Douglas Partners
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REPORT
ON
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED TOURIST & RESIDENTIAL DEVELOPMENT
COMBERTON GRANGE
JERVIS BAY

Prepared for:
SHAOLIN TEMPLE FOUNDATION (AUSTRALIA)

PROJECT 48670.02
SEPTEMBER 2009

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TABLE OF CONTENTS

Page

AC:ds
Project 48670.02
15 September 2009

REPORT ON PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED TOURIST AND RESIDENTIAL DEVELOPMENT
COMBERTON GRANGE, JERVIS BAY

1. INTRODUCTION

This report presents the results of a preliminary geotechnical investigation undertaken at the site of a proposed tourist and residential development at Comberton Grange, Jervis Bay. The work was commissioned by Conybeare Morrison International Pty Ltd, project managers acting on behalf of the Shaolin Temple Foundation (Australia), developers of the site.

It is understood that the proposed development comprises a mixed tourist, residential and commercial development, including a temple, educational facilities, farms, hotel, staff accommodation, dwellings, commercial centre and a golf course. Investigation was carried out in a 285 ha portion of an overall 1249 ha property in order to provide information on subsurface conditions within the proposed development area, in order to provide preliminary information on subsurface conditions to assist in conceptual planning for the project.

The investigation comprised field mapping by a senior geotechnical engineer, test pit excavation and borehole drilling, followed by laboratory testing of selected samples, engineering analysis and reporting. Details of the work undertaken and the results obtained are given in the report, together with comments relating to planning, design and construction practice.

A draft report was circulated by mail on 20 August 2009. This report supersedes all previous verbal advice and written correspondence.

The field work was undertaken concurrently with preliminary contamination and acid sulphate soil assessments, the results of which are given in separate reports (Project 48670 and 48670.01) dated September 2009.

Site survey plans and aerial photos were provided by the client for the investigation.

2. SITE DESCRIPTION

The site, which comprises two individual portions, nominated as the Northern (174.5 ha) and Southern (110.5 ha) Development Areas, is located within the north-western section of a larger property that includes Lot 1 in DP 725955, Lot 1 DP 550098, Lot 4 DP 63404 and Lots 59 – 61 in DP 755928.

The Northern Development Area (NDA, refer Drawing 1) is an irregular shaped area with maximum north-south and east-west dimensions of 1400 m and 1200 m respectively. It is centred on a series of west to north-east and west to south-east ridgelines which are separated by south-easterly trending depressions which drain to the Currambene Creek floodplain some 2 km to the south. Site levels fall at grades of 1 in 10 to 1 in 25, with an overall difference in level estimated to be about 36 m from the highest part to the lowest part of the development area. At the time of the assessment, the NDA was heavily vegetated and largely inaccessible with the exception of a grid of tracks formerly used for timber transportation.

The Southern Development Area (SDA, refer Drawing 2) is an irregular shaped, elongated area with maximum plan dimensions of 2300 m and 600 m respectively. It is located on the south-west facing flanks of a ridgeline with site levels falling towards Currambene Creek at grades of 1 in 10 to 1 in 25, with an overall difference of about 34 m. At the time of the assessment, the SDA was predominantly cleared and used for cattle grazing. A remnant forest was located along the north-eastern extent of the proposed development area.

3. REGIONAL GEOLOGY

Reference to the 1:250 000 Wollongong Geological Series Sheet (Ref 1) indicates that the proposed development areas are underlain by Nowra Sandstone and Wandrawandian Siltstone both belonging to the Shoalhaven Group of Permian age. The Nowra Sandstone comprises quartz sandstone whilst the Wandrawandian Siltstone comprises sandstone, siltstone and conglomerate.

The test pits confirmed the geological mapping, with sandstone and siltstone encountered in those pits that intersected rock.

Reference to the 1:25 000 Yalwal/Nowra Acid Sulphate Risk Map (Ref 2) indicates *"no known occurrence – acid sulphate soils are not known or expected to occur in these environments"*, within the proposed development area. The mapping indicates the likelihood of acid sulphate soils within the Currambene Creek floodplain (below about RL 4 m) to the south of the development area. The results of the preliminary acid sulphate soil assessment (Project 48670.01) were consistent with the broad scale mapping, with acid sulphate soils *"not expected to be encountered"*.

4. FIELD WORK

4.1 Methods

The field work comprised field mapping by a senior geotechnical engineer followed by test pit excavation and borehole drilling. Relevant site features noted during the inspection are shown on the colour photoplates given in Appendix B, with the locations indicated on Drawings 1 and 2 (Appendix A).

Pits 1 – 25 were excavated to depths of 0.8 – 3.3 m with a John Deere 315SJ backhoe fitted with a 600 mm wide bucket. The pits were logged on site by an environmental scientist who collected representative disturbed samples to aid in strata identification and for possible laboratory testing.

Bores 26 – 28 were drilled with a Gemcodril 210B soil sampling and drilling rig and were advanced with 125 mm diameter continuous solid flight augers to the termination depths (limit of investigation) of 6 m. Standard penetration tests (SPT) were carried out at regular intervals to assist with strata identification and for possible laboratory testing. Details of the SPT procedure are given in the accompanying notes (Appendix B) with the penetration 'N' values recorded on the borehole logs.

The approximate locations of the field tests are shown on Drawings 1 and 2 (Appendix A). The surface levels (to Australian Height Datum, AHD) and coordinates (MGA) shown on the logs were determined by contour interpolation and by hand-held GPS receivers respectively and as such, are approximate only.

4.2 Results

4.2.1 Site Inspection

Inspection of the site by a senior geotechnical engineer on 26 May 2009 indicated the following:

- limited access within the proposed NDA due to heavy vegetation growth, with the exception of an orthogonal grid of gravel tracks previously used for timber haulage;
- uniform slopes within the northern area, which locally steepen in the vicinity of watercourses and drainage depressions;
- evidence of previous timber plantation in the NDA;
- uniform slopes within the SDA which are predominantly cleared due to previous grazing activities;
- remnants of a previous homestead in the south-western section of the proposed development areas;
- generally upright tree growth patterns in both proposed development areas;
- no indications of deep-seated site instability.

4.2.2 Subsurface Investigation

Details of the subsurface conditions encountered are given on the test pit and borehole logs included in Appendix B, together with notes defining classification methods and descriptive terms.

Relatively uniform conditions were encountered underlying the site, with the succession of strata broadly summarised as follows:

TOPSOIL/FILLING:	to depths of 0.1 – 0.5 m (but generally to 0.2 – 0.4 m);
CLAY:	variably stiff to hard clay and shaly clay to depths of 0.8 – 3.7 m. Pits 9, 11 – 16, 18 and 19 were terminated in residual clay at depths of 1.5 – 3.3 m;
BEDROCK:	initially extremely low to very low strength sandstone and siltstone becoming low to medium strength at refusal of the backhoe bucket at depths of 0.8 – 2.8m in Pits 4, 6 – 8, 10 and 20 – 24. Pits 1, 2, 5 and 17 and Bores 26 – 28 were terminated in extremely weathered rock at depths of 1.8 – 6.0m.

No free groundwater was observed in any of the pits during excavation or whilst auger drilling in the boreholes. It is noted that the pits were immediately backfilled following excavation, which precluded long term monitoring of groundwater levels.

5. LABORATORY TESTING

Selected samples from the pits were tested in the laboratory for measurement of field moisture content, Atterberg limits, linear shrinkage, compaction properties, California bearing ratio, particle size distribution, Emerson Class number, pH, chloride/sulphate concentrations, electrical conductivity and exchangeable sodium percentage (sodicity). The detailed test report sheets are given in Appendix C and are summarised in Tables 1 – 3.

Table 1: Results of Compaction and CBR Tests

Pit No	Depth (m)	FMC (%)	OMC (%)	MDD (t/m^3)	CBR (%)	Material
3	0.8 – 1.0	20.5	18.1	1.75	4	Silty Clay
9	2.3 – 2.5	19.4	18.1	1.75	4	Silty Clay
16	0.5 – 0.7	21.3	24.0	1.55	9	Silty Sandy Clay

Where FMC = Field moisture content; OMC = Optimum Moisture Content; MDD = Maximum Dry Density; CBR = California Bearing Ratio

The results of the particle size distribution tests indicate the soils tested are predominantly clays whilst the topsoil comprises silty sand.

The results in Table 2 indicate that the soils tested are of variable plasticity and as such, would be susceptible to shrinkage and swelling with changes in soil moisture content. The results of the Emerson Class testing indicate only a slight susceptibility for dispersion, with the exception of the dispersive soil tested at Pit 25 (0.5 – 0.7 m).

Table 2: Results Plasticity and Dispersion Tests

Pit No	Depth (m)	W (%)	W_L (%)	W_P (%)	I_P (%)	LS (%)	ECN	Material
1	0.3 – 0.5	18.6	44	19	25	10.5		Silty clay
1	0.8 – 1.0	13.3						Silty clay
2	0.0 – 0.25	14.2					4	Silty clay
3	0.8 – 1.0	20.5						Silty clay
3	1.3 – 1.5	20.6	44	20	24	10.5		Silty clay
4	0.4 – 0.5	26.5					4	Silty clay
5	0.8 – 1.0	18.8	44	18	26	11.5		Silty clay
6	0.4 – 0.5	16.3					4	Silty clay
7	1.3 – 1.5	24.9	42	22	20	10.5		Silty clay
8	0.8 – 1.0	12.9						Silty clay
9	0.0 – 0.25	13.3					4	Topsoil
9	1.8 – 2.0	22.5	37	19	18	9.0		Clay
9	2.3 – 2.5	19.4						Silty Clay
10	0.4 – 0.5	19.3						Silty clay
12	0.3 – 0.5	23.4					4	Silty clay
14	0.5 – 0.8	19.6	69	23	46	15.0		Sandy silty clay
15	0.5 – 0.7	22.0						Silty clay
16	0.5 – 0.7	21.3					4	Silty sandy clay
17	0.5 – 0.7	5.4	30	18	12	7.0		Sandy clay
19	0.5 – 0.7	21.2						Silty sandy clay
20	0.5 – 0.7	31.6					4	Silty clay
20	1.0 – 1.2	13.9						Silty clay
20	1.5 – 1.7	15.0	52	19	33	14.5		Sandy silty clay
21	0.0 – 0.2	12.4					8	Clayey sandy silt
22	0.5 – 0.7	18.9	65	27	38	16.0	4	Sandy gravelly silty clay
22	1.0 – 1.2	13.5						Sandy gravelly silty clay
23	0.5 – 0.7	8.8						Sandy gravelly silty clay
24	0.5 – 0.7	8.9	35	22	13	7.5		Sandy gravelly silty clay
25	0.5 – 0.7	16.9					1	Silty clay
25	1.0 – 1.2	18.0						Silty clay

Where W = Field moisture content; W_L = Liquid limit
W_P = Plastic limit; I_P = Plasticity index
LS = Linear shrinkage; ECN = Emerson Class Number

Table 3: Results of Chemical and Electrical Tests

Pit No	Depth	pH	Cl (mg/kg)	SO_4^{2-} (mg/kg)	EC (μS/cm)	Factor	ECe [(1)] (dS/m)	ESP	Material
2	1.8 – 2.0	5.4	<100	64	130	8	1.04	37	Clay
5	0.4 – 0.5	5.0	<100	<25	110	8	0.88	19	Clay
11	0.8	5.0	<100	35	56	8	0.45	15	Sandy Clay
15	1.0 – 1.2	4.9	<100	51	39	8	0.31	23	Clay
17	1.0 – 1.2	5.2	<100	<25	65	8	0.52	28	Clay

Note (1): ECe = EC x textural factor (Ref 3)
1dS/m = 1000 μS/m

Where Cl^- = Chloride concentration
SO_4^{2-} = Sulphate concentration
EC = Electrical conductivity
Factor = Soil texture factor (Ref 3)
ECe = Electrical conductivity of a saturated extract
ESP = Exchangeable sodium percentage

Reference to AS 2159 – 1996 (Ref 4) indicates that the soils tested are generally classified as non-aggressive to concrete and steel piles. The sample from Pit 15 (1.0 – 1.2 m) is classified as mildly aggressive to concrete due to a pH in the range 4.5 – 5.0.

Furthermore, the site soils are non-saline but highly sodic. The main implication of sodic soils is that erosion can occur due to concentrated surface flows.

6. PROPOSED DEVELOPMENT

It is understood that the proposed development comprises a tourist and residential complex, including temple, education complex, hotel, staff accommodation, dwellings, commercial buildings and a golf course.

7. COMMENTS

7.1 General

The following comments are based on the results of site reconnaissance, subsurface investigations and Douglas Partners involvement in similar projects. It is understood that further investigations will be undertaken as the planning and design of the subdivision proceeds and accordingly this report must be considered as being preliminary in nature.

7.2 Development Considerations

7.2.1 Stability Assessment

The following slope stability assessment is based on the results of the geological reconnaissance, the limited subsurface investigation and company involvement in similar projects. It includes consideration of bedrock geology, observed or anticipated soil depth, steepness of slope relative to historical or ancient slope failures in similar materials, the disturbance of soil and vegetation cover during development, the influence of groundwater or surface saturation and the effects of earthquake forces.

The study area has been qualitatively classified in accordance with the methods of the Australian Geomechanics Society (AGS – 2007, Ref 5) relevant extracts of which are included in Appendix C. The study area has been divided into three risk of instability zones – very low, low and moderate risk of instability. The approximate interpreted zone boundaries are shown on Drawings 3 and 4, with the results of the assessment outlined in Tables 4 and 5.

It is noted that the boundary between risk zones will commonly be transitional and as such dual classifications (eg: very low to low and low to moderate risk of instability) have been employed in some areas of transitional change in slope. It is anticipated that zone boundaries would be confirmed or modified by more extensive investigation undertaken as planning and design proceeds.

Table 4: Slope Stability Assessment (Area of Slight Relief)

Hazard	Likelihood	Consequence to Proposed Development	Risk to Proposed Development
Creep of surface soils	Rare	Minor	Very low
Active/deep-seated slide	Rare to Barely Credible	Major to Catastrophic	Very low to low

Table 5: Slope Stability Assessment (Area of Moderate Relief)

Hazard	Likelihood	Consequence to Proposed Development	Risk to Proposed Development
Creep of surface soils	Possible	Minor	Moderate
Active/deep-seated slide	Rare	Major to Catastrophic	Low to moderate

In summary, it is considered that the areas of slight topographic relief are classified as either very low or low risk of damage to property occurring as a result of slope instability, whilst the area of moderate relief would be classified as moderate risk. Notwithstanding the stability classifications nominated, development of the site for the proposed development is considered geotechnically feasible with respect to slope stability, with development in moderate risk zones to be in accordance with accepted hillside practice (Ref 5) and the specific recommendations given in this report.

7.2.2 Site Classification

Classification of individual allotments or building areas within the site should comply with the requirements of AS 2870 – 2007 Residential Slabs and Footings (Ref 6). Based on the results of the field investigation and the limited laboratory testing together with previous experience in similar geological settings, the subsurface profiles would most likely be equivalent to Class M (moderately reactive) or Class H (highly reactive) with the final classification dependent on soil reactivity, soil strength and rock depth.

Class P conditions may also be present in the drainage depressions should weak soils be encountered during project-specific subsurface investigation. Re-classification of such areas to M or H may be possible subject to the extent of earthworks undertaken during construction. In areas of moderate relief, P (hillside) classifications would likely result.

7.2.3 Site Preparation and Earthworks

Site preparation for the construction of residential structures should include the removal of topsoils and other deleterious materials from the proposed building areas. In areas that require filling, the stripped surfaces should be proof rolled in the presence of an experienced geotechnical engineer.

To validate bearing pressures within controlled filling, sufficient field inspections and in-situ testing of future earthworks should be undertaken in order to satisfy the requirements of a Level 1 inspection and testing service as defined in AS 3798 – 2007 (Ref 7). In areas where filling is required to achieve design levels, allowance should be made for filling within building areas to be compacted to at least 98% standard compaction, with placement moisture contents to be within 2% of standard optimum (as measured in the standard compaction test).

Filling within road alignments should be compacted to at least 95% standard compaction to within 0.5 m of design subgrade level, with the top 0.5 m to be compacted to at least 100% standard compaction. Placement moisture contents should also be within 2% of standard optimum. Based on the limited testing undertaken to date, the residual soils underlying the site would appear suitable for re-use as filling, subject to appropriate geotechnical validation testing being undertaken both prior to and during construction.

Earthworks required for pavement construction will need to be based on batters formed no steeper than 3:1 (H:V) in the residual clays and 1.5:1 (H:V) in weathered rock. All batters should be suitably protected against erosion, with toe and spoon drains constructed as a means of controlling surface flows on the batters.

Subject to the existing site contours, excavation and filling (should it be proposed within the moderate risk zones) may need to be limited to a maximum vertical height of 1 m respectively below or above the existing ground surface. Proposed earthworks that exceed the above requirements should be subject to review by a geotechnical engineer during the design phase of the individual project. Excavation that exceeds 1 m may need to be supported by engineer-designed retaining walls founded on bedrock. However, it must be accepted that creep movement in retaining walls constructed perpendicular to the slope is probably inevitable, due to the high active pressures of the retained material.

Site observations have indicated the presence of silty and sandy topsoils and clays which could be adversely affected by inclement weather. Whilst these soils are typically stiff to very stiff consistency when dry, they may rapidly lose strength during rainfall and saturation, resulting in difficult trafficability conditions. As a result, surface drainage which directs runoff away from work areas should be installed prior to construction, possibly in conjunction with the designation of construction equipment haul routes to minimise trafficking of stripped areas.

Conventional sediment and erosion control measures should be implemented during the construction phase, with exposed surfaces to be topsoiled and vegetated as soon as practicable following the completion of earthworks.

7.2.4 Retaining Structures

It is suggested that earth pressures on cantilever or gravity retaining walls due to the retained soils be estimated using a triangular pressure distribution calculated as follows:

$$\sigma_z = \gamma.Ka.z$$

where	σ_z	=	horizontal pressure at depth z
	γ	=	unit weight of retained soil
		=	20 kN/m^3
	Ka	=	active earth pressure coefficient
		=	0.3 for stiff clays and compacted filling
		=	0.1 for low strength sandstone

The angle of inclination of the retained soils must be taken into account when determining the active earth pressure coefficient, as the above values are for horizontal backfill only.

Design of retaining walls should also make allowance for a partial hydrostatic head over the top 1 m of wall (to accommodate short-term inundation during storm events) and for all superimposed or surcharge loads that will occur.

Drainage must be provided behind the walls or alternatively, full hydrostatic pressure allowed for in the design. In the event that hydrostatic pressures are allowed, densities of the retained soils can be appropriately reduced to the buoyant values.

7.2.5 Footings

All footing systems should be designed and constructed in accordance with engineering principles which take into account subsurface profiles, proposed loads and stability zoning.

The selection of bearing stratum will be dependent on the type of structures, the proposed loads, resultant settlements and stability zoning. Project-specific geotechnical investigation with subsurface profiling should be undertaken at the appropriate time as planning proceeds in order to determine most suitable foundation systems for the various structures.

As a guide, typical bearing pressures on various strata are as follows:

Allowable base bearing on stiff clay or compacted filling	100 kPa (for loads up to 300 kN)
Allowable base bearing on very low strength rock	500 kPa
Allowable base bearing on low strength rock	1500 kPa

Footings should be inspected by a suitable qualified engineer prior to the pouring of concrete to confirm the appropriateness of the bearing stratum for the adopted design pressures.

For construction in the steeper (moderate risk) areas, reference should be made to the publication by AGS (Ref 5), relevant extracts of which are included in Appendix D. The principal recommendation for building in the moderate risk areas is for footings to found below the zones of potential creep and within the underlying weathered rock of low or greater strength.

7.2.6 Site Maintenance and Drainage

The developed site should be maintained in accordance with the CSIRO publication *"Foundation Maintenance and Footing Performance: A Homeowners Guide"*, a copy of which is included in Appendix D. Whilst it must be accepted that minor cracking in most structures is inevitable, the guide describes suggested site maintenance practices aimed at minimising foundation movement to keep cracking within acceptable limits.

Surface drainage should be installed and maintained at the site. All collected stormwater, groundwater and roof runoff should be discharged into the stormwater disposal system. Similarly, effluent flows should be directed to the sewerage system. Subsurface drainage may also be required with the locations and extent to be determined in consultation with the design engineer at the appropriate time.

7.2.7 Preliminary Pavement Thickness Design

Table 6 summarises a range of pavement thickness designs based on the procedures given in APRG (Ref 8) for varying traffic loadings and subgrade CBR values. Based on previous experience in the Nowra area, typical CBR values would be around 3% for clay soils increasing to around 5% for weathered rock.

Table 6: Preliminary Pavement Thickness Design

Traffic Loading (ESA)	Total Pavement Thickness (mm)[1]			
	CBR < 3%[2]	CBR 3%	CBR 4%	CBR 5%
Car Parks[3]	250 (400)	250	225	200
1×10^4	400 (550)	400	335	290
5×10^4	450 (600)	450	375	320
1×10^5	470 (620)	470	390	340
5×10^5	530 (650)	530	445	380

Note (1): Total pavement thickness is inclusive of asphalt wearing course, base and subbase
Note (2): Bracketed figures indicate total boxing depth, taking into account 150 mm of subgrade replacement.
Note (3) In areas restricted to cars and light commercial vehicles up to 3 tonne gross weight

The pavements should be placed and compacted in layers no thicker than 150 mm, with control exercised over placement moisture contents. If layer thicknesses greater than 150 mm are proposed, it may be necessary to test the top and bottom of the layer to ensure that the minimum level of compaction has been achieved through the layer.

Table 7 – Materials and Compaction

Layer	Material Quality	Minimum Compaction
Wearing Course	To conform to APRG requirements	To conform to APRG requirements
Base Course	To conform to APRG requirements Soaked CBR ≥ 80%, PI ≤ 6%	Minimum dry density ratio of 98% Modified (AS 1289 Test 5.2.1)
Sub-base Course	To conform to APRG requirements Soaked CBR ≥ 50%, PI ≤ 12%	Minimum dry density ratio of 95% Modified (AS 1289 Test 5.2.1)
Subgrade Replacement	Soaked CBR ≥ 15%	Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)
Subgrade		Minimum dry density ratio of 100% Standard (AS 1289 Test 5.1.1)

Where PI = plasticity index

Whilst the use of lesser quality pavement materials than that detailed in Table 7 may be feasible, some compromise in either performance and/or pavement life must be anticipated and accepted.

7.2.8 Pavement Drainage

Surface and subsurface drainage should be installed and maintained to protect the pavement and subgrade. The subsurface drains should be located at a minimum of 0.5 m depth below the excavation level. Guidelines on the arrangement of subsurface drainage are given on

Page 20 of ARRB – SR41 (Ref 9). It should be noted that if the sub-base is of low permeability relative to the base layer, then the subsurface drain must intersect all pavement layers as shown in ARRB – SR41.

8. SUMMARY

The preliminary geotechnical assessment undertaken has indicated that the site will be geotechnically suitable for the proposed development, with comments given on geotechnical limitations, development guidelines, likely site classification, stability considerations and indicative pavement thicknesses. Conceptual comments on design and construction aspects are also given in the report. Detailed geotechnical investigation and assessment (including additional subsurface excavation/drilling and laboratory testing of selected samples) will be required as the design of the development proceeds and as such, this report must be considered as being preliminary only and should not be used for final design.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

A Castrissios
Senior Associate

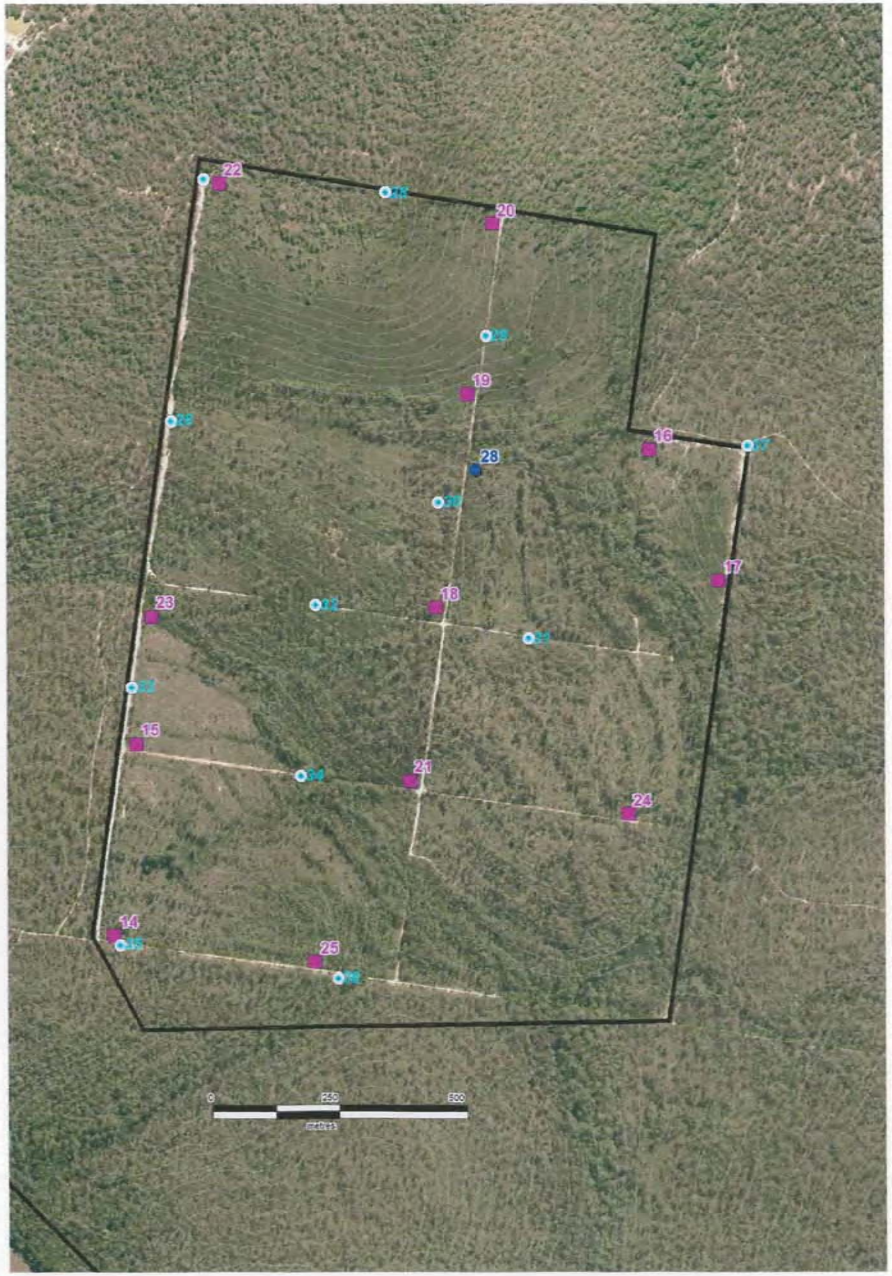
Michael J Thom
Principal

References:

1. Geology of Wollongong 1:250 000 Geological Series Sheet No 56-9 – 11, Dept of Mines, (1966).
2. 1:25 000 Yalwal/Nowra Acid Sulphate Risk Map, Dept of Land and Water Conservation (1997).
3. Map of Salinity Potential in Western Sydney, DIPNR (2002).
4. Australian Standard AS 2159 – 1995 *Piling – Design and Installation*.
5. *Practice Note Guidelines for Landslide Risk Management*, Australian Geomechanics Society Landslide Taskforce (2007).
6. Australian Standard AS 2870 – 1996 *Residential Slabs and Footings.*
7. Australian Standard AS 3798 – 2007 *Guidelines on Earthworks for Commercial and Residential Developments.*
8. APRG – Report No 21 – *A Guide to the Design of New Pavements for Light Traffic*, Austroads Pavement Research Group, 1997.
9. ARRB – SR41 – A Structural Design Guide for Flexible Residential Street Pavements, Australian Road Research Board, Special Report No. 41, 1989.

APPENDIX A

Drawings



PHOTOGRAPI	EASTING	NORTHING	PHOTOANGLE
1	282,633	6,126,501	335
2	282,690	6,126,808	300
3	282,690	6,126,808	180
4	282,752	6,126,659	310
5	282,752	6,126,659	90
6	282,800	6,126,570	90
7	282,800	6,126,570	90
8	282,880	6,126,476	120
9	283,177	6,126,405	120
10	283,135	6,126,303	250
11	283,163	6,126,251	320
12	283,272	6,126,241	280
13	283,272	6,126,241	170
14	283,387	6,126,070	140
15	283,517	6,125,688	290
16	283,380	6,125,511	190
17	283,380	6,125,511	190
18	283,336	6,125,402	310
19	283,300	6,125,194	105
20	283,300	6,125,194	185
21	283,403	6,125,111	120
22	283,441	6,125,220	80
23	283,436	6,125,257	80
24	283,451	6,125,288	45
25	283,451	6,125,288	0
26	283,412	6,128,173	0
27	283,477	6,128,645	120
28	283,835	6,128,620	90
29	284,032	6,128,340	0
30	283,937	6,128,014	90
31	284,113	6,127,748	90
32	283,695	6,127,814	270
33	283,334	6,127,653	90
34	283,665	6,127,479	90
35	283,309	6,127,150	90
36	283,737	6,127,085	90
37	284,542	6,128,125	180

LEGEND

- SITE BOUNDARY
- TEST PIT LOCATION
- TEST BORE LOCATION
- PHOTOGRAPH LOCATION

Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: SHAOLIN TEMPLE FOUNDATION AUSTRALIA DRAWN BY: JAS · SCALE: AS SHOWN · OFFICE: WOL APPROVED BY: · DATE: 20 JUL 09	TITLE: NORTHERN AREA SITE PLAN PROPOSED RESIDENTIAL AND TOURIST DEVELOPMENT COMBERTON GRANGE	PROJECT: 48670.02 DRAWING: 1 REVISION: A

PHOTOGRAPH	EASTING	NORTHING	PHOTOANGLE
1	282,633	6,126,501	335
2	282,690	6,126,808	300
3	282,690	6,126,808	180
4	282,752	6,126,659	310
5	282,752	6,126,659	90
6	282,800	6,126,570	90
7	282,800	6,126,570	90
8	282,880	6,126,476	120
9	283,177	6,126,405	120
10	283,135	6,126,303	250
11	283,163	6,126,251	320
12	283,272	6,126,241	280
13	283,272	6,126,241	170
14	283,387	6,126,070	140
15	283,517	6,125,688	290
16	283,380	6,125,511	190
17	283,380	6,125,511	190
18	283,336	6,125,402	310
19	283,300	6,125,194	105
20	283,300	6,125,194	185
21	283,403	6,125,111	120
22	283,441	6,125,220	80
23	283,436	6,125,257	80
24	283,451	6,125,288	45
25	283,451	6,125,288	0
26	283,412	6,128,173	0
27	283,477	6,128,645	120
28	283,835	6,128,620	90
29	284,032	6,128,340	0
30	283,937	6,128,014	90
31	284,113	6,127,748	90
32	283,695	6,127,814	270
33	283,334	6,127,653	90
34	283,665	6,127,479	90
35	283,309	6,127,150	90
36	283,737	6,127,085	90
37	284,542	6,128,125	180

LEGEND

- SITE BOUNDARY
- TEST PIT LOCATION
- TEST BORE LOCATION
- PHOTOGRAPH LOCATION

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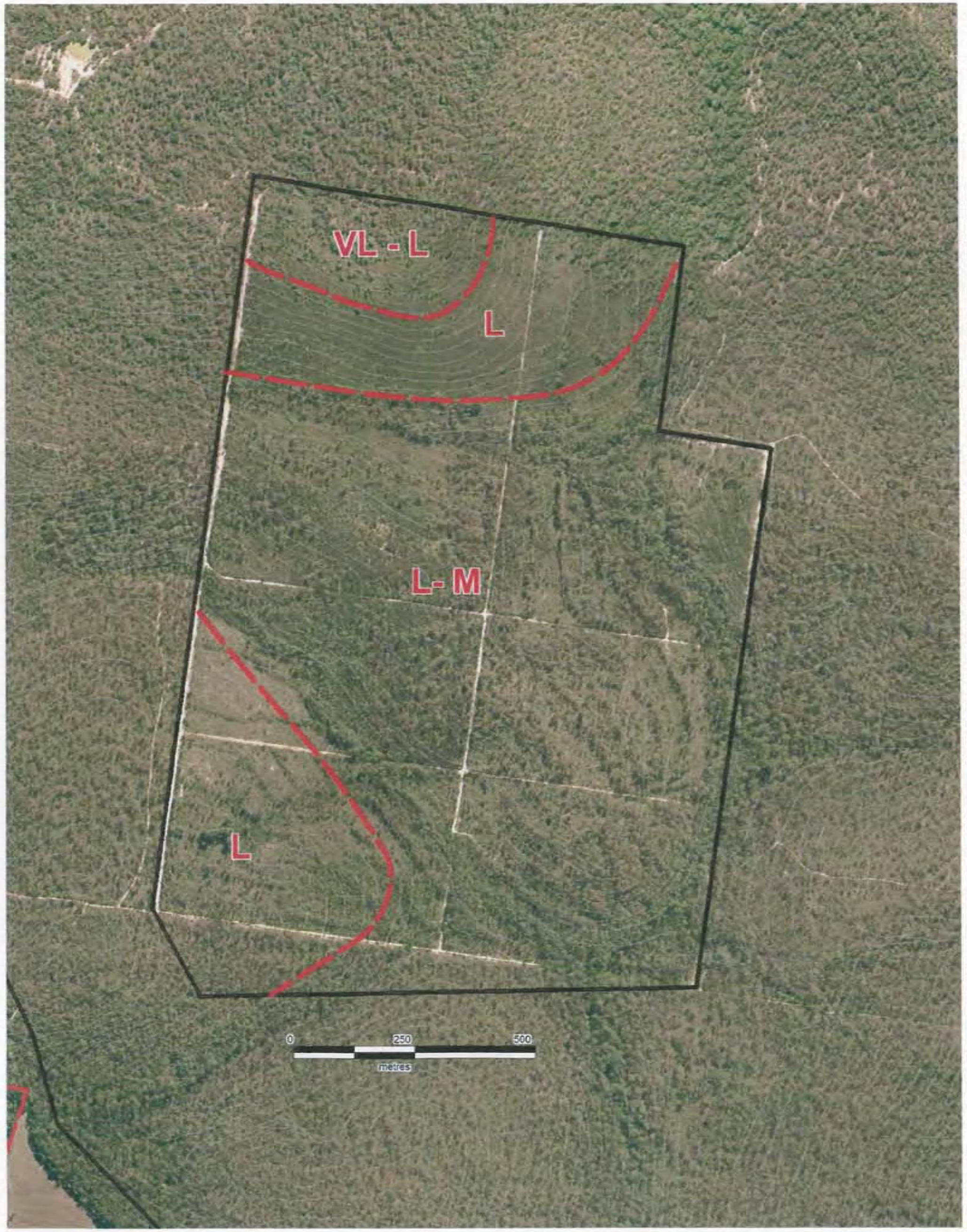
Geotechnics • Environment • Groundwater

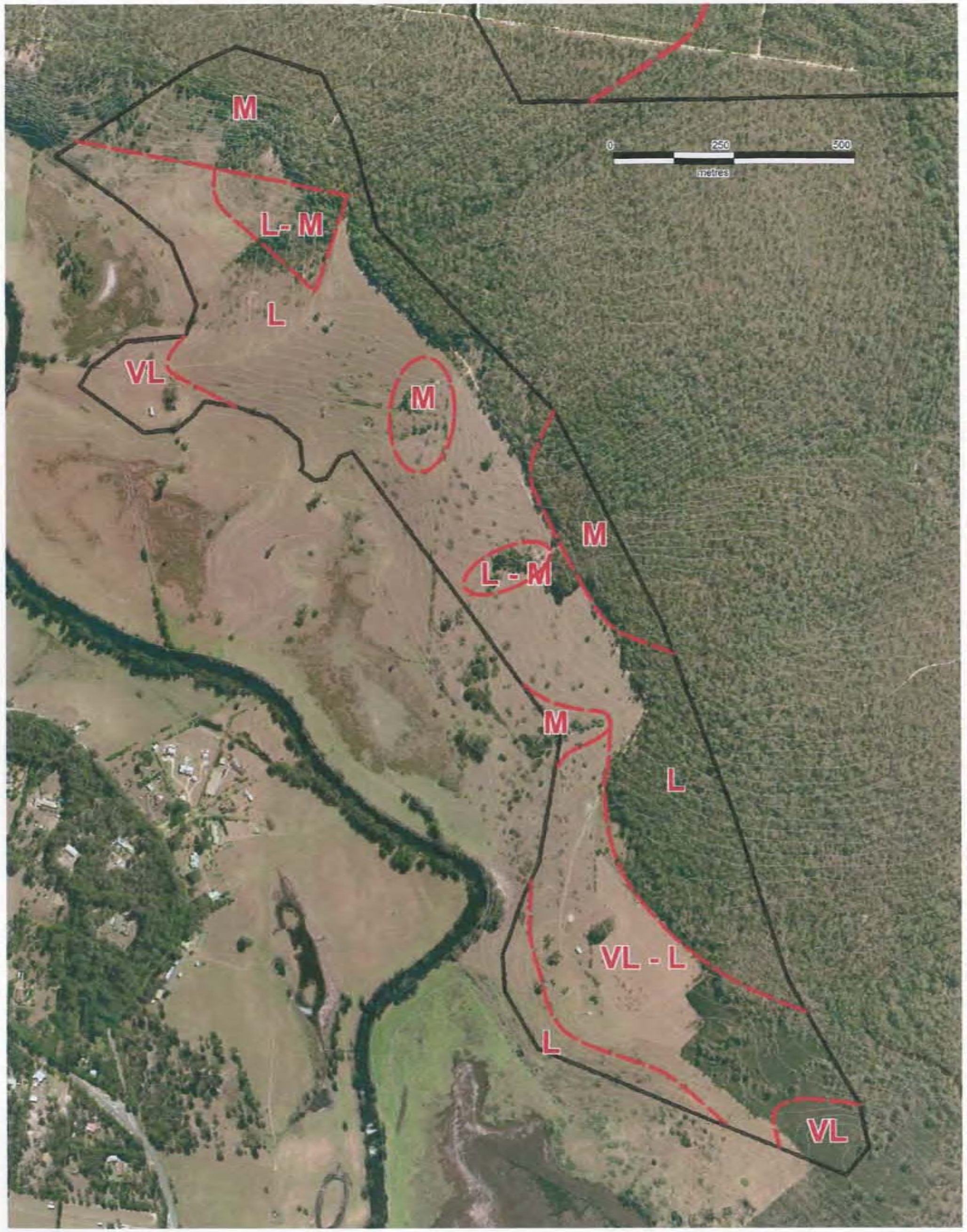
CLIENT: SHOALIN TEMPLE FOUNDATION AUSTRALIA		TITLE: SOUTHERN AREA SITE PLAN PROPOSED RESIDENTIAL AND TOURIST DEVELOPMENT COMBERTON GRANGE	PROJECT: 48670.02
DRAWN BY: JAS	SCALE: AS SHOWN	OFFICE: WOL	DRAWING: 2
APPROVED BY: B	DATE: 20 JUL 09		REVISION: A



LEGEND

———	SITE BOUNDARY
— — —	STABILITY RISK BOUNDARY
VL	VERY LOW
L	LOW
M	MODERATE

Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: SHAOLIN TEMPLE FOUNDATION AUSTRALIA		TITLE: NORTHERN AREA STABILITY RISK BOUNDARIES PROPOSED RESIDENTIAL AND TOURIST DEVELOPMENT COMBERTON GRANGE	PROJECT: 48670.02
	DRAWN BY: JAS	SCALE: AS SHOWN	OFFICE: WOL	DRAWING: 3
	APPROVED BY:		DATE: 20 JUL 09	REVISION: A



LEGEND

- SITE BOUNDARY
- STABILITY RISK BOUNDARY
- VL VERY LOW
- L LOW
- M MODERATE

Douglas Partners Geotechnics · Environment · Groundwater	CLIENT: SHAOLIN TEMPLE FOUNDATION AUSTRALIA			TITLE: SOUTHERN AREA STABILITY RISK BOUNDARIES PROPOSED RESIDENTIAL AND TOURIST DEVELOPMENT COMBERTON GRANGE	PROJECT: 48670.02
	DRAWN BY: JAS	SCALE: AS SHOWN	OFFICE: WOL		DRAWING: 4
	APPROVED BY:		DATE: 20 JUL 09		REVISION: A

APPENDIX B

Notes Relating to this Report
Colour Photoplates
Test Pit Logs (Pits 1 – 25)
Borehole Logs (Bores 26 – 28)

NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigations Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00 mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT “N” Value (blows/300 mm)	CPT Cone Value (q_c — MPa)
Very loose	less than 5	less than 2
Loose	5—10	2—5
Medium dense	10—30	5—15
Dense	30—50	15—25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing with a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling are given in the report.

Drilling Methods.

The following is a brief summary of drilling methods currently adopted by the Company and some comments on their use and application.

Test Pits — these are excavated with a backhoe or a tracked excavator, allowing close examination of the in-situ soils if it is safe to descent into the pit. The depth of penetration is limited to about 3 m for a backhoe and up to 6 m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) — the hole is advanced by a rotating plate or short spiral auger, generally 300 mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling — the hole is advanced by pushing a 100 mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling in soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling — the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling — similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. from SPT).

Continuous Core Drilling — a continuous core sample is obtained using a diamond-tipped core barrel, usually 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" — Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch cone — abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australian Standard 1289, Test 6.4.1.

In the tests, a 35 mm diameter rod with a cone-tipped end is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separate 130 mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected by electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20 mm per second) the information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: —

- Cone resistance — the actual end bearing force divided by the cross sectional area of the cone — expressed in MPa.
- Sleeve friction — the frictional force on the sleeve divided by the surface area — expressed in kPa.
- Friction ratio — the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range:—

$$q_c \text{ (MPa)} = (0.4 \text{ to } 0.6) \text{ N (blows per 300 mm)}$$

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range:—

$$q_c = (12 \text{ to } 18)\, c_u$$

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculation of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Hand Penetrometers

Hand penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150 mm increments of penetration. Normally, there is a depth limitation of 1.2 m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer — a 16 mm diameter flat-ended rod is driven with a 9 kg hammer, dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as the Scala Penetrometer) — a 16 mm rod with a 20 mm diameter cone end is driven with a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). The test was developed initially for pavement subgrade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Bore Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes, the frequency of sampling and the possibility of other than 'straight line' variations between the boreholes.

Ground Water

Where ground water levels are measured in boreholes, there are several potential problems;

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions — the potential for this will depend partly on bore spacing and sampling frequency
- changes in policy or interpretation of policy by statutory authorities
- the actions of contractors responding to commercial pressures.

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage, well after the event.

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

PLATE 1

PLATE 2

PLATE 3

PLATE 4

PLATE 5

PLATE 6

PLATE 7

PLATE 8

PLATE 9

PLATE 10

PLATE 11

PLATE 12

PLATE 13

PLATE 14

PLATE 15

PLATE 16

PLATE 17

PLATE 18

PLATE 19

PLATE 20

PLATE 21

PLATE 22

PLATE 23

PLATE 24

PLATE 25

PLATE 26

PLATE 27

PLATE 28

PLATE 29

PLATE 30

PLATE 31

PLATE 32

PLATE 33

PLATE 34

PLATE 35

PLATE 36

PLATE 37

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DESCRIPTION AND CLASSIFICATION OF ROCKS FOR ENGINEERING PURPOSES

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties - i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining or discolouration of the rock substance usually by limonite has taken place. The colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh Stained	Fs	Rock substance unaffected by weathering, but showing limonite staining along joints.
Fresh	Fr	Rock substance unaffected by weathering.

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index ($I_{S(50)}$) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by Australian Standard 4133.4.1 - 1993.

Term	Symbol	Field Guide*	Point Load Index $I_{S(50)}$ MPa	Approx Unconfined Compressive Strength q_u ** MPa
Extremely low	EL	Easily remoulded by hand to a material with soil properties	<0.03	< 0.6
Very low	VL	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; too hard to cut a triaxial sample by hand. SPT will refuse. Pieces up to 3 cm thick can be broken by finger pressure.	0.03-0.1	0.6-2
Low	L	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long 40 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.	0.1-0.3	2-6
Medium	M	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.	0.3-1.0	6-20
High	H	Can be slightly scratched with a knife. A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow, rock rings under hammer.	1 - 3	20-60
Very high	VH	Cannot be scratched with a knife. Hand specimen breaks with pick after more than one blow, rock rings under hammer.	3 - 10	60-200
Extremely high	EH	Specimen requires many blows with geological pick to break through intact material, rock rings under hammer.	>10	> 200

Note that these terms refer to strength of rock material and not to the strength of the rock mass, which may be considerably weaker due to rock defects.

* The field guide assessment of rock strength may be used for preliminary assessment or when point load testing is not able to be done.

** The approximate unconfined compressive strength (q_u) shown in the table is based on an assumed ratio to the point load index of 20:1. This ratio may vary widely.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2 m

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks. The orientation of rock defects is measured as an angle relative to a plane perpendicular to the core axis. Note that where possible, recordings of the actual defect spacing or range of spacings is preferred to the general terms given below.

Term	Description
Fragmented	The core consists mainly of fragments with dimensions less than 20 mm.
Highly Fractured	Core lengths are generally less than 20 mm - 40 mm with occasional fragments.
Fractured	Core lengths are mainly 40 mm - 200 mm with occasional shorter and longer sections.
Slightly Fractured	Core lengths are generally 200 mm - 1000 mm with occasional shorter and longer sections.
Unbroken	The core does not contain any fracture.

ROCK QUALITY DESIGNATION (RQD)

This is defined as the ratio of sound (i.e. low strength or better) core in lengths of greater than 100 mm to the total length of the core, expressed in percent. If the core is broken by handling or by the drilling process (i.e. the fracture surfaces are fresh, irregular breaks rather than joint surfaces) the fresh broken pieces are fitted together and counted as one piece.

SEDIMENTARY ROCK TYPES

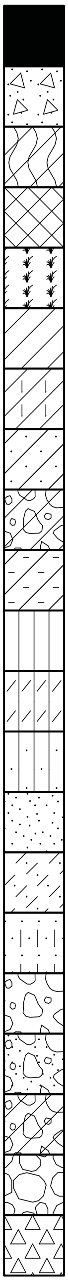
This classification system provides a standardised terminology for the engineering description of sandstone and shales, particularly in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Rock Type	Definition
Conglomerate	More than 50% of the rock consists of gravel-sized (greater than 2 mm) fragments
Sandstone:	More than 50% of the rock consists of sand-sized (0.06 to 2 mm) grains
Siltstone:	More than 50% of the rock consists of silt-sized (less than 0.06 mm) granular particles and the rock is not laminated.
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay-sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, eg. clayey sandstone, sandy shale.

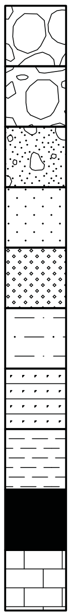
GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL



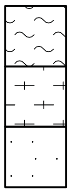
- BITUMINOUS CONCRETE
- CONCRETE
- TOPSOIL
- FILLING
- PEAT
- CLAY
- SILTY CLAY
- SANDY CLAY
- GRAVELLY CLAY
- SHALY CLAY
- SILT
- CLAYEY SILT
- SANDY SILT
- SAND
- CLAYEY SAND
- SILTY SAND
- GRAVEL
- SANDY GRAVEL
- CLAYEY GRAVEL
- COBBLES/BOULDERS
- TALUS

SEDIMENTARY ROCK



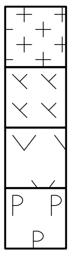
- BOULDER CONGLOMERATE
- CONGLOMERATE
- CONGLOMERATIC SANDSTONE
- SANDSTONE FINE GRAINED
- SANDSTONE COARSE GRAINED
- SILTSTONE
- LAMINITE
- MUDSTONE, CLAYSTONE, SHALE
- COAL
- LIMESTONE

METAMORPHIC ROCK



- SLATE, PHYLITTE, SCHIST
- GNEISS
- QUARTZITE

IGNEOUS ROCK



- GRANITE
- DOLERITE, BASALT
- TUFF
- PORPHYRY

TEST PIT LOG

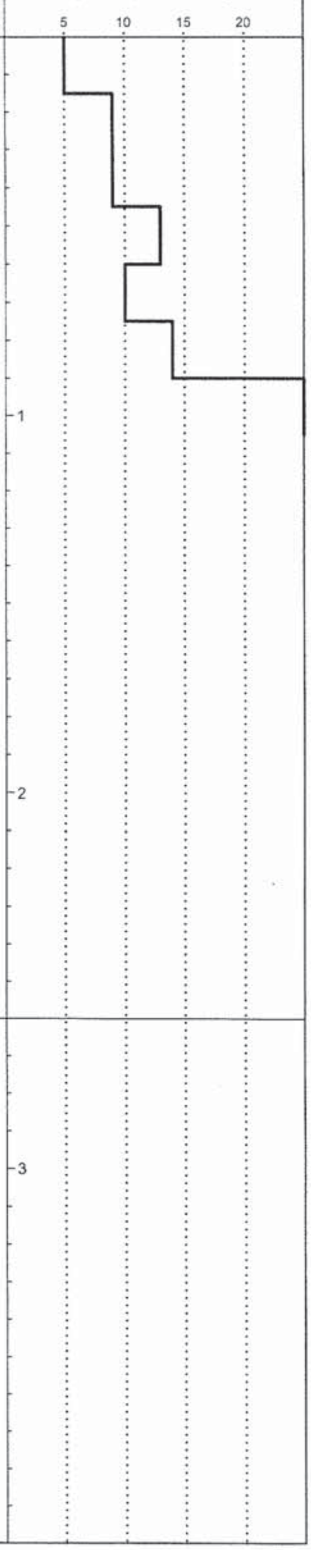
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 20 m AHD
EASTING: 283492
NORTHING: 6125086
DIP/AZIMUTH: 90°/--

PIT No: 1
PROJECT No: 48670
DATE: 29 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
20	0.0	FILLING - brown fine to coarse gravelly (siltstone) silty clay filling with some cobbles, boulders (siltstone) and rootlets	E	0.0–0.1			
			D	0.25–0.3			
	0.3	CLAY - grey mottled orange red clay with some sand and rootlets	D	0.3–0.5			
			U	0.5–0.8			
	0.8	CLAY - red orange mottled grey clay with trace rootlets	D, E	0.8–0.9		pp = 310-340kPa	
19	1						
			D	1.3–1.5		pp = 190-220kPa	
	1.8	SILTSTONE - very low strength, slightly to moderately weathered, red orange mottled grey brown siltstone	D, E	1.8–2.0			
18	2						
			D	2.3–2.6			
	2.6	Pit discontinued at 2.6m (slow progress in low strength siltstone)					
17	3						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: DBY
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

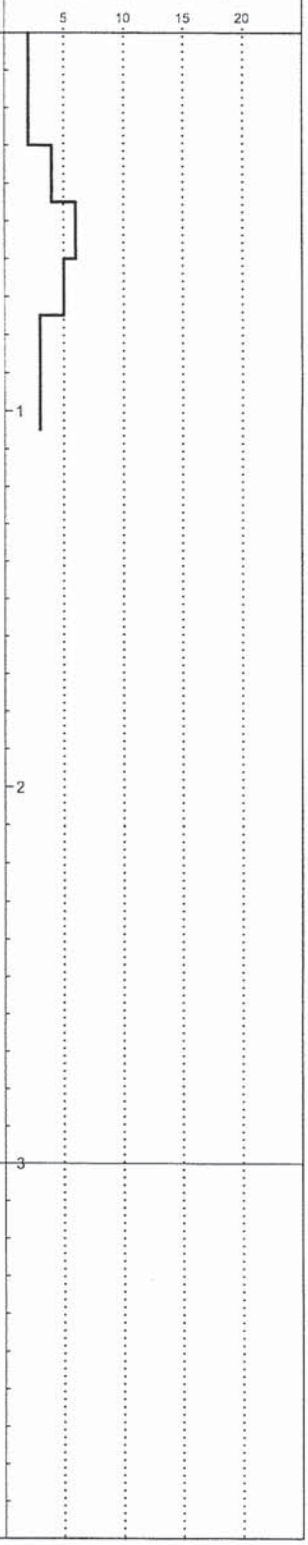
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283535
NORTHING: 6125197
DIP/AZIMUTH: 90°/--

PIT No: 2
PROJECT No: 48670
DATE: 29 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
16		TOPSOIL - brown silty clay with some rootlets, humid to damp		E	0.0			
				D	0.1			
					0.25			
	0.4	CLAY - grey mottled yellow brown clay with some rootlets		D, E	0.4		pp = 330-440kPa	
	0.5	CLAY - red orange mottled grey clay			0.5			
				D, E	0.8		pp = 190-240kPa	
15	1				1.0			
				D	1.3		pp = 160-290kPa	
					1.5			
				D, E	1.8		pp = 230-290kPa	
14	2				2.0			
				D	2.3		pp = 230kPa	
					2.5			
	2.8	SILTSTONE - very low strength, slightly to moderately weathered, red orange mottled grey siltstone		D, E	2.8			
13	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0			

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

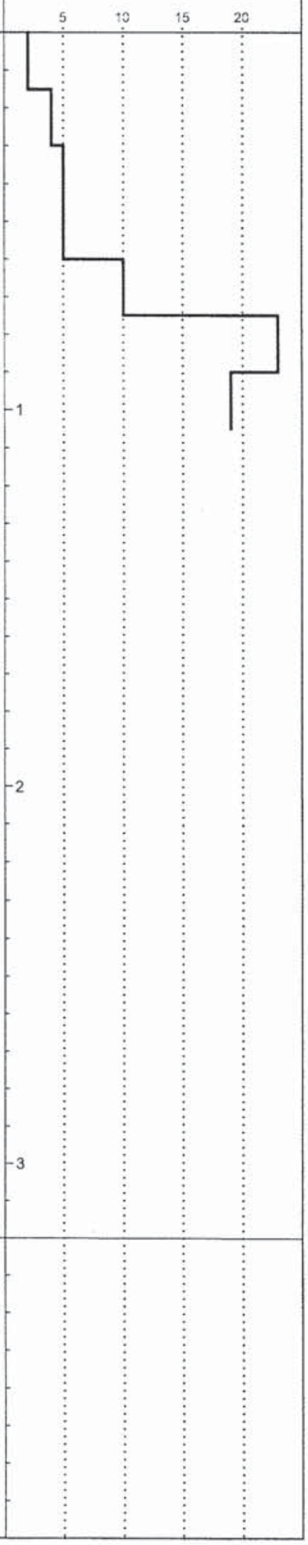
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 12 m AHD
EASTING: 283427
NORTHING: 6125437
DIP/AZIMUTH: 90°/--

PIT No: 3
PROJECT No: 48670
DATE: 29 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments	Water
12	0.0	TOPSOIL - brown silty clay with some rootlets, humid to damp	E	0.0–0.1			
	0.2	CLAY - red mottled brown clay with some rootlets	D, E	0.2–0.25		pp = 320-430kPa	
	0.4	CLAY - grey mottled yellow orange red clay with some rootlets and trace silt	D, E	0.4–0.5		pp = 340-410kPa	
	0.8	CLAY - yellow red mottled grey clay with trace silt and rootlets	B, E	0.8		pp = 330kPa	
11	1						
			D	1.3–1.5		pp = 400-440kPa	
			D, E	1.8–2.0		pp = 210-280kPa	
10	2						
	2.3	SILTSTONE - very low to low strength, slightly to moderately weathered, orange red mottled grey siltstone	D	2.5–2.6			
9	3		D, E	3.0–3.2			
	3.2	Pit discontinued at 3.2m (limit of investigation)					

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 5/9/09

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TEST PIT LOG

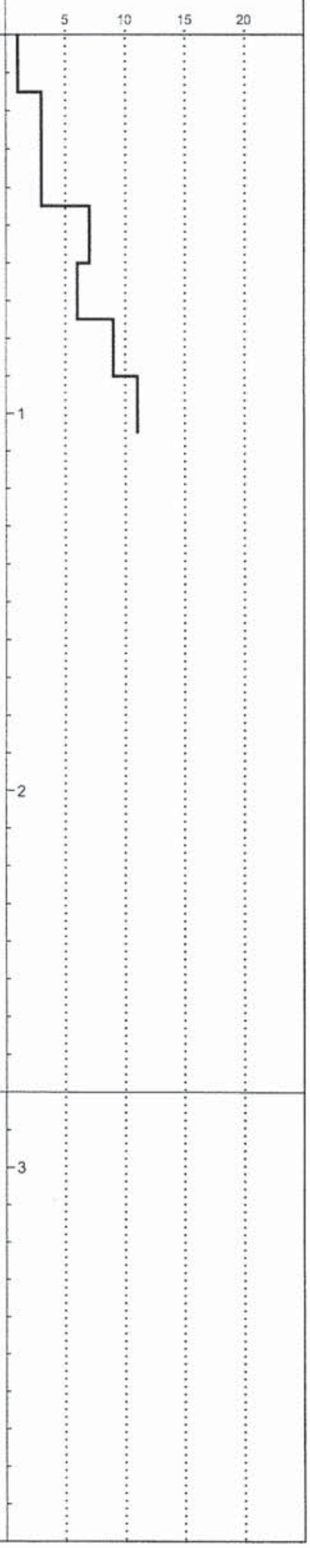
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 19 m AHD
EASTING: 2833565
NORTHING: 6125698
DIP/AZIMUTH: 90°/--

PIT No: 4
PROJECT No: 48670
DATE: 29 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling Type	Sampling Depth	Results & Comments
19	0.0	TOPSOIL - brown silty clay with some rootlets, damp to moist	E	0.0 – 0.1	
	0.2	CLAY - orange mottled brown grey clay with some rootlets, damp to moist	D	0.2 – 0.25	pp = 260-300kPa
	0.4	CLAY - red mottled orange clay with some rootlets and trace silt, humid to damp	D, E	0.4 – 0.5	pp = 280-360kPa
	0.8	CLAY - grey mottled orange red clay with trace silt and rootlets, humid to damp	D, E	0.8 – 1.0	pp = 280-380kPa
18	1				
	1.3	CLAY - orange red mottled grey clay with trace rootlets and silt, humid to damp (RESIDUAL SOIL)	D	1.3 – 1.5	pp = 300-370kPa
		- becoming more grey below 1.7m	D, E	1.8 – 2.0	pp = 300-400kPa
17	2				
	2.5	SILTSTONE - low strength, slightly to moderately weathered, orange red mottled grey siltstone	D, E	2.5 – 2.8	
	2.8	Pit discontinued at 2.8m (refusal in medium strength siltstone)			
16	3				

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: DBY
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A Auger sample
D Disturbed sample
B Bulk sample
U, Tube sample (x mm dia.)
W Water sample
C Core drilling
pp Pocket penetrometer (kPa)
PID Photo ionisation detector
S Standard penetration test
PL Point load strength Is(50) MPa
V Shear Vane (kPa)
> Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

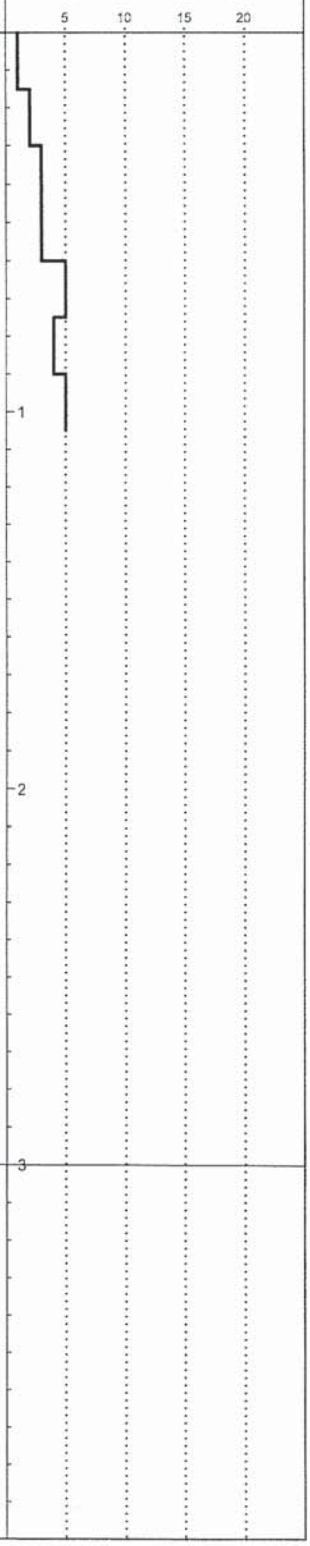
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283374
NORTHING: 6125864
DIP/AZIMUTH: 90°/--

PIT No: 5
PROJECT No: 48670
DATE: 28 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments	Water
16		TOPSOIL - brown silty clay with some rootlets, damp to moist	E	0.0–0.1			
	0.2	CLAY - grey red mottled yellow brown clay with some rootlets and trace silt, humid to damp	D, E	0.2–0.25		pp = 280-380kPa	
	0.4	CLAY - red mottled grey clay with some rootlets and trace silt, humid to damp	B, E	0.4–0.5		pp = 340-540kPa	
			D, E	0.8–1.0		pp = 340-490kPa	
15	1						
	1.3	CLAY - orange mottled grey clay with some sand and trace rootlets, damp to moist	D	1.3–1.5		pp = 120-210kPa	
	1.8	SILTSTONE - low strength, slightly to moderately weathered, orange red mottled grey siltstone	D, E	1.8–2.0			
14	2		D	2.3–2.5			
			D, E	2.8–3.0			
13	3	3.0 Pit discontinued at 3.0m (limit of investigation)					

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 5/9/09

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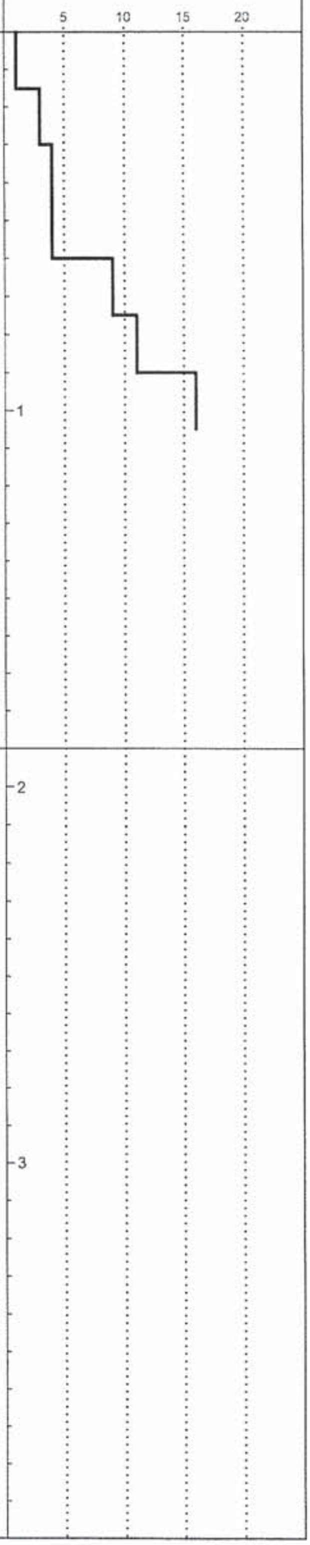
TEST PIT LOG

CLIENT: Shaolin Temple Foundation (Australia)	**SURFACE LEVEL:** 32 m AHD		**PIT No:** 6
PROJECT: Proposed Residential & Tourist Development	**EASTING:** 283337		**PROJECT No:** 48670
LOCATION: Comberton Grange	**NORTHING:** 6126165		**DATE:** 28 May 09
	DIP/AZIMUTH: 90°/--		**SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments
32	0.0	TOPSOIL - brown silty clay with some rootlets, damp to moist	E	0.0 – 0.1		
	0.2	CLAY - grey mottled orange red clay with some silt and rootlets and trace sand, humid to damp	D	0.2 – 0.25		pp = 180-400kPa
	0.4	SANDY CLAY - yellow orange mottled grey sandy clay with some rootlets, humid to damp	D, E	0.4 – 0.5		pp = 230-250kPa
			U			
	0.7	CLAY - orange red mottled grey clay with trace sand and silt, humid to damp		0.7		
			D, E	0.8 – 1.0		pp = 330-380kPa
31	1					
	1.2	SILTSTONE - low strength, slightly to moderately weathered, orange red mottled grey brown siltstone	D, E	1.3 – 1.5		
	1.9	Pit discontinued at 1.9m (refusal in medium strength siltstone)				
30	2					
29	3					

Water: –

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: D
Date: 15/9/09

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TEST PIT LOG

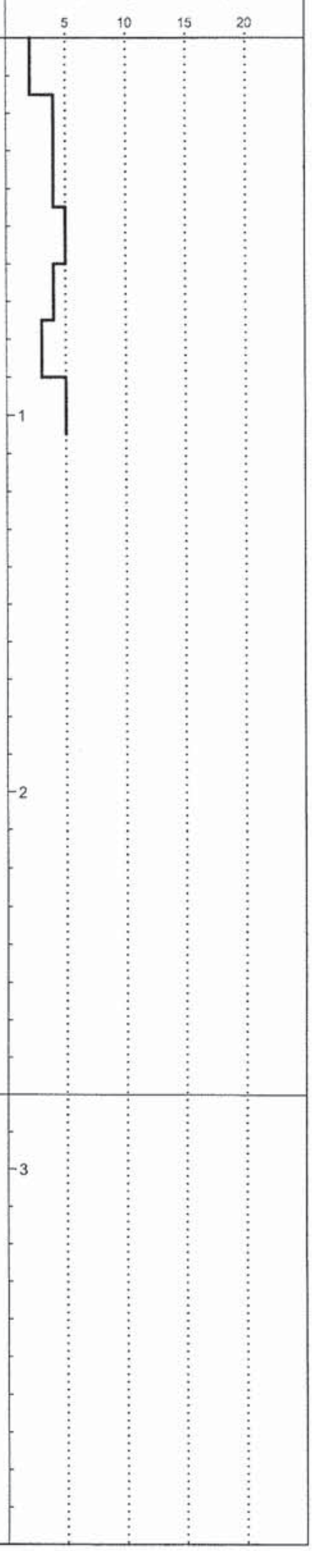
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283117
NORTHING: 6126243
DIP/AZIMUTH: 90°/--

PIT No: 7
PROJECT No: 48670
DATE: 27 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
16	0.0	TOPSOIL - brown silty clay with some fine to coarse gravel and rootlet remains, humid to damp		E	0.0			
				D	0.1			
					0.2			
	0.3	CLAY - orange mottled red clay with trace silt, humid to damp			0.3		pp = 300-400kPa	
				D, E				
					0.5			
	0.7	CLAY - red orange mottled grey clay, humid to damp			0.7		pp = 320kPa	
				D, E				
15	1				1.0			
					1.3		pp = 280-310kPa	
				D				
					1.5			
	1.6	CLAY - grey brown clay, humid to damp			1.7		pp = 300-370kPa	
				D, E				
14	2				2.0			
	2.3	SILTSTONE - low strength, grey brown siltstone						
					2.5			
				D, E				
	2.8	Pit discontinued at 2.8m (refusal on medium strength siltstone)			2.8			
13	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: DBY
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

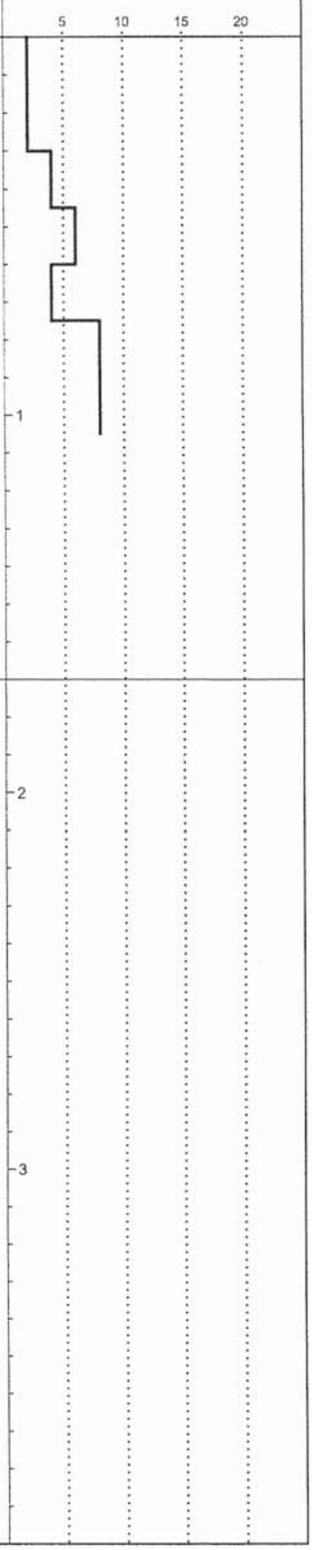
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 30 m AHD
EASTING: 283052
NORTHING: 6126522
DIP/AZIMUTH: 90°/--

PIT No: 8
PROJECT No: 48670
DATE: 27 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
30		TOPSOIL - dark brown silty clay with some rootlets, damp to moist		E	0.0			
				D	0.1			
					0.25			
	0.3	CLAY - orange red mottled grey clay with trace silt, humid to damp		D, E	0.3		pp = 300-420kPa	
					0.5			
				U				
	0.8	SANDY CLAY - orange mottled grey sandy clay, humid to damp		D, E	0.8		pp = 200-300kPa	
					0.9			
29	1							
				D, E	1.3		pp = 200-300kPa	
					1.5			
	1.7	Pit discontinued at 1.7m (refusal on low to medium strength siltstone)						
28	2							
27	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: DBY
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Duplicate BD1/270509 collected at 0 - 0.1m

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials:
Date: 15/9/09

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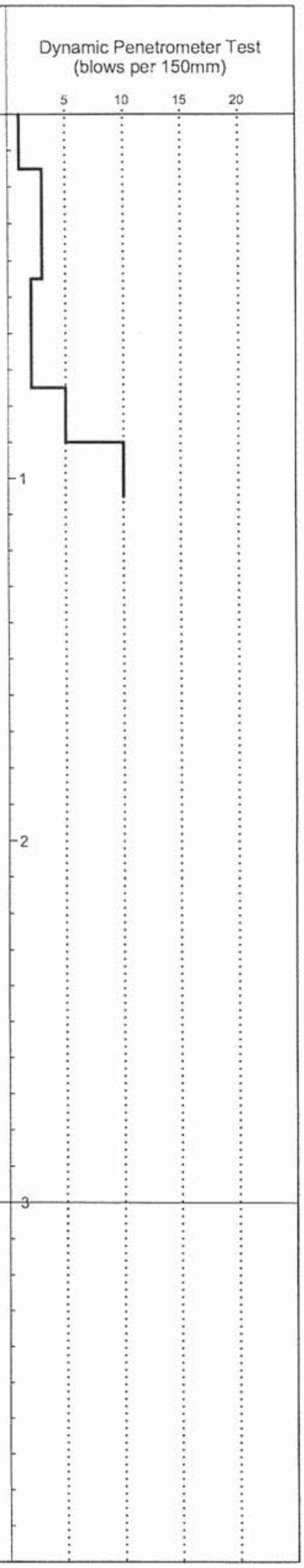
TEST PIT LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 11 m AHD
EASTING: 282698
NORTHING: 6126697
DIP/AZIMUTH: 90°/--

PIT No: 9
PROJECT No: 48670
DATE: 28 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
11		TOPSOIL - brown silty clay with some rootlets, damp to moist		E	0.0			
				D	0.1			
					0.25			
	0.4	CLAY - yellow mottled brown grey clay with trace rootlets, humid to damp		D, E	0.4		pp = 260-330kPa	
					0.5			
				D, E	0.8		pp = 300-440kPa	
10	1				1.0			
				D	1.3		pp = 230-290kPa	
					1.5			
		- becoming damp to moist below 1.8m		D, E	1.8		pp = 130-170kPa	
9	2				2.0			
		- trace silt below 2.3m		B	2.3		pp = 90-180kPa	
					2.5			
				D, E	2.8		pp = 160-190kPa	
8	3 3.0	Pit discontinued at 3.0m (limit of investigation)			3.0			



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

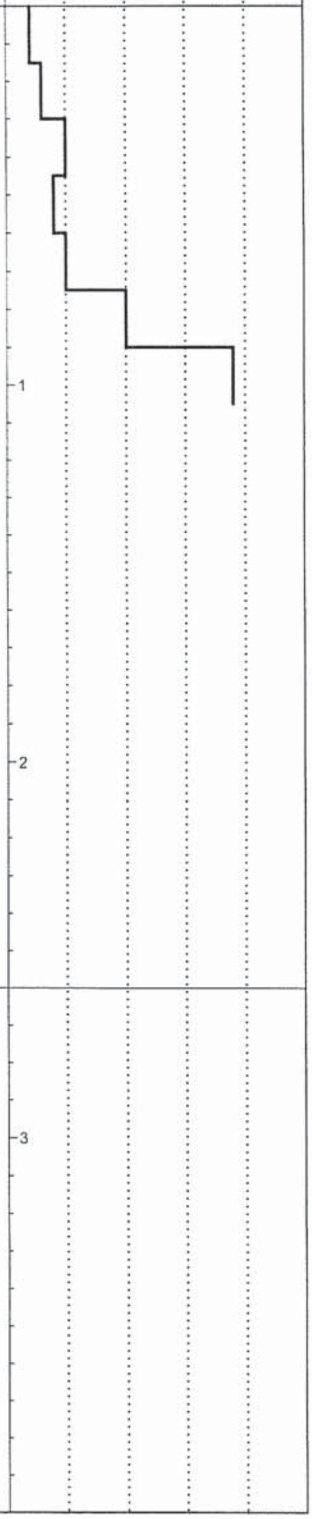
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 26 m AHD
EASTING: 282803
NORTHING: 6126789
DIP/AZIMUTH: 90°/--

PIT No: 10
PROJECT No: 48670
DATE: 28 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling Type	Sampling Depth	Sample	Results & Comments	Water
26		TOPSOIL - light to dark brown silty clay with trace rootlets, damp to moist	E	0.0			
			D	0.1–0.25			
	0.3	CLAY - orange mottled brown slightly sandy clay with trace rootlets, humid to damp	D	0.4–0.5		pp = 190kPa	
	0.8	CLAY - orange red mottled grey clay with some sand and trace rootlets and root remains, humid to damp	D, E	0.8–1.0		pp = 220-270kPa	
25	1						
			D	1.3–1.5		pp = 120-200kPa	
			D, E	1.8–2.0		pp = 160-190kPa	
24	2						
			D	2.3–2.5		pp = 190-300kPa	
	2.5	SANDSTONE - very low to low strength, slightly to moderately weathered, orange red mottled grey brown sandstone	D	2.5–2.6			
	2.6	Pit discontinued at 2.6m (refusal in medium strength sandstone)					
23	3						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

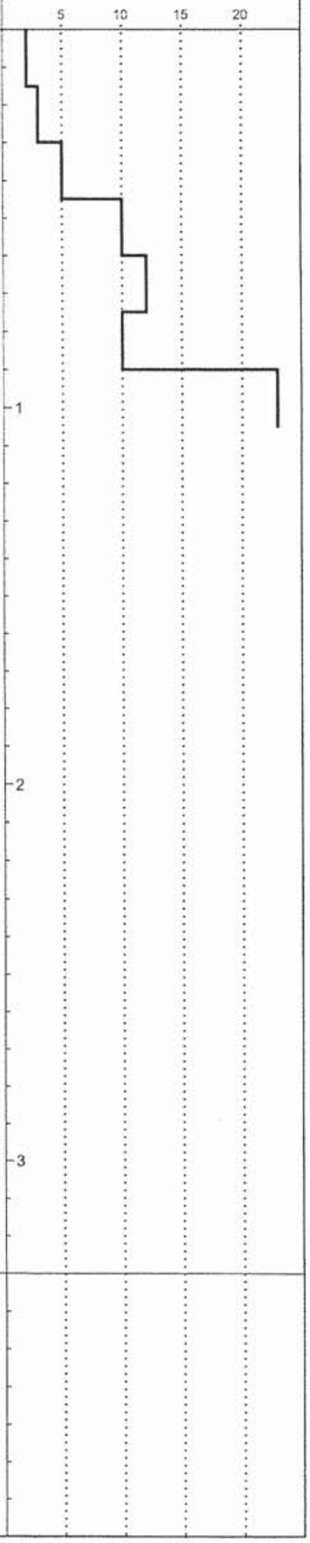
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 8 m AHD
EASTING: 282550
NORTHING: 6126445
DIP/AZIMUTH: 90°/--

PIT No: 11
PROJECT No: 48670
DATE: 28 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
8		TOPSOIL - light grey to brown silty clay with some rootlets, humid to damp		E	0.0			
				D	0.1 – 0.25			
	0.4	CLAY - red mottled brown clay with some rootlets and trace silt		D	0.4 – 0.5		pp = 420-480kPa	
	0.8	SANDY CLAY - yellow red mottled grey brown sandy clay with trace silt and rootlets		D, E	0.8 – 1.0		pp = 480-600kPa	
7	1			D	1.3 – 1.5		pp > 600kPa	
	1.6	CLAY - red mottled grey brown clay with some sand and trace silt and rootlets, humid to damp		D, E	1.8 – 2.0		pp = 270-340kPa	
6	2			D	2.3 – 2.5		pp = 200-320kPa	
	2.9	CLAY - orange red mottled brown grey slightly sandy clay, humid to damp						
5	3			D, E	3.0 – 3.3		pp = 190-230kPa	
	3.3	Pit discontinued at 3.3m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Duplicate BD1/280509 collected at 0 - 0.1m

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 18 m AHD
EASTING: 282892
NORTHING: 6126425
DIP/AZIMUTH: 90°/--

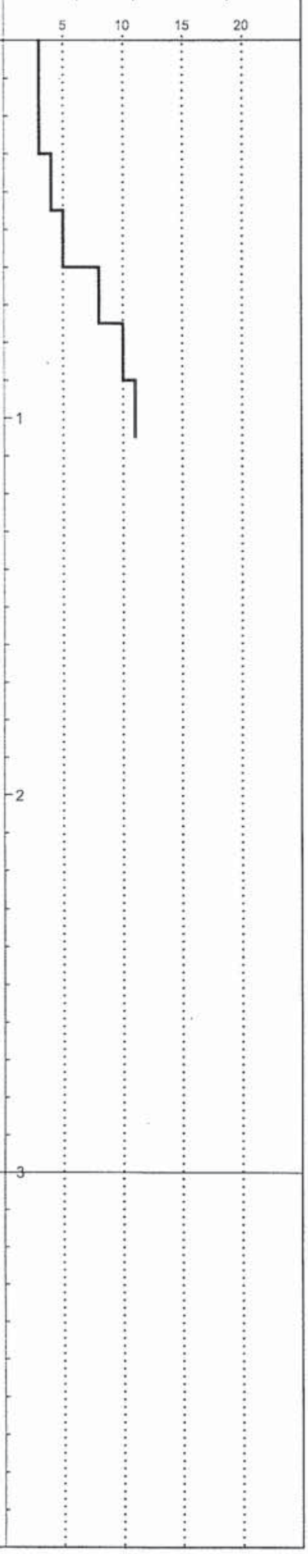
PIT No: 12
PROJECT No: 48670
DATE: 27 May 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata
18	0.0	TOPSOIL - brown silty clay with some rootlets, humid to damp
	0.3	CLAY - orange yellow mottled grey brown clay with trace silt, humid to damp
17	1.1	CLAY - red mottled grey clay, humid to damp - trace sand below 2.3m
15	3.0	Pit discontinued at 3.0m (limit of investigation)

Type	Depth	Sample	Results & Comments
E	0.0		
D	0.1–0.25		
	0.3		pp = 230-350kPa
D, E	0.3–0.5		
	0.8		pp = 310-440kPa
D, E	0.8–1.0		
	1.3		pp = 250-290kPa
D	1.3–1.5		
	1.7		pp = 230-320kPa
D, E	1.7–2.0		
	2.3		pp = 230-320kPa
D	2.3–2.5		
	2.8		pp = 340-380kPa
D, E	2.8–3.0		

Water: –

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: DBY
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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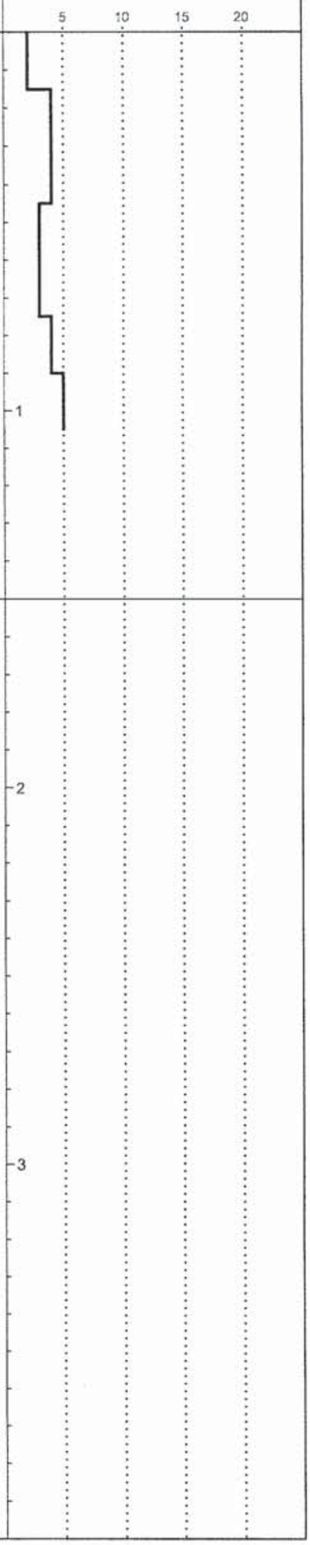
TEST PIT LOG

CLIENT: Shaolin Temple Foundation (Australia)	**SURFACE LEVEL:** 16 m AHD	**PIT No:** 13
PROJECT: Proposed Residential & Tourist Development	**EASTING:** 283615	**PROJECT No:** 48670
LOCATION: Comberton Grange	**NORTHING:** 6125034	**DATE:** 17 Jun 09
	DIP/AZIMUTH: 90°/--	**SHEET** 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
16		TOPSOIL - brown silty clay with some rootlets and organic content		E	0.0			
	0.1	CLAY - yellow mottled brown grey clay with some rootlets and trace silt (RESIDUAL SOIL)		D	0.1 – 0.2		pp = 360-480kPa	
	0.5	CLAY - orange grey mottled red clay with trace rootlets and silt (RESIDUAL SOIL)		D	0.5 – 0.7		pp = 200-330kPa	
15	1			D, E	1.0 – 1.3		pp = 120-150kPa	
	1.4	CLAY - orange red mottled grey clay with trace ironstone gravel		B	1.4 – 1.5		pp = 120-200kPa	
	1.5	Pit discontinued at 1.5m (limit of investigation)						
14	2							
13	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Gemco 210B

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [illegible]
Date: 15/9/09

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TEST PIT LOG

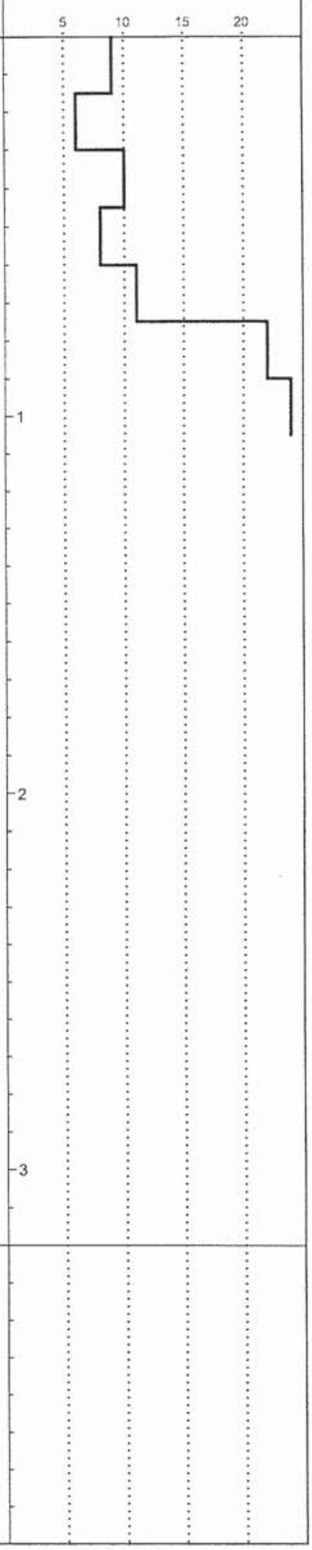
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 38 m AHD
EASTING: 283263
NORTHING: 6127173
DIP/AZIMUTH: 90°/--

PIT No: 14
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
38		TOPSOIL - brown silty clay with rootlets and some fine to course sand		E, D	0.0 – 0.2		pp = 0kPa	
	0.3	CLAY - hard, brown mottled red and grey clay			0.5		pp > 600kPa pp > 600kPa	
				U E, D, B	0.8			
	0.8	SHALY CLAY - hard, grey mottled red shaly clay (extremely weathered siltstone)			0.9			
37	1			E, D	1.0 – 1.3		pp > 600kPa	
				E, D	1.5 – 1.8		pp > 600kPa	
36	2			D	2.0 – 2.3		pp > 600kPa	
				D	2.6 – 2.8		pp > 600kPa	
35	3			D	3.0 – 3.2		pp > 600kPa	
	3.2	Pit discontinued at 3.2m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

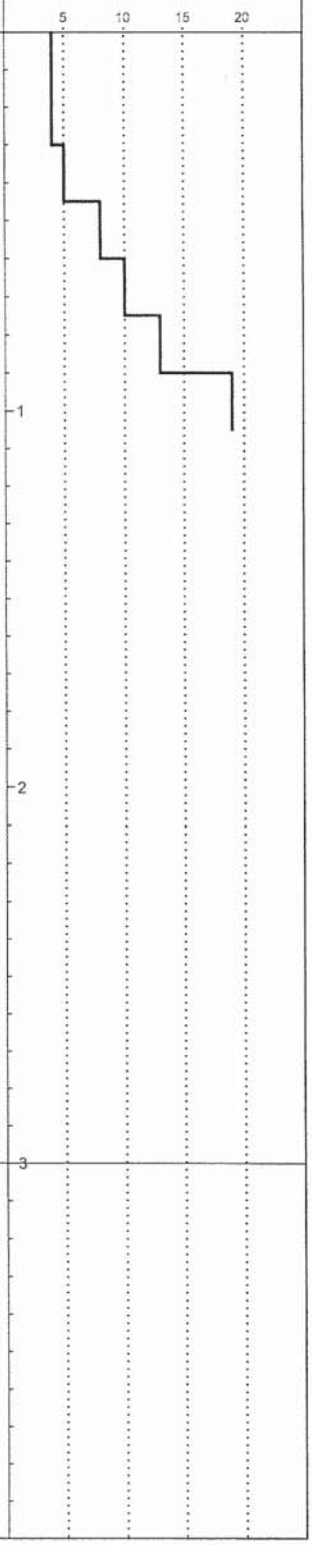
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283318
NORTHING: 6127538
DIP/AZIMUTH: 90°/--

PIT No: 15
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
16		TOPSOIL - brown slightly sandy silty clay with some rootlets		D, E	0.0 – 0.2			
	0.4	CLAY - stiff, orange mottled grey and red clay, humid		D, E	0.5 – 0.7		pp = 150-200kPa	
15	0.8	CLAY - very stiff, grey mottled orange (slightly shaly) clay, humid		D	1.0 – 1.2		pp = 240-470kPa	
				D	1.5 – 1.7		pp = 170-340kPa	
14				E, D	2.0 – 2.2		pp = 270-320kPa	
				D	2.5 – 2.7		pp = 290-410kPa	
		- becoming hard shaly clay below 2.7m		D	2.8 – 3.0		pp = 400-480kPa	
13	3.0	Pit discontinued at 3.0m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: AAW
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample, Duplicate BD1/010709 collected at 0 - 0.2m

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

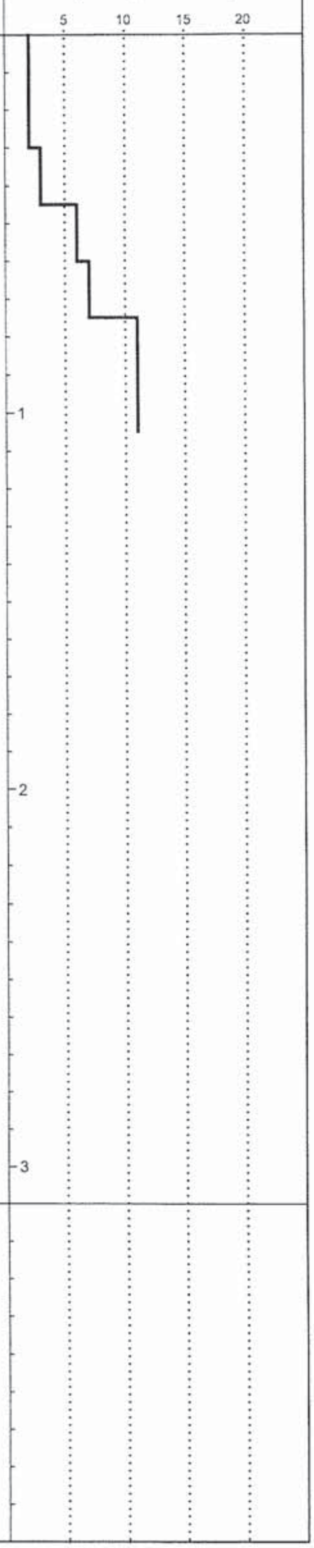
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 22 m AHD
EASTING: 284347
NORTHING: 6128172
DIP/AZIMUTH: 90°/--

PIT No: 16
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
22		TOPSOIL - brown silty clay with some rootlets and trace fine sand		E, D	0.0–0.2		pp = 0	
	0.5	CLAY - stiff, orange clay			0.5		pp = 470-550kPa	
				U D, B	0.7–0.9			
21	1.0	SHALY CLAY - very stiff, grey mottled orange shaly clay		D, E	1.0–1.2		pp > 600kPa	
				D	1.5–1.7		pp > 600kPa	
20	2			D	2.0–2.2		pp > 600kPa	
		- becoming hard below 2.4m		D, E	2.5–2.7		pp > 600kPa	
		- becoming humid to damp below 2.8m		D	2.9–3.1		pp > 600kPa	
19	3.1	Pit discontinued at 3.1m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket
LOGGED: AAW
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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TEST PIT LOG

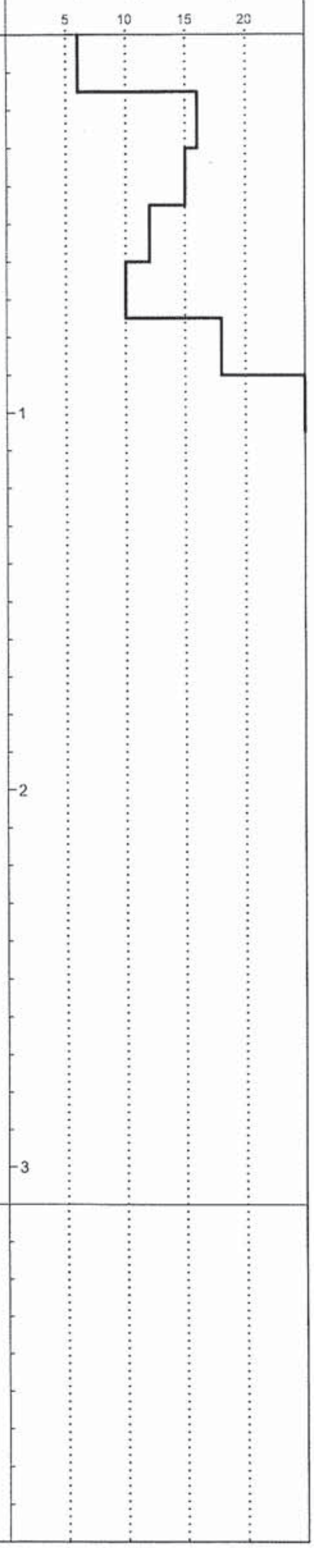
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 24 m AHD
EASTING: 284521
NORTHING: 6127846
DIP/AZIMUTH: 90°/--

PIT No: 17
PROJECT No: 48670
DATE: 02 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
24		TOPSOIL - brown silty clay with rootlets		D, E	0.0 – 0.2		pp = 0	
	0.3	CLAY - hard, orange mottled grey clay		D	0.5 – 0.7		pp > 600kPa	
23	1			D, E	1.0 – 1.2		pp > 600kPa	
	1.2	SHALY CLAY - hard, grey mottled orange shaly clay		D	1.5 – 1.8		pp > 600kPa	
		- becoming very hard below 2.0m						
22	2							
	2.0	SILTSTONE - very low strength, grey siltstone with dry bands		E, D	2.0 – 2.2		pp > 600kPa	
				D	2.5 – 2.7		pp > 600kPa	
21	3			D	2.9 – 3.1		pp > 600kPa	
	3.1	Pit discontinued at 3.1m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

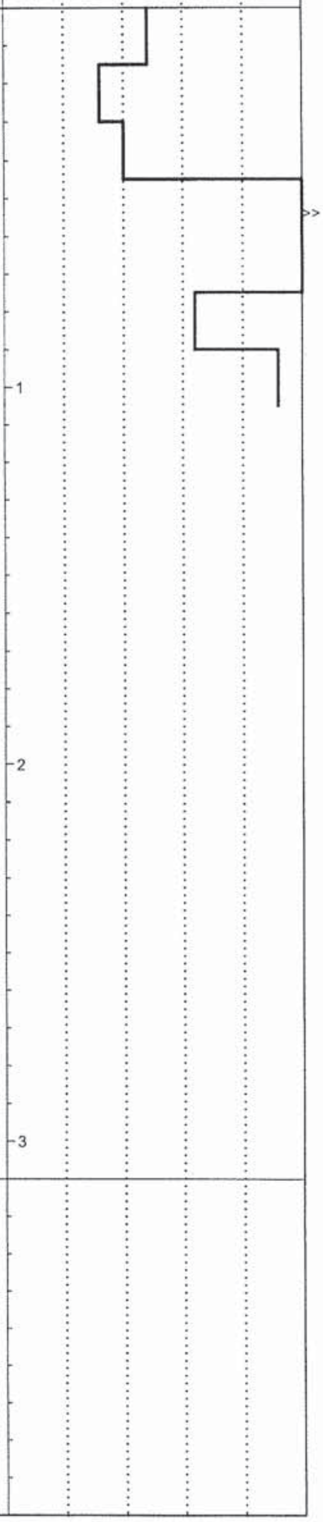
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 32 m AHD
EASTING: 283940
NORTHING: 6127777
DIP/AZIMUTH: 90°/--

PIT No: 18
PROJECT No: 48670
DATE: 17 Jun 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
32		CLAY - light brown clay with trace rootlets, moist to wet		E	0.0			
	0.1	CLAY - yellow mottled orange clay with trace silt, humid to damp (RESIDUAL)		D	0.1–0.2		pp > 600kPa	
				D	0.5–0.7		pp = 370-460kPa	
	0.8	CLAY - grey mottled red orange clay, humid to damp						
31	1			D, E	1.0			
	1.2	SHALY CLAY - hard, grey mottled red brown shaly clay with trace silt/sand			1.2			
				D	1.4–1.5		pp > 600kPa	
30	2			D, E	2.0–2.2		pp > 600kPa	
		- grading to extremely weathered sandstone						
				D	2.5–2.7		pp = 380kPa	
29	3			D, E	3.0–3.1			
	3.1	Pit discontinued at 3.1m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Gemco 210B

LOGGED: DBY

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [illegible]
Date: 15/9/09

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TEST PIT LOG

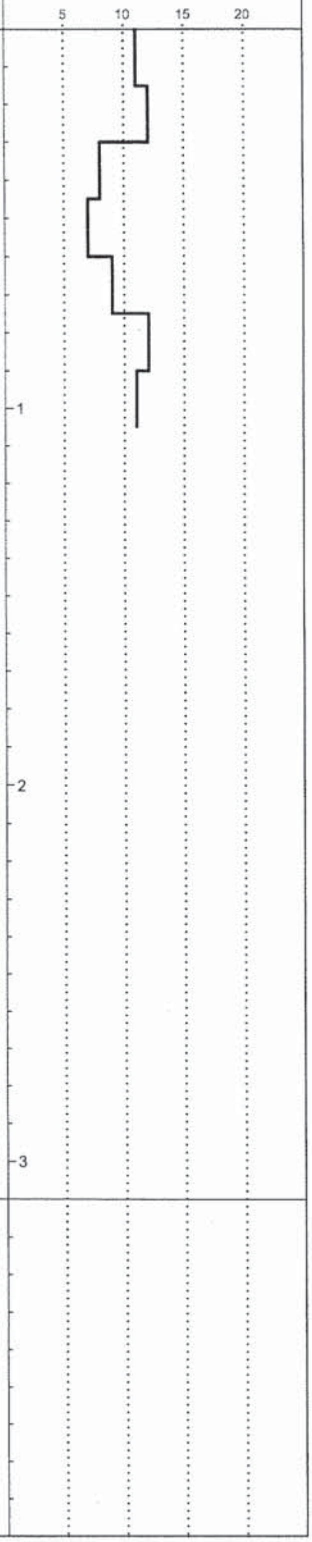
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 24 m AHD
EASTING: 284007
NORTHING: 6128182
DIP/AZIMUTH: 90°/--

PIT No: 19
PROJECT No: 48670
DATE: 02 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
24		TOPSOIL - brown clay with some rootlets		E, D	0.0 – 0.2		pp > 600kPa	
	0.3	CLAY - very stiff, orange mottled grey clay with trace organic content		E, D	0.5 – 0.7		pp > 600kPa	
	0.7	CLAY - stiff, red mottled grey clay						
23	1			D	1.0 – 1.2		pp = 320-470kPa	
	1.2	CLAY - stiff, grey mottled red clay		E, D	1.5 – 1.7		pp = 180-310kPa	
22	2	- becoming very stiff below 2.0 m		D	2.0 – 2.2		pp = 200-450kPa	
				D	2.5 – 2.7		pp = 380-480kPa	
21	3			D	2.9 – 3.1		pp = 310-500kPa	
	3.1	Pit discontinued at 3.1m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample, Duplicate BD1/020709 collected at 0-0.2 m

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 5/7/09

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TEST PIT LOG

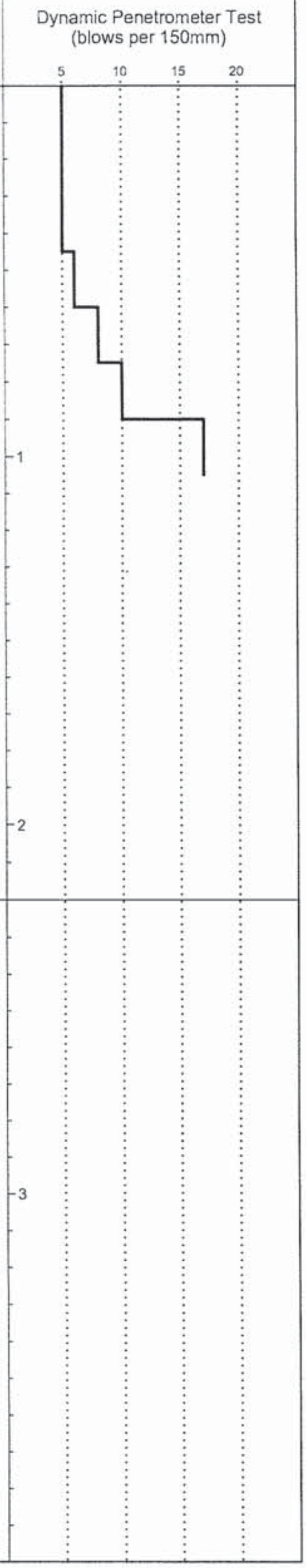
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 36 m AHD
EASTING: 284060
NORTHING: 6128555
DIP/AZIMUTH: 90°/--

PIT No: 20
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
36		TOPSOIL - brown clay with some rootlets, humid		D, E	0.0 – 0.2		pp = 90-160kPa	
	0.4	CLAY - stiff, brown mottled red and grey clay		D, E	0.5 – 0.7		pp = 200-310kPa	
	0.8	CLAY - hard, red mottled grey clay						
35	1			D	1.0 – 1.2		pp > 600kPa	
				D	1.5 – 1.7		pp > 600kPa	
34	2			D	2.0 – 2.2		pp > 600kPa	
	2.2	Pit discontinued at 2.2m (refusal in hard slightly shaly clay)						
33	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▽ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

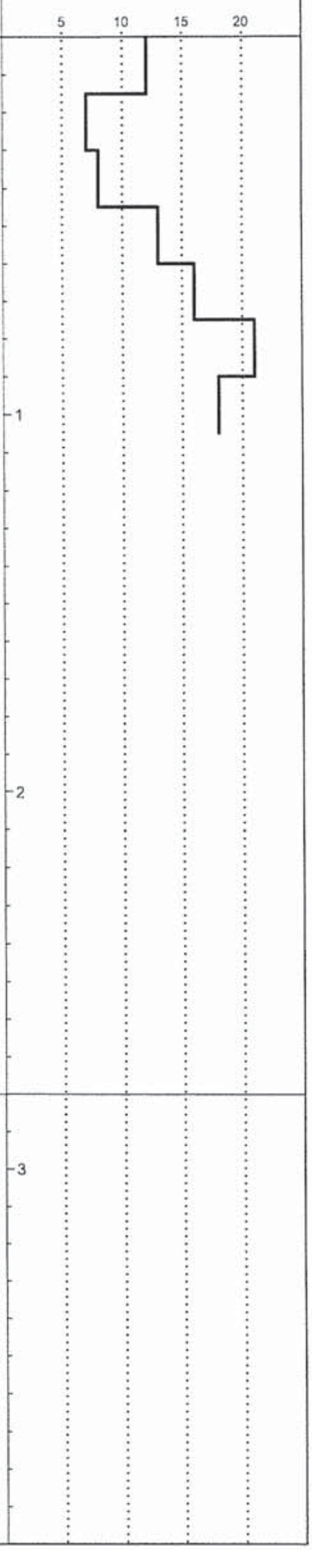
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 20 m AHD
EASTING: 283900
NORTHING: 6127455
DIP/AZIMUTH: 90°/--

PIT No: 21
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
20	0.0	TOPSOIL - brown silty clay with trace fine sand		D, E	0.0 – 0.2		pp = 0	
	0.3	CLAY - very stiff, orange mottled red and grey clay		D, E	0.5 – 0.7		pp > 600kPa	
19	0.9	CLAY - hard, red mottled grey clay		D	1.0 – 1.2		pp > 600kPa	
				D, E	1.5 – 1.7		pp > 600kPa	
18	2.0	CLAY - hard, grey mottled red clay		D	2.0 – 2.2		pp > 600kPa	
				D	2.5 – 2.7		pp > 600kPa	
17	2.8	Pit discontinued at 2.8m (refusal in hard clay)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample, Duplicate BD2/010709 collected at 0-0.2 m

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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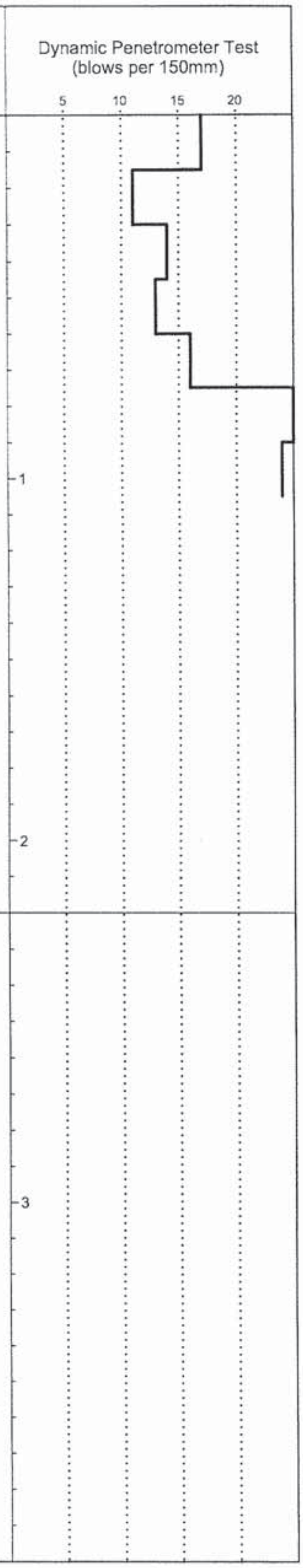
TEST PIT LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 44 m AHD
EASTING: 283475
NORTHING: 6128641
DIP/AZIMUTH: 90°/--

PIT No: 22
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Type	Depth	Sample	Results & Comments	Water
44		TOPSOIL - brown silty clay with some rootlets	E, D	0.0–0.2		pp = 0	
	0.3	CLAY - hard, orange mottled grey clay	D	0.5–0.7		pp > 600kPa	
43	0.9	SHALY CLAY - hard, grey mottled orange shaly clay	D, B	1.0–1.2		pp > 600kPa	
	1.5	SILTSTONE - low strength, grey siltstone with some clay bands	D, E	1.5–1.7		pp > 600kPa	
42			D	2.0–2.2		pp > 600kPa	
	2.2	Pit discontinued at 2.2m (refusal)					
41	3						



RIG: Deere 315SJ - 600mm bucket
LOGGED: AAW
WATER OBSERVATIONS: No free groundwater observed
REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

Douglas Partners
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TEST PIT LOG

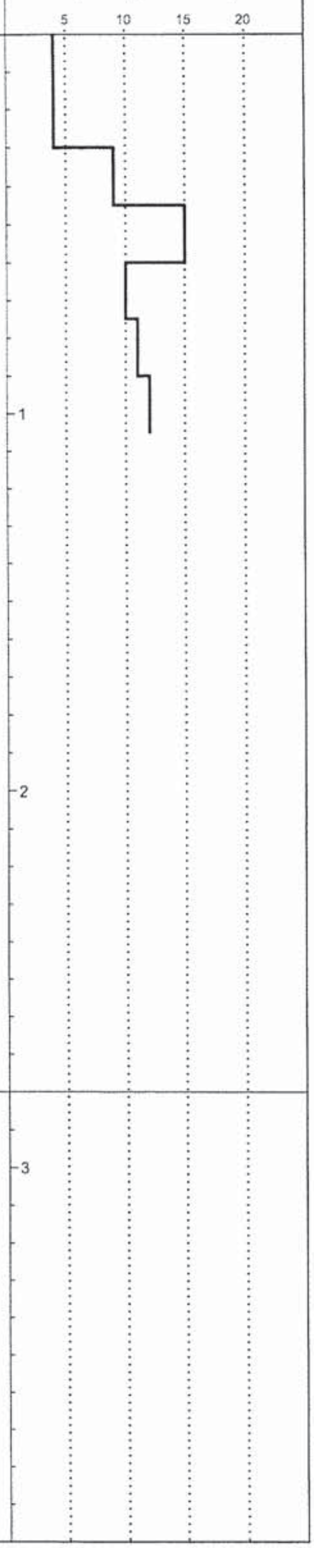
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283351
NORTHING: 6127832
DIP/AZIMUTH: 90°/--

PIT No: 23
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
16		TOPSOIL - brown silty clay with some roots		E, D	0.0–0.2		pp = 180-290kPa	
	0.4	CLAY - hard, orange mottled grey slightly sandy clay		D	0.5–0.7		pp > 600kPa	
15	1			E, D	1.0–1.2		pp = 340-480kPa	
	1.3	SANDY CLAY - stiff, grey mottled orange sandy clay, damp		D	1.5–1.7		pp = 220-300kPa	
14	2			D	2.0–2.2		pp = 240-370kPa	
				D	2.5–2.7		pp = 320-420kPa	
	2.7	SILTSTONE - dark brown and red siltstone		D	2.7–2.8		pp > 600kPa	
	2.8	Pit discontinued at 2.8m (refusal on siltstone)						
13	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ⊻ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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TEST PIT LOG

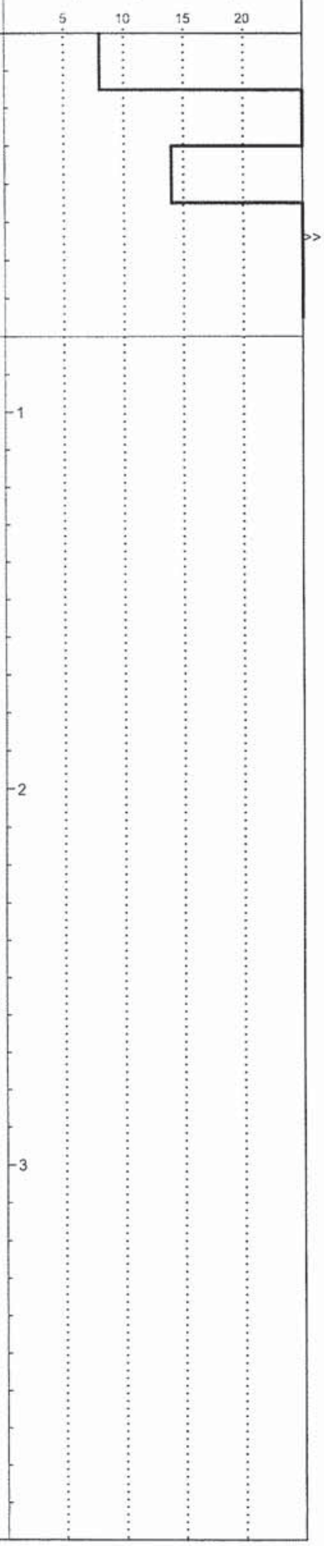
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 20 m AHD
EASTING: 284314
NORTHING: 6127397
DIP/AZIMUTH: 90°/--

PIT No: 24
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
20		TOPSOIL - brown silty clay with some sand		D, E	0.0 – 0.2		pp = 0	
	0.3	CLAY - hard, grey mottled orange clay		D, E	0.5 – 0.7		pp > 600kPa	
	0.8	Pit discontinued at 0.8m (refusal in medium strength, weathered, red and grey shale)						
19	1							
18	2							
17	3							

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [illegible]
Date: 15/9/09

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TEST PIT LOG

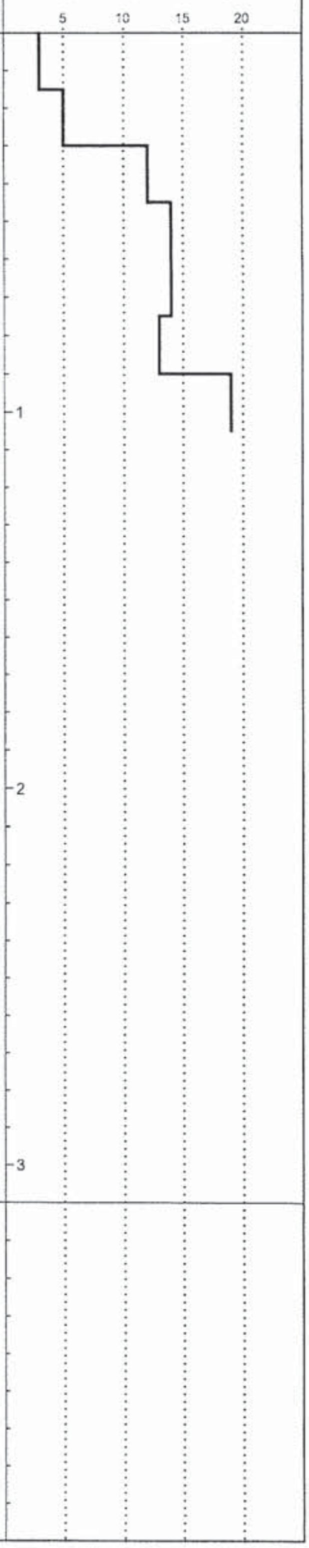
CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 20 m AHD
EASTING: 283757
NORTHING: 6127080
DIP/AZIMUTH: 90°/--

PIT No: 25
PROJECT No: 48670
DATE: 01 Jul 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water
20		SANDY CLAY - brown sandy clay with some silt		E, D	0.0–0.2		pp = 20-30kPa	
	0.4	CLAY - stiff, grey mottled orange clay with trace sand, humid		E, D	0.5–0.7		pp = 250-320kPa	
19	1			D	1.0–1.2		pp = 160-170kPa	
	1.4	CLAY - stiff, red mottled grey clay, humid		D	1.5–1.7		pp = 180-250kPa	
18	2			D	2.0–2.2		pp = 160-210kPa	
		- becoming firm to stiff below 2.5 m		D, E	2.5–2.7		pp = 60-100kPa	
17	3			D	2.9–3.1		pp = 60-150kPa	
	3.1	Pit discontinued at 3.1m (limit of investigation)						

Dynamic Penetrometer Test (blows per 150mm)



RIG: Deere 315SJ - 600mm bucket

LOGGED: AAW

WATER OBSERVATIONS: No free groundwater observed

REMARKS: E = environmental sample

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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BOREHOLE LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 32 m AHD
EASTING: 282968
NORTHING: 6126708
DIP/AZIMUTH: 90°/--

BORE No: BH26
PROJECT No: 48670
DATE: 17 Jun 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling Type	Sampling Depth	Sample	Results & Comments	Water
32	0	TOPSOIL - black sandy topsoil					
	0.25	TOPSOIL - brown sandy topsoil with some gravel					
	0.5	CLAY - light brown/red clay					
	0.75	CLAY - very stiff, mottled orange, grey and red clay					
31	1		S	1.0 – 1.45		5,8,13 N = 21	
30	2.0	CLAY - hard, mottled grey and red silty clay					
		- some moist daly at 2.4m	S	2.5 – 2.95		6,17,21 N = 38	
29	3						
	3.65	SANDSTONE - extremely low strength, extremely weathered, mottled orange/red and grey sandstone					
28	4		S	4.0 – 4.16		13,5/50mm refusal	
27	5		S	5.5 – 5.64		17/140mm,-,- refusal	
26	6.0	Bore discontinued at 6.0m (limit of investigation)					

Well Construction Details

0	Monument cover
1	backfill
	casing
	bentonite
	screen
5	sand
6	

RIG: Gemco 210B **DRILLER:** P Boers **LOGGED:** AC **CASING:**
TYPE OF BORING: Solid flight auger (TC-bit) to 6.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Standpipe installed to 6.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: B
Date: 15/9/09

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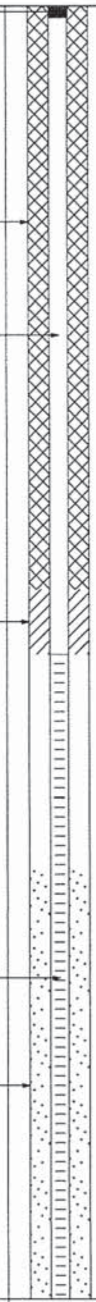
BOREHOLE LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 16 m AHD
EASTING: 283421
NORTHING: 6125283
DIP/AZIMUTH: 90°/--

BORE No: BH27
PROJECT No: 48670
DATE: 17 Jun 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Sampling Type	Sampling Depth	Sample	Results & Comments	Water	Well Construction Details
16	0.0	CLAY - brown clay						Monument cover
	0.3	CLAY - very stiff, mottled orange and grey clay						
15	1		S	1.0 – 1.45		3,8,13 N = 21		1 backfill
								casing
14	2							2
			S	2.5 – 2.8		6,18,- refusal		
13	2.8	SANDSTONE - extremely low strength, extremely weathered, brown sandstone						bentonite
	3							3
12	4.0	SANDSTONE - extremely low strength, extremely weathered, brown sandstone with bands of low strength, highly weathered, grey sandstone	S	4.0 – 4.06		5/60mm,-,- refusal		4
								screen
11	5							5 sand
10	6.0	Bore discontinued at 6.0m (limit of investigation)						6



RIG: Gemco 210B **DRILLER:** P Boers **LOGGED:** AC **CASING:**
TYPE OF BORING: Solid flight auger (TC-bit) to 6.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Standpipe installed to 6.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U_x	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	▷	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 5/9/09

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BOREHOLE LOG

CLIENT: Shaolin Temple Foundation (Australia)
PROJECT: Proposed Residential & Tourist Development
LOCATION: Comberton Grange

SURFACE LEVEL: 20 m AHD
EASTING: 284010
NORTHING: 6128076
DIP/AZIMUTH: 90°/--

BORE No: BH28
PROJECT No: 48670
DATE: 17 Jun 09
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Type	Depth	Sample	Results & Comments	Water	Well Construction Details
20		CLAY - orange clay							Monument cover
	0.6	CLAY - very stiff, mottled orange red and grey clay							
19	1			S	1.0		5,10,13 N = 23		1 backfill
		- moist clay at 1.4m			1.45				casing
18	2								2
				S	2.5		8,10,16 N = 26		bentonite
					2.95				
17	3 3.0	SANDSTONE - extremely low strength, extremely weathered sandstone							3
16	4 4.0	SANDSTONE - extremely low strength, extremely weathered, grey sandstone		S	4.0 4.11		10/110mm,-,- refusal		4
									screen
15	5 5.0	SHALE - extremely low strength, extremely weathered, grey shale							5 sand
14	6 6.0	Bore discontinued at 6.0m (limit of investigation)							6

RIG: Gemco 210B **DRILLER:** P Boers **LOGGED:** AC **CASING:**
TYPE OF BORING: Solid flight auger (TC-bit) to 6.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: Standpipe installed to 6.0m

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	PID	Photo ionisation detector
B	Bulk sample	S	Standard penetration test
U,	Tube sample (x mm dia.)	PL	Point load strength Is(50) MPa
W	Water sample	V	Shear Vane (kPa)
C	Core drilling	>	Water seep ▼ Water level

CHECKED
Initials: [signature]
Date: 15/9/09

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APPENDIX C

Laboratory Test Report Sheets

Douglas Partners
Geotechnics · Environment · Groundwater

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wollongong@douglaspartners.com.au

RESULTS OF MOISTURE CONTENT TEST

Client: CONYBEARE MORRISON INTERNATIONAL PTY LTD

Project: PROPOSED TOURIST & RESIDENTIAL DEVELOPMENT

Location: FOREST ROAD, COMBERTON GRANGE

Project No: 48670.02
Report No: UL09-108A
Report Date: 17/6/09

Date Sampled: 27 - 28/5/09
Date of Test: 5/6/09
Page: 1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
Pit 1	0.3 - 0.5	Red orange silty clay	18.6
Pit 1	0.8 - 1.0	Mottled orange brown sandy silty clay	13.3
Pit 2	0.00 - 0.25	Light brown silty clay	14.2
Pit 3	0.8 - 1.0	Mottled red brown silty clay	20.5
Pit 3	1.3 - 1.5	Mottled red grey silty clay	20.6
Pit 4	0.4 - 0.5	Orange brown silty clay	26.5
Pit 5	0.8 - 1.0	Red orange grey silty clay	18.8
Pit 6	0.4 - 0.5	Orange brown sandy silty clay	16.3
Pit 7	1.3 - 1.5	Red brown silty clay	24.9
Pit 8	0.8 - 1.0	Mottled orange grey silty clay	12.9
Pit 9	0.00 - 0.25	Brown silty sand (topsoil)	13.3
Pit 9	1.8 - 2.0	Brown orange clay	22.5
Pit 9	2.3 - 2.5	Mottled red brown silty clay	19.4
Pit 10	0.4 - 0.5	Orange brown silty clay	19.3
Pit 12	0.3 - 0.5	Brown silty clay	23.4

Test Method(s): AS 1289.2.1.1-2005, .2.1.2-2005, .2.1.4-2005, .2.1.5-2005

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number: 828

This Document is issued in accordance with NATA's Accreditation requirements.
Accredited for compliance with ISO/IEC 17025

Approved Signatory:

Tested: JR, TZ
Checked: TZ, DE

Dave Evans
Laboratory Manager

Form No R001 Rev 7 of Issue July 2006

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RESULTS OF MOISTURE CONTENT TEST

Client:	Conybeare Morrison International Pty Ltd	**Project No:**	48670.02
		Report No:	UL09-123A
Project:	Proposed Tourist and Residential Develpoment	**Report Date:**	20/7/09
		Date Sampled:	27-28/5/09
Location:	Forest Road, Comberton Grange	**Date of Test:**	7 & 10/7/09
		Page:	1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	MOISTURE CONTENT (%)
Pit 14	0.5 - 0.8	Red brown sandy silty clay	19.6
Pit 15	0.5 - 0.7	Mottled red brown orange silty clay	22.0
Pit 16	0.5 - 0.7	Orange brown silty sandy clay	21.3
Pit 17	0.5 - 0.7	Brown orange sandy clay	5.4
Pit 19	0.5 - 0.7	Mottled brown orange grey silty sandy clay	21.2
Pit 20	0.5 - 0.7	Orange brown silty clay	31.6
Pit 20	1.0 - 1.2	Mottled red grey silty clay	13.9
Pit 20	1.5 - 1.7	Mottled red grey sandy silty clay	15.0
Pit 21	0.0 - 0.2	Brown clayey sandy silt	12.4
Pit 22	0.5 - 0.7	Brown clay	18.9
Pit 22	1.0 – 1.2	Brown sandy gravelly silty clay	13.5
Pit 23	0.5 – 0.7	Brown sandy gravelly silty clay	8.8
Pit 24	0.5 - 0.7	Brown sandy gravelly silty clay	8.9
Pit 25	0.5 - 0.7	Grey brown silty clay	16.9
Pit 25	1.0 - 1.2	Grey sandy silty clay	18.0

Test Method(s): AS 1289.2.1.1, .2.1.2, .2.1.4, .2.1.5

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

NATA NATA Accredited Laboratory Number: 828

This Document is issued in accordance with NATA's Accreditation requirements.
Accredited for compliance with ISO/IEC 17025

ACCREDITED FOR TECHNICAL COMPETENCE

Approved Signatory:

Tested: DE
Checked: LP

Dave Evans
Laboratory Manager

Douglas Partners
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RESULTS OF MOISTURE CONTENT, PLASTICITY AND LINEAR SHRINKAGE TESTS

Client:	CONYBEARE MORRISON INTERNATIONAL PTY LTD	**Project No:**	48670.02
		Report No:	UL09-108B
Project:	PROPOSED TOURIST & RESIDENTIAL DEVELOPMENT	**Report Date:**	17/6/09
		Date Sampled:	27-28/5/09
Location:	FOREST ROAD, COMBERTON GRANGE	**Date of Test:**	16/6/09
		Page:	1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	CODE	W_F %	W_L %	W_P %	PI %	*LS %
Pit 1	0.3 - 0.5	Red orange silty clay	2,3,5	18.6	44	19	25	10.5
Pit 3	1.3 - 1.5	Mottled red grey silty clay	2,3,5	20.6	44	20	24	10.5
Pit 5	0.8 - 1.0	Red orange grey silty clay	2,3,5	18.8	44	18	26	11.5
Pit 7	1.3 - 1.5	Red brown silty clay	2,3,5	24.9	42	22	20	10.5
Pit 9	1.8 - 2.0	Brown orange clay	2,3,5	22.5	37	19	18	9.0

Legend:
W_F Field Moisture Content
W_L Liquid limit
W_P Plastic limit
PI Plasticity index
LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:
Moisture Content: AS 1289 2.1.1
Liquid Limit: AS 1289 3.1.2
Plastic Limit: AS 1289 3.2.1
Plasticity Index: AS 1289 3.3.1
Linear Shrinkage: AS 1289 3.4.1

Code
Sample history for plasticity tests
1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests
5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

Approved Signatory:

NATA Accredited Laboratory Number: 828
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ACCREDITED FOR TECHNICAL COMPETENCE

Tested:	JR, TZ
Checked:	TZ

David Evans
Laboratory Manager

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RESULTS OF MOISTURE CONTENT, PLASTICITY AND LINEAR SHRINKAGE TESTS

Client:	**Conybeare Morrison International Pty Ltd**	**Project No:**	48670.02
		Report No:	UL09-123B
Project:	Proposed Tourist and Residential Development	**Report Date:**	20/7/09
		Date Sampled:	27-28/5/09
Location:	Forest Road, Comberton Grange	**Date of Test:**	10/7/09
		Page:	1 of 1

TEST LOCATION	DEPTH (m)	DESCRIPTION	CODE	W_F %	W_L %	W_P %	PI %	*LS %
Pit 14	0.5 - 0.8	Red brown sandy silty clay	2,3,5	19.6	69	23	46	15.0
Pit 17	0.5 - 0.7	Brown orange sandy clay	2,3,5	5.4	30	18	12	7.0
Pit 20	1.5 - 1.7	Mottled red grey silty clay	2,3,5	15.0	52	19	33	14.5
Pit 22	0.5 - 0.7	Brown clay	2,3,5	18.9	65	27	38	16.0
Pit 24	0.5 - 0.7	Brown sandy gravelly silty clay	2,3,5	8.9	35	22	13	7.5

Legend:
- W_F Field Moisture Content
- W_L Liquid limit
- W_P Plastic limit
- PI Plasticity index
- LS Linear shrinkage from liquid limit condition (Mould length 125mm)

Test Methods:

Moisture Content:	AS 1289 2.1.1
Liquid Limit:	AS 1289 3.1.2 , 3.1.1
Plastic Limit:	AS 1289 3.2.1
Plasticity Index:	AS 1289 3.3.1
Linear Shrinkage:	AS 1289 3.4.1

Code

Sample history for plasticity tests
1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

Approved Signatory:

Tested: JR, TZ
Checked: DE

David Evans
Laboratory Manager

NATA Accredited Laboratory Number: 828
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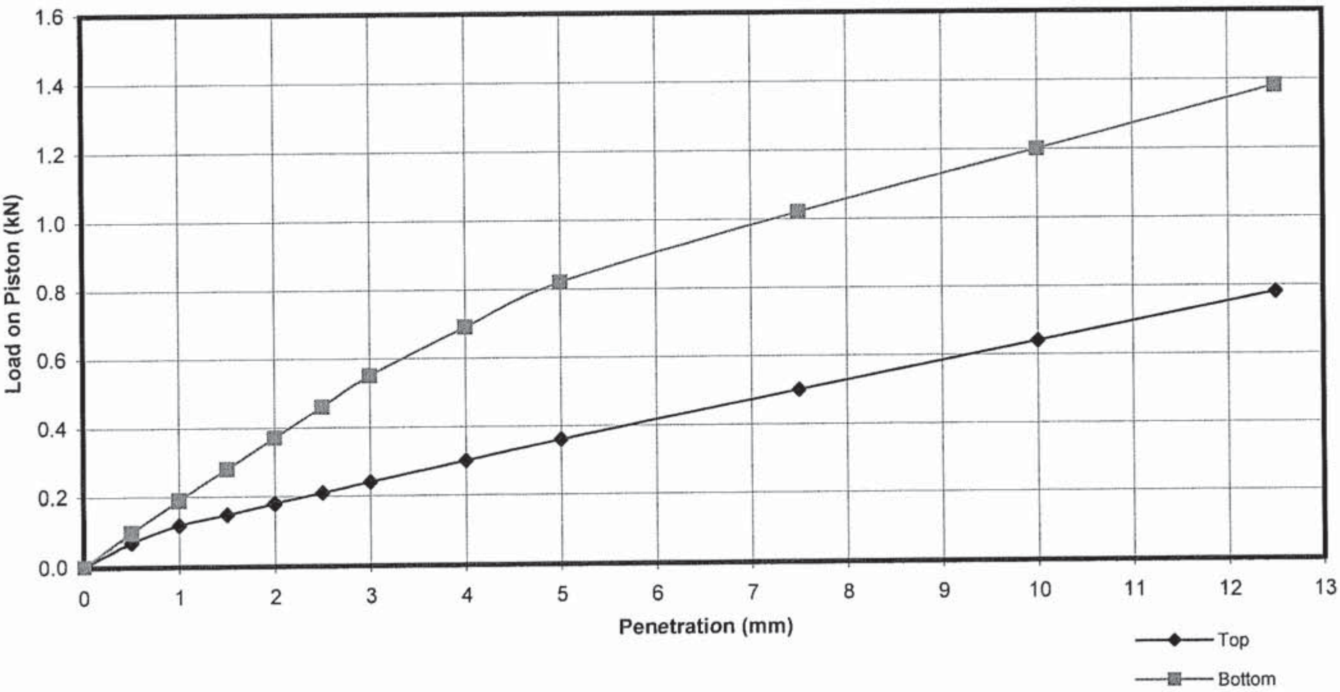
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-108C
Project :	Proposed Tourist & Residential Development	**Report Date :**	17/06/2009
		Date Sampled :	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	11/06/2009
Test Location :	Pit 3		
Depth / Layer :	0.8 - 1.0m	**Page:**	1 of 1



Description: Mottled red brown silty clay

Test Method(s): AS 1289.6.1.1-1998, AS 1289.2.1.1-2005

Sampling Method(s): Sampled by Wollongong Engineering Department **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 100% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 2.2%
MOISTURE RATIO: 101% of STD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		18.3	1.75
After soaking		22.8	1.71
After test	Top 30mm of sample	28.5	-
	Remainder of sample	21.0	-
Field values		20.5	-
Standard Compaction		18.1	1.75

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	2.5 mm	1.5
	5.0 mm	2.0
BOTTOM	2.5 mm	3.5
	5.0 mm	4.0

Form R019 Rev4 July 2006

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number: 828
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Approved Signatory:

Tested:	TZ
Checked:	DE

David Evans
Laboratory Manager

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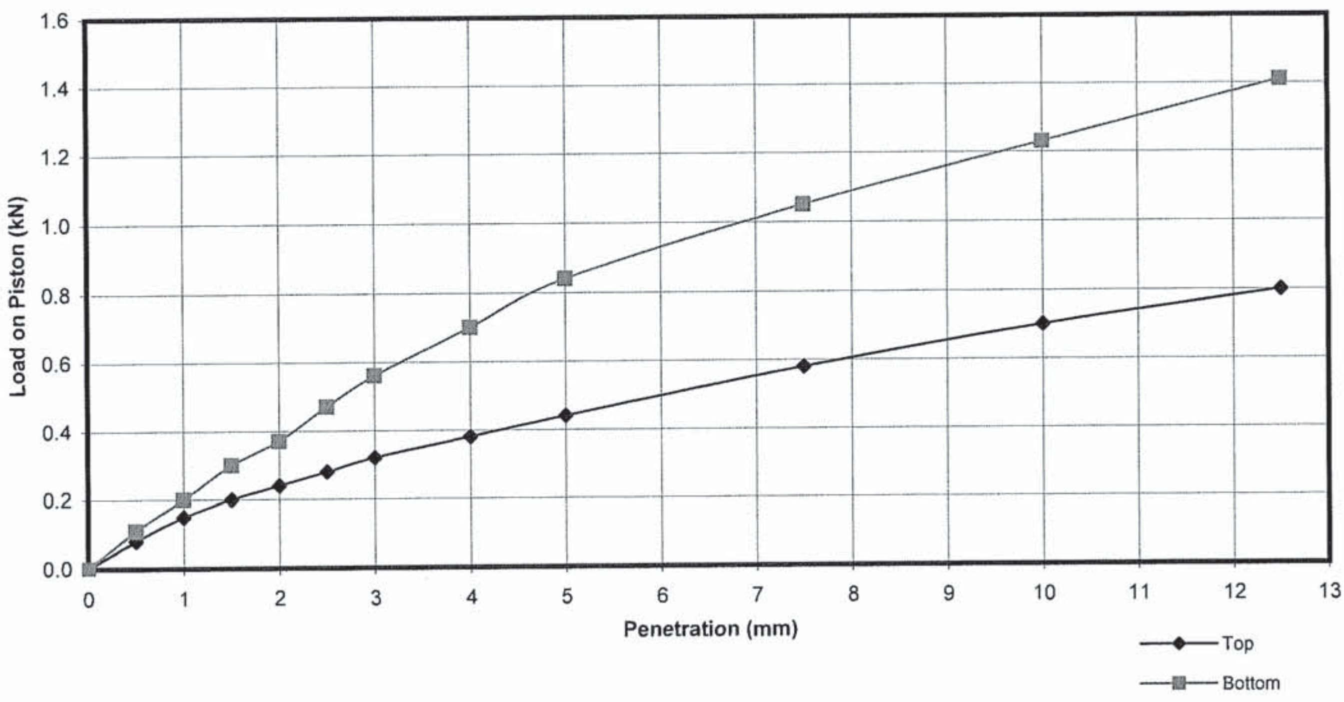
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-108D
Project :	Proposed Tourist & Residential Development	**Report Date :**	17/06/2009
		Date Sampled :	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	11/06/2009
Test Location :	Pit 9		
Depth / Layer :	2.3 - 2.5m	**Page:**	1 of 1



Description: Mottled red brown silty clay

Test Method(s): AS 1289.6.1.1-1998, AS 1289.2.1.1-2005

Sampling Method(s): Sampled by Wollongong Engineering Department

Percentage > 19mm: 0.0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 100% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.8%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		18.1	1.76
After soaking		19.7	1.74
After test	Top 30mm of sample	20.8	-
	Remainder of sample	18.7	-
Field values		19.4	-
Standard Compaction		18.1	1.75

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**2.5 mm**	**2.0**
	5.0 mm	**2.0**
BOTTOM	**2.5 mm**	**3.5**
	5.0 mm	**4.0**

Form R019 Rev4 July 2006

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Approved Signatory:

Tested:	TZ
Checked:	DE

David Evans
Laboratory Manager

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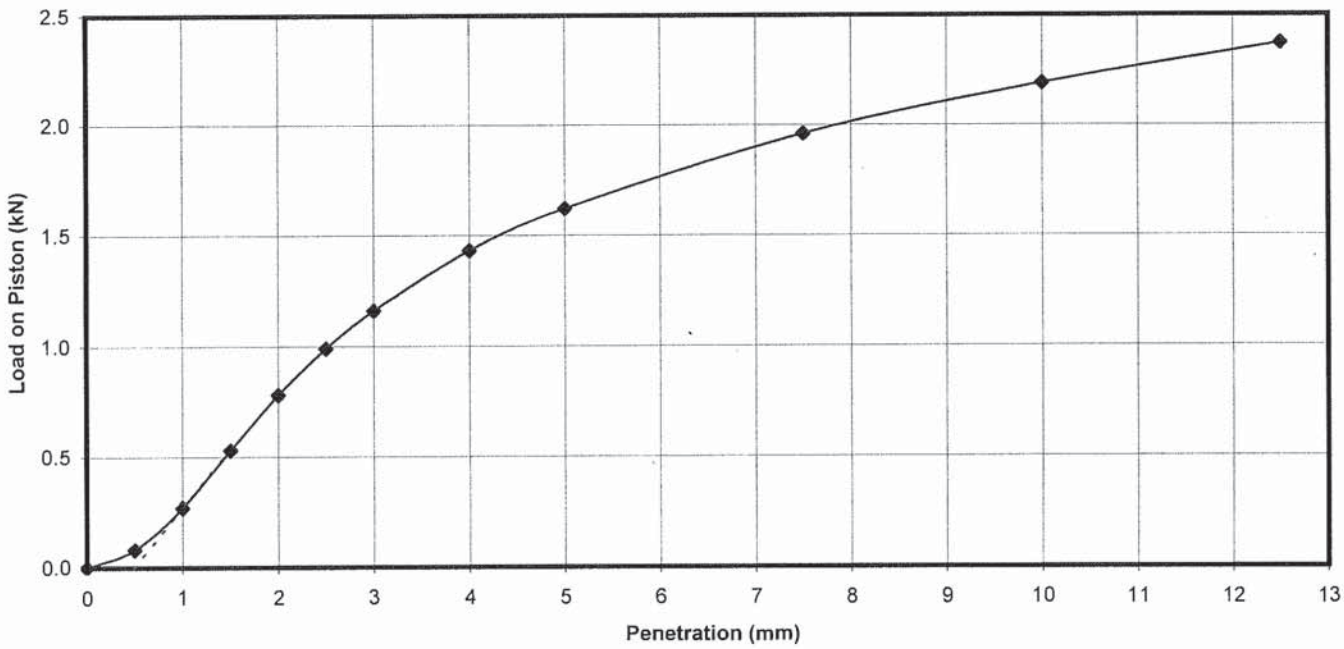
RESULT OF CALIFORNIA BEARING RATIO TEST

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-123C
Project :	Proposed Tourist and Residential Development	**Report Date :**	20/07/2009
		Date Sampled :	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	13/07/2009
Test Location :	Pit 16		
Depth / Layer :	0.5 - 0.7m	**Page:**	1 of 1



Description: Orange brown silty sandy clay

Test Method(s): AS 1289.6.1.1, AS 1289.2.1.1

Sampling Method(s): Sampled by Wollongong Engineering Department **Percentage > 19mm:** 0.0%

LEVEL OF COMPACTION: 100% of STD MDD **SURCHARGE:** 4.5 kg **SWELL:** 0.3%
MOISTURE RATIO: 98% of STD OMC **SOAKING PERIOD:** 4 days

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		23.6	1.55
After soaking		27.2	1.55
After test	Top 30mm of sample	28.4	-
	Remainder of sample	26.2	-
Field values		21.3	-
Standard Compaction		24.0	1.55

RESULTS		
TYPE	PENETRATION	CBR (%)
TOP	**2.5 mm**	**9**
	5.0 mm	**9**

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Approved Signatory:

Tested:	JR, LP
Checked:	DE

David Evans
Laboratory Manager

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DETERMINATION OF EMERSON CLASS NUMBER OF SOIL

Client: CONYBEARE MORRISON INTERNATIONAL PTY LTD
Project: PROPOSED TOURIST & RESIDENTIAL DEVELOPMENT
Location: FOREST ROAD, COMBERTON GRANGE

Project No: 48670.02
Report No: UL09-108G
Report Date: 17/6/09
Date of Test: 16/6/09
Page: 1 of 1

SAMPLE NO	DEPTH (m)	DESCRIPTION	WATER TYPE	WATER TEMP	CLASS NO.
Pit 2	0.00 – 0.25	Light brown silty clay	Distilled	22°C	4
Pit 4	0.4 – 0.5	Orange brown silty clay	Distilled	22°C	4
Pit 6	0.4 – 0.5	Orange brown sandy silty clay	Distilled	22°C	4
Pit 9	0.00 – 0.25	Brown silty sand (Top soil)	Distilled	22°C	4
Pit 12	0.3 – 0.5	Brown silty clay	Distilled	22°C	4

Test Method(s): AS 1289 3.8.1 - 2006

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks:

Form No R005 Rev 7 of Issue July 2006

Approved Signatory:

David Evans
Laboratory Manager

Tested: TZ
Checked: TZ

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DETERMINATION OF EMERSON CLASS NUMBER OF SOIL

Client: Conybeare Morrison International Pty Ltd

Project: Proposed Tourist and Residential Development

Location: Forest Road, Comberton Grange

Project No: 48670.02
Report No: UL09-123D
Report Date: 20/7/09

Date of Test: 9/7/09
Page: 1 of 1

SAMPLE NO	DEPTH (m)	DESCRIPTION	WATER TYPE	WATER TEMP	CLASS NO.
Pit 16	0.5 – 0.7	Orange brown silty sandy clay	Distilled	23°C	4
Pit 20	0.5 – 0.7	Orange brown silty clay	Distilled	22°C	4
Pit 21	0.0 – 0.2	Brown clayey sandy silty	Distilled	22°C	8
Pit 23	0.5 – 0.7	Brown sandy gravelly silty clay	Distilled	22°C	4
Pit 25	0.5 – 0.7	Grey sandy silty clay	Distilled	22°C	1

Test Method(s): AS 1289 3.8.1

Sampling Method(s): Sampled by Wollongong Engineering

Remarks:

Approved Signatory:

David Evans
Laboratory Manager

Tested: TZ, JR
Checked: TZ

NATA NATA Accredited Laboratory Number: 828

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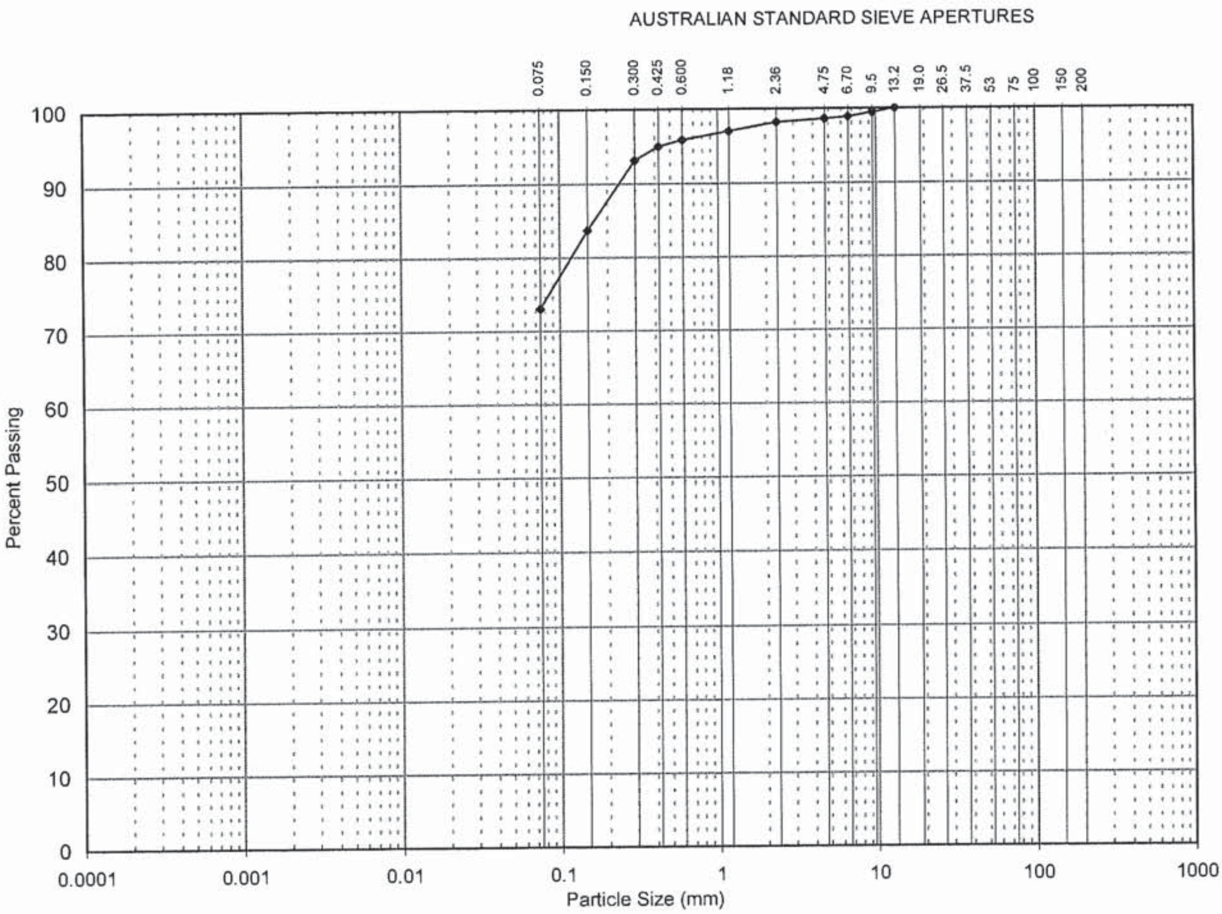
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-108E
Project :	Proposed Tourist & Residential Development	**Report Date :**	17-Jun-09
		Date Sampled:	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	12-Jun-09
Road No:	- **Sample / Pit No:** Pit 1	**Depth / Layer:**	0.8 - 1.0m
Chainage:	- **Section / Lot No:** -	**Test Request No:**	-
		Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	100%
9.5	99%
6.7	99%
4.75	99%
2.36	98%
1.18	97%
0.600	96%
0.425	95%
0.300	93%
0.150	84%
0.075	73%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

0.002 0.006 0.02 0.06 0.2 0.6 2.0 6.0 20 60

Description: Mottled orange brown sandy silty clay

Test Method(s): AS 1289.3.6.1 - 1995,

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

Form R004A Rev4 1 Jul 2006

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Approved Signatory:

Tested:	JR
Checked:	DE

David Evans
Laboratory Manager

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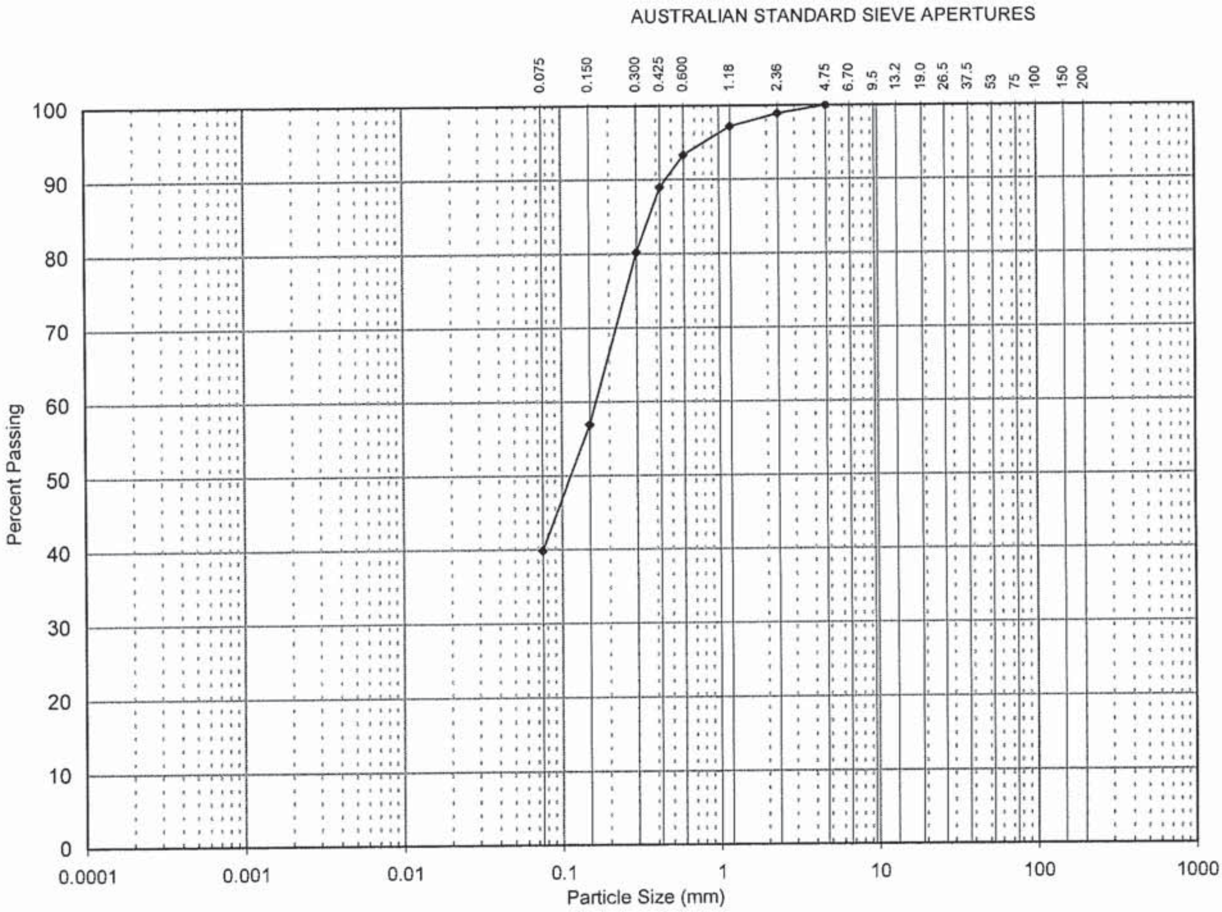
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	Conybeare Morrison International Pty Ltd			**Project No. :**	48670.02
				Report No. :	UL09-108F
Project :	Proposed Tourist & Residential Development			**Report Date :**	17-Jun-09
				Date Sampled:	27-28/5/2009
Location :	Forest Road, Comberton Grange			**Date of Test:**	12-Jun-09
Road No:	-	**Sample / Pit No:**	Pit 9	**Depth / Layer:**	0.00 - 0.25m
Chainage:	-	**Section / Lot No:**	-	**Test Request No:**	-
				Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	99%
1.18	97%
0.600	93%
0.425	89%
0.300	80%
0.150	57%
0.075	40%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Brown silty sand (topsoil)

Test Method(s): AS 1289.3.6.1 - 1995,

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

Approved Signatory:

Tested:	JR
Checked:	DE

David Evans
Laboratory Manager

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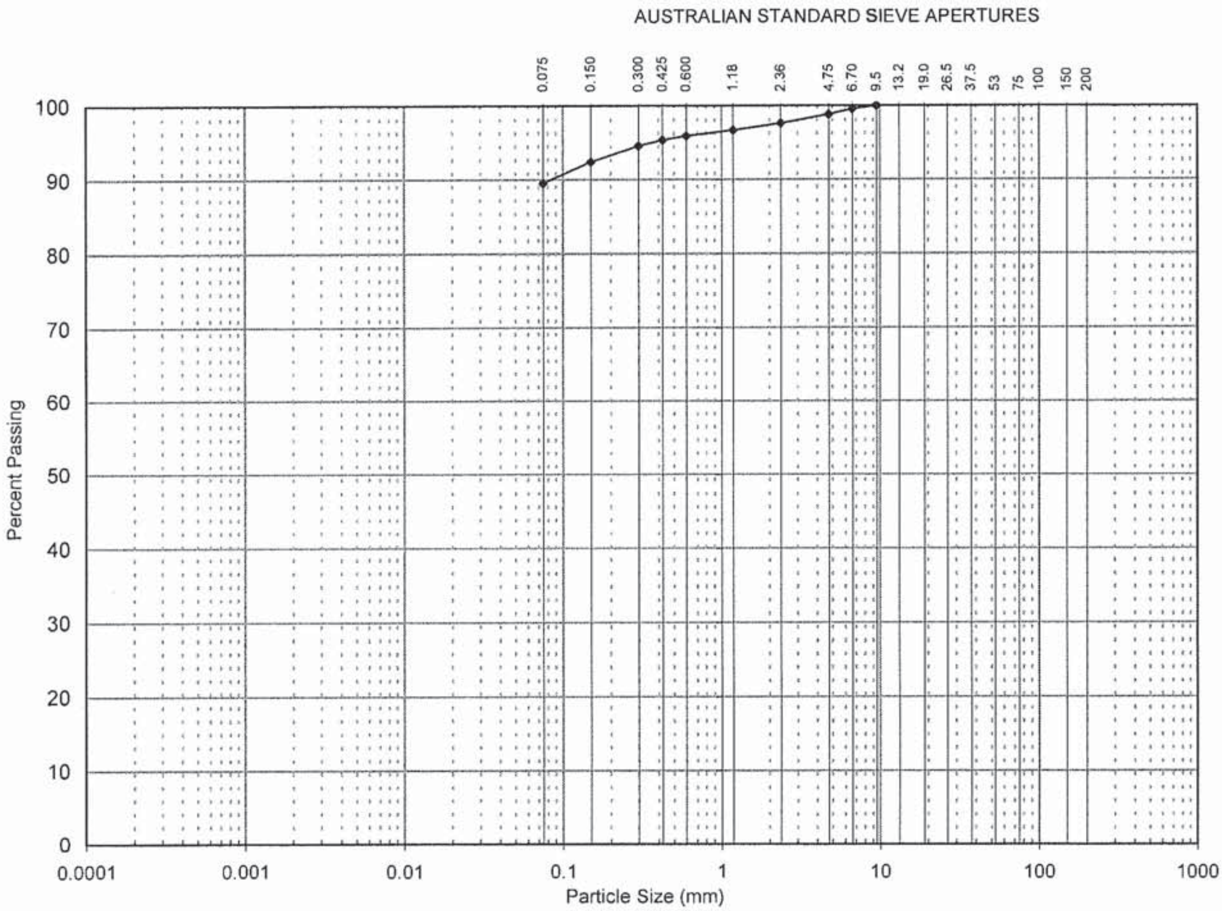
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-123E
Project :	Proposed Tourist and Residential Development	**Report Date :**	20-Jul-09
		Date Sampled:	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	17/7/2009
Road No:	- **Sample / Pit No:** Pit 14	**Depth / Layer:**	0.5 - 0.8m
Chainage:	- **Section / Lot No:** -	**Test Request No:**	-
		Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	100%
6.7	100%
4.75	99%
2.36	98%
1.18	97%
0.600	96%
0.425	95%
0.300	95%
0.150	92%
0.075	90%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	

0.002 · 0.006 · 0.02 · 0.06 · 0.2 · 0.6 · 2.0 · 6.0 · 20 · 60

Description: Red brown sandy silty clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

Approved Signatory:

Tested:	JR
Checked:	DE

David Evans
Laboratory Manager

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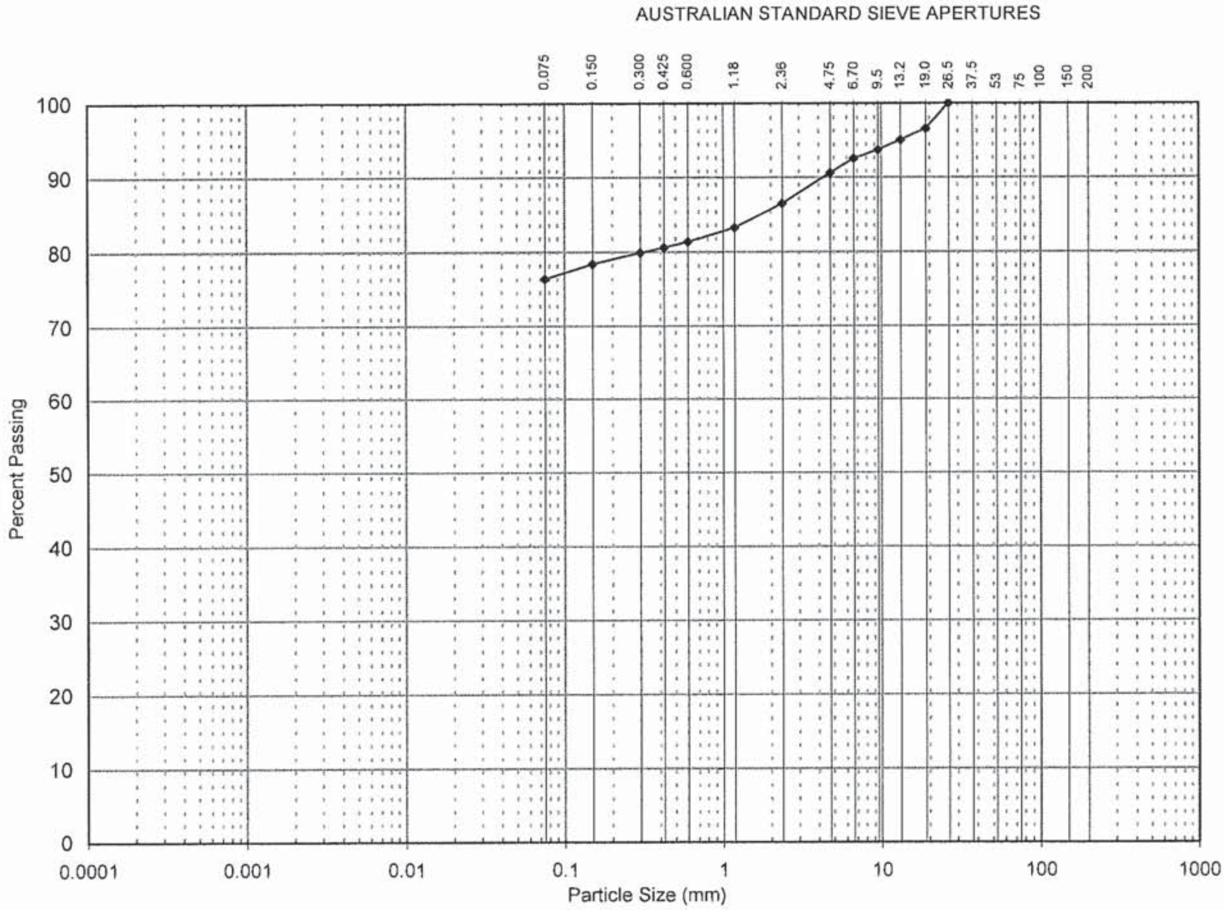
RESULTS OF PARTICLE SIZE DISTRIBUTION

Client :	Conybeare Morrison International Pty Ltd	**Project No. :**	48670.02
		Report No. :	UL09-123F
Project :	Proposed Tourist and Residential Development	**Report Date :**	20-Jul-09
		Date Sampled:	27-28/5/2009
Location :	Forest Road, Comberton Grange	**Date of Test:**	7/7/2009
Road No:	- **Sample / Pit No:** Pit 22	**Depth / Layer:**	1.0 - 1.2m
Chainage:	- **Section / Lot No:** -	**Test Request No:**	-
		Page:	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	100%
19.0	97%
13.2	95%
9.5	94%
6.7	93%
4.75	91%
2.36	86%
1.18	83%
0.600	81%
0.425	81%
0.300	80%
0.150	78%
0.075	76%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Brown sandy gravelly silty clay

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by Wollongong Engineering Department

Remarks: -

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Approved Signatory:

Tested:	JR
Checked:	DE

David Evans
Laboratory Manager

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www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 29678

Client:
Douglas Partners Unanderra
Unit 1, 1 Luso Drive
Unanderra
NSW 2526

Attention: Arthur Castrissios

Sample log in details:

Your Reference:	**48670, Proposed Res. & Tourist Dev.**
No. of samples:	3 Soils
Date samples received:	11/06/09
Date completed instructions received:	11/06/09

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	18/06/09
Date of Preliminary Report:	Not Issued
Issue Date:	18/06/09

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Results Approved By:

Jacinta Hurst
Operations Manager

Miscellaneous Inorg - soil Our Reference: Your Reference Type of sample	UNITS ------------- ------------	29678-1 Pit 2/1.8-2.0 Soil	29678-2 Pit 5/0.4-0.5 Soil	29678-3 Pit 11/0.8 Soil
Date prepared	-	15/06/2009	15/06/2009	15/06/2009
Date analysed	-	15/06/2009	15/06/2009	15/06/2009
pH 1:5 soil:water	pH Units	5.4	5.0	5.0
Chloride 1:5 soil:water	mg/kg	<100	<100	<100
Sulphate, SO4 1:5 soil:water	mg/kg	64	<25	35
Electrical Conductivity 1:5 soil:water	µS/cm	130	110	56

ESP/CEC Our Reference: Your Reference Type of sample	UNITS ------------- ------------	29678-1 Pit 2/1.8-2.0 Soil	29678-2 Pit 5/0.4-0.5 Soil	29678-3 Pit 11/0.8 Soil
Exchangeable Ca*	meq/100g	0.040	0.34	0.090
Exchangeable K*	meq/100g	0.52	0.65	0.54
Exchangeable Mg*	meq/100g	4.4	4.3	2.3
Exchangeable Na*	meq/100g	3.0	1.3	0.54
Cation Exchange Capacity*	meq/100g	8.0	6.5	3.5
ESP*	%	37.0	19.0	15.0

Method ID	Methodology Summary
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
LAB.11	Chloride determined by argentometric titration.
LAB.9	Sulphate determined turbidimetrically.
LAB.2	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 20th ED and Rayment & Higginson.
Metals.23	Determination of exchangeable cations and cation exchange capacity in soil.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			15/06/2009	29678-1	15/06/2009 || 15/06/2009	LCS-1	15/06/2009
Date analysed	-			15/06/2009	29678-1	15/06/2009 || 15/06/2009	LCS-1	15/06/2009
pH 1:5 soil:water	pH Units		LAB.1	[NT]	29678-1	5.4 || 5.4 || RPD: 0	LCS-1	100%
Chloride 1:5 soil:water	mg/kg	100	LAB.11	<100	29678-1	<100 || <100	LCS-1	104%
Sulphate, SO4 1:5 soil:water	mg/kg	25	LAB.9	<25	29678-1	64 || 60 || RPD: 6	LCS-1	94%
Electrical Conductivity 1:5 soil:water	µS/cm	1	LAB.2	<1.0	29678-1	130 || 120 || RPD: 8	LCS-1	104%

QUALITY CONTROL ESP/CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Exchangeable Ca*	meq/100g	0.01	Metals.23	<0.01	29678-3	0.090 || 0.090 || RPD: 0	LCS-1	83%
Exchangeable K*	meq/100g	0.01	Metals.23	<0.01	29678-3	0.54 || 0.52 || RPD: 4	LCS-1	107%
Exchangeable Mg*	meq/100g	0.01	Metals.23	<0.01	29678-3	2.3 || 2.4 || RPD: 4	LCS-1	92%
Exchangeable Na*	meq/100g	0.01	Metals.23	<0.01	29678-3	0.54 || 0.55 || RPD: 2	LCS-1	102%
Cation Exchange Capacity*	meq/100g	1	Metals.23	<1.0	29678-3	3.5 || 3.6 || RPD: 3	[NR]	[NR]
ESP*	%	1	Metals.23	<1.0	29678-3	15.0 || 15.0 || RPD: 0	[NR]	[NR]

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job

INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than

RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

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enquiries@envirolabservices.com.au
www.envirolabservices.com.au

CERTIFICATE OF ANALYSIS 30623

Client:
Douglas Partners Unanderra
Unit 1, 1 Luso Drive
Unanderra
NSW 2526

Attention: Arthur Castrissios

Sample log in details:

Your Reference:	**48670.02, Prop. Tourist & Res. Dev.**
No. of samples:	2 Soils
Date samples received:	07/07/09
Date completed instructions received:	07/07/09

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	14/07/09
Date of Preliminary Report:	Not Issued
Issue Date:	14/07/09

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Results Approved By:

Giovanni Agosti
Technical Manager

Miscellaneous Inorg - soil Our Reference: Your Reference Type of sample	UNITS ------------- ------------	30623-1 Pit 15/1.0-1.2 Soil	30623-2 Pit 17/1.0-1.2 Soil
Date prepared	-	10/07/2009	10/07/2009
Date analysed	-	10/07/2009	10/07/2009
pH 1:5 soil:water	pH Units	4.9	5.2
Chloride 1:5 soil:water	mg/kg	<100	<100
Sulphate, SO4 1:5 soil:water	mg/kg	51	<25
Electrical Conductivity 1:5 soil:water	μS/cm	39	65

ESP/CEC Our Reference: Your Reference Type of sample	UNITS ------------- ------------	30623-1 Pit 15/1.0-1.2 Soil	30623-2 Pit 17/1.0-1.2 Soil
Exchangeable Ca*	meq/100g	0.020	0.020
Exchangeable K*	meq/100g	0.13	0.19
Exchangeable Mg*	meq/100g	0.86	1.6
Exchangeable Na*	meq/100g	0.29	0.68
Cation Exchange Capacity*	meq/100g	1.3	2.5
ESP*	%	23.0	28.0

Method ID	Methodology Summary
LAB.1	pH - Measured using pH meter and electrode in accordance with APHA 20th ED, 4500-H+.
LAB.11	Chloride determined by argentometric titration.
LAB.9	Sulphate determined turbidimetrically.
LAB.2	Conductivity and Salinity - measured using a conductivity cell and dedicated meter, in accordance with APHA2510 20th ED and Rayment & Higginson.
Metals.23	Determination of exchangeable cations and cation exchange capacity in soil.

QUALITY CONTROL Miscellaneous Inorg - soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			10/7/09	[NT]	[NT]	LCS-1	10/7/09
Date analysed	-			10/7/09	[NT]	[NT]	LCS-1	10/7/09
pH 1:5 soil:water	pH Units		LAB.1	[NT]	[NT]	[NT]	LCS-1	101%
Chloride 1:5 soil:water	mg/kg	100	LAB.11	<100	[NT]	[NT]	LCS-1	100%
Sulphate, SO4 1:5 soil:water	mg/kg	25	LAB.9	<25	[NT]	[NT]	LCS-1	114%
Electrical Conductivity 1:5 soil:water	µS/cm	1	LAB.2	<1.0	[NT]	[NT]	LCS-1	102%

QUALITY CONTROL ESP/CEC	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Exchangeable Ca*	meq/100g	0.01	Metals.23	<0.01	[NT]	[NT]	LCS-1	107%
Exchangeable K*	meq/100g	0.01	Metals.23	<0.01	[NT]	[NT]	LCS-1	112%
Exchangeable Mg*	meq/100g	0.01	Metals.23	<0.01	[NT]	[NT]	LCS-1	104%
Exchangeable Na*	meq/100g	0.01	Metals.23	<0.01	[NT]	[NT]	LCS-1	97%
Cation Exchange Capacity*	meq/100g	1	Metals.23	<1.0	[NT]	[NT]	[NR]	[NR]
ESP*	%	1	Metals.23	<1.0	[NT]	[NT]	[NR]	[NR]

Report Comments:

Asbestos was analysed by Approved Identifier: Not applicable for this job

INS: Insufficient sample for this test NT: Not tested PQL: Practical Quantitation Limit <: Less than >: Greater than
RPD: Relative Percent Difference NA: Test not required LCS: Laboratory Control Sample NR: Not requested

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria:

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and speciated phenols is acceptable. Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and speciated phenols.

APPENDIX D

AGS Extract
CSIRO Publication

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	**1: CATASTROPHIC 200%**	**2: MAJOR 60%**	**3: MEDIUM 20%**	**4: MINOR 5%**	**5: INSIGNIFICANT 0.5%**
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	**Notional Boundary**					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

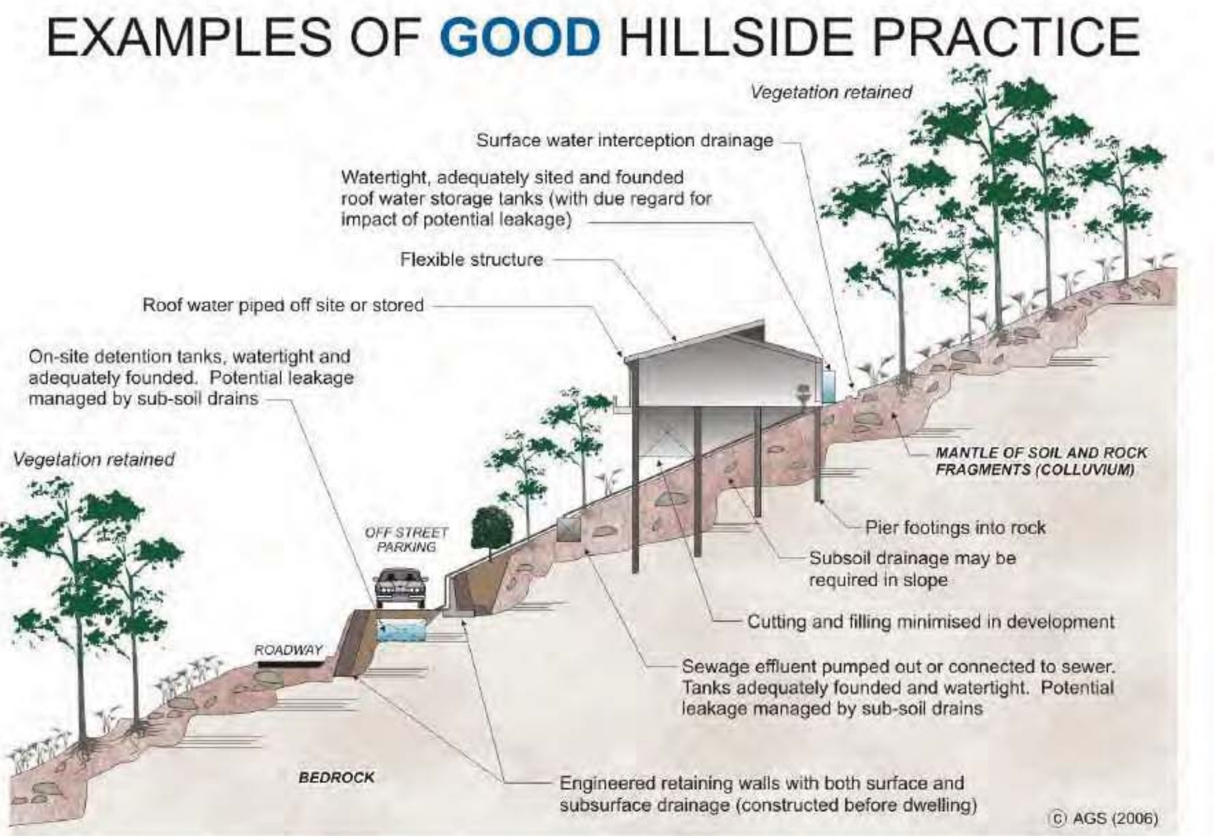
QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

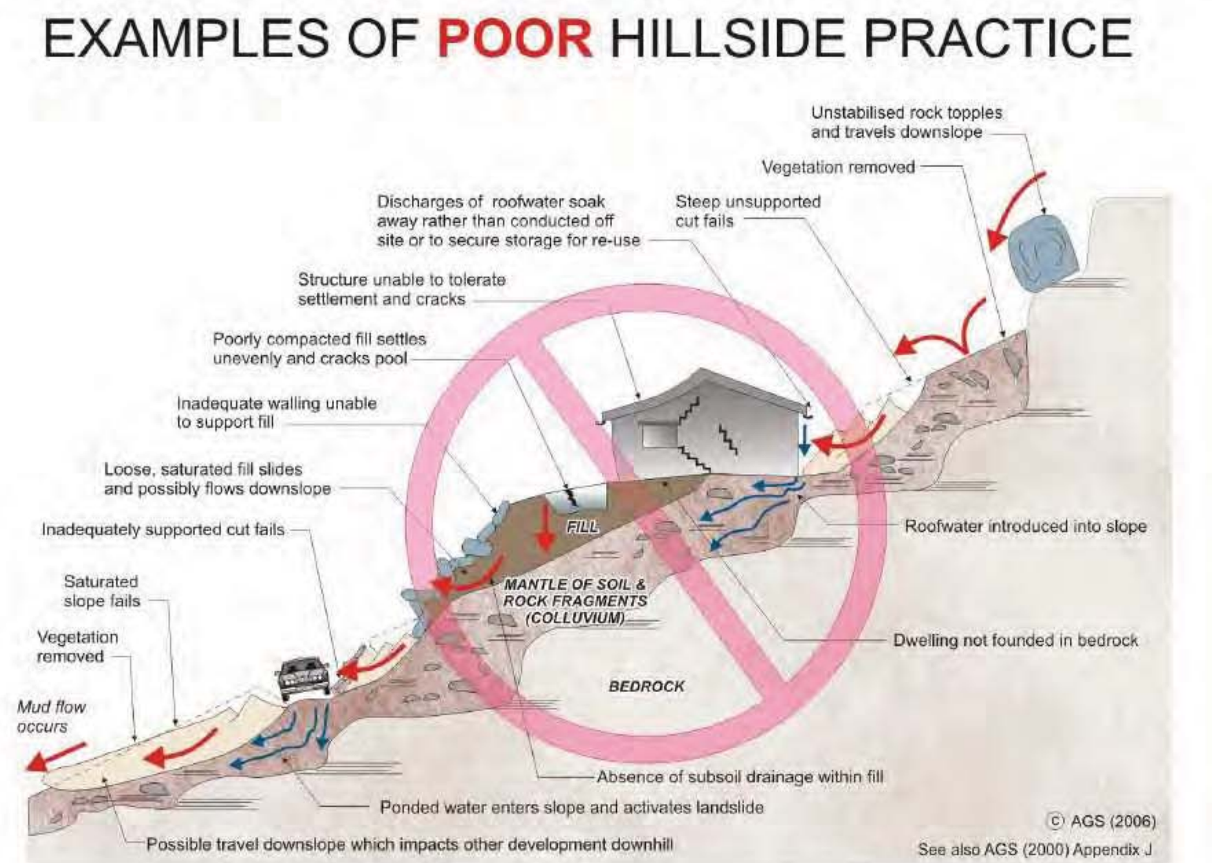
Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	**Notional Boundary**			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes:
(2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.
(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.
(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

APPENDIX G - SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	*POOR ENGINEERING PRACTICE*
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical practitioner 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.	Indiscriminatory 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.	


EXAMPLES OF GOOD HILLSIDE PRACTICE
Vegetation retained
Surface water interception drainage
Watertight, adequately sited and founded roof water storage tanks (with due regard for impact of potential leakage)
Flexible structure
Roof water piped off site or stored
On-site detention tanks, watertight and adequately founded. Potential leakage managed by sub-soil drains
Vegetation retained
OFF STREET PARKING
ROADWAY
MANTLE OF SOIL AND ROCK FRAGMENTS (COLLUVIUM)
Pier footings into rock
Subsoil drainage may be required in slope
Cutting and filling minimised in development
Sewage effluent pumped out or connected to sewer. Tanks adequately founded and watertight. Potential leakage managed by sub-soil drains
BEDROCK
Engineered retaining walls with both surface and subsurface drainage (constructed before dwelling)
© AGS (2006)


EXAMPLES OF POOR HILLSIDE PRACTICE
Unstabilised rock topples and travels downslope
Vegetation removed
Discharges of roofwater soak away rather than conducted off site or to secure storage for re-use
Steep unsupported cut fails
Structure unable to tolerate settlement and cracks
Poorly compacted fill settles unevenly and cracks pool
Inadequate walling unable to support fill
Loose, saturated fill slides and possibly flows downslope
Inadequately supported cut fails
FILL
Roofwater introduced into slope
Saturated slope fails
MANTLE OF SOIL & ROCK FRAGMENTS (COLLUVIUM)
Vegetation removed
Dwelling not founded in bedrock
BEDROCK
Mud flow occurs
Absence of subsoil drainage within fill
Ponded water enters slope and activates landslide
Possible travel downslope which impacts other development downhill
© AGS (2006)
See also AGS (2000) Appendix J

Foundation Maintenance and Footing Performance: A Homeowner's Guide

BTF 18 replaces Information Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction
There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion
All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation
This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil
All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure
This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

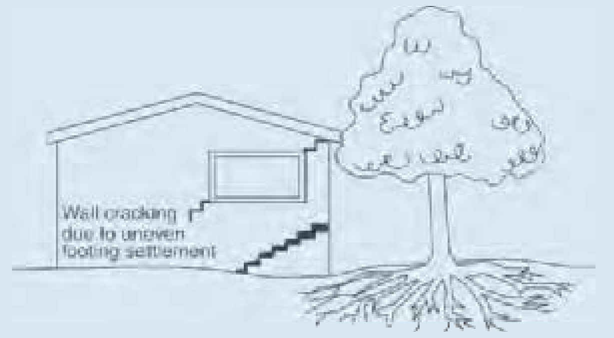
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

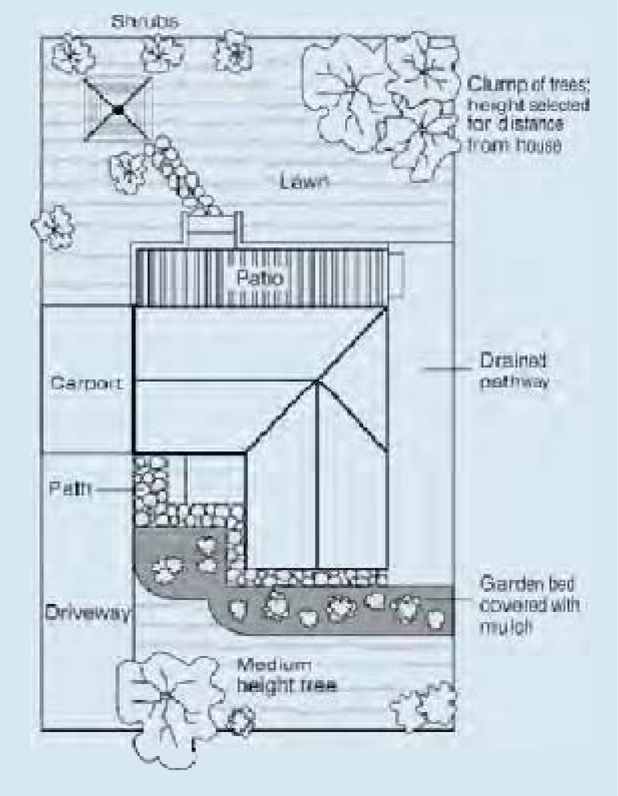
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation
In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden
The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees
Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs
State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation
Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

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