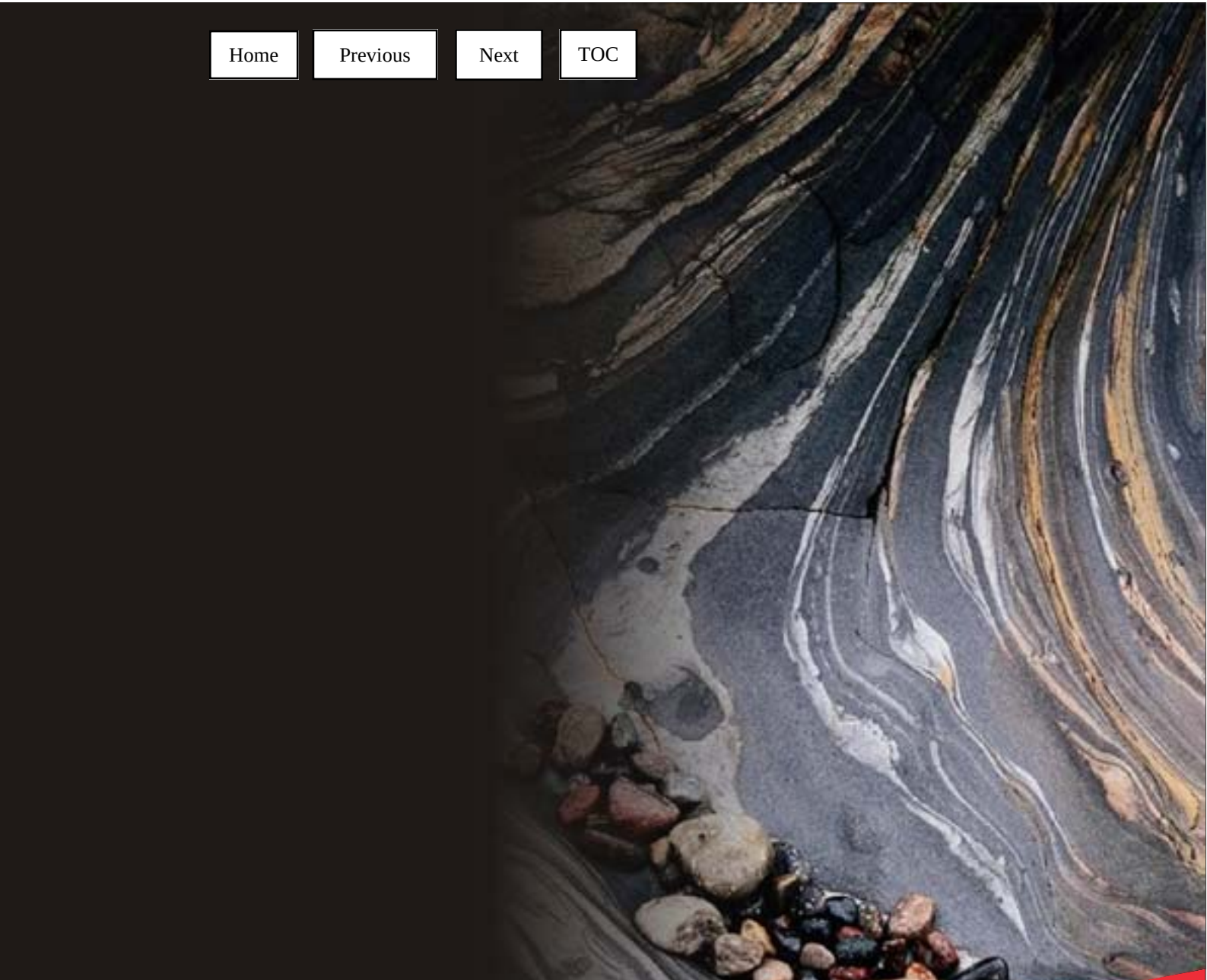

APPENDIX 4

Soils Analyses

ASSET GEOTECHNICAL
geotechnical engineering consultants

Umwelt (Australia) Pty Ltd

Proposed Lynwood Quarry Marulan

Report on
Soil Survey

0689-1D
11 May 2005

ASSET GEOTECHNICAL ENGINEERING PTY LTD
ABN 24 093 381 107

PO Box 3385
15 Sandlewood Close
Rouse Hill NSW 2155
Ph: 02 9836 2144
Fax: 02 9836 0225
assetgeo@callaustralia.net.au

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geotechnical engineering consultants

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Fax 02 9836 0225
assetgeo@callaustralia.net.au

0689-1D
11 May 2005

Umwelt (Australia) Pty Ltd
PO Box 838
TORONTO NSW 2283

Attention: Mr John Merrell

Dear Sir,

PROPOSED LYNWOOD QUARRY, MARULAN
REPORT ON SOIL SURVEY

We are pleased to present our report on a soil survey carried out for the above project.

This report documents field and laboratory investigations and provides discussion and recommendations for land capability with respect to existing site conditions and with respect to rehabilitation of areas after quarrying.

Please contact us if you have any questions regarding this report or if you require further assistance.

For and on behalf of
Asset Geotechnical Engineering Pty Ltd

Mark Bartel

Mark Bartel
BE MEngSc MIEAust CPEng
Principal Geotechnical Engineer

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of a soil survey for the proposed Lynwood hard rock quarry near Marulan. The investigation was commissioned by Mr John Merrell of Umwelt (Australia) Pty Ltd. The work was carried out in accordance with a proposal by Asset Geotechnical Engineering Pty Ltd dated 7 July 2004, reference P0673.

The objective of the survey is to provide information on the surface and subsurface soil conditions as part of an Environmental Impact Statement (EIS) for the proposed quarry. Specifically, the report describes the properties of the soils present in the project area and outlines measures required to achieve a suitable rehabilitation outcome.

This report should be read in conjunction with the attached Information Sheets.

2.0 SCOPE OF WORK

The scope of work for the soil survey comprised:

- A review of existing regional maps and reports relevant to the project area, held within our files.
- Review of Soil Landscape Maps prepared by the Department of Infrastructure, Planning and Natural Resources (DIPNR).
- Visual observations of surface features.
- Logging of 22 test pits (TP1 to TP22), to sample and assess the nature and consistency of soils at accessible areas of the project area.
- Carrying out laboratory tests on the recovered soil samples to provide data on chemical and physical properties.
- Engineering assessment and reporting.

The test pits were excavated on 3rd and 4th November 2004 using a rubber-tyred backhoe. The test locations are shown on the attached Figure 2.

The test pits were excavated to depths ranging from 0.35 metres to 1.3 metres depth and were terminated in weathered bedrock. On completion of logging and sampling, each test pit was backfilled with the excavation spoil and lightly tamped using the backhoe bucket before rolling with the backhoe tyre. Remaining spoil was left and trimmed neatly flush or slightly mounded to the adjacent ground surface.

The test pit locations were set out by our engineer and were located by hand-held GPS measurements. The subsurface conditions encountered were recorded during the progress of the excavations. Soil samples were retained for laboratory testing. Surface levels at the test locations were not determined.

Engineering logs are provided in Appendix A to this report. The results of the laboratory testing are summarised in Section 5 and are provided in Appendix B.

3.0 PROJECT AREA DESCRIPTION & REGIONAL GEOLOGY

The project area is located approximately 3km west of Marulan as shown in the attached Figure 1. The project area occupies approximately 1000 hectares adjacent to the Hume Highway, and is dissected by the Main Southern Railway.

The regional topography includes gently undulating plains, undulating rises, and rolling low hills to steep hills. The overall relief is about 80m, from about RL 710m AHD to about RL 630m AHD. The terrain is incised by numerous open depressions and watercourses that generally flow towards Joarimin Creek near the centre of the project area, Marulan Creek in the south, or Lakyersleigh Creek in the northwest. The Main Southern Railway cuts through the project area near the centre running in a roughly westerly direction before crossing Joarimin Creek and heading northwest.

Vegetation includes open forest and woodland that has been cleared over much of the lower areas. Current land use comprises predominantly open grazing.

The 1:250,000 Goulburn Geological Map indicates the project area is underlain predominantly by Bindook Porphyry (quartz feldspar porphyry, dacite, felsite, and tuff) with the southeastern corner underlain by Marulan Granite (granite and granodiorite).

Numerous rocky outcrops and rock covered areas were observed over the elevated hilly parts of the project area.

4.0 SOIL LANDSCAPES

The DIPNR soil landscape mapping identifies four landscape units within the project area. The units are summarised below.

Bindook Road

Undulating low hills on Devonian Bindook Porphyry. This unit is identified by the sub-angular porphyry rock outcrop on upper slopes and crests.

Bindook Road variant A

This variant features steeper hills and stony ridgelines with more rock outcrop than the Bindook Road landscape.

Jaqua

This unit is characterised by long foot-slopes and undulating low rises on Devonian Granite and Permian sediments.

Marulan

Comprising gently undulating rises to undulating low hills formed on Devonian Granite. Distinct surface expression of outcropping well rounded spheroidal Granite tors is common.

The soil landscape boundaries have been transposed from the SCA maps onto the Towrang 1:25,000 Topographic Map as shown in the attached Figure 2.

5.0 SUBSURFACE PROFILE FROM TEST PITTING

The generalised subsurface profile as per the test pitting is summarised below:

Layer	Description	Depth to Base (m)
Topsoil	SILT / Sandy SILT / Silty SAND, low plasticity fines, fine to medium sand	0.05 / 0.20
Slopewash	Clayey SAND / Sandy SILT / Gravelly SILT, fine to medium grained, low plasticity fines	0.15 / 0.4
Residual	SAND / Clayey SAND, fine to medium grained	0.4 / 1.15
Residual	CLAY / Sandy CLAY, medium plasticity	0.4 / 1.0
Bedrock	PORPHYRY or GRANITE, medium to coarse grained	– –

6.0 LABORATORY TEST RESULTS

Results from the laboratory testing undertaken on selected soil samples are included in Appendix B and are summarised in Table 1 below.

Table 1 - Laboratory Test Results

Sample	Engineering Description	pH	Conductivity dS/m	Multiplication Factor	Ece dS/m	Chloride mg/kg	Cation Exchange Capacity cmol+/kg	Emerson Class	Exchangeable Sodium %	Resistivity ohm.m	SO4 mg/kg	Total Phosphorous mg/kg	Available Potassium mg/kg	Total Sulphur %
TP1 / 0-0.1	Sandy SILT (Topsoil)	5.5	0.090	*10*	*0.9*	15								
TP1 / 0.05-0.15	Gravelly Clayey SAND (Slopewash)	6.0	0.090	*14*	*1.3*	33	3.1	6	0.3	>100	43			
TP1 / 0.5-0.6	Sandy CLAY (Residual)	5.1	0.080	*8*	*0.6*	62	6.2	5	3.8	63	35			
TP2 / 0-0.1	Sandy SILT (Topsoil)	4.7	0.240	*10*	*2.4*	38								
TP2 / 0.2-0.3	Silty SAND (Slopewash)	5.3	0.080	*14*	*1.1*	25								
TP2 / 0.4-0.5	Sandy CLAY (Residual)	5.0	0.110	*8*	*0.9*	47								
TP3 / 0.05-0.15	Sandy SILT (Topsoil)	7.1	0.210	*10*	*2.1*	35	7.1	6	0.4	51	19			
TP3 / 0.25-0.35	Clayey SAND (Slopewash)	7.1	0.070	*14*	*1.0*	22	3.0	5	0.6	75	17			
TP4 / 0-0.1	Silty SAND (Topsoil)	5.2	0.030	*14*	*0.4*	5	3.1	8				68	135	0.021
TP4 / 0.3-0.4	Clayey SAND (Residual)	5.4	0.015	*14*	*0.2*	<5	2.5	6				42	78	0.007
TP5 / 0.05-0.15	Sandy SILT (Topsoil)	4.5	0.075	*10*	*0.8*	60								
TP6 / 0-0.15	SILT (Topsoil)	4.8	0.070	*10*	*0.7*	15								
TP7 / 0-0.15	Sandy SILT (Topsoil)	4.8	0.100	*10*	*1.0*	30								
TP8 / 0-0.1	Silty SAND (Topsoil)	5.4	0.100	*14*	*1.4*	8	5.8	8				260	180	0.029
TP8 / 0.4-0.6	SAND (Residual)	5.4	0.030	*17*	*0.5*	8								
TP9 / 0-0.1	SILT (Topsoil)	4.5	0.230	*10*	*2.3*	49								
TP10 / 0-0.05	SILT (Topsoil)	4.5	0.100	*10*	*1.0*	14	5.6	6				390	86	0.038
TP10 / 0.05-0.15	Sandy SILT (Slopewash)	4.5	0.090	*10*	*0.9*	7								
TP10 / 0.5-0.6	Sandy CLAY (Residual)	5.2	0.070	*8*	*0.6*	64	6.9	5				200	27	0.02
TP11 / 0-0.1	Sandy SILT (Topsoil)	4.6	0.330	*10*	*3.3*	45								
TP13 / 0-0.05	SILT (Topsoil)	4.7	0.180	*10*	*1.8*	8								
TP13 / 0.1-0.2	Sandy SILT (Residual)	4.6	0.070	*10*	*0.7*	32								
TP14 / 0-0.1	Silty SAND (Topsoil)	5.8	0.080	*14*	*1.1*	12	8.3	6				260	135	0.032
TP14 / 0.1-0.2	Gravelly Silty SAND (Residual)	5.4	0.055	*14*	*0.8*	29								
TP14 / 0.4-0.6	Sandy CLAY (Residual)	5.3	0.045	*8*	*0.4*	26	10.4	5				67	82	0.009
TP16 / 0-0.1	Silty SAND (Topsoil)	5.0	0.050	*14*	*0.7*	10								
TP18 / 0.05-0.1	Silty SAND (Topsoil)	5.3	0.040	*14*	*0.6*	10	3.8	6				120	185	0.017
TP18 / 0.15-0.25	Clayey SAND (Slopewash)	4.8	0.040	*14*	*0.6*	18								
TP18 / 0.6-0.7	Sandy CLAY (Residual)	5.5	0.060	*8*	*0.5*	35								
TP19 / 0.05-0.1	SILT (Topsoil)	5.3	0.090	*10*	*0.9*	110	3.3	6				200	50	0.012
TP19 / 0.5-0.65	CLAY (Residual)	5.1	0.120	*8*	*1.0*	120	15.8	8				84	55	0.013
TP21 / 0.05-0.1	Silty SAND (Topsoil)	5.0	0.095	*14*	*1.3*	79								
TP22 / 0-0.1	SILT (Topsoil)	4.8	0.150	*10*	*1.5*	150								

The laboratory testing indicates that the soils are not dispersive by nature, are assessed to be slightly to moderately acidic and non-saline to slightly saline. The soils generally have a low Cation Exchange Capacity (CEC), which will limit the soil's ability to retain nutrients. The soil phosphorous levels are generally sufficient for grazing / open pasture use. However, the potassium and sulphur levels are relatively low and should be improved during rehabilitation to facilitate plant growth should it be desired to establish permanent pasture.

7.0 REHABILITATION

Topsoil from areas to be quarried should be stripped and stockpiled separately from lower subsoils. During rehabilitation after quarrying, the topsoil should be spread and amended as follows, based on the proposed land use:

Areas to be used for Native Vegetation (i.e. not grazing or cultivation)

- No amendment is considered necessary.

Areas to be used for Permanent Grazing Land:

- Increase pH to a target value of between 6 and 8.5. To raise the pH by 1, lime should be spread at the rate of 2500 kg/ha and thoroughly mixed to 100mm depth.
- Potassium should be raised to a target minimum value of 125 mg/kg. A dosage rate of 200 kg/ha is recommended for initial treatment.
- Organic materials (e.g. manure), ammonium sulphur, or gypsum should be added to improve sulphur levels. A dosage rate of 10 to 20 kg of sulphur per hectare should be applied.

❖ ❖ ❖ ❖ ❖

Information Sheet 1 of 3

ASSET GEOTECHNICAL
geotechnical engineering consultants

SCOPE OF SERVICES

The geotechnical report ("the report") has been prepared in accordance with the scope of services as set out in the contract, or as otherwise agreed, between the Client and Asset Geotechnical Engineering Pty Ltd ("Asset"). The scope of work may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

RELIANCE ON DATA

Asset has relied on data provided by the Client and other individuals and organizations, to prepare the report. Such data may include surveys, analyses, designs, maps and plans. Asset has not verified the accuracy or completeness of the data except as stated in the report. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations ("conclusions") are based in whole or part on the data, Asset will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Asset.

GEOTECHNICAL ENGINEERING

Geotechnical engineering is based extensively on judgment and opinion. It is far less exact than other engineering disciplines. Geotechnical engineering reports are prepared for a specific client, for a specific project and to meet specific needs, and may not be adequate for other clients or other purposes (e.g. a report prepared for a consulting civil engineer may not be adequate for a construction contractor). The report should not be used for other than its intended purpose without seeking additional geotechnical advice. Also, unless further geotechnical advice is obtained, the report cannot be used where the nature and/or details of the proposed development are changed.

LIMITATIONS OF SITE INVESTIGATION

The investigation programme undertaken is a professional estimate of the scope of investigation required to provide a general profile of subsurface conditions. The data derived from the site investigation programme and subsequent laboratory testing are extrapolated across the site to form an inferred geological model, and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour with regard to the proposed development. Despite investigation, the actual conditions at the site might differ from those inferred to exist, since no subsurface exploration program, no matter how comprehensive, can reveal all subsurface details and anomalies.

The engineering logs are the subjective interpretation of subsurface conditions at a particular location and time, made by trained personnel. The actual interface between materials may be more gradual or abrupt than a report indicates.

SUBSURFACE CONDITIONS ARE TIME DEPENDENT

Subsurface conditions can be modified by changing natural forces or man-made influences. The report is based on conditions that existed at the time of subsurface exploration. Construction operations adjacent to the site, and natural events such as floods, or ground water fluctuations, may also affect subsurface conditions, and thus the continuing adequacy of a geotechnical report. Asset should be kept appraised of any such events, and should be consulted to determine if any additional tests are necessary.

VERIFICATION OF SITE CONDITIONS

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of the report that Asset be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of change of soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

REPRODUCTION OF REPORTS

 Where information from the accompanying report is to be included in contract documents or engineering specification for the project, the entire report should be included in order to minimize the likelihood of misinterpretation from logs.

REPORT FOR BENEFIT OF CLIENT

The report has been prepared for the benefit of the Client and no other party. Asset assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of Asset or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own inquiries and obtain independent advice in relation to such matters.

OTHER LIMITATIONS

Asset will not be liable to update or revise the report to take into account any events or emergent circumstances or fact occurring or becoming apparent after the date of the report.

Information Sheet 2 of 3

ASSET GEOTECHNICAL
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LOG ABBREVIATIONS AND NOTES

METHOD

borehole logs		*excavation logs*	
AS	auger screw *	NE	natural excavation
AD	auger drill *	HE	hand excavation
RR	roller / tricone	BH	backhoe bucket
W	washbore	EX	excavator bucket
CT	cable tool	DZ	dozer blade
HA	hand auger	R	ripper tooth
D	diatube		
B	blade / blank bit		
V	V-bit		
T	TC-bit		

* bit shown by suffix e.g. ADV

coring
NMLC, NQ, PQ, HQ

SUPPORT

borehole logs		*excavation logs*	
N	nil	N	nil
M	mud	S	shoring
C	casing	B	benched
NQ	NQ rods		

CORE—LIFT

casing installed

barrel withdrawn

NOTES, SAMPLES, TESTS

D	disturbed
B	bulk disturbed
U50	thin-walled sample, 50mm diameter
HP	hand penetrometer (kPa)
SV	shear vane test (kPa)
DCP	dynamic cone penetrometer (blows per 100mm penetration)
SPT	standard penetration test
N*	SPT value (blows per 300mm)
	* denotes sample taken
Nc	SPT with solid cone
R	refusal of DCP or SPT

USCS SYMBOLS

GW	Well graded gravels and gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands and gravelly sands, little or no fines.
SP	Poorly graded sands and gravelly sands, little or no fines.
SM	Silty sand, sand-silt mixtures.
SC	Clayey sand, sand-clay mixtures.
ML	Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands.
CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
OL	Organic silts and organic silty clays of low plasticity.
MH	Inorganic silts of high plasticity.
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity.
PT	Peat muck and other highly organic soils.

MOISTURE CONDITION

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

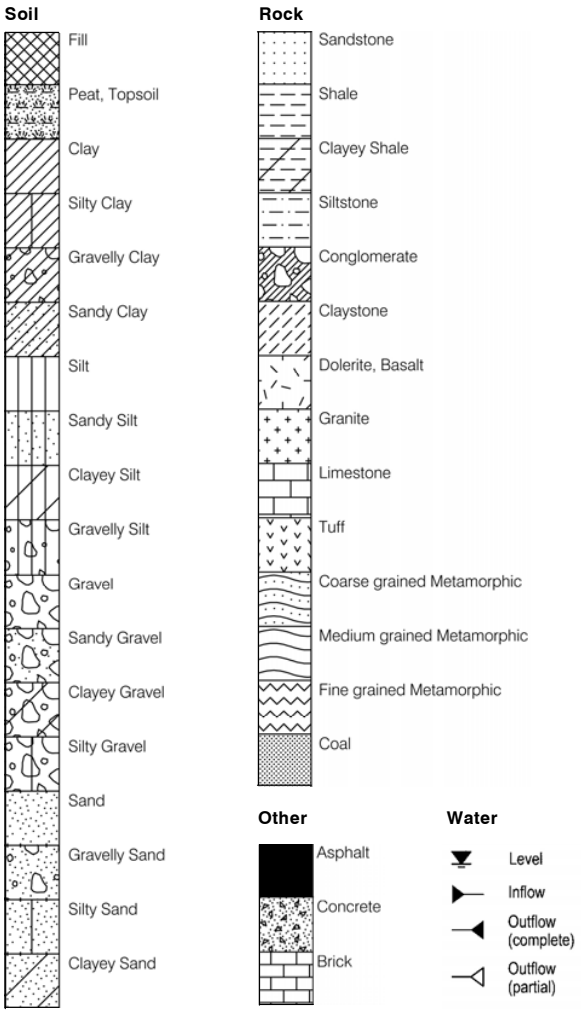
CONSISTENCY

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard

DENSITY INDEX

VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

GRAPHIC LOG



Boundaries
known ------ probable ..... possible

WEATHERING

XW	extremely weathered
HW	highly weathered
MW	moderately weathered
SW	slightly weathered
FR	fresh

STRENGTH

EL	extremely low
VL	very low
L	low
M	medium
H	high
VH	very high
EH	extremely high

RQD (%)

= sum of intact core pieces > 2 x diameter / total length of section being evaluated x 100

DEFECTS

type		*coating*	
JT	joint	cl	clean
PT	parting	st	stained
SZ	shear zone	ve	veneer
SM	seam	co	coating

shape		roughness	
pl	planar	po	polished
cu	curved	sl	slickensided
un	undulating	sm	smooth
st	stepped	ro	rough
ir	irregular	vr	very rough

inclination
measured above axis and perpendicular to core

Information Sheet 3 of 3

ASSET GEOTECHNICAL
geotechnical engineering consultants

AS1726-1993

Soils and rock are described in the following terms, which are broadly in accordance with AS1726-1993.

SOIL

MOISTURE CONDITION

Term	Description
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through the hand.
Moist	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.

Moisture content of cohesive soils may also be described in relation to plastic limit (W_P) or liquid limit (W_L) [>> much greater than, > greater than, < less than, << much less than].

CONSISTENCY OF COHESIVE SOILS

Term	Su (kPa)	Term	Su (kPa)
Very soft	< 12	Very Stiff	100 – 200
Soft	12 – 25	Hard	> 200
Firm	25 – 50	Friable	–
Stiff	50 – 100		

DENSITY OF GRANULAR SOILS

Term	Density Index(%)	Term	Density Index (%)
Very Loose	< 15	Dense	65 – 85
Loose	15 – 35	Very Dense	>85
Medium Dense	35 – 65		

PARTICLE SIZE

Name	Subdivision	Size (mm)
Boulders		> 200
Cobbles		63 – 200
Gravel	coarse	20 – 63
	medium	6 – 20
	fine	2.36 – 6
Sand	coarse	0.6 – 2.36
	medium	0.2 – 0.6
	fine	0.075 – 0.2
Silt & Clay		< 0.075

MINOR COMPONENTS

Term	Proportion by Mass	
	coarse grained	fine grained
Trace	≤ 5%	≤ 15%
Some	5 – 2%	15 – 30%

SOIL ZONING

Layers	Continuous exposures.
Lenses	Discontinuous layers of lenticular shape.
Pockets	Irregular inclusions of different material.

SOIL CEMENTING

Weakly	Easily broken up by hand.
Moderately	Effort is required to break up the soil by hand.

USCS SYMBOLS

Symbol	Description
GW	Well graded gravels and gravel-sand mixtures, little or no fines.
GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.
GM	Silty gravels, gravel-sand-silt mixtures.
GC	Clayey gravels, gravel-sand-clay mixtures.
SW	Well graded sands and gravelly sands, little or no fines.
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OL	Organic silts and organic silty clays of low plasticity.
MH	Inorganic silts of high plasticity.
CH	Inorganic clays of high plasticity.
OH	Organic clays of medium to high plasticity.
PT	Peat muck and other highly organic soils.

ROCK

SEDIMENTARY ROCK TYPE DEFINITIONS

Rock Type	Definition (more than 50% of rock consists of …..)
Conglomerate	... gravel sized (>2mm) fragments.
Sandstone	... sand sized (0.06 to 2mm) grains.
Siltstone	... silt sized (<0.06mm) particles, rock is not laminated.
Claystone	... clay, rock is not laminated.
Shale	... silt or clay sized particles, rock is laminated.

LAYERING

Term	Description
Massive	No layering apparent.
Poorly Developed	Layering just visible. Little effect on properties.
Well Developed	Layering distinct. Rock breaks more easily parallel to layering.

STRUCTURE

Term	Spacing (mm)	Term	Spacing
Thinly laminated	<6	Medium bedded	200 – 600
Laminated	6 – 20	Thickly bedded	600 – 2,000
Very thinly bedded	20 – 60	Very thickly bedded	> 2,000
Thinly bedded	60 – 200		

STRENGTH

Term	Is50 (MPa)	Term	Is50 (MPa)
Extremely Low	<0.03	High	1.0 – 3.0
Very low	0.03 – 0.1	Very High	3.0 – 10.0
Low	0.1 – 0.3	Extremely High	>10.0
Medium	0.3 – 1.0		

NOTE: Is50 = Point Load Strength Index

WEATHERING

Term	Description
Residual Soil	Soil derived from weathering of rock; the mass structure and substance fabric are no longer evident.
Extremely …..	Rock is weathered to the extent that it has soil properties (either disintegrates or can be remoulded). Fabric of original rock is still visible.
Highly …..	Rock strength usually highly changed by weathering; rock may be highly discoloured.
Moderately …..	Rock strength usually moderately changed by weathering; rock may be moderately discoloured.
Slightly …..	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh	Rock shows no signs of decomposition or staining.

DEFECT DESCRIPTION

Type	
Joint	A surface or crack across which the rock has little or no tensile strength. May be open or closed.
Parting	A surface or crack across which the rock has little or no tensile strength. Parallel or sub-parallel to layering/ bedding. May be open or closed.
Sheared Zone	Zone of rock substance with roughly parallel, near planar, curved or undulating boundaries cut by closely spaced joints, sheared surfaces or other defects.
Seam	Seam with deposited soil (infill), extremely weathered insitu rock (XW), or disoriented usually angular fragments of the host rock (crushed).

Shape	
Planar	Consistent orientation.
Curved	Gradual change in orientation.
Undulating	Wavy surface.
Stepped	One or more well defined steps.
Irregular	Many sharp changes in orientation.

Roughness	
Polished	Shiny smooth surface.
Slickensided	Grooved or striated surface, usually polished.
Smooth	Smooth to touch. Few or no surface irregularities.
Rough	Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper.
Very Rough	Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper.

Coating	
Clean	No visible coating or discolouring.
Stained	No visible coating but surfaces are discoloured.
Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
Coating	Visible coating ≤1mm thick. Thicker soil material described as seam.

APPENDIX A

Field Investigation Results

ASSET GEOTECHNICAL
geotechnical engineering consultants

PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
assetgeo@callaustralia.net.au

EX no:	TP01
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, dark grey, grass roots	>>Wp	F		TOPSOIL
			D		0.1		SC	Gravelly Clayey SAND, medium to cause grained, fine rounded gravel, light grey	M-W	MD		SLOPEWASH
					0.25		CL	Sandy CLAY, medium plasticity, fine to medium sand, mottled orange-brown and grey	>Wp	VSt		RESIDUAL
			D		0.5							
					0.75		CL	Sandy CLAY, medium plasticity, medium to coarse sand, light grey		VSt-H		
					1.0							
					1			PORPHYRY, medium to coarse grained, grey, highly weathered				BEDROCK
					1.1			TP01 terminated at 1.1m				
					1.5							
					2.0							

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PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP02
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, medium plasticity, grey, grass roots	>>Wp	F		TOPSOIL
					0.1		SM	Silty SAND, fine grained, light grey	M	MD		SLOPEWASH
			D									
			D		0.4		CL	Sandy CLAY, medium plasticity, grey with orange-brown mottle, medium sand	>Wp	VSt		RESIDUAL
					0.5							
					0.7			PORPHYRY, medium grained, grey, moderately weathered				BEDROCK
					0.8			TP02 terminated at 0.8m				
					1.0							
					1.5							
					2.0							

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Fax: (02) 9836 0225
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EX no:	TP03
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, dark grey, grass roots	>Wp	F		TOPSOIL
					0.1		SC	Clayey SAND, fine to medium grained, light brown	M	MD		SLOPEWASH
			D									
					0.35		CL	Sandy CLAY, medium plasticity, mottled orange-brown and grey	>Wp	VSt		RESIDUAL
			D		0.5							
					0.9			PORPHYRY, medium grained, grey, moderately weathered				BEDROCK
					0.95			TP03 terminated at 0.95m				
					1.0							
					1.5							
					2.0							

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Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP04
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, fine to medium grained, grey and dark grey, some medium to coarse gravel	M	L		TOPSOIL
					0.1		SC	Clayey SAND, medium to coarse grained, light grey, medium plasticity fines, some medium to coarse gravel		MD		RESIDUAL
			D									
					0.4			PORPHYRY, medium to coarse grained, light brown, extremely weathered				BEDROCK
					0.5							
					0.9			PORPHYRY, medium to coarse grained, moderately weathered				
					1.0							
					1			TP04 terminated at 1m				
					1.5							
					2.0							

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Ph: (02) 9836 2144
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EX no:	TP05
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, light brown	D	Fb		TOPSOIL
					0.2		CL	Sandy CLAY, medium plasticity, orange-brown and grey mottled, medium to coarse grained sand	<Wp	H		RESIDUAL
			D		0.5							
					0.8			PORPHYRY, medium to coarse grained, brown and grey, extremely weathered				BEDROCK
					1.0							
					1.05			PORPHYRY, medium to coarse grained, dark brown, HW-MW				
					1.1			TP05 terminated at 1.1m				
					1.5							
					2.0							

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EX no:	TP06
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D		0.05		ML	SILT, low plasticity, dark grey, roots	=Wp	St		TOPSOIL
							ML	SILT, low plasticity, grey				
		NE			0.15			PORPHYRY, medium to coarse grained, grey and orange-brown, extremely to highly weathered				BEDROCK
					0.35			Refusal on PORPHYRY, moderately weathered TP06 terminated at 0.35m				
					0.5							
					1.0							
					1.5							
					2.0							

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EX no:	TP07
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, dark grey, grass roots	>Wp	F		TOPSOIL
					0.05		CL	Sandy CLAY, medium plasticity, light brown with orange-brown mottle, fine to medium sand		VSt		RESIDUAL
			D									
					0.4			PORPHYRY, medium to coarse grained, light brown, extremely to highly weathered				BEDROCK
					0.5							
					0.55			Refusal on PORPHYRY, medium to coarse grained, brown, highly to moderately weathered TP07 terminated at 0.55m				
					1.0							
					1.5							
					2.0							

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Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP08
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, fine to medium grained, dark grey, grassroots	M	L		TOPSOIL
					0.1		SP	SAND, fine to medium grained, orange-brown		MD		RESIDUAL
			D		0.5							
					0.8		SC	Clay SAND, fine to medium grained, mottled orange-brown and light brown				
					1.0							
					1.15			PORPHYRY, medium to coarse grained, mottled light grey and orange-brown, highly weathered				BEDROCK
					1.25			TP08 terminated at 1.25m				
					1.5							
					2.0							

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Fax: (02) 9836 0225
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EX no:	TP09
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	SILT, low plasticity, dark grey, grass roots	>Wp	F		TOPSOIL
			D		0.1		SM	Silty SAND, fine grained, light grey	M	MD		SLOPEWASH
					0.3		CL	Sandy CLAY, medium plasticity, mottled light brown and orange-brown, fine to medium sand	>Wp	VSt		RESIDUAL
			D		0.5							
					0.75			GRANITE, medium to coarse grained, brown and orange-brown mottle, extremely weathered				BEDROCK
					0.8			Near refusal on GRANITE, highly to moderately weathered TP09 terminated at 0.8m				
					1.0							
					1.5							
					2.0							

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Fax: (02) 9836 0225
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EX no:	TP10
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	SILT, low plasticity, dark grey, grass roots	=Wp	St		TOPSOIL
			D		0.05		ML	Sandy SILT, low plasticity, grey	<Wp			SLOPEWASH
					0.15		CL	Sandy CLAY		VSt		RESIDUAL
			D		0.5							
					0.6			PORPHYRY, medium to coarse grained, mottled light grey and brown, XW-HW				BEDROCK
					0.8			Near refusal on HW-MW PORPHYRY TP10 terminated at 0.8m				
					1.0							
					1.5							
					2.0							

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Fax: (02) 9836 0225
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EX no:	TP11
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, dark grey to brown, grass roots	=Wp	St		TOPSOIL
					0.15		SM	Silty Gravelly SAND, fine to coarse sand, fine gravel, light grey	M	MD		SLOPEWASH
			D									
					0.35		CL	Sandy CLAY, medium plasticity, mottled grey and orange-brown	>Wp	St-VSt		RESIDUAL
					0.5							
			D									
					0.9			GRANITE, medium to coarse grained, mottled light grey and orange-brown, XW				BEDROCK
					1.0							
					1			Near refusal on GRANITE, medium to coarse grained, HW-MW TP11 terminated at 1m				
					1.5							
					2.0							

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Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP12
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information						material information						
method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, dark grey to grey, grass roots	>Wp	F		TOPSOIL
			D		0.1		ML	Gravelly SILT, low plasticity, light grey/brown, fine gravel		St		RESIDUAL
					0.25		CL	Sandy CLAY, medium plasticity, mottled brown and grey, fine to coarse sand		VSt		
			D		0.5							
					0.9			GRANITE, medium to coarse grained, grey and brown, XW				BEDROCK
					0.95			TP12 terminated at 0.95m				
					1.0							
					1.5							
					2.0							

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Fax: (02) 9836 0225
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EX no:	TP13
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	3.11.2004
principal:	READYMIX	finished:	3.11.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	SILT, low plasticity, dark brown, grass roots	>Wp	F		TOPSOIL
			D		0.1		ML	Sandy SILT, low plasticity, light brown	D	Fb		RESIDUAL
			D		0.25		CL	Sandy CLAY, medium plasticity, mottled orange-brown, brown and grey	<Wp	H		
					0.5							
					0.6			PORPHYRY, medium to coarse grained, modelled brown, orange-brown and white, XW				BEDROCK
					0.85			Near refusal on PORPHYRY, medium to coarse grained, brown and grey, MW TP13 terminated at 0.85m				
					1.0							
					1.5							
					2.0							

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Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP14
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, fine to medium grained, dark brown, grass roots	D	MD		TOPSOIL
			D		0.1		SM	Gravelly Silty SAND, fine to medium grained, fine gravel, light brown with orange-brown mottle		MD		RESIDUAL
					0.25		CL	Sandy CLAY, medium plasticity, light brown with orange-brown mottle, fine to coarse sand	< = Wp	H		
			D		0.5							
					0.85			GROUND, medium to coarse grained, grey, XW				BEDROCK
					0.95			TP14 terminated at 0.95m				
					1.0							
					1.5							
					2.0							

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Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP15
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D		0.15		ML	SILT, low plasticity, dark to light grey	<Wp	F		TOPSOIL
			D				ML	Sandy SILT, low plasticity, light brown, fine to coarse sand		St		RESIDUAL
			D		0.45 0.5		CL	Sandy CLAY, medium plasticity, mottled light brown and orange-brown	>Wp	VSt		
					0.95 1.0			PORPHYRY, medium to coarse grained, mottle light grey and orange-brown, XW-HW				BEDROCK
					1.15			Near refusal on PORPHYRY, medium to coarse grained, MW TP15 terminated at 1.15m				
					1.5							
					2.0							

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Ph: (02) 9836 2144
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EX no:	TP16
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, medium grained, dark grey, grass roots	M-W	L		TOPSOIL
					0.1		SC	Clayey SAND, medium grained, light grey, some fine gravel		MD		SLOPEWASH
			D									
					0.35		CL	Sandy CLAY, medium plasticity, light grey with orange-brown mottle, trace fine gravel	>Wp	VSt		RESIDUAL
			D		0.5							
					1.0							
					1			PORPHYRY, medium to coarse grained, mottled grey, brown and white				BEDROCK
					1.2			TP16 terminated at 1.2m				
					1.5							
					2.0							

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EX no:	TP17
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	slow seepage					ML	Sandy SILT, low plasticity, dark grey, grass roots	M	F		TOPSOIL
			D									
					0.15		CL	Sandy CLAY, medium plasticity, light grey, medium to coarse sand	> > Wp	St		RESIDUAL
			D									
					0.3		SC	Clayey SAND, medium to coarse grained, light grey	W	MD		
			D		0.5							
					0.7			PORPHYRY, medium to coarse grained, light grey, XW-HW				BEDROCK
					1.0							
					1.2			TP17 terminated at 1.2m				
					1.5							
					2.0							

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geotechnical engineering consultants

PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
assetgeo@callaustralia.net.au

EX no:	TP18
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, fine to medium grained, dark grey to black, grass roots	M	L		TOPSOIL
					0.1		SC	Clayey SAND, fine to medium grained, light brown	M-W			SLOPEWASH
			D									
					0.25		CL	Sandy CLAY, medium plasticity, light grey and light brown with orange-brown mottle	>Wp	St-VSt		RESIDUAL
					0.5							
			D									
					0.7			GRANITE, medium to coarse grained, mottled light grey and brown, XW-HW				BEDROCK
					1.0							
					1			Near refusal on GRANITE, medium to coarse grained, MW TP18 terminated at 1m				
					1.5							
					2.0							

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PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP19
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetro-meter kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	SILT, low plasticity, grey	M	F		TOPSOIL
					0.15		CL	CLAY, medium plasticity, mottled brown and orange/red-brown	>Wp	St-VSt		RESIDUAL
			D		0.5							
					0.75			GRANITE, medium to coarse grained, mottled light grey, brown and white, XW				BEDROCK
					1.0							
					1.3			TP19 terminated at 1.3m				
					1.5							
					2.0							

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Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP20
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	Sandy SILT, low plasticity, grey, grass roots, fine to medium sand	M	L-MD		TOPSOIL
					0.1		ML	Sandy SILT, low plasticity, grey, fine to coarse sand				RESIDUAL
			D									
					0.3		CL	Sandy CLAY, medium plasticity, mottled light brown and orange-brown, fine to medium sand	=Wp	H		
					0.5							
			D									
					0.8			PORPHYRY, medium to coarse grained, light grey, XW				BEDROCK
					1.0							
					1.05			TP20 terminated at 1.05m				
					1.5							
					2.0							

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Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP21
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				SM	Silty SAND, fine grained, dark grey, grass roots	M	L		TOPSOIL
					0.1		SC	Clayey SAND, medium grained, light brown				RESIDUAL
			D									
					0.5							
					0.5		CL	Sandy CLAY, medium plasticity, mottled light grey, brown and orange-brown, medium to coarse sand	>Wp	VSt		
			D									
					0.9			PORPHYRY, medium to coarse grained, mottled orange-brown and grey, XW				BEDROCK
					1.0							
					1.25			TP21 terminated at 1.25m				
					1.5							
					2.0							

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PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
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EX no:	TP22
sheet:	1 of 1
job no.:	0689-1

Excavation Log

client:	UMWELT (AUSTRALIA) PTY LTD	started:	4.12.2004
principal:	READYMIX	finished:	4.12.2004
project:	PROPOSED HARD ROCK QUARRY	logged:	MAB
location:	MARULAN	checked:	MAB
equipment:	4WD BACKHOE	RL surface:	
dimensions:	0.45m wide by 2.0m long	datum:	

excavation information | material information

method	support	water	notes samples, tests, etc	RL	depth metres	graphic log	USCS symbol	material soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency/ density index	hand penetrometer kPa (100 200 300 400)	structure and additional observations
BH	N	NE	D				ML	SILT, low plasticity, grey and brown, grass roots	=Wp	F		TOPSOIL
					0.1		ML	Sandy Clayey SILT, low plasticity, light brown, fine to coarse sand				RESIDUAL
			D									
			D		0.3		CL	Sandy CLAY, medium plasticity, mottled brown and orange-brown, fine to coarse sand	>Wp	VSt		
					0.5			PORPHYRY, medium to coarse grained, mottled grey and brown, XW-HW				BEDROCK
					0.85			TP22 terminated at 0.85m				
					1.0							
					1.5							
					2.0							

APPENDIX B

Laboratory Test Results

SYDNEY
ANALYTICAL
LABORATORIES

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852

ANALYTICAL REPORT for:

ASSET GEOTECHNICAL ENGINEERING PTY LTD

15 SANDLEWOOD CLOSE
ROUSE HILL 2155

ATTN: MARK BARTEL

JOB NO: SAL15321

CLIENT ORDER: 0689-1

DATE RECEIVED: 15/11/04

DATE COMPLETED: 26/11/04

TYPE OF SAMPLES: SOILS

NO OF SAMPLES: 29

NATA Accredited Laboratory
Number: 1884

.....
Issued on 09/12/04
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321
CLIENT ORDER: 0689-1

	SAMPLES	pH 1:5	COND. dS/m	Cl mg/kg	CEC cmol+/kg	*EMERS. Class
1	TP1/0-0.1	5.5	0.090	15		
2	TP2/0-0.1	4.7	0.24	38		
3	TP2/0.2-0.3	5.3	0.080	25		
4	TP2/0.4-0.5	5.0	0.11	47		
5	TP4/0-0.1	5.2	0.030	5	3.1	8
6	TP4/0.3-0.4	5.4	0.015	<5	2.5	6
7	TP5/0.05-0.15	4.5	0.075	60		
8	TP6/0-0.15	4.8	0.070	15		
9	TP7/0-0.05	4.8	0.10	30		
10	TP8/0-0.1	5.4	0.10	8	5.8	8
11	TP8/0.4-0.6	5.4	0.030	8		
12	TP9/0-0.1	4.5	0.23	49		
13	TP10/0-0.05	4.5	0.10	14	5.6	6
14	TP10/0.05-0.15	4.5	0.090	7		
15	TP10/0.5-0.6	5.2	0.070	64	6.9	5
16	TP11/0-0.1	4.6	0.33	45		
17	TP13/0-0.05	4.7	0.18	8		
18	TP13/0.1-0.2	4.6	0.070	32		
19	TP14/0-0.1	5.8	0.080	12	8.3	6
20	TP14/0.1-0.2	5.4	0.055	29		
21	TP14/0.4-0.6	5.3	0.045	26	10.4	5
22	TP16/0-0.1	5.0	0.050	10		
23	TP18/0.05-0.1	5.3	0.040	10	3.8	6
24	TP18/0.15-0.25	4.8	0.040	18		
25	TP18/0.6-0.7	5.5	0.060	35		
26	TP19/0.05-0.1	5.3	0.090	110	3.3	6
27	TP19/0.5-0.65	5.1	0.12	120	15.8	8
28	TP21/0.05-0.1	5.0	0.095	79		
29	TP22/0-0.1	4.8	0.15	150		
DUPLICATES:						
19	TP14/0-0.1	5.8	0.090	11	8.1	6
MDL		0.1	0.001	5	0.1	
Method Code		WA1	WA2	WA4	S7	C43
Preparation		P5	P5	P5	P5	P1

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321
CLIENT ORDER: 0689-1

	SAMPLES	Total P mg/kg	*Av.K mg/kg	*Tot.S %
5	TP4/0-0.1	68	135	0.021
6	TP4/0.3-0.4	42	78	0.007
10	TP8/0-0.1	260	180	0.029
13	TP10/0-0.05	390	86	0.038
15	TP10/0.5-0.6	200	27	0.020
19	TP14/0-0.1	260	135	0.032
21	TP14/0.4-0.6	67	82	0.009
23	TP18/0.05-0.1	120	185	0.017
26	TP19/0.05-0.1	200	50	0.012
27	TP19/0.5-0.65	84	55	0.013
DUPLICATES:				
19	TP14/0-0.1	230	130	0.029
MDL		5	1	0.002
Method Code		WA15	S4	HT3
Preparation		P5	P5	P5

RESULTS ON DRY BASIS

SYDNEY ANALYTICAL LABORATORIES

LABORATORY DUPLICATE REPORT

JOB NO: SAL15321
CLIENT ORDER: 0689-1

Sample Number	Analyte	Units	MDL	Sample Result	Duplicate Result	%RPD
TP14/0-0.1	pH		0.1	5.8	5.8	0
TP14/0-0.1	Conductivity	dS/m	0.001	0.080	0.090	12
TP14/0-0.1	Chloride	mg/kg	5	12	11	8
TP14/0-0.1	CEC	cmol+/kg	0.1	8.3	8.1	2
TP14/0-0.1	*Emerson Class	Class		6	6	0
TP14/0-0.1	Total P	mg/kg	5	260	230	12
TP14/0-0.1	Available K	mg/kg	1	135	130	4
TP14/0-0.1	*Total Sulphur	%	0.002	0.032	0.029	10

Acceptance criteria:

RPD <50% for low level (<20xMDL)
RPD <30% for medium level (20-100xMDL)
RPD <15% for high level (>100xMDL)
No limit applies at <2xMDL

MDL = Method Detection Limit

All results are within the acceptance criteria

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321
CLIENT ORDER: 0689-1

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory.

P5	Sample dried, split and crushed to -150um
P1	Analysis performed on sample as received
WA1	pH - 1:5 soil/water extract Determined by APHA 4500B
WA2	Conductivity - 1:5 soil/water extract Determined by APHA 2510B
WA4	Chloride - 1:5 soil/water extract Determined by APHA 4110B
S7	Cation Exchange Capacity & Exchangeable/Soluble Cations Determined by Silver Thiourea Method CEC-1
*C43	Modified Emerson Crumb Test: Based on AS1547-1990 Appendix F
WA15	Total Phosphorus - H2SO4/HF Digestion Determined by APHA 4500BF
*S4	Available Phosphorus - Bray Extract (0.03N NH4F) Determined by APHA 4500F
*HT3	Total Sulphur - Determined by High Temperature Furnace

The laboratory's NATA registration does not cover performance of this service

A preliminary report was faxed on 26/11/04

SYDNEY ANALYTICAL LABORATORIES

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852

ANALYTICAL REPORT for:

ASSET GEOTECHNICAL ENGINEERING PTY LTD

15 SANDLEWOOD CLOSE
ROUSE HILL 2155

ATTN: MARK BARTEL

JOB NO: SAL15321B

CLIENT ORDER: 0698-1

DATE RECEIVED: 15/11/04

DATE COMPLETED: 26/11/04

TYPE OF SAMPLES: SOILS

NO OF SAMPLES: 4

NATA Accredited Laboratory
Number: 1884

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Issued on 09/12/04
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321B
CLIENT ORDER: 0698-1

	SAMPLES	pH 1:5	COND. dS/m	CEC cmol+/kg	ESP %	*Resis. ohm.m
1	TP1/0.05-0.15	6.0	0.090	3.1	0.3	>100
2	TP1/0.5-0.6	5.1	0.080	6.2	3.8	63
3	TP3/0.05-0.15	7.1	0.21	7.1	0.4	51
4	TP3/0.25-0.35	7.1	0.070	3.0	0.6	75
MDL		0.1	0.001	0.1	0.1	1
Method Code		C1	WA2	S7	C35	C21
Preparation		P5	P5	P5	P5	P8

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321B
CLIENT ORDER: 0698-1

	SAMPLES	*EMERS. Class	Cl mg/kg	SO4 mg/kg
1	TP1/0.05-0.15	6	33	43
2	TP1/0.5-0.6	5	62	35
3	TP3/0.05-0.15	6	35	19
4	TP3/0.25-0.35	5	22	17
	MDL		5	5
	Method Code	C43	WA4	WA6
	Preparation	P1	P5	P5

RESULTS ON DRY BASIS

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321B
CLIENT ORDER: 0698-1

METHODS OF PREPARATION AND ANALYSIS

The tests contained in this report have been carried out on the samples as received by the laboratory.

P5	Sample dried, split and crushed to -150um
P8	Sample dried and crushed to pass 6.7mm sieve
P1	Analysis performed on sample as received
C1	pH - AS1289.4.3.1
WA2	Conductivity - 1:5 soil/water extract Determined by APHA 2510B
S7	Cation Exchange Capacity & Exchangeable/Soluble Cations Determined by Silver Thiourea Method CEC-1
C35	Exchangeable Sodium Percentage - Silver Thiourea Extract Determined by APHA 3500B
*C21	Electrical Resistivity - RTA T185
*C43	Modified Emerson Crumb Test: Based on AS1547-1990 Appendix F
WA4	Chloride - 1:5 soil/water extract Determined by APHA 4110B
WA6	Sulphate - 1:5 soil/water extract Determined by APHA 4110B

The laboratory's NATA registration does not cover performance of this service

A preliminary report was faxed on 26/11/04

SYDNEY ANALYTICAL LABORATORIES

Office:
PO BOX 48
ERMINGTON NSW 2115

Laboratory:
1/4 ABBOTT ROAD
SEVEN HILLS NSW 2147
Telephone: (02) 9838 8903
Fax: (02) 9838 8919
A.C.N. 003 614 695
A.B.N. 81 829 182 852

ANALYTICAL REPORT for:

ASSET GEOTECHNICAL ENGINEERING PTY LTD

15 SANDLEWOOD CLOSE
ROUSE HILL 2155

ATTN: MARK BARTEL

JOB NO: SAL15321C

CLIENT ORDER: 0704-1

DATE RECEIVED: 18/11/04

DATE COMPLETED: 30/11/04

TYPE OF SAMPLES: SOIL

NO OF SAMPLES: 1

NATA Accredited Laboratory
Number: 1884

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Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321C
CLIENT ORDER: 0704-1

	SAMPLES	pH 1:5	COND. dS/m	CEC cmol+/kg	ESP %	*P SORP mg/kg	*EMERS. Class
1	Ex1/0.1-0.5	4.7	0.025	4.6	1.1	580	6
MDL		0.1	0.001	0.1	0.1	1	
Method Code		C1	WA2	S7	C35	S9	C43
Preparation		P5	P5	P5	P5	P5	P1

RESULTS ON DRY BASIS

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL15321C
CLIENT ORDER: 0704-1

METHODS OF PREPARATION AND ANALYSIS

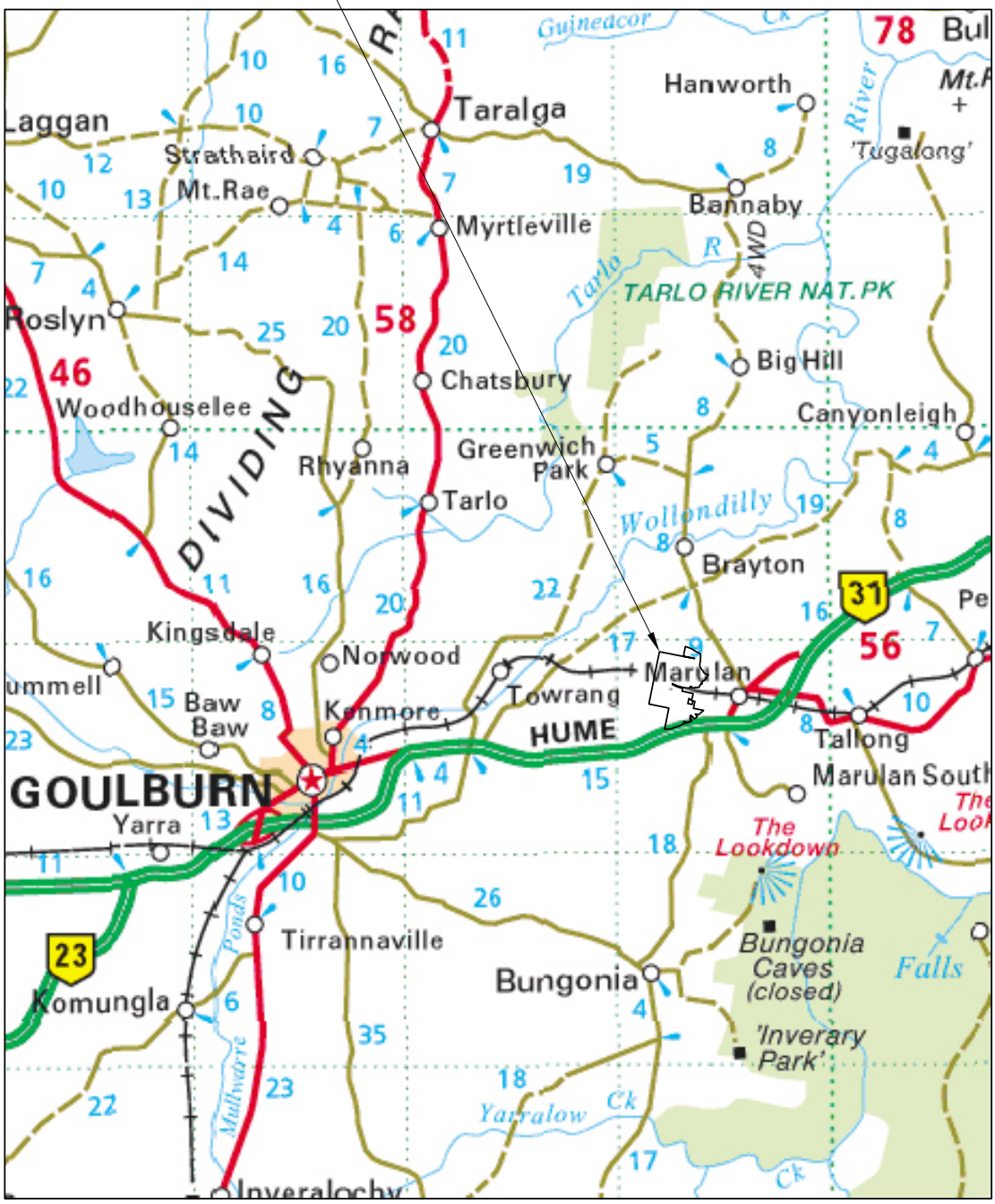
The tests contained in this report have been carried out on the samples as received by the laboratory.

P5	Sample dried, split and crushed to -150um
P1	Analysis performed on sample as received
C1	pH - AS1289.4.3.1
WA2	Conductivity - 1:5 soil/water extract Determined by APHA 2510B
S7	Cation Exchange Capacity & Exchangeable/Soluble Cations Determined by Silver Thiourea Method CEC-1
C35	Exchangeable Sodium Percentage - Silver Thiourea Extract Determined by APHA 3500B
*S9	Phosphorus Sorption - Dept of Agriculture Standard Method Determined by APHA 4500F
*C43	Modified Emerson Crumb Test: Based on AS1547-1990 Appendix F

The laboratory's NATA registration does not cover performance of this service

A preliminary report was faxed on 30/11/04

FIGURES



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rev	by	date	description
–	–	–	–

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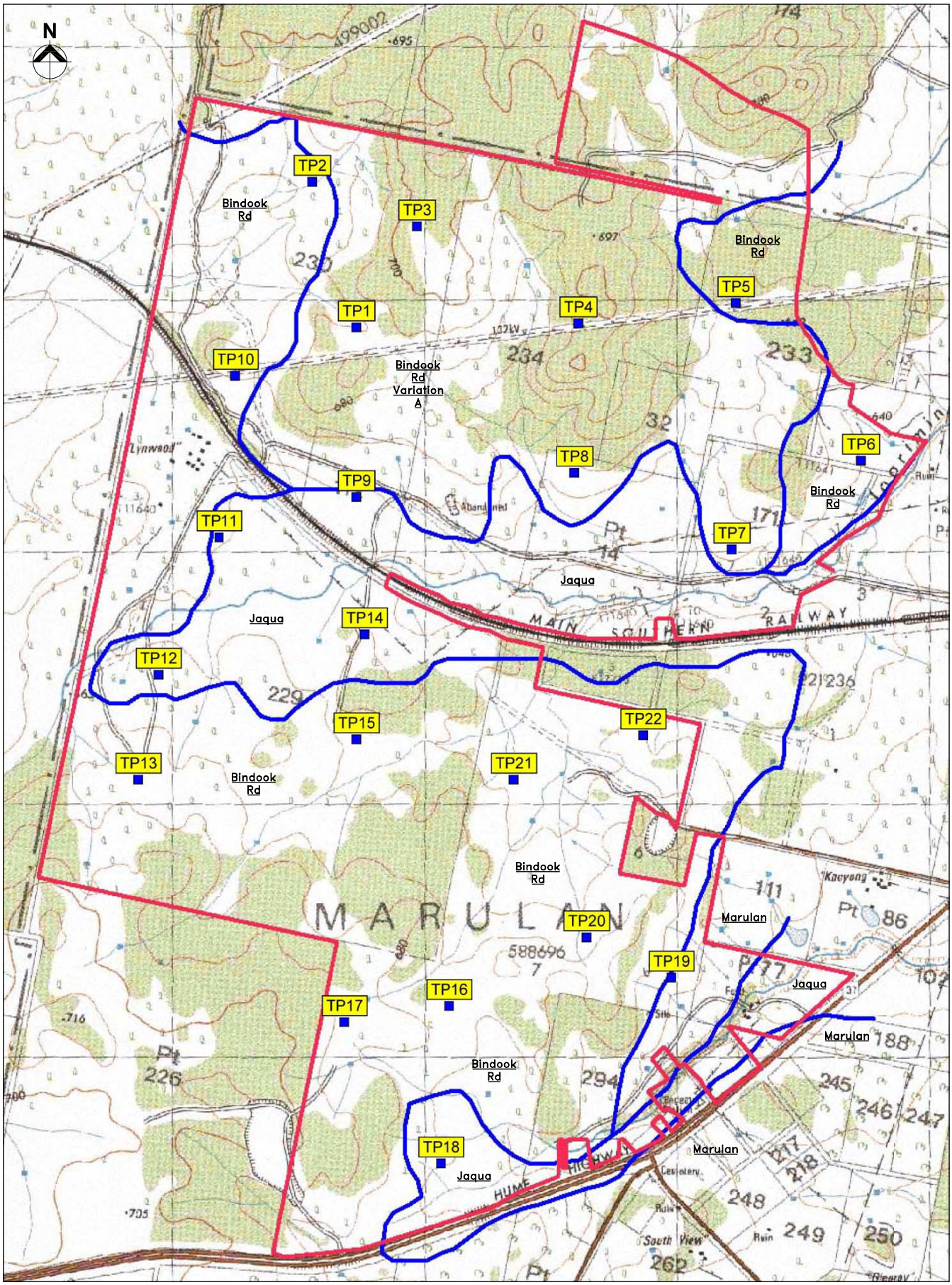
geotechnical engineering consultants

PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
assetgeo@callaustralia.net.au

PROPOSED HARD ROCK QUARRY
MARULAN
for
UMWELT (AUSTRALIA) PTY LTD

SITE LOCALITY

drawn: MAB		fig: 1
date: 5.11.04		
checked:		rev: –
scale: as shown		job no.: 0689–1



LEGEND

QUARRY BOUNDARY

SOIL LANDSCAPE BOUNDARY

TEST PIT LOCATION

SOURCE:
1:25,000 TOWRANG
TOPOGRAPHIC MAP

rev	by	date	description
A	MAB	17.2	Soil landscapes added

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geotechnical engineering consultants
PO Box 3385
Rouse Hill NSW 2155
Ph: (02) 9836 2144
Fax: (02) 9836 0225
assetgeo@callaustralia.net.au

PROPOSED HARD ROCK QUARRY
MARULAN
for
UMWELT (AUSTRALIA) PTY LTD

TEST LOCATIONS AND SOIL LANDSCAPE

drawn: MAB	fig: 2
date: 17.2.05	
checked:	rev: A
scale: 1:15,000 @ A3	job no.: 0689–1

APPENDIX 4B

Soil Landscape Description

Appendix 4B - Soil Landscape Description

Soil landscape descriptions are adapted from DIPNR (2003)

Bindook Road Variation A

Bindook Road variation A is the predominate soil landscape unit in the area north of the Main Southern Railway. The crests and upper slopes of Bindook Road variation A soils are characterised by Paralithic Bleached Leptic Tenosols (Lithosols) with the mid and upper slopes being characterised by Brown Kurosols (Red and Yellow Podzolic Soils). Lower slopes of the soil landscape unit are characterised by Grey Sodosols (Solodic Soils).

The Bindook Road variant A soil landscape typically contains three horizons. The topsoil consists of two horizons (A1 and A2), with the materials comprising the A1 horizon ranging from a weak sandy loam to a silty/fine granular clay loam. pH for the A1 horizon range from 4.5 to 5.5. The A2 horizon is comprised of bleached dilatant sandy clay loam. The pH of the A2 horizon ranges from 4.5 to 5.5 with the texture of the material ranging from sandy clay loam to silty clay loam.

The A1 and A2 horizons of the Bindook Road variant A soil landscape overly a sub-angular medium clay subsoil being reddish brown to yellowish brown in colour. The pH of the subsoil ranges from 5 to 6 with the structure ranging from moderate to strong pedality.

Bindook Road

Bindook Road is the predominate soil landscape unit to the south of the Main Southern Railway. This soil landscape unit also runs along the western edge of the project area, with patches also found in the northeast of the project area as shown on Figure 5.2 of the main text of the Environmental Impact Statement (EIS).

The Bindook Road soil landscape typically has four horizons, being the A1 and A2 horizons as well as the B2 and B3 horizons. The A1 horizon ranges from a weak sandy loam to a silty/fine sandy granular clay loam. Field pH ranges from 4.5 to 5.5. The structure of the A1 horizon ranges from massive to moderate pedality for the silty/fine sandy loam and from massive to weak pedal for the weak sandy loam. Fragment sizes range from coarse gravel to cobbles with the peds being 2-5 mm and angular in shape.

The A2 horizon is comprised of a bleached dilatant sandy clay loam with a pH range of 4.5 to 5.5. The fragment sizes of coarse gravel to cobbles overlies the strong brown sub angular blocky medium clay of the subsoil B2 horizon. The B2 horizon has a pH range of 5 to 6 with fragment sizes ranging from coarse gravel to cobbles. Ped sizes for the B2 horizon are in the order of 20-50 mm. The B2 horizon is characterised by moderate to strong pedality with fragment sizes ranging from coarse gravel to cobbles.

The greyish brown medium heavy sandy clay of the B2/3 horizon underlies the A2 horizon. The sandy clay material is characterised by angular to sub-angular blocky ped shapes ranging from gravel to cobbles. This horizon is highly erodible, dispersive and sodic in nature.

Jaqua

The Jaqua soil landscape unit is found in the project area along the main channel of Joarimin Creek. The Jaqua soil landscape unit is also located in the southeastern corner of the project area. The rises of the Jaqua soil landscape unit are characterised by Yellow Kurosols (yellow podsolic soils) with the foot slopes being characterised by yellow and brown Sodosols (Soloths, Solidic Soils and Solodized Solonetz). The channels are characterised by Stratic Rudosols comprising alluvial soils.

The Jaqua soil landscape unit is generally composed of A1, A2 and B2 horizons. The A1 and A2 horizon is comprised of a number of materials typically being poorly structured loamy sand to sandy clay loam and a bleached dilatent silty clay loam. The loamy sand to sandy clay loam is brown to dark greyish brown in colour with ped sizes ranging from <2 mm up to 5 mm. Ped shapes are granular and polyhedral with ped structure ranging from single grained to weak pedal. The pH of the poorly structured loamy sand to sandy clay loam is highly variable, ranging from 4.5 to 10 with all materials having a high concentrated flow erodibility. The bleached dilatant silty clay loam displays characteristics similar to the other materials comprising the A1 and A2 horizon.

The subsoils of the Jaqua soil landscape unit are of a clayey nature and include a sodic mottled well structured medium clay, a moderately structured clay and a moderately structured dispersive clay. The pH ranges for the moderately structured clay range from 5 to 6 with the ped structure ranging from moderate to strong pedality. Fragment sizes range from fine gravel to coarse gravel with ped shape being sub-angular blocky to angular blocky.

The moderately structured dispersive clay is greyish yellow in colour and has a pH range of 6 to 9. Fragment sizes are fine gravel to coarse gravel and ped size and shape are consistent with the other materials which comprise the Jaqua sub soil horizon. The concentrated flow erodibility of the dispersive subsoil is high as is the non-concentrated flow erodibility.

Marulan

The Marulan Soil Landscape unit is found in a small band in southeastern corner of the project area. The upper slopes of the Marulan Soil Landscape Unit contain Paralithic Leptic Rudosols (Lithosols) and Chemic Tenosols (Earthy Sands) with Shallow Red Kandosols (Red Earths) also being present. The mid slopes of the soil landscape unit contain Red Kurosols (Red Podzolic Soils) with the lowers slopes containing Brown Sodosols (Solodic Soils).

The Marulan soil landscape unit typically contains an A1 horizon which consists of a brown coarse sandy loam/sandy clay loam. The fragment sizes range from fine gravel to stones with ped shapes being sub-angular blocky to polyhedral. The structure is massive to weak pedal. The A2 horizon consists of a reddish brown, massive sandy clay loam and a bleached hardsetting sandy loam/clay loam. pH of the A2 horizon ranges from 5 to 6.5 with fragment sizes ranging from fine gravel to gravel. The concentrated flow erodibility and the non-concentrated flow erodibility potential of both the A1 and A2 horizons is considered to be high.

The subsoil of the Marulan soil landscape unit contains two horizons, the B and B2 horizon. The B horizon is composed of an earthy sandy loam with fragment size ranging from fine gravel to gravel. The pH of the B horizon ranges from 5.5 to 7 with the flow erodibility of the horizon being high.

The B2 horizon consists of red subangular blocky clay and a sodic yellow subangular blocky clay. The red subangular blocky clay has a pH range of 4 to 6.5, while the sodic yellow subangular blocky clay has a pH range of 5.5 to 7. Both material are characterised by a high concentrated flow erodibility and a moderate non-concentrated flow erodibility.