



**PORT DOUGLAS LAND DEVELOPMENTS PTY LTD**

**GEOTECHNICAL INVESTIGATION**

**PROPOSED PUMP STATION  
STAGE 1A & 1B PORT DOUGLAS ESTATE  
CAPTAIN COOK HIGHWAY, CRAIGLIE**

**REPORT NUMBER: GT19-242-001R REV 1**

**AUGUST 2019**

**REVISION 1**

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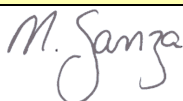
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## TABLE OF CONTENTS

1.	INTRODUCTION _____	1
2.	STANDARDS & GUIDELINES _____	2
3.	PROPOSED DEVELOPMENT _____	2
4.	FIELDWORK _____	2
5.	LABORATORY TESTING _____	2
6.	SITE CONDITIONS AND OBSERVATIONS _____	3
7.	ENGINEERING ASSESSMENT AND RECOMMENDATIONS _____	4
8.	SEASONAL INFLUENCES _____	14
9.	CONSTRUCTION INSPECTION _____	14
10.	LIMITATIONS _____	14
APPENDIX A – SITE PLAN _____		
APPENDIX B – BOREHOLE LOGS _____		
APPENDIX C – LABORATORY TEST RESULTS _____		
APPENDIX D – PHOTOS _____		
APPENDIX E - UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT _____		

## 1. INTRODUCTION

ETS Geo Pty Ltd (ETS) has conducted a geotechnical investigation for the proposed pump station and pavement at the Stage 1A & 1B Port Douglas Estate subdivision on the Captain Cook Highway in Craiglie.

The objective of the geotechnical investigation for the pump station as defined by the client is to provide:

- The nature and type of sub-surface material including depths to and thicknesses of fill material, natural soils, rock, etc;
- Excavation conditions and shoring requirements for the construction of the wet well;
- Standing water level;
- Foundation recommendations:
  - Site Classification;
  - Allowable bearing capacity and estimated settlement at 7m below the existing ground surface levels;
- Horizontal bearing capacity at 1 – 1.5m below the existing ground surface levels;
- Preliminary Acid Sulfate Soil assessment; and
- Soaked CBR test at a depth between 0.2 – 1.0m below the existing ground surface level (pump station site).

The objective of the geotechnical investigation for the pavement design as defined by the client is to provide:

- Soaked CBR and Atterberg Limits test results for three (3) test pit locations nominated by the customer across the proposed subdivision area at a depth of 1 – 2m below the existing surface levels.

## **2. STANDARDS & GUIDELINES**

The soil classification descriptions, field and laboratory testing were completed in general accordance with the following Australian Standards.

AS 1726-2017                      Geotechnical Site Investigations

AS 1289                              Methods of Testing Soils for Engineering Purposes

## **3. PROPOSED DEVELOPMENT**

It is understood that a 7m deep 2.1m diameter manhole is proposed at the pump station, as well as associated structures to be founded on a 16m<sup>2</sup> concrete slab. The manhole has an approximate weight of 20t. A preliminary design was not available at this stage.

## **4. FIELDWORK**

The fieldwork was conducted by ETS on the 15<sup>th</sup> of August 2019 and included a visual assessment of the site, its surrounds and a subsurface investigation. The fieldwork comprised:

- One (1) borehole was drilled to a depth of 9.0m with a truck mounted drill rig at the proposed pump station location with Standard Penetration Testing (SPT) and undisturbed U50 sampling at regular intervals, and
- Three (3) test pits to a depth of 2.5m in the vicinity of the proposed internal roads within the proposed subdivision with bulk sampling.

The test locations are presented on Drawing GT19-242-001 DWG in Appendix A. The results of the fieldwork (Borehole and test pit logs) are presented in Appendix B.

## **5. LABORATORY TESTING**

The following laboratory testing was conducted in NATA accredited laboratories on samples recovered during fieldwork in order to assist with the assessment of geotechnical design parameters to be used in the analysis:

- Atterberg Limits;
- Particle Size Distribution;
- California Bearing Ratio (1pt – STD);
- Soil pH<sub>F</sub> and pH<sub>FOX</sub>; and
- Chromium Suite Analysis.

Results of the laboratory testing are presented in Appendix C.

## **6. SITE CONDITIONS AND OBSERVATIONS**

### **6.1 Visual Assessment**

The site is currently used for sugar cane farming and at the time of investigation the sugar cane had been harvested from the proposed subdivision site. The ground surfaces were generally described as being gently sloping to the East. An open drain of approximately 2m to 3m deep and 6m to 8m wide was present along the northern boundary. An open battered drain was also present on the western boundary between the cane field and the Bruce Highway and another shallow open drain was present to the East. A large stockpile of soil was present in the Northeastern corner of the site.

### **6.2 Subsurface Conditions**

The 1:250,000 Geological Map of Mossman (1996) shows that the site is underlain by Quaternary deposits comprising “Mainly quartzose to lithic sublabile sand, muddy sand, silt, mud; rare peat: undivided coastal (supratidal, intertidal, beach-ridge, dune coastal-flat and swamp) deposits”.

The subsurface conditions encountered are loose Clayey SAND underlain by very stiff to hard low plasticity CLAY with various contents of fine to medium grained sand. Table 1 presents a summary of the subsurface conditions.

Groundwater was encountered in BH1 at a depth of 2.2m during the fieldwork. It should be noted that groundwater levels are affected by climatic conditions and therefore groundwater levels may vary with time. The groundwater table was not encountered at the test pit locations which is likely attributed to higher ground surface levels at these locations.

**TABLE 1: Subsurface Profile Summary**

Material Description	Depth Encountered (m)			
	BH1	TP1	TP2	TP3
TOPSOIL: Sandy Silty CLAY (CL) Firm	0 – 0.3	-	-	-
Clayey SAND (SC) Loose	0.3 – 1.1	-	-	-
Sandy CLAY / Silty CLAY (CL) Very Stiff	1.1 – 7.0	0 – 0.3	0 – 0.35	0 – 0.3
Silty CLAY (CL) Very Stiff to Hard	7.0 – 9.4	0.3 – 2.5	0.35 – 2.5	0.3 – 2.5

## 7. ENGINEERING ASSESSMENT AND RECOMMENDATIONS

### 7.1 Assessed Geotechnical Issues

Based on the available data the following geotechnical issues are considered to have some impact on the proposed pump station development at this site.

- Selection of a suitable footing system. The footing system chosen should be able to accommodate both compression loads (without excessive settlement) when the pump station is fully constructed and oppose uplift forces due to pore water pressure during and after construction;
- Excavation and support;
- Presence of Actual or Potential Acid Sulfate Soil.

The above potential geotechnical issues have been addressed in Sections 7.2, 7.4 and 7.5.

The potential presence of actual or potential acid sulfate soil across the subdivision at the pavement locations has also been identified and has also been discussed in Section 7.5.

Furthermore, the horizontal bearing capacity at 1m to 1.5m depth, geotechnical design parameters for the pavement design and earthworks recommendations are provided in Sections 7.3, 7.6 and 7.7 respectively.

## **7.2 Suitable Foundation System**

### **7.2.1 Pump Station Manhole**

The base of the manhole is assumed to be located at 7m depth, below which very stiff to hard low to medium plasticity Silty CLAY was confirmed to be present to a depth of 9.4m.

Considering the depth and diameter of the manhole, an allowable bearing capacity of 300kPa may be adopted for the foundation of the manhole.

Considering the shallow groundwater table at the proposed pump station location and allowing for groundwater rising to within 0.5m of the ground surface around the pump station, the groundwater head associated with the floor construction at 7m depth equates with a uniform uplift pressure of approximately 65kPa. Based on discussions with Cardno, the deadweight from the pump station structure will be insufficient to counteract this uplift loading. Therefore measures should be taken to resist uplift of the manhole. Over excavation and backfill with concrete to increase the dead weight of the manhole or screw piles at the base of the excavation may be considered. Should the depth of the foundation (i.e. 7m) be altered, it is recommended the uplift pressure should similarly be reassessed.

### **7.2.2 Shallow Foundations**

Shallow foundation conditions at the proposed pump station location comprise loose Clayey SAND up to 1.2m depth. Loose SAND is not considered suitable for shallow foundations and improvement of this sand layer, such as remove and re-compact in accordance with the earthworks recommendations provided in Section 7.7 may be considered. Alternatively, structures can be founded a minimum of 0.3m in the very stiff clay below the sand, i.e. at minimum 1.5m depth. It should be noted that the loose sand layer thickness may vary across the structure footprint.

An Allowable Bearing Capacity of 200kPa is readily achieved for footings (i.e. short bored piers) founded in the very stiff CLAY. The Allowable Bearing Capacity for foundations in the re-compacted sand depends on the dimensions of the foundation, as well as the achieved density of the sand after compaction. A medium dense sand can generally be achieved after appropriate compaction, in which an Allowable Bearing Capacity of 150kPa is readily achieved for a concrete slab of 3m by 5m. For



smaller footings, such as 0.3m wide strip footings, an Allowable Bearing Capacity of 100kPa is readily achieved. These assessments are based on the assumption that the groundwater table is not encountered within the zone of influence beneath the footing.

The anticipated immediate settlement below foundations of maximum 1m wide founded in the clay is less than 10mm, for a footing load of 100kPa. The anticipated immediate settlement below foundations of maximum 3m wide and 5m long founded in the sand is less than 10mm, for a footing load of 100kPa.

It is recommended that Dynamic Cone Penetrometer testing is undertaken in the excavated footings to confirm the required soil strength has been achieved and remains constant or improves to a depth equal to three (3) times the width of the footing.

All footings should be designed using engineering principles by an experienced and suitably qualified structural engineer.

### 7.2.3 Site Classification

It is noted that site classification in accordance with AS2870 may not be strictly applicable for the pump station structure. Assessment using engineering principals should be adopted. However, for completeness and any associated structures constructed at ground surface level within the near surrounds at the pump station location a site classification in accordance with AS2870 is provided.

Due to the soft soils encountered the site is classified as **CLASS – P** in accordance with AS2870-2011 “Residential Slabs and Footings – Construction”.

Laboratory test results indicate that the soil is considered slightly reactive to changes in moisture content with an estimated characteristic surface movement ( $y_s$ ) within the Class S category (0 to 20mm) in accordance with AS2870-2011<sup>2</sup> “Residential Slabs

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<sup>1</sup> Australian Standard AS 2870-2011 “Residential Slabs and Footings – Construction”, Standards Australia

<sup>2</sup> Australian Standard AS 2870-2011 “Residential Slabs and Footings – Construction”, Standards Australia

and Footings – Construction”. This classification is based on the site in its current state (i.e. no additional earthworks).

Should any filling be undertaken at the proposed structure location the estimated predicted ground surface movement ( $y_s$ ) should be re-assessed as the reported site classification may change.

The characteristic surface movement ( $y_s$ ) estimated in this report does not take into account the effects of future trees planted for landscaping purposes. It is recommended that any proposed landscaping for the project is reviewed by ETS well prior to construction phase to ensure that the given site classification for the site is not affected.

### 7.3 Horizontal Bearing Capacity

The Horizontal Bearing Capacity at 1m to 1.5m below surface level has been assessed, based on the ground conditions encountered at BH1. A loose Clayey SAND is present between depths of 1.0m and 1.2m and a very stiff low plasticity CLAY is present between depths of 1.2m and 1.5m depth. The Horizontal Bearing Capacity is considered equal to the horizontal passive pressure and is provided in Table 2.

**TABLE 2: Horizontal Passive Pressure**

Depth	Horizontal Passive Pressure (Ultimate) (kPa)	
	CLAY (CL) Very Stiff	Clayey SAND (SC) Loose
1.0	-	24
1.3	51	31
1.5	57	36

1. The above calculations assume a water table level at 1.0m below the ground surface level.

## 7.4 Excavation Conditions and Support

It is anticipated that excavations will consist of the following:

- Small excavations– for foundations;
- Trenching – for underground services and pipes; and
- Deep excavation for manhole.

Excavation through the loose SAND and very stiff CLAY for shallow foundations and trenches is expected to be readily undertaken using small earthmoving equipment (i.e. 5-10t excavator / small to medium size backhoe).

Excavation conditions for the manhole comprise loose sand to 1.2m underlain by very stiff low plasticity clay to 7m depth. Excavation through the very stiff CLAY for the manhole is expected to be undertaken using medium to large size earthmoving equipment (10t – 25t excavator).

Groundwater was encountered at 2.2m depth and therefore water seepage into the excavation is anticipated. Therefore a retention system, such as shoring or caisson sinking should be considered.

Lateral earth pressure coefficients for use in retention systems design are presented in Table 3. These recommended lateral earth pressure coefficients do not take into account a sloping backfill, surcharge loads or water pressures behind the excavation shoring. If the shoring is to be designed to resist water infiltration, then it would be advisable to also allow for some differential pressure between the outside and inside of the excavation, following dewatering of the excavation by pumping.

**TABLE 3: Lateral Earth Pressure Coefficients**

Material	Depth (m)	Unit Weight (kN/m <sup>3</sup> )	Friction Angle (°) (drained)	Lateral Earth Pressure Coefficients	
				k <sub>a</sub>	k <sub>p</sub>
Clayey SAND (SC) Loose	0.3 – 1.2	18	30	0.33	3.00
Sandy / Silty CLAY (CL) Very Stiff	1.2 – 7.0	19	28	0.36	2.77

## 7.5 Preliminary Acid Sulfate Soil Assessment

The Douglas Shire's planning scheme operates under the repealed "State Planning Policy 02/02 (SPP 02/02); Planning and Managing Development Involving Acid Sulfate Soils" which requires consideration for Acid Sulfate Soils (ASS).

The site of the proposed development has the possibility of containing ASS, as they predominantly occur on coastal lowlands with elevations generally below 5m Australian Height Datum (AHD). Where excavations are likely to disturb  $\geq 100\text{m}^3$  of soil and are below 5m AHD, the investigation procedures outlined in the SPP 02/02 applies.

A preliminary ASS assessment was undertaken for the project which consisted of selecting eighteen (18) samples for  $\text{pH}_{\text{FIELD}}$  and  $\text{pH}_{\text{FOX}}$  screening tests. Following this testing and a review of the test results was completed, the following comments are provided in reference to the testing results:

- Where the soils pH ( $\text{pH}_{\text{FIELD}}$ ) is less than 4, it is an indicator that actual acid sulfate soil (AASS) is present. None of the samples tested had a  $\text{pH}_{\text{FIELD}}$  value of less than 4.
- Where the pH after oxidation ( $\text{pH}_{\text{FOX}}$ ) is less than 3, there is an effervescent reaction and the  $\text{pH}_{\text{FOX}}$  is lower than  $\text{pH}_{\text{F}}$ , it is an indicator that potential acid sulfate soil (PASS) is present. None of the samples fell into this category.
- If the  $\text{pH}_{\text{FOX}}$  is greater than 3 and less than 4 but still has an effervescent reaction and the  $\text{pH}_{\text{FOX}}$  is lower than  $\text{pH}_{\text{FIELD}}$  then the screening tests, it is an indicator that the material is possibly PASS and further quantative analysis is recommended. None of the samples fell into this category.

Following the preliminary screening tests, five (5) samples were selected for further quantative analysis in the form of Chromium Suite testing, which determines whether or not the specified action criterion are exceeded. The testing results are summarised below in Table 4, and the SGS Environmental test reports are included in Appendix C.

**TABLE 4: Quantative Analysis Test Summary**

Test No.	Sample Depth (m)	Soil Description (Texture)	SCR (mol H <sup>+</sup> /t)	TAA (mol H <sup>+</sup> /t)
BH1	4.4 – 4.5	Fine	<5	<5
BH1	9.0 – 9.4	Fine	<5	<5
TP1	0.6 – 0.8	Fine	<5	15
TP2	0.35 – 0.55	Fine	<5	17
TP3	1.5 – 1.7	Fine	<5	7

Two (2) soil types (fine and medium texture) were identified during the investigation, however, only fine textured samples were selected for quantitative laboratory testing. The soil types correlating action criteria are specified in Appendix 5, Table 6 of the “State Planning Policy 2/02 Guideline”. The criteria are used to define when ASS disturbed at a site will need to be treated and managed. The action criteria use the sum of the existing plus potential acidity (e.g. s-TAA + S<sub>CR</sub>; both expressed as moles H<sup>+</sup>/tonne & % w/w of S units) to set a trigger level for different soil texture types and amounts of material disturbed.

Considering the soil type (fine and coarse texture) and the quantity of soils likely to be disturbed, the action criteria in Table 5 apply.

**TABLE 5: Action Criteria ASS**

Type of Material	Action Criteria if 1- 1000 tonnes of material is disturbed	
	Existing + Potential Acidity	
Texture Range	Equivalent Sulfur (% w/w S) (oven-dry basis)	Equivalent acidity (mol H <sup>+</sup> / tonne) (oven-dry basis)
Medium	0.06	36
Fine	0.1	62

The threshold values for TAA and  $S_{CR}$  were not exceeded on any of the samples tested according to the soils texture type.

Based on the results of the preliminary ASS assessment, an Acid Sulfate Soil Management Plan is **not required** for the excavations and filling associated with this project.

## 7.6 Pavement Design Parameters

It is understood that pavement may be constructed at the site. Following earthworks, it is envisaged that a Sandy or Silty CLAY (CL) or Clayey Sand (SC) subgrade will be exposed. Laboratory testing has been carried out on the expected subgrade material from all test locations to determine this material's California Bearing Ratio (CBR), as well as its Atterberg Limits and Particle Size Distribution. The CBR value represents the 'strength' of this material, compacted to 98% standard compaction, under saturation. It is noted that the test locations and depths were nominated by the customers civil design engineers for the project.

The Soaked CBR test and Atterberg Limits test results are presented in Table 6.

**TABLE 6: Laboratory Test Results For Pavement Design**

Test Type	Depth Encountered (m)			
	BH1 0.2 – 0.4m	TP1 1.5 – 1.7m	TP2 1.3 – 1.5m	TP3 1.5 – 1.7m
Liquid Limit (%)	~*	32	32	26
Plastic Limit (%)	-	19	17	18
Plastic Index	-	13	15	8
Linear shrinkage (%)	-	8.0	7.5	5.5
CBR Value (%)	15	11	15	11

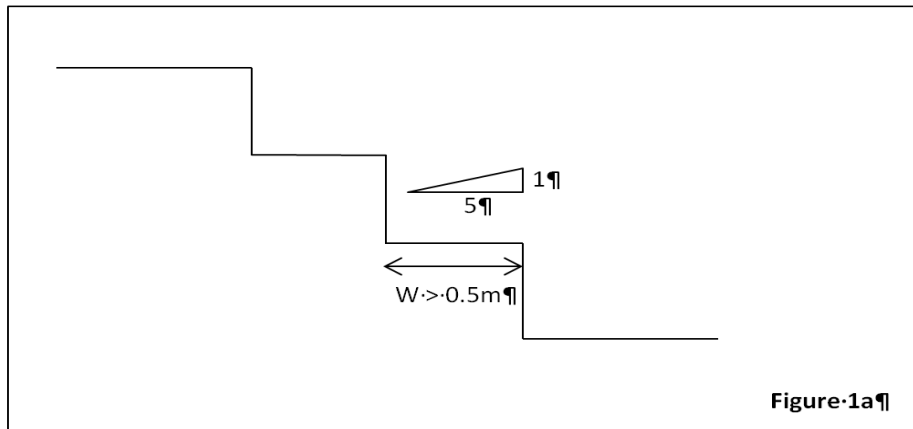
Notes: \* Liquid Limit not obtainable due to fine grained sand content

## 7.7 Earthworks

The following general procedures are suggested for any site preparation and earthworks to be performed at the site:

- Strip & remove topsoil, soil containing significant amounts of organic materials, 'uncontrolled' fill and any deleterious soft, wet or highly compressible materials if encountered at subgrade or pavement formation levels;
- Undertake 'proof' rolling of the exposed surface levels across the site with a minimum 12 tonne static weight smooth drum roller or similar. Any soft or loose material that cannot be improved by compaction should be removed and replaced with approved select fill;
- Any exposed natural foundation soils should be compacted to a minimum dry density ratio of 98% using Standard compaction and moisture treated to a moisture range of -2%(dry) to +2%(wet) of optimum moisture content (OMC);
- Any exposed clay subgrade soils, at or close to formation level, should be sealed or covered as soon as practicable, in order to reduce the opportunity for desiccation and cracking (due to drying), or softening and swelling (due to wetting) with moist conditions;
- Where the formation levels are to be raised or subgrade materials are to be excavated (i.e. remove & replace), the foundation soils should be prepared as detailed above;
- Approved filling should be undertaken by placing fill in uniform horizontal layers not exceeding 200mm loose thickness and compact to achieve a dry density ratio of at least 98% using Standard compaction for cohesive soil or to at least 70% density index for sand. The moisture content of any cohesive soil fill materials should be maintained at -2% to +2% of OMC, during and after compaction;
- Filling should be placed at least two (2) metres beyond the design profile and then trimmed to the design profile.
- Where unsuitable materials are to be excavated it is recommended that all excavated in-situ soils are removed from the site and approved select fill is placed and compacted in the excavation. The excavation should be benched to "key in" the select fill material and optimise compaction. The benches

should slope back at 1V:5H and be at least 0.5m wide, refer to Figure 1a below.



- Approved filling (general fill) should be a well graded material free from organic materials, have a Plasticity Index less than or equal to 15%, and should not contain any individual particles greater than 75mm in size.
- In order for filling to be considered 'controlled' any earthworks that are undertaken beneath any of the proposed structures or pavements are to be performed under full time 'Level 1' inspection and testing as described and in accordance with AS3798:2007.

The above procedures will necessitate geotechnical inspection and testing services to be employed throughout construction.

It should be noted that there may be trafficability issues for rubber wheeled earthmoving equipment if construction activities are undertaken either during, or soon after, wet weather, due to the moistening and softening of the soils. In order to minimise these issues, the use of tracked equipment is suggested. In addition to this, achieving a satisfactory 'proof' roll under wet weather conditions may also be difficult. Should this situation arise, additional geotechnical advice should be sought.



## 8. SEASONAL INFLUENCES

Seasonal influences, i.e. “wet season” versus “dry season” may affect the foundation conditions on a site. At some sites softening of the cohesive soils (silt and clay) may be observed due to a higher moisture content in the soil compared to the moisture content at the time of the investigation. As a consequence, the undrained shear strength of the soil may be higher during the dry season and lower during the wet season. Therefore, if moisture conditions encountered during construction are considered to be different to those that were encountered during the fieldwork, it is recommended that additional geotechnical advice be sought. Depending on the circumstances, it may be necessary to modify the design or implement some form of foundation improvement.

## 9. CONSTRUCTION INSPECTION

Inspections by ETS Geo Pty Ltd shall be required for foundation excavations to confirm adequate conditions.

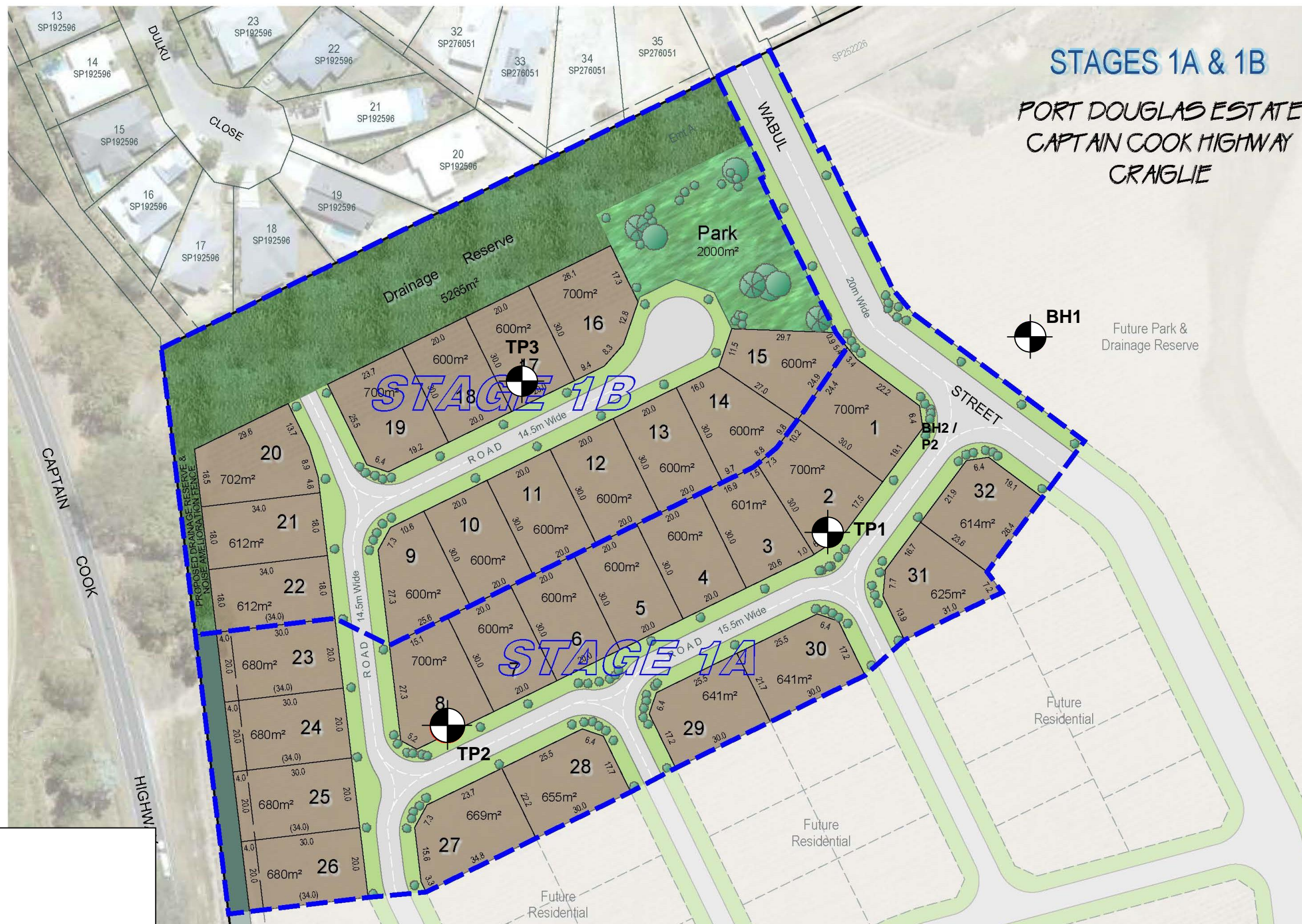
## 10. LIMITATIONS

We have prepared this report for the use of **PORT DOUGLAS LAND DEVELOPMENTS PTY LTD** for design purposes in accordance with generally accepted geotechnical engineering practices.

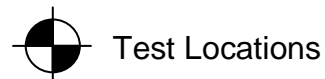
No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **PORT DOUGLAS LAND DEVELOPMENTS PTY LTD** or their design consultants, i.e. Architect & Civil/Structural Engineers. It may not contain sufficient information for purposes of other parties or for other uses. Your attention is drawn to the document - “Understand the Limitations of Your Geotechnical Report”, which is included in Appendix C of this report. This document has been prepared to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimise the risks associated with the ground works for this project. The document is not intended to reduce the level of responsibility accepted by ETS, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

## **APPENDIX A – SITE PLAN**





#### Legend



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**TITLE:**  
**TEST LOCATIONS**  
STAGE 1A & 1B PORT DOUGLAS ESTATE  
CAPTAIN COOK HIGHWAY  
CRAIGLIE QLD

**CLIENT:** PORT DOUGLAS LAND DEVELOPMENTS PTY LTD

**PROJECT NO.:**  
GT19-242

**DATE:**  
19/08/19

**SCALE:**  
NTS

**OFFICE:**  
CNS

**DRAWN BY:**  
CDB

**APPROVED BY:**  
LJ

**DRAWING NO.:** GT19-242-001 DWG



## **APPENDIX B – BOREHOLE LOGS**

<b>BOREHOLE NO.:</b>	BH1	<b>SHEET :</b>	1 OF 2
<b>CUSTOMER:</b>	Port Douglas Land Developments	<b>JOB NO :</b>	GT19-242
<b>PROJECT:</b>	Stage 1A & 1B Port Douglas Estate	<b>DATE:</b>	13/8/19
<b>LOGGED BY:</b>	DK	<b>REVIEWED BY:</b>	CDB
<b>DRILL MODEL:</b>	DB 2000	<b>RL:</b>	-
<b>HOLE DIAMETER:</b>	100 mm	<b>COORDINATES:</b>	E: 337135.000, N: 8170624.000 (55 MGA94)

DEPTH (m)	TECHNIQUE	SUPPORT	WATER	SAMPLE OR FIELD TEST	USCS SYMBOL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PENETRATION		
0											1	2	3
				BS 0.20 - 0.40 m	CL		TOPSOIL: Sandy Silty CLAY: low plasticity, grey-brown.		F				
				SPT 0.60 - 1.05 m 4, 2, 2 N=4	SC		Clayey SAND: fine grained, pale yellow-brown, low plasticity.		L	0.6 - 0.8m Bulk sample			
					SC		Clayey SAND: fine to medium grained, pale grey, low plasticity.						
				D 1.40 - 1.50 m U50 1.50 - 1.95 m	CL		Sandy CLAY: low plasticity, pale grey mottled yellow, fine to medium grained.		M	PP = 350, 420, 400kPa			
					CL		Silty CLAY: low plasticity, pale orange-brown mottled grey, with fine to medium grained sand.						
				D 2.90 - 3.00 m U50 3.00 - 3.45 m	CL					PP = 300, 320, 320kPa			
					CL		Sandy Silty CLAY: low plasticity, pale grey mottled yellow-brown, fine to medium grained.		VSt	PP = 300, 280, 250kPa			
				D 4.40 - 4.50 m U50 4.50 - 4.95 m	CL				M to W				
					CL					PP = 350, 320, 320kPa			
				D 5.90 - 6.00 m U50 6.00 - 6.45 m	CL								
				SPT 7.00 - 7.45 m 9, 15, 19 N=34	CI		Silty CLAY: medium plasticity, pale grey mottled orange-brown, trace of fine to medium grained sand.		M	VSt to H			
					CI								

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#### TECHNIQUE

AS auger screwing  
AD auger drilling  
RR roller/tricone  
CB claw or blade bit

#### SUPPORT

C casing  
W water  
N none

#### SAMPLES AND TESTING

N SPT  
U50 undisturbed tube dia mm  
D disturbed sample  
BS bulk sample  
PP pocket penetrometer (UCS) kPa  
HV hand vane

#### WATER

standing water level  
inflow  
partial loss  
complete loss

#### CONSISTENCY/DENSITY

*Fines*  
VS very soft  
S soft  
F firm  
St stiff  
VSt very stiff  
H hard  
*Coarse*  
VL very loose  
L loose  
MD medium dense  
D dense  
VD very dense

#### MOISTURE CONDITION


D dry  
M moist  
W wet

#### PENETRATION





0 no resistance to  
4 absolute refusal

#### NOTES

<b>BOREHOLE NO.:</b>	BH1	<b>SHEET :</b>	2 OF 2
<b>CUSTOMER:</b>	Port Douglas Land Developments	<b>JOB NO :</b>	GT19-242
<b>PROJECT:</b>	Stage 1A & 1B Port Douglas Estate	<b>DATE:</b>	13/8/19
<b>LOGGED BY:</b>	DK	<b>REVIEWED BY:</b>	CDB
<b>DRILL MODEL:</b>	DB 2000	<b>RL:</b>	-
<b>HOLE DIAMETER:</b>	100 mm	<b>COORDINATES:</b>	E: 337135.000, N: 8170624.000 (55 MGA94)

DEPTH (m)	TECHNIQUE	SUPPORT	WATER	SAMPLE OR FIELD TEST	USCS SYMBOL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	PENETRATION		
8	AD/T	N		SPT 8.00 - 8.45 m 8, 10, 15 N=25	CI		Silty CLAY: medium plasticity, pale grey mottled orange-brown, trace of fine to medium grained sand.	M	VSt to H		1	2	3
9	SPT	N		SPT 9.00 - 9.40 m 8, 16, 25/100mm Refusal N>50									
10							BOREHOLE BH1 TERMINATED AT 9.40 m						
11													
12													
13													
14													
15													
16													

g:\NT 10.0.000 CR TRIAL LIBRARY GLB Log NON-CORED BOREHOLE GT19-242 BOREHOLE LOGS.GPJ <<DrawingFiles>> 27/08/2019 09:25 Developed by Datgel Pty Ltd

<b>TECHNIQUE</b> AS auger screwing AD auger drilling RR roller/tricone CB claw or blade bit	<b>SAMPLES AND TESTING</b> N SPT U50 undisturbed tube dia mm D disturbed sample BS bulk sample PP pocket penetrometer (UCS) kPa HV hand vane	<b>CONSISTENCY/DENSITY</b> <i>Fines</i> VS very soft S soft F firm St stiff VSt very stiff H hard <i>Coarse</i> VL very loose L loose MD medium dense D dense VD very dense	<b>MOISTURE CONDITION</b> D dry M moist W wet	<b>PENETRATION</b> 0 no resistance to 4 absolute refusal
<b>SUPPORT</b> C casing W water N none	<b>WATER</b>  standing water level  inflow  partial loss  complete loss	<b>NOTES</b>		

<b>HOLE NO.:</b>	TP1	<b>SHEET :</b>	1 OF 1
<b>CUSTOMER:</b>	Port Douglas Land Developments	<b>JOB NO :</b>	GT19-242
<b>PROJECT:</b>	Stage 1A & 1B Port Douglas Estate	<b>DATE:</b>	13/8/19
<b>LOGGED BY:</b>	DK	<b>REVIEWED BY:</b>	CDB
<b>MACHINE:</b>	Bobcat	<b>RL:</b>	-
<b>PIT DIMENSIONS:</b>	-	<b>COORDINATES:</b>	E: 337093.000, N: 8170576.000 (55 MGA94)

DEPTH (m)	METHOD	WATER	SAMPLE OR FIELD TEST	USCS SYMBOL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	DCP (blows per 300mm)	STRUCTURE AND ADDITIONAL OBSERVATIONS
0.0	BU	Not Encountered	D 0.10 - 0.30 m	CL		Silty CLAY: low plasticity, pale grey-brown, trace of fine grained sand.	D to M	VSt		
0.5			BS 0.60 - 0.80 m	CL		Silty CLAY: low plasticity, pale yellow mottled orange, trace of fine to medium grained sand.		VSt to H		
1.0										
1.5			BS 1.50 - 1.70 m	CL		Silty CLAY: low plasticity, pale orange mottled yellow, with fine to medium grained sand.	M			
2.0				CL				H		
2.5						TEST TP1 TERMINATED AT 2.50 m				
3.0										
3.5										
4.0										

g:\NT 10.0.000 CR TRIAL LIBRARY.GLB Log TEST PIT GT19-242 BOREHOLE LOGS.GPJ <<DrawingFile>> 27/08/2019 09:25 Developed by Dargel Pty Ltd

#### METHOD

BU bucket  
AU auger

#### SAMPLES AND TESTING

U50 undisturbed tube dia mm  
D disturbed sample  
BS bulk sample  
PP pocket penetrometer (UCS) kPa  
HV hand vane

#### WATER

☒ standing water level  
▶ inflow  
◀ partial loss  
▶ complete loss

#### CONSISTENCY/DENSITY

*Fines*  
VS very soft  
S soft  
F firm  
St stiff  
VSt very stiff  
H hard  
*Coarse*  
VL very loose  
L loose  
MD medium dense  
D dense  
VD very dense

#### MOISTURE CONDITION

D dry  
M moist  
W wet

#### PENETRATION

0 no resistance to  
4 absolute refusal

#### NOTES

<b>HOLE NO.:</b>	TP2	<b>SHEET :</b>	1 OF 1
<b>CUSTOMER:</b>	Port Douglas Land Developments	<b>JOB NO :</b>	GT19-242
<b>PROJECT:</b>	Stage 1A & 1B Port Douglas Estate	<b>DATE:</b>	13/8/19
<b>LOGGED BY:</b>	DK	<b>REVIEWED BY:</b>	CDB
<b>MACHINE:</b>	Bobcat	<b>RL:</b>	-
<b>PIT DIMENSIONS:</b>	-	<b>COORDINATES:</b>	E: 336967.000, N: 8170460.000 (55 MGA94)

DEPTH (m)	METHOD	WATER	SAMPLE OR FIELD TEST	USCS SYMBOL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	DCP (blows per 300mm)	STRUCTURE AND ADDITIONAL OBSERVATIONS
0.0	BU	Not Encountered		CL		Silty CLAY: low plasticity, pale grey.	D to M	VSt		
0.35 - 0.55 m			BS 0.35 - 0.55 m	CL		Silty CLAY: low plasticity, pale yellow mottled pale orange, trace of fine to medium grained sand.		VSt to H		
0.60 - 0.80 m			BS 0.60 - 0.80 m							
1.0						Silty CLAY: low plasticity, pale orange mottled pale yellow, with fine to medium grained sand.				
1.30 - 1.50 m			BS 1.30 - 1.50 m				M			
1.5				CL				H		
2.0										
2.5						TEST TP2 TERMINATED AT 2.50 m				
3.0										
3.5										
4.0										

g:\NT 10.000 CR TRIAL LIBRARY.GLB Log TEST PIT GT19-242 BOREHOLE LOGS.GPJ <<DrawingFile>> 27/08/2019 09:25 Developed by Dargel Pty Ltd

#### METHOD

BU bucket  
AU auger

#### SAMPLES AND TESTING

U50 undisturbed tube dia mm  
D disturbed sample  
BS bulk sample  
PP pocket penetrometer (UCS) kPa  
HV hand vane

#### WATER

☒ standing water level  
▶ inflow  
◀ partial loss  
◀ complete loss

#### CONSISTENCY/DENSITY

*Fines*  
VS very soft  
S soft  
F firm  
St stiff  
VSt very stiff  
H hard  
*Coarse*  
VL very loose  
L loose  
MD medium dense  
D dense  
VD very dense

#### MOISTURE CONDITION

D dry  
M moist  
W wet

#### PENETRATION

0 no resistance to  
4 absolute refusal

#### NOTES



<b>HOLE NO.:</b>	TP3	<b>SHEET :</b>	1 OF 1
<b>CUSTOMER:</b>	Port Douglas Land Developments	<b>JOB NO :</b>	GT19-242
<b>PROJECT:</b>	Stage 1A & 1B Port Douglas Estate	<b>DATE:</b>	13/8/19
<b>LOGGED BY:</b>	DK	<b>REVIEWED BY:</b>	CDB
<b>MACHINE:</b>	Bobcat	<b>RL:</b>	-
<b>PIT DIMENSIONS:</b>	-	<b>COORDINATES:</b>	E: 337005.000, N: 8170565.000 (55 MGA94)

DEPTH (m)	METHOD	WATER	SAMPLE OR FIELD TEST	USCS SYMBOL	GRAPHIC LOG	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	DCP (blows per 300mm)	STRUCTURE AND ADDITIONAL OBSERVATIONS
0.0	BU	Not Encountered	BS 0.10 - 0.30 m	CL		Silty CLAY: low plasticity, pale grey-brown.	D to M	VSt		
0.5			BS 0.60 - 0.80 m	CL		Silty CLAY: low plasticity, pale yellow mottled pale orange, trace of fine to medium grained sand.		VSt to H		
1.0										
1.5			BS 1.50 - 1.70 m	CL		Silty CLAY: low plasticity, pale orange mottled pale yellow, with fine to medium grained sand.	M	H		
2.0										
2.5						TEST TP3 TERMINATED AT 2.50 m				
3.0										
3.5										
4.0										

#### METHOD

BU bucket  
AU auger

#### SAMPLES AND TESTING

U50 undisturbed tube dia mm  
D disturbed sample  
BS bulk sample  
PP pocket penetrometer (UCS) kPa  
HV hand vane

#### WATER

☒ standing water level  
▶ inflow  
◀ partial loss  
◀ complete loss

#### CONSISTENCY/DENSITY

*Fines*  
VS very soft  
S soft  
F firm  
St stiff  
VSt very stiff  
H hard  
*Coarse*  
VL very loose  
L loose  
MD medium dense  
D dense  
VD very dense

#### MOISTURE CONDITION

D dry  
M moist  
W wet

#### PENETRATION

0 no resistance to  
4 absolute refusal

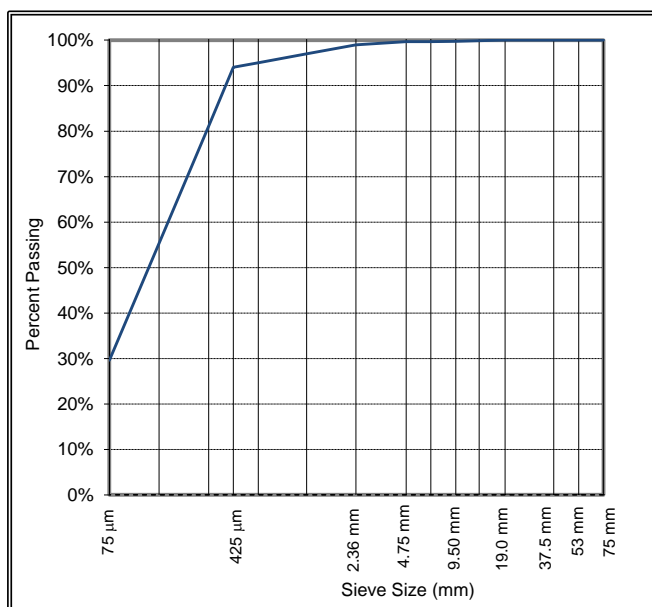
#### NOTES

## **APPENDIX C – LABORATORY TEST RESULTS**

## Quality of Materials Report



Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242- CS31117 Q
Client Address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Test Request No:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craigie		
Lab No:	CS31117	Sample Location:	BH 1
Date Sampled:	13/08/2019		55K 0337135
Date Tested:	16/08/2019		8170624
Sampled By:	DK		0.2 - 0.4m
Sample Method:	AS1289.1.2.1.6.5.3	Spec Description:	-
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Spec Number:	-
Remarks:	-		

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		100	
4.75mm		100	
2.36mm		99	
0.425mm		94	
0.075mm		30	

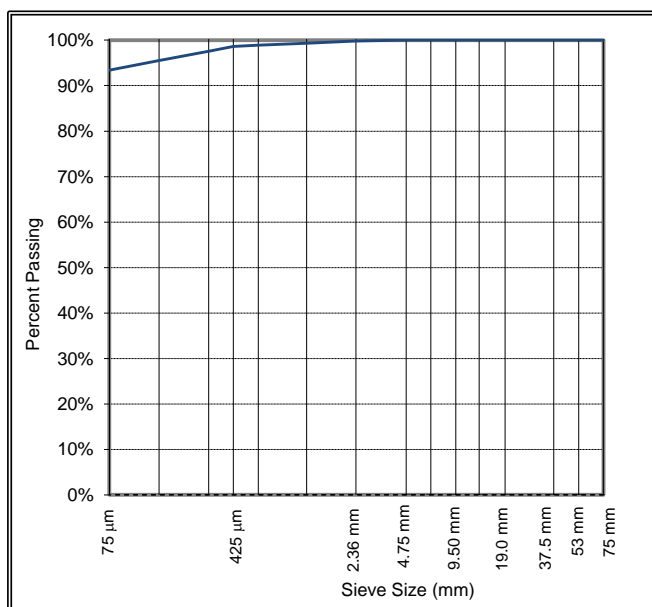
Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Air Dried - Dry Sieved				
Liquid Limit (%)	AS1289.3.1.2	Slippage in Cup, Liquid Limit could not be obtained.		
Plastic Limit (%)	AS1289.3.2.1		*	
Plasticity Index	AS1289.3.3.1		*	
Linear Shrinkage (%)	AS1289.3.4.1		*	
P.I. X % Passing 0.425mm				
L.S. X % Passing 0.425mm				
Ratio of % Passing (0.075 / 0.425)			0.31	

 <p>ACCREDITED FOR TECHNICAL COMPETENCE</p>	<p>Accredited for compliance with ISO/IEC 17025 - Testing</p>	APPROVED SIGNATORY	FORM NUMBER
		 Karl Hodgson - Laboratory Manager NATA Accreditation No. 20026 Cairns Laboratory	FM-RP-120-3

## Quality of Materials Report

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242- CS31123 Q
Client Address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Test Request No:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craigie		
Lab No:	CS31123	Sample Location:	BH 1
Date Sampled:	13/08/2019		55K 0337135
Date Tested:	19/08/2019		8170624
Sampled By:	DK		7.0 - 7.45
Sample Method:	AS1289.1.2.1.6.5.3	Spec Description:	-
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Spec Number:	-
Remarks:	-		



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		100	
4.75mm		100	
2.36mm		100	
0.425mm		99	
0.075mm		93	

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Air Dried - Dry Sieved				
Liquid Limit (%)	AS1289.3.1.2		42	
Plastic Limit (%)	AS1289.3.2.1		16	
Plasticity Index	AS1289.3.3.1		26	
Linear Shrinkage (%)	AS1289.3.4.1 *		13	
P.I. X % Passing 0.425mm			2565	
L.S. X % Passing 0.425mm			1282	
Ratio of % Passing (0.075 / 0.425)			0.95	

\* 254mm linear shrinkage mould used, Shrinkage had cracked & curled.

 <p>ACCREDITED FOR TECHNICAL COMPETENCE</p>	<p>Accredited for compliance with ISO/IEC 17025 - Testing</p>	APPROVED SIGNATORY	FORM NUMBER
		 Karl Hodgson - Laboratory Manager NATA Accreditation No. 20026 Cairns Laboratory	FM-RP-120-3



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 07 4047 8699  
[admin@etsgeo.com.au](mailto:admin@etsgeo.com.au)  
 PO Box 587  
 REDLYNCH QLD 4870  
 1/220 Scott Street  
 Cairns QLD 4870

## Atterberg Limits Report

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242- CS31110 ATT
Client Address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31110	Sample Location:	
Date Sampled:	13/08/2019	Test Pit 1	
Date Tested:	21/08/2019	55K 0337093	
Sampled By:	DK	8170576	
Sample Method:	AS1289.1.2.1.6.5.4	1.5 - 1.7m	
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Sample History:	Air Dried
Remarks:	-	Sample Preparation:	Dry Sieved

Page 1 of 1

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289 3.1.2	-	32	-
Plastic Limit (%)	AS1289 3.2.1	-	19	-
Plasticity Index	AS1289 3.3.1	-	13	-
Linear Shrinkage (%)	AS1289.3.4.1 *	-	8.0	-

\* 250mm linear shrinkage mould used, Shrinkage had cracked.



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 Testing.

APPROVED SIGNATORY

*K. Hodgson*

Karl Hodgson - Laboratory Manager  
 Cairns Laboratory  
 NATA Accreditation No. 20026

FORM NUMBER

FM-RP-125  
 2



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 Cairns QLD 4870

## Atterberg Limits Report

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242- CS31113 ATT
Client Address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31113	Sample Location:	Test Pit 2
Date Sampled:	13/08/2019		55K 0336967
Date Tested:	21/08/2019		8170460
Sampled By:	DK		1.3 - 1.5m
Sample Method:	AS1289.1.2.1.6.5.4	Lot Number:	-
Material Source:	Insitu Material	Sample History:	Air Dried
For Use As:	-	Sample Preparation:	Dry Sieved
Remarks:	-		

Page 1 of 1

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289 3.1.2	-	32	-
Plastic Limit (%)	AS1289 3.2.1	-	17	-
Plasticity Index	AS1289 3.3.1	-	15	-
Linear Shrinkage (%)	AS1289.3.4.1 *	-	7.5	-

\* 250mm linear shrinkage mould used, Shrinkage had cracked.



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 Testing.

APPROVED SIGNATORY

Karl Hodgson - Laboratory Manager  
 Cairns Laboratory  
 NATA Accreditation No. 20026

FORM NUMBER

FM-RP-125  
 2



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 REDLYNCH QLD 4870  
 1/220 Scott Street  
 Cairns QLD 4870

## Atterberg Limits Report

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242- CS31116 ATT
Client Address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31116	Sample Location:	
Date Sampled:	13/08/2019	Test Pit 3	
Date Tested:	21/08/2019	55K 0337135	
Sampled By:	DK	8170624	
Sample Method:	AS1289.1.2.1.6.5.4	1.5 - 1.7m	
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Sample History:	Air Dried
Remarks:	-	Sample Preparation:	Dry Sieved

Page 1 of 1

Plasticity Tests	Test Method	Specification Minimum	Result	Specification Maximum
Liquid Limit (%)	AS1289 3.1.2	-	26	-
Plastic Limit (%)	AS1289 3.2.1	-	18	-
Plasticity Index	AS1289 3.3.1	-	8	-
Linear Shrinkage (%)	AS1289.3.4.1 *	-	5.5	-

\* 250mm linear shrinkage mould used, Shrinkage had not cracked, crumbled or curled.



Accredited for compliance with ISO/IEC 17025 -  
 Testing.

APPROVED SIGNATORY

Karl Hodgson - Laboratory Manager  
 Cairns Laboratory  
 NATA Accreditation No. 20026

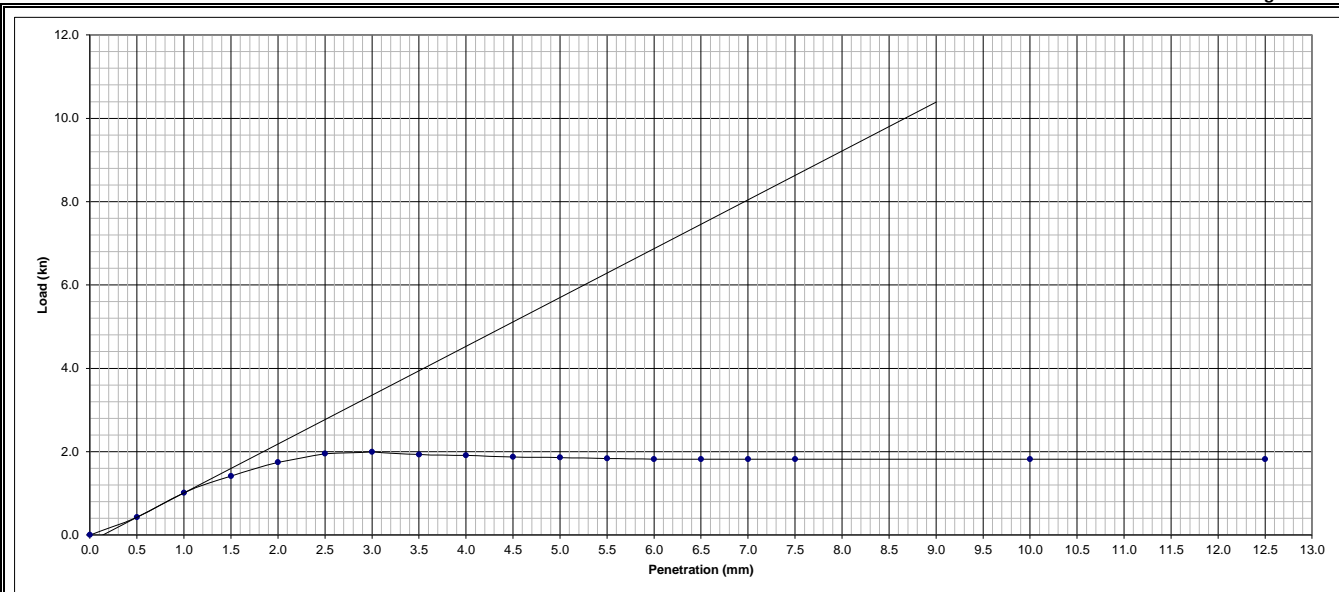
FORM NUMBER

FM-RP-125  
 2

## California Bearing Ratio Report (1 Point)

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242 -CS31117 CBR
Client address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31117	Sample Location:	BH 1
Date Sampled:	13/08/2019		55K 0337135
Date Tested:	21/08/2019		8170624
Sampled By:	DK		0.2 - 0.4m
Sample Method:	AS1289.1.2.1.6.5.3	Test Method :	AS 1289.6.1.1
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Item Number :	-
Remarks:	-		

Page 1 of 1



Maximum Dry Density - MDD (t/m³) :	1.818	Dry Density after Soak (t/m³) :	1.783
Optimum Moisture Content - OMC (%) :	13.5	Moisture Content after Soak (%) :	15.9
Compactive Effort :	Standard	Density Ratio after Soak (%) :	98
Nominated % Maximum Dry Density Compaction :	98	Hygroscopic Moisture Content (%) :	10.4
Nominated % Optimum Moisture Content Compaction :	100.0	Moisture Content (Top) after Penetration (%) :	16.8
Achieved Dry Density before Soak (t/m³) :	1.782	Optional Moisture Content (Remainder) after Penetration (%) :	16.2
Achieved Percentage of Maximum Dry Density (%) :	98	CBR 2.5mm (%) :	15
Achieved Moisture Content (%) :	13.5	CBR 5.0mm (%) :	9
Achieved Percentage of Optimum Moisture Content (%) :	100	CBR Value (%) :	15
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	Soaked / 4	Minimum Specified CBR Value (%) :	-
Swell (%) / Surcharge (kg):	0.0 / 4.5	Oversize Material (%)	

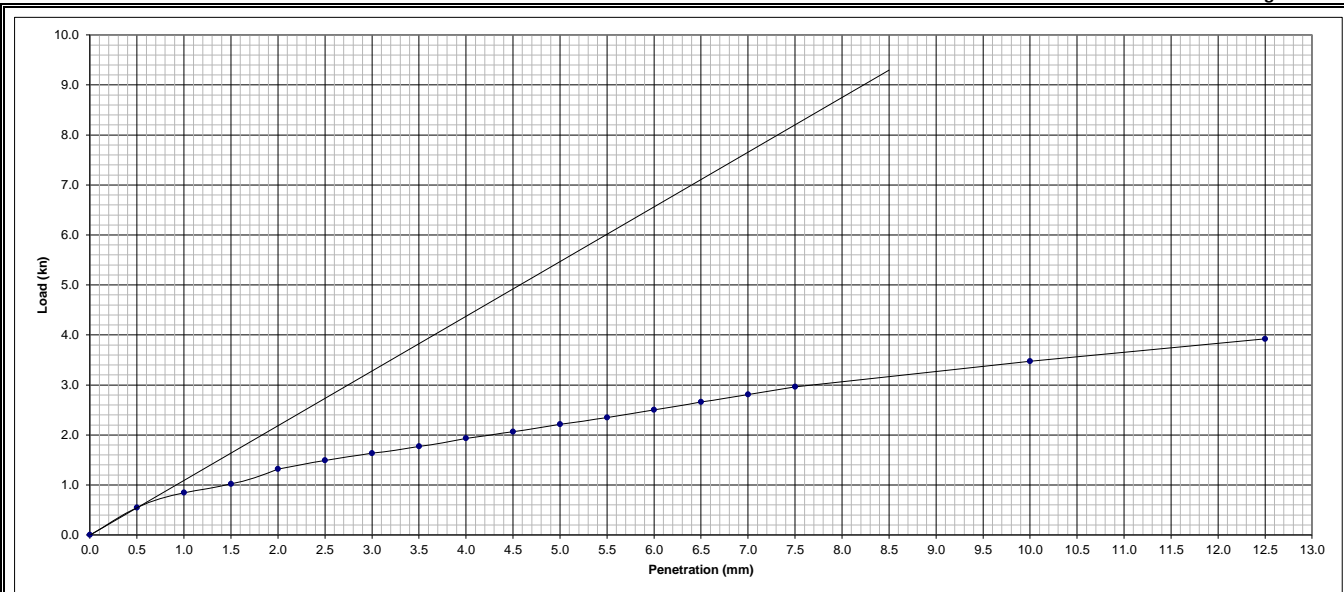
Soil Description : Refer Borehole Log.



## California Bearing Ratio Report (1 Point)



Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242 -CS31110 CBR
Client address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31110	Sample Location:	Test Pit 1
Date Sampled:	13/08/2019		55K 0337093
Date Tested:	21/08/2019		8170576
Sampled By:	DK		1.5 - 1.7m
Sample Method:	AS1289.1.2.1.6.5.4	Test Method :	AS 1289.6.1.1
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Item Number :	-
Remarks:	-		

Page 1 of 1



Maximum Dry Density - MDD (t/m³) :	1.796	Dry Density after Soak (t/m³) :	1.756
Optimum Moisture Content - OMC (%) :	15.3	Moisture Content after Soak (%) :	17.6
Compactive Effort :	Standard	Density Ratio after Soak (%) :	98
Nominated % Maximum Dry Density Compaction :	98	Hygroscopic Moisture Content (%) :	14.6
Nominated % Optimum Moisture Content Compaction :	100.0	Moisture Content (Top) after Penetration (%) :	17.7
Achieved Dry Density before Soak (t/m³) :	1.758	Optional Moisture Content (Remainder) after Penetration (%) :	17.0
Achieved Percentage of Maximum Dry Density (%) :	98	CBR 2.5mm (%) :	11
Achieved Moisture Content (%) :	15.4	CBR 5.0mm (%) :	11
Achieved Percentage of Optimum Moisture Content (%) :	101	CBR Value (%) :	11
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	Soaked / 4	Minimum Specified CBR Value (%) :	-
Swell (%) / Surcharge (kg):	0.0 / 4.5	Oversize Material (%) :	

Soil Description : Refer Test Pit Log.

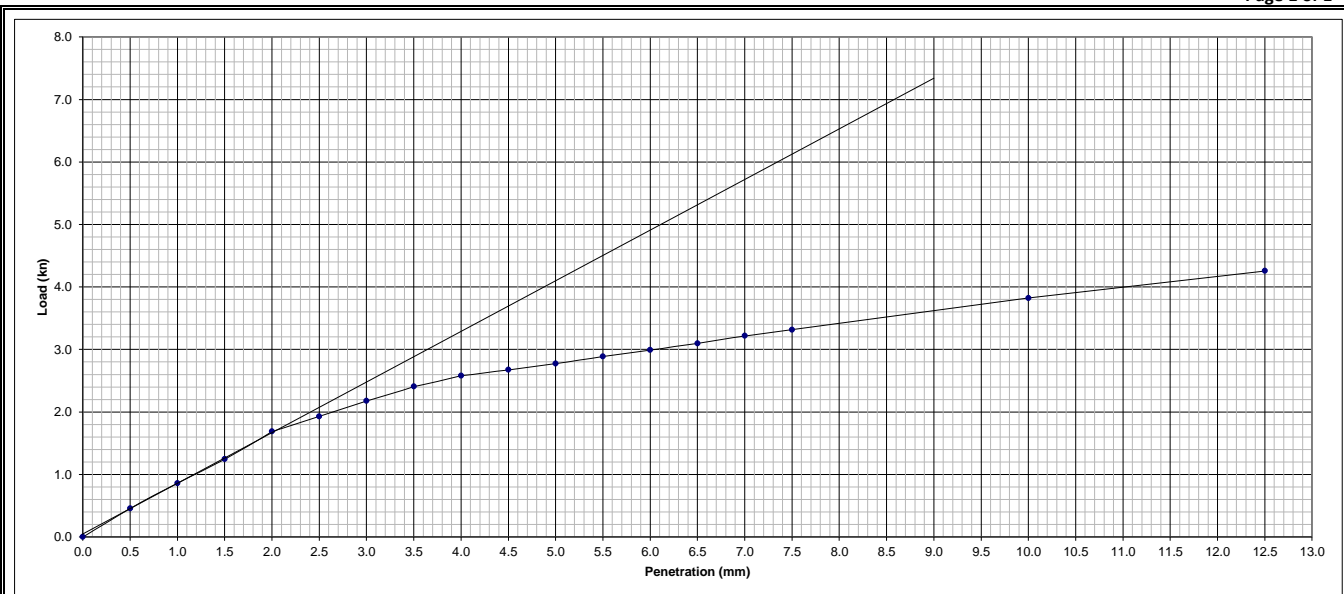
 ACCREDITED FOR <b>TECHNICAL          COMPETENCE</b>	Approved Signatory	Form Number
	 Karl Hodgson - Lab Manager Cairns Laboratory NATA Accred. No. 20026	FM-RP-121-5

Accredited for compliance with ISO/IEC 17025 - Testing.



## California Bearing Ratio Report (1 Point)

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242 -CS31113 CBR
Client address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31113	Sample Location:	Test Pit 2
Date Sampled:	13/08/2019		55K 0336967
Date Tested:	21/08/2019		8170460
Sampled By:	DK		1.3 - 1.5m
Sample Method:	AS1289.1.2.1.6.5.4	Test Method :	AS 1289.6.1.1
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Item Number :	-
Remarks:	-		

Page 1 of 1



Maximum Dry Density - MDD (t/m³) :	1.867	Dry Density after Soak (t/m³) :	1.831
Optimum Moisture Content - OMC (%) :	14.2	Moisture Content after Soak (%) :	17.9
Compactive Effort :	Standard	Density Ratio after Soak (%) :	98
Nominated % Maximum Dry Density Compaction :	98	Hygroscopic Moisture Content (%) :	13.2
Nominated % Optimum Moisture Content Compaction :	100.0	Moisture Content (Top) after Penetration (%) :	18.3
Achieved Dry Density before Soak (t/m³) :	1.835	Optional Moisture Content (Remainder) after Penetration (%) :	16.4
Achieved Percentage of Maximum Dry Density (%) :	98	CBR 2.5mm (%) :	15
Achieved Moisture Content (%) :	13.9	CBR 5.0mm (%) :	14
Achieved Percentage of Optimum Moisture Content (%) :	98	CBR Value (%) :	15
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	Soaked / 4	Minimum Specified CBR Value (%) :	-
Swell (%) / Surcharge (kg):	0.0 / 4.5	Oversize Material (%)	
Soil Description :	Refer Test Pit Log.		

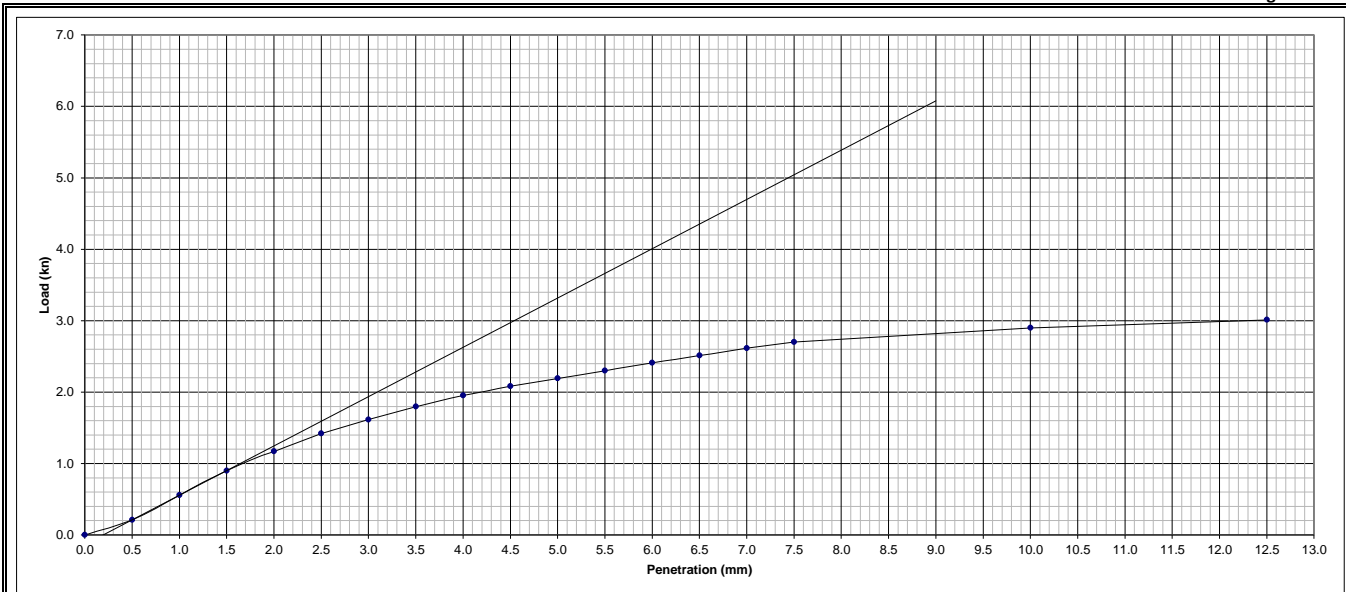
 ACCREDITED FOR <b>TECHNICAL          COMPETENCE</b>	Approved Signatory	Form Number
	 Karl Hodgson - Lab Manager Cairns Laboratory NATA Accred. No. 20026	FM-RP-121-5

Accredited for compliance with ISO/IEC 17025 - Testing.



## California Bearing Ratio Report (1 Point)

Client:	Port Douglas Land Developments Pty Ltd	Report Number:	GT19-242 -CS31116 CBR
Client address:	PO Box 13-413 Christchurch 8141 NZ.	Report Date:	26/08/2019
Job Number:	GT19-242	Order Number:	-
Project:	Proposed Sump Station, Wabul Street		
Location:	Craiglie		
Lab No:	CS31116	Sample Location	Test Pit 3
Date Sampled:	13/08/2019		55K 0337135
Date Tested:	23/08/2019		8170624
Sampled By:	DK		1.5 - 1.7m
Sample Method:	AS1289.1.2.1.6.5.4	Test Method :	AS 1289.6.1.1
Material Source:	Insitu Material	Lot Number:	-
For Use As:	-	Item Number :	-
Remarks:	-		

Page 1 of 1



Maximum Dry Density - MDD (t/m³) :	1.831	Dry Density after Soak (t/m³) :	1.783
Optimum Moisture Content - OMC (%) :	11.7	Moisture Content after Soak (%) :	18.4
Compactive Effort :	Standard	Density Ratio after Soak (%) :	97
Nominated % Maximum Dry Density Compaction :	98	Hygroscopic Moisture Content (%) :	12.1
Nominated % Optimum Moisture Content Compaction :	100.0	Moisture Content (Top) after Penetration (%) :	15.7
Achieved Dry Density before Soak (t/m³) :	1.792	Optional Moisture Content (Remainder) after Penetration (%) :	16.5
Achieved Percentage of Maximum Dry Density (%) :	98	CBR 2.5mm (%) :	11
Achieved Moisture Content (%) :	12.2	CBR 5.0mm (%) :	11
Achieved Percentage of Optimum Moisture Content (%) :	104	CBR Value (%) :	11
Test Condition (Soaked/Unsoaked) / Soaking Period (Days) :	Soaked / 4	Minimum Specified CBR Value (%) :	-
Swell (%) / Surcharge (kg):	0.0 / 4.5	Over-size Material (%)	% Excluded
Soil Description :	Refer Test Pit Log.		

 <p>Accredited for compliance with ISO/IEC 17025 - Testing.</p>	Approved Signatory	Form Number
	 Karl Hodgson - Lab Manager Cairns Laboratory NATA Accred. No. 20026	FM-RP-121-5



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## ACID SULFATE SOILS FIELD TESTING REPORT

### pH<sub>F</sub> and pH<sub>FOX</sub> Results

<b>Client:</b> Port Douglas Land Developments Pty Ltd	<b>Report No:</b> GT19-242-001 ASS
<b>Project:</b> Stages 1A & 1B Port Douglas Estate <b>Captain Cook Highway</b> <b>Craigie QLD 4877</b>	<b>Order No:</b>
<b>Sampled By:</b> Darren Koch <b>Sampled Date:</b> 13 <sup>th</sup> August 2019	<b>Tested By:</b> Darren Koch <b>Site or Lab:</b> Cairns <b>Tested Date:</b> 15 <sup>th</sup> August 2019

### BOREHOLE NO: 1

Field Test No.	Description	Depth	pH F	pH FOX	Reaction*
1	Clayey SAND	0.2 - 0.4	6.64	6.01	XX
2	Clayey SAND	0.6 – 0.8	6.35	5.81	XX
3	Sandy CLAY	1.4 – 1.5	6.86	5.91	XX
4	Silty CLAY	2.9 – 3.0	6.78	5.35	XX
5	Sandy Silty CLAY	4.4 – 4.5	6.43	5.22	XX
6	Sandy Silty CLAY	5.9 – 6.0	6.68	6.01	XX
7	Silty CLAY	7.0 – 7.45	6.51	5.83	X
8	Silty CLAY	8.0 – 8.45	6.71	5.99	X
9	Silty CLAY	9.0 – 9.45	6.32	5.30	X
10					

- Rate reaction with peroxide: X = low, XX = medium, XXX = high, XXXX = extreme

SIGNATURE:

SIGNED BY: Cynthia de Bok  
 POSITION: Geotechnical Engineer  
 DATED: 19<sup>th</sup> August 2019  
 ETS Laboratory: Cairns



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## ACID SULFATE SOILS FIELD TESTING REPORT

### pH<sub>F</sub> and pH<sub>FOX</sub> Results

<b>Client:</b> Port Douglas Land Developments Pty Ltd	<b>Report No:</b> GT19-242-002 ASS
<b>Project:</b> Stages 1A & 1B Port Douglas Estate Captain Cook Highway Craigie QLD 4877	<b>Order No:</b>
<b>Sampled By:</b> Darren Koch <b>Sampled Date:</b> 13 <sup>th</sup> August 2019	<b>Tested By:</b> Darren Koch <b>Site or Lab:</b> Cairns <b>Tested Date:</b> 15 <sup>th</sup> August 2019

### TEST PIT NO: 1

Field Test No.	Description	Depth	pH F	pH FOX	Reaction*
1	Silty CLAY	0.1 - 0.3	6.25	5.68	XXX
2	Silty CLAY	0.6 – 0.8	5.94	5.34	XX
3	Silty CLAY	1.5 – 1.7	5.92	5.61	XX
4					
5					
6					
7					
8					
9					
10					

- Rate reaction with peroxide: X = low, XX = medium, XXX = high, XXXX = extreme

SIGNATURE:

SIGNED BY: Cynthia de Bok  
 POSITION: Geotechnical Engineer  
 DATED: 19<sup>th</sup> August 2019  
 ETS Laboratory: Cairns



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## ACID SULFATE SOILS FIELD TESTING REPORT

### pH<sub>F</sub> and pH<sub>FOX</sub> Results

<b>Client:</b> Port Douglas Land Developments Pty Ltd	<b>Report No:</b> GT19-242-002 ASS
<b>Project:</b> Stages 1A & 1B Port Douglas Estate Captain Cook Highway Craigie QLD 4877	<b>Order No:</b>
<b>Sampled By:</b> Darren Koch <b>Sampled Date:</b> 13 <sup>th</sup> August 2019	<b>Tested By:</b> Darren Koch <b>Site or Lab:</b> Cairns <b>Tested Date:</b> 15 <sup>th</sup> August 2019

### TEST PIT NO: 2

Field Test No.	Description	Depth	pH F	pH FOX	Reaction*
1	Silty CLAY	0.35 - 0.55	5.50	5.32	XX
2	Silty CLAY	0.6 – 0.8	6.11	5.83	XX
3	Silty CLAY	1.3 – 1.5	6.29	5.83	XX
4					
5					
6					
7					
8					
9					
10					

- Rate reaction with peroxide: X = low, XX = medium, XXX = high, XXXX = extreme

*Cynthia de Bok*

SIGNATURE:

SIGNED BY: Cynthia de Bok  
 POSITION: Geotechnical Engineer  
 DATED: 19<sup>th</sup> August 2019  
 ETS Laboratory: Cairns



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## ACID SULFATE SOILS FIELD TESTING REPORT

### pH<sub>F</sub> and pH<sub>FOX</sub> Results

<b>Client:</b> Port Douglas Land Developments Pty Ltd	<b>Report No:</b> GT19-242-002 ASS
<b>Project:</b> Stages 1A & 1B Port Douglas Estate Captain Cook Highway Craigie QLD 4877	<b>Order No:</b>
<b>Sampled By:</b> Darren Koch <b>Sampled Date:</b> 13 <sup>th</sup> August 2019	<b>Tested By:</b> Darren Koch <b>Site or Lab:</b> Cairns <b>Tested Date:</b> 15 <sup>th</sup> August 2019

### TEST PIT NO: 3

Field Test No.	Description	Depth	pH F	pH FOX	Reaction*
1	Silty CLAY	0.1 - 0.3	5.81	5.31	XX
2	Silty CLAY	0.6 – 0.8	6.08	5.75	XX
3	Silty CLAY	1.5 – 1.7	5.81	5.21	XX
4					
5					
6					
7					
8					
9					
10					

- Rate reaction with peroxide: X = low, XX = medium, XXX = high, XXXX = extreme

*Cynthia de Bok*

SIGNATURE:

SIGNED BY: Cynthia de Bok  
 POSITION: Geotechnical Engineer  
 DATED: 19<sup>th</sup> August 2019  
 ETS Laboratory: Cairns

## CLIENT DETAILS

Contact Darren Koch  
Client ETS GEO PTY LTD  
Address PO BOX 587  
REDLYNCH QLD 4870

Telephone 61 7 4047 8600  
Facsimile (Not specified)  
Email darrenk@etsgeo.com.au

Project **GT19-242 Proposed Pump Stn Craiglie**  
Order Number **GEO-291**  
Samples 5

## LABORATORY DETAILS

Manager Anthony Nilsson  
Laboratory SGS Cairns Environmental  
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Portsmith QLD 4870

Telephone +61 07 4035 5111  
Facsimile +61 07 4035 5122  
Email AU.Environmental.Cairns@sgs.com

SGS Reference **CE141386 R1**  
Date Received 16 Aug 2019  
Date Reported 27 Aug 2019

## COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146).

This report cancels and supersedes the report No.CE141386-R0. dated 23/08/19 issued by SGS Environment, Health and Safety due to amended sample ids.

## SIGNATORIES



Anthony Nilsson  
Operations Manager



Jon Dicker  
Manager Northern QLD



Parameter	Units	LOR	CE141386.001	CE141386.002	CE141386.003	CE141386.004
Sample Number			CE141386.001	CE141386.002	CE141386.003	CE141386.004
Sample Matrix			Soil	Soil	Soil	Soil
Sample Date			13 Aug 2019	13 Aug 2019	13 Aug 2019	13 Aug 2019
Sample Name			BH1 4.4-4.5m	BH1 9.0-9.45m	TP1 0.6-0.8m	TP2 0.35-0.55m

#### Moisture Content Method: AN002 Tested: 16/8/2019

% Moisture	%w/w	0.5	16	15	13	12
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#### TAA (Titratable Actual Acidity) Method: AN219 Tested: 23/8/2019

pH KCl	pH Units	-	5.6	5.5	5.1	4.8
Titratable Actual Acidity	kg H <sub>2</sub> SO <sub>4</sub> /T	0.25	<0.25	<0.25	0.74	0.86
Titratable Actual Acidity (TAA) moles H <sup>+</sup> /tonne	moles H <sup>+</sup> /T	5	<5	<5	15	17
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01	0.02	0.03
Sulphur (SKCl)	%w/w	0.005	<0.005	<0.005	0.006	<0.005

#### Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 23/8/2019

Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H <sup>+</sup> /T	5	<5	<5	<5	<5

#### Chromium Suite Net Acidity Calculations Method: AN220 Tested: 23/8/2019

s-Net Acidity	%w/w S	0.005	0.010	0.010	0.028	0.030
a-Net Acidity	moles H <sup>+</sup> /T	5	6	6	17	19
Liming Rate	kg CaCO <sub>3</sub> /T	0.1	NA	NA	NA	1.4
Verification s-Net Acidity	%w/w S	-20	0.00	0.00	0.00	0.00
a-Net Acidity without ANCBT	moles H <sup>+</sup> /T	5	6	6	17	19
Liming Rate without ANCBT	kg CaCO <sub>3</sub> /T	0.1	NA	NA	NA	1.4

#### HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014 Tested: 23/8/2019

Acid Soluble Sulfur (SHCl)	%w/w	0.005	<0.005	<0.005	0.011	0.010
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Sample Number CE141386.005  
Sample Matrix Soil  
Sample Date 13 Aug 2019  
Sample Name TP3 1.5-1.7m

Parameter	Units	LOR
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### Moisture Content Method: AN002 Tested: 16/8/2019

% Moisture	%w/w	0.5	<b>14</b>
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### TAA (Titratable Actual Acidity) Method: AN219 Tested: 23/8/2019

pH KCl	pH Units	-	<b>5.5</b>
Titratable Actual Acidity	kg H <sub>2</sub> SO <sub>4</sub> /T	0.25	<b>0.37</b>
Titratable Actual Acidity (TAA) moles H <sup>+</sup> /tonne	moles H <sup>+</sup> /T	5	<b>7</b>
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<b>0.01</b>
Sulphur (SKCl)	%w/w	0.005	<0.005

### Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 23/8/2019

Chromium Reducible Sulphur (Scr)	%	0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H <sup>+</sup> /T	5	<5

### Chromium Suite Net Acidity Calculations Method: AN220 Tested: 23/8/2019

s-Net Acidity	%w/w S	0.005	<b>0.014</b>
a-Net Acidity	moles H <sup>+</sup> /T	5	<b>9</b>
Liming Rate	kg CaCO <sub>3</sub> /T	0.1	NA
Verification s-Net Acidity	%w/w S	-20	<b>0.00</b>
a-Net Acidity without ANCBT	moles H <sup>+</sup> /T	5	<b>9</b>
Liming Rate without ANCBT	kg CaCO <sub>3</sub> /T	0.1	NA

### HCl Extractable S, Ca and Mg in Soil ICP OES Method: AN014 Tested: 23/8/2019

Acid Soluble Sulfur (SHCl)	%w/w	0.005	<0.005
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MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

### Chromium Reducible Sulphur (CRS) Method: ME-(AU)-[ENV]AN217

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chromium Reducible Sulphur (Scr)	LB070769	%	0.005	<0.005	0%	97%
Chromium Reducible Sulphur (Scr)	LB070769	moles H+/T	5	<5		

### TAA (Titratable Actual Acidity) Method: ME-(AU)-[ENV]AN219

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH KCl	LB070766	pH Units	-	6.0	0%	101%
Titratable Actual Acidity	LB070766	kg H2SO4/T	0.25	<0.25	0%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB070766	moles H+/T	5	<5	0%	92%
Titratable Actual Acidity (TAA) S%/w	LB070766	%w/w S	0.01	<0.01	0%	92%

### METHOD

### METHODOLOGY SUMMARY

AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN014	This method is for the determination of soluble sulfate (SO <sub>4</sub> -S) by extraction with hydrochloric acid. Sulphides should not react and would normally be expelled. Sulfur is determined by ICP.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulfide (H <sub>2</sub> S) which is collected and titrated with iodine (I <sub>2</sub> (aq)) to measure SCR.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulfur are determined by ICP-AES.
AN220	Chromium Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.

## FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.  
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- 1 Bq is equivalent to 27 pCi
- 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: [www.sgs.com.au/pv.sgsvr/en-gb/environment](http://www.sgs.com.au/pv.sgsvr/en-gb/environment).

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## **APPENDIX D – PHOTOS**



**PHOTO 1: Overview of Site in North-eastern Direction**



**PHOTO 2: Overview of Site in in South-western Direction**



**PHOTO 3: Open Drain Along Northern Boundary**



## **APPENDIX E - UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT**



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## UNDERSTAND THE LIMITATIONS OF YOUR GEOTECHNICAL REPORT

This report has been based on project details as provided to us at the time of the commission. It therefore applies only to the site investigated and to a specific set of project requirements as understood by ETS Geo Pty Ltd.

If there are changes to the project, you need to advise us in order that the effect of the changes on the report recommendations can be adequately assessed. ETS Geo Pty Ltd cannot take responsibility for problems that may occur due to project changes if they are not consulted.

It is important to remember that the subsurface conditions described in the report represent the state of the site at the time of investigation. Natural processes and the activities of man can result in changes to site conditions. For example, ground water levels can change or fill can be placed on a site after the investigation is completed. If there is a possibility that conditions may have changed with time, ETS Geo Pty Ltd should be consulted to assess the impact on the recommendations of the report.

The site investigation only identifies the actual subsurface conditions at the location and time when the samples were taken. Geologists and engineers then extrapolate between the investigation points to provide an assumed three-dimensional picture of the site conditions. The report is based on the assumption that the site conditions as identified at the investigation locations are representative of the actual conditions throughout an area. This may not be the case and actual conditions may differ from those inferred to exist. This will not be known until

construction has commenced. Your geotechnical report and the recommendations contained within it can therefore only be regarded as preliminary.

In the event that conditions encountered during construction are different to those described in the report, ETS Geo Pty Ltd should be consulted immediately. Nothing can be done to change the actual site conditions which exist but steps can be taken to reduce the impact of unexpected conditions. For this reason, the services of ETS Geo Pty Ltd should be retained through the development stage of a project.

Problems can occur when other design professionals misinterpret a report. To help avoid this, ETS Geo Pty Ltd should be retained for work with other design professionals to explain the implications of the report.

This report should be retained as a complete document and should not be copied in part, divided or altered in any way.

It is recommended that ETS Geo Pty Ltd is retained during the construction phase to confirm that conditions encountered are consistent with design assumptions. For example, this may involve assessment of bearing capacity for footings, stability of natural slopes or excavations or advice on temporary construction conditions.

This document has been produced to help all parties involve recognise their individual responsibilities.