DISCLAIMER

This document is provided for information purposes only in connection with the public exhibition of the Planning Proposal to amend the Great Lakes LEP 2014 in respect of increased height of building and maximum floor space ratio controls applying to land in the Forster Civic Precinct Site (Lot 11 - 13 DP 47987).

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COASTPLAN CONSULTING

PROPOSED RESIDENTIAL DEVELOPMENT

CORNER OF LAKE, WEST & MIDDLE STREET, FORSTER

GEOTECHNICAL INVESTIGATION

TA01582/01-AB

20 February 2006

Coffey

TA01582/01-AB-AB NWR
20 February 2006

Coastplan Consulting Pty Ltd
PO BOX 568
FORSTER NSW 2428

Attention: Mark Beauman (MorrisBray Architects)

Dear Sir

RE: PROPOSED RESIDENTIAL DEVELOPMENT
CORNER LAKE, WEST & MIDDLE STREETS, FORSTER
GEOTECHNICAL INVESTIGATION

Please find enclosed our report outlining the geotechnical investigations that were carried out at the above site. The purpose of the investigation work described herein was to assess the geotechnical issues regarding footing system design and basement wall construction / shoring and methods of de-watering the site.

Further discussion on the uses and limitations of this report are presented in the attached document '*Important Information about your Coffey Report*'.

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

For and on behalf of
COFFEY GEOSCIENCES PTY LTD

STEVEN MORTON

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1. INTRODUCTION

This report presents the results of a geotechnical assessment carried out by Coffey Geosciences Pty Ltd (Coffey) for the proposed residential development to be located on the corners of Lake, West and Middle Streets, Forster and occupies an area of 12,340m^2. A site survey plan was provided by Coastplan Consulting Pty Ltd, which forms the basis of Drawing No TA01582/01-1.

The work was commissioned by Simon Carroll of Coastplan Consulting Pty Ltd.

The proposed development is understood to comprise the construction of a residential unit development consisting of approximately 150 – 160 units broken into 5 buildings of 5 storeys each with basement car parking. It is assumed that the basement floor level will require excavation of approximately 2-3m below the natural ground surface.

The purpose of the work was to provide recommendations on the following:

- Site preparation;
- Excavation conditions, including comments on suitable permanent and temporary support for excavations and dewatering;
- Alternative footing or piling types and founding levels, including recommendations as to allowable bearing pressure and probable settlements;
- Special requirements for construction procedures and on-site drainage;
- The suitability of the site soils for use as fill and on fill construction procedures;
- Acid sulfate soil conditions and requirements for an acid sulfate soil management plan;
- On site stormwater disposal systems and dewatering.

The following report presents the results of field investigations and laboratory testing and provides discussion and recommendations relevant to the above scope of work.

2. FIELD WORK

2.1 General

The field investigations were carried out on 19 January 2006 and comprised the following:

- Four Cone Penetrometer Tests (CPT) to assess the subsurface conditions and suitable founding stratum, to a maximum depth of 12.28m;
- Drilling of five hand augered boreholes to identify soil types, obtain soil samples for acid sulfate laboratory testing and perform infiltration testing ;
- Dynamic Cone Penetrometer Tests (DCP's) at each of the five hand augered locations;
- Field mapping of site features, CPT and borehole locations.

The field investigations were carried out in the full time presence of a Geotechnical Engineer from Coffey who located the CPT and borehole locations, nominated sample depths and produced engineering field logs. Falling Head infiltration and permeability testing was conducted adjacent to all boreholes. The engineering logs are presented in Appendix A together with explanation sheets defining the terms and symbols used in their preparation. The CPT and DCP results are also presented in Appendix A.

Borehole and CPT test locations are indicated on Drawing No TA01582/01-1. Ground surface levels at the borehole locations are shown on the logs. The levels were estimated from the contours shown on the supplied survey drawing.

2.2 Infiltration Testing

Infiltration (falling head) testing was carried out at selected locations, adjacent to HA1, HA2, HA3, HA4 and H5, as shown on Drawing No. TA01582/01-1. The results of the infiltration testing are presented in Appendix A, and are summarised below:

TABLE 1 – RESULTS OF INFILTRATION TESTING

TEST LOCATION	HYDRAULIC CONDUCTIVITY K (m / day)	DEPTH TO WATER TABLE (m)
HA1 (INF1)	30.1	2.75
HA2 (INF2)	19.1	> 3.5
HA3 (INF3)	43.7	> 3.5
HA4 (INF4)	13.4	2.75
HA5 (INF5)	13.5	3.05

3. SITE CONDITIONS

3.1 Surface Conditions

The site is located at the corners of Lake, West and Middle Streets, Forster and occupies a total plan area of 12,340m^2. At the time of the field investigation, two small single storey brick buildings and a concrete slab occupied these lots, as shown on Drawing No TA01582/01-1. The site is bounded by Lake Street to the north, Middle Street and the Department of Education and Training to the south, West Street to the west and single storey brick units and the Department of Education and Training to the east.

Topographically, the site is situated on the back slopes of a frontal dune behind Main Beach, with gentle surface slopes towards the South and South-western boundaries of the lot. Drainage of the site was judged to be via infiltration into the upper sandy soil layers, and via existing drains. At the time of the field investigation, the site was vegetated by short grass with a few scattered medium sized to mature trees. Trafficability of the site was good.

3.2 Subsurface Conditions

Based on the 1:250,000 Geological Series Map, the site is judged to be underlain by deep Quaternary Alluvium comprising gravel, sand, silt and clay deposits. The typical subsurface profiles encountered are summarised in Table 2.

TABLE 2 – SUMMARY OF SOIL PROPERTIES

UNIT	DESCRIPTION
1	SAND and Silty SAND, fine to medium grained, grey/dark grey, loose.
2	SAND, medium grained, varying density, generally dense (Indurated?).
3	SAND, medium grained, medium dense.
4	SAND, medium grained, dense to very dense.

Table 3 contains a summary of the distribution of the above units in the boreholes.

TABLE 3 – SUMMARY OF THE SOIL UNITS ENCOUNTERED AT EACH BOREHOLE LOCATION

CPT	UNIT 1	UNIT 2	UNIT 3	UNIT 4
	DEPTH IN METRES			
CPT1	0.0 – 5.0	5.0 – 8.0	8.0 – 10.0	10.0 – 12.2
CPT2	0.0 – 6.4	6.4 – 7.2	7.2 – 8.0	8.0 – 8.7
CPT3	0.0 – 4.2	4.2 – 5.5	5.5 – 6.5	6.5 – 6.7
CPT4	0.0 – 3.0	3.0 – 4.2	4.2 – 5.2	5.2 – 5.8

The water table was encountered in boreholes HA1, HA4 and HA5 at depths ranging between 2.75m and 3.05m below the existing surface level. Monitoring of water levels for adjacent developments has indicated ground water levels generally ranging from RL 1.2m to RL 3.2m.

From previous experience in the area and the CPT results it is expected that a layer of indurated sand or 'Coffee Rock" will be encountered at depths ranging between 2m to 7m below the existing surface level. Previous investigations in the area indicate that the indurated sand is a layer of inconsistent density which occurs at variable depths. The cone penetrometer test results from the current investigation also indicate the variable nature of this layer (Unit 2), which is typically very dense at the upper surface, but of variable density below this level dependent on the degree of induration and cementation of the sands.

The depths of CPT refusal for the current investigation are summarised in Table 4.

TABLE 4 - DEPTH OF INVESTIGATION AT EACH CPT LOCATION

TEST LOCATION	MAXIMUM DEPTH (m)
CPT1	12.28
CPT2	8.74
CPT3	6.68
CPT4	5.82

4. LABORATORY TESTING

Samples obtained during the field investigation were returned to Coffey's NATA accredited Newcastle Laboratory for testing. Samples not tested were stored for possible future reference and will be held for three months prior to disposal. Samples selected for testing are discussed in Section 5.

5. DISCUSSION AND RECOMMENDATIONS

5.1 Acid Sulfate Soils Assessment

5.1.1 Scope of work

The Acid Sulfate Soils (ASS) assessment has involved the following steps:

- Reference to the Forster Acid Sulfate Soils Risk Map (1:25,000 scale, 1995 edition) published by the Soil Conservation Service of NSW;
- Five hand augered boreholes were drilled to a maximum depth of 3.5m. Samples obtained were tightly sealed in plastic bags, placed on ice in the field and maintained on ice during transport to Coffey's NATA accredited Newcastle laboratory;
- pH and accelerated (Hydrogen Peroxide, H2O2) oxidation screening tests were performed on seven samples recovered from the field, in accordance with laboratory test methods 21Af and 21Bf presented in the ASSMAC Acid Sulfate Soil Manual (August 1998 and revisions);

The results of ASS screening laboratory testing are presented in Appendix B and are discussed in the following pages.

5.1.2 Background information

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

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 2m 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 (that is 10,000 years ago to present day), predominantly in the 7,000 years since the last rise in sea level. It is generally considered pyritic soils that formed prior to the Holocene period (that is more than 10,000 years ago) would already have oxidised and leached during periods of low sea level occurring at or around the time of the ice ages.

5.1.3 Significance of ASS

Disturbance or poorly managed development or use of acid sulfate soils can generate significant amounts of sulfuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid 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 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 can have detrimental effect on aquatic ecosystems.

5.1.4 Acid Sulfate Soils Risk Map

Reference to the Acid Sulfate Soils Risk Map of Forster (Reference 9433s4) indicates the site has a low probability of acid sulfate soils which if present, would be expected to occur at depths greater than 3m below the ground surface. The map indicates the site to be underlain by windblown (Aeolian) sand deposits, and sedimentary deposits associated with an estuarine tidal flat.

5.2 Screening Tests

Samples obtained during the field investigation were screened for the presence of actual and potential acid sulfate soils using methods 21Af and 21Bf of the 1998 ASSMAC Guidelines. The test results are attached, and revealed the following:

- pH values in 1:5 soil to distilled water mix ranging from 6.88 to 7.47. A pH of <4 in this test can indicate the presence of actual ASS;
- pH values of soil in 30% H_2O_2 were between 4.76 and 5.09. A pH of <3 in this test can indicate the presence of potential ASS;
- A maximum pH change of 2.51 after oxidation with H_2O_2 was recorded. Significant pH changes (>2) after oxidation with H_2O_2 can indicate potential ASS;
- No visible effervescence was observed in the samples tested. Vigorous (effervescent) reactions with oxidation in 30% H_2O_2 can indicate potential ASS;
- No obvious odours were released upon oxidation with H_2O_2. A sulphurous odour is often associated with oxidising potential ASS;
- Temperatures of 23.7°C to 24.5°C were recorded in all H_2O_2 oxidation screening tests. Generally the oxidation of significant quantities of pyrite in this test will elevate temperatures to >60 °C.

5.3 Laboratory Analysis

Laboratory test results attached, and are summarised in Table 5.

TABLE 5 - ACID SULFATE SOILS (ASS) TEST RESULTS

SAMPLE LOCATION	DEPTH (metres)	SCREENING TEST	
		pH_F	pH_{FOX}
HA1	3.0 – 3.1	7.05	4.84
HA1	3.4 – 3.5	7.10	4.95
HA2	3.4 – 3.5	7.47	4.46
HA3	3.4 – 3.5	7.22	5.09
HA4	3.4 – 3.5	6.88	4.76
HA5	3.1 – 3.2	6.79	4.81
HA5	3.4 – 3.5	7.01	4.91
Levels of Concern for Screening Test	-	<4	<3

5.4 Conclusion

Results of the Acid Sulfate Soils (ASS) screening tests indicate that the samples tested were not actual or potential ASS. As a result, it was concluded that there was no need for a detailed ASS analysis and assessment. An ASS Management Plan would not be required for development of this site.

5.5 Excavation Conditions and Stability

It is anticipated that excavations for the proposed basement area would be achieved using conventional excavator, which should be equipped with a smooth bladed ('gummy") bucket to avoid over-disturbance of the site soils below the required bulk excavation level. Excavations below the water table should be avoided due to collapsing of wet sands, unless dewatering is undertaken.

Care must be taken not to cause relaxation of ground supporting nearby structures during excavation of the proposed basement area. Measures involving temporary earthworks batters or shoring systems should be employed until permanent retaining systems are constructed. Permanent and temporary earthworks batters may be formed at angles no steeper than 2H:1V. Temporary and permanent retaining options include contiguous bored piles and sheet piles.

Retaining walls may be designed for an active earth pressure coefficient (Ka) of 0.30 and a passive earth pressure coefficient (Kp) of 3.3.

Retaining walls, basement walls and temporary shoring should be designed for surcharge loading from slopes or structures behind the walls. All retaining walls should be constructed with granular, free draining backfill with adequate surface and subsurface drainage.

5.6 Water Table

Based on the results obtained during the field work, groundwater levels at the present time are at a depth of 2.75m or greater below the existing surface level.

Depth to water table is variable due to existing surface levels, rainfall and other influences including permeability, regional groundwater flow, recharge areas, surface condition, infiltration areas and subsoil drainage. In the absence of long term monitoring which extends over an extreme rainfall event, the basement should be designed for a 1m rise in water level above the highest observed water level in the area, which is equivalent to approximately RL 1.85m to 3.89m AHD.

Therefore some dewatering and shoring or permanent support may be required during construction. Dewatering of the excavations could be achievable using a sump and pump arrangement or localised spear points surrounding the site or local excavations. Past experience has found both such arrangements to be successful on sites with similar indurated sand profiles. A contingency plan for the spear points should be considered in the event that the spears penetrate the indurated sand into the underlying high permeability sands. Unless general site dewatering is required spears should not exceed 4m depth and should be sized and spaced in a configuration designed on the basis of the permeability values outlined in this report.

5.7 Dewatering

5.7.1 Regulatory Background and Applicable Guidelines

For assessing groundwater quality, it is first necessary to assess the beneficial uses of groundwater downgradient of the site being assessed.

Given the proximity of the site to Wallis Lake, it is considered unlikely that groundwater will be used before discharging to Wallis Lake. Therefore it is considered that there are no potential beneficial uses of the groundwater prior to discharge to Wallis Lake. Wallis Lake sustains aquatic ecosystems and is also used for recreational purposes.

The threshold concentrations presented in the ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* are considered applicable for the protection of aquatic ecosystems of the receiving waters. As these guidelines apply to receiving waters, it is generally conservative to apply these to groundwater discharging to receiving waters.

ANZECC (2000) advocates a site-specific approach to developing guideline trigger values based on such factors as local biological affects data, the current level of disturbance of the ecosystem etc. The guidelines present 'low risk guidelines trigger values' which are defined as concentrations of key performance parameters below which there is a low risk that adverse biological affects will occur.

It is important to note that these are not threshold values at which an environmental problem is likely to occur if exceeded. Rather, these values trigger two possible responses. The first response, to continue monitoring, occurs if the measured value is less than the trigger value, showing that there is a 'low risk' that a problem exists. The alternative response, either further site-specific investigations to assess whether or not there is an actual problem or a need for management/remedial action, occurs if the trigger value is exceeded suggesting that a 'potential risk' exists.

Low risk trigger values are provided for the protection of 80-99% of species in marine and fresh waters (presented in Table 3.4.1 of the guidelines), with the trigger value depending on the 'health of the receiving waters.

It is noted that Wallis Lake is tidal in the general area where it is expected the site groundwater would discharge. It is therefore considered that the marine water trigger values are relevant as against the fresh water criteria. It is understood that the EPA's policy is that the trigger values for the protection of 95% of aquatic ecosystems should be used. Therefore, we have selected trigger values for protection of 95% of marine water species for initial comparison purposes.

ANZECC (2000) state that there is currently insufficient data to derive a high reliability trigger value for TPH but propose a low reliability trigger value for TPH of 7μg/L. This guideline is generally considered by industry to be overly conservative and is also well below the TPH detection limit that most laboratories can achieve. Another commonly internationally used guideline for TPH is contained in Dutch (1994), which present a target and intervention values for mineral oils. The intervention value is 325μg/L, and this value will be used for TPH in this assessment.

Guidelines for the recreational water use are presented in ANZECC (2000) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Table 5.2.3 of the guidelines).* For the chemicals of concern at the site, these guidelines are less sensitive than the aquatic ecosystem guidelines.

5.7.2 Conclusions

It is understood that the Great Lakes Council would prefer any water collected during the dewatering process on a construction site be re-injected into the groundwater table on site. It is considered that the limited amount of space around the areas of the site under construction will preclude Coastplan Consulting from being able to re-inject water. As such, it is recommended that groundwater collected during the dewatering process be disposed of off-site to stormwater. For such disposal, testing of any discharge water would be required and advice should be sought by Coffey Geosciences.

5.8 Site Preparation & Re-use of Materials

Site preparation for structure or pavement support should consist of the following:

- Areas for proposed structures, pavements or controlled fill placement should be stripped to remove all vegetation, non-controlled fill, topsoil, root affected or other potentially deleterious materials, which may either be disposed to spoil or stockpiled for later landscaping purposes only;
- Following stripping, the exposed subgrade should be proof rolled to identify any wet or excessively deflecting material. All such areas should be over-excavated and replaced with a clean sand or other approved material;
- At design subgrade level for pavements or surface structures, the surface should be compacted for a depth of at least 1m to a minimum density index of 70% (AS1289 5.6.1). Compaction should be confirmed by penetrometer testing prior to placement of pavement materials or pouring of concrete for foundations;
- The top 300mm of subgrade below general pavement areas should be compacted to a minimum density index of 80% (AS1289 5.6.1);
- If site regrading is to occur or existing trees are to be removed, then approved clean sand fill should be compacted to a minimum density index of 70% (AS1289 5.6.1) in maximum lifts of 0.5m depth;
- Controlled fill should be battered at maximum slopes of 1V:2H or flatter, or be supported by properly designed and constructed retaining walls;
- Following bulk excavation to design sub-floor level, the surface should be inspected for trafficability. Due to the potential for wet sands, allowance should be made for over excavation and placement of a 300mm coarse granular working platform of select quality fill such as quarry overburden or similar;
- Based on the results of subsurface investigations, it is anticipated the majority of soils excavated from the proposed basement area would be suitable for re-use as fill for the building area including re-use as backfill for retaining wall structures;

- Earthworks should be carried out in accordance with the recommendations outlined in AS3798-1996, 'Guidelines on Earthworks for Commercial and Residential Developments'.

5.9 Foundations

5.9.1 High Level Footings

The proposed development will consist of a number of five storey residential developments, with excavation for a part basement car park required.

Following bulk excavation, the material to be exposed over the majority of the building footprint will comprise loose to medium dense sands within about 1m to 4.5m of the dense sand layer ('Coffee Rock').

Shallow footings (eg. Strip, pad footings or raft slabs) may be founded on the very dense sands only. Due to the profile consisting of loose to medium dense sands below the water table, use of high level footings would not be considered practical for this site.

5.9.2 Foundation Design Parameters

For pier or pile support of the proposed unit development, some suitable options may include:

- Displacement 'Atlas' Screw Piles founded into dense sands;
- 'Steel' Screw Piles founded into dense sands;
- Non-Displacement Grout Injected (CFA) Piles founded into dense sands;
- Driven Displacement Hardwood or Precast Concrete piles into dense sand;

It is recommended that piled foundations be taken below the level of the indurated sand and subsequent sand layers of variable density, and be founded in the underlying Unit 4 dense to very dense sands below a depth of approximately 5.5m to 12m from the existing ground surface level at the time of this investigation. Design parameters have been provided in Table 6 for founding at a depth of 5.5 to 12m where dense sands or better are expected.

It should be noted that steel screw piles may not have enough capacity to penetrate through the upper surface of the indurated sand and extend down to the level of the dense to very dense sands.

Driven displacement piles carry the risk of causing vibration induced damage to adjacent buildings or structures. Dilapidation surveys would be required on all structures within 50m of the site. Driven piles may require pre-drilling through the upper indurated sand to ensure the piles are founded in the dense sand below the lower clayey layer.

Piles should not be founded within three diameters of the low density sand and clay layers between approximately 4m and 9.5m depth. Settlement of piles founded above the 9m level should be assessed once pile loads are known.

Piles founded in the dense sands may be proportioned for the following ultimate capacities in accordance with AS2159-1995, 'Piling – Design & Installation'.

TABLE 7 - PILE DESIGN - ULTIMATE STRENGTH PARAMETERS

PILE TYPE	ULTIMATE END BEARING (f_b) (MPa)	ULTIMATE SIDE ADHESION (f_s) (kPa)
Non Displacement Piles - Grout Injected (CFA) Pile	5.5 MPa	45 kPa
Displacement Piles - 'Atlas' Screw Piles - Steel Screw Piles*	10 MPa 10 MPa	85 kPa Refer to supplier
* *Parameters to be proved by pile load tests*		

A geotechnical reduction factor ($Ø_g$) of 0.50 should be applied to all ultimate capacities quoted above to obtain limit Geotechnical Design Strengths for single piles. Bored non-displacement piles should be closely supervised by experienced persons to ensure adequate construction practices are followed.

These recommendations do not preclude the use of established correlations for specific pile types and may be upgraded by carrying out pile load testing.

6. CONSTRUCTION RISK

The extent of testing associated with this assessment is limited to discrete borehole locations and variations in ground conditions can occur between and away from such locations. If conditions other than those described in this report are encountered during construction, further advice should be sought without delay.

Further discussion on the uses and limitations of this assessment is presented in the attached document, '*Important Information about your Coffey Report*'.

For and on behalf of

COFFEY GEOSCIENCES PTY LTD

STEVEN MORTON

REFERENCES:

1. Ahern, CR, Stone, Y and Blunden, B (1998), 'Acid Sulfate Soils Assessment Guidelines'. Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW.

Information

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 the subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

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

Your report will only give preliminary recommendations

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

Your report is prepared for specific purposes and persons

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

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 have incorporated the report findings.

Data should not be separated from the report*

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

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

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

Responsibility

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

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

TA01582/01-AB-AB
20 February 2006

APPENDIX A

Results of Field Investigations

Coffey

Soil Description

Explanation Sheet (1 of 2)

Coffey

DEFINITION:

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

Other materials are described using rock description terms.

CLASSIFICATION SYMBOL & SOIL NAME

Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2

PARTICLE SIZE DESCRIPTIVE TERMS

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

MOISTURE CONDITION

Dry Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.

Moist Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.

Wet As for moist but with free water forming on hands when handled.

CONSISTENCY OF COHESIVE SOILS

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

DENSITY OF GRANULAR SOILS

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

MINOR COMPONENTS

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

SOIL STRUCTURE

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

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

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

TRANSPORTED SOILS

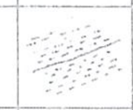
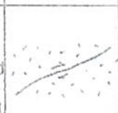
Aeolian soil	Deposited by wind.
Alluvial soil	Deposited by streams and rivers.
Colluvial soil	Deposited on slopes (transported downslope by gravity)
Fill	Man made deposit. Fill may be significantly more variable between tested locations than naturally occurring soils.
Lacustrine soil	Deposited by lakes.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

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

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

• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.

COMMON DEFECTS IN SOIL

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

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

Rock Description

Explanation Sheet (1 of 2)

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

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

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

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering or penetrative fabric (eg. bedding, cleavage etc.) are:
Massive	No layering or penetrative fabric.
Indistinct	Layering or fabric just visible. Little effect on properties.
Distinct	Layering or fabric is easily visible. Rock breaks more easily parallel to layering or fabric.

CLASSIFICATION OF WEATHERING PRODUCTS

Term	Abbreviation	Definition
Residual Soil	RS	Soil derived from the weathering of rock, the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely Weathered Material	XW	Material is weathered to such an extent that it has soil properties, ie. it either disintegrates or can be remoulded in water. Original rock fabric still visible.
Highly Weathered Rock	HW	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
Moderately Weathered Rock	MW	The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable.
Slightly Weathered Rock	SW	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance.
Fresh Rock	FR	Rock substance unaffected by weathering.

Notes on Weathering:

1. *AS1726 suggests the term "Distinctly Weathered" (DW) to cover the range of substance weathering conditions between XW and SW. For projects where it is not practical to delineate between HW and MW or it is judged that there is no advantage in making such a distinction, DW may be used with the definition given in AS1726.*
2. *Where physical and chemical changes were caused by hot gasses and liquids associated with igneous rocks, the term "altered" may be substituted for "weathering" to give the abbreviations XA, HA, MA, SA and DA.*

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbreviation	Point Load Index, I_s50 (MPa)	Field Guide
Very Low	VL	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	L	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm blows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	EH	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

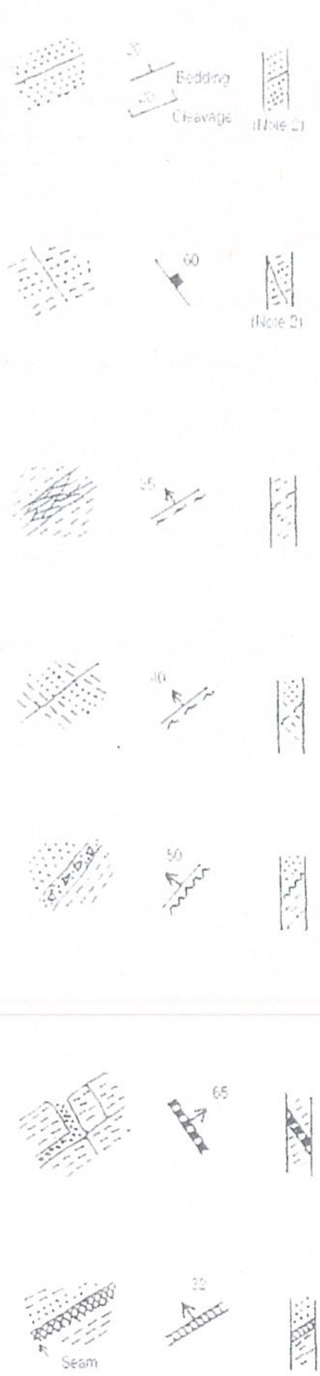
Notes on Rock Substance Strength:

1. *In anisotropic rocks the field guide to strength applies to the strength perpendicular to the anisotropy. High strength anisotropic rocks may break readily parallel to the planar anisotropy.*
2. *The term "extremely low" is not used as a rock substance strength term. While the term is used in AS1726-1993, the field guide therein makes it clear that materials in that strength range are soils in engineering terms.*
3. *The unconfined compressive strength for isotropic rocks (and anisotropic rocks which fail across the planar anisotropy) is typically 10 to 25 times the point load index (Is50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.*

COMMON DEFECTS IN ROCK MASSES

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

Diagram | Map Symbol | Graphic Log (Note 1)



DEFECT SHAPE TERMS

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

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

ROUGHNESS TERMS

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

COATING TERMS

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

BLOCK SHAPE TERMS

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

Notes on Defects:

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

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Client:	COASTPLAN CONSULTING	Borehole No.	HA 1
Principal:		Sheet	1 of 1
Project:	PROPOSED RESIDENTIAL DEVELOPMENT	Office Job No.:	TA01582/01
Borehole Location:	CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER	Date started:	19.1.2006
		Date completed:	19.1.2006
		Logged by:	NWR
		Checked by:	

drill model and mounting:	Hand Auger	Easting:		slope:	-90°	R.L. Surface:	3.6
hole diameter:	100 mm	Northing		bearing:		datum:	AHD

drilling information / **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
HA		N			3.5	0.0		SM	TOPSOIL: Silty SAND, fine to medium grained, grey/dark grey.	M			TOPSOIL
					3.0	0.5							
						~0.8		SP	SAND: medium grained, grey.				AEOLIAN
					2.5	1.0		SP	SAND: medium grained, white.				
					2.0	1.5							
					1.5	2.0							
						~2.3		SP	SAND: medium grained, white/grey mottled.				AEOLIAN / ALLUVIUM
					1.0	2.5							
			▼ 12:00pm			~2.8				W			
				D	0.5	3.0							
				D		3.5							
					0.0				Borehole HA 1 terminated at 3.5m				
						4.0							

method
- AS auger screwing*
- AD auger drilling*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- B blank bit
- V V bit
- T TC bit
- *bit shown by suffix e.g. ADT

support
- M mud
- N nil
- C casing

penetration
1 2 3 4 — no resistance ranging to refusal

water
- 10/1/98 water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- V vane shear (kPa)
- P pressuremeter
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

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

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

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Borehole No.	*HA 2*
Sheet	1 of 1
Office Job No.:	*TA01582/01*
Date started:	*19.1.2006*
Date completed:	*19.1.2006*
Logged by:	*NWR*
Checked by:	

Coffey

Client:	*COASTPLAN CONSULTING*
Principal:	
Project:	*PROPOSED RESIDENTIAL DEVELOPMENT*
Borehole Location:	*CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER*

drill model and mounting:	Hand Auger	Easting:		slope:	-90°	R.L. Surface:	5.2
hole diameter:	100 mm	Northing		bearing:		datum:	AHD

drilling information / **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material (soil type: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency/density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
HA		N	None Observed		5.0	0.0–0.5		SM	**TOPSOIL:** Silty SAND, fine to medium grained, grey/dark grey.	M			TOPSOIL
					4.5	0.5–1.4		SP	**SAND:** medium grained, grey.				AEOLIAN
					4.0, 3.5, 3.0	1.4–2.5		SP	**SAND:** medium grained, white.				AEOLIAN / ALLUVIAL
				D (approx. 3.0 m)	2.5, 2.0	2.5–3.5		SP	**SAND:** medium grained, white/grey mottled.				
				D (approx. 3.4 m)		(approx. 3.3 m)				W			
					1.5	3.5			Borehole HA 2 terminated at 3.5m				
						4.0							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit
*bit shown by suffix	
e.g.	ADT

support

M mud N nil
C casing

penetration

1 2 3 4 — no resistance ranging to refusal

water

10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description

based on unified classification system

moisture

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

consistency/density index

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

Form GEO 5.3 Issue 3 Rev.2 BOREHOLE TA01582-01.GPJ COFFEY.GDT 24.02.06

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Borehole No.	HA 3
Sheet	1 of 1
Office Job No.:	TA01582/01
Date started:	19.1.2006
Date completed:	19.1.2006
Logged by:	NWR
Checked by:	

Client: COASTPLAN CONSULTING

Principal:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Borehole Location: CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER

drill model and mounting: Hand Auger	Easting:	slope: -90°	R.L. Surface: 5.6		
hole diameter: 100 mm	Northing	bearing:	datum: AHD		

drilling information / **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material (soil type: plasticity or particle characteristics, colour, secondary and minor components)	moisture condition	consistency/density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
HA		N	None Observed		5.5			SM	**TOPSOIL:** Silty SAND, fine to medium grained, grained, grey/pale grey.	M			TOPSOIL
					5.0	0.5		SP	**SAND:** medium grained, pale grey.				AEOLIAN
					4.5	1.0							
								SP	**SAND:** medium grained, white.				AEOLIAN / ALLUVIAL
					4.0	1.5							
					3.5	2.0							
					3.0	2.5							
				D	2.5	3.0							
				D		3.5							
					2.0				Borehole HA 3 terminated at 3.5m				
						4.0							

method

AS	auger screwing*
AD	auger drilling*
RR	roller/tricone
W	washbore
CT	cable tool
HA	hand auger
DT	diatube
B	blank bit
V	V bit
T	TC bit

*bit shown by suffix e.g. ADT

support: M mud, N nil, C casing

penetration: 1 2 3 4 — no resistance ranging to refusal

water: 10/1/98 water level on date shown; water inflow; water outflow

notes, samples, tests

U_{50}	undisturbed sample 50mm diameter
U_{63}	undisturbed sample 63mm diameter
D	disturbed sample
N	standard penetration test (SPT)
N*	SPT - sample recovered
Nc	SPT with solid cone
V	vane shear (kPa)
P	pressuremeter
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

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

consistency/density index

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

Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Borehole No.	HA 4
Sheet	1 of 1
Office Job No.:	TA01582/01
Date started:	19.1.2006
Date completed:	19.1.2006
Logged by:	NWR
Checked by:	

Client: COASTPLAN CONSULTING

Principal:

Project: PROPOSED RESIDENTIAL DEVELOPMENT

Borehole Location: CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER

Coffey

drill model and mounting:	Hand Auger	Easting:	slope: -90°	R.L. Surface:	5.6
hole diameter:	100 mm	Northing	bearing:	datum:	AHD

drilling information / material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
HA		N			5.5			SM	**TOPSOIL:** Silty SAND, fine to medium grained, grey/dark grey.	M			TOPSOIL
					5.0	0.5		SP	**SAND:** medium grained, grey.				AEOLIAN
					4.5	1.0							
					4.0	1.5		SP	**SAND:** medium grained, white.				AEOLIAN / ALLUVIAL
					3.5	2.0		SP	**SAND:** medium grained, off white.				
					3.0	2.5							
			▼										
				D	2.5	3.0							
				D		3.5							
					2.0				Borehole HA 4 terminated at 3.5m				
						4.0							

method
AS auger screwing*
AD auger drilling*
RR roller/tricone
W washbore
CT cable tool
HA hand auger
DT diatube
B blank bit
V V bit
T TC bit
*bit shown by suffix
e.g. ADT

support
M mud N nil
C casing

penetration
1 2 3 4
no resistance ranging to refusal

water
10/1/98 water level on date shown
water inflow
water outflow

notes, samples, tests
U_{50} undisturbed sample 50mm diameter
U_{63} undisturbed sample 63mm diameter
D disturbed sample
N standard penetration test (SPT)
N* SPT - sample recovered
Nc SPT with solid cone
V vane shear (kPa)
P pressuremeter
Bs bulk sample
E environmental sample
R refusal

classification symbols and soil description
based on unified classification system

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

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

BOREHOLE TA01582-01.GPJ COFFEY.GDT 24.02.06

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Coffey Geosciences Pty Ltd ACN 056 335 516

Engineering Log - Borehole

Borehole No. *HA 5*

Sheet 1 of 1

Office Job No.: *TA01582/01*

Client: *COASTPLAN CONSULTING*

Principal:

Project: *PROPOSED RESIDENTIAL DEVELOPMENT*

Borehole Location: *CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER*

Date started: *19.1.2006*

Date completed: *19.1.2006*

Logged by: *NWR*

Checked by:

Coffey

drill model and mounting: Hand Auger | Easting: | slope: -90° | R.L. Surface: 5.1

hole diameter: 100 mm | Northing | bearing: | datum: AHD

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency/density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
HA		N			5.0			SM	TOPSOIL: Silty SAND, fine to medium grained, grey/pale grey	M			TOPSOIL
					4.5	0.5		SP	SAND: medium grained, pale grey.				AEOLIAN
					4.0	1.0		SP	SAND: medium grained, off white.				AEOLIAN / ALLUVIAL
					3.5	1.5							
					3.0	2.0							
					2.5	2.5							
			▼	D	2.0	3.0				W			ALLUVIAL
				D		3.5			Borehole HA 5 terminated at 3.5m				
					1.5	4.0							

method
- AS auger screwing*
- AD auger drilling*
- RR roller/tricone
- W washbore
- CT cable tool
- HA hand auger
- DT diatube
- B blank bit
- V V bit
- T TC bit
- *bit shown by suffix
- e.g. ADT

support
- M mud
- N nil
- C casing

penetration 1 2 3 4 — no resistance ranging to refusal

water
- ▼ 10/1/98 water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U_{50} undisturbed sample 50mm diameter
- U_{63} undisturbed sample 63mm diameter
- D disturbed sample
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- V vane shear (kPa)
- P pressuremeter
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description
based on unified classification system

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

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

Coffey Geosciences Pty Ltd A.C.N. 056 335 516 JAN23-06

Geotechnical | Resources | Environmental | Technical | Project Management

1/4 Douglas Avenue, Tuncurry, NSW, 2428
Ph: (02) 6555 8554 Fax: (02) 6555 7849

Coffey

dynamic penetrometer test results

client :	COASTPLAN CONSULTING	job no :	TA01582/01
principal :		laboratory :	TAREE
project :	PROPOSED RESIDENTIAL DEVELOPMENT	report date :	January 23, 2006
location :	CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER	test report :	JAN23-06/1
test procedure :	AS1289 6.3.2 Cone Tip and 6.3.3 Blunt Tip	test date :	14-01-06

readings recorded in blows per 150mm

depth below surface (mm)	test numbers 1	2	3	4	5				test locations/remarks
150	1	5	1	2	3				
300	1	3	1	5	5				
450	2	5	2	9	9				
600	2	6	2	11	9				
750	2	4	2	9	6				
900	2	4	2	7	3				
1050	2	4	3	6	3				
1200	3	5	2	4	5				
1350	4	6	4	5	6				
1500	7	7	4	5	7				
1650	10	9	5	6	7				
1800	16	8	4	7	6				
1950	18	9	5	6	7				
2100		10	6	6	5				
2250		11	7	6	8				
2400		16	5	5	7				
2550			5	5	10				
2700			7	5	14				
2850			8	7	18				
3000			8	10					
3150			12	11					
3300			14	13					
3450			18						
3600									
3750									
3900									
4050									

General Information :

AS1289 6.3.2 Cone Tip
AS1289 6.3.3 Blunt Tip

NATA Accredited Laboratory No. 431

Authorised Signature:

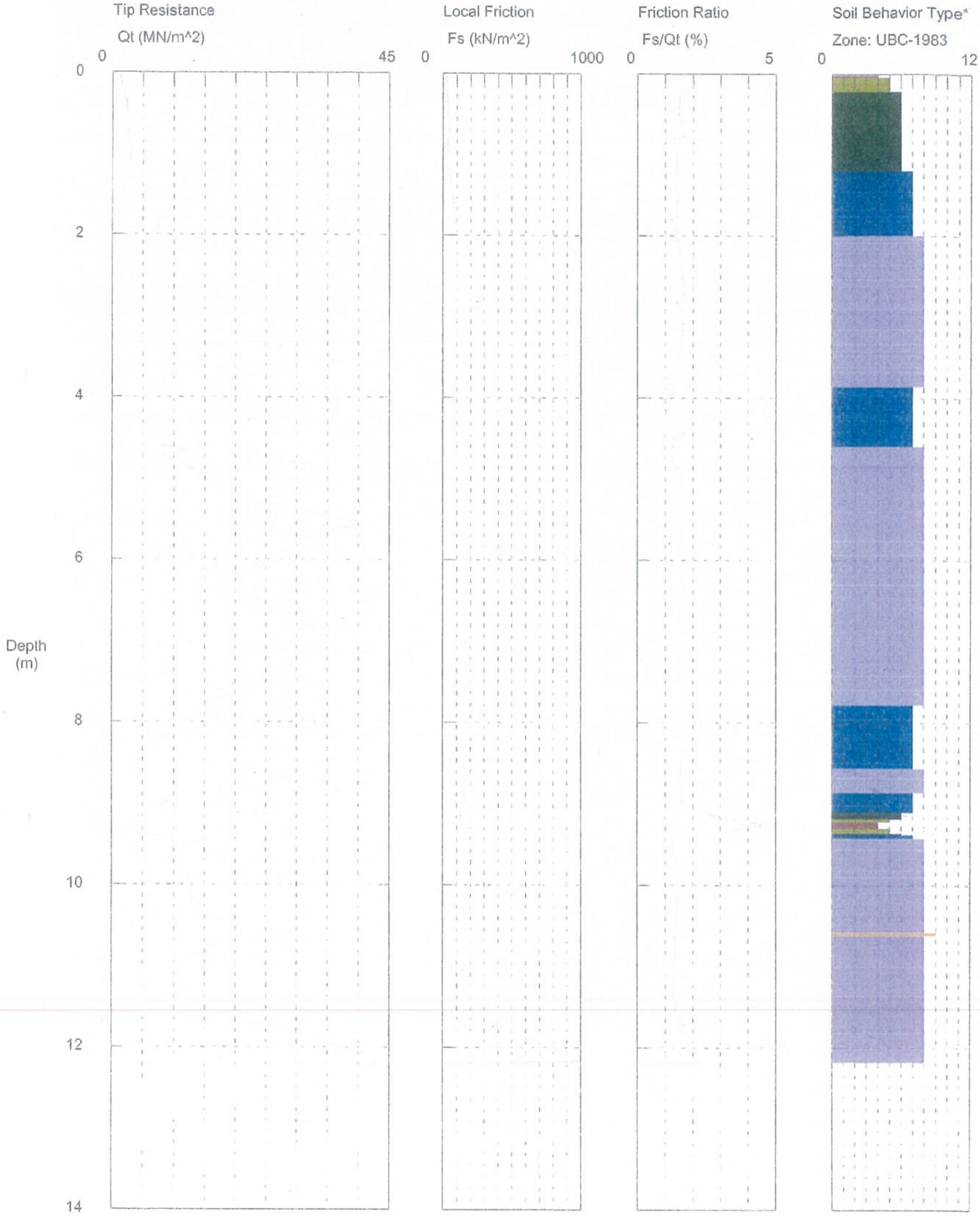
Alan Cullen

Date : 23 January 2006

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Fos-01
Cone Used: 10T3CH

CPT Date/Time: 01-18-06 22:50
Location: Foster
Job Number: 248



Maximum Depth = 12.28 meters

Depth Increment = 0.020 meters

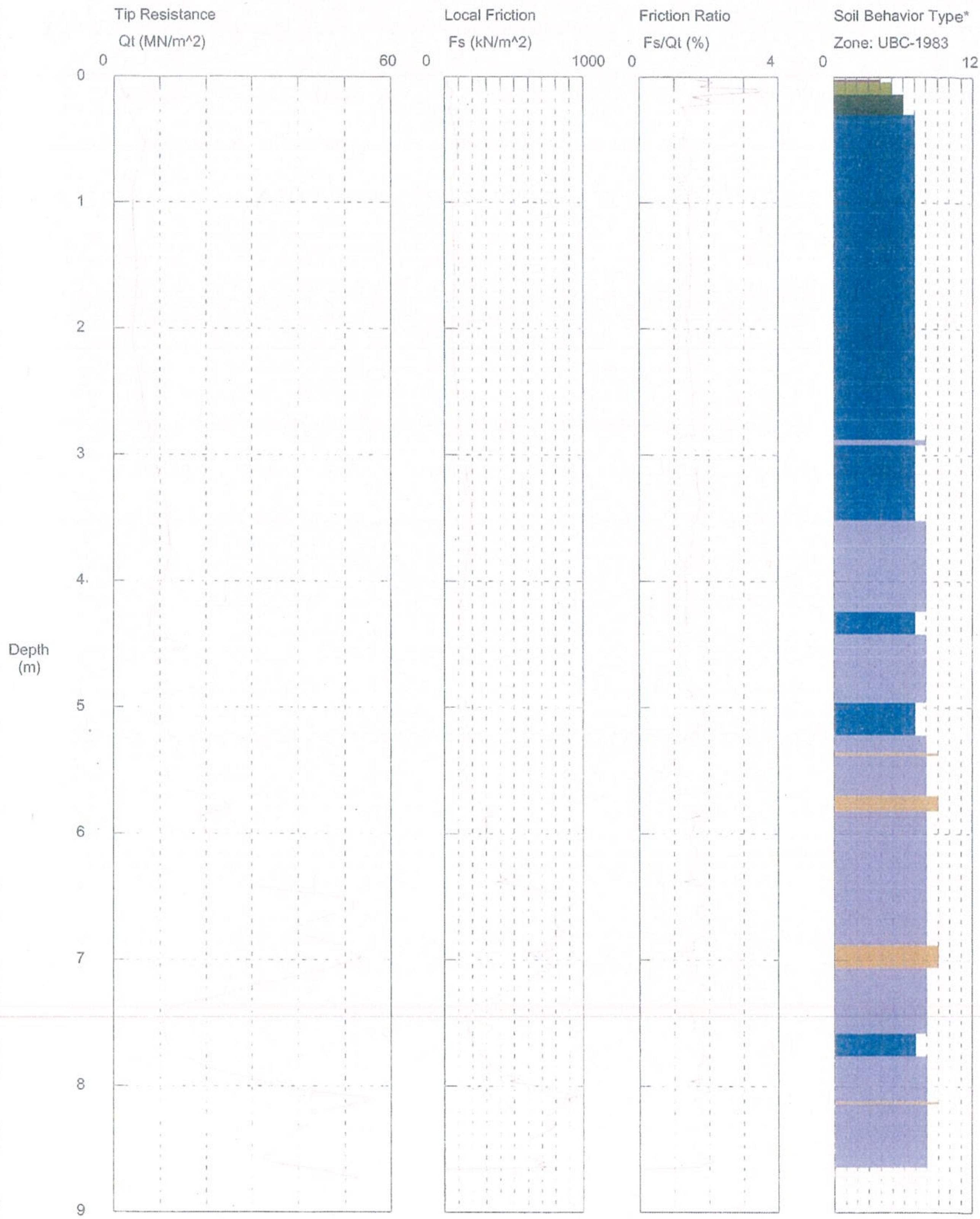
1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

›il behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Fos-02
Cone Used: 10T3CH

CPT Date/Time: 01-18-06 23:49
Location: Foster
Job Number: 248



Maximum Depth = 8.74 meters

Depth Increment = 0.020 meters

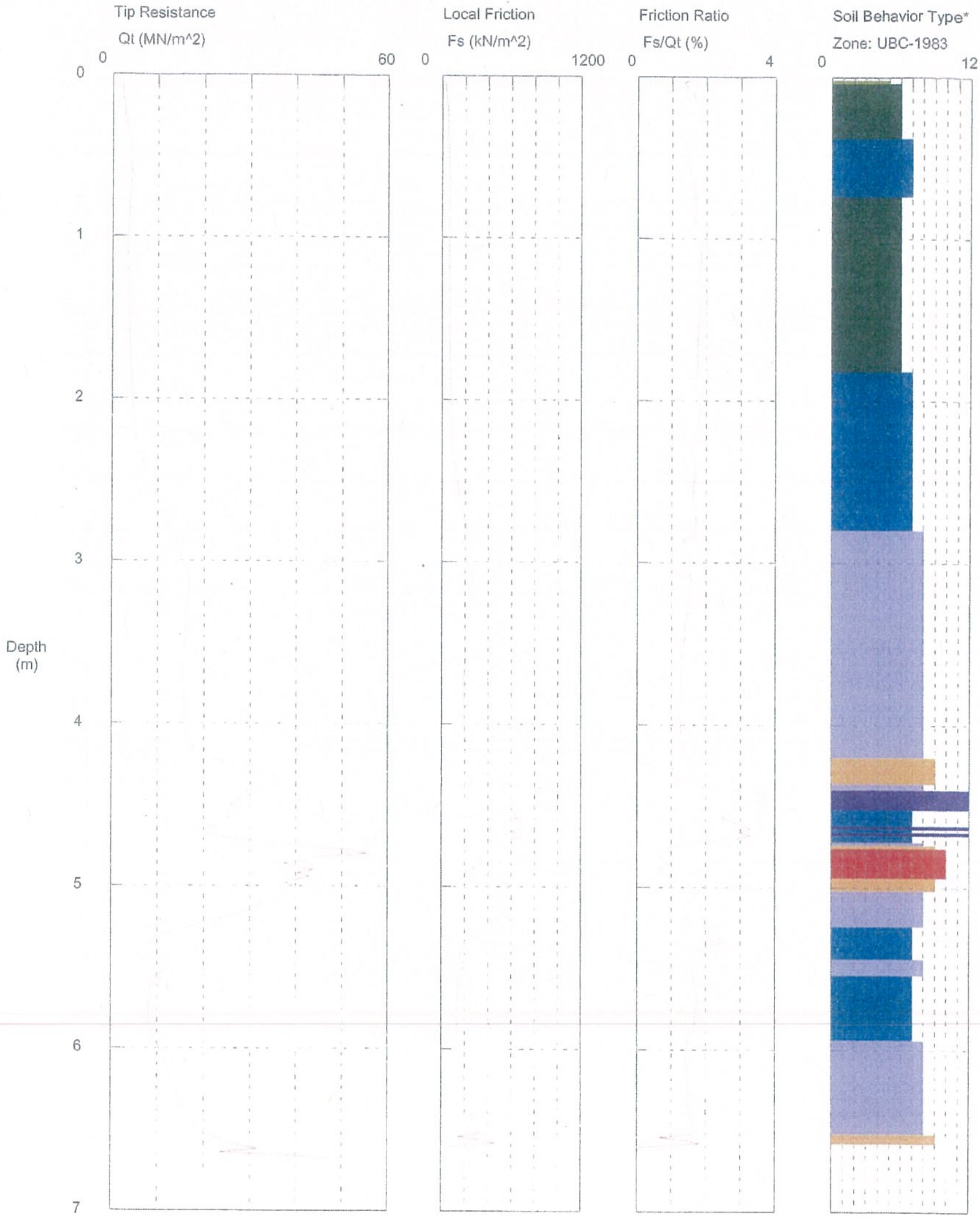
1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

›il ‑‑havior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Fos-03
Cone Used: 10T3CH

CPT Date/Time: 01-19-06 00:20
Location: Foster
Job Number: 248



Maximum Depth = 6.68 meters

Depth Increment = 0.020 meters

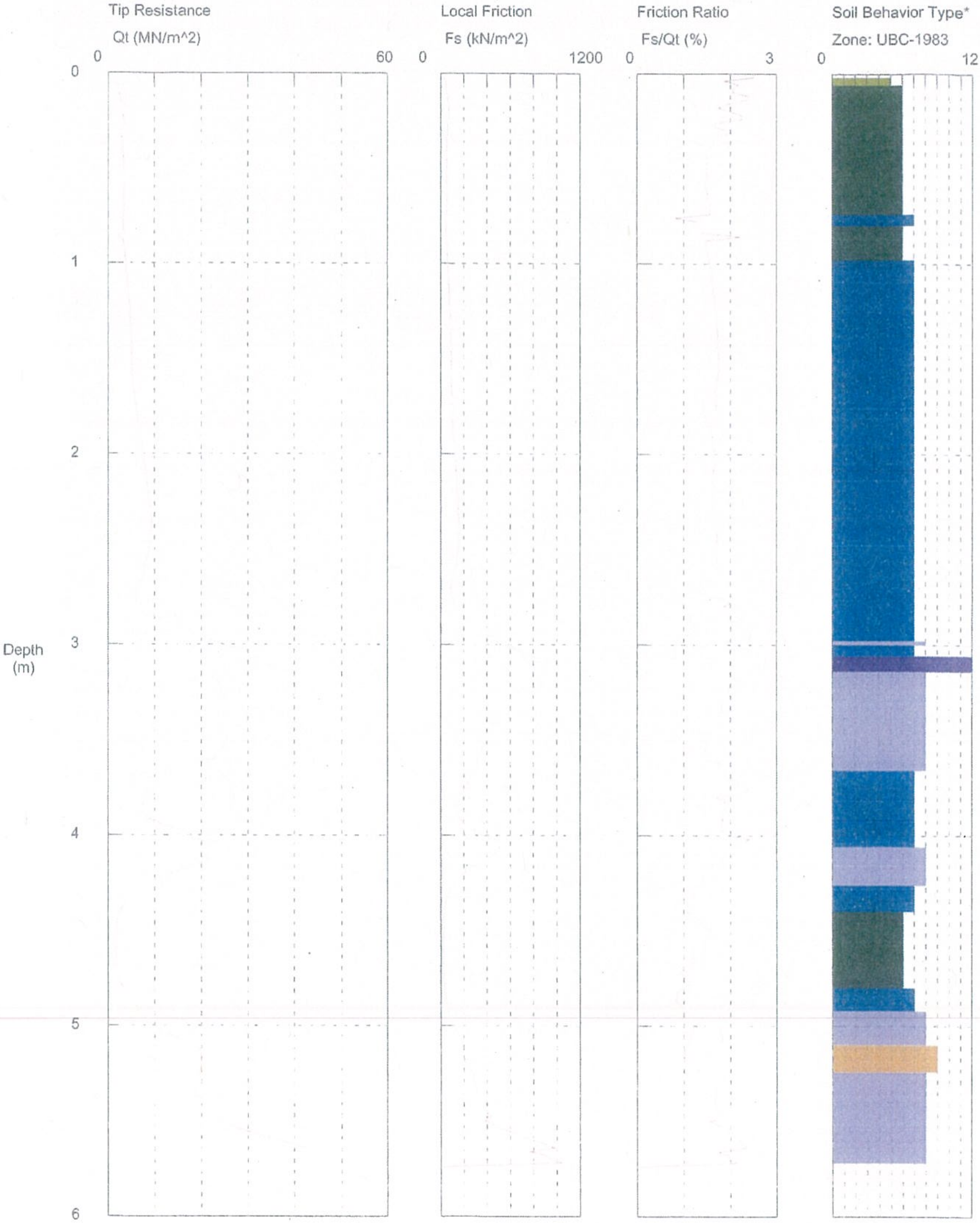
1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

›il behavior type and SPT based on data from UBC-1983

NEWSYD Geotechnical Testing

Operator: LJB
Sounding: Fos-04
Cone Used: 10T3CH

CPT Date/Time: 01-19-06 00:36
Location: Foster
Job Number: 248



Maximum Depth = 5.82 meters

Depth Increment = 0.020 meters

1 sensitive fine grained	4 silty clay to clay	7 silty sand to sandy silt	10 gravelly sand to sand
2 organic material	5 clayey silt to silty clay	8 sand to silty sand	11 very stiff fine grained (*)
3 clay	6 sandy silt to clayey silt	9 sand	12 sand to clayey sand (*)

›il behavior type and SPT based on data from UBC-1983

APPENDIX B

Laboratory Test Results

Coffey Geosciences Pty Ltd
ACN 056 335 516

job no: TA01582/01-AB

sheet 1 of 1

Coffey

acid sulfate soil screening test

office: NEWCASTLE

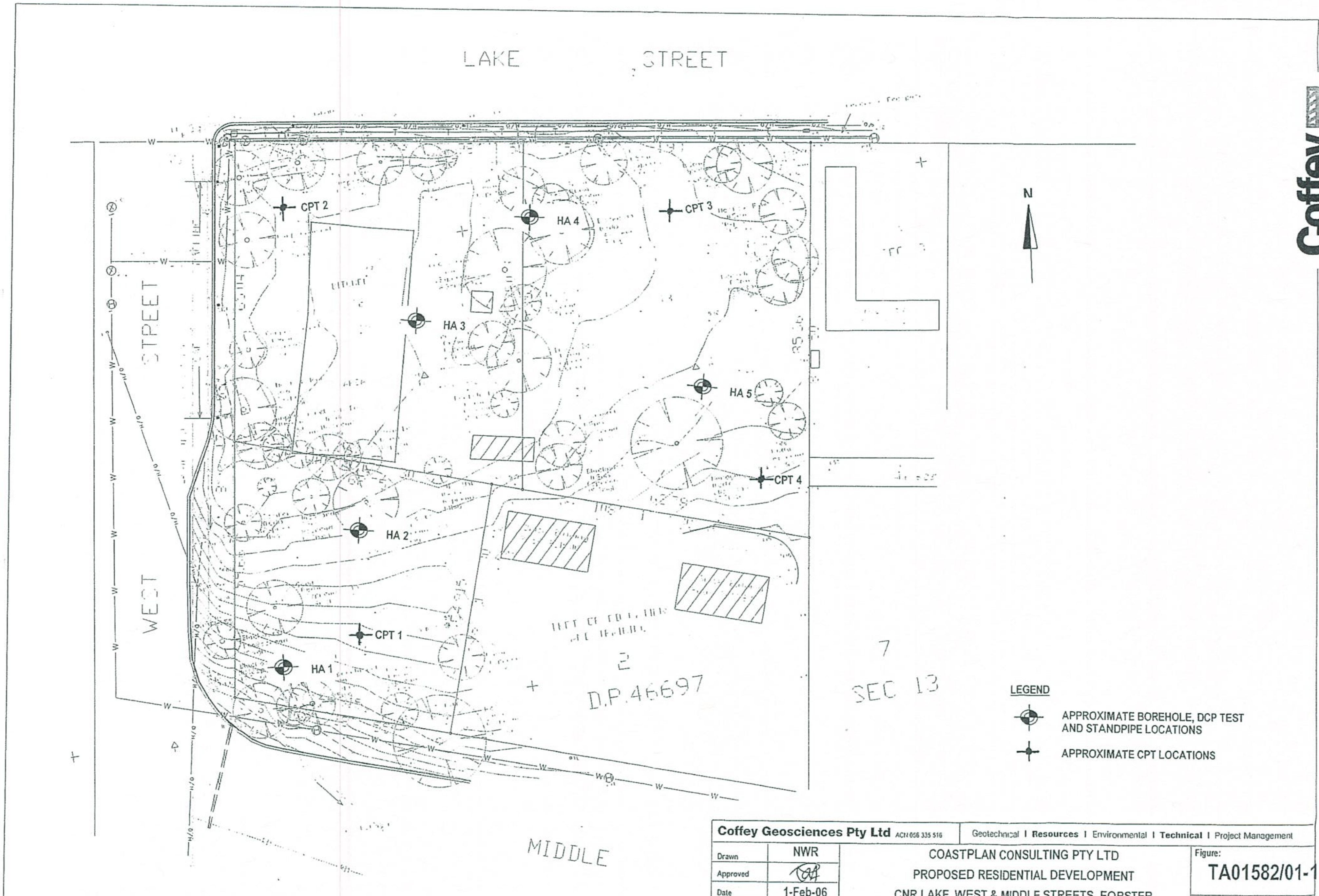
client:	COASTPLAN CONSULTING	date:	23-01-06
principal:		test location:	LAB
project:	PROPOSED RESIDENTIAL DEVELOPMENT	tested by:	NWR and LD
location:	CORNER LAKE, WEST AND MIDDLE STREETS, FORSTER	checked by:	[signature]

date samples recovered: 19-01-06 pH meter used/serial HORIBA D-24 date of calibration: 23-01-06

hydrogen peroxide pH prior to use: 4.85 hydrogen peroxide temperature prior to use: 24.4°C

sample location	depth (m)	RL (mAHD)	soil description	pH_F pH in 1:5 distilled water	pH_{FOX} (oxidation in 30% hydrogen peroxide) time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH_F-pH_{FOX})	Additional comments
HA1	3.0-3.1	-	SAND	7.05	10	4.84	23.7	A	Nil	No	2.21	
HA1	3.4-3.5	-	SAND	7.10	10	4.95	23.9	A	Nil	No	2.15	
HA2	3.4-3.5	-	SAND	7.47	10	4.96	24.1	A	Nil	No	2.51	
HA3	3.4-3.5	-	SAND	7.22	10	5.09	24.0	A	Nil	No	2.13	
HA4	3.4-3.5	-	SAND	6.88	10	4.76	24.4	A	Nil	No	2.12	
HA5	3.1-3.2	-	SAND	6.79	10	4.81	24.5	A	Nil	No	1.98	
HA5	3.4-3.5	-	SAND	7.01	10	4.91	24.5	A	Nil	No	2.10	

NOTES:
1. Observed Reaction: a. No visible effervescence b. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:



Coffey Geosciences Pty Ltd ACN 056 335 516		Geotechnical I Resources I Environmental I Technical I Project Management	
Drawn	NWR	COASTPLAN CONSULTING PTY LTD PROPOSED RESIDENTIAL DEVELOPMENT CNR LAKE, WEST & MIDDLE STREETS, FORSTER APPROXIMATE TEST LOCATIONS	Figure: TA01582/01-1
Approved	[signature]		
Date	1-Feb-06		Document: TA01582/01 AB
Scale	NTS		

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