

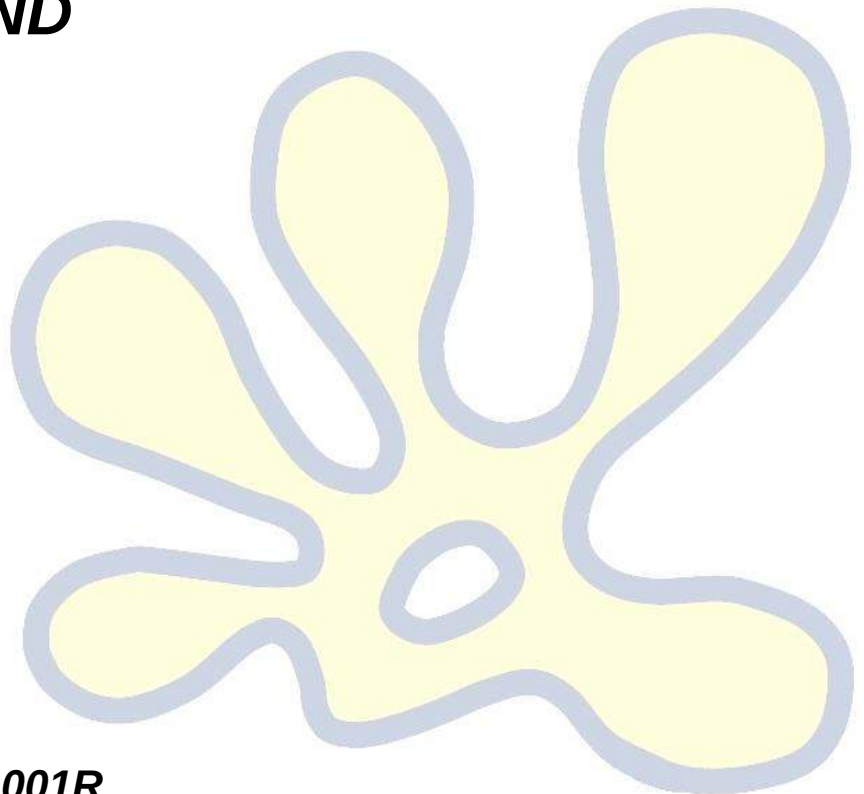


***GEOTECHNICAL SITE INVESTIGATION
FOR NOAH CREEK TRAIL HEAD
CAMP GROUND***

N. BAR & C. RYAN

8 MAY 2017

REFERENCE: GG0032-001R



GEOTECHNICAL SITE INVESTIGATION FOR NOAH CREEK TRAIL HEAD CAMP GROUND

Noah Creek Development Pty Ltd

Lot 62 on SP146421
Cape Tribulation Road
Thornton Beach QLD 4873
Australia

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8 May 2017

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1.0 Introduction

This report presents the findings of a geotechnical investigation carried out for proposed camp grounds and amenities to be located at 'Noah Creek', Lot 62 Cape Tribulation Road, Thornton Beach (Cape Tribulation) as illustrated in Figure 1.

Real property description: LOT 62 on SP146421

Local authority: Douglas Shire Council

The investigation was carried out by Gecko Geotechnics Pty Ltd (GG) for Noah Creek Development Pty Ltd (NCD).



Figure 1 – Contour Map of Noah Creek Land Division: Lot 62-64 Cape Tribulation Road; Remote Trail Camping Locations (1-5); For inset: see Figure 2 (Heweston, 2017)

It is understood the Trail Head Camp Ground development (location shown in Figure 2) shall include in the order of 20 light weight, single storey rooved-camping facilities and amenity blocks as outlined in the draft plan: Figure 3.

Initial site investigations were carried out by Mr Andrew Heweston (NCD) and comprised the excavation of three test pits (A, B & C in Figure 3) in September 2016. Several test pit photographs and soil samples were provided to GG for review.



Figure 2 – Location of Proposed Camp Ground (Heweston, 2017)

The investigation involved the two additional boreholes at the Trail Head Camp Ground site for the evaluation of the subsurface conditions and collection of samples. These were supplemented by ten dynamic cone penetrometer tests. The site investigation was followed by laboratory testing, engineering analysis and reporting.

The purpose of the investigation was to determine the subsurface conditions at the site to allow for the provision of:

- A summary of the subsurface materials and groundwater conditions if encountered;
- Geotechnical design parameters and recommendations for:
 - Foundation type
 - Allowable bearing capacities (high level footings) and end bearing capacity and shaft friction (pier footings)
 - Estimated settlements (total and differential)
- Site classification to AS2870

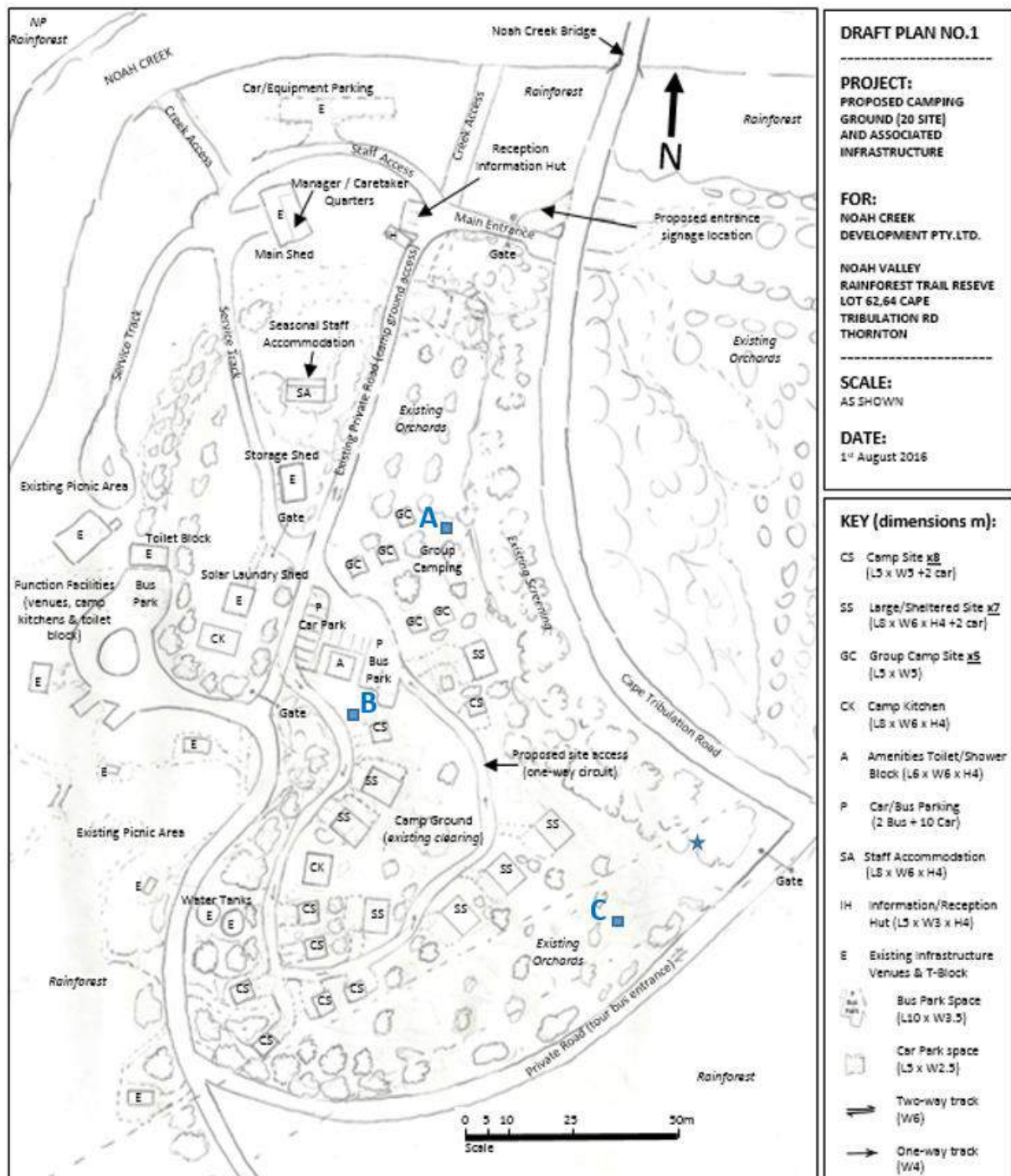


Figure 3 – Draft Site Plan including the location of previous Test Pits, A, B & C (Heweston, 2017)

2.0 Field investigation

The field investigation by GG on 15 March 2017 comprised the excavation of two hand auger boreholes to 600mm depth. The boreholes were undertaken at the locations nominated by the customer in the project brief to supplement existing test pit information which is understood to have encountered uniform Sandy CLAY to 1.5m and was examined by GG. The boreholes were logged by our Geotechnical Engineer in accordance with AS1726. Borehole logs are available in Appendix C.

Dynamic Cone Penetrometer (DCP) testing was carried out alongside each of the nominated test locations and eight additional areas within the proposed Trail Head Camp Ground in order to assess the strength / density of the soils encountered. Logs are available in Appendix D.

The approximate test locations are indicated on the plan in Appendix A.

3.0 Geological setting

The Daintree area is characterised by high level alluvium and colluvium consisting sand, silt clay and minor gravel. This is typically underlain by deposits of arenite, siltstone, mudstone, metabasalt, granite and schist of the Hodgkinson Formation.

4.0 Site description

The site is located on the western side of Cape Tribulation Road, Thornton. It gently slopes (<5° downward to the north-east) and is covered in thick, short grass. Several large, deep-rooted trees are present throughout the site. Table 1 summarizes site assessments for the immediate areas around test pits A, B and C. Photographs of the subject site are presented in Appendix B.

Table 1 – Site Assessment

Site Factor	Test Pit Area - A	Test Pit Area - B	Test Pit Area - C
Slope	0-5 degrees	0-5 degrees	5 degrees
Material Encountered	Sandy CLAY	Sandy CLAY	Sandy CLAY
Erosion/Landslip	Not Noted	Not Noted	Not Noted
Boulders/Rock Outcrop	Not Noted	Not Noted	Not Noted
Vegetation	Cleared, grass & trees	Cleared, grass	Cleared, grass
Watercourse	~100m to Noah Creek	~100m to Noah Creek	~200m to Noah Creek
Water Table	Not encountered	Not encountered	Not encountered
Fill	Nil	Nil	Nil
Flooding	Not Likely	Not Likely	Not Likely
Other Site Factors	Storm water run-off from adjacent hillside	Storm water run-off from adjacent hillside	Storm water run-off from adjacent hillside
	Topsoil 0-0.2m	Topsoil 0-0.2m	Topsoil 0-0.1m

The site is bounded by Noah Creek on its northern and western boundaries.

5.0 Ground conditions

Detailed borehole logs are presented in Appendix C. Uniform subsurface conditions were generally encountered across the site. Sandy CLAY was encountered in boreholes AH1 and AH2 as well as the preliminary test pits (A, B & C).

No free groundwater was encountered at the test locations to the depths investigated. However, the material at the base of AH1 and AH2 (below 0.2m) was considered moist. It should be noted that groundwater levels are affected by climatic conditions and by soil permeability and is therefore likely to vary throughout the seasons.

6.0 Footing design

The use of either an upper level or a deep footings system is considered feasible for use at this site. All structures should be designed in accordance with the principles of AS2870 and AS2159 where applicable and in accordance with recommendations outlined in this report.

6.1 High level footings

Based on the ground conditions observed throughout the site, it is considered high level footings may be founded into the stiff or better Sandy CLAY encountered approximately 0.3m below the current ground surface level except location DCP7. Footings at this level may be designed to achieve an Allowable Bearing Capacity of 100kPa. This assessment is based on a footing width of 0.3m founded a minimum of 0.3m depth. At and in the vicinity of location DCP7 it is recommended that upper level footings are founded a minimum of 0.6m in order to achieve an allowable bearing capacity of 100kPa.

Footings should be designed to accommodate immediate settlements of up to 20mm, differential settlement across the site has been estimated to be up to 10mm. The calculation of settlement is based on uniform loading not exceeding 100kPa on footings 0.3m wide founded at 0.3m.

Due to the limited number of tests completed throughout the site, should the use of upper level footings be considered, it is recommended that GG inspect all excavated footings to confirm material types and the bearing capacity.

6.2 Site classification

Site soil reactivity classification provides a method to estimate the amount of seasonal ground movement resulting from soil moisture variations throughout the year.

GG has determined the anticipated ground surface movement based on the procedure outlined in AS2870, the laboratory test results and a review of the soil profiles encountered during the investigation.

AS2870 does not provide recommended values for design suction (H_s) and change in suction for the Cape Tribulation area. GG has therefore adopted values based on local experience and published literature for North Queensland.

The results of this assessment indicate that the site falls into the 'M' Classification with anticipated seasonal movement between 20 to 40mm. This classification is based on the proviso that footings in and around the vicinity of DCP1-DCP6 and DCP8-DCP10 are

founded below 0.3m and below 0.6m in and around the vicinity of DCP7. This classification does not take into consideration the influence of existing or future trees planted for landscaping purposes near the proposed development.

In the event that any cutting or filling is undertaken at the proposed structure locations, the classification should be re-assessed as the classification may change.

The CSIRO Brochure entitled "Foundation Maintenance and Footing Performance: A Homeowner's Guide" provides commentary on good site management practice that should be adopted at this site.

The results of the Atterberg Limits and Particle Size Distribution Testing are presented in Appendix D.

6.3 Deep footings

Where larger loads are anticipated or where upper level footings are not practical, the use of short pier footings may be adopted. These piers may be founded into the Sandy CLAY of stiff to very stiff or better consistency typically encountered below 0.8m.

In and around locations DCP1-DCP3 and DCP6-DCP10 an Ultimate End Bearing Capacity for non-displacement piles (bored piles) of 765kPa can be adopted. An Ultimate Shaft Friction of 29kPa may be adopted.

The end bearing value are provided upon the assumption that the piles extend a minimum of one pile diameter into the founding material to allow for confirmation of the materials by GG examination of the drill cuttings.

Pile design should include assessment of both strength and serviceability limit states. Following an assessment of the overall design Average Risk Rating (ARR), in accordance with the guidelines presented in AS2159-2009, a geotechnical strength reduction factor (Φ_{gb}) of 0.48 may be adopted for the site. The assessment was based on the risk factors anticipated for the site, the investigation, the design and installation, as appropriate for low redundancy pile systems.

7.0 Recommended Further Work

It is strongly recommended that GG are engaged during site development to carry out inspections of any excavated upper level or bored pier footings. These inspections will confirm design assumptions made in the report.

8.0 Residual Design Risk and Limitations

GG have employed accepted geotechnical engineering procedures, and our opinions and conclusions are made in accordance with generally accepted principles and practices of this profession. The contents of this report are valid as of the date of preparation. However, changes in the condition of the site can occur over time as a result of either natural processes or human activity. In addition, advancements in the practice of geotechnical engineering and changes in applicable practice codes may affect the validity of this report. Consequently, this report should not be relied upon after an elapsed period of six months without a review by GG for verification of validity.

This document has been prepared by GG for the particular purpose outlined in our proposal for the use by Noah Creek Development Pty Ltd for design purposes. No other warranty, expressed or implied, is made as to the professional advice included in this report.

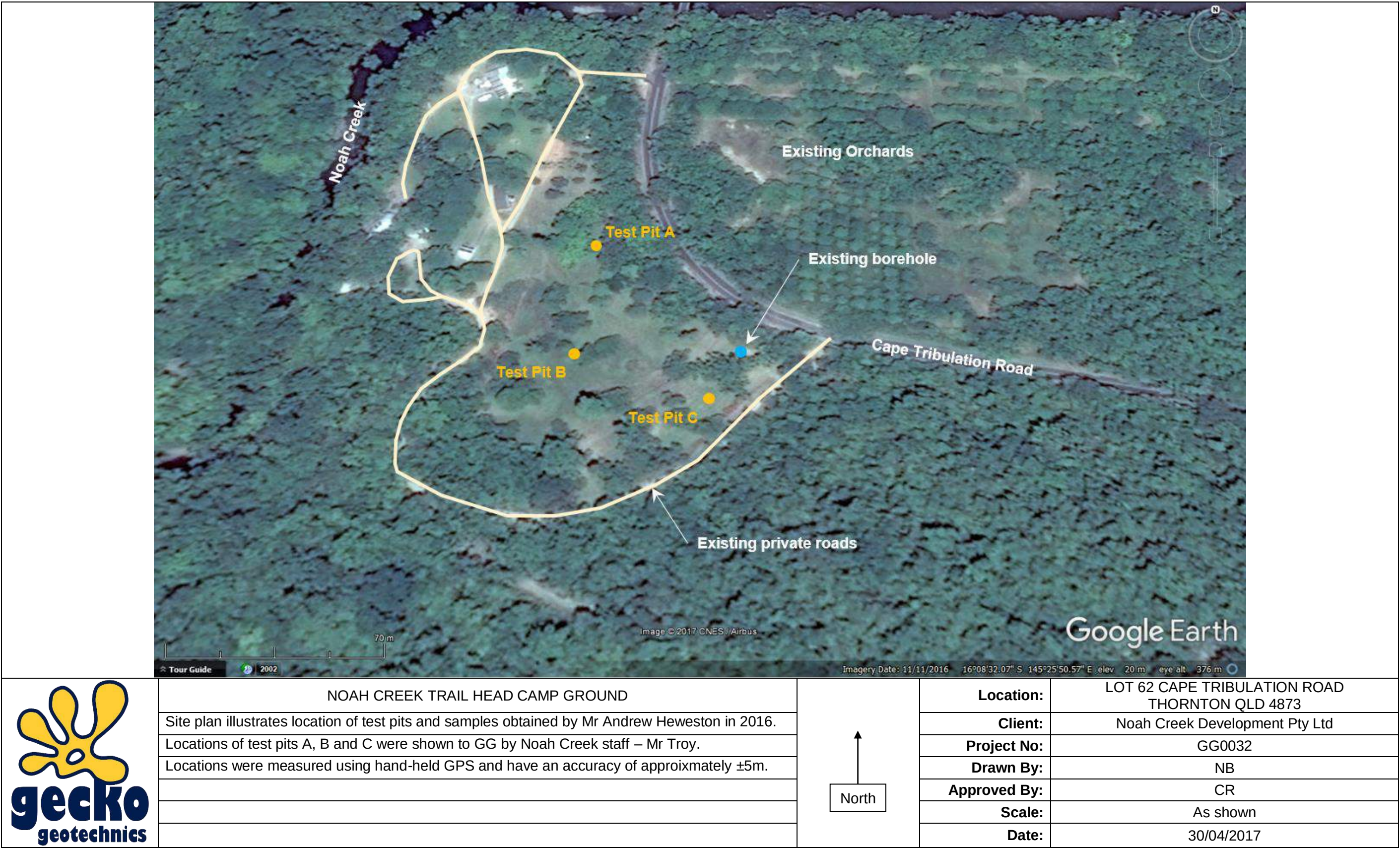
It should be understood that conditions may exist which were not detected given the limited nature of the enquiry GG was engaged to undertake with respect to this site. Variations in conditions may exist between assessed locations, and there may be special conditions pertaining to the site which have not been revealed by the investigation which therefore have not been taken into account in the report. Therefore, additional investigations or studies may be required.

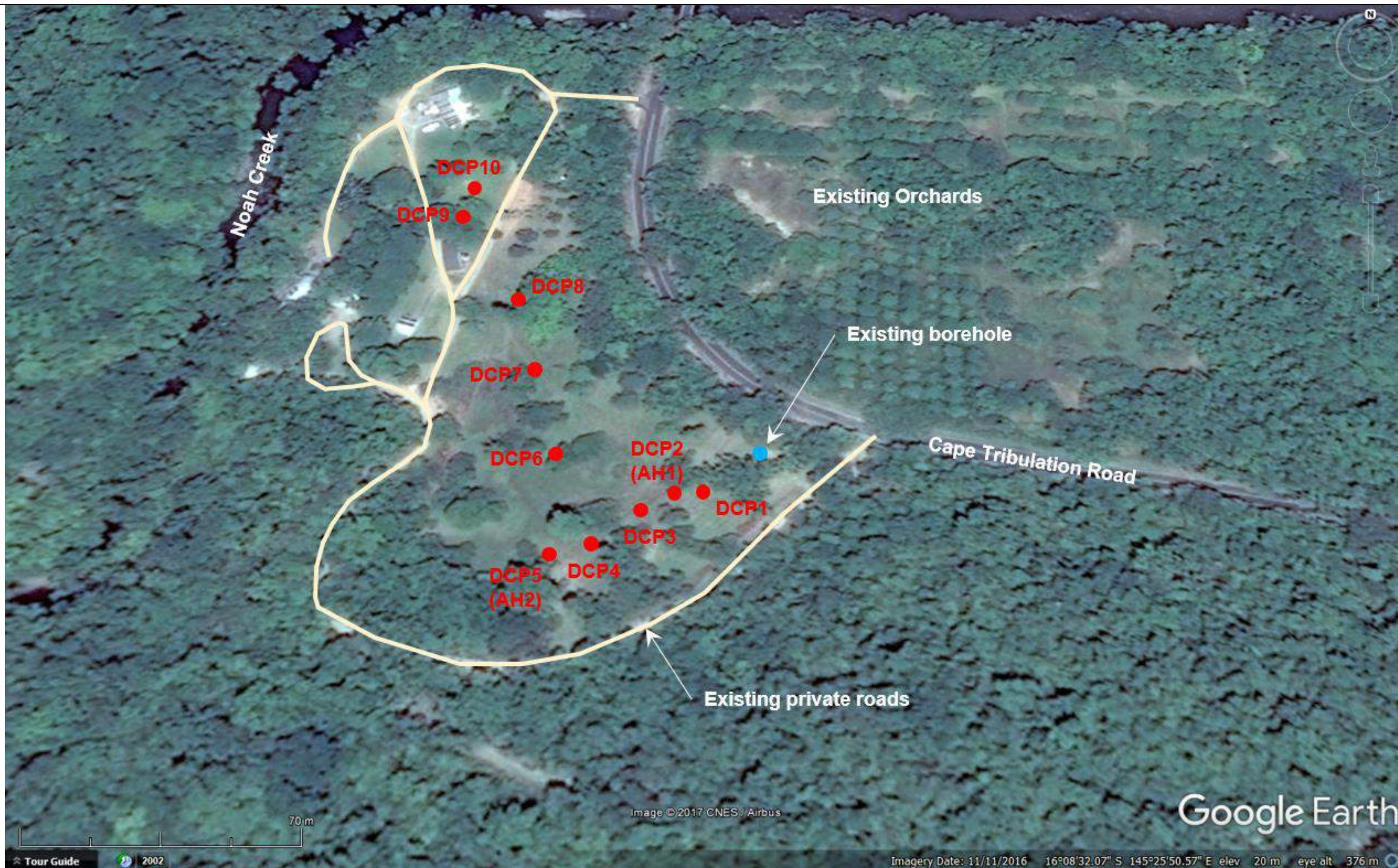
The report has been prepared for use by Noah Creek Development Pty Ltd and not for use by any other parties, as this report may not contain sufficient information for use by those parties.

9.0 References

Heweston, A. 2017, *Site classification*, Personal Email Communication 12 March 2017.

10.0 Appendix A - Site Plans





NOAH CREEK TRAIL HEAD CAMP GROUND

Site plan illustrates location of field tests undertaken by GG on 15 March 2017.
Locations were measured using hand-held GPS and have an accuracy of approximately $\pm 5\text{m}$.



Location:	LOT 62 CAPE TRIBULATION ROAD THORNTON QLD 4873
Client:	Noah Creek Development Pty Ltd
Project No:	GG0032
Drawn By:	NB
Approved By:	CR
Scale:	As shown
Date:	30/04/2017

11.0 Appendix B - Site Photographs

11.1 September 2016 (Heweston, 2017)

11.1.1 Test Pit A





11.1.2 Test Pit B





11.1.3 Test Pit C





11.2 March 2017



Looking ~west from DCP1 toward DCP2 (AH1)



Looking ~east from DCP5 (AH2) toward existing drill hole and DCP1



Looking ~south from DCP8 toward DCP5 (AH2)



Looking ~north from DCP10

12.0 Appendix C - Borehole Logs

Hand auger borehole logs AH1 – AH2 are presented in this section.

Legend

Moisture Condition

D- Dry

M- Moist

W- West

Consistency

VS- very soft, S- soft, F- firm, St- Stiff

Vst- Very Stiff, H- Hard

Density

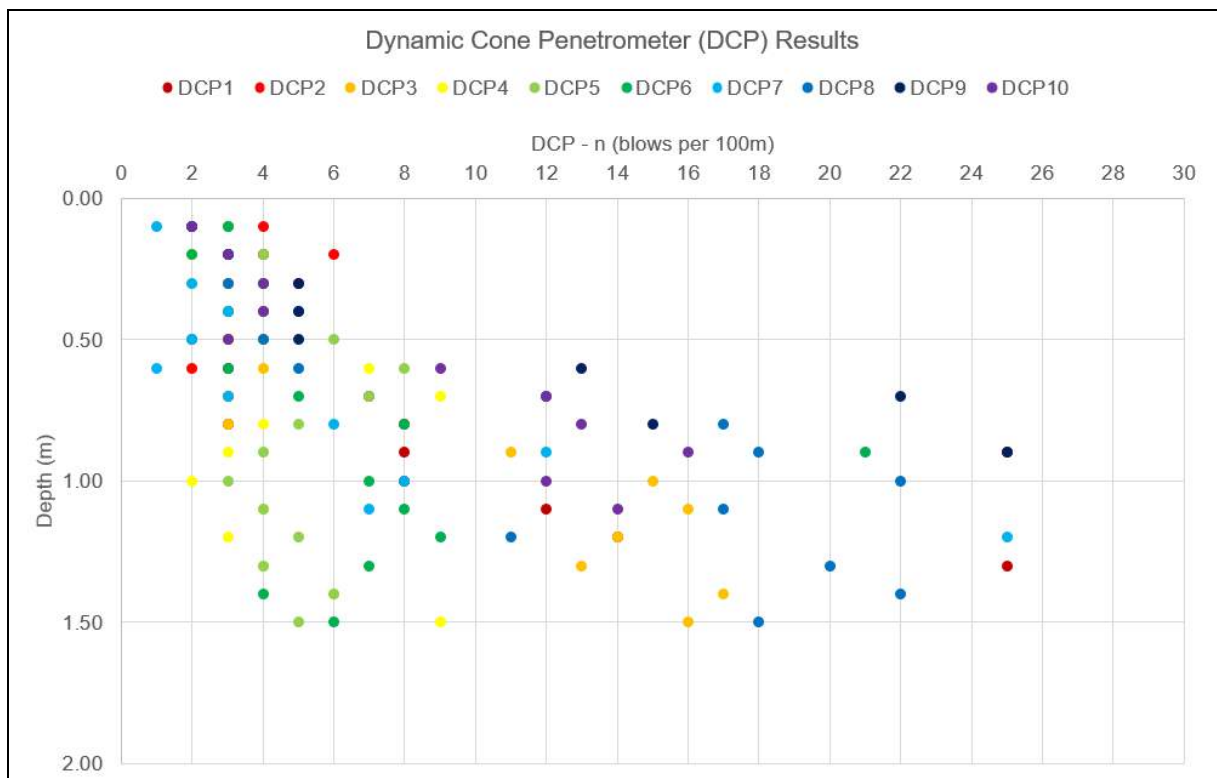
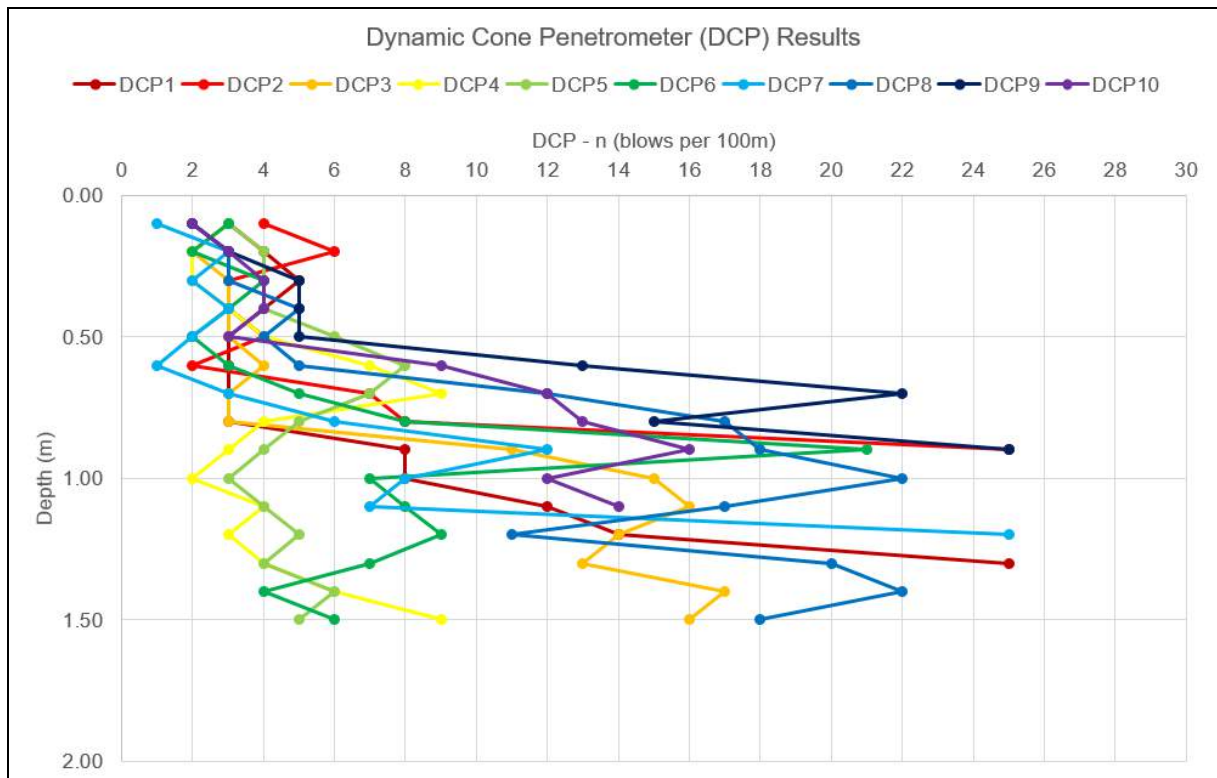
VL- very loose, L- loose, MD- medium dense

D- dense, VD- very dense

HOLE NO.:		AH1 (DCP2)			SHEET:		1 of 1			
CUSTOMER:		Noah Creek Developments Pty Ltd			JOB NO:		GG0032			
PROJECT:		Trail Head Camp Ground			DATE:		15-Mar-2017			
LOGGED BY:		NB			REVIEWED BY:		CR			
MACHINE:		Hand auger			RL:		-			
PIT DIMENSIONS:		0.2m diameter			COORDINATES:		GPS Waypoint #7			
Depth (m)	Method	Water	Sample or Field Test	USCS Symbol	Soil/Rock Description		Moisture Condition	Consistency/ Density	DCP (blows per 100mm)	Additional Observations
0.0	Not Encountered			CL	Sandy CLAY: low plasticity, brown mottled orange, medium to coarse sand, trace coarse gravel to cobbles and organic matter		M	St	4	DCP refusal
0.1									6	
0.2									3	
0.3					Sandy CLAY: low plasticity, brown mottled orange, medium to coarse sand, trace fine to medium gravel				3	
0.4									4	
0.5			Sample 0.5-0.6m			2				
0.6						7				
0.7						8				
0.8						25				
0.9										
1.0										
1.1										
1.2										
1.3										
1.4										
1.5										

HOLE NO.:		AH2 (DCP5)		SHEET:		1 of 1			
CUSTOMER:		Noah Creek Developments Pty Ltd		JOB NO:		GG0032			
PROJECT:		Trail Head Camp Ground		DATE:		15-Mar-2017			
LOGGED BY:		NB		REVIEWED BY:		CR			
MACHINE:		Hand auger		RL:		-			
PIT DIMENSIONS:		0.2m diameter		COORDINATES:		GPS Waypoint #10			
Depth (m)	Method	Water	Sample or Field Test	USCS Symbol	Soil/Rock Description	Moisture Condition	Consistency/ Density	DCP (blows per 100mm)	Additional Observations
0.0	Not Encountered			CL	Sandy CLAY: low plasticity, brown mottled orange, medium to coarse sand, trace coarse gravel to cobbles and organic matter	M	St	3	
0.1								4	
0.2			Sample 0.5-0.6m		Sandy CLAY: low plasticity, brown mottled orange, medium to coarse sand, trace fine gravel			4	
0.3								4	
0.4								6	
0.5								8	
0.6								7	
0.7								5	
0.8								4	
0.9								3	
1.0								4	
1.1								5	
1.2								4	
1.3								6	
1.4								5	
1.5									

13.0 Appendix D – Dynamic Cone Penetrometer Logs



Depth (m)	n (blows per 0.1m)									
	DCP1	DCP2	DCP3	DCP4	DCP5	DCP6	DCP7	DCP8	DCP9	DCP10
0.0 – 0.1	3	4	3	3	3	3	1	2	2	2
0.1 – 0.2	4	6	2	2	4	2	3	3	3	3
0.2 – 0.3	5	3	3	2	4	4	2	3	5	4
0.3 – 0.4	4	3	3	3	4	3	3	5	5	4
0.4 – 0.5	3	4	3	4	6	2	2	4	5	3
0.5 – 0.6	3	2	4	7	8	3	1	5	13	9
0.6 – 0.7	3	7	3	9	7	5	3	12	22	12
0.7 – 0.8	3	8	3	4	5	8	6	17	15	13
0.8 – 0.9	8	25	11	3	4	21	12	18	25	16
0.9 – 1.0	8		15	2	3	7	8	22		12
1.0 – 1.1	12		16	4	4	8	7	17		14
1.1 – 1.2	14		14	3	5	9	25	11		
1.2 – 1.3	25		13	4	4	7		20		
1.3 – 1.4			17	6	6	4		22		
1.4 – 1.5			16	9	5	6		18		

14.0 Appendix E - Laboratory Testing Results



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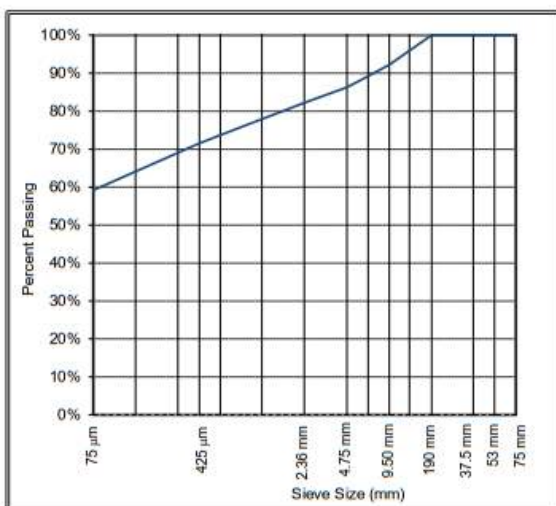
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TOWNSVILLE
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Unit D 26-30 Lorna Court
BOHLE QLD 4818

Quality of Materials Report

Client:	Gecko Geotechnics	Report Number:	GT17-097 -22154 Q
Client Address:	PO Box 14226, Mount Sheridan QLD 4868	Report Date:	28/03/2017
Job Number:	GT17-097	Test Request No:	-
Project:	Noah Valley Eco-Resort		
Location:	Cape Tribulation		
Lab No:	CS22154	Sample Location:	AH1 (DCP2) - Depth 0.5 - 0.6m
Date Sampled:	17/03/2017		
Date Tested:	25/03/2017	Spec Description:	
Sampled By:	Client	Lot Number:	-
Sample Method:	As Supplied	Spec Number:	
Material Source:	Insitu Material		
For Use As:	-		
Remarks:	Sample tested as received. This report does not endorse sampling.		

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Particle Size Distribution			
Test Method AS1289.3.6.1			
A.S.	Specification		Result
	Specification	Result	Specification
Sieve Size	Minimum	% Passing	Maximum
75mm		100	
53mm		100	
37.5mm		100	
19.0mm		100	
9.5mm		92	
4.75mm		86	
2.36mm		82	
0.425mm		72	
0.075mm		59	

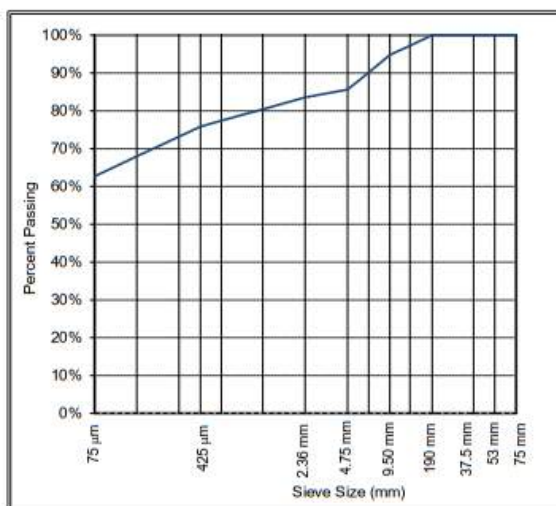
Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.1.2	-	44	-
Plastic Limit (%)	AS1289.3.2.1	-	25	-
Plasticity Index	AS1289.3.3.1	-	19	-
Linear Shrinkage (%)	AS1289.3.4.1	-	12.5	-
P.I. X % Passing 0.425mm			1359	
L.S. X % Passing 0.425mm			894	
Ratio of % Passing (0.075 / 0.425)			0.83	

	Accredited for compliance with ISO/IEC 17025 - Testing	APPROVED SIGNATORY	FORM NUMBER
		 Peter Armstrong - Laboratory Manager Cairns Laboratory NATA Accreditation No. 20026	FM-RP-120-2

Quality of Materials Report

Client:	Gecko Geotechnics	Report Number:	GT17-097 -22155 Q
Client Address:	PO Box 14226, Mount Sheridan QLD 4868	Report Date:	28/03/2017
Job Number:	GT17-097	Test Request No:	-
Project:	Noah Valley Eco-Resort		
Location:	Cape Tribulation		
Lab No:	CS22155	Sample Location:	AH2 (DCP5)
Date Sampled:	17/03/2017		
Date Tested:	25/03/2017		
Sampled By:	Client		
Sample Method:	As Supplied	Depth 0.5 - 0.6m	
Material Source:	Insitu Material	Spec Description:	
For Use As:	-	Lot Number:	-
Remarks:	Sample tested as received. This report does not endorse sampling.		
		Spec Number:	

Page 1 of 1



Particle Size Distribution			
Test Method AS1289.3.6.1			
A.S.	Specification		Result
	Specification	Result	Specification
Sieve Size	Minimum	% Passing	Maximum
75mm		100	
53mm		100	
37.5mm		100	
19.0mm		100	
9.5mm		95	
4.75mm		86	
2.36mm		84	
0.425mm		76	
0.075mm		63	

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289.3.1.2	-	46	-
Plastic Limit (%)	AS1289.3.2.1	-	22	-
Plasticity Index	AS1289.3.3.1	-	24	-
Linear Shrinkage (%)	AS1289.3.4.1	-	14.0	-
P.I. X % Passing 0.425mm			1820	
L.S. X % Passing 0.425mm			1062	
Ratio of % Passing (0.075 / 0.425)			0.83	

 ACCREDITED FOR TECHNICAL COMPETENCE	Accredited for compliance with ISO/IEC 17025 - Testing	APPROVED SIGNATORY	FORM NUMBER
		 Peter Armstrong - Laboratory Manager Cairns Laboratory NATA Accreditation No. 20026	FM-RP-120-2

