BORDER-TECH

GEOTECHNICAL ENGINEERING SERVICES

GEOTECHNICAL ENGINEERING ASSESSMENT

PREPARED FOR
CODLEA PTY LTD

AT

LOT 73 ON DP 851902
BAYSIDE WAY
BRUNSWICK HEADS

PREPARED BY
BORDER-TECH
GEOTECHNICAL ENGINEERING SERVICES

SUITE 10, 8 CORPORATE HOUSE
CORPORATION CIRCUIT
TWEED HEADS SOUTH NSW 2486
Ph: (07) 5524 6199 Fax: (07) 5524 6533
Email: info@bordertech.com.au
www.bordertech.com

Our Ref: BT 19034-2

November 2010

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1.0 INTRODUCTION

As requested by Codlea Pty Ltd, Border-Tech has completed the broad scaled geotechnical investigation for the proposed residential subdivision development at Lot 73 DP851902 Bayside Way Brunswick Heads, in Northern New South Wales (NSW) *(See Figure 1)*.

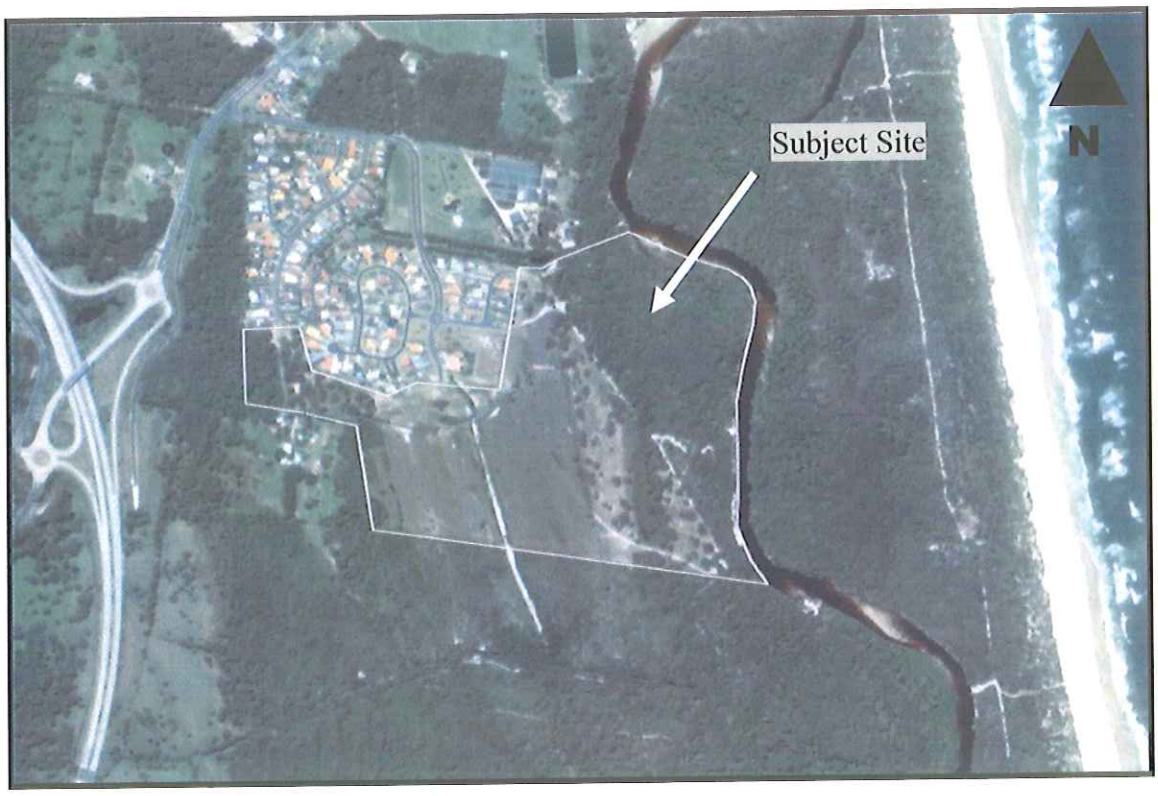


Figure 1 – Approximate location of subject site

It is understood that this report will be submitted as part of a Part 3A Major Project Development Application (DA) to the NSW Department of Planning. This report amongst other things is guided at satisfying Section 5.5 *'Hazard Management and Mitigation - Geotechnical'* as part of the NSW Director-General's requirements issued on the 12th of January 2007.

In addition to the to the above requirements this broadscale investigation was aimed to assess the subsurface conditions at the site along with providing a geotechnical report for use by earthworks contractors and associated consultants including civil engineers. The scope of services provided by Border-Tech has been detailed in Section 2.0 of this report.

2. SCOPE OF WORKS AND PROPOSED DEVELOPMENT

2.1 Scope of Works

The scope of the geotechnical services provided by Border-Tech was directed towards evaluating the following items as outlined in our proposal referenced JW: P09 658-GE dated the 16th of April 2009:-

- Identify possible geotechnical constraints to the development.
- Borelogs and results of subsurface materials encountered including assessment of quality of these materials for use as structural fill.
- Site classification for structures within the scope of AS2870-1996.
- Preliminary footing types and founding materials including allowable bearing pressures and likely settlement.
- Earthworks recommendations.
- Preliminary pavement design values using CBR testing.
- Assessment of the lower alluvial deposits and their effect on the proposed development including

Border-Tech received written authorisation on the 19th of April 2009 to proceed with the above scope of works by Mr Ian Fraser on behalf of Codlea Pty Ltd.

2.2 Proposed Development

Discussions between Ian Fraser and Border-Tech along with a prepared consultant brief and preliminary conceptual plans of the proposed development have indicated the following key development proposals:-

- The subdivision of a approximately 31ha parcel of land to create a residential housing estate.
- The development is envisaged to consist of approximately 23ha of residential development including 178 residential allotments that will comprise of single dwelling, dual occupancy and medium density.
- The remaining 8.2ha land will include areas of public parkland and an environmental reserve adjacent to Simpsons Creek.

- Earthworks and minor reshaping of the existing topography including bulk earthworks, roadways, paths, underground services and possible retention basins. Bulk earthworks plans are not yet developed, however as a minimum expectation it is anticipated that topsoil would need to be stripped across the wider building envelope with fill used to raise the lower lying areas above designated flood levels.

3. EXISTING ENVIRONMENT

The subject site lies on the southern side of Brunswick Heads approximately 2km south of the Brunswick Heads town centre and 500m west of Brunswick Beach. The land is described as Lot 73 DP 851902 Bayside Way, Brunswick Heads. It has an area of approximately 31.33ha bordered by Simpsons Creek to the east, undeveloped bushland to the south and west, and the established residential development of Stage 1 of the Bayside Brunswick development to the north.

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

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

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

Figure 2 – Picture of subject site showing typical vegetation and topography looking from south western corner towards the northern portion of the site

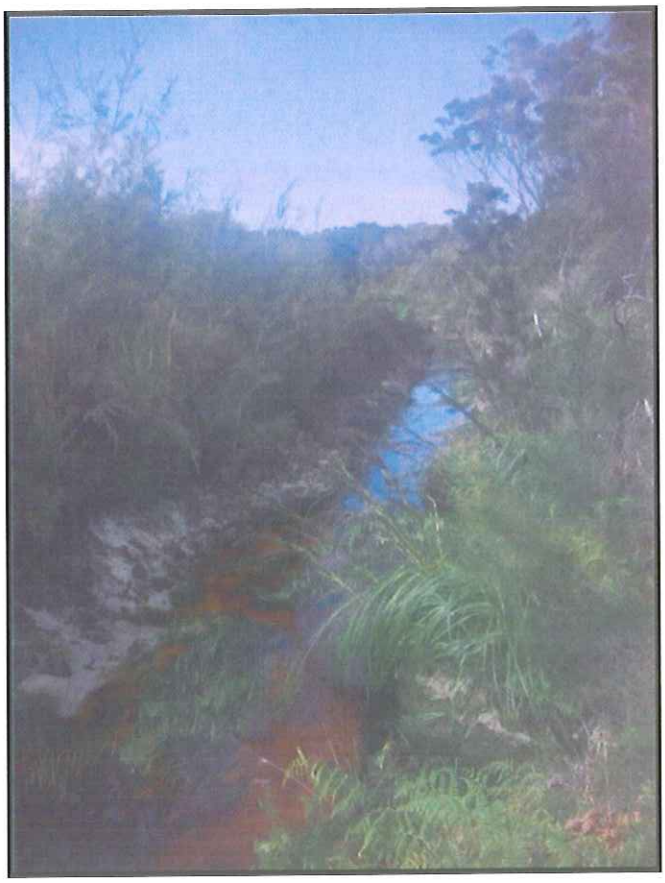


Figure 3 – Picture of drain which is located in the central portion of the site

4. FIELD WORK AND METHODOLOGY

The field work consisted of boreholes over the site using a vehicle mounted MaidTech 500 and truck mounted Gold Coast Hydraulic drilling rig. In total twenty seven boreholes were undertaken to varying depths of 3.0 – 6.5m. Site investigation drillers and a geotechnical engineer from our office carried out the borehole drilling and fieldwork between the 29th of April and 1st of May 2009.

The location of the boreholes was nominated by a geotechnical engineer from Border-Tech and was based on existing surface conditions, access and possible underground services. The boreholes were spread out over the site to represent the underlying subsurface materials.

The subsurface profile was logged by a geotechnical engineer and senior driller from Border-Tech with disturbed samples returned to the laboratory for analysis.

The results of the fieldwork are summarised in the form of engineering borelogs attached to this report *(See Appendix B)* with locations of test sites shown on the attached site plan *(See Appendix A)*.

This investigation has been carried out in accordance with AS 1726 – 1993 '*Geotechnical Site Investigations*' in terms of soil description.

5. GEOTECHNICAL CONDITIONS

5.1 Geology and Subsurface Conditions

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

Based on the borehole drilling, the soils across the majority of the site are characterised by a layer of dark grey medium dense to dense sand overlying pale grey dense sand. A stained dark grey/brown dense to very dense sand (slightly cemented) was found below approximately 1.5m extending to varying depths. Clean dense sands and indurated very dense sands generally continued to the terminated depths with the exception of silty sand mixtures within several boreholes.

Soils beneath the sand ridge on the eastern side of the site exhibited mainly pale grey medium dense sand with a shallow layer of darker grey topsoil. Shallow organic rich deposits, overlying pale grey sand and stained dark grey/brown sand were found around the northern end of the central drain.

5.2 Groundwater

Groundwater was encountered at approximately 0.5m below existing surface level across the flatter areas of the site with levels no deeper than 1.8m in more elevated positions (*See Borelogs – Appendix B).* The water table may fluctuate in this area as a result of tidal movement and during periods of high rainfall.

6. RESULTS AND RECOMMENDATIONS

6.1 Earthworks Recommendations

Border-Tech has not received earthworks plans for the proposed development and it is understood that such plans have not been detailed as far. Border-Tech should be contacted once bulk earthworks and civil plans have been finalised to ensure recommendations within this report remain valid.

6.1.1 Excavation Characteristics

It is anticipated that the proposed development will comprise of stripping, clearing and bulk excavation works to form the road ways, building platforms, and driveways. It is understood that proposed cuts would be minimal and likely to involve removing topsoil containing organic material with and cutting elevated dunes located over the site, particularly in the north and eastern portion of the site. Shallow trench excavation for underground services including stormwater and sewer will also be required. Fill depths are also likely to be minimal.

Based on the borehole results excavations for trenches and bulk earthworks would be suitable using standard medium sized earthworks equipment such as D6 – D7 size tractor and 15 – 30 tonne excavators.

6.1.2 Traffickability and Site Preparation

All site preparation works and earthworks should be carried out in accordance with AS 3798-2007 *'Guidelines on earthworks for residential and commercial developments'*.

At the time of the investigations traffickability was considered to be good across the majority of the site. There were areas of poor drainage where water appeared to be ponding and soft surface materials were exposed. These areas were considered not suitable to access for heavy vehicles. These soft surface materials may pose difficulties with traffickability during earthworks especially if these soils are subject to heavy or consistent

rain. If difficulties are experienced the use of a haulage road into the working construction area would be considered appropriate for this site to allow access in poor weather conditions. Crushed rock or concrete, large gravel or imported sub base material would be considered appropriate as the base coarse for a haulage road. In saying this it is highly preferred that earthworks are carried out on this site in dry weather conditions where little rain has occurred in a period of two (2) weeks prior to earthworks commencing.

The contractors should be completely aware of the ground conditions and topography of the site prior to the commencement of earthworks.

6.1.3 General Earthworks Procedures and Recommendations

Earthwork procedures should be carried out in accordance with above mentioned standards (AS 3798-2007) and also include the following:-

- Clearing, stripping and grubbing should be carried out in areas subject to any earthworks. All soils containing grass and root material should be stripped from the construction areas, removed from site or stockpiled for later use as landscaping material. These materials are not considered suitable for structural fill. Stripping depths will be shallow on this site (0.1 – 0.2m) with possible isolated areas containing deeper organic material.
- Any depressions formed by the removal of vegetation, underground elements etc. should have all disturbed weakened soil cleaned out, backfilled and compacted with suitable fill in a controlled manner.
- Where fill is to be placed, the exposed ground surface should be inspected from a representative from Border-Tech, to detect any soft or loose material. Loose soils, particularly loose surface clayey sands, should be compacted to the appropriate requirements or removed and replaced.
- Any insitu soils free of organic material and deleterious material are considered suitable for structural fill.
- Fill material is to be placed in layers not exceeding 200mm loose thickness. Where backfill for service trenches is carried out the above layer thickness applies however if vibrating plates are used the layers are to be placed in 100mm loose thickness.

- Material is to be compacted to achieve the following standard Maximum Dry Density (MDD) ratios as determined by AS 1289 Test 2.2.1. These compaction standards are to be confirmed with the local council requirements and earthworks standards at the time of earthworks.

Residential allotments	95%
Base material for roadways	98%
Sub-base material for roadways	95%

- Compaction is to be tested as per AS 3798 – 2007, Section 8.0 and carried out by a NATA accredited soils laboratory.

It is recommended that the placement of all structural fill material be inspected, tested and certified by Border-Tech as per Level 1 requirements during the earthworks operations to ensure the recommendations in this report are adhered too and that all fill is placed in a controlled manner in accordance with AS 3798 – 2007.

6.1.4 Batter Slopes and Embankments

Due to the general topography on the site being relatively level it is not expected that areas on the site will require battering back however the following recommendations have been provided to assist with earthworks plans and designs to be established, if required. Full engineering earthworks drawings may be required to be reviewed if batter slopes presented in Table 1 are not sufficient. Where filling is required in areas a suitable representative from Border-Tech is to be onsite to ensure stripping and benching operations are satisfactorily achieved.

The following batter slopes presented in Table 1 are considered to be suitable for the different soil conditions encountered on the site. Where soil conditions vary from those presented in Table 1 Border-Tech may provide guidance and alternative slope angles on site during construction.

Table 1 – Batter Slopes

Material	Short Term (Maximum)	Long Tern (Maximum)
Natural sands and silty sands		
- loose	1V:2H(26°)	1V:2.5H(22°)
- medium dense	1V:1.5H(33°)	1V:2H(26°)
Filled sand[1]	1V:1.5H(33°)	1V:2H(26°)

Notes: A geotechnical engineer from Border-Tech may be required to be on site during excavations to ensure batter slopes presented in Table 1 are suitable for the site conditions.

[1] All fill batters should be overfilled, compacted and cut back at a maximum angle given in Table 1 for filled batters.

The slope angles above are normally considered to be the maximum slope angle to achieve a long term factor of safety in excess of 1.5 using general controlled fill materials or for natural soils. The batter slopes assume that no surcharge loadings will be applied and no seepage is present. If seepage is encountered or present at any stage suitable batter slopes will be required for these conditions.

All permanent batter slopes are required to be protected from erosion and scour by use of appropriate drainage and vegetation.

6.1.5 Assessment of Insitu Material for use as General Fill

Quality testing to confirm the existing material for use as structural fill should be carried out prior to delivery to other sites and can be undertaken prior to or during earthworks. Contractors may then submit details of their proposed fill source including NATA accredited quality certificates. In addition Border-Tech has undertaken an Acid Sulfate Soil Assessment (Our Ref: BT 19034-A dated May 2009) which concluded that soils within the upper 2.0m below existing surface levels are non acid sulfate, however the pH of these soils is relatively low and may need to be considered. The sands and silty sand materials encountered on the site are considered suitable fill materials.

6.2 Preliminary Site Classification

It is understood that the subdivision will be for residential purposes. From the field investigations a preliminary site classification may be beneficial for determining the feasibility and suitability of the proposed subdivision. However the following site

classifications are intended for preliminary purposes only and individual site investigations would be required to allow foundation design parameters to be achieved.

The following site classifications are only for structures that fall under the guidelines of AS 2870 - 1996 *'Residential slabs and footings - Construction'*. The natural subsurface materials encountered on the site are considered suitable for residential construction with a recommended classification of Class S.

6.3 Preliminary Foundation Recommendations

As a general approach, we recommend that all load bearing footings for a residence be supported on similar competent natural strata around the entire perimeter of the building. In areas of fill and natural soils this may involve deepening the perimeter footing or the use of backhoe piers/short bored piers or screw piles to support the perimeter footings and carry the footing loads to similar competent material.

Given the subsurface profile encountered lightly loaded structures such as residential dwellings may be supported using raft slabs, waffle rafts or conventional strip footings incorporated into the slab design. These foundations types are expected to be founding in uniform material where an allowable bearing pressure of 100 kPa is available. Settlements of these foundations designed in accordance with these recommendations should not be more than 20mm. This does not include movements expected due to reactivity of foundation soils, if clay fill materials are used.

Based on the expectation of adequate fill compaction, testing and inspections being carried out, if required, the support of slab loads on compacted fill can be adopted, with an estimated allowable bearing capacity of 150kPa being available within the fill. However, it should be noted that all fill settles to some extent, no matter how well compacted. The nature of the fill material, location and depth over a building area would also need to be considered when selecting the appropriate footing and slab system.

6.4 Pavement Design

The anticipated subgrade over the site consists of natural or filled sandy mixtures. These materials are generally considered suitable as subgrade materials. A recommended

California Bearing Ratio (CBR) of 8 – 10% for the pavement design and/or internal roads can be adopted for design purposes.

7. DISCUSSION

The following recommendations and conclusions made in regards to the geotechnical investigation are to be taken into consideration as part of the proposed development:-

1. The subsurface conditions encountered predominantly consisted of clean sands with the exception of areas containing silty sands and some traces of organic materials. Layers of indurated very dense sand were encountered over the site.
2. All site preparation works and earthworks should be carried out in accordance with AS 3798-2007 *'Guidelines on earthworks for residential and commercial developments'*. Refer to Sections 6.1 for details on recommendations for earthworks operations.
3. Based on the preliminary investigations the typical site classifications for isolated structures in accordance with AS 2870-1996 include equivalent Class S conditions subject to individual site assessments. In saying this construction loads are to be founded into competent strata as detailed in Section 6.4. Typically shallow standard foundation designs and conventional footing and slab construction will be required over the site.
4. In general it is recommended that the proposed development is feasible and the subsurface conditions are suitable for the likely structures.
5. All building and development should follow good engineering and construction practice.

8. LIMITS OF INVESTIGATION

Every reasonable effort has been made to locate test sites so that the boreholes are representative of the soil conditions within the area to be investigated. The client should be made aware however, that this assessment has been based on limited site data using small test sites.

Notes on understanding your geotechnical report have been attached to this report as Appendix C.

If you should require any further information or clarification or should building plans or soil conditions vary substantially from those indicated please do not hesitate to contact this office.

Yours faithfully
For and on behalf of
BORDER - TECH

James Walle *B.Eng. Civil (Hons)*
Geotechnical Engineer

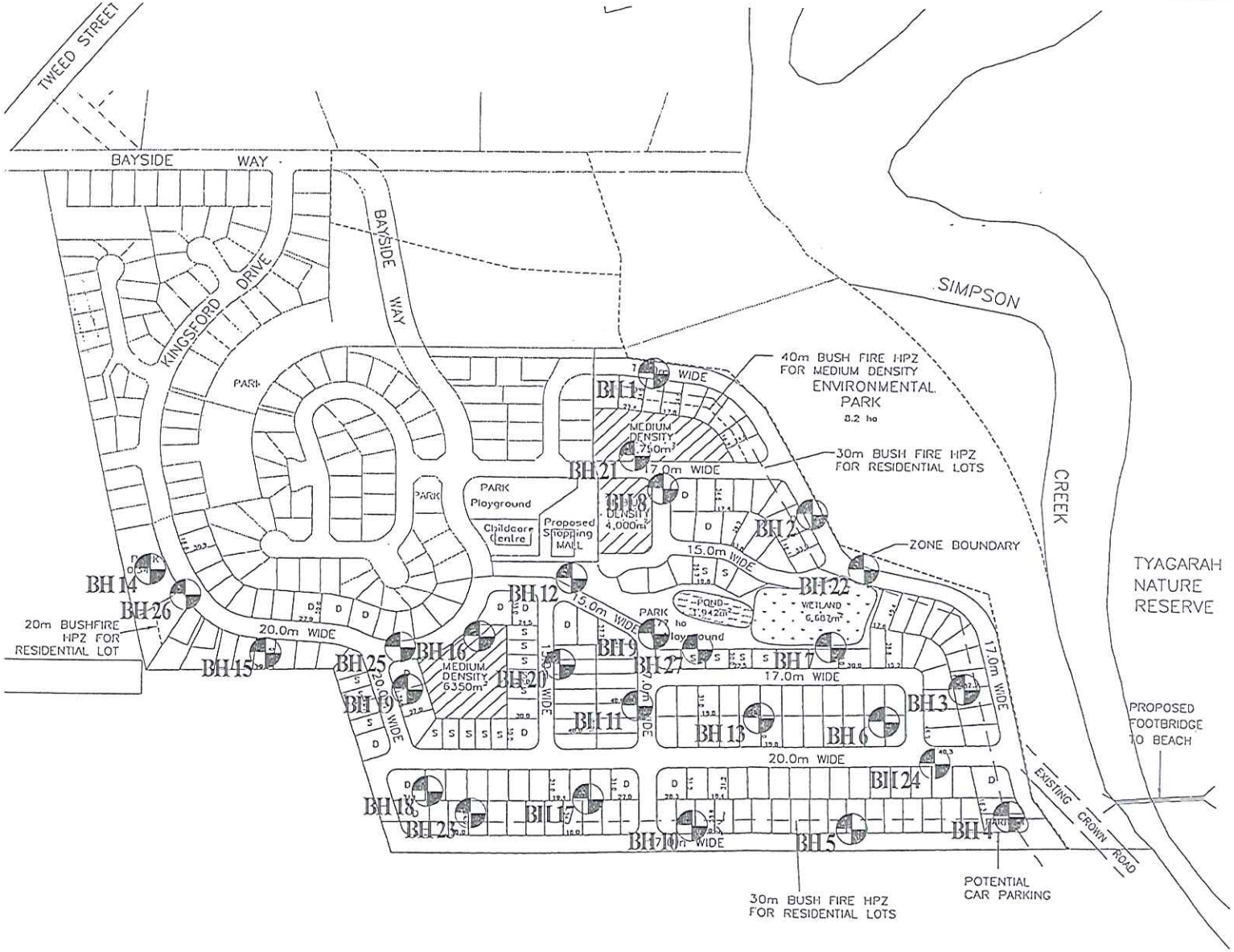
H.T.Teo *M.I.E. (Aust), C.P.Eng., R.P.E.Q. (1812)*
Senior Geotechnical Engineer

9. REFERENCES

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

APPENDIX A

SITE PLAN



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

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

CLIENT: CODLEA PTY LTD

PROJECT: LOT 73 BAYSIDE WAY
BRUNSWICK HEADS

NORTH

JOB No:
BT 19034-1

SITE PLAN

APPENDIX B

BOREHOLE PROFILE

BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES
Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

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

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM		▼	1.2		(SP) SAND: Fine sand, Moist, Pale grey	DENSE	2 2 3 4 5 6 6 7 7
ALLUVIUM			2.0		(SP) SAND: Fine sand, Moist becoming wet, Grey	DENSE	
ALLUVIUM			3.0		(SP) SAND: Fine sand, Wet, Grey/brown	DENSE	

BH 1 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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GEOTECHNICAL ENGINEERING SERVICES
Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 2
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM		▽	0.8		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming LOOSE	1 1 1 2 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1
ALLUVIUM			2.0 3.0		(SP) SAND: Fine sand, Wet, Grey/brown	MEDIUM DENSE Becoming DENSE	1 1 1 3 4 5 5 6 6

BH 2 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 3
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM		▼	0.8		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	1 1 1 1 1 1 1 1 1 1 1 1 2 2 3 3 4 4 5 5 7 7 7
ALLUVIUM			2.2 3.0		(SP) SAND: Fine sand, Wet, Dark grey/black	DENSE	8

BH 3 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

Logged By	DAW	Date	1/05/09	Checked By		Date	

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GEOTECHNICAL ENGINEERING SERVICES
Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 4
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1

EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 1 3 4 4 5 5 7 10 10
			1.5				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 4 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 5
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM					(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 1 1 1 3 4 5 7 9 10 10
		▼	0.8				
			3.0				

BH 5 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 6
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 1 2 3 4 5 6 6 8 10 10
			3.0				

BH 6 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 7
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 1 2 2 3 6 8 8 8 10
ALLUVIUM			1.7 3.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 7 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 8
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 2 2 1 2 2 8 8 10 10
ALLUVIUM			1.5 3.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 8 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 9
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 2 1 2 2 3 5 8 8 10
			1.4				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 9 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 10
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 2 3 7 8 8 8 10
ALLUVIUM			2.7 3.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	

BH 10 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 11
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 2 2 3 5 8 7 8 8 9
ALLUVIUM			1.5		(SP) SAND: Fine sand, Wet, Grey	DENSE	
ALLUVIUM			2.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 11 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 12
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
FILL					(SP) SAND: Fine sand, Trace of CLAY, Moist, Dark grey	MEDIUM DENSE Becoming DENSE	1 1 2 3 2 5 4 5 4 5 4 3 3 6 3 6
			1.6				
ALLUVIUM		▼	1.8		(SP) SAND: Fine sand, Moist becoming wet, Dark grey/brown	DENSE	8 8 10
			3.0				

BH 12 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 13
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 2 1 1 2 3 3 3 5 7 8 8 8
ALLUVIUM			1.5		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 13 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 14
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 2 1 2 3 5 7 8 9 9 10
			1.8				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 14 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 15
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.6		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE Becoming DENSE	1 1 1 1 2 3 3 3 5 6 8 8 8 9
ALLUVIUM			1.6		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 15 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 16
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
FILL		▼	1.4		(SM) SAND: Fine sand, Trace of CLAY, Moist, Dark grey	MEDIUM DENSE	2 3 5 4 4 5 3 6 5 4 5 5 6 6
ALLUVIUM			3.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	8 8 10

BH 16 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 17
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▽	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	1 1 2 3 2 3 5 7 8 8 8
ALLUVIUM			1.4		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 17 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 18
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	1 1 1 2 2 2 3 5 8 8 10
ALLUVIUM			2.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 18 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 19
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Trace of organic material, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	1 1 2 2 3 5 7 8 8 8
ALLUVIUM			2.0		(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 19 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 20
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1

EQUIPMENT TYPE: MAIDTECH 500 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SP) SAND: Fine sand, Moist, Dark grey	MEDIUM DENSE	1 1
ALLUVIUM		▼	0.5		(SP) SAND: Fine sand, Moist becoming wet, Pale grey	MEDIUM DENSE	1 1 1 2 2 3 5 8 8 9
			1.7				
ALLUVIUM					(SP) SAND: Fine sand, Wet, Dark grey/brown	DENSE	
			3.0				

BH 20 TERMINATED AT 3.0m
LIMIT OF INVESTIGATION

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

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 21
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.6		(SM) Silty SAND: Fine to coarse sand, Moist, Brown/black	MEDIUM DENSE	
		▼	1.1		(SW) SAND: Coarse sand, Moist becoming wet, Pale grey/white	MEDIUM DENSE	
			1.4				
	SPT 6,9,12 N = 21		1.5		(SM) Silty SAND: Fine to coarse sand, Wet, Brown	MEDIUM DENSE	
			1.8		(SM) Silty SAND: Fine sand, Wet, Dark brown	DENSE	
			3.0				
	SPT 3,5,7 N = 12						
			3.8		(SP) SAND: Fine to coarse sand, With SILT, Wet, Pale yellow	MEDIUM DENSE	
			4.3		(SM) Silty SAND: Fine sand, Wet, Pale orange/ brown	DENSE	
	SPT 30/150mm N >50		4.5		(SP) SAND: Fine to coarse sand, Trace of SILT, Moist, Dark orange/brown	VERY DENSE	
			5.2		(SP) SAND: Fine to coarse sand, Trace of SILT, Moist, Dark brown/black	VERY DENSE	
	SPT 36/150mm N >50		6.0				
			6.15				

BH 21 TERMINATED AT 6.15m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 22
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.5		(SM) Silty SAND: Fine to coarse sand, Moist, Brown and dark brown	LOOSE	
	SPT 1,1,2 N = 3		0.6		(SW) SAND: Coarse sand, Moist becoming wet, Pale grey/white	LOOSE To MEDIUM DENSE	
		▼	1.0				
	SPT 2,4,4 N = 8		1.5				
			2.8				
	SPT 5,10,12 N = 22		3.0		(SW) SAND: Fine sand, Wet, Pale grey/white	MEDIUM DENSE To DENSE	
	SPT 30/150mm N >50		4.5				
			5.1		(SP) SAND: Fine to coarse sand, Trace of SILT, Wet, Brown	VERY DENSE	
	SPT 10,23, 30/120mm N >50		6.0				
			6.3		(SP) SAND: Fine to coarse sand, Trace of SILT, Moist, Dark brown/black	VERY DENSE	
			6.42				

BH 22 TERMINATED AT 6.42m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 23
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM		▽	0.3		(SM) Silty SAND: Fine sand, With organic material (fine tree roots), Wet, Black	LOOSE	
			0.8				
	SPT 4,9,11 N = 20		1.0		(SP) SAND: Fine to coarse sand, Trace of organic material (fine tree roots), Wet, Pale grey/white	MEDIUM DENSE	
			2.1				
	SPT 6,9,15 N = 24		2.5		(SW) SAND: Fine to coarse sand, Wet, Pale grey/ white	MEDIUM DENSE	
	SPT 12,30/150mm N >50		4.0		(SM) Silty SAND: Fine to coarse sand, Wet, Pale brown	VERY DENSE	
			4.7		(SP) SAND: Fine to coarse sand, Trace of SILT, Moist, Dark brown/black	VERY DENSE	
	SPT 30/150mm N >50		5.5				
			5.65				

BH 23 TERMINATED AT 5.65m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 24
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.3		(SM) Silty SAND: Fine to coarse sand, With organic material (fine tree roots), Moist, Black	LOOSE	
			1.1		(SP) SAND: Fine to coarse sand, Moist becoming wet, Pale grey/white	MEDIUM DENSE	
	SPT 2,3,4 N = 7		1.5		(SW) SAND: Fine to coarse sand, Moist becoming wet, Pale grey/white	MEDIUM DENSE	
			2.1				
	SPT 6,10,12 N = 22		3.0				
		▼	3.9				
	SPT 6,14,17 N = 31		4.5			DENSE	
			5.1		(SM) Silty SAND: Fine to coarse sand, Moist, Brown	VERY DENSE	
	SPT 10,30/150mm N >50		6.0				
			6.3		(SP) SAND: Fine to coarse sand, Trace of SILT, Moist, Dark brown/black	VERY DENSE	

BH 24 TERMINATED AT 6.3m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 25
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.5		(SM) Silty SAND: Fine to coarse sand, With organic material (fine roots) throughout, Moist, Grey/brown	LOOSE	
	SPT 4,5,6 N = 11	▼	0.6 0.8		(SM) Silty SAND: Fine to coarse sand, Moist becoming wet, Pale grey	MEDIUM DENSE	
			1.2		(SM) Silty SAND: Coarse sand, Wet, Dark brown/black	MEDIUM DENSE	
	SPT 7,12,12 N = 24		1.5 1.7		(SM) Silty SAND: Fine to coarse sand, Wet, Pale grey	DENSE	
			2.2		(SM) Silty SAND: Coarse sand, Wet, Dark brown	MEDIUM DENSE	
	SPT 6,7,11 N = 18		3.0				
			4.0		(SP) SAND: Fine sand, Trace of SILT, Moist, Dark brown/black	VERY DENSE	
	SPT 32/150mm N >50		4.5				
			6.0				
	SPT 36/150mm N >50		6.15				

BH 25 TERMINATED AT 6.15m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 26
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.2		(SM) Silty SAND: Fine to coarse sand, With organic material (fine roots) throughout, Moist, Dark brown	LOOSE	
			0.5		(SP) SAND: Coarse sand, Moist, Grey	MEDIUM DENSE	
	SPT 4,4,5 N = 9	▼	0.6 0.7				
					(SM) Silty SAND: Fine to coarse sand, Moist becoming wet, Brown	MEDIUM DENSE	
			1.5				
	SPT 7,11,13 N = 24						
			2.3				
			2.6		(SM) Silty SAND: Fine sand, Moist, Dark brown/black	DENSE	
					(SP) SAND: Fine sand, Trace of SILT, Moist, Dark brown/black	DENSE To VERY DENSE	
			3.0				
	SPT 5,9,14 N = 23						
			4.5				
	SPT 30/150mm N >30		4.65				

BH 26 TERMINATED AT 4.65m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

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BORDER - TECH

GEOTECHNICAL ENGINEERING SERVICES
Suite 10, No. 8 Corporation Cct, Tweed Heads South Ph (07) 5524 6199
1/35 Old Pacific Highway, Yatala Ph (07) 3804 6844

BOREHOLE PROFILE

CLIENT: CODLEA PTY LTD	BOREHOLE No: BH 27
PROJECT: LOT 73 BAYSIDE WAY BRUNSWICK HEADS	JOB No: BT 19034-1
EQUIPMENT TYPE: GCH 200 HOLE DIAMETER: 110mm APPROXIMATE SL (m): -	

Geological Profile	Samples / Tests	WATER	Depth in m	Graphic Log	Soil or Rock Description – Field and /or Laboratory	Consistency / Rel. Density	DCP Blows / 100mm
ALLUVIUM			0.3		(SM) Silty SAND: Fine to coarse sand, Moist, Dark brown/black	LOOSE	
		▼	1.0		(SP) SAND: Fine to coarse sand, Wet, Pale grey	DENSE	
	SPT 9,17,22 N = 39		1.5				
			2.1				
			2.3		(SP) SAND: Fine to coarse sand, Trace of SILT, Wet, Brown	VERY DENSE	
	SPT 15,30/150mm N >50		3.0		(SP) SAND: Fine sand, Cemented (Indurated), Trace of SILT, Wet, Dark brown/black	VERY DENSE	
	SPT 30/150mm N >50		4.5				
			4.65				

BH 27 TERMINATED AT 4.65m
LIMIT OF INVESTIGATION

NOTES: Standard Penetration Test (SPT) to AS 1289 6.3.1 – 2004.

Logged By	LD	Date	30/04/09	Checked By		Date	

APPENDIX C

NOTES ON UNDERSTANDING YOUR GEOTECHNICAL REPORT

SCOPE These standard notes may be of assistance when understanding terms and recommendations given in this report. These notes are for general conditions and not all terms given may be of concern to the report attached. The descriptive terms adopted by Border-Tech are given below and are largely consistent with Australian Standards AS1726-1993 'Geotechnical Site Investigations'.

CLIENT can be described and is limited to the financer of this geotechnical investigation.

LEGALITY and privacy of this document is based on communication between Border-Tech and the client. Unless indicated otherwise the report was prepared specifically for the client involved and for the purposes indicated by the client. Use by any other party for any purpose, or by the client for a different purpose, will result in recommendations becoming invalid and Border-Tech will hold no responsibility for problems which may arise.

GEOTECHNICAL REPORTS are predominantly derived using professional estimates determined from the results of fieldwork, in-situ and laboratory testing and experience from previous investigations in the area, from which geotechnical engineers then formulate an opinion about overall subsurface conditions. The client must be made aware that the investigations are undertaken to ensure minimal site impact using test-pits or small diameter boreholes and soil conditions on-site may vary from those encountered during the investigation.

CLIENTS RESPONSIBILITY to notify this office should there be adjustments in proposed structure/location or inconsistencies with material descriptions given in this report and those encountered on site. Border-Tech is able to provide a range of services from on-site inspections to full project supervision to confirm recommendations given in the report.

CSIRO Publication BTF 18 'Foundation Maintenance and Footing Performance: A Homeowner's Guide' explains how to adequately maintain drainage during and post construction which lies as the responsibility of the client. Suitable drainage ensures recommendations given in this report remain valid.

INVESTIGATION METHODS adopted by Border-Tech are designed to incorporate individual project-specific factors to obtain information on the physical properties of soil and rock around a site to design earthworks and foundations for proposed structures. The following methods of investigation currently adopted by this company are summarised below:-

HAND AUGER – investigations enable field work to be undertaken where access is limited. The materials must have sufficient cohesion to stand unsupported in an unlined borehole and there must be no large cobbles boulders or other obstructions which would prevent rotation of the auger.

TEST-PITS – investigations are carried out with an excavator or backhoe, allowing a visual inspection of sub-surface material in-situ and from samples removed. The limit of investigation is restricted by the reach of the excavator or backhoe.

CONTINUOUS SPIRAL FLIGHT AUGERING TECHNIQUES – investigations are advanced by pushing a 100mm diameter spiral into the sub-surface and withdrawing it at regular intervals to allow sampling or testing as it emerges.

WASH BORING – investigations are advanced by removing the loosened soil from the borehole by a stream of water or drilling mud issuing from the lower end of the wash pipe which is worked up and down or rotated by hand in the borehole. The water or mud carries the soil up the borehole where it overflows at ground level where the soil in suspension is allowed to settle in a pond or tank and the fluid is re-circulated or discharged to waste as required.

NON-CORE ROTARY DRILLING – investigations are advanced using a rotary bit with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from feel and rate of penetration.

ROTARY MUD DRILLING – is carried out as above using mud as support and circulating fluid for the borehole drilling. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling.

CONTINUOUS CORE DRILLING – investigations are carried out in rock material, specimens of rock in the form of cylindrical cores are recovered from the drill holes by the means of core barrel. The core barrel is provided at its lower end with a detachable core bit which carries industrial diamond chips in a matrix of metal. Rotation of the barrel by means of the drill rods causes the core bit to cut an annulus in the rock, the cuttings being washed to the surface by a stream of pumped down the hollow drill rods.

TESTING METHODS adopted by Border-Tech to determine soil properties include but not limited to the following:-

U50 – Undisturbed samples are obtained by inserting a 50mm diameter thin-walled steel tube into the material and withdrawing with a sample of the soil in a moderately undisturbed condition.

PP – Pocket Penetrometer tests are commonly used on thin walled tube samples of cohesive soils to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils. They may also be used for the same purpose in freshly excavated trenches.

VS – Vane Shear test are commonly used in-situ or on thin walled tube samples of cohesive soils by introducing the vane into the material where the measurement of the undrained shear strength is required. Then the vane is rotated and the torsional force required to cause shearing is calculated.

DCP – Dynamic Cone Penetrometer tests are commonly used in-situ to measure the strength attributes of penetrability and compaction of sub-surface materials.

SPT – Standard Penetration Tests are commonly uses to determine the density of granular deposits but are occasionally used in cohesive material as a means of determining strength and also of obtaining a relatively undisturbed sample. Samples and results are obtained by driving a 50mm diameter split tube through blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. Blow counts are recorded for 150mm intervals with the sum of the number of blows required for the second and third 150mm of penetration is termed the "standard penetration resistance" or the "N-value".

GEOLOGICAL ORIGINS of sub-surface material plays a considerable role in the development of engineering parameters and have been summarised as follows:-

FILL – materials are man made deposits, which may be significantly more variable between test locations than naturally occurring soils.

RESIDUAL – soils are present in a region as a result of weathering over the geological time scale.

COLLUVIAL – soils have been deposited recently, on the geological time scale, as soils being transported slowly down slope due to gravitational creep.

ALLUVIAL – soils have been deposited recently, on the geological time scale, as water borne materials.

AEOLIAN – soils have been deposited recently, on the geological time scale, as wind borne materials.

SOIL DESCRIPTION is based on an assessment of disturbed samples, as recovered from boreholes and excavations, and from undisturbed materials. Soil descriptions adopted by Border-Tech are largely consistent with AS 1726-1993 '*Geotechnical Site Investigation*'. Soil types are described according to the predominating particle size, qualified by the grading of other particles present on the following bases detailed in Table 1.

COHESIVE SOILS ability to hold moisture known as its liquid limit is the state of a soil when it goes from a solid state to a liquid state described in Table 2

TABLE 1

Soil Classification	Particle Size
Clay	< 0.002 mm
Silt	0.002 – 0.06 mm
Sand	0.06 – 2.00 mm
Gravel	2.00 – 60.0 mm

TABLE 2

Descriptive Type	Range of Liquid Limit %
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50

Furthermore to soil description cohesive soils are described on there strength (assessed in conjunction with penetration tests) and liquid limit. Non-cohesive soil strengths are described by there density index. With descriptions for cohesive and non-cohesive soils summarised in Table 3.

TABLE 3

COHESIVE SOILS		NON-COHESIVE SOILS	
Term	Undrained Shear Strength kPa	Term	Density Index %
Very soft	≤ 12	Very Loose	≤15
Soft	> 12 ≤25	Loose	> 15 ≤35
Firm	> 25 ≤50	Medium Dense	> 35 ≤65
Stiff	> 50 ≤100	Dense	> 65 ≤85

Very Stiff	> 100 ≤200	Very Dense	> 85
Hard	> 200		

Description of terms used to describe material portion are summarised in Table 4.

TABLE 4

COARSE GRAINIED SOILS		FINE GRAINED SOILS	
% Fines	**Modifier**	**% Coarse**	**Modifier**
≤ 5	Omit or 'trace'	≤ 15	Omit or 'trace'
> 5 ≤12	Describe as 'with'	> 15 ≤30	Describe as 'with'
> 12	Prefix soil as 'silty/clayey'	> 30	Prefix soil as 'sandy/gravelly'

ROCK DESCRIPTIONS are determined from disturbed samples or specimens collected during field investigations. A rocks presence of defects and the effects of weathering are likely to have a great influence on engineering behaviour.

Rock Material Weathering Classification is summarised in Table 5.

TABLE 5

Term	Symbol	Definition
Residual Soils	-	Soil developed on extremely weathered 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 Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to decomposition of weathering products in pores
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh rock	FR	Rock shows no signs of decomposition or staining

Rock Material Strength Classification is summarised in Table 6.

TABLE 6

Term	Symbol	Point load index (MPa) I_s50	Field guide to strength
Extremely Low	EL	≤0.03	Easily remoulded by hand to a material with soil properties
Very Low	VL	>0.03 ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure
Low	L	>0.1 ≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling
Medium	M	>0.3 ≤1.0	Readiy scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
High	H	>1.0 ≤3.0	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer
Very High	VH	>3.0 ≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer
Extremely High	EH	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

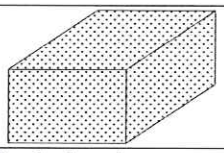
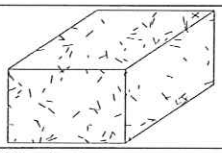
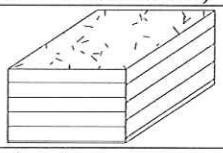
Rock Material Defect Shapes are summarised in Table 7.

TABLE 7

Term	Description
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
Smooth	The defect has a flat even finish
Rough	The defect has a irregular disoriented finish

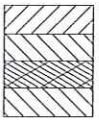
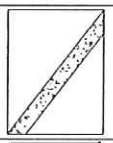
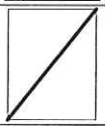
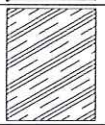
Rock Material Texture and Fabric are summarised in Table 8.

TABLE 8

Geological Description	Massive		Layered (Bedded foliate cleaved)
Diagram			
Fabric Type	Effectively homogenous and isotropic. Bulky or equi-dimensional grains uniformly distributed	Effectively homogeneous and isotropic. Elongated	Effective homogeneous with planar anisotropy. Elongated or tabular grains or pores in a layered arrangement

Rock Material Defect Type is summarised in Table 9

TABLE 9

Term	Definition	Diagram
Bedding	Signifying existence of beds or laminatae. Planes dividing sedimentary rocks of the same or different lithology. Structure occurring in granite and similar rocks evident in a tendency to split more or less horizontally to the land surface	
Cross Bedding	Also called cross-lamination or false bedding. The structure commonly present in granular sedimentary rocks, which consists of tabular, irregularly lenticular or wedge-shaped bodies lying essentially parallel to the general stratification and which them selves show pronounced lamination structure in which the laminae are steeply inclined to the general bedding.	
Crushed Seam	A fracture at a more or less acute angle to applied force generally with some pulverized material along its surface	
Joint	A fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.	
Parting	A small joint in rock or a layered rock where the tendency of crystals to separate along certain planes that are not true cleavage planes.	
Sheared Zone	A fracture that results from stresses which tend to shear one part of a specimen past the adjacent part