Appendix C

Urban Capability Assessment

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

EDGEWORTH LOCAL ENVIRONMENT PLAN

GEOLink Pty Ltd
Coffs Harbour

GEOTWARA20544AC-AC
7 November 2009

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SPECIALISTS MANAGING THE EARTH

7 November 2009

GEOLink Pty Ltd
PO Box 1446
COFFS HARBOUR NSW 2450

Attention: Simon Waterworth

Dear Simon

RE: EDGEWORTH LOCAL ENVIRONMENT PLAN

GEORGE BOOTH DRIVE, EDGEWORTH

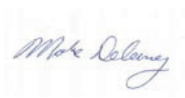
URBAN CAPABILITY ASSESSMENT - FINAL REPORT

Please find enclosed our report on geotechnical and Phase 1 contamination aspects of the proposed land development off George Booth Drive and Government Road, Edgeworth. The report discusses the geotechnical conditions found at the site and their significance to future development in terms of urban capability and recommends management guidelines and constraints regarding slope stability, salinity, contamination and extractive/mineral resources.

The findings of this preliminary assessment indicate that the site is appropriate for urban development in relation to the issues addressed herein. The report is aimed at a feasibility level for the purposes of planning and re-zoning for potential urban development. More detailed geotechnical work will be required for geotechnical design prior to construction once the layout of the proposed developments are known.

If you have any questions regarding this matter please contact Andrew Tait or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd



Mark Delaney

Principal Engineering Geologist

CONTENTS

CONTENTS

CONTENTS

CONTENTS

1 INTRODUCTION

This report presents the results of a geotechnical and phase 1 contamination urban capability assessment carried out by Coffey Geotechnics Pty Ltd (Coffey) as part of a Local Environmental Study on an area of approximately 95 ha located on the southern side of George Booth Drive, Edgeworth . The land is bordered by the George Booth Drive to the north, Government Road to the west and Nelson Street to the south.

The work was commissioned by Simon Waterworth on behalf of GEOLink Pty Ltd in a letter dated 11 April 2008 (Ref: 1062678).

The purpose of the work conducted by Coffey was to provide a report that would support a draft amendment to the Lake Macquarie Local Environment Plan (LMLEP2004) to rezone the lands for urban and conservation use, addressing geotechnical and contamination issues that might affect future development of the site. The assessment has therefore addressed the geotechnical capability of the land for urban development in relation to the following issues:

- Slope stability;
- Erosion characteristics and susceptibility to erosion;
- Salinity;
- General foundation conditions;
- Excavatability and presence of rock;
- General pavement subgrade and road construction conditions;
- Drainage and water table depth;
- Mine subsidence;
- Localised filling / dumping and contamination risk;
- Extractive resources.

2 SCOPE OF WORK AND METHODOLOGY

The urban capability assessment was based on a review of available data together with an appraisal of site conditions, soil types and site geology and a subsurface investigation. The work involved the following steps:

- Initial site visit and overall appraisal of site conditions;
- A broad subsurface investigation;
- Desk top study involving review of geological and topographical maps and aerial photographs, as well as reports on nearby sites held within Coffey archives together with review of available data from a range of other sources including Department Primary Industries and Mine Subsidence Board;
- Observation and mapping of any slope stability, drainage, seepage, groundwater;
- Observation and mapping of any erosion and/or scouring and the effect of existing erosion protection measures;

- Observation and mapping of any areas of site disturbance, filling or potential contamination;
- Mapping of exposures in road cuttings or other excavations to confirm rock types, soil depths and soil/rock characteristics;

3 FIELD WORK

Field work was carried out on 8 and 9 July 2008 and comprised of:

- 13 test pits (TP1 to TP13) excavated using a rubber tracked excavator, to depths of up to approximately 2m with samples taken within nominated materials for subsequent laboratory testing;
- Observation and mapping of relevant site features.

Engineering logs of the test pits together with explanation sheets defining the terms and symbols used in their preparation are enclosed in Appendix A. Test locations are shown on Figure 2. Test pits were located using hand held GPS to MGA co-ordinates and checked relative to existing site boundaries and features. Reduced levels of the boreholes have been interpolated from the survey plan provided to Australian Height Datum (AHD).

4 SITE CONDITIONS

4.1 Surface Conditions

Reference to the 1:25000 Wallsend Topographical Sheet, shows the site to be situated within moderately undulating topography with relief in the order of RL 60m to RL 20m AHD. The study area is dominated by a rounded ridgeline that trends north/ north west with a prominent rounded peak toward the middle of the area marking the highest point of the site.

A dendritic catchment is shown over the site with drainage directed toward Slatey Creek to the west and Crocked Hat Creek to the east. Both creeks feed into Cockle Creek, that inturn flows into the northern reaches of Lake Macquarie.

Populated residential urban areas are located to the immediate south of the site within Barnsley, to the north west of the site in Holmesville and to the north east of the site within Edgeworth/Cameron Park.

Topographically, the site is occupied by the aforementioned ridgeline with a series of broad convex spurs that splay out around the ridge. Drainage gullies situated between the spurs are typified by an incised rectilinear gully form toward the head of the gullies that become broad and convex in form toward the foot slopes of the site. The base of the gullies generally expose sandstone outcrop toward the mid to upper slopes with little scour erosion and no creep or slump features noted along the gully banks. Alluvial / colluvial deposits become thicker toward the footslopes of the area within the gullies, however soil depths area assessed to be minor (<1m) with silty to sandy soils noted as the major soil component.

Slopes are generally in the order of 8° to 10° toward the upper slopes of the site flattening to 5° to 8° toward the footslopes of the site. Steep slopes up to 25° are noted toward the crest/head of gullies over the site. It is assessed that these steep slopes are attributed to natural gully formation with no significant instability observed in these areas. Some minor undercutting and minor potential for block toppling instability were noted within these areas.

The site is predominantly moderately to densely timbered with mature eucalypt generally up to 10m in height with a sparse to moderate cover of undergrowth up to 1.5m high.

Drainage occurs by overland flow into a series of drainage gullies that encompass the site. Drainage is assessed to be good to very good over the majority of the site, with the exception of a portion of low lying land to the north west of the site shown as Domain E on Figure 2. Drainage in this area is directed overland into a channel that is aligned parallel to Government Road and drains to the south west toward Slatey Creek. Significant dispersive erosional features were noted within the drainage channel including near vertical scour erosion, undercutting of the bank and pronounced rill erosional features within the creek bank. An increase in tea tree and similar saline resistant vegetation is noted in this area. Drainage in this location is assessed to be fair to poor.

A spring with minor to moderate seepage out flow was noted toward the middle - western side of the ridgeline located within the middle to upper slopes of a drainage gully as shown on Figure 1. The groundwater at this location exhibited an ironstained brown/red colour with marshy vegetation occurring down slope from the spring area.

Three electrical transmission line easements traverse the site in a general north east alignment. Vegetation within these easements has been cleared and comprises mainly of a sparse to moderate cover of grass and low bushes. A former borrow/ quarry area is located toward the north of the site and is approximately 6m to 8m deep.

4.2 Subsurface Conditions

Reference to the 1:250000 Newcastle Coalfield Regional Geological Sheet, indicates that the site is underlain by the Boolaroo Subgroup of the Newcastle Coal Measures, Late Permian in age comprising of sandstone, conglomerate, siltstone, tuff and coal. Reference to the Newcastle Coalfield Surface Geology Sheet coupled with site mapping indicates that the elevated areas of the site are underlain by the Upper Pilot Seam with associated tuffaceous and siltstone inter – burden. The lower sections of the site (below RL 40m) are inferred to be underlain by predominantly sandstone rocks belonging to the Seahampton Sandstone Member of the Boolaroo Subgroup.

Reference to the Newcastle Soil Landscape Series Sheet 1:100000 indicate that the site is predominantly located within the Killingworth soil landscape variant. The landscape variant is characterised by rolling to steep hills with slope grades >20%. Soils associated with this soil landscape include yellow podzolic and yellow soloths on the crests and hill slopes. Bleached loams and lithosols are located on some crests. Such soils present geomorphologic limitations including high water erosion seasonal water logging, sodic and dispersible soils and very strongly acid soils of low fertility with high run-on and seasonal waterlogging, and are a potential foundation hazard.

A summary of geotechnical units encountered over the site is presented in Table 1 with the distribution of the geotechnical units as encountered in the test pits presented in Table 2.

TABLE 1 - SUMMARY OF GEOLOGICAL UNITS

GEOLOGICAL UNIT	SOIL/ROCK TYPE	MATERIAL DESCRIPTION
UNIT 1	TOPSOIL/SLOPE WASH	Gravelly Silty SAND, fine to coarse grained, brown low plasticity fines, fine to medium grained silt, sub-rounded gravel with some rootlets.
UNIT 2	COLLUVIUM	Sandy CLAY, low to high plasticity, grey, mottled grey/orange, fine to medium grained sand.
UNIT 3	RESIDUAL	Sandy CLAY/ CLAY/ Clayey SAND, medium to high plasticity fines, grey brown mottled orange, fine to medium grained sand, moisture content greater than plastic limit and a very stiff to hard consistency.
UNIT 4A	EXTREMELY WEATHERED SANDSTONE	Clayey SAND, fine to medium grained, low to medium plasticity fines, mottled orange/grey
UNIT 4B	EXTREMELY WEATHERED SILTSTONE	Clayey Sandy GRAVEL, fine to coarse siltstone gravel, fine to coarse grained sand, low plasticity fines, grey.
UNIT 4C	EXTREMELY WEATHERED TUFF	CLAY, medium to high plasticity, pale grey/ white
UNIT 4D	EXTREMELY WEATHERED COAL	CLAY, low to medium plasticity, black.
UNIT 5A	HIGHLY WEATHERED SANDSTONE	Fine to medium grained, thin subhorizontal bedding, orange / pale grey. estimated low to medium strength
UNIT 5B	HIGHLY WEATHERED SILTSTONE	Sub horizontal bedding, some fine sandstone lenses, grey, estimated very low to low strength.

TEST PIT (Surface Level mAHD)	DEPTH OF GEOTECHNICAL UNIT ENCOUNTERED BELOW GROUND SURFACE LEVEL (m)								
	UNIT 1 Topsoil	UNIT 2 Colluvium	UNIT 3 Residual	UNIT 4A XW Sandstone	UNIT 4B XW Siltstone	UNIT 4C XW Tuff	UNIT 4D XW Coal	UNIT 5A HW Sandstone	UNIT 5B HW Siltstone
TP1 (24.70)	0.00 – 0.20	-	0.20 – 0.50	0.50 – 0.70	-	-	-	0.70 – 0.90R	
TP2 (24.70)	0.00 – 0.10	0.10 – 0.40	0.40 - > 2.00	-		-	-	-	
TP3 (20.70)	0.00 – 0.10	0.10 – 1.40	1.40 - >2.00	-	-	-	-	-	
TP4 (21.20)	0.00 – 0.20	-	0.20 – 0.60	-	0.60 – 0.70	-	-	-	0.70 - > 0.80
TP5 (23.35)	0.00 – 0.20	-	0.20 - 1.00	-	1.00 – 1.30	1.50 - >2.00	1.30 – 1.50	-	
TP6 (25.20)	0.00 – 0.30	-	0.30 - >2.00	-	-	-	-	-	
TP7 (44.40)	0.00 – 0.20	-	-	0.20 – 0.30	-	-	-	0.30 – 0.50R	
TP8 (24.20)	0.00 – 0.30	-	0.30 - >2.00	-	-	-	-	-	
TP9 (30.20)	0.00 – 0.20	-	0.20 – 1.30	1.30 - >1.40	-	-	-	-	
TP10 (23.80)	0.00 – 0.30	-	0.30 – 0.70	-	-	-	-	0.70 – 0.80R	
TP11 (36.50)	0.00 – 0.35	-	-	-	1.10 – 1.20 1.60 – 1.70	0.50 – 1.10 1.90 - >2.10	1.20 – 1.60 1.70 – 1.90	0.35 – 0.50	
TP12 (24.30)	0.00 – 0.30	-	0.30 – 1.40	-	-	1.80 – 2.10	1.40 – 1.80	-	
TP13 (31.60)	0.00 – 0.30	0.30 – 0.50	0.50 – 0.70	-	0.70 – 0.80	-	-	-	

Investigations and mapping show that the site is underlain by a series of sedimentary units that are generally sub horizontally bedded. Mapping indicated an overall bedding dip of 5° to 10° dipping toward the south west. Archival mining plans held by Coffey indicate regional dip toward the southwest of 2° to 5°. Distinct structural lineation mapped over the site, comprising of mainly sub vertical jointing indicate a north west trend, with more indistinct joints generally occurring perpendicular to this trend. The soil cover over the site increases to 1.5m to 2.0m toward the footslopes of the site, generally below RL 30m. Above this level the profile is generally limited to a thin cover of poorly developed gravelly clays (<0.5m) overlying highly weathered rock of estimated low to medium strength.

4.3 Groundwater

No groundwater seepage was encountered within the test pits during the limited time they remained open. Groundwater seepage was noted within a gully on the western side of the ridgeline at approximate RL 35m AHD and it is considered that this is associated with subcrop of a coal seam.

Depth to the water table is variable due to rainfall or other similar factors, the influence of which may not have been apparent at the time of field work. The field investigation was conducted following a period of heavy rain and water was observed to be ponding in the eastern area of the site which is considered to be in a slight low lying gully.

The depth to the regional groundwater table beneath the site is expected to be in the order of 5m or less over the lower western and eastern parts of the site increasing to in the order of 10m to 15m below the central hillside knoll, where natural mounding of the groundwater surface is expected to occur due to infiltration recharge. Localised groundwater seepages are likely to occur at subcrop of coal seams, as the occurrence of lateral seepage along coal seams is a common phenomenon in the Newcastle and Lake Macquarie region.

4.4 Geotechnical Domains

The proposed development has been divided into a series of geotechnical domains based on the limited subsurface investigation and likely surface and subsurface conditions. Due to the size of the site, the classification into geotechnical domains are broad and based on the extent that conditions will impact on potential development. The geotechnical units are defined in Table 3 and delineated over the site as shown in Figure 2.

TABLE 3 - GEOTECHNICAL UNITS

	DOMAIN A	DOMAIN B	DOMAIN C	DOMAIN D	DOMAIN E
SETTING	Ridge tops and crests	Mid-slope areas on flanks of undulating the ridgeline and spurs	Footslopes of the site broadly undulating areas uniform slope profile	Upper slopes and crests of gully areas	Low lying area of the site,
SLOPE	0 – 2°	8 – 10°	2° – 5°	20° – 25°	<2°
GEOLOGY	Weathered Sandstone and Tuff (Lower Croudace Bay Formation)	Weathered Sandstone/ Siltstone/ tuff and coal) (Upper Pilot Seam and associated inter-burden)	Weathered Sandstone/ Siltstone (Seahampton Sandstone Member)	Predominantly weathered sandstone	Weathered Sandstone/ Siltstone (Seahampton Sandstone Member)
SOIL TYPE	Thin topsoil layer overlying highly weathered rock	Residual Clays with deposits on the lower slopes	Residual Clays on upper slopes with a thin colluvial layer on the lower slopes	Thin sandy topsoil overlying highly weathered sandstone,	Colluvial clays overlying residual clays
ESTIMATED SOIL DEPTH	<0.5m	0.5m – 1m	1m – 1.5m	<0.5m	1.5m - >2m
DRAINAGE	Well drained by runoff	Well drained by runoff	Well drained by runoff	Some wet areas adjacent to spring features	Some wet areas during prolonged rainfall
EROSION	Some minor rill erosion	Some minor rill erosion on slopes	No significant erosion	Minor erosion in gully floor	Significant dispersive erosion within channel banks
CONSTRAINTS	Difficult excavation conditions in rock	Difficult excavation conditions in rock	Potentially wet subgrade conditions. Moderately to highly reactive soils	Potential for block instability, along steep rock exposures, difficult construction conditions on steep slopes.	Potentially silty moisture sensitive soils, water logged,

4.5 LABORATORY TESTING

Samples obtained during the field investigations were returned to Coffey's NATA registered Newcastle Laboratory for testing. The testing program comprised of:

- Six Emerson Crumb Dispersion tests;
- Nine exchangeable cations tests;
- Eight pH and electric conductivity (EC) tests;
- Four shrink swell index tests.

The results of the laboratory testing are presented in Appendix B and summarised/discussed in Section 5.

5 FACTORS AFFECTING DEVELOPMENT

5.1 Slope Stability Assessment

5.1.1 Basis of Assessment

The risk of slope instability has been assessed from the observed site conditions in accordance with the classification system formulated by the Australian Geomechanics Society and published in *'Australian Geomechanics News, Number 10, 1985'* (see Attachment 1: Classification of Risk of Slope Instability, for explanation of risk categories and implications for development).

The report provides an assessment of the risk of slope instability on the proposed land development area. The report also recommends some geotechnical constraints for the site development in light of the assessed risk of slope instability. The onus is on the owner, potential owner, or interested party to decide whether the assessed level of risk is acceptable taking into account the likely economic consequences of the risk and the recommended geotechnical constraints.

This report should not be regarded as a site investigation report for the design of foundations, although general recommendations regarding foundation types have been made.

5.1.2 Evidence of Slope Instability

No evidence of overall slope instability was observed on the site at the time of field work. Localised minor erosion and scouring was observed along creek banks. Minor potential toppling instability was noted with exposed steep sandstone outcrops toward the heads of gullies. These were generally typified by small tabular boulders/cobbles (up to 0.5m in dimension) that had detached from the greater rockmass along weathered open joints. It is assessed that this localised feature is more associated with erosion and does not pose a risk to slope stability at the site.

5.1.3 Assessed Risk of Slope Instability

Slope stability is controlled by slope angle, material strength, subsoil profile and surface and subsurface water concentration. The risk of slope instability for has been based on the site observations recorded in Section 4 and Table 3. On the basis of these site features, the geotechnical units have been assigned a slope instability risk in accordance with the classification system in Attachment 1. The risk of slope instability for the geotechnical units is summarised in Table 4.

TABLE 4 - ASSESSED GEOTECHNICAL RISK OF SLOPE INSTABILITY

GEOTECHNICAL DOMAIN	ASSESSED INSTABILITY RISK CLASSIFICATION	COMMENT
A	Low	No specific constraints. General constraints and recommendations of this report would apply.
B	Low	Design development to accommodate slope profile. Minimise disturbance to slopes.
C	Low	Development in low undulating areas should minimise disturbance to slopes and general constraints and recommendations in this report would apply.
D	Medium	Development toward the head/crest of incised gullies should minimise disturbance to slopes, especially enhancing any potential rock toppling failure, general constraints and recommendations in this report would apply most notably adequate drainage measures and sound engineering filling procedure.
E	Low	Development in low near level areas should minimise disturbance to slopes. Colluvial soils should not be used for structural fill/ embankment unless treated accordingly. General constraints and recommendations in this report would apply.

Based on the slope instability risk levels presented in Table 4, the site is suitable for urban development and it would be normal practice in the Lake Macquarie area for urban development to occur under these risk levels.

5.2 Extractive and Mineral Resources

Consultation with the Department of Primary industries indicated that the extractive or mineral leases over the site include:

- Petroleum and Gas lease PEL 267, Sydney Gas Operations, expires January 2012;
- Consolidated Coal Lease 725, West Wallsend Colliery owned by Oceanic Coal Pty Ltd expires September 2010.

No existing quarry leases or applications were noted from the search. The subsurface investigation conducted at the site did not reveal any substantial economic quarry resource such as potential aggregate for concrete or road base manufacture or potential deep clay deposits for masonry or construction purposes. Previous quarrying operations have been noted toward the north of the site, however no documentation of this operation has been found with the DPI or land titles search. It is assessed that the quarry was likely used as a borrow area for general fill, possibly in operation during the 1970's (assessed from aerial photo chronology).

Database research within DPI archives show that coal exploration investigation was carried out in the study area vicinity within the Holmesville / Barnsley locality during the 1950's. Summaries of these reports suggest that open cut mining of the Australasian Seam in this area would be uneconomical due to the inferior quality of the coal. It is generally accepted that the Upper Pilot Seam (outcrops over the site) is of inferior coal quality and has not been extensively mined over the Newcastle area and does not constitute an economical mining target.

5.3 Mine Subsidence

Enquiries made with the Lake Macquarie section of the Mine Subsidence Board (MSB) reveal that the site was undermined by West Wallsend Colliery. It is understood that long wall mining panels five to ten were extracted from beneath the site between 1991 and 1995. It is understood that mining was conducted at an approximate depth of 190m to 235m below the existing surface level within the Borehole seam. Discussions with the MSB indicate that further mining is unlikely beneath the proposed study area. It is assessed from previous mine subsidence studies conducted in Newcastle, that this depth of cover would be adequate for construction residential development without restrictions being imposed by the MSB.

As the site occurs within a proclaimed Mine Subsidence District, the MSB is a consenting authority and approval for all development will be required. The MSB can impose restrictions or not provide consent for development on the basis of subsidence constraints and as such early consultation should be sought for any proposed development. Plans and details for any proposed development should be supplied to the DPI Minerals and the Leaseholder to assess impact if any future underground mining is proposed (unlikely).

5.4 Urban Salinity, Sodicity and Erosion

The salinity assessment described herein has been undertaken by means of a Site and Soil Evaluation (SSE) conducted in accordance with *Site Investigations for Urban Salinity* (DLWC, 2002).

5.4.1 Background Information

All soils in Australia contain variable quantities of salts, generally in the lower soil profile or weathered soil region. Most of the salts are in relatively deep sinks and aquifers and out of reach to cause damage to most plants or infrastructure.

Urban salinity is caused by the mobilisation of salts in the soil profile by surface water or groundwater. Salts naturally occur in soil from sources such as weathering of rock and soil, soils formed on old sea beds, salt lakes or other saline soils, or from the ocean via wind and rain.

When the water table rises close to the surface, it carries dissolved salts that are normally locked in the soil and rock profile to the surface.

5.4.2 Significance of Urban Salinity

Development of bushland for urban use can change the movement of surface and groundwater resulting in a change in the way salts and other minerals interact.

High salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive soil conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works. Thus, the management, design and construction of urban developments must take into consideration the impacts of salinity.

The impact of salts is not only related to the amount of salt and water present, but is also associated with the types of salts or cations (positively charged ions) present in the soil, the chemical and physical reactions with building materials and the amount of wetting and drying occurring (DLWC, 2002).

5.4.3 Soil Erodibility / Dispersivity

Dispersible soils greatly limit water movement through the soil, resulting in poor drainage and waterlogging. The Emerson Aggregate Class is used as a general guide to sodicity and dispersibility of a soil; however dispersion is also influenced by factors such as soil type, exchangeable cations, salinity and sodicity.

Emerson Aggregate Class numbers were determined as an indicator for sodicity / salinity of on-site soils. The results of laboratory testing are presented in Appendix B and summarised in Table 5.

TABLE 5 - SUMMARY OF EMERSON CLASS NUMBER AND SODICITY RATING

TEST PIT LOCATION	SAMPLE DEPTH (m)	EMERSON AGGREGATE CLASS	SODICITY RATING [1]
TP1	0.40 – 0.50	5	Unlikely to be sodic
TP2	0.10 – 0.20	5	Unlikely to be sodic
TP3	0.3 – 0.4	2	May be sodic
TP6	0.3 – 0.6	5	Unlikely to be sodic
TP9	0.40 – 0.60	5	Unlikely to be sodic
TP12	0.40 – 0.80	2	May be sodic
TP13	0.30 – 0.60	5	Unlikely to be sodic
NOTE: [1]Adapted from Hazelton & Murphy, 1992 (Reference 2)			

Based on the results of laboratory testing, and reference to Hazelton & Murphy (1992), the majority of soils over the site are unlikely to be sodic or dispersive based on Emerson Aggregate Class numbers. Colluvial soils within the lower lying Domain E terrain unit may be sodic and show increased susceptibility to erosion. This can be addressed by adopting approximate soil and erosion treatment measures during development including treatment of sodic and dispersive soils by the addition of gypsum.

5.4.4 Salinity of Soil Profiles

Salinity is determined by the electrical conductivity (EC) of a soil water extract corrected for texture. As the concentration of salt increases, the EC increases because salt separates into positively and negatively charged ions when dissolved in water.

The laboratory test results used to assess the salinity of the soil profile are presented in Table 6.

TABLE 6 - SUMMARY OF SALINITY TEST RESULTS AND SOIL SALINITY CLASSES

SAMPLE LOCATION	DEPTH (m)	pH	EC (1:5) (ds/m)	EC_e [1] (ds/m)	SOIL TEXTURAL CLASSIFICATION	SOIL SALINITY CLASS [2]
TP1	0.4 – 0.5	6.3	0.034	0.238	Medium clay	Non – saline
TP2	0.1 – 0.2	6.5	0.022	0.242	Sandy loam	Non – saline
TP3	0.3 – 0.4	6.3	0.300	2.1	Medium clay	Slight – saline

SAMPLE LOCATION	DEPTH (m)	pH	EC (1:5) (ds/m)	EC_e [1] (ds/m)	SOIL TEXTURAL CLASSIFICATION	SOIL SALINITY CLASS [2]
TP5	0.6 – 0.7	5.3	0.390	2.7	Medium clay	Slight – saline
TP6	0.3 – 0.6	6.5	0.024	0.14	Heavy Clay	Non – saline
TP9	0.4 – 0.6	5.6	0.069	0.48	Heavy Clay	Non – saline
TP11	0.5 – 0.8	5.2	0.480	2.88	Heavy Clay	Slight – saline
TP12	0.4 – 0.8	6.4	2.200	13.2	Heavy Clay	Highly Saline
TP13	0.3 – 0.6	5.7	0.450	3.6	Light Clay	Slight – saline

NOTE:

[1] Calculated using Table 6.1 from Ref.1.

[2] Salinity classes were obtained from Table 6.2 in Ref.1.

A saline soil is defined as a soil that contains sufficient soluble salt to adversely affect plant growth and / or land use. Reference to the Department of Land and Water Conservation Salinity Guidelines (2002) indicates that a soil with an ECe of 4 dS/m is considered saline, as it is the level at which many crops are affected.

As shown by the results in Table 2, urban salinity is unlikely to be an issue on this site. One sample indicates high saline properties, however vegetation in the vicinity of this test pit (TP12) was moderately dense and did not appear to be showing detrimental effects due to saline soils (dying off, wilting). The majority of samples tested were characterised by an ECe of <4 dS/m.

5.4.5 Sodicity and Cation Exchange Capacity of Soil Profiles

The Emerson Aggregate Class is used as a general guide to sodicity and dispersibility of a soil. As discussed in Section 5.4.3, the majority of soils over the site are unlikely to be dispersive (sodic) based on Emerson Aggregate Class numbers.

Cation Exchange Capacity (CEC) is required to accurately assess soil sodicity. Cation Exchange Capacity (CEC) is the capacity of the soil to hold and exchange positively charged cations, such as sodium, calcium, magnesium and potassium, and thus is a major controlling agent of the stability of a soils structure.

When wet, sodic soils lose their structure and disperse into very small particles that fill pore spaces and create an impermeable layer that can severely impede water movement through the soil profile. Thus, dispersible soils often result in poor drainage and waterlogging.

The sodicity of a soil is expressed as the amount of exchangeable sodium as a percentage of the cation exchange capacity (or ESP%). It relates to the likely dispersion of the soil on wetting, and the shrink/swell properties of a soil (DLWC, 2002).

The laboratory test results used to assess the sodicity of the soil profile are presented in Table 7.

TABLE 7 – EXCHANGEABLE BASE CATION CONCENTRATIONS AND SODICITY RATING

SAMPLE LOCATION	DEPTH (m)	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	CATION EXCHANGE CAPACITY	ESP%	SODICITY RATING
		CONCENTRATIONS (mg/kg)				Meq%		
TP1	0.4 – 0.5	96	730	200	330	8.2	10.6	Sodic
TP3	0.3 – 0.4	20	1000	940	210	13	31.5	Sodic
TP6	0.3 – 0.6	30	460	190	180	5.2	16.0	Sodic
TP12	0.4 – 0.8	28	2200	5400	640	43	53.5	Strongly Sodic
TP13	0.3 – 0.6	30	1300	110	350	12	4	Non Sodic

The sodicity ratings presented in Table 7 were obtained from Site Investigations for Urban Salinity (DLWC, 2002).

5.4.6 Summary of Testing

Based on the results of laboratory testing, the site soils are considered to be slightly sodic to sodic and non to partially dispersive. Sodic soils are assessed to be more prominent toward the low lying areas of the site (Domain E). Erosional features such as rill channels and steep undercut creek banks were noted in this area. While sodicity has no direct impact on salinity, the dispersive nature of the soils will have an effect on the erodibility of the site soils in this area.

Site management strategies must be designed to minimise the effects of altered water and salt movement. To limit erosion of sodic soils on the site, the development strategy should include sediment and erosion control plans that take into account saline and sodic soils.

It is also recommended that liming or addition of gypsum of the soil be undertaken to improve the stability of the soil structure, thus minimising the potential for dispersion.

Sandy soils and acid soils that have been leached often have very low levels of exchangeable calcium and magnesium that limits plant growth. The results as shown in Table 7 indicate low levels of exchangeable calcium. A ratio of exchangeable calcium to exchangeable magnesium of less than 2 is thought to favour clay dispersion. The addition of lime will increase the concentration of calcium in the soil structure that should promote plant growth and minimise dispersion, thus assisting the management of Urban Salinity on the site. The desirable proportion of the calcium in a soil to support plant growth is equivalent to 65-80% of the total Cation Exchange Capacity (CEC).

5.4.7 Management of Salinity

Provided site management strategies are designed to minimise the effects of altered water and salt movement, salinity is not likely to have a significant impact on the proposed land development. The main concern on the site is the possibility of a rising water table in the lower–lying areas and it is possible that urban salinity effects will be experienced on the site if the water table is allowed to rise. Development that maintains existing drainage patterns across the site will help negate rising water table effects. It is recommended that some further salinity assessment be undertaken to comply with the DLWC salinity assessment guidelines, prior to construction. Further assessment should be targeted at the lower lying areas of the site (Domain E).

Urban Salinity has the potential to adversely affect residential footings and road pavements. It is therefore recommended that some further sampling be undertaken across the proposed residential area to confirm the assumptions of this preliminary report. In addition to the laboratory testing undertaken for this investigation, aggressivity or corrosivity testing can be used to assess the exposure classification of concrete and steel structural elements in accordance with AS2159-1996.

5.4.8 Management of Erosion

Soil erosion during and after construction on the site will require careful management. Levels of erosion should be able to be maintained within normally acceptable levels by adopting good soil erosion and sedimentation control practices, including:

- Plan for soil and water management concurrently with engineering design and in advance of any earthworks;
- Minimise the area and duration of soil exposure by staged development and controlled clearing;
- Stockpile stripped soil for reuse and protect from erosion;
- Control stormwater run-off by diverting clean run-off from denuded areas, minimising slope gradient, length and run-off velocities;
- Trap soil and water pollutants using silt traps, sediment basins, perimeter banks, silt fences and nutrient traps as appropriate;
- Promote regeneration of native vegetation in gullies and on steep slopes (>10°) and in areas previously cleared;
- Quick rehabilitation of disturbed areas.

All personnel on the site involved with earthworks, land clearing or construction should be made fully aware of the issues associated with Urban Salinity. Sediment and erosion control plans must take into account saline and sodic soils.

5.4.9 Management of Site Drainage

Adequate surface and stormwater drainage should be installed and maintained on the building site. The site has low-lying areas and is, in parts, poorly drained (wet ground), most notably within the Domain E area toward the western boundary..

Dispersible soils greatly limit water movement through the soil, resulting in poor drainage and waterlogging. To limit water logging, and rising water table, the following principles should be considered in development of the site:

- Planting of deep rooted native trees to prevent rising of the water table in the gullies;
- Retaining or planting native vegetation where possible;
- Treating potentially sodic soils with gypsum before landscaping;
- Designing storm water detention ponds and water features to reduce infiltration;
- Minimising soils disturbance, including reduced cut and fill;
- Improving or maintaining drainage around gully regions or natural drainage paths.

5.5 Acid Sulphate Soils

5.5.1 Background Information

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

Pyritic soils typically form as waterlogged, saline sediments rich in iron and sulphate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 5m AHD. They can also form as bottom sediments in coastal rivers and creeks.

Pyritic soils of concern on low lying NSW and coastal lands have mostly formed in the Holocene period (ie: 10,000 years ago to present day), predominantly in the 7000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene (ie: >10,000 years ago) would have already oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen.

5.5.2 Significance of ASS

Disturbance or poorly managed development and use of acid sulphate soils can generate significant amounts of sulphuric acid, which can lower soil and water pH to extreme levels (generally <4) and produce acid soils, resulting in high salinity.

The low pH, high salinity soils can reduce or altogether preclude vegetation growth and can produce aggressive conditions which may be detrimental to concrete and steel components of structures, foundations, pipelines and other engineering works.

Generation of acid conditions often releases aluminium, iron and other naturally occurring elements from the otherwise stable soil matrices. High concentrations of some such elements, coupled with low pH and alterations to salinity can be detrimental to aquatic life. In severe cases, affected waters flowing off site into aquatic ecosystems can have a detrimental effect on those aquatic ecosystems.

5.5.3 Acid Sulphate Soils Risk Map

Reference to the 1:25000 Wallsend Acid Sulfate Risk Map, indicates that the subject area contains no known occurrence of Acid Sulphate Soils. The presence of stiff to hard residual soils weathered in place and derived from rocks with a Permian age of deposition (250Ma) underlying the investigation site combined with the lowest elevation onsite of approximately RL20m AHD suggests the occurrence of acid sulfate soils at the site is highly unlikely and an acid sulfate management plan will not be required.

6 PHASE 1 ENVIRONMENTAL SITE ASSESSMENT

6.1 Phase 1 Investigation Objectives

The objectives of the Phase 1 ESA was to identify potentially contaminating past and present activities at the site, provide a preliminary assessment of site contamination, and provide recommendations for further assessment, if considered appropriate.

These objectives will be achieved by carrying out preliminary non-intrusive review activities, such as review of aerial photographs, site walkover, record searches, and interviews with long term site employees or residents in the immediate area (if available).

The work was carried out with reference to the following guidelines:

- NSW EPA Guidelines for Consultants Reporting on Contaminated Sites, 1997;
- NSW DEC Guidelines for the NSW Site Auditor Scheme (2nd ed), 2006;
- DUAP EPA Managing Land Contamination Planning Guidelines, SEPP 55 – Remediation of Land, 1998.

6.2 Background Information

6.2.1 Site Description

The site comprises five lots: Lot 88 DP 755262 (Lot 88); Lot 107 DP 1000408 (Lot 107); Lot 17 DP 849003 (Lot 17); Lot 6 DP 4647 (Lot 6); and Lot 7 DP 4647 (Lot 7). The site is located in the Local Government Area of Lake Macquarie, Parish of Teralba and County of Northumberland. The total site area is approximately 95 hectares.

The surrounding land appears to comprise of bushland and residential properties. The majority of the site is bushland, with the exception of a former quarry and two residential lots on the western side.

6.2.2 Environmental Site Observations

The site comprises three distinct areas: the largest part of the site is bushland; a second part of the site comprises of an old quarry which appears to have been partially filled in; and a third part of the site is rural/residential in use. The approximate extent of these areas is shown on Figure 3. Selected photographs of the site are presented in Appendix E.

Bushland Area

The bushland part of the site is generally undeveloped, and covered with mature trees, bushes and grasses. There are three power line corridors intersecting the site which have been cleared of most vegetation. These generally run in a southwest to northeast direction. There are numerous tracks throughout the bushland, none of which appear to have been deliberately cut.

Rubbish and general household waste has generally been dumped in scattered, isolated locations throughout the bushland. An area on the northeast of the site, where two power line corridors intersect with George Booth Drive, appears to be used for dumping of rubbish on a regular basis. During the site walkover a water truck was observed to be dumping an unknown quantity of liquid in this area. The person operating the truck indicated that the liquid was water from Telstra pits.

The rubbish comprises mostly of domestic household type waste, and included cardboard boxes, tyres, metal sheets, hose pieces, foam, carpet, vacuum cleaners, computer, televisions and stereo parts, furniture, clothes, and toys. There are some piles of demolition type waste, such as concrete, however these are generally rare. Three burnt out cars were also observed, but it is possible more are scattered throughout the site.

Quarry Area

The quarry area is located in approximately the centre of the northern boundary. The quarry was formerly used to quarry sandstone. It appears to have been partially filled. There was no evidence of machinery, or areas where machinery may have been kept or maintained.

There was a lot of rubbish dumped in the quarry area, and the roads leading into it are well cleared, indicating that the area is probably regularly used for illegal dumping. The rubbish comprised some domestic household type waste similar to the rubbish in the bushland area, however there is quite a lot of demolition type waste such as concrete rubble, roof tiles, and metal sheets. An old air filter was also observed. There was an odour in the quarry area, which is likely to be emanating from the dumped rubbish.

Rural/Residential Area

The rural/residential area is located on the northwestern side of the site. It comprises two lots of land, Lot 6 and Lot 7. During the site walkover two residences were observed, one on each lot. The lots were also used to agist horses, and there were sheds which appears to be associated with the horse agisting. These appeared to be timber framed and metal clad. Two small grain silos were also observed on one of the lots.

Government Road runs along the front of these residential blocks, and extends up to the northwestern corner of the whole site area. The northern part of Government Road is bitumen paved, however it becomes a gravel road near the residences. Bitumen was noted to have been sprayed along the eastern edge of the gravel road.

6.2.3 Hydrology

Slatey Creek is located approximately 350m southeast of the site. It is expected that groundwater from the site would flow towards Slatey Creek.

A search of the NSW Department of Water and Energy (NSW DWE) groundwater bore information indicated that there were no groundwater bores registered within 1km of the site. The NSW DWE indicated that the nearest bore was approximately 2km from the site, but no information was provided on this bore.

Information from the geotechnical test pits indicates that groundwater was not encountered. The likely levels across the site are discussed in Section 4.3 Groundwater.

The topography and geology of the site are further discussed in Section 4.

6.3 Site History

6.3.1 Historical Information

NSW WorkCover Dangerous Goods Records

A search of the Stored Chemical Information Database and microfiche records held by NSW WorkCover has been carried out for Lot 6 (23 Government Drive), Lot 17 (George Booth Drive), Lot 88 (40 Carinda Ave), and Lot 107 (2 Cologne Close) which comprise the majority part of the site. The search did not locate records pertaining to the lots.

To date, no authorisation letter has been provided to carry out a search for Lot 7 which comprises on of the residential lots.

Lake Macquarie City Council Records

A search of the Lake Macquarie City Council (Council) records was carried out. We have viewed information on the property files for Lot 6 and Lot 7 which are both residential lots.

The results of the search for Lot 6 identified a letter dated 9 May 1994 from the site owner allowing Council to dump surplus fill on the lot. The letter indicates the fill would come from road and drainage construction and would comprise approximately 1000m^3 in volume. It is not known if this fill was actually placed on the lot. Another letter dated 11 March 1980 indicates that sullage waste water was not being disposed of correctly and requesting that measures be taken so that the waste water can be disposed of appropriately.

The results for the search of Lot 7 identified information dating from 22 December 1999 to 30 December 2003 relating to the onsite sewage treatment plant which comprises a septic system.

NSW EPA Notices

A check of the NSW EPA website for notices issued under the Environmentally Hazardous Chemicals Act (1985) and the Contaminated Land Management Act (1997) was carried out on 11 August 2008. The check indicated that there are no notices for properties near the site.

6.3.2 Land Titles Search

The site is comprised of five lots: Lot 88 DP 755262 (Lot 88); Lot 107 DP 1000408 (Lot 107); Lot 17 DP 849003 (Lot 17); Lot 6 DP 4647 (Lot 6) and Lot 7 DP 4647 (Lot 7).

Lot 88 comprises an approximately 8,000m^2 area on the eastern side of the site. Lot 88 has been owned by the Council of Education from 1870 to 1989, and Minister for Education from 1989 to 2001. In 2001 Hammersmith Management Pty Limited purchased the lot.

Lot 107 comprises the largest portion of the site. Up until 1999, Lot 107 comprised of two different lots. However the owners of these lots appear to have been similar since they were granted in 1913. In general Lot 107 has been owned by coal mining companies from 1913 to 2000. In 2000 the site was purchased by Hammersmith Management Pty Limited.

Lot 17 has been owned by various government road, public transport or transport authorities from 1914 to today.

Lot 6 has been owned by private individuals from 1906 to today. The occupations of these individuals include wife of miner (1906 to 1935), wife of constable and wife of poultry farmer (1935 to 1947), miner (1947 to 1958), storekeeper (1958 to 1959), ice vendor (1959 to 1963), contractor (1963 to 1966), crane driver (1966 to 1986), widow (1986 to 1989), and solicitor (1993 to 1993). No records of the occupations of the owners have been kept from 1993 onwards. The lot is currently owned by Mr Lawrence Mernagh.

Lot 7 has been owned by private individuals from 1906 to today. The occupations of these individuals include wife of gold miner (1906 to 1940), wife of poultry farmer and wife of engineer (1940 to 1969), and married woman (1969 to 1993). No records of the occupations of the owners have been kept since 1993. The lot is currently owned by Stephen and Katrina King.

The land titles documents provided by Advance Legal Search are presented in Appendix C.

6.3.3 Review Aerial Photography

A review of aerial photographs of the site between 1954 and 2008 was carried out. A summary of the findings is provided in Table 8 below and the aerial photographs are presented in Appendix D.

TABLE 8 - SUMMARY OF AERIAL PHOTOGRAPH REVIEW

DATE	AERIAL PHOTOGRAPH DESCRIPTION
1954	- Majority of the site is bushland. There are no power line corridors present. - Appears to be a gravel/dirt road where Lot 17 crosses through the site, and George Booth Drive appears to be a gravel/dirt road. - Appears to be structures on the residential part of the site, indicating that Lot 6 and Lot 7 are used for residential or rural purposes. - No evidence of the quarry was observed. - The surrounding land appears to be bushland and residential in nature.

DATE	AERIAL PHOTOGRAPH DESCRIPTION
1966	- The majority of the site is bushland. - Two power line corridors cut across the site in a southwest to northwest direction, similar to the current alignment. - Rural/residential area similar to 1954 photograph. - No evidence of the quarry was observed. - The surrounding land appears to be bushland and residential in nature.
1974	- Similar to 1966, with the following exceptions - A third power line corridor is present. - The quarry is apparent, and the area appears clear of vegetation indicating it may be in use. - The surrounding land appears to be bushland and residential in nature.
1983	- Site is similar to 1974. - Quarry appears to be smaller than in 1974, indicating it may no longer be in use.
1993	- Similar to 1983 photograph. - Surrounding land to the east has become more developed.
2008	- Similar to 1993 photograph. The site appears to be in its current configuration.

6.3.4 Interviews

No interviews were carried out as the client was unable to provide contact details for anyone with historical knowledge of the site. A search of the phone book revealed that the residents of Lot 6 and Lot 7 are not listed.

6.4 Areas of Environmental Concern

The following Areas of Environmental Concern (AEC) were identified and are shown on Figure 3:

- **AEC 1:** Former quarry. This area may have been partially filled in with fill from unknown sources. It is possible the fill comes from onsite as well. Rubbish comprising of household domestic waste and demolition waste has been dumped in the quarry area. No obvious large stains were observed, however there was an odour in the area;
- **AEC 2:** Area of dumped rubbish where two of the power line corridors and George Booth Drive intersect. The rubbish mainly comprised of household domestic waste. A water truck was observed dumping water during the site walkover, indicating that liquids are also potentially illegally dumped in the area. No obvious large stains or odours were observed;

- **AEC 3:** Scattered, isolated rubbish across the bushland area;
- **AEC 4:** Residences and sheds on Lot 6 and Lot 7. There is the potential for use of asbestos containing materials (ACM), lead paint in the buildings, and spraying of pesticides around the buildings. There is the potential for imported fill to have been on placed Lot 6 in the early 1908's.

6.4.1 Potential Contaminants and Receptors

The potential contaminants of concern and receptors from the AECs are summarised in Table 2 below.

TABLE 9 - SUMMARY OF POTENTIAL CONTAMINANTS OF CONCERN AND RECEPTORS FROM AECS

AEC	POTENTIAL CONTAMINANTS OF CONCERN	POTENTIAL RECEPTORS
1	TPH, BTEX, PAH, Metals, OCPs, OPPs, PCBs and asbestos	Surrounding soil, surface water
2	TPH, BTEX, PAH, Metals, OCPs, OPPs, PCBs and asbestos	Surrounding soil, surface water
3	TPH, BTEX, PAH, Metals, OCPs, OPPs, PCBs and asbestos	Surrounding soil, surface water
4	Metals, OCPs, OPPs, and asbestos	Surrounding soil and imported fill soil

NOTE:

TPH = total petroleum hydrocarbons; BTEX = benzene, toluene, ethyl-benzene, xylene; PAH = poly-aromatic hydrocarbons; Heavy Metals = arsenic, cadmium, chromium, copper, lead, nickel, zinc and mercury; OCPs – organochlorine pesticides; OPPs = organophosphorous pesticides; PCBs = poly-chlorinated biphenyls.

In general it is considered that the potential contamination would probably be restricted to surface soils within the AECs. Within the quarry area, there is a potential for deeper contamination, however groundwater has not been considered as a likely receptor as in this area as groundwater is likely to be approximately 20m to 30m below the ground surface. On Lot 6 where there is potentially imported fill material, it is not known how deep this fill material could be. Surface water was not observed during the site visit, though it is a potential receptor during periods of prolonged rainfall.

6.5 Conclusions and Recommendations

The Phase 1 ESA indicates that in general the site has not been developed, with the exception of the power line corridors, the former quarry, and the residential area on the western side.

The Phase 1 ESA identified four areas of environmental concern (AEC) as shown on Figure 3. Generally these were associated with the dumping of rubbish onto the site. One of the AECs related to the residences and sheds on Lot 6 and Lot 7 of the site.

Based on the findings of the Phase 1 ESA, it is recommended that should it be proposed to redevelop the land, or change its current use, further Phase 2 ESA investigation should be carried out. Coffey were provided with information from Council's Senior Environmental Officer via the client, which indicates that a Phase 2 ESA would not be required at rezoning stage, but would be required at the development application stage. Coffey agrees with this assessment.

Based on the available information a Phase 2 ESA would include:

a. Sampling of soils in accordance with the NSW EPA (1995) Sampling Design Guidelines in AEC 1 and AEC 2. Soils would be sampled throughout the fill in AEC 1 (former quarry) down to the top of the natural material;

b. Spot sampling of surface soils within AEC 3 at point source locations of contamination (i.e. car bodies and batteries) for petroleum and metal contamination. It is not known how many locations this may comprise, but it is estimated that at least 20 samples may be required;

c. Sampling of surface soils around the residences and sheds on Lot 6 and Lot 7, and a hazardous material assessment (asbestos survey) of the structures;

d. Depending on the results of the Phase 2 ESA, a Remediation Action Plan may need to be prepared to address the cleanup of areas with contamination identified during the Phase 2 ESA;

e. Depending on the size of each individual lot, the Phase 2 ESA, remediation and validation works would be carried out once a subdivision plan has been prepared, as this would allow a lot by lot assessment which would provide a greater degree of confidence in the completeness of the assessment and potential remediation.

Should the land remain in its current use, the risk to human health or the environment from the potential contamination is likely to be low. Further assessment would not be necessary should the land stay in its current use.

Measures should be employed to restrict further illegal dumping at the site to limit future liability.

7 GEOTECHNICAL CONSTRAINTS ON DEVELOPMENT

The following geotechnical constraints are based on slope stability and soil erosion considerations. The constraints are aimed at providing broad guidelines to assist in development planning. It is envisaged that further refinement and delineation of geotechnical constraints, including pavement and foundation designs, will occur with more detailed assessment of separate areas of the site as development proceeds.

7.1 Area for Development

Most of the site is considered suitable for development from a slope stability, soil erosion and drainage viewpoint. The areas not suitable at this stage include the lower lying areas of Domain E. These areas may be suitable for development provided natural surface and subsurface drainage paths are remediated and controlled, and that the level of the land is raised.

Development of the site should be undertaken in accordance with good hillside construction practice and sound engineering principles. Development in gully areas should minimise disturbance to slopes, and general constraints and recommendations in this report would apply.

7.2 Type of Structure and Foundations

There are no particular geotechnical constraints on the type of structures provided they are founded on footings designed and constructed in accordance with the principles of AS2870-1996, '*Residential Slabs and Footings'*.

Development should be designed to accommodate the natural slope profile. A site classification should be undertaken once site layout and regrade design levels are known.

The site conditions are generally suitable for support of residential structures on high level footing systems such as raft or waffle pod slabs or strip and pad footings.

7.3 Site Clearance and Preparation

Soil erosion during and after construction on the site, will require careful management. Levels of erosion should be able to be maintained within normally acceptable levels by adopting good soil erosion and sedimentation control practices, including:

- Plan for soil and water management concurrently with engineering design and in advance of any earthworks;
- Minimise the area and duration of soil exposure by staged development and controlled clearing;
- Stockpile stripped soil for reuse and protect from erosion;
- Control stormwater run-off by diverting clean run-off from denuded areas, minimising slope gradient, length and run-off velocities;
- Control stormwater run-off by diverting clean run-off from denuded areas, minimising slope gradient, length and run-off velocities;
- Trap soil and water pollutants using silt traps, sediment basins, perimeter banks, silt fences and nutrient traps as appropriate;
- Promote regeneration of native vegetation in gullies and in areas previously cleared;
- Quick rehabilitation of disturbed areas.

7.4 Excavation

Where excavation is required, it is anticipated that all materials could be excavated by conventional dozer blade or backhoe bucket at least to the depths indicated on the attached field logs and summarised in Table 2.

The near surface colluvial soils (Unit 2) on-site particularly in Domain E are expected to be moisture sensitive and it is also possible that water inflows or seepages may be encountered within the depth of the excavation. Therefore, if wet weather is encountered prior to or during earthworks, over-excavation and placement of a working platform of granular fill will be required to allow site trafficability. Filling might be required to bring subgrade back to design level.

Excavations should be supported by properly designed and constructed retaining walls or else battered at 1V:2H or flatter and protected against erosion with steeper batters in competent rock materials feasible subject to specific geotechnical assessment. The design of roads should be undertaken to limit the degree of slope excavation required.

7.5 Reuse of Materials

The following comments are made regarding the suitability of the site materials for reuse in filled areas:

- Where site regrade is proposed, all existing topsoil, vegetation or other potentially deleterious material should be removed to spoil or stockpiled for reuse as landscaping materials only;
- Stripping is generally expected to be required to depths of about 0.1m to 0.2m (topsoil layer), but may be significantly deeper where wet, silty soils are encountered;
- Underlying very stiff clays should be carefully stripped as necessary and stockpiled for reuse as general site fill;
- The clayey soils on-site are expected to be moderately to highly reactive (susceptible to volume changes with variation in moisture content) and will need to be placed and compacted to a minimum density ratio of 95% Standard Compaction within ±2% of OMC to minimise reactive soil movements;
- Excavated rock materials apart from weathered coal are suitable for re-use as engineered fill.

7.6 Filling

Filling should be undertaken in accordance with sound engineering principles as set out in AS3798-2007 '*Guideline on Earthworks for Commercial and Residential Structures'.*

The residual and weathered rock materials that would be derived from cuts on the site are typically useful for site regrade fill with appropriate moisture control and particle size regulation during placement and compaction. The topsoil and slopewash materials are generally suitable for landscaping use only.

Where site regrading is proposed, the following general course of action should be taken:

- Strip existing topsoil, root affected material and deleterious material to spoil. Following stripping, the surface should be inspected for trafficability;
- Following stripping, the exposed subgrade materials should be proof rolled to identify any wet or excessively deflecting material. Any such areas should be over excavated and backfilled with an approved select material. The near surface soils onsite are expected to be moisture sensitive and therefore, if wet weather is encountered prior to or during earthworks, over excavation and placement of a working platform of granular fill may be required to assist site trafficability;
- Approved fill should be placed in layers not exceeding 300mm loose thickness and compacted to a minimum dry density ratio of 98% Standard (AS1289 5.1.1 or equivalent) beneath structures and 95% Standard as general site fill.

The expertise of the contractor, the nature of the fill material and the degree of supervision of the filling will determine the footing design required for any structures placed on the fill constructed in the manner discussed above.

Earthworks should be carried out in accordance with the recommendations outlined in AS3798-2007, '*Guidelines for Earthworks for Commercial and Residential Developments'*. If specific earthworks requirements are required for industrial development, then earthworks specification should be designed by an experienced engineer familiar with the site conditions.

7.7 Retaining Walls

Retaining walls should be designed for surcharge loading from slopes, retaining walls, structures and other existing or future improvements in the vicinity of the wall.

Adequate subsurface and surface drainage should be provided behind all retaining walls. All structural retaining walls and all landscaping walls in excess of 1m should be designed by an experienced engineer familiar with the site conditions.

7.8 Access and Road Construction

Access and site modifications should comply with the recommendations above.

Placement of roads through Domain E is likely to require some over-excavation of wet and/or silty material, and subsequent subgrade replacement or elevation over inundated areas. Waterlogging of these layers, particularly after wet weather, can result in the requirement for use of geofabric and placement of a granular working platform prior to placement and compaction of subsequent fill or pavement layers. Surface and sub-soil drains will also be required to improve drainage.

Further geotechnical assessment is required to identify areas where specific design requirements will be needed, such as recommendations regarding provision of drainage and evaluation of subgrade conditions for pavement thickness design.

Based on the shallow depth to rock present over significant areas of the site, the road design should be undertaken to limit potential constraints associated with excavation of hard rock.

7.9 Drainage

7.9.1 Stormwater Drainage

All collected stormwater run-off should be piped into an inter-allotment drainage system utilising the existing watercourses, in a controlled manner that limits erosion. Surface and sub-soil drains will be required to improve drainage.

Dispersible soils greatly limit water movement through the soil, often resulting in poor drainage and waterlogging. To limit water logging, and rising water table, the following principles should be considered in development of the site:

- Planting of deep rooted native trees to prevent rising of the water table in the low lying areas and gullies;
- Retaining or planting native vegetation where possible;
- Treating potentially sodic or dispersive soils with gypsum before landscaping;
- Designing storm water detention ponds and water features to reduce infiltration;

- Minimising soils disturbance, including reduced cut and fill;
- Improving or maintaining drainage around gully regions or natural drainage paths.

7.9.2 Sewage Disposal

It is assessed that sewer for any proposed development should be connected to the existing dedicated sewer waste drainage system that services the area and treated off site. The site conditions are not amenable for the onsite disposal of effluent unless broad acreage type development is proposed.

7.10 Pavements

At the time of the field investigation, moisture content of the Unit 3 CLAY soils in the majority of test pits were assessed to be at or slightly below Optimum Moisture Content (OMC). However It is likely Unit 3 materials with field moisture content greater than OMC will be encountered and therefore it should be anticipated that some drying back and moisture conditioning of the subgrade may be necessary prior to compaction and placement of pavement materials. The required time period to prepare the subgrade is likely to be dependant on the prevailing weather conditions at the time of construction. Where Unit 3 CLAY materials are encountered at subgrade level, a CBR value ranging from 3% to 5% is assessed to be likely for preliminary pavement thickness calculations.

Where weathered rock (Unit 4/5) subgrades are encountered, the sandstone should be ripped and re-compacted to a minimum depth of 250mm to break-up preferential drainage paths and provide a dense homogenous surface on which to construct the pavement.

Ripped and re-compacted weathered rock may be assumed to have a preliminary design CBR of 10%; however this should be confirmed by the geotechnical authority at the time of construction.

In low lying areas such as Domain E where over wet Colluvial CLAY/SAND and SILT are encountered (Unit 2), it is assessed that a CBR of <3% is likely and that subgrade improvement or replacement will be necessary. This may involve stabilising prepared subgrades with lime, use of geofabrics or removal of a nominal depth of Unit 2 soils and replacement with select fill.

It is recommended that a detailed pavement investigation be conducted incorporating CBR laboratory testing, when the alignment, level and traffic loading of the proposed roads are designed.

7.11 Site Classification

Samples were obtained during the subsurface investigation for shrink swell testing to assist in identifying the broad soil reactivity over the site. Samples were taken to representatively reflect the shrink swell index of the different residual clays encountered over the site. Results of testing are presented in Appendix B and summarised in Table 10.

TABLE 10 – SUMMARY OF SHRINK SWELL INDEX TESTING

LOCATION	SAMPLE DEPTH (m)	MATERIAL DESCRIPTION	FIELD MOISTURE CONTENT (%)	SHRINK SWELL INDEX (I_{ss})
TP2	0.50 – 0.80	Unit 3 Residual (CL – CH Sandy CLAY)	16.5	1.4
TP4	0.30 – 0.60	Unit 3 Residual (CH Sandy CLAY)	19.0	2.0
TP8	0.40 – 0.65	Unit 3 Residual (CL – CH Sandy CLAY)	18.0	2.5
TP10	0.30 – 0.52	Unit 3 Residual (CH CLAY)	31.7	4.4

Table 11 summarises the likely site classifications for the separate domains based on the results of the field investigations and laboratory testing. The classifications presented in Table 11 should be taken as indicative values only. When the nature and location of development are finalised, additional testing should be conducted specific to the proposed development site to give a more comprehensive classification for the footing design of residential or commercial structures.

TABLE 11 - SUMMARY OF SITE CLASSIFICATION

GEOTECHNICAL DOMAIN	GENERAL SUBSURFACE PROFILE	SITE CLASSIFICATION
Domain A	Exposed to very shallow rock (<0.5m)	Class S
Domain B	Very Shallow to Shallow Rock (0.5m – 1.0m)	Class S – M
Domain C	Residual Clays 1.0m to > 1.5m	Class M – H

This assessment does not take into account any proposed site regrading. The effects of changes to the soil profile by additional cutting and filling and the effects of past and future trees should be considered in selection of the design value for differential movement.

All structural footings (including edge beams, internal beams and load support thickenings) on the site above allotments should be founded as follows:

- Footings to be uniformly founded in stiff Unit 3 residual clayey soils, Unit 4/5 weathered rock or on controlled engineered fill beneath all Unit 1 topsoil, uncontrolled fill, Unit 2 Colluvial soils and disturbed material associated with former tree stump removal or previous structures;
- Footings are to be founded outside of or below all zones of influence resulting from existing or future service trenches or excavations.

All footings should be designed and constructed in accordance with the requirements of AS2870-1996. Adequate surface and stormwater drainage should be installed and maintained on each building site. All collected stormwater and roof run-off should be discharged into existing gully flow lines or water courses in a controlled manner in accordance with local government requirements.

Footings should be sited away from test pit locations or remedial measures to test pits. This is because test pits are usually backfilled with excavated material, using only the backhoe bucket for compaction, and such compaction may not be adequate according to the provisions of AS2870-1996.

The classification presented above is provided on the basis that the performance expectations set out in Appendix B of AS2870-1996 are acceptable and that site maintenance complies with the provisions of CSIRO Sheet BTF 18, *Foundation Maintenance and Footing Performance: A Homeowner's Guide*, a copy of which is attached.

8 CONCLUSION

Development of the site for urban use is considered feasible from a geotechnical and environmental Phase 1 contamination assessment point of view. The scope of work for this assessment was based on a feasibility level studies, to identify to Council the key geotechnical and environmental contamination constraints and issues in terms of urban land capability. Based on the results of this assessment, it is considered that the land is suitable for urban development.

The area is assessed to have an overall low risk of slope instability and it is considered that the site is appropriate for development subject to the geotechnical constraints on development detailed in Section 7. No significant areas of instability were noted over the area, due mainly to a thin soil cover towards the steeper areas of the site (Domain B) and minimal groundwater migration. The site management procedures should be constantly reviewed to ensure that opportunities for development of impacts from slope instability are minimised and controls effectively managed.

The minimal degree of sodicity and salinity of the majority of site soils will not significantly effect future urban development. It is assessed that elevated levels of sodicity within Domain E may have the potential to impact present and future development in this area of the site; however such impacts could be reduced if development is appropriately managed. The site management procedures should be constantly reviewed to ensure that opportunities for development of impacts from Urban Salinity and sodicity (dispersivity) are minimised.

Further geotechnical investigations will be required at the design stage to allow pavement design and lot classifications to AS2870-1996. At that stage some further salinity assessment should be undertaken to comply with salinity assessment guidelines and confirm the findings of this preliminary report.

The Phase 1 ESA indicates that in general the site has not been developed, with the exception of the power line corridors, the former quarry, and the residential area on the western side.

The Phase 1 ESA identified four areas of environmental concern (AEC) as shown on Figure 3. Generally these were associated with the dumping of rubbish onto the site. One of the AECs related to the residences and sheds on Lot 6 and Lot 7 of the site.

Based on the findings of the Phase 1 ESA, it is recommended that should it be proposed to redevelop the land, or change its current use, further Phase 2 ESA investigation should be carried out. Coffey were provided with information from Council's Senior Environmental Officer via the client, which indicates that a Phase 2 ESA would not be required at rezoning stage, but would be required at the development application stage. Coffey agrees with this assessment.

Based on the available information a Phase 2 ESA would include:

f. Sampling of soils in accordance with the NSW EPA (1995) Sampling Design Guidelines in AEC 1 and AEC 2. Soils would be sampled throughout the fill in AEC 1 (former quarry) down to the top of the natural material;

g. Spot sampling of surface soils within AEC 3 at point source locations of contamination (i.e. car bodies and batteries) for petroleum and metal contamination. It is not known how many locations this may comprise, but it is estimated that at least 20 samples may be required;

h. Sampling of surface soils around the residences and sheds on Lot 6 and Lot 7, and a hazardous material assessment (asbestos survey) of the structures;

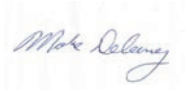
i. Depending on the results of the Phase 2 ESA, a Remediation Action Plan may need to be prepared to address the cleanup of areas with contamination identified during the Phase 2 ESA;

j. Depending on the size of each individual lot, the Phase 2 ESA, remediation and validation works would be carried out once a subdivision plan has been prepared, as this would allow a lot by lot assessment which would provide a greater degree of confidence in the completeness of the assessment and potential remediation.

Should the land remain in its current use, the risk to human health or the environment from the potential contamination is likely to be low. Further assessment would not be necessary should the land stay in its current use.

Measures should be employed to restrict further illegal dumping at the site to limit future liability.

For and on behalf of Coffey Geotechnics Pty Ltd



Mark Delaney

Principal Engineering Geologist

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

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

Your report is based on project specific criteria

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

Subsurface conditions can change

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

Interpretation of factual data

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

Your report will only give preliminary recommendations

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

Your report is prepared for specific purposes and persons

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

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Important information about your **Coffey** Report

Interpretation by other design professionals

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

Data should not be separated from the report*

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

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

Geoenvironmental concerns are not at issue

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

Rely on Coffey for additional assistance

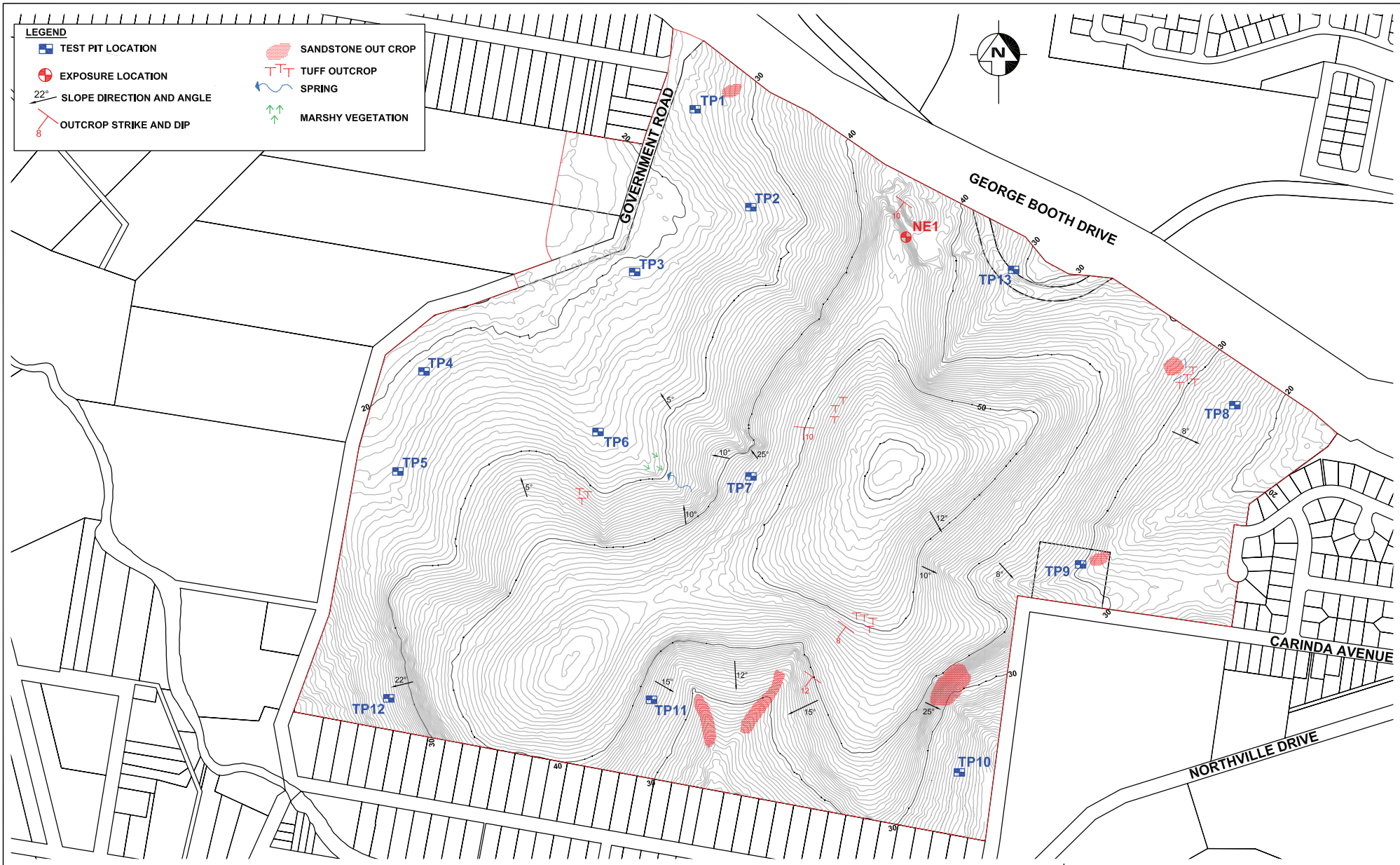
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As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

Responsibility

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

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

Figures



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Scale (metres)

drawn	NLS
approved	AMT
date	28-08-08
scale	1:5000
original size	A3

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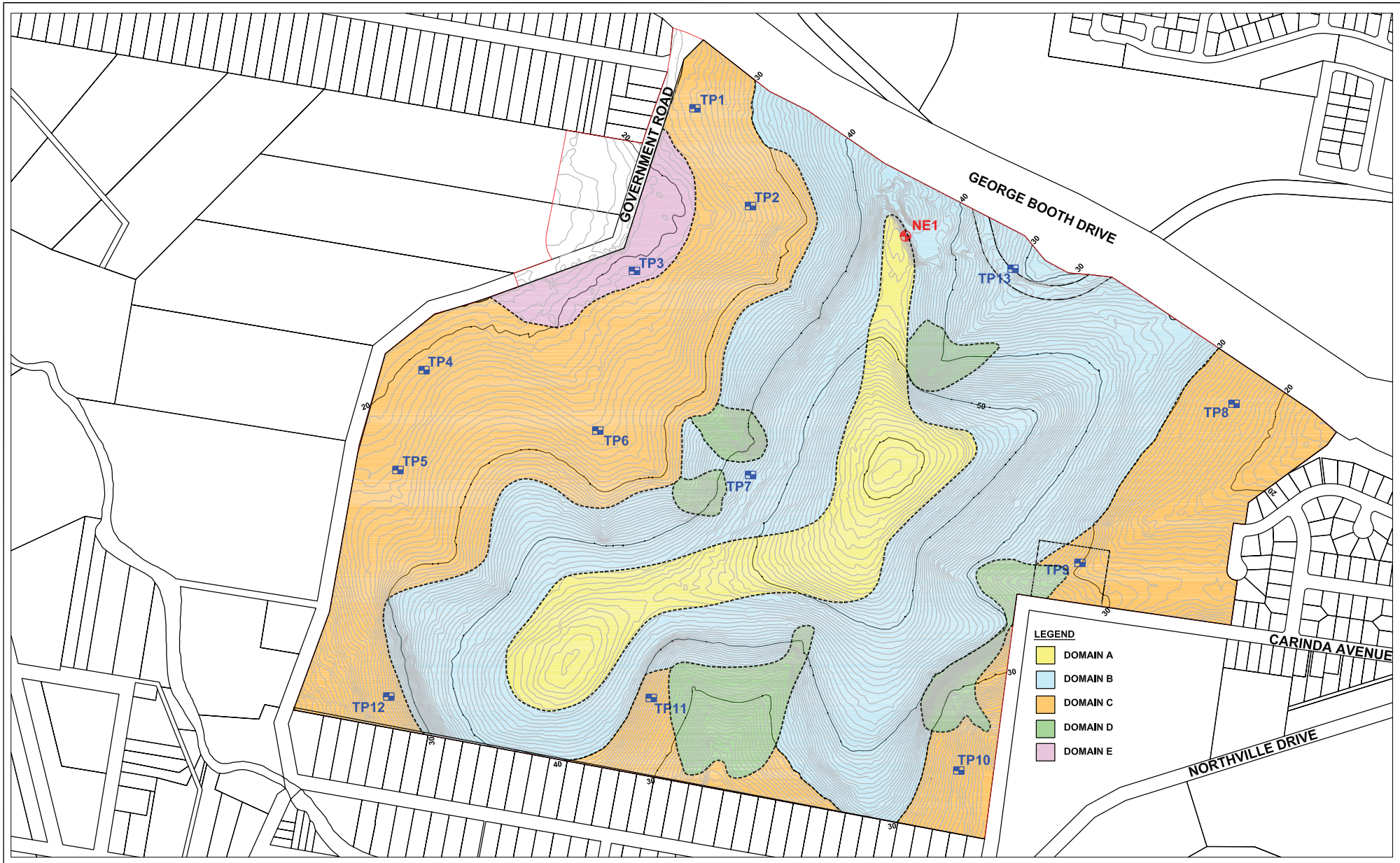
client: GEOLINK

project: EDGEWORTH ENVIRONMENTAL PLAN
GEORGE BOOTH DRIVE & GOVERNMENT ROAD,EDGEWORTH
GEOTECHNICAL MAPPING AND CONSTRAINTS ASSESSMENT

title: TESTING LOCATION PLAN

project no: GEOTWARA20544AC

figure no: FIGURE 1



revision	description	drawn	approved	date

0 5 10 20 30
Scale (metres)

drawn	NLS
approved	AMT
date	15-08-08
scale	1:500
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: GEOLINK

project: EDGEWORTH ENVIRONMENTAL PLAN
GEORGE BOOTH DRIVE & GOVERNMENT ROAD,EDGEWORTH
GEOTECHNICAL MAPPING AND CONSTRAINTS ASSESSMENT

title: INFERRED GEOTECHNICAL DOMAINS

project no: GEOTWARA20544AC

figure no: FIGURE 2

revision	description	drawn	approved	date

0 50 100 200 300
Scale (metres)

drawn	NLS
approved	ELC
date	15-08-08
scale	1:5000
original size	A3

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SPECIALISTS MANAGING THE EARTH

client: GEOLINK

project: EDGEWORTH ENVIRONMENTAL PLAN
GEORGE BOOTH DRIVE & GOVERNMENT ROAD,EDGEWORTH
GEOTECHNICAL MAPPING AND CONSTRAINTS ASSESSMENT

title: SITE PLAN SHOWING AREAS OF ENVIRONMENTAL CONCERN (AEC's)

project no: GEOTWARA20544AC

figure no: FIGURE 3

Appendix A

Results of Field Investigation

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Soil Description Explanation Sheet (1 of 2)

DEFINITION:

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

CLASSIFICATION SYMBOL & SOIL NAME

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

PARTICLE SIZE DESCRIPTIVE TERMS

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

MOISTURE CONDITION

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

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

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

CONSISTENCY OF COHESIVE SOILS

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

DENSITY OF GRANULAR SOILS

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

MINOR COMPONENTS

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

SOIL STRUCTURE

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

GEOLOGICAL ORIGIN

WEATHERED IN PLACE SOILS

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

TRANSPORTED SOILS

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

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Soil Description Explanation Sheet (2 of 2)

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

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

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

COMMON DEFECTS IN SOIL

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

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

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Rock Description Explanation Sheet (1 of 2)

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

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

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

SUBSTANCE DESCRIPTIVE TERMS:

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

CLASSIFICATION OF WEATHERING PRODUCTS

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

Notes on Weathering:

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

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbrev-iation	Point Load Index, I_S50 (MPa)	Field Guide
Very Low	**VL**	Less than 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
Low	**L**	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	**M**	0.3 to 1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	**H**	1 to 3	A piece of core 150mm long by 50mm can not be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	**VH**	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
Extremely High	**EH**	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.

Notes on Rock Substance Strength:

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

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Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES

Term	Definition	Diagram	Map Symbol	Graphic Log (Note 1)
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub parallel to layering (eg bedding) or a planar anisotropy in the rock substance (eg, cleavage). May be open or closed.		20 Bedding 20 Cleavage	(Note 2)
Joint	A surface or crack across which the rock has little or no tensile strength. but which is not parallel or sub parallel to layering or planar anisotropy in the rock substance. May be open or closed.		60	(Note 2)
Sheared Zone (Note 3)	Zone of rock substance with roughly parallel near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects. Some of the defects are usually curved and intersect to divide the mass into lenticular or wedge shaped blocks.		35	
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.		40	
Crushed Seam (Note 3)	Seam with roughly parallel almost planar boundaries, composed of disoriented, usually angular fragments of the host rock substance which may be more weathered than the host rock. The seam has soil properties.		50	
Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface.		65	
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.	Seam	32	

Notes on Defects:

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

TERMS

DEFECT SHAPE

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

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

ROUGHNESS TERMS

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

COATING TERMS

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

BLOCK SHAPE TERMS

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

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Engineering Log - Excavation

Excavation No. TP 1

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368590 m | R.L. Surface: 24.70

excavation dimensions: 2m long 0.3m wide | Northing: 6356938 m | datum:

excavation information | material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EXC		N	None Observed		24.5			SM	TOPSOIL: Silty SAND, fine to coarse grained sand, low liquid limit silt, some organics, dark grey.	M			TOPSOIL
				D		0.5		CL	Sandy CLAY: medium to high plasticity, fine to medium grained, pale brown - brown.	M>Wp	VSt	×	RESIDUAL
					24.0			SC	Clayey SAND: fine to medium grained, low plasticity, pale brown - pale grey.	M<Wp	VD		EXTREMELY WEATHERED SANDSTONE
									SANDSTONE: fine to coarse grained, tuffaceous composition, grey, pale brown.	D			HIGHLY WEATHERED SANDSTONE
					23.5	1.0			Test pit TP 1 terminated at 0.9m				
					23.0	1.5							
					22.5	2.0							
						2.5							

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13. NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

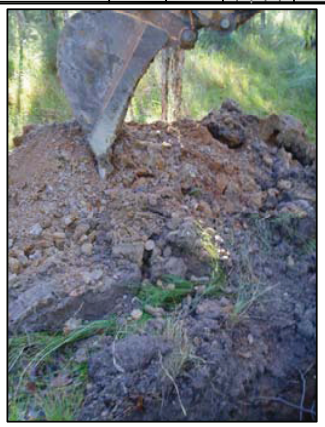
		Excavation No.	TP 2
		Sheet	1 of 1
		Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD	Date started:	9.7.2008
Principal:		Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN	Logged by:	AMT
Test pit location:	REFER TO FIGURE 2	Checked by:	AMT

equipment type and model:	Backhoe	Pit Orientation:	Easting:	368669 m	R.L. Surface: 24.70
excavation dimensions:	2m long 0.3m wide		Northing:	6356798 m	datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EXC		N	None Observed	D	24.5	0.0		CL	TOPSOIL: Sandy CLAY, low plasticity, fine to medium grained sand, grey, some organics and roots.				TOPSOIL
								CL	Sandy CLAY: low plasticity, fine to medium grained sand, grey.	M>Wp	St	×	COLLUVIAL
				U50	24.0	0.5		CL	Sandy CLAY: medium plasticity, fine to medium grained sand, mottled brown grey - pale grey.		VSt	×	RESIDUAL
					23.5	1.0		CL / SC	Sandy CLAY / Clayey SAND: medium plasticity, fine to coarse grained sand, mottled orange grey / pale grey.			×	
					23.0	1.5						×	
					22.5	2.0						×	
						2.5			Test pit TP 2 terminated at 2m				

Sketch



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

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

coffey geotechnics

Engineering Log - Excavation

Excavation No. TP 3

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model: Backhoe

Pit Orientation:

Easting: 368503 m

R.L. Surface: 20.70

excavation dimensions: 2m long 0.3m wide

Northing: 6356707 m

datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		20.5 / 0.0		CL	TOPSOIL: Sandy CLAY, low plasticity, fine to medium grained sand, some organics and roots, grey.	M			TOPSOIL
							CL / CH	Sandy CLAY: medium to high plasticity, fine to medium grained sand, grey.	M>Wp	VSt / H	×	COLLUVIAL
				Bs	0.5							
					20.0 / 1.0		CL / CH	Sandy CLAY: medium to high plasticity, fine to medium grained sand, mottled grey / orange.		VSt	×	
					19.5 / 1.5		CL	Sandy CLAY / Clayey SAND: medium to low plasticity, fine to medium grained sand, pale grey / orange.		VSt / H	×	RESIDUAL
					19.0 / 2.0			Trace of fine to medium grained, angular sandstone occuring.				
					18.5 / 2.5			Test pit TP 3 terminated at 2m				

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system		consistency/density index	
N	natural exposure	S	shoring	U50	undisturbed sample 50mm diameter	moisture		VS	very soft
X	existing excavation	N	nil	U63	undisturbed sample 63mm diameter	D	dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4	no resistance ranging to refusal	D	disturbed sample	M	moist	F	firm
B	bulldozer blade	water		V	vane shear (kPa)	W	wet	St	stiff
R	ripper	water level on date shown		Bs	bulk sample	Wp	plastic limit	VSt	very stiff
E	excavator	water inflow		E	environmental sample	WL	liquid limit	H	hard
		water outflow		R	refusal			Fb	friable
								VL	very loose
								L	loose
								MD	medium dense
								D	dense
								VD	very dense

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. TP 4

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368205 m | R.L. Surface: 21.20

excavation dimensions: 2m long 0.3m wide | Northing: 6356565 m | datum:

excavation information / material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		21.0	0.0		SM	TOPSOIL: Silty SAND, fine to medium grained sand, low liquid limit, some organics and roots, dark grey.				TOPSOIL
				U50		0.5		CH	CLAY: high plasticity, some fine to medium grained sand, pale grey	M>Wp	VSt	x	RESIDUAL
					20.5			GP	Clayey Sandy GRAVEL: fine to coarse grained angular siltstone gravel, fine to coarse grained sand, some low plasticity fines, grey.	M<Wp	VD		EXTREMELY WEATHERED SILTSTONE
										M			HIGHLY WEATHERED SILTSTONE
									SILTSTONE: grey, trace of fine grained sandstone lenses, remnant subhorizonatl ironstained joints.				
						1.0			Test pit TP 4 terminated at 0.8m				
					20.0								
						1.5							
					19.5								
						2.0							
					19.0								
						2.5							

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No.	TP 5
Sheet	1 of 1
Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD
Date started:	9.7.2008
Principal:	
Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN
Logged by:	AMT
Test pit location:	REFER TO FIGURE 2
Checked by:	AMT

equipment type and model:	Backhoe	Pit Orientation:	Easting:	368168 m	R.L. Surface: 23.25
excavation dimensions:	2m long 0.3m wide		Northing:	6356423 m	datum:

excavation information

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EXC		N	None Observed		23.0	0.0		SM	TOPSOIL: Silty SAND, fine to medium grained sand, low liquid limit, some organics and roots, grey.				TOPSOIL
				D	22.5	0.5		CH	CLAY: high plasticity, some fine to medium grained sand, grey - orange.	M>Wp	H	×	RESIDUAL
					22.0	1.0		CL	Gravelly CLAY: medium plasticity, fine to coarse grained, angular siltstone gravel, grey.	M<Wp			EXTREMELY WEATHERED SILTSTONE
						1.5		CL	CLAY: low plasticity, black.	M	Fb		EXTREMELY WEATHERED COAL
					21.5	2.0		CL - CH	CLAY: medium to high plastcity, pale grey / white.	M<Wp	H		EXTREMELY WEATHERED TUFF
					21.0	2.5			Test pit TP 5 terminated at 2m				

Sketch

method

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

support

S shoring N nil

penetration

1 2 3 4 no resistance ranging to refusal

water

water level on date shown

water inflow

water outflow

notes, samples, tests

U50	undisturbed sample 50mm diameter
U63	undisturbed sample 63mm diameter
D	disturbed sample
V	vane shear (kPa)
Bs	bulk sample
E	environmental sample
R	refusal

classification symbols and soil description based on unified classification system

moisture

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

consistency/density index

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

TESTPIT TP 1 - 13. NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

		Excavation No.	TP 6
		Sheet	1 of 1
		Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD	Date started:	9.7.2008
Principal:		Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN	Logged by:	AMT
Test pit location:	REFER TO FIGURE 2	Checked by:	AMT

equipment type and model:	Backhoe	Pit Orientation:	Easting:	368452 m	R.L. Surface:	25.20	
excavation dimensions:	2m long 0.3m wide		Northing:	6356479 m	datum:		

excavation information | material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		25.0			SM	TOPSOIL: Silty SAND, fine to medium grained sand, low liquid limit, some organics, grey.	M			TOPSOIL
				D		0.5		CL / CH	Sandy CLAY: medium to high plasticity, fine sand, mottled pale grey, brown.	M>Wp	H	×	RESIDUAL
					24.5								
						1.0						×	
					24.0								
						1.5		SC/ CL	Sandy CLAY: medium plasticity, fine to coarse grained sand, trace of fine to medium grained sandstone gravel, mottled pale grey, orange - red.	M<Wp	Fb		
					23.5								
						2.0			Test pit TP 6 terminated at 2m				
					23.0								
						2.5							

Sketch

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

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

coffey geotechnics

Engineering Log - Excavation

Excavation No.	TP 7
Sheet	1 of 1
Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD
Date started:	9.7.2008
Principal:	
Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN
Logged by:	AMT
Test pit location:	REFER TO FIGURE 2
Checked by:	AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368668 m | R.L. Surface: 44.40

excavation dimensions: 2m long 0.3m wide | Northing: 6356416 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed					SM	TOPSOIL: Silty SAND, fine to coarse grained sand, low liquid limit, silt, grey, some organics.				TOPSOIL
					44.0	0.5		CL / SC	Clayey SAND: low to medium plasticity, fine to medium grained sand, some fine to coarse grained, orange, sandstone gravel, mottled orange grey.	M>Wp	VSt	×	EXTREMELY WEATHERED SANDSTONE
									SANDSTONE: fine to medium grained, bedding - thin (<5mm) subhorizontal, orange / pale grey estimated medium strength.	D			HIGHLY WEATHERED SANDSTONE
									Test pit TP 7 terminated at 0.5m				
					43.5	1.0							
					43.0	1.5							
					42.5	2.0							
					42.0	2.5							

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

coffey geotechnics

Engineering Log - Excavation

Excavation No.	TP 8
Sheet	1 of 1
Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD
Date started:	9.7.2008
Principal:	
Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN
Logged by:	AMT
Test pit location:	REFER TO FIGURE 2
Checked by:	AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 369356 m | R.L. Surface: 24.20

excavation dimensions: 2m long 0.3m wide | Northing: 6356517 m | datum:

excavation information | **material substance**

method	penetration 1 2 3	support	water	notes samples, tests etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		24.0	0.0		SM	TOPSOIL: Silty SAND, fine grained, low liquid limit siltstone, some organics, pale grey.	M			TOPSOIL
				U50	23.5	0.5		CH	Sandy CLAY: high plasticity, fine to coarse grained sand, (tuffaceous), pale grey, orange.	M<Wp	H	600 600 600 600	RESIDUAL
					23.0	1.0							
					22.5	1.5							
					22.0	2.0			Test pit TP 8 terminated at 2m				
						2.5							

Sketch

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

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. TP 9

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

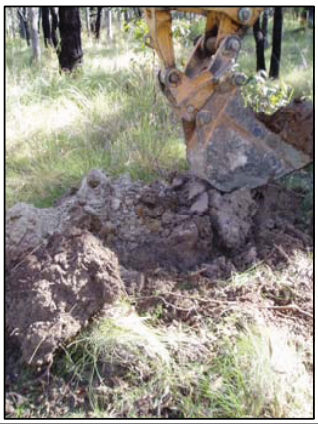
equipment type and model: Backhoe | Pit Orientation: | Easting: 369136 m | R.L. Surface: 30.20

excavation dimensions: 2m long 0.3m wide | Northing: 6356291 m | datum:

excavation information / material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
EXC			None Observed	D	30.0	0.5		SM	TOPSOIL: Silty SAND, fine to medium grained, low liquid limit, brown - dark brown.				TOPSOIL
					29.5	1.0		CH	CLAY: high plasticity, trace of fine grained sand, brown - grey.	M>Wp	VSt	x x x	RESIDUAL
					29.0	1.5		SC	Sandy CLAY: fine to coarse grained, low plasticity fines,fine to medium grained sandstone gravel, pale grey - orange	M	VD		EXTREMELY WEATHERED SANDSTONE
					28.5	2.0			Test pit TP 9 terminated at 1.4m				
					28.0	2.5							

Sketch



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

support
- S shoring
- N nil

penetration
1 2 3 4 no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No.	TP10
Sheet	1 of 1
Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD
Date started:	9.7.2008
Principal:	
Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN
Logged by:	AMT
Test pit location:	REFER TO FIGURE 2
Checked by:	AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368965 m | R.L. Surface: 23.80

excavation dimensions: 2m long 0.3m wide | Northing: 6355996 m | datum:

excavation information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa 100 200 300 400	structure and additional observations
EXC		N	None Observed		23.5	0.5		SM	TOPSOIL: Silty SAND, fine to medium grained sand, low liquid limit, grey, some organics.	M			TOPSOIL
				U50				CH	CLAY: high plasticity, pale grey, trace of fine grained sand.	M>Wp	VSt	x x	RESIDUAL
					23.0				SANDSTONE: fine to coarse grained, grey / brown.			x	HIGHLY WEATHERED SANDSTONE
									Test pit TP10 terminated at 0.8m				
					22.5	1.0							
						1.5							
					22.0								
						2.0							
					21.5								
						2.5							

Sketch

method		support		notes, samples, tests		classification symbols and soil description based on unified classification system		consistency/density index	
N	natural exposure	S	shoring	U50	undisturbed sample 50mm diameter	moisture		VS	very soft
X	existing excavation	N	nil	U63	undisturbed sample 63mm diameter	D	dry	S	soft
BH	backhoe bucket	penetration 1 2 3 4		D	disturbed sample	M	moist	F	firm
B	bulldozer blade		no resistance ranging to refusal	V	vane shear (kPa)	W	wet	St	stiff
R	ripper	water		Bs	bulk sample	Wp	plastic limit	VSt	very stiff
E	excavator		water level on date shown	E	environmental sample	WL	liquid limit	H	hard
			water inflow	R	refusal			Fb	friable
			water outflow					VL	very loose
								L	loose
								MD	medium dense
								D	dense
								VD	very dense

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. TP11

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368528 m | R.L. Surface: 36.50

excavation dimensions: 2m long 0.3m wide | Northing: 6356099 m | datum:

excavation information							material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
EXC		N	None Observed					SM	TOPSOIL: Silty SAND, fine to medium grained, low liqlud limit, some organics ,grey.	M			TOPSOIL
					36.0	0.5		CL	Sandy CLAY: medium plasticity, fine to coarse grained sand, some cobble of fine to medium grained sandstone up to 200mm in size.	M>Wp	VSt	×	EXTREMELY TO HIGHLY WEATHERED SANDSTONE
				D				CH	CLAY: high plasticity, pale grey, white.	<Wp		×	EXTREMELY WEATHERED TUFF
					35.5	1.0			SILTSTONE: fine to medium grained, pale pink - red, some coal lenses.	M	H		EXTREMELY TO HIGHLY WEATHERED SILTSTONE
								CL	CLAY: low plasticity, black.	<Wp	Fb		EXTREMELY WEATHERED COAL
					35.0	1.5			SILTSTONE: fine to medium grained, pale pink / red.		H		EXTREMELY TO HIGHLY WEATHERED SILTSTONE
								CL	CLAY: low plasticity, black.		Fb		EXTREMELY WEATHERED COAL
					34.5	2.0		CL	CLAY: low to medium plasticity, pale grey / white.				EXTREMELY WEATHERED TUFF
					34.0	2.5			Test pit TP11 terminated at 2.1m				

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No. TP12

Sheet 1 of 1

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 368155 m | R.L. Surface: 24.30

excavation dimensions: 2m long 0.3m wide | Northing: 6356101 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		24.0 / 0.0		SM	TOPSOIL: Silty SAND, fine to coarse grained, low liquid limit, grey, some organics.				TOPSOIL
				D	0.5		CH	Sandy CLAY: medium to high plasticity, fine to medium grained sand, pale grey, pale brown.			× ×	RESIDUAL
					23.5 / 1.0		CL / SC	Sandy CLAY / Clayey SAND: low to medium plasticity, fine to coarse grained, orange / brown.	M>Wp	VSt		
							CL	Sandy CLAY: medium plasticity, fine to medium grained sand, mottled grey / brown.			× × ×	
					23.0 / 1.5		CL	CLAY: low plasticity, black.		St		EXTREMELY WEATHERED COAL
					22.5 / 2.0		CL	CLAY: low plasticity, mottled pale grey, pale brown - white.			×	EXTREMELY WEATHERED TUFF
					22.0 / 2.5			Test pit TP12 terminated at 2.1m				

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

coffey geotechnics

Engineering Log - Excavation

Excavation No.	TP13
Sheet	1 of 1
Project No:	GEOTWARA20544AC
Client:	GEOLINK PTY LTD
Date started:	9.7.2008
Principal:	
Date completed:	9.7.2008
Project:	EDGEWORTH LOCAL ENVIRONMENT PLAN
Logged by:	AMT
Test pit location:	REFER TO FIGURE 2
Checked by:	AMT

equipment type and model: Backhoe | Pit Orientation: | Easting: 369042 m | R.L. Surface: 31.60

excavation dimensions: 2m long 0.3m wide | Northing: 6356709 m | datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
EXC		N	None Observed		31.5 / 0.0		SM	TOPSOIL: Silty SAND, fine to medium grained sand, grey, some organics.	M			TOPSOIL
				D	0.5		CL	Sandy CLAY: low to medium plasticity, fine to coarse grained sand, trace of fine to coarse grained sandstone gravel, grey.	M>Wp	VSt	×	COLLUVIAL
					31.0		CL	Sandy CLAY: medium plasticity, fine to medium grained sand, mottled grey / orange.			×	RESIDUAL
								SANDSTONE: fine to medium grained, orange / grey.				HIGHLY WEATHERED SANDSTONE
								Test pit TP13 terminated at 0.8m				
					30.5 / 1.0							
					30.0 / 1.5							
					29.5 / 2.0							
					2.5							

Sketch

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

support
- S shoring
- N nil

penetration
1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

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Engineering Log - Excavation

Excavation No. NE1

Sheet 1 of 2

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model:

Pit Orientation:

Easting: 368889 m

R.L. Surface: 48.50

excavation dimensions: m long m wide

Northing: 6356756 m

datum:

excavation information | material substance

method	penetration 1 2 3	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro-meter kPa (100 200 300 400)	structure and additional observations
					48.0	0.5			SANDSTONE: fine to medium grained, subhorizontal bedding (2°), orange / grey, estimated medium strength.	D			HIGHLY TO MEDIUM WEATHERED SANDSTONE JT1 238° / 2°S, PL, RO, SN, (FE) SPACING < 0.3m JT2 310° / 90°, PL, SO, CN, SPACING <1.0m JT3 170° / 90°, PL, RO, CN, SPACING <1.0m. JT4 150° / 90°, PL, RO, CN, SPACING <0.5m
					47.5	1.0			SILTSTONE: subhorizontal bedding (8°), thin lamination, grey, estimated low strength.				EXTREMELY TO HIGHLY WEATHERED SILSTONE, 230° / 8°S
					47.0	1.5			TUFF: orane / white, massive, estimated very low strength.			600	EXTREMELY TO HIGHLY WEATHERED TUFF
					46.5	2.0			COAL: Indistinct cleated mass, black.				EXTREMELY TO HIGHLY WEATHERED COAL (Upper Pilot Seam)
					46.0	2.5			SILTSTONE: carbonaceous thin, interlamination of coal bands (<5mm), dark grey / black.				HIGHLY WEATHERED CARBONACEOUS SILSTONE, 290° / 10°S
					45.5	3.0			SILTSTONE: subhorizontal, coarse interlamination, grey, estimated low strength.				HIGHLY WEATHERED SILTSTONE
					45.0	3.5			Estimated low strength, increasing to medium strength, sandstone interbedding occuring.				

Sketch

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

support
- S shoring
- N nil

penetration 1 2 3 4 — no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

coffey geotechnics

Engineering Log - Excavation

Excavation No. NE1

Sheet 2 of 2

Project No: GEOTWARA20544AC

Client: GEOLINK PTY LTD

Date started: 9.7.2008

Principal:

Date completed: 9.7.2008

Project: EDGEWORTH LOCAL ENVIRONMENT PLAN

Logged by: AMT

Test pit location: REFER TO FIGURE 2

Checked by: AMT

equipment type and model:

Pit Orientation:

Easting: 368889 m

R.L. Surface: 48.50

excavation dimensions: m long m wide

Northing: 6356756 m

datum:

excavation information						material substance						
method	penetration 1 2 3	support	water	notes samples, tests, etc	RL / depth metres	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetrometer kPa (100 200 300 400)	structure and additional observations
								SILTSTONE: subhorizontal, coarse interlamination, grey, estimated low strength. (continued)	D			HIGHLY WEATHERED SILTSTONE
								COAL: indistinct cleated mass, black.			600	EXTREMELY TO HIGHLY WEATHERED COAL, 280° / 2°S
					44.5 / 4.0			TUFF: occuring as clay, high plasticity, massive, pale grey.				HIGHLY WEATHERED TUFF
					44.0 / 4.5							
								SILTSTONE: thin lamination, brown / grey, estimated very low to low strength.				HIGHLY WEATHERED SILTSTONE
					43.5 / 5.0							
								TUFF: occuring as clay, high plasticity, massive, pale grey.				HIGHLY WEATHERED TUFF
					43.0 / 5.5							
					42.5 / 6.0							
					42.0 / 6.5							
								Test pit NE1 terminated at 6.5m				
					41.5 / 7.0							

Sketch

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

support
- S shoring
- N nil

penetration 1 2 3 4: no resistance ranging to refusal

water
- water level on date shown
- water inflow
- water outflow

notes, samples, tests
- U50 undisturbed sample 50mm diameter
- U63 undisturbed sample 63mm diameter
- D disturbed sample
- V vane shear (kPa)
- Bs bulk sample
- E environmental sample
- R refusal

classification symbols and soil description based on unified classification system

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

consistency/density index

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

TESTPIT TP 1 - 13, NE1.GPJ COFFEY.GDT 19.8.08

Form GEO 5.2 Issue 3 Rev.2

Appendix B

Results of Laboratory Testing

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

Warabrook, Newcastle Laboratory

Coffey Geotechnics Pty Ltd
ABN 93 056 929 483
Lot 101, 19 Warabrook Boulevard
Warabrook NSW 2304

Telephone: +61 2 4016 2300
Facsimile: +61 2 4016 2380

California Bearing Ratio

Report No: CBR:WARA08S-01828
Issue No: 1
This report replaces all previous issues of report no 'CBR:WARA08S-01828'.

Client: Coffey Geotechnics (Warabrook)
19 Warabrook Boulevard
Warabrook NSW 2304

Principal:
Job No: LABTWARA00540AA
Project: GEOTWARA 20627AA - Proposed Rural Subdivision
Lot No: **TRN:**

Approved Signatory: Alan Cullen (Laboratory Manager)
NATA Accredited Laboratory Number: 431
Date of Issue: 18/03/2008

Sample Details

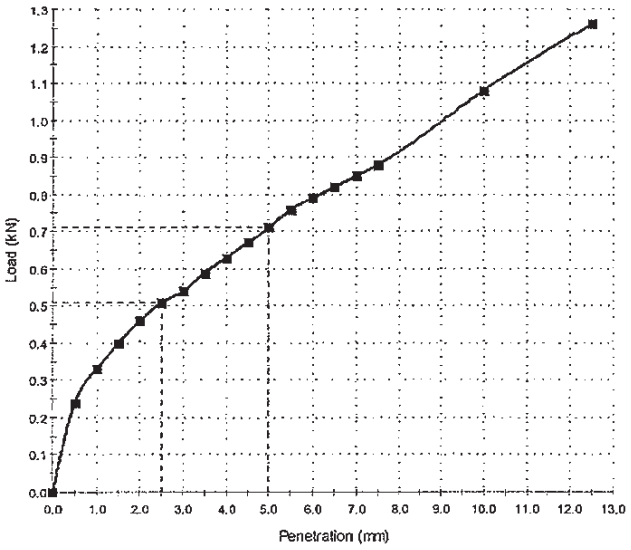
Product: 0.6 - 0.8m
Source: TP1 (Bs)
Location: Tea Gardens
Client Ref: 0001

Date Sampled: 4/03/2008
Sampling Method: AS1289.1.2.1 Clause 6.4b
Sample ID: WARA08S-01828

Test Results

Description	Result
Test Method	AS 1289.6.1.1
Maximum Dry Density (t/m³)	1.600
Optimum Moisture Content (%)	22.7
CBR 2.5mm (%)	**4.0**
CBR 5.0mm (%)	3.5
Preparation	Soaked
Initial Moisture Content (%)	20.7
Achieved Dry Density (t/m³)	1.639
Achieved Moisture Content (%)	20.7
Swell (%)	2.0
Moisture After Penetration (%)	24.4
Period of Soaking (days)	4
Moisture Content of Top 30mm (%)	25.8
Moisture of Penetrated End (%)	
Compaction Type	Standard
Surcharge Mass (kg)	4.50
Laboratory Moisture Ratio After Compaction (%)	91
Laboratory Density Ratio After Compaction (%)	103
Oversize Material Excluded	YES
Percent Oversize Excluded	0.0
Rate of Penetration	1.0

Chart



CBR (%): 4.0

Comments

(CH) Sandy CLAY - High Plasticity, Brown, Fine to Coarse Sand with Traces of Silt
FMC = 25.4%

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Warabrook Laboratory
Coffey Geotechnics Pty Ltd
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Report No.: MAT:JUL22-01 **Issue No.: 1**

This report replaces all previous issues.

Aggregate/Soil Test Report

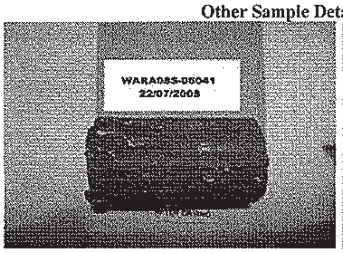
Client:	Coffey Geotechnics Warabrook (GEOTWARA20544AC)
Principal:	Geolink P/L
Job No.:	INFOWARA00037AA
Project:	Edgeworth Local Environment Plan
Location:	Edgeworth NSW
Lot No.:	- **TRN:** -

Approved Signatory: Alan Cullen
Laboratory Manager
NATA Accredited Laboratory Number: 431
Date of Issue:

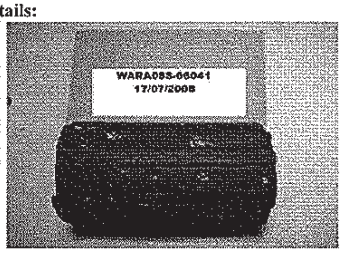
Sample Details

Sample ID:	WARA08S-06041
Field Sample:	TP2 @ 0.5 - 0.8m
Date Sampled:	09/07/2008
Source:	-
Material:	(CL-CH) CLAY, motled reddish brown, brownish grey, trace fine gravel
Specification:	-
Sampling Method:	U50
Location:	TP2 @ 0.5 - 0.8m

Other Sample Details:



Length before drying: 85.78mm



Length after drying: 83.99mm

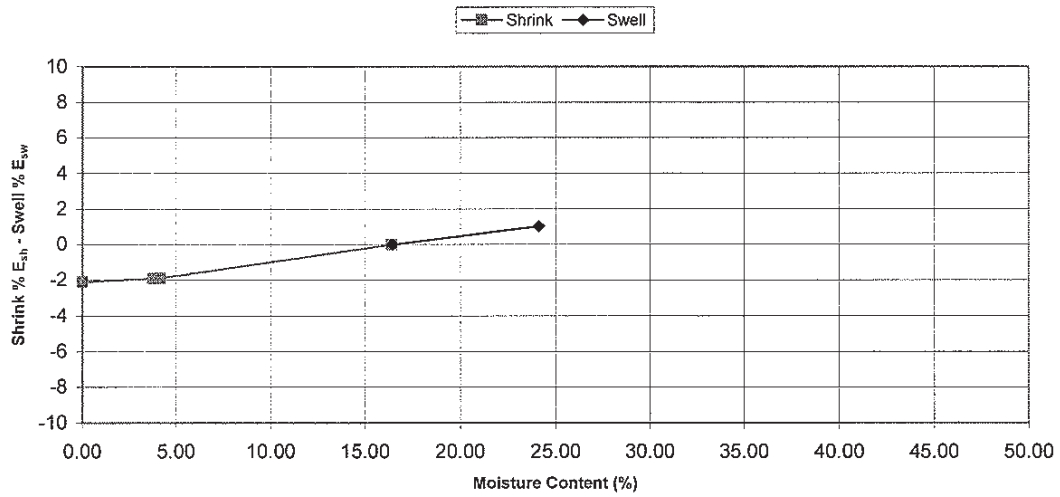
Test Results

Swell Test

Swell on Saturation %	Moisture Content % before test	Moisture Content % after test	Estimated unconfined Compressive strength before test	kPa	Estimated unconfined Compressive strength after test
1.0	16.5	24.1	>600		250

Shrink Test

Shrink on drying %	Est. inert material present %	Extent of crumbling during shrinkage	Extent of cracking during shrinkage
2.1	Nil	Nil	Slight



Test Method and remarks:
Shrink/Swell AS1289.7.1.1
Estimated unconfined compressive strength obtained using pocket penetrometer.

Shrink Swell Index:
I_{ss} = 1.4

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Warabrook Laboratory
Coffey Geotechnics Pty Ltd
ABN 93 056 929 483
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Telephone: +61 02 4016 2300
Facsimile: +61 02 40162380

Report No.: MAT:JUL22-02 Issue No.: 1
This report replaces all previous issues.

Aggregate/Soil Test Report

Client:	Coffey Geotechnics Warabrook (GEOTWARA20544AC)
Principal:	Geolink P/L
Job No.:	INFOWARA00037AA
Project:	Edgeworth Local Environment Plan
Location:	Edgeworth NSW
Lot No.:	- **TRN:** -

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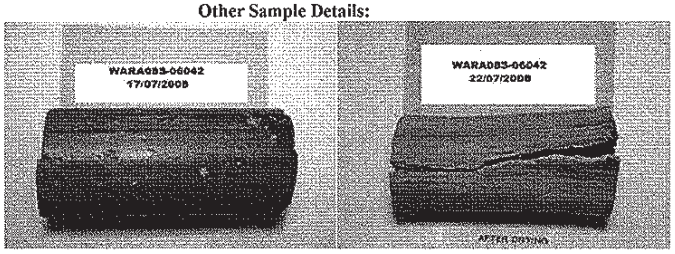
Approved Signatory: Alan Cullen
Laboratory Manager
NATA Accredited Laboratory Number: 431
Date of Issue:

Sample Details

Sample ID:	WARA08S-06042
Field Sample:	TP4 @ 0.3 - 0.6m
Date Sampled:	09/07/2008
Source:	-
Material:	(CH) CLAY trace silt, grey
Specification:	-
Sampling Method:	U50
Location:	TP4 @ 0.3 - 0.6m

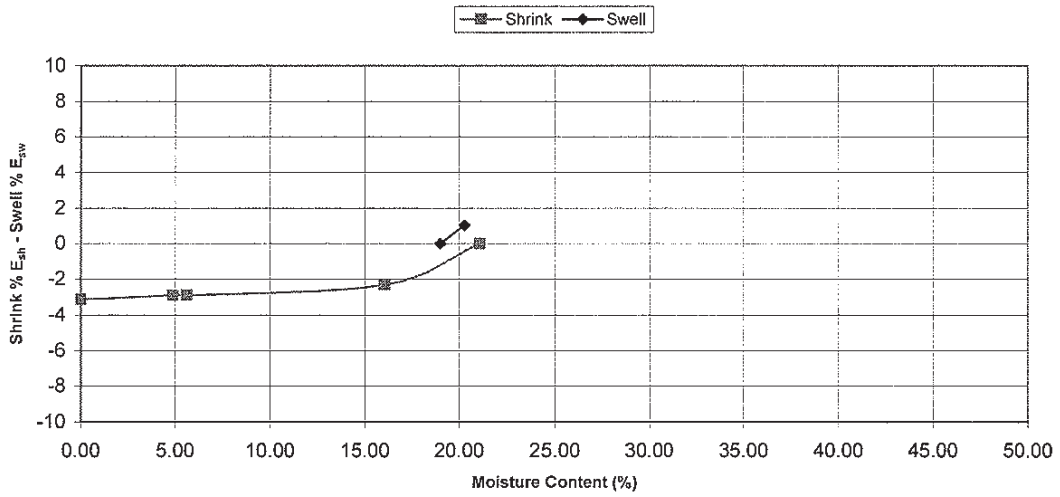
Other Sample Details:



Length before drying: 99.24mm Length after drying: 96.13mm

Test Results

Swell Test						Shrink Test			
Swell on Saturation %	Moisture Content % before test	Moisture Content % after test	Estimated unconfined Compressive strength before test	kPa	Estimated unconfined Compressive strength after test	Shrink on drying %	Est. inert material present %	Extent of crumbling during shrinkage	Extent of cracking during shrinkage
1.0	19.0	20.3	>600		310	3.1	Nil	Nil	Extreme



Test Method and remarks:
Shrink/Swell AS1289.7.1.1
Estimated unconfined compressive strength obtained using pocket penetrometer.

Shrink Swell Index:
I_{ss} = 2.0

Form Number: WARABROOK 151: Issue 1.0

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Warabrook Laboratory
Coffey Geotechnics Pty Ltd
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Facsimile: +61 02 40162380

Report No.: MAT:JUL22-03 **Issue No.: 1**

This report replaces all previous issues.

Aggregate/Soil Test Report

Client:	Coffey Geotechnics Warabrook (GEOTWARA20544AC)
Principal:	Geolink P/L
Job No.:	INFOWARA00037AA
Project:	Edgeworth Local Environment Plan
Location:	Edgeworth NSW
Lot No.:	- **TRN:** -

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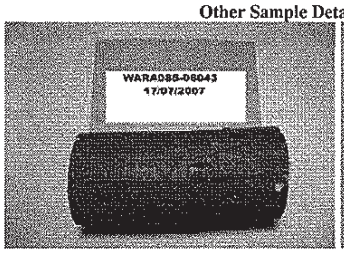
Approved Signatory: Alan Cullen
Laboratory Manager
NATA Accredited Laboratory Number: 431
Date of Issue:

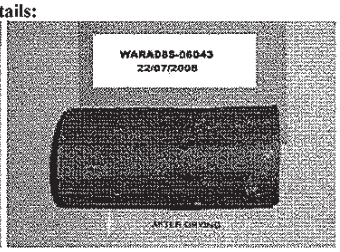
Sample Details

Sample ID:	WARA08S-06043
Field Sample:	TP8 @ 0.40 - 0.65m
Date Sampled:	09/07/2008
Source:	-
Material:	(CL-CH) CLAY, mottled reddish brown, brownish grey.
Specification:	-
Sampling Method:	U50
Location:	TP8 @ 0.40 - 0.65m

Other Sample Details:



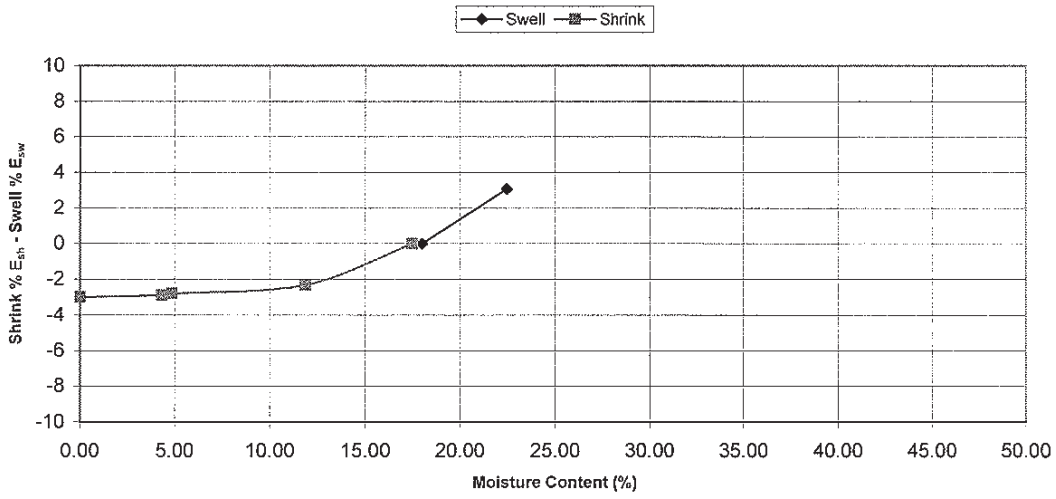
Length before drying: 97.59mm



Length after drying: 94.66mm

Test Results

Swell Test						Shrink Test			
Swell on Saturation %	Moisture Content % before test	Moisture Content % after test	Estimated unconfined Compressive strength before test	kPa	Estimated unconfined Compressive strength after test	Shrink on drying %	Est. inert material present %	Extent of crumbling during shrinkage	Extent of cracking during shrinkage
3.1	18.0	22.5	600		200	3.0	Nil	Nil	Nil



Test Method and remarks:
Shrink/Swell AS1289.7.1.1
Estimated unconfined compressive strength obtained using pocket penetrometer.

Shrink Swell Index:
I_{ss} = 2.5

Form Number: WARABROOK 151: Issue 1.0

coffey information
SPECIALISTS IN SCIENTIFIC TESTING SOLUTIONS

Warabrook Laboratory
Coffey Geotechnics Pty Ltd
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Telephone: +61 02 4016 2300
Facsimile: +61 02 40162380

Report No.: MAT:JUL22-04 **Issue No.: 1**

This report replaces all previous issues.

Aggregate/Soil Test Report

Client:	Coffey Geotechnics Warabrook (GEOTWARA20544AC)
Principal:	Geolink P/L
Job No.:	INFOWARA00037AA
Project:	Edgeworth Local Environment Plan
Location:	Edgeworth NSW
Lot No.:	- **TRN:** -

NATA WORLD RECOGNISED ACCREDITATION

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

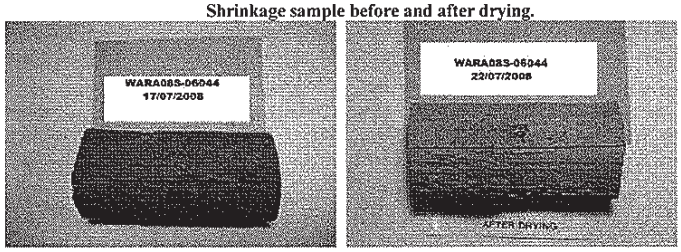
{This document may not be reproduced except in full.}

Approved Signatory: Alan Cullen
Laboratory Manager
NATA Accredited Laboratory Number: 431
Date of Issue:

Sample Details

Sample ID:	WARA08S-06044
Field Sample:	TP10 @ 0.30 - 0.52m
Date Sampled:	09/07/2008
Source:	-
Material:	(CL-CH) CLAY, greyish brown
Specification:	-
Sampling Method:	U50
Location:	TP10 @ 0.30 - 0.52m

Shrinkage sample before and after drying.



Length before drying: 94.67mm Length after drying: 87.80mm

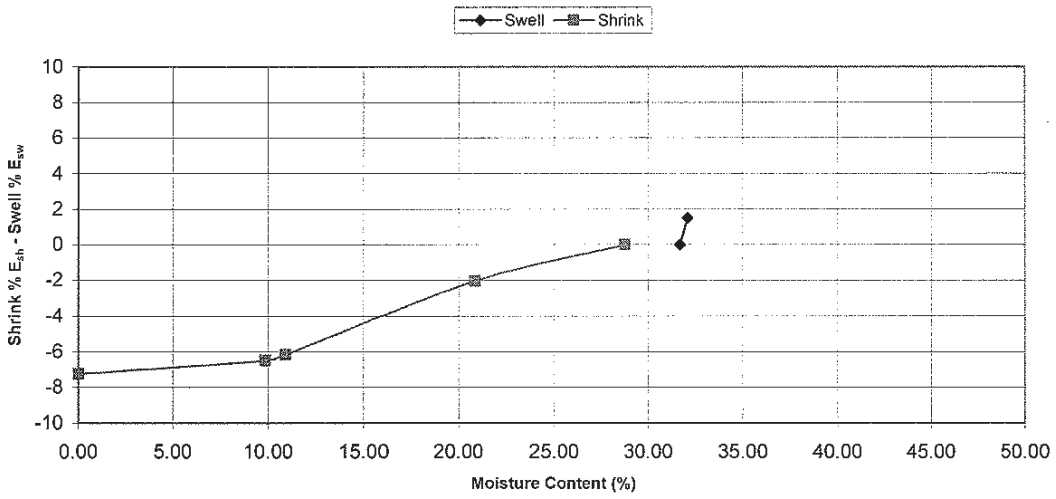
Test Results

Swell Test

Swell on Saturation %	Moisture Content % before test	Moisture Content % after test	Estimated unconfined Compressive strength before test	kPa	Estimated unconfined Compressive strength after test
1.5	31.7	32.1	200		150

Shrink Test

Shrink on drying %	Est. inert material present %	Extent of crumbling during shrinkage	Extent of cracking during shrinkage
7.3	Nil	Nil	Nil



Test Method and remarks:
Shrink/Swell AS1289.7.1.1
Estimated unconfined compressive strength obtained using pocket penetrometer.

Shrink Swell Index:
I_{ss} = 4.4

Form Number: WARABROOK 151; Issue 1.0

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Report No.: MAT:JUL23-02 **Issue No.: 1**

This report replaces all previous issues of report no. 'MAT:(type number here)':

Determination of Emerson class number

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06032	**Material source**	Testpit 1
Sample identification	Testpit 1 @ 0.4 - 0.5m		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 9.35

time dispersion commences: Nil

time dispersion completed:

Material Description

(CL) CLAY, low plasticity, pale brown.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ (7)
  - does not swell ☐ (8)
  - complete dispersion ☐ (1)
  - partical dispersion ☐ (2)
  - no dispersion ☒

Immersion of remoulded material

- disperses ☐ (3)
- does not disperse ☒
  - calcite or gypsum present ☐ (4)
  - calcite or gypsum absent ☒
    - vigorous shaking ☐
    - disperses ☒ (5)
    - flocculates ☐ (6)

Emerson class number
5

coffey information
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Report No.: MAT:JUL23-02 Issue No.: 1

This report replaces all previous issues of report no. 'MAT:(type number here)'.

Determination of Emerson class number

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06033	**Material source**	Testpit 2
Sample identification	Testpit 2 @ 0.1 - 0.2m		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 9.40

time dispersion commences: Nil

time dispersion completed:

Material Description

(CL) CLAY, low plasticity, with traces of silt and clay, brown.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - complete dispersion ☐ (1)
  - partical dispersion ☐ (2)
  - no dispersion ☒
    - **Immersion of remoulded material**
      - disperses ☐ (3)
      - does not disperse ☒
        - calcite or gypsum present ☐ (4)
        - calcite or gypsum absent ☒
          - vigorous shaking ☐
          - disperses ☒ (5)
          - flocculates ☐ (6)
- swell ☐ (7)
- does not swell ☐ (8)

Emerson class number
5

Form Number:WARABROOK 139/Issue 2.0

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Report No.: MAT:JUL23-02 **Issue No.: 1**

This report replaces all previous issues of report no. 'MAT:(type number here)'.

Determination of Emerson class number

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06034	**Material source**	Testpit 3
Sample identification	Testpit 3 @ 0.3 - 0.4m		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 10.05

time dispersion commences: Nil

time dispersion completed:

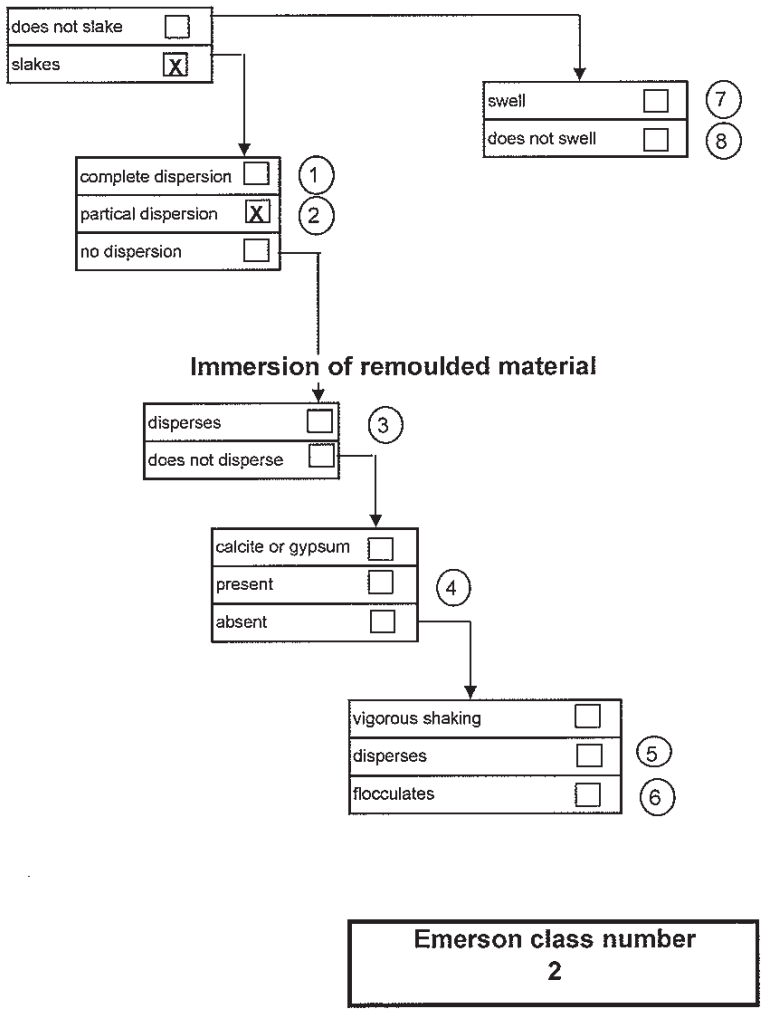
Material Description

(CL) CLAY, medium plasticity, brown.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs



Emerson class number
2

Form Number:WARABROOK 139:Issue 2.0

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Determination of Emerson class number

Report No.: MAT:JUL23-02 **Issue No.: 1**
This report replaces all previous issues of report no. 'MAT:(type number here)'.

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06036	**Material source**	Testpit 6
Sample identification	Testpit 6 @ 0.3 - 0.6m		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 10.05

time dispersion commences: Nil

time dispersion completed:

Material Description

(CL) CLAY, medium plasticity, brown.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs

- does not slake ☐
- slakes ☒
  - swell ☐ (7)
  - does not swell ☐ (8)
  - complete dispersion ☐ (1)
  - partical dispersion ☐ (2)
  - no dispersion ☒
    - **Immersion of remoulded material**
    - disperses ☐ (3)
    - does not disperse ☒
      - calcite or gypsum present ☐ (4)
      - calcite or gypsum absent ☒
        - vigorous shaking ☐
        - disperses ☒ (5)
        - flocculates ☐ (6)

Emerson class number
5

Form Number:WARABROOK 139:Issue 2.0

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Determination of Emerson class number

Report No.: MAT:JUL23-02 **Issue No.: 1**

This report replaces all previous issues of report no. 'MAT:(type number here)'.

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06037	**Material source**	Testpit 9
Sample identification	Testpit 9 @ 0.4 - 0.6m		

Test Data	Immersion of air dried crumbs

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 10.05

time dispersion commences: Nil

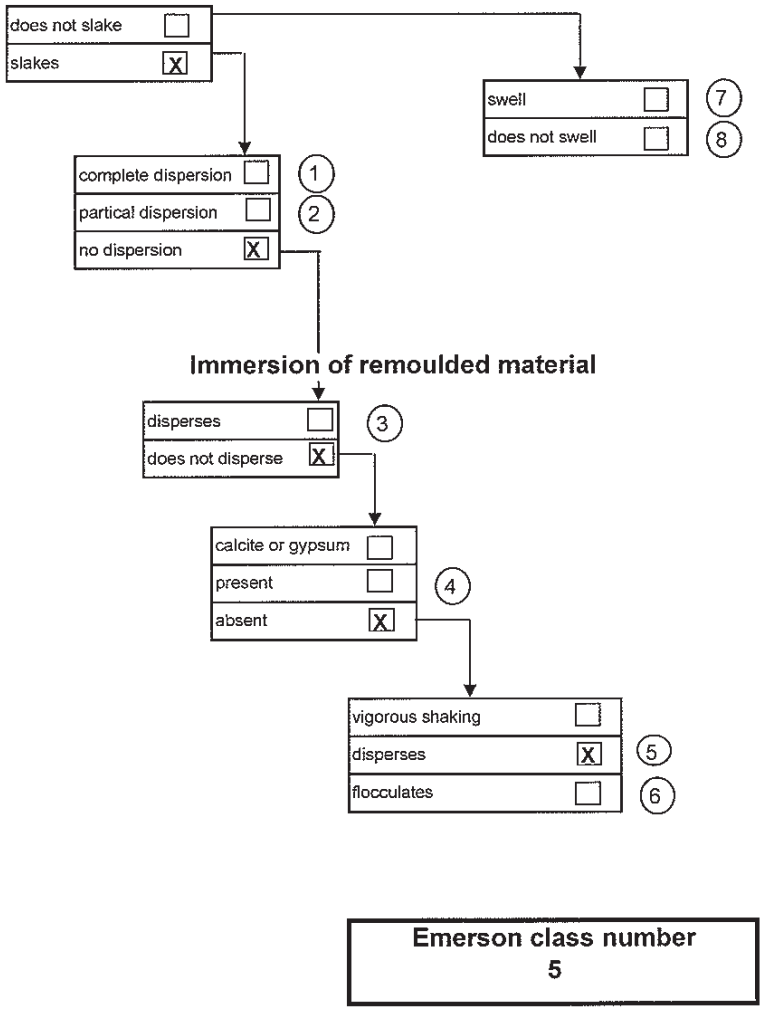
time dispersion completed:

Material Description

(CL) CLAY, medium plasticity, brown.

type of water used: Demineralised

water temperature 19.1°c



Emerson class number
5

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Determination of Emerson class number

Report No.: MAT:JUL23-02 — **Issue No.: 1**

This report replaces all previous issues of report no. 'MAT:(type number here)'.

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06039	**Material source**	Testpit 122
Sample identification	Testpit 12 @ 0.4 - 0.8m		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 10.05

time dispersion commences: Nil

time dispersion completed:

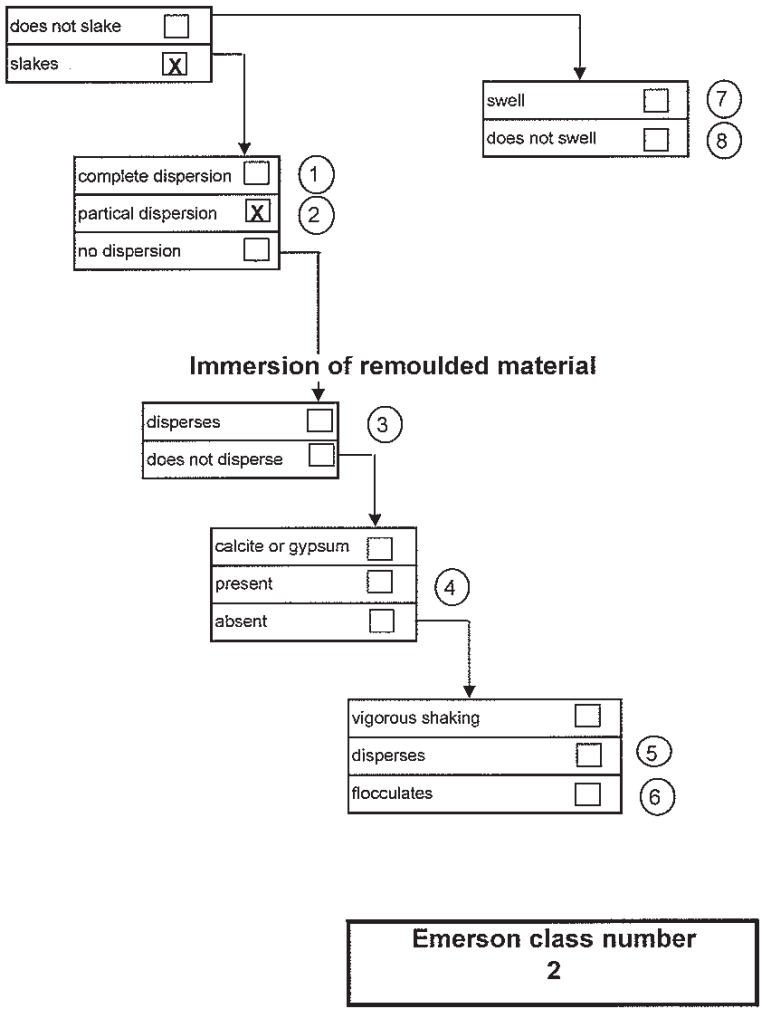
Material Description

(CL) CLAY, medium plasticity, brown.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs



Emerson class number
2

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Facsimile: +61 02 4016 2380

Report No.: MAT:JUL23-02 **Issue No.: 1**

This report replaces all previous isues of report no. 'MAT:(type number here)'.

Determination of Emerson class number

Client:	COFFEY GEOTECHNICS PTY LTD 19 WARABROOK BOULEVARD WARABROOK NSW 2304
Principal:	GEOLINK PTY LTD
Job No.:	INFOWARA00037AA
Project:	GEOTWARA20544AC - Edgeworth Local Environmental Plan
Lot No.:	**TRN:**

NATA
WORLD RECOGNISED ACCREDITATION

Approved Signatory: Marc Henty
Laboratory Operations Manager
NATA Accredited Laboratory Number: 431
Date of Issue: 23/07/08

Sample Details

Test procedure	AS1289 3.8.1	**Date sampled**	21/7/2008
Sample number	WARA0S-06040	**Material source**	Testpit 13
Sample identification	Testpit 13		

Test Data

Air Dried Crumbs

time start of test: 9.00

time dispersion commences: Nil

time dispersion completed:

Remoulded Material

time start of test: 10.08

time dispersion commences: Nil

time dispersion completed:

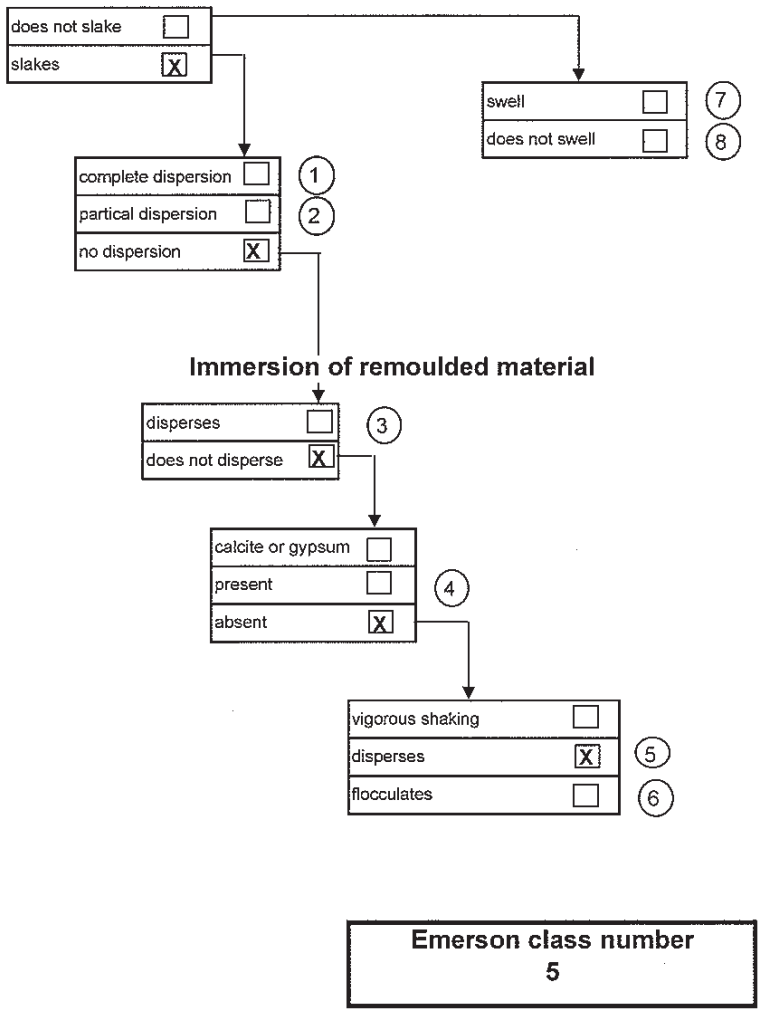
Material Description

(CL-CH) CLAY, medium to high plasticity, white / grey.

type of water used: Demineralised

water temperature 19.1°c

Immersion of air dried crumbs



Emerson class number
5

coffey

Chain of Custody

S173-174 — T-19.1°C — No: 14378

Laboratory Quotation / Order No: — Job No: GBOTWARA 20544AC — Sheet — of

Dispatch to: (Address & Phone No.) SGS ALEXANDRIA U16 33 MADDOX ST, ALEXANDRIA 2015	Sampled by: ATAIT	Consigning Officer: Andrew Ryan Date Dispatched: 17/7/08
Attention:	Project Manager: (report results to) ATAIT	Courier Service: TNT Consignment Note No: 893223832

Relinquished by:	Date:	Time:	Received by:	Date:	Time:
A Ryan	17/7/08	3.00pm	David	21/7	

Comments	Sample Matrix	Container Type and Preservative	Sample No.	Date Sampled	Analyses Required: PAHs	TPHs	MAHs + BTEX	Metals	23 HM	Ecotox Suite	Cd, Mg, K, Na								Sample Condition on Receipt
TP1 0.4 - 0.5	06032	PLASTIC BAG	1						/		/								
TP2 0.1 - 0.2	06033	↓	2						/		/								
TP3 0.3 - 0.4	06034		3						/		/								
TP5 0.6 - 0.7	06035		4						/										
TP6 0.3 - 0.6	06036		5						/		/								
TP9 0.4 - 0.6	06037		6						/										
TP11 0.5 - 0.8	06038		7						/										
TP12 0.4 - 0.8	06039		8						/		/								
TP13 0.3 - 0.6	06040		9						/		/								
									/		/								

Received 21/7 1
By D
Time 9 am/pm
Samples intact yes/no
Ice/Cooler Pack yes/no
Comments: 62621

Special Laboratory Instructions:

Detection Limits: — Turnaround Required:

JOB NUMBER MUST BE REFERENCED ON ALL SUBSEQUENT PAGES

Copies: **WHITE:** Sign on release. **YELLOW:** If dispatched to Interstate Lab, Lab to sign on receipt and fax back to Coffey. **BLUE:** To be returned with results.

AU.SampleReceipt.Sydney (Sydney)

From: Shayne McKenzie [Shayne_McKenzie@coffey.com]
Sent: Monday, 21 July 2008 3:40 PM
To: AU.SampleReceipt.Sydney (Sydney)
Cc: Andrew Tait
Subject: Sample Identification for recieved samples

Andy,
That's exactly what's happened, anyway the lab numbers and TP's are as such:

Lab Number	TP and depth
06032	TP1 @ 0.4-0.5m
06033	TP2 @ 0.1 - 0.2m
06034	TP3 @ 0.3 - 0.4m
06035	TP5 @ 0.6 - 0.7m
06036	TP6 @ 0.3 - 0.6m
06037	TP9 @ 0.4 - 0.6m
06038	TP11 @ 0.5 - 0.8m
06039	TP12 @ 0.4 - 0.8m
06040	TP13 @ 0.3 - 0.6m

Regards

SHAYNE MCKENZIE
Senior Technical Officer

Coffey Information
19 Warabrook Boulevard Warabrook NSW 2304 Australia
T (+61) (2) 4016 2300 F (+61) (2) 4016 2380
coffey.com

-----Original Message-----
From: Andrew Tait
Sent: Monday, July 21, 2008 1:49 PM
To: Shayne McKenzie
Subject: FW: GEOTWARA20544AC, SGS# 62621

Shayne,

Can you please help me here? SGS does not know what bag is what. I think our lab has renumbered with their own codes and has not update the COC. Can you tell me what (TP) is what ("06...)?

Thanks,

Andy
-----Original Message-----
From: AU.SampleReceipt.Sydney (Sydney) [mailto:AU.SampleReceipt.Sydney@sgs.com]
Sent: Monday, 21 July 2008 1:44 PM
To: Andrew Tait
Subject: GEOTWARA20544AC, SGS# 62621

Dear Andrew,

We have received these samples. The bags were labelled "06032-06040" inclusive

with the corresponding depths.

They were not labelled as "TP" as per COC. Please confirm the identity of the samples. Thank You.

Kind Regards

Emily Yin

Environmental Services

Sample Administration Officer

SGS Australia Pty Ltd

Unit 16, 33 Maddox St

Alexandria, NSW, 2015

Phone: +61 (0)2 8594 0400

Fax: +61 (0)2 8594 0499
E-mail: au.samplereceipt.sydney@sgs.com <mailto:au.samplereceipt.sydney@sgs.com>

Web: www.au.sgs.com <http://www.au.sgs.com/>

SHAYNE McKENZIE
Senior Technical Officer

Coffey Information
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coffey.com

SGS

LABORATORY REPORT COVERSHEET

Date: 28 July 2008

To: Coffey Geotechnics
19 Warabrook Blvd
WARABROOK NSW 2304

Attention: Andrew Tait

Your Reference: GEOTWARA 20544AC - 62621
Laboratory Report No: 60455
Samples Received: 23/07/2008
Samples / Quantity: 5 Soils

The above samples were received intact and analysed according to your written instructions. Unless otherwise stated, solid samples are reported on a dry weight basis and liquid samples as received.

Shey Goddard
Administration Manager
CAIRNS

Jon Dicker
Manager
CAIRNS

SGS Australia Pty Ltd | Environmental Services Unit 2, 58 Comport Street, Portsmith 4870 QLD Australia
ABN 44 000 964 278 | t +61 (0)7 4035 5111 f +61 (0)7 4035 5122

CLIENT: Coffey Geotechnics
PROJECT: GEOTWARA 20544AC - 62621

Laboratory Report No: 60455

LABORATORY REPORT

Cation Exchange Capacity Suite Our Reference Your Reference	Units	60455-1 62621 - 2	60455-2 62621 - 3	60455-3 62621 - 5
Date Extracted		25/07/2008	25/07/2008	25/07/2008
Date Analysed		28/07/2008	28/07/2008	28/07/2008
Sodium, Na	mg/kg	200	940	190
Sodium (meq%)	meq%	0.87	4.1	0.83
Exchangeable Sodium	%	11	32	16
Potassium, K	mg/kg	330	210	180
Potassium (meq%)	meq%	0.84	0.54	0.46
Exchangeable Potassium	%	10	4	9
Calcium, Ca	mg/kg	96	20	30
Calcium (meq%)	meq%	0.48	0.10	0.15
Exchangeable Calcium	%	6	<1	3
Magnesium, Mg	mg/kg	730	1,000	460
Magnesium (meq%)	meq%	6.0	8.2	3.8
Exchangeable Magnesium	%	73	63	72
CEC	meq%	8.2	13	5.2

CLIENT: Coffey Geotechnics **Laboratory Report No:** 60455
PROJECT: GEOTWARA 20544AC - 62621

LABORATORY REPORT

Cation Exchange Capacity Suite Our Reference Your Reference	Units	60455-4 62621 - 8	60455-5 62621 - 9
Date Extracted		25/07/2008	25/07/2008
Date Analysed		28/07/2008	28/07/2008
Sodium, Na	mg/kg	5,400	110
Sodium (meq%)	meq%	23	0.48
Exchangeable Sodium	%	54	4
Potassium, K	mg/kg	640	350
Potassium (meq%)	meq%	1.6	0.90
Exchangeable Potassium	%	4	7
Calcium, Ca	mg/kg	28	30
Calcium (meq%)	meq%	0.14	0.15
Exchangeable Calcium	%	<1	1
Magnesium, Mg	mg/kg	2,200	1,300
Magnesium (meq%)	meq%	18	11
Exchangeable Magnesium	%	42	87
CEC	meq%	43	12

CLIENT: Coffey Geotechnics **Laboratory Report No:** 60455
PROJECT: GEOTWARA 20544AC - 62621

LABORATORY REPORT

TEST PARAMETERS	UNITS	LOR	METHOD
Cation Exchange Capacity Suite			
Date Extracted			
Date Analysed			
Sodium, Na	mg/kg	2	AN122 CEI-014
Sodium (meq%)	meq%	0.01	Calculation
Exchangeable Sodium	%	1	Calculation
Potassium, K	mg/kg	2	AN122 CEI-014
Potassium (meq%)	meq%	0.01	Calculation
Exchangeable Potassium	%	1	Calculation
Calcium, Ca	mg/kg	2	AN122 CEI-014
Calcium (meq%)	meq%	0.01	Calculation
Exchangeable Calcium	%	1	Calculation
Magnesium, Mg	mg/kg	2	AN122 CEI-014
Magnesium (meq%)	meq%	0.01	Calculation
Exchangeable Magnesium	%	1	Calculation
CEC	meq%	0.01	R & H**

CLIENT: Coffey Geotechnics
PROJECT: GEOTWARA 20544AC - 62621

Laboratory Report No: 60455

LABORATORY REPORT

QUALITY CONTROL	UNITS	Blank	Replicate Sm#	Replicate Sample||Replicate
Date Extracted		[NT]	60455-1	25/07/2008 || 25/07/2008
Date Analysed		[NT]	60455-1	28/07/2008 || 28/07/2008
Sodium, Na	mg/kg	[NT]	60455-1	200 || 200 || RPD: 0
Sodium (meq%)	meq%	[NT]	60455-1	0.87 || 0.87 || RPD: 0
Exchangeable Sodium	%	[NT]	60455-1	11 || 11 || RPD: 0
Potassium, K	mg/kg	[NT]	60455-1	330 || 330 || RPD: 0
Potassium (meq%)	meq%	[NT]	60455-1	0.84 || 0.84 || RPD: 0
Exchangeable Potassium	%	[NT]	60455-1	10 || 10 || RPD: 0
Calcium, Ca	mg/kg	[NT]	60455-1	96 || 97 || RPD: 1
Calcium (meq%)	meq%	[NT]	60455-1	0.48 || 0.49 || RPD: 2
Exchangeable Calcium	%	[NT]	60455-1	6 || 6 || RPD: 0
Magnesium, Mg	mg/kg	[NT]	60455-1	730 || 730 || RPD: 0
Magnesium (meq%)	meq%	[NT]	60455-1	6.0 || 6.0 || RPD: 0
Exchangeable Magnesium	%	[NT]	60455-1	73 || 73 || RPD: 0
CEC	meq%	[NT]	60455-1	8.2 || 8.2 || RPD: 0

CLIENT: Coffey Geotechnics **Laboratory Report No:** 60455
PROJECT: GEOTWARA 20544AC - 62621

LABORATORY REPORT

NOTES:
LOR - Limit of Reporting.

Analysis Date: Between 23/07/08 **and** 28/07/08

Appendix C

Site History Information