

Appendix D3

Geotechnical investigations:

Preliminary information on soil compressibility and acid sulphate soil issues (Coffey Geotechnics, May 2012)

28 May 2012

Roads and Maritime Services
90 Crown St
WOLLONGONG NSW 2500

Attention: Daniel Horan

Dear Daniel

RE: PRELIMINARY INFORMATION ON SOIL COMPRESSIBILITY AND ACID SULFATE SOIL ISSUES
PROPOSED BERRY BYPASS - SOUTHERN ROUTE OPTION
BERRY NORTH INTERCHANGE (CH15400) TO BERRY SOUTH INTERCHANGE (CH20600)
BERRY, NSW

1 INTRODUCTION

At the request of Roads and Maritime Services (RMS), Coffey Geotechnics Pty Ltd (Coffey) has carried out a preliminary geotechnical assessment of subsurface information for the southern route option of the Berry Bypass project.

The southern route option is approximately 5 kilometres in length and is located to the south of the Berry Township. It is understood that a geotechnical assessment is required as part of preferred route selection studies being undertaken by RMS. Coffey was commissioned to carry out an assessment of geotechnical data supplied by RMS. However, RMS has also requested that Coffey prepare a preliminary assessment of the geotechnical data by 28 May 2012. This was required in order to provide an updated 'likely construction cost' of the southern option, to be communicated to the general public by Thursday, 31 May 2012.

The objectives of this letter were to provide preliminary information on:-

- Geotechnical model for the site;
- Soft soils along the Broughton Creek Floodplain in terms of likely settlement under future fill loads, and the likely ground treatment options that may be necessary for these soils to reduce long term settlement issues to levels tolerable by RMS;
- Likely stability issues for embankments;
- Likely extent and nature of Acid Sulfate Soils;

2 PREVIOUS GEOTECHNICAL INVESTIGATIONS

Several geotechnical reports have previously been carried out on a wider study area between Gerringong and Bomaderry. Three of these reports contain test data (borehole, cone penetration test, test pit and laboratory testing) in the vicinity of Berry. These reports are:

- Roads and Maritime Services (Southern Region), (21 May 2012), "*Factual Geotechnical Investigation Report*". Foxground and Berry Bypass Project, Proposed South Berry Option, Princes Highway (HW1), Berry, NSW, Job Ref:11-02, WBS: D/00386/C/P1.
- Coffey Geotechnics, (May 2010), "*Geotechnical Interpretive Report for Concept Design*". Preferred Route of the Princes Highway, Gerringong to Bomaderry. Report Ref: GEOTWOLL02580AE-BL.
- Coffey Geotechnics, (February 2010), "*Geotechnical Factual Report for Concept Design*". Gerringong to Bomaderry. Report Ref: GEOTWOLL02580AE-BD.
- Maunsell-Aecom and Coffey Geotechnics, (October 2007), "*Preliminary Geotechnical Report - Gerringong to Bomaderry Princes Highway Upgrade*".

3 SUBSURFACE CONDITIONS

3.1 General Subsurface Conditions

We note that the proposed road in the northern portion of the site as it passes over the Broughton Creek floodplain will be constructed using a low height bridge. The bridge will be approximately 1200m long, and will finish at about CH17300. For the purposes of assessment of soft soils, we have only commented on the ground conditions south of this bridge, as this is the area where embankments are proposed that are potentially prone to settlement issues.

Based on our review of the subsurface data gathered from other projects by Coffey in the vicinity of the site and geotechnical field investigations for this project, we have come up with a preliminary model for the area of the site between about CH 17300 and CH 19020. The general soil units encountered are presented in Table 1:

TABLE 1 SUMMARY OF SOIL UNITS

UNIT	SOIL TYPE	DESCRIPTION
1	Fill	Localised deposits, encountered in existing road embankments and hardstand areas. Imported asphalt, road base or local soil fill for highway embankments and pavement fill materials. Fill near or beneath railway areas.
2	Topsoil	Variable thickness up to 0.5m thick, Sandy/Silty CLAY/ Clayey Organic Silt, soft to stiff.
3.1	Upper Alluvium	CLAY / Sandy Silty CLAY firm to very stiff. Approximately 2m to 2.5m thick, over-consolidated/dessicated crust. Possible layers of Acid Sulfate Soils (Estuarine Soils?) present.
3.2	Alluvial Clays	CLAY, Stiff to Very Stiff. Approximately 2.5m – 4m thick, over-consolidated clays.
3.3	Alluvial Gravels	Sandy GRAVEL / Clayey GRAVEL / GRAVEL: gravel deposits are many metres thick, and generally overlie the contact with weathered rock, gravel is fine to coarse grained, some cobbles, some sandier bands.
4	Berry Siltstone (Weathered Rock)	Siltstone / Sandy Siltstone: highly weathered to fresh, generally high strength within a metre or two of rock contact.

A plot of overconsolidation ratio (OCR) has been prepared based on the results of the piezocone testing. Based on the OCR profile presented in Attachment A-1, the subsoil conditions beneath the southern route of the Berry Bypass generally comprise deep alluvial deposits of clays or gravels, underlain by weathered siltstone rock. The shallow portions of the clay soils appear to be moderately to heavily overconsolidated, and the deeper deposits of the clay soils are heavily overconsolidated.

We note that the test locations are spaced between 200m and 500m apart. The presence of paleochannels and other buried deposits of compressible soils should not be discounted. Further work will be necessary to further assess ground conditions, if this route is to be selected.

3.2 Groundwater

Based on the results of “Factual Geotechnical Investigation Report” (Report Ref. 11-02, WBS: D/00386/C/P1) dated 21 May, 2012, groundwater was encountered at a depth of between 0.3m and 2.3m beneath the ground surface. However, groundwater was not encountered in Boreholes B6, B10 and B15. Groundwater conditions are likely to be affected by tidal influences and will fluctuate seasonally due to periods of increased rainfall, temperature and other seasonal factors. It is noted that the area is prone to flooding and large areas of the site were underwater for periods of the investigation.

3.3 Interpretation of CPT Data

Estimation of s_u from the CPT data was made using “effective” cone resistance. The cone resistance was corrected for pore pressure effect and cone factor was evaluated as follows (Lunne et al (1997)):

$$N_{kt} = \frac{(q_t - \sigma_{v0})}{s_u}$$

Where: N_{kt} is the cone factor

A N_{kt} value of approximately 17 was used based on the available correlations.

It also indicates that the following relationship between undrained shear strength (s_u) and vertical effective stress (σ'_{v0}) can be conservatively made from the curve fitting for normally consolidated state. Although the soils at the site are overconsolidated, equation for normally consolidated soils are conservatively assumed for preliminary model.

$$s_u = 0.21 \times \sigma'_{v0}$$

The over-consolidation ratio (OCR) is defined as the ratio of the maximum past effective consolidation stress and the present effective overburden stress and is used in settlement calculations.

Shear Strengths from correlated CPT investigations were used to assess OCR in accordance with the following equation from Ladd et al (1977), Mayne et al (1988), Robertson (2006):

$$s_u = 0.21 \times \sigma'_{v0} \times OCR^m$$

Where: $m = 1 - \frac{C_r}{C_c}$ C_c is compression index and C_r is the recompression index.

The plots of OCR versus depth for the preliminary model is presented in Attachment A-1.

4 SOFT COMPRESSIBLE SOILS AND LONG TERM SETTLEMENTS

A preliminary estimate of the potential long term settlements was estimated based on the depth of soft soils at the site and the likely depth of fill (5m to 11m embankment height) to be placed along the alignment. The Alluvial CLAY at the site is overconsolidated. Settlement will occur due to compression of the Alluvial CLAY units when subjected to loads in excess of preconsolidation pressures. As the soil is moderately to heavily overconsolidated, it appears that significant extra soil stress (and therefore significant thicknesses of road embankment fill) is necessary for the soils to reach their preconsolidation pressure.

4.1 Assumptions

The following assumptions were made to estimate the preliminary long term settlements:

- Based on the depth of compressible clays and the location of the proposed bridge (CH16100 – CH17300) a Soft Soil Model was not developed along CH15400 – CH17300.
- A preliminary soft soil model was developed for the proposed Berry Bypass from CH17300 to CH19020.
- The critical section at CH17800 (near B8/CPT403A) was used to estimate the potential preliminary long term settlement;
- Design life of the embankment was assumed to be 40 years;
- Long term Settlement was estimated for a maximum embankment height of 5m over most of the model with a height of up to 11m towards the western end of the model near the south coast railway;
- Total settlements consists of:
 1. Immediate settlement induced by full embankment load during construction;
 2. Consolidation settlement induced by embankment load over design life;
 3. Creep settlement under full embankment load over design life;

- Immediate settlement induced by full embankment load will likely occur during Initial construction phase;
- Immediate settlement was estimated using one-dimensional elastic compression theory with consideration of stress reduction factor;
- Settlement within the soil units will occur generally in accordance with one dimensional consolidation theory;
- Initial Construction period was assumed to be 3 months;
- Post initial construction settlement consists of the remaining consolidation settlement and creep settlement immediate after a 3 month initial construction period; and
- Groundwater table is assumed to be 0.3m below ground surface for estimation of preliminary settlement.
- We assume that for the 11m high embankment that the topsoil is stripped and removed prior to construction. For the lower 5m high embankments the topsoil is largely left in place;

4.2 RMS Settlement Criteria

The RMS Settlement criteria for this section of road are as follows:

- Following construction of the pavement, settlement should be limited to a maximum of 10mm of settlement in any 12 month period,
- A maximum of 100mm of settlement in a 40 year period.

4.3 Results of Preliminary Consolidation Settlement Analysis

Based on the preliminary analysis results, the findings can be summarized as follows:

- Immediate settlement due to embankment construction during the 3 month construction period was estimated to be less than 50mm between CH17300 – CH19020;
- Along CH17300 - CH18650, post initial construction period, the estimated additional total settlement over the design period of 40 years due to 5m of embankment is estimated to be up to 100mm;
- In the area CH18650 – CH19020, the embankment height will vary from 5m up to 11m in height, with the maximum height of 11m achieved in the vicinity of the south coast railway between about CH18800 and CH19000. Post initial construction period, the estimated additional total settlement over the design period of 40 years due to between 5m and 11m of embankment may be up to 100mm. This information is based on the information from one borehole, B15. There is some chance that the total settlement criteria of 100mm could be exceeded and up to 150mm of settlement may occur with this increased embankment height if old buried paleochannels of soft soils are encountered in this area. Further testing should be carried out to check the model in this area, and check whether there are significant implications for construction for this high embankment area;
- Based on preliminary calculations of the time of settlement, (and assuming no ground treatment is used to accelerate settlement) primary consolidation will not have finished within the fifty year design life period. As such, ongoing settlements (both primary and creep settlements) are expected to occur after the fifty year period. However as indicated, these total primary settlements are not expected to be above the expected settlement criteria;

4.4 Comments on Ground Improvement Works

Based on preliminary consolidation analysis and comparison of the settlement results to the RMS criteria, significant ground improvement techniques are not likely to be necessary at this site.

It is recommended that the cost for minor ground improvement works such as preloading and surcharging using wick drains over short spans along the alignment should be included in preliminary construction costs.

If ground treatment is required over shorter sections (eg. where old buried paleochannels may occur) then the suggested ground improvement options based on the preliminary analysis are as follows:

- **Preloading:** The site could be preloaded under the proposed embankment fill to remove a portion of the likely primary consolidation that will occur, thus reducing settlement during and after the construction of the road alignment. This option would not treat any secondary consolidation that may occur.
- **Surcharging:** The site could be surcharged with additional soil (in addition to the proposed fill embankment soil) to consolidate the soils and 'iron out' the majority of secondary consolidation before constructing the pavement layers, thus reducing the settlement during and after the construction of the road alignment. Surcharging is generally carried out using several metres of additional soil fill placed over the top of the final design embankment level;
- **Surcharge with Wick Drains:** Wick drains could be installed into the clays, prior to placement of a surcharge load. The wick drains act by reduce the drainage path of the water being squeezed out of the clay layers, thus accelerating the consolidation of the soil units (compared to the 'surcharging only' option) and reducing the amount of time necessary for ground treatment works;
- **Other Techniques:** Where the construction timing does not allow sufficient time for preloading or surcharging, other techniques could potentially be used. A cost-benefit analysis would need to be carried out to assess the feasibility of these techniques. Some of these techniques could involve use of lightweight/ultralightweight fill, stone columns, lime columns or other methods.

4.5 Comments on Road Alignment

Coffey has been asked to comment on the positioning of the proposed alignment in terms of whether there is a 'better' location for the road in terms of broad ground conditions.

The further the road is pushed southwards, there is increased risk of encountering areas where rock is deeper, increased thicknesses of soft soils and Acid Sulfate Soils.

If RMS is to avoid further issues in this regard, it would be better to either leave the road where the current alignment is proposed, or push the road further north and closer to the Rail Corridor and Berry Township area, as ground conditions are expected to be less favourable southwards from the current alignment.

5 COMMENTS ON STABILITY ISSUES FOR FUTURE EMBANKMENTS

The soils at this site are overconsolidated and generally stiff to very stiff and only relatively shallow deposits of topsoil or organic soils have been currently identified. The test locations are relatively widely spaced and some paleochannels of poorer quality soils may still be present onsite.

At present there does not appear to be widespread issues for stability of embankments in terms of rotational and/or sliding failure if they were constructed at this site using standard construction procedures for road embankments.

Closer analysis of the footing area for the 11m high embankment will need to be carried out in the vicinity of the rail corridor and B-15. Some stabilising techniques such as inclusion of ground strengthening materials (geogrids, etc) may be required in this area.

In all areas, it is assumed here that the ground surface is prepared such that the ground surface is level prior to placement of fill. This is important in order to avoid the development of potential adversely oriented slide planes at the base of the fill embankment mass and potential 'sliding failure' mechanisms.

6 ACID SULFATE SOILS

A copy of the Acid Sulfate Soil (ASS) results table is attached in Table A-2.

We note that this testing was carried out by others, and we have not had a chance to review such details as the testing methodologies or whether the sample holding times were met. If there are issues with the testing methods or data, then our comments regarding ASS materials may change.

The data carried out by RMS should be considered as preliminary data as a higher density of testing should be carried out for a detailed ASS study. Further spatial testing for ASS should be carried out. This data should only be used to provide broad assessment of whether there are potentially large scale ASS issues at this site.

This table shows comparisons of ASS testing results to ASSMAC (1998) guidelines. In assessing what guideline values to use for this assessment, it is assessed that more than 1000 tonnes of ASS materials would potentially be disturbed during a large scale construction exercise such as this.

Samples were taken generally at 1m intervals in the boreholes where testing was carried out. The depth ranges for testing ranged from between about 0.5m and 2.95m.

Out of the 48 samples tested, four were tested within boreholes N1 and N2. These boreholes are not relevant to the southern alignment, and therefore there are a total of 44 samples that require comment in terms of the presence of ASS materials.

The comments on the relevant test results are below:

- There were 44 results with TAA above guideline values, indicating the soils appear to be acidic. However the presence of TAA does not necessarily indicate the presence of Acid Sulfate Soils;
- The %S KCl results returned 6 results where the %S KCl was above guidelines values. These were in boreholes B9, B19 and B23. We note that B19 and B23 are both located well away from the proposed alignment. B19 is located well south of the proposed southern alignment and B23 is located north of the alignment. These boreholes are not considered directly relevant to the assessment of whether ASS materials are present at the 'southern alignment' location. The results in B9 are considered directly relevant to the ASS assessment;
- There was one exceedance when the 44 samples were tested for Chromium Reducible Sulfur from B19/2.5-2.95m.

The 1:25,000 ASS Risk Map 'Burrier (Berry)' indicates the:

- The elevated portions of the site are underlain by areas described as 'no known occurrence' of Acid Sulfate Soils.
- The low lying parts of the site where the site passes across the floodplain areas lie in a 'low risk' area. The map indicates the geological environment over the low lying parts of the proposed southern route is such that these landform areas are not expected to contain Acid Sulfate Soils.

The low lying portions of the site are located towards the northern extremity of the Shoalhaven River floodplain in areas where ASS materials are not expected to contain significant deposits of ASS materials, although smaller deposits can still be encountered. ASS materials are typically encountered in estuarine type environments. The investigation generally encountered alluvial soils that were overconsolidated and not typical of ASS materials. Our preliminary assessment of the results indicates that there are no widespread deposits of ASS materials at this site, but ASS was encountered within the

alignment in B9. However, ASS materials could still be present in other areas of the site and the level of testing carried out does not constitute a 'comprehensive assessment' of ASS materials at this site.

The boreholes were carried out at a spacing of 200m to 500m along the proposed road alignment. Whilst widespread ASS materials are not expected at this site, some localised and shallow deposits of ASS materials may be encountered, particularly within old buried paleochannels (eg. old creek or river channels). One sample from B9 (located a few hundred metres south of the proposed alignment) does indicate the presence of ASS materials. Further testing should be carried out to check for the presence of such paleofeatures within the low lying areas of the floodplain.

An Acid Sulfate Soil Management Plan should be prepared for this site.

7 LIMITATIONS

The results of this assessment are preliminary and further work is currently being carried out. The advice on our final report that will be presented in several weeks time will supersede this advice.

For and on behalf of Coffey Geotechnics Pty Ltd



Scott Morrison

Associate Geotechnical Engineer

Attachments:

Important Information about your Coffey Report

Figure supplied by RMS, titled 'Berry Bypass, South Berry Option, Geotechnical Investigation, Sheet 1 of 4', dated 21/5/2012

Table A-1: OCR profile from piezocone results

Table B-1: Summary of ASS testing results

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.

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.

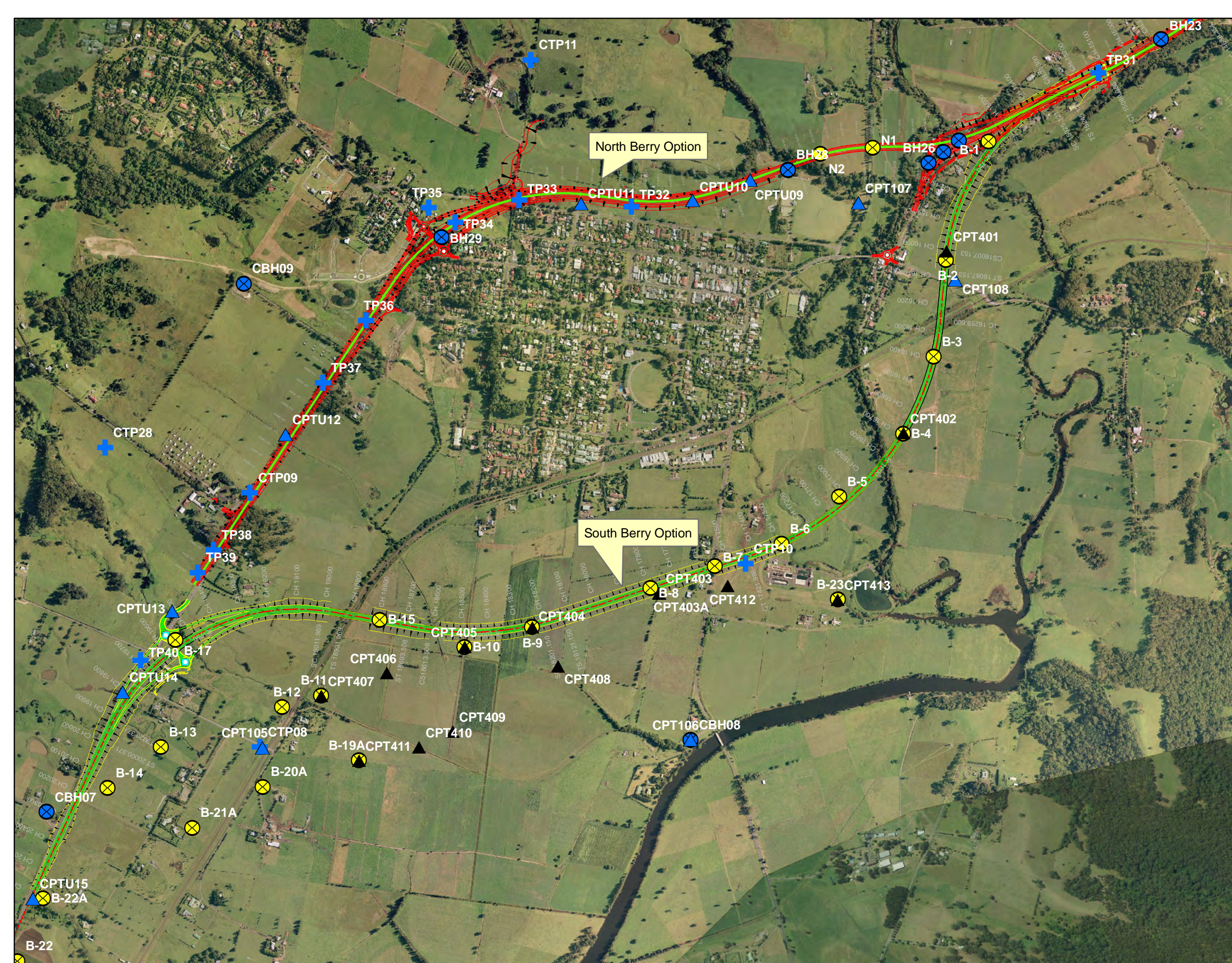
Rely on Coffey for additional assistance

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.



Legend

Pre 2012 Investigation

TYPE

- Borehole
- CPT
- Test Pit

2012 Investigation

- Cone Penetration Testing (CPT)
- Boreholes

SCALES

1:13,000 @ A3



REPORT No. 11-02
 PRINTED DATE 21/05/12

DESIGNED: M. BOYS
 REVIEWED: D. HORAN

FILE PATH
 G:\Operations\Technical Services\Geotech\Projects\11-02
 Foxground and Berry Bypass\South Berry Option\Drawings
 and Plans\GIS

**Berry Bypass, South Berry Option
 Geotechnical Investigation**

**Transport
 Roads & Maritime
 Services**
 Southern Geotechnical Services

SHEET No.
1 OF 4

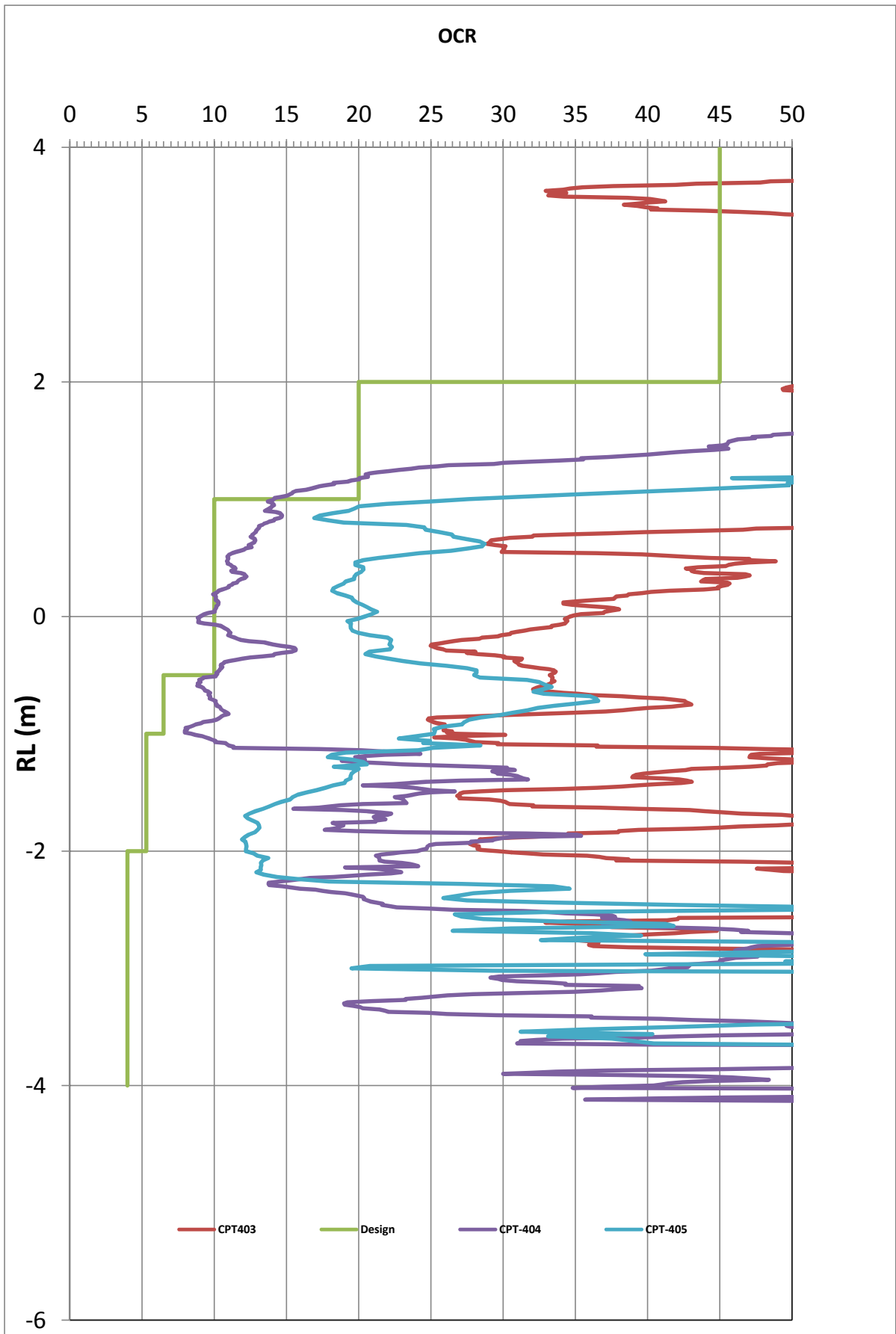


TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID	Action Criteria	B2	B2	B3	B3	B3	B4	B4	B4	B5	B6
		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Texture Category		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Depth (m)		0.5 - 0.95	1.5 - 1.95	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	0.5 - 0.95
pH KCl		4.51	5.04	5.55	5.66	5.41	4.80	4.80	5.14	5.16	4.08
TAA (moles H+/ tonne)*	18 ¹	58.2	41.3	26.7	24.4	30.5	35.2	35.2	22.1	51.6	92.4
S KCl (%)	0.03 ¹	..	..	..	..	..	..	..	..	..	0.008
Scr (%)	0.03 ¹	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potasium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed

TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID	Action Criteria	B6	B6	B7	B7	B7	B7	B8	B8	B8	B9
		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Texture Category		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Depth (m)		1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.65 - 1.25	1.65 - 3.1	3 - 3.45	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95
pH KCl		4.15	4.49	4.59	4.90	4.24	3.69	4.29	4.07	3.90	4.03
TAA (moles H+/ tonne)*	18 ¹	114.5	44.1	83.5	38.0	93.8	99.9	102.7	101.8	91.5	121.5
S KCl (%)	0.03 ¹	0.012	0.007	..	..	0.026	0.008	0.003	0.017	0.008	0.098
Scr (%)	0.03 ¹	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0	<0.01	0.0

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potasium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed

TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID		B9	B9	B11	B11	B12	B12	B13	B13	B13	B17
Media		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Texture Category		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Depth (m)	Action Criteria	1.5 - 1.95	0.5 - 0.95	0.5 - 0.95	1.5 - 1.95	0.5 - 0.95	1.65 - 2.1	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95
pH KCl		4.23	4.61	5.54	5.97	5.05	5.39	6.26	5.74	5.95	5.13
TAA (moles H+/ tonne)*	18 ¹	66.6	27.7	26	16	32.4	26.7	13	16	18	30.0
S KCl (%)	0.03 ¹	0.075	..	..	..	..	..	..	..	..	..
Scr (%)	0.03 ¹	0.0	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	0.0	<0.01	<0.01

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potassium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed

TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID	Action Criteria	B17	B17	B19	B19	B19	B21A	B21A	B21A	B22	B22
		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Texture Category		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Depth (m)		1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.5 - 1.95
pH KCl		5.13	5.70	3.90	5.13	3.91	4.09	4.16	4.73	4.01	3.69
TAA (moles H+/ tonne)*	18 ¹	28.1	24.4	87	30	124	83	61.9	34.7	118.7	104.6
S KCl (%)	0.03 ¹	..	..	0.051	..	0.080	0.009	0.005	..	0.016	0.007
Scr (%)	0.03 ¹	<0.01	<0.01	0.0	<0.01	1.6	<0.01	0.0	0.0	0.0	0.0

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potassium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed

TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID	Action Criteria	B22	B23	B23	B23	N1	N1	N2	N2	B23	B23
		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Media		Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Texture Category		Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine	Fine
Depth (m)		2.5 - 2.95	0.5 - 0.95	1.5 - 1.95	2.5 - 2.95	0.5 - 0.95	1.5 - 1.95	0.5 - 0.95	1.5 - 1.95	0.5 - 0.95	1.5 - 1.95
pH KCl		3.94	4.91	4.35	5.07	4.45	4.83	5.48	5.41	4.91	4.35
TAA (moles H+/ tonne)*	18 ¹	69.9	48.3	67.6	44.6	91.5	37.5	32.4	25.3	48.3	67.6
S KCl (%)	0.03 ¹	0.009	..	0.037	..	0.002	..	..	..	..	0.037
Scr (%)	0.03 ¹	0.0	<0.01	<0.01	<0.01	<0.01	0.0	0.0	<0.01	<0.01	<0.01

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potasium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed

GEOTWOLL03387AA-AA Berry Southern Alignment

TABLE B-1:

SUMMARY OF ASS LABORATORY RESULTS

Sample ID	Action Criteria	B23
		Soil
Media		Fine
Texture Category		2.5 - 2.95
Depth (m)		
pH KCl		5.07
TAA (moles H+ / tonne)*	18 ¹	44.6
S KCl (%)	0.03 ¹	..
Scr (%)	0.03 ¹	<0.01

NOTES:

Bold Concentration exceeds ASSMAC (1998) action level

¹ Based on ASSMAC (1998) Acid Sulfate Soil Manual dependant upon soil texture category.

- Not Analysed

^{TAA} Total Actual Acidity

^{S KCL} Potassium chloride extractable sulfur

^{Scr} Chromium reducible sulfur

¹ Depends on soil texture category

.. test not requested

The above table assumes that more than 1000 tonnes of material is disturbed