

Report on Preliminary Geotechnical Assessment

Great Keppel Island Resort Revitalisation Project

Prepared for GKI Resort Pty Ltd

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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# **Executive Summary**

This report presents the results of a preliminary geotechnical assessment undertaken as part of an environmental impact statement (EIS) for proposed resort revitalisation at Great Keppel Island. The aim of the investigation was to undertake a preliminary assessment of the sub-surface soil and groundwater conditions in proposed development precincts.

Topography on Great Keppel Island is dominated by two northwest to southeast trending ridges. The southern ridgeline is relatively steep and is dominated by Mt Wyndham. These ridges extend to the beaches to form rocky headlands and cliffs. A series of sandy beaches and beach ridges exist between the headlands.

Great Keppel Island is primarily underlain by the Carboniferous aged Shoalwater Formation of the Curtis Island Group. Thin veneers of Quaternary sand, alluvium and estuarine mud overlie the Carboniferous sequence in the north-eastern area of the island as well as the south-western area. Central areas of the island are mapped as comprising fine grained alluvial sediments such as estuarine mud and sand, clay, silt, and minor gravel. A large deposit of sand encountered in the central area of the island was considered to be a mixture of dune sands and colluvium.

Estimates of excavatability and anticipated requirements for safe batter slopes are given based on the materials encountered at test locations and from preliminary observations.

Fine granular soils are prevalent at the site and Emerson class test results indicate that the near surface soils have a medium potential for erosion and a medium potential for environmental harm, if disturbed. A detailed erosion hazard assessment will be required once the extent of the development has been confirmed.

Subsurface soils will generally be suitable for re-use as bulk and structural filling, if required. Reuse will be contingent upon control of field procedures in accordance with standard practices for engineering works and earthworks design. It is recommended that bulk samples of rock be recovered and submitted for a suite of aggregate and classification testing to better assess the potential use of any rock sources.

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# Report on Preliminary Geotechnical Assessment Great Keppel Island Resort Revitalisation Plan

## 1. Introduction

This report presents the results of a preliminary geotechnical assessment undertaken as part of an environmental impact statement (EIS) as part of the proposed Great Keppel Island Resort Revitalisation Plan. The investigation was undertaken at the request of CQ Consulting Group (project environmental consultants) on behalf of GKI Resort Pty Ltd (site owners).

It is understood that the proposed development will be over three main precincts (Drawing 1) and will comprise an eco-tourism hotel and spa with villas and apartments, a golf course, as well as a marina and research facility.

The aim of the investigation, as outlined in Douglas Partners Pty Ltd (DP) Proposal BNE100639 Revision 1 dated 20 October 2010, was to undertake a preliminary assessment of the sub-surface soil and groundwater conditions at the site in order to provide comments on:

- surface geology and confirm regional geological mapping.
- identify areas of potential geotechnical risk to the development, such as cut slopes, boggy ground etc;
- excavation of shallow boreholes to approximately 0.5 m to 1.0 m in depth with a hand auger, lithological descriptions of the surface soils, and collection of suitable soil samples for geotechnical testing;
- geotechnical laboratory testing of samples including Emerson class number (i.e. dispersion) and pH determination; plasticity and wet sieve grading, organic content, and laboratory permeability;
- identify the erosion potential of surface soils;
- inspect and assess existing water supply bores and recently (2006) installed monitoring bores on the island including recording standing groundwater levels and measurement of field water quality (pH & EC).

The investigation comprised an assessment of topography and geology, drilling of twenty shallow auger bores, measuring groundwater levels in previously constructed bores, and laboratory testing of selected samples. Details of the field work are presented in this report, together with comments and recommendations on the issues listed above.

Additional laboratory testing has been undertaken on samples recovered from some of the bores for the purpose of an Acid Sulfate Soils (ASS) assessment. Results of such testing are described in a separate report.

Assessment of the groundwater levels and water quality tests are described in a separate report.



# 2. Previous Investigations

Douglas Partners has previously undertaken two groundwater investigation projects on Great Keppel Island. These comprised:

- 1. Groundwater Supply Investigation (DP 2007a).
- 2. Drilling and installation of two production bores near Long Beach (DP 2007b).

**Groundwater Supply Investigation** (DP 2007a) was carried out to assess the potential groundwater resources on Great Keppel Island and to assess the sustainable yield of those resources. Investigations included an electromagnetic (EM) geophysical survey, installation and construction of 10 monitoring bores, water quality sampling and analysis, development of conceptual hydrogeological models, and groundwater modelling to assess the sustainable yield of the two groundwater resources identified within the two major sand deposits on the island. Results of the investigation are presented in DP (2007a).

**Drilling and Installation of Two Production Bores (Near Long Beach)** (DP 2007b) was undertaken to increase and supplement the existing resort water supply. Most of this aquifer had been affected by salt water intrusion, so the location of each bore and the long-term pumping rates would be critical to the sustainability of the supply. Results of the investigation are presented in DP (2007b).

Results of these investigations will be used for the purposes of the EIS and referenced in a separate groundwater assessment. Reference to these reports in this preliminary geotechnical assessment is for historical completeness.

# 3. Site Location and General Description

Great Keppel Island is the largest island in the Keppel group of islands, lying approximately 19 km east-south-east of Yeppoon on the Central Queensland coastline. It is located within the Mackay/ Capricorn region of the Great Barrier Reef Marine Park.

The former Great Keppel Island Resort is located on a dune sand deposit on the western side of the island (Drawing 1) between Fisherman's Beach and Long Beach. The main accommodation and resort facilities are situated mainly near Fisherman's Beach where the topography is generally flat with some elevated villas on a hill immediately south of the former resort. The former resort is enclosed by a wire mesh fence for security and safety purposes and includes several swimming pools, tennis, squash and volley bal courts, a golf course, communal and office buildings.

A sealed landing strip is located to the east of the former resort aligned approximately north-west to south-east. The landing strip is near level and raised above the surrounding ground at the northern end and rises at an angle of approximately 5 degrees to the south and is adjoined by sand dunes on either side. Former staff quarters are located to the north east of the landing strip and also to the north east of the lookout access road.



The existing resort, villas and staff accommodation generally comprise a mixture of block work and reinforced concrete structures and elevated timber structures on concrete piers and/or plinths. Several industrial sheds and a desalination plant are also located on the north side of the landing strip and are in various states of disrepair. At the time of the investigation, some of the structures were being used as storage facilities for local businesses under approval of the client.

Residential houses, some retail properties and accommodation facilities including the Keppel Haven Resort, and Keppel Island Village are also located on this dune sand deposit between Fisherman's Beach and Putney Beach.

Several partially sealed roads adjoin the former resort with additional unsealed, locally heavily rutted tracks stemming off the main road. The sealed road continues from Fisherman's Beach along the eastern side of the landing strip and then traverses north and east up to the "lookout". Beyond the lookout, the road generally comprises rock outcrops and unsealed sandy tracks.

An historical quarry is located to the north-east of the runway, just south of the road to the "lookout". At the time of the investigation, the quarry was being used as a storage area for green waste materials.

# 4. Topography

Topography on Great Keppel Island is dominated by two northwest to southeast trending ridges (Drawing 2). The southern ridgeline is relatively steep and is dominated by Mt Wyndham with a maximum elevation of approximately 175 m AHD. Elevations along the northern ridgeline range between approximately 75 m AHD in the northwest and 155 m AHD in the southeast. These ridges extend to the beaches to form rocky headlands and cliffs. A series of sandy beaches and beach ridges exist between the headlands.

Coastal sand dunes exist between Wreck Bay and Butterfish Bay on the eastern side of the island, as well as in the southwest area of the island between Long Beach, Fisherman's Beach and Putney Beach. A flat to undulating topography is present in the dune sand areas. The topography becomes slightly undulating on the eastern side of the island towards Wreck Bay.

A valley exists in the central area of the island between the two major ridges. It falls from an elevation of approximately 65 m AHD behind Clam Bay to sea level at Leeke's Beach in the northwest.

Leeke's Creek, Putney Creek, and Blackall Creek drain the ridges toward the west. Some tidal wetlands exist behind Putney Beach and Leeke's Beach. Other minor perennial creeks are relatively short and flow directly into the Pacific Ocean.



# 5. Regional Geology

Published geological maps for the Rockhampton region (Dept of Natural Resources, Mines & Water, 2006) indicate that Great Keppel Island is primarily underlain by the Carboniferous aged Shoalwater Formation of the Curtis Island Group (Drawing 3).

The Shoalwater Formation is characterised by highly deformed and metamorphosed thin to thick bedded quartose and lithic sandstones (Max Winders, 2006). Kirkegaard *et al.* (1970) interpreted the deformed rocks of the Curtis Island Group as being part of the most easterly unit of the New England Fold Belt. According to Smith (1998), this sequence experienced four periods of deformation which resulted in a cleavage dipping gently to the west, a crenulated cleavage moderately to steeply to the east and several systems of folds and rare boudinage systems. Late Palaeozoic quartose, arenite and mudstone of the Shoalwater formation make up the major hills and slopes on Great Keppel Island.

The Shoalwater Formation overlies the early Palaeozoic Wandilla formation which is quite widespread along the mainland coast facing the Keppel Isles (Dept of Natural Resources, Mines & Water, 2006).

Thin veneers of Quaternary sand, alluvium and estuarine mud overlie the Carboniferous sequence in three separate lower lying areas of the island (Dept of Natural Resources, Mines & Water, 2006). The north-eastern area of the island between Wreck Beach and Butterfish Bay, as well as the south-western area between Long Beach, Fisherman's Beach and Putney Beach are mapped as containing Quaternary deposits including fore dune, beach ridge, and dune sands. Central areas of the island are mapped as comprising fine grained alluvial sediments such as estuarine mud and sand, clay, silt, and minor gravel. Sands and other alluvial deposits occur in the drainage basin of Leeke's Creek and Blackall Creek (Max Winders, 2006).

There is no direct fossil evidence in the Shoalwater Formation and none is documented in Murray (1975) or Kirkegaard *et al.* (1970). Due to the age of the formation and the metamorphosis that would have occurred, it is considered unlikely that fossils would be present.

# 6. Soils

No soil mapping is available for Great Keppel Island. However, Max Winders (2006) extrapolated the likely soil and land resources from published geological mapping (Section 5), land zone descriptions in regional ecosystem mapping, and land resources maps. An assessment of the probable land resource area, soils, and potential rural land uses for various parts of the island was made based on land zones, geology and associated ecosystems and is summarised in Table 1. It was concluded that *"land not required for development, recreation, aesthetic or conservation purposes would only have grazing potential"* (Max Winders, 2006: 5) and no parts of Great Keppel Island would be regarded as "good quality agricultural land" under Queensland's State Planning Policy (SPP 1/92, 1992).

Land Zone	Description	Geology	Land Resource Area	Soils
1	Quaternary marine deposits	Qhe – estuarine mud, sand	Marine Plains	Saline grey cracking clays, black and grey mottled clays; saline muds and sands
2	Quaternary coastal dunes and beaches	Qhb – beach ridge sand; Qhd – high blowout dune sand Qhf – fore dune sand	Coastal sand dunes	Very deep bleached sands; deep brown and yellow sands; wet bleached sands; black peaty sands
3	Cainozoic alluvial plains and piedmont fans	Qa – undifferentiated creek and floodplain alluvium	Alluvial plains	Dark and brown, sandy and loamy alluvial soils; dark grey and brown cracking clays; bleached sodic duplex soils; bleached grey massive earths
11	Mesozoic to Proterozoic moderately to strongly deformed and metamorphosed sediments and interbedded volcanics	Cs – quartzose arenite, mudstone	Eucalypt duplex uplands	Shallow stony grey and brown loams; bleached sodic duplex soils; brown and red duplex soils; red and yellow massive earths
12	Mesozoic to Proterozoic igneous rocks; Predominantly granitoids and intermediate to acid terrestrial volcanics	Cs – quartzose arenite, mudstone	Eucalypt duplex uplands	Shallow stony grey and brown loams; bleached sodic duplex soils; brown and red duplex soils; red and yellow massive earths

#### Table 1: Extrapolation of land zones on Great Keppel Island (Max Winders, 2006)

# 7. Field Work Methods

Field work was undertaken between 22 and 24 November 2010 and comprised the augering of twenty shallow bores (designated Bores HA1 to HA20) at various locations across the proposed development precincts as follows:

- Bores HA1 to HA3, HA12 to HA14, and HA18 to HA20 were located within the proposed Fisherman's Beach Precinct Eco-tourism Villas and Eco-tourism Apartments;
- Bores HA4 to HA9 were located in the proposed Clam Bay Precinct;
- Bores HA10 and HA11 were located on Putney Beach in the vicinity of the proposed Marina Precinct; and
- Bores HA15 to HA17 were located in the vicinity of the proposed Fisherman's Beach Precinct - Eco-tourism Hotel and Spa.

The bores were drilled using a hand operated 75 mm diameter auger to depths of between 1 m and 1.2 m. Disturbed and near surface bulk samples were recovered for the purposes of geotechnical laboratory testing using the auger and a shovel. Strata identification was undertaken through observation of auger cutting returns. On completion of drilling, the bores were backfilled with drill spoil.



The bores were set out with reference to the "Great Keppel Island Proposed Development Areas" Drawing 103160-001A provided by CQ Consulting Group which included eastings and northings. The actual test locations were recorded using a Garmin hand held GPS accurate in position to approximately 5 m. The bore co-ordinates were referenced to GDA 94 datum and are included on the borehole log sheets and the approximate test locations are indicated on Drawing 4 and Drawing 5.

The bores were drilled by a senior geotechnical engineer and environmental engineer who logged the subsurface conditions and collected samples for visual and tactile assessment, and laboratory testing.

Inspection of the rock outcrops at the quarry was also undertaken.

# 8. Field Work Results

The borehole log report sheets are attached together with notes defining classification methods and terms used to describe the soils and rocks.

In summary, the subsurface conditions comprised **silty sand** and **sand** to the limit of the current investigation. The subsurface conditions encountered are further described below in relation to the various proposed development precincts.

# 8.1 Proposed Fisherman's Beach Precinct (Bores HA1 to HA3, HA12 to HA14, and HA18 to HA20)

- Sand estimated very loose, initially dark brown near the surface grading light brown, orange-brown and light grey with depth, fine to medium grained sand was encountered from the surface at all locations. The sand generally comprised rootlets near the surface, was moist with a trace of silt. The sand was encountered to the termination of the bores at between 1 m and 1.2 m depth.
- No free groundwater was encountered during auger drilling.

#### 8.2 Proposed Clam Bay Precinct (Bores HA4 to HA9)

- Sand estimated very loose, initially dark brown and grey near the surface grading light brown, orange-brown and light grey with depth, fine to medium grained sand was encountered from the surface at all locations. The sand generally comprised rootlets near the surface, was moist with a trace to some silt. Bore HA6 encountered some shell fragments from 0.1 m to 0.2 m depth. The sand was encountered to the termination of all the bores at 1.2 m depth.
- No free groundwater was encountered during auger drilling.



#### 8.3 **Proposed Marina Precinct (Bores HA10 and HA11)**

- Sand estimated very loose, light brown and white, fine to medium grained sand was encountered from the surface at both locations. The sand was moist grading wet at close to the levels of observed water ingress. The sand was encountered to the termination depth of the bores at 1 m (HA10) and 1.1 m (HA11).
- Free groundwater was encountered during auger drilling at 0.5 m depth in Bore HA10 and at 1 m depth in Bore HA11.

## 8.4 Proposed Fisherman's Beach Precinct (Bores HA15 to HA17)

- Sand estimated very loose, initially dark brown in HA15 and HA16, and orange-brown in HA17, fine to medium grained sand was encountered from the surface at all locations. The sand generally comprised rootlets near the surface in Bores HA15 and HA16, was moist with a trace to some silt. The silt content was reduced in Bores HA15 and HA16 below 0.15 m and 0.2 m depth respectively. The sand was encountered to the termination of the bores at 1.1 m or 1.2 m depth.
- No free groundwater was encountered during auger drilling.

## 8.5 Rock Outcrop in Former Quarry

The exposed face within the quarry was inspected and photographs of the quarry site and general rock exposure are presented below as Figure 1 and Figure 2

Figure 1 and Figure 2.



Figure 1: General Photograph of Quarry Site





Figure 2: Photograph of Rock Exposure at Quarry Site

The rock was observed to comprise low strength (and stronger) quartzose sandstone with distinct quartz veins. The bedding was thinly laminated and generally aligned on a bearing of 320 degrees, and dipping into the face at approximately 8 to 10 degrees with a dip direction of 50 degrees.

Rock outcrops were also observed along the access road to the lookout and generally formed the surface of the access road down to the eastern side of the lookout ridgeline (Figure 3) and along the access track from the Quarry to Long Beach (Figure 4) between Bores HA1 and HA2.



Figure 3: Rock Exposure at Surface of Road on Eastern side of Lookout







Figure 4: Rock Exposure at Surface of Track between Bores HA1 and HA2 (Quarry to Long Beach Access Track)

## 8.6 Interpretation of Actual Soil Conditions

Sand and localised outcrops of quartzose sandstone rock were generally encountered during the investigation, which is in broad agreement with the geological mapping. Soil strata identified comprised sand and silty sand in all auger holes.

The lateral extent of the sand deposit encountered in the central area of the island was found to be more extensive than that shown on the published geology (Dept of Natural Resources, Mines & Water, 2006). Sands encountered are considered to be a mixture of dune sands and colluvium. The approximate extent of the sand deposit is shown on Drawing 6.

#### 8.7 Groundwater Monitoring

Monitoring of standing groundwater levels in the existing monitoring bores was undertaken during the field work and the results are summarised in Table 2. Assessment of the groundwater results including evaluation of the field parameter testing undertaken during the field work (temperature, pH, electrical conductivity) is presented in the groundwater report under separate cover.



	Location	Date	Elevation	Total Bore	SWL			
Bore ID	(GDA94)^	Sampled	(m AHD)^	Depth (m BGL)	(m BGL)	(m AHD)		
MB1	E288785, N7434995	22/11/2010	4.28	NM	NM	NM		
MB2	E289195, N7434893	22/11/2010	5.4	3.65	2.75	2.65		
MB7	E289102, N7434740	22/11/2010	9.39	13.71	7.18	2.21		
MB8	E289265, N7434616	22/11/2010	13.92	14.58	11.78	2.14		
MB10	E289826, N7434203	22/11/2010	8.64	17.26	7.24	1.40		
MB11	E289682, N7434566	22/11/2010	34.34	-	-	-		
PB1	E289828, N7434205	22/11/2010	8.73	18.42	7.16	1.57		
PB2	E289776, N7434244	22/11/2010	12.81	22.13	11.25	1.56		
Long Beach Bore 1 (LBB1)	NM	22/11/2010	NM	9.60	4.76	NM		
Long Beach Pump House 1 (LBPH1)	E290042, N7434057	22/11/2010	9.12	15.70	7.61	NM		
Oval Bore 1 (OB1)	E288916, N7434642	22/11/2010	2.77	NM	NM	NM		
Oval Bore 2 (OB2)	E288973, N7434696	22/11/2010	3.37	NM	NM	NM		
Desal. Plant Bore 1	E289068, N7434815	22/11/2010	NM	4.93	2.50	NM		

#### Table 2: Results of Groundwater Monitoring

Notes :

SWL Standing water level

m BGL metres below ground level

NM not measured

As surveyed by Schlencker Surveying Pty Ltd. Coordinates in GDA94 coordinate system



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# 9. Laboratory Testing

Geotechnical laboratory testing comprised:

- pH determination;
- Emerson class dispersion tests;
- wet sieve grading;
- percent dispersion tests;
- Atterberg limits tests; and
- permeability tests on samples compacted to a target of 100% Standard maximum dry density at close to the field moisture content.

Analytical testing as part of this geotechnical assessment comprised organic matter content as requested by the project engineers. Detailed report sheets are attached, and the results are summarised in Table 3.

Testing for ASS has been undertaken on selected samples from Bores HA12 to HA16 and HA18 to HA20, the results of which will be reported in a separate report.



#### Table 3: Results of Geotechnical Laboratory Testing

Bore No.	Depth (m)	Description	рН	Emerson Class No.	Potential for Erosion (BCC, 2006)	NMC (%)	LL (%)	PL (%)	PI (%)	LS (%)	Sand Content (%75 μm to 2 mm)	Silt/Clay Fines Content (%<75 μm)	Percent Dispersion (%)	Permeability (k <sub>20</sub> ) (m/s)	Organic Matter (%)
HA1	0.2-0.6	Slightly silty sand	5.7	6	Medium	7.7	NO	NO	NP	NO	86	14	67.0	4 x 10 <sup>-6</sup>	0.6
HA2	0.1-0.4	Sand with a trace of silt	6.0	6	Medium	5.4	NO	NO	NP	NO	97	3	0.0	3 x 10⁻⁵	1.2
HA3	0.2-0.5	Sand with a trace of silt	6.6	6	Medium	4.6	NO	NO	NP	NO	97	3	0.0	7 x 10 <sup>-5</sup>	0.5
HA4	0.3-0.6	Sand with some silt	6.1	6	Medium	5.1	NO	NO	NP	NO	92	8	13.0	2 x 10 <sup>-5</sup>	0.6
HA5	0.3-0.5	Sand with some silt	5.5	6	Medium	5.6	NO	NO	NP	NO	93	7	91.0	6 x 10 <sup>-5</sup>	< 0.5
HA6	0.1-0.5	Sand with some silt	5.+	6	Medium	5.1	NO	NO	NP	NO	92	8	91.0	4 x 10 <sup>-5</sup>	< 0.5
HA7	0.3-0.6	Sand with some silt	5.7	6	Medium	5.7	NO	NO	NP	NO	92	8	0.0	8 x 10 <sup>-5</sup>	0.6
HA8	0.2-0.5	Sand with some silt	5.4	6	Medium	5.6	NO	NO	NP	NO	91	9	48.0	2 x 10 <sup>-5</sup>	0.6
HA9	0.3-0.5	Sand with some silt	5.4	6	Medium	6.4	NO	NO	NP	NO	91	9	92.0	3 x 10 <sup>-5</sup>	0.6
HA12	0.2-0.6	Sand with a trace of silt	6.4	6	Medium	5.9	NO	NO	NP	NO	96	4	14.0	8 x 10 <sup>-5</sup>	< 0.5
HA13	0.2-0.5	Silty sand	5.9	6	Medium	15.8	NO	NO	NP	NO	65	35	18.0	1 x 10 <sup>-7</sup>	1.3
HA15	0.2-0.5	Sand with some silt	7.4	6	Medium	7.0	NO	NO	NP	NO	95	5	0.0	2 x 10 <sup>-5</sup>	1.9
HA17	0.2-0.5	Sand with a trace of silt	5.5	6	Medium	4.4	NO	NO	NP	NO	97	3	0.0	2 x 10⁻⁵	0.6
HA19	0.2-0.5	Sand with a trace of silt	7.2	6	Medium	3.6	NO	NO	NP	NO	98	2	0.0	4 x 10 <sup>-5</sup>	< 0.5

Notes:

NMC = Natural Moisture Content; LL = Liquid limit; PL = Plastic Limit; PI = Plasticity Index, LS = Linear Shrinkage, NO = Not Obtainable, NP = Non-Plastic



# **10. Proposed Development**

It is understood that the proposed development may include:

- an eco-tourism hotel and spa;
- eco-tourism villas and apartments;
- a golf course and golf resort facility;
- a marina facility;
- a retail village;
- upgrades to the existing air strip; and
- establishment of environmental buffer zones and environmental protection areas.

No indication of structural loadings and/or earthworks concept plans was provided for the preparation of this preliminary assessment.

# 11.Comments

#### **11.1 Appreciation of Ground Conditions**

Surface geology encountered, as described in Section 6 above, generally comprise sand to depths of between 1 m and 1.2 m at the locations tested. Rock outcrops comprising low strength (and stronger) quartzose sandstone were observed in several locations in close proximity to the locations tested.

In the central area of the island, proposed for golf course development, a large deposit of sand was encountered and was found to be more extensive than the published geology (Dept of Natural Resources, Mines & Water, 2006). Sands encountered in the central area of the island were considered to be a mixture of dune sands and colluvium. An interpretation of the surface geology based on the results of this assessment is shown on Drawing 6.

Groundwater ingress was encountered at depths of 0.5 m and 1 m in two of the shallow auger bores undertaken as part of this preliminary geotechnical assessment. Groundwater levels were measured at depths of between 2.5 m and 11.78 m in the existing monitoring bores (Section 8.7).

#### 11.2 Excavatability

No indication of excavation depths or project specific requirements was available at the time of preparation of this preliminary geotechnical assessment.

Based on the conditions encountered, it is estimated that excavation may be undertaken by general medium sized excavation plant, such as backhoes or 8-15 tonne hydraulic excavator or drott, for cuts in any existing filling and existing sandy soils. The use of pneumatic tools or rock breakers is likely to be required where concrete is encountered.



A preliminary assessment of the rock outcrop indicates that large hydraulic excavators fitted with hydraulic rock hammers and/or large dozers with medium to hard ripping and low productivity may be required for excavation of the observed low strength (or stronger) rock. The ease of excavation in rock is dependent upon several factors including rock strength, defect spacing, defect orientation, bedding thickness, machine size and operator skill.

It should be recognised that the above excavatability estimates are based on materials encountered at the test locations only and from preliminary observations of rock outcrops, and that conditions may prove more difficult (or easier) for excavatability between and beyond these test locations. It is recommended that additional geotechnical drilling of the rock be undertaken to provide a better assessment of rock excavatability.

# 11.3 Safe Batter Slopes

Batter slopes cut to 1.5 m depth may be formed near vertical for temporary trenches for footing and/or services installation. Batter slopes up to 3 m height cut in the estimated very loose sand, with a non-surcharged, non-sloping crest, may be designed for temporary batter slopes of 2H:1V or long term slopes of 2.5H to 3H:1V. Ground conditions can vary and will need to be inspected and verified by a geotechnical engineer at the time of construction.

It is further recommended that all batters incorporate crest and toe drainage, and be covered with vegetation (or similar) to provide erosion protection.

The soil slopes may need to be flattened to 3H:1V or less, in order to allow vehicular access for maintenance of grass.

#### **11.4 Erodability and Erosion Control**

Fine granular soils are prevalent at the site, and the Emerson class tests indicate that the near surface sandy soils have a medium potential for erosion, and a medium potential for environmental harm if disturbed. There are several other factors that are required to undertake an erosion hazard assessment, which at this stage, due to the conceptual nature of the development, are outside the scope of this report. These factors include:

- average slope of the site prior to operational works;
- anticipated duration of site disturbance;
- erosive rainfall risk during site disturbance;
- off-site sediment control;
- run-off entering the site;
- extent of site disturbance.

It follows from the above that the once the extent of the development has been confirmed at the site, the above additional contributing factors can be addressed by the project managers/contractors to fully evaluate/assess the erosion hazards.



Erosion control measures at the surface will require detailed design; however, it is expected that, as a minimum, where disturbance cannot be avoided, measures will need to include silt fences, sediment basins in large areas of disturbance, measures to limit water runoff velocity (such as benching) and prompt installation of topsoiling and grassing or hydromulching in completed areas.

## 11.5 Re-Use of Site Soils/Rock and Workability

From the results of the preliminary field work, it is concluded that the subsurface soils at the site will generally be suitable for re-use as bulk and structural filling (if required). Such re-use is contingent upon particle size distribution being controlled along with moisture content, and upon minimum placement and compaction requirements being met in accordance with standard practices for engineering works and earthworks design.

Rock won from excavation will generally be suitable for re-use as bulk filling (i.e. for platform subgrade construction). Such re-use is contingent upon particle size distribution being controlled along with moisture content, and upon minimum placement and compaction requirements being met in accordance with standard practices for engineering works and earthworks design.

The crushability of such potential rock materials won from cuts at the site is dependent upon the size of rock material won from excavation or blasting. Several factors will affect the size of the material won from excavation including:

- the depth of tyne penetration and ripping run lengths;
- the spacing between ripping runs;
- the spacing between shot holes;
- the depth of shot holes; and
- the strength, fracture and bedding/fracture spacing of the rock.

To better qualify the potential uses of any rock sources at the site, it is recommended that bulk samples of rock be recovered from site and submitted for a suite of aggregate and classification testing such as adopted by Queensland Department of Main Roads.



# 12. References

Brisbane City Council (2006) Erosion Hazard Assessment, Supporting Technical Notes. Brisbane.

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**Kirkegaard, A.G., Shaw, R.D., Murray, C.G., (1970)**, 'Geology of the Rockhampton and Port Clinton 1:250 000 Sheet Areas', *Geological Survey of Queensland Report No. 38*, pp:51-54 and Plates 1-6.

**Max Winders & Associates Pty Ltd, (2006)**, *Preliminary Review, Environmental Planning Issues, Great Keppel Island*, Document No. 06-020, Max Winders & Associates Pty Ltd, Brisbane.

Murray, C.G., Fergusson, C.L., Flood P.G., Whitaker, W.G., & Korsch, R.J., (1987), 'Plate Tectonic Model for the Carboniferous Evolution of the New England Fold Belt', *Australian Journal of Earth Sciences*, Volume 34, pp:213-236.

**Queensland Department of Natural Resources, Mines and Water (2006)**, *Australia 1:100,000 Geological Series, Rockhampton, Queensland*, Sheet 9051 (map). Brisbane

**Smith, J.V., (1998)**, 'Morphology and kinematics of boudinage vein systems, Great Keppel Island, Queensland', *Australian Journal of Earth Sciences*, Volume 45, Issue 5, pp:807-815.

# **13. Limitations of this Report**

DP has prepared this preliminary geotechnical assessment report as part of for this project at Great Keppel Island in accordance with DP's Proposal BNE100639 Rev 1 dated 20 October 2010 and acceptance received on 9 November 2010 from GKI Resorts Pty Ltd. This report is provided for the exclusive use of GKI Resorts Pty Ltd and their consulting architects, engineers and scientists for this project only and for the purposes described in the report. It should not be used for other projects or by a third party. In preparing this report, DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the subsurface conditions only at the specific sampling or testing location, and then only to the depth investigated and at the time the work was carried out. Subsurface conditions can change abruptly due to variable geological processes and also as a result of anthropogenic influences. Such changes may occur after DP's field testing has been completed.



DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with the attached notes and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion given in this report.

**Douglas Partners Pty Ltd** 

# Drawings

Drawing 1 – Proposed Development Precincts

Drawing 2 – Great Keppel Island Topography

Drawing 3 – Great Keppel Island Geology

Drawing 4 – Test Location Plan

Drawing 5 – Test Location Plan, Precinct 2

Drawing 6 – Great Keppel Island Revised Geological Plan



	CLIENT: GKI Resort Pty Ltd		TITLE:	Proposed Precincts of Development
Douglas Partners	OFFICE: Brisbane	DRAWN BY: JT		Preliminary Geotechnical Assessment
Geotechnics   Environment   Groundwater	SCALE: As shown	DATE: 31 August 2011		Great Keppel Island Resort Revitalisation Plan

P:\Groundwater Projects\74586.00 Great Keppel Island EIS\Drawings\Geo Drawings\Rev.1\Drawing 1.dwg



dD	Douglas Partners
	Geotechnics   Environment   Groundwater

	TITLE: Great Keppel Island Topography
JT	Preliminary Geotechnical Assessment
igust 2011	Great Keppel Island Resort Revitalisation Plan

P:\Groundwater Projects\74586.00 Great Keppel Island EIS\Drawings\Geo Drawings\Rev.1\Drawing 2.dwg



(D	Douglas Partners
	Geotechnics   Environment   Groundwater

CLIENT: GKI Resort Pty Ltd		
OFFICE: Brisbane	DRAWN BY: JT	
SCALE: As shown	DATE: 31 August 2011	

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dD	<b>Douglas Partners</b>	
	Geotechnics   Environment   Groundwater	

CLIENT: GKI Resort Pty Ltd		
OFFICE: Brisbane	DRAWN BY: JT	
SCALE: As shown	DATE: 31 August 2011	

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CLIENT: GKI Resort Pty Ltd	
OFFICE: Brisbane	DRAWN BY: JT
SCALE: 1:4,000(A3)	DATE: 31 August 2011

**Great Keppel Island Resort Revitalisation Plan** 

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dD	<b>Douglas Partners</b>
	Geotechnics   Environment   Groundwater

CLIENT: GKI Resort Pty Ltd		
OFFICE: Brisbane	DRAWN BY: JT	
SCALE: As shown	DATE: 31 August 2011	

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# Appendix A

Explanatory Notes



#### Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

#### Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

#### **Borehole and Test Pit Logs**

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

#### Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

 In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

#### Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

# About this Report

#### **Site Anomalies**

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

#### **Information for Contractual Purposes**

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

#### **Site Inspection**

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

# Appendix B

Borehole Reports (Bores HA1 to HA20)

# Soil Descriptions

#### **Description and Classification Methods**

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

#### Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Туре	Particle size (mm)	
Boulder	>200	
Cobble	63 - 200	
Gravel	2.36 - 63	
Sand	0.075 - 2.36	
Silt	0.002 - 0.075	
Clay	<0.002	

The sand and gravel sizes can be further subdivided as follows:

Туре	Particle size (mm)	
Coarse gravel	20 - 63	
Medium gravel	6 - 20	
Fine gravel	2.36 - 6	
Coarse sand	0.6 - 2.36	
Medium sand	0.2 - 0.6	
Fine sand	0.075 - 0.2	

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded a good representation of all particle sizes
- Poorly graded an excess or deficiency of particular sizes within the specified range
- Uniformly graded an excess of a particular particle size
- Gap graded a deficiency of a particular particle size with the range

#### **Cohesive Soils**

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	VS	<12
Soft	S	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

#### **Cohesionless Soils**

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose		4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

# Soil Descriptions

#### Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil derived from in-situ weathering of the underlying rock;
- Transported soils formed somewhere else and transported by nature to the site; or
- Filling moved by man.

Transported soils may be further subdivided into:

- Alluvium river deposits
- Lacustrine lake deposits
- Aeolian wind deposits
- Littoral beach deposits
- Estuarine tidal river deposits
- Talus scree or coarse colluvium
- Slopewash or Colluvium transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

# Rock Descriptions

#### **Rock Strength**

Rock strength is defined by the Point Load Strength Index  $(Is_{(50)})$  and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index Is <sub>(50)</sub> MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	М	0.3 - 1.0	6 - 20
High	Н	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

\* Assumes a ratio of 20:1 for UCS to Is<sub>(50)</sub>

#### **Degree of Weathering**

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

#### **Degree of Fracturing**

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description	
Fragmented	Fragments of <20 mm	
Highly Fractured	Core lengths of 20-40 mm with some fragments	
Fractured	Core lengths of 40-200 mm with some shorter and longer sections	
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections	
Unbroken	Core lengths mostly > 1000 mm	
# **Rock Descriptions**

#### **Rock Quality Designation**

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

#### **Stratification Spacing**

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 289617 NORTHING: 7435023 DIP/AZIMUTH: -90°/-- BORE No: HA1 **PROJECT No: 74586** DATE: SHEET 1 OF 1

#### Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Sample (blows per mm) Depth Results & Comments (m) Strata 5 10 15 20 0.0 SAND - estimated very loose, dark brown, slightly silty fine to medium grained sand, moist, trace of rootlets A 0.1 0.2 0.2 SAND - estimated very loose, light brown, slightly silty fine to medium grained sand, moist в 0.4 SAND - estimated very loose, orange-brown, slightly silty fine to medium grained sand, moist 0.6 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 289770 **NORTHING:** 7434721 DIP/AZIMUTH: -90°/-- BORE No: HA2 **PROJECT No: 74586** DATE: SHEET 1 OF 1

#### Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Depth Sample (blows per mm) Type Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, trace of silt and rootlets A 0.1 В 0.4 0.4 SAND - estimated very loose, light brown, fine to medium grained sand, trace of silt, moist 0.5 Α 0.6 1 - 1 1.1 Bore discontinued at 1.1m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 289277 **NORTHING:** 7434954 DIP/AZIMUTH: -90°/-- BORE No: HA3 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Sample Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, trace of silt and rootlets 0.1 0.1 SAND - estimated very loose, light grey, sand, trace of silt, moist A 0.2 в 0.5 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

G P U\_x W

₽

A Auger sample B Bulk sample BLK Block sample

CDF

Core drilling Disturbed sample Environmental sample

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) EASTING: 291095 **NORTHING:** 7435421 DIP/AZIMUTH: -90°/-- BORE No: HA4 **PROJECT No: 74586** DATE: SHEET 1 OF 1

		Description	lic		San	Sampling & In Situ Testing		<u> </u>	ت Dynamic Penetrometer Test				
묍	Depth (m)	of Strata	Graph Log	Type	Jepth	ample	Results & Comments	Wate		hamic P (blov	vs per m	im)	est
		SAND - estimated very loose, dark brown, fine to medium grained sand, moist, some silt and trace of rootlets				S					15		
	-			A	0.1				-				
					0.2				-				
	- 0.3	SAND - estimated very loose, orange-brown, fine to medium grained sand, some silt, moist		B	0.3				1				
									-				
	. 1.2	Bore discontinued at 1.2m							-				

DRILLER: CRB/KH RIG: n/a TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDE

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 291510 NORTHING: 7435198 DIP/AZIMUTH: -90°/-- BORE No: HA5 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Sample Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, some silt, trace of rootlets 0.1 A 0.2 0.3 0.3 SAND - estimated very loose, orange-brown, fine to medium grained sand, with some silt, moist в 0.6 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 291932 NORTHING: 7435170 DIP/AZIMUTH: -90°/-- BORE No: HA6 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Depth (blows per mm) Type Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, some silt, trace of rootlets A 0.1 0.1 SAND - estimated very loose, light brown, fine to medium grained sand, moist, with some silt, shell fragments in the upper 100mm в 0.5 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Sampling & In Situ Testing

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 292259 NORTHING: 7435171 DIP/AZIMUTH: -90°/-- BORE No: HA7 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Sample Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, grey, fine to medium grained sand, moist, some silt А 0.2 0.3 0.3 SAND - estimated very loose, light grey, fine to medium grained sand, moist, some silt в 0.6 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 292646 NORTHING: 7435038 DIP/AZIMUTH: -90°/-- BORE No: HA8 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Depth Sample (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, some silt, trace of rootlets A 0.1 0.2 0.2 SAND - estimated very loose, orange-brown, fine to medium grained sand, moist, some silt в 0.5 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 292536 NORTHING: 7435207 DIP/AZIMUTH: -90°/-- BORE No: HA9 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Type Depth Sample (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium grained sand, moist, some silt, trace of rootlets A 0.1 0.1 SAND - estimated very loose, orange-brown, fine to medium grained sand, moist, some silt 0.3 в 0.5 1 - 1 1.2 Bore discontinued at 1.2m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288880 **NORTHING:** 7435912 DIP/AZIMUTH: -90°/-- BORE No: HA10 **PROJECT No: 74586** DATE: SHEET 1 OF 1

# Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Type Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - etimated very loose, light brown and white, fine to medium grained sand, moist А 0.2 ▼ 1 1.0 Bore discontinued at 1.0m

LOGGED: CRB/KH

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger

WATER OBSERVATIONS: Groundwater ingress at 0.5m depth **REMARKS:** 

**SAMPLING & IN SITU TESTING LEGEND** LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Is(50) (MPa) pp Pocket penetrometer (kPa) S Standard penetration test V Shear vane (kPa) Gas sample Piston sample Tube sample (x mm dia.) Water sample Water seep Water level A Auger sample B Bulk sample BLK Block sample G P U, W Core drilling Disturbed sample Environmental sample CDF ₽

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3

□ Cone Penetrometer AS1289.6.3.2



CLIENT: Tower Holdings Pty Ltd **PROJECT:** 

Great Keppel Island

#### LOCATION:

SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288891 NORTHING: 7435708 DIP/AZIMUTH: -90°/-- BORE No: HA11 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Type Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - etimated very loose, light brown and white, fine to medium grained sand, moist A 0.3 Ţ - 1 1 1.1 Bore discontinued at 1.1m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: Groundwater ingress at 1m depth **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288952 **NORTHING:** 7434885 DIP/AZIMUTH: -90°/-- BORE No: HA12 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Type Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium ASS samples taken from grained sand, moist, trace of silt and rootlets 0m to 1m depth at 0.25m intervals 0.2 0.3 SAND - estimated very loose, light brown, fine to medium grained sand, moist, trace of silt в 0.5 1 1.0 Bore discontinued at 1.0m

LOGGED: CRB/KH

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed

**REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

**SAMPLING & IN SITU TESTING LEGEND** LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Is(50) (MPa) pp Pocket penetrometer (kPa) S Standard penetration test V Shear vane (kPa) Gas sample Piston sample Tube sample (x mm dia.) A Auger sample B Bulk sample BLK Block sample G P U\_x W Water sample Water seep Water level Core drilling Disturbed sample Environmental sample ₽



SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3

SURFACE LEVEL: --

288966 **NORTHING:** 7434957 DIP/AZIMUTH: -90°/-- BORE No: HA13 **PROJECT No: 74586** DATE: SHEET 1 OF 1

#### Sampling & In Situ Testing Description Graphic Water Dynamic Penetrometer Test Depth Log പ of Sample Depth (blows per mm) Type Results & Comments (m) Strata 10 5 15 20 0.0 SILTY SAND - estimated very loose, dark brown, silty fine .... ASS samples taken from to medium grained sand, moist, trace of rootlets 0m to 1m depth at 0.25m intervals • • • • $\cdot |\cdot| \cdot$ .... 0.15 SILTY SAND - estimated very loose, light brown, silty fine . . . . . to medium grained sand, moist 0.2 $\cdot |\cdot| \cdot |$ $\cdot |\cdot| \cdot |$ $\cdot |\cdot| \cdot |$ · | · | · | $\cdot |\cdot| \cdot |$ в · | · | · | $\cdot |\cdot| \cdot |$ $\cdot |\cdot| \cdot |$ $\cdot |\cdot| \cdot |$ 0.5 $\cdot |\cdot| \cdot |$ $\cdot |\cdot| \cdot |$ · | · | · | 0.6 SAND - estimated very loose, light grey, fine to medium grained sand, moist, trace of silt 1 1.0 Bore discontinued at 1.0m RIG: n/a DRILLER: CRB/KH LOGGED: CRB/KH

TYPE OF BORING: 100mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

**REMARKS:** 

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3

□ Cone Penetrometer AS1289.6.3.2





CLIENT: **PROJECT:** 

#### LOCATION:

Tower Holdings Pty Ltd Geotechnical and Groundwater Investigation (EIS) **EASTING**: Great Keppel Island

SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288889 **NORTHING:** 7434906 DIP/AZIMUTH: -90°/--

BORE No: HA14 **PROJECT No: 74586** DATE: SHEET 1 OF 1

20

### Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Depth (blows per mm) Type Results & Comments (m) Strata 10 5 15 0.0 SAND - estimated very loose, dark brown, fine to medium ASS samples taken from grained sand, moist, trace of silt and rootlets 0m to 1m depth at 0.25m intervals 0.1 SAND - estimated very loose, orange-brown, fine to medium grained sand, moist, trace of silt 0.35 SAND - estimated very loose, light-brown, fine to medium grained sand, moist, trace of silt - grading wet 1 1.0 Bore discontinued at 1.0m

LOGGED: CRB/KH

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed

**REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

**SAMPLING & IN SITU TESTING LEGEND** LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Is(50) (MPa) pp Pocket penetrometer (kPa) S Standard penetration test V Shear vane (kPa) Gas sample Piston sample Tube sample (x mm dia.) A Auger sample B Bulk sample BLK Block sample G P U\_x W Water sample Water seep Water level Core drilling Disturbed sample Environmental sample ₽

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288865 NORTHING: 7434680 DIP/AZIMUTH: -90°/-- BORE No: HA15 **PROJECT No: 74586** DATE: SHEET 1 OF 1

### Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Depth (blows per mm) Type Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, dark brown, fine to medium ASS samples taken from grained sand, moist, some silt, trace of rootlets 0m to 1m depth at 0.25m intervals 0.2 0.2 SAND - estimated very loose, light-brown, fine to medium grained sand, moist в 0.5 1 - 1 1.1 Bore discontinued at 1.1m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288948 **NORTHING:** 7434553 DIP/AZIMUTH: -90°/-- BORE No: HA16 **PROJECT No: 74586** DATE: SHEET 1 OF 1

20

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Depth (blows per mm) Type Results & Comments (m) Strata 10 5 15 0.0 SAND - estimated very loose, dark brown, fine to medium ASS samples taken from grained sand, moist, trace of silt and rootlets 0m to 1m depth at 0.25m intervals 0.15 SAND - estimated very loose, light grey-brown, fine to medium grained sand, moist 1 - 1 1.1 Bore discontinued at 1.1m

DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3

Douglas Partners

Geotechnics | Environment | Groundwater

□ Cone Penetrometer AS1289.6.3.2

**SAMPLING & IN SITU TESTING LEGEND** Gas sample Piston sample Tube sample (x mm dia.) Water sample Water seep Water level LEGEND PID Photo ionisation detector (ppm) PL(A) Point load axial test Is(50) (MPa) PL(D) Point load diametral test Is(50) (MPa) pp Pocket penetrometer (kPa) S Standard penetration test V Shear vane (kPa) A Auger sample B Bulk sample BLK Block sample G P U\_x W Core drilling Disturbed sample Environmental sample CDF ₽

WATER OBSERVATIONS: No free groundwater observed

RIG: n/a

**REMARKS:** 

SURFACE LEVEL: --

CLIENT: Tower Holdings Pty Ltd **PROJECT:** Geotechnical and Groundwater Investigation (EIS) EASTING: 289166 LOCATION:

Great Keppel Island

**NORTHING:** 7434518 DIP/AZIMUTH: -90°/-- BORE No: HA17 **PROJECT No: 74586** DATE: SHEET 1 OF 1

Γ		Description	hic		San	npling &	& In Situ Testing	_	_				
R	i Depth (m)	of	Log	be	pth	nple	Results &	Wate	Dyn	amic P (blov	'enetro vs per	meter mm)	lest
		Strata	0	L L	De	Sar	Comments		5	10	D 1	5	20
		SAND - estimated very loose, orange-brown, fine to medium grained sand, moist, trace of silt											
													÷
	F								-				÷
					0.2								
					0.2								
													-
	-												:
				В									÷
	[												
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	-				0.5								-
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	-								-				:
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	-1												-
													:
	-												
													-
	1.2	Bore discontinued at 1.2m											
	ŀ								-				:
													÷
	[												
L												:	

DRILLER: CRB/KH RIG: n/a TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

A Auger sample B Bulk sample BLK Block sample

CDE

Core drilling Disturbed sample Environmental sample

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3



SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) **EASTING**: 288844 **NORTHING:** 7434917 DIP/AZIMUTH: -90°/-- BORE No: HA18 **PROJECT No: 74586** DATE: SHEET 1 OF 1

## Sampling & In Situ Testing Description Graphic Log Water Dynamic Penetrometer Test Depth പ of Sample Type Depth (blows per mm) Results & Comments (m) Strata 10 5 15 20 0.0 SAND - estimated very loose, brown, fine to medium ASS samples taken from grained sand, moist, trace of silt 0m to 1m depth at 0.25m intervals 0.3 SAND - estimated very loose, light brown, fine to medium grained sand, moist 1 1.0 Bore discontinued at 1.0m

RIG: n/a DRILLER: CRB/KH TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed

**REMARKS:** 

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3





SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) EASTING: 288976 NORTHING: 7435039 DIP/AZIMUTH: -90°/-- BORE No: HA19 **PROJECT No: 74586** DATE: SHEET 1 OF 1

		Description	0		Sam	ampling & In Situ Testing						
Å	Depth	of	aphic	e	th th	e e		ater	Dynamic	Penetr	omete	Test
Ē	(m)	Strata	U U U	Typ	Dept	Samp	Comments	≥	5	10	15	20
	-	SAND - estimated very loose, orange-brown, fine to medium grained sand, moist, trace of silt			0.0		ASS samples taken from Om to 1m depth at 0.25m intervals		-			
	-			В					-			
	-				0.5					-	ł	
									-			
	-1 1.0	Bore discontinued at 1.0m							-			

DRILLER: CRB/KH RIG: n/a TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed **REMARKS:** 

LOGGED: CRB/KH

SURVEY DATUM: MGA94 Zone 56K CASING: NIL

□ Sand Penetrometer AS1289.6.3.3

□ Cone Penetrometer AS1289.6.3.2





Tower Holdings Pty Ltd

Great Keppel Island

#### **PROJECT:** LOCATION:

CLIENT:

SURFACE LEVEL: --

Geotechnical and Groundwater Investigation (EIS) EASTING: 289085 NORTHING: 7435060 DIP/AZIMUTH: -90°/-- BORE No: HA20 **PROJECT No: 74586** DATE: SHEET 1 OF 1

		<b>-</b>			Sampling & In Situ Testing							
, Depth		Description	iphic og	0	- L	<u>e</u>		ater	Dynamic Penetrometer Test			
Ľ	(m)	Strata	Gra	Type	Dept	amp	Results & Comments	Ň	(DI	ows per	mm)	20
	-	SAND - estimated very loose, light grey, fine to medium grained sand, moist, trace of silt		Typ		Sam	ASS samples taken from Om to 1m depth at 0.25m intervals	\$	-	<u>10</u>		20
	- 1 1.0 - -	Bore discontinued at 1.0m	<u></u>						- <b>1</b>			

LOGGED: CRB/KH

DRILLER: CRB/KH RIG: n/a TYPE OF BORING: 100mm diameter hand auger WATER OBSERVATIONS: No free groundwater observed

**REMARKS:** 

CDF

CLIENT:

**PROJECT:** 

LOCATION:

Tower Holdings Pty Ltd

Great Keppel Island

 
 SAMPLING & IN SITU TESTING LEGEND

 G
 Gas sample
 PID
 Phot

 P
 Piston sample
 PL(A) Poin
 PL(A) Poin

 U
 Tube sample (xmm dia.)
 PL(D) Point
 PL(D) Point

 W
 Water sample
 PD
 Poto

 W
 Water sample
 Stan
 Stan

 mple
 ¥
 Water level
 V
 Sheat

 LEGEND

 PID
 Photo ionisation detector (ppm)

 PL(A) Point load axial test Is(50) (MPa)

 PL(D) Point load diametral test Is(50) (MPa)

 pp
 Pocket penetrometer (kPa)

 S
 Standard penetration test

 V
 Shear vane (kPa)

 A Auger sample B Bulk sample BLK Block sample Core drilling Disturbed sample Environmental sample

SURVEY DATUM: MGA94 Zone 56K CASING: NIL □ Sand Penetrometer AS1289.6.3.3



# Appendix C

Laboratory Report Sheets



+61 7 3357 5535 www.trilab.com.au 10/104 Newmarket Rd, Windsor QLD 4030

	PARTICLE SIZE DISTRIBUTION						
		PERCENTA	GE DISPERS	ON T	EST REPOR	т	
Client	Douglas	Partners Pty Lto	3		Report No.	10110823-%D	
Project	74586				Test Date	9/12/2010	
					Report Date	13/12/2010	
Client ID	HA3				Depth (m)	0.20-0.50	
Sieve Size	Passing	100					
(mm)	%						
150.0	_						
75.0		90					
53.0							
37.5		80		+	┼┼┤ ── ┤ ││ │ │ │		
26.5							
19.0							
9.5		70					
4.75	100						
2.36	99	60					
1.18	99	() ()					
0.600	99	%) BL					
0.425	98						
0.300	93	Ра					
0.150	12	40					
0.075	3	40					
0.073	3						
0.05	2	30					
0.036	2						
0.036	2	20					
0.025	2	20					
0.010	2						
0.013	2	10					
0.0096	2						
0.0068	1				1		
0.0048	1	0.001	0.01		0.1	1 10	
0.004	1	0.001	0.01	Portio!-	Sizo (mm)		
0.0034	0			Particle	size (mm)		
0.0028	0						
0.0024	0	D	ISPERSION (%) :	0.0			
0.0014	0		~ /				
OTES/REMARI	<u> </u>	Upper line: + dispe Moisture Content 4 Sample/s supplied	rsant, Lower line: - dis 4.6% -2.36r by the client	persant nm Soil P	article Density (t/m <sup>3</sup> )	2.84 Page 1 of 1 REPO3	
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratio traceable to A	accordance with NATA's or compliance with ISO/II ons, and/or measuremer sustralian/National Stanc	accreditation ES 17025. The its included in this lards.	V	Authorised Signatory <i>Jamus Quul</i> J. Russell	Competence	
						Laboratory No. 9	

The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab's "Standard Terms and Conditions of Business" for further details. Trilab Pty Ltd ABN 25 065 630 506



ATTERBERG LIMITS TEST REPORT Test Method: A\$1289.2.1.1.3.1.2.3.2.1.3.3.1.3.4.1							
Client: Douglas Partr	ners Pty Ltd	Report No.	10110823	3-AL			
Project: 74586		Test Date: Report Date:	10/12/10 13/12/10				
Client ID: HA3	Depth(m): 0	.2-0.5	Sample No	. 10110823			
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (%	%):	Not Obtainable			
Plastic Limit (%):	Not Obtainable	Field Moisture Cont	tent (%):	4.6			
Plasticity Index (%):	Non Plastic						
Client ID: HA15	Depth(m): 0	2-0.5	Sample No	10110824			
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (%	%):	Not Obtainable			
Plastic Limit (%):	Not Obtainable	Field Moisture Cont	tent (%):	7.0			
Plasticity Index (%):	Non Plastic						
Client ID: HA9	Sample No.	10110825					
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (%	%):	Not Obtainable			
Plastic Limit (%):	Not Obtainable	Field Moisture Cont	6.4				
Plasticity Index (%):	Non Plastic						
Client ID: HA8	Depth(m): 0.	.2-0.5 Sample No.10110826					
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (%	%):	Not Obtainable			
Plastic Limit (%):	Not Obtainable	Field Moisture Cont	tent (%):	5.6			
Plasticity Index (%):	Non Plastic						
Remarks: The sample/s were tested oven dried, dry sieved and in a 125 – 250mm mould. *Crumbling occurred. +Curling occurred							
The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.							
This Document is i accred Accredited for c The results of measurements traceable to A	ssued in accordance with NATA litation requirements. ompliance with ISO/IEC 17025 the tests, calibrations, and/or included in this document are ustralian/National standards	a's	Authorised Si Januar J. J. Russel	gnatory Quall			

Manager

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

N ATA Accredited Laboratory Number 9926 Form Number:GT004-5 ANALYTICAL CHEMISTRY & TESTING SERVICES

# (ALS)

#### Environmental Division

#### CERTIFICATE OF ANALYSIS

Work Order	EB1022118	Page	: 1 of 5
Client		Laboratory	: Environmental Division Brisbane
Contact	: RESULTS ADDRESS	Contact	: Carsten Emrich
Address	: P O BOX 3317	Address	: 32 Shand Street Stafford QLD Australia 4053
	NEWMARKET QLD, AUSTRALIA 4031		
E-mail	: test@trilab.com.au	E-mail	: carsten.emrich@alsenviro.com
Telephone	: +61 07 3257 5535	Telephone	: +61 7 3243 7123
Facsimile	: +61 07 3357 5531	Facsimile	: +61 7 3243 7218
Project	: 74586	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: AG1167		
C-O-C number	:	Date Samples Received	: 03-DEC-2010
Sampler	:	Issue Date	: 14-DEC-2010
Site	:		
		No. of samples received	: 14
Quote number	:	No. of samples analysed	: 14

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

WORLD RECOGNISED



Accredited for compliance with ISO/IEC 17025.

> Environmental Division Brisbane Part of the ALS Laboratory Group 32 Shand Street Stafford QLD Australia 4053 Tel. +61-7-3243 7222 Fax. +61-7-3243 7218 www.alsglobal.com A Campbell Brothers Limited Company

Page	: 2 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	74586



#### **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society. LOR = Limit of reporting

^ = This result is computed from individual analyte detections at or above the level of reporting

Page	: 3 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### Analytical Results

Sub-Matrix: SOIL	Client sample ID		10110823-HA3	10110824-HA15	10110825-HA9	10110826-HA8	10110827-HA1	
					0.2 - 0.5	0.3 - 0.5	0.2 - 0.5	0.2 - 0.6
	Cl	ient sampli	ng date / time	03-DEC-2010 10:30	03-DEC-2010 10:37	03-DEC-2010 10:30	03-DEC-2010 10:30	03-DEC-2010 10:30
Compound	CAS Number	LOR	Unit	EB1022118-001	EB1022118-002	EB1022118-003	EB1022118-004	EB1022118-005
EP004: Organic Matter								
Organic Matter		0.5	%	0.5	1.9	0.6	0.6	0.6

Page	: 4 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### Analytical Results

Sub-Matrix: SOIL	Client sample ID		10110828-HA17	10110829-HA4	10110830-HA13	10110831-HA7	10110832-HA12	
			0.2 - 0.5	0.2 - 0.6	0.2 - 0.5	0.3 - 0.6	0.2 - 0.6	
	Cl	ient samplii	ng date / time	03-DEC-2010 10:30				
Compound	CAS Number	LOR	Unit	EB1022118-006	EB1022118-007	EB1022118-008	EB1022118-009	EB1022118-010
EP004: Organic Matter								
Organic Matter		0.5	%	0.6	0.6	1.3	0.6	<0.5

Page	: 5 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### Analytical Results

Sub-Matrix: SOIL	Client sample ID		10110833-HA2	10110834-HA19	10110835-HA5	10110836-HA6		
			0.1 - 0.4	0.2 - 0.5	0.3 - 0.5	0.1 - 0.5		
	Cl	ient samplii	ng date / time	03-DEC-2010 10:30	03-DEC-2010 10:30	03-DEC-2010 10:30	03-DEC-2010 10:30	
Compound	CAS Number	LOR	Unit	EB1022118-011	EB1022118-012	EB1022118-013	EB1022118-014	
EP004: Organic Matter								
Organic Matter		0.5	%	1.2	<0.5	<0.5	<0.5	

#### Environmental Division



#### QUALITY CONTROL REPORT

Work Order	: EB1022118	Page	: 1 of 5
Client		Laboratory	: Environmental Division Brisbane
Contact	: RESULTS ADDRESS	Contact	: Carsten Emrich
Address	: P O BOX 3317	Address	: 32 Shand Street Stafford QLD Australia 4053
	NEWMARKET QLD, AUSTRALIA 4031		
E-mail	: test@trilab.com.au	E-mail	: carsten.emrich@alsenviro.com
Telephone	: +61 07 3257 5535	Telephone	: +61 7 3243 7123
Facsimile	: +61 07 3357 5531	Facsimile	: +61 7 3243 7218
Project	: 74586	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Site	:		
C-O-C number	:	Date Samples Received	: 03-DEC-2010
Sampler	:	Issue Date	: 14-DEC-2010
Order number	: AG1167		
		No. of samples received	: 14
Quote number	:	No. of samples analysed	: 14

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

	NATA Accredited Laboratory 825	Signatories This document has been electronically signed by the authorized signatories indicated below. Electronic signing has be carried out in compliance with procedures specified in 21 CER Part 11.					
accordance with NATA accreditation requirements.	Signatories	Position	Accreditation Category	Accreditation Category			
	Kim McCabe	Senior Inorganic Chemist	Inorganics				
WORLD RECOGNISED	Accredited for compliance with ISO/IEC 17025.						
Environmental Division Brisbane Part of the ALS Laboratory Group							
32 Shand Street Stafford QLD Australia 4053 Tel. +61-7-3243 7222 Fax. +61-7-3243 7218 www.alsglobal.com							

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Page	: 2 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### **General Comments**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society. LOR = Limit of reporting RPD = Relative Percentage Difference

# = Indicates failed QC

Page	: 3 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	74586



#### Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR:-No Limit; Result between 10 and 20 times LOR:-0% - 50%; Result > 20 times LOR:-0% - 20%.

Sub-Matrix: SOIL			Laboratory Duplicate (DUP) Report						
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EP004: Organic Matte	er (QC Lot: 1596003)								
EB1022039-001	Anonymous	EP004: Organic Matter		0.5	%	0.6	0.6	0.0	No Limit
EB1022118-009	10110831-HA7 0.3 - 0.6	EP004: Organic Matter		0.5	%	0.6	0.6	0.0	No Limit



#### Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: SOIL	Method Blank (MB)	Laboratory Control Spike (LCS) Report						
	Report	Spike	Spike Recovery (%)	Recovery	Limits (%)			
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP004: Organic Matter (QCLot: 1596003)								
EP004: Organic Matter		0.5	%	<0.5	2.3 %	100	87	111

Page	: 5 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOS). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

• No Matrix Spike (MS) Results are required to be reported.

#### Environmental Division



#### INTERPRETIVE QUALITY CONTROL REPORT

Work Order	: EB1022118	Page	: 1 of 5
Client Contact Address	: TRILAB PTY LTD : RESULTS ADDRESS : P O BOX 3317 NEWMARKET QLD, AUSTRALIA 4031	Laboratory Contact Address	<ul> <li>Environmental Division Brisbane</li> <li>Carsten Emrich</li> <li>32 Shand Street Stafford QLD Australia 4053</li> </ul>
E-mail Telephone Facsimile	test@trilab.com.au +61 07 3257 5535 +61 07 3357 5531	E-mail Telephone Facsimile	carsten.emrich@alsenviro.com +61 7 3243 7123 +61 7 3243 7218
Project Site	: 74586 :	QC Level	NEPM 1999 Schedule B(3) and ALS QCS3 requirement
C-O-C number Sampler Order number	: : : AG1167	Date Samples Received Issue Date	: 03-DEC-2010 : 14-DEC-2010
Quote number	:	No. of samples received No. of samples analysed	: 14 : 14

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Interpretive Quality Control Report contains the following information:

- Analysis Holding Time Compliance
- Quality Control Parameter Frequency Compliance
- Brief Method Summaries
- Summary of Outliers

#### Environmental Division Brisbane

Part of the ALS Laboratory Group

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Page	: 2 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



#### Analysis Holding Time Compliance

The following report summarises extraction / preparation and analysis times and compares with recommended holding times. Dates reported represent first date of extraction or analysis and precludes subsequent dilutions and reruns. Information is also provided re the sample container (preservative) from which the analysis aliquot was taken. Elapsed period to analysis represents number of days from sampling where no extraction / digestion is involved or period from extraction / digestion where this is present. For composite samples, sampling date is assumed to be that of the oldest sample contributing to the composite. Sample date for laboratory produced leachates is assumed as the completion date of the leaching process. Outliers for holding time are based on USEPA SW 846, APHA, AS and NEPM (1999). A listing of breaches is provided in the Summary of Outliers.

Holding times for leachate methods (excluding elutriates) vary according to the analytes being determined on the resulting solution. For non-volatile analytes, the holding time compliance assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These soil holding times are: Organics (14 days); Mercury (28 days) & other metals (180 days). A recorded breach therefore does not guarantee a breach for all non-volatile parameters.

Matrix: SOIL Evaluation: * = Holding time breach ; ✓ = Within holding time								holding time.
Method		Sample Date	Extraction / Preparation			Analysis		
Container / Client Sample ID(s)			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP004: Organic Matter								
Snap Lock Bag 10110823-HA3 - 0.2 - 0.5, 10110825-HA9 - 0.3 - 0.5, 10110827-HA1 - 0.2 - 0.6, 10110829-HA4 - 0.2 - 0.6, 10110831-HA7 - 0.3 - 0.6,	10110824-HA15 - 0.2 - 0.5, 10110826-HA8 - 0.2 - 0.5, 10110828-HA17 - 0.2 - 0.5, 10110830-HA13 - 0.2 - 0.5, 10110832-HA12 - 0.2 - 0.6,	03-DEC-2010	10-DEC-2010	10-DEC-2010	✓	10-DEC-2010	10-DEC-2010	•
10110833-HA2 - 0.1 - 0.4, 10110835-HA5 - 0.3 - 0.5,	10110834-HA19 - 0.2 - 0.5, 10110836-HA6 - 0.1 - 0.5							
Page	: 3 of 5							
------------	------------------							
Work Order	: EB1022118							
Client	: TRILAB PTY LTD							
Project	: 74586							



# **Quality Control Parameter Frequency Compliance**

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(where) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Evaluation: * = Quality Control frequency not within specification ; 🗸 = Quality Control frequency within specification								
Quality Control Sample Type		С	ount		Rate (%)		Quality Control Specification	
Analytical Methods	Method	QC	Regular	Actual	Expected	Evaluation		
Laboratory Duplicates (DUP)								
Organic Matter	EP004	2	15	13.3	10.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement	
Laboratory Control Samples (LCS)								
Organic Matter	EP004	1	15	6.7	5.0	✓	NEPM 1999 Schedule B(3) and ALS QCS3 requirement	
Method Blanks (MB)								
Organic Matter	EP004	1	15	6.7	5.0	1	NEPM 1999 Schedule B(3) and ALS QCS3 requirement	

Page	: 4 of 5
Work Order	: EB1022118
Client	: TRILAB PTY LTD
Project	: 74586



## **Brief Method Summaries**

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Organic Matter	EP004	SOIL	AS1289.4.1.1 - 1997., Dichromate oxidation method after Walkley and Black. This method is compliant with
Preparation Methods	Method	Matrix	Method Descriptions
Organic Matter	EP004-PR	SOIL	AS1289.4.1.1 - 1997., Dichromate oxidation method after Walkley and Black. This method is compliant with
			NEPM (1999) Schedule B(3) (Method 105)



### Summary of Outliers

### **Outliers : Quality Control Samples**

The following report highlights outliers flagged in the Quality Control (QC) Report. Surrogate recovery limits are static and based on USEPA SW846 or ALS-QWI/EN/38 (in the absence of specific USEPA limits). This report displays QC Outliers (breaches) only.

#### Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

- For all matrices, no Method Blank value outliers occur.
- For all matrices, no Duplicate outliers occur.
- For all matrices, no Laboratory Control outliers occur.
- For all matrices, no Matrix Spike outliers occur.

#### **Regular Sample Surrogates**

• For all regular sample matrices, no surrogate recovery outliers occur.

#### **Outliers : Analysis Holding Time Compliance**

This report displays Holding Time breaches only. Only the respective Extraction / Preparation and/or Analysis component is/are displayed.

• No Analysis Holding Time Outliers exist.

#### **Outliers : Frequency of Quality Control Samples**

The following report highlights breaches in the Frequency of Quality Control Samples.

• No Quality Control Sample Frequency Outliers exist.



PERMEABILITY BY CONSTANT HEAD TEST REPORT									
Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H F	lead (1988) Manual of Laboratory Testing, 10.7)								
Client: Douglas Partners Pty Ltd	Report No. 10110823-CHP								
Project: 74586	Test Date: 10/12/10								
-	Report Date: 14/12/10								
Sample Number:	10110823								
Client ID:	HA3								
Depth (m):	0.2-0.5								
Initial Wet Density (t/m <sup>3</sup> ):	1.63								
Initial Moisture Content (%):	3.3								
Water Used:	Тар								
Hydraulic Gradient:	-								
Surcharge (kPa):	2.2								
Pressure Applied (kPa):	3.7								
Percentage Material Retained / Sieve Size (mm)	0/19								
PERMEABILITY:	k <sub>20</sub> = 7 x 10 <sup>−5</sup> m/s								
Remarks: The specimen was compacted as requested by the	client.								
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Ptv I td "Standard Terms and (	strument or sample at the time of test unless otherwise clearly								
Sample/s supplied by the client	Page: 1 of 1								
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James VIIII J. Russell

Manager



EMERSON CLASS NUMBER TEST REPORT Test Method: AS1289 3.8.1									
Client: Douglas Partne	ers Pty Ltd		Rep	ort No.	10110823	3-EM			
Project: 74586			Test Rep	Date: ort Date:	10/12/10 13/12/10				
Sample No.	10110823	10110	824	10110825	10110826	10110827			
Client ID:	HA3	HA1	15	HA9	HA8	HA1			
Depth (m):	0.2-0.5	0.2-0	).5	0.3-0.5	0.2-0.5	0.2-0.6			
Description:	Clayey Sand	Sar	nd	Sand	Clayey Sand	Clayey Sand			
	brown	gre	y	brown	red	brown			
Emerson Class No.:	6	6		6	5	6			
Sample No.	10110929	10110	1920	10110820	10110821	10110922			
	10110626		1029	10110630	10110031	10110632			
Client ID:	HA17	НА	4	HA13	HA7	HA12			
Depth (m):	0.2-0.5	0.3-0	0.6	0.2-0.5	0.3-0.6	0.2-0.6			
Description:	Sand	Clayey	Sand	Clayey Sand	Clayey Sand	Sand			
	brown	red/br	own	brown	grey	brown			
Emerson Class No.:	6	6		6	6	6			
Remarks: Tested with distilled water at 24 <sup>o</sup> C									
	<u> </u>		<del>.</del> .,	. 1.	<u>(1) (1) (1) (1) (1) (1) (1) (1) (1) (1) </u>				
stated. Reference should be made to T	The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.								
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Manager

N ATA Accredited Laboratory Number 9926 Form Number: GT007-5

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



pH TEST REPORT									
Client: Douglas Partners F	Pty Ltd	St Wethou	Report	t No.		1011	0823-	PH	
Project: 74586	Test Date: Report Date:			10-1 13/1	10-13/12/10 13/12/10				
Sample No.	1011082	3 101	110824	1011	0825	1011	0826	10110	0827
Client ID:	HA3	F	IA15	H.	A9	H	48	HA	\1
Depth (m):	0.20-0.50	0 0.2	20-0.50	0.30	-0.50	0.20	0.50	0.20-	0.60
Description	Clayey Sar	nd S	Sand	Sa	and	Clayey	/ Sand	Clayey	Sand
Description	brown		grey	bro	own	bro	wn	brov	wn
рН	6.55	-	7.39	5.	43	5.	43	5.7	<b>'</b> 4
Sample No.	1011082	8 101	110829	1011	0830	1011	0831	10110	1832
Client ID:	HA17		HA4	HA13		HA7		HA	12
Depth (m):	0.20-0.50	0 0.3	0-0.60	0.20	0.20-0.50 (		0.60	0.20-	0.60
Description	Sand	Clay	ey Sand	Clayey Sand		Clayey Sand		Sa	nd
Description	brown	b	orown	bro	own	bro	wn	bro	wn
рН	5.52	(	6.09	5.	93	5.	69	6.3	37
Sample No.	40	440000	4044	0004	4044	0005	4044	0000	
Client ID:	10	10110833 HA2		ΗΔ19		0835 45	1011 H	0836 46	
Depth (m):	0	10-0.40	0.20			0.30-0.50		-0.50	
	Cla	ivev San	d Clave	Clavey Sand		Clavey Sand		v Sand	
Description		brown	bro	own	red brown		brown		
pН		6.03		18	5.	5.46 5.		57	
The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly									
stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.									
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TECHNICAL

Manager

J. Russell

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



	I	FERCENT	Test Met	CERSION thod: AS 1289 3.8.			
Client	Douglas	Partners Pty	Ltd		Report No.	10110824-%D	
Project	74586				Test Date	9/12/2010	
					Report Date	13/12/2010	
Client ID	HA15				Depth (m)	0.20-0.50	
Sieve Size	Passing	100 -					
(mm)	%						
150.0							
75.0		90					
53.0							
37.5		80					
26.5							
19.0							
9.5		70					
4.75							
2.36		60					
1.18		(%					
0.600	100	,) 6u					
0.425	99	is 50					
0.300	88	<u>₽</u>					
0.150	11	40					
0.075	5						
0.074	5						
0.053	4	30					
0.037	4						
0.026	4	20					
0.019	4						
0.014	4						
0.01	3	10					
0.0071	2						
0.0051	1	o —					
0.0042	1	0.001		0.01	0.1	1	
0.0036	1			Part	icle Size (mm)		
0.0029	1						
0.0025	1						
0.0015	1		DISPERSIC				
NOTES/REMARI	<u>KS:</u>	Upper line: + dis Moisture Conten Sample/s supplie	persant, Lowe at 7% ed by the client	r line: - dispersan -2.36mm Soi	t I Particle Density (t/m	<sup>3</sup> ) 2.67 Page 1 of 1 REP038	
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratio traceable to A	ccordance with NAT r compliance with IS ns, and/or measurer ustralian/National St	A's accreditation O/IES 17025. The ments included in t andards.	his L	Authorised Signatory <i>Jamun Rus</i> J. Russell		



Tect Method: As 1290 6 7 1 5 1 1 / KH 2 (Pased on K H Hoad (1999) Manual of Laboratory Testing 10 7)									
Client: Douglas Partners Pty I to	Report No. 10110824-CHP								
Project: 74586	Test Date: 13/12/10								
	Report Date: 14/12/10								
Sample Number:	10110824								
Client ID:	HA15								
Depth (m):	0.2-0.5								
Initial Wet Density (t/m <sup>3</sup> ):	1.70								
Initial Moisture Content (%):	7.7								
Water Used:	Тар								
Hydraulic Gradient:	-								
Surcharge (kPa):	2.2								
Pressure Applied (kPa):	3.7								
Percentage Material Retained / Sieve Size (mm)	0/19								
PERMEABILITY:	$k_{20} = 2 \times 10^{-5} \text{ m/s}$								
Remarks: The specimen was compacted as requested by the	client .								
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Control of the state of t	Strument or sample at the time of test unless otherwise clearly Conditions of Business" for further details.								
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J. Russell Manager



	PARTICLE SIZE DISTRIBUTION						
		PERCENTA	GE DISPERS	ON T	EST REPOR	т	
Client	Douglas	Partners Pty Lto	3		Report No.	10110825-%D	
Project	74586				Test Date	9/12/2010	
					Report Date	13/12/2010	
Client ID	HA9				Depth (m)	0.30-0.50	
Sieve Size	Passing	100 -					
(mm)	%						
150.0							
75.0		90					
53.0							
37.5		80	+ + + + + + + + + + + + + + + + + + +				
26.5							
19.0							
9.5		70					
4.75							
2.36		60					
1.18		(%					
0.600	100	) gni					
0.425	98	S 50					
0.300	84	ш					
0.150	15	40					
0.075	9						
0.071	9	20					
0.051	7	30 -					
0.036	6						
0.025	6	20					
0.019	5						
0.014	4	10					
0.0097	2						
0.0069	2						
0.0049	1	o 丰 🔤					
0.004	1	0.001	0.01		0.1	1	
0.0035	0			Particle	Size (mm)		
0.0029	0						
0.0025	0	П	ISPERSION (%)	92.0			
0.0014	0						
NOTES/REMARI	<u> </u>	Upper line: + dispe Moisture Content 6 Sample/s supplied	rsant, Lower line: - dis 6.4% -2.36r by the client	persant nm Soil P	article Density (t/m <sup>3</sup> )	2.75 Page 1 of 1 REP03	
This documer requirements results of the document are	nt is issued in a Accredited fo tests, calibratic traceable to A	accordance with NATA's r compliance with ISO/II ons, and/or measuremer ustralian/National Stand	accreditation ES 17025. The ats included in this lards.	V	Authorised Signatory		



PERMEABILITY BY CONSTANT HEAD TEST REPORT Test Method: As 1289 6 7 1 5 1 1 / KH 2 (Based on K H Head (1988) Manual of Laboratory Testing, 10 7)									
Client: Douglas Partners Pty Ltd	Report No. 10110825-CHP								
Project: 74586	Test Date: 13/12/10								
	Report Date: 14/12/10								
Sample Number:	10110825								
Client ID:	HA9								
Depth (m):	0.3-0.5								
Initial Wet Density (t/m <sup>3</sup> ):	1.73								
Initial Moisture Content (%):	5.8								
Water Used:	Тар								
Hydraulic Gradient:	-								
Surcharge (kPa):	2.2								
Pressure Applied (kPa):	3.7								
Percentage Material Retained / Sieve Size (mm)	0/19								
PERMEABILITY:	$k_{20} = 3 \times 10^{-5} m/s$								
Remarks: The specimen was compacted as requested by the	e client .								
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Pty Ltd "Standard Terms and	strument or sample at the time of test unless otherwise clearly Conditions of Business" for further details.								
Sample/s supplied by the client	Page: 1 of 1								
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Accredited for compliance with ISO/IEC 17025	tomes Quest II								
The results of the tests, calibrations, and/or									



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J. Russell Manager

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



	PARTICLE SIZE DISTRIBUTION						
	I	PERCENTAC	GE DISPERSION 1 Test Method: AS 1289 3.8.2	EST REPOR	т		
Client	Douglas	Partners Pty Ltd		Report No.	10110826-%D		
Project	74586			Test Date	9/12/2010		
				Report Date	13/12/2010		
Client ID	HA8			Depth (m)	0.20-0.50		
Sieve Size	Passing	100					
(mm)	%						
150.0		90					
75.0 52.0							
37.5							
31.0 DE E		80					
20.0							
19.0		70					
9.5							
2 36							
1 18		60					
0.600	100	6 (%)					
0.000	99	us 50					
0.300	01	Ба					
0.500	23	40					
0.075	0	40					
0.070	7						
0.051	7	30					
0.036	6						
0.025	6	20					
0.019	6						
0.014	5						
0.0096	5	10					
0.0068	4						
0.0049	3	0					
0.004	3	0.001	0.01	0.1	1		
0.0035	3		Partic	le Size (mm)			
0.0028	3						
0.0024	3						
0.0014	2		SFERSIUN (%): 48.0				
NOTES/REMAR	<u>KS:</u>	Upper line: + dispers Moisture Content 5. Sample/s supplied b	sant, Lower line: - dispersant 6% -2.36mm Soil l by the client	Particle Density (t/m <sup>3</sup> )	2.76 Page 1 of 1 REP03801		
This documer requirements results of the document are	nt is issued in a Accredited fo tests, calibratic traceable to A	accordance with NATA's a r compliance with ISO/IE ons, and/or measurement ustralian/National Standa	accreditation S 17025. The s included in this ards.	Authorised Signatory James June J. Russell	Laboratory No. 9926		



PERMEABILITY BY CONSTAN	PERMEABILITY BY CONSTANT HEAD TEST REPORT Test Method: As 1289 6 7 1 5 1 1 / KH 2 (Based on K H Head (1988) Manual of Laboratory Testing, 10 7)							
Client: Douglas Partners Pty Ltd	Report No. 10110826-CHP							
Project: 74586	Test Date: 13/12/10							
	Report Date: 14/12/10							
Sample Number:	10110826							
Client ID:	HA8							
Depth (m):	0.2-0.5							
Initial Wet Density (t/m <sup>3</sup> ):	1.76							
Initial Moisture Content (%):	4.8							
Water Used:	Тар							
Hydraulic Gradient:	-							
Surcharge (kPa):	2.2							
Pressure Applied (kPa):	3.7							
Percentage Material Retained / Sieve Size (mm)	0/19							
PERMEABILITY:	$k_{20} = 2 \times 10^{-5} m/s$							
Remarks: The specimen was compacted as requested by the	e client .							
The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details								
Sample/s supplied by the client	Page: 1 of 1							
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J. Russell



	PARTICLE SIZE DISTRIBUTION				
PERCENTAGE DISPERSION TEST REPORT					
Client	Douglas	Partners Pty Ltd		Report No.	10110827-%D
Project	74586			Test Date	9/12/2010
				Report Date	0.20.0.60
Sieve Size	Passing			Deptil (III)	0.20-0.00
(mm)	" ussing	100			
150.0					
75.0		90			
53.0					
37.5		80			
26.5		00			
19.0					
9.5		70			
4.75					
2.36		60			
1.18		(%			
0.600		, gui tr			
0.425	100	s 50			
0.300	94				
0.150	25	40			
0.075	14				
0.071	13	30			
0.05	12				
0.036	10				
0.025	9	20			
0.019	7				
0.014	6	10			
0.0096	6				
0.0069	4				
0.0049	2	0.001	0.01	0.1	1
0.0025	1		Particl	le Size (mm)	
0.0035	1				
0.0020	1				
0.0024	1	DISPERS	ION (%) : 67.0		
NOTES/REMARK	<u>I ⁻'</u> ⟨S:	Upper line: + dispersant. Low	ver line: - dispersant		
		Moisture Content 7.7% Sample/s supplied by the clie	-2.36mm Soil F	Particle Density (t/m <sup>3</sup> )	2.73 Page 1 of 1 REP03801
This documer requirements results of the document are	nt is issued in a Accredited fo tests, calibratic traceable to A	ccordance with NATA's accreditation r compliance with ISO/IES 17025. T ons, and/or measurements included in ustralian/National Standards.	n 'he n this	Authorised Signatory James Jussell J. Russell	Laboratory No. 9926



	ATTERBERG L Test Method: AS12892	<b>LIMITS TEST REP</b>	<b>PORT</b>		
Client: Douglas Part	ners Pty Ltd	Report No.	10110827	7-AL	
Project: 74586		Test Date: Report Date:	10/12/10 13/12/10		
Client ID: HA1	Depth(m): 0	.2-0.6	Sample No.	10110827	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Obtai	nable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	7.7	
Plasticity Index (%):	Non Plastic				
Client ID: HA17	Depth(m): 0	.2-0.5	Sample No.	10110828	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Obta	inable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	4.4	L I
Plasticity Index (%):	Non Plastic				
Client ID: HA4	Depth(m): 0	.3-0.6	Sample No.	10110829	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Obta	inable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	5.1	
Plasticity Index (%):	Non Plastic				
Client ID: HA13	Depth(m): 0	.2-0.5	Sample No.	10110830	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Obta	inable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	15.8	В
Plasticity Index (%):	Non Plastic				
Remarks: The sample *Crumbling occurred. +Curling occurred	e/s were tested oven dri	ed, dry sieved and in	a 125 – 250i	mm mould.	
he results of calibrations and tests tated. Reference should be made ample/s supplied by the client	s performed apply only to the to Trilab Pty Ltd "Standard T	specific instrument or sam erms and Conditions of Bu	ple at the time o Isiness" for furth	f test unless othe er details.	rwise clearly Page: 1 of
This Document is accre Accredited for The results of measurements traceable to A	issued in accordance with NATA ditation requirements. compliance with ISO/IEC 17025 the tests, calibrations, and/or included in this document are Australian/National standards	A's e	Authorised Si	gnatory Qualifi I	

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



PERMEABILITY BY CONSTANT HEAD TEST REPORT						
Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H F	lead (1988) Manual of Laboratory Testing, 10.7)					
Client: Douglas Partners Pty Ltd	Report No. 10110827-CHP					
Project: 74586	Test Date: 09/12/10					
	Report Date: 14/12/10					
Sample Number:	10110827					
Client ID:	HA1					
Depth (m):	0.2-0.6					
Initial Wet Density (t/m <sup>3</sup> ):	1.74					
Initial Moisture Content (%):	6.7					
Water Used:	Тар					
Surcharge (kPa):	0					
Pressure Applied (kPa):	8.8					
Percentage Material Retained / Sieve Size (mm)	0/19					
PERMEABILITY:	$k_{20} = 4 \times 10^{-6} \text{ m/s}$					
Remarks: The specimen was compacted as requested by the	client .					
The results of calibrations and tests performed apply only to the specific in stated. Patarance should be made to Trileb Pty Ltd "Standard Terms and the state of	strument or sample at the time of test unless otherwise clearly					
Sample/s supplied by the client	Page: 1 of 1					
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Accredited for compliance with ISO/IEC 17025 The results of the tests calibrations and/or	James besusall					

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	PARTICLE SIZE DISTRIBUTION						
PERCENTAGE DISPERSION TEST REPORT Test Method: AS 1289 3.8.2							
Client	Douglas	Partners Pty Lto	k		Report No.	10110828	3-%D
Project	74586				Test Date	9/12/2010	)
					Report Date	13/12/20 <sup>-</sup>	10
Client ID	HA17				Depth (m)	0.20-0.50	
Sieve Size	Passing	100 -					
(mm)	%	100					
150.0							
75.0		90					
53.0							
37.5		80					
26.5							
19.0							
9.5		70					
4.75							
2.36		60					
1.18		(%					
0.600		) gni					
0.425	100	ass 50					
0.300	93	-					
0.150	13	40					
0.075	3						
0.069	3	30					
0.049	2						
0.035	1						
0.025	0	20					
0.018	0						
0.013	0	10					
0.0093	0						
0.0066	0						
0.0047	0	0 +		01			<u>                                      </u>
0.0038	0	0.001	0.	Dortiol-	Sizo (mm)		
0.0033	0			Particle	size (min)		
0.0027	0						
0.0024	0	D	ISPERSION (%)	0.0			
	0	Linnar lina, i diara	roopt Louise lines	lionorcost			
NOTES/REMAR	<u> </u>	Moisture Content 4 Sample/s supplied	4.4% -2.3 by the client	6mm Soil Pa	article Density (t/m <sup>3</sup> )	2.88 Page 1 of	1 REP0380
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PERMEABILITY BY CONSTANT HEAD TEST REPORT							
Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H F	lead (1988) Manual of Laboratory Testing, 10.7)						
Client: Douglas Partners Pty Ltd	Report No. 10110828-CHP						
Project: 74586	Test Date: 10/12/10						
	Report Date: 14/12/10						
Sample Number:	10110828						
Client ID:	HA17						
Depth (m):	0.2-0.5						
Initial Wet Density (t/m <sup>3</sup> ):	1.66						
Initial Moisture Content (%):	3.0						
Water Used:	Тар						
Surcharge (kPa):	2.2						
Pressure Applied (kPa):	8.8						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	$k_{20} = 4 \times 10^{-5} m/s$						
Remarks: The specimen was compacted as requested by the	client.						
The results of calibrations and tests performed apply only to the specific in stated. Performed should be made to Trileb Pty Ltd "Standard Terms and the state of	strument or sample at the time of test unless otherwise clearly						
Sample/s supplied by the client	Page: 1 of 1						
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Manager



	PARTICLE SIZE DISTRIBUTION				
PERCENTAGE DISPERSION TEST REPORT					
Client	Douglas	Partners Pty Ltd		Report No.	10110829-%D
Project	74586			Test Date	9/12/2010
				Report Date	13/12/2010
Client ID	HA4			Depth (m)	0.30-0.60
Sieve Size	Passing	100			
(mm)	%				
150.0		90			
75.0 53.0					
37.5					
26.5		80			
19.0					
9.5		70			
4.75					
2.36		60			
1.18					
0.600		6) BL			
0.425	100				
0.300	95	Č.			
0.150	18	40			
0.075	8				
0.073	8				
0.051	8	30			
0.036	7				
0.026	7	20			
0.019	7				
0.014	7	10			
0.0098	5				
0.007	4				
0.005	3	0.001	0.01	0.1	1
0.0041	3		Particle	e Size (mm)	-
0.0036	3				
0.0029	<u>ა</u>				
0.0025	<u>२</u>	DIS	PERSION (%): 13.0		
NOTES/REMAR	<u>S:</u>	Upper line: + dispersa Moisture Content 5.1 Sample/s supplied by	nt, Lower line: - dispersant % -2.36mm Soil P the client	Particle Density (t/m <sup>3</sup> )	2.69 Page 1 of 1 REP03801
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratic a traceable to A	accordance with NATA's acc r compliance with ISO/IES ons, and/or measurements i ustralian/National Standard	preditation 17025. The ncluded in this s.	Authorised Signatory <i>Jamus Quuu</i> J. Russell	Laboratory No. 9926



PERMEABILITY BY CONSTANT HEAD TEST REPORT Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H Head (1988) Manual of Laboratory Testing, 10.7)							
Client: Douglas Partners Pty Ltd	Report No. 10110829-CHP						
Project: 74586	Test Date:         07/12/10           Report Date:         14/12/10						
Sample Number:	10110829						
Client ID:	HA4						
Depth (m):	0.3-0.6						
Initial Wet Density (t/m <sup>3</sup> ):	1.76						
Initial Moisture Content (%):	4.7						
Water Used:	Тар						
Surcharge (kPa):	0						
Pressure Applied (kPa):	8.8						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	$k_{20} = 2 \times 10^{-5} m/s$						
Remarks: The specimen was compacted as requested by the	client .						
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Pty Ltd "Standard Terms and the statement of the statem	astrument or sample at the time of test unless otherwise clearly Conditions of Business" for further details.						
Sample/s supplied by the client	Page: 1 of 1						
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PERMEABILITY BY FALLING HEAD TEST REPORT							
	Test Method: AS1289 6.7.2, KH 2 (Based )	on K H Head (1988) M	anual of Laboratory Test	ing, 10.7)			
Client:	Douglas Partners Pty Ltd	Report No.	10110830-FH	Ρ			
Project:	74586	Test Date:	14/12/10				
		Report Date:	14/12/10				
Sample N	0:		10110830				
Client ID:			HA13				
Depth (m)	:		0.2-0.5				
Initial Mois	sture Content (%):		14.8				
Initial Wet	Density (t/m <sup>3</sup> )		1.84				
Surcharge	e & Pressure applied (kPa):		2.2/8.5				
PERME	ABILITY:		$K_{20} = 1 \times 10^{-7} m_{0}$	/s			
Remarks:	The sample was tested as requeste	d by the client.					
The results	of calibrations and tests performed apply only to	the specific instrument of	or sample at the time of test	unless otherwise clearly			
stated. Refe	erence should be made to Trilab Pty Ltd "Standa	rd Terms and Conditions	of Business" for further de	tails.			
Sample/s su	ipplied by the client			Page: 1 of 1			
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$\mathbf{V}$	The results of the tests, calibrations, and/or		( James Vicuse	11			
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Manager



	PARTICLE SIZE DISTRIBUTION				
PERCENTAGE DISPERSION TEST REPORT Test Method: AS 1289 3.8.2					
Client	Douglas	Partners Pty Ltd		Report No.	10110831-%D
Project	74586			Test Date	9/12/2010
				Report Date	13/12/2010
Client ID	HA7			Depth (m)	0.30-0.60
Sieve Size	Passing	100			
(mm)	%	100			
150.0					
75.0		90			
53.0					
37.5		80			
26.5					
19.0					
9.5		70			
4.75					
2.36		60			
1.18		(%			
0.600	100	) (ing			
0.425	98	sse 50			
0.300	85	<u></u>			
0.150	17	40			
0.075	8				
0.072	8	20			
0.051	6	30			
0.036	5				
0.026	4	20			
0.019	4				/
0.014	4	10			
0.0098	2				
0.0069	2				
0.0049	1	0			
0.004	1	0.001	0.01	0.1	1
0.0035	0		Partic	le Size (mm)	
0.0028	0				
0.0024	0	DI	SPERSION (%) : 0.0		
0.0014	-1				
NOTES/REMARI	<u>KS:</u>	Upper line: + dispers Moisture Content 5. Sample/s supplied b	sant, Lower line: - dispersant 7% -2.36mm Soil by the client	Particle Density (t/m <sup>3</sup> )	2.76 Page 1 of 1 REP0380
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	ATTERBERG L Test Method: AS1289.2	<b>IMITS TEST REI</b>	<b>PORT</b>		
Client: Douglas Pa	rtners Pty Ltd	Report No.	10110831	1-AL	
Project: 74586		Test Date: Report Date:	10/12/10 13/12/10		
Client ID: HA7	Depth(m): 0.	3-0.6	Sample No.	. 10110831	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Obta	ainable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	5.7	7
Plasticity Index (%):	Non Plastic				
Client ID: HA12	Depth(m): 0.	2-0.6	Sample No.	. 10110832	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Ob	ainable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	5.	.9
Plasticity Index (%):	Non Plastic				
Client ID: HA2	Depth(m): 0.	1-0.4	Sample No.	. 10110833	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Ob	ainable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	5.	.4
Plasticity Index (%):	Non Plastic				
Client ID: HA19	Depth(m): 0.	2-0.5	Sample No.	.10110834	
Liquid Limit (%):	Not Obtainable	Linear Shrinkage (9	%):	Not Ob	ainable
Plastic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	3.	.6
Plasticity Index (%):	Non Plastic				
Remarks: The samp *Crumbling occurred +Curling occurred	ole/s were tested oven drie	ed, dry sieved and in	a 125 – 250	mm mould.	
he results of calibrations and te tated. Reference should be mai ample/s supplied by the client	sts performed apply only to the s de to Trilab Pty Ltd "Standard To	specific instrument or sam erms and Conditions of Bu	ple at the time o Isiness" for furth	f test unless oth er details.	erwise clearly Page: 1 of
This Document acc Accredited for The results measurement traceable to	is issued in accordance with NATA creditation requirements. or compliance with ISO/IEC 17025 of the tests, calibrations, and/or hts included in this document are o Australian/National standards	e L	Authorised Si	gnatory Qualifi 1	

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



PERMEABILITY BY CONSTANT HEAD TEST REPORT Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H Head (1988) Manual of Laboratory Testing, 10.7)							
Client: Douglas Partners Pty Ltd	Report No. 10110831-CHF	, D					
Project: 74586	Test Date: 07/12/10 Report Date: 14/12/10						
Sample Number:	10110831						
Client ID:	HA7						
Depth (m):	0.3-0.6						
Initial Wet Density (t/m <sup>3</sup> ):	1.63						
Initial Moisture Content (%):	4.0						
Water Used:	Тар						
Surcharge (kPa):	2.2						
Pressure Applied (kPa):	8.8						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	k <sub>20</sub> = 8 x 10 <sup>−5</sup> m/s						
Remarks: The specimen was compacted as requested by the	client.						
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Pty Ltd "Standard Terms and C	strument or sample at the time of test unless otherw Conditions of Business" for further details.	vise clearly					
Sample/s supplied by the client		Page: 1 of 1					
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		PART		STRIBUTIO	N		
		PERCENTA	GE DISPERS	ON TEST R	EPOR	Т	
Client	Douglas	Partners Pty Lto	1	Repor	t No.	101108	332-%D
Project	74586			Test D	ate	9/12/20	010
				Repor	t Date	13/12/2	2010
Client ID	HA12			Dept	th (m)	0.20-0.60	
Sieve Size	Passing	100 -					
(mm)	%	100					
150.0							
75.0		90					
53.0					/		
37.5		80					
26.5							
19.0							
9.5		70					
4.75	100						
2.36	99	60					
1.18	99	(%					
0.600	99	6) Bu					
0.425	98						
0.300	84	<u>е</u>					
0.150	10	40					
0.075	4						
0.075	3						
0.053	3	30					
0.037	3						
0.026	3	20					
0.019	3						
0.014	2	10					
0.01	2	10 -					
0.0071	1						
0.0051	1	o 🗕 🗆					
0.0042	1	0.001	0.01	0.1		1	10
0.0036	0			Particle Size (mm)			
0.003	0						
0.0026	0			14.0			
0.0015	0	U					
OTES/REMARI	<u>KS:</u>	Upper line: + disper Moisture Content 5 Sample/s supplied	rsant, Lower line: - dis 5.9% -2.36r by the client	persant nm Soil Particle Den	sity (t/m <sup>3</sup> )	2.66 Page	<b>1 of 1</b> REP03
This documen requirements results of the document are	nt is issued in a . Accredited fo tests, calibratio e traceable to A	accordance with NATA's or compliance with ISO/IE ons, and/or measuremen sustralian/National Stand	accreditation ES 17025. The ts included in this ards.	Authorised	Signatory Autory sell		DITED FOR HINCAL HETEROE



PERMEABILITY BY CONSTAN	PERMEABILITY BY CONSTANT HEAD TEST REPORT							
Lest Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H F	lead (1988) Manual of Laboratory Testing, 10.7)							
Client: Douglas Partners Pty Ltd	Report No. 10110832-CHP							
Project: 74586	Test Date: 07/12/10							
-	Report Date: 14/12/10							
Sample Number:	10110832							
Client ID:	HA12							
Depth (m):	0.2-0.6							
Initial Wet Density (t/m <sup>3</sup> ):	1.66							
Initial Moisture Content (%):	4.3							
Water Used:	Тар							
Surcharge (kPa):	2.2							
Pressure Applied (kPa):	8.8							
Percentage Material Retained / Sieve Size (mm)	0/19							
PERMEABILITY:	k <sub>20</sub> = 8 x 10 <sup>−5</sup> m/s							
Remarks: The specimen was compacted as requested by the	client .							
The results of calibrations and tests performed apply only to the specific in	strument or sample at the time of test unless otherwise clearl	ly						
Sample/s supplied by the client	Page: 1 c	of 1						
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		PARTI		DISTR	IBUTION	
	l	PERCENTAC	Test Method:	th <b>RSION</b> AS 1289 3.8.	TEST REPOR	т
Client	Douglas	Partners Pty Ltd			Report No.	10110833-%D
Project	74586				Test Date	9/12/2010
					Report Date	13/12/2010
Client ID	HA2				Depth (m)	0.10-0.40
Sieve Size	Passing	100				
(mm)	%					
150.0						
75.0		90				
53.0						
37.5		80				
26.5						
19.0						
9.5		70				
4.75						
2.36		60				
1.18		(%				
0.600		) gni				
0.425	100	ass 50				
0.300	94	-				
0.150	15	40				
0.075	3					
0.072	2	30				
0.051	2	50				
0.036	1					
0.026	1	20				
0.019	1					
0.014	1	10				
0.0097	0					
0.0069	0					
0.0049	0	0		0.01	<u> </u>	<u>↓↓↓↓↓↓↓↓↓↓</u> ►
0.004	-1	5.001		0.01 B. 4	U.I	I
0.0035	-1			Part	icie Size (mm)	
0.0028	0					
0.0025	-1	DI	SPERSION (%	6): 0.0		
0.0014	-2	Llana a Para - P	••••••••••	- Paul		
NOTES/REMARI	<u> </u>	Upper line: + dispers Moisture Content 5. Sample/s supplied b	ant, Lower line: 4% -: y the client	- dispersan 2.36mm Soi	t I Particle Density (t/m <sup>3</sup> )	2.72 Page 1 of 1 REP038
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratic traceable to A	accordance with NATA's a r compliance with ISO/IES ons, and/or measurements ustralian/National Standa	ccreditation S 17025. The s included in this rds.	U	Authorised Signatory <i>Jamus Luss</i> J. Russell	



PERMEABILITY BY CONSTAN	PERMEABILITY BY CONSTANT HEAD TEST REPORT						
Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H H	lead (1988) Manual of Laboratory Testing, 10.7)						
Client: Douglas Partners Pty Ltd	Report No. 10110833-CHP						
Project: 74586	Test Date: 13/12/10						
	Report Date: 14/12/10						
Sample Number:	10110833						
Client ID:	HA2						
Depth (m):	0.1-0.4						
Initial Wet Density (t/m <sup>3</sup> ):	1.65						
Initial Moisture Content (%):	3.9						
Water Used:	Тар						
Surcharge (kPa):	2.2						
Pressure Applied (kPa):	3.7						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	k <sub>20</sub> = 3 x 10 <sup>−5</sup> m/s						
Remarks: The specimen was compacted as requested by the	client.						
The results of calibrations and tests performed apply only to the specific in stated. Reference should be made to Trilab Ptv Ltd "Standard Terms and Compared to Trilab Ptv Ltd" (Standard Terms) and Compared to Trilab Ptv Ltd" (Standa	strument or sample at the time of test unless otherwise clearly Conditions of Business" for further details.						
Sample/s supplied by the client	Page: 1 of 1						
This Document is issued in accordance with	Authorised Signatory						
NATA's accreditation requirements.	1 1 11						
The results of the tests calibrations and/or	( James ULUANI						

TECHNICAL COMPETENCE

measurements included in this document are traceable to Australian/National standards

M n J. Russell

Manager



	EMERSO	N CLASS N Test Method:	IUMBER TI AS1289 3.8.1	EST REPO	RT		
Client:	Douglas Partners Pty	Ltd	Report No.	. 10 <sup>-</sup>	110833-EM		
Project:	74586	Test Date: Report Dat	10/ te: 13/	/12/10 /12/10			
	Sample No.	10110833	10110834	10110835	10110836	]	
	Client ID:	HA2	HA19	HA5	HA6		
	Depth (m):	0.1-0.4	0.2-0.5	0.3-0.5	0.1-0.5	•	
	Description:	Clayey Sand	Clayey Sand	Clayey Sand	Clayey Sand		
		brown	brown	red/	brown		
				brown			
	Emerson Class No.:	6	6	6	6		
Rema	Remarks: Tested with distilled water at 24 <sup>o</sup> C						
The results	of calibrations and tests performed a	upply only to the spec	cific instrument or s	sample at the time of	of test unless otherv	wise clearly	
stated. Ref	erence should be made to Trilab Pty	Ltd "Standard Term	s and Conditions of	Business" for furt	her details.	Dama dadd	
Sample/s s	This Document is is	suad in accordance with	h	Authorised S	ignatory	Page: 1 of 1	
	NATA's accred Accredited for con I The results of the te	itation requirements. npliance with ISO/IEC 7025 ests, calibrations, and/or		Jamin J. Russe	Qual I		
N ATA Acc Form Number	The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National standards N ATA Accredited Laboratory Number 9926 Form Number: GT007-5						



		PART	ICLE SIZE DI	STRIB	UTION		
		PERCENTA	GE DISPERS	ION TE 289 3.8.2	EST REPOR	Т	
Client	Douglas	Partners Pty Ltd	I		Report No.	10110834-%	D
Project	74586				Test Date	9/12/2010	
					Report Date	13/12/2010	
Client ID	HA19				Depth (m)	0.20-0.50	
Sieve Size	Passing	100 -					
(mm)	%						
150.0							
75.0		90					++-
53.0							
37.5		80					
26.5							
19.0							
9.5		70					+++
4.75							
2.36		60	+ + + + + + + + + + + + + + + + + + +		+ + + + + + + + + + + + + + + + + + + +		+++
1.18		(%)					
0.600	100	) gni					
0.425	99	Pass					
0.300	88						
0.150	10	40					
0.075	2						
0.075	2	30					
0.053	1						
0.037	1						
0.026	1	20					
0.019	1						
0.014	1	10	+ + + + + + + + + + + + + + + + + + +			$\downarrow$	+++
0.01	1						
0.0071	1						
0.005	0	0.001	0.0	1	0.1		1
0.0041	-1			Particle	Size (mm)		
0.0036	-1						
0.0029	0						
0.0025	1	D	ISPERSION (%) :	0.0			
NOTES/REMARI	<u> 1</u> KS:	Upper line: + disper Moisture Content 3 Sample/s supplied I	rsant, Lower line: - dis 3.6% -2.36i by the client	spersant mm Soil Pa	article Density (t/m <sup>3</sup> )	2.67 Page 1 of 1	REP0380
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratic traceable to A	accordance with NATA's r compliance with ISO/IE ons, and/or measuremen ustralian/National Stand	accreditation S 17025. The ts included in this ards.	V	Authorised Signatory <i>Jamus Quist</i> J. Russell		No 992



PERMEABILITY BY CONSTANT HEAD TEST REPORT							
Test Method: As 1289 6.7.1, 5.1.1 / KH 2 (Based on K H F	lead (1988) Manual of Laboratory Testing, 10.7)						
Client: Douglas Partners Pty Ltd	Report No. 10110834-CHP						
Project: 74586	Test Date: 10/12/10						
	Report Date: 14/12/10						
Sample Number:	10110834						
Client ID:	HA19						
Depth (m):	0.2-0.5						
Initial Wet Density (t/m <sup>3</sup> ):	1.60						
Initial Moisture Content (%):	2.7						
Water Used:	Тар						
Surcharge (kPa):	2.2						
Pressure Applied (kPa):	3.7						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	k₂₀ = 7 x 10 <sup>−5</sup> m/s						
Remarks: The specimen was compacted as requested by the	client.						
The results of calibrations and tests performed apply only to the specific ir	astrument or sample at the time of test unless otherwise clearly						
stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.							
This Desumant is issued in accordance with	Authorized Signatory						
NATA's accreditation requirements	Authorised Signatory						
Accredited for compliance with ISO/IEC 17025	the collision of the						
The results of the tests, calibrations, and/or	1 James UCUMU						
measurements included in this document are	J. Russell						

Manager

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



	PARTICLE SIZE DISTRIBUTION						
		PERCENTA	GE DISE	PERSION 1 100d: AS 1289 3.8.1		T	
Client	Douglas	Partners Pty Lto	ł		Report No.	10110835-%D	
Project	74586				Test Date	10/12/2010	
					Report Date	13/12/2010	
Client ID	HA5				Depth (m)	0.30-0.50	
Sieve Size	Passing	100					
(mm)	%						
150.0							
75.0		90					
53.0							
37.5		80					
26.5							
19.0							
9.5		70					
4.75							
2.36		60					
1.18		(%)					
0.600	100	) gnii					
0.425	99	Lass					
0.300	95	-					
0.150	18	40					
0.075	7						
0.074	4	30					
0.052	4						
0.037	4						
0.026	4	20					
0.019	4						
0.014	4	10					
0.0099	4						
0.007	2						
0.005	2	0 +		0.01		A	
0.0041	2	0.001		0.01	U.1	I	
0.0035	2			Parti	icie Size (mm)		
0.0029	2						
0.0025	1	D	ISPERSIO	N (%) : 91.0			
0.0015	1	Lleven Part P		 P			
NUTES/REMAR	<u> </u>	Moisture Content & Sample/s supplied	rsant, Lower 5.6% <u>by the c</u> lient	-2.36mm Soil	t Particle Density (t/m <sup>3</sup> )	) 2.70 Page 1 of 1 REP0380	
This documer requirements results of the document are	nt is issued in a . Accredited for tests, calibratio traceable to A	ccordance with NATA's r compliance with ISO/II ns, and/or measuremer ustralian/National Stanc	accreditation ES 17025. The hts included in th lards.	is	Authorised Signatory <i>Jamus Luss</i> J. Russell		



ATTERBERG LIMITS TEST REPORT Test Method: AS1289 2 1 1 3 1 1 3 1 2 3 2 1 3 3 1 3 4 1						
Client:	Douglas Partner	rs Pty Ltd	Report No.	10110835-/	۹L	
Project:	74586		Test Date: Report Date:	10/12/10 13/12/10		
Client	t ID: HA5	Depth(m): 0	3-0 5	Sample No. 1	0110835	
Liqui	id Limit (%):	Not Obtainable	Linear Shrinkage (	%):	Not Obtainable	
Plast	tic Limit (%): ticity Index (%):	Not Obtainable Non Plastic	Field Moisture Con	tent (%):	5.6	
Client	t ID: HA6	Depth(m): 0.	1-0.5	Sample No. 1	0110836	
Liqui	id Limit (%):	Not Obtainable	Linear Shrinkage (S	%):	Not Obtainabl	е
Plast	tic Limit (%):	Not Obtainable	Field Moisture Con	tent (%):	5.1	
Plast	ticity Index (%):	Non Plastic				
Rem *Cru +Cu	Remarks: The sample/s were tested oven dried, dry sieved and in a 125 – 250mm mould.         *Crumbling occurred.         +Curling occurred    The results of calibrations and tests performed apply only to the specific instrument or sample at the time of test unless otherwise clearly stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.					
Sample/s su	pplied by the client	d in accordance with NATA	<b>`</b>	Authoricad Signs	Page	e: 1 of 1
	Accredited for comp The results of the measurements incl traceable to Austr	tion requirements. pliance with ISO/IEC 17025 tests, calibrations, and/or luded in this document are ralian/National standards	e L	James James James James James J. Russell	und	

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING



PERMEABILITY BY CONSTANT HEAD TEST REPORT							
Test Method. As 1269 6.7.1, 5.1.1 / KH 2 (based on K H F							
Client: Douglas Partners Pty Ltd	Report No. 10110835-CHP						
Project: 74586	Test Date: 07/12/10						
	Report Date: 14/12/10						
Sample Number:	10110835						
Client ID:	HA5						
Depth (m): 0.3-0.5							
Initial Wet Density (t/m <sup>3</sup> ):	1.69						
Initial Moisture Content (%):	4.6						
Water Used:	Тар						
Surcharge (kPa):	0						
Pressure Applied (kPa):	8.8						
Percentage Material Retained / Sieve Size (mm)	0/19						
PERMEABILITY:	k₂₀ = 6 x 10 <sup>−5</sup> m/s						
Remarks: The specimen was compacted as requested by the	client.						
The results of calibrations and tests performed apply only to the specific in	strument or sample at the time of test unless otherwise clearly						
stated. Reference should be made to Trilab Pty Ltd "Standard Terms and Conditions of Business" for further details.							
This Desument is issued ind	Authorized Cignotory						
NATA's accreditation requirements	Autorised Signatory 2 M Al						
Accredited for compliance with ISO/IEC 17025	A collision of the second s						
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TECHNICAL measurements included in this document are	J. Russell						

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ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Manager



		PERCENTA	GE DISPERSIO Test Method: AS 1289	N TEST REPOR	Т		
Client	Douglas	Partners Pty Ltd		Report No.	10110836-%D		
Project	74586			Test Date	9/12/2010		
				Report Date	13/12/2010		
Client ID	HA6			Depth (m)	0.10-0.50		
Sieve Size	Passing	100 -					
(mm)	%	100					
150.0							
75.0		90					
53.0							
37.5		80					
26.5							
19.0							
9.5		70					
4.75							
2.36		60					
1.18		(%)					
0.600	100	- Guine - Guin					
0.425	99	Lass -					
0.300	90						
0.150	20	40					
0.075	8						
0.072	8	30					
0.051	7						
0.036	6						
0.026	6	20					
0.019	4						
0.014	4	10		/			
0.0097	3						
0.0069	3	<u>ہ ا</u>					
0.0049	<u> </u>	0.001	0.01	0.1	1		
0.004	1		1	Particle Size (mm)			
0.0035	1			. ,			
0.0023	1						
0.0014	1	DI	ISPERSION (%): 9	1.0			
NOTES/REMARI	<u>KS:</u>	Upper line: + disper Moisture Content 5 Sample/s supplied b	sant, Lower line: - disper .1% -2.36mm by the client	sant Soil Particle Density (t/m <sup>3</sup> )	2.74 Page 1 of 1 REP0380		
This documer requirements results of the document are	nt is issued in a . Accredited fo tests, calibratic e traceable to A	accordance with NATA's a r compliance with ISO/IE ons, and/or measurement ustralian/National Standa	accreditation S 17025. The ts included in this ards.	Authorised Signatory	Laboratory No. 992		



PERMEABILITY BY CONSTANT HEAD TEST REPORT						
Client: Douglas Partners Pty Ltd	Report No. 10110836-CHP					
Project: 74586	Test Date: 07/12/10					
	Report Date: 14/12/10					
Sample Number:	10110836					
Client ID:	HA6					
Depth (m): 0.1-0.5						
Initial Wet Density (t/m <sup>3</sup> ):	1.72					
Initial Moisture Content (%):	4.9					
Water Used:	Тар					
Surcharge (kPa):	2.2					
Pressure Applied (kPa):	8.8					
Percentage Material Retained / Sieve Size (mm)	0/19					
PERMEABILITY:	k <sub>20</sub> = 4 x 10 <sup>−5</sup> m/s					
Remarks: The specimen was compacted as requested by the	client.					
The results of calibrations and tests performed apply only to the specific in	strument or sample at the time of test unless otherwise cl	early				
stated. Reference should be made to Trilab Pty Ltd "Standard Terms and C Sample/s supplied by the client	Conditions of Business" for further details.	: 1 of 1				
This Document is issued in accordance with	Authorised Signatory	-				
NATA's accreditation requirements						
<b>NATA</b> Accredited for compliance with ISO/IEC 17025						
The results of the tests calibrations and/or	( James ULIIAN					
accretion of the total of total	J. Russell					

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measurements included in this document are traceable to Australian/National standards

J. Russell

Manager