BORDER-TECH

GEOTECHNICAL ENGINEERING SERVICES

PREPARED FOR
CODLEA PTY LTD

ACID SULFATE SOILS ASSESSMENT

LOT 73 on DP 851902
BAYSIDE WAY, BRUNSWICK HEADS

Ref: BT 19034-A2

BORDER-TECH
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1.0 INTRODUCTION

Border-Tech was commissioned by Codlea Pty Ltd to undertake an Acid Sulfate Soil (ASS) Assessment at Lot 1 in DP871039 Bayside Way Brunswick Heads, in Northern New South Wales (NSW). It is understood that this report will be submitted as part of a Part 3A Major Project Development Application, to the NSW Department of Planning.

A previous testing regime consisting of 23 boreholes was carried out by Border-Tech in November 2003. The results of this investigation (Our Ref: Job No BT 12582) were presented as Appendix D of the preliminary assessment prepared by Jim Glazebrook and Assosciates Pty Ltd, dated August 2006. This testing failed to identify any evidence of ASS, however due to the incomplete nature of the initial investigation, additional testing and reporting was required to satisfy Section 5.3 of the NSW Director-General's Environmental Assessment Requirements. This document brings together the results of the 2003 and 2009 ASS testing in order to generate an accurate assessment of acid sulfate conditions at the site. Correspondence with a senior environmental scientist from the Department of Environment and Climate Change was undertaken in regard to the required sampling intensity prior to the latest sampling event.

1.1 Scope of Work

Written authorisation to proceed with additional testing and an Acid Sulfate Soils Investigation was provided by Mr Ian Fraser on 17 April 2009. The scope of works involved the following:

- Drilling of an additional seven (7) boreholes to 2.0m below surface level;
- Screening and laboratory testing of samples;
- Preparation of a detailed Acid Sulfate Soils Assessment.

The investigation was conducted with reference to the New South Wales Acid Sulfate Soils Advisory Committee (ASSMAC) Guidelines 1998. Laboratory analysis was undertaken in accordance with the Acid Sulfate Soils Laboratory Methods Guidelines (Ahern et. al. 2004).

1.1.1 Objectives

The assessment aimed to satisfy the following objectives:

- To determine the presence and extent of ASS within the site;
- To estimate the net acid generating potential of ASS material and;
- To provide management options and treatment procedures if necessary.

1.2 Consultation

The following correspondence with relevant planning authorities was undertaken throughout the course of the project in 2009.

Table 1: Consultation

Date	Between	Method	Nature of Conversation
29/4/2009	Nathan Piper and Glenn Atkinson (Senior Environmental Scientist Department of Environment and Climate Change)	Email	Mr Atkinson indicated that the proposed sampling regime should be sufficient
3/6/2009	Nathan Piper and Glenn Atkinson (Senior Environmental Scientist Department of Environment and Climate Change)	Email	Requesting information on relevant parties for review of draft report
4/6/2009	Nathan Piper and Jon Keats (Head Industry and Waste Unit North Coast)	Email	Department of Planning does not have the resources for review of draft reports

2.0 EXISTING ENVIRONMENT

The subject site lies on the southern side of Brunswick Heads approximately 2km south of the Brunswick Heads town centre and approximately 500m west of Brunswick Beach. The land is described as Lot 1 in DP871039 Bayside Way Brunswick Heads. It has an area of 31.33 ha bordered by Simpsons Creek to the east, undeveloped bushland to the south and west, and Stage 1 of the Bayside Brunswick development to the north.

Approximately 23ha of the site has been previously cleared. This area is now vegetated by a slashed open heath community. Dense remnant vegetation comprising of closed wet and dry sclerophyll forest exists along the eastern portion of the site. A wetland of state environmental significance (SEPP 14) is located in the north-eastern corner adjoining Simpsons Creek.

Two main drainage pathways exist on the site, terminating in Simpsons Creek. The central and western portion of the site is drained to the south where it meets with another east-west running drain. Water flow on the eastern side of the site is channelled in a north-east direction, directly to Simpsons Creek.

The site is generally flat with surface levels ranging between approximately RL 3.0m and RL 5.0m. The eastern side of the site contains several north-south running sand ridges which represent the hind dunes of the barrier beach system (Morand, 1994). The central and western side of the site is characterised by an extremely low, level to gently undulating beach ridge plain (Morand, 1994).

Figure 1 shows the location of the subject site with site photos attached as Appendix 4.

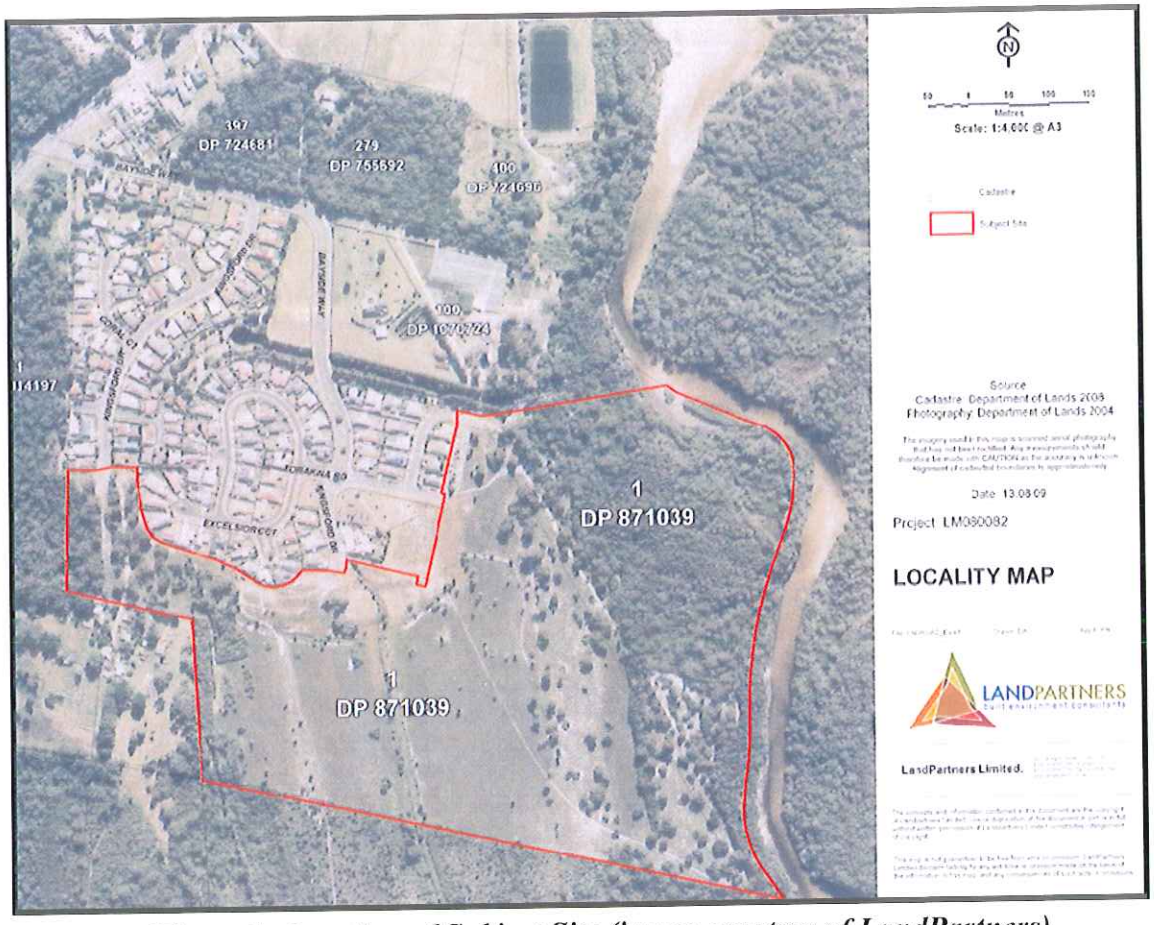


Figure 1: Location of Subject Site (image courtesy of LandPartners)

2.1 Geology and Subsurface Conditions

The Geological Survey of Queensland and NSW, Moreton Geology Map, 1:500,000 series, shows the site to be located on the juncture of a Holocene beach ridge system and a Pleistocene parabolic dune system. Soils in this area will likely consist of quartz and heavy mineral sands.

Based on the borehole drilling, the soils across the majority of the site are characterised by a layer of dark grey sand overlying pale grey sand. A stained dark grey/brown sand was found below approximately 1.5m to the termination depth of 2.0m. Soils beneath the sand ridge on the eastern side of the site exhibited mainly pale grey sand with a shallow layer of darker grey topsoil. Shallow organic rich deposits, overlying pale grey sand and stained dark grey/brown sand were found around the northern end of the central drain.

Some minor discrepancies have emerged with the field classifications made in 2003 and 2009. For this reason the borehole logs from 2009 will be referred to in preference to those from 2003. The seven borehole logs from 2009 can be identified by the (09) suffix in the borehole name. Borehole logs are presented as Appendix 2.

2.2 Groundwater

Supplementary work carried out by Border-Tech on 7 May 2009 encountered groundwater at approximately 0.5m below existing surface level across the flatter areas of the site with levels no deeper than 1.8m in more elevated positions. The water table may fluctuate during periods of high rainfall. A detailed 'Surface and Groundwater Assessment' compiled by Waste Solutions Australia Pty Ltd (*Ref W516*) is an accompanying document as part of the environmental assessment (EA).

2.3 Acid Sulfate Risk

The Huonbrook-Brunswick Heads ASS Risk Map produced by the Department of Land and Water Conservation (DLWC) rates the vast majority of the site as having a 'low probability' of ASS materials within the soil profile. ASS materials, if present, will be within 1-3m of the soil surface, however the environment of deposition has generally not been suitable for their formation (DLWC 1997).

The mangrove environment in the north-eastern corner of the site represents a small pocket of 'high probability' terrain where ASS are expected to be at or near the soil surface (DLWC 1997). This area is not within the area of proposed disturbance.

2.4 Field Observations

No field indicators of ASS including odours, iron staining, stunted vegetation, scalding or jarosite formation were identified during the site investigation.

3.0 PROJECT DISCUSSION

Border-Tech has received a consultant brief and final proposed layout plans dated 13/10/10 indicating the type of development proposed for the site (*see Figure 2*). From this information it is understood that the project involves the subdivision of a 31.33ha parcel of land to create a residential housing estate consisting of a total of 178 allotments of various sizes. Of the 31ha, approximately 23ha is to be developed into a mixture of single dwelling, dual occupancy and medium density lots. The remaining land will include areas of public parkland and an 8.2ha environmental reserve adjacent to Simpsons Creek.

Border-Tech has not viewed bulk earthworks plans, however it is anticipated that a small amount of topsoil would need to be stripped across the wider building envelope with fill used to raise the lower lying areas above designated flood levels.

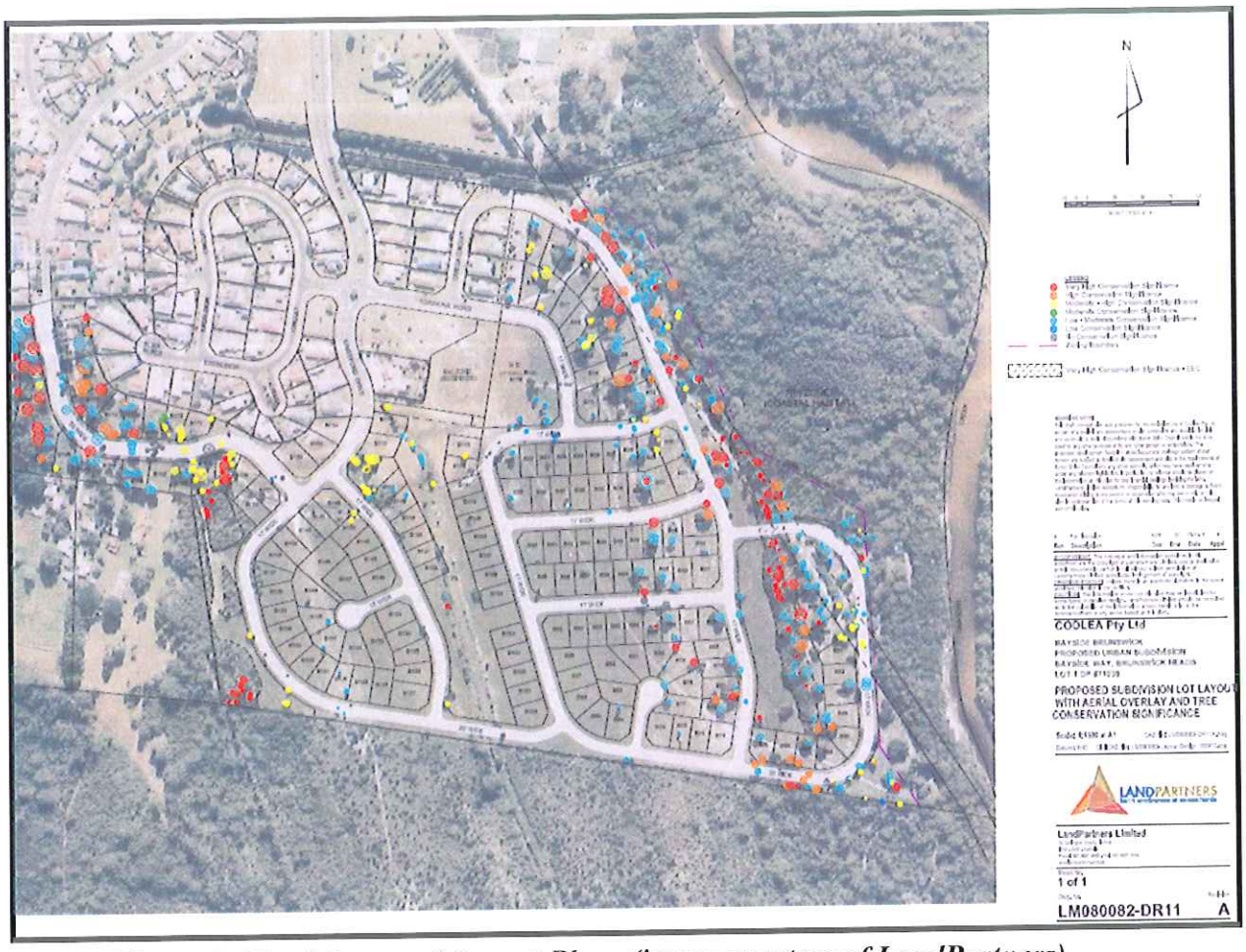


Figure 2: Final Proposed Layout Plans (image courtesy of LandPartners)

4.0 SAMPLING AND ANALYSIS

Site evaluation and sampling was initially undertaken on 17 November 2003 in order to assess the presence of actual and potential acid sulfate soils across the site. This involved sampling at twenty-three (23) locations to a depth of 2.0m below existing surface level. Borehole locations were spread out across the area of the proposed development (excluding the environmental protection area) with roughly 1 borehole/ha.

Further borehole drilling was conducted on 7 May 2009 and involved sampling at 7 locations across the site. Boreholes were again extended to a depth of 2.0m below existing surface level. See Appendix 1 for site plans showing all borehole locations.

All boreholes were excavated using a 4WD mounted drilling rig, with samples recovered directly from spiral flight augers at 0.50m depth increments. All samples were sealed in plastic bags with excess air evacuated and stored on site below 4°C to prevent oxidation. Samples were assigned unique identification numbers at our laboratory prior to testing.

In 2003 a total of 92 samples were recovered for field pH (pH_F) and peroxide pH testing (pH_{FOX}) which were conducted using a 1MNaCl soil suspension for pH_F, with peroxide

added for pH_{FOX} testing. Ten (10) samples were then selected for laboratory analysis by the POCAS method. In 2009 a total of 28 samples were recovered for field pH and peroxide pH testing with 7 samples selected for laboratory analysis by the Chromium Reducible Sulfur Suite (S_{CR} method 22B) (*see Table 2*).

Changes in best practice acid sulfate testing and in particular the development of the Laboratory Methods Guidelines, Version 2.1 (Ahern, *et al* 2004.) have seen both the screening test method and laboratory testing methods change between the two sampling events. Screening test methods as per the above guideline now use a deionised water suspension for pH_F testing and plain 30% H_2O_2 for pH_{FOX}. Laboratory analysis by the Chromium Reducible Sulfur Suite is now done in preference to the POCAS test.

Table 2: Summary of Sampling Events

	No. of Holes	Depth (m)	Screenings	Lab Tests
2003	23	2.0	92 (1MNaCl + H_2O_2)	10 (POCAS)
2009	7	2.0	28 (H_2O or H_2O_2)	7 (S_{CR})
Total	30	N/A	120	17

Screening tests (Field pH and pH oxidation) were conducted by qualified Border-Tech personnel, with laboratory analysis of soil samples by the POCAS and Chromium Reducible Sulfur Suite (S_{CR}) conducted by Mazlab Pty Ltd at Tweed Heads South, NSW.

5.0 RESULTS AND DISCUSSION

5.1 Screening Tests

Two measurements of pH are made as part of the screening process, both of which are carried out on a soil:water paste. The first of which (pH_F) is used to indicate the current pH of the soil. The second test (pH_{FOX}) uses an oxidising agent in the form of 30% hydrogen peroxide to identify un-oxidised sulfates/sulfides in the soil and measure the potential effect of these compounds on soil pH if oxidised. The reaction rate is noted and logged on a scale from nil to very high.

A soil with an initial pH (pH_F) of less than 4 is considered likely to be an actual acid sulfate soil (AASS), while a soil exhibiting a pH after oxidation (pH_{FOX}) of less than 3 is considered to be a potential acid sulfate soil (PASS) (Dear et al. 2002). Table 3 shows a summary of the screening test results with laboratory certificates attached as Appendix 3.

Table 3: Screening Test Results 2003 and 2009

Test	Range	Ass Range
2003 – suspension in 1MNaCl + H_2O_2		
pH_F	2.8 – 4.7	<4.0 (AASS)
pH_{FOX}	2.5 – 4.2	<3.0 (PASS)
Reaction to H_2O_2	Nil – Low	Mod – Very high
2009 – suspension in de-mineralised water and H_2O_2		
pH_F	4.1 – 5.6	<4.0 (AASS)
pH_{FOX}	3.3 – 5.4	<3.0 (PASS)
Reaction to H_2O_2	Nil – Low	Mod – Very high

Screening test results indicate the following:

- The soils onsite have a relatively low initial pH with very little potential to oxidise
- Reactivity to peroxide was Nil-Low
- Screening test results from 2009 using deionised water instead of 1mNaCl recorded slightly higher initial pH readings than 2003, however both testing events demonstrated very low oxidising potential.
- There is no discernable pH differences between samples taken above the water table, and therefore in an oxidised state, to those below the water table in an un-oxidised state.

Screening test results suggest that ASS are not present on the subject site, however considerable existing acidity was evident. As screening tests are indicative only, quantitative laboratory testing was required to confirm this.

5.2 Laboratory Testing

A total of 17 samples were selected for laboratory analysis by both the POCAS (2003) and the Chromium Reducible Sulfur Suite (2009) (S_{CR} Method 22B). Selection for laboratory analysis was based on the most positive screening test results and the most likely ASS soil profiles. In 2009, due to the lack of any positively screened samples, a decision was made not to run laboratory tests on the freely drained sands in the upper profile and instead concentrate on deeper samples below the water table.

Table 4: POCAS Test Results 2003

Sample	pH KCL	S_{POS} (S%)	TAA (Mol H^+/t)
BH 1 1.50	3.6	0.00	12
BH 5 1.50	4.1	0.00	2
BH 7 0.50	3.7	0.00	8
BH10 2.00	3.7	0.00	7
BH11 0.50	3.4	0.00	8
BH14 1.50	3.8	0.00	8
BH 15 1.00	4.1	0.00	1
BH 18 2.00	3.5	0.00	13
BH 21 0.50	3.4	0.00	7
BH 22 1.00	3.7	0.00	6

POCAS test results recorded no detectable sulfate and relatively low actual acidity (TAA). Please refer to Table 5 below for 2009 laboratory results.

Table 5 displays a summary of the Chromium Reducible Sulfur test results and the acid base account (ABA). The ABA assesses the risk of acid production by using the following formula:

Equation 1: $$Net\ Acidity = S_{CR} + TAA + S_{NAS} - ANC$$

Where:

- S_{CR} = Potential Sulfidic Acidity (Mol H^+/t)
- TAA = Actual Acidity (Mol H^+/t)
- S_{NAS} = Retained Acidity (Mol H^+/t)
- ANC = Measured Acid Neutralising Capacity / Fineness Factor (Mol H^+/t)

Table 5: Acid Base Accounting 2009

Sample	pH KCL	S_{CR} (S%)	S_{CR} (Mol H^+/t)	TAA (Mol H^+/t)	S_{NAS} (Mol H^+/t)	ANC (Mol H^+/t)	Net Acidity (Mol H^+/t)
BH 1 1.00 – 1.50	5.4	<0.01	<2	2	-	-	2
BH 2 1.00 – 1.50	4.9	<0.01	<2	5	-	-	5
BH 3 1.50 – 2.00	6.2	<0.01	<2	3	-	-	3
BH 4 0.50 – 1.00	4.8	<0.01	<2	5	-	-	5
BH 5 1.50 – 2.00	6.1	<0.01	<2	2	-	-	2
BH 6 1.00 – 1.50	4.3	<0.01	<2	15	<2	-	15
BH7 1.50 – 2.00	3.9	<0.01	<2	20	<2	-	20

The laboratory test results show that none of the samples submitted for analysis had any detectable sulfate. Actual acidity ranged from 2 – 20 moles H+/tonne and only one sample

breached the Net Acidity Action Criteria for ASS of 18 moles H+/tonne for coarse textured materials.

Due to the lack of detectable sulfate and inability of the samples to react to peroxide the soils onsite cannot be considered as acid sulfate soils. Test results and field observations indicate the presence of a naturally acidic coastal heathland environment adapted to relatively low soil pH levels. Disturbance of this material will not lead to the oxidation of sulfides or the mobilisation of significant amounts of acidity. Neutralisation (lime treatment) of this environment has the capacity to be very damaging to the local ecology.

5.3 Potential Impacts

No impact to Potential or Actual ASS sediments is expected as part of the proposed development. In the event that excavations are required outside of the proposed building envelope or below 2.0m below surface level within the building envelope additional testing should be considered by the consent authority.

5.4 Mitigating Measures

Acid Sulfate Soils were not identified within the proposed building envelope and therefore no mitigating measures are proposed.

6.0 CONCLUSION

The results of the investigation suggest that acid sulfate soils are not present within the proposed building envelope to a depth of 2.0m below existing surface level. The clean pale grey – dark grey sands found across the site did exhibit a relatively low initial pH however showed little to no potential to oxidise and produce additional acidity. Disturbance of this material is not going to lead to sulfate oxidation or significant levels of mobilised acidity and therefore no further action is proposed. In fact, "liming these ecosystems to neutralise their natural acidity can be [environmentally] devastating" (Sullivan, L.A 2008).

Recommendations set-out in this report are based on the information supplied at the time of assessment. Should any details change, further testing and/or assessment may be required.

Should you require any further information or clarification please do not hesitate to contact the undersigned at this office.

Yours faithfully
For and on behalf of
BORDER - TECH

Nathan Piper *B.Sc (Env)*
Environmental Scientist

7.0 REFERENCES

Ahern, C.R., McElnea, A.E, and Sulivan, L.A. (2004). *Acid Sulfate Soils Laboratory Methods Guidelines*. Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia. ISBN 1 920920 66 8

Dear, S.E., Moore, N.G., Dobos, S.K., Watling, K.M, and Ahern, C.R. (2002). *Queensland Acid Sulfate Soil Technical Manual*. Queensland Department of Natural Resources and Mines, Indooroopilly, Queensland, Australia.

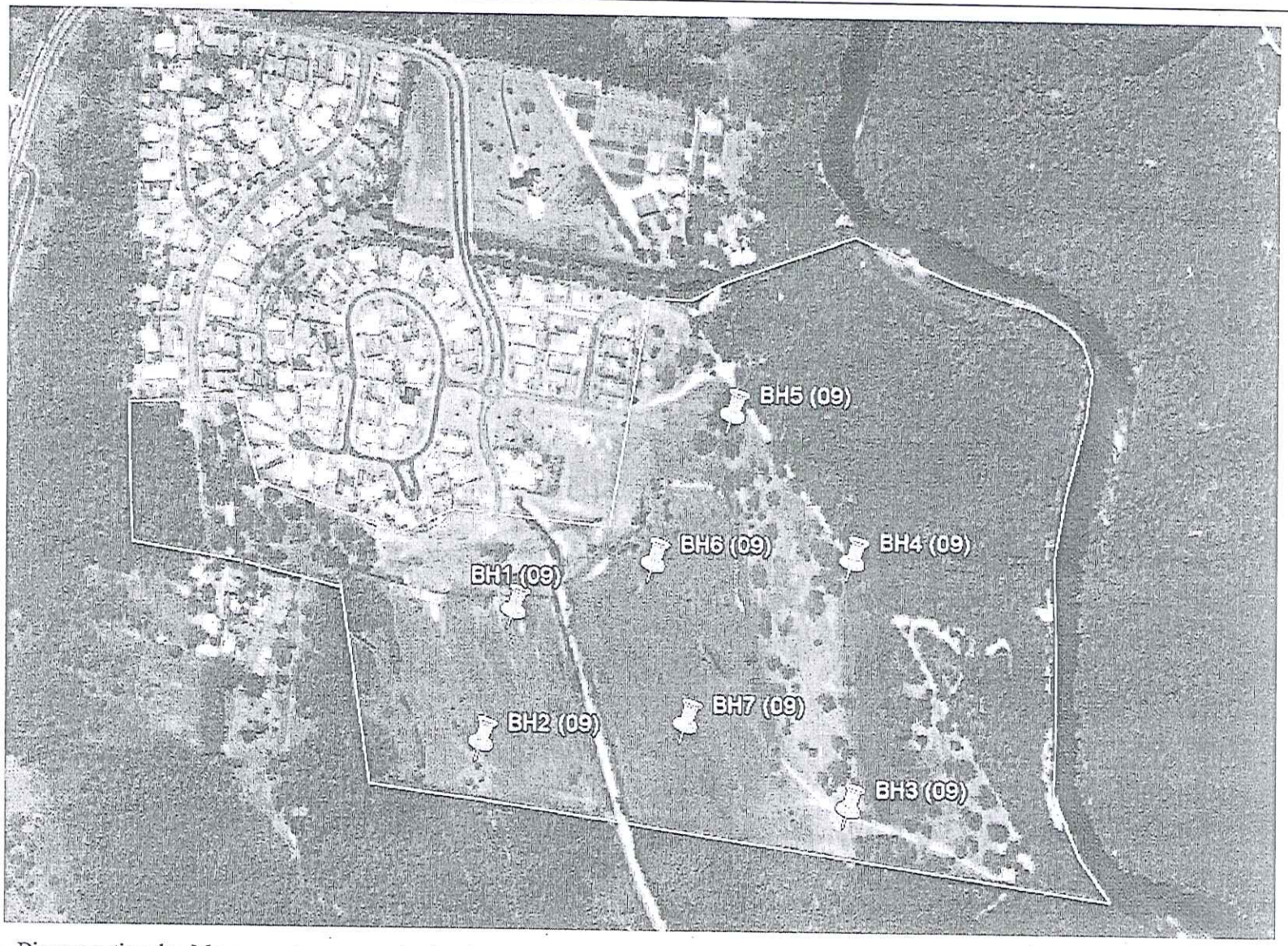
Morand, D.T. (1994). *Soil Landscapes of the Lismore – Ballina 1:100 000 Sheet*. Department of Conservation and Land Management.

Department of Land and Water Conservation (DLWC). (1997). *Acid Sulfate Soil Risk Map (Edition Two) – Huonbrook and Brunswick Heads*. DLWC.

Sullivan L.A. (2008). *Chapter 1: Introduction to Acid Sulfate Soil Material in, Acid Sulfate Soils: Interpretation, Assessment and Management*. Centre for Acid Sulfate Soil Research, Southern Cross University.

APPENDIX 1 – SITE PLANS

2009



Note: Drawing not to scale - Diagrammatic only - Measurements are approximate only

BORDER - TECH

Unit 10 Corporate House, 8 Corporation Circuit
Tweed Heads South NSW 2486

CLIENT: CODLEA PTY LTD

PROJECT: LOT 73 BAYSIDE WAY
BRUNSWICK HEADS, NSW

NORTH

JOB No:
BT 19034-A

SITE PLAN

FIGURE 1. ACID SULFATE SOILS BOREHOLE LOCATIONS (2003)

Client

Codlea Pty Ltd
c/- Martin Findlater & Associates Pty Ltd

Project

Proposed Subdivision at
Bayside Brunswick Estate
Brunswick Heads

Job Number : BT 12582
Figure Number : 1 of 2

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Plan supplied by - Martin Findlater & Associates Pty Ltd

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APPENDIX 2 - BORELOGS

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1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 1 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
FILL	Samples At 0.5m Increments	▼	1.4		(SM) SAND: Fine sand, Trace of CLAY, Moist, Dark grey	MEDIUM DENSE	
ALLUVIUM			2.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 1 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES:

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 2 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Moist, Dark grey	MEDIUM DENSE	
ALLUVIUM	Samples At 0.5m Increments	▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	
			1.4				
ALLUVIUM			2.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 2 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES:

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 3 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
AEOLIAN			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	
AEOLIAN	Samples At 0.5m Increments	▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	
			2.0				

BH 3 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES: Dynamic Cone Penetrometer (DCP) to AS 1289 6.3.2 – 1997.

Logged By	DAW	Date	7/05/09	Checked By		Date	3/5/2009

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 4 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
AEOLIAN	Samples At 0.5m Increments	▼	0.8		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	
			2.0				

BH 4 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES:

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 5 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
AEOLIAN			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	
AEOLIAN	Samples At 0.5m Increments	▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	
ALLUVIUM			1.5		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			2.0				

BH 5 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES:

Logged By DAW Date 7/05/09 Checked By Date 30/5/2009

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BOREHOLE PROFILE

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PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	
ALLUVIUM	Samples At 0.5m Increments	▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	
			1.4				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 6 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES: Dynamic Cone Penetrometer (DCP) to AS 1289 6.3.2 – 1997.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 7 (09)
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-A
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	
ALLUVIUM	Samples At 0.5m Increments	▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	
			1.5				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			2.0				

BH 7 TERMINATED AT 2.0m
LIMIT OF INVESTIGATION

NOTES:

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 1
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
ALLUVIUM			1.1		SAND: Fine grained sand, Moist, Pale grey/brown (SP)	
			2.0		Silty SAND: Fine grained sand, Moist to wet, Dark grey/brown (SM)	
					BH 1 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 2
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
			0.2		Silty SAND: Fine grained sand, Dry to moist, Grey (SM)	
ALLUVIUM			1.6		SAND: Fine grained sand, Moist to very moist, Pale grey/brown (SP)	
			2.0		SAND: Fine grained sand, Very moist to wet, Pale brown (SP)	
					BH 2 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 3
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
			0.2		Silty SAND: Fine grained sand, Dry to moist, Grey (SM)	
ALLUVIUM			1.1		SAND: Fine grained sand, Moist to very moist, Pale grey/brown (SP)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Grey /brown (SM)	
					BH 3 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 4
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
			0.2		Silty SAND: Fine grained sand, Dry to moist, Grey (SM)	
ALLUVIUM			0.9		SAND: Fine grained sand, Moist to very moist, Pale grey/brown (SP)	
			1.7		Silty SAND: Fine grained sand, Moist to wet, Dark grey /brown (SM)	
			2.0		Silty SAND: Fine grained sand, Wet, Brown (SM)	
					BH 4 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 5
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.6		Silty SAND: Fine grained sand, Some organic material (Decomposed vegetable matter), Moist, Dark grey (SM)	
ALLUVIUM			1.0		SAND: Fine grained sand, Trace of silt, Moist, Grey /brown (SP)	
			1.6		Silty SAND: Fine grained sand, Very moist, Grey (SM)	
			2.0		Silty SAND: Fine grained sand, Wet, Grey/brown (SM)	
					BH 5 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 6
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organic material (Decomposed vegetable matter), Moist, Dark grey (SM)	
ALLUVIUM			0.7		SAND: Fine grained sand, Trace of silt, Moist, Grey /brown (SP)	
			2.0		Silty SAND: Fine grained sand, Moist to very moist, Dark grey/brown (SM)	
					BH 6 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 7
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.6		Silty SAND: Fine grained sand, Moist, Dark grey black (SM)	
ALLUVIUM			1.2		Silty SAND: Fine grained sand, Moist, Dark grey (SM)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Grey/brown (SM)	
					BH 7 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 8
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.4		Silty SAND: Fine grained sand, Moist, Grey (SM)	
ALLUVIUM			1.6		SAND: Fine grained sand, Very moist, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Wet, Dark grey/brown (SM)	
					BH 8 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 9
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Moist, Dark grey (SM)	
ALLUVIUM			1.2		SAND: Fine grained sand, Moist, Pale brown (SP)	
			1.6		Silty SAND: Fine grained sand, Very moist, Grey (SM)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Grey/brown (SM)	
					BH 9 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 10
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Moist, Dark grey (SM)	
ALLUVIUM			0.7		SAND: Fine grained sand, Moist, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Grey/brown (SM)	
					BH 10 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 11
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist, Pale grey (SP)	
					BH 11 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD						BOREHOLE No: BH 12
PROJECT: BAYSIDE BRUNSWICK ESTATE						JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200					HOLE DIAMETER: 100mm	
Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist, Pale grey (SP)	
					BH 12 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 13
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
			0.6		SAND: Fine grained sand, Moist to very moist, Pale brown (SP)	
ALLUVIUM					SAND: Fine grained sand, Very moist to wet, Dark grey/brown (SP)	
			2.0		BH 13 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT:	CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No:	BH 14
PROJECT:	BAYSIDE BRUNSWICK ESTATE	JOB No:	BT 12582
EQUIPMENT TYPE:	JACRO 200	HOLE DIAMETER:	100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
ALLUVIUM			0.6		SAND: Fine grained sand, Moist to very moist, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Dark grey/brown (SM)	
					BH 14 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 15
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Moist, Dark grey (SM)	
ALLUVIUM			1.9		SAND: Fine grained sand, Moist, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Moist to wet, Dark grey/brown (SM)	
					BH 15 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 16
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.6		Silty SAND: Fine grained sand, Dry to moist, Grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist to wet, Pale brown (SP)	
					BH 16 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 17
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Moist, Grey (SM)	
ALLUVIUM			1.3		SAND: Fine grained sand, Dry to moist to wet, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Moist to wet, Grey/brown (SM)	
					BH 17 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 18
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Moist, Grey (SM)	
ALLUVIUM			1.2		SAND: Fine grained sand, Moist, Pale brown (SP)	
			2.0		Silty SAND: Fine grained sand, Very moist to wet, Dark Grey/brown (SM)	
					BH 18 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 19
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.6		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist, Pale grey (SP)	
					BH 19 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT:	CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No:	BH 20
PROJECT:	BAYSIDE BRUNSWICK ESTATE	JOB No:	BT 12582
EQUIPMENT TYPE:	JACRO 200	HOLE DIAMETER:	100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist, Pale grey (SP)	
					BH 20 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 21
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.2		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
AEOLIAN			2.0		SAND: Fine grained sand, Dry to moist, Pale grey (SP)	
					BH 21 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT:	CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No:	BH 22
PROJECT:	BAYSIDE BRUNSWICK ESTATE	JOB No:	BT 12582
EQUIPMENT TYPE:	JACRO 200	HOLE DIAMETER:	100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.3		Silty SAND: Fine grained sand, Some organics material (Decomposed vegetable matter), Moist, Dark grey (SM)	
ALLUVIUM			0.7		SAND: Fine grained sand, Dry to moist, Pale brown (SP)	
			1.6		Silty SAND: Fine grained sand, Moist, Grey/brown (SM)	
			2.0		SAND: Fine grained sand, Very moist to wet, Pale brown (SP)	
					BH 22 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD c/- MARTIN FINDLATER & ASSOCIATES PTY LTD	BOREHOLE No: BH 23
PROJECT: BAYSIDE BRUNSWICK ESTATE	JOB No: BT 12582
EQUIPMENT TYPE: JACRO 200	HOLE DIAMETER: 100mm

Geological Profile	Samples	WATER	Depth in m	Graphic Log	Soil or Rock Type, Structure	Consistency/ Rel. Density
TOPSOIL			0.6		Silty SAND: Fine grained sand, Moist, Grey (SM)	
ALLUVIUM			1.1		SAND: Fine grained sand, Moist, Pale grey (SP)	
			1.6		Silty SAND: Fine grained sand, Very moist to wet, Dark grey/brown (SM)	
			2.0		Silty SAND: Fine grained sand (indurated), Moist, Dark grey/brown (SM)	
					BH 23 TERMINATED AT 2.0m LIMIT OF INVESTIGATION	

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APPENDIX 3 – LABORATORY CERTIFICATES

BORDER-TECH

ABN 22 379 074 308

Head Office & Engineering
Suite 10 Corporate House
8 Corporation Circuit
PO Box 6340
Tweed Heads South NSW 2486

telephone: 07 55 246 199
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info@bordertech.com.au
www.bordertech.com.au

Project: Lot 73 Bayside Way, Brunswick Heads **Date:** 7/5/09

Job No: BT 19034-A **Page No:** 1 of 2

SCREENING TEST RESULTS

Sample No.	Bag No.	Soil Description	Reaction to H_2O_2	pH_F	pH_{FOX}
E18754	BH01 0 – 0.5	Sand (SM): Dark grey	Low	4.2	4.9
E18755	BH01 0.5 – 1.0	Sand (SM): Dark grey	Low	4.7	4.9
E18756	BH01 1.0 – 1.5	Sand (SM): Dark grey	Low	4.8	5.2
E18757	BH01 1.5 – 2.0	Sand (SP): Dark grey/brown	Nil	4.9	5.0
E18758	BH02 0 – 0.5	Sand (SP): Pale Grey	Low	5.3	5.0
E18759	BH02 0.5 – 1.0	Sand (SP): Pale Grey	Nil	4.8	5.1
E18760	BH02 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.6	5.0
E18761	BH02 1.5 – 2.0	Sand (SP): Dark grey/brown	Nil	4.6	4.9
E18762	BH03 0 – 0.5	Sand (SP): Dark grey	Low	5.0	5.0
E18763	BH03 0.5 – 1.0	Sand (SP): Pale Grey	Nil	5.5	5.3
E18764	BH03 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.8	5.4
E18765	BH03 1.5 – 2.0	Sand (SP): Pale Grey	Nil	5.4	5.3
E18766	BH04 0 – 0.5	Sand (SP): Pale Grey	Low	5.2	4.7
E18767	BH04 0.5 – 1.0	Sand (SP): Pale Grey	Low	4.6	4.9
E18768	BH04 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.3	3.4
E18769	BH04 1.5 – 2.0	Sand (SP): Pale Grey	Nil	4.1	3.9
E18770	BH05 0 – 0.5	Sand (SP): Dark grey	Nil	4.6	3.5
E18771	BH05 0.5 – 1.0	Sand (SP): Pale Grey	Nil	5.6	5.0
E18772	BH05 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.7	5.3
E18773	BH05 1.5 – 2.0	Sand (SP): Dark grey/brown	Nil	5.1	5.4

Screening Test Methods as per Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1. (Watling, K.M., Ahern, C.R, and Hey, K.M. 2004.)

BORDER-TECH

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Project: Lot 73 Bayside Way, Brunswick Heads **Date:** 7/5/09

Job No: BT 19034-A **Page No:** 2 of 2

SCREENING TEST RESULTS

Sample No.	Bag No.	Soil Description	Reaction to H_2O_2	pH_F	pH_{FOX}
E18774	BH06 0 – 0.5	Sand (SP): Dark grey	Nil	4.7	5.0
E18775	BH06 0.5 – 1.0	Sand (SP): Pale Grey	Nil	5.0	5.2
E18776	BH06 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.3	3.8
E18777	BH06 1.5 – 2.0	Sand (SP): Dark grey/brown	Nil	4.5	4.5
E18778	BH07 0 – 0.5	Sand (SP): Dark grey	Low	4.4	4.2
E18779	BH07 0.5 – 1.0	Sand (SP): Pale Grey	Nil	4.6	4.2
E18780	BH07 1.0 – 1.5	Sand (SP): Pale Grey	Nil	4.2	3.3
E18781	BH07 1.5 – 2.0	Sand (SP): Dark grey/brown	Nil	4.3	3.3

Screening Test Methods as per Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1. (Watling, K.M., Ahern, C.R, and Hey, K.M. 2004.)

BORDER-TECH
Geotechnical Engineering Services

12 GREENWAY DRIVE, SOUTH TWEED HEADS
1/35 OLD PACIFIC HIGHWAY, YATALA

ACID SULFATE SOILS SCREENING TEST RESULTS

pH_F pH_{FOX}

CLIENT: CODLEA PTY LTD C/- MARTIN FINDLATER & ASSOCIATES PTY LTD

JOB No: 12582

PROJECT: BAYSIDE BRUNSWICK ESTATE

Sample #	Location & Depth	Soil Classification	Date Sampled	Reaction to HCl	Reaction to H_2O_2	PH_F 1:05 suspension in 1MNaCl	PH_{FOX} 1:05 suspension in 1MNaCl
49131	BH1 0.5	Silty SAND(SM)Pale brown with grey	17/11/03	Nil	Nil	3.7	3.6
49132	BH1 1.0	SAND(SP)Pale grey/brown	17/11/03	Nil	Nil	3.9	3.6
49133	BH1 1.5	Silty SAND(SM)Dark grey/brown mottle	17/11/03	Nil	Nil	3	2.5
49134	BH1 2.0	Silty SAND(SM)Dark grey/brown mottle	17/11/03	Nil	Nil	3.1	2.6
49135	BH2 0.5	Silty SAND(SM) Pale grey	17/11/03	Nil	Nil	3.7	3.6
49136	BH2 1.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.5	3.3
49137	BH2 1.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.2	3.1
49138	BH2 2.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.6	3.5
49139	BH3 0.5	Silty SAND(SM) Pale grey	17/11/03	Nil	Nil	3.8	3.5
49140	BH3 1.0	SAND(SP) Pale brown	17/11/03	Slight	Nil	3.8	3.4
49141	BH3 1.5	Silty SAND(SM) Grey/brown	17/11/03	Slight	Nil	3.3	2.8
49142	BH3 2.0	Silty SAND(SM) Grey/brown	17/11/03	NIl	Nil	3.5	3.2
49143	BH4 0.5	Silty SAND(SM) Pale grey	17/11/03	NIl	Nil	3.6	3.4
49144	BH4 1.0	SAND(SP) Pale brown	17/11/03	Slight	Nil	3.3	2.9
49145	BH4 1.5	Silty SAND(SM)Dark grey/brown mottle	17/11/03	Nil	Nil	3.6	2.9
49146	BH4 2.0	Silty SAND(SM) Brown	17/11/03	Nil	Nil	3	3.2
49147	BH5 0.5	Silty SAND(SM)Pale brown/grey mottle	17/11/03	Nil	Nil	3.8	2.7
49148	BH5 1.0	SAND(SP) Grey with brown mottle	17/11/03	Nil	Nil	3.4	3.4
49149	BH5 1.5	Silty SAND(SM) Grey	17/11/03	Nil	Nil	3.4	3.1
49150	BH5 2.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.7	3
49151	BH6 0.5	Silty SAND(SM)Pale brown/grey mottle	17/11/03	Nil	Nil	3.6	3.3
49152	BH6 1.0	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	3.8	3.3
49153	BH6 1.5	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	3.8	3.5
49154	BH6 2.0	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	3.5	3.3
49155	BH7 0.5	Silty SAND(SM) Dark grey/black	17/11/03	Nil	Nil	3.1	2.7
49156	BH7 1.0	Silty SAND(SM) Dark grey	17/11/03	Nil	Nil	3.7	3.3
49157	BH7 1.5	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	4	3.6
49158	BH7 2.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.7	3.2
49159	BH8 0.5	Silty SAND(SM) Grey	17/11/03	Nil	Nil	3.4	3.3
49160	BH8 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.5	3.5
49161	BH8 1.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.9	3.7
49162	BH8 2.0	Silty SAND(SM)Dark grey/brown	17/11/03	Nil	Nil	3.8	3
49163	BH9 0.5	Silty SAND(SM) Pale brown	17/11/03	Nil	Nil	3.8	3.7
49164	BH9 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	4.1	3.9
49165	BH9 1.5	Silty SAND(SM) Grey	17/11/03	Nil	Nil	3.7	3.4
49166	BH9 2.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.1	2.8
49167	BH10 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.5	3.2
49168	BH10 1.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.2	3
49169	BH10 1.5	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.3	3
49170	BH10 2.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3	2.7

BORDER-TECH
Geotechnical Engineering Services

12 GREENWAY DRIVE, SOUTH TWEED HEADS
1/35 OLD PACIFIC HIGHWAY, YATALA

ACID SULFATE SOILS SCREENING TEST RESULTS

pH_F pH_{FOX}

CLIENT: CODLEA PTY LTD C/ - MARTIN FINDLATER & ASSOCIATES PTY LTD

JOB No: BT 12582

PROJECT: BAYSIDE BRUNSWICK ESTATE

Sample #	Location & Depth	Soil Classification	Date Sampled	Reaction to HCl	Reaction to H_2O_2	PH_F 1:05 suspension in 1MNaCl	PH_{FOX} 1:05 suspension in 1MNaCl
49171	BH 11 0.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	2.8	2.7
49172	BH 11 1.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.7	3.6
49173	BH 11 1.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.9	3.9
49174	BH 11 2.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.5	3.3
49175	BH 12 0.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	4.2	3.8
49176	BH 12 1.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	4	4.3
49177	BH 12 1.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.8	3.6
49178	BH 12 2.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.6	3.4
49179	BH 13 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	4	4
49180	BH 13 1.0	SAND(SP) Dark grey/brown	17/11/03	Nil	Nil	3.3	3.1
49181	BH 13 1.5	SAND(SP) Dark grey/brown	17/11/03	Nil	Nil	3.5	3.5
49182	BH 13 2.0	SAND(SP) Dark grey/brown	17/11/03	Nil	Nil	3.5	3.4
49183	BH 14 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.8	3.8
49184	BH 14 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.3	3
49185	BH 14 1.5	Silty SAND(SM)Dark grey/brown	17/11/03	Nil	Nil	3.2	2.8
49186	BH 14 2.0	Silty SAND(SM)Dark grey/brown	17/11/03	Nil	Nil	3.3	3.2
49187	BH 15 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.3	3.1
49188	BH 15 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.3	3
49189	BH 15 1.5	SAND(SP) Pale brown	17/11/03	Slight	Nil	3.4	3
49190	BH 15 2.0	Silty SAND(SM)Dark grey/brown	17/11/03	Moderate	Nil	3	3
49191	BH 16 0.5	Silty SAND(SM) Grey	17/11/03	Nil	Nil	3.9	3.8
49192	BH 16 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	4.2	4.1
49193	BH 16 1.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	4.2	4
49194	BH 16 2.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.8	3.8
49195	BH 17 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	4	3.9
49196	BH 17 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.4	3.2
49197	BH 17 1.5	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	2.8	2.5
49198	BH 17 2.0	Silty SAND(SM) Grey/brown	17/11/03	Nil	Nil	3.5	3.4
49199	BH 18 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.8	3.7
49200	BH 18 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3	2.7
49201	BH 18 1.5	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	2.9	2.6
49202	BH 18 2.0	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	2.8	2.6
49203	BH 19 0.5	Silty SAND(SM)Pale brown/grey mottle	17/11/03	Nil	Nil	3.6	3.5
49204	BH 19 1.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.7	3.5
49205	BH 19 1.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.7	3.5
49206	BH 19 2.0	SAND(SP) Pale brown	17/11/03	Nil	Nil	2.8	2.7
49207	BH 20 0.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.5	3.5
49208	BH 20 1.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.7	3.6
49209	BH 20 1.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.7	3.5
49210	BH 20 2.0	SAND(SP) Pale grey	17/11/03	Nil	Slight	3.5	3.5

BORDER-TECH
Geotechnical Engineering Services

12 GREENWAY DRIVE, SOUTH TWEED HEADS
1/35 OLD PACIFIC HIGHWAY, YATALA

ACID SULFATE SOILS SCREENING TEST RESULTS

pH_F pH_{FOX}

CLIENT: CODLEA PTY LTD C/ - MARTIN FINDLATER & ASSOCIATES PTY LTD

JOB No: BT 12582

PROJECT: BAYSIDE BRUNSWICK ESTATE

Sample #	Location & Depth	Soil Classification	Date Sampled	Reaction to HCl	Reaction to H_2O_2	PH_F 1:05 suspension in 1MNaCl	PH_{FOX} 1:05 suspension in 1MNaCl
49211	BH 21 0.5	SAND(SP) Pale grey	17/11/03	Slight	Slight	3.7	3.4
49212	BH 21 1.0	SAND(SP) Pale grey	17/11/03	Slight	Nil	3.7	3.5
49213	BH 21 1.5	SAND(SP) Pale grey	17/11/03	Nil	Nil	4	3.8
49214	BH 21 2.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	3.6	3.5
49215	BH 22 0.5	SAND(SP) Pale brown	17/11/03	Nil	Nil	3.1	2.9
49216	BH 22 1.0	Silty SAND(SM) Grey/brown	17/11/03	Slight	Nil	3	2.8
49217	BH 22 1.5	Silty SAND(SM) Grey/brown	17/11/03	Slight	Nil	3.3	3.1
49218	BH 22 2.0	SAND(SP) Pale brown	17/11/03	Slight	Nil	3.3	3.1
49219	BH 23 0.5	SAND(SP) Pale grey	17/11/03	Nil	Slight	4.1	3.7
49220	BH 23 1.0	SAND(SP) Pale grey	17/11/03	Nil	Nil	4.7	4.2
49221	BH 23 1.5	Silty SAND(SM) Dark grey/brown	17/11/03	Nil	Nil	3.3	3
49222	BH 23 2.0	Silty SAND(SM)Grey/brown,indurated	17/11/03	Nil	Nil	3.5	3.1

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Client: Border Tech
Mazlab Job No: BTT 1886

Project: Lot 73 Bayside Way, Brunswick (BT19034)
Date: 15/05/2009

Certificate of Test Results – Chromium Reducible Sulphur

Sample No.	Client I.D	Soil Description (truncated)	pH KCL	SCr mol H+/t %S	TAA mol H+/t %S	SNAS mol H+/t %S	ANC mol H+/t NA= Scr< action limit	Net Acidity mol H+/t %S	Liming Rate (Kg/ dry t)
22662	BH01 1.00-1.50m	SAND(SP) grey	5.4	<2 <0.01%	2 <0.01%	- -	- -	2	Nil
22663	BH02 1.00-1.50m	SAND(SP) grey	4.9	<2 <0.01%	5 0.01%	- -	- -	5	Nil
22664	BH03 1.50-2.00m	SAND(SP) light grey	6.2	<2 <0.01%	3 <0.01%	- -	- -	3	Nil
22665	BH04 0.50-1.00m	SAND(SP) grey	4.8	<2 <0.01%	5 0.01%	- -	- -	5	Nil
22666	BH05 1.50-2.00m	SAND(SP) light grey	6.1	<2 <0.01%	2 <0.01%	- -	- -	2	Nil
22667	BH06 1.00-1.50m	Indurated SAND(SP) dark brown	4.3	<2 <0.01%	15 0.02%	<2 <0.01%	- -	15	Nil
22668	BH07 1.50-2.00m	Indurated SAND(SP) dark brown	3.9	<2 <0.01%	20 0.03%	<2 <0.01%	- -	20	1.6

SENT
DATE 15/05/09 BY

Checked By: Date:

Laboratory Test Methods follow procedures described in : QASSIT – Acid Sulphate Soils Laboratory Methods Guidelines – Version 2.1 June 2004

Form Number MAZREP03

MAZLAB PTY. LIMITED
A.C.N. 083 815 338
A.B.N. 87 083 815 338

Certificate of Pocas Test Results

Issued: 28/11/03,2:12 PM

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Ref. No. : BTT0975 Project : BT12582, for Border-Tech

Ref. No.	I.D.	Date Sampled /Tested	Description	Reactions to Peroxide & Acid	Exclud. Gravel Shell	Density (t/m3) M/C (%)	Liming Rate (Kg/t) Using TPA	Liming Rate (Kg/t) Using TAA + Spos	pHKCl pHOx	TAA TPA (mol H+/t)	SKCL SP (mol SO4/t)	SPOS (%)
1	BH01 1.50 # 49133	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, dark brown, trace of low pl. fines, wet.	Nil Nil	- -	1.6 e 23.7	0.0	0.0	3.6 7.0	12 0	0 0	0.00
2	BH05 1.50 # 49149	17/11/2003 24/11/2003	Silty SAND (SM), fine to medium grained, grey-brown mottled dark grey, low pl. fines, moist.	Nil Slight	- -	- 19.7	0.0	0.0	4.1 7.3	2 0	0 1	0.00
3	BH07 0.50 # 49155	17/11/2003 24/11/2003	Silty SAND (SM), fine to medium grained, dark grey-brown, low pl. fines, moist.	Slight Nil	- -	- 8.3	0.0	0.0	3.7 6.6	8 0	0 0	0.00
4	BH10 2.00 # 49170	17/11/2003 24/11/2003	Silty SAND (SM), fine to medium grained, dark grey-brown, low pl. fines, moist.	Slight Nil	- -	- 24.1	0.0	0.0	3.7 7.4	7 0	1 1	0.00
5	BH11 0.50 # 49171	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, grey-brown, trace of low pl. fines, just moist.	Nil Nil	- -	- 1.8	0.0	0.0	3.4 4.5	8 16	1 1	0.00
6	BH14 1.50 # 49185	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, dark grey-brown mottled light grey-brown, trace of low pl. fines, wet.	Nil Nil	- -	1.7 e 22.7	0.0	0.0	3.8 7.5	8 0	0 1	0.00
7	BH15 1.00 #49188	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, grey-brown, trace of low pl. fines, moist.	Nil Slight	- -	- 20.4	0.0	0.0	4.1 7.4	1 0	1 1	0.00
8	BH18 2.00 # 49202	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, dark brown-black, trace of low pl. fines, wet.	Nil Nil	- -	1.6 e 25.8	0.0	0.0	3.5 7.6	13 0	1 1	0.00
9	BH21 0.50 # 49211	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, grey-brown, trace of low pl. fines, just moist.	Nil Nil	- -	- 1.5	0.0	0.0	3.4 8.3	7 0	0 0	0.00
10	BH22 1.00 # 49216	17/11/2003 24/11/2003	SAND (SP), fine to medium grained, grey-brown, trace of low pl. fines, moist.	Nil Nil	- -	- 9.2	0.0	0.0	3.7 7.2	6 0	0 0	0.00

e Density value from moisture content, estimated saturation and asumed s.g. of 2.65
v Density value from measured volume.
r Density value from remoulded sample.

Test method follows procedures described in POCAS - Method 21, (Vers. 2.1, 6 Nov 97) Peroxide Oxidation - Combined Acidity & Sulfate (POCAS) Method. [ASS Method 21]
Liming rate is calculated using a supplied combined safety and neutralising factor of 155.0% and combined action levels of 18molH+/t & 0.03% S. (safety factor not applied to negative TAA values)

POCAS Analysis Codes: pHKCl 21A, pHOx 21B, TAA 21F, TPA 21G, SKCL 21Ca, SP 21Da, SPOS 21Ea

APPENDIX 4 – SITE PHOTOS

Figure 2 – Subject Site Facing East in South–West Corner

Figure 3 – Subject Site Facing South from Kingsford Drive

Figure 4 – Subject Site Facing South-East from Kingsford Drive

Figure 5 – Subject Site facing East with the Proposed Environmental Protection Area in the Distance