.63	2.12
BH18-07	March 6, 2018	4.65	2.30
BH18-08	March 6, 2018	7.04	5.20
BH18-10	March 6, 2018	4.40	1.64
BH18-11	March 6, 2018	5.25	3.48

Groundwater was encountered in TP6 at a depth of 0.7 m BGS. Groundwater was not encountered in any of the other test pit locations. Based on the March 2018 water level measurements (see **Table 2-2**), the depth to groundwater can be expected to range from 1.52 to 6.76 m BGS. In order to confirm seasonal high groundwater in the area of the storm water management facilities, continuous groundwater level monitoring is recommended.

Bedrock was not encountered in the boreholes drilled as part of the geotechnical assessment completed at the site in which the drilled depths ranging from 2.1 to 8.2 m BGS.

For the consideration and design of LID stormwater management techniques, Table 4.1 of the MOE Storm Water Management Planning and Design Manual should be adhered to; infiltration rate ≥ 15 mm/hr, > 1 m to groundwater table and > 1 m to bedrock.

We trust this report satisfies your needs. If there are questions or if more information is required, please do not hesitate to contact our office.

Prepared by: Reviewed by:

Nicole Collins Gord Jarvis

Environmental Technician Team Lead - Environment

APPENDIX

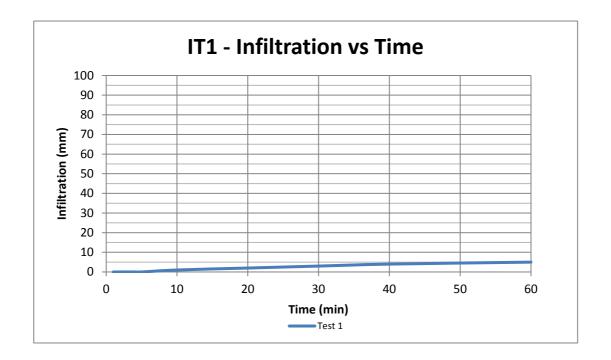
DRAWINGS



APPENDIX

A INFILTRATION TEST DATA

Location - TP1 Test 1 Time (min) Infiltration (mm) 1 0.0 2 0.0 3 0.0 4 0.0 5 0.0 10 1.0 20 2.0 30 3.0 40 4.0 60 5.0

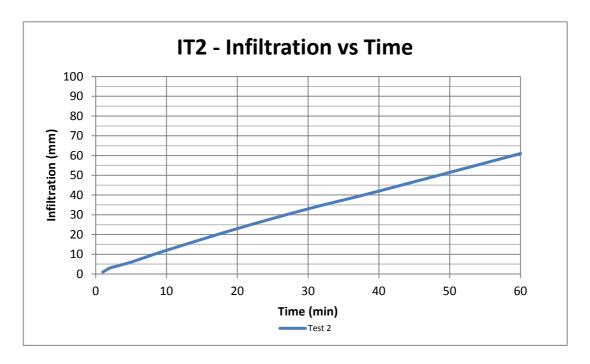


Location IT1



Location - TP2 Test 2

Time (min)	Infiltration (mm)
1	1.0
2	3.0
3	4.0
4	5.0
5	6.0
10	12.0
20	23.0
30	33.0
40	42.0
60	61.0

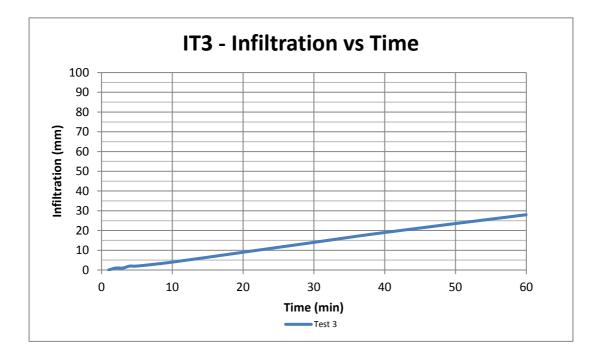


Location IT2



Location - TP3 Test 3

Time (min)	Infiltration (mm)
1	0.0
2	1.0
3	1.0
4	2.0
5	2.0
10	4.0
20	9.0
30	14.0
40	19.0
60	28.0



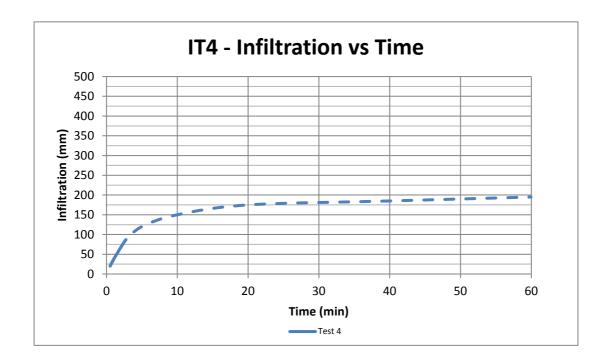
Location IT3

wsp

Location - TP4

Test 4

Time (min)	Infiltration (mm
0.5	20.0
1	37.0
1.5	52.0
2	67.0
2.5	81.0
2.75	87.0



Location IT4

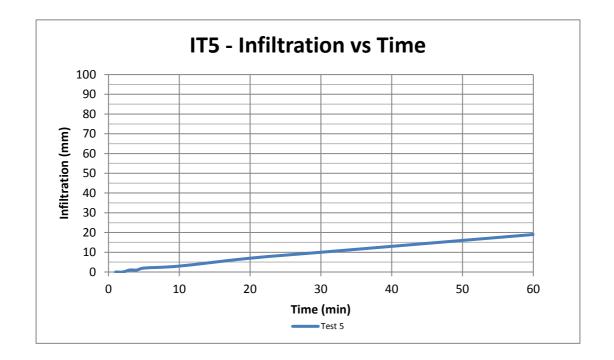
wsp

Test 5 Time (min) Infiltration (mm) 1 0.0 2 0.0 3 1.0 4 1.0 5 2.0 10 3.0 20 7.0 30 10.0 40 13.0

19.0

60

Location - TP5

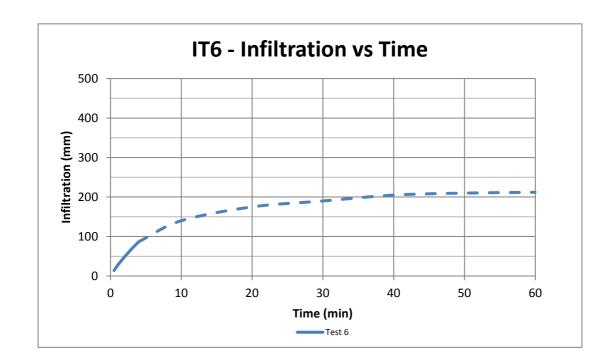


Location IT5



Location - TP5 Test 6

Time (min)	Infiltration (mm)
0.5	14.0
1	27.0
1.5	38.0
2	49.0
2.5	59.0
3	69.0
3.5	78.0
4	87.0



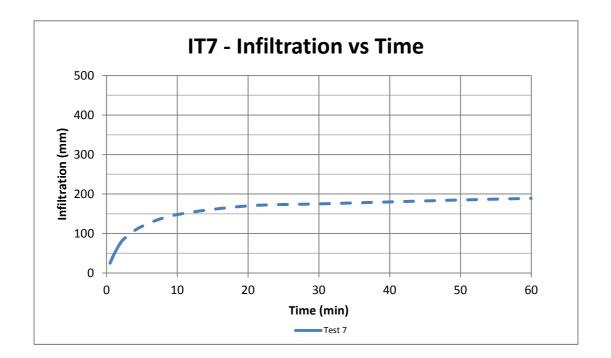
Location IT6



Location - TP6

Test 7

Time (min)	Infiltration (mm)
0.5	25.0
1	45.0
1.5	62.0
2	77.0
2.5	87.0



Location IT7



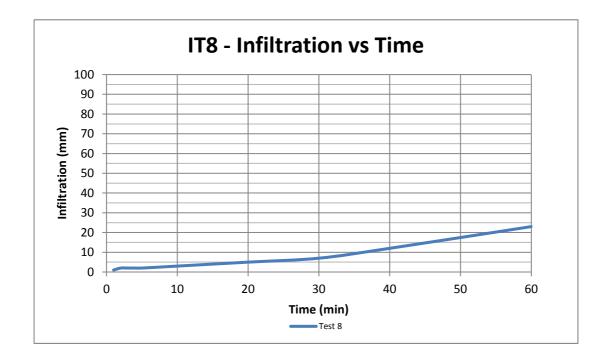
Test 8 Time (min) Infiltration (mm) 1 1.0 2 2.0 3 2.0 4 2.0 5 2.0

23.0

Location - TP7

103.0205.0307.04012.0

60

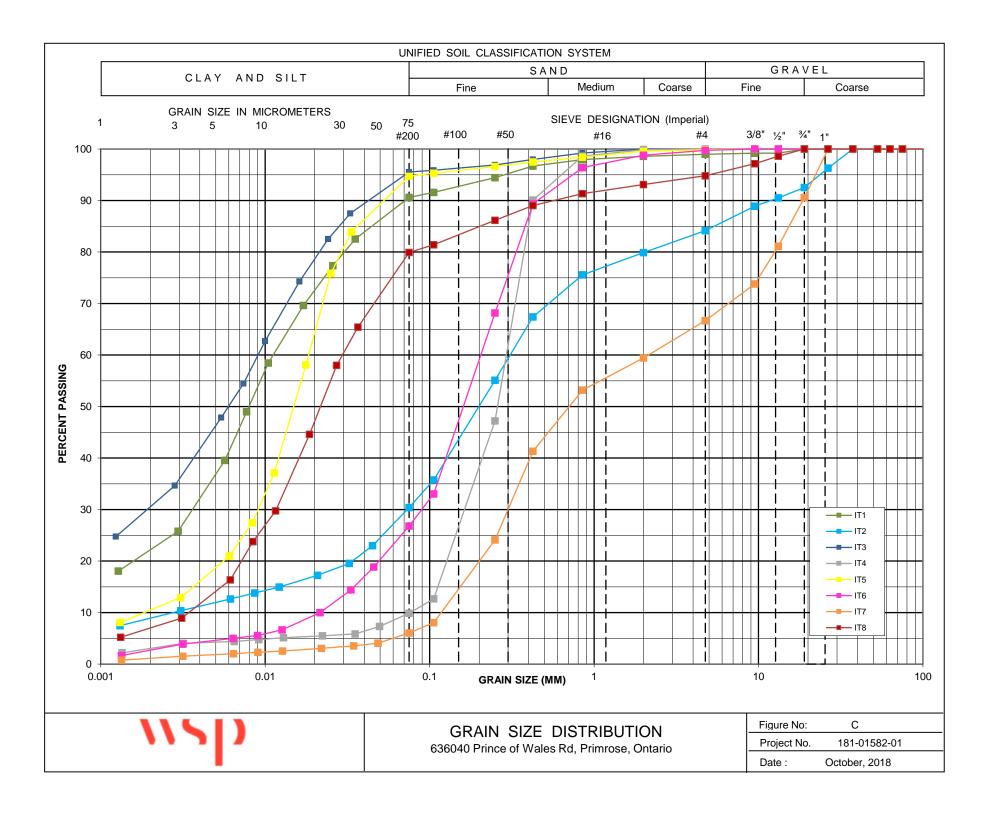


Location IT8



APPENDIX

B GRAIN SIZE DISTRIBUTION



APPENDIX

C BOREHOLE LOGS

ENCL NO.: 1



PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

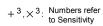
CLIENT: Deltini Commercial Developments

Method: Hollow Stem Auger

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm DATUM: Relative Date: Feb/28/2018

BH L	OCATION: See Figure 1																			
	SOIL PROFILE		s	SAMPL	ES	ا س		RESI	STANC	E PLO	NE IRA	TION TI	ESI	PLASTI	C NATI	JRAL	LIQUID		Þ	REMARKS
(m) ELEV DEPTH		STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	SHEA O UI	L	INED	TH (kF + - ×	Pa) FIELD VA & Sensitiv LAB VA	ANE rity ANE		TER CC	v DNTEN	LIQUID LIMIT W _L T (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT V (kN/m³)	
0.0	Ground Surface TOPSOIL: 24cm	1.11/2	z	-	-	0 0	Ш		0 4		-		JO	-	2	.0 3	1			GR SA SI CL All samples
0.2	CLAYEY SANDY SILT (Reworked): trace gravel, brown, moist, very loose		1	SS	2			2								>				read 0ppm on PID meter
0.8	SILTY CLAY TILL: trace gravel, trace sand, brown, moist, firm		2	SS	8			* 8								o				
- 1.5 	GRAVELLY SILTY SAND TILL: trace clay, occasional cobble, brown, wet, compact		3	SS	11			111							0					32 34 26 8
2.3	SAND AND GRAVEL: some silt, some cobble/boulder pieces, grey. dry, dense to very dense	0.0	4	SS	42					42					o					
3		0.0	5 /	SS	50/					50/	50mm									
1. LOGICA - COSTOCHINE DO PRINCE PLANT AND PRINCE PLANT P	AUGER REFUSAL: Notes: 1) Auger refusal on boulders. 2) Redrilled second hole 1 m North of original borehole and had auger refusal at 1.4mbg. 2) Redrilled third hole 2m South of original borehole and had auger refusal at 3.2mbg. 3) Borehole was dry and open upon completion.				o umi															







PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments Method: Hollow Stem Auger ENCL NO.: 2

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm

DATUM: Relative Date: Feb/28/2018

SOLIFORFILE SAMPLES SAMPLES SAMPLES SOLIFOR	1	JM: Relative							Date.	reb/2	28/201	0									
Common C	BH L			_		F 0	_	1	STANDARD PENETRATION TEST										1	1	1
Ground Surface		SOIL PROFILE		5	SAMPLES		<u>~</u>	1	RES	STANC	E PLO			_51	PLASTIC NATURAL LIQUID					M	REMARKS
Ground Surface	(m)		10			(0)	S S	l _	2	0 4	0 6	0 8	0 10	00		CON	TENT	LIMIT	PEN.	ĮN.	AND GRAIN SIZE
Ground Surface	ELEV	DESCRIPTION	J.	<u>د</u>		3 2 2	_ N O.	l ö				TH (kF	Pa)	ANE.				w _L	E KE	RAL (DISTRIBUTION
Ground Surface	DEPTH	DESCRIPTION	ΑTA	1BE	ш	900		\ \				+	& Sensitiv	vity	WAT	TER CC	ONTEN	T (%)	ğΘ.	MTW.	(%)
O.0 TOPSOIL: 38cm O.4 SILT AND SAND (Reworked): trace clay, trace gravel, trace organics, brown, noist, every loose organics, brown, noist, every loose brown, wet, loose O.8 SANDY SILT (Reworked): some clay, some gravel, trace organics, brown, wet, loose O.8 SANDY SILT (Reworked): some clay, some clay, some cobbles and boulders, brown, wet, loose dense dense GRAVELLY SILTY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense GRAVELL's Silty Sand Till: trace clay, some cobbles and boulders, brown, wet, loose GRAVEL: some sand, some silt, some cobble pounders, some cobbles and boulders, brown, wet, loose GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Expression of the state of the sta		Ground Surface	STR	Ş	Ι¥Ε		S S S											30		_	
0.4 SILT AND SAND (Reworked): trace clay, trace gravel, trace organics, brown, noist, very loose organics, brown, noist, very loose brown, wet, loose brown, wet, loose organics, brown, wet, loose or	. 0.0			╀	· ·	<u> </u>															All samples
SILT AND SAND (Reworked): trace clay, trace gravel, trace organics, brown, moist, very loose organics, brown, moist, very loose SANDY SILT (Reworked): some clay, some gravel, trace organics, brown, wet, loose 1.5 GRAVELLY SILTY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense dense 4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 3 Simm piezometer was installed	ŀ		17:31	1	00	1			. .								l ,				read 0ppm on
trace clay trace gravel, trace organics, brown, most, very loose to loose SANDY SILT (Reworked): some clay, some gravel, trace organics, brown, wet, loose brown, wet, loose dense d	0.4	SILT AND SAND (Reworked):	Fin		33	4			🕇⁴								`	1			PID Meter
No loose SANDY SILT (Reworked): some clay, some gravel, trace organics, brown, wet, loose 1.5 GRAVELLY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense dense 4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borshole was dry and open upon completion. 2) SS 8 4.9 END OF BOREHOLE: Notes: 1) Borshole was dry and open upon completion. 2) SI SS 8 4.9 END OF BOREHOLE: Notes: 1) Borshole was dry and open upon completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some completion. 2) Sing piecewise was installed and some silt, some silt, some silt, some some completion. 2) Sing piecewise was installed and some silt, some silt, some some silt, some some silt, some some silt, some some some silt, some some some some some some some some	F *	trace clay, trace gravel, trace		_					П												
SANDY SILT (Reworked): some clay, some gravel, trace organics, brown, wet, loose 1.5 GRAVELLY SILTY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense dense 4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) SS 8 4 SS 36 5 SS 39 4 SS 36 4 SS 36 4 SS 36 5 SS 39 6 SS 44 6 SS 44 7 SS 36 7 SS 39 8 SS 9 8 S	- 08	organics, brown, moist, very loose	НĤ	1					П												
clay, some gravel, trace organics, brown, wet, loose 1.5 GRAVELLY SILTY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense dense 4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) SS 8 4.4 SS 36 4.5 SS 39 4.6 SS 44 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 3 mm piezometer was installed.	1 0.0	SANDY SILT (Reworked): some							Ш												
1.5 GRAVELLY SILTY SAND TILL: trace clay, some cobbles and boulders, brown, wet, loose dense dense	F	clay, some gravel, trace organics,		2	SS	8			₽ 8							0					
trace clay, some cobbles and boulders, brown, wet, loose dense	ţ	brown, wet, loose		ł																	
trace clay, some cobbles and boulders, brown, wet, loose dense	Ŀ								Ш												
boulders, brown, wet, loose dense d	- 1.5																				
dense de	-	boulders, brown, wet, loose	10 P	3	SS	9			49						0						
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	2	, , ,																			
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	ţ								`												
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	ŀ	dense		1																	
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	F				00	200															
4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	ļ.		1110	4	55	36				1	36				ľ						
4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	ļ.							1													
4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	3			_			 : ::														
4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	F			1				:													
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	ļ.			. 5	SS	39		1			39				0						
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	<u> </u>																				
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	Ł							•													
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	F ₄							.	l												
4.3 GRAVEL: some sand, some silt, some cobble/boulder pieces, grey, dry, dense 6 SS 44	F		1111					. W. L.	3.9 mE	GL	1										
some cobble/boulder pieces, grey, dry, dense 6 SS 44	1 4 2	CRAVEL come cond come cilt	ĬŊ.					ilviai oc	1, 2010	1	1										
dry, dense 6 SS 44	4.3							1													
4.9 END OF BOREHOLE: Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	F		20	6	SS	44					44										
Notes: 1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	F		βÔ]													
1) Borehole was dry and open upon completion. 2) 30mm piezometer was installed	4.9																				
completion. 2) 30mm piezometer was installed																					
2) 30mm piezometer was installed upon completion.		completion.																			
		2) 30mm piezometer was installed																			
		upon completion.																			
																			1		
																			1		
	9118																				
	SPJ 19/3																				
	88																				
	1682-00 E																		1		
	20 181-0																		1		
	TROIT																				
	-2016-SP																		1		
	901																		1		
	88							<u> </u>	<u> </u>									<u> </u>			

ENCL NO.: 3



PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments Method: Hollow Stem Auger

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm

DATUM: Relative Date: Feb/28/2018

BH L	OCATION: See Figure 1																			
	SOIL PROFILE		S	AMPL	ES.	<u>_</u>		RES	TANDA ISTANC	RD PEI E PLO	NETRA T <u></u>	TION T	EST	PLASTI	C NATI	JRAL	LIQUID		₽	REMARKS
(m) ELEV DEPTH		STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	SHEA O U	AR STI NCONF UICK T	RENG INED RIAXIA	TH (ki + L ×	Pa) FIELD V & Sensiti LAB V	ANE vity ANE	LIMIT W _P ⊢— WA	CON V TER CC	w ONTEN	LIQUID LIMIT W _L T (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT V (kN/m³)	
0.0	Ground Surface TOPSOIL: 32cm	11/2	_		-	0 0	Ш		-					<u> </u>						GR SA SI CL All samples
- 0.3		7	1	SS	8			₽ 8								5				read 0ppm on PID meter
0.8	SILT: some clay, some sand, brown, wet, loose		2	SS	8			≇ 8								o				
- 1.5 - 1.5 	CLAYEY SILT TO SILT AND CLAY: some sand, trace gravel, brown, moist, firm to very stiff		3	SS	5	. ¥	W. L. Mar 06	1. 5 mE 5, 2018 ₽ 5	GL							0				
- - - - -	trace sand, occasional gravel		4	SS	7			1								o				
3 - - - 3.4		0.0	5	SS	21			$ \ $	21						o					
- - - 4 - -	brown, wet, compact	0.00																		
4.6 - -	brown, saturated, very dense		6	SS	60		:			\	60			0						
5.0	END OF BOREHOLE: Notes: 1) Borehole was wet at 3.1 mbg and was open upon completion. 2) 30mm piezometer was installed upon completion.					GPAPH				rs refer		g=-20/								

REF. NO.: 181-01582-00

ENCL NO.: 4



PROJECT: Geotechnical Investigation & Phase Two ESA

CLIENT: Deltini Commercial Developments

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose

DATUM: Relative

Method: Hollow Stem Auger

Diameter: 200mm

Date: Feb/27/2018

BH LOCATION: See Figure 1

BHT	OCATION: See Figure 1 SOIL PROFILE			SAMPL	FS				STANDA	RD PEN	ETRATIO	N TEST	П				Г		
	OOILT NOT ILL	Ι.		IVII L		GROUND WATER CONDITIONS		1					PLAST LIMIT	IC NATI MOIS CON	URAL	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	T WT	REMARKS AND
(m)		STRATA PLOT			S E	-WA	N C	SHE	AR ST	RENGT	H (kPa) + FIEL + & Se	100	W _P		N O	\mathbf{W}_{L}	(KPa)	AL UN	GRAIN SIZE
ELEV DEPTH	DESCRIPTION	4TA I	NUMBER	111	BLOWS 0.3 m	UND	ELEVATION	0 (JNCONF	INED	+ FIÉL	D VANE ensitivity	\\\\\	TER CO	OMTEN	T (%)	Š (Š	ATUR/ (k)	DISTRIBUTION (%)
	Ground Surface	STR	N	TYPE	ž	GRC	ELE	• •	JUICK I	RIAXIAL 10 60	^ LAE	100				30		2	GR SA SI CL
. 0.0	TOPSOIL: 36cm	7/1/2																	All samples
		7.7	1	SS	22				P 22				0						read 0ppm on PID meter
0.4	SILTY SAND: brown, moist, compact																		
[•																		
- 1																			
			2	SS	24				24				0						
-									Ш										
-									11										
-		H	3	SS	27				2 7				0						
2									Н										
[Ш										
-									Ш										
			4	SS	23				23				0						
-									11										
-	compact to dense								11										
-			5	SS	30				30				0						
-]"										
3.8	SAND: trace gravel, trace silt, brown, dry, dense																		
			6	SS	38					38			0						
- 4.2 -	SILTY SAND: trace gravel, brown, moist, dense								\perp										
-																			
[7	SS	35		:			35									
5									$\perp I$										
<u> </u>		崫							$\perp \perp$										
-							1		$\perp \perp$										
-		拙							11										
-							1		11										
F	moist to wet, compact	ili.							11										
[most to mot, compact		8	SS	26				11										
-			0	33	20		:		26						1				
							W. L.	l											
7							Mar 0	, 201	8										
									1										
-									1										
- - 7.6	CLAYEY SANDY SILT: brown, wet,					l: H:	1		1										
866	compact	1111		00	10			.	<u>[</u>]										
8 8 8			9	SS	16			"	16					'	•				
8.2	END OF BOREHOLE:	ИŦŊ	\vdash			-	-	\vdash					\vdash				\vdash		
TR-01-12	Notes: 1) Borehole was wet at 7.4 mbg and																		
06-2016-5	was open upon completion.																		
NSP SOIL L	50mm groundwater monitoring well was installed upon completion.																		
						GRAPH	3		Numbe			30/							

REF. NO.: 181-01582-00

ENCL NO.: 5



PROJECT: Geotechnical Investigation & Phase Two ESA

CLIENT: Deltini Commercial Developments

Method: Hollow Stem Auger PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm

DATUM: Relative Date: Feb/27/2018

BH L	OCATION: See Figure 1		_						TANDA	חם חב	NETDA	TION T	TOT					_		
	SOIL PROFILE		S	SAMPL	.ES	<u>_</u>		RES	ISTANO ISTANO	RD PE E PLO		TION I	ESI	PLASTI	NATU	JRAL	LIQUID		₽	REMARKS
(m)		5			(0)	GROUND WATER CONDITIONS		2	20 4	10 6	80 0	30 1	00	PLASTIC LIMIT	CON	TENT	LIQUID	PEN.	NATURAL UNIT WT (kN/m³)	AND GRAIN SIZE
ELEV	DESCRIPTION	STRATA PLOT	œ		BLOWS 0.3 m	D S	ELEVATION			RENG	TH (kl	Pa) FIFLD V	ANF	W _P	v	v 	W _L	SKET SKET	RAL (KN/m	DISTRIBUTION
DEPTH	DESCRIPTION	₹AT/	NUMBER	й			N E		NCONF UICK T	FINED RIAXIA	+ L ×	FIELD V & Sensiti	vity ANE	WAT	ER CC	NTEN	T (%)	ğ0	N T¥I	(%)
	Ground Surface		Ž	TYPE	ż	9.0 0.0	ä						00	1	0 2	0 3	30			GR SA SI CL
0.0		\(\frac{1}{2\ldot \frac{1}{2\gamma}}\).																		All samples
0.3	FILL: gravelly silty sand, trace organics, brown, wet, loose		1	SS	6			₽ 6							0					read 0ppm on PID meter
- - - - -	gravelly sand, some silt, compact		2	SS	22			\	22					0						
- - -																				
- - 2 -			3	SS	20		w i		20						0					
2.3	trace clay, cobble pieces, brown,	** • () • ()			00		W.L.: Mar 06	, 2018	١١											
- - - 3	wet, compact	 	4	SS	29		:		29											
). a.O.	5	ss	16		:	4	16					0						
-		(· · · · · · · · · · · · · · · · · · ·																		
- _4 -		9.0							`											
-																				
4.6	GRAVELLY SILT AND SAND TILL: some clay, cobble pieces, brown, moist, very dense		6	SS	82							82		0						
<u>5</u> - -																				
5.5	GRAVELLY SANDY SILT TILL: some clay, cobble pieces, grey,										1									
- - - 6	moist, dense		7	SS	44					1 44				0						
6.1	END OF BOREHOLE: Notes:	1111																		
	1) Borehole was open and dry upon																			
	completion. 2) 50mm groundwater monitoring																			
	well was installed upon completion.																			
9718																				
GPJ 10/3																				
BHLOG																				
31-01582-0																				
OT-120 1																				
016-SPT PI																				
100																				
de M					<u> </u>	<u> </u>		<u> </u>										<u> </u>		
	NDWATER ELEVATIONS					GRAPH	. 3	V.3	Numbe	rs refer	_	8 =3%		at Eailu						

ENCL NO.: 6



PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments Method: Hollow Stem Auger

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm DATUM: Relative Date: Feb/26/2018

BH L	OCATION: See Figure 1																			
	SOIL PROFILE		5	SAMPL	ES	<u></u>		RESI	randa Stanc	RD PEI	NETRA T <u> </u>	TION T	EST	PLASTI	NATU	JRAL	LIQUID		⊳	REMARKS
(m) ELEV DEPTH	DESCRIPTION Ground Surface	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	SHEA O UI	LESTE NCONF JICK TI	RENG INED	TH (kF + L ×	Pa) FIELD VA & Sensitiv LAB VA	ANE vity ANE	PLASTIC LIMIT W _P I— WAT	ER CC	v DMTEN	LIQUID LIMIT W _L T (%)	POCKET PEN. (Cu) (kPa)	NATURAL UNIT V (kN/m³)	AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
0.0	TOPSOIL: 43cm	<u>17 · 24</u>	1	SS	4			₹4									86	3		All samples read 0ppm on PID meter
- 0.4 - -	FILL: sandy silt, trace gravel, trace clay, trace organics, brown, moist, very loose to loose gravelly sandy silt, some clay, trace organics, occasional cobble pieces,																			
_1 - -	organics, occasional cobble pieces, compact		2	SS	14			1	4					0						
- 1.5 	SAND AND GRAVEL: some silt, cobble pieces, brown, wet, compact		3	SS	28				28					0						
2.1	END OF BOREHOLE:	.o. `:																		
2.1	Notes: 1) Borehole was open and dry upon completion.																			
						GPADH						9 -20/								

REF. NO.: 181-01582-00

ENCL NO.: 7



PROJECT: Geotechnical Investigation & Phase Two ESA

CLIENT: Deltini Commercial Developments

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose

DATUM: Relative

Method: Hollow Stem Auger

. Hollow Stern Auger

Diameter: 200mm Date: Mar/01/2018

BH LO	OCATION: See Figure 1								TA NIC	- A D D	DEN	CTD A	TION T	-o-							
	SOIL PROFILE		S	SAMPL	.ES] _~		RES	SIANL	NCE I	PLOT	ETRA	TION T	ESI	PLASTI	NATI	JRAL	LIQUID	,	Ş	REMARKS
(m)		5			(A)	GROUND WATER CONDITIONS			20	40	60			00	PLASTI LIMIT W _P		TENT	LIMIT W _L	Pa)	NATURAL UNIT WT (kN/m³)	AND GRAIN SIZE
ELEV DEPTH	DESCRIPTION	STRATA PLOT	E.		BLOWS 0.3 m	1 0 E	ELEVATION		AR S			H (kF	Pa) FIELD V & Sensiti	ANE	** _P		·		CU) (K	RAL W	DISTRIBUTION
DEPIN		RAT	NUMBER	TYPE		N S	EVA					×	& Sensiti LAB V	vity ANE	WAT	ER CC	ONTEN	NT (%)	2	₹	(%)
0.0	Ground Surface	N 7. 7.	ž	<u>}</u>	ż	15 KX	<u> </u>		20	40	60	8	0 1	00	1	0 2	20	30			GR SA SI CL
0.0	TOPSOIL: 30cm	<u> </u>	ł																		
0.3	SILTY SAND (Reworked): trace		1	SS	3	\otimes		3								0					PID:0.6ppm
F	organics, brown, moist, very loose to loose		<u> </u>			$ \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! \! $		Ш													
ļ			\vdash			₩₩		П													
1			2	SS	6			4 6								0					
1.1	SAND: some gravel, brown, wet, loose] -					Π.													PID:0.7ppm
-						▓፟፠		$ \ $													
[cobble pieces, compact					\aleph		۱ ۱													
-			3	ss	20				20								0				PID:10ppm
2						$\bowtie \bowtie$		Ι,	/												
-	CLAVEV CIL To begoing an elect	111	_			lacksquare		L./	<u></u>												
2.3	CLAYEY SILT: brown, moist, firm/stiff						W. L. Mar 06	2 .3 / n 3, 201	BGL 8												
2.6	SILT AND SAND TILL: trace	141	4	SS	8			8							()					P1D:2:3ppm 10
- 3	gravel, some clay, brown, very moist to wet, loose to compact		-				1														
-		Ι _Ι Φ.	┢			1:11:	-	$ \ $													
-	OAND transmitt transmit	li.	5	SS	15			1	15							0					
3.4	SAND: trace silt, trace gravel, brown, wet, compact								ĺ												PID:2.6ppm
[·																				
4]														
-			ł																		
-		:::																			
-	cobble pieces		<u> </u>				1														
-	cobbie pieces	: :			40			ΙI													
5			6	SS	13			*	13						')					PID:0.9ppm
5.2	END OF BOREHOLE:	<u> </u>				\vdash												+			
	Notes: 1) Borehole was wet at 2.3 mbg and																				
	was open upon completion.																				
	2) 30mm piezometer was installed upon completion.																				
90/30/18																					
068.GPJ																					
32-00 BHL																					
20 181-015																					
PIROTA																					
00.2016.4																					
TION SOUTH		<u></u>	<u> </u>					<u>L</u> _												L_	

REF. NO.: 181-01582-00



PROJECT: Geotechnical Investigation & Phase Two ESA

CLIENT: Deltini Commercial Developments

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose

DATUM: Relative

Method: Hollow Stem Auger

ENCL NO.: 8

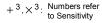
Diameter: 200mm

Date: Mar/01/2018

BH LOCATION: See Figure 1

BHT	OCATION: See Figure 1 SOIL PROFILE		S	SAMPL	FS	l	l	STANDA RESISTANO	RD PENI	ETRATION 1	EST							
	OOILT NOT ILL	Ι.		JAIVII L		GROUND WATER CONDITIONS					00	PLASTI LIMIT	C NATU	JRAL TURE TENT	LIQUID LIMIT	POCKET PEN. (Cu) (kPa)	T WT	REMARKS AND
(m)		PLOJ			WS E	WA.	N O	SHEAR STI	RENGT	H (kPa)	1	W _P		N	WL	KET PE) (kPa)	AL UN N/m³)	GRAIN SIZE DISTRIBUTION
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	ш	BLOWS 0.3 m	NO E	ELEVATION	O UNCONF QUICK TI	INED	+ FIÉLD V + & Sensit	ANE ivity		TER CC	ONTEN	T (%)	POC Cu	JATUR. (k	(%)
	Ground Surface		NON	TYPE	ŗ	GRC	出		0 60		00				30		2	GR SA SI CL
0.0	TOPSOIL: 25cm	<u> 1/2</u>																
0.3	SILTY SAND (Reworked): brown, moist, compact		1	SS	18			18				0						PID:0.6ppm
0.8	SILTY SAND TO SAND: trace gravel, brown, damp to moist, compact		2	SS	19			2 19				0						PID:0.9ppm
- 1.5 	SAND: some silt, trace gravel, brown, damp to moist, compact		3	SS	25			¤ 25				0						PID:0.7ppm
-			4	ss	29			29				0						PID:0.9ppm
- - - -	10mm clayey silt layer, dense		5	SS	43				4 3			o						PID:0.5ppm
- - - - 4																		
-	cobble pieces		6	SS	32			₽32					o					PID:0.4ppm
- - - - - - - - - - - - - - - - - - -	wet						W. L. (Mar 06	5.2 mBGL , 2018										
- - - -	some silt to silty, compact		7	SS	18			■ 18					o					PID:1.4ppm
7		:::																
7.0	END OF BOREHOLE: Notes: 1) Borehole was wet at 5.2 mbg and was open upon completion. 2) 50mm groundwater monitoring well was installed upon completion.																	
7 1008 day																		
4						GRAPH		3 Number		g-30/		-						





ENCL NO.: 9



PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments

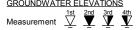
Method: Hollow Stem Auger

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose

DATUM: Relative

Diameter: 200mm Date: Feb/28/2018

	JM: Relative							Date:	Feb/2	28/2018)										
BHT	OCATION: See Figure 1 SOIL PROFILE			SAMPL	FS			s	TANDA	RD PEN E PLOT	IETRA	TION T	EST								
(m)	SOIL PROFILE	ΤĆ		AIVIPL		ATER 3		1		E PLOT		_	00			ITENT	LIQUID LIMIT	PEN.	INIT WT	REMA ANI	D
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	ш	BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	0 U	NCONF	RENGT INED RIAXIAL	+	FIÈLD VA & Sensitiv	ANE vity	W _P ├── WA ⁻		w O ONTEN	w _∟ ——I T (%)	POCKET PEN. (Cu) (kPa)	ATURAL U (kN/m³	GRAIN DISTRIB (%	UTION
	Ground Surface	STR	N N	TYPE	þ	GRC	믬			0 60			00				30		_	GR SA	SI CL
. 0.0	TOPSOIL: 38cm	<u>17 · 7</u>	1	ss	2			3 2							0					All samp read 0pp PID met	om on
0.4	SILT AND SAND TILL: some clay, trace gravel, trace organics, brown, wet, very loose				_	-														T ID IIIC	Ci
0.8	SAND AND GRAVEL: trace to some silt, brown, wet, compact	ö. 0	2	SS	25			`	25						0						
-		o.																			
2	grey, saturated	.o.	3	SS	22				22					,	•					33 58	(9)
2.3	SANDY SILT TILL: some clay,	. o .																			
- 2.5	some gravel, brown, wet, compact		4	SS	20				20						0						
3 3.1	GRAVELLY SILT AND SAND TILL:	10 a 10	\vdash			-		l /													
- - - - -	some clay, grey, saturated, compact		5	SS	12			1:	2					0							
- -4 - - - -																					
4.6	SILTY SAND TILL: some gravel, trace clay, cobble pieces, grey, saturated, dense		6	SS	32	-			32	2					•						
5.0		<u> </u>						<u> </u>													
0.0	Notes: 1) Borehole was wet at 0.7 mbg and caved to 1.2 mbg upon completion.																				
0/30/18																					
882.00 BHLOGS.GPJ. 1																					
MY29-2017 Oct-00 16-8FT P.OT-120 181-01																					
WSP SOIL LOG-20																					





PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments Method: Hollow Stem Auger ENCL NO.: 10

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm

DATUM: Relative Date: Feb/26/2018

BH L	OCATION: See Figure 1									DD DE1		TION T							_	
	SOIL PROFILE		S	SAMPL	ES	<u>~</u>		RES	STANC	RD PEN E PLOT		TION I	ESI	PLASTI	C NATI	JRAL TURE	LIQUID		¥	REMARKS
(m) ELEV DEPTH	DESCRIPTION Ground Surface	STRATA PLOT	NUMBER	TYPE	"N" BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	SHEA O UI	AR STI NCONF UICK T	0 60 RENGT INED RIAXIAL	H (kF + . ×	Pa) FIELD V & Sensitiv LAB V	ANE vity ANE	LIMIT W _P ⊢— WA ⁻	CON V TER CO	TENT v D ONTEN	LIMIT W _L	POCKET PEN. (Cu) (kPa)	NATURAL UNIT WT (kN/m³)	AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
- 0.0		7/1/																		All samples
-		<u>12 : 31</u> :3 (2)	1	SS	3			3							0					read 0ppm on PID meter
_ 0.5	clay, trace gravel, trace organics,																			
0.8 - - -	brown, wet, very loose CLAYEY SANDY SILT TILL: trace gravel, brown, moist, loose		2	SS	6			■ 6							o					
- 1.5 - - - - - - -	CLAYEY SILT TILL: some sand, trace gravel, brown, moist, stiff		3	SS	11		W. L. Mar 06	1.6 mE , 2 9 i i	GL							0				
2.3	SILT AND CLAY TILL: trace sand,		-																	
_ - - - - 3	trace gravel, cobble pieces, brown, moist, stiff		4	SS	12			■ 12	2						o					
3.1	trace gravel, brown, moist, stiff to very stiff		5	ss	15				15						o					
_ 3.4	SAND: some gravel, some silt, cobble pieces, silt seams, brown,							\												
- - - - -	saturated, compact to dense								\setminus											
- - - 5			6	SS	39				}	39					0					
5.2	END OF BOREHOLE: Notes: 1) Borehole was wet at 3.2 mbg and caved to 3.8 mbg upon completion. 2) 50mm groundwater monitoring well was installed upon completion.																			



PROJECT: Geotechnical Investigation & Phase Two ESA REF. NO.: 181-01582-00

CLIENT: Deltini Commercial Developments Method: Hollow Stem Auger ENCL NO.: 11

PROJECT LOCATION: 636040 Prince of Wales Rd W, Primrose Diameter: 200mm

DATUM: Relative Date: Feb/26/2018

	OCATION: Con Figure 4							Duto.	. 00/2	26/2018										
BHL	OCATION: See Figure 1			AMDI	EC	l -		S	ΓANDA	RD PEN	ETRAT	ION TE	ST					Г		
(m)	SOIL PROFILE	TO	8	SAMPL		/ATER IS	_	2	0 4	RD PEN E PLOT) 80	10	0	PLASTI LIMIT W _P	NATI MOIS CON	JRAL TURE TENT V	LIQUID LIMIT W _L	PEN.	UNIT WT	REMARKS AND GRAIN SIZE
ELEV DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS 0.3 m	GROUND WATER CONDITIONS	ELEVATION	O UI	NCONF	RENGT INED RIAXIAL	+ 8	IÉLD VA Sensitivi	NE ty NE	-	ER CO	·—	 T (%)	POCKET PEN. (Cu) (kPa)	NATURAL I (KN/m	DISTRIBUTION (%)
L.,	Ground Surface		ž	۲	ż	<u> </u>	П	2	0 4	0 60) 80) 10	0	1	0 2	20 ;	30			GR SA SI CL
0.0	TOPSOIL: 42cm	<u>√ √ 1/2</u>	1	SS	4			¥ 4							,	•				All samples read 0ppm on PID meter
0.4	some clay, trace gravel, brown, wet,																			
0.8	SANDY SILT TILL: some clay, trace gravel, brown, moist, loose		2	SS	6			¤ 6							c					4 22 58 16
- 1.5	CLAYEY SILT TILL: some sand, trace gravel, brown, moist, firm		3	SS	4			1								0				
2.3	SAND: some gravel, some silt, brown, moist, compact	1111	4	SS	24			\	24					(>					
- - - - -	trace gravel, wet		5	SS	28		W. L.	3.5 mE	■ 28						o					
- - 4 - -							IMAT U	3, 2018												
4.6	GRAVELLY SILTY SAND: brown, saturated, loose to compact	3.0.0.0	6	SS	10			■10							0					
5.3	END OF BOREHOLE: Notes: 1) Borehole was wet at 4.3 mbg and caved to 4.4 mbg upon completion. 2) 50mm groundwater monitoring well was installed upon completion.	- S Inn																		