



**PREPARED FOR
KENMAR FARMS PTY LTD**

ACID SULFATE SOIL ASSESSMENT

LOT 4 in DP 876253
WILLOW AVENUE, BOGANGAR

Ref: BT 19135-A(2)

**BORDER-TECH
SUITE 10, 8 CORPORATE HOUSE
CORPORATION CIRCUIT
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1.0 INTRODUCTION

Border-Tech was commissioned by Kenmar Farms Pty Ltd to undertake an Acid Sulfate Soil (ASS) Assessment at Lot 4 in DP 876253 Willow Avenue, Bogangar. The investigation is required to satisfy section 5.3 of the Director General's Environmental Assessment Requirements dated 6 March 2009. 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.

1.1 Scope of Work

This investigation is limited to the land fronting Willow Avenue subject to the proposed 12 residential lots with an area of approximately 8400m². Written authorisation to proceed was provided on 29 May 2009.

The investigation was conducted in accordance with 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 of acid sulfate soil materials within the site;
- To estimate the net acid generating potential of the soil material and;
- To provide management options and treatment procedures if necessary.



Figure 1 – Approximate Location of Subject Site

2.0 PROJECT DISCUSSION

Border-Tech has received a consultant brief and preliminary conceptual drawings indicating the type of development proposed for the site. From this information it is understood that the project involves the creation of a 13 lot subdivision with residential lot sizes ranging from 569 m^2 – 1065 m^2 and a residue lot (Lot 13) of 11.37 hectares. The subject site (*see Figure 1 above*) is proposed to be divided into the 12 residential lots and has an area of approximately 8400 m^2 . A site map showing the proposed layout is displayed in Appendix 1.

Minor reshaping of the existing topography will be required and is likely to include widening of the existing public road (Willow Avenue) and construction of a footpath and underground services. Bulk earthworks plans are not yet developed, however as a minimum expectation it is anticipated that topsoil would need to be stripped across the wider building envelopes, with additional minor disturbances for slab footings.

3.0 SITE DESCRIPTION

The subject site has an approximate area of 8400 m² located within Lot 4 DP 876253. The site has frontage to Willow Avenue Bogangar, with an existing drainage channel located at the rear of the block. Residential house blocks border the site along the eastern and north-western boundaries.

The site is flat and low lying with an elevation below RL5.0m AHD. Fill material from the adjacent drainage channel was previously placed on the site to a depth of at least 1.5m. A key fish habitat area, as defined by NSW Department of Primary Industries, is located in close proximity to the subject site.

At the time of the site investigation the block was vegetated by mown grass and scattered large eucalypt trees. Site photos are presented as Figures 2 and 3 below.



Figure 2 – View of Subject Site Looking East



Figure 3 – View of Subject Site Looking North

3.1 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 a Pleistocene parabolic dune system. Soils in this area will likely consist of quartz sands.

Based on the borehole drilling, the soils onsite consist of a layer fine-medium dark grey silty sand with a trace of organic material, overlying fine-medium brown-pale grey sand to the termination depth of 2.0m. Fill material from the adjacent drainage canal has been periodically placed on the site since the 1950's, to a total depth of approximately 2.5m.

3.2 Groundwater

Groundwater was not encountered during the investigation. The water table may fluctuate as a result of tidal movement and during periods of high rainfall.

3.3 Acid Sulfate Risk

The Cudgen ASS Risk Map produced by the Department of Land and Water Conservation (DLWC) classifies the site as 'disturbed terrain' which includes filled areas as well as former mines and dredged sites (DLWC 1997).

Tweed Shire Council's planning maps classify the site as Class 3, which requires any development with possible works beyond 1.0m below ground level to conduct an acid sulfate soil investigation.

4.0 SAMPLING AND ANALYSIS

Site evaluation and sampling was undertaken on 10 June 2009 in order to assess the presence of actual and potential acid sulfate soils within the site. This involved sampling at four (4) locations across the site. Borehole locations are displayed on the attached site map (*see Appendix 1*). All Boreholes were extended to a depth of 2.0m below existing surface level using a 4WD drilling rig incorporating spiral flight auguring techniques.

Samples were recovered directly from spiral flight augers at 0.5m depth intervals and sealed in plastic bags with excess air removed. All samples were stored on site below 4°C to prevent oxidation. A total of 16 samples were recovered for field pH and peroxide pH testing, with 8 of these samples selected for laboratory analysis by the Chromium Reducible Sulfur Suite (S_{CR} method 22B).

Screening tests (Field pH and pH oxidation) were conducted by qualified Border-Tech personnel, with laboratory analysis of soil samples by the 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 1 shows a summary of the screening test results with laboratory certificates attached as Appendix 3.

Table 1: Screening Test Results

Test	Range	Ass Range
pH_F	4.3 – 5.1	<4.0 (AASS)
pH_{FOX}	3.5 – 4.1	<3.0 (PASS)
Reaction to H_2O_2	Nil - Low	Mod – Very high

Screening test results indicate that ASS are not present on the subject site. However as screening tests are indicative only, quantitative laboratory testing was required to confirm this.

5.2 Laboratory Testing

A total of 8 samples were selected for laboratory analysis by the Chromium Reducible Sulfur Suite (SCR Method 22B). Selection for laboratory analysis was based on the most positive screening test results, whilst maintaining a representative spread of samples through the soil profile.

Table 2 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:

$$\text{Net Acidity} = S_{CR} + TAA + S_{NAS} - ANC$$

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 2: Acid Base Accounting

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 0.50 – 1.00	4.8	<0.01	<2	20	-	-	20
BH 1 1.50 – 2.00	5.4	<0.01	<2	2	-	-	2
BH 2 0.50 – 1.00	4.8	<0.01	<2	17	-	-	17
BH 2 1.50 – 2.00	4.8	<0.01	<2	12	-	-	12
BH 3 0.00 – 0.50	4.7	<0.01	<2	18	-	-	18
BH3 1.00 – 1.50	4.7	<0.01	<2	10	-	-	10
BH 4 0.50 – 1.00	4.8	<0.01	<2	15	-	-	15
BH 4 1.50 – 2.00	4.9	<0.01	<2	15	-	-	15

The laboratory test results indicate the following:

- The soil onsite has a relatively low initial pH.
- None of the samples submitted for Chromium analysis breached the Oxidisable Sulfur Action Criteria of 0.03%S or had any detectable sulfate.
- One (1) of the samples (BH 1 0.50 – 1.00) breached the Net Acidity Action Criteria of 18 moles H^+ /tonne with a result of 20 moles H^+ /tonne.
- Due to the low initial pH the soil is considered not to have any acid neutralising capacity (ANC).

The soils onsite have been shown to exhibit a relatively low initial pH with no reactivity to peroxide or possess any detectable sulfate, and therefore cannot be considered as ASS. Coastal aeolian soil landscapes (such as the subject site) are known to be relatively acidic, a fact that was reflected in the test results.

One sample did breach the Net Acidity Action Criteria of 18 moles H^+ /tonne based entirely upon its actual acidity. However, given that liming of naturally acidic coastal soil landscapes can be detrimental to the local ecology and excavations onsite will be largely limited to footing and service trenches, neutralisation treatment is therefore not advised.

6.0 CONCLUSION

The results of the investigation suggest that acid sulfate soils are not present at the subject site to a depth of 2.0m below existing surface level. The dark grey - brown sands found across the site did exhibit a relatively low initial pH, however showed little, if any, 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 Sullivan, 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). In *Queensland Acid Sulfate Soil Technical Manual*. Queensland Department of Natural Resources and Mines, Indooroopilly, Queensland, Australia.

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 PLAN



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: KENMAR FARMS PTY LTD

PROJECT: LOT 4 WILLOW AVENUE
BOGANGAR

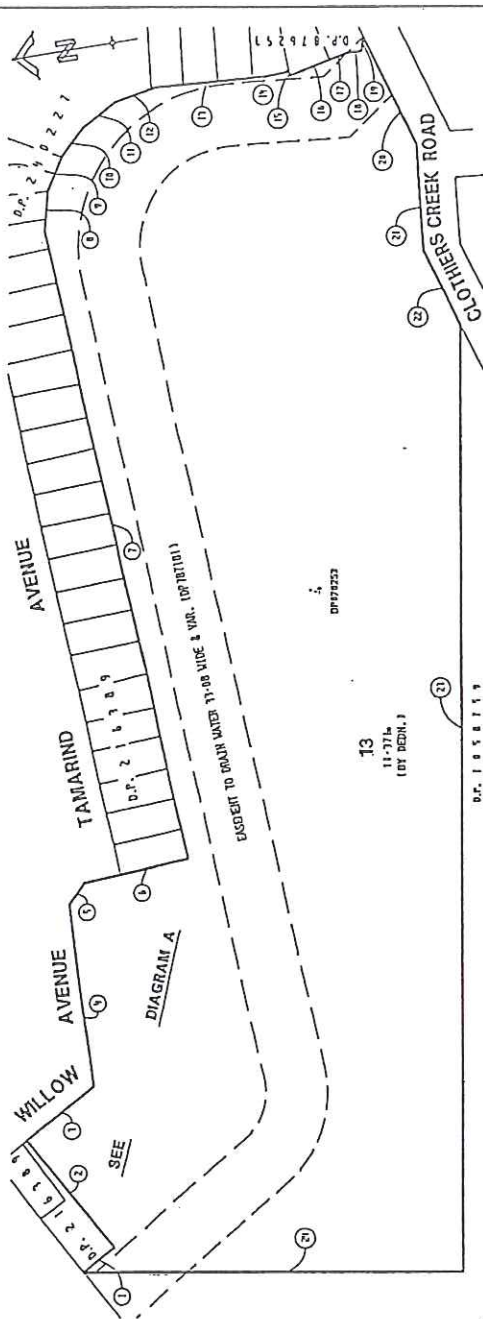


JOB No:
BT 19135-A

SITE PLAN

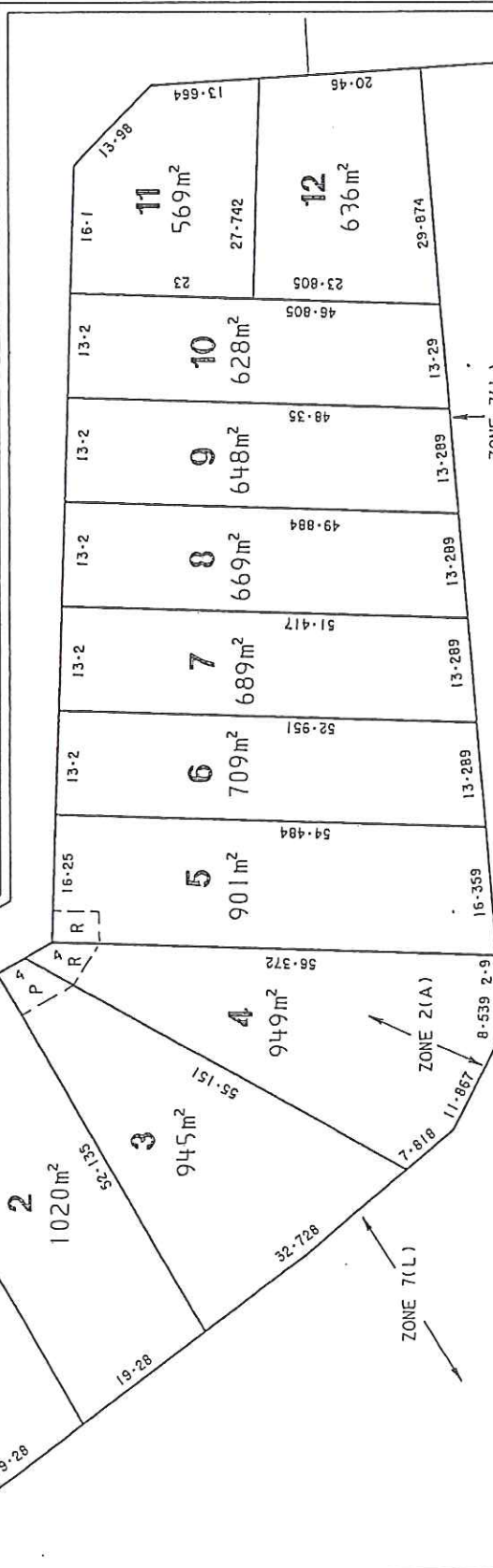
LOCATION PLAN

DIAGRAM A
SCALE 1 : 600



NO	BEARING	DIST.
1	150°01'20"	21.35
2	7°01'20"	7.23
3	150°01'20"	46.23
4	91°47'40"	98.55
5	134°01'40"	13.98
6	176°22'20"	58.2
7	86°22'20"	344.765
8	104°14'10"	21.72
9	122°25'50"	19.645
10	135°28'10"	19.035
11	150°47'10"	21.78
12	169°05'50"	22.57
13	103°39'10"	53.71
14	87°13'40"	2.365
15	168°04'20"	10.42
16	183°48'20"	7.82
17	106°01'00"	7.74
18	252°28'30"	64.115
19	275°28'00"	56.675
20	252°34'40"	44.125
21	279°14'20"	508.24
22	9°14'20"	205.3

NO	BEARING	DIST.	ARC	RADIUS
14	179°12'50"	19.89	19.91	128.975



0 30 m 60 m 90 m 120 m 150 m

PLAN OF PROPOSED SUBDIVISION

Of Lot 4 in DP876253

Willow Avenue - Bogangar

Parish of CUDGEN County of ROUS

J:\14400\14448\Projects\171990.pro

Scale 1 : 600

Level Datum -

F.Bk L.Bk -

Drawn R.W.K. Chk'd

Important Notes:

THE PROPOSED BOUNDARIES, AREAS AND DIMENSIONS AS SHOWN HEREON ARE PRELIMINARY ONLY AND ARE SUBJECT TO FINAL DESIGN, FINAL SURVEY AND REGISTRATION IN THE LANDS TITLE OFFICE.

P DENOTES PROPOSED EASEMENT FOR CARPARKING

R DENOTES PROPOSED RIGHT OF CARRIAGEWAY

(THIS NOTE IS AN INTEGRAL PART OF THIS PLAN)

REGISTERED PROPRIETOR:

KENMAR FARMS PTY LTD

Revision

Chk'd

B & P SURVEYS

CONSULTING SURVEYORS

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Tweed Heads NSW 2485 Australia

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Ref. No. T14448

Date 01/09/2008

Drawing No./Site 17199 D

Rev. -

APPENDIX 2 - BORELOGS

BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES

Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199

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

BOREHOLE PROFILE

CLIENT: KENMAR FARMS PTY LTD						BOREHOLE No: BH 1		
PROJECT: LOT 4 WILLOWVALE AVENUE BOGANGAR						JOB No: BT 19135-A		
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -								
Geological Profile	Samples / Tests	W A T E R	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm	
TOPSOIL			0.3		(SM) Silty SAND: Fine to medium sand, Trace of organic material, Moist, Dark grey			
FILL					(SP) SAND: Fine to medium sand, With SILT, Moist, Brown			
			1.4					
			1.6		(SP) SAND: Fine to medium sand, Moist, Brown and pale grey			
ALLUVIUM			2.0		(SP) SAND: Fine to medium sand, Moist, Brown			
BH 1 TERMINATED AT 2.0m LIMIT OF INVESTIGATION								
NOTES:								
Logged By SH		Date 10/06/09		Checked By 		Date 18/11/09		

BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES

Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199

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

BOREHOLE PROFILE

CLIENT: KENMAR FARMS PTY LTD						BOREHOLE No: BH 2	
PROJECT: LOT 4 WILLOWVALE AVENUE BOGANGAR						JOB No: BT 19135-A	
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -							
Geological Profile	Samples / Tests	W A T E R	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
TOPSOIL			0.2		(SM) Silty SAND: Fine to medium sand, Trace of CLAY, Trace of organic material, Moist, Dark grey		
FILL				(SP) SAND: Fine to medium sand, With SILT, Moist, Brown			
			1.2		(SP) SAND: Fine to medium sand, Moist, Grey/brown		
			1.8		(SP) SAND: Fine to medium sand, Moist becoming wet, Grey/brown		
			2.0				
BH 2 TERMINATED AT 2.0m LIMIT OF INVESTIGATION							
NOTES:							
Logged By SH		Date 10/06/09		Checked By 		Date 18/11/09	

BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES

Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199

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

BOREHOLE PROFILE

CLIENT: KENMAR FARMS PTY LTD						BOREHOLE No: BH 3	
PROJECT: LOT 4 WILLOWVALE AVENUE BOGANGAR						JOB No: BT 19135-A	
EQUIPMENT TYPE: MAIDTECH 500						HOLE DIAMETER: 110mm	
APPROXIMATE SL (m): -							
Geological Profile	Samples / Tests	W A T E R	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
TOPSOIL			0.2		(SM) Silty SAND: Fine to medium sand, Moist, Dark grey/brown		
FILL			1.1		(SP) SAND: Fine to medium sand, With SILT, Moist, Dark brown and pale grey		
					(SP) SAND: Fine to medium sand, Moist, Brown		
			1.8				
			2.0		(SP) SAND: Fine to medium sand, Trace of CLAY, Moist becoming wet, Grey		
BH 3 TERMINATED AT 2.0m LIMIT OF INVESTIGATION							
NOTES:							
Logged By SH Date 10/06/09				Checked By  Date 18/18/09			

BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES

Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199

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

BOREHOLE PROFILE

CLIENT: KENMAR FARMS PTY LTD						BOREHOLE No: BH 4	
PROJECT: LOT 4 WILLOWVALE AVENUE BOGANGAR						JOB No: BT 19135-A	
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -							
Geological Profile	Samples / Tests	W A T E R	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
TOPSOIL			0.2		(SM) Silty SAND: Fine to medium sand, Moist, Dark grey/brown		
FILL				(SP) SAND: Fine to medium sand, With SILT, Moist, Pale brown and grey/brown			
			0.8		(SP) SAND: Fine to medium sand, With SILT, Moist, Brown		
			2.0				
BH 4 TERMINATED AT 2.0m LIMIT OF INVESTIGATION							
NOTES:							
Logged By SH Date 10/06/09				Checked By  Date 18/11/09			

APPENDIX 3 – LABORATORY CERTIFICATES

Project: Willow Avenue, Bogangar
Job No: BT 19135-A

Date: 10/6/09
Page No: 1 of 1

SCREENING TEST RESULTS

Sample No.	Bag No.	Soil Description	Reaction to H ₂ O ₂	pH _F	pH _{FOX}
E18782	BH01 0 – 0.5	Silty Sand (SM): Dark grey, Trace of organic material	Nil	4.9	4.1
E18783	BH01 0.5 – 1.0	Sand (SP): brown	Nil	4.3	3.9
E18784	BH01 1.0 – 1.5	Sand (SP): brown	Nil	4.4	3.9
E18785	BH01 1.5 – 2.0	Sand (SP): brown	Nil	4.7	4.1
E18786	BH02 0 – 0.5	Silty Sand (SM): Dark grey, Trace of organic material	Nil	5.1	4.0
E18787	BH02 0.5 – 1.0	Sand (SP): brown	Low	4.7	3.1
E18788	BH02 1.0 – 1.5	Sand (SP): Grey-brown	Nil	4.7	3.9
E18789	BH02 1.5 – 2.0	Sand (SP): Grey-brown	Nil	4.6	4.1
E18790	BH03 0 – 0.5	Sand (SP): Dark brown and pale grey	Low	5.4	4.0
E18791	BH03 0.5 – 1.0	Sand (SP): Dark brown and pale grey	Nil	4.6	3.7
E18792	BH03 1.0 – 1.5	Sand (SP): Brown	Nil	4.6	4.1
E18793	BH03 1.5 – 2.0	Sand (SP): Grey, trace of CLAY	Nil	4.5	3.5
E18794	BH04 0 – 0.5	Sand (SP): Pale brown and grey/brown	Low	5.1	3.9
E18795	BH04 0.5 – 1.0	Sand (SP): Pale brown and grey/brown with SILT	Nil	4.6	3.9
E18796	BH04 1.0 – 1.5	Sand (SP): Brown with SILT	Nil	4.5	4.0
E18797	BH04 1.5 – 2.0	Sand (SP): Brown with SILT	Nil	4.5	4.1

*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.)*

Client: Border Tech
Mazlab Job No: BTT 1902

Project: Willow Ave, Bogangar (BT19135-A)
Date: 16/06/2009

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 m ⁺ /t NA= Ser< action limit	Net Acidity mol H ⁺ /t %S	Liming Rate kg/dry.t
22889	BH01 0.50-1.00m	SAND(SP) brown, traces of light yellow-brown	4.8	<2 <0.01%	20 0.03%	-	-	20	1.6
22890	BH01 1.50-2.00m	SAND(SP) light grey	5.4	<2 <0.01%	2 <0.01%	-	-	2	Nil
22891	BH02 0.50-1.00m	SAND(SP) brown-dark brown	4.8	<2 <0.01%	17 0.03%	-	-	17	Nil
22892	BH02 1.50-2.00m	SAND(SP) grey-brown	4.8	<2 <0.01%	12 0.02%	-	-	12	Nil
22893	BH03 0.00-0.50m	SAND(SP) brown	4.7	<2 <0.01%	18 0.03%	-	-	18	1.4
22894	BH03 1.00-1.50m	SAND(SP) brown-light brown	4.7	<2 <0.01%	10 0.02%	-	-	10	Nil
22895	BH04 0.50-1.00m	SAND(SP) brown, traces of light brown	4.8	<2 <0.01%	15 0.02%	-	-	15	Nil
22896	BH04 1.50-2.00m	SAND(SP) brown, traces of light brown	4.9	<2 <0.01%	15 0.02%	-	-	15	Nil

S E N T	
DATE 16/6/09	BY <i>[Signature]</i>

Checked By:

Date:

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

Form Number MAZRP106