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PRELIMINARY GEOTECHNICAL ASSESSMENT - BEXHILL VILLAGE PROPOSED REZONING

John Jacobson & Kevin Teeling

GEOTALST03108AA-AB
29 August 2007

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Figures

Appendices

1 INTRODUCTION

Coffey Geotechnics Pty Ltd (Coffey) has conducted a preliminary Geotechnical investigation for the proposed rezoning of Bexhill Village situated directly east of the Bexhill settlement.

The aim of the study, which was commissioned by John Jacobson & Kevin Teeling, was to identify potential geotechnical issues that may affect the rezoning and subsequent development proposed for the site. The report was commissioned to provide:

- A slope hazard assessment, noting the observed hazards on the site and our assessment of the likelihood of those hazards occurring.
- An assessment of excavation conditions at the location of proposed cuts (if known) for road construction.
- An assessment of the suitability of the site soils for use as fill.
- Preliminary recommendations and design parameters for retaining walls and batter slope angles to support permanent and temporary excavations.

Coffey conducted the work in general accordance with proposal GEOTALST03108AA-AA. This report presents the results of the assessment.

2 SCOPE OF WORK

2.1 Fieldwork

Fieldwork was carried out on 18 and 19 July, and 20 August 2007 and comprised a site walkover by an Engineering Geologist from our Northern Rivers Office, and the excavation of 22 test pits with a rubber tyred backhoe. Test pits were excavated in order to aid assessment of the subsurface conditions, and define a geotechnical model for the landforms of the site. A review of publicly available air photos, geological maps and soil landscape maps was also undertaken for the site and the immediate surrounding areas. The investigation locations have been shown on Figures 1, 2 and 3 overlying aerial photography, the proposed residential lots and road alignments, and the slope analysis plan respectively.

Engineering Logs were compiled during the exposure of the test pits and these are presented in Appendix A, with explanation sheets defining the terms and symbols used in their preparation.

3 SITE DESCRIPTION & PROPOSED DEVELOPMENT

The site is approximately rectangular and extends around 820m in the north-south orientation and 450m in the east-west orientation. Figure 1 indicates the site boundaries including aerial photography of the site.

The proposed development is understood to entail a large number of residential blocks and access roads across the site. The proposed layout of the blocks and road alignments has been attached as Figure 2. We note this layout is preliminary and is likely to change prior to construction.

The site is situated mostly on the western face of a basalt ridge and alluvial floodplains. As such, generally the northern and eastern halves of the property fall, and therefore drain, southwards and westwards respectively, at slopes of between 10% (5.7°) and 20% (11.3°) with some areas steeper than 20%. The steepest slopes observed on the site are located west of the ridgeline near the north east corner of the site. The lower-lying south-eastern quadrant of the site is typically flatter at less than

10% and slopes down to the south. A slope analysis plan has been attached as Figure 3 indicating the extent and angle of the slopes. (This plan was computed by Riordans Consulting Surveyors, based on an initial site survey. The slope analysis has been computed, but not confirmed on the ground by surveyors.)

The site is currently used for cattle grazing and includes an abandoned small slaughterhouse near the centre of the northern boundary. Vegetation consists mainly of grass with scattered trees. More dense vegetation exists along the steeper slopes of the west facing ridgeline. This ridgeline is steep to very steep and includes slopes up to 100% (45°), and exposures of basalt outcrop and boulder scree.

Evidence of slope instability and slope wash soils of cobbles and boulders was observed throughout the investigation on the slopes at the western side of the property. Features included colluvial soils, rotated boulders and the steep rocky scarp slope, that is interpreted to be a landslide failure plain and the source of the deep colluvial material near the central north east portion of the site. Minor landslide scarps of up to 5m in length were also observed along the steeper portions of the hillside to the south.

A large area of hummocky ground showing signs consistent with landslide debris was observed around TP12. The extent of the area is marked on Figure 3. This material was interpreted to be colluvium, which is a combination of slope wash soils and landslide deposits derived from weathering and mass movement of the slopes uphill. The slope uphill of the hummocky ground near the ridgeline are bouldery and include areas of rock outcrop. This slope lacks a colluvial clay profile or residual soil profile.

Small areas of fill (e.g. bricks, tyres) were observed near the western boundary close to the existing township, in particular west of the creek near TP9.

Some services (Telstra and water mains) were observed along the western boundary of the site, and a subsurface telecommunications line was observed to transect the site from west to east along the fence line between paddocks.

4 SUB-SURFACE CONDITIONS

4.1 Stratigraphy

The Tweed Heads 1:250,000 geological map shows that the site is underlain by Lismore Basalt and sedimentary rocks, possibly of the Kangaroo Creek Sandstone of the Grafton Formation and/or the Nerranleigh Fernvale Group.

The Soils and Landscapes map of the Lismore and Ballina area (1:100,000 scale) indicates that the site, east of the main road through Bexhill, consists of soils classified into three general types, which are described as:

- CLA in the north-west of the site – Calico landscape variant typically consisting of rolling hills with long slopes of the Walloon Coal Measures (sedimentary formation of silt- and sandstones). This is classed as a transferral landscape. It is noted that dispersive clays may exist in this landscape variant coupled with low fertility rates and high erosion potential. Steep slopes present a mass movement hazard.
- EL in the south of the site – Eltham Landscape of alluvial floodplains which drains basaltic areas. It is noted that acid soils are common and that a flood hazard typically exists in this landform.

- RO in the east of the site – Rosebank Landscape of Lismore Basalt landscape of rolling hills with slopes typically 20 – 40%. Furthermore, it is noted that the Rosebank landscape is prone to acid soil generation, and steep slopes create a mass movement hazard.

Directly west of the main road through Bexhill, a sandstone quarry exists, and it is indicated on the above map that this quarry is located in the Kangaroo Creek Sandstone formation, which is overlain by the Lismore basalt in the area of the quarry.

The above general classification of the site soils was generally observed to be consistent with the site conditions during the site investigation, however the boundaries between the units varied in location.

In the area characterised as RO or Lismore Basalts, the soil profile typically presented as follows:

- Colluvium typically silty clay, red to red brown and grey, firm to hard, medium to high plasticity, which may include variable portions of gravel, cobbles and boulders. The colluvial material is derived from slopewash and landslide events, and is characterised by being unpredictable between investigation locations. (The colluvium is generally assessed to have similar engineering properties to uncontrolled earth fill) overlying –
- Extremely weathered basalt typically characterised as dense clayey gravels, upon which refusal occurred in some instances on an extremely weathered basalt shelf.

In the area characterised as CLA or Calico landscape, the soil profile typically presented as follows:

- A silty clay layer at the surface, of colluvial origin, highly plastic, from pale grey to dark brown to black, firm to very stiff, overlying –
- Residual sandy / silty clay layer, colour ranging from pale grey to orange mottled brown and grey, stiff, overlying –
- Extremely weathered Sandstone and siltstone, dense to very dense, typically described as a sandy clay or clayey sand to gravel.

In the area characterised as EL or alluvial floodplains, the soil profile typically presented as follows:

- Alluvial silty clay, of high plasticity, brown with a trace of rootlets, overlying –
- Alluvial silty clay, grey and mottled brown in colour, changing to grey at depth, stiff. Refusal was typically not encountered in the alluvial floodplain areas.

Further details of the materials intersected by the boreholes are given on the Engineering Logs presented in Appendix A, with explanation sheets defining the terms and symbols used in their preparation.

4.2 Groundwater

All test pits presented moist to wet soils. Conditions suggesting groundwater seepage were observed at three locations, TP9, TP13, and TP10. No overnight observations of standing water levels were made as test pits were filled in directly after exposure.

Groundwater inflow was observed at 1.1m at TP9, which was situated in the lower lying area next to a minor creek. At TP13, inflow was observed at 4.7m, being upstream of TP9. The groundwater inflow at TP9 and TP13 is presumably due to the proximity to the creek.

Groundwater inflow was observed at 2.8m at TP10 near the extremely weathered basalt to rock interface, which suggests that some perching of the water table on the slopes is possible. It is our experience in the basaltic terrains of the Lismore Basalt that perched groundwater tables are common,

and that prediction of groundwater levels and seepage is very difficult. Groundwater levels fluctuate dramatically with rainfall, and vary locally depending on the degree of fracturing and jointing of the rock mass.

Ground water levels may fluctuate after rain or as a consequence of other climatic effects, so seepage may occur on other parts of the slopes at other times.

4.3 Slope Hazard Assessment

A number of instability related hazards were noted across the site and have been used to assess the likelihood of future slope instability. Hazards noted were:

- Soil creep
- Small translational landslides of $5m^3$ to $10m^3$
- Hummocky ground consistent with debris from a large older landslide event,
- Exposed very steep scree slopes consistent with a back scarp landform derived from a large landslide.

These hazards were noted generally on slopes that are underlain by basaltic soils. Soil creep is expected to be most active on the areas underlain by colluvium.

Figure 3 presents landslide hazard zones (Low, Medium, High and Very High) based on the observed landslide hazards on site, the topography, and the subsurface soil profile.

The Hazard zones are detailed below:

Low Hazard: This area lies on predominantly gently sloping ground on the crests of ridges, and the floodplain downslope of potential landslide debris run-out reach. Slope angles are generally less than 10% and instability is considered to be unlikely, other than localised events along the immediate margins of creeks. Steeper slopes underlain by sedimentary rocks are included in this classification.

Medium Hazard: This area includes steeper slopes on the flanks of the hillsides and gullies. Slope angles are typically in the range of 15% up to approximately 20%. Instability involving rapid mass movement is considered to be unlikely on undisturbed ground, though soil creep is an active slow process. The likelihood of rapid mass movement (such as landslides) occurring is likely to increase significantly if the natural drainage is altered or slopes are steepened by excavation or filling, without adequate engineering of structures.

The trigger for landslide events may be inadequately supported excavation, poor engineering, seismic events, significant increases in the soil moisture regime (such as excessive and prolonged rainfall or leaking services), or development conducted not in accordance with good hillside practice (Appendix B) or a combination of all of the above.

High Hazard: This area is restricted to the steeper ground on hillsides and in drainage gullies. These slopes exhibit signs of existing soil creep, erosion and mass movement. Slope angles are greater than 20%. It is considered that there is significant potential risk of localised landslides or similar rapid mass movement in this area. Soil creep is expected to be an active process in this area where soil thicknesses are greater than 1m deep. The extent and depth of colluvial soils at specific location will significantly affect the likelihood of slope instability occuring. Likelihoods will increase significantly if the natural drainage or existing vegetation is removed or slopes are steepened by excavation or filling without adequate engineering.

Very High Hazard: This area includes areas of previous landslide debris, the very steep slopes steeper than 35% and slopes immediately downhill of very steep slopes and scree slopes. The likelihood of translational landslides, rock rolling events, debris flows and remobilisation of landslide debris is considered significant, as landslides are an active process in this area. Settlement of the landslide debris is expected to be ongoing and unpredictable. Construction of roads and buildings in this area will require particular and detailed attention to the geological hazards so as not to further increase the slope instability hazards.

Slope instability is an active and ongoing process.

5 RECCOMENDATIONS

5.1 Recommendations for Development Based on Slope Hazard Assessment

The design and construction of all the structures and infrastructure on the site should be carried out in accordance with good hillside practice as outlined in Appendix B. It must be accepted that the potential risks associated with hillside construction are greater than construction on level ground in the same geological environment. The impact of development may be adverse and inappropriate construction techniques can increase the potential for ground movement.

Careful attention should be paid to the treatment of water emanating from springs as these have the potential to significantly increase the risks associated with instability if they are not appropriately handled. Methods for treatment of water emanating from springs may take the form of trench drains or horizontal borehole drains, with flows directed to the stormwater system. The need for such systems, and the location and design will need to be assessed during design of structures forming the developments.

Recommendations for each Hazard Zone are provided below:

Low Hazard: This area is considered suitable for residential development with the potential for instability placing no restrictions on house type or design other than good engineering and construction practice. Note that development of the floodplain soils at the base of the slopes will require consideration of other geotechnical issues, in particular periodic inundation and very reactive soils that may have a low bearing capacity.

Moderate Hazard: This area is considered suitable for residential development, however the likelihood of slope instability could increase significantly if the natural drainage is altered or slopes steepened by excavation or filling. Earthworks should be minimised, and filling restricted to a maximum of 1m. Septic / Grey water system discharge should be carefully controlled to reduce changes to soil moisture.

It is recommended that geotechnical assessments complying with AGS2000 be carried out for individual house blocks in this area to provide appropriate advice on the footing design and potential engineering constraints posed by slope instability hazards for proposed houses. As a minimum, footings for such structures will be required to found below all slopewash and colluvial soils. Engineering design and construction should follow the guidelines for hillside construction and practice attached as Appendix A.

High Hazard: The likelihood of instability will increase significantly if the natural drainage is altered, existing vegetation is removed, or slopes steepened by excavation or filling.

Residential construction may require significant engineering and slope hazard assessment works in this area. Should construction be undertaken it is recommended that site-specific geotechnical studies that include subsurface investigations be carried out for individual developments to provide appropriate

advice on slope stability issues, footing design and potential engineering constraints. *The costs of such investigations would likely be significant. Some sites may require significant stabilisation works prior to undertaking the development.*

Very High Hazard: This area would not typically be considered suitable for development. Should it be considered, significant stabilisation works may be needed to remediate the hazards, and considerable engineering and design input would be needed to undertake developments. Foundations of buildings are expected to require deep piled solutions and would likely be cost prohibitive, or significant earthworks may be required to remove the landslide debris and replace it with controlled fill to allow shallow foundations.

The above comments assume that excavations, drainage and construction work are carried out in accordance with good industry practice. General recommendations and guidelines for good and poor hillside construction practice are shown in Appendix B.

At the least all slope stability risk assessments should be carried out in accordance with 'Landslide Risk Management Concepts and Guidelines' published by the Australian Geomechanics Society.

5.2 Excavation Conditions

Generally, excavations with hydraulic excavation equipment should proceed readily to similar depths as that undertaken in our investigations (depths of around 1.5m) across the eastern half (Lismore Basalt profile) of the site. The backhoe, which was equipped with a bucket 300mm with clay/tiger teeth typically refused around 2m below the ground surface, but in some instances excavation depths of up to 5m were achieved. Spoil from these excavations will be generally Silty Clay and gravel with some cobbles.

In the alluvial flood plain area of the site excavation proceeded to depths of 5m without difficulty. Spoil from excavations in the alluvial area will typically be highly plastic clays.

In the area underlain by sedimentary rocks (north-western area of the site) excavation was typically possible to 2m depth. The excavator refused at 2m depth in TP11 while excavations proceeded with little resistance to about 4m at the other test pits in this area (TP7, TP9, TP13). Spoil from excavations may include sandy clay and clayey gravel.

The very steep portion of the north west of the site includes significant areas of exposed rock and boulders, and excavation of these areas is likely to require the use of rock breaking equipment and techniques. Depending on the volume and nature of bulk excavation, and the production rates required, either very large bulldozers and/or blasting may be required. Detailed excavations would require hydraulic rock breakers.

Significant variation is expected in the depth of the soil profile across the site. Local areas where bedrock is shallower and rock strengths are greater than typical are expected.

5.3 Suitability of Site Soils for Use as Fill

Generally the soils exposed on the site are suitable for re-use as controlled fill. The following comments should be noted:

- The placement or removal of greater than 1m of material on areas noted as "moderate" slope hazard or any fill or excavation in areas of "high" or "very high" slope hazard should be undertaken only after seeking suitably qualified and experienced engineering input.

- Where site regrade is proposed, all existing topsoil, including uncontrolled fill, vegetation or other potentially deleterious material should be removed to spoil or stockpiled for re-use as landscaping materials only;
- The basalt derived residual and colluvial soils are expected to be moderately to highly reactive (susceptible to volume changes with variation in moisture content), and the alluvial soils of the low lying areas are expected to be highly to extremely reactive. These soils will need to be placed and compacted to the specifications below to reduce the risk of excessive soil movements.
- The alluvial soils are expected to be highly to extremely reactive.
- Moisture conditioning of the alluvial soils and some colluvial soils will be required to achieve the moisture specification. Potentially the alluvial soils may require drying, and the colluvial soils may require wetting up.
- Removal of oversize material from basalt derived soil types may be required prior to use of the material as fill, depending on the proposed land use.

Fill placement methodology:

- All fill should be placed in accordance with relevant Australian Standards, notably AS3798-2007.
- Approved fill beneath residential structures should be placed in layers not exceeding 300mm loose thickness and be compacted to a minimum dry density ratio of 95% Standard Compaction for cohesive materials provided applied foundation pressures are less than 100 kPa. Further advice should be sought should applied foundation pressures to controlled fill areas exceed 100 kPa.
- Granular soils such as sand and gravel (which were not observed on this site, and if required would need to be imported) should be compacted to a Minimum Density Index of 70%. Depending on the size of the granular material used, a method specification may need top be developed for the site to allow compaction of the granular material.
- Clay fill should be placed and maintained at ±2% of Standard OMC.
- All filling beneath residential structures should be carried out under Level 1 construction monitoring and testing as defined in AS3798-2007.
- Adequate consideration should be given to the type of material used beneath the structures, in terms of implications on the site classification.

All Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007, '*Guidelines for Earthworks for Commercial and Residential Developments*'.

5.4 Batter Slopes and Retaining Wall Design Parameters

5.4.1 Temporary & Permanent Batter Slopes

Table 1 presents recommendations for both temporary and permanent unsupported batter slopes

Table 1: Temporary and Permanent Batter Slope Recommendations

Material	Batter Slope Type	Maximum Slope Angle (Horizontal: Vertical)
Fill, Alluvial Soils and Colluvium	Temporary	2H:1V
	Permanent	3H:1V
Residual Soil	Temporary	1H:1V
	Permanent	2H:1V
Highly Weathered Basalt and Sedimentary Rock	Temporary	0.5H:1V
	Permanent	1H:1V

Adequate drainage should be provided for all batter slopes. As a minimum during rainfall, surface water on the high side of temporary slopes should be diverted away from the slope face and the face protected by the placement of plastic sheeting. Should observation of the temporary slopes used during construction indicate the batter slopes are not performing adequately, further advice should be sought.

Should exposures of greater than 1.5m in height be excavated in highly weathered rock we recommend that an engineering geologist should map the faces to assess the likelihood of pre existing defects in the rock and soil affecting the slope stability.

Where structures or roadways are proposed to be founded above batter slopes a setback may be required. At the least a setback of the height of the batter slope should be imposed from the crest of the slope. Further advice should be sought if structures are to be constructed within this distance.

5.4.2 Retaining Walls

Gravity type retaining walls may be designed on the basis of a triangular stress distribution. Design parameters for the geotechnical units are shown in Table 2. Design of the walls must take into account any surcharge from sloping ground or other loadings behind the wall which will increase the earth pressure loads from the horizontal ground case. Global failure of the structure should also be checked for acceptable factors of safety.

Adequate drainage should be provided for all retaining walls. Vertical drains should be connected to a geofabric wrapped perimeter drain provided at the toe of the final excavation, which should discharge to the site stormwater system to provide long term drainage behind excavation walls. Flushing points should be incorporated into the design of the perimeter drain and periodic maintenance should be incorporated into the management plan of the proposed development.

Drainage measures as described above, if properly maintained, should reduce the risk of elevated pore pressures at the back of the wall, however pore pressures may still be generated at other points behind the wall. The design should incorporate an allowance for such pressures. A typical allowance of

potential water pressure build-up equivalent to one-half the wall height is considered to be reasonable with such drainage measures installed.

TABLE 2: Preliminary Retaining Wall Design Parameters

UNIT	UNIT WEIGHT (kN/m^3)	EFFECTIVE COHESION c' (kPa)	EFFECTIVE FRICTION ANGLE Φ' (degrees)
Controlled Fill[1]	20	0	32
Colluvial Soils	20	0	25
Residual Silty and Sandy Clay	20	5	28
Extremely Weathered Material	22	10	34

Notes: 1. Assumes a cohesion-less and granular free draining fill placed and compacted in accordance with AS4678-2002 Earth Retaining Structures.

5.5 Note on proposed lot layout

We understand the current lot layout is preliminary, however numerous lots on the current layout are very steep, and do not include an appropriately sloped building pad. Based on the landforms on the site and the slope instability hazards observed, we would recommend that you consider changing the layout to allow buyers of the lots room to accommodate the slope instability issues inherent with development of sloping sites. Furthermore, the landslide scarp and colluvial debris observed in the north west of the site are not likely to be economically developed, and may be a suitable site for community lands, flora and fauna reserves, and regeneration of the depleted rainforest habitat that once occupied the site if such is considered desirable.

Buyers of lots thar are assessed as having a moderate hazard or greater will be required to found either on piles or use more advanced designs than cut to fill project homes. It is likely that specific structural and geotechnical engineering will be required for construction on these lots.

When adjusting the lot layout we recommend that the slope stability issues raised in this report be considered, and that where possible roadways, contour the site topography rather than transecting the slopes. Possibly a 'precinct' model of development may suit this site.

5.6 Foundation of roadways on colluvial soils

We do not recommend foundation of structures or roadways on colluvial soils or uncontrolled fill, unless specific and detailed investigations of the sites are undertaken, and suitable foundation conditions found or created. Foundation of roadways on colluvium may lead to increased slope instability risks and poor performance (settlement and landslide) of the roads and drainage infrastructure.

Earthworks should be limited to the minimum practical, and all filling founded wholly on residual soils, and placed in accordance AS3798-2007. Stormwater water discharge should be carefully controlled and adequately sized to reduce changes to soil moisture.

Based on the slope angles observed in the field, it is likely that retaining walls will be required to support the road corridor in some areas of fill and cut. These retaining walls should be engineered in accordance with AS4678 – 2002, Earth Retaining Structures, and should be founded within residual soil or weathered rock depending on their design loadings. Cut slopes steeper than 2H:1V in residual soil will require support, and batter slopes on controlled fill should not be placed steeper than 3H:1V

5.7 Development of alluvial floodplains

Geotechnically the soils within floodplains of the Lismore region are extremely reactive, and typically require deep (greater than 2m) piled foundations for residential structures. Foundations for larger structures than two stories may be required to extend to rock at considerable depth.

Piled foundations are required to be designed for uplift and drag exerted by expansion and contraction of the soils to the depth of seasonal influence (around 2m). In some cases de-bonding of piles in this zone is required. Other strategies could be employed, but all involve some cost above the usual.

Alluvial floodplains include deposits derived from flood events, and as such are expected to be inundated by floodwaters in the future. Specific advice pertaining to flooding may be required to develop these areas.

5.8 Recommendations for further work

Over and above the works recommended for investigation of the proposed residential lots prior to construction, we recommend detailed assessment of the cut portions of road works will be required prior to construction. The aim of further investigation work would be to more accurately assess foundation conditions at the location of the works, and confirm the preliminary design parameters offered herein. This work could only be carried out once lot layouts are confirmed.

6 LIMITATIONS

The assessment presented in this report is based on a limited number of investigation locations and observations. Engineering judgement has been made to assess potential conditions between investigation sites, but significant variability should be expected in the nature and depth of the soil units within man made and geological environments such as those evident at this site.

This report presents a preliminary assessment of the site conditions at the time of the site works. These conditions may change in the future. The parameters provided here are for preliminary design and planning purposes only. Further investigation will be required for individual residential developments, road construction and detailed assessment of slope stability risks.

Consideration should be given to these factors when following recommendations in this report.

For and on behalf of Coffey Geotechnics Pty Ltd

Tom Nicholson.

Tom Nicholson

Senior Engineering Geologist

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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

AERIAL PHOTOGRPAHY AND SITE BOUNDARIES PROVIDED BY CLIENT. ORIGINALLY DRAWN ON 18/10/05.

0 40 80 120 160 200 240

Scale (metres)

drawn	RV
approved	TGN
date	27/8/07
scale	1:3,000
original size	A3

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client:	RIORDANS CONSULTING SURVEYORS PTY LTD
project:	PROPOSED REZONING, BEXHILL VILLAGE PRELIMINARY GEOTECHNICAL INVESTIGATION BEXHILL NSW
title:	AERIAL PHOTOGRAPHY INDICATING TEST PIT LOCATIONS
project no:	GEOTALST03108AA
figure no:	FIGURE 1

LOT ALOCATION PROVIDED BY CLIENT. ORIGINALLY DRAWN ON 18/10/05.

0 40 80 120 160 200 240

Scale (metres)

drawn	RV
approved	TGN
date	8/8/07
scale	1:3,000
original size	A3

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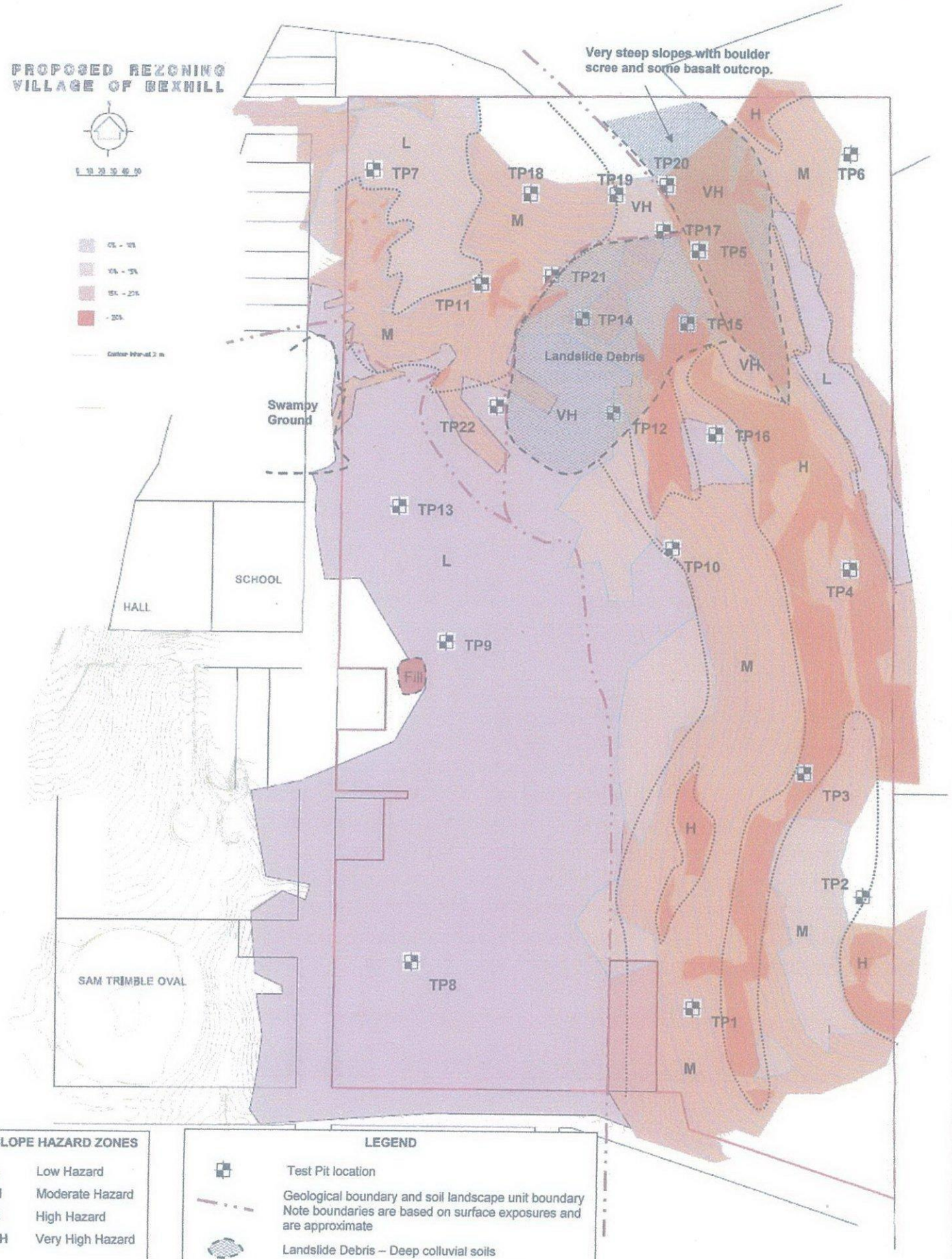
SPECIALISTS MANAGING THE EARTH

client:	RIORDANS CONSULTING SURVEYORS PTY LTD
project:	PROPOSED REZONING, BEXHILL VILLAGE PRELIMINARY GEOTECHNICAL INVESTIGATION BEXHILL NSW
title:	PROPOSED LOT LAYOUT
project no: GEOTALST03108AA	figure no: FIGURE 2



SLOPE HAZARD ZONES	
L	Low Hazard
M	Moderate Hazard
H	High Hazard
VH	Very High Hazard

LEGEND

- Test Pit location
- Geological boundary and soil landscape unit boundary Note boundaries are based on surface exposures and are approximate
- Landslide Debris – Deep colluvial soils
- Very steep slopes with boulder scree and some basalt

SLOPE ANALYSIS PLAN PROVIDED BY CLIENT.

0 40 80 120 160 200 240
Scale (metres)

drawn	RV
approved	TGN
date	28/8/07
scale	1:3,000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client:	RIORDANS CONSULTING SURVEYORS PTY LTD
project:	PROPOSED REZONING, BEXHILL VILLAGE PRELIMINARY GEOTECHNICAL INVESTIGATION BEXHILL NSW
title:	SLOPE ANALYSIS PLAN AND HAZAD ASSESSMENT
project no: GEOTALST03108AA	figure no: FIGURE 3

Appendix A

Engineering Borehole Logs and Explanation Sheets

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Engineering Log - Excavation

Excavation No. **TP1**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **18.7.2007**

Principal:
Date completed: **18.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **ALB**

Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c
Pit Orientation: NS
Easting: 534088 m
R.L. Surface:
excavation dimensions: 3m long 0.5m wide
Northing: 6817461 m
datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	V=89,45kPa	0.5		CH	**Clay:** high plasticity, dark grey, trace of roots to 0.2m, trace of boulders and cobbles to 300mm in diameter.	M	St	x	COLLUVIAL SOIL
				U50	1.0							
					1.5		CH	**Silty CLAY:** high plasticity, pale grey-brown, some medium to coarse grained gravel.		VSt	x	RESIDUAL SOIL
				D	2.0		GW	**Gravel:** coarse, dark grey, with a trace of high plasticity clay.		VD	x 600	EXTREMELY WEATHERED BASALT
					2.5			TP1 terminated at 2.2m due to refusal on extremely weathered basalt shelf. Test pit TP1 terminated at 2.2m				
					3.0							
					3.5							
					4.0							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	moisture	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter	D dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	M moist	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	W wet	St	stiff
R	ripper	water		Bs	bulk sample	W_p plastic limit	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W_L liquid limit	H	hard
			water inflow	R	refusal		Fb	friable
			water outflow				VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

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Engineering Log - Excavation

Excavation No. **TP2**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Principal:

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

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

Date started: ***18.7.2007***

Date completed: ***18.7.2007***

Logged by: ***ALB***

Checked by:

equipment type and model: Case 520c | Pit Orientation: NW/SE | Easting: 534234 m | R.L. Surface:

excavation dimensions: 2.8m long 0.5m wide | Northing: 6817535 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	D	0.5		CH	**CLAY:** high plasticity, dark brown, trace of roots to 0.4m depth.	M	F	x	COLLUVIAL SOIL
				D	1.0		CH	**Silty CLAY:** medium to high plasticity, pale grey, some gravel with cobbles.		VSt	x	RESIDUAL SOIL
					1.5							
				D	2.0		GW	**Gravel:** coarse grained gravel, brown with some medium plasticity clay.		VD	600 x	EXTREMELY WEATHERED BASALT
					2.5			TP2 terminated at 2.3m due to refusal on extremely weather basalt shelf. Test pit TP2 terminated at 2.3m				
					3.0							
					3.5							
					4.0							

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. **TP3**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **18.7.2007**

Principal:

Date completed: **18.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 534198 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6817636 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	D	0.5		CH	**CLAY:** high plasticity, dark brown, trace of rootlets to 0.2m depth.	M	St	x	COLLUVIAL SOIL
					1.0		CH	**Silty CLAY:** high plasticity, pale brown-grey, some medium to coarse grained gravel.		H	x	RESIDUAL SOIL
					1.5		GW	**Gravel:** Coarse grained, brown-dark grey, a trace of medium plasticity clay.		VD	600 x	EXTREMELY WEATHERED ROCK
					2.0			TP3 terminated at 2.0m due refusal on extremely weathered basalt shelf Test pit TP3 terminated at 2m				
					2.5							
					3.0							
					3.5							
					4.0							

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. **TP4**
Sheet 1 of 1
Project No: **GEOTALST03108AA**
Date started: **18.7.2007**
Date completed: **18.7.2007**
Logged by: **ALB**
Checked by:

Client: ***RIORDANS CONSULTING SURVEY***
Principal:
Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***
Test pit location: ***REFER TO FIGURE***

equipment type and model: Case 520c | Pit Orientation: | Easting: 534266 m | R.L. Surface:
excavation dimensions: 2.7m long 0.5m wide | Northing: 6817804 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	VS=71,23 kPa U50	0.5		CH	**CLAY:** high plasticity, dark brown, trace of rootlets to 0.2m depth.	M	St		COLLUVIAL SOIL
							CH	**Silty CLAY:** high plasticity, brown, trace of cobbles.		VSt	x	
					1.0		CH	**Silty CLAY:** medium to high plasticity, pale brown, some medium to coarse grained gravel and cobbles.		H	x	RESIDUAL SOIL
				D	1.5						x	
					2.0		GW	**Gravel:** coarse grained gravel, brown-grey, trace of medium plasticity clay.		VD	600+	EXTREMELY WEATHERED BASALT
					2.5			TP5 terminated at 2.5m due to refusal on extremely weathered basalt rock shelf Test pit TP4 terminated at 2.5m				
					3.0							
					3.5							
					4.0							

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. **TP5**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **18.7.2007**

Principal:

Date completed: **18.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 534193 m | R.L. Surface:

excavation dimensions: 2.3m long 0.5m wide | Northing: 6818085 m | datum:

excavation information						material substance					
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED	D			CH	**Silty CLAY:** high plasticity, dark brown, trace of rootlets, cobbles and boulders to 0.4m diameter.	M	H		COLLUVIAL SOIL
					1		CH	**Silty CLAY:** high plasticity, pale brown-grey, with some coarse grained gravel and cobbles.		VSt		
				D	2							
					3							
					4					St		
				D			GP	**Gravel:** coarse grained cobbly gravel, brown-grey, with some high plasticity clay.		D		RESIDUAL SOIL
					5			TP5 terminated at 4.6m due to refusal on boulders. Test pit TP5 terminated at 4.6m				
					6							
					7							
					8							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter		VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter		S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample		F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)		St	stiff
R	ripper	water		Be	bulk sample	moisture	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	D dry	H	hard
			water inflow	R	refusal	M moist	Fb	friable
			water outflow			W wet	VL	very loose
						W_P plastic limit	L	loose
						W_L liquid limit	MD	medium dense
							D	dense
							VD	very dense

TESTPIT GEOTCOPH03108AA.GPJ COFFEY.GDT 21.8.07

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Engineering Log - Excavation

Excavation No. **TP6**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***18.7.2007***

Principal:

Date completed: ***18.7.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***RV***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 534318 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6818162 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
BH		N	NONE OBSERVED			0.5		GC	**Gravelly CLAY:** high plasticity, pale brown, with some cobbles.	M	St H	X 600	COLLUVIAL SOIL
						1.0		GW	**Clayey GRAVEL:** coarse grained gravel, brown.		VD		EXTREMELY WEATHERED BASALT
						1.5			TP5 terminated at 1.1m due to refusal on extremely weathered basalt shelf. Test pit TP6 terminated at 1.1m				
						2.0							
						2.5							
						3.0							
						3.5							
						4.0							

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. **TP7**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **18.7.2007**

Principal:
Date completed: **18.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **ALB**

Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 533931 m | R.L. Surface:
excavation dimensions: 2.5m long 0.5m wide | Northing: 6818198 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED	U50	1		CH	**FILL:** Clay, high plasticity, dark brown, with trace of roots and bricks.	M	F	x	FILL
							CH	**CLAY:** high plasticity, pale grey.		VSt	x	COLLUVIAL SOIL
					2		CH	**Silty CLAY:** high plasticity, brown grey, with some gravel.		VSt	x	
				D	3		CH	**Silty CLAY:** high plasticity, white.		St	x	RESIDUAL SOIL SILTSTONE (NO STRUCTURE)
										VSt	x	
					4		SC	**Sandy CLAY:** medium plasticity, sand is fine to coarse grained.		H	x 600	EXTREMELY WEATHERED SANDSTONE
					5			TP7 terminated at 4.7m approaching refusal on extremely weathered sandstone. Test pit TP7 terminated at 4.7m				
					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. **TP8**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***19.7.2007***

Principal:

Date completed: ***19.7.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***ALB***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 533856 m | R.L. Surface:

excavation dimensions: 2.8m long 0.5m wide | Northing: 6817552 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	VS=53,26 kPa U50			CH	**Silty CLAY:** high plasticity, brown, trace of rootlets.	M	F		ALLUVIAL SOIL
							CH	**Silty CLAY:** high plasticity, grey mottle brown.		St	x	
				VS=76,20 kPa	1 2			Change colour to grey.				
				D VS=51,1 kPa	3						x	
					4						x	
					5						x	
					6			TP8 terminated at 5.2m due to limit of machine. Test pit TP8 terminated at 5.2m				
					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)
- Ba 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 GEOTCOPH03108AA.GPJ COFFEY.GDT 21.8.07

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Engineering Log - Excavation

Excavation No. **TP9**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **19.7.2007**

Principal:

Date completed: **19.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **RV**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 533932 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6817801 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N		VS= 43,17 kPa			CH	**Silty CLAY:** high plasticity, black, trace of roots and organics.	M	F	x	ALLUVIAL SOIL
				Bs	1		CH	**CLAY:** high plasticity, grey, some mottle brown specks.			x	RESIDUAL SOIL
			1.1	D	2			Colour change to brown>		St	x	
				D	3		SC	**Clayey SAND:** high plasticity, sand is fine grained, grey/orange.		MD	x	
					4			TP9 terminated at 5.1 m due to limit of machine reach. Test pit TP9 terminated at 5.1m				
					5							
					6							
					7							
					8							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	moisture	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter	D dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	M moist	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	W wet	St	stiff
R	ripper	water		Bs	bulk sample	Wp plastic limit	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W_L liquid limit	H	hard
			water inflow	R	refusal		Fb	friable
			water outflow				VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP10**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***19.7.2007***

Principal:

Date completed: ***19.7.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***RV***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 534136 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6817845 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
BH		N	2.8	VS=56,20 kPa	0.5		CH	**Silty CLAY:** high plasticity, black.	M	St	x x	COLLUVIAL SOIL
					1.0							
					1.5		GC	**Clayey GRAVEL:** coarse grained, brown, angular gravel particles.		D		RESIDUAL SOIL
					2.0							
				D	2.5		GC	**Clayey GRAVEL:** coarse grained, brown, clay is medium plasticity.		VD		EXTREMELY WEATHERED BASALT
					3.0			TP10 terminated at 3.1m die to refusal on extremely weathered basalt shelf. Test pit TP10 terminated at 3.1m				
					3.5							
					4.0							

Sketch

TESTPIT GEOTCOFH03108AA.GPJ COFFEY.GDT 21.8.07

Form GEO 5.2 Issue 3 Rev.2

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. **TP11**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY*** Date started: ***19.7.2007***
Principal: Date completed: ***19.7.2007***
Project: ***BEXHILL GEOTECHNICAL INVESTIGATION*** Logged by: ***RV***
Test pit location: ***REFER TO FIGURE*** Checked by:

equipment type and model: Case 520c Pit Orientation: NW-SE Easting: 534007 m R.L. Surface:
excavation dimensions: 2.5m long 0.5m wide Northing: 6818087 m datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED		0.0		CH	**Silty CLAY:** high plasticity, dark brown, trace of rootlets.	M	F	x	COLLUVIAL SOIL
					0.5		CH	**Silty CLAY:** high plasticity, pale orange.		St		RESIDUAL SOIL
					1.0						x	
					1.5		GC	**Clayey Silty GRAVEL:** coarse grained gravel, brown, trace of fossils.		D		EXTREMELY WEATHERED BASALT
				D	2.0							
					2.5			TP11 terminated at 2.1 due to refusal of machine on extremely weathered sandstone shelf. Test pit TP11 terminated at 2.1m				
					3.0							
					3.5							
					4.0							

Sketch

TESTPIT GEOTCOFH03108AA.GPJ COFFEY.GDT 21.8.07

Form GEO 5.2 Issue 3 Rev 2

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. **TP12**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **19.7.2007**

Principal:

Date completed: **19.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **RV**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: NE-SW | Easting: 534103 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6817971 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED	D	1		CH	**Silty CLAY:** high plasticity, dark brown, trace of rootlets.	M	St	X	COLLUVIAL SOIL
							CH	**CLAY:** high plasticity, black, some cobbles from 0.4 down to 4.1.		F	X	
					2							
					3							
					4		CH	**Silty Sandy CLAY:** high plasticity, pale grey, some brown mottling.		VSt	X	
					5			TP12 terminated at 4.7m due to machine reach limit between large boulders of colluvial origin. Test pit TP12 terminated at 4.7m				
					6							
					7							
					8							

Sketch

method		support		notes, samples, tests		classification symbols and soil description	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	based on unified classification system	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter		S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	moisture	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	D dry	St	stiff
R	ripper	water		Bs	bulk sample	M moist	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W wet	H	hard
			water inflow	R	refusal	Wp plastic limit	Fb	friable
			water outflow			W_L liquid limit	VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP13**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **19.7.2007**

Principal:
Date completed: **19.7.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **RV**

Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c | Pit Orientation: NNE-SSW | Easting: 533911 m | R.L. Surface:
excavation dimensions: 2.5m long 0.5m wide | Northing: 6817916 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	4.7	U50	1		CH	**Silty CLAY:** high plasticity, dark brown, traceo fo rootlets.	M	St	x	ALLUVIAL SOIL
							CH	**CLAY:** high plasticity, dark grey.		F	x	
					2		SC	**Sandy CLAY:** high plasticity, fine to medium grained sand, orange/pale grey.		St		RESIDUAL SOIL
				D	3						x	
					4			some wide clayey sand zones from 3.5m.				
					5				W		x	
					6			TP13 terminated at 5.1 due to limit of machine. Test pit TP13 terminated at 5.1m				
					7							
					8							

Sketch

method		support		notes, samples, tests		classification symbols and soil description	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	based on unified classification system	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter		S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	moisture	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	D dry	St	stiff
R	ripper	water		Ba	bulk sample	M moist	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W wet	H	hard
			water inflow	R	refusal	Wp plastic limit	Fb	friable
			water outflow			W_L liquid limit	VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP14**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **20.8.2007**
Principal:
Date completed: **20.8.2007**
Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **ALB**
Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c | Pit Orientation: SE-NW | Easting: 534098 m | R.L. Surface:
excavation dimensions: 2.5m long 0.5m wide | Northing: 6818060 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED		1		CH	**TOPSOIL:** Silty Clay, high plasticity, dark brown, with a trace of roots, with a trace of cobbles	M	St		COLLUVIAL TOPSOIL
							GC	**Gravelly CLAY:** High plasticity, brown, gravel is coarse grained, with some cobbles and boulders to 0.4m diameter		H	x	COLLUVIAL SOIL
					2			Clay is friable			x	
					3					VSt		
					4			Three 500mm diameter boulders from 3.5m to 4.5m			x	
					5						x	
					6			End of hole at 5.4m due to limit of machine Test pit TP14 terminated at 5.4m				
					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

Form GEO 5.2 Issue 3 Rev 2
TESTPIT GEOTCOFH03108AA.GPJ COFFEY.GDT 21.8.07

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP15**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **20.8.2007**

Principal:

Date completed: **20.8.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 534156 m | R.L. Surface:

excavation dimensions: 2.8m long 0.5m wide | Northing: 681030 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED		0.5		CH	**TOPSOIL:** Silty Clay, high plasticity, dark grey, with a trace of cobbles	M	F	x	COLLVIAL TOPSOIL
					1.0		GC	**Cobbly Gravelly CLAY:** High plasticity, gravel is coarse grained, sub angular cobbles to 0.2m in diameter			x	COLLUVIAL SOIL
					1.5					St	x	
					2.0		CH	**CLAY:** High plasticity, pale grey		VSt	x	
					2.5		GW	**GRAVEL:** Coarse grained, pale orange-brown, with some medium plasticity clay		D		EXTREMELY WEATHERED BASALT pp >600
					3.0							
					3.5			End of hole at 3.2m due to limit of required investigation Test pit TP15 terminated at 3.2m				
					4.0							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter		VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter		S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	moisture	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	D dry	St	stiff
R	ripper	water		Bs	bulk sample	M moist	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W wet	H	hard
			water inflow	R	refusal	Wp plastic limit	Fb	friable
			water outflow			W_L liquid limit	VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP16**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **20.8.2007**

Principal:
Date completed: **20.8.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **ALB**

Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 534161 m | R.L. Surface:
excavation dimensions: 1.8m long 0.5m wide | Northing: 6817961 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED		0.5		CH	**Silty CLAY:** High plasticity, grey, with some coarse gravel and cobbles up to 0.2m in diameter	M	St	x	COLLUVIAL SOIL
					1.0		GC	**Gravelly CLAY:** Medium to coarse grained, clay is medium plasticity, brown-orange		VSt		RESIDUAL SOIL
					1.5		GW	**GRAVEL:** Coarse grained, brown-grey, with a trace of medium plasticity clay		D/VD	x	EXTREMELY WEATHERED BASALT
					2.0						600	
					2.5							
					3.0			End of hole at 2.8m due to limit of required investigation Test pit TP16 terminated at 2.8m				
					3.5							
					4.0							

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. **TP15**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***20.8.2007***

Principal:

Date completed: ***20.8.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***ALB***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 534156 m | R.L. Surface:

excavation dimensions: 2.8m long 0.5m wide | Northing: 681030 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED		0.5		CH	**TOPSOIL:** Silty Clay, high plasticity, dark grey, with a trace of cobbles	M	F	x	COLLVIAL TOPSOIL
					1.0		GC	**Cobbly Gravelly CLAY:** High plasticity, gravel is coarse grained, sub angular cobbles to 0.2m in diameter			x	COLLUVIAL SOIL
					1.5					St	x	
					2.0		CH	**CLAY:** High plasticity, pale grey		VSt	x	
					2.5		GW	**GRAVEL:** Coarse grained, pale orange-brown, with some medium plasticity clay		D		EXTREMELY WEATHERED BASALT pp >600
					3.0							
					3.5			End of hole at 3.2m due to limit of required investigation Test pit TP15 terminated at 3.2m				
					4.0							

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. **TP17**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **20.8.2007**

Principal:

Date completed: **20.8.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: E-W | Easting: 534149 m | R.L. Surface:

excavation dimensions: 2.3m long 0.5m wide | Northing: 6818125 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED		0		CH	**TOPSOIL:** Clay, high plasticity, dark grey, with a trace of roots and cobbles	M	F	x	COLLUVIAL TOPSOIL
							CH	**Gravelly Boulder CLAY:** High plasticity, brown, grey, gravel is coarse grained, up to 40% boulders and cobbles to 600mm in diameter			x	COLLUVIAL SOIL
					1							
					2						x	
					3						x	
										S	x	
				D	4		CH	**CLAY:** High plasticity, white with some medium grained sand		VSt	x	RESIDUAL SOIL
											x	
					5			End of hole at 4.8m due to collapse of pit Test pit TP17 terminated at 4.8m				
					6							
					7							
					8							

Sketch

TESTPIT GEOTCOFFH03108AA.GPJ COFFEY.GDT 27.08.07

Form GEO 5.2 Issue 3 Rev 2

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. **TP18**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **20.8.2007**

Principal:

Date completed: **20.8.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: E-W | Easting: 534080 m | R.L. Surface:

excavation dimensions: 2m long 0.5m wide | Northing: 6818147 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL 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
BH		N	NONE OBSERVED		0.5		CH	**TOPSOIL:** Clay, high plasticity, dark grey, with a trace of roots and cobbles	M	F	x	COLLUVIAL TOPSOIL
					1.0		CH	**CLAY:** High plasticity, white, pale brown, with some sand		VSt	x	RESIDUAL SOIL
					1.5		SC	**Silty CLAY:** High plasticity, white, pale orange		H		EXTREMELY WEATHERED SANDSTONE pp >600
					2.0							pp >600
					2.5			End of hole at 2.4m due to limit of required investigation Test pit TP18 terminated at 2.4m				
					3.0							
					3.5							
					4.0							

Sketch

method		support		notes, samples, tests		classification symbols and soil description	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	based on unified classification system	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter		S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	moisture	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	D dry	St	stiff
R	ripper	water		Bs	bulk sample	M moist	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W wet	H	hard
			water inflow	R	refusal	Wp plastic limit	Fb	friable
			water outflow			W_L liquid limit	VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

coffey geotechnics

Engineering Log - Excavation

Excavation No. **TP19**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**

Date started: **20.8.2007**

Principal:

Date completed: **20.8.2007**

Project: **BEXHILL GEOTECHNICAL INVESTIGATION**

Logged by: **ALB**

Test pit location: **REFER TO FIGURE**

Checked by:

equipment type and model: Case 520c | Pit Orientation: N-S | Easting: 534127 m | R.L. Surface:

excavation dimensions: 2m long 0.5m wide | Northing: 6818135 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
BH		N	NONE OBSERVED		0.0		CH	**TOPSOIL:** Clay, high plasticity, dark grey, with a trace of roots and cobbles`	M	F		COLLUVIAL TOPSOIL
					0.5		CH	**CLAY:** High plasticity, white, pale brown, with some fine to medium grained sand		VSt	x	RESIDUAL SOIL
					1.0						x	
					1.5		CH	**CLAY:** High plasticity, white, pale orange		H		EXTREMELY WEATHERED SANDSTONE
					2.0						x	
					2.5			End of hole at 2.2m due to limit of required investigation Test pit TP19 terminated at 2.2m				
					3.0							
					3.5							
					4.0							

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. **TP20**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***20.8.2007***

Principal:

Date completed: ***20.8.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***ALB***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: | Easting: 534165 m | R.L. Surface:

excavation dimensions: 2.3m long 0.5m wide | Northing: 6818156 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		N	NONE OBSERVED		0.5		GC	**Bouldery Gravelly CLAY:** High plasticity, brown, gravel is coarse, trace of roots to 0.5m, basalt and sandstone clasts (10%), boulders to 0.7m in diameter	M	St	x	COLLUVIAL SOIL
					1.0					VSt	x	
					1.5		GW	**GRAVEL:** Coarse grained, dark grey, brown		VD		HIGHLY WEATHERED BASALT
					2.0			End of hole at 1.9m due to refusal on highly weathered basalt Test pit TP20 terminated at 1.9m				
					2.5							
					3.0							
					3.5							
					4.0							

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. **TP22**

Sheet 1 of 1

Project No: **GEOTALST03108AA**

Client: ***RIORDANS CONSULTING SURVEY***

Date started: ***20.8.2007***

Principal:

Date completed: ***20.8.2007***

Project: ***BEXHILL GEOTECHNICAL INVESTIGATION***

Logged by: ***ALB***

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

Checked by:

equipment type and model: Case 520c | Pit Orientation: E-W | Easting: 534007 m | R.L. Surface:

excavation dimensions: 2.5m long 0.5m wide | Northing: 6818057 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	depth RL / 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
BH		1	NONE OBSERVED		0.5		CH	**TOPSOIL:** Silty Clay, high plasticity, grey, trace roots to 0.3m depth	M	F	x	COLLUVIAL TOPSOIL
					1.0		CH	**Silty CLAY:** High plasticity, white, pale orange, with some fine to medium grained sand		St/VST	x	RESIDUAL SOIL
					1.5							
					2.0						x	
					2.5		CH	**Silty CLAY:** High plasticity, white, pale orange, with some medium grained sand		H	x	EXTREMELY WEATHERED SANDSTONE
					3.0			End of hole at 2.5m due to limit of required investigation Test pit TP22 terminated at 2.5m				
					3.5							
					4.0							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system	consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	moisture	VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter	D dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	M moist	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	W wet	St	stiff
R	ripper	water		Bs	bulk sample	Wp plastic limit	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W_L liquid limit	H	hard
			water inflow	R	refusal		Fb	friable
			water outflow				VL	very loose
							L	loose
							MD	medium dense
							D	dense
							VD	very dense

TESTPIT GEOTCOFH03108AA.GPJ COFFEY.GDT 27.08.07

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Engineering Log - Excavation

Excavation No. **TP21**
Sheet 1 of 1
Project No: **GEOTALST03108AA**

Client: **RIORDANS CONSULTING SURVEY**
Date started: **20.8.2007**
Principal:
Date completed: **20.8.2007**
Project: **BEXHILL GEOTECHNICAL INVESTIGATION**
Logged by: **ALB**
Test pit location: **REFER TO FIGURE**
Checked by:

equipment type and model: Case 520c | Pit Orientation: E-W | Easting: 534054 m | R.L. Surface:
excavation dimensions: 2.1m long 0.5m wide | Northing: 6818083 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
BH		N	NONE OBSERVED		0.5		CH	**TOPSOIL:** Clay, high plasticity, dark grey, with a trace of roots, with a trace of cobbles to 200mm diameter	M	St		COLLUVIAL SOIL
					1.0		CH	**Silty CLAY:** High plasticity, white-orange, with some medium to coarse grained sand		VSt	X	
					1.5		CH	**Silty CLAY:** High plasticity, white, plae grey, with some medium to coarse grained sand		H	X	EXTREMELY WEATHERED SANDSTONE
					2.0			End of hole at 2.1m due to limit of required investigation Test pit TP21 terminated at 2.1m				
					2.5							
					3.0							
					3.5							
					4.0							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system		consistency/density index	
N	natural exposure	S	shoring	U_{50}	undisturbed sample 50mm diameter	moisture		VS	very soft
X	existing excavation	N	nil	U_{63}	undisturbed sample 63mm diameter	D	dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	M	moist	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	W	wet	St	stiff
R	ripper	water		Bs	bulk sample	Wp	plastic limit	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	W_L	liquid limit	H	hard
			water inflow	R	refusal			Fb	friable
			water outflow					VL	very loose
								L	loose
								MD	medium dense
								D	dense
								VD	very dense

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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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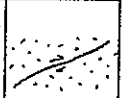
Soil Description Explanation Sheet (2 of 2)

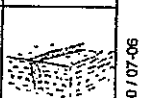
SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

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.				
			DRY STRENGTH	DILATANCY	TOUGHNESS		
		SILTS & CLAYS Liquid limit less than 50	None to Low	Quick to slow	None	ML	SILT
			Medium to High	None	Medium	CL	CLAY
			Low to medium	Slow to very slow	Low	OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium	MH	SILT
			High	None	High	CH	CLAY
			Medium to High	None	Low to medium	OH	ORGANIC CLAY
HIGHLY ORGANIC SOILS		Readily identified by colour, odour, spongy feel and frequently by fibrous texture.				Pt	PEAT

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

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM
PARTING	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (eg bedding). May be open or closed.	
JOINT	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 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 rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.
Defect	Discontinuity or break in the continuity of a substance or substances.
Mass	Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME	Simple rock names are used rather than precise geological classification.
PARTICLE SIZE	Grain size terms for sandstone are:
Coarse grained	Mainly 0.6mm to 2mm
Medium grained	Mainly 0.2mm to 0.6mm
Fine grained	Mainly 0.06mm (just visible) to 0.2mm
FABRIC	Terms for layering 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 fail across the planar anisotropy) is typically 10 to 25 times the point load index (I_s50). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

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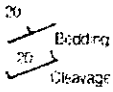
Rock Description Explanation Sheet (2 of 2)

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. Formed by weathering of the rock substance in place.			

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

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.

Appendix B

Examples of Good Hillside Practice

APPENDIX J

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.	

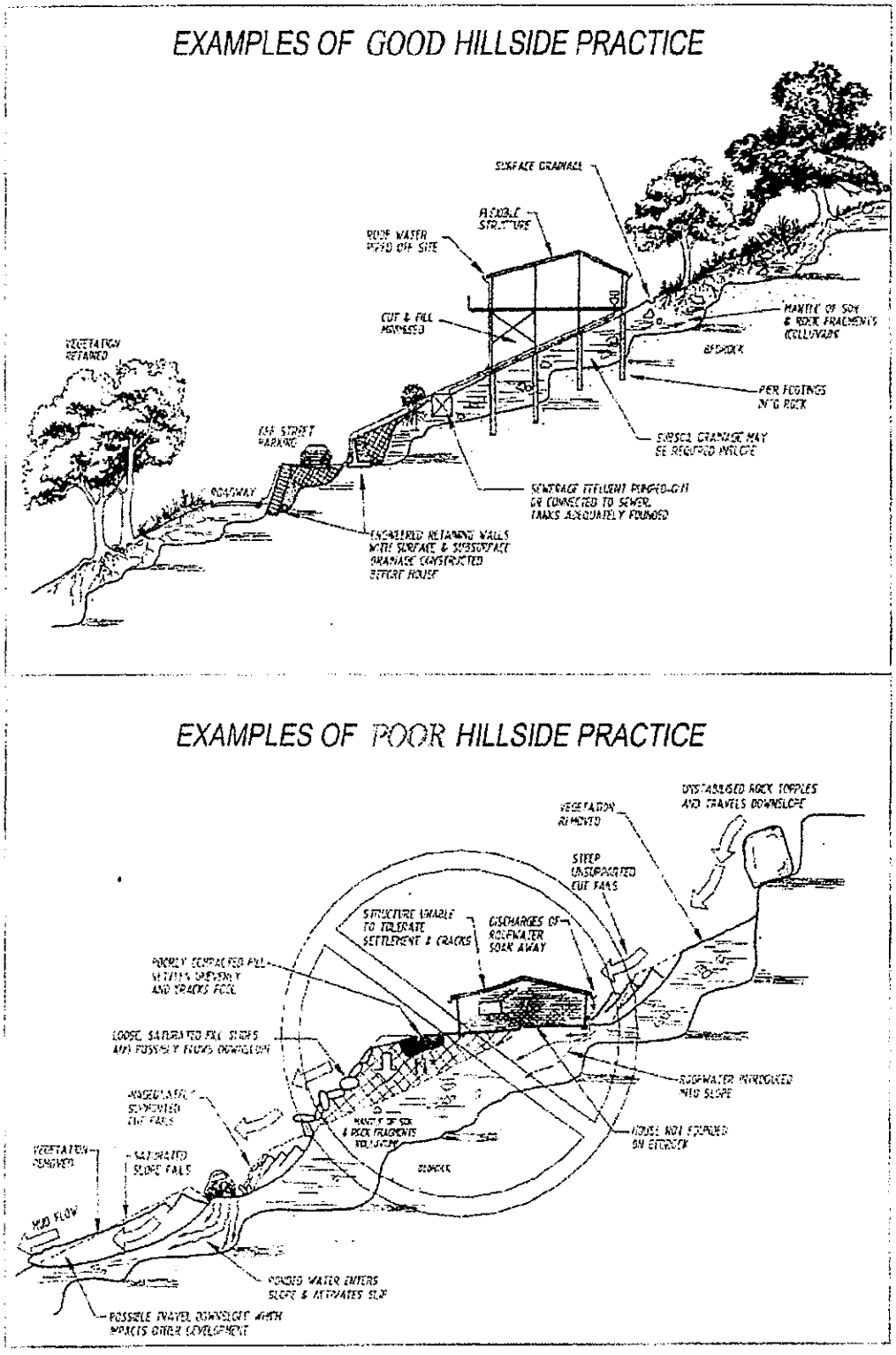


Figure J1: Illustrations of Good and Poor Hillside Practice