PRELIMINARY GEOTECHNICAL ASSESSMENT

Pacific Bay Western Lands, Coffs Harbour NSW
Thakral Holdings Limited

GEOTCOFH02134AB-AB
20 June 2008

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
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20 June 2008

Thakral Holdings Limited
C/- GHD Pty Ltd
2/115 West High Street
Coffs Harbour NSW 2450

Attention: Phil Pigram

Dear Phil

RE: Preliminary Geotechnical Assessment at Pacific Bay Western Lands, Coffs Harbour NSW

Coffey Geotechnics Pty Ltd is pleased to present our report on the geotechnical investigation for the above site.

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

We trust that this report meets with your requirements. If you require further information please contact the undersigned in our Coffs Harbour office

For and on behalf of Coffey Geotechnics Pty Ltd

Chris Pressdee

Associate Engineering Geologist

Distribution:	Original held by:	Coffey Geotechnics Pty Ltd (Coffey)
	1 Copies	Coffey (Coffs Harbour library)
	3 Copies	Thakral Holdings Limited

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1 INTRODUCTION

Coffey Geotechnics Pty Ltd (Coffey) has conducted a preliminary geotechnical assessment for the proposed residential subdivision located at the Pacific Bay Western Lands, Coffs Harbour, NSW. The aims of the study which was commissioned by David Hogendijk of Thakral Holdings Limited, were to provide the following:

- An assessment of potential slope stability issues in the development area and a discussion on the effects of slope instability on the proposed development;
- A discussion on the geotechnical issues for development in areas which are subject to difficult ground conditions (low lying areas).
- Preliminary recommendations as to appropriate building types and slope support recommendations based on slope geometry and subsurface conditions;
- Preliminary recommendations as to suitable foundation options;
- Preliminary recommendations as to batter slopes for permanent and temporary excavations;
- An assessment of potential reuse of materials as engineered fill and on fill construction procedures;
- Recommendations for appropriate erosion, and sediment control measures; and
- An opinion as to the suitability of the site for residential development;

Coffey conducted the work in accordance with proposal no. GEOTCOFH02134AB-AA. This report presents the results from the site investigation.

2 SITE LOCATION AND SURROUNDING LANDUSE

The site covers an area of approximately 5ha that is accessed from West Korora Road and Bruxner Park Road, Coffs Harbour in NSW.

The site incorporates slightly to steeply sloping hills that are typical of the Coffs Harbour hinterland, and a low lying, valley bottom area. At the time of the investigation the site consisted of grassy hillsides, a densely forested area designated as protected koala habitat and a rugby field with a number of small associated structures. It is understood that the far western portion of the site previously contained a banana plantation. The site is partially bisected by Jordans Creek which runs from the approximate centre of the site through to the south eastern corner.

The eastern boundary of the site comprises of the Pacific Highway and the existing Bananacoast Caravan Park while the northern boundary is made up of the Bruxner Park rural residential subdivision. The southern boundary of the site consists of West Korora Road and partially forested land while the western boundary consists of densely forested land and a private dwelling.

3 FIELD WORK

The geotechnical assessment has been undertaken in a phased approach, aiming to optimise findings from the overall investigation.

The fieldwork was conducted over three days and comprised a detailed walk over survey on 23 May 2008 to enable observation of geomorphological (landform and land) processes.

The investigation also comprised the excavation of 4 test pits on steeply sloping ground, 10 test pits on slightly sloping ground and 3 test pits in low lying areas. The test pits were excavated over two days on 26 and 27 May 2008 to depths of between 1.1m and 4.9m.

Fieldwork was conducted in the presence of either an Associate Engineering Geologist or Scientist who logged the materials observed, took samples and recorded results of *in situ* testing. Figure 1 shows the test pit locations. Engineering Logs are presented in Appendix A together with explanation sheets defining the terms and symbols used in their preparation.

4 WALKOVER SURVEY

Prior to excavating the test pits, a walkover survey was undertaken focussing on geomorphological and geological features of the landscape and any existing exposures in the nearby area, together with groundwater and surface water features that were identifiable.

4.1 Topography

The site was typified by steep sloping hills with a decreasing gradient opening out to lower lying areas towards the coastal plain.

The proposed development can be divided into three separate regions being Region 1 (steeply sloping land), Region 2 (slightly sloping land) and Region 3 (low lying land). The zoning of the regions is presented in Figure 2 of this report.

Region 1 (located on the far western portion of the site) was observed to have slopes of up to about 30° sloping towards the south.

Region 2 (located within the north eastern and central portions of the site) was characterised by slopes in the order of between 10° to 20° in all directions. A ridge orientated in an approximate east west direction bisected the region whereby slopes drain to the north and south into a broad valley to the north and a smaller valley to the south.

Region 3 (located within the south eastern corner of the site) consists of generally flat low lying alluvial land leading on to Jordans Creek. A natural batter towards the creek of about 0.8m in height was observed in part of the area.

Water was present on the days of the investigation within Jordans Creek as well as on the surface in localised areas to the north east of the existing rugby field. Springs are likely to be common within the lower lying valley sides of Region 2 around the north eastern and north western fringes of the rugby field. Whilst not specifically identified, reedy grasses within these areas are possibly associated with springs.

At the time of the investigation, the only development observed to be present on the site was the existing rugby field and associated structures and access road. The rugby field and associated structures appear to be located on an area where cut and fill earthworks have been carried out. The extents of the cut and fill earthworks are unknown to Coffey.

Some unsealed tracks were observed to be cutting through the remainder of the site.

4.2 Slope Instability

Much of the development is proposed on sloping, and in some locations very steeply sloping ground. Critical to the investigation is the assessment of slope instability and this was the focus of the walkover survey and subsequent subsurface investigation.

Notably the majority of steep slopes were observed to have a cover of colluvium. Colluvium is a term applied to soils that have been subject to downslope movement in their development.

No evidence of deep seated instability was specifically recorded by the walkover survey. Such evidence could include inclined or rotated trees or fence posts that could also result from soil creep, or sharp breaks in slope that could represent landslide backscarps from slumped soils. Similarly hummocky ground or wet ground within hillslopes could represent the toe of landslides, and no such features were identified during the survey.

Despite the above, the potential for ongoing soil creep in the colluvium mantling the steeper slopes cannot be overlooked.

The survey did not identify any areas of boulders or rock outcrops above the planned development areas that could represent a source of risk to end users from toppling or rolling.

5 INTRUSIVE INVESTIGATION

The 17 test pits were excavated using a 17 tonne excavator equipped with a 600mm width bucket. Four of these test pits were excavated within the steeply sloping residual area (Region 1) and were designated TP101 to TP104. Ten of the test pits were excavated within the slightly sloping residual area (Region 2) and were designated TP105 to TP114. Three of the test pits were excavated within the low lying alluvial area (Region 3) and were designated TP115 to TP117.

Fieldwork was carried out in the full time presence of a Scientist from Coffey who nominated the test pit locations, logged the subsurface conditions and collected samples. Engineering logs of the test pits are presented in Appendix B.

The subsurface conditions have been separated into the hill slope areas (Regions 1 and 2) associated with the slope instability assessment and the low lying area (Region 3).

The 1:250,000 Geological Map of Dorrigo-Coffs Harbour indicates the site to be underlain by the Coramba Beds, comprising silicious argillites.

The following geological profile has been interpreted in the hillslope area subject to the slope instability assessment:

- **Topsoil:** Silty Clay, medium plasticity, moist, dark brown, root affected to between 0.15m and 0.3m depth; overlying,
- **Colluvial Soil:** Clay, Sandy Silty Clay and Gravely Clay, medium to high plasticity, moist, red/orange and light brown, firm to very stiff to depths of between 0.7m and 2.5m; overlying,
- **Residual Soil:** Clay, Silty Clay, medium to high plasticity, moist, red/orange with yellow mottle and light grey with orange mottle, stiff to hard, grading to,
- **Extremely Weathered to Highly Weathered Argillite and Greywacke:** Relic rock structure with extremely closely spaced defects (spacing < 80mm), estimated low to medium strength, pale grey-orange and dark grey-orange, grading to

- **Moderately Weathered Argillite and Greywacke:** Extremely closely spaced defects (spacing < 80mm), estimated medium to high strength, pale to dark grey and brown.

The following soil profile has been interpreted in the low lying area:

- **Topsoil:** Silty Clay and Silty Gravely Clay, medium to high plasticity, moist, dark brown, root affected to between 0.4m and 0.7m depth; overlying,
- **Alluvial Soil 1 (TP115 Only):** Gravel, loose, medium to coarse grained rounded gravel with some cobbles, to a depth of 2m, overlying,
- **Alluvial Soil 2:** Interbedded (or lenses) of clay, silty clay, sandy clay and silty gravely clay, with some medium to coarse gravel and cobbles, low to high plasticity, moist and wet, firm to stiff to depths extending beyond the depth of investigation.

Groundwater seepage was observed in some of the test pits undertaken in both the hillslope and low lying areas. In particular, seepage was observed on the hillslope area of Region 2 around the rugby field and in all three of the test pits within the low lying area (Region 3). Additionally, on the day of the investigation surface water was noted to be ponding on the surface within the Region 2 area on the north eastern corner of the rugby field. Jordans Creek which bisects the site had a steady flow of water on the days of the investigation.

6 CONSIDERATION FOR DESIGN AND CONSTRUCTION

6.1 Construction on Sloping Ground

The investigation has recorded a significant cover of colluvial soil over sloping ground, which is indicative that the site is likely to be subject to soil creep. Whilst no evidence of past deep seated instability has been noted during the investigation it will be important for each house site to be further inspected for evidence of possible deep seated instability during preparation for construction. Also note that construction of the access will change the landform such that instability may be more likely. For preliminary guidance, engineered fill or permanent cut batter slopes should not be constructed at gradients any steeper than 2H to 1V (26°) up to 3m in height. Excavations in natural soil materials may also be retained by engineer designed retaining walls, soil nail walls or the like. Excavations in rock will be required to be battered back or supported, (rock support may facilitate the use of rockbolts, dowels, mesh and shotcrete). Appropriate batter angles or support for excavations in rock will require site specific assessment as construction proceeds.

It is the nature of colluvium that it has been subject to downslope movement in its formation. As such there is potential for preexisting shear planes within the soil. The potential reduced shear strength of the soils on these planes must be considered in the design of slopes (cuttings) and retaining structures for example. It is advised that post peak / residual shear strength parameters be adopted in the design of all retaining structures that support colluvium. Retaining walls must found within residual soil or bedrock below the colluvium.

Sloping ground is susceptible to erosion, and this will be enhanced during site clearance and construction periods. The presence of vegetation has the dual benefit of binding surface soils and reducing soil moisture, increasing its shear strength. Clearance of vegetation should be kept to the minimum that is practical.

Erosion of soils can be exacerbated where springs exist and improved drainage in such areas will be needed. From initial observation particular attention must be paid to lower slopes in Region 3 and the southern portion of Region 2 (surrounding the rugby field).

6.1.1 Areas of Steep Surface Slopes (greater than 10º)

Construction on steeply sloping ground (in particular areas with slopes greater than 10º) must take into account the potential for near surface 'soil creep' within the colluvium.

All construction should be in accordance with good hillside practice as illustrated on the attached Figure in Appendix E. This implies that houses should be of "pole type" construction supported on piles that are extended into bedrock beneath the colluvium. Design of piles must take into account potential for lateral loading from soil creep, requiring them to extend into the underlying bedrock. The bedrock will provide capacity in end bearing and side adhesion (skin friction) for piles. The construction of cut/fill platforms in this area is not considered appropriate.

Soil creep can impact shallow footings, walls, footways, services and gardens. If minor cutting is required, retaining structures can be designed for the support of sloping and potentially creep affected soils. The key to the design of retaining structures and also for maintenance of slope stability is the provision of drainage away from critical areas behind walls and at the crests of slopes. The stability of cuts in rock would need to be assessed progressively as construction proceeds. Rock support such as rockbolts, dowels, mesh and shotcrete may be required.

A site specific stability assessment taking into account the landform and nature of the specific residence will be required for each site on steeply sloping ground.

6.1.2 Areas of Gentle Surface Slopes (less than 10º) and Deep Soil Profiles

Construction in shallow sloping ground (say less that 10º) might be less critical in terms of slope instability. Specific investigation should be undertaken at each house site to assess the subsoil profile for its foundation characteristics in terms of support of spread footings and ground bearing slabs or piles.

Drainage of any sloping ground will be imperative for the control of soil creep. Cut/fill platforms may not be economically practical on some sites depending on the configuration of the structure and specific allotment. Although stability issues are likely to be a bit less critical than in steeply sloping areas, good hillside practice as shown in Appendix E should be followed unless specific engineering advice to the contrary is obtained.

6.1.3 Shallow Bedrock

Higher slopes at the ridge of Region 1 and Region 2 have a shallow cover of soil overlying low to medium strength Greywacke and medium to high strength Argillite.

The bedrock will provide an appropriate foundation for the support of footings. There can be increased construction costs associated with excavating for footings and services into bedrock. The potential for uplift can become critical for buildings constructed in this location due to wind loading. The bedrock will provide axial capacity for piles and anchors if required.

6.2 Construction in Low lying Areas

Our investigation has highlighted one specific area of low-lying ground (Region 3).

Within this area groundwater was recorded to be shallow and the underlying soils include low plasticity silty clays which can be especially susceptible to deterioration under trafficking.

It is likely that provision of a working platform will be needed to allow subsequent construction to proceed, including the provision of subgrade for pavement and the placement of engineered fill for support of buildings and structures. Such a platform would comprise free draining and adequately robust granular fill that is placed and compacted in layers to provide a relatively rigid mattress. Depending on the subsurface conditions encountered, construction of working platforms may require the use of geofabric and geogrid materials. During site preparation observation should be undertaken by a geotechnical engineer who can advise on the possible need for initial excavation of superficial unsuitable soils (e.g. high compressibility or organic soils) prior to placement of the platform, subgrade improvement or structural fill.

6.3 Road Construction on Sidelong Slopes and in Valley Axes

Preliminary layout plans provided to date indicate that some of the access roads might be located along the gullies where relatively steep slopes will cross perpendicular to the road alignment.

Roads located in these areas will require relatively significant earthworks to allow them to be terraced into the hillslopes. Specific attention must be paid to the design of earthworks on sloping ground, whereby engineered fill must be placed onto level benches that are cut into the slopes. Depending on the design slope angles and the space provided for the roads the final design may need to incorporate retaining walls. Provision and maintenance of drainage on sloping ground and at retaining structures will be imperative. For preliminary guidance, engineered fill or permanent cut batter slopes should not be constructed at gradients any steeper than 2H to 1V (26°) up to 3m in height. Excavations in rock will be required to be battered back or supported, (rock support may facilitate the use of rockbolts, dowels, mesh and shotcrete). Appropriate batter angles or support for excavations in rock will require site specific assessment as construction proceeds.

The roads must be designed with sufficient drainage for control of runoff from the valley sides into the central gully as cutting and embankment slopes will be susceptible to erosion.

For and on behalf of Coffey Geotechnics Pty Ltd

Chris Pressdee

Associate Engineering Geologist

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

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

Your report will only give preliminary recommendations

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

Your report is prepared for specific purposes and persons

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

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Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

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

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

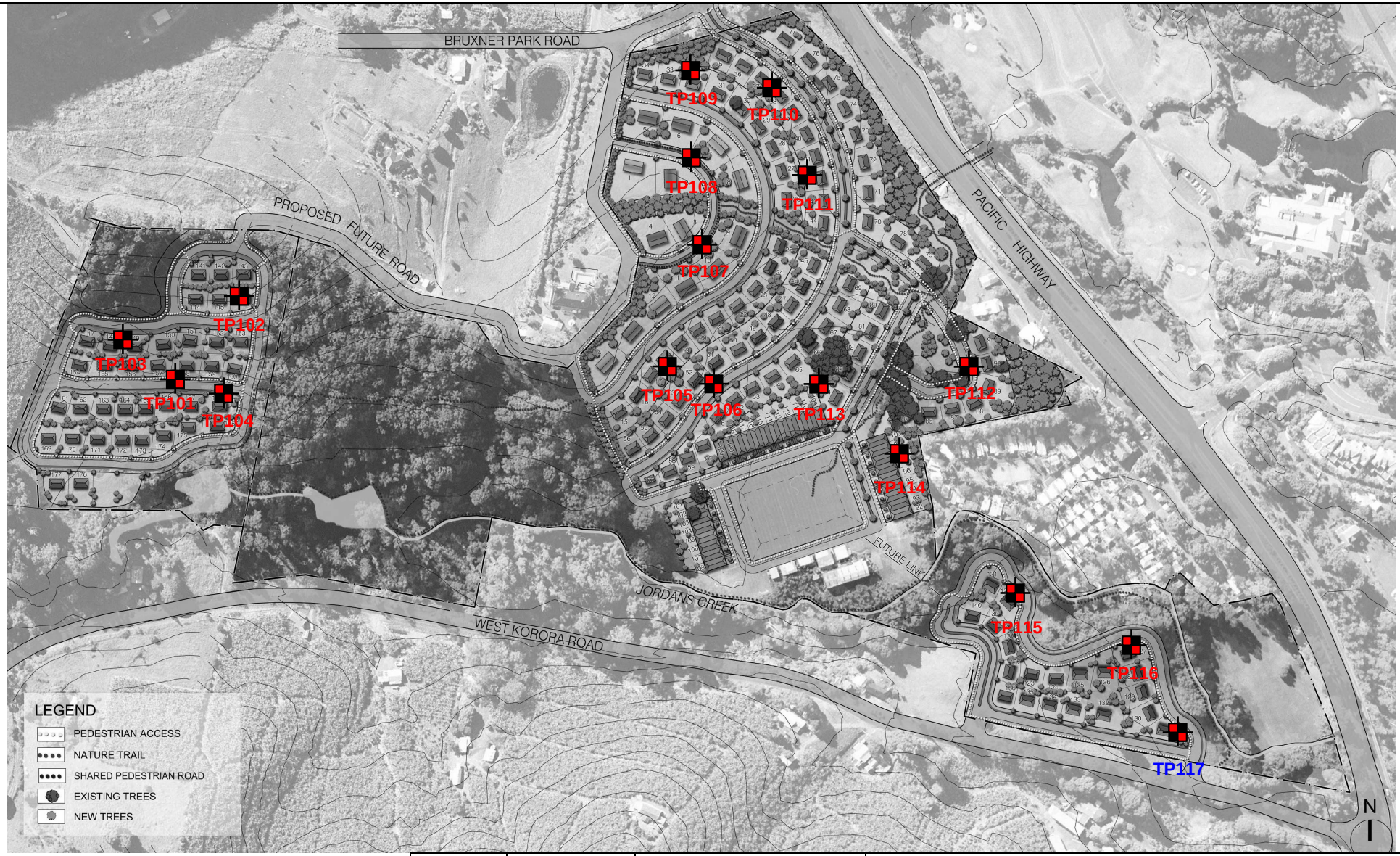
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

Responsibility

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

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

Figures



drawn	**SK**
approved	**CP**
date	**3 June 2008**
scale	**NTS**
original size	**A4**

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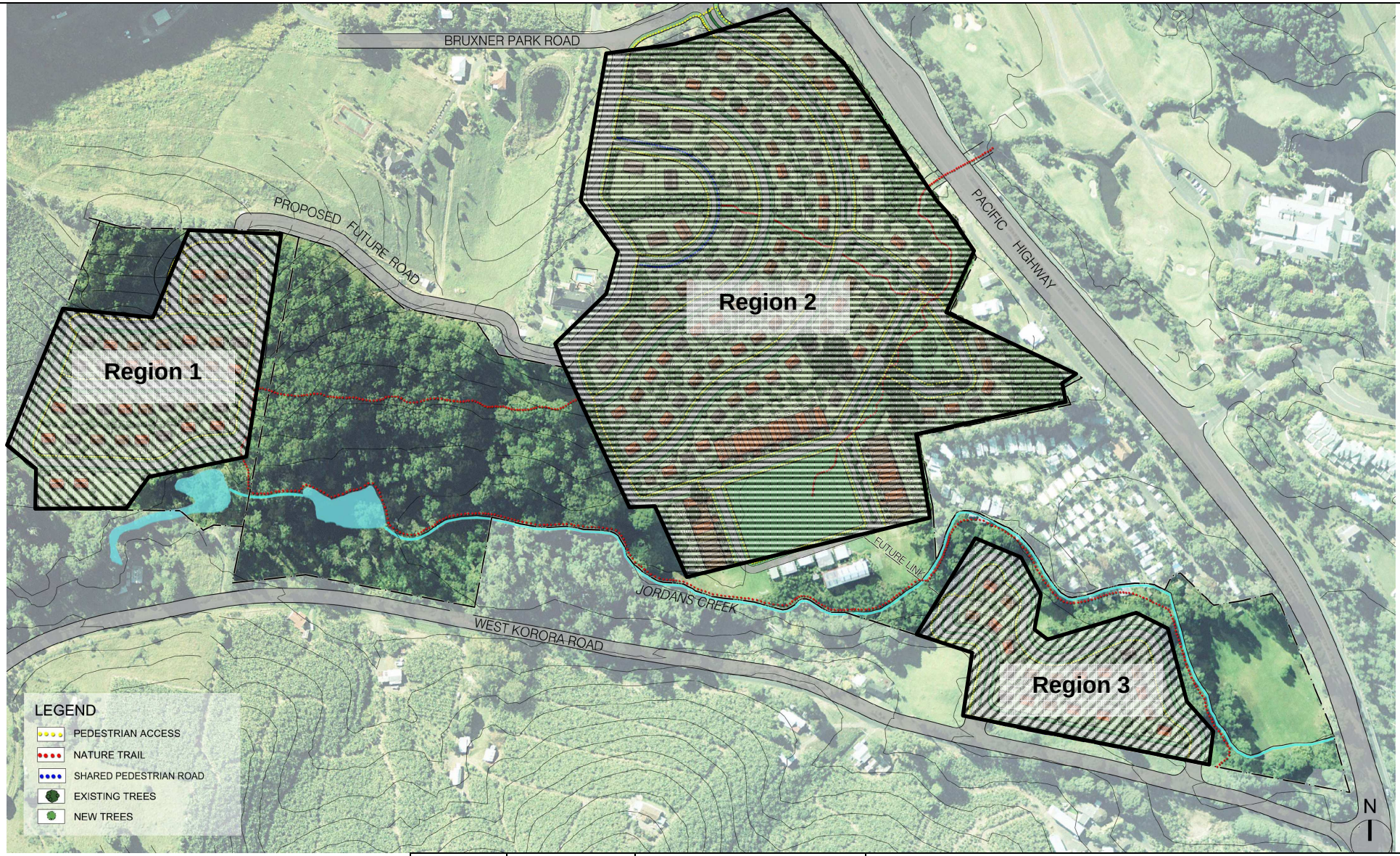
client: **Thakral Holdings Limited**

project: **Interpretive Report on Preliminary Geotechnical Assessment at Pacific Bay Western Lands, Coffs Harbour NSW**

title: **Test Pit Location Plan**

project no: **GEOTCOFH02134AB-AB**

figure no: **Figure 1**



drawn	**SK**
approved	**CP**
date	**3 June 2008**
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original size	**A4**

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SPECIALISTS MANAGING THE EARTH

client: **Thakral Holdings Limited**

project: **Interpretive Report on Preliminary Geotechnical Assessment at Pacific Bay Western Lands, Coffs Harbour NSW**

title: **Site Plan Showing Approximate Region Boundaries**

project no: **GEOTCOFH02134AB-AB**

figure no: **Figure 2**

Appendix A

Engineering Logs

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Soil Description Explanation Sheet (1 of 2)

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 600 µm
	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.

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Soil Description Explanation Sheet (2 of 2)

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 materials 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.					
		SILTS & CLAYS Liquid limit less than 50	**DRY STRENGTH**	**DILATANCY**	**TOUGHNESS**			
			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%. • Modium 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 <0.2 m 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.	

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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 roch 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 of 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 of 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	Abbrev-iation	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 bows 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 fall 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.

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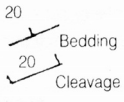
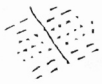
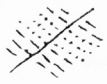
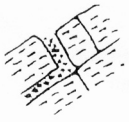
Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
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. Formad by weathering of the rock substance in place.			

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.

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 greate than cross section

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Engineering Log - Excavation

Excavation No. **TP101**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***26.5.2008***

Principal:

Date completed: ***26.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 511971 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651377 m | datum:

excavation 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
E		N	None Observed		0		OH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M			TOPSOIL
							CH	**Silty CLAY:** medium plasticity, red with a trace of fine grained sub angular gravel		St		RESIDUAL SOIL
				D	1							
					2			**ARGILLILTE:** extremely weathered very low strength, with some fine to medium grained sand, pale grey-orange		H/Fb		WEATHERED ROCK
					3							Getting softer and more silty.
				D								
					4			TP101 terminated at 3.8m due to limit of required investigation.				
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. ***TP102***

Sheet 1 of 1

Project No: ***GEOTCOFH02134AB***

Client: ***Thakral Holdings Limited***

Date started: ***26.5.2008***

Principal:

Date completed: ***26.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512037 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651627 m | datum:

excavation 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
E		N	None Observed	D	1		OH / CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown, with some sand	M	VSt		TOPSOIL
								CLAY: medium plasticity, red/orange, some fine to medium grained sand and silt				COLLUVIAL SOIL
							CH	**Sandy Silty CLAY:** low plasticity, light brown mottle orange			×	pp=300kPa
				D	2			**ARGILLILTE:** highly weathered, low strength, dark grey/orange		H		WEATHERED ROCK
											600 ×	pp=600kPa
					3			TP102 terminated at 2.5m due to limit of required investigation.				
					4							
					5							
					6							
					7							
					8							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration (1 2 3 4)
- no resistance ranging to refusal

water
- 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
- V vane shear (kPa)
- 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

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Engineering Log - Excavation

Excavation No. **TP103**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***26.5.2008***

Principal:

Date completed: ***26.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 511929 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651505 m | datum:

excavation 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
E		N	None Observed	D	0		OH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	VSt		TOPSOIL
							CH	**Silty CLAY:** medium plasticity, light brown, with some coarse grained angular gravel and cobbles of moderately weathered high strength argillite				COLLUVIAL SOIL
					1			**ARGILLITE:** moderately weathered, high strength, dark grey, highly fractured				WEATHERED ROCK
				D	2							Joints appear infilled with silty clay.
								TP103 terminated at 2.0m due to excavator refusal.				
					3							
					4							
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP104**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***26.5.2008***

Principal:

Date completed: ***26.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 511984 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651438 m | datum:

excavation 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
E			None Observed	D D		1 2 3		OH CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown **CLAY:** medium to high plasticity, red/orange, some sub angular gravel	M	VSt		TOPSOIL COLLUVIAL SOIL
									CLAY: medium to high plasticity, red/orange mottled yellow, with some coarse angular gravel and cobbles of moderately weathered high strength meta argillite Witrh some coarse angular gravel and cobbles of moderately weathered high strength argillite. **META ARGILLITE:**moderately weathered, high strength, dark grey, highly fractured		VSt		RESIDUAL SOIL WEATHERED ROCK
						4 5 6 7 8			TP104 terminated at 3.6m due to limit of required investigation.				

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
no resistance ranging to refusal

water
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
V vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP105**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512397 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651480 m | datum:

excavation 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
E		N			0		OH	**TOPSOIL:** Clay, low to medium plasticity, some silt	M			TOPSOIL, roots
							CH	**Silty CLAY:** medium plasticity, light brown, traces of fine grained sand		VSt		COLLUVIAL SOIL
					1		CH	**CLAY:** medium plasticity, red/orange, some silt and fine to medium grained sand, traces of sub angular gravel		VSt	×	pp=200kPa
							CH	**CLAY:** high plasticity, light grey and white with orange mottle, with some coarse angular gravel				RESIDUAL SOIL Some water seepage.
				D	2						×	pp=200kPa
				D				**GREYWACKE:** highly weathered, low strength, pale brown/orange				WEATHERED ROCK, joints appear infilled with pale grey silt
								TP105 terminated at 2.1m due to bucket refusal.				
					3							
					4							
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP106**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512445 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651483 m | datum:

excavation 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
E		N				1		OH	**TOPSOIL:** Clay, medium plasticity, dark brown, some silt	M	VSt		TOPSOIL
								CH					COLLUVIAL SOIL
								CH	**Silty Sandy CLAY:** medium plasticity, light brown, sand is fine to medium grained, some sub angular fine grained gravel				
				D		2			**Sandy CLAY:** medium plasticity, orange/red with grey mottle, sand is fine to medium grained, with some silt, trace of medium to coarse angular gravel of moderately weathered high strength argillite			×	Traces of roots. Some water seepage. pp=300kPa
									GREYWACKE: highly weathered, medium strength, pale brown/orange, highly fractured				WEATHERED ROCK, joints appear infilled with pale grey silty clay
				D		3						×	pp=350kPa
									TP106 terminated at 3.0m due to limit of required investigation.				
						4							
						5							
						6							
						7							
						8							

Sketch

method
N natural exposure
X existing excavation
BH backhoe bucket
B bulldozer blade
R ripper
E excavator

support
S shoring N nil

penetration
1 2 3 4
no resistance ranging to refusal

water
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
V vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP107**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512422 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651595 m | datum:

excavation 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
E		N	None Observed	D	1		OH / CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	F		TOPSOIL COLLUVIAL SOIL
								Gravelly CLAY: medium plasticity, red/orange, gravel is fine to medium grained, some fine to medium grained sand				
					2		CH	**Sandy Gravelly CLAY:** medium to low plasticity, light yellow/brown, sand is fine to medium grained, gravel is medium grained and angular		VSt		
				D	3			**GREYWACKE:** highly weathered, low strength, pale grey and red, highly fractured			x	WEATHERED ROCK Iron staining in fractures. pp=100kPa
					4			TP107 terminated at 3.5m due to limit of required investigation.				
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

TESTPIT GEOTCOFH02134AB.GPJ COFFEY.GDT 19.6.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP108**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512389 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651643 m | datum:

excavation 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
E		N	None Observed	D	1		OH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	VSt	×	TOPSOIL COLLUVIAL SOIL Traces of roots. pp=250kPa
							CH	**Sandy CLAY:** medium plasticity, red/orange, sand is fine to medium grained				
							CH	**Sandy CLAY:** medium to high plasticity, sand is fine to medium grained				
								ARGILLITE: moderately weathered, high strength, pale brown			×	WEATHERED ROCK pp=350kPa
					2			TP108 terminated at 1.5m due to excavator refusal.				
					3							
					4							
					5							
					6							
					7							
					8							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration (1 2 3 4) — no resistance ranging to refusal

water
- 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
- V vane shear (kPa)
- 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

TESTPIT GEOTCOFH02134AB.GPJ COFFEY.GDT 19.6.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP109**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512401 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 66511713 m | datum:

excavation 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
E		N	None Observed		1		OH CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown **CLAY:** medium to high plasticity, red/orange, some medium and coarse grained angular gravel of moderately weathered high strength argillite, traces of fine to medium grained sand and silt	M	VSt	×	TOPSOIL, some roots COLLUVIAL SOIL Traces of old tree roots. pp=300kPa WEATHERED ROCK
					2			**ARGILLITE:** moderately weathered, high strength, pale brown TP109 terminated at 1.2m due to bucket refusal.				
					3							
					4							
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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 geotechnics

Engineering Log - Excavation

Excavation No. **TP110**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512466 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651714 m | datum:

excavation 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
E		N	None Observed		0		CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	VSt		TOPSOIL
					1			**CLAY:** medium to high plasticity, red/orange, with some coarse angular gravel and cobbles of moderately weathered high strength argillite			×	COLLUVIAL SOIL pp=300kPa
								ARGILLITE: moderately weathered, high strength, pale brown				WEATHERED ROCK
					2			TP110 terminated at 1.1m due to bucket refusal.				
					3							
					4							
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP111**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512477 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651639 m | datum:

excavation 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
E		N	None Observed		0		OH / CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	St		TOPSOIL
					1			**CLAY:** medium to high plasticity, red/orange				COLLUVIAL SOIL
				D	2			**GREYWACKE:** highly weathered, low to medium strength, pale brown/orange, highly fractured				WEATHERED ROCK, joints appear infilled with pale grey silty clay
					3							
				D	4			Quartz vane at 4.0m.				
					5			TP111 terminated at 4.3m due to limit of required investigation.				
					6							
					7							
					8							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration (1 2 3 4) — no resistance ranging to refusal

water
- 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
- V vane shear (kPa)
- 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

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Engineering Log - Excavation

Excavation No. ***TP112***

Sheet 1 of 1

Project No: ***GEOTCOFH02134AB***

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512705 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651468 m | datum:

excavation 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
E		N	None Observed	D	1		CH	**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M			TOPSOIL
							CH	**CLAY:** medium plasticity, red/orange, some yellow mottle		St		RESIDUAL SOIL Traces of tree roots.
					2			Slight rock structure noted from 1.9m.		H	×	pp=450kPa Fine roots.
					3		CL	**Silty Sandy CLAY:** low to medium plasticity, light yellow mottle white, sand is fine to medium grained				
					4			TP112 terminated at 3.7m due to limit of required investigation.				
					5							
					6							
					7							
					8							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration (1 2 3 4) — no resistance ranging to refusal

water
- 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
- V vane shear (kPa)
- 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

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Engineering Log - Excavation

Excavation No. **TP113**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512552 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651449 m | datum:

excavation 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
E		N	None Observed	D	1		GP	**FILL:** gravel, medium grained, some fine to medium grained sand	D	St		FILL
							CH	**CLAY:** medium to high plasticity, red/orange, some fine grained sub angular gravel	M			RESIDUAL SOIL
					2			Some yellow mottle and grey starting at 1.5m.				
				D	3		ML	**SILT:** low liquid limit, pale grey, with a trace of clay and fine angular gravel		VSt		Gravel is layered throughout silt material.
					4							
					5			TP113 terminated at 4.9m due to limited reach of excavator.				
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP114**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512598 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651405 m | datum:

excavation 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
E		N	▶	D	1		CH	**TOPSOIL:** Silty Clay, medium plasticity, brown to dark brown	M	St		TOPSOIL
							CH	**Silty CLAY:** medium to high plasticity, light brown with orange/grey mottle, with some coarse angular gravel and cobbles of moderately weathered high strength argillite	W			RESIDUAL SOIL Signs of iron staining.
					2							Very wet, water seepage at 2.0m to base.
				D	3			**META ARGILLITE:** highly weathered, low to medium strength, pale brown and red/orange, highly fractured				WEATHERED ROCK Rapid water inflow, joints appear infilled with silty clay.
					4			TP114 terminated at 3.4m due to bucket refusal.				
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

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Engineering Log - Excavation

Excavation No. **TP115**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512683 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651290 m | datum:

excavation 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
		N						OH	**TOPSOIL:** Silty Clay, medium plasticity, traces of fine grained angular gravel	M			TOPSOIL
				D		1		GP	**GRAVEL:** medium to coarse grained, rounded with some coarse sand and rounded cobbles	W			ALLUVIAL SOIL
						2		CH	**CLAY:** high plasticity, white mottled yellow, with some silt				Rapid water inflow at 1.4m.
									TP115 terminated at 2.0m due to limit of required investigation.				
						3							
						4							
						5							
						6							
						7							
						8							

Sketch

method
- N natural exposure
- X existing excavation
- BH backhoe bucket
- B bulldozer blade
- R ripper
- E excavator

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- 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
- V vane shear (kPa)
- 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 geotechnics

Engineering Log - Excavation

Excavation No. **TP116**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512809 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651239 m | datum:

excavation 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
E		N				0		OH	**TOPSOIL:** Silty Gravelly Clay, medium to high plasticity, gravel is fine to medium grained, rounded	M			TOPSOIL
								CH	**Sandy CLAY:** high to medium grained plasticity, light brown mottle grey with a trace of coarse rounded gravel		F		ALLUVIAL SOIL
			►	D		1		CH	**Silty Gravelly CLAY:** medium plasticity, grey, gravel is medium to coarse grained and angular				
				D		2		CH	**Silty CLAY:** low to medium plasticity, light grey/white, some fine grained sand				
						3							
						4							
									TP116 terminated at 4.0m due to limit of required investigation.				
						5							
						6							
						7							
						8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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 geotechnics

Engineering Log - Excavation

Excavation No. **TP117**

Sheet 1 of 1

Project No: **GEOTCOFH02134AB**

Client: ***Thakral Holdings Limited***

Date started: ***27.5.2008***

Principal:

Date completed: ***27.5.2008***

Project: ***Pacific Bay Western Lands Development***

Logged by: ***ST***

Test pit location: ***REFER TO FIGURE 1***

Checked by: ***SK***

equipment type and model: 17t excavator | Pit Orientation: | Easting: 512805 m | R.L. Surface: Not measured

excavation dimensions: m long m wide | Northing: 6651178 m | datum:

excavation 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
E		N			1			**TOPSOIL:** Silty Clay, medium plasticity, dark brown	M	F		TOPSOIL
								Silty CLAY: medium to high plasticity, light brown	Wp			ALLUVIAL SOIL
					2			**Sandy Gravelly CLAY:** low plasticity, orange/red, coarse rounded gravel, sand is medium grained, some silt		St		
								Silty CLAY: grey mottle white, with some coarse rounded gravel and cobbles	M	F		
					3							
					4			TP117 terminated at 3.6m due to limit or required investigation.				
					5							
					6							
					7							
					8							

Sketch

method

N	natural exposure
X	existing excavation
BH	backhoe bucket
B	bulldozer blade
R	ripper
E	excavator

support

S shoring N nil

penetration

1 2 3 4 — no resistance ranging to refusal

water

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
V	vane shear (kPa)
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

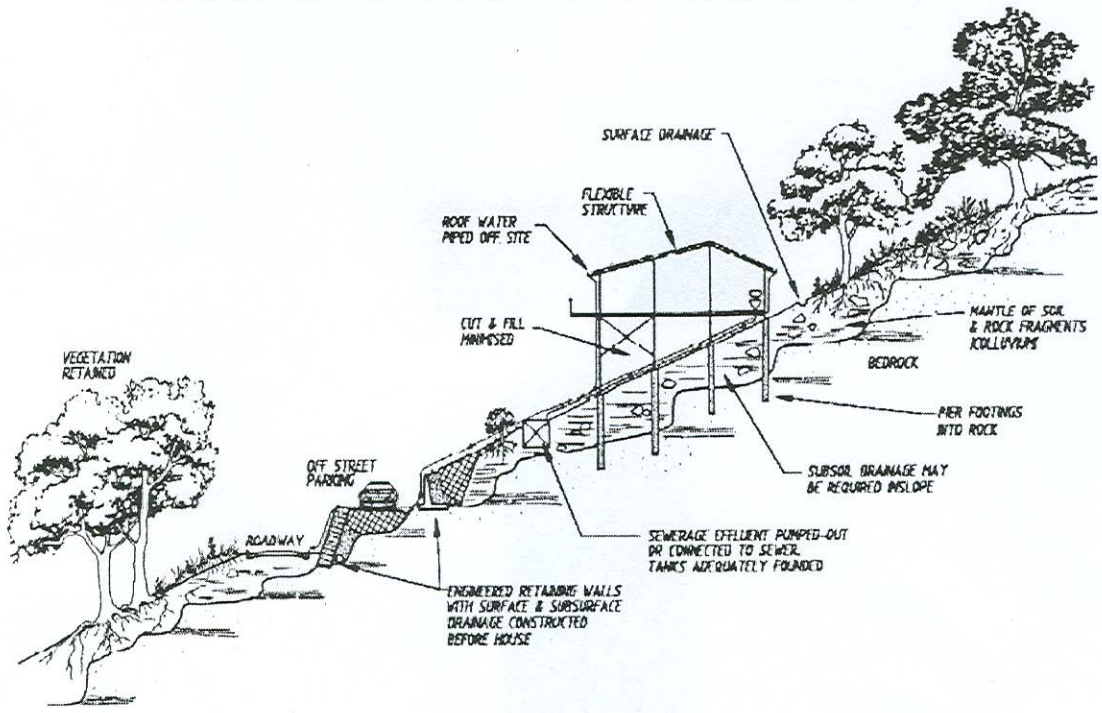
consistency/density index

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

Appendix B

Examples of Good Hillside Practice

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE

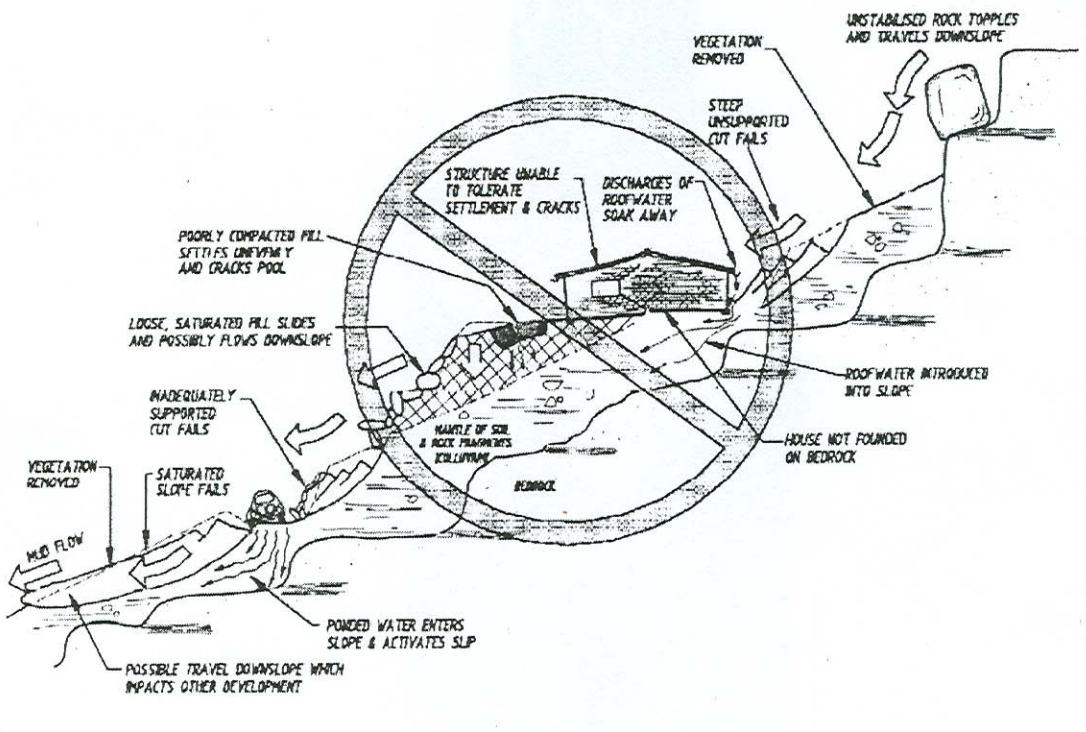


FIGURE 2: ILLUSTRATIONS OF GOOD AND POOR HILLSIDE PRACTICE

This figure is an extract from LANDSLIDE RISK MANAGEMENT CONCEPTS AND GUIDELINES as presented in Australian Geomechanics, Vol 35, No. 1, 2000 which discusses the matter more fully.

SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance including onto property below. Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on rock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within rock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide general falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond on bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge roof runoff into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by geotechnical consultant	
SITE VISITS	Site Visits by consultant may be appropriate during construction/	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident see advice. If seepage observed, determine causes or seek advice on consequences.	

FIGURE 3: SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

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