

Appendix A

Results of Field Investigations



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.







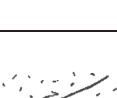
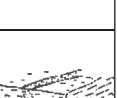
Soil Description Explanation Sheet (2 of 2)

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	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	
		GRAVELS WITH FINES (Appreciable amount of fines)	Predominantly one size or a range of sizes with more intermediate sizes missing.	GP	GRAVEL	
		CLEAN SANDS (Little or no 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	
		SANDS WITH FINES (Appreciable amount of fines)	Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	SAND	
			Non-plastic fines (for identification procedures see ML below).	SM	SILTY SAND	
		Plastic fines (for identification procedures see CL below).	SC	CLAYEY SAND		
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
	SILTS & CLAYS Liquid limit less than 50	DRY STRENGTH	DILATANCY	TOUGHNESS		
		None to Low	Quick to slow	None	ML	SILT
		Medium to High	None	Medium	CL	CLAY
	SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low	OL	ORGANIC SILT
		High	None	High	MH	SILT
		Medium to High	None	Low to medium	CH	CLAY
	HIGHLY ORGANIC SOILS	Readily identified by colour, odour, spongy feel and frequently by fibrous texture.			Pt	PEAT

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

COMMON DEFECTS IN SOIL

TERM	DEFINITION	DIAGRAM	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.		SOFTENED ZONE	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.	
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.		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	
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.		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.	
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.		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.	

Rock Description Explanation Sheet (1 of 2)

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

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

Rock Substance In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material, may be isotropic or anisotropic.

Defect Discontinuity or break in the continuity of a substance or substances.

Mass Any body of material which is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

SUBSTANCE DESCRIPTIVE TERMS:

ROCK NAME Simple rock names are used rather than precise geological classification.

PARTICLE SIZE Grain size terms for sandstone are:
 Coarse grained Mainly 0.6mm to 2mm
 Medium grained Mainly 0.2mm to 0.6mm
 Fine grained Mainly 0.06mm (just visible) to 0.2mm

FABRIC Terms for layering of penetrative fabric (eg. bedding, cleavage etc.) are:

Massive No layering or penetrative fabric.

Indistinct Layering or fabric just visible. Little effect on properties.

Distinct Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric.

ROCK SUBSTANCE STRENGTH TERMS

Term	Abbreviation	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.
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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.
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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.
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Very High	VH	3 to 10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
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Extremely High	EH	More than 10	Specimen requires many blows with geological pick to break; rock rings under hammer.
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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:

- 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.
- 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.

Notes on Rock Substance Strength:

- 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.
- 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.
- 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 (I_{s50}). The ratio may vary for different rock types. Lower strength rocks often have lower ratios than higher strength rocks.

Rock Description Explanation Sheet (2 of 2)

COMMON DEFECTS IN ROCK MASSES		Diagram	Map Symbol	Graphic Log (Note 1)	DEFECT SHAPE	TERMS
Term	Definition				Planar	The defect does not vary in orientation
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.				Planar	The defect does not vary in orientation
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.				Curved	The defect has a gradual change in orientation
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.				Undulating	The defect has a wavy surface
Sheared Surface (Note 3)	A near planar, curved or undulating surface which is usually smooth, polished or slickensided.				Stepped	The defect has one or more well defined steps
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.				Irregular	The defect has many sharp changes of orientation
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.				Note: The assessment of defect shape is partly influenced by the scale of the observation.	
Extremely Weathered Seam	Seam of soil substance, often with gradational boundaries. Formad by weathering of the rock substance in place.				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 greater than cross section

Notes on Defects:

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

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**

Principal:

Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model:	4WD Backhoe	Pit Orientation:	Easting:	m	R.L. Surface:	2.586
excavation dimensions:	1.5m long 0.4m wide		Northing:	m	datum:	AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	penetration meter	structure and additional observations
1	2	3		RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.5			TOPSOIL: SAND, fine to medium grained, dark brown with approximately 30% low plasticity fines, with 300mm of rootlets.	M			TOPSOIL
				0.5		CI	Sandy CLAY: medium plasticity, dark brown-orange, sand fine to medium grained.				
		D		2.0		SP	SAND: fine to medium grained, pale grey-white.		VD		
				1.0			Becoming pale grey-brown.	W			
		D		1.5							
				1.5							
		D		2.0			Test pit TP 1 terminated at 1.9m				
				0.5							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density Index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Excavation No. **TP 2**
 Sheet 1 of 1
 Project No. **GEOTSGTE20248AA**
 Date started: **4.4.2007**
 Date completed: **4.4.2007**
 Logged by: **CW**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.433
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3			RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.0			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark brown with approximately 30% of low plasticity fines, with approximately 300mm of rootlets.	M			TOPSOIL
				0.5		CI	Sandy CLAY: medium plasticity, dark brown-orange, with some sand lenses.	M/W	St		
				1.5							
				1.0							
				0.5		SP	SAND: fine to medium grained, brown-dark grey.	W			
				0.0							Rapid inflow of groundwater and pit collapsing below 1.7m depth.
				2.0			Test pit TP 2 terminated at 1.9m				
				2.5							

Sketch

Form GEO 5.2 Issue 3 Rev.2 TESTPIT_20248AA LOGS.GPJ COFFEY.GDT 23.10.07

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

Excavation No. **TP 3**
 Sheet 1 of 1
 Project No. **GEOTSGTE20248AA**
 Date started: **4.4.2007**
 Date completed: **4.4.2007**
 Logged by: **CW**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m		R.L. Surface: 2.571					
excavation dimensions: 1.5m long 0.4m wide				Northing: m		datum: AHD					
excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
BH	1 2 3	N		2.5			TOPSOIL: Silty Clayey SAND, fine to coarse grained, pale brown-brown, low plasticity fines with some rootlets to 300mm.	M			TOPSOIL
				0.5		SC	Clayey SAND: fine to medium grained, orange-brown / pale brown, low plasticity fines.		VD		
				1.0		SP	SAND: fine to coarse grained to fine to medium grained, pale grey-white. Becoming pale brown-white.	M/W			
				1.5							
				2.0							
				2.5							
				2.0			Test pit TP 3 terminated at 1.8m				
				0.5							
				2.5							

Sketch

Form GEO 5.2 Issue 3 Rev.2

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

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.260
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	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	structure and additional observations
BH		N		2.0			TOPSOIL: Silty CLAY, medium plasticity, dark grey-black, small percentage of sand <10% with some rootlets.	M			TOPSOIL
			D	0.5		CH	CLAY: medium to high plasticity, dark grey.	M>Wp	St	X	
			D	1.5						X	
			D	1.0						X	
				1.0						X	
				1.5						X	
				0.5						X	
				2.0		SP	SAND: fine to coarse grained, pale grey.	W		X	
			D	2.0						X	Rapid inflow of groundwater at 2.0m depth.
				0.0			Test pit TP 4 terminated at 2.1m				
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**

Principal:

Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.765
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.5			TOPSOIL: SAND, fine to medium grained, dark brown, with low plasticity fines, approximately 30% fines with some rootlets to approximately 150mm.	M			TOPSOIL
			D	0.5		CI	Sandy CLAY: medium plasticity, orange-brown, sand fine to medium grained.		VSt	*	
			D	2.0		SP	SAND: fine to medium grained, pale grey-white.		VD		
			D	1.0			Becoming pale grey-brown.				
			D	1.5							
			D	1.5							
			D	1.0					W		Rapid groundwater inflow below 1.7m depth.
				2.0			Test pit TP 5 terminated at 1.9m				
				0.5							
				2.5							

Sketch

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

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.846
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance								
method	penetration			notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1	2	3									
BH					0.5			TOPSOIL: Silty SAND, fine to medium grained, dark grey mottled white, with some rootlets and roots to 150mm.	D			TOPSOIL
				D	2.0		SM	Silty SAND: fine to medium grained, brown / red cemented sand nodules.	M	VD		INDURATED SAND?
				D	1.0		SP	SAND: fine to medium grained, pale brown-white with some cemented sand nodules.				
					1.5			Becoming pale grey-white.	W			
					2.0			Lenses of cemented sand nodules dark brown-red present.				Water visible. Pit collapsing due to groundwater.
					2.1			Test pit TP 6 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **13.4.2007**


Principal:

 Date completed: **13.4.2007**



 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **JJT**





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

 Checked by: 

 equipment type and model: _____ Pit Orientation: _____ Easting: m _____ R.L. Surface: 2.388
 excavation dimensions: m long m wide _____ Northing: m _____ datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HA		N		2.0		CH	Sandy CLAY: high plasticity, dark brown, sand fine to medium grained.	M			
			D	0.5							
				1.5		SC	Clayey SAND: fine to medium grained, grey.	W	VD		
			D	1.0			Hole terminated at 1.0m, hole collapsing because of groundwater. Test pit TP 7 terminated at 1m				
				1.0							
				1.5							
				0.5							
				2.0							
				0.0							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **13.4.2007**

Principal:

Date completed: **13.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** Logged by: **JJT**

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

Checked by:

equipment type and model: _____ Pit Orientation: _____ Easting: m _____ R.L. Surface: 3.184
excavation dimensions: m long m wide _____ Northing: m _____ datum: AHD

excavation information				material substance						
method 1 2 3	penetration support water	notes samples, tests, etc	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
HA	N		3.0		SP	Clayey SAND: fine to medium grained, black.	M	D		
	Not Measured		0.5							
			2.5			Hole terminated at 0.6m, sand too dry to retrieve. Test pit TP 8 terminated at 0.6m				
			1.0							
			2.0							
			1.5							
			1.5							
			2.0							
			1.0							
			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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Excavation No. **TP 9**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **4.4.2007**
 Date completed: **4.4.2007**
 Logged by: **CW**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m		R.L. Surface: 2.735					
excavation dimensions: 1.5m long 0.4m wide				Northing: m		datum: AHD					
excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
BH	1 2 3	N		2.5			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey, low plasticity fines, with some rootlets and thick roots to 100mm.	M			TOPSOIL
				0.5		SC	Clayey SAND: fine to medium grained, dark brown-black, low plasticity fines with some black cemented sand nodules up to approximately 0.13m diameter.		D/D/D		
				2.0		SP	SAND: medium to coarse grained, pale grey-white.				
				1.5							
				1.0			04-04-07 10:41am Becoming pale grey-brown.				
				2.0				W			Groundwater inflow below 1.8m depth.
				0.5			Test pit TP 9 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **4.4.2007**


Principal:

 Date completed: **4.4.2007**

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

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

 Checked by: 

 equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.585
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N		2.5			TOPSOIL: Clayey SAND, fine to medium grained, brown, low plasticity fines, with some rootlets and roots (10-30mm thick) to approximately 450mm.	M			TOPSOIL
		None Observed	D	2.0		SC	Clayey SAND: fine to medium grained, pale brown, with some cemented sand nodules, low plasticity fines.		MD		
			D	1.5		SP	SAND: fine to medium grained, pale grey-white.		D		
			D	1.0					VD		
			D	0.5			One big, 0.7mm dia., cemented sand nodule.		W		No obvious groundwater level or inflow but pit collapsing.
				2.0			Test pit TP10 terminated at 1.9m				
				0.5							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**


Date started: **4.4.2007**

Principal:







Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** logged by: **CW**





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

Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.732
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance								
method	penetration			notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
	1	2	3									
BH					2.5			TOPSOIL: Silty SAND, fine to medium grained, grey-brown, low plasticity fines? with some rootlets.	M			TOPSOIL
					0.5		SC	Clayey SAND: fine to medium grained, pale grey-brown, low plasticity fines.		VD		
				D	2.0		SC	Clayey SAND: fine to medium grained, orange-brown, dark brown-black, low plasticity fines, with cemented sand nodules up to approximately 0.13mm dia.				
				D	1.0		SP	SAND: fine to coarse grained, pale grey-brown.	W			
					1.5			Colour change.				
				D	1.0							
					2.0			Test pit TP11 terminated at 1.9m				
					0.5							
					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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **4.4.2007**


Principal:

 Date completed: **4.4.2007**





 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

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

 Checked by: 

 equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 3.126
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres RL	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N		3.0			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey, low plasticity fines, with some rootlets to approximately 350mm.	M			TOPSOIL
				0.5		SC	Clayey SAND / Sandy CLAY: fine to medium grained, dark grey-brown, medium plasticity fines.		St	X	
			D	2.5		CL	Sandy CLAY: low to medium plasticity, orange-brown, sand fine to medium grained.				
				1.0		SP	SAND: fine to coarse grained, pale grey-white.		VD		
				2.0			Becoming pale grey-brown.				
				1.5							
				1.5							
				2.0							
				2.0			Test pit TP12 terminated at 2m				
				1.0							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Excavation No. **TP13**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **4.4.2007**
 Date completed: **4.4.2007**
 Logged by: **CW**
 Checked by:

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.825
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa 100 200 300 400	structure and additional observations
BH	1 2 3	N		2.5			TOPSOIL: Silty SAND, fine to medium grained, dark grey-black with some rootlets and roots (10-30mm thick).	D/M			TOPSOIL
				2.0		SM	Silty SAND: dark brown-dark red, fine to medium grained, with cemented sand nodules to 0.16mm dia. Becoming brown-pale brown cemented nodules of sand still present.	M	VD		Bucket scraping on hard layer.
				1.5							
				1.0							
				0.5							
				2.0			Becoming dark brown-brown weakly cemented nodules present.	W			
				2.5			Test pit TP13 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) B bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**


Principal:








Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**





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

Checked by: 

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m		R.L. Surface: 2.760					
excavation dimensions: 1.5m long 0.4m wide				Northing: m		datum: AHD					
excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
BH	1 2 3	N		2.5			TOPSOIL: Silty CLAY, medium plasticity fines, brown with some rootlets approximately 400mm.				TOPSOIL
				0.5		CH	CLAY: high plasticity, brown-dark brown.		VSt	X	
			D	2.0						X	
			D	1.0			Becoming dark grey-black with some mottled orange.			X	
			D	1.5						X	
			D	1.5						X	
			D	1.0						X	
				2.0			Test pit TP14 terminated at 1.8m				
				0.5							
				2.5							

Sketch

TESTPIT 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4  no resistance ranging to refusal water  water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Form GEO 5.2 Issue 3 Rev.2

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**


Principal:

Date completed: **4.4.2007**



Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

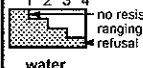



Test pit location: **REFER TO FIGURE 1**

Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.355
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information					material substance							
method	penetration			notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
	1	2	3									
BH					2.0			TOPSOIL: Silty (Clayey) SAND, fine to medium grained, dark grey-black, with some roots 10mm and rootlets to approximately 400mm.	M			TOPSOIL
				D	0.5		SP	SAND: fine to coarse grained, pale grey-brown, small percent of fines <20%. Becoming pale grey mottled black and white.	M/W	D/V/D		
				D	1.5							
				D	1.0							
				D	1.5							Pit collapsing no groundwater observed.
					0.5			Pit collapsing. Test pit TP15 terminated at 1.7m				
					2.0							
					0.0							
					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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**

Principal:

Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.683
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance								
method	penetration	support	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	structure and additional observations
	1 2 3										100 200 300 400 meter	
BH		N			2.5			TOPSOIL: Silty SAND, fine to medium grained, dark grey-black mottled white, with some rootlets.	D			TOPSOIL
					0.5		SP	SAND: fine to medium grained, pale grey-brown.	M	D		
			D		2.0					VD		
					1.0							
			D		1.5				M/W			
					1.5							
					1.0		SP	SAND: fine to medium grained, dark grey-black, cemented sand nodules, coffee rock.	W			INDURATED SAND
					2.0			Pit collapsing. Test pit TP16 terminated at 1.8m				
					0.5							
					2.5							

Sketch

TESTPIT 20248AA LOGS.GPJ COFFEY GDT 23.10.07

Form GEO 5.2 Issue 3 Rev.2

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

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**

Principal:

Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.635
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance						
method	penetration	support	notes samples, tests, etc	depth, metres	graphic log	classification symbol	material	moisture condition	consistency/density index	structure and additional observations
1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			
BH		N		2.5			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low plasticity fines, with some rootlets.	D		
				0.5						
			D	2.0		SC	Silty Clayey SAND: fine to medium grained, dark brown / red, low to medium plasticity fines, with cemented nodules of SAND.	M	VD	
				1.0						
			D	1.5		SC	Clayey SAND: fine to medium grained, brown-pale brown, low plasticity fines, with weakly cemented nodules of sand.			
				1.5						
				1.0						
			D	2.0		SP	SAND: fine to coarse grained, pale grey-pale brown.			
				1.5						
				1.0						
				2.0			becoming grey-brown.	W		Rapid inflow of groundwater below 1.7m depth.
				0.5			Pit collapsing. Test pit TP17 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **5.4.2007**

Principal:

 Date completed: **5.4.2007**

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

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

Checked by:

 equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.302
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance			
method	penetration	support	notes samples, tests, etc	graphic log	classification symbol	material	structure and additional observations
1 2 3		water	RL	depth metres		soil type: plasticity or particle characteristics, colour, secondary and minor components.	
BH		N				TOPSOIL: Sandy CLAY, low to medium plasticity, dark brown-black, sand fine to medium grained, with some rootlets to 100mm.	TOPSOIL
				2.0			
				0.5	CI	CLAY: medium plasticity, dark grey mottled orange, with minor sand component approximately 10%.	VSt
			D		SC	Clayey SAND: fine to medium grained, grey, low plasticity fines.	D
				1.5			
				1.0	SP	SAND: fine to coarse grained, pale grey-white. Becoming grey / brown.	VD
			D				
				1.0			
				0.5		Sand becoming indurated and dark brown / red.	W
			D				
				2.0		Pit collapsing due to inflow of groundwater, collapsing from sides. Test pit TP18 terminated at 1.9m	
				0.0			
				2.5			

Sketch

TESTPIT 20248AA LOGS GPJ COFFEY.GDT 23.10.07

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4 no resistance ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Form GEO 5.2 Issue 3 Rev.2

Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **4.4.2007**


Principal:

 Date completed: **4.4.2007**

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

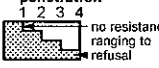



 Test pit location: **REFER TO FIGURE 1**

 Checked by: 

 equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.261
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information					material substance							
method	penetration			notes samples, tests, etc	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	structure and additional observations
	1	2	3									
BH					2.0			TOPSOIL: Clayey SAND, fine to medium grained, dark brown-black, low plasticity fines with some rootlets.	D			TOPSOIL
				D	0.5		CH	Sandy CLAY: medium to high plasticity, dark brown-black, sand fine to coarse grained.				
				D	1.5			Becoming dark grey-grey.				
				D	1.0		SP	SAND: fine to coarse grained, pale grey-white.	W	VD		
				D	1.0			Becoming pale brown / grey.				
					0.5			Pit collapsing due to groundwater. Test pit TP19 terminated at 1.8m				
					2.0							
					0.0							
					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  water  water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **4.4.2007**

Principal:

Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.255
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3			RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.0		CL	TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, with some rootlets.	D			TOPSOIL
				0.5		CL	Sandy CLAY: low plasticity, dark brown-red, sand fine to medium grained, trace of rootlets and cemented sand nodules.	M			
				1.5		M/W	Sandy CLAY: low to medium plasticity, pale grey-pale brown mottled orange, sand fine to medium grained.				
				1.0							
				1.0							
				1.5			Becoming pale brown / grey.				
				0.5			Pit collapsing due to groundwater. Test pit TP20 terminated at 1.7m				
				2.0							
				0.0							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **4.4.2007**


Principal:

 Date completed: **4.4.2007**




 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

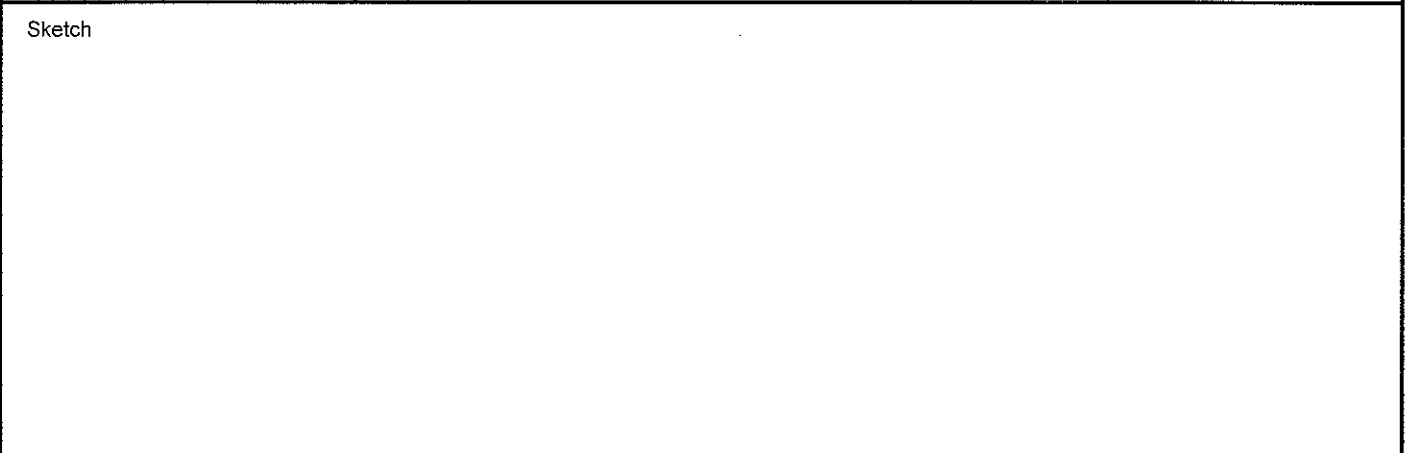
 Test pit location: **REFER TO FIGURE 1**





 Checked by: 

 equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.675
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance								
method	penetration	support	notes samples, tests, etc	depth RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.5				TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey, low plasticity fines with some rootlets and some thick roots to 300mm.	M			TOPSOIL
				0.5			SC	Clayey SAND: fine to medium grained, orange-pale brown, low plasticity fines with some cemented red sand nodules.		VD		
			D	2.0			SP	SAND: fine to medium grained, pale grey-white.				
				1.0								
			D	1.5								
				1.5				Becoming pale brown-pale grey.				
				1.0								
				2.0					W			Rapid groundwater inflow below 1.7m depth.
			D	2.0				Test pit TP21 terminated at 2m				
				0.5								
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Excavation No. **TP22**
 Sheet 1 of 1
 Project No. **GEOTSGTE20248AA**
 Date started: **4.4.2007**
 Date completed: **4.4.2007**
 Logged by: **CW**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model:	4WD Backhoe	Pit Orientation:	Easting: m	R.L. Surface:	2.332						
excavation dimensions:	1.5m long 0.4m wide		Northing: m	datum:	AHD						
excavation information			material substance								
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
BH	1 2 3	N		2.0			TOPSOIL: Sandy CLAY, low to medium plasticity, dark brown-black, sand fine to medium grained, with some rootlets.	D			TOPSOIL
			D	0.5		Cl	CLAY: medium plasticity, dark brown-black, with some sand component approximately 30%.	M			
				1.5		SM	Silty SAND: fine to medium grained, brown-pale brown, with some cemented sand nodules.		D		
			D	1.0		SP	SAND: fine to medium grained, pale grey-white.	M/W			
				1.5			Becoming pale grey / brown.		VD		
			D	0.5							
		04-04-07 2:50pm		2.0			Pit collapsing due to groundwater inflow. Test pit TP22 terminated at 1.9m				
				0.0							
				2.5							

Sketch

TESTPIT 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.2 Issue 3 Rev.2

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4 no resistance ranging to refusal water water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Excavation No. **TP23**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **5.4.2007**
 Date completed: **5.4.2007**
 Logged by: **CW**
 Checked by:

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.090
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
1 2 3										100 200 300 400	
BH		N		2.0			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black, low plasticity fines, with some rootlets to 300mm.	D			TOPSOIL
				0.5		SC	Clayey SAND: fine to medium grained, dark grey-black, low to medium plasticity fines.				
			D	1.5		CL	Sandy CLAY: low to medium plasticity, pale brown / orange, sand fine to medium grained.	M			
			D	1.0		SC	Clayey SAND: fine to medium grained, pale grey / pale brown, low plasticity fines.		VD		
			D	1.0		SP	SAND: fine to coarse grained, pale grey-white.				
			D	1.5			None Observed				
			D	2.0			Becoming grey / brown.	W			No visible water, but pit collapsing below 1.7m depth.
			D	2.0			Test pit TP23 terminated at 2m				
				0.0							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m		R.L. Surface: 2.177					
excavation dimensions: 1.5m long 0.4m wide				Northing: m		datum: AHD					
excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth metres RL	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	structure and additional observations
BH		N		2.0			TOPSOIL: Sandy CLAY, low to medium plasticity, sand fine to medium grained, with some rootlets to 100mm.	M		X	TOPSOIL
				0.5		CL	Sandy CLAY: low to medium plasticity, orange, sand fine to coarse grained.			X	
				1.5		SP	SAND: fine to medium grained, pale grey-white mottled orange.		D		
				1.0					VD		
				1.0							
				1.5							
				0.5							
				2.0			Lenses of colour change to pale grey / brown, with some clay lenses.	W			
				0.0			Pit collapsing from groundwater table. Test pit TP24 terminated at 2m				
				2.5							

Sketch

TESTPIT 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.2 Issue 3 Rev.2

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

Excavation No. **TP25**

Sheet 1 of 1

Project No: **GEOTSGTE20248AA**

Client: **TATTERSALL SURVEYORS PTY LTD**


Date started: **5.4.2007**

Principal:





Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** logged by: **CW**





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

Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.611
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N		2.5			TOPSOIL: Silty SAND, fine to medium grained, dark grey mottled white with some rootlets and roots (10mm) to 150mm.	D			TOPSOIL
				0.5							
			D	2.0			Silty SAND: fine to medium grained, dark grey-black, cemented nodules of SAND.	M	D		INDURATED SAND
				1.0					VD		
			D	1.5			100mm band of pale grey-pale brown and then becoming grey-brown weakly cemented sand nodules.	W			
				1.5							
				1.0							
			D	2.0			Becoming dark brown / red weakly sand nodules.				Rapid inflow of groundwater below 1.9m depth.
				0.5			Test pit TP25 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT 20248AA LOGS.GPJ COFFEY GDT 23.10.07

Form GEO 5.2 Issue 3 Rev.2

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**


Date started: **4.4.2007**

Principal:







Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** logged by: **CW**

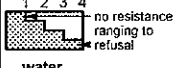



Test pit location: **REFER TO FIGURE 1**

Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 1.709
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
	1 2 3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		1.5			TOPSOIL: Silty Sandy CLAY, medium plasticity, dark grey-black, sand fine to medium grained, with some rootlets to 100mm.	M			TOPSOIL
			D	0.5		SP	SAND: fine to coarse grained, pale grey-white.		D		
			D	1.0							
			D	1.0							
			D	0.5			Becoming pale brown / grey.				
			D	1.5							
				0.0			Pit collapsing due to groundwater. Test pit TP26 terminated at 1.5m				
				2.0							
				-0.5							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**


Date started: **4.4.2007**

Principal:

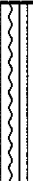


Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** logged by: **CW**





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

Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 1.536
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information					material substance							
method	penetration 1 2 3 4	support	water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N			0.5			TOPSOIL: Silty (Clayey) SAND, fine to medium grained, dark grey-black, with some rootlets to 200mm.	D			TOPSOIL
				D	1.0		SM	Silty SAND: fine to medium grained, dark brown, with some cemented sand nodules.	M	VD		
				D	1.5		SP	SAND: fine to coarse grained, brown / grey, with small percent of fines approximately 20-30% possibly clay lenses or nodules.				
					2.0			Becoming pale grey-white.	M/W			
					2.5			Becoming pale grey / brown.				
					-0.5			Pit collapsing due to groundwater inflow. Test pit TP27 terminated at 1.8m				

Sketch

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

Client: **TATTERSALL SURVEYORS PTY LTD**


Date started: **4.4.2007**

Principal:




Date completed: **4.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** logged by: **CW**

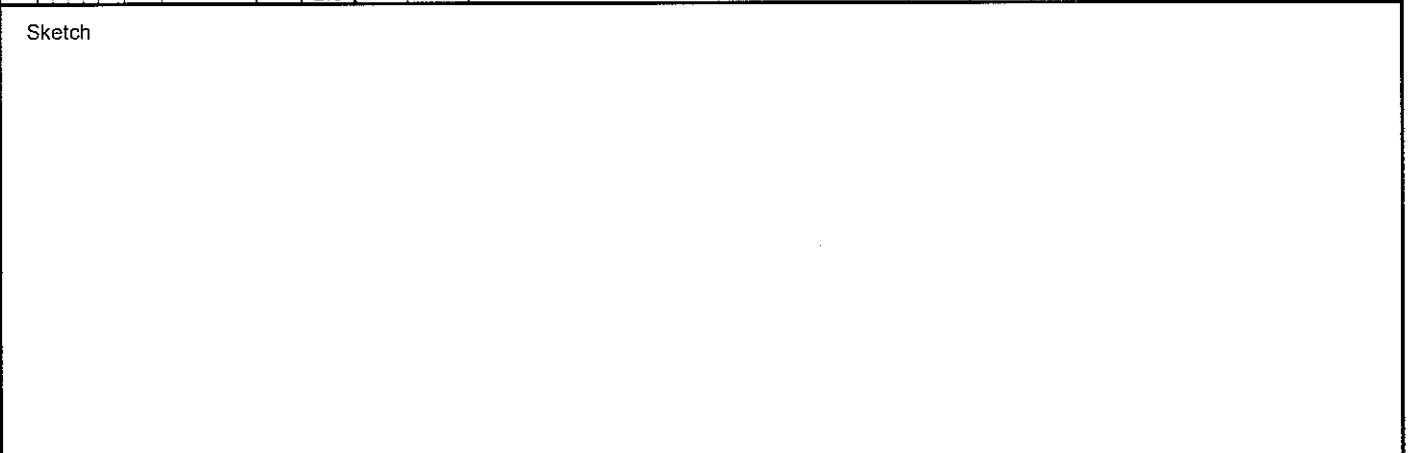
Test pit location: **REFER TO FIGURE 1**

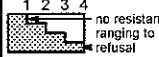
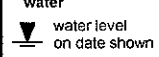
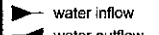
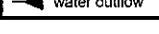
Checked by: 

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 2.012
excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance								
method	penetration			notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa meter	structure and additional observations
	1	2	3									
BH					0.5			TOPSOIL: Silty SAND, fine to medium grained, dark grey-black, with some rootlets.	D			TOPSOIL
				D	1.0		SM	Silty SAND: fine to medium grained, dark brown-black / red, cemented sand nodules.	M	D		
				D	1.5		SP	SAND: fine to coarse grained, pale brown / grey. Becoming brown / grey mottled orange.	W			
					2.0			Test pit TP28 terminated at 1.8m				

Sketch



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

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **5.4.2007**


Principal:

 Date completed: **5.4.2007**

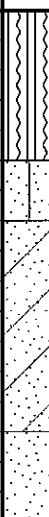
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**





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

 Checked by: 

equipment type and model: 4WD Backhoe	Pit Orientation:	Easting: m	R.L. Surface: 2.170
excavation dimensions: 1.5m long 0.4m wide		Northing: m	datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH	1 2 3	N		2.0			TOPSOIL: Silty SAND, fine to medium grained, dark brown-black, with some rootlets.	D			TOPSOIL
				0.5			Silty SAND: fine to medium grained, pale grey / pale brown.				
				1.5			SC	Clayey SAND: fine to medium grained, pale brown, low plasticity fines.	M		
				1.0			D	1.0	SP	SAND: fine to medium grained, pale grey-white.	W
				0.5				0.5			
		05-04-07 3:12pm		2.0			Pit collapsing. Test pit TP29 terminated at 1.7m				
				0.0							
				2.5							

Sketch

method N natural exposure X existing excavation BH backhoe bucket BB bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4  no resistance ranging to refusal water  water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO.5.2 Issue 3 Rev.2

Engineering Log - Excavation

Excavation No. **TP30**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **5.4.2007**
 Date completed: **5.4.2007**
 Logged by: **CW**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 1.159
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		1.0			TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low plasticity fines, some rootlets 300mm and roots to 300mm.	D			TOPSOIL
				0.5		SP	SAND: fine to coarse grained, pale grey-white. Becoming pale brown-grey.	W	MD		Some inflow of groundwater to pit at 0.3m, 8:05am, pit slowly collapsing from sides, organic odour.
			D	0.5					D		
			D	1.0							
				0.0							
				1.5			Becoming dark brown-red, with some cemented sand nodules.				
				-0.5							
				2.0			Pit collapsing. Test pit TP30 terminated at 1.7m				
				-1.0							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 0.732
 excavation dimensions: 1.5m long 0.4m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3			RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
BH		N		0.5		SC	TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low to medium plasticity fines, with layer of mulch and rootlets to 100mm. Clayey SAND: fine to medium grained, pale grey / pale brown, low plasticity fines.	D	MD		TOPSOIL (swampy area) organic odour.
				0.5					D		
				0.0			Becoming grey / brown.				Very slow inflow of groundwater.
				1.0							
				-0.5		SP	SAND: fine to medium grained, dark brown-red, indurated cemented sand nodules.				Rapid inflow of groundwater.
				1.5							
				-1.0			Silty Gravelly SAND: fine to coarse grained, dark grey-black, gravel fine to medium grained, rounded-subrounded.				
				2.0			Pit collapsing due to inflow of groundwater. Test pit TP31 terminated at 1.8m				
				-1.5							
				2.5							

Sketch

TESTPIT 20248AA LOGS.GPJ COFFEY GDT 23.10.07

Form GEO 5.2 Issue 3 Rev.2

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

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **5.4.2007**


Principal:

 Date completed: **5.4.2007**

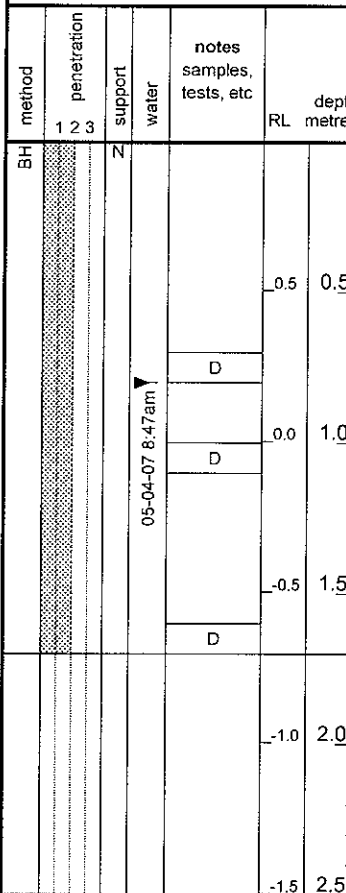


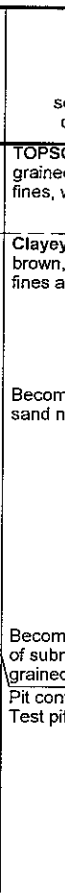
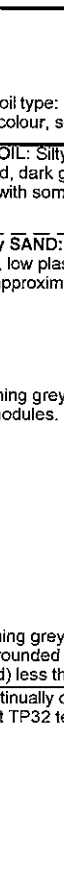

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **CW**

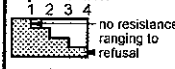
 Test pit location: **REFER TO FIGURE 1**

 Checked by: 

equipment type and model: 4WD Backhoe	Pit Orientation:	Easting: m	R.L. Surface: 0.994
excavation dimensions: 1.5m long 0.4m wide		Northing: m	datum: AHD

excavation information				material substance							
method	penetration 1 2 3	support water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N					TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low plasticity fines, with some rootlets and roots (10mm).	D			TOPSOIL (swampy area)
				0.5		SC	Clayey SAND: fine to coarse grained, pale grey-pale brown, low plasticity fines maybe low percentage of fines approximately 30-40%.	M	D		Some inflow of water.
			D	0.0			Becoming grey-brown, some presence of cemented sand nodules.	W			Moderate inflow of groundwater 8:47am.
			D	-0.5			Becoming grey mottled brown / orange and presence of subrounded to rounded gravel (fine to medium grained) less than 10mm size.				
				-1.0			Pit continually collapsed due to water table. Test pit TP32 terminated at 1.7m				
				-1.5							

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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density Index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

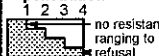



Test pit location: **REFER TO FIGURE 1**

Checked by: 

equipment type and model: 4WD Backhoe	Pit Orientation:	Easting: m	R.L. Surface: 0.923
excavation dimensions: 1.5m long 0.4m wide		Northing: m	datum: AHD

excavation information				material substance								
method	penetration			notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
	1	2	3									
BH								TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low plasticity fines, with some rootlets to 250mm.	D/M			TOPSOIL (swampy area)
					0.5		SC	Clayey SAND: fine to coarse grained, pale grey-pale brown.	M	D		Very slow inflow of groundwater 8:56am, organic odour.
				D				Becoming grey / brown.				
					1.0							
					1.5							
					2.0		SP	SAND: fine to medium grained, dark brown-black, some cemented nodules of sand.				
					2.0			Pit collapsing due to water table. Test pit TP33 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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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TESTPIT 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO.5.2 issue 3 Rev.2

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **5.4.2007**

Principal:

Date completed: **5.4.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Logged by: **CW**

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

Checked by:

equipment type and model:	4WD Backhoe	Pit Orientation:	Easting:	m	R.L. Surface:	0.893
excavation dimensions:	1.5m long 0.4m wide		Northing:	m	datum:	AHD

excavation information				material substance							
method	penetration 1 2 3	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	pocket penetro- meter kPa 100 200 300 400	structure and additional observations
BH		N					TOPSOIL: Silty Clayey SAND, fine to medium grained, dark grey-black mottled white, low to medium plasticity fines.	M			TOPSOIL
				0.5		SC	Clayey SAND: fine to coarse grained, pale grey-white, low plasticity fines. Becoming pale grey-pale brown.		D		
			D			SP	SAND: with some clayey lenses, fine to medium grained, low plasticity fines.	M/W			Very slow inflow of water, 9:13am.
				1.0		SC	Clayey SAND: fine to coarse grained, grey / brown, low to medium plasticity fines. Pit slowly collapsing due to water table.	W	MD		
			D						L		
				-0.5					MD		
				1.5							
				-1.0							
				2.0		SM	Silty SAND: fine to medium grained, dark brown / red.				
							Pit collapsing due to groundwater. Test pit TP34 terminated at 2m				
				-1.5							
				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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH35**
 Sheet 1 of 1
 Project No. **GEOTSGTE20248AA**
 Date started: **11.4.2007**
 Date completed: **11.4.2007**
 Logged by: **JJT**
 Checked by:

Engineering Log - Borehole

Client: **TATTERSALL SURVEYORS PTY LTD**

Principal:

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Borehole Location: **REFER TO FIGURE 1**

drill model and mounting: MD20 Easting: slope: -90° R.L. Surface: 1.006
 hole diameter: 100 mm Northing bearing: datum: AHD

drilling information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1 2 3				RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HF		C				SP	SAND: fine to medium grained, grey.	M	MD		
			SPT 2,2,3 N*=5	0				W			
			SPT 2,3,11 N*=14	-1					D		
			SPT 6,4,12 N*=16	-3							
				-4			Borehole BH35 terminated at 4m				
				-5							
				-6							
				-7							
				-8							

BOREHOLE 20248AA LOGS GPJ COFFEY.GDT 23.10.07

Form GEO 5.3 Issue 3 Rev 2

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter 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 W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH36**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **11.4.2007**
 Date completed: **11.4.2007**
 Logged by: **JJT**
 Checked by:

Engineering Log - Borehole

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Borehole Location: **REFER TO FIGURE 1**

drill model and mounting: MD20 Easting: slope: -90° R.L. Surface: 2.361
 hole diameter: 100 mm Northing bearing: datum: AHD

drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3								soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HF		C			2			SC	Clayey SAND: fine to medium grained, black, clay low plasticity.	M			
			▼	SPT 4,4,5 N*=9	1			SP	SAND: fine grained, white.	W	D		
					1			SP	SAND: fine to medium grained, black (coffee rock).				
					2			SP	SAND: fine grained, white.				
				SPT 2,9,11 N*=20	0				Becoming grey.		VD		
					3								
				SPT 6,13,24 N*=37	-1								
					4			SP	SAND: fine to medium grained, black (coffee rock).				
					-2				Becoming softer.				
				SPT 6,9,23 N*=32	-3								
					6								
				SPT 8,16,14 N*=30	-4								
					7								
					-5				Borehole BH36 terminated at 7m				
					8								

method AS auger screwing* AD auger drilling* RR roller/fricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/198 water level on date shown ▲ water inflow ▼ water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter 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 W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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BOREHOLE 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.3 Issue 3 Rev.2

Borehole No. **BH37**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **11.4.2007**
 Date completed: **11.4.2007**
 Logged by: **JJT**
 Checked by:

Engineering Log - Borehole

Client: **TATTERSALL SURVEYORS PTY LTD**

Principal:

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

Borehole Location: **REFER TO FIGURE 1**


drill model and mounting: MD20 Easting: slope: -90° R.L. Surface: Not Measured
 hole diameter: 100 mm Northing bearing: datum: AHD

drilling information				material substance								
method	penetration	support	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1	2	3						soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 meter	
HF		C			1		SC	Clayey SAND: fine to medium grained, black, clay low plasticity.	M			
			SPT 4,6,10 N*=16				SP	SAND: fine to medium grained, white.		D		
					2			Becoming dark brown, with some organic material.		W		
			SPT 1,7,8 N*=15									
					3							
			SPT 6,18,R N*=R									
					4		SP	SAND: fine to medium grained, black (coffee rock).		VD		INDURATED SAND
					5			Becoming brown.				
			SPT 5,7,R N*=R									
					6							
			SPT 6,7,R N*=R									
					7							
					8			Borehole BH37 terminated at 7m				

BOREHOLE 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.3 Issue 3 Rev.2

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V v bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter 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 W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH38**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **11.4.2007**
 Date completed: **11.4.2007**
 Logged by: **JJT**
 Checked by: 

Engineering Log - Borehole











Client: **TATTERSALL SURVEYORS PTY LTD**

Principal:

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**





Borehole Location: **REFER TO FIGURE 1**

Checked by:

drilling information				material substance									
method	penetration			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
	1	2	3										
HF					2			CL	TOPSOIL: Clayey SAND, fine grained, dark grey, clay low plasticity. Sandy CLAY: medium to high plasticity, grey, sand fine grained.	M >Wp			TOPSOIL
				SPT 2,2,3 N*=5	1			CL	Sandy CLAY: low to medium plasticity, dark brown, sand fine grained.				
					0			SW	SAND: fine to medium grained, grey.	W			
				SPT 4,5,5 N*=10	2								
					3								
				SPT 12,18,23 N*=41	4				Becoming black.				
					5								
				SPT 4,8,11 N*=19	6								
					7								
				SPT 4,8,8 N*=16	8								
					9				Borehole BH38 terminated at 7m				
					10								

BOREHOLE 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.3 Issue 3 Rev 2

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **1.6.2007**

Principal:

 Date completed: **1.6.2007**


 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **RJP**

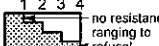
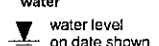
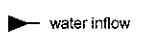
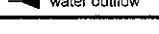
 Test pit location: **REFER TO FIGURE 1**

 Checked by: 

equipment type and model:	4WD Backhoe	Pit Orientation:	Easting:	m	R.L. Surface:	2.77
excavation dimensions:	2m long 0.45m wide		Northing:	m	datum:	AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1	2	3					soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		2.5		CH	TOPSOIL: Sandy Silty CLAY, medium plasticity, dark grey, sand fine to medium grained.	M			TOPSOIL Root affected.
			D	0.5			CLAY: high plasticity, grey-brown and orange mottled, some sand.	>Wp	St		
				2.0						X	
			D	1.0		CH	CLAY: high plasticity, grey-grey-brown, some orange mottled with a trace of sand fine to medium grained.				
				1.5						X	
			D	1.5		SP	SAND: fine to medium grained, white / light grey-brown.	W			Pit collapsing below 1.4m, organic odour.
				1.0			Moderate groundwater inflow below 1.4m. Test pit TP39 terminated at 1.7m				
				2.0							
				0.5							
				2.5							

Sketch

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

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **1.6.2007**


Principal:






 Date completed: **1.6.2007**

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

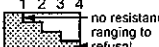



 Logged by: **RJP**

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

 Checked by: 

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m	R.L. Surface: 2.59							
excavation dimensions: 2m long 0.45m wide		Northing: m		datum: AHD								
excavation information			material substance									
method	penetration	support	water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
BH	1 2 3	N			2.5			TOPSOIL: Silty Sandy CLAY, medium plasticity, dark grey, sand fine to medium grained.	>Wp			TOPSOIL Root affected.
					0.5		CI	Sandy CLAY: medium plasticity, grey-brown and orange mottled, sand fine to medium grained.	St			
				D	2.0			Becoming grey-brown and sand content increasing to Sandy CLAY / Clayey SAND.				
				D	1.5		SP	SAND: fine to medium grained, grey-brown with some clay.	W			
				D	1.5		SP	SAND: fine to medium grained, light grey-brown.				Rapid groundwater inflow below 1.4m. Organic odour.
					2.0			Pit collapsing below 1.1m. Test pit TP40 terminated at 1.7m				
					0.5							
					2.5							

Sketch

method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper M excavator	support S shoring N nil penetration 1 2 3 4  water  water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

 Client: **TATTERSALL SURVEYORS PTY LTD**

 Date started: **1.6.2007**


Principal:

 Date completed: **1.6.2007**

 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**

 Logged by: **RJP**

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

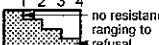
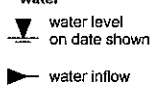
 Checked by: 

equipment type and model:	4WD Backhoe	Pit Orientation:	Easting:	m	R.L. Surface:	3.63
excavation dimensions:	2m long 0.45m wide		Northing:	m	datum:	AHD

excavation information				material substance				structure and additional observations			
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material		moisture condition	consistency/density index	pocket penetrometer
1	2	3					soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
BH		N		3.5			TOPSOIL: Sandy CLAY, medium plasticity, grey-brown, sand fine to medium grained.	M			TOPSOIL Root affected.
				0.5		Ci	Sandy CLAY: medium plasticity, light grey-brown and orange mottled, sand fine to medium grained.	>Wp	St	X	Slow groundwater inflow below 2.2m. Organic odour.
			D	3.0			Becoming light grey-light grey-brown and orange mottled.			X	
			D	2.5			Sand content increasing light grey-brown and orange mottled.			X	
			D	1.5		SP	SAND: fine to medium grained, light grey-brown some orange mottled, cemented.	M			
				2.0							
				2.0							
				1.5							
				2.5		SP	SAND: fine to medium grained, white-light grey-brown.	W			

Sketch Test pit TP41 terminated at 2.5m



method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4  no resistance ranging to refusal water  water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit 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
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Excavation No. **TP42**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **1.6.2007**
 Date completed: **1.6.2007**
 Logged by: **RJP**
 Checked by:

Engineering Log - Excavation

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe		Pit Orientation:		Easting: m	R.L. Surface: 2.82							
excavation dimensions: 2m long 0.45m wide		Northing: m		datum: AHD								
excavation information				material substance								
method	penetration	support	water	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/density index	pocket penetrometer kPa	structure and additional observations
BH		N			2.5			TOPSOIL: Silty Sandy CLAY, low to medium plasticity, sand fine to medium grained, dark grey-brown.	M			TOPSOIL Root affected.
				D	0.5		CI	Sandy CLAY: medium plasticity, grey-brown and orange mottled, sand fine to medium grained.	>Wp	St	X	
				D	2.0		CI	Sandy CLAY: medium plasticity, grey-grey-brown some orange mottled, sand fine to medium grained, sand content increasing.			X	
				D	1.0		SP	SAND: fine to medium grained, white. Becoming grey-grey-brown, with a trace to some clay.	W			Very slow water inflow below 1.1m.
					1.5							
					1.5							
					1.0			Test pit TP42 terminated at 1.7m				
					2.0							
					0.5							
					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 U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Engineering Log - Excavation

Excavation No. **TP43**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **1.6.2007**
 Date completed: **1.6.2007**
 Logged by: **RJP**
 Checked by:

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Test pit location: **REFER TO FIGURE 1**

equipment type and model: 4WD Backhoe Pit Orientation: Easting: m R.L. Surface: 4.75
 excavation dimensions: 2m long 0.45m wide Northing: m datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1 2 3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
BH		N		4.5		SP	SAND: fine to medium grained, grey-brown. Becoming light grey-brown.	M			AEOLIAN Root affected to 0.15m.
			D	4.0							
				1.0		SP	SAND: fine to medium grained, grey-brown and orange mottled, trace to some clay.				Very slow water inflow below 1.7m.
			D	3.5							
				1.5		SP	SAND: fine to medium grained, light grey-brown, some weakly cemented nodules, grey-brown.				Very slow water inflow below 1.7m.
			D	3.0				W			
				2.0			Test pit TP43 terminated at 1.85m				
				2.5							
				2.5							

Sketch

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

Client: **TATTERSALL SURVEYORS PTY LTD**

Date started: **1.6.2007**

Principal:


Date completed: **1.6.2007**

Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS** Logged by: **RJP**

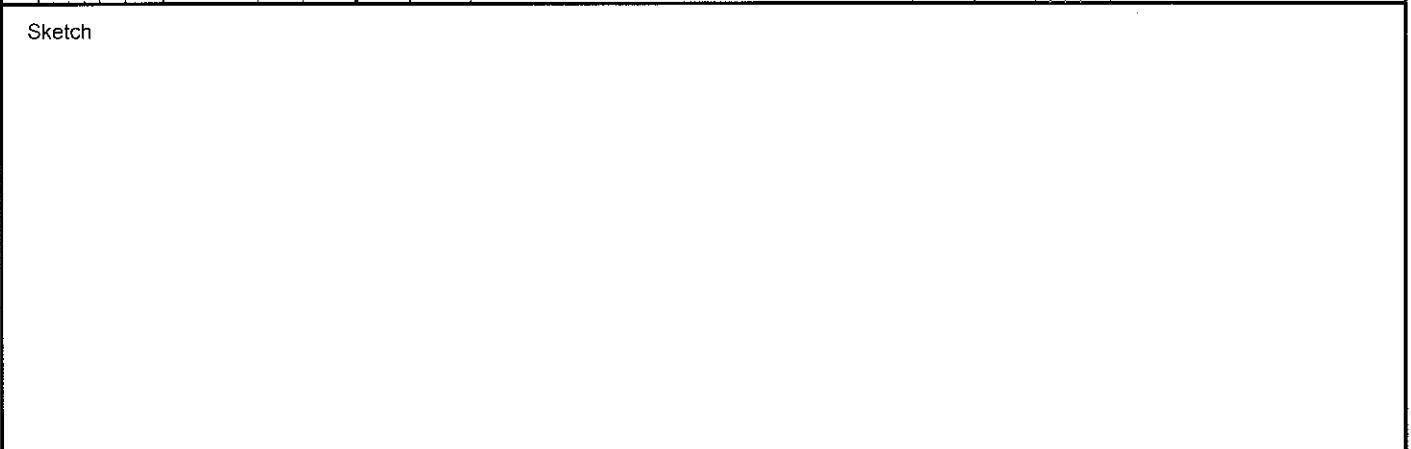
Test pit location: **REFER TO FIGURE 1**

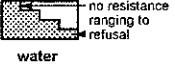
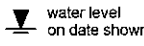
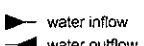
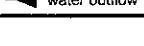
Checked by: 

equipment type and model: 4WD Backhoe	Pit Orientation:	Easting: m	R.L. Surface: 4.46
excavation dimensions: 2m long 0.45m wide		Northing: m	datum: AHD

excavation information				material substance							
method	penetration	support	notes samples, tests, etc	depth RL metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1 2 3							soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400 kPa	
BH		N		4.0		SP	SAND: fine to medium grained, dark grey-brown. Becoming light grey-brown.	M			AEOLIAN Root affected to 0.3m.
		None Observed	D	3.5		SP	SAND: fine to medium grained, dark brown, some silt / Silty SAND.				INDURATED SAND
			D	3.0			Becoming cleaner and less cemented, brown.				
				2.5			Test pit TP44 terminated at 1.8m				
				2.0							

Sketch



method N natural exposure X existing excavation BH backhoe bucket B bulldozer blade R ripper E excavator	support S shoring N nil penetration 1 2 3 4  no resistance ranging to refusal water  water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample V vane shear (kPa) Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH45**
 Sheet 1 of 2
 Project No. **GEOTSGTE20248AA**
 Date started: **5.6.2007**
 Date completed: **5.6.2007**
 Logged by: **RJP**
 Checked by:


Engineering Log - Borehole

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Borehole Location: **REFER TO FIGURE 1**

drill model and mounting: Easting: slope: -90° R.L. Surface: 3.20
 hole diameter: mm Northing bearing: datum: AHD


drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
	1 2 3								soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HF		C			3			SP	SAND: fine to medium grained, grey-brown.	M	D		AEOLIAN SAND
				SPT 2,5,7 N*=12	2	1			Becoming light grey-brown.				
						2			Becoming dark grey-brown.	W			
				SPT 5,6,8 N*=14	3	3			Becoming dark grey-brown.				
					0	4			Becoming dark grey-brown.				
				SPT 3,15,21 N*=36	-1	5		SP	SAND: fine to coarse grained, dark brown, trace of gravel fine grained and silt.		VD		
						6			With a trace fine grained gravel.				20 blows for 100mm penetration.
				SPT 9,21,20 N*=41	-3	7			With a trace fine grained gravel.				
						8			Becoming fine to medium grained, light brown and brown.				21 blows for 100mm penetration.
				SPT 8,18,21 N*=39	-4				Becoming fine to medium grained, light brown and brown.				

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/96 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH45**
 Sheet 2 of 2
 Project No. **GEOTSGTE20248AA**
 Date started: **5.6.2007**
 Date completed: **5.6.2007**
 Logged by: **RJP**
 Checked by: 

Engineering Log - Borehole





Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Borehole Location: **REFER TO FIGURE 1**

drilling model and mounting:		Easting:		slope: -90°		R.L. Surface: 3.20							
hole diameter: mm		Northing		bearing:		datum: AHD							
drilling information				material substance									
method	penetration	support	water	notes samples, tests, etc	RL	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1 2 3									soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HF		C			-5			SP	SAND: fine to coarse grained, dark brown, trace of gravel fine grained and silt. (continued)	W	D		
				SPT 5,13,17 N*=30		9							
					-6								
					10								
				SPT 1,6,15 N*=21		-7							
						11			Borehole BH45 terminated at 10.45m				
					-8								
					12								
					-9								
					13								
					-10								
					14								
					-11								
					15								
					-12								
					16								

Collapsed back to 2.3m

BOREHOLE 20248AA LOGS.GPJ COFFEY.GDT 23.10.07

Form GEO 5.3 Issue 3 Rev.2

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT diatube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4  no resistance ranging to refusal water  10/1/98 water level on date shown  water inflow  water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter 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 W _p plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VS _t very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Borehole No. **BH46**
 Sheet 1 of 1
 Project No: **GEOTSGTE20248AA**
 Date started: **6.6.2007**
 Date completed: **6.6.2007**
 Logged by: **RJP**
 Checked by:

Engineering Log - Borehole

Client: **TATTERSALL SURVEYORS PTY LTD**
 Principal:
 Project: **RIVERSIDE ESTATE PROJECT APPLICATION, TEA GARDENS**
 Borehole Location: **REFER TO FIGURE 1**

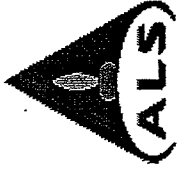
drill model and mounting: Easting: slope: -90° R.L. Surface: 1.07
 hole diameter: mm Northing bearing: datum: AHD

drilling information				material substance							
method	penetration	support	notes samples, tests, etc	depth metres	graphic log	classification symbol	material	moisture condition	consistency/density index	pocket penetrometer	structure and additional observations
1	2	3		RL			soil type: plasticity or particle characteristics, colour, secondary and minor components.			100 200 300 400	
HF		C					TOPSOIL: Sandy CLAY / Clayey SAND, low plasticity, dark grey, sand fine to medium grained, some silt.	M			TOPSOIL
			SPT 3,2,2 N*=4	0		SP	SAND: fine to medium grained, grey-brown. Becoming light grey-brown.	W	MD		
			SPT 7,12,14 N*=26	-1		SP	SAND: fine to medium grained, dark brown, trace silt.		VD		
			SPT 5,16,23 N*=39	-2		SP	SAND: fine to medium grained, some clay, brown and dark brown, trace fine grained gravel.				
			SPT 2,9,18 N*=27	-3		SP	SAND: fine to medium grained, light brown.				
			SPT 3,10,18 N*=28	-4			Becoming fine to coarse grained, trace fine grained gravel, light grey-brown.				
				-5							
				-6							
				-7							
				-8			Borehole BH46 terminated at 7.45m				

method AS auger screwing* AD auger drilling* RR roller/tricone W washbore CT cable tool HA hand auger DT dialtube B blank bit V V bit T TC bit *bit shown by suffix e.g. ADT	support M mud N nil C casing penetration 1 2 3 4 no resistance ranging to refusal water 10/1/98 water level on date shown water inflow water outflow	notes, samples, tests U ₅₀ undisturbed sample 50mm diameter U ₆₃ undisturbed sample 63mm diameter D disturbed sample N standard penetration test (SPT) N* SPT - sample recovered Nc SPT with solid cone V vane shear (kPa) P pressuremeter Bs bulk sample E environmental sample R refusal	classification symbols and soil description based on unified classification system moisture D dry M moist W wet Wp plastic limit W _L liquid limit	consistency/density index VS very soft S soft F firm St stiff VSt very stiff H hard Fb friable VL very loose L loose MD medium dense D dense VD very dense
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Appendix B

Results of Laboratory Testing



ALS Environmental

CERTIFICATE OF ANALYSIS

Client	: COFFEY GEOTECHNICS	Laboratory	: Environmental Division Brisbane	Page	: 1 of 10
Contact	: MIR ROB PEARCE	Contact	: Tim Klimister	Work Order	: EB0704186
Address	: 13 MANGROVE ROAD SANDGATE NSW AUSTRALIA 2304	Address	: 32 Shand Street Stafford QLD Australia 4053		
E-mail	: robert_pearce@coffey.com.au	E-mail	: Services.Brisbane@alsenviro.com		
Telephone	: 49676377	Telephone	: 61-7-3243 7222		
Facsimile	: 49675402	Facsimile	: 61-7-3243 7259		
Project	: GEOTSGTE 20248AA	Quote number	: EN1007/07	Date received	: 17 Apr 2007
Order number	: 2524			Date issued	: 8 May 2007
C-O-C number	: 0361-0362			No. of samples	- Received : 19
Site	: - Not provided -			Analysed	: 19

ALSE - Excellence in Analytical Testing

NATA Accredited Laboratory
825

This document is issued in accordance with NATA's accreditation requirements.

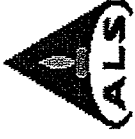
Accredited for compliance with ISO/IEC 17025.



WORLD RECOGNISED ACCREDITATION

This document has been electronically signed by those names that appear on this report and are the authorised signatories. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatory	Position	Department
Lea-Ellen Catt	Laboratory Technician - Acid Sulphate Soils	Inorganics - NATA 825 (818 - Brisbane)



Page Number : 2 of 10
Client : COFFEY GEOTECHNICS
Work Order : EB0704186

Comments

This report for the ALSE reference EB0704186 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

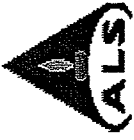
- Analytical Results for Samples Submitted
- Surrogate Recovery Data

The analytical procedures used by ALS Environmental have been developed from established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insufficient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QW/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. * Indicates failed Surrogate Recoveries.

Specific comments for Work Order EB0704186

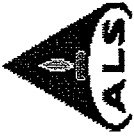
Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO₃) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. Conversion to liming rate in kg/m³ = kg/t x wet bulk density in t/m³.
Excess ANC not required because pH OX less than 6.5.



ALS Environmental

Analytical Results

Analyte	CAS number	Laboratory Sample ID	LOR	Units	Client Sample ID				
					BH36 0.5-1.0	BH36 3.5-4.0	BH37 5.0-5.5	BH37 6.5-7.0	
Sample Matrix Type / Description					SOIL				
Sample Date / Time					11 Apr 2007 15:00				
Laboratory Sample ID					EB0704186-001				
LOR					EB0704186-002				
Units					EB0704186-003				
Units					EB0704186-004				
Units					EB0704186-005				
EA029-A: pH Measurements									
pH KCl (23A)			0.1	pH Unit	4.6	5.2	4.5	4.6	4.2
pH OX (23B)			0.1	pH Unit	4.2	3.8	2.7	2.7	4.1
EA029-B: Acidity Trail									
Titratable Peroxide Acidity (23F)			2	mole H+ / l	26	11	37	41	108
Titratable Actual Acidity (23G)			2	mole H+ / l	28	19	120	118	137
Titratable Sulfidic Acidity (23H)			2	mole H+ / l	<2	8	83	77	29
sulfidic - Titratable Actual Acidity (s-23F)			0.02	% pyrite S	0.04	<0.02	0.06	0.06	0.17
sulfidic - Titratable Peroxide Acidity (s-23G)			0.02	% pyrite S	0.04	0.03	0.19	0.19	0.22
sulfidic - Titratable Sulfidic Acidity (s-23H)			0.02	% pyrite S	<0.02	<0.02	0.13	0.12	0.05
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)			0.02	% S	<0.02	<0.02	0.09	0.10	0.04
Peroxide Oxidisable Sulfur (23E)			0.02	% S	<0.02	<0.02	0.09	0.10	0.04
acidity - Peroxide Oxidisable Sulfur (a-23E)			10	mole H+ / l	<10	<10	56	63	25
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)			0.02	% Ca	0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)			0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)			0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Calcium (a-23X)			10	mole H+ / l	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)			0.02	% Mg	0.02	<0.02	<0.02	<0.02	0.04
Peroxide Magnesium (23Tm)			0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.04
Acid Reacted Magnesium (23U)			0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
acidity - Acid Reacted Magnesium (a-23U)			10	mole H+ / l	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-G: Retained Acidity									
Net Acid Soluble Sulfur (20Ie)			0.02	% S	---	---	---	---	0.03
acidity - Net Acid Soluble Sulfur (a-20J)			10	mole H+ / l	---	---	---	---	14
sulfidic - Net Acid Soluble Sulfur (s-20J)			0.02	% pyrite S	---	---	---	---	0.02
HCl Extractable Sulfur (20Be)			0.02	% S	---	---	---	---	0.03



Page Number : 4 of 10
 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

ALS Environmental

Analytical Results

Analyte	CAS number	Client Sample ID :		Sample Matrix Type / Description :	Sample Date / Time :	Laboratory Sample ID :
		LOR	Units			
EA029-H: Acid Base Accounting		1.5	0.04	BH36 0.5-1.0 SOIL	11 Apr 2007 15:00	EB0704186-001
ANC Fineness Factor	0.5	1.5	0.04	BH36 3.5-4.0 SOIL	11 Apr 2007 15:00	EB0704186-002
Net Acidity (sulfur units)	0.02 % S	1.5	0.15	BH37 5.0-5.5 SOIL	11 Apr 2007 15:00	EB0704186-003
Net Acidity (acidity units)	10 mole H+ / t	1.5	0.17	BH37 6.5-7.0 SOIL	11 Apr 2007 15:00	EB0704186-004
Liming Rate	1 kg CaCO3/t	1.5	0.24	BH38 0.5-1.0 SOIL	11 Apr 2007 15:00	EB0704186-005
			26			
			11			
			<1			
			7			
			8			
			147			
			11			

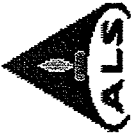


ALS Environmental

Page Number : 5 of 10
 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

Analytical Results

Analyte	CAS number	Client Sample ID :				Laboratory Sample ID :
		BH38 6.5-7.0	TP33 1.1-1.2	TP34 1.0-1.1	TP32 1.6-1.7	
Sample Matrix Type / Description :		SOIL				SOIL
Sample Date / Time :		5 Apr 2007 15:00				5 Apr 2007 15:00
Laboratory Sample ID :		EB0704186-006				EB0704186-009
LOR		Units				
EA029-A: pH Measurements		5.2	5.7	4.9	5.0	5.0
pH KCl (23A)	0.1 pH Unit					
pH DX (23B)	0.1 pH Unit	4.2	3.0	2.8	2.8	3.5
EA029-B: Acidity Trail						
Titratable Actual Acidity (23F)	2 mole H+ / t	11	2	15	7	11
Titratable Peroxide Acidity (23G)	2 mole H+ / t	17	42	99	55	56
Titratable Sulfidic Acidity (23H)	2 mole H+ / t	6	40	84	47	45
sulfidic - Titratable Actual Acidity (s-23F)	0.02 % pyrite S	<0.02	<0.02	0.02	<0.02	<0.02
sulfidic - Titratable Peroxide Acidity (s-23G)	0.02 % pyrite S	0.03	0.07	0.16	0.09	0.09
sulfidic - Titratable Sulfidic Acidity (s-23H)	0.02 % pyrite S	<0.02	0.06	0.13	0.08	0.07
EA029-C: Sulfur Trail						
KCl Extractable Sulfur (23Ce)	0.02 % S	<0.02	<0.02	0.04	<0.02	<0.02
Peroxide Sulfur (23De)	0.02 % S	<0.02	0.12	0.21	0.12	0.08
Peroxide Oxidisable Sulfur (23E)	0.02 % S	<0.02	0.12	0.16	0.12	0.08
acidic - Peroxide Oxidisable Sulfur (a-23E)	10 mole H+ / t	<10	75	102	76	47
EA029-D: Calcium Values						
KCl Extractable Calcium (23Vh)	0.02 % Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Vh)	0.02 % Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)	0.02 % Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidic - Acid Reacted Calcium (a-23X)	10 mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)	0.02 % S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values						
KCl Extractable Magnesium (23Sm)	0.02 % Mg	<0.02	<0.02	0.03	<0.02	<0.02
Peroxide Magnesium (23Tm)	0.02 % Mg	<0.02	0.02	0.03	<0.02	<0.02
Acid Reacted Magnesium (23U)	0.02 % Mg	<0.02	0.02	<0.02	<0.02	<0.02
acidic - Acid Reacted Magnesium (a-23U)	10 mole H+ / t	<10	18	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)	0.02 % S	<0.02	0.03	<0.02	<0.02	<0.02
EA029-H: Acid Base Accounting						
ANC Fineness Factor	0.5	1.5	1.5	1.5	1.5	1.5
Net Acidity (sulfur units)	0.02 % S	<0.02	0.12	0.19	0.13	0.09
Net Acidity (acidity units)	10 mole H+ / t	11	77	117	84	58
Liming Rate	1 kg CaCO3/t	<1	6	9	6	4

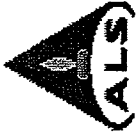


ALS Environmental

Page Number : 6 of 10
 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

Analytical Results

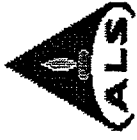
Analyte	CAS number	Laboratory Sample ID	LOR	Units	Client Sample ID				
					TP28 0.6-0.7	TP27 1.1-1.2	TP26 1.5-1.6	TP25 1.9-2.0	TP19 0.5-0.6
Sample Matrix Type / Description					SOIL	SOIL	SOIL	SOIL	SOIL
Sample Date / Time					5 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00	5 Apr 2007 15:00
Laboratory Sample ID					EB0704186-011	EB0704186-012	EB0704186-013	EB0704186-014	EB0704186-015
EA029-A: pH Measurements									
pH KCl (23A)			0.1	pH Unit	4.4	5.0	5.4	4.3	4.5
pH OX (23B)			0.1	pH Unit	3.1	2.8	3.3	2.2	3.6
EA029-B: Acidity Trail									
Titration Actual Acidity (23F)			2	mole H+ / t	53	21	7	46	36
Titration Peroxide Acidity (23G)			2	mole H+ / t	94	33	197	53	95
Titration Sulfidic Acidity (23H)			2	mole H+ / t	40	12	189	8	59
sulfidic - Titration Actual Acidity (s-23F)			0.02	% pyrite S	0.08	0.03	<0.02	0.07	0.06
sulfidic - Titration Peroxide Acidity (s-23G)			0.02	% pyrite S	0.15	0.05	0.32	0.08	0.15
sulfidic - Titration Sulfidic Acidity (s-23H)			0.02	% pyrite S	0.06	<0.02	0.30	<0.02	0.08
EA029-C: Sulfur Trail									
KCl Extractable Sulfur (23Ce)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Sulfur (23De)			0.02	% S	<0.02	<0.02	<0.02	0.05	0.02
Peroxide Oxidisable Sulfur (23E)			0.02	% S	<0.02	<0.02	<0.02	0.05	0.02
acidic - Peroxide Oxidisable Sulfur (a-23E)			10	mole H+ / t	<10	<10	<10	30	13
EA029-D: Calcium Values									
KCl Extractable Calcium (23Vh)			0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Peroxide Calcium (23Wh)			0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
Acid Reacted Calcium (23X)			0.02	% Ca	<0.02	<0.02	<0.02	<0.02	<0.02
acidic - Acid Reacted Calcium (a-23X)			10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Calcium (s-23X)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-E: Magnesium Values									
KCl Extractable Magnesium (23Sm)			0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.02
Peroxide Magnesium (23Tm)			0.02	% Mg	<0.02	<0.02	<0.02	<0.02	0.02
Acid Reacted Magnesium (23U)			0.02	% Mg	<0.02	<0.02	<0.02	<0.02	<0.02
acidic - Acid Reacted Magnesium (a-23U)			10	mole H+ / t	<10	<10	<10	<10	<10
sulfidic - Acid Reacted Magnesium (s-23U)			0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
EA029-G: Retained Acidity									
Net Acid Soluble Sulfur (20Je)			0.02	% S	<0.02	---	---	<0.02	---
acidic - Net Acid Soluble Sulfur (a-20J)			10	mole H+ / t	<10	---	---	<10	---
sulfidic - Net Acid Soluble Sulfur (s-20J)			0.02	% pyrite S	<0.02	---	---	<0.02	---
HCl Extractable Sulfur (20Be)			0.02	% S	<0.02	---	---	<0.02	---



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 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

Analytical Results

Analyte	CAS number	Laboratory Sample ID :		Client Sample ID :	Sample Matrix Type / Description :	Sample Date / Time :
		LOR	Units			
EA029-H: Acid Base Accounting				TP28 0.6-0.7	SOIL	5 Apr 2007 15:00
ANC Fineness Factor	0.5			TP27 1.1-1.2	SOIL	5 Apr 2007 15:00
Net Acidity (sulfur units)	0.02 % S			TP26 1.5-1.6	SOIL	5 Apr 2007 15:00
Net Acidity (acidity units)	10 mole H+ / t			TP25 1.9-2.0	SOIL	5 Apr 2007 15:00
Liming Rate	1 kg CaCO3/t			TP19 0.5-0.6	SOIL	5 Apr 2007 15:00
				EB0704186-011	EB0704186-012	EB0704186-013
				1.5	1.5	1.5
				0.08	<0.02	0.12
				53	<10	76
				4	<1	6
						4
						4

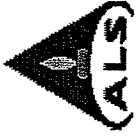


ALS Environmental

Page Number : 8 of 10
 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

Analytical Results

Analyte	CAS number	Client Sample ID : Sample Matrix Type / Description : Sample Date / Time : Laboratory Sample ID :	Units	TP14 0.6-0.7 SOIL (5 Apr 2007 15:00)				TP6 2.0-2.1 SOIL (5 Apr 2007 15:00)				BH37/0.5-1.0 SOIL (5 Apr 2007 (15:00))				BH37 2.0-2.5 SOIL (5 Apr 2007 (15:00))			
				EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019	EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019	EB0704186-016	EB0704186-017	EB0704186-018	EB0704186-019				
EA029-A: pH Measurements																			
pH KCl (23A)		0.1 pH Unit		4.1	4.9	5.1	5.0												
pH OX (23B)		0.1 pH Unit		4.1	3.9	4.1	3.2												
EA029-B: Acidity Trail																			
Titratable Peroxide Acidity (23F)		2 mole H+ / t		70	16	14	24												
Titratable Actual Acidity (23G)		2 mole H+ / t		22	15	102	102												
Titratable Sulfidic Acidity (23H)		2 mole H+ / t		<2	<2	88	78												
sulfidic - Titratable Actual Acidity (s-23F)		0.02 % pyrite S		0.11	0.02	0.02	0.04												
sulfidic - Titratable Peroxide Acidity (s-23G)		0.02 % pyrite S		0.04	0.02	0.16	0.16												
sulfidic - Titratable Sulfidic Acidity (s-23H)		0.02 % pyrite S		<0.02	<0.02	0.14	0.12												
EA029-C: Sulfur Trail																			
KCl Extractable Sulfur (23Ce)		0.02 % S		0.04	<0.02	<0.02	<0.02												
Peroxide Sulfur (23De)		0.02 % S		0.06	<0.02	<0.02	0.03												
Peroxide Oxidisable Sulfur (23E)		0.02 % S		<0.02	<0.02	<0.02	0.03												
acidity - Peroxide Oxidisable Sulfur (a-23E)		10 mole H+ / t		10	<10	<10	21												
EA029-D: Calcium Values																			
KCl Extractable Calcium (23Vh)		0.02 % Ca		<0.02	<0.02	<0.02	<0.02												
Peroxide Calcium (23Vh)		0.02 % Ca		<0.02	<0.02	<0.02	<0.02												
Acid Reacted Calcium (23X)		0.02 % Ca		<0.02	<0.02	<0.02	<0.02												
acidity - Acid Reacted Calcium (a-23X)		10 mole H+ / t		<10	<10	<10	<10												
sulfidic - Acid Reacted Calcium (s-23X)		0.02 % S		<0.02	<0.02	<0.02	<0.02												
EA029-E: Magnesium Values																			
KCl Extractable Magnesium (23Sm)		0.02 % Mg		0.08	<0.02	<0.02	<0.02												
Peroxide Magnesium (23Tm)		0.02 % Mg		0.09	<0.02	<0.02	<0.02												
Acid Reacted Magnesium (23U)		0.02 % Mg		<0.02	<0.02	<0.02	<0.02												
acidity - Acid Reacted Magnesium (a-23U)		10 mole H+ / t		12	<10	<10	<10												
sulfidic - Acid Reacted Magnesium (s-23U)		0.02 % S		<0.02	<0.02	<0.02	<0.02												
EA029-G: Retained Acidity																			
Net Acid Soluble Sulfur (20Ue)		0.02 % S		<0.02															
acidity - Net Acid Soluble Sulfur (a-20J)		10 mole H+ / t		<10															
sulfidic - Net Acid Soluble Sulfur (s-20J)		0.02 % pyrite S		<0.02															
HCl Extractable Sulfur (208e)		0.02 % S		0.05															

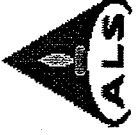


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 Client : COFFEY GEOTECHNICS
 Work Order : EB0704186

ALS Environmental

Analytical Results

Analyte	CAS number	Client Sample ID :		TP14 0.6-0.7 SOIL 5 Apr 2007 15:00 EB0704186-016	TP6 2.0-2.1 SOIL 5 Apr 2007 15:00 EB0704186-017	BH37 0.5-1.0 SOIL (5 Apr 2007) (15:00) EB0704186-018	BH37 2.0-2.5 SOIL (5 Apr 2007) (15:00) EB0704186-019
		LOR	Units				
EA029-H: Acid Base Accounting							
ANC Fineness Factor		0.5		1.5	1.5	1.5	1.5
Net Acidity (sulfur units)		0.02 % S		0.02	0.02	0.02	0.07
Net Acidity (acidity units)		10 mole H+ / t		84	16	14	44
Liming Rate		1 kg CaCO3/t		6	1	1	3



ALS Environmental

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Client : COFFEY GEOTECHNICS
Work Order : EB0704186

Surrogate Control Limits

- No surrogates present on this report.

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** office: **Newcastle (LABTSGTE00173AA)**
 principal: **Newcastle** date: **12/04/07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **Newcastle**
 location: **TEA GARDENS** tested by: **NH/GR**
 checked by:

date samples recovered: pH meter used/serial **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **22.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	time (mins)	pH _{FOX}	temp (°C)	oxidation in 30% hydrogen peroxide			Additional comments	
								Effervescence (see note below)	Odour	Colour change during reaction		pH Change (ie pH _F -pH _{FOX})
TP3	1.0-1.1		Sand/ Clay	5.60	10	3.85	25	b	Y	N	1.75	
TP27	1.1-1.2		Sand	4.47	10	3.35	25	a	N	N	1.12	
TP28	0.6-0.7		Sand / Clay	4.95	10	3.55	25	b	Y	N	1.4	
TP22	1.8-1.9		Sand	5.59	10	4.68	25	a	N	N	0.91	
TP6	1.5-1.6		Sand	4.71	10	2.60	25	a	N	N	2.11	
TP9	1.9-2.0		Sand	5.25	10	4.15	25	a	N	N	1.1	
TP24	0.5-0.6		Clay / Sand	5.03	10	3.63	24	a	N	N	1.4	
TP24	1.0-1.1		Sand	5.11	10	3.88	24	a	N	N	1.23	
TP24	1.9-2.0		Sand	5.56	10	5.24	24	a	N	N	0.32	

NOTES: 1. Observed Reaction: a. No visible effervescence. b. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: TATTERSAL SURVEYORS		office: Newcastle	date: 13/04/07	test location: Newcastle									
principal:				tested by: NH									
project: RIVERSIDE ESTATE PROJECT APPLICATION				checked by:									
location: Tea Gardens													
date samples recovered:		pH meter used/serial Horiba	date of calibration:										
hydrogen peroxide pH prior to use: 5.46		hydrogen peroxide temperature prior to use: 22.3											
sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)						Additional comments		
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction		pH Change (ie pH _F -pH _{FOX})	
TP18	0.6-0.7		Sand	4.81	10	4.17	23	A	N	N	0.64		
TP18	1.8-1.9		Sand	5.27	10	4.45	23	A	N	N	0.82		
TP6	0.6-0.7		Silty Sand	4.76	10	4.15	23	A	N	N	0.61		
TP6	1.0-1.1		Sand	4.80	10	4.15	23	A	N	N	0.65		
TP4	0.5-0.6		Clay	5.62	10	4.13	23	A	Y	N	1.49		
TP17	1.1-1.2		Sand	5.46	10	5.21	23	A	N	N	0.25		
TP11	1.0-1.1		Sand	5.70	10	5.37	24	A	N	N	0.33		
TP22	0.5-0.6		Silty Sand	5.83	10	5.40	24	b	N	N	0.43		
NOTES:		1. Observed Reaction:		a. No visible effervescence. Slight to moderate effervescence		c. Vigorous effervescent reaction							
		2. Strong Odour:											

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** office: **Newcastle**
 principal: **Newcastle** date: **12/04/07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** tested by: **NH**
 location: **TEA GARDENS** checked by:

date samples recovered: **10-04-07** pH meter used/serial **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **22.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)					Additional comments		
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour		Colour change during reaction	pH Change (ie pH _F -pH _{FOX})
TP12	0.6-0.7		Sand	5.99	10	3.98	22		N	N	2.01	
TP12	1.1-1.2		Sand	5.66	10	4.13	22		N	N	1.53	
TP12	1.9-2.0		Sand	6.44	10	4.71	23		N	N	1.73	
TP13	1.1-1.2		Sand	5.30	10	4.28	23		N	N	1.02	
TP14	0.6-0.7		Clay	5.20	10	3.26	23		N	N	1.94	
TP14	1.7-1.8		Clay	4.89	10	3.42	23		N	N	1.47	
TP15	1.1-1.2		Sand	4.84	10	3.85	23		N	N	0.99	
TP34	1.9-2.0		Sand	6.33	10	5.45	23		N	N	0.88	
TP31	0.6-0.7		Sand	6.56	10	4.80	23		N	N	1.76	
TP30	0.6-0.7		Sand	6.00	10	4.90	23		N	N	1.1	
TP32	1.6-1.7		Sand	6.40	10	1.43	30		Y	N	4.97	

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS**
 principal: **NEWCASTLE**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION**
 location: **TEA GARDENS**
 office: Newcastle
 date: **12/04/07**
 test location: **Newcastle**
 tested by: **NH**
 checked by:

date samples recovered: **10-04-07** pH meter used/serial: **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **22.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)						Additional comments	
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction		pH Change (ie pH _F -pH _{FOX})
TP31	1.0 - 1.1		Sand	6.00	10	3.63	24	A	N	N	2.37	
TP34	0.55 - 0.65		Sand	6.76	10	4.51	25	B	Yes	N	2.25	
TP32	0.7 - 0.8		Sand	5.20	10	3.91	24	S	N	N	1.29	
TP33	1.1-1.2		Sand	6.34	10	1.45	30	B	Yes	N	4.89	
TP34	1.0 - 1.1		Sand	6.35		1.36	33	B	Yes	Yes	4.99	Lighter in peroxide
TP30	1.5 - 1.6		Sand	5.25	10	2.81	25	b	Yes	N	2.44	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS**
 principal: **Newcastle**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION**
 location: **TEA GARDENS**
 office: Newcastle
 date: **13/04/07**
 test location: **Newcastle**
 tested by: **NH**
 checked by:

date samples recovered: **10-04-07** pH meter used/serial **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.49** hydrogen peroxide temperature prior to use: **22.0**

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)						Additional comments	
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction		pH Change (ie pH _F -pH _{FOX})
TP4	2.0-2.1		Sand	5.75	10	1.65	28	B	Y	Y	4.1	Lighter After Reaction
TP19	1.1-1.2		Clay	5.20	10	3.50	23	A	N	N	1.7	
TP9	1.0-1.1		Sand	4.90	10	3.60	23	A	N	N	1.3	
TP25	0.6-0.7		Sand	4.55	10	3.25	22	A	N	N	1.3	
TP25	1.9-2.0		Clay	4.36	10	3.26	23	A	N	N	1.1	
TP6	2.0-2.1		Sand	4.94	10	4.06	22	A	N	N	0.88	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** date: **13/04/07**
 principal: **Newcastle** test location: **Newcastle**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** tested by: **NH/GR**
 location: **TEA GARDENS** checked by:

date samples recovered: pH meter used/serial Horiba date of calibration:
 hydrogen peroxide pH prior to use: **5.28** hydrogen peroxide temperature prior to use: **21.0**

sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)					Additional comments		
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour		Colour change during reaction	pH Change (ie pH _F -pH _{FOX})
TP16	0.5-0.6		Sand	4.96	10	4.72	21.5	a	N	N	0.24	
TP16	1.7-1.8		Sand	4.93	10	3.83	21.5	a	N	N	1.1	
TP3	1.7-1.8		Sand	5.65	10	5.42	21.0	a	N	N	0.23	
TP5	1.5-1.6		Sand	5.25	10	4.50	21.5	a	N	N	0.75	
TP5	0.9-1.0		Sand	5.78	10	4.98	21.5	a	N	N	0.8	
TP2	1.0-1.1		Sand	5.53	10	3.36	21.5	a	N	N	2.17	
TP10	0.5-0.6		Sand	5.25	10	4.60	21	a	N	N	0.65	
TP10	1.8-1.9		Sand	5.50	10	4.60	21	a	N	N	0.9	
TP1	1.0-1.1		Sand	5.60	10	4.79	21	a	N	N	0.81	
TP262	0.5-0.6		Sand	4.90	10	4.70	21	a	N	N	0.2	
TP26	1.0-1.1		Sand	4.75	10	4.28	21	a	N	N	0.47	

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** office: **Newcastle**
 principal: **Newcastle** date: **13/04/07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **NH/GR**
 location: **TEA GARDENS** tested by: **NH/GR**
 checked by:

date samples recovered: pH meter used/serial **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **22.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	time (mins)	pH _{FOX} (°C)	effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})	Additional comments
TP21	1.1-1.2		Sand	5.30	10	5.20	a	N	N	0.1	
TP10	1.1-1.2		Sand	5.30	10	4.80	a	N	N	0.5	
TP20	0.6-0.7		Sand	5.03	10	4.17	a	N	N	0.86	
TP20	1.6-1.7		Sand	5.10	10	5.01	a	N	N	0.09	
TP29	1.1-1.2		Sand	5.20	10	4.03	b	Y	N	1.17	
TP28	1.7-1.8		Sand	5.10	10	4.60	a	N	N	0.5	
TP19	0.5-0.6		Sand	4.96	10	3.70	b	Y	N	1.26	
TP1	0.5-0.6		Sand	7.28	10	5.32	a	N	N	1.96	

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client:	TATTERSAL SURVEYORS												
principal:	office: Newcastle												
project:	date: 12/04/07												
location:	test location: Newcastle												
	tested by: NH												
	checked by:												
date samples recovered:		10-04-07		pH meter used/serial		Horiba		date of calibration:		22.3			
hydrogen peroxide pH prior to use:		5.46		hydrogen peroxide temperature prior to use:								22.3	
sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)							Additional comments	
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})		
TP31	1.0-1.1		Sand	6.00	10	3.63	24	a	N	N	2.37		
TP34	0.55-0.65		Sand	6.76	10	4.51	25	b	Y	N	2.25		
TP32	0.7-0.8		Sand	5.20	10	3.91	24	a	N	N	1.29		
TP33	1.1-1.2		Sand	6.34	10	1.45	30	b	Y	N	4.89		
TP34	1.0-1.1		Sand	6.35	10	1.36	33	b	Y	Y	4.99	Lighter in Peroxide	
TP30	1.5-1.6		Sand	5.25	10	2.81	25	b	Y	N	2.44		
NOTES:													
1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction													
2. Strong Odour:													

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** office: **Newcastle**
 principal: **13/04/07** date:
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **Newcastle**
 location: **TEA GARDENS** tested by: **NH/**
 checked by:

date samples recovered: **11/04/07** pH meter used/serial **Horiba** date of calibration:
 hydrogen peroxide pH prior to use: **5.47** hydrogen peroxide temperature prior to use: **23.0**

sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)						Additional comments	
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction		pH Change (ie pH _F -pH _{FOX})
BH23	0.5-1.0		Sand	5.83	10	5.01	22	a	N	N	0.82	
BH35	2.0-2.5		Sand	6.15	10	4.30	23	b	N	N	1.85	
BH35	3.5-4.0		Sand	6.45	10	5.18	22	a	N	N	1.27	
BH36	0.5-1.0		Sand	5.03	10	4.24	23	b	Y	N	0.79	
BH36	2.0-2.5		Sand	5.26	10	3.78	22	a	N	N	1.4	
BH36	3.5-4.0		Sand	5.75	10	3.26	22	a	N	N	2.49	
BH36	5.0-5.5		Sand	6.19	10	4.22	23	a	N	N	1.97	
BH37	0.5-1.0		Sand	5.85	10	4.67	23	b	N	N	1.18	
BH37	2.0-2.5		Sand	5.55	10	3.92	22	a	N	N	1.63	
BH37	3.5-4.0		Sand	5.80	10	4.25	22	a	Y	N	1.55	
BH37	5.0-5.5		Sand	5.83	10	3.27	22	b	N	N	2.56	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSAL SURVEYORS** office: **Newcastle**

principal: **date: 13/04/07**

project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **Newcastle**

location: **TEA GARDENS** tested by: **NH/GR**

checked by:

date samples recovered: **pH meter used/serial Horiba** date of calibration:

hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **22.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	pH _{FOX} (oxidation in 30% hydrogen peroxide)				Additional comments			
					time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)		Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})
BH37	6.5-7.0		Sand	5.73	10	3.07	23	b	N	N	2.66	
BH58	0.5-1.0		Sand / Clay	5.19	10	4.20	22	b	N	N	0.99	
BH38	2.0-2.5		Sand / Clay	5.50	10	4.15	22	a	Y	N	1.35	
BH38	3.5-4.0		Sand	5.53	10	4.38	21	a	N	N	1.15	
BH38	5.0-5.5		Sand	5.93	10	4.55	22	a	N	N	1.38	
BH38	6.5-7.0		Sand	5.63	10	4.26	22	a	Y	N	1.39	

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
2. Strong Odour:

RESULTS OF ACID SULFATE SOIL ANALYSIS (Page 1 of 1)

9 samples supplied by Coffey on 14th June, 2007 - Lab. Job No. E7466
 Analysis requested by Warabrook - Your Project: Proposed subdivision

Sample Site	Depth (m)	EAL lab code	Texture (note 6)	Moisture Content (% moisture)	Lab. Bulk Density tonne DW/m ³	TAA pH _w	Titratable Actual Acidity (TAA) mole H ⁺ /tonne (to pH 6.5)	Reduced Inorganic Sulfur (% chromium reducible S) (%Scr) (note 2)	Reduced Inorganic Sulfur (Scr) mole H ⁺ /tonne	NET ACIDITY Chromium Sulfate mole H ⁺ /tonne (based on %ScrS)	LIME CALCULATION Chromium Sulfate kg CaCO ₃ /m ³ (includes 1.5 safety Factor)
Method No.							23F	22B	a- 22B	note 5	note 5
TP 39	1.0 - 1.1	E7466/1	Fine	24.9	1.2	4.27	52	0.006	4	56	5
TP 40	1.5 - 1.6	E7466/2	Coarse	15.9	1.3	4.83	9	<0.005	0	9	1
TP 41	0.5 - 0.6	E7466/3	Fine	18.0	1.6	4.42	39	<0.005	0	39	5
TP 42	1.0 - 1.1	E7466/4	Fine	21.9	1.1	4.63	33	0.007	4	37	3
TP 43	1.7 - 1.8	E7466/5	Coarse	11.7	1.4	5.13	7	<0.005	0	7	1
BH 45	5.5 - 5.9	E7466/6	Coarse	16.0	1.6	5.04	16	0.011	7	22	3
BH 46	1.0 - 1.1	E7466/7	Coarse	18.5	1.3	5.38	3	0.028	17	20	2
BH 46	2.5 - 3.0	E7466/8	Coarse	17.8	1.4	5.23	9	0.016	10	18	2
BH 46	5.5 - 6.0	E7466/9	Coarse	18.3	1.4	5.91	2	0.013	8	10	1

NOTE:

- All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)
- Samples analysed by SPOCAS method 23 (ie Suspension Peroxide Oxidation Combined Acidity & sulfate) and 'Chromium Reducible Sulfur' technique (Scr - Method 22B)
- Methods from Aherm, CR, McElnea AE, Sullivan LA (2004). *Acid Sulfate Soils Laboratory Methods Guidelines*. QLD DNRME.
- Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)
- ABA Equation: Net Acidity = Potential Sulfidic Acidity (ie. ScrS or Sox) + Actual Acidity + Retained Acidity - measured ANC/FF
- For Texture: coarse = sands to loamy sands; medium = sandy loams to light clays; fine = medium to heavy clays and silty clays
- Denotes not requested or required
- CNS, TAA and ANC are NATA certified but other SPOCAS segments are currently not NATA certification
- Results at or below detection limits are replaced with '0' for calculation purposes.
- Projects that disturb >1000 tonnes of soil, the $\geq 0.03\%$ S classification guideline would apply.

(Classification of potential acid sulfate material if: coarse Scr $\geq 0.03\%$ S or 19mole H⁺/t; medium Scr $\geq 0.06\%$ S or 37mole H⁺/t; fine Scr $\geq 0.1\%$ S or 62mole H⁺/t)



Lab. Accred. No.: 14960

acid sulfate soil screening test

client: **TATTERSALL SURVEYORS PTY LTD** office: **NEWCASTLE**
 principal: **NEWCASTLE** date: **08-06-07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **NEWCASTLE**
TEA GARDENS tested by: **SB**
 location: **REFER TO FIGURE 1** checked by:

date samples recovered: **01-04-07** pH meter used/serial **HORIBA** date of calibration: **08-06-07**
 hydrogen peroxide pH prior to use: **5.45** hydrogen peroxide temperature prior to use: **20.4**

sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	time (mins)	pH FOX	temp (°C)	Effervescence (see note below)	pH _{FOX} (oxidation in 30% hydrogen peroxide)			Additional comments
									Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})	
TP39	0.5-0.6		Clay	7.47	20	4.38	20.6	B	A		3.09	
TP39	1.0-1.1		Clay	6.75	25	3.86	20.7	B	A		2.89	
TP39	1.5-1.6		Sand	7.29	15	5.46	20.3	A	A		1.83	
BH46	1.0-1.5		Sand	6.57	22	2.28	20.3	B	B		4.29	
BH46	2.5-3.0		Sand	6.70	21	4.38	20.2	B	A		2.32	
BH46	4.0-4.5		Sand	7.67	20	4.66	20.2	A	A		3.01	
BH46	5.5-6.0		Sand	7.68	19	5.33	20.0	A	A		2.35	
BH46	7.0-7.5		Sand	7.25	18	5.77	19.9	A	A		1.48	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSALL SURVEYORS PTY LTD** office: **NEWCASTLE**
 principal: **NEWCASTLE** date: **08-06-07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **NEWCASTLE**
TEA GARDENS tested by: **SB**
 location: **REFER TO FIGURE 1** checked by:

date samples recovered: **01-04-07** pH meter used/serial **HORIBA** date of calibration: **08-06-07**
 hydrogen peroxide pH prior to use: **5.15** hydrogen peroxide temperature prior to use: **20.2**

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})	Additional comments
TP41	0.5-0.6		Clay	5.20	42	3.86	20.8	B	B		1.34	
TP41	1.0-1.1		Sandy Clay	5.18	43	4.06	20.8	B	A		1.12	
TP41	1.5-1.6		Clayey Sand	5.02	44	4.35	21.0	A	A		0.67	
TP41	2.4-2.5		Sand	6.02	46	4.67	20.7	A	A		1.35	
TP40	0.5-0.6		Clay	6.17	55	4.64	20.4	B	A		1.53	
TP40	1.0-1.1		Clay	5.65	56	4.50	20.4	A	A		1.15	
TP40	1.5-1.6		Sand	5.90	57	4.73	20.3	A	A		1.17	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSALL SURVEYORS PTY LTD** office: **NEWCASTLE**
 principal: **NEWCASTLE** date: **08-06-07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **NEWCASTLE**
TEA GARDENS tested by: **SB**
 location: **REFER TO FIGURE 1** checked by:

date samples recovered: **01-04-07** pH meter used/serial **HORIBA** date of calibration: **08-06-07**
 hydrogen peroxide pH prior to use: **5.55** hydrogen peroxide temperature prior to use: **20.6**

sample location	depth (m)	RL (mAHD)	soil description	pH _F pH in 1:5 distilled water	pH _{Fox} (oxidation in 30% hydrogen peroxide)				Additional comments	
					time (mins)	pH _{Fox}	temp (°C)	Effervescence (see note below)		Odour
TP43	0.5-0.6		Sand	4.09	4.94	21.2	B	A		-
TP43	1.0-1.1		Sand	5.26	4.90	20.9	A	A		0.36
TP43	1.7-1.8		Sand	5.83	5.18	20.7	A	A		0.65
TP42	0.5-0.6		Clay	5.71	4.24	20.7	B	A		1.47
TP42	1.0-1.1		Sandy Clay	5.25	4.19		A	A		1.06
TP42	1.5-1.6		Sand	5.44	4.15	20.8	B	A		1.29

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSALL SURVEYORS PTY LTD** office: **NEWCASTLE**
 principal: **NEWCASTLE** date: **08-06-07**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** test location: **NEWCASTLE**
TEA GARDENS tested by: **SB**
 location: **REFER TO FIGURE 1** checked by:

date samples recovered: **01-04-07** pH meter used/serial **HORIBA** date of calibration: **07-06-07**
 hydrogen peroxide pH prior to use: **5.44** hydrogen peroxide temperature prior to use: **20.9**

sample location	depth (m)	RL (mAHD)	soil description	pH in 1:5 distilled water	pH _{Fox} (oxidation in 30% hydrogen peroxide)					Additional comments		
					time (mins)	pH Fox	temp (°C)	Effervescence (see note below)	Odour		Colour change during reaction	pH Change (ie pH _F -pH _{Fox})
TP44	0.5-0.6		Sand	4.70	28	4.57	20.4	B	B		0.13	
TP44	1.0-1.1		Silty Sand	4.95	30	4.75	20.4	B	A		0.20	
TP44	1.5-1.6		Sand	5.04	31	5.07	20.5	A	A			

NOTES: 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

acid sulfate soil screening test

client: **TATTERSALL SURVEYORS PTY LTD** office: **NEWCASTLE** date: **08-06-07**
 principal: **NEWCASTLE**
 project: **RIVERSIDE ESTATE PROJECT APPLICATION** tested by: **SB**
 location: **TEA GARDENS**
REFER TO FIGURE 1 checked by:

date samples recovered: **01-04-07** pH meter used/serial **HORIBA** date of calibration: **08-06-07**
 hydrogen peroxide pH prior to use: **5.46** hydrogen peroxide temperature prior to use: **20.3**

sample location	depth (m)	RL (mAHD)	soil description	pH _F in 1:5 distilled water	time (mins)	pH _{FOX}	temp (°C)	Effervescence (see note below)	Odour	Colour change during reaction	pH Change (ie pH _F -pH _{FOX})	Additional comments
BH45	1.0-1.5		Sand	6.35	15	5.21	20.3	A	A		1.14	
BH45	2.5-3.0		Sand	6.84	16	5.40	19.9	A	A		1.44	
BH45	4.0-4.5		Sand	6.16	17	4.72	19.9	A	A		1.44	
BH45	4.0-4.5*		Sand	7.10	18	5.45	19.5	A	A		1.65	
BH45	5.5-5.9		Sand	6.17	20	4.80	20.1	A	A		1.37	
BH45	7.0-7.4		Sand	6.49	21	5.34	20.0	A	A		1.15	
BH45	8.5-9.0		Sand	6.68	21	5.20	20.0	A	A		1.48	
BH45	10.0-10.5		Sand	6.95	22	5.09	20.0	A	A		1.85	

NOTES:
 1. Observed Reaction: a. No visible effervescence. Slight to moderate effervescence c. Vigorous effervescent reaction
 2. Strong Odour:

Appendix C

Acid Sulfate Soils Management Plan

4 June 2007

Tattersall Surveyors Pty Ltd
PO Box 54
RAYMOND TERRACE NSW 2324

Attention: Bob Lander

Dear Bob

RE: PROPOSED SUBDIVISION

**RIVERSIDE ESTATE PROJECT APPLICATION AND SUBSEQUENT STAGES, TEA
GARDENS**

GENERAL ACID SULFATE SOILS MANAGEMENT PLAN

Please find enclosed a generic Acid Sulfate Soils (ASS) Management Plan for all future developments within the proposed Riverside Estate Project Application and subsequent stages, Tea Gardens. The plan is aimed at being useable by all future service installers, builders or property owners. It presents an overview of acid sulfate conditions at the site, the potential for exposure to ASS and then provides recommendations and procedures for management and monitoring of ASS conditions.

If you have any questions regarding this management plan, please do not hesitate to contact Robert Pearce or the undersigned.

For and on behalf of Coffey Geotechnics Pty Ltd



Arthur Love

Principal Geotechnical Engineer

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1 INTRODUCTION

Coffey Geotechnics Pty Ltd (Coffey) has prepared a generic Acid Sulfate Soils Management Plan for future developments within the proposed Riverside Estate Project Application, Tea Gardens. The work was commissioned by Bob Lander of Tattersall Surveyors, on behalf of Crighton Properties, the developers of the Riverside Estate.

The Riverside Estate area has been subject to numerous previous acid sulfate soil (ASS) assessments and management plans. Previous development of the adjoining Myall Quays estate has been undertaken in accordance with ASS Management Plans prepared specifically for the development earthworks programs.

The purpose of the plan provided in this document was to provide a generic plan for management of ASS in future earthworks that occur within the Riverside Estate. It is understood the plan is to be provided as a reference to all lot purchasers and contractors required to work on the site. It has therefore been formatted in a way that will be useable to individual land owners to assist in obtaining DA approvals and in controlling and managing ASS during the development of each lot.

2 SITE CONDITIONS AND PROPOSED DEVELOPMENT

Topographically, the proposed development area is located within low lying coastal sand plains, with elevations typically of the order of 0.75m to between about 2.5m to 3m AHD. Vegetation generally comprises of tall grasses and scattered medium sized eucalypts.

Geologically the site is located within a region of windblown sand deposits probably of Pleistocene age (ie. greater than 20,000 years old) overlain by alluvial clays and the subsurface profiles encountered during our current investigation at the site and numerous previous investigations at the adjoining Myall Quays site revealed four main natural materials:

- TOPSOIL: Silty Clayey SAND, fine to medium grained, dark brown and dark grey;
- ALLUVIAL CLAY: Sandy CLAY and CLAY, medium to high plasticity and Clayey SAND, fine to medium grained;
- AEOLIAN SAND: fine to medium grained, pale grey / white and pale grey / brown;
- INDURATED SAND: fine to medium grained, dark brown, pale brown and orange / brown.

Groundwater depths generally vary from 0.3m to 2.0m below the surface.

3 WHAT ARE ACID SULFATE SOILS (ASS)?

3.1 Background Information

Acid Sulfate Soils (ASS) are soils which contain significant concentrations of iron sulphide or pyrite which, when exposed to oxygen in the presence of sufficient moisture, oxidises, resulting in the generation of sulfuric 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 in waterlogged, saline sediments rich in iron and sulfate. Typical environments for the formation of these soils include tidal flats, salt marshes and mangrove swamps below about RL 1m 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 7,000 years since the last rise in sea level. It is generally considered that pyritic soils which formed prior to the Holocene period (ie. >10,000 years ago) would already have oxidised and leached during periods of low sea level which occurred during ice ages, exposing pyritic coastal sediments to oxygen.

3.2 Significance of ASS

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

The low pH, 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.

Generation of the 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 aquatic ecosystems.

4 ASS AND THE DEVELOPMENT OF RIVERSIDE ESTATE

Prior to development, the area was occupied by low lying sand plains with elevations typically of the order of 0.75m to about 3m AHD.

The development of the adjoining Myall Quays residential estate involved raising the level of the land to achieve a minimum surface level of 2.1m AHD. Fill used to raise land levels was won onsite and from a sand pit located to the west of the site. All fill used in the development was tested in accordance with relevant guidelines and if necessary treated in accordance with the Acid Sulfate Soils Management Plan for the site. Similar fill materials will also be used to raise site levels across part of Riverside Estate Project Application.

5 POTENTIAL FOR OXIDATION OF ACID SULFATE SOILS

Installation of services involves placement of sewer mains to varying depths of up to 8m below final ground surface level. Risers are installed on each lot so the connection to sewer will not be required to extend to a depth of more than 1m. However, there is a requirement to pier structures in the vicinity of the sewer main to below the zone of influence. As this will be below the water table in most cases driven or screw piles are likely to be used and therefore extensive exposure of ASS is not likely.

As the majority of residential developments do not involve excavation below 1m depth, the following scenarios for exposure of ASS are envisaged:

- Swimming pool excavations exceeding 1m deep;

- Bored piers exceeding 1m deep;
- Other excavations that exceed 1m deep or involve dewatering by lowering the water table to depths of more than 1m.

It is assumed that excavations for roads will not be below 1m deep and therefore it is not envisaged that road excavation will encounter ASS or Potential ASS.

For any such proposed excavations, or dewatering projects, an acid sulfate soils assessment should be undertaken, involving sampling and analysis of soils to the proposed depth of excavation.

6 MANAGEMENT OF EXPOSED ACID SULFATE SOILS

6.1 Neutralisation

The preferred method for managing the relatively small quantities of acid sulfate soil likely to be excavated is neutralisation by lime. The required dosing rate should be derived from testing of representative samples of the soil prior to excavation. Soil samples should be obtained at a rate of 1 per 50m³ of soil disturbed. Samples should be taken by a suitably qualified soils technician, engineer, or soil scientist and submitted to a NATA registered laboratory for analysis by POCAS or Chromium Reducible Sulfur methods.

The recommended liming agent is fine agricultural lime with an Effective Neutralising Value (ENV) of 98% or more. Using lime of this type, the required dosing rate can be calculated from the results of the laboratory testing using the following formula:

$$\text{Lime required (kg lime/tonne soil)} = 1.5 \times \text{Total Potential Acidity (kg H}_2\text{SO}_4\text{/tonne soil)}$$

The lime and soil should be thoroughly mixed, preferably in a bunded area as close as possible to the source, with provision for runoff water to be collected and treated prior to release. Exposed soils in the walls and floors of the excavations should be treated by spreading of lime on the exposed surfaces.

For excavations disturbing less than 1,000 tonnes of soil, liming will be required unless analysis results fall below the following criteria:

SOIL TYPE	ACTION CRITERIA
Sand to loamy sand	0.03% oxidisable sulfur 18 mol H ⁺ /tonne
Sandy loam to light clay	0.06% oxidisable sulfur 36 mol H ⁺ /tonne
Medium to heavy clay or silty clay	0.1% oxidisable sulfur 62 mol H ⁺ /tonne

Where more than 1,000 tonnes of soil is to be disturbed, all soils should be treated unless test results fall below 0.03% oxidisable sulfur or 18 mol H⁺/tonne.

Neutralised soils can be used elsewhere on site provided test results on the neutralised soil meet the above criteria.

6.2 Dewatering

To minimise the impacts of dewatering for installation of services or other excavations, the following recommendations apply:

- Where possible, undertake excavations in the wet (ie without dewatering);
- Minimise the depth and extent of dewatering by staging the works and maintaining the groundwater level as close as possible to the working surface or pipe inverts;
- Minimise the time of exposure of potential ASS by staging excavations, immediately installing services or pipes and backfilling excavation as soon as services are installed;
- Excavated groundwater should be pumped to a holding tank, pond or bunded area. The pH of the water should be measured and the water released only if a pH of 6.5 to 9.0 is achieved. If water pH is less than 6.5, lime should be added as a slurry to the water until pH meets the required values. The preferred method of water disposal is by overland discharge at a rate that allows infiltration into the sand subsoils. Direct runoff to surface drainage or waterways should be avoided;
- Larger exposures, such as those on the batters of detention basins should be further limed and the lower parts of the batter should have a lime buffer placed in the form of limed sand bags (10% lime in sand) to allow neutralisation of acid leachate generated from the excavation walls. If required, (as indicated by pH monitoring) additional neutralisation of water should be undertaken.

7 MONITORING

7.1 pH Monitoring

The following monitoring is recommended to gauge neutralisation of excavated potential ASS:

- Daily measurement of soil pH in distilled water and hydrogen peroxide. Additional lime should be added if soil pH <4 (in distilled water) or pH<3 (in hydrogen peroxide) is encountered;
- Laboratory testing by POCAS or CRS methods at a rate of one per 50m³ (or part thereof) of neutralised soil;
- Monitoring and liming should continue until required levels have been achieved.

7.2 Water Monitoring

Monitoring of pH in water discharged from dewatering operation should be as discussed in Section 7.1.

Surface waters, such as drainage lines, ponds or creeks in the vicinity of excavations or dewatering operation should also be monitored. Discharge to surface water should be avoided if practical, but where necessary, background water quality testing should be undertaken. Discharges should comply with ANZECC 2000 guidelines.

The following criteria are presented for discharge to surface water:

pH INDICATOR	FRESH WATER	MARINE ECOSYSTEM
pH	6.5 – 8.5	<0.2 unit change
Fe (Total)	500µg/L	N/A
Total Dissolved Solids	0-1500mg/L	>1500 mg/L
Aluminium (Total)	5µg/L for pH <6.5 100µg/L for pH >6.5	-

8 CONTINGENCY PLAN

Contingency plans have been discussed in the preceding section but are summarised below. Sufficient lime should be stored on site to allow implementation of the plans.

Soil

Where tests indicate lime neutralisation has not achieved acceptable results, additional lime shall be mixed through the soil until an acceptable result is achieved.

Water

Water not meeting the criteria outlined above should be treated by addition of lime in the form of a slurry. Mixing rates should be judged by monitoring pH during the process and be confirmed by laboratory testing prior to release. Care should be taken to add lime gradually, as 'over-shooting' can occur rapidly in such operations.

9 CONCLUSIONS

All personnel on sites involved with excavation or dewatering should be made fully aware of the issues associated with exposure of ASS and the requirements of this plan.

The site management procedures should be constantly reviewed to ensure that opportunities for exposure and oxidation of ASS are minimised.

For and on behalf of Coffey Geotechnics Pty Ltd



Arthur Love

Principal Geotechnical Engineer