Appendix A

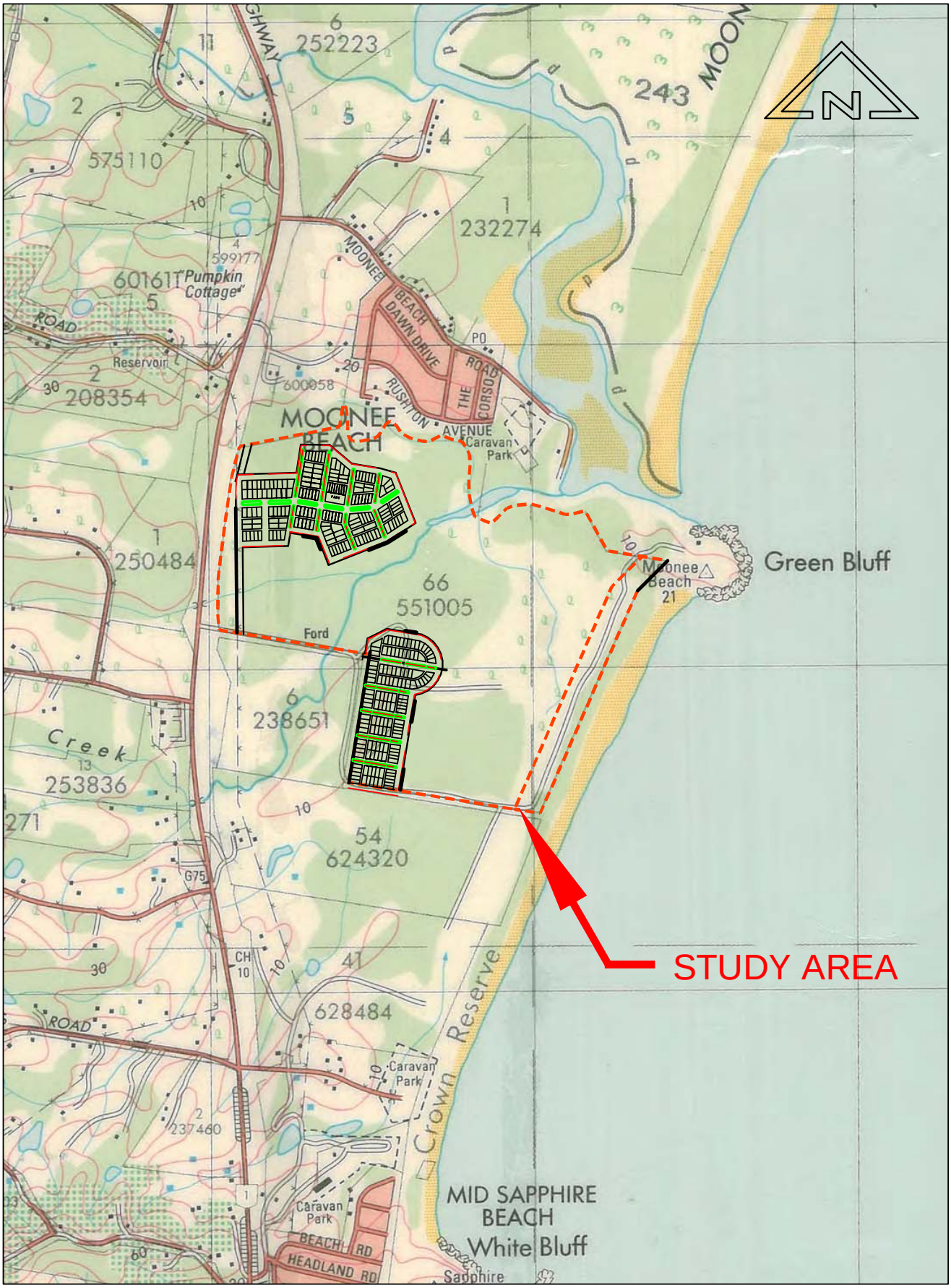
Engineering Plans

Figure 1 – Site Plan

Drawing 22-11948-SK01 – Sewer Infrastructure Concept

Drawing 22-11948-SK02 – Water Infrastructure Concept

Drawing 22-11948-SK03 – Existing Services



GHD

22 11948

SITE PLAN

figure 1.

PRELIMINARY

No	Revision	Drawn	Checked	Approved	Date
E	REVISED DESIGN	JMK			16.11.07
D	REVISED LOT LAYOUT	JMK			10.10.07
C	REVISED LOT LAYOUT	JMK			13.06.07
B	REVISED LOT LAYOUT	BA			02-12-04
A	PRELIMINARY	BA			30-09-04

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 25 50 75 100 125m
SCALE IN METRES (1:2500 BEFORE REDUCTION)

GHD
MANAGEMENT ENGINEERING ENVIRONMENT
GHD Pty Ltd ACN 008 488 373
2/115 West High St Coff Harbour NSW 2450
PO Box 1340 Coff Harbour NSW 2450
T 61 2 6650 5600 F 61 2 6652 6021
E cfsmail@ghd.com.au www.ghd.com.au

Scale	AS SHOWN	DO NOT SCALE	
Drawn	B. ALGIE	Designed	W. COOPER
Drafting Check		Design Check	
Approved			
Date			

This Drawing must not be used for Construction unless signed as Approved

Client HILLVIEW HEIGHTS ESTATE PTY LTD
Project MERCER LAND, MOONEE BEACH
Title SEWER CONCEPT
Original Size A1
Drawing No: 22-11948-SK01
Rev: E

Cad File No: G:\22\11948\cad\ 22-11948-SK01(SEW)-12.06.07.dwg
Plot Date: 16 November, 2007 - 3:57 PM

PROPOSED SERVICES LEGEND

- W — DN100
- DN150
- DN200
- DN250
- DN300

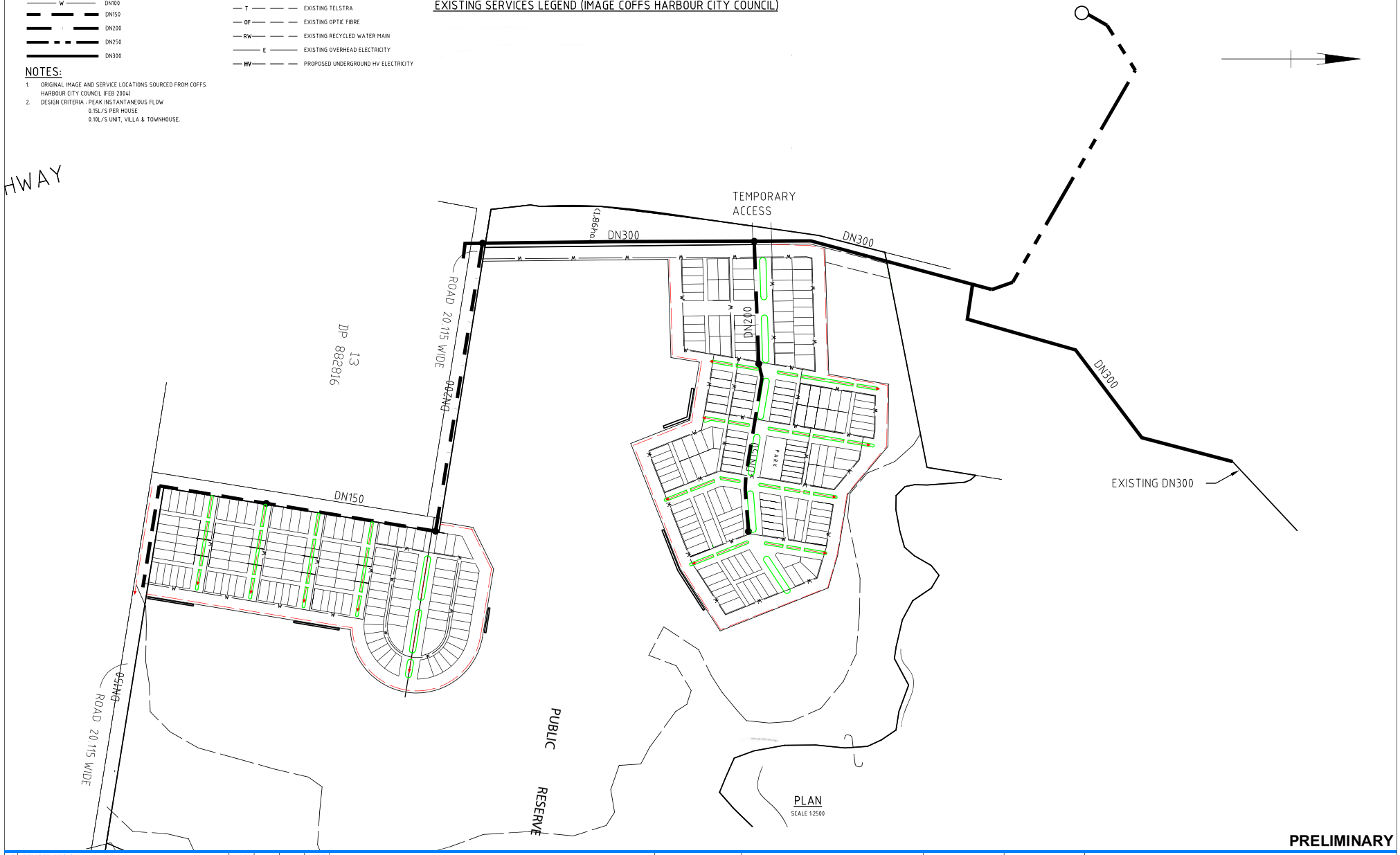
LEGEND

- T — EXISTING TELSTRA
- OF — EXISTING OPTIC FIBRE
- RW — EXISTING RECYCLED WATER MAIN
- E — EXISTING OVERHEAD ELECTRICITY
- HV — PROPOSED UNDERGROUND HV ELECTRICITY

NOTES:

1. ORIGINAL IMAGE AND SERVICE LOCATIONS SOURCED FROM COFFS HARBOUR CITY COUNCIL (FEB 2004)
2. DESIGN CRITERIA - PEAK INSTANTANEOUS FLOW
   0.15L/S PER HOUSE
   0.10L/S UNIT, VILLA & TOWNHOUSE.

EXISTING SERVICES LEGEND (IMAGE COFFS HARBOUR CITY COUNCIL)



PLAN
SCALE 1:2500

PRELIMINARY

No	Revision	Drawn	Checked	Approved	Date
E	REVISED DESIGN	JMK			16.11.07
D	REVISED LOT LAYOUT	JMK			10.10.07
C	REVISED LOT LAYOUT	JMK			13.06.07
B	REVISED LOT LAYOUT	BA			02-12-04
A	PRELIMINARY	BA			30-09-04

Note: * indicates signatures on original issue of drawing or last revision of drawing

0 25 50 75 100 125m
SCALE IN METRES (1:2500 BEFORE REDUCTION)

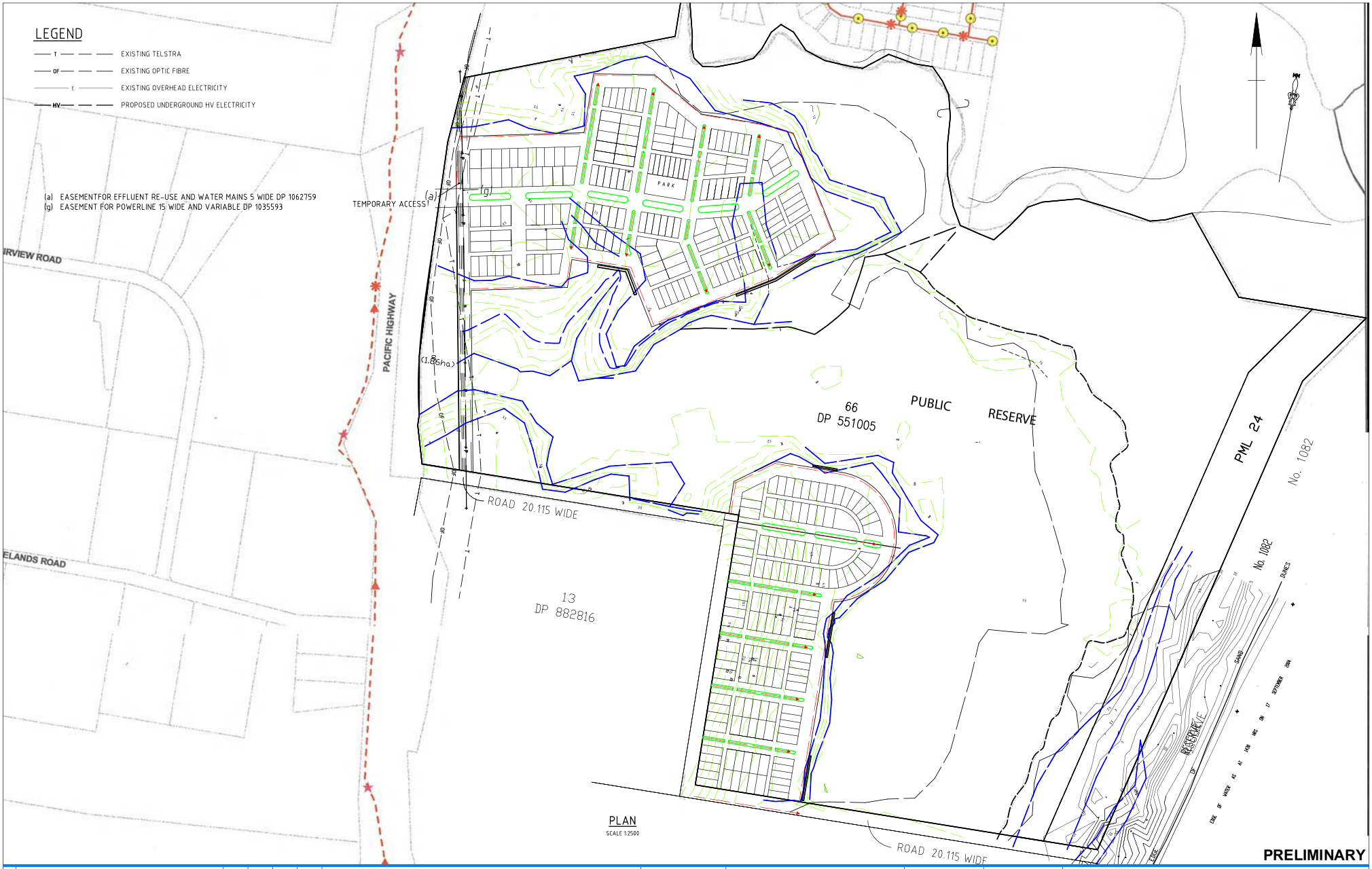
GHD
MANAGEMENT ENGINEERING ENVIRONMENT
GHD Pty Ltd ACN 008 488 373
2/115 West High St Coff Harbour NSW 2450
PO Box 1340 Coff Harbour NSW 2450
T 61 2 6650 6600 F 61 2 6652 6021
E cfsmail@ghd.com.au www.ghd.com.au

Scale	AS SHOWN — DO NOT SCALE
Drawn	B. ALGIE
Designed	W. COOPER
Drafting Check	
Design Check	
Approved	
Date	

This Drawing must not be used for Construction unless signed as Approved

Client: HILLVIEW HEIGHTS ESTATE PTY LTD
Project: MERCER LAND, MOONEE BEACH
Title: WATER CONCEPT
Original Size: A1
Drawing No: 22-11948-SK02
Rev: E

Cad File No: G:\22\11948\cad\ 22-11948-SK02(WATER) 12.06.07.dwg
Plot Date: 16 November, 2007 - 12:05 PM



No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Checked	Approved	Date
D	REVISED LOT LAYOUT		JMK			10.10.07
C	REVISED LOT LAYOUT		JMK			13.06.07
B	REVISED LOT LAYOUT		BA			02-12-04
A	PRELIMINARY		BA			30-09-04

0 25 50 75 100 125m
SCALE IN METRES (1:2500 BEFORE REDUCTION)

GHD MANAGEMENT ENGINEERING ENVIRONMENT

GHD Pty Ltd ACN 008 488 373
2/115 West High St Coff Harbour NSW 2450
PO Box 1340 Coff Harbour NSW 2450
T 61 2 6650 6600 F 61 2 6652 6021
E cfsmail@ghd.com.au www.ghd.com.au

Scale	AS SHOWN — DO NOT SCALE
Drawn	B. ALGIE
Designed	W. COOPER
Drafting Check	
Design Check	
Approved	
Date	

This Drawing must not be used for Construction unless signed as Approved

Client: HILLVIEW HEIGHTS ESTATE PTY LTD
Project: MERCER LAND, MOONEE BEACH
Title: EASEMENTS AND SERVICE LOCATIONS

Original Size: A1
Drawing No: 22-11948-SK03
Rev: D

Cad File No: G:\22\11948\cad\ 22-11948-SK03(EASEMENT)-12.06.07.dwg
Plot Date: 16 November, 2007 - 12:20 PM

Appendix B

Geotechnical Report

GHD PTY LTD

HILLVIEW HEIGHTS ESTATE SUBDIVISION - MOONEE BEACH

Pacific Highway, Moonee Beach

GEOTECHNICAL ASSESSMENT

CH1318/1-AB

18 October 2004

CH1318/1-AB
18 October 2004

GHD Pty Ltd
2/115 West High Street
COFFS HARBOUR NSW 2450

Attention: Mr Wayne Cooper

Dear Sir,

RE: PROPOSED HILLVIEW HEIGHTS ESTATE SUBDIVISION - MOONEE BEACH GEOTECHNICAL INVSTIGATION

Coffey Geosciences Pty Ltd (Coffey) is pleased to present our report on the geotechnical investigation for the above site.

We draw your attention to the attached sheet entitled "Important Information About Your Coffey Report" which should be read in conjunction with this report.

We trust that this report meets with your requirements. If you require further information please contact the undersigned in our Coffs Harbour office.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

DAVID BARKER
Senior Geotechnical Engineer

Distribution:	Original held by:	Coffey Geosciences Pty Ltd
	1 copy	Coffey Geosciences Pty Ltd (Brisbane Library)
	3 copies	GHD Pty Ltd

53B Fairlawn Street Nathan
QLD 4111 Australia
PO Box 108 Salisbury
QLD 4107 Australia
Telephone +61 7 3274 4411
Facsimile +61 7 3274 4977
Email brisbane@coffey.com.au

TABLE OF CONTENTS

1. INTRODUCTION

Coffey Geosciences Pty Ltd has conducted a geotechnical assessment for a proposed subdivision to be located off the Pacific Highway at Moonee Beach. The aims of the study, which was commissioned by Wayne Cooper of GHD Pty Ltd, were to assess:

- General comments on subsurface conditions and excavation conditions at the site;
- Preliminary pavement design parameters;
- Acid sulfate soils, including recommendations on likely treatment options if required, and;
- General comments on the results of testing for soil salinity.

Coffey conducted the work in general accordance with proposal no. CH1318/1-AA. This report presents the results of the site investigation.

2. SITE DESCRIPTION & PROPOSED DEVELOPMENT

The site is approximately 15ha and is situated parallel to the Pacific Highway at Moonee Beach. The site is bounded by the highway to the west, beach sand dunes to the east, a creek to the north and by vacant land to the south. We understand that the vacant land to the south is likely to become a medium density residential subdivision.

Regionally the site is situated within generally flat to moderately sloping topography. Locally, the ground surface is undulating with gentle to moderate slopes between 5^{o} and 13^{o}. These slopes generally form the sides of drainage gullies which run through the site from west to east and south to north. The site is currently undeveloped, except for an easement running parallel to the highway within which services have been installed. The majority of the site is covered by native trees, however towards the east the vegetation becomes thicker and shorter due to it's proximity to the ocean. Most of the gullies had standing water, and towards the east of the site in the low area behind the sand dunes the ground was wet.

Drawings provided by the client showed the general subdivision layout, though it is understood that the subdivision is at a preliminary planning stage and development details are not yet known.

3. SCOPE OF WORK

3.1 Fieldwork

Fieldwork was carried out on 15 September 2004 and comprised the excavation of nine test pits (TP1 to TP9) to depths between 1.5m and 3m by rubber tyred backhoe.

Fieldwork was conducted by a Scientist from Coffey who located the pits, took samples and recorded results of in-situ testing, and produced field logs of the subsurface conditions observed. Figure 1 shows the investigation locations. Engineering Logs are presented in Appendix A, with explanation sheets defining the terms and symbols used in their preparation.

3.2 Laboratory Testing

Laboratory testing as follows was conducted on samples recovered during fieldwork:

- Six standard compaction and soaked CBR tests;

- Five pH and electrical conductivity tests;
- Sixteen acid sulfate soils screening tests, and;
- One Peroxide Oxidisable Combined Acidity and Sulfate (POCAS) test.

Laboratory test result sheets are presented in Appendix B. The results of the laboratory testing are summarised in Tables 1, 2 and 3 below.

TABLE 1: SUMMARY OF CBR TEST RESULTS

LOCATION	DEPTH (m)	MATERIAL TYPE	FIELD MOISTURE CONTENT (%)	OPTIMUM MOISTURE CONTENT (%)	CBR (%)
TP3	0.4-0.6	CLAY	24.6	26.5	2
TP4	0.4-0.6	CLAY	19.3	22.6	6
TP5	0.4-0.6	CLAY	19.5	22.7	5
TP6	0.4-0.6	CLAY	21.5	23.2	6
TP7	0.4-0.6	CLAY	24.0	26.4	2
TP8	0.4-0.6	SAND	11.1	17.4	16

TABLE 2: SUMMARY OF pH AND ELECTRICAL CONDUCTIVITY TEST RESULTS

LOCATION	DEPTH (m)	pH	ELECTRICAL CONDUCTIVITY
TP3	0.4-0.6	4.40	0.118
TP5	0.4-0.6	5.05	0.125
TP6	0.4-0.6	4.43	0.350
TP7	0.4-0.6	4.45	0.204
TP8	0.4-0.6	7.63	0.122

TABLE 3: RESULTS OF ACID SULFATE SOILS SCREENING TESTS

LOCATION	SAMPLE DEPTH (m)	TEXTURE	pH IN WATER	pH in 30% H_2O_2
TP1	0-0.5	Fine	5.7	3.6
TP1	0.5-1	Fine	5.2	4.3
TP1	1-1.5	Fine	5.4	4.8
TP1	1.5-1.8	Fine	5.3	4.2
TP2	0-0.5	Fine	5.7	3.8
TP2	0.5-1	Fine	5.6	4.4
TP2	1-1.5	Fine	5.6	3.3
TP2	1.5-2	Fine	5.4	3.3
TP6	0-0.5	Fine	5.5	2.5
TP6	0.5-1	Fine	4.8	3.6
TP6	1-1.5	Fine	4.5	4.0
TP6	1.5-2	Fine	4.7	4.1
TP7	0-0.5	Fine	5.4	3.5
TP7	0.5-1	Fine	4.7	3.8
TP7	1-1.5	Fine	4.3	3.9
TP7	1.5-2	Fine	4.3	3.2

Note: Texture assessed with reference to Table 4.4 ASSMAC Assessment Guidelines, 1998.

The sample from TP6 at 0-0.5m depth was sent to an external laboratory for POCAS testing. The results indicate the sample has a value of peroxide oxidisable sulphur of S_{POS}=0.02%.

4. SUB-SURFACE CONDITIONS

4.1 Stratigraphy

The Dorrigo / Coffs Harbour 1:250,000 geological map indicates that the site is on the boundary of the Coramba Beds comprising of mudstone, siltstone and greywacke with minor volcanic intervals and Quaternary Alluvium comprising of sands and clays.

The stratigraphy interpreted from the test pits TP1 to TP7 may be summarised as follows:

- **Topsoil (TP1 to TP5):** Silt/Clayey Silt, grey / dark brown, to depths between 0.3m and 0.4m, overlying;
- **Colluvial Soil (TP2, TP6 and TP7):** Silty Clay / Clay, low to medium plasticity, grey-brown / brown, to a depth of about 1m in TP2 and about 0.3m in TP6 and TP7, overlying;

- **Residual Soil:** Clay, high plasticity, generally very stiff to hard, assessed to be Sandy Clay grading to Sandy Gravelly Clay in TP2, grading to extremely weathered siltstone in TP1, to beyond the limit of investigation.

The stratigraphy interpreted from the test pits TP8 and TP9 may be summarised as follows:

- **Fill (TP8 only):** Silt to 0.05m depth overlying Gravelly Clay to a depth of 0.4m, overlying;
- **Alluvial Soil? (TP8 only):** Sand, fine to medium grained, pale brown, to a depth of 1m, overlying;
- **Organic Soil (TP8 only):** Organic Silt, black, some sand, to a depth of 1.1m, overlying;
- **Alluvial Soil (TP8 and TP9):** Sand, fine to medium grained, pale brown, to beyond the limit of investigation.

Further details of the materials intersected by the test pits are given on the Engineering Logs presented in Appendix A, with explanation sheets defining the terms and symbols used in their preparation.

4.2 Groundwater

Groundwater inflow was observed in TP2 only at 1m depth. Ground water levels may fluctuate after rain or as a consequence of other climatic effects.

5. PAVEMENT DESIGN PARAMETERS

Laboratory CBR testing indicated that site soils have a soaked CBR of between 2% and 6%. On the basis of the CBR test results, a preliminary design CBR of 2% is recommended for design of flexible pavements. Coffey can assist with pavement design if required. Site preparation as shown in Section 9 is recommended as a minimum to enable this design CBR to be achieved.

Due to the preliminary nature of the geotechnical assessment, a limited amount of sampling and testing has been carried out for assessment of preliminary pavement design parameters. It is recommended that additional sampling and testing be carried out to assess the design CBR of subgrade materials once the development design has been finalised, in particular the location of the pavements.

There are several alternatives for the construction of flexible pavements on subgrade materials with a low design CBR such as in this case, including;

- Over-excavation of existing subgrade materials and replacement with a select material which has a higher soaked CBR value. The required flexible pavement thickness will depend on the depth of over-excavation and the soaked CBR of the select material.
- Mixing of lime with the subgrade soils by in-situ pulvimixer or similar. The addition of lime to clayey subgrade soils generally results in an increased soaked CBR and thus a thinner required granular pavement thickness. This method is generally cost-effective for large areas of road where the reduction in pavement gravels offsets the increased subgrade preparation costs. Our experience suggests that a soaked CBR of up to about 7% may be achievable in clay soils with the addition of 3% lime by dry weight. It is recommended that laboratory testing be carried out to assess the effectiveness of the addition of lime to subgrade soils at this site.

6. ACID SULFATE SOILS

6.1 Formation and Potential Impacts

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of pyrite which, when exposed to oxygen, in the presence of sufficient moisture, oxidises, resulting in the generation of sulfuric acid. Unoxidised pyritic soils are referred to as potential ASS (PASS). When the soils are exposed, the oxidation of pyrite occurs and sulfuric acids are generated, the soils are said to be actual ASS (AASS).

Pyritic soils typically form in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rives and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period, (i.e. 10,000 years ago to present day) predominantly in the 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen.

Disturbance or poorly managed development and use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid and salts, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of the acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off-site can have detrimental effect on aquatic ecosystems.

6.2 Laboratory Testing

Samples obtained for the acid sulfate assessment were screened for the presence of actual and potential ASS using laboratory methods 21Af and 21Bf of Ahern CR, Blunden B and Stone Y (eds) (1998), Acid Sulfate Soil Laboratory Methods Guidelines, ASSMAC.

The results of the acid sulfate soil screening tests are summarised in Table 3 shown in Section 3.2.

The following comments are noted from the results presented in Table 3.

- pH of 1:5 soil water solution produced pH<4 in none of the 16 samples tested. Soil water pH<4 in this test is an indication of actual acid sulfate soil.
- H_2O_2 oxidation produced pH<3 in one of the samples tested. Soil pH<3 in this test is an indication of potential acid sulfate soil;

On the basis of the screening results, and taking into account the relatively low pH of the water as mentioned above, it is considered that the site soils to 3m depth are not actual potential acid sulfate soils, but may be potential acid sulfate soils. To further assess the potential for acid generation, one sample was selected for additional testing and sent to an external analytical laboratory for POCAS testing. The results of the POCAS testing are presented in Appendix B and are summarised in Table 4.

TABLE 4: RESULTS OF POCAS TEST

Location	Depth (m)	Texture based on field logs	S_{POS} (%)	Action Criteria Value for S_{POS}[2] (%)	TPA (mole/tonne)	Action Criteria Value for TPA[1] (mole/tonne)	Action Criteria Value for TPA[2] (mole/tonne)
TP6	0-0.5	Fine	0.02	0.03	**51**	62	18

Note: Values in bold and underlined exceed action criteria.

1. Action criteria from those presented in ASSMAC (1998) Acid Sulfate Soil Guidelines for excavations of less than 1000 tonnes of soil.
2. Action criteria from those presented in ASSMAC (1998) Acid Sulfate Soil Guidelines for excavations of greater than 1000 tonnes of soil.

Based on the laboratory test results, Total Potential Acidity (TPA) in the sample from TP6 at 0-0.5m depth exceeded the action criteria value in Table 4.4 of the ASSMAC Guidelines for excavations of greater than 1000 tonnes. TPA did not exceed that action criteria value for excavations of less than 1000 tonnes. Potential Oxidisable Sulfur (S_{POS}) did not exceed action criteria values.

6.3 Discussion and Recommendations

Due to the preliminary nature of the geotechnical assessment, a limited amount of sampling and testing has been carried out for assessment of acid sulfate soils. In addition, some areas which may contain acid sulfate soils were inaccessible at the time of the field investigation. It is recommended that additional sampling and testing be carried out to assess acid sulfate soils once the development design has been finalised and the location and depth of proposed excavations are known.

Reference to the Moonee Beach Acid Sulfate Soils Risk Map published by the Department of Land and Water Conservation indicates the proposed subdivision development is located partly in an area which has no known occurrence of acid sulfate soils and partly in an area which has a low probability of the occurrence of acid sulfate soils between 1m and 3m below the ground surface.

As shown on the engineering logs, most of the test pits were excavated within residual soil profiles. Residual soils are derived from the weathering of rock, and are generally not considered likely to be actual or potential acid sulfate soils, as they were not formed as discussed in Section 6.1. However, some unoxidised pyrite can remain in soils which have been weathered from pyrite containing parent rock, which can lead to acid generation when soils are excavated in significant quantities. In addition, the soil sample tested by the POCAS method was taken from 0-0.5m depth, and may contain organic material which can affect the 'acid trail' TPH result, which provides some justification for using only the 'sulfur trail' S_{POS} and TSA results.

On the basis of the preliminary assessment, it is recommended that further assessment of acid sulfate soils be carried out prior to excavation of site soils once the location and depth of excavations are known in more detail. The assessment should target alluvial soil areas below about RL5m AHD, though may include sampling and testing of some residual soils. Based on the results of the preliminary assessment, the residual soils are not considered to be potential acid sulfate soils, though test results indicate they may have some acid generating potential. Excavated soils may require treatment with up to 4kg of lime per tonne of excavated soil for excavations of greater than 1000 tonnes as a precautionary measure to neutralise acidity

produced by oxidation of the soils when excavated.

Good quality fine agricultural lime should be used to treat excavated PASS. In calculating the liming ratio a factor of safety of 1.5 has been allowed (as recommended in the ASSMAC guidelines) above the theoretical requirement to take into account the rate of lime reactivity and the possibility of inhomogeneous mixing, particularly in the cohesive soils.

The time required for applied lime to neutralise PASS is widely variable and depends on the specific properties of the neutralised soil, although the lime will begin to neutralise the acid soils from the time of application. Measurement of the neutralisation of the PASS being treated should be undertaken at a later date to provide an indication that the neutralisation process is working or has worked effectively.

Soil acidity in excavated materials should be monitored. Should field pH tests and laboratory tests show that the soil acidity has not fallen below action criteria, then the material must be reworked and additional lime treatment carried out until it is verified that the soil meets the required standard.

7. SOIL SALINITY

It is understood that the client required a preliminary assessment of soil salinity at the site. In consultation with the client and an external testing laboratory, soil samples were taken at various locations across the site at about 0.5m depth. These samples were sent to an external laboratory, who tested the sample for pH and Electrical Conductivity (EC) by making a1:5 soil:water paste. The results of this testing are shown in Table 2.

For the assessment of soil salinity, reference was made to the paper P.G. Slavich and G.H. Patterson (1993), "Estimating the Electrical Conductivity of Saturated Paste Extracts from 1:5 Soil:Water Suspensions and Texture", pp 73-81 of Aust. J. Soil Res., 1993 [Reference 1]. This paper provides a method of estimating the EC of a saturated paste extract (EC_e) from the EC of a 1:5 soil:water paste ($EC_{1:5}$). Soil analysis methods are based on EC_e. Reference 1 suggests that EC_e may be estimated using a conversion factor *f*, the values for which are shown in a table and vary depending on the soil texture. Table 1 in Reference 1 indicates that the conversion factor for a medium to heavy clay is about *f*=7 and for a sand *f*= 10 to 20. Estimated values of EC_e are shown in Table 5.

TABLE 5: ESTIMATES OF EC_e

TEST PIT	DEPTH	$EC_{1:5}$ (dS/m)	*f*	EC_e (dS/m)
TP3	0.4-0.6	0.118	7	0.8
TP5	0.4-0.6	0.125	7	0.9
TP6	0.4-0.6	0.350	7	2.5
TP7	0.4-0.6	0.204	7	1.4
TP8	0.4-0.6	0.122	10	1.2
			15	1.8
			20	2.4

The estimates shown in Table 5 indicate that values of $EC_e$for the soil samples range from about 1dS/m to

2.5dS/m.

8. EXCAVATION CONDITIONS

Excavations are likely to be within the residual and alluvial materials, and may need to progress through extremely weathered material.

Based on experience with similar conditions, excavation in soil strength materials such as the hard clay residual material and medium dense alluvial material could be conducted using conventional excavators or bull dozers at least to the depth of the test pits included in Appendix A. Subsurface conditions below the limit of investigation are not known, and it is recommended that further assessment of excavation conditions be carried out if deep excavations are proposed.

Groundwater inflow was observed in one test pit at the time of the investigation, though groundwater conditions may change if rainfall is experienced prior to or during construction. The rate of water inflow is likely to be dependant on the excavation location, as water inflow in the residual clay soils are likely to significantly less than the alluvial sand soils.

9. SITE PREPARATION AND EARTHWORKS

Site preparation and earthworks suitable for pavement and structure support should consist of:

- Prior to construction of roads and placement of any fill, the proposed areas should be stripped to remove all fill, vegetation, topsoil, root affected or other potentially deleterious material;
- Following stripping, the exposed subgrade materials should be proof rolled to identify any wet or excessively deflecting material. As the near surface soils on site were observed to comprise clay, they may be susceptible to changes in strength depending on soil moisture conditions at the time of construction. Any such areas should be over excavated and backfilled with an approved select material;
- Approved bulk fill beneath roads should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum density ratio of 95% Standard Compaction in accordance with AS1289 5.1.1 or equivalent. Clay subgrade fill should be placed and maintained at 60% to 90% of Optimum Moisture Content;
- The top 300mm of natural subgrade below pavements or the final 300mm of road subgrade replaced should be compacted to a minimum density ratio of 100% Standard Compaction or equivalent within the above stated moisture range;
- Fill beneath structures should be placed in layers not exceeding 300mm loose thickness and be compacted to a minimum density ratio of 95% Standard Compaction within ±2% of OMC;
- All fill should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion;
- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-1996, '*Guidelines for Earthworks for Commercial and Residential Developments*'.

The extent of testing associated with this preliminary assessment is limited and variations in ground conditions

may occur between test locations. It is recommended that further geotechnical investigations be carried out prior to development to reduce the risk of variations in ground conditions and to assess issues discussed in this report.

We draw your attention to the attached sheet entitled “Important Information About Your Coffey Report” which should be read in conjunction with this report.

Please contact David Barker or the undersigned if you require further information.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

DAVID BARKER
Senior Geotechnical Engineer

Information

Important information about your **Coffey** Report

Coffey

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Coffey Geosciences Pty Ltd ABN 057 056 335 516

Coffey

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they have incorporated the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

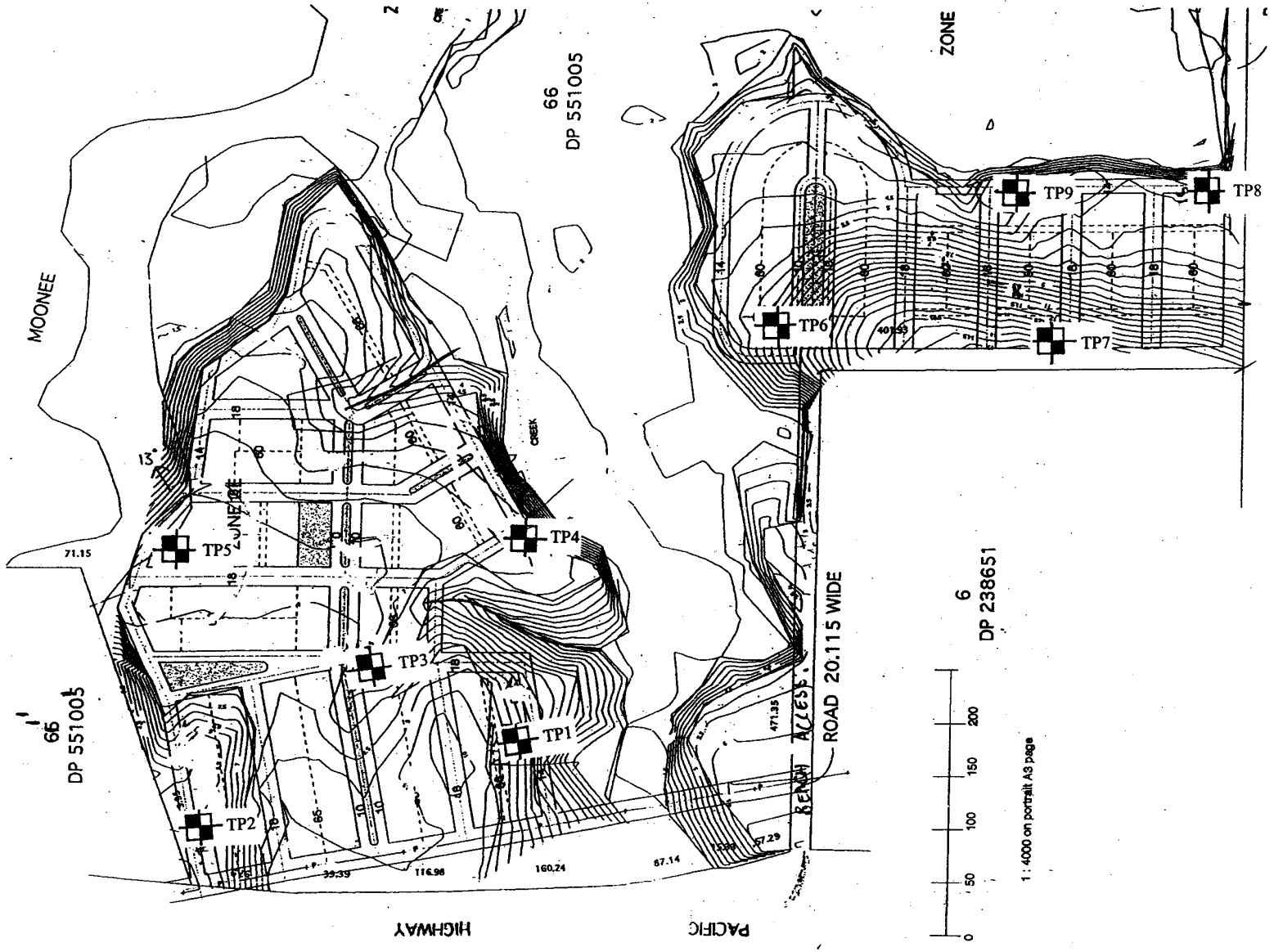
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design toward construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

** For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical Information in Construction Contracts" published by the Institution of Engineers Australia, National Headquarters, Canberra, 1987.*

20252 / 07-01



Coffey

Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I Resources I Environmental I Technical I Project Management	
Drawn	ELC	GHD PTY LTD PROPOSED SUBDIVISION MOONEE BEACH SITE PLAN	Drawing no: FIGURE 1
Approved			
Date	20/9/04		
Scale	1:4000		

Coffey

APPENDIX A

ENGINEERING LOGS

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP1***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N		D		0.5		MH	**TOPSOIL:** Silt, high plasticity, dark brown.	M			TOPSOIL
				D				CH	**CLAY:** high plasticity, orange-brown.		VSt/H	×	RESIDUAL SOIL
				D		1.0			Gradual colour change to pale grey/orange-brown.			× ×	
				D		1.5						×	
				D									EXTREMELY WEATHERED SILTSTONE
						2.0			Backhoe refusal on weathered siltstone. Test pit TP1 terminated at 1.8m				
						2.5							
						3.0							
						3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP2***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
BH		N		D		0.0		MH	**TOPSOIL:** Clayey Silt, high plasticity, dark brown	M			TOPSOIL
				D		0.5		CL	**Silty CLAY/Clayey SILT:** low plasticity, brown.		St/VSt	×	COLLUVIAL SOIL ?
			15/9/04 ▼	D		1.0		CH	**Sandy CLAY:** high plasticity, pale grey/orange-brown, sand is fine grained	W	VSt/H	×	RESIDUAL SOIL
				D		1.5						×	
						2.0							
						2.5		CH	**Sandy Gravelly CLAY:** high plasticity, pale grey/orange-brown, sand is fine to medium grained, gravel is fine to medium grained, some quartz				
						3.0			Test pit TP2 terminated at 3m				
						3.5							
						4.0							

Sketch

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP3***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N				0.0		MH	**TOPSOIL:** Silt, high plasticity, grey	D			TOPSOIL
				Bs		0.5		CH	**CLAY:** high plasticity, orange-brown Gradual colour change to pale grey/red.		H	600 600 600	RESIDUAL SOIL
						1.0							
						1.5							
						2.0							
						2.5			Test pit TP3 terminated at 2.6m				
						3.0							
						3.5							
						4.0							

Sketch

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

water level on date shown

water inflow

water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
V	vane shear (kPa)
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

D	dry
M	moist
W	wet
Wp	plastic limit
W_L	liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP4***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N				0.0		MH	**TOPSOIL:** Silt, high plasticity, grey	D			TOPSOIL
				Bs		0.5		CH	**CLAY:** high plasticity, orange-brown		H/Fb	600 600 600	RESIDUAL SOIL
						1.0			Gradual colour change to pale grey/orange-brown.				
						1.5							
						2.0			Test pit TP4 terminated at 1.7m				
						2.5							
						3.0							
						3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP5***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N				0.0		MH	**TOPSOIL:** Silt, high plasticity, grey	D			TOPSOIL
				Bs		0.5		CH	**CLAY:** high plasticity, orange-brown		H	600 600 600	RESIDUAL SOIL
						1.0							
						1.5							
						2.0			Test pit TP5 terminated at 1.7m				
						2.5							
						3.0							
						3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Coffey Geosciences Pty Ltd ACN 056 335 516

Excavation No. ***TP6***

Engineering log - Excavation

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD*** Date started: ***15.9.2004***

Principal: Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH*** Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1*** Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N		D (0-0.5m)				CL	**CLAY:** low plasticity, grey-brown	D			COLLUVIAL SOIL
				Bs (0.4-0.6m)		0.5		CH	**CLAY:** high plasticity, orange-brown		H/Fb	600	RESIDUAL SOIL
				D (0.5-1m)		1.0			Gradual colour change to pale grey/red.			600	
				D		1.5						600	
				D		2.0							
						2.5			Test pit TP6 terminated at 2.4m				
						3.0							
						3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP7***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
BH		N		D (0-0.5m)		0.5		CL	**Silty CLAY:** medium plasticity, grey	D			COLLUVIAL SOIL
				Bs (0.4-0.6m)				CH	**CLAY:** high plasticity, orange-brown		H	600 600	RESIDUAL SOIL
				D (0.5-1m)		1.0			Gradual colour change to pale grey/red.			600	
				D		1.5							
				D		2.0			Some iron cementing.				
						2.5			Test pit TP7 terminated at 2.5m				
						3.0							
						3.5							
						4.0							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP8***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
BH		N				0.0		MH	**FILL:** Silt, high plasticity, dark brown	M			TOPSOIL
								CH	**FILL:** Gravelly Clay, orange-brown.				FILL
				Bs		0.5		SP	**SAND:** fine to medium grained, pale brown		MD		ALLUVIAL SOIL?
						1.0		OL	**SILT:** high plasticity, black, organic silt, some sand	W			ORGANIC SOIL
								SP	fine to medium grained				ALLUVIAL SOIL
						1.5			**SAND:** fine to medium grained, pale brown				
						2.0							
						2.5							
						3.0			Test pit TP8 terminated at 2.8m				
						3.5							
						4.0							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
V vane shear (kPa)
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

moisture
D dry
M moist
W wet
Wp plastic limit
W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering log - Excavation

Excavation No. ***TP9***

Sheet 1 of 1

Office Job No.: ***CH1318/1***

Client: ***GHD PTY LTD***

Date started: ***15.9.2004***

Principal:

Date completed: ***15.9.2004***

Project: ***PROPOSED SUBDIVISION - MOONEE BEACH***

Logged by: ***ELC***

Test pit location: ***REFER TO FIGURE 1***

Checked by:

equipment type and model: BACKHOE Pit Orientation: Easting: m R.L. Surface:

excavation dimensions: 2m long 0.45m wide Northing: m datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
BH		N				0.5		SP	**SAND:** fine to medium grained, pale brown	D / M	L		MARINE/ALLUVIAL SOIL
						1.0							
						1.5							
									Test pit TP9 terminated at 1.5m				
						2.0							
						2.5							
						3.0							
						3.5							
						4.0							

Sketch

TESTPIT CH1318-1.GPJ COFFEY.GDT 10.22.04

Form GEO 5.2 Issue 3 Rev.2

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- W_L liquid limit

consistency/density index

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

Soil Description

Explanation Sheet

Coffey

DEFINITION:

In engineering terms soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil.

Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (USC) as shown in the table on the following page.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200mm
Cobbles		63mm to 200mm
Gravel	coarse	20mm to 63mm
	medium	6mm to 20mm
	fine	2.36mm to 6mm
Sand	coarse	600μm to 2.36mm
	medium	200μm to 600μm
	fine	75μm to 200μm

MOISTURE CONDITION

Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH su (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort.
Soft	12 - 25	A finger can be pushed into the soil to about 25mm depth.
Firm	25 - 50	The soil can be indented about 5mm with the thumb, but not penetrated.
Stiff	50 - 100	The surface of the soil can be indented with the thumb, but not penetrated.
Very Stiff	100 - 200	The surface of the soil can be marked, but not indented with thumb pressure.
Hard	>200	The surface of the soil can be marked only with the thumbnail.
Friable	-	Crumbles or powders when scraped by thumb nail.

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very Loose	Less than 15
Loose	15 - 35
Medium Dense	35 - 65
Dense	65 - 85
Very Dense	Greater than 85

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:	
		Coarse grained	Fine grained
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	<5%	<15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	5% - 12%	15% - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure or sample	Weakly cemented	Easily broken up by hand in air or water
Lenses	Discontinuous layers of lenticular shape	Moderately cemented	Effort is required to break up the soil by hand in air or water
Pockets	Irregular inclusions of differential material		

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

Extremely weathered material	Structure and fabric of parent rock visible
Residual soil	Structure and fabric of parent rock not visible

TRANSPORTED SOILS

Aeolian soil	Deposited by wind
Alluvial soil	Deposited by stream and rivers
Colluvial soil	Deposited on slopes (transported downslope by gravity)
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes
Marine soil	Deposited in ocean basins, bays, beaches and estuaries

Form No. GEO5.7. Issue 3. Rev.2.

Coffey

Explanation Sheet

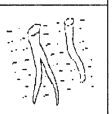
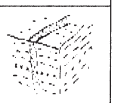
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60mm and basing fractions on estimated mass)						USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of material less than 63mm is larger than 0.075mm	(A 0.075mm particle is about the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.		GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.		GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)		GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below).		GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing.		SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.		SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).		SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).		SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63mm is smaller than 0.075mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2mm				
			DRY STRENGTH	DILATANCY	TOUGHNESS		
		SILTS AND CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
			Medium to high	None	Medium	CL	CLAY
			Low to medium	Slow to very slow	Low	OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to none	Low to medium	MH	SILT
			High	None	High	CH	CLAY
			Medium to high	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS			Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	PEAT

* Low plasticity - Liquid Limit W_L less than 35%. Medium plasticity - W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2m in length	
SHEARED ZONE	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.	
SHEARED SURFACE	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.	

TERM	DEFINITION	DIAGRAM
SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
TUBE	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter.	
TUBE CAST	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases the soil which makes up the tube cast is cemented.	
INFILLED SEAM	Sheet or wall like body of soil substance or mass with roughly planer to irregular near parallel boundaries which cuts through a soil mass. Formed by infilling of open joints.	

Rock Description

Explanation Sheet

Coffey

AS1726-1993 – The descriptive terms used by Coffey are given below. They are broadly consistent with Australian Standard AS1726-1993.

DEFINITIONS: Rock substance, defect and mass are defined as follows:

Substance	Effectively homogeneous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects. In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or in water. Other material is described using soil descriptive terms.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME – Simple rock names are used rather than precise geological classification.

PARTICLE SIZE – Grain size terms for sandstone are:

Coarse grained	0.6mm to 2mm
Medium grained	0.2mm to 0.6mm
Fine grained	0.6mm (just visible) to 0.2mm

FABRIC – Terms for layering or penetrative fabric (eg. bedding, cleavage) are:

Massive	No layering or penetrative fabric
Poorly developed	Layering or fabric just visible. Little effect on properties.
Well developed	Layering or fabric distinct. Rock breaks more easily parallel to layering or fabic.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	**RS**	Soil derived from the weathering of rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered	**XW**	Material is weathered to such an extent that it has soil properties, ie, it either disintegrates or can be remoulded, in water. Fabric of original rock still visible.
Distinctly Weathered	**DW**	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly Weathered	**SW**	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	**FR**	Rock shows no sign of decomposition or staining.

Note: *Where physical and chemical changes were caused by hot gases and liquids associated with igneous rocks the terms slightly altered (SA), distinctly altered (DA) and extremely altered (XA) may be used.*

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbreviation	Point Load Index, I_S50 (MPa)	Field Guide to Strength
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm diameter can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

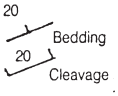
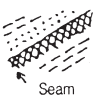
Notes:

1. *In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.*
2. *The term extremely low is not used as a rock substance strength term. The term is used in AS1726-1993 but the field guide to strength makes it clear that it is a soil in engineering terms.*
3. *The unconfined compressive strength to isotropic rocks and anisotropic rocks which do not fail parallel to the planar anisotropy is typically 10 to 25 times the point load index. The ratio may vary for different rock types and lower strength rocks often have lower ratios than higher strength rocks.*

Form No. GEO5.8 Issue 3 Rev. 1.

Coffey

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.			 (Note 2)
Joint	A surface or crack across which the rock has little or no tensile strength but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.			 (Note 2)
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.			
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.			
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.			
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint. Infilled seams less than 1mm thick may be described as veneer or coating on joint surface.			
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formed by weathering of the rock substance in places.			

Notes on defects:

1. *Borehole logs show the true dip of defects and face sketches and sections the apparent dip.*
2. *Partings and joints are not usually shown on the graphic log unless considered significant.*
3. *Sheared zones, sheared surfaces and crushed seams are faults in geological terms.*

DEFECT SHAPE TERMS

Planar	The defect does not vary in orientation
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps
Irregular	The defect has many sharp changes in orientation

Note:
The assessment of defect shape is partly influenced by the scale of observation.

ROUGHNESS TERMS

Slickensided	Grooved or striated surface; usually polished
Polished	Shiny smooth surface
Smooth	Smooth to touch; few or no surface irregularities
Rough	Many small surfaxce irregularities (amplitude generally less than 1mm); feels like fine to coarse sand paper
Very rough	Many large surface irregularities (amplitude generally more than 1mm); feels like, or coarser than, very coarse sand paper

COATING TERMS

Clean	No visible coating
Stained	No visible coating but surfaces are discoloured
Veneer	A visible coating of soil or mineral too thin to measure; may be patchy
Coating	A visible coating up to 1mm thick . Thicker soil material is described using appropriate defect terms (eg, infilled seam). Thicker rock strength material is usually described as a vein

BLOCK SHAPE TERMS

Blocky	Approximately equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

APPENDIX B

LABORATORY TEST RESULTS

CONTROL TESTING LABORATORIES

Inc. Concrete Control. A.B.N. 57 056 335 516
Correspondence: P O Box 704, Coffs Harbour NSW 2450 Fax (02) 6651 5194

1919 Coffs Harbour: 601 Coramba Road (02) 6651 3213
3329 Byron Bay: 2/2 Banksia Drive (02) 6685 8504
9541 Armidale: 2/215 Mann Street (02) 6771 3040
9622 Mobile Laboratory No. 1

Client	GHD PTY LTD			A/C Ref.	CH 1318/1
Project	SUB-DIVISION			Lab. No.	1919
Location	MOONEE BEACH			Test No.	25208
Material	SUB GRADE			Client Ref.	
Date Sampled	15/9/2004	by	ELC	Lot No.	
Date Tested	29/9/2004	by	TR, LJ, JC & BM	Page 1	of 2

CALIFORNIA BEARING RATIO REPORT

Sample No.		A	B	C	D	E
Location/Test Pit No.		TP3	TP4	TP5	TP6	TP7
Depth (m)		0.4 - 0.6	0.4 - 0.6	0.4 - 0.6	0.4 - 0.6	0.4 - 0.6
LABORATORY COMPACTION	**LABORATORY REPORT**					
Maximum Dry Density	t/m3	1.52	1.59	1.61	1.60	1.52
Optimum Moisture Content	%	26.5	22.6	22.7	23.2	26.4
Material Retained 19.0 mm sieve	%	0	0	0	0	0
Compaction Specified	%	100.0	100.0	100.0	100.0	100.0
Compaction Achieved	%	99.5	99.5	100.0	100.0	99.5
	SPECIMEN DRY DENISTY					
i At Compaction	t/m3	1.51	1.58	1.61	1.60	1.51
ii After Soaking	t/m3	1.45	1.56	1.60	1.58	1.48
	SPECIMEN MOISTURE CONTENT					
Field	%	24.6	19.3	19.5	21.5	24.0
i At Compaction	%	26.3	22.6	22.3	23.2	26.4
ii After Soaking	%	31.0	25.6	24.8	25.5	29.7
iii Top 30mm layer	%	35.0	27.7	26.9	27.0	34.3
iv Rest of Sample	%	29.9	25.0	23.9	24.9	28.3
	CBR TEST DETAILS					
Soaking Period	days	4	4	4	4	4
Swell	%	4.0	2.0	1.3	1.7	2.7
Penetration	mm	2.5	2.5	2.5	5.0	2.5
CALIFORNIA BEARING RATIO	**%**	**2**	**6**	**5**	**6**	**2**
Test Methods Used		ACD	ACD	ACD	ACDJ	ACD

Test Methods

A. RTA T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

B. RTA T112 Dry Density/Moisture Relations of Road Materials (Modified Compaction).

C. RTA T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method) (9KG Surcharge).

E. RTA T117A Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Ten day soak period).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

G. AS 1289 5.2.1 Dry Density/Moisture Relationship (Modified Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 5.0 mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

L. RTA T132 Determination of the California Bearing Ratio of Road Material Modified or Stabilised. Compactive effort Std.

M. Maximum Density Determined using Test Method RTA T164 and T166.

Approved Signatory

J. MORRISON

Date: 6/10/04

NATA Accredited Laboratory Number: 1919
NATA endorsed test report. This document shall not be reproduced, except in full.

CONTROL TESTING LABORATORIES

Inc. Concrete Control. A.B.N. 57 056 335 516
Correspondence: P O Box 704, Coffs Harbour NSW 2450 Fax (02) 6651 5194

1919 Coffs Harbour: 601 Coramba Road (02) 6651 3213
3329 Byron Bay: 2/2 Banksia Drive (02) 6685 8504
9541 Armidale: 2/215 Mann Street (02) 6771 3040
9622 Mobile Laboratory No. 1

Client	GHD PTY LTD			A/C Ref.	CH 1318/1
Project	SUB-DIVISION			Lab. No.	1919
Location	MOONEE BEACH			Test No.	25208
Material	SUB GRADE			Client Ref.	
Date Sampled	15/9/2004	by	ELC	Lot No.	
Date Tested	29/9/2004	by	TR, LJ, JC & BM	Page 2	of 2

CALIFORNIA BEARING RATIO REPORT

Sample No.		F				
Location/Test Pit No.		TP8				
Depth (m)		0.4 - 0.6				
LABORATORY COMPACTION	**LABORATORY REPORT**					
Maximum Dry Density	t/m3	1.64				
Optimum Moisture Content	%	17.4				
Material Retained 19.0 mm sieve	%	2				
Compaction Specified	%	100.0				
Compaction Achieved	%	100.0				
SPECIMEN DRY DENISTY						
i At Compaction	t/m3	1.64				
ii After Soaking	t/m3	1.63				
SPECIMEN MOISTURE CONTENT						
Field	%	11.1				
i At Compaction	%	17.4				
ii After Soaking	%	19.8				
iii Top 30mm layer	%	21.1				
iv Rest of Sample	%	19.4				
CBR TEST DETAILS						
Soaking Period	days	4				
Swell	%	-0.1				
Penetration	mm	2.5				
CALIFORNIA BEARING RATIO	**%**	**16**				
Test Methods Used		CDM				

Test Methods

A. RTA T111 Dry Density/Moisture Relations of Road Materials (Standard Compaction).

B. RTA T112 Dry Density/Moisture Relations of Road Materials (Modified Compaction).

C. RTA T120 Determination of Moisture Content of Road Materials (Standard Method).

D. RTA T117 Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Standard Method) (9KG Surcharge).

E. RTA T117A Determination of the California Bearing Ratio of Remoulded Specimens of Road Materials (Ten day soak period).

F. AS 1289 5 1.1 Dry Density/Moisture Relationship (Standard Compaction).

G. AS 1289 5.2.1 Dry Density/Moisture Relationship (Modified Compaction).

H. AS 1289 2.1.1 Determination of Moisture Content (Standard Method).

I. AS 1289 6.1.1 Determination of the California Bearing Ratio of A Soil -Standard Method For a Remoulded Specimens .

J. 5.0 mm result reported, NO repeat test performed.

K. Sampled according to AS 1141.3.1

L. RTA T132 Determination of the California Bearing Ratio of Road Material Modified or Stabilised. Compactive effort Std.

M. Maximum Density Determined using Test Method RTA T164 and T166.

Approved Signatory

J. MORRISON

Date: 6/10/04

NATA Accredited Laboratory Number: 1919
NATA endorsed test report. This document shall not be reproduced, except in full.

Environmental Analysis Laboratory

RESULTS OF SOIL ANALYSIS (Page 1 of 1)

5 samples supplied by Coffey on 20th September, 2004 - Lab. Job No. E2711

Analysis requested by David Barker.

Sample Site	Depth (m)	pH (1:5 water)	Conductivity (1:5 water) dS/m (note 8)
TP3	0.4-0.6	4.40	0.118
TP5	0.4-0.6	5.05	0.125
TP6	0.4-0.6	4.43	0.350
TP7	0.4-0.6	4.45	0.204
TP8	0.4-0.6	7.63	0.122

NOTE:

1 - All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2 - Methods from Stone, Y. Ahern CR, and Blunden B (1998). **Acid Sulphate Soil Manual 1998.** ASSMAC, Wollongbar, NSW.

3 - Conductivity 1 dS/m = 1 mS/cm = 1000 μS/cm

checked: .....

DETERMINATION OF ACID SULFATE SOIL PROPERTIES

CERTIFICATE OF ANALYSIS

Analysis By: **Bio-Track Pty Ltd** ABN 91 056 237 275

781 Mt. Glorious Road Highvale, Brisbane, Australia, 4520 Ph. 07 3289 7179 Fx. 07 3289 7155

LAB REFERENCE LR2994.753 DATE OF REPORT 08 OCTOBER 2004 @15:56:51
CLIENT NAME DAVID BARKER c/o COFFEY GEOSCIENCES PTY LTD PO BOX 704 COFFS HARBOUR NSW 2450
PROJECT NAME CH1318/1 YOUR PROJECT/JOB REFERENCE CH1318/1
SAMPLING DATE 15/9/04 NUMBER OF SAMPLES 1 Samples supplied by client SAMPLE TYPE:SOIL SAMPLE FOR ACID SULFATE STUDY
DATE RECEIVED 29 SEPTEMBER 2004 PACKAGING SAMPLES LABELLED - INTACT - BAGGED - CHILLED IN INSULATED PACKAGING Ground Oven Dry Samples DISPOSED ON 1/6/2005

Sample ID as received. METHODOLOGY: As per (DNR QASSIT May 2004) for <850 um sample fraction, oven dry (85'C) mass. All reported values gravimetric, dry mass.
LIME1 rates calculated to neutralise TPA (or TAA if >TPA)+ aS_RAS -ANC_E/1.5 LIME2 rates calculated to neutralise TAA + aS_POS or S_Cr + aS_RAS -ANC_E/1.5
NB. Lime rates assume 97% lime neutralisation but DO NOT include any safety factors. Suggested factor=1.5-1.8. Rates are kg/ton.
CBN POS= moles carbonate alkalinity released by oxidation assuming (Ca POS - Ca KCl) + (Mg POS - Mg KCl) is due to carbonate solution.
Blanks represent unmeasured values, zeros represent measured values. If pH KCl>4.5 then s-RAS may be zero for undisturbed soil.

ID.	DEPTH	pH	pH	TAA	TPA	TSA	S KCl	S P	S POS	S Cr	s-RAS	s EQ	Ca KCl	Ca P	Mg KCl	Mg P	CBN POS	LIME1	LIME2	sANC_E
	m	KCL	ox	m/t	m/t	m/t	%	%	%	%	%	%	kg/t	mg/kg	mg/kg	mg/kg	m/t	kg/t	kg/t	%
Analytical Method Codes		23A	23B	23F	23G	23H	23Ce	23De	23Ee	22B	s23Re	s	23Vh	23Wh	23Sm	23Tm	a23U&X			s19A2
TP 6	0-0.3	4.13	5.07	48	51	3	<0.01	0.02	0.02		<0.01	0.097	0	205	0	285	34	2.7	2.0	

Signatory *R. Johnston* For and behalf of Bio-Track Pty Ltd

GHD Pty Ltd ABN 39 008 488 373

2/115 West High Street
Coffs Harbour NSW 2450
T: (02) 6650 5600 F: (02) 6652 6021 E: cfsmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	W. Cooper	V. Joseph	*V. Joseph*	V. Joseph	*V. Joseph*	Oct 04
1	W. Cooper	V. Joseph	*V. Joseph*	V. Joseph	*V. Joseph*	Dec 04
2	W. Cooper	T. Ryan		T. Ryan		14 Jun 07