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SPECIALISTS MANAGING THE EARTH

PRELIMINARY GEOTECHNICAL AND ACID SULFATE SOIL ASSESSMENT

Lot 112 DP1073791, Lyons Road, Sawtell NSW

Utila Pty Ltd

GEOTCOFH02467AA-AC
24 February 2009

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
1/18 Hurley Drive Coffs Harbour NSW 2450 Australia

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SPECIALISTS MANAGING THE EARTH

24 February 2009

Utila Pty Ltd
c/o Geoff Slattery &
Partners Pty Ltd
PO Box K198
Haymarket NSW 1240

Attention: Geoff Slattery

Dear Geoff

RE: Preliminary Geotechnical and Acid Sulfate Soil Assessment for Urban Development at Lot 112 DP1073791, Lyons Road, Sawtell NSW

Coffey Geotechnics Pty Ltd is pleased to present our Preliminary Geotechnical and Acid Sulfate Soils Assessment prepared for the proposed residential subdivision development located on Lot 112 DP1073791, Lyons Road, Sawtell NSW.

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

I trust that this report meets with your requirements. If you require further information please contact the undersigned in our Coffs Harbour office on (02) 6651 3213.

For and on behalf of Coffey Geotechnics Pty Ltd

Matt Rowbotham

Senior Engineering Geologist

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EXECUTIVE SUMMARY

Coffey Geotechnics Pty Ltd (Coffey) was engaged by Utila Pty Ltd to undertake a Preliminary Geotechnical and Acid Sulfate Soil Assessment at Lot 112 DP1073791, Lyons Road, Sawtell NSW. The purpose of the assessment was to identify the potential geotechnical issues and investigate the presence of Acid Sulfate Soils (ASS).

Lot 112 is 38.78 Ha in area of which about 25 Ha has been cleared and is currently used for cattle grazing. The remaining land is dense bush land and was not included in this investigation.

Coffey Geotechnics understands that the findings in this investigation will assist in the preparation of a development application to be lodged with the NSW Department of Planning.

In brief, the geotechnical assessment identified the southern portion of the site as having an increased risk of slope instability based primarily on the steeper surface slopes in this area. Proposed developments in these steeper areas are more likely to be suited to split level house construction or pole house construction. It is recommended that these areas be further assessed by an intrusive investigation prior to the commencement of construction.

The hillslope areas of the subject site are underlain by silty clay soils and the low lying watercourse areas are underlain by silty clay/clayey silt soils with relatively high silt contents. These low lying areas with high silt contents can be problematic for compaction equipment during placement and compaction of fill materials. As such it is recommended that developments in these areas be managed by experienced engineers and earthworks contractors. Further to the above the site soils are assessed to be non dispersive.

During our investigation a portion of land on the western boundary was being excavated for select fill and replaced with imported fill. Coffey does not know if the fill placed in the excavation has been placed under Level 1 conditions in accordance with AS3798-2007. Should the fill in the area not have been placed under Level 1 conditions, then the fill would not be suitable for support of structural loads.

For the assessment of acid sulfate soils, the soil is considered to be predominately an acidic soil, with PASS in the south-west corner of the site. It is recommended that if soils are to be removed from the low lying area in the south-west of the site (where PASS was encountered) that the upper 0.5m of soils be stripped, stockpiled and treated with lime to increase the pH.

Notwithstanding the above, the site is considered suitable for residential development purposes. Coffey recommends that a more detailed geotechnical investigation be undertaken of the site prior to construction. This investigation would be aimed at further assessing the site and in particular the steeper slopes in the southern portion of the site.

1 INTRODUCTION

1.1 Background

The site, Lot 112, is part of the proposed residential subdivision and is located off Lyons Road, Sawtell NSW. Lot 112 is 38.78 Ha in area of which about 25 Ha has been cleared and is currently used for cattle grazing. The remaining land is dense bush land and was not included in this investigation.

It is understood that the works carried out in this investigation will assist in the preparation of a development application to be lodged with the NSW Department of Planning. Included as part of the Director General's assessment requirements for the project are the following:

6.1 *Contamination*, Identify any contamination on site and appropriate mitigation measures in accordance with the provisions of *SEPP 55 – Remediation of Land;*

6.2 *Acid Sulfate Soils (ASS)* , Identify the presence and extent of acid sulfate soils on the site and, where relevant, appropriate mitigation measures;

6.4 *Geotechnical*, Provide an assessment of any geotechnical limitations that may occur on the site and if necessary, appropriate design considerations that address these limitations.

This report discusses the geotechnical issues for the site and discusses the results of an ASS assessment. The results of the contamination investigation are provided under a separate cover report. Reference for the contamination report is GEOTCOFH02467AA-AB.

1.2 Investigation Objectives

1.2.1 Preliminary Geotechnical Investigation

The objectives of the geotechnical assessment were to broadly identify specific site features and site constraints which may affect the design and planning for the development. In particular our objectives were to:

- Identify areas of steep slopes and potential instability,
- Provide a preliminary assessment of likely foundation conditions,
- Provide an assessment of areas of erosion potential and areas affected by poor drainage.

1.2.2 Acid Sulfate Soil (ASS) Investigation

The objective of the ASS Investigation was to assess the presence or absence of ASS for those cleared areas of Lot 112 located below 5m AHD contour.

2 SITE DESCRIPTION

The site (Lot 112) is located south of Lyons Road, Sawtell NSW. The subject site area is typified by gently to moderately sloping hills and creek beds that drain towards the lower lying estuarine creek system of Bonville Creek. Topographically, the site is situated in an area of undulating topography and is located on the crest and slopes of a low ridge line which generally trends in a southeast-northwest direction. Within the site four distinct water courses were observed which drain water from the site. Two broad concave watercourses were located to the north and northeast of the ridge which directed drainage towards the southeast and north respectively. Two smaller watercourses were also located to the southwest and southeast of the ridge, these watercourses directed drainage towards the southwest and east of the site respectively. The low lying areas at the base of the two larger gullies had saturated soils and reedy vegetation. A dam was located in the northeast area of the site which received flow from the two larger watercourses.

At the time of the investigation there were no existing buildings or structures located onsite. A cattle stockyard was located on the central western boundary of the site. During the site walkover several small piles of fill were observed in the northern portion of the site to the west of the dams.

The site is bounded by cleared land and residential allotments to the north, bushland to the west and south and paperbark tree forest to the east and south west of the site. Lyons Road was located approximately 180m north of the site, parallel to the northern boundary.

Vegetation observed during the investigation predominantly comprised medium length grass cover with scattered trees bordering the banks of the small creeks and semi dense paperbark forest around the dams.

During the site walkover scattered large trees and stumps were observed together with large depressions where tree stumps had likely been removed.

Some minor gully erosion was observed at the head of the watercourses in the southwest of the site and in the large watercourse in the central portion of the site.

No obvious visual evidence of past land instability was observed during the site walkover assessment.

At the time of fieldwork on the 7th and 8th January 2009 some earthworks activity was being undertaken adjacent to the central western boundary of the site, see Photo 1 below. The upper topsoil layer had been stripped and was stockpiled to the west and east of the earthworks area. Within the stripped area, the natural insitu residual soils were being excavated for use as select fill for the adjacent development to the north, the depths of excavation extended up 3m below the natural surface level. The unsuitable materials from the adjacent development (to the north) were being used to backfill the excavation (see Photo 1 below). Generally these backfill materials were assessed to comprise medium plasticity silty clay.

Photo 1 – Earthworks undertaken in the central western section of the site, the view is towards the south west.

3 SCOPE OF WORK

3.1 Geotechnical

For the preliminary investigation, our scope of work involved:

- Interpretation of geological mapping and aerial photography to identify areas of potential geotechnical hazards;
- A site walkover carried out by an Engineering Geologist to observe site conditions to enable assessment of geotechnical hazards and other relevant issues related to the site. The site walkover assessment included site observations, mapping of surface features and collation of observed information relevant to the geotechnical issues on site. The walkover assessment did not require extension beyond the property boundaries;
- Sampling of site soils was undertaken in conjunction with our Phase 1 Environmental Investigation "Report Reference GEOTCOFH02467AA-AB". During the investigation 28 locations were sampled which included 10 hand auger boreholes (drilled up to 2m depth) and 18 shallow hand augers (drilled up to 0.5m depth). The sampling locations are indicated on Figure 1.
- Laboratory testing comprising:
    - Six (6) Atterberg Limits and
    - Ten (10) Emerson Crumb Dispersion tests.

3.2 Acid Sulfate Soil

The ASSMAC Manual requires a minimum sampling density of 2 borehole locations per hectare for sites which are larger than 4 Ha where extensive development is proposed. On Lot 112, land which is cleared and located below 5m AHD occupies an area of approximately 5 Ha. Based on the above assumption, 10 boreholes were drilled to depths of up to 2.0m or prior refusal. Soil samples were taken at about 0.5m intervals, sealed in plastic bags and kept on ice during fieldwork and transport to an independent laboratory. Soil samples were screened for the presence of ASS and further tested using the Chromium Reducible Sulphur (CRS) method. Results of the ASS assessment are included the later sections of this report.

3.3 Geology

The 1:250,000 Geological Map of Dorrigo-Coffs Harbour indicates the site to be underlain by both Quaternary Alluvium and the Brooklana Formation. Quaternary alluvium generally comprises, clay, silt sand and gravel and the Brooklana formation comprises silicious mudstone and siltstone rocktypes. Generally the low lying areas are underlain by Quaternary Alluvium which in turn are underlain by the Brooklana Formation. The soils on the hillslopes and ridgelines comprise clay soils which grade to rocktypes of the Brooklana Formation.

3.4 Geotechnical Terrain Units

Based on surface and subsurface conditions encountered during the investigation the site can be broadly separated into two geotechnical terrain units; the low-lying watercourse areas, and the elevated hillslopes.

The subsurface conditions within the watercourses can generally be described as follows:

- **Topsoil:** Silty Clay, medium plasticity, dark grey/brown some fine roots/organics to about 0.2m depth, overlying;
- **Alluvial/Colluvial Soil :** Silty Clay, medium to high plasticity, firm, dark grey to pale grey/grey, traces of gravel fine to medium, subrounded up to 1.5m deep, overlying,
- **Residual:** Silty Clay, medium to high plasticity, grey mottled dark orange/ dark yellow/ pale brown/ white, some gravel fine to medium grained (quart and silicious mudstone) to beyond the depth of investigation.

The subsurface conditions within hillslopes can generally be described as follows:

- **Topsoil:** Silty Clay, medium plasticity, dark grey/brown some fine roots/organics to about 0.2m depth, overlying;
- **Residual:** Silty Clay, medium to high plasticity, grey mottled orange/yellow to beyond the depth of investigation.

3.5 Groundwater

Groundwater was observed at the ground surface within the low lying watercourses in the north of the site and was also observed to be seeping from the hillslopes (springs/soaks) and discharging to the watercourse in the southwest of the site. It should be noted that groundwater levels and seepage rates are likely to fluctuate during periods of increased rainfall.

4 LAB TESTING

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

- Six (6) Atterberg limits and linear shrinkage tests to assist in soil classifications;
- Ten (10) Emerson Crumb Dispersion tests.

The results of the laboratory testing are summarised in Table 1 and Table 2. Laboratory test result sheets are presented in Appendix A.

Table 1: Results From Atterberg Limits Testing

Test Location	Sample Depth (m)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
C10	0.15-0.5	40	23	17	10
G2	0.15-0.5	29	19	10	7.5
G6	0.15-0.5	32	21	11	6.5
HA1	0.5-2.0	49	26	23	11
HA5	1.2-1.5	33	15	18	10.5
HA6	0.2-1.0	27	13	14	7.5

Based on the above Atterberg limits results the soils tested range from low to medium plasticity clays and some silts.

Table 2: Results From Emerson Class Testing

Test Location	Sample Depth (m)	Emerson Class Number
C5.5	0.15-0.5	5
C10	0.15-0.5	5
G2	0.15-0.5	4
G6	0.15-0.5	4
E8	0.15-0.5	4
HA1	0.5-2.0	4
HA3	0.5-1.0	4
HA3	1.0-2.0	4
HA5	1.2-1.5	4
HA6	0.2-1.0	4

Based on the above Emerson Crumb tests the soils tested are classified as non dispersive.

5 PRELIMINARY GEOTECHNICAL ASSESSMENT – CONSIDERATION FOR DESIGN AND CONSTRUCTION

Based on the findings of our site investigation, Figure 2 indicates the geomorphological features.

5.1 Construction on Hillslopes

The walkover assessment has indicated that a small portion of the site comprises moderately sloping ground (10º to 15º). Whilst no obvious visible evidence of past instability has been noted during the assessment it is possible that slope instability could occur from construction works or modifications to surface slopes. As such it is important that these sites be further investigated for evidence of possible instability. As a guide, sites which are likely to require assessment for slope instability are those with surface slopes **greater than 10º**. Areas of the site with slopes exceeding 10 degrees are generally confined to the southern portion of the site adjacent to the creek lines and are indicated in Figure 3. These areas of steeper slopes are more likely to be suited to split level residential construction, pole house construction or other similar mode of construction that limits slope modifications.

Construction on gently sloping ground (**say less than 10º**) is likely to be less critical in terms of slope instability and is considered to be at lower risk of potential instability. These areas of the site are more likely to be suited to single level slab on ground construction or split level residential construction. The areas of gently sloping ground (<10º slopes) extend across the central and northern portions of the site.

It is recommended that intrusive investigations (such as test pitting) be undertaken over the site to further assess the subsurface conditions and the potential for slope instability.

5.2 Construction in Low lying Areas

Based on our investigations within the watercourses areas, the subsurface conditions are likely to comprise firm alluvial clay and silty soils overlying stiffer alluvial clay and residual clay soils. For construction in these areas, consideration may need to be given to the shallow groundwater table, soils with inadequate bearing pressures and the presence of soils with high silt contents which can be problematic for fill placement and compaction. Construction in these areas may require dewatering, excavation and replacement with controlled Level 1 fill or piled foundations to suitable founding strata below and uncontrolled fill or unsuitable natural materials.

Construction in these low lying areas is likely to be governed by set back distances provided by flood studies. Should structures be required in these low lying areas then further investigation is recommended. A plan of the site (Figure 4) has been produced which indicates the locations and extent of the low lying areas.

5.3 Preliminary Assessment of Foundation Parameters

For shallow footings founded in stiff clay materials (i.e. as encountered on the hillslopes) an allowable bearing pressure of 100kPa may be adopted for design purposes.

5.4 Presence of Fill

At the time of the investigation a portion of land on the western boundary the site (about 80m by 80m) was stripped of topsoil and was being excavated for use as select fill in an adjacent development to the north. At the same time the excavation was being backfilled with material which was considered unsuitable for the purposes of the northern development. Coffey has not observed the quality of the fill that has been placed in the excavation and does not know if the fill has been placed under Level 1 supervision in accordance with AS3798-2007. Should the fill in the area not have been placed under Level 1 conditions then the fill will not be considered suitable for support for structural footings. As such, should the land be included as potential land to develop, then the fill will need to be removed and replaced and compacted with approved fill under Level 1 conditions, or all structures in that part of the site will require piering through the fill to suitable natural ground.

5.5 Soaks and Springs

Several areas of seepage were observed within the watercourse catchment in the southwest of the site. Due to the likely wet subsurface conditions associated with such seepage consideration needs to be given to further assessing the subsurface conditions in this area prior to development. Associated with these seepage zones were gully erosion features which have developed downslope of the seepage points. To limit the effects of erosion in these areas, it is likely that permanent drainage structures such as gravel drains will be required which manage the water flow and prevent further erosion.

5.6 Erosion Potential

The soils tested are classified as non-dispersive, however it should be recognised that no soils are completely resistant to erosion and as such appropriate erosion protection measures should be adopted during design and construction of the development.

5.7 Grubbing and Backfilling of Tree Stump Holes

During the site walk over several large tree stumps were observed and potholes and disturbed areas were observed where previous large tree stumps had been removed. Coffey recommends that any such areas be grubbed out to remove materials which have not formed insitu, (i.e. any disturbed areas from the removal of the tree stumps should be over excavated and spoiled). The excavations should then be backfilled with approved fill under Level 1 supervision in accordance with AS3798-2007.

6 GEOTECHNICAL ASSESSMENT - CONCLUSIONS AND RECOMMENDATIONS

Based on the information collected during the preliminary investigation and the results of the laboratory testing it is considered that the site is suitable for residential development. Coffey recommends that a more detailed investigation be undertaken of the site prior to construction. This investigation would be aimed at further assessing the site and in particular the steeper slopes in the southern portion of the site.

7 ACID SULFATE SOILS

Acid Sulfate Soils (ASS) are soils containing 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, and 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 rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period (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 (greater than 10,000 years ago) would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen.

7.1 Significance of ASS

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 less than 4) and produce acid 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 some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off-site into aquatic ecosystems can have a detrimental effect on these ecosystems.

7.2 Mapped Occurrences of Acid Sulfate Soils

The 1:250,000 Geological Map of Dorrigo-Coffs Harbour indicates the site to be underlain by Quaternary Alluvium generally comprising sand, gravel, silt and clay overlying the Brooklana Formation.

The Acid Sulfate Soils Risk Map (Reference 3) of Coffs Harbour indicates that the east and north east sections of the site is located on an area of low probability of acid sulfate soils between 1m and 3m below ground surface.

7.3 Laboratory Testing

Samples collected during fieldwork were placed in sealed plastic bags and stored in chilled insulated containers during transit to cold storage at Coffey's Coffs Harbour laboratory.

Samples obtained for the acid sulfate assessment were sent to an external NATA registered laboratory and screened for the presence of 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 (Reference 1). The results of the acid sulfate soil screening tests are summarised in Table 3.

Table 3: Summary of Acid Sulfate Soil Screening Tests

Borehole	Depth (m)	pH in Water	pH after Immersion in H_2O_2	pH Change
HA1	0.5	4.3	**2.9**	- 1.4
HA1	1.5	4.4	3.2	- 1.2
HA3	0	4.7	**2.1**	- 2.6
HA3	0.5	4.9	**2.2**	- 2.7
HA3	1.0	4.5	**2.4**	- 2.1
HA3	1.5	4.3	**2.3**	- 2.0
HA3	2.0	4.4	**2.6**	- 1.8
HA4	2.0	4.9	**2.5**	- 2.4
HA5	0.5	4.9	**2.4**	- 2.5
HA5	1.0	4.6	**2.3**	- 2.3
HA6	0	5.3	**2.7**	- 2.6
HA6	0.5	4.8	**2.6**	- 2.2
HA6	1.0	4.4	**2.9**	- 1.5
HA7	0.5	4.7	**2.5**	- 2.2
HA8	0.4	5.0	**2.3**	- 2.7
HA8	1.0	4.5	**2.6**	- 1.9
HA8	1.5	4.6	3.3	- 1.3
HA9	0.5	4.4	**2.4**	- 2.0
HA10	0.5	4.0	**2.1**	- 1.9
HA10	1.0	**3.7**	**1.9**	- 1.8

The following points are noted from Table 3:

1. Soil in water produced a pH<4 for one of the samples tested. Soil:water pH<4 in this test is generally an indication of actual acid sulfate soil;
2. Oxidation with hydrogen peroxide produced a pH<3 in eighteen of the samples tested. Soil:peroxide pH<3 in this test is generally an indication of potential acid sulfate soil;
3. The total pH change from distilled water to peroxide ranged between 1.3 and 2.7 pH units. A pH change of > 1 pH Units can indicate PASS; and
4. Reaction rates in peroxide were low to moderate, with high and very high reaction rates recorded in 10 of the 40 samples. The effervescence and release of gases can be an indicator of PASS;

The screening results therefore indicated the soils sampled and screened contained PASS and some actual ASS. Based on these results twenty samples were selected to be retested to further define ASS conditions present in the soils (HA1 – HA10).

7.4 Quantitative Laboratory Testing

Quantitative laboratory testing was undertaken using the Chromium Reducible Sulphur (CRS) Suite method at the Biotrack analytical laboratory. The laboratory results for TAA, CRS and %SKCl are compared to action criteria presented in Reference 1 in Table 4 below. The laboratory results sheets are present in Appendix B. The analytical results are summarised in Table 4.

Table 4 – Summary of CRS Analytical Results

Sample	Grainsize	pH KCl	Acid Trail (mol H^+/tonne)		Sulfur Trail (% S reducible)			Liming Rate (kg $CaCO_3/m^3$)
			TAA	Action Criteria	Scr	SEQ	Action Criteria	
HA1: 0.5m	Fine	3.81	47	< 0.01	< 0.01	0.085	0.1	3
HA1: 1.5m	Fine	3.78	15	< 0.01	< 0.01	0.029	0.1	1
HA3: 0m	Fine	4.10	73	< 0.01	< 0.01	0.132	0.1	4
HA3: 0.5m	Fine	4.04	45	< 0.01	< 0.01	0.079	0.1	3
HA3: 1.0m	Fine	4.10	24	< 0.01	< 0.01	0.041	0.1	1
HA3: 1.5m	Fine	3.95	29	< 0.01	< 0.01	0.052	0.1	2
HA3: 2.0m	Fine	4.04	16	< 0.01	< 0.01	0.028	0.1	1
HA4: 2.0m	Fine	3.90	16	< 0.01	< 0.01	0.029	0.1	1

Sample	Grainsize	pH KCl	Acid Trail (mol H^+/tonne)		Sulfur Trail (% S reducible)			Liming Rate (kg $CaCO_3/m^3$)
			TAA	Action Criteria	Scr	SEQ	Action Criteria	
HA5: 0.5m	Fine	4.07	35	< 0.01	< 0.01	0.061	0.1	2
HA5: 1.0m	Fine	4.07	24	< 0.01	< 0.01	0.044	0.1	1
HA6: 0m	Fine	4.25	38	< 0.01	< 0.01	0.069	0.1	2
HA6: 0.5m	Fine	3.85	53	< 0.01	< 0.01	0.090	0.1	3
HA6: 1.0m	Fine	3.89	32	< 0.01	< 0.01	0.056	0.1	2
HA7: 0.5m	Fine	4.48	18	< 0.01	< 0.01	0.034	0.1	1
HA8: 0.4m	Fine	3.89	42	< 0.01	< 0.01	0.076	0.1	2
HA8: 1.0m	Fine	3.77	29	< 0.01	< 0.01	0.052	0.1	2
HA8: 1.5m	Fine	3.74	22	< 0.01	< 0.01	0.040	0.1	1
HA9: 0.5m	Fine	4.04	26	< 0.01	< 0.01	0.044	0.1	1
HA10: 0.5m	Fine	4.45	**78**	< 0.01	**0.12**	0.281	0.1	9
HA10: 1.0m	Fine	3.78	**67**	< 0.01	< 0.01	0.121	0.1	4

In order to assess the significance of the ASS potential, the laboratory results were compared to action criteria in the Acid Sulfate Soil Manual *(*Reference 1).

The action criteria presented in the manual trigger the need to prepare an Acid Sulfate Soil Management Plan and obtain development consent. The action criteria are based on oxidisable sulfur concentrations for three differing soil textures. In this case, soils are in the fine grained category. The manual provides different action levels depending on the amount of ASS that is to be disturbed. For this case, the action levels are based on an oxidisable sulfur level of 0.1% or an acidity of 62 moles per tonne.

Three soil samples tested recorded TAA concentrations exceeding the adopted action criteria. This indicates actual acidity. The extractable sulfur results are low, which indicates that the acidity is not sulfuric in nature, and therefore the soils are **not** AASS. Sample HA10 (0.5m) recorded an extractable sulfur concentration of 0.12%, which is slightly above the action criteria of 0.1% and TAA concentrations of 78mol/tonne which exceed the adopted criteria and indicates the sample represents PASS.

7.5 Discussion and Recommendations

Testing showed concentrations of Total Actual Acidity (TAA) above the action criteria of 62 moles H^+/tonne in four samples, with the remaining samples ranging from 15 – 53 moles H^+/tonne. Therefore the soils are acidic, but extractable sulfur testing indicates that the acidity is not sulfuric in nature. Based on this the soils are **not** AASS. Nineteen of the twenty samples had sulfur (% S_{cr}) concentrations below the action criteria of 0.1%. The 'sulfur' trail indicates that these soils are not PASS.

Sample HA10 (0.5m) recorded TAA above the action criteria and sulfur (% Scr) concentrations slightly above (0.12%) the action criteria of 0.1%, indicating that this sample was PASS. The sample was collected from the low lying area in the south-west corner of the site.

The soil is considered to be predominantly an acidic soil, with some PASS present in the south-west corner of the site. It is recommended that if soils are to be removed from the low lying area in the south-west of the site where PASS was encountered that the upper 0.5m of soils be stripped, stockpiled and treated with lime to increase the pH.

The acidic soils encountered within the remaining areas of the site are typical of the area, and the site is likely to be located within a naturally acidic environment. The exposure of soils from this site is not likely to produce further acidity, based on test results described above. The presence of the existing acidic soils is likely to be consistent with surrounding sites and therefore their presence will not have a significant negative effect to the environment or health.

Liming ratios have been calculated for the PASS and acidic soils should liming be required. Good quality fine agricultural lime should be used to treat excavated PASS. In calculating the liming ratios a factor of safety of 1.5 has been allowed above the theoretical requirement to take into account the rate of lime reactivity and the possibility of inhomogeneous mixing, particularly in the cohesive soils. Using a 95% confidence limit for the liming results provided, the liming ratio requirements were assessed to be 13.5kg of lime per tonne of soil for the PASS soils.

8 LIMITATIONS

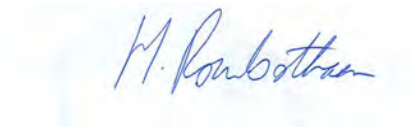
The findings contained in this report are the result of discrete/specific methodologies used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points. Should any site conditions be encountered during constructions that vary significantly from those discussed in this report, Coffey should be advised so that appropriate action can be taken.

Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

Guidance on the uses and limitations of this assessment is presented in the attached document '*Important information about your Coffey Report*', in accordance with which this report should be read.

If you have any questions regarding this assessment, please contact the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd



Matt Rowbotham

Senior Engineering Geologist

REFERENCES

1- Ahern C R, Stone Y and Blunden B. 1998. Acid Sulfate Soil Manual, Acid Sulfate Soils Management Advisory Committee, Wollongbar, NSW.

2- Department of Natural resources, Mines and Energy. 2004. Acid Sulfate Soils Laboratory Methods Guidelines. Version 2.1, June.

3- Department of Land and Water Conservation. 1995. Coffs Harbour 1:250,000 Geological Series Sheet

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

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 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 geotechnics
SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

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 incorporate 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

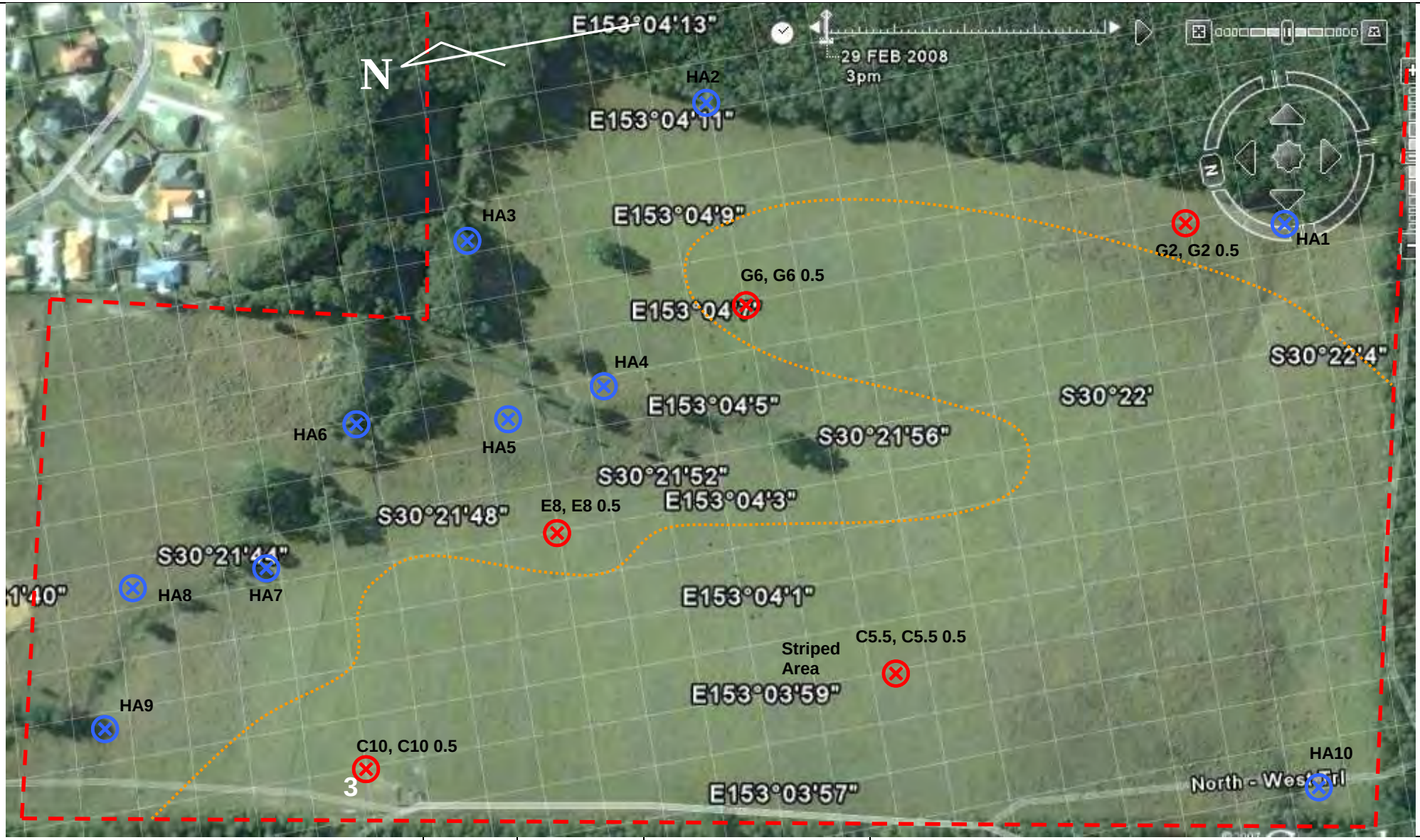
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

Figures

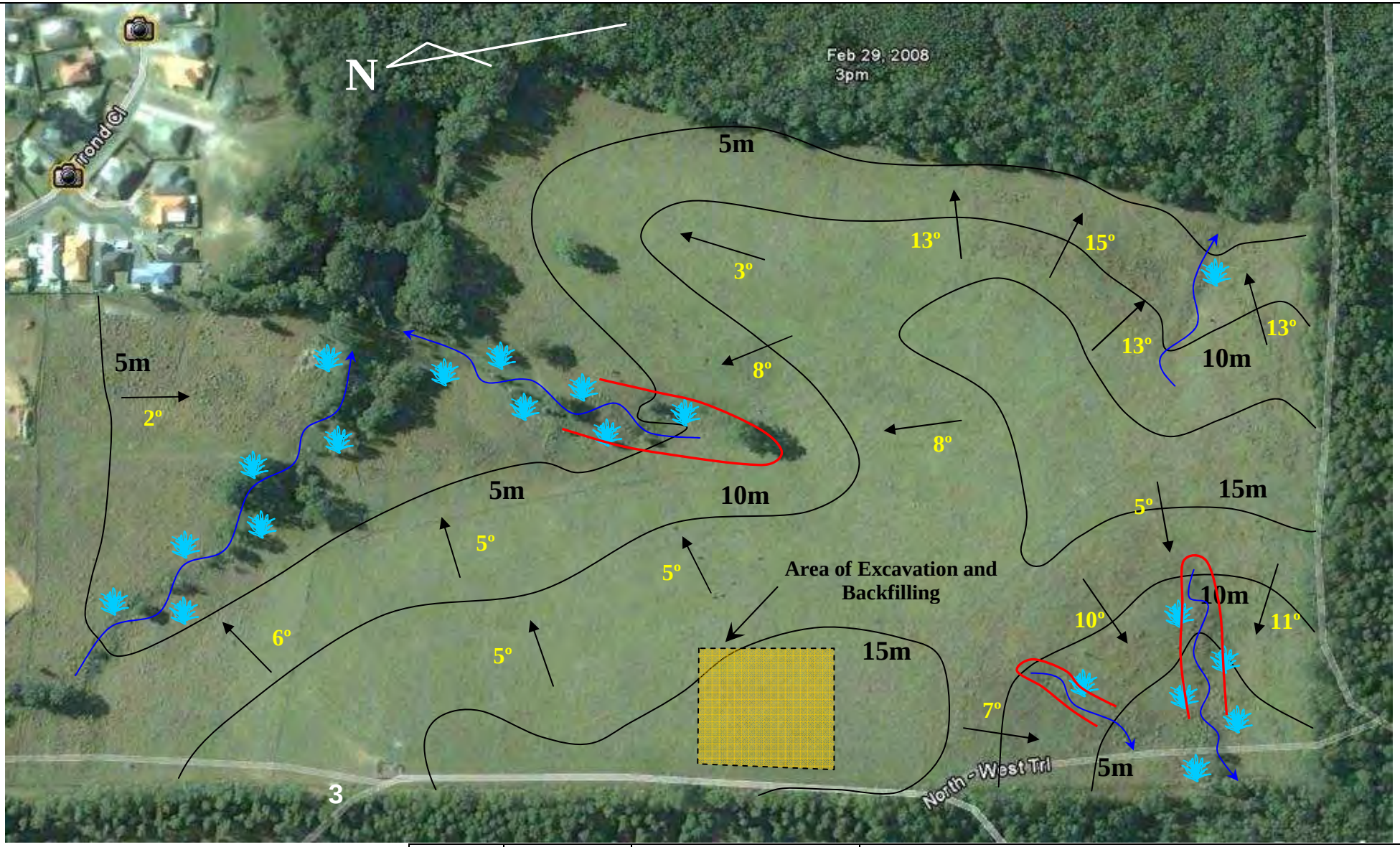


Sourced from Google Earth

drawn	ST
approved	MR
date	24/2/09
scale	NTS
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	**Utila Pty Ltd**
project:	**Preliminary Geotechnical and Acid Sulphate Soil Assessment** **Lot 112 DP1073791, Lyons Road, Sawtell NSW**
title:	**Plan Indicating Sample Locations**
project no: **GEOTCOFH02467AA-AB**	figure no: Figure 1

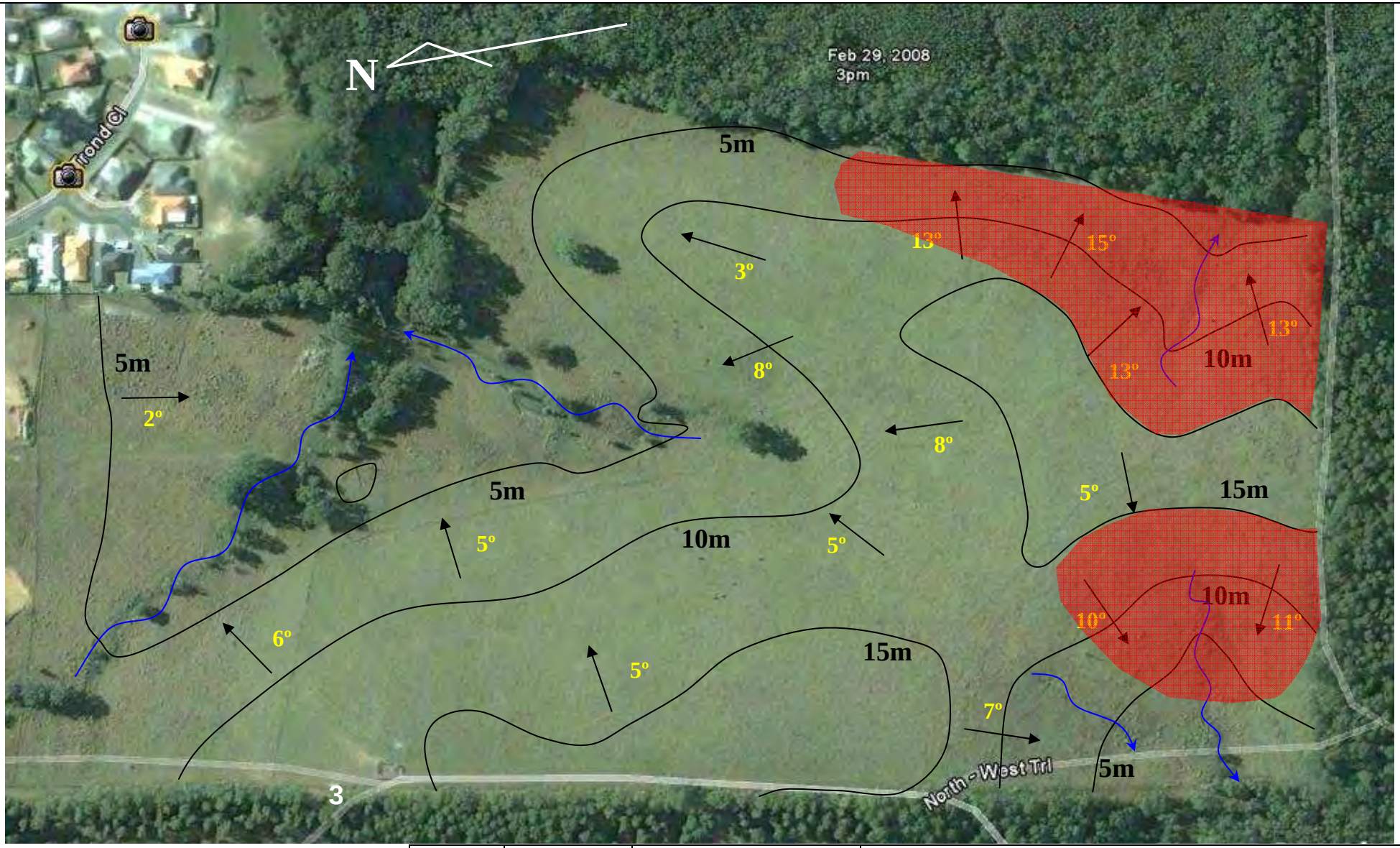


Watercourse and Seepage	
5m	Approximate Contour RL
5°	Slope Direction/Slope Angle
	Erosion Feature

drawn	ST
approved	MR
date	24/2/09
scale	NTS
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	Ulita Pty Ltd
project:	Preliminary Geotechnical and Acid Sulphate Soil Assessment Lot 112 DP1073791, Lyons Road, Sawtell NSW
title:	Geomorphological Interpretation Map
project no: GEOTCOFH02467AA	figure no: 2

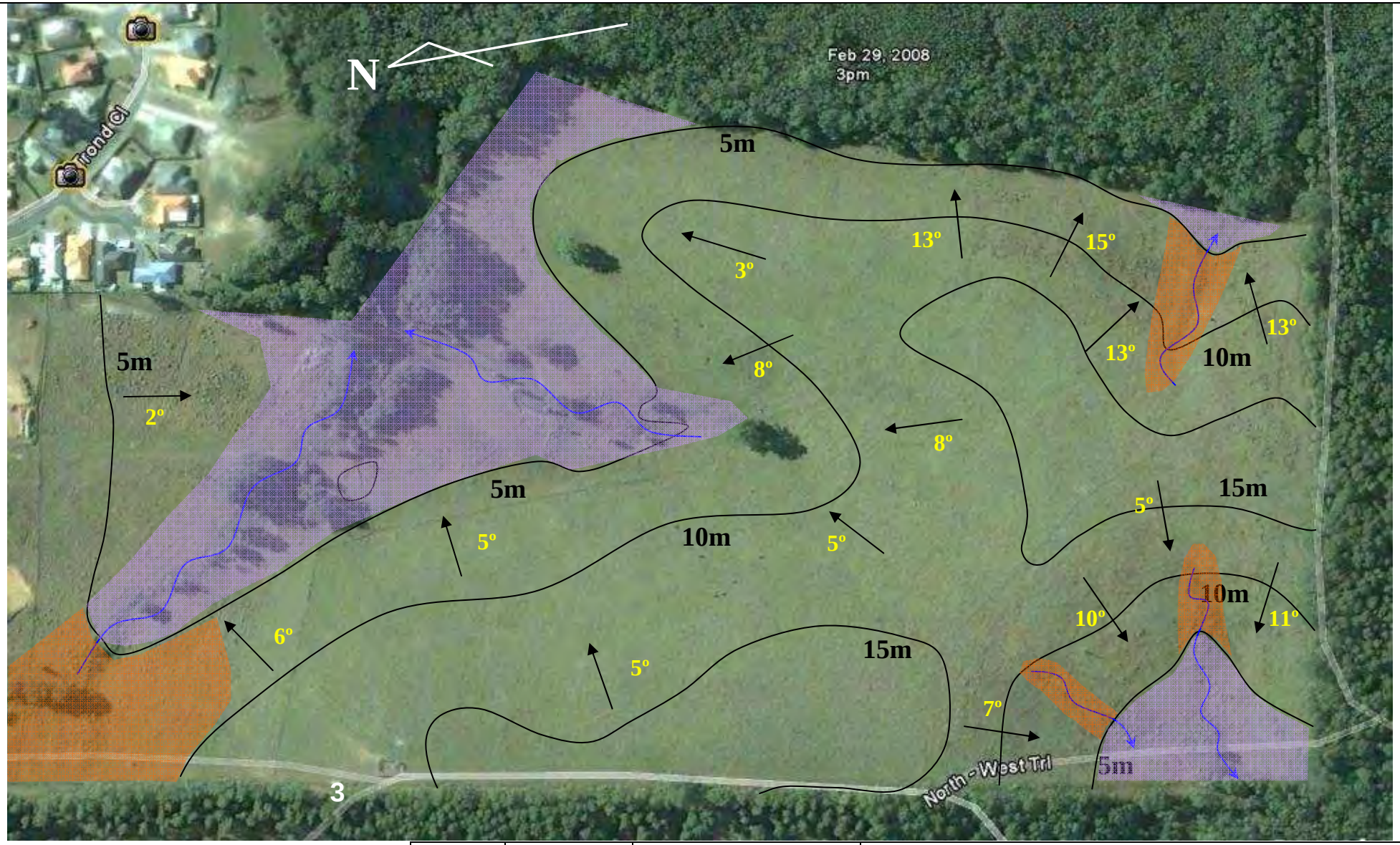


Steeper Slope Areas 10° to 15°

drawn	ST
approved	MR
date	24/2/09
scale	NTS
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	Ulita Pty Ltd
project:	Preliminary Geotechnical and Acid Sulphate Soil Assessment Lot 112 DP1073791, Lyons Road, Sawtell NSW
title:	Map Indicating Areas of Steeper Surface Slopes
project no: GEOTCOFH02467AA	figure no: 3



Gully Lines and Low Lying Areas

Upper Zone of Gully Lines

drawn	ST
approved	MR
date	24/2/09
scale	NTS
original size	A4

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	Ulita Pty Ltd
project:	Preliminary Geotechnical and Acid Sulphate Soil Assessment Lot 112 DP1073791, Lyons Road, Sawtell NSW
title:	Map Indicating Low Lying Areas and/or Gully Features
project no: GEOTCOFH02467AA	figure no: 4

Appendix A

Laboratory Test Results (Geotechnical Investigation)

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
Coffs Harbour NSW 2450

Telephone: +61 2 6651 3213
Facsimile: +61 2 6651 5194

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00046
Issue No: 1

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	TRN:

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 27/01/2009

Sample Details

Sample ID:	COFH09S-00046
Field Sample:	C10
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	C10, 0.15 - 0.5m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 5	
Soil Description		red brown Silty Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	
Moisture Content (%)	AS 1289.2.1.1	21.4	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	10.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	40	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	23	
Plasticity Index (%)	AS 1289.3.3.1	17	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
Coffs Harbour NSW 2450

Telephone: +61 2 6651 3213
Facsimile: +61 2 6651 5194

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00047
Issue No: 1

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	TRN:

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 27/01/2009

Sample Details

Sample ID:	COFH09S-00047
Field Sample:	G6
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	No Specification
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	G6, 0.15 - 0.5m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	25.2	
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		yellow brown Silty Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Wet Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	6.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	32	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	21	
Plasticity Index (%)	AS 1289.3.3.1	11	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
Coffs Harbour NSW 2450

Telephone: +61 2 6651 3213
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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Report No: MAT:COFH09S-00048
Issue No: 1

Material Test Report

Client: Coffey Geotechnics Pty Ltd
1/18 Hurley Drive
Coffs Harbour NSW 2450

Principal:
Project No.: LABTCOFH00054FG
Project Name: GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.: **TRN:**

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID: COFH09S-00048
Field Sample: HA6
Date Sampled: 14/01/2009
Source: Site
Material: Natural
Specification: No Specification
Sampling Method: Submitted by client
Project Location: Geoff Slattery - Proposed residential subdivision,
Sample Location: HA6, 0.2 - 1.0m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	00	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	7.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	27	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	13	
Plasticity Index (%)	AS 1289.3.3.1	14	
Moisture Content (%)	AS 1289.2.1.1	16.4	
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		grey Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
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Telephone: +61 2 6651 3213
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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Report No: MAT:COFH09S-00049
Issue No: 1

Material Test Report

Client: Coffey Geotechnics Pty Ltd
1/18 Hurley Drive
Coffs Harbour NSW 2450

Principal:
Project No.: LABTCOFH00054FG
Project Name: GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.: **TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID: COFH09S-00049
Field Sample: G2
Date Sampled: 14/01/2009
Source: Not Specified
Material:
Specification:
Sampling Method:
Project Location: Geoff Slattery - Proposed residential subdivision,
Sample Location: G2, 0.15 - 0.5m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		red brown Silty Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	
Moisture Content (%)	AS 1289.2.1.1	17.4	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	7.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	29	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	10	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
Coffs Harbour NSW 2450

Telephone: +61 2 6651 3213
Facsimile: +61 2 6651 5194

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Report No: MAT:COFH09S-00050
Issue No: 1

Material Test Report

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

This document is issued in accordance with NATAs accreditation requirements. Accredited for compliance with ISO/IEC 17025.

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID:	COFH09S-00050
Field Sample:	C5.5
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	C5.5, 0.15 - 0.5m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 5	
Soil Description		red brown Silty Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

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Coffs Harbour NSW 2450

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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00051
Issue No: 1

Client: Coffey Geotechnics Pty Ltd
1/18 Hurley Drive
Coffs Harbour NSW 2450

Principal:
Project No.: LABTCOFH00054FG
Project Name: GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.: **TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID: COFH09S-00051
Field Sample: HA1
Date Sampled: 14/01/2009
Source: Site
Material: Natural
Specification:
Sampling Method: Submitted by client
Project Location: Geoff Slattery - Proposed residential subdivision,
Sample Location: HA1, 0.5 - 2.0m

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.2	
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		grey Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	11.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	49	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	26	
Plasticity Index (%)	AS 1289.3.3.1	23	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00052
Issue No: 1

Client: Coffey Geotechnics Pty Ltd
1/18 Hurley Drive
Coffs Harbour NSW 2450

Principal:
Project No.: LABTCOFH00054FG
Project Name: GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.: **TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID: COFH09S-00052
Field Sample: HA5
Date Sampled: 14/01/2009
Source: Not Specified
Material:
Specification:
Sampling Method:
Project Location: Geoff Slattery - Proposed residential subdivision,
Sample Location: HA5, 1.2 - 1.5

Other Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	16.0	
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	10.5	
Mould Length (mm)		254	
Crumbling		No	
Curling		No	
Liquid Limit (%)	AS 1289.3.1.1	33	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	15	
Plasticity Index (%)	AS 1289.3.3.1	18	
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		orange grey Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
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Coffs Harbour NSW 2450

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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00053
Issue No: 1

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID:	COFH09S-00053
Field Sample:	HA3
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	HA3, 1.0 - 2.0

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		orange grey Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
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Coffs Harbour NSW 2450

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coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00054
Issue No: 1

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID:	COFH09S-00054
Field Sample:	E8
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	E8, 0.15 - 0.5m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		grey Gravelly Silty Clay	
Type of Water		distilled water	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments
N/A

Coffs Harbour Laboratory

Coffey Information Pty Ltd
ABN 92 114 364 046
1/18 Hurley Drive
Coffs Harbour NSW 2450

Telephone: +61 2 6651 3213
Facsimile: +61 2 6651 5194

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Material Test Report

Report No: MAT:COFH09S-00055
Issue No: 1

Client:	Coffey Geotechnics Pty Ltd 1/18 Hurley Drive Coffs Harbour NSW 2450
Principal:	
Project No.:	LABTCOFH00054FG
Project Name:	GEOTCOFH02467AA - LOT 112 Lyons Rd. Sawtell
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Dean Clark
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 29/01/2009

Sample Details

Sample ID:	COFH09S-00055
Field Sample:	HA3
Date Sampled:	14/01/2009
Source:	Site
Material:	Natural
Specification:	
Sampling Method:	Submitted by client
Project Location:	Geoff Slattery - Proposed residential subdivision,
Sample Location:	HA3, 0.5 - 1.0m

Other Test Results

Description	Method	Result	Limits
Emerson Class Number	AS 1289.3.8.1	Class 4	
Soil Description		red brown Silty Clay	
Type of Water		Distilled	
Temperature of Water (°C)		25.0	

Particle Size Distribution

Method:
Drying by:
Date Tested:

Sieve Size	% Passing	Limits

Chart

Comments

N/A

Laboratory Test Request

Addressed to: Laboratory Manager Adam

COFH

Job No: 02467AA Sheet 1 of 1

Client: Geoff Slatter & Partners P/L

Principal:

Project: Proposed Residential subdivision

Location: LOT 112 Lyons Rd Sawtell NSW

Date: 14/1/09

By: AH

Checked:

Engineer:

Priority:

Store Location:

Coffey

Location	Sample Depth From	Sample Depth To	Sample Type	Test Required [—] Visual	Moisture Content	Atterberg Limits +LS	Sieve Analysis to 75 µm	Unconfined Compression	Compaction std / mod	C.B.R. ..... soaked	Emerson	Test Performed [✕]	Kemp Sample
C10	0.15	0.5	DB		/	/					/		
G6	0.15	0.5	DB		/	/					/		
HA6	0.2	1.0	DB		/	/					/		
G2	0.15	0.5	DB		/	/					/		
CS.5	0.15	0.5	DB		▬	▬					/		
HA1	0.5	2.0	DB		/	/					/		
HA5	1.2	1.5	DB		/	/					/		
HA3	1.0	2.0	DB								/		
E8	0.15	0.5	DB								/		
HA3	0.5	1.0	DB								/		
		6 x Atterbergs & LS											
		10 x Emerson crumbs											

Pretest Action	By	Noted
1.		
2.		
3.		
4.		
5.		

Post Test Action	By	Noted
1.		
2.		
3.		
4.		
5.		

1. Procedure to AS 1289 where applicable or as indicated

2. Keep Samples: ✓ Indicates Stores residue after testing ✕ Indicates Samples May be Destroyed

Appendix B

Laboratory Test Results (ASS Investigation)

A.S.S. FIELD SCREEN ANALYSIS REPORT

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 EMAIL **pe@biotrack.com.au**

DATE OF REPORT 22 JANUARY 2009
CLIENT NAME MR ANDREW BALLARD
CLIENT FIRM COFFEY GEOTECHNICS PTY LTD YOUR PROJECT/JOB REFERENCE GEOTCOFH02467AA
CLIENT ADDRESS PO BOX 704 COFFS HARBOUR 2450
PROJECT NAME GEOTCOFH02467AA SAMPLING DATE 7/1/9
NUMBER OF SAMPLES 42 SAMPLE TYPE SOIL SAMPLE FOR ACID SULFATE STUDY
PACKAGING SAMPLES LABELLED - INTACT - BAGGED - CHILLED IN INSULATED PACKAGING
SAMPLES DISPOSED ON 1/5/2009
LOG-IN DATE 21 JANUARY 2009 LAB REF. LR21019.536

TEST METHODOLOGY FOR pH_f AND pH_fox AS PER QASSIT 2004 Laboratory Methods. Indications based on pH data only.
RATE: 0=none 1=slight 2=moderate 3=high 4=very high (steam evolved) visual observation at 0-5 minutes.
TEMP: Surface temperature rise ('C) oxidised sample at 5 minutes.

SAMPLE ID	Upper	Lower (m)	pH_f	pH_fox	change	RATE	TEMP	INDICATION
HA1	0		4.7	3.1	-1.6	4	7	low TAA & moderate TPA
HA1	0.5		4.3	2.9	-1.4	2	9	moderate TPA
HA1	1.0		5.3	3.8	-1.5	1	4	low TAA
HA1	1.5		4.4	3.2	-1.2	2	3	moderate TPA
HA1	2.0		4.3	3.5	-0.8	3	5	low sulphide
HA2	0.5		4.6	3.2	-1.4	1	3	low TAA & moderate TPA
HA2	1.0		5.1	3.8	-1.3	1	4	low TAA
HA2	1.5		5.5	4.3	-1.2	0	4	low TAA
HA2	2.0		5.8	4.3	-1.5	0	5	low TAA
HA3	0		4.7	2.1	-2.6	4	4	low TAA & high TPA & sulphide possible
HA3	0.5		4.9	2.2	-2.7	4	2	low TAA & high TPA & sulphide possible
HA3	1.0		4.5	2.4	-2.1	4	4	low TAA & high TPA & sulphide possible
HA3	1.5		4.3	2.3	-2.0	3	4	high TPA
HA3	2.0		4.4	2.6	-1.8	2	4	moderate TPA
HA4	0.5		4.1	3.1	-1.0	2	4	moderate TPA
HA4	1.0		4.5	3.4	-1.1	2	3	low TAA & moderate TPA
HA4	1.5		4.8	2.9	-1.9	2	5	low TAA & moderate TPA
HA4	2.0		4.9	2.5	-2.4	1	4	low TAA & moderate TPA & sulphide possible
HA5	0.5		4.9	2.4	-2.5	4	4	low TAA & high TPA & sulphide possible
HA5	1.0		4.6	2.3	-2.3	4	15	low TAA & high TPA & sulphide possible
HA5	1.5		4.6	3.1	-1.5	1	2	low TAA & moderate TPA
HA5	2.0		4.9	3.0	-1.9	1	3	low TAA & moderate TPA
HA6	0		5.3	2.7	-2.6	4	0	low TAA & moderate TPA & sulphide possible
HA6	0.5		4.8	2.6	-2.2	4	0	low TAA & moderate TPA & sulphide possible
HA6	1.0		4.4	2.9	-1.5	3	3	moderate TPA
HA6	1.5		5.3	3.8	-1.5	3	1	low TAA
HA6	2.0		5.1	3.3	-1.8	3	2	low TAA & moderate TPA
HA7	0.5		4.7	2.5	-2.2	3	4	low TAA & moderate TPA & sulphide possible
HA7	1.0		4.6	2.7	-1.9	2	2	low TAA & moderate TPA
HA7	1.5		4.6	3.1	-1.5	1	1	low TAA & moderate TPA
HA7	2.0		4.8	3.2	-1.6	1	2	low TAA & moderate TPA
HA8	0.4		5.0	2.3	-2.7	4	0	low TAA & high TPA & sulphide possible
HA8	1.0		4.5	2.6	-1.9	2	7	low TAA & moderate TPA
HA8	1.5		4.6	3.3	-1.3	3	7	low TAA & moderate TPA
HA8	2.0		4.6	3.3	-1.3	4	7	low TAA & moderate TPA
HA9	0.5		4.4	2.4	-2.0	2	3	high TPA
HA9	1.0		4.3	3.3	-1.0	1	2	moderate TPA
HA9	1.4		4.6	3.3	-1.3	1	2	low TAA & moderate TPA
HA10	0.5		4.0	2.1	-1.9	2	4	high TPA
HA10	1.0		3.7	1.9	-1.8	2	3	high TPA
HA10	1.5		3.4	2.5	-0.9	1	2	moderate TAA & moderate TPA & low sulphide
HA10	2.0		3.6	2.5	-1.1	2	4	moderate TPA

Signatory For and behalf of Bio-Track Pty Ltd

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 LR29019.378 DATE OF REPORT 06 FEBRUARY 2009 @09:08:51
CLIENT NAME MR ANDREW BALLARD c/o COFFEY GEOTECHNICS PTY LTD PO BOX 704 COFFS HARBOUR 2450
PROJECT NAME GEOTCOFH02467AA YOUR PROJECT/JOB REFERENCE GEOTCOFH02467AA
SAMPLING DATE 7/1/9 NUMBER OF SAMPLES 20 Samples supplied by client SAMPLE TYPE:SOIL SAMPLE FOR ACID SULFATE STUDY
DATE RECEIVED 29 JANUARY 2009 PACKAGING SAMPLES LABELLED - INTACT - BAGGED - CHILLED IN INSULATED PACKAGING Ground Oven Dry Samples DISPOSED ON 1/10/2009

Sample ID as received. METHODOLOGY: As per (DNR QASSIT May 2004), oven dried (85'C), >1000 um shell removed, fine grind. All reported values gravimetric, dry mass.
%sEQ (equivalent sulphur) calculated as moles TAA/624 + %S Cr + %sNAS - sANC/ 1.5 (sNAS included irrespective of pH).
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_BT/1.5
NB. Lime rates assume 97% lime neutralisation but DO NOT include any safety factors. Suggested factor=1.5-2. Rates are kg/ton. Multiply by bulk density to convert to kg/m3.
Fineness Factor (FF)=1.5 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 & <0.x represent measured values. If pH KCl>4.5 then s-RAS (calculated from acid extract) may be zero for undisturbed soil. Ca NAS is the acid reactive calcium calculated as the difference between 1 M KCl and 4 M HCl soluble Ca.

ID. DEPTH	pH	pH	TAA	TPA	TSA	S KCl	S P	S POS	S Cr	s-NAS	s EQ	Ca KCl	Ca P	Mg KCl	Mg P	CBN POS	LIME1	LIME2	sANC_BT/FF	Ca NAS
m	KCL	ox	m/t	m/t	m/t	%	%	%	%	%	%	mg/kg	mg/kg	mg/kg	mg/kg	m/t	kg/t	kg/t	%	mg/kg
Analytical Method Codes	23A	23B	23F	23G	23H	23Ce	23De	23Ee	22B	s20Je	s	23Vh	23Wh	23Sm	23Tm	a23U&X			s19A2	
HA1 0.5	3.81		47			<0.01			<0.01	<0.01	0.085	77		284			3			<10
HA1 1.5	3.78		15			<0.01			<0.01	<0.01	0.029	157		327			1			10
HA3 0.0	4.10		73			<0.01			<0.01	<0.01	0.132	97		157			4			35
HA3 0.5	4.04		45			<0.01			<0.01	<0.01	0.079	51		85			3			13
HA3 1.0	4.10		24			<0.01			<0.01	<0.01	0.041	37		56			1			<10
HA3 1.5	3.95		29			<0.01			<0.01	<0.01	0.052	26		50			2			<10
HA3 2.0	4.04		16			<0.01			<0.01	<0.01	0.028	44		38			1			<10
HA4 2.0	3.90		16			<0.01			<0.01	<0.01	0.029	46		344			1			<10
HA5 0.5	4.07		35			<0.01			<0.01	<0.01	0.061	223		90			2			32
HA5 1.0	4.07		24			<0.01			<0.01	<0.01	0.044	59		63			1			<10
HA6 0.0	4.25		38			<0.01			<0.01	<0.01	0.069	507		210			2			81
HA6 0.5	3.85		53			<0.01			<0.01	<0.01	0.090	54		114			3			<10
HA6 1.0	3.89		32			<0.01			<0.01	<0.01	0.056	34		106			2			<10
HA7 0.5	4.48		18			<0.01			<0.01	<0.01	0.034	31		36			1			<10
HA8 0.4	3.89		42			<0.01			<0.01	<0.01	0.076	75		139			2			31
HA8 1.0	3.77		29			<0.01			<0.01	<0.01	0.052	23		244			2			<10
HA8 1.5	3.74		22			<0.01			<0.01	<0.01	0.040	24		308			1			<10
HA9 0.5	4.04		26			0.01			<0.01	<0.01	0.044	7720		128			1			<10
HA10 0.5	4.45		78			0.04			0.12	0.04	0.281	64		34			9			27
HA10 1.0	3.78		67			0.01			<0.01	0.01	0.121	94		57			4			<10

Signatory P. Robertson For and on behalf of Bio-Track Pty Ltd