

# REPORT Geotechnical Studies Port Douglas Wave Park

Submitted to:

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# **Table of Contents**

1.0	INTRO	ODUCTION1
2.0	SITE	INVESTIGATIONS
3.0	LABC	DRATORY TESTING1
4.0	RESU	ILTS OF INVESTIGATION2
	4.1	Review of existing information2
	4.1.1	Geology2
	4.1.2	Soils2
	4.1.3	Acid sulfate soils
	4.2	Surface conditions4
	4.3	Subsurface conditions
	4.4	Groundwater
	4.5	Laboratory Testing - Geotechnical
	4.6	Acid Sulfate Soils
	4.6.1	ASS Action Criteria8
	4.6.2	ASS Screening Tests
	4.6.3	Chromium Suite Analysis9
	4.6.4	Groundwater Quality
5.0	ENGI	NEERING COMMENTS10
	5.1	Ground conditions
	5.2	Proposed development
	5.3	Bulk earthworks12
	5.3.1	Cut and fill areas12
	5.3.2	Fill materials13
	5.3.3	Excavation conditions13
	5.3.4	Unsuitable materials13
	5.3.5	Acid sulfate soils13
	5.3.6	Groundwater13
	5.4	Proposed water features
	5.5	Proposed buildings14

	5.5.1	Proposed hotel	.14
	5.5.2	Proposed residential buildings	.14
6.0	FURTH	ER GEOTECHNICAL INPUT	.14
7.0	IMPORT	ANT INFORMATION	.15

### TABLES

Table 1: Summary groundwater levels within monitoring wells	6
Table 2: Results of classification testing	7
Table 3: Results of Emerson Class testing	7
Table 4: ASS Action Criteria (National Acid Sulfate Soils Guidance, 2018)	8
Table 5: Groundwater Quality Test Results	10

### PLATES

Plate 1 Regional geology (DNRM)	2
Plate 2 Soils Map	3
Plate 3 ASS Risk Map	3
Plate 4: Site areas	4
Plate 5: Selected photographs at time of investigation	5
Plate 6: Schematic layout of proposed development	11
Plate 7: Schematic layout of proposed cut and fill earthworks	12

### FIGURES

Figure 001 – Site Investigation Plan

Figure 002 – Inferred Subsurface Section

### APPENDICES

**APPENDIX A** Geotechnical Borehole Reports and Explanatory Notes

APPENDIX B Geotechnical Laboratory Testing Certificates

APPENDIX C Acid Sulfate Soil Testing Summary Results and Laboratory Certificates, Groundwater Laboratory Test Certificates

**APPENDIX D** Important Information Relating to this Report



## **1.0 INTRODUCTION**

Graben Pty Ltd (Graben) engaged Golder Associates Pty Ltd (Golder) to carry out geotechnical studies related to a proposed wave park development located at Mowbray near Port Douglas. Preliminary information provided by Hunt Design indicates that the development is proposed to extend across predominantly low lying sugar cane fields between the Captain Cook Highway and the Mowbray River. In general terms development of the park would require bulk earthworks to raise the level of the site where required, plus construction of ponds and associated infrastructure and buildings.

The aims of the studies were to provide a broadscale assessment of near-surface ground and groundwater conditions across the site and to provide an initial assessment of potential geotechnical constraints and opportunities associated with the project (e.g. potential presence of soft compressible soils or Acid Sulfate Soils).

The studies were carried out in accordance with our proposal CX20446551-001-L-Rev0, dated 3 December 2020. This report presents the initial results of the studies.

## 2.0 SITE INVESTIGATIONS

A desktop review of published geological, soils and acid sulfate risk maps was initially conducted to assess potential variations in ground conditions across the site. A site walkover was conducted by Golder on 18 December 2020 to assess general site conditions and to set-out proposed investigation locations.

The field investigation was carried out on 21 and 22 December 2020 and involved:

- Excavation and sampling of eight test pits (designated TP1 to TP8) to depths ranging from about 2.5 m to 3.2 m;
- Drilling of four boreholes (designated BH1 to BH4) to depths ranging from about 5.2 m to 6.1 m. The boreholes were drilled using a trailer mounted drill rig using a combination of auguring and wash boring drilling techniques;
- Performance of a Dynamic Cone Penetrometer (DCP) test adjacent to each test pit and borehole location; and
- Installation and development of groundwater monitoring wells at each borehole location. Field measurements of groundwater depth, pH and EC. Collection of groundwater samples for assessment of ASS indicators. Installation of data loggers in each well.

Geotechnical staff from Golder recorded the subsurface conditions encountered in the test pits and boreholes, plus recovered soil and groundwater samples for laboratory testing.

Test locations are shown in Figure 001. Test pit, borehole and DCP reports are presented in Appendix A. Ground surface elevations at each investigation location were interpolated from contours from drawing No. PR148361-1 A, dated 17 November 2020 (Site Plan – Port Douglas Wave Park, Lot 123 SR687, prepared by RPS Australia East Pty Ltd).

## 3.0 LABORATORY TESTING

ASS screening tests were conducted by Golder on 29 selected soil samples recovered during the site investigation.

Selected soil samples recovered from the test pits were submitted to NATA accredited laboratories for the assessment of the following:

6 no. moisture content;



- 6 no. particle size distribution (grading);
- 6 no. Atterberg limits and linear shrinkage (plasticity);
- 6 no. Emerson Class number; and
- 8 no. Chromium suite analysis.

Groundwater samples from the four wells were submitted to a NATA accredited laboratory for analysis of:

- Metals including iron and aluminium; and
- Major cations and anions including chloride and sulfate.

Laboratory test certificates are presented in Appendix B and C.

## 4.0 RESULTS OF INVESTIGATION

## 4.1 Review of existing information

### 4.1.1 Geology

An excerpt of the regional geology map published electronically by the Queensland Department of Natural Resources and Mines (DNRM) is presented in Plate 1. The map indicates that the site is underlain by the following geological units:

- Qhcb Quaternary (Holocene) age deposits comprising sand ridges in the lower lying areas of the site;
- TQa Quaternary/Tertiary age high-level alluvial deposits comprising sand, silt, clay and minor gravel in the area along the Captain Cook Highway nearer the Mowbray River; and
- TQr Quaternary/Tertiary age colluvial and residual soil deposits (generally on older land surfaces) comprising clay, silt, sand, and gravel in the area along the Captain Cook Highway further away from the Mowbray River.





### 4.1.2 Soils

An excerpt from the soils map (1:50,000 scale on Queensland Globe) is shown on Plate 2. The map indicates the presence of Hull series soils over most of the site. Clifton series soils are present in the area along the Captain Cook Highway and Mangroves series soils are present in parts of the site near the north western and north eastern site boundaries.

Hull series soils are formed on sand ridges and are generally associated with acid sulfate soils below the water table. Mangrove soils are undifferentiated soils subject to tidal inundation and may be associated with acid sulfate soils. Clifton series soils are not typically associated with acid sulfate soils.



Plate 2 Soils Map

## 4.1.3 Acid sulfate soils

An excerpt from the ASRIS ASS risk map is shown on Plate 3. The map indicates a low probability of occurrence across most of the site. The map also indicates a high probability of ASS occurrence near parts of the north western and north eastern site boundaries.



### Plate 3 ASS Risk Map



## 4.2 Surface conditions

At the time of the site investigation, most of the site was covered with sugar cane. The site gently grades north east towards the Mowbray River and the coast with surface elevations ranging from about RL ~6 m AHD (where the site adjoins the Captain Cook Highway) to RL ~1 m AHD (within creeks/ drains that cross the site typically in a north-west direction towards the Mowbray River). The site is bounded by vegetated land and the Mowbray River to the north east and north west; adjacent cane farms to the south east; and the Captain Cook Highway and cane farms to the south west.

For discussion purposes the site has been divided into three main areas (northern, central, southern) based on subsurface conditions encountered during the investigation. These areas are shown in Plate 4.



Plate 4: Site areas

Selected site photographs at the time of the site investigation are presented in Plate 5.











Plate 5: Selected photographs at time of investigation





## 4.3 Subsurface conditions

Subsurface conditions encountered within the test pits and boreholes can generally be summarised as follows:

### Southern area (TP1, TP3 and BH1, BH2)

- Firm to stiff sandy clay (inferred disturbed/ reworked ground) to depths ranging from about 0.2 m to 0.5 m underlain by;
- Stiff to hard sandy clay/ clay to depths ranging from about 3.2 m to 6.1 m depth (i.e. depth of investigation in test pits and boreholes). A layer of firm sandy clay (i.e. lower strength clay) was observed at depths ranging from about 0.6 m to 1.6 m in TP3 located near a creek inlet.

### Central area (TP2, TP4, TP5)

- Medium dense to very dense clayey sand/ sand (inferred disturbed/ reworked ground) to depths ranging from about 0.2 m to 0.5 m underlain by;
- Medium dense to dense clayey sand/ sand to depths ranging from about 0.7 m to 1.2 m underlain by;
- Stiff to hard sandy clay/ clay to depths ranging to about 3.1 m depth (i.e. depth of investigation in test pits). A layer firm sandy clay (i.e. lower strength clay) was observed at depths ranging from about 1.7 m to 2.4 m in TP5 located near a drain/ creek).

### Northern area (TP6, TP7, TP8 and BH3, BH4)

- Loose to medium dense sand (inferred disturbed/ reworked ground) to depths ranging from about 0.2 m to 0.5 m, underlain by;
- Medium dense to dense sand (with some gravel bands) to depths ranging from about 2.5 m to 3.1 m in the test pits (i.e. depth of investigation) and to a depth of about 4.2 m depth in the boreholes, underlain by;
- Very stiff to hard clay / sand clay to a depth of about 5.5 m (i.e. depth of borehole investigations).

Figure 002 presents a typical section through the site with inferred subsurface conditions.

## 4.4 Groundwater

A summary of groundwater levels measured within monitoring wells (BH1 to BH4) is presented in Table 1.

Table 1: Summary groundwater	levels within monitoring wells
------------------------------	--------------------------------

	Surface RL (m	Depth to grour	ndwater (m bgl)
Location ID	AHD)	13 Jan 2021	15 Jan 2021
BH1	2.3	0.96	0.75
BH2	2.3	0.16	0.15
BH3	2.3	0.57	0.35
BH4	2.2	0.76	0.57

It should be noted that groundwater levels may fluctuate seasonally and be higher during heavy rainfall periods. In addition, groundwater levels may be tidally influenced given the proximity to the Mowbray River and associated creeks/ drains.



Instrumentation has been installed in each monitoring well to allow continued monitoring of groundwater levels and groundwater quality until mid 2021. Further comments regarding groundwater levels and quality are proposed to be provided following the monitoring period.

## 4.5 Laboratory Testing - Geotechnical

Results of laboratory testing are summarised in Table 2 and Table 3. Laboratory test certificates are presented in Appendix B.

	Sample		Particle	e size distr	ibution	A	tterberg lim	its		
Test pit	depth (m bgl)	мС' (%)	Fines (%)	Sand (%)	Gravel (%)	Liquid limit (%)	Plastic limit (%)	Plasticity Index (%)	LS² (%)	Material classification
TP1	0.80 – 0.90	13.7	66	32	2	36	20	16	7	Sandy CLAY (CI)
TP2	1.10 – 1.20	19.1	94	6	0	37	20	17	8	CLAY (CI)
TP3	0.50 – 0.60	13.0	42	58	0	23	16	7	3.5	Sandy CLAY (CL)
TP4	1.50 – 1.60	22.2	74	26	0	28	16	12	6	CLAY (CL)
TP6	1.50 – 1.60	5.8	2	98	0	NO <sup>3</sup>	NO	NP <sup>4</sup>	0	SAND (SP)
TP8	1.80 – 1.90	31.1	11	66	23	NO	NO	NP	0	SAND (SW)

### Table 2: Results of classification testing.

Notes:

1 - MC - Moisture Content

2 – LS – Linear Shrinkage

3 – NO – Not Obtainable

4– NP – Non Plastic

### Table 3: Results of Emerson Class testing

Test pit	Sample depth (m bgl)	Material classification	Emerson Class Number
TP1	0.80 – 0.90	Sandy CLAY (CI)	6
TP2	1.10 – 1.20	CLAY (CI)	6
TP3	0.50 – 0.60	Sandy CLAY (CL)	6
TP4	1.50 – 1.60	CLAY (CL)	2
TP6	1.50 – 1.60	SAND (SP)	6
TP8	1.80 – 1.90	SAND (SW)	4

## 4.6 Acid Sulfate Soils

## 4.6.1 ASS Action Criteria

The following key guidance documents were considered for this ASS assessment:

- National Acid Sulfate Soils Guidance: National acid sulfate soils sampling and identification methods manual, June 2018, Water Quality Australia, Department of Agriculture and Water Resources, Commonwealth of Australia
- National Acid Sulfate Soils Guidance: National acid sulfate soils identification and laboratory methods manual, June 2018, Water Quality Australia, Department of Agriculture and Water Resources, Commonwealth of Australia
- Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines. 2014. Department of Science, Information Technology, Innovation and the Arts, Queensland Government.

Table 4 summarises ASS action criteria. These categories are used to identify whether action / management of ASS disturbances is required, based on 'net acidity'. For this assessment, an action criterion of 0.03% Equivalent Sulfur has been adopted conservatively as the volume of disturbance during site development is yet to be confirmed.

			Ne	t Acidity		
Type of Material		1-1000 tonnes m	aterials disturbed	> 1000 tonnes materials disturbed (and major fill projects)		
Texture Range	Approx. Clay Content (%)	Equivalent sulfur %S oxidisable	Equivalent acid mol H⁺/tonne	<b>Equivalent sulfur</b> %S oxidisable (oven- dry basis)	<b>Equivalent acid</b> mol H <sup>+</sup> /tonne (oven-dry basis)	
Fine Texture Light medium to heavy clays	> 40	≥ 0.10	≥ 62	≥ 0.03	≥ 18	
Medium Texture Clayey sand to light clays	5 – 40	≥ 0.06	≥ 36	≥ 0.03	≥ 18	
Coarse Texture and Peats Sands to loamy sands	< 5	≥ 0.03	≥ 18	≥ 0.03	≥ 18	

### Table 4: ASS Action Criteria (National Acid Sulfate Soils Guidance, 2018)

## 4.6.2 ASS Screening Tests

The pH<sub>F</sub> and pH<sub>FOX</sub> screening method consists of two steps; determining the field pH of 1:5 soil/water suspension, and by the addition of 30% Hydrogen Peroxide, allowing the sample time to oxidise, before determining the pH<sub>FOX</sub> (pH after oxidation) of the reacted sample. The screening tests are used to indicate the likelihood of a soil containing actual acidity (i.e. Actual ASS [AASS]) and/or potential acidity (Potential ASS [PASS]).

The following interpretation of screening tests has been used:

- 1) AASS potential is indicated by:  $pH_F \leq 4.0$
- 2) PASS potential is indicated by:
  - Strong indication: pH<sub>FOX</sub> <3, large ΔpH and a strong reaction with hydrogen peroxide.</p>
  - Inconclusive: pH<sub>FOX</sub> 3 4 and low, medium or strong reaction with hydrogen peroxide
  - Low indication: pH<sub>FOX</sub> > 4 and low, medium or strong reaction with hydrogen peroxide.

Soil screening test results on recovered soil samples from this investigation are summarised in Table A in Appendix C.

The screening test results indicated the following:

- A low AASS potential was indicated in all soil samples tested.
- Low to inconclusive indication of PASS for all investigation locations, except for a sample of clay at location TP5 at a depth of 2.2 to 2.3 m (i.e. 0.0 to -0.1 m AHD) which had a strong indication of PASS.

### 4.6.3 Chromium Suite Analysis

Based on screening test results, 8 soil samples were selected for Chromium suite analysis. These soil samples were selected to provide a broad coverage of the soil profile.

Results of laboratory testing, including Acid-Base Accounting (ABA) to calculate net acidity and liming rates, are summarised in Table B in Appendix C. As recommended in the *National acid sulfate soils identification and laboratory methods manual*, ANC has not been included in the calculation of net acidity as incubation testing has not been conducted.

The laboratory results indicated the following:

- The absence of AASS in the samples tested.
- The presence of PASS in soil samples tested below 0 m AHD at the following locations:
  - Location TP5 clay from a depth of 2.2 to 2.3 m (0 to -0.1 m AHD)
  - Location TP8 sand from a depth of 1.8 to 1.9 m (0 to -0.1 m AHD) and 2.5 to 2.6 m (-0.7 to -0.8 m AHD)
- Lime treatment rates range from 14 kg lime/m<sup>3</sup> to 39 kg lime/m<sup>3</sup> to neutralise the calculated net acidity in these identified PASS soils.

## 4.6.4 Groundwater Quality

ASS indicator parameter results for groundwater are summarised in Table 5.

 Table 5: Groundwater Quality Test Results

Parameter	BH1	BH2	BH3	BH4
Sample Date	15/01/2021	15/01/2021	15/01/2021	15/01/2021
pH (field reading)	6.2	6.8	7.2	7.5
EC µS/cm (field reading)	23641	12955	498	6614
Sulfate mg/L	-	-	8.3	300
Chloride mg/L	-	-	44	1900
Total Alkalinity mg/L	-	-	160	220
Dissolved Aluminium mg/L	-	-	0.017	0.027
Dissolved Iron mg/L	-	-	0.066	0.9

These field and laboratory test results indicated:

- Electrical conductivity (EC) of all locations was brackish, except location BH3 which was fresh.
- PH readings ranged from 6.2 to 7.5 indicating slightly acidic conditions to neutral conditions.
- Total alkalinity indicates a high buffering capacity in groundwater and is interpreted to be Class 1 buffering capacity (i.e. generally adequate to maintain acceptable pH levels in the future).
- Aluminum concentrations do not indicate the presence of active ASS.

## 5.0 ENGINEERING COMMENTS

## 5.1 **Ground conditions**

As outlined in Section1.0, the aims of the studies were to provide a broadscale assessment of near-surface ground and groundwater conditions across the site. On this basis the site has been divided into three main areas (northern, central, southern) based on subsurface conditions encountered during the investigation. The inferred extent of each area is shown in plan on Plate 4 in Section 4.2 and in cross section on Figure 2. Ground conditions encountered in each area are summarised as follows:

- Southern Area Predominantly stiff to hard clays to depths greater than about 4 m;
- Central Area Variable thickness of loose to dense sands to depths ranging to about 4 m, overlying stiff to hard clays; and
- Northern Area Predominantly loose to dense sands to depths greater than about 4 m.

In general terms groundwater measured in mid January 2021 ranged from a depth of about 0.3 m or a level of about 2.0 m AHD in the south eastern part of the site (i.e. BH2 and BH3) dropping to a depth of about 0.7 m or a level of about 1.5 m AHD in the north western part of the site (i.e. BH1 and BH4).

## 5.2 Proposed development

Existing surface levels range from ~6 m AHD along the Captain Cook Highway dropping to ~2 m AHD about 100m north east of the highway. The remainder of the site is generally around ~2 m AHD dropping locally to ~1 m AHD within creeks/ drains that cross the site. Cut and fill earthworks are proposed to achieve design levels for the proposed development.

A copy of the schematic layout of the proposed development from a drawing provided by Hunt Design is presented in Plate 6.



Plate 6: Schematic layout of proposed development

In general terms the main features of the proposed development include the following:

- Wave pool located in the north western part of the site;
- Lagoon located in the central and south eastern part of the site;
- Hotel and amenities buildings located between the wave pool and the lagoon;
- Residential development around the north eastern and south eastern sides of the lagoon, plus on an island within the lagoon; and
- Access roads throughout the site, plus carparking along the Captain Cook Highway site boundary.

Comments on geotechnical issues relating to the proposed development are presented in the following sections.

# 5.3 Bulk earthworks

## 5.3.1 Cut and fill areas

A copy of the schematic layout of the proposed cut and fill earthworks from a drawing provided by Hunt Design is presented in Plate 7.



### Plate 7: Schematic layout of proposed cut and fill earthworks

In general terms the proposed earthworks are summarised as follows:

- Carparking area Excavation to levels ranging from 3.5 m to 4.5 m AHD. Maximum depth of excavation expected to be ~1.5 m. Excavated materials expected to comprise mainly clays. Groundwater not expected to be encountered.
- Wave Pool and Lagoons Excavation to a level of 0.0 m AHD in both features. Maximum depth of excavation expected to be ~2 m. Excavated materials expected to comprise mainly clays in the Southern Area, grading to variable mixtures of clays and sands in the Central Area and sands in the Northern Area. Groundwater expected to be encountered near the surface during the wet season and at a depth of about 1 m to 1.5 m in the dry season.
- Residential areas and areas surrounding wave pool and lagoon Filling to levels ranging from 3.2 m to 3.5 m AHD. Maximum depth of fill expected to be about 1.5 m. Fill expected to comprise materials won from bulk excavations for the carparking area, wave pool and lagoon.
- Hotel area Filling to a level of 4.0 m AHD. Maximum depth of fill expected to be about 1.5 m. Fill expected to comprise materials won from bulk excavations for the carparking area, wave pool and lagoon.

#### **Fill materials** 5.3.2

As outlined above fill materials won from excavations are expected comprise mainly clays in the Southern Area, variable amounts of clays and sands in the Central Area (with the amount of sand increasing towards the Northern Area), and mainly sands in the Northern Area. All of these materials are considered to be suitable for use as controlled (or engineered) fill, subject to appropriate moisture conditioning for compaction.

Filling operations should be managed such that specific areas are filled using one material (i.e. clays, sands or blended mixtures of clays and sands). For example, filling for the hotel area should comprise consistent materials throughout, rather than clay fill at the southern end and sand fill at the northern end.

#### 5.3.3 **Excavation conditions**

Excavations to depths ranging to about 6 m (i.e. the maximum depth investigated) should encounter clays ranging from firm to hard and sands ranging from loose to dense. Excavation of these materials should be achievable using conventional earthmoving equipment (e.g. large tracked excavators).

Excavations for the proposed wave pool and lagoon are generally not expected to be greater than about 2 m in depth, however these excavations are likely to encounter groundwater at depths ranging from just below the surface in the wet season to about 1.5 m in the dry season. Earthworks should be carried out in the dry season to minimise the depth of excavation required underwater.

#### 5.3.4 Unsuitable materials

Near surface materials containing significant amounts of organic material should not be used for controlled filling. Given that most of the site is used for sugar cane farming allowance will need to be made for stripping to depths ranging from about 0.2 m to 0.5 m to remove soils containing organics from both cut and fill areas.

Previous experience with development on cane fields indicates that there is a potential for unsuitable materials to be encountered in some areas of the site where earthworks were carried out previously to improve the farming area. Such areas include former creeks, gullies or other low lying areas that were backfilled (often with trees and other vegetation) to level the surface. No areas of this type of backfilling were encountered during the recent site investigation, however further investigation of suspect areas identified from aerial photos should be carried out when access is not restricted by the sugar cane.

#### 5.3.5 Acid sulfate soils

ASS risk mapping generally indicated a low potential for ASS in the near surface soils across most of the site, however there is a high probability of encountering ASS in mangrove areas surrounding the site. The preliminary ASS investigation detected PASS in soil samples analysed below 0 m AHD at two locations. These locations are considered to be associated with surrounding mangroves and/or former drainage features and may not be representative of conditions under all site areas. Deposits of ASS may be present in deeper layers of soils below the investigated depth.

Groundwater testing results suggest a historically undisturbed environment and a buffering capacity generally adequate to maintain acceptable pH levels in the future.

Results to date suggest that there is a relatively low potential that ASS will be encountered in materials above the seasonal water table across most of the site. Excavations and dewatering in or adjacent to higher risk mangrove areas should be avoided (refer Plate 3 in Section 4.1.3). More detailed ASS investigations and preparation of an ASS Management Plan are recommended when design has advanced such that the extent of project disturbances (i.e. excavation and dewatering) are better known.

#### 5.3.6 Groundwater

As outlined above excavations for the proposed wave pool and lagoon are generally not expected to be greater than about 2 m in depth, however these excavations are likely to encounter groundwater at depths



ranging from just below the surface in the wet season to about 1.5 m in the dry season. It is understood that the base of the wave pool and the lagoon is proposed to be at about 0.0 m AHD. The base of the wave pool is proposed to be concrete lined and the lagoon may need to be lined (with clay or geosynthetics) to minimise seepage and maintain a water level at about 2.8 m AHD. If this is the case these excavations will probably need to be dewatered for construction of the liners.

## 5.4 **Proposed water features**

As outlined above the base of the water features is proposed to be at about 0.0 m AHD. The base of the pool is proposed to be concrete lined and the base of the lagoon may have to be lined. Based on the results of the limited investigations to date and the currently proposed location of the pool and lagoon, indications are that the foundation conditions in the base of both features should be mainly very stiff to hard clays.

## 5.5 Proposed buildings

## 5.5.1 Proposed hotel

It is understood that the proposed hotel buildings are to be three level structures constructed on a fill platform at about 4.0 m AHD. It may be feasible to support the structures on high level footings founded in controlled fill, depending on building loads and tolerable settlements.

## 5.5.2 Proposed residential buildings

Proposed residential buildings are likely to be one or two level structures constructed on various fill platforms around and within the lagoon. These structures are likely to be able to be supported on high level footings founded in controlled fill.

## 6.0 FURTHER GEOTECHNICAL INPUT

As outlined previously the aims of these studies were to provide a broadscale assessment of near-surface ground and groundwater conditions across the site and to provide an initial assessment of potential geotechnical constraints and opportunities associated with the project. Once development details are advanced additional geotechnical investigations will be required. Potential issues that may need to be addressed include, but are not limited to, the following:

- Further investigation to better assess ground conditions in the footprint of the proposed wave pool and lagoon (i.e. excavation conditions and fill material quality);
- Further investigation to better assess groundwater conditions in the area of the proposed wave pool and lagoon (i.e. permeability conditions and dewatering options);
- Further investigation to better assess ground conditions in the footprint of development areas, particularly the proposed hotel area.
- Deeper investigations to assess whether soft compressible clays are present at depth in the Central and Northern Areas, particularly areas of proposed development near mangrove areas (refer Plate 3 in Section 4.1.3);
- Further ASS investigations and preparation of an ASS Management Plan once project disturbances are known.

## 7.0 IMPORTANT INFORMATION

Your attention is drawn to the document titled - "Important Information Relating to this Report", which is included as Appendix D of this report. The statements presented in that document are intended to inform a reader of the report about its proper use. There are important limitations as to who can use the report and how it can be used. It is important that a reader of the report understands and has realistic expectations about those matters. The Important Information document does not alter the obligations Golder Associates has under the contract between it and its client.

# Signature Page

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Malcolm Cook







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NOTE(S) 1. COORDINATE S' REFERENCE(S) Service Layer Credi	TSTEM: GDA2020 MGA ZONE 55 ts © State of Queensland (Department of Natural Resources,
NOTE(S) 1. COORDINATE S' REFERENCE(S) Service Layer Credi Mines and Energy) Includes material @	TSTEM: GDA2020 MGA ZONE 55 ts @ State of Queensland (Department of Natural Resources, 2021
NOTE(S) 1. COORDINATE S REFERENCE(S) Service Layer Credi Mines and Energy) Includes material ©	rstete of Queensland (Department of Natural Resources, 202 The State of Queensland © Planet Labs Netherlands B.V. 2020
NOTE(S) 1. COORDINATE S' REFERENCE(S) Service Layer Credi Mines and Energy) Includes material ©	rstEtk: GDA2020 MGA ZONE 55 ts: @ State of Queensland (Department of Natural Resources, 202 The State of Queensland @ Planet Labs Netherlands B.V. 2020
NOTE(S) 1. COORDINATE S REFERENCE(S) Service Layer Credi Mines and Energy) Includes material @ PROJECT	reger of Queensland (Department of Natural Resources, 2022) The State of Queensland @ Planet Labs Netherlands B.V. 2020

PORT DOUGLAS WAVE PARK

TITLE SITE INVESTIGATION PLAN

CONTROL FIGURE PROJECT NO. 20446551 REV. 1



Appendix A

# Geotechnical Borehole Test Pit & DCP Reports and Explanatory Notes



## CLIENT: Graben Pty Ltd

PROJECT: Wave Park LOCATION: Mowbray

JOB NO: 20446551 COORDS: 338377.0 m 8169175.0 m MGA2020 55 SURFACE RL: 6.10 m DATUM: AHD WIDTH: 0.45 m PIT DEPTH: 3.20 m BUCKET TYPE: 450 mm toothed bucket

**REPORT OF TEST PIT: TP1** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling DATE: 21/12/20 LOGGED: CD

CHECKED: SB

DATE: 14/1/21

F		E	Exca	/ation		Sampling				Field Ma	ateria	al Des	scription					
	METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	0	D( (AS´ Blows	CP TES 1289.6 per 10	ST .3.2) 0 mm 5 20	25
				-0.0 - -	6.10	DS 0.20-0.30 m			CI	Sandy CLAY medium plasticity, brown, fine to medium grained sand		F	Inferred disturbed/ re-worked ground (cane farming)					-
		L		- 0.5	<u>0.50</u> 5.60					red		St -	ALLUVIAL SOIL					-
	-			- - 1.0—		DS 0.80-0.90 m						VSt						-
	×		Щ	- - 1.5 —	<u>1.40</u> 4.70						w>							-
	ш		ō			DS 1.60-1.70 m					PL							-
39 8.30.004 Datgel Tools		м		-	<u>2.40</u> 3.70							VSt						-
wingFile>> 04/02/2021 09:				2.5														-
VT 20446551.GPJ < <drav< td=""><td></td><td></td><td></td><td>3.0 —</td><td>2.90</td><td></td><td></td><td></td><td></td><td>TEST PIT DISCONTINUED @ 3.20 m</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td></drav<>				3.0 —	2.90					TEST PIT DISCONTINUED @ 3.20 m								-
CORED FULL PAGE GIN				- 3.5 —						TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED								-
IB.GLB Log GAP NON-I																		-
3AP 8_16.8L	This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.																	



# GOLDER

CLIENT:

Graben Pty Ltd

PROJECT: Wave Park LOCATION: Mowbray

JOB NO: 20446551 COORDS: 338520.0 m 8169325.0 m MGA2020 55 SURFACE RL: 2.40 m DATUM: AHD WIDTH: 0.45 m PIT DEPTH: 3.10 m BUCKET TYPE: 450 mm toothed bucket

**REPORT OF TEST PIT: TP2** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling DATE: 21/12/20 LOGGED: CD DATE: 14/1/21 CHECKED: SB

		Exca	vation		Sampling				Field M	ateria	al De	scription				
METHOD	EXCAVATION	WATER	DEPTH (metres)	DEPTH RL	Sample or Field test	RECOVERED	LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	DC (AS1) Blows p 0 5 1	P TES 289.6.3 per 100 0 15	Г .2) mm 20 2	5
			-0.0	2.40	DS 0.00-0.10 m	-		SC	Clayey SAND fine to medium grained, brown, low plasticity clay		D	Inferred re-worked ground (cane farming)				
			-	0.40	DS 0 40 0 50 m			80		м						
			0.5—	2.00	DS 0.40-0.50 m			54	SAND fine to medium grained, poorly graded, grey		VD	ALLUVIAL SUIL				
			-	0.70 1.70				CI	CLAY medium plasticity, orange mottled grey, trace fine to medium grained sand							
			- 1.0-	1.10	DS 1.00-1.10 m											
				1.30	DS 1.10-1.20 m			СН	CLAY high plasticity, red mottled grey, with fine grained sand		St - VSt					
×	м	Щ	- 1.5—	-	DS 1.50-1.60 m											
		0	-	-												
			- 20-	-						w > PL	VSt					
			-	-	DS 2.00-2.10 m											
			-	-												
			2.5-	-	DS 2.50-2.60 m						н					
			-													
			3.0 —	<u>3.00</u> -0.60	DS 3.00-3.10 m				trace fine grained gravel							
			-	-0.70					TEST PIT DISCONTINUED @ 3.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED							
			3.5-	-												
			-	-												
			-													
I			+.U—	geot	This report of test pit technical purposes or information only	must b nly, with and do	e rea iout a not i	ad in atterr	conjunction with accompanying notes and abb pt to assess possible contamination. Any refe ssarily indicate the presence or absence of soi	revia rence l or gi	tions. es to p round	It has been prepared for potential contamination are water contamination.	∍ for G	iAP gIN	T FN. I	=0



Tools

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GAP 8 16.8 LIB.GLB

# GOLDER

CLIENT:

Graben Pty Ltd PROJECT: Wave Park

LOCATION: Mowbray JOB NO:

20446551

COORDS: 338279.0 m 8169469.0 m MGA2020 55 SURFACE RL: 2.20 m DATUM: AHD WIDTH: 0.45 m PIT DEPTH: 3.10 m BUCKET TYPE: 450 mm toothed bucket

**REPORT OF TEST PIT: TP3** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling LOGGED: CD DATE: 21/12/20 CHECKED: SB DATE: 14/1/21

RL3

Excavation Sampling **Field Material Description** MOISTURE CONDITION CONSISTENCY DENSITY **GROUP SYMBOL** DCP TEST NOF RECOVERED STRUCTURE AND (AS1289.6.3.2) Blows per 100 mm SAMPLE OR GRAPHIC LOG EXCAVATI RESISTAN METHOD SOIL/ROCK MATERIAL DESCRIPTION ADDITIONAL WATER DEPTH (metres) FIELD TEST OBSERVATIONS DEPTH RL 10 15 20 25 0 5 Inferred re-worked ground (cane farming) 2 20 CI Sandy CLAY medium plasticity, brown, fine to medium grained w > St DS 0.10-0.20 m sand PL 0.20 Sandy CLAY low plasticity, grey mottled orange, fine to medium grained sand CL ALLUVIAL SOIL St -VSt 0.5 DS 0.50-0.60 m Μ 1.0 L DS 1.00-1.10 m F 1.5 DS 1.50-1.60 m GNE Ж 1.60 CI CLAY medium plasticity, grey mottled orange, with fine grained sand VSt DS 1.80-1.90 m 2.0 DS 2.00-2.10 m <<DrawingFile>> 04/02/2021 09:39 8.30.004 Datgel <sup>-</sup> w > PL 2.5 DS 2.50-2.60 m М н 3.0 DS 3.00-3.10 m -0.90 TEST PIT DISCONTINUED @ 3.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED 3.5 Бо 40 This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for GAP gINT FN. F01 information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



CLIENT: Graben Pty Ltd

LOCATION: Mowbray

JOB NO: 20446551

PROJECT: Wave Park

COORDS: 338730.0 m 8169332.0 m MGA2020 55 SURFACE RL: 1.80 m DATUM: AHD WIDTH: 0.45 m PIT DEPTH: 3.10 m BUCKET TYPE: 450 mm toothed bucket

**REPORT OF TEST PIT: TP4** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling DATE: 21/12/20 LOGGED: CD

CHECKED: SB

DATE: 14/1/21

Þ	Excavation Sampling Field Material Description																	
			Exca	vation	1	Sampling				Field Ma	ateria	I De	scription	-				
	METHOD	EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	<b>GROUP SYMBO</b>	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	e O	D (AS Blows	CP TE 1289.6 per 1 10 1	ST 3.3.2] 00 m 5 2	) m 20 25
				-0.0	1.80	DS 0.10-0.20 m			SC	Clayey SAND fine to medium grained, brown, medium plasticity clay		MD	Inferred re-worked ground (cane farming)					
				- - 0.5—	1.60	DS 0.40-0.50 m				pale orange-brown		D	ALLUVIAL SOIL					-
		L		- - 1.0—	1.00	DS 0.90-1.00 m						MD						
				-	0.80 <u>1.20</u> 0.60	DS 1.20-1.30 m			СН	grey, trace fine grained gravel		VSt						
				-	<u>1.40</u> 0.40				CL	medium grained sand CLAY low plasticity, grey mottled pale orange, with fine		H						
Ì	EX		GNE	-	-	DS 1.50-1.60 m				grained sand		St						
004 Datgel Tools				2.0	-	DS 2.00-2.10 m					w> PL	VSt						-
:DrawingFile>> 04/02/2021 09:39 8.30.		М		- 2.5— - -		DS 2.50-2.60 m						н						
6551.GPJ <<				3.0 —	-1.30	DS 3.00-3.10 m												
GLB Log GAP NON-CORED FULL PAGE GINT 20446				3.5 —	-1.30					TEST PIT DISCONTINUED @ 3.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED								
GAP 8_16.8 LIB.	1			4.0—	geot	This report of test pit n echnical purposes only information only a	nust y, w nd o	t be re ithout do not	ad in atten nece	conjunction with accompanying notes and abb pt to assess possible contamination. Any refer ssarily indicate the presence or absence of soil	reviat rence or gr	ions. s to p ound	It has been prepared for potential contamination an water contamination.	e for	. (	GAP g	INTI	



Tools

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Log GAP NON-CORED FULL

GAP 8 16.8 LIB.GLB

# GOLDER

CLIENT: Graben Pty Ltd

PROJECT: Wave Park

LOCATION: Mowbray

JOB NO: 20446551 COORDS: 338545.0 m 8169510.0 m MGA2020 55 SURFACE RL: 2.20 m DATUM: AHD WIDTH: 0.45 m PIT DEPTH: 3.10 m BUCKET TYPE: 450 mm toothed bucket

**REPORT OF TEST PIT: TP5** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling LOGGED: CD DATE: 21/12/20 CHECKED: SB DATE: 14/1/21

Excavation Sampling **Field Material Description** MOISTURE CONDITION CONSISTENCY DENSITY **GROUP SYMBOL** DCP TEST NCF RECOVERED STRUCTURE AND (AS1289.6.3.2) Blows per 100 mm SAMPLE OR GRAPHIC LOG EXCAVATI RESISTAN METHOD SOIL/ROCK MATERIAL DESCRIPTION ADDITIONAL OBSERVATIONS WATER DEPTH (metres) FIELD TEST DEPTH RL 10 15 20 25 0 5 2 20 SD. ALLUVIAL SOIL SAND SC fine to medium grained, poorly graded, pale brown, with low plasticity clay DS 0.10-0.20 m D D 0.50 1.70 0.5 DS 0.50-0.60 m SC Clayey SAND fine to medium grained, grey, medium plasticity clav MD D М 1.0 DS 1.00-1.10 m <u>1.10</u> 1.10 Sandy CLAY medium plasticity, grey mottled orange, fine to medium grained sand L St 1.5 DS 1.50-1.60 m GNE Ж w > PL 2.0 F 2.10 0.10 CI CLAY medium plasticity, dark grey, with fine grained sand, trace shells DS 2.20-2.30 m w~ LL 2.40 CI CLAY medium plasticity, grey mottled pale orange, with fine grained sand 2.5 DS 2.50-2.60 m VSt w > М PI н 3.0 DS 3.00-3.10 m -0.90 TEST PIT DISCONTINUED @ 3.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED 3.5 40 This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for GAP gINT FN. F01 information only and do not necessarily indicate the presence or absence of soil or groundwater contamination. RL3



Tools

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Log GAP NON-CORED FULL PAGE GINT 20446551.GPJ

GAP 8 16.8 LIB.GLB

# GOLDER

CLIENT: Graben Pty Ltd

PROJECT: Wave Park

LOCATION: Mowbray JOB NO: 20446551

COORDS: 338311.0 m 8169598.0 m MGA2020 55 SURFACE RL: 2.60 m DATUM: AHD WIDTH: 1.20 m PIT DEPTH: 2.50 m BUCKET TYPE: 1200 mm mud bucket

**REPORT OF TEST PIT: TP6** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling LOGGED: CD DATE: 21/12/20 CHECKED: SB DATE: 14/1/21

RL3

Excavation Sampling **Field Material Description** MOISTURE CONDITION CONSISTENCY DENSITY **GROUP SYMBOL** DCP TEST NOF RECOVERED STRUCTURE AND (AS1289.6.3.2) Blows per 100 mm SAMPLE OR GRAPHIC LOG EXCAVATI RESISTAN METHOD SOIL/ROCK MATERIAL DESCRIPTION ADDITIONAL OBSERVATIONS WATER DEPTH (metres) FIELD TEST DEPTH RL 10 15 20 25 0 5 -0.0-2 60 Inferred re-worked ground (cane farming) SD SAND fine to medium grained, poorly graded, pale brown, trace clay D L DS 0.10-0.20 m ALLUVIAL SOIL MD 0.5 DS 0.50-0.60 m 1.0 DS 1.00-1.10 m М Щ L D 1.5 DS 1.50-1.60 m 2.0 DS 2.10-2.20 m water inflow at 2.1 m w VD 0.20 DS 2.40-2.50 m GP Sandy GRAVEL fine to coarse grained, grey, fine to coarse grained sand, with cobbles -2.5 0.10 TEST PIT DISCONTINUED @ 2.50 m SIDEWALL COLLAPSE FROM 2.1 M GROUNDWATER ENCOUNTERED @ 2.10 m DEPTH BACKFILLED 3.0 3.5 40 This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for GAP gINT FN. F01 information only and do not necessarily indicate the presence or absence of soil or groundwater contamination.



CLIENT:

JOB NO:

LOCATION: Mowbray

Graben Pty Ltd PROJECT: Wave Park

20446551

COORDS: 338618.0 m 8169597.0 m MGA2020 55 SURFACE RL: 2.80 m DATUM: AHD WIDTH: 1.20 m PIT DEPTH: 2.90 m BUCKET TYPE: 1200 mm mud bucket

**REPORT OF TEST PIT: TP7** 

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling DATE: 21/12/20 LOGGED: CD

DATE: 14/1/21 CHECKED: SB

		E	Exca	vation		Sampling				Field Ma	ateria	l De	scription					
METUOD		EXCAVATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS	Е 0	DC (AS1 llows	CP TES 289.6. per 10 0 15	GT 3.2) 0 mm 20	25
EV		L EXCAVATIO	WATER	н - - - - - - - - - -	DEPTH RL 2.80 2.60 2.60	SAMPLE OR FIELD TEST DS 0.50-0.60 m DS 1.00-1.10 m	RECOVERE		GROUP SYM	SOIL/ROCK MATERIAL DESCRIPTION			STRUCTURE AND ADDITIONAL OBSERVATIONS			2 289.6. per 10 0 15	3.2) 0 mm 20 	25
GAP NON-CORED FULL PAGE GINT 20446551.GPJ < <drawingfile>&gt; 04/02/2021 09:39 8:30.004 Datgel Tools</drawingfile>				2.0	<u>2.00</u> 0.80	DS 2.10-2.20 m				shells TEST PIT DISCONTINUED @ 2.90 m SIDEWALL COLLAPSE FROM 2.5 M GROUNDWATER ENCOUNTERED @ 2.10 m DEPTH BACKFILLED	w	D						
GAP 8_16.8 LIB.GLB Lo	4.0 4.0 This report of test pit must be read in conjunction with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination. Any references to potential contamination are for information only and do not necessarily indicate the presence or absence of soil or groundwater contamination. BL 3																	



REPORT OF TEST PIT: TP	8
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CLIENT:	Graben Pty Ltd
PROJECT:	Wave Park
LOCATION:	Mowbray

Park

oray JOB NO: 20446551 COORDS: 338818.0 m 8169621.0 m MGA2020 55 SURFACE RL: 1.80 m DATUM: AHD WIDTH: 1.20 m PIT DEPTH: 3.10 m BUCKET TYPE: 1200 mm mud bucket

SHEET: 1 OF 1 MACHINE: New Holland E55Bx CONTRACTOR: Saxon Drilling LOGGED: CD DATE: 21/12/20 DATE: 14/1/21 CHECKED: SB

		Exca	vation		Sampling				Field M	ateri	al De	scription					
METHOD	EXCAVATION	WATER	DEPTH (metres)	DEPTH RL	Sample or Field test	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY	STRUCTURE AND ADDITIONAL OBSERVATIONS	( Ble 0 5	DC AS12 ows p	P TES 289.6.3 per 100 0 15	3T 3.2) 0 mm 5 20	25
			0.0	1.80	DS 0.10-0.20 m			SP	SAND fine to medium grained, poorly graded, brown, trace medium plasticity clay		L	Inferred re-worked ground (cane farming) ALLUVIAL SOIL					
			- - 0.5—	<u>0.40</u> 1.40	DS 0.50-0.60 m			•			MD						
			-	-						м							
			1.0 <i>—</i> -	<u>1.00</u> 0.80	DS 1.00-1.10 m				pale grey		D						
X			- - 1.5 —	<u>1.50</u> 0.30	DS 1.50-1.60 m				trace organic material					J			
			-	<u>1.80</u> 0.00	DS 1.80-1.90 m			sw	fine to coarse grained, well graded, grey, with fine								
atgel I ools			2.0-	<u>2.10</u> -0.30	-			SP	fine to medium grained, poorly graded, trace	W-W							
U 09:39 8.30.004 D			- - 2.5—	-							D - VD						
Ingrile>> 04/02/202			-	-	DS 2.50-2.60 m					w							
40001.GPJ < <ur></ur>			3.0-	-1.30	DS 3.00-3.10 m				TEST PIT DISCONTINUED @ 3.10 m								
ILL PAGE GINI 204			-	-					TARGET DEPTH GROUNDWATER ENCOUNTERED @ 2.10 m DEPTH BACKFILLED								
			3.5 —	-													
SLIB.GLB LOG G			4.0-	-	This report of test pit	muet	t be re	ad in	conjunction with accompanying notes and abh	revia	tione	It has been prepared for					
GAP 8_10				geol	technical purposes on information only	nly, w and o	ithout do not	atten	npt to assess possible contamination. Any refe essarily indicate the presence or absence of soi	rence or g	es to round	potential contamination an Iwater contamination.	e for	G	AP gl	NT FN	I. F01 RL



# **REPORT OF BOREHOLE: BH1**

CLIENT:	Graben Pty Ltd
PROJECT:	Wave Park
LOCATION:	Mowbray
JOB NO:	20446551

COORDS: 338321.0 m 8169340.0 m MGA2020 55 SURFACE RL: 2.30 m DATUM: AHD INCLINATION: -90° HOLE DEPTH: 5.20 m





# **REPORT OF BOREHOLE: BH2**

CLIENT:	Graben Pty Ltd
PROJECT:	Wave Park
LOCATION:	Mowbray
JOB NO:	20446551

COORDS: 338640.0 m 8169209.0 m MGA2020 55 SURFACE RL: 2.30 m DATUM: AHD INCLINATION: -90° HOLE DEPTH: 6.10 m

	Drilling Sampling						Field Material Des	cripti	on				
COLTEM	DENETRATION	RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE		PIEZOMETER DETAILS
				-1  0	2.30			0 0 0 0 0 0 0 0 0	CI	Sandy CLAY medium plasticity, brown, fine to medium grained sand			Monument
				- - 1_ - - 2_	<u>1.30</u> 1.00	DS 1.50-1.60 m			СІ	CLAY medium plasticity, pale orange brown, with fine grained sand		F - Si	Bentonite
9:38 8.30.004 Datgel Tools		М	GNE	- - 3_ - - -							w <sup>2</sup> PL		Sand -
AGE_GINT 20446551.GPJ_< <drawingfile>&gt;_04/02/2021 (</drawingfile>				4								VSt -	
LB Log GAP NON-CORED FULL PA				6	-3.80					END OF BOREHOLE @ 6.10 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED			Bentonite
GAP 8_16.8 LIB.G				7—	T geot	his report of borehole echnical purposes on information only a	e mu nly, w and o	st be re ithout a do not	ead ir atterr nece	n conjunction with accompanying notes and abbreviations npt to assess possible contamination. Any references to p ssarily indicate the presence or absence of soil or ground	. It ha otenti water	s bee al con contar	n prepared for tamination are for mination. GAP gINT FN. F01d RL3



# **REPORT OF BOREHOLE: BH3**

CLIENT:	Graben Pty Ltd
PROJECT:	Wave Park
LOCATION:	Mowbray
JOB NO:	20446551

COORDS: 338754.0 m 8169482.0 m MGA2020 55 SURFACE RL: 2.30 m DATUM: AHD INCLINATION: -90° HOLE DEPTH: 5.50 m

		Dri	lling		Sampling				Field Material Desc	riptic	n	
METHOD	PENETRATION	WATER	DEPTH (metres)	DEPTH RL	Sample or Field test	RECOVERED	GRAPHIC LOG	GROUP SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE	CONSISTENCY DENSITY	PIEZOMETER DETAILS
			-1	2 30			• • • •	SP	SAND			Monument
			- - - 1	0.50 1.80	DS 0.30-0.40 m				fine to medium grained, brown, trace medium plasticity clay	м	D	Grout Grout
	L		- - 2	<u>1.50</u> 0.80 <u>2.00</u> 0.30	DS 2.00-2.10 m				pale brown, trace shells	-	VD	
004 Datgel Tools			- - 3							w	D	Sand -
rawingFile>> 04/02/2021 09:38 8.30			- 4 - -	<u>4.50</u> -2.20				CI	CLAY medium plasticity, pale brown mottled orange, with fine grained sand		D - VD	
GINT 20446551.GPJ < <d< td=""><td>м</td><td></td><td>5</td><td>-3.20</td><td>DS 4.90-5.00 m</td><td></td><td></td><td></td><td>END OF BOREHOLE @ 5.50 m</td><td>w&gt; PL</td><td>VSt</td><td></td></d<>	м		5	-3.20	DS 4.90-5.00 m				END OF BOREHOLE @ 5.50 m	w> PL	VSt	
GLB Log GAP NON-CORED FULL PAGE			6   						TARGET DEPTH GROUNDWATER ENCOUNTERED @ 2.00 m DEPTH			
GAP 8_16.8 LIB.	_1		7—	T geot	his report of borehole echnical purposes on information only a	e mus ily, w and o	st be re ithout a do not	ead ir atterr nece	n conjunction with accompanying notes and abbreviations. Ipt to assess possible contamination. Any references to pot ssarily indicate the presence or absence of soil or groundwa	lt has entia ater c	s beer I cont contar	n prepared for tamination are for mination. GAP gINT FN. F01d RL3



# **REPORT OF BOREHOLE: BH4**

CLIENT:	Graben Pty Ltd
PROJECT:	Wave Park
LOCATION:	Mowbray
JOB NO:	20446551

COORDS: 338435.0 m 8169675.0 m MGA2020 55 SURFACE RL: 2.20 m DATUM: AHD INCLINATION: -90° HOLE DEPTH: 5.50 m




GAP 8\_16.8 LIB.GLB Log GAP DCP PSP GINT 20446551.GPJ <<DrawingFile>> 01/02/2021 11:02 8.30.004 Dagel Tools



# GOLDER

Graben Pty Ltd

Wave Park

Mowbray

CLIENT: PROJECT: LOCATION:

## **REPORT OF DCP TESTS**

SHEET: 2 OF 2

CHECKED: SB

DATE: 14/1/21



Appendix B

# Laboratory Testing Certificates - Geotechnical



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

## **MOISTURE CONTENT REPORT**

Client:	Golder Ass	sociates Pty Ltd	Report Number:	11512/R/32238-1	
Client Address:	216, Drape	er Street, Cairns	Project Number:	11512/P/760	
Project:	20446551	- Mowbray	Lot Number:		
Location:	Cairns		Internal Test Request:	11512/T/16458	
Component:	20446551		Client Reference/s:	20446551 - Mowbray	
Area Description:	Mowbray		Report Date / Page:	25/01/2021	Page 1 of 1

Test Procedures:	AS1289.2.1.1			
Sample Number	11512/S/83624	11512/S/83625	11512/S/83626	11512/S/83627
ID / Client ID				
Lot Number	-	-	-	-
Date / Time Sampled	14/01/2021	14/01/2021	14/01/2021	14/01/2021
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Sampled By	Client Sampled	Client Sampled	Client Sampled	Client Sampled
Tested By	Jacqueline Pohlner	Jacqueline Pohlner	Jacqueline Pohlner	Jacqueline Pohlner
Date Tested	14/01/2021	14/01/2021	14/01/2021	14/01/2021
Material Source	Not Supplied	Not Supplied	Not Supplied	Not Supplied
Material Type	Not Supplied (Not Supplied)			
ID	TP1	TP2	TP3	TP4
Depth (M)	0.8-0.9	1.1-1.2	0.5-0.6	1.5-1.6
Moisture Content (%)	13.7	19.1	13.0	22.2

Sample Number	11512/S/83628	11512/S/83629
ID / Client ID		
Lot Number	-	-
Date / Time Sampled	14/01/2021	14/01/2021
Sampling Method	Tested As Received	Tested As Received
Sampled By	Client Sampled	Client Sampled
Tested By	Jacqueline Pohlner	Jacqueline Pohlner
Date Tested	14/01/2021	15/01/2021
Material Source	Not Supplied	Not Supplied
Material Type	Not Supplied (Not Supplied)	Not Supplied (Not Supplied)
ID	TP6	TP8
Depth (M)	1.5-1.6	1.8-1.9
Moisture Content (%)	5.8	31.1

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Auction

Approved Signatory: Craig Wilson Form ID: W20Rep Rev 3



Address: Shed 3, 5 Commercial Place

Earlville QLD 4870

LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

## **QUALITY OF MATERIALS REPORT**

Client:	Golder Associate	es Pty Ltd				Report N	lumber:	11512/R/32239-1	
Client Address:	216, Draper Stre	et, Cairns				Project N	Number:	11512/P/760	
Project:	20446551 - Mow	/bray				Lot Num	ber:		
Location:	Cairns					Internal	Test Request:	11512/T/16458	
Component:	20446551					Client Re	eference/s:	20446551 - Mowbra	ау
Area Description:	Mowbray					Report D	Date / Page:	25/01/2021	Page 1 of 6
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, /	AS1289.3.2.1,	AS12	289.3.4.1, AS	61289.2.1	.1, AS 1289.3.3.	1	
Sample Number	11512/S/83624				ID		Т	P1	
Sampling Method	Tested As Recei	ved			Depth (M)		0	.8-0.9	
Date Sampled	14/01/2021								
Sampled By	Client Sampled								
Date Tested	18/01/2021				Material So	ource	Not Supplied		
Att. Drying Method	Oven Dried				Material Ty	/pe	Not Supplied (N	lot Supplied)	
Atterberg Preparation	Dry Sieved				Material De	escription	CI Sandy Clay,	medium plasticity,	trace of gravel, or
AS Sieve (mm)	Specification Minimum (%)	Percent Passing (%)	Specification Maximum (%)		F	PARTICL	E SIZE DISTR	IBUTION GRAPH	4
19.0		100		1	100 -				
9.5		100			90				
6.7		99			80	/			
4.75		99			70				
2.36		98		(%)	/0				
1.18		96		gui	60				
0.600		93		SSP	50				
0.425		90		ent	40				
0.300		86		erce					
0.150		76		α.	30 -				
0.075		66			20				
					10				
					0 1				
					2	0	0 0 0	- 12 -	6. 9. 13 19
					075	150	\$00 \$25	18 <mark>36 75</mark>	7 01 <mark>1</mark> 2 10
							AS Sieve	Size (mm)	
Test Result	Specification Minimum (%)	Result	Specification Maximum (%)		Test Resu	ılt	Specification Minimum (%)	Result (%)	Specification Maximum (%)
Liquid Limit (%)		36		0.07	5/0.425 Fine	s Ratio		0.73	
Plastic Limit (%)		20		PIx	0.425 Ratio	(%)		1438.4	
Plastic Index (%)		16		LS x	0.425 Ratio	(%)		629.3	
Linear Shrinkage (%)		7.0		Linea	ar Shrinkage	Defects	Cracking	•	•

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

Address:

# **QUALITY OF MATERIALS REPORT**

	-		/						
Client:	Golder Associat	es Pty Ltd				Report N	Number:	11512/R/32239-1	
Client Address:	216, Draper Stre	et, Cairns				Project I	Number:	11512/P/760	
Project:	20446551 - Mov	/bray				Lot Num	iber:		
Location:	Cairns					Internal	Test Request:	11512/T/16458	
Component:	20446551					Client R	eference/s:	20446551 - Mowbra	ау
Area Description:	Mowbray					Report D	Date / Page:	25/01/2021	Page 2 of 6
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, /	AS1289.3.2.1,	, AS1	1289.3.4.1, AS	61289.2.1	.1, AS 1289.3.3	.1	
Sample Number	11512/S/83625				ID			TP2	
Sampling Method	Tested As Rece	ived			Depth (M)			1.1-1.2	
Date Sampled	14/01/2021								
Sampled By	Client Sampled								
Date Tested	18/01/2021				Material So	ource	Not Supplied		
Att. Drying Method	Oven Dried				Material Ty	/pe	Not Supplied	Not Supplied)	
Atterberg Preparation	Dry Sieved				Material De	escription	CI Clay, medi	um plasticity, trace o	f sand, red brown
AS Sieve (mm)	Specification Minimum (%)	Percent Passing (%)	Specification Maximum (%)		I	PARTICL	E SIZE DIST	RIBUTION GRAPH	4
19.0		100		1	100		~ · · · · · · · · · · · · · · · · · · ·		
2.36		100			90				
1.18		99			80				
0.600		98		_	70				
0.425		98		(%)					
0.300		98		sing	60				
0.150		96		Pas	50				
0.075		94		ent	40				
				Perc	30				
					20				
					10				
					o 1,				
					0.0	0.15	0.60	4.79 2.36 1.18	19.0 9.5 6.7
					ŭ	8	8 6 8	- Cine (mm)	10 0
							AS SIEV	e Size (mm)	
Test Result	Specification Minimum (%)	Result	Specification Maximum (%)		Test Resu	ılt	Specification Minimum (%)	Result (%)	Specification Maximum (%)
Liquid Limit (%)		37		0.0	75/0.425 Fine	es Ratio		0.96	
Plastic Limit (%)		20		PL	x 0.425 Ratio	(%)		1667.7	
Plastic Index (%)		17		LS	x 0.425 Ratio	(%)		784.8	
Linear Shrinkage (%)		8.0		Lin	ear Shrinkage	e Defects	-		

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

Address:

# **QUALITY OF MATERIALS REPORT**

Client:	Golder Associate	es Pty Ltd				Report N	lumber:	11512/R/32239-1	
Client Address:	216, Draper Stre	et, Cairns				Project N	Number:	11512/P/760	
Project:	20446551 - Mow	/bray				Lot Num	ber:		
Location:	Cairns					Internal	Test Request:	11512/T/16458	
Component:	20446551					Client Re	eference/s:	20446551 - Mowbra	ау
Area Description:	Mowbray					Report D	Date / Page:	25/01/2021	Page 3 of 6
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, J	AS1289.3.2.1,	AS12	289.3.4.1, AS	61289.2.1	.1, AS 1289.3.3	.1	
Sample Number	11512/S/83626				ID		-	ГРЗ	
Sampling Method	Tested As Rece	ived			Depth (M)		(	0.5-0.6	
Date Sampled	14/01/2021								
Sampled By	<b>Client Sampled</b>								
Date Tested	18/01/2021				Material So	ource	Not Supplied		
Att. Drying Method	Oven Dried				Material Ty	/pe	Not Supplied (	Not Supplied)	
Atterberg Preparation	Dry Sieved			_	Material De	escription	CL Sandy Cla	y, low plasticity, yello	ow brown.
AS Sieve (mm)	Specification Minimum (%)	Percent Passing (%)	Specification Maximum (%)		F	PARTICL	E SIZE DISTR	IBUTION GRAPH	4
19.0		100			100				
2.36		100			90		/		
1.18		99			80	/			
0.600		99			70				
0.425		97		(%)					
0.300		95		sing	60	1			
0.150		51		Pass	50				
0.075		42		ent	40				
				Perc	20				
				-	30 -				
					20				
					10				
					o 1				<u></u>
					0.0	0.1	0.4	4.7 2.3	19. 13. 9.5
					75	50	8 2 8	о <del>о</del> и	N 0
							AS Sieve	e Size (mm)	
Test Result	Specification Minimum (%)	Result	Specification Maximum (%)		Test Resu	llt	Specification Minimum (%)	Result (%)	Specification Maximum (%)
Liquid Limit (%)		23		0.07	75/0.425 Fine	s Ratio		0.43	
Plastic Limit (%)		16		Pl x	0.425 Ratio	(%)		681.8	
Plastic Index (%)		7		LS ×	x 0.425 Ratio	(%)		340.9	
Linear Shrinkage (%)		3.5		Line	ear Shrinkage	e Defects	-		

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

Address:

# **QUALITY OF MATERIALS REPORT**

Client:	Golder Associat	es Pty Ltd				Report N	Number:	11512/R/32239-1	
Client Address:	216, Draper Stre	et, Cairns				Project N	Number:	11512/P/760	
Project:	20446551 - Mov	vbray				Lot Num	ıber:		
Location:	Cairns					Internal	Test Request:	11512/T/16458	
Component:	20446551					Client R	eference/s:	20446551 - Mowbr	ay
Area Description:	Mowbray					Report D	Date / Page:	25/01/2021	Page 4 of 6
Test Procedures	AS1289.3.6.1, A	S1289.3.1.2, /	AS1289.3.2.1,	, AS1	1289.3.4.1, A	S1289.2.1	1, AS 1289.3.3	9.1	
Sample Number	11512/S/83627				ID			TP4	
Sampling Method	Tested As Rece	ived			Depth (M)			1.5-1.6	
Date Sampled	14/01/2021								
Sampled By	Client Sampled								
Date Tested	19/01/2021				Material S	ource	Not Supplied		
Att. Drying Method	Oven Dried				Material T	уре	Not Supplied	(Not Supplied)	
Atterberg Preparation	Dry Sieved				Material D	escription	CL Clay, low p	plasticity, with sand,	trace of gravel, ye
AS Sieve (mm)	Specification Minimum (%)	Percent Passing (%)	Specification Maximum (%)			PARTICL	E SIZE DIST	RIBUTION GRAPH	4
19.0		100		1	100				
4.75		100			90	/			
2.36		100			80				
1.18		99		_	70				
0.600		98		(%)					
0.425		98		sing	60				
0.300		97		Pas	50				
0.150		87		ent	40				
0.075		74		Perc	30				
					20				
					10				
					0 1,				
					0.07	0.15	0.60	4.75 2.36 1.18	19.0 9.5 6.7
					ŭ	8	ð íð ð	a Siza (mm)	
							AS SIEV	e Size (mm)	1
Test Result	Specification Minimum (%)	Result	Specification Maximum (%)		Test Res	ult	Specification Minimum (%)	Result (%)	Specification Maximum (%)
Liquid Limit (%)		28		0.0	75/0.425 Fine	es Ratio		0.76	
Plastic Limit (%)		16		PL	x 0.425 Ratio	(%)		1172.4	
Plastic Index (%)		12		LS	x 0.425 Ratio	v (%)		586.2	
Linear Shrinkage (%)		6.0		Lin	ear Shrinkag	e Defects	-		

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number: 1986 11512 Chilban

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

# **QUALITY OF MATERIALS REPORT**

Client:	Golder Associa	ates Pty Ltd			Report N	Number: 1	1512/R/32239-1	
Client Address:	216, Draper St	reet, Cairns			Project N	Number: 1	1512/P/760	
Project:	20446551 - Mo	owbray			Lot Num	ber:		
Location:	Cairns				Internal	Test Request: 1	1512/T/16458	
Component:	20446551				Client Re	eference/s: 2	0446551 - Mowbra	ау
Area Description:	Mowbray				Report D	Date / Page: 2	5/01/2021	Page 5 of 6
Test Procedures	AS1289.3.6.1,	AS1289.3.1.2, A	S1289.3.2.1,	, AS1289.3.4.1, A	S 1289.3.3	3.1		
Sample Number	11512/S/83628	3		ID		TF	P6	
Sampling Method	Tested As Rec	eived		Depth (M)		1.	5-1.6	
Date Sampled	14/01/2021							
Sampled By	Client Sample	Ł						
Date Tested	19/01/2021			Material S	ource	Not Supplied		
Att. Drying Method	Oven Dried			Material T	уре	Not Supplied (N	ot Supplied)	
Atterberg Preparation	Dry Sieved			Material D	escription	SP SAND, with	trace silt, yellow br	own.
AS Sieve (mm)	Specification Minimum (%	Percent ) Passing (%)	Specification Maximum (%)		PARTICL	E SIZE DISTRI	BUTION GRAPH	4
19.0		100		100		-	· ·	
2.36		100		90				
1.18		100		80				
0.600		100		70	/			
0.425		99		8				
0.300		97		문 60 ·	- 1			
0.150		10		Se 50				
0.075		2		1 40				
				erce				
				<u> </u>				
				20	1			
				10				
					0		- 12 -	6 9 13 19
				075	150	425 <sup>10</sup>	12 36 75	7 <mark>6 8</mark> .2
						AS Sieve	Size (mm)	
Test Result	Specification Minimum (%	Result	Specification Maximum (%)	Test Res	ult	Specification Minimum (%)	Result (%)	Specification Maximum (%)
Liquid Limit (%)		Not Obtainable	e	0.075/0.425 Fin	es Ratio		0.02	
Plastic Limit (%)		Not Obtainable	e	PI x 0.425 Ratio	(%)		-	1
Plastic Index (%)		Non Plastic		LS x 0.425 Ratio	o (%)		0.0	1
Linear Shrinkage (%)		0.0		Linear Shrinkag	e Defects	-	1	L

Remarks Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 – Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

# **QUALITY OF MATERIALS REPORT**

Client:	Golder Associ	ates Pty Ltd				Report N	Number:	11512/R/32239-1		
Client Address:	216, Draper S	treet, Cairns				Project N	Project Number: 11512/P/760			
Project:	20446551 - M	owbray				Lot Num	Lot Number:			
Location:	Cairns					Internal	Test Request:	11512/T/16458		
Component:	20446551	20446551					eference/s:	20446551 - Mowbra	ay	
Area Description:	Mowbray					Report D	Date / Page:	25/01/2021	Page 6 of 6	
Test Procedures	AS1289.3.6.1	AS1289.3.1.2, /	AS1289.3.2.1,	AS1	289.3.4.1, AS	S 1289.3.3	3.1			
Sample Number	11512/S/8362	9			ID		T	P8		
Sampling Method	Tested As Re	ceived			Depth (M)		1	.8-1.9		
Date Sampled	14/01/2021									
Sampled By	Client Sample	d								
Date Tested	20/01/2021				Material So	ource	Not Supplied			
Att. Drying Method	Oven Dried				Material Ty	ype	Not Supplied (I	Not Supplied)		
Atterberg Preparation	Dry Sieved Material De				escription	SW SAND, wit	n some gravel and s	silt, black.		
AS Sieve (mm)	Specificatio Minimum (%	n Percent b) Passing (%)	Specification Maximum (%)		1	PARTICL	E SIZE DISTR	IBUTION GRAPH	H	
26.5	100									
19.0	95 90				90			•		
13.2		92			80					
9.5		91			70					
6.7		88		(%)	/0	/				
4.75		83		Bui	60	_/				
2.36		77		ass	50	_/_				
1.18		73		ent F	40	1				
0.600		71		erce		/				
0.425		70		<u>u</u>	30 -					
0.300		68			20					
0.150		42			10					
0.075		11								
					0.075	0.150	- 1.18 - 0.600 - 0.425	4.75 2.36	· 26.5 · 19.0 · 13.2 · 9.5	
	ŭ				-	AS Sieve	Size (mm)			
Test Result	Specificatio Minimum (%	n <b>Result</b>	Specification Maximum (%)		Test Resu	ult	Specification Minimum (%)	Result (%)	Specification Maximum (%)	
Liquid Limit (%)		Not Obtainabl	е	0.075/0.425 Fine				0.16		
Plastic Limit (%)		Not Obtainabl	е	PI x	0.425 Ratio	(%)		-		
Plastic Index (%)		Non Plastic		LS	x 0.425 Ratio	o (%)		0.0		
Linear Shrinkage (%)		0.0		Line	ear Shrinkage	e Defects	-			

Remarks Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W85Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

# **EMERSON CLASS NUMBER REPORT**

Client:	Golder As	sociates Pty Ltd		Rep	ort Number:	11512/R	/32240-1	
Client Address:	216, Drap	er Street, Cairns		Proje	ect Number:	11512/P/	/760	
Project:	20446551	- Mowbray		Lot Number:				
Location:	Cairns			Inter	(16458			
Component:	20446551			Clier	nt Reference/s:	2044655	1 - Mowbray	
Area Description:	Mowbray			Rep	ort Date / Page:	25/01/20	21 Page 1 of 2	
Test Procedures:		AS1289.3.8.1						
Sample Number		11512/S/83624	11512/S/83625		11512/S/836	26	11512/S/83627	
ID / Client ID								
Lot Number		-	-		-		-	
Date / Time Sampled		14/01/2021	14/01/2021		14/01/2021	l	14/01/2021	
Date Tested		15/01/2021	15/01/2021		15/01/2021	l	15/01/2021	
Material Source		Not Supplied	Not Supplied		Not Supplie	d	Not Supplied	
Material Type		Not Supplied (Not Supplied)	Not Supplied (Not Suppl	ied)	Not Supplied (Not S	Supplied)	Not Supplied (Not Supplied)	
Sampling Method		Tested As Received	Tested As Received		Tested As Rece	eived	Tested As Received	
Water Type		Distilled	Distilled		Distilled		Distilled	
Water Temperature (0	C°)	25	25		25		25	
ID		TP1	TP2		TP3		TP4	
Depth (M)		0.8-0.9	1.1-1.2		0.5-0.6		1.5-1.6	
Soil Description		CI Sandy Clay, medium plasticity,	Cl Clay, medium plasticity, t	race of	CL Sandy Clay, low pl	asticity, yell	CL Clay, low plasticity, with sand, t	
Emerson Class Num	ber	6	6		6		2	

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Auklan

Approved Signatory: Craig Wilson Form ID: W34Rep Rev 2



LaboratoryCairns LaboratoryPhone:07 4033 7815Fax:07 4054 6632Email:Cairns@constructionsciences.net

Shed 3, 5 Commercial Place Earlville QLD 4870

## **EMERSON CLASS NUMBER REPORT**

Client:	Golder As	sociates Pty Ltd		Rep	ort Number:	11512/R	/32240-1	
Client Address:	216, Drape	er Street, Cairns		Proje	ect Number:	11512/P	/760	
Project:	20446551	- Mowbray		Lot I	Number:			
Location:	Cairns			Inter	rnal Test Request:	11512/T/	/16458	
Component:	20446551			Clier	nt Reference/s:	2044655	1 - Mowbray	
Area Description:	Mowbray			Rep	ort Date / Page:	25/01/20	21	Page 2 of 2
Test Procedures:		AS1289.3.8.1						
Sample Number		11512/S/83628	11512/S/83629					
ID / Client ID								
Lot Number		-	-					
Date / Time Sampled		14/01/2021	14/01/2021					
Date Tested		15/01/2021	20/01/2021					
Material Source		Not Supplied	Not Supplied					
Material Type		Not Supplied (Not Supplied)	Not Supplied (Not Suppl	ied)				
Sampling Method		Tested As Received	Tested As Received					
Water Type		Distilled	Distilled					
Water Temperature (C	C°)	24	26					
ID		TP6	TP8					
Depth (M)		1.5-1.6	1.8-1.9					
Soil Description		SP SAND, with trace silt, yellow br	SW SAND, with some grav	el and				
Emerson Class Num	ber	6	4					

Remarks

Results apply to the sample/s as received.

Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation Number: Corporate Site Number:

Chillson

Approved Signatory: Craig Wilson Form ID: W34Rep Rev 2

Appendix C

Acid Sulfate Soil Summary Results and Laboratory Certificates, Groundwater Quality Laboratory Test Certificates

#### Acid Sulfate Soil Screening Test Results



Client: Project: -Location:

GARBEN PTY LTD GEOTECHNICAL SITE ASSESMENT - PORT DOUGLAS WAVE PARK PROPOSED WAVE PARK

GOLD	DER Job No:	2044655	1						
Borehole ID	Sample Depth Range (m bgl)	Sample Depth Range (RL m AHD)	Sampled Date	Soil Type	(J) Hđ pH Units	AASS Likelihood	Hd (Field Ox) DH	Reaction Rate	PASS Likelihood
	0 - 0.1	2.40 - 2.30	21/12/2020	Clayey SAND	4.3	Nil	4.4	L	Low
	0.4 - 0.5	2.00 - 1.90	21/12/2020	SAND	5.8	Nil	5.4	L	Low
	1 - 1.1	1.40 - 1.30	21/12/2020	Sandy CLAY	6.2	Nil	5.0	L	Low
TP2	1.1 - 1.2	1.30 - 1.20	21/12/2020	CLAY	5.7	Nil	4.2	L	Low
11 2	1.5 - 1.6	0.90 - 0.80	21/12/2020	CLAY	5.3	Nil	4.0	L	Low
	2 - 2.1	0.40 - 0.30	21/12/2020	CLAY	5.6	Nil	4.8	М	Low
	2.5 - 2.6	-0.100.20	21/12/2020	CLAY	6.3	Nil	5.7	L	Low
	3 - 3.1	-0.600.70	21/12/2020	CLAY	6.9	Nil	5.8	М	Low
	0 - 0.1	2.20 - 2.10	21/12/2020	Silty Sandy CLAY	5.7	Nil	4.1	L	Low
	0.5 - 0.6	1.70 - 1.60	21/12/2020	Clayey SAND	4.5	Nil	3.3	L	Inconclusive
	1 - 1.1	1.20 - 1.10	21/12/2020	Clayey SAND	4.6	Nil	4.6	L	Low
TP3	1.5 - 1.6	0.70 - 0.60	21/12/2020	CLAY	4.2	Nil	4.3	L	Low
	2 - 2.1	0.20 - 0.10	21/12/2020	CLAY	5.8	Nil	5.0	М	Low
	2.5 - 2.6	-0.300.40	21/12/2020	CLAY	6.5	Nil	5.5	L	Low
	3 - 3.1	-0.800.90	21/12/2020	CLAY	6.8	Nil	5.9	L	Low
	0.1 - 0.2	2.10 - 2.00	21/12/2020	SAND	6.2	Nil	4.5	М	Low
	0.5 - 0.6	1.70 - 1.60	21/12/2020	Clayey SAND	5.5	Nil	4.2	L	Low
	1 - 1.1	1.20 - 1.10	21/12/2020	Clayey SAND	5.9	Nil	4.8	М	Low
TP5	1.5 - 1.6	0.70 - 0.60	21/12/2020	Sandy CLAY	5.6	Nil	5.2	М	Low
	2.2 - 2.3	0.000.10	21/12/2020	CLAY	7.6	Nil	2.8	М	Strong Indication
	2.5 - 2.6	-0.300.40	21/12/2020	CLAY	6.2	Nil	5.8	L	Low
	3 - 3.1	-0.800.90	21/12/2020	CLAY	7.2	Nil	6.8	L	Low
	0.1 - 0.2	1.70 - 1.60	21/12/2020	SAND	8.3	Nil	3.9	L	Inconclusive
	0.5 - 0.6	1.30 - 1.20	21/12/2020	SAND	7.2	Nil	6.4	L	Low
	1 - 1.1	0.80 - 0.70	21/12/2020	SAND	8.1	Nil	3.9	L	Low
TP8	1.5 - 1.6	0.30 - 0.20	21/12/2020	SAND	6.2	Nil	4.7	L	Low
	1.8 - 1.9	0.000.10	21/12/2020	SAND	7.1	Nil	5.9	L	Low
	2.5 - 2.6	-0.700.80	21/12/2020	SAND	7.5	Nil	6.2	L	Low
	3 - 3.1	-1.201.30	21/12/2020	SAND	8.2	Nil	6.1	L	Low
Notes:	-	-		-		-		-	-

1) AASS potential is indicated by:  $pH_F \leq 4.0$ 

2) PASS potenital is indicated by:

 $\blacksquare$  Strong indication: pH  $_{FOX}$  <3, large  $\Delta pH$  and a strong reaction with hydrogen peroxide.

Inconclusive: pH<sub>FOX</sub> 3 – 4 and low, medium or strong reaction with hydrogen peroxide

Low indication: pH<sub>FOX</sub> > 4 and low, medium or strong reaction with hydrogen peroxide.
3) pH Fox Reaction Rate: L - Low; M - Medium; H - High; X - Extreme; V - Volcanic

		Acid Sulf	ate Soi	l Summa	ry of Chromiur	m Suite A	nalysis										
GOLD	ER	Client:   Graben Pty Ltd     Project:   Geotechnical Site Assesment     Location:   Lot 123 on SR687. 5640 Captain Cook Highway, Mowbray     Job No:   20446551															
Test Location	Depth Ra	nge (m bgl)	Samp Range (	le Depth RL m AHD)	Material Description	pH <sub>FIELD</sub>	рН <sub>ксі</sub>	sTAA (% pyrite S)	S <sub>NAS</sub> (if pH less than 4.5)	Existing / (sTAA + (	Acidity % S ).75 x S <sub>NAS</sub> )	Chromium Reducible Sulfur (S <sub>CR</sub> ) % S	Acid Neutralising Capacity % CaCO3 (if pH more than 6.5)	Net Acidity (%S) (SCR+Existing Acidity) excluding ANC	ls This AASS	ls This PASS	Liming Rate (kg CaCO <sub>3</sub> /m3)
TP2	0.4	0.5	2	1.9	SAND	5.8	6.3	<0.01			0.000	< 0.005		0.000	No	No	NA
TP3	0.1	0.2	2.1	2	Sandy CLAY	5.7	5.8	< 0.01			0.000	< 0.005		0.000	No	No	NA
TP3	1	1.1	1.2	1.1	Clayey SAND	4.6	5.1	0.02			0.020	< 0.005		0.020	No	No	NA
TP5	1	1.1	1.2	1.1	Clayey SAND	5.9	6.2	<0.01			0.000	0.005		0.005	No	No	NA
TP5	2.2	2.3	0	-0.1	CLAY	7.6	6.4	< 0.01			0.000	0.51		0.510	No	YES	38.6
TP6	2.1	2.2	0.5	0.4	SAND		9.7	<0.01			0.000	< 0.005	11	0.000	No	No	NA
TP8	1.8	1.9	0	-0.1	SAND	7.1	9.5	< 0.01			0.000	0.21	11	0.210	No	YES	15.9
TP8	2.5	2.6	-0.7	-0.8	SAND	7.5	9.6	< 0.01			0.000	0.19	4.7	0.190	No	YES	14.4
														ASS action criteria ≥0.03 %S			
Note: 1. Liming ra 2. Fineness	te: 1. Liming rates assume a bulk density of 1.60 t/m3																





CLIENT DETAILS		LABORATORY DETAI	LS
Contact	Calum Dunsworth	Manager	Anthony Nilsson
Client	GOLDER ASSOCIATES PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 5823	Address	Unit 2, 58 Comport St
	216 DRAPER ST		Portsmith QLD 4870
	CAIRNS QLD 4870		
Telephone	07 4054 8200	Telephone	+61 07 4035 5111
Facsimile	07 4054 8201	Facsimile	+61 07 4035 5122
Email	CDunsworth@golder.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	20446551	SGS Reference	CE150309 R0
Order Number	(Not specified)	Date Received	13 Jan 2021
Samples	8	Date Reported	18 Jan 2021

COMMENTS .

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146/19038)

SIGNATORIES \_

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### CE150309 R0

	San Sa Si Si Si	nple Number CE1 ample Matrix ample Depth ample Name	50309.001 CE150309.00 Soil Soil 0.4-0.5 0.1-0.2 TP2 TP3	02 CE150309.003 Soil 1.0-1.1 TP3	CE150309.004 Soil 1.0-1.0 TP5
Parameter	Units	LOR			
Moisture Content Method: AN002 Tested: 14/1/2021					
% Moisture	%w/w	0.5	4.1 16	12	13

#### TAA (Titratable Actual Acidity) Method: AN219 Tested: 15/1/2021

рН КСІ	pH Units	-	6.3	5.8	5.1	6.2
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	<0.25	0.61	<0.25
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	<5	12	<5
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01	0.02	<0.01
Sulphur (SKCI)	%w/w	0.005	-	-	-	-

### Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 18/1/2021

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

### Acid Neutralising Capacity (ANC) Method: AN214 Tested: 15/1/2021

Acid Neutralisation Capacity (ANCBT) as % CaCO <sub>3</sub>	% CaCO3	0.1	-	-	-	-
Acid Neutralisation Capacity (ANCBT) as kg H <sub>2</sub> SO <sub>4</sub> /t	kg H2SO4/T	0.1	-	-	-	-
ANC as % CaCO <sub>3</sub>	% CaCO3	0.1	-	-	-	-
Lime Equivalence	% CaCO3	0.1	-	-	-	-



### CE150309 R0

	San Sa Sa Sa Sa	nple Number ( ample Matrix ample Depth ample Name	CE150309.005 Soil 2.2-2.3 TP5	CE150309.006 Soil 2.1-2.2 TP6	CE150309.007 Soil 1.8-1.9 TP8	CE150309.008 Soil 2.5-2.6 TP8
Parameter	Units	LOR				
Moisture Content Method: AN002 Tested: 14/1/2021						
% Moisture	%w/w	0.5	16	21	26	24

#### TAA (Titratable Actual Acidity) Method: AN219 Tested: 15/1/2021

pH KCI	pH Units	-	6.4	9.7	9.5	9.6
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	<0.25	<0.25	<0.25
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	<5	<5	<5
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01	<0.01	<0.01
Sulphur (SKCI)	%w/w	0.005	-	-	-	-

### Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 18/1/2021

Chromium Reducible Sulphur (Scr)	%	0.005	0.51	<0.005	0.21	0.19		
Chromium Reducible Sulphur (Scr)	moles H+/T	5	319	<5	132	117		

### Acid Neutralising Capacity (ANC) Method: AN214 Tested: 15/1/2021

Acid Neutralisation Capacity (ANCBT) as % CaCO <sub>3</sub>	% CaCO3	0.1	-	11	11	4.7
Acid Neutralisation Capacity (ANCBT) as kg H <sub>2</sub> SO <sub>4</sub> /t	kg H2SO4/T	0.1	-	110	110	46
ANC as % CaCO <sub>3</sub>	% CaCO3	0.1	-	11	11	4.7
Lime Equivalence	% CaCO3	0.1	-	11	11	4.7



#### 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.

#### Acid Neutralising Capacity (ANC) Method: ME-(AU)-[ENV]AN214

Parameter	QC	Units	LOR	MB	LCS
	Reference				%Recovery
Acid Neutralisation Capacity (ANCBT) as % CaCO <sub>3</sub>	LB085803	% CaCO3	0.1	<0.1	96%
Acid Neutralisation Capacity (ANCBT) as kg H <sub>2</sub> SO <sub>4</sub> /t	LB085803	kg H2SO4/T	0.1	<0.1	NA
ANC as % CaCO <sub>3</sub>	LB085803	% CaCO3	0.1	<0.1	NA
Lime Equivalence	LB085803	% CaCO3	0.1	<0.1	

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

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS
	Reference					%Recovery
Chromium Reducible Sulphur (Scr)	LB085872	%	0.005	<0.005	0%	87%
Chromium Reducible Sulphur (Scr)	LB085872	moles H+/T	5	<5		

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

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS
	Reference					%Recovery
рН КСІ	LB085801	pH Units	-	5.7	0 - 2%	98%
Titratable Actual Acidity	LB085801	kg H2SO4/T	0.25	<0.25	0%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB085801	moles H+/T	5	<5	0%	92%
Titratable Actual Acidity (TAA) S%w/w	LB085801	%w/w S	0.01	<0.01	0%	92%



### **METHOD SUMMARY**

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.
AN214	Acid Neutralising Capacity (ANC)or Neutralising Value (NV): The crushed or as received sample is reacted with excess normal acid (HCI) and then back titrated with standard sodium hydroxide to determine the acid consumed. The result is expressed as kg H2SO4/tonne or %CaCO3. Based on AS4969-13.
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulfide (H2S) which is collected and titrated with iodine (I2(aq)) to measure SCR.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCI 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.



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 QFH QC result is above the upper tolerance performance of this service QFL QC result is below the lower tolerance ++ Indicative data, theoretical holding time exceeded. The sample was not analysed for this analyte

NVI

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 calcuated 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:

- a. 1 Bq is equivalent to 27 pCi
- b. 37 MBq is equivalent to 1 mCi

Indicates that both \* and \*\* apply.

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: <u>www.sqs.com.au/en-gb/environment-health-and-safety</u>.

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### SAMPLE RECEIPT ADVICE

- CLIENT DETAILS	CLIENT DETAILS LABORATORY DETAILS		
Contact	Calum Dunsworth	Manager	Anthony Nilsson
Client	GOLDER ASSOCIATES PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 5823	Address	Unit 2, 58 Comport St
	216 DRAPER ST		Portsmith QLD 4870
	CAIRNS QLD 4870		
Telephone	07 4054 8200	Telephone	+61 07 4035 5111
Facsimile	07 4054 8201	Facsimile	+61 07 4035 5122
Email	CDunsworth@golder.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	20446551	Samples Received	Wed 13/1/2021
Order Number	(Not specified)	Report Due	Thu 21/1/2021
Samples	8	SGS Reference	CE150309

\_ SUBMISSION DETAILS

This is to confirm that 8 samples were received on Wednesday 13/1/2021. Results are expected to be ready by COB Thursday 21/1/2021. Please quote SGS reference CE150309 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Samples clearly labelled	Yes	Complete documentation received	Yes
Sample container provider	SGS	Sample cooling method	Ice Bricks
Samples received in correct containers	Yes	Sample counts by matrix	8 Soils
Date documentation received	13/1/2021	Type of documentation received	COC
Number of eskies/boxes received	1	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	Chilled
Sufficient sample for analysis	Yes	Turnaround time requested	Standard
Sufficient sample for analysis	Yes	I urnaround time requested	Standard

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS -

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SGS Australia Pty Ltd ABN 44 000 964 278



### SAMPLE RECEIPT ADVICE

#### - CLIENT DETAILS -

#### Client GOLDER ASSOCIATES PTY LTD

Project 20446551

SUMMARY	OF ANALYSIS					
No.	Sample ID	Acid Neutralising Capacity (ANC)	Chromium Reducible Sulphur (CRS)	HCI Extractable S, Ca and Mg in Soil ICP OES	Moisture Content	TAA (Titratable Actual Acidity)
001	TP2 0.4-0.5	4	2	1	1	5
002	TP3 0.1-0.2	4	2	1	1	5
003	TP3 1.0-1.1	4	2	1	1	5
004	TP5 1.0-1.0	4	2	1	1	5
005	TP5 2.2-2.3	4	2	1	1	5
006	TP6 2.1-2.2	4	2	1	1	5
007	TP8 1.8-1.9	4	2	1	1	5
008	TP8 2.5-2.6	4	2	1	1	5

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document. The numbers shown in the table indicate the number of results requested in each package. Please indicate as soon as possible should your request differ from these details . Testing as per this table shall commence immediately unless the client intervenes with a correction .





CLIENT DETAILS		LABORATORY DETAIL	LS
Contact	Dustin Peacocke	Manager	Anthony Nilsson
Client	GOLDER ASSOCIATES PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 5823	Address	Unit 2, 58 Comport St
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Telephone	07 4054 8200	Telephone	+61 07 4035 5111
Facsimile	07 4054 8201	Facsimile	+61 07 4035 5122
Email	DPeacocke@golder.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	20446551	SGS Reference	CE150386 R0
Order Number	(Not specified)	Date Received	15 Jan 2021
Samples	2	Date Reported	28 Jan 2021
		·	

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(3146/19038)

Metals - The Limit of Reporting (LOR) has been raised due to interferences from the sample matrix.

SIGNATORIES -

& Bergamo

Alyson BERGAMO Senior Laboratory Technician

Maristela GANZAN Quality Coordinator

Anthony NILSSON Operations Manager

Jon Dicker Manager Northern QLD

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1900

### CE150386 R0

		Sample Number Sample Matrix Sample Date Sample Name	CE150386.001 Water 15 Jan 2021 BH3	CE150386.002 Water 15 Jan 2021 BH4
Parameter	Units	LOR		
pH in water Method: AN101 Tested: 15/1/2021				
pH**	pH Units	0.1	7.8	7.8
Alkalinity Method: AN135 Tested: 15/1/2021				
Total Alkalinity as CaCO3	mg/L	5	160	220
Bicarbonate Alkalinity as CaCO3	mg/L	5	160	220
Carbonate Alkalinity as CaCO3	mg/L	5	<5	<5
Hydroxide Alkalinity as CaCO3	mg/L	5	<5	<5

#### Chloride by Discrete Analyser in Water Method: AN274 Tested: 27/1/2021

Chloride, Cl

### Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 22/1/2021

Aluminium, Al	mg/L	0.005	0.017	0.027
Calcium, Ca	mg/L	0.1	68	97
Iron, Fe	mg/L	0.005	0.066	0.90
Magnesium, Mg	mg/L	0.1	3.6	130
Potassium, K	mg/L	0.1	2.2	82
Sodium, Na	mg/L	0.5	19	980
Sulfur asSulfate, SO4	mg/L	0.5	8.3	300
Zinc, Zn	mg/L	0.005	<0.005	0.006
Total Hardness by Calculation	mg CaCO3/L	1	180	790

mg/L

### Metals in Water (Dissolved) by ICPOES-USN Method: AN320/AN322 Tested: 22/1/2021

Arsenic, As	mg/L	0.003	0.008	0.010
Cadmium, Cd	mg/L	0.0001	<0.0001	0.0003
Chromium, Cr	mg/L	0.001	<0.0010	<0.0020↑
Copper, Cu	mg/L	0.001	<0.001	<0.002↑
Lead, Pb	mg/L	0.001	<0.001	<0.002↑
Nickel, Ni	mg/L	0.001	<0.001	<0.002↑



	Sa	mple Number Sample Matrix Sample Date Sample Name	CE150386.001 Water 15 Jan 2021 BH3	CE150386.002 Water 15 Jan 2021 BH4	
Parameter	Units	LOR			
Mercury (dissolved) in Water Method: AN311(Perth)/A	h)/AN312 Tested: 21/1/2021				
Mercury	mg/L	0.00005	<0.00005	<0.00005	

### Calculation of Anion-Cation Balance (SAR Calc) Method: AN121 Tested: 28/1/2021

Sum of Cation Milliequivalents*	meq/L	-	4.58	60.5
Sum of Anion Milliequivalents*	meq/L	-	4.66	63.9
Anion-Cation Balance	%	-100	-0.8	-2.7



#### 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.

#### Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Alkalinity as CaCO3	LB085802	mg/L	5	<5	0 - 7%	107 - 115%
Bicarbonate Alkalinity as CaCO3	LB085802	mg/L	5	<5		
Carbonate Alkalinity as CaCO3	LB085802	mg/L	5	<5		
Hydroxide Alkalinity as CaCO3	LB085802	mg/L	5	<5		

### Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS
	Reference					%Recovery
Chloride, Cl	LB086166	mg/L	1	<1	0 - 1%	105 - 106%

#### Mercury (dissolved) in Water Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS	MS
	Reference					%Recovery	%Recovery
Mercury	LB086014	mg/L	0.00005	<0.00005	0%	96 - 98%	93 - 96%

#### Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC	Units	LOR	MB	LCS
	Reference				%Recovery
Aluminium, Al	LB086080	mg/L	0.005	<0.005	102%
Calcium, Ca	LB086080	mg/L	0.1	<0.1	105%
Iron, Fe	LB086080	mg/L	0.005	<0.005	107%
Magnesium, Mg	LB086080	mg/L	0.1	<0.1	98%
Potassium, K	LB086080	mg/L	0.1	<0.1	103%
Sodium, Na	LB086080	mg/L	0.5	<0.5	102%
Sulfur asSulfate, SO4	LB086080	mg/L	0.5	<0.5	
Zinc, Zn	LB086080	mg/L	0.005	<0.005	103%
Total Hardness by Calculation	LB086080	mg CaCO3/L	1	<1	



#### 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.

#### Metals in Water (Dissolved) by ICPOES-USN Method: ME-(AU)-[ENV]AN320/AN322

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Arsenic, As	LB086082	mg/L	0.003	<0.003	111%
Cadmium, Cd	LB086082	mg/L	0.0001	<0.0001	112%
Chromium, Cr	LB086082	mg/L	0.001	<0.0010	104%
Copper, Cu	LB086082	mg/L	0.001	<0.001	98%
Lead, Pb	LB086082	mg/L	0.001	<0.001	106%
Nickel, Ni	LB086082	mg/L	0.001	<0.001	105%

#### pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC	Units	LOR	MB	DUP %RPD	LCS
	Reference					%Recovery
pH**	LB085802	pH Units	0.1	5.8 - 8.5	0 - 4%	100 - 101%



### **METHOD SUMMARY**

METHOD	
— METHOD —	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as $\mu$ mhos/cm or $\mu$ S/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN121	This method is used to calculation the balance of major Anions and Cations in water samples and converts major ion concentration to milliequivalents and then summed. Anions sum and Cation sum is calculated as a difference and expressed as a percentage.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN274	Chloride by Discrete Analyse: Chloride reacts with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference APHA 4500CI-
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
AN320/AN322	ICP-OES (Ultrasonic Nebuliser): After preservation with 10% nitric acid, a wide range of metals and some non-metals in solution can be measured by ICP- Ultrasonic nebulisation. Solutions are aspirated using an ultrasonic nebuliser into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN322	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B



### **METHOD SUMMARY**

METHOD Calculation

METHODOLOGY SUMMARY

Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.



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 QFH QC result is above the upper tolerance performance of this service QFL QC result is below the lower tolerance ++ Indicative data, theoretical holding time exceeded. The sample was not analysed for this analyte

NVI

Not Validated

Indicates that both \* and \*\* apply.

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 calcuated 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:

- a. 1 Bq is equivalent to 27 pCi
- b. 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: <u>www.sqs.com.au/en-gb/environment-health-and-safety</u>.

This document is issued by the Company under its General Conditions of Service accessible at <u>www.sqs.com/en/Terms-and-Conditions.aspx</u>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein.

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### STATEMENT OF QA/QC PERFORMANCE

CLIENT DETAILS		LABORATORY DETAI	LS
Contact	Dustin Peacocke	Manager	Anthony Nilsson
Client	GOLDER ASSOCIATES PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 5823 216 DRAPER ST CAIRNS QLD 4870	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4054 8200	Telephone	+61 07 4035 5111
Facsimile	07 4054 8201	Facsimile	+61 07 4035 5122
Email	DPeacocke@golder.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	20446551	SGS Reference	CE150386 R0
Order Number	(Not specified)	Date Received	15 Jan 2021
Samples	2	Date Reported	28 Jan 2021

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document. This QA/QC Statement must be read in conjunction with the referenced Analytical Report. The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Cairns Environmental laboratory).

SAMPLE SUMMARY

SGS Australia Pty Ltd ABN 44 000 964 278



### HOLDING TIME SUMMARY

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria. If the sampled date is not supplied then compliance with criteria cannot be determined. If the received date is after one or both due dates then holding time will fail by default.

Alkalinity							Method: I	ME-(AU)-[ENV]AN135
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH3	CE150386.001	LB085802	15 Jan 2021	15 Jan 2021	29 Jan 2021	15 Jan 2021	29 Jan 2021	15 Jan 2021
BH4	CE150386.002	LB085802	15 Jan 2021	15 Jan 2021	29 Jan 2021	15 Jan 2021	29 Jan 2021	15 Jan 2021
Chloride by Discrete Analyser in	Water						Method: I	ME-(AU)-[ENV]AN274
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
ВНЗ	CE150386.001	LB086166	15 Jan 2021	15 Jan 2021	12 Feb 2021	27 Jan 2021	12 Feb 2021	27 Jan 2021
BH4	CE150386.002	LB086166	15 Jan 2021	15 Jan 2021	12 Feb 2021	27 Jan 2021	12 Feb 2021	27 Jan 2021
Mercury (dissolved) in Water							Method: ME-(AU)-[ENV	]AN311(Perth)/AN312
Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
BH3	CE150386.001	LB086014	15 Jan 2021	15 Jan 2021	12 Feb 2021	21 Jan 2021	12 Feb 2021	25 Jan 2021
BH4	CE150386.002	LB086014	15 Jan 2021	15 Jan 2021	12 Feb 2021	21 Jan 2021	12 Feb 2021	25 Jan 2021
Metals in Water (Dissolved) by	ICPOES						Method: I	ME-(AU)-[ENV]AN320
Metals in Water (Dissolved) by Sample Name	ICPOES Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Method: I Analysis Due	ME-(AU)-[ENV]AN320 Analysed
Metals in Water (Dissolved) by Sample Name BH3	ICPOES Sample No. CE150386.001	QC Ref LB086080	Sampled 15 Jan 2021	Received 15 Jan 2021	Extraction Due 14 Jul 2021	Extracted 22 Jan 2021	Method: I Analysis Due 14 Jul 2021	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021
Metals in Water (Dissolved) by Sample Name BH3 BH4	ICPOES Sample No. CE150386.001 CE150386.002	QC Ref LB086080 LB086080	Sampled 15 Jan 2021 15 Jan 2021	Received 15 Jan 2021 15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021	Extracted 22 Jan 2021 22 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by I	ICPOES Sample No. CE150386.001 CE150386.002 CPOES-USN	QC Ref LB086080 LB086080	Sampled 15 Jan 2021 15 Jan 2021	Received 15 Jan 2021 15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021	Extracted 22 Jan 2021 22 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 )-[ENV]AN320/AN322
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by I Sample Name	ICPOES Sample No. CE150386.001 CE150386.002 CPOES-USN Sample No.	QC Ref LB086080 LB086080 QC Ref	Sampled 15 Jan 2021 15 Jan 2021 Sampled	Received 15 Jan 2021 15 Jan 2021 Received	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due	Extracted 22 Jan 2021 22 Jan 2021 Extracted	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 )-[ENV]AN320/AN322 Analysed
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by I Sample Name BH3	ICPOES Sample No. CE150386.001 CE150386.002 CPOES-USN Sample No. CE150386.001	QC Ref LB086080 LB086080 QC Ref LB086082	Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021	Received 15 Jan 2021 15 Jan 2021 Received 15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 14 Jul 2021	Extracted 22 Jan 2021 22 Jan 2021 Extracted 22 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due 14 Jul 2021	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 )-[ENV]AN320/AN322 Analysed 25 Jan 2021
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by I Sample Name BH3 BH4	ICPOES     Sample No.       CE150386.001     CE150386.002       CPOES-USN     Sample No.       CE150386.001     CE150386.001	QC Ref LB086080 LB086080 QC Ref LB086082 LB086082	Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021 15 Jan 2021	Received       15 Jan 2021       15 Jan 2021       Received       15 Jan 2021       15 Jan 2021       15 Jan 2021       15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 14 Jul 2021 14 Jul 2021	Extracted 22 Jan 2021 22 Jan 2021 Extracted 22 Jan 2021 22 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due 14 Jul 2021 14 Jul 2021	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 )-[ENV]AN320/AN322 Analysed 25 Jan 2021 25 Jan 2021
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by in Sample Name BH3 BH4 pH in water	Sample No.       CE150386.001       CE150386.002       CPOES-USN       Sample No.       CE150386.001       CE150386.002	QC Ref LB086080 LB086080 QC Ref LB086082 LB086082	Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021 15 Jan 2021	Received       15 Jan 2021       15 Jan 2021       Received       15 Jan 2021       15 Jan 2021       15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 14 Jul 2021 14 Jul 2021	Extracted 22 Jan 2021 22 Jan 2021 Extracted 22 Jan 2021 22 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due 14 Jul 2021 14 Jul 2021 Method: I	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 3-[ENV]AN320/AN322 Analysed 25 Jan 2021 25 Jan 2021 ME-(AU)-[ENV]AN101
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by in Sample Name BH3 BH4 pH in water Sample Name	ICPOES     Sample No.     CE150386.001     CE150386.002     CPOES-USN     Sample No.     CE150386.001     CE150386.001     CE150386.001     CE150386.002     Sample No.     Sample No.     CE150386.002     Sample No.	QC Ref LB086080 LB086080 QC Ref LB086082 LB086082 QC Ref	Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021 15 Jan 2021 5 Jan 2021	Received       15 Jan 2021       15 Jan 2021       Received       15 Jan 2021       15 Jan 2021       Received       Received	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due	Extracted 22 Jan 2021 22 Jan 2021 Extracted 22 Jan 2021 22 Jan 2021 22 Jan 2021 Extracted	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due 14 Jul 2021 14 Jul 2021 Method: I Analysis Due	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 )-[ENV]AN320/AN322 Analysed 25 Jan 2021 25 Jan 2021 ME-(AU)-[ENV]AN101 Analysed
Metals in Water (Dissolved) by Sample Name BH3 BH4 Metals in Water (Dissolved) by in Sample Name BH3 BH4 pH in water Sample Name BH3	ICPOES     Sample No.     CE150386.001     CE150386.002     CPOES-USN     Sample No.     CE150386.001     CE150386.001     CE150386.002     Sample No.     CE150386.001     Sample No.     Sa	QC Ref LB086080 LB086080 QC Ref LB086082 LB086082 QC Ref LB085802	Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021 15 Jan 2021 Sampled 15 Jan 2021	Received       15 Jan 2021       15 Jan 2021       Received       15 Jan 2021       Stan 2021       Received       15 Jan 2021       Stan 2021       15 Jan 2021       15 Jan 2021	Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 14 Jul 2021 14 Jul 2021 Extraction Due 16 Jan 2021	Extracted 22 Jan 2021 22 Jan 2021 Extracted 22 Jan 2021 22 Jan 2021 22 Jan 2021 Extracted 15 Jan 2021	Method: I Analysis Due 14 Jul 2021 14 Jul 2021 Method: ME-(AU Analysis Due 14 Jul 2021 14 Jul 2021 Method: I Analysis Due 16 Jan 2021	ME-(AU)-[ENV]AN320 Analysed 24 Jan 2021 24 Jan 2021 34 Jan 2021 34 Jan 2021 25 Jan 2021 25 Jan 2021 ME-(AU)-[ENV]AN101 Analysed 15 Jan 2021



### **SURROGATES**

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in Green when within suggested criteria or Red with an appended reason identifier when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No surrogates were required for this job.



Alkalinity

### **METHOD BLANKS**

### CE150386 R0

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria.

#### Method: ME-(AU)-[ENV]AN135

Sample Number	Parameter	Units	LOR	Result
LB085802.001	Total Alkalinity as CaCO3	mg/L	5	<5
LB085802.055	Total Alkalinity as CaCO3	mg/L	5	<5
LB085802.082	Total Alkalinity as CaCO3	mg/L	5	<5
LB085802.136	Total Alkalinity as CaCO3	mg/L	5	<5
Chloride by Discrete Analyser in Water			Meth	od: ME-(AU)-[ENV]AN274
Sample Number	Parameter	Units	LOR	Result
LB086166.001	Chloride, Cl	mg/L	1	<1
LB086166.026	Chloride, Cl	mg/L	1	<1
LB086166.051	Chloride, Cl	mg/L	1	<1
Mercury (dissolved) in Water			Method: ME-(AU)-[E	ENV]AN311(Perth)/AN312
O surved a Manual sur	Demonstern	L Inite	1.00	Descult

Sample Number	Parameter	Units	LOR	Result
LB086014.001	Mercury	mg/L	0.00005	<0.00005
LB086014.026	Mercury	mg/L	0.00005	<0.00005

Metals in Water (Dissolved) by ICPOES			Meth	od: ME-(AU)-[ENV]AN320
Sample Number	Parameter	Units	LOR	Result
LB086080.001	Aluminium, Al	mg/L	0.005	<0.005
	Calcium, Ca	mg/L	0.1	<0.1
	Iron, Fe	mg/L	0.005	<0.005
	Magnesium, Mg	mg/L	0.1	<0.1
	Potassium, K	mg/L	0.1	<0.1
	Sodium, Na	mg/L	0.5	<0.5
	Zinc, Zn	mg/L	0.005	<0.005
Metals in Water (Dissolved) by ICPOES-USN			Method: ME-	(AU)-IENVIAN320/AN322

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Sample Number	Parameter	Units	LOR	Result
LB086082.001	Arsenic, As	mg/L	0.003	<0.003
	Cadmium, Cd	mg/L	0.0001	<0.0001
	Chromium, Cr	mg/L	0.001	<0.0010
	Lead, Pb	mg/L	0.001	<0.001
	Nickel, Ni	mg/L	0.001	<0.001

pH in water			Meth	od: ME-(AU)-[ENV]AN101
Sample Number	Parameter	Units	LOR	Result
LB085802.001	pH**	pH Units	0.1	7.6
LB085802.055	pH**	pH Units	0.1	5.8
LB085802.082	pH**	pH Units	0.1	5.8
LB085802.136	pH**	pH Units	0.1	8.5



### **DUPLICATES**

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may give a different calculated RPD.

Alkalinity						Meth	od: ME-(AU)-	[ENV]AN135
Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
CE150158A.001	LB085802.163	Total Alkalinity as CaCO3	mg/L	5	<5	<5	137	0
CE150316.001	LB085802.164	Total Alkalinity as CaCO3	mg/L	5	31	32	31	5
CE150317.001	LB085802.165	Total Alkalinity as CaCO3	mg/L	5	170	170	18	0
CE150324.001	LB085802.171	Total Alkalinity as CaCO3	mg/L	5	57.919845978	\$0.394832456 <sup>,</sup>	1 23	4
CE150334.001	LB085802.172	Total Alkalinity as CaCO3	mg/L	5	<5	<5	200	0
CE150341.001	LB085802.173	Total Alkalinity as CaCO3	mg/L	5	0	0	200	0
CE150342.001	LB085802.174	Total Alkalinity as CaCO3	mg/L	5	270	260	17	2
CE150343.001	LB085802.175	Total Alkalinity as CaCO3	mg/L	5	01.662207166	602.969283341	17	0
CE150345.001	LB085802.166	Total Alkalinity as CaCO3	mg/L	5	181.58469054	981.83407732	15	0
CE150345.011	LB085802.167	Total Alkalinity as CaCO3	mg/L	5	26.154899153	325.839571519	16	0
CE150345.021	LB085802.168	Total Alkalinity as CaCO3	mg/L	5	99.116655348	398.717104565	17	0
CE150354.001	LB085802.176	Total Alkalinity as CaCO3	mg/L	5	7.8544570553	36.3327511244	85	21
CE150355.001	LB085802.177	Total Alkalinity as CaCO3	mg/L	5	07.10101913	518.947250589	i 19	10
CE150355.011	LB085802.178	Total Alkalinity as CaCO3	mg/L	5	4.0166182812	24.2141652937	136	0
CE150356.001	LB085802.179	Total Alkalinity as CaCO3	mg/L	5	1.4503880629	1.1742045742	200	0
CE150365.001	LB085802.180	Total Alkalinity as CaCO3	mg/L	5	96.166979490	503.543471675	20	7
CE150390.001	LB085802.184	Total Alkalinity as CaCO3	mg/L	5	127.07	27.069381211	19	0

Chloride by Discrete Analyser in Water Method: ME-(AU)-[ENV]AN274 Original Duplicate Units LOR Original Duplicate Criteria % RPD % CE150343A.001 LB086166.005 607.631 Chloride, Cl mg/L 1 599.323 15 1 CE150390.002 LB086166.016 Chloride, Cl mg/L 3.516 3.515 43 0 1 CE150423.005 LB086166.030 Chloride, Cl 27.122 27.52 19 mg/L 1 1 CE150436.003 LB086166.041 78.934 78.776 Chloride, Cl mg/L 1 16 0 CE150452.007 LB086166.055 Chloride, Cl mg/L 1 74.91 75.099 16 0

#### Mercury (dissolved) in Water

Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
CE150345.007	LB086014.014	Mercury	µg/L	0.00005	-0.00795	-0.0081	200	0
CE150345.017	LB086014.025	Mercury	µg/L	0.00005	-0.006	-0.0054	200	0
CE150423.001	LB086014.039	Mercury	µg/L	0.00005	0	0	200	0
CE150423.009	LB086014.048	Mercury	µg/L	0.00005	-0.0045	-0.0048	200	0

pH in water						Meth	od: ME-(AU)-	[ENV]AN101
Original	Duplicate	Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
CE150158A.001	LB085802.163	pH**	pH Units	0.1	6.6	6.5	17	1
CE150316.001	LB085802.164	pH**	pH Units	0.1	7.0	7.1	16	1
CE150317.001	LB085802.165	pH**	pH Units	0.1	8.6	8.6	16	0
CE150324.001	LB085802.171	pH**	pH Units	0.1	7.2098531723	37.1813025474	16	0
CE150330.001	LB085802.170	pH**	pH Units	0.1	8.3	8.1	16	2
CE150334.001	LB085802.172	pH**	pH Units	0.1	4.903304100	04.6953697204	17	4
CE150341.001	LB085802.173	pH**	pH Units	0.1	3.460371971	13.4611387252	18	0
CE150342.001	LB085802.174	pH**	pH Units	0.1	7.9	7.9	16	0
CE150343.001	LB085802.175	pH**	pH Units	0.1	7.4722785949	97.4825768470	16	0
CE150345.001	LB085802.166	pH**	pH Units	0.1	7.5672159194	47.4133534431	16	2
CE150345.011	LB085802.167	pH**	pH Units	0.1	7.3617420196	67.3371310234	16	0
CE150345.021	LB085802.168	pH**	pH Units	0.1	7.9897603988	38.0061254501	16	0
CE150348.001	LB085802.169	pH**	pH Units	0.1	7.703948497	77.7659287452	16	1
CE150354.001	LB085802.176	pH**	pH Units	0.1	6.0219573974	15.9263834953	17	2
CE150355.001	LB085802.177	pH**	pH Units	0.1	7.295989036	57.3759446144	16	1
CE150355.011	LB085802.178	pH**	pH Units	0.1	5.7576303482	25.8917431831	17	2
CE150356.001	LB085802.179	pH**	pH Units	0.1	5.1475248336	65.1414790153	17	0
CE150365.001	LB085802.180	pH**	pH Units	0.1	7.4087634086	67.4023962020	16	0
CE150374.001	LB085802.181	pH**	pH Units	0.1	7.621570587	17.7176961898	16	1
CE150380.001	LB085802.182	pH**	pH Units	0.1	7.405024528	57.4111571311	16	0
CE150388.001	LB085802.183	pH**	pH Units	0.1	7.564891815	17.6389203071	16	1
CE150390.001	LB085802.184	pH**	pH Units	0.1	7.3616638183	37.2796912193	16	1


Recovery is shown in Green when within suggested criteria or Red with an appended dagger symbol (†) when outside suggested criteria.

### Method: ME-(AU)-[ENV]AN135

Method: ME-(AU)-IENVIAN274

Method: ME-(AU)-[ENV]AN311(Perth)/AN312

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB085802.002	Total Alkalinity as CaCO3	mg/L	5	65	59.5	80 - 120	110
LB085802.003	Total Alkalinity as CaCO3	mg/L	5	230	229	80 - 120	102
LB085802.056	Total Alkalinity as CaCO3	mg/L	5	64	59.5	80 - 120	107
LB085802.057	Total Alkalinity as CaCO3	mg/L	5	240	229	80 - 120	103
LB085802.083	Total Alkalinity as CaCO3	mg/L	5	64	59.5	80 - 120	107
LB085802.084	Total Alkalinity as CaCO3	mg/L	5	230	229	80 - 120	102
LB085802.137	Total Alkalinity as CaCO3	mg/L	5	68	59.5	80 - 120	115
LB085802.138	Total Alkalinity as CaCO3	mg/L	5	230	229	80 - 120	102

#### Chloride by Discrete Analyser in Water

Alkalinity

	· ·						
Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB086166.002	Chloride, Cl	mg/L	1	130	125	80 - 120	104
LB086166.003	Chloride, Cl	mg/L	1	11	10	80 - 120	106
LB086166.027	Chloride, Cl	mg/L	1	140	125	80 - 120	108
LB086166.028	Chloride, Cl	mg/L	1	11	10	80 - 120	105
LB086166.052	Chloride, Cl	mg/L	1	130	125	80 - 120	106
LB086166.053	Chloride, Cl	mg/L	1	11	10	80 - 120	106

### Mercury (dissolved) in Water

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB086014.002	Mercury	mg/L	0.00005	0.0019	0.002	80 - 120	96
LB086014.027	Mercury	mg/L	0.00005	0.0020	0.002	80 - 120	98

#### Metals in Water (Dissolved) by ICPOES

Metals in Water (Dissolved)	Is in Water (Dissolved) by ICPOES				N	lethod: ME-(A	U)-[ENV]AN320
Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB086080.002	Aluminium, Al	mg/L	0.005	1.0	1	80 - 120	102
	Calcium, Ca	mg/L	0.1	21	20	80 - 120 80 - 120	105
	Iron, Fe	mg/L	0.005	1.1	1		107
	Magnesium, Mg	mg/L	0.1	20	20	80 - 120	98
	Potassium, K	mg/L	0.1	21	20	80 - 120	103
	Sodium, Na	mg/L	0.5	20	20	80 - 120	102
	Zinc, Zn	mg/L	0.005	1.0	1	80 - 120	103
Metals in Water (Dissolved)	n Water (Dissolved) by ICPOES-USN				Method:	ME-(AU)-IEN	/IAN320/AN322

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB086082.002	Arsenic, As	mg/L	0.003	<0.003	0.002	80 - 120	111
	Cadmium, Cd	mg/L	0.0001	0.011	0.01	80 - 120	112
	Chromium, Cr	mg/L	0.001	0.010	0.01	80 - 120	104
	Copper, Cu	mg/L	0.001	0.010	0.01	80 - 120	98
	Lead, Pb	mg/L	0.001	0.011	0.01	80 - 120	106
	Nickel, Ni	mg/L	0.001	0.011	0.01	80 - 120	105
pH in water	l in water				N	/lethod: ME-(A	U)-[ENV]AN101

Sample Number	Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB085802.006	pH**	pH Units	0.1	7.5	7.415	98 - 102	101
LB085802.060	pH**	pH Units	0.1	7.5	7.415	98 - 102	101
LB085802.087	pH**	pH Units	0.1	7.4	7.415	98 - 102	100
LB085802.141	pH**	pH Units	0.1	7.5	7.415	98 - 102	101



## **MATRIX SPIKES**

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub-sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury (dissolve	od) in Water			Ме	thod: ME-(AU)	[ENV]AN31	1(Perth)/AN312	
QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
CE150341.001	LB086014.004	Mercury	mg/L	0.00005	0.0019	-0.00525	-	93
CE150345.018	LB086014.029	Mercury	mg/L	0.00005	0.0019	-0.00675	-	96



Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in Green when within suggested criteria or Red with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

No matrix spike duplicates were required for this job.



Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

- \* NATA accreditation does not cover the performance of this service.
- \*\* Indicative data, theoretical holding time exceeded.
- \*\*\* Indicates that both \* and \*\* apply.
- Sample not analysed for this analyte.
- IS Insufficient sample for analysis.
- LNR Sample listed, but not received.
- LOR Limit of reporting.
- QFH QC result is above the upper tolerance.
- QFL QC result is below the lower tolerance.
- ① At least 2 of 3 surrogates are within acceptance criteria.
- 2 RPD failed acceptance criteria due to sample heterogeneity.
- ③ Results less than 5 times LOR preclude acceptance criteria for RPD.
- ④ Recovery failed acceptance criteria due to matrix interference.
- Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
- 6 LOR was raised due to sample matrix interference.
- O LOR was raised due to dilution of significantly high concentration of analyte in sample.
- Image: Image:
- I Low surrogate recovery due to the sample emulsifying during extraction.
- Sample was retested due to suspected contamination during field filtering.
- <sup>(f)</sup> Sample was retested due to suspected carry-over from previous high level sample.
- <sup>1</sup> Sample was retested from Non Preserved bottle due to Total metals bottle result < Filtered.
- t Refer to relevant report comments for further information.

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# SGS EHS Cairns COC CE150386

source: Calms.pdf page: 2 SGS Ref: CE150386\_COC

Project No:	20446551	Phase:			Lab Name:	<u></u>	SGS		GOLDER	ASSOCIA	TES PTY I	TD						Phon		7 54 8200			-	2.1
Site ID No.:	·	Site Location:			Quote No.				216 Drape	r St. Cairns.	4870									7 54 9301			G	Golder
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LAB ID		SAMPLE ID	SAMPLE DEPTH	SAMPLE DATE	SAMPLE COUNT	SAMPLE MATRIX			Dissolved M Hg. Ni, Pb, 2	Major cation														
	BH3			15-1-21	2	WATER			x	x														
	BH4			15.1-21	2	WATER			X	X				+			-		+	+	+	+		
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R. S. S. Sand		A. 16 3 5								1									T					
SAMPLE MATRIX - So	il/Sediment/Fill/Wate	r/Other			SAMPLE TY	PE = Composite(C)/Disc	rete(DC)/Disturbed(	(DS)/Core()	CR). Grab Sa	mple (GS)			HICH CON	TENTRATION	. sinds									
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## 2×500NP 2×125AW



## SAMPLE RECEIPT ADVICE

- CLIENT DETAILS	3	LABORATORY DETA	ILS
Contact	Dustin Peacocke	Manager	Anthony Nilsson
Client	GOLDER ASSOCIATES PTY LTD	Laboratory	SGS Cairns Environmental
Address	PO BOX 5823 216 DRAPER ST CAIRNS QLD 4870	Address	Unit 2, 58 Comport St Portsmith QLD 4870
Telephone	07 4054 8200	Telephone	+61 07 4035 5111
Facsimile	07 4054 8201	Facsimile	+61 07 4035 5122
Email	DPeacocke@golder.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	20446551	Samples Received	Fri 15/1/2021
Order Number	(Not specified)	Report Due	Fri 22/1/2021
Samples	2	SGS Reference	CE150386

- SUBMISSION DETAILS

This is to confirm that 2 samples were received on Friday 15/1/2021. Results are expected to be ready by COB Friday 22/1/2021. Please quote SGS reference CE150386 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Ves	Complete documentation received	Ves
600	Complete documentation received	les Brieke
363	Sample cooling method	ICE DITCKS
Yes	Sample counts by matrix	2 Water
15/1/2021	Type of documentation received	COC
1	Samples received in good order	Yes
Yes	Sample temperature upon receipt	Chilled
Yes	Turnaround time requested	Standard
	Yes SGS Yes 15/1/2021 1 Yes Yes	YesComplete documentation receivedSGSSample cooling methodYesSample counts by matrix15/1/2021Type of documentation received1Samples received in good orderYesSample temperature upon receiptYesTurnaround time requested

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS -

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SGS Australia Pty Ltd ABN 44 000 964 278



## SAMPLE RECEIPT ADVICE

#### - CLIENT DETAILS -

### Client GOLDER ASSOCIATES PTY LTD

Project 20446551

_	SUMMARY	OF ANALYSIS								
	No.	Sample ID	Alkalinity	Calculation of Anion-Cation Balance	Chloride by Discrete Analyser in Water	Mercury (dissolved) in Water	Metals in Water (Dissolved) by ICPOES	Metals in Water (Dissolved) by	pH in water	
	001	BH3	4	3	1	1	9	6	1	
	002	BH4	4	3	1	1	9	6	1	

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document. The numbers shown in the table indicate the number of results requested in each package. Please indicate as soon as possible should your request differ from these details . Testing as per this table shall commence immediately unless the client intervenes with a correction .

Appendix D

## Important Information Relating to This Report



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