APPENDIX C
GEOTECHNICAL REPORT

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Report

Infiltration Testing and Acid Sulfate Soil Assessment
Proposed Residential Development
Sector 8, Macpherson Street
Warriewood, NSW

Prepared for
Australand Holdings Ltd
C/- Gutteridge Haskins & Davey Pty Ltd
PO Box 5403
NEWCASTLE WEST NSW 2302

Ref: JC00010D
July 2002

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3rd July 2002

JC00010D-r1

Australand Holdings Ltd
C/- Gutteridge Haskins & Davey Pty Ltd
PO Box 5403
NEWCASTLE WEST NSW 2302

Attention: Mr Ian Joliffe

Dear Sir

Re: Infiltration Investigation and Acid Sulfate Soil Assessment
Sector 8, Macpherson Street, Warriewood

Please find attached our infiltration investigation and Acid Sulfate soil assessment report for the above site.

If you require clarification of any aspect of our proposal please contact the undersigned.

Yours faithfully
GeoEnviro Consultancy Pty Ltd

Solern Liew CPEng
Director

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1. INTRODUCTION

This report presents the results of infiltration testing and acid sulfate soil assessment carried out at the Sector 8, Macpherson Street, Warriewood. The investigation was commissioned by Mr R.A Biancato of Australand Holdings Ltd in his letter dated 22nd May 2002 following our fee proposal Ref JC00010-L2 dated 10th May 2002.

The investigation was in response to Pittwater Council's letter dated 13th March 2002. The purposes of the investigation were to;

- Assess the permeability of the natural subsurface soil profile for water management of the proposed development.
- Assess the presence of potential acid sulfate soils or acid sulfate soil.

2. SITE DESCRIPTION

Sector 8 is located at the south western corner of Macpherson Street and Garden Street at Warriewood. The overall site which contains 9 lots (Lot 1 & 2 DP 18303, Lots A, B & C DP 328260, Lot 1 DP 593363, Lot B DP 334543, Lot 12 DP 659528 and Lot 11 DP 5464) measures about 550m east-west and 360m north-south. Refer to Drawing No 1 for site locality plan.

The western portion of Sector 8 (eg. Lot 1 DP 18303) and southern portion of Lot 2 DP 18303 is located near the foothill of a gentle hill with ground surface sloping to the east at angles less than 6 degrees. On the remaining major portion of Sector 8, ground surface is approximately level. Based on the survey plan provided, ground surface level of the site ranges from about reduced level (RL) 28m Australian Height Datum (AHD) on the western extremities to about RL 12m AHD on the eastern extremities of the site.

Fern Creek transects Lots 1 and 2 in the middle and runs along the rear boundary of Lots A to C.

The 1:100,000 Soil Landscape of Sydney Series 9130 prepared by the Soil Conservation Services of NSW indicates the site to be underlain by swamp soil belonging to the Warriewood landscape grouping. Typically soil profile in the general area is deep and

consists of sandy humus Podzols and dark mottled Siliceous sands overlying acid peats in depression and pale siliceous sands.

The 1:100,000 geological map of Sydney indicated the major portion of the site to be underlain stream alluvial and estuarine sediments consisting of silty to peaty quartz sand, silt and clay with ferruginous and humic cementation in places. On the western portion of Sector 8 (eg. Lot 1 DP 18303) and southern portion of Lot 2 DP 18303, interbedded laminite shale and quartz to lithic quartz sandstone underlies the site.

3. INVESTIGATION PROCEDURE

Fieldwork for the investigation included excavation of test pits at 12 locations (TP 101 to 112) as shown on the attached Drawing No 1. The test pits were excavated using a rubber tyred backhoe on the 27th May 2002. Two locations (TP 101 and 105) along the creek line were nominated by Gutteridge Haskins & Davey Pty Ltd. TP 101 had to be relocated slightly to the west due to inaccessibility of the site to a backhoe.

The test pits were initially excavated to a depth of about 0.8m below existing ground surface using a smooth bucket to prepare infiltration test pads. The double-ring infiltrometer test involve installation of inner (100mm diameter) and outer rings (300mm diameter), embedded into the pads. The pad around the rings was compacted to avoid water from infiltrating through the disturbed areas. Following installation of the rings, the outer ring was filled with water to saturate the surrounding soil, followed by filling of the inner ring with water. The height difference between the water levels of the inner and outer rings was measured with time. Upon completion of the infiltration testing, manual excavation of the pads were carried out in order to check the wetting zone.

Following the infiltration testing, the test pits were excavated to depths varying from 1.5m to 3.7m below existing ground surface. Soil samples were taken from the test pits for assessment of acid sulfate soil. The samples were preserved in cooled containers and sent to Sydney Analytical Laboratories (SAL), a NATA accredited laboratory for pH and Peroxide pH Test to provide an initial screen to determine soils acid sulfate potential. The tests involved the measurement of pH and the pH after oxidation (pH_{ox}) with a 30% hydrogen peroxide solution. Following the pH and Peroxide pH test, Peroxide Oxidation Combined Acidity and Sulfate (POCAS) tests on two samples were performed.

Details of the subsurface profile encountered are presented on the test pit reports in Appendix A of this report. The laboratory test reports are attached in Appendix B. Explanatory notes defining terms and symbols used in the report are attached in Appendix C.

4. SUBSURFACE CONDITIONS

For details of the subsurface profile encountered, refer to the test pit reports. The following is a summary of the subsurface profile encountered.

Fill

Fill was encountered in TP 101 to a depth of about 0.7m below existing ground surface and is overlain by a layer of topsoil. The fill consists of silty sand with a significant amount of rubbish fill such as steel pieces, wires, ash, bricks, etc.

Topsoil/Fill

Topsoil and topsoil/fill was encountered in the remaining test pits with thickness ranging from 300mm to 600mm. The topsoil and topsoil/fill consists predominantly of clayey sandy silt and clayey silty sand.

Natural

Natural soil beneath the fill and topsoil was found to consist predominantly of sand and silty clayey sand. A relatively more clayey stratum was encountered in TP 107, 111 and 112. The natural soil profile tends to become more clayey and gravelly at lower depths.

Bedrock

Bedrock was not encountered in all test pits except TP 112 where sandstone was encountered at about 1.2m below existing ground surface.

Groundwater

Some ground water seepage was encountered in TP 101, 102, 103, 105, 108, 109 and 110 at depths varying from 1.4m to 3.3m.

5. INFILTRATION RATES

The following are calculated permeability rates for natural soil profile at the various locations based on double-ring infiltrometer testing;

Test Pit No	Soil Stratum Tested	Calculated Permeability Rate
101	Sand	2.5×10^{-3} cm/s
102	Sand	1.9×10^{-3} cm/s
103	Sand	7.1×10^{-4} cm/s
104	Silty Sand	2.1×10^{-4} cm/s
105	Sand	7.0×10^{-4} cm/s
106	Silty Clayey Sand	6.3×10^{-4} cm/s
107	Sandy Silty Clay	2.3×10^{-4} cm/s
108	Sand	1.6×10^{-3} cm/s
109	Sand	1.2×10^{-3} cm/s
110	Sand	1.5×10^{-3} cm/s
111	Clayey Sand/Sandy Clay	3.2×10^{-4} cm/s
112	Silty Clay Sand/Sandy Clay	8.1×10^{-5} cm/s

6. ACID SULFATE SOIL ASSESSMENT

For details of the laboratory test results, refer to Appendix B. The following is a summary of the test results;

pH and Peroxide Tests

Test Pit	Depth (m)	pH (H_2O)	pH (H_2O_2)
TP 101	0.7-1.0	7.1	5.4
	1.8-2.0	7.3	5.2
TP102	0.8-1.0	7.3	6.2
	1.8-2.0	6.9	6.1
TP103	0.5-0.8	6.8	4.4
	2.0-2.3	6.5	4.4
TP104	0.6-0.9	6.5	4.3
	1.7-2.0	5.2	4.7
TP105	0.6-1.0	6.1	4.2
	1.8-2.2	5.3	4.5
TP106	0.4-0.7	6.0	4.0
	1.8-2.1	5.7	4.9
TP107	0.5-0.8	5.8	4.2
	1.8-2.0	5.7	4.8
TP108	0.3-0.7	7.4	5.7
	1.7-2.0	6.3	5.1
	3.0-3.5	5.0	4.4
TP109	0.8-1.1	5.9	4.2
	1.7-2.0	5.8	4.4
	3.0-3.5	4.9	4.0
TP110	0.7-1.0	5.7	3.9
	1.7-2.0	5.7	4.1
	2.6-3.0	4.9	4.3
TP111	0.6-0.9	5.7	4.4
	1.9-2.2	5.1	4.6
TP112	0.3-0.8	5.2	3.9
	1.2-1.5	4.6	4.0

Three factors are considered to show a positive indication of potential acid sulfate soils. These factors are:

1. The strength of the reaction with peroxide (it can not be used alone as organic matter and other soil constituents such as manganese oxides can also cause a reaction);
2. A pH_{ox} value less than 3 indicates potential acid sulfate soils (the more the pH_{ox} values falls below 3, the more positive the results); and
3. The difference between field pH and pH_{ox} (a large difference gives a more definite indication of potential acid sulfate soils).

POCAS

TP	Depth (m)	TAA (mol/t)	TPA (mol/t)	S_{kcl} (%)	S_P (%)	S_{pos} (%)	TSA (mol/t)
110	0.7-1.0	<5	<5	<0.01	<0.01	<0.01	<5
112	0.3-0.8	<5	<5	<0.01	<0.01	<0.01	<5

Note:
TAA - KCl Extractable Acidity
TPA - Total Potential Acidity
S_{KCl} – KCl Extractable Sulfur
S_p- Peroxide Sulfur
S_{pos} – Peroxide Oxidisable Sulfur
TSA - Total Suifidic Acidity

The pH and Peroxide Tests did not have any indication of potential acid sulfate soil or acid sulfate soil. The POCAS analysis indicates all parameters to be below detection limits.

Based on the laboratory test results, potential acid sulfate soil or potential acid sulfate soil was not encountered. As the results of the analysis were below the ASSMAC action criteria, acid sulfate management plan is not required.

7. CLOSURE

The interpretation and recommendations submitted in this report are based in part upon data obtained from a limited number of testpit. The nature and extent of variations between test locations may not become evident until construction..

Groundwater conditions are only briefly examined in this investigation. Due to the proximity of the site to the creek, ground water may be encountered during pier excavation. The groundwater conditions may vary seasonally or as a consequence of construction activities on or adjacent to the site.

In view of the above, the subsurface soil and rock conditions between the test locations may be found to be different or interpreted to be different from those expected. If such differences appear to exist, we recommend that this office be contacted without delay.

The statements presented in this document are intended to advise you of what should be your realistic expectations of this report and to present you with recommendations on how to minimise the risk associated with groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd,

but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in to doing.

Attached in Appendix C are documents entitled Explanatory Notes which should be read in conjunction with this report as it details important limitation regarding this report.

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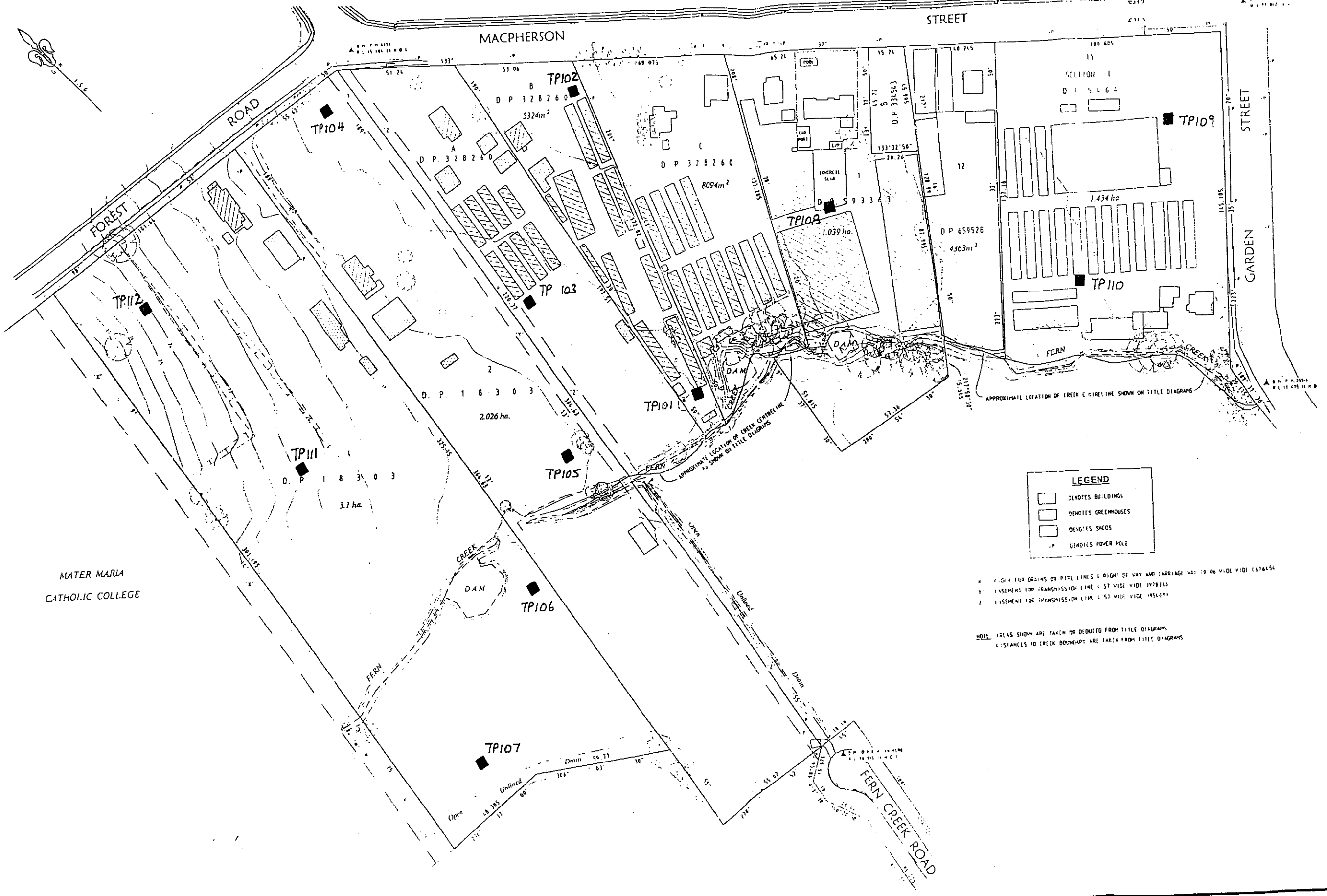

Legend

■ Test Pit

GeoEnviro Consultancy

Drawn By:	SL	Date : 3/7/02	
Checked By:	SL	Date : 3/7/02	
Revision By:		Date:	
Scale:	Proportional	A3	

Australand Holdings Ltd

Sector 8 Macpherson Street, Warriewood

Test Pit Location Plan

Project No: JC00010E | Drawing No: 1

APPENDIX A

Test Pit Reports

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 101.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None			0.5			Fill: Silty Sand, fine to medium grained, with some steel pieces, wires, ash, bricks and tin cans, dark grey and brown	M			
			DG	1.0		SP	Sand: fine to medium grained, grey with some silt	M	VL		Double Ring Infiltrometer Test Depth at 0.8m
			DG	1.5 2.0 2.5 3.0		SM/SC	Silty Sandy Clay/Clayey Silty Sand: fine to medium grained, grey brown with some gravels	M			
				3.5			End of TP 101 at 3.3m				

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 102.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Topsoil/Fill: Clayey Silt Sand, fine to medium grained, with some gravel brown	M			
				0.5		SP	Sand: fine to medium grained, grey with some silt.				Double Ring Infiltrometer Test Depth at 0.8m
			DG	1.0		CL	Silty Sandy Clay: low plasticity, grey brown and yellow brown, with some gravel.	M			
			DG	1.5							
				2.0			End of TP 102 at 2.2m				
				2.5							
				3.0							
				3.5							

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 103.

Client: Australand Holdings Limited
Project: Infiltration Testing and Acid Sulphate Soil Testing
Location: Sector 8 - Warriewood

Job no: JC00010D
Date: 27. 5. 2002
Logged by: LM
Checked By: SL

Equipment: Rubber Tyred Backhoe
Pit Dimensions:

R.L.Surface:
Datum: AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Topsoil/Fill: Clayey Sandy Silt, with some gravel, dark brown	M			
			DG	0.5		SP	Sand: fine to medium grained, grey with some gravel	M -L	VL -L		Double Ring Infiltrometer Test Depth at 0.8m
				1.0							
				1.5		CI/ SC	Silty Sandy Clay/Clayey Sand: fine to medium grained, brown, grey with some gravel	M			
			DS	2.0							
				2.5			End of TP 103 at 2.5m				
				3.0							
				3.5							

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 104.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None	dry					Topsoil/Fill: Clayey Silty Sand, fine to medium grained, dark brown				
				0.5		SP	Sand: fine to medium grained, grey with some gravel	M	(St)		
			DS								Double Ring Infiltrometer Test Depth at 0.8m
				1.0		CL/SC	Sandy Gravelly Clay/Clayey Sand: fine to medium grained, low plasticity yellow brown	(M) MC =PL	(Vst)		
				1.5							
			DS	2.0							
				2.5							
							End of TP 104 at 2.6m				
				3.0							
				3.5							

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 105.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None			0.5			Topsoil: Clayey Sandy Silt, low liquid limit, with some gravel, dark brown	M			
			DS	1.0		SP	Sand: fine to medium grained, grey with some gravel	M	(VL)		Double Ring Infiltrometer Test Depth at 0.8m
			DS	1.5 2.0 2.5		CL /SC	Silty Sandy Clay: low plasticity, yellow brown and brown with some gravel	(M) MC <= PL	(Vst)		
				3.0		Cl	Gravelly Silty Clay: medium plasticity, brown and orange, with some gravel	MC <= PL	(H)		
				3.5			End of TP 105 at 3.1m				

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Test Pit Report

Test Pit No: 106.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Topsoil: Clayey Silty Sand, fine to medium grained, brown and grey with some gravel	M			
			DS	0.5		SM	Silty Clayey Sand: fine to medium grained grey and brown with some gravel	M			Double Ring Infiltrometer Test Depth at 0.8m
				1.0		CL	Sandy Silty Clay: low plasiticty, brown with some gravel	MC <= PL	(St-Vst)		
			DS	1.5							
				2.0		CI	Gravelly Silty Clay/Sandy Clay: medium plasticity, orange brown	MC <= PL			
				2.5			End of TP 106 at 2.5m				
				3.0							
				3.5							

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 107.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None	dry					Topsoil: Clayey Sandy Silt, low liquid limit. Grey and brown, with some gravel	M			
			DS	0.5		CL	Sandy Silty Clay: low plasticity, yellow brown with some gravel	(M) MC <= PL	(Vst)		Double Ring Infiltrometer Test Depth at 0.8m
			DS	1.0 1.5		CL-Cl	Gravelly Sandy Clay: low to medium plasticity, orange brown and brown	MC <PL	(H)		
				2.0 2.5 3.0 3.5			End of TP 107 at 2.2m				

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Test Pit Report

Test Pit No: 108.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Topsoil/Fill: Clayey Silty Sand, fine to medium grained, grey and brown with some gravel				
			DS	0.5		SP	Sand: fine to medium grained, grey and brown with some gravel	M	(VL -L)		Double Ring Infiltrometer Test Depth at 0.8m
				1.0			As above but weakly cemented				
			DS	1.5		SP/ SC	Sand/Clayey Sand: fine to medium grained brown and yellow brown, with some gravel	M	(St-Vst)		
				2.0							
				2.5							
			DS	3.0		Cl	Gravelly Silty Clay: medium plasticity with some ironstone gravel	MC <= PL	(Vst)		
				3.5			End of TP 108 at 3.5m				

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Test Pit Report

Test Pit No: 109.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Topsoil/Fill: Clayey Silty Sand, fine to medium grained, grey and brown				
				0.5		SP	Sand: fine to medium grained , with some gravel, brown	M	VL		
			DS	1.0			As above but weakly cemented				Double Ring Infiltrometer Test Depth at 0.8m
				1.5		SM/SC	Clayey Silty Sand/Clayey Sand: fine to medium grained, brown and yellow with some gravel	M	L		
			DS	2.0							
				2.5							
				3.0							
		▶	DS			CL	Sand Clay/Gravelly Silty Clay: low plasticity, orange and brown	MC <= PL			
				3.5							
							End of TP 109 at 3.7m				

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Test Pit Report

Test Pit No: 110.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None						Fill/Topsoil/Sity Clayey Sand, fine to medium grained, with some gravel, grey	M			
			DS	0.5		SP	Sand: fine to medium grained, brown with some gravel	M	(L)		Double Ring Infiltrometer Test Depth at 0.8m
				1.0			As above but weakly cemented.				
			DS	1.5		SC SP	Sand/Clayey Sand: fine to medium grained, yellow brown, with some gravel	M	(L-MD)		
			DS	2.0		SC/ Cl	Silty Sandy Clay/Clayey Sand: medium plasticity, with some gravel, orange brown	M	MD		
				2.5							
				3.0		Cl	Gravelly Sandy Clay: medium plasticity brown	M-W			
				3.5			End of TP 110 at 3.3m				

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 111.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None	dry		0.5			Topsoil: Clayey Sandy Silt, low liquid limit, grey brown and dark brown	M			
			DS	1.0		SC/CI	Clayey Sand/Sandy Clay: medium plasticity, fine to medium grained, with some gravel	M	(L)		Double Ring Infiltrometer Test Depth at 0.8m
			DS	1.5 2.0		CI	Sandy Silty Clay: medium plasticity orange brown, with some gravel	MC <= PL	(Vst)		
				2.5 3.0 3.5			End of TP 111 at 2.2m				

GeoEnviro Consultancy Pty Ltd

Test Pit Report

Test Pit No: 112.

Client:	Australand Holdings Limited	Job no:	JC00010D
Project:	Infiltration Testing and Acid Sulphate Soil Testing	Date:	27. 5. 2002
Location:	Sector 8 - Warriewood	Logged by:	LM
		Checked By:	SL
Equipment:	Rubber Tyred Backhoe	R.L.Surface:	
Pit Dimensions:		Datum:	AHD

Method	Support	Water	Notes: Samples, Tests, etc	Depth(m)	Classification Symbol	Unified Soil Classification	Material Description Soil Type, Plasticity or Particle Characteristic, colour, secondary and minor component	Moisture Content	Consistency/Density Index	Hand Penetrometer(kPa)	Structure and Additional Observations
Backhoe	None	dry					Topsoil/Fill: Clayey Sandy Silt, low liquid limit, with some gravel, grey				
			DS	0.5		SC	Silty Clayey Sand: fine to medium grained brown and orange brown, with some gravel	M	(L-MD)		Double Ring Infiltrometer Test Depth at 0.8m
				1.0		CI	Gravelly Sandy Clay: medium plasticity orange brown mottled red	MC <PL			
			DS	1.5			Sandstone: fine to medium grained low strength, brown				
							End of TP 112 at 1.5m				Backhoe refusal.
				2.0							
				2.5							
				3.0							
				3.5							

Appendix B

Laboratory Certificates

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:

GEOENVIRO CONSULTANCY PTY LTD

PO BOX 1543
MACQUARIE CENTRE 2113

ATTN: SOLERN LIEW

JOB NO: SAL11983

CLIENT ORDER: JC00010D

DATE RECEIVED: 30/05/02

DATE COMPLETED: 16/06/02

TYPE OF SAMPLES: SOILS

NO OF SAMPLES: 27

NATA Accredited Laboratory
Number: 1884

NATA ENDORSED TEST REPORT
This document shall not be reproduced, except in full.

.....
Issued on 20/06/02
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL11983
CLIENT ORDER: JC00010D

	SAMPLES	pH 1:5	pH H2O2	TAA mol/T	TPA mol/T	*S(KCl) %
1	TP101/0.7-1.0	7.1	5.4			
2	TP101/1.8-2.0	7.3	5.2			
3	TP102/0.8-1.0	7.3	6.2			
4	TP102/1.8-2.0	6.9	6.1			
5	TP103/0.5-0.8	6.8	4.4			
6	TP103/2.0-2.3	6.5	4.4			
7	TP104/0.6-0.9	6.5	4.3			
8	TP104/1.7-2.0	5.2	4.7			
9	TP105/0.6-1.0	6.1	4.2			
10	TP105/1.8-2.2	5.3	4.5			
11	TP106/0.4-0.7	6.0	4.0			
12	TP106/1.8-2.1	5.7	4.9			
13	TP107/0.5-0.8	5.8	4.2			
14	TP107/1.8-2.0	5.7	4.8			
15	TP108/0.3-0.7	7.4	5.7			
16	TP108/1.7-2.0	6.3	5.1			
17	TP108/3.0-3.5	5.0	4.4			
18	TP109/0.8-1.1	5.9	4.2			
19	TP109/1.7-2.0	5.8	4.4			
20	TP109/3.0-3.5	4.9	4.0			
21	TP110/0.7-1.0	5.7	3.9	<5	<5	<0.01
22	TP110/1.7-2.0	5.7	4.1			
23	TP110/2.6-3.0	4.9	4.3			
24	TP111/0.6-0.9	5.7	4.4			
25	TP111/1.9-2.2	5.1	4.6			
26	TP112/0.3-0.8	5.2	3.9	<5	<5	<0.01
27	TP112/1.2-1.5	4.6	4.0			
DUPLICATES:						
20	TP109/3.0-3.5	4.8	4.1			
MDL		0.1	0.1	5	5	0.01
Method Code		WA1	C27	C31	C30	C41
Preparation		P1	P1	P12	P12	P12

ANALYTICAL REPORT

JOB NO: SAL11983
CLIENT ORDER: JC00010D

	SAMPLES	*S(P) %	*S(POS) %	TSA mol/T
21	TP110/0.7-1.0	<0.01	<0.01	<5
26	TP112/0.3-0.8	<0.01	<0.01	<5
MDL		0.01	0.01	5
Method Code		C41	C41	C42
Preparation		P12	P12	P12

RESULTS ON DRY BASIS

SYDNEY ANALYTICAL LABORATORIES

LABORATORY DUPLICATE REPORT

JOB NO: SAL11983
CLIENT ORDER: JC00010D

Sample Number	Analyte	Units	MDL	Sample Result	Duplicate Result	%RPD
TP109/3.0-3.5	pH		0.1	4.9	4.8	2
TP109/3.0-3.5	pH	H2O2	0.1	4.0	4.1	2

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

ANALYTICAL REPORT

JOB NO: SAL11983
CLIENT ORDER: JC00010D

METHODS OF PREPARATION AND ANALYSIS

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

P1	Analysis performed on sample as received
P12	Sample dried, jaw crushed and sieved at 2mm Visible shell removed prior to crushing
WA1	pH - 1:5 soil/water extract Determined by APHA 4500B
C27	Nett Acid Generation pH - H2O2 Extract ASSMAC Manual - Appendix 1
C31	Total Actual Acidity - RTA T1030
C30	Total Potential Acidity - RTA T1031
*C41	Peroxide Oxidation - Combined Acidity & Sulphate (POCAS) ASS Method 21 (Draft 1.63 for ASSMACTC May 1997)
C42	Total Sulphidic Acidity - Calculation (TPA-TAA)

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

A preliminary report was faxed on 16/06/02

GEOENVIRO CONSULTANCY Pty Ltd

1/2

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC000109
Client:
Project: ACID SULPHATE SOIL TESTING
Location: SECTOR 8, WARRIEWOOD

Sample Date: 27.5.2002
Sampled By: VM
Project Manager: SL
Store Location: BLACKTOWN

External Laboratory Details:
Laboratory name: SAL 11983
Address:
Contact: LANCE

Sampling Details: Location	Depth (m) From	Depth (m) To	Sample Type: Soil	Sample Type: Water	GC/MS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg)	Metals Sb Be Co Mn Se Sn	pH / [illegible]	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide	Keep Sample
TP 101	0.7	1.0	DG					/								
TP 101	1.8	2.0	DG					/								
TP 102	0.8	1.0	DG					/								
TP 102	1.8	2.0	DG					/								
TP 103	0.5	0.8	DG					/								
TP 103	2.0	2.3	DG					/								
TP 104	0.6	0.9	DG					/								
TP 104	1.7	2.0	DG					/								
TP 105	0.6	1.0	DG					/								
TP 105	1.8	2.2	DG					/								
TP 106	0.4	0.7	DG					/								
TP 106	1.8	2.1	DG					/								
TP 107	0.5	0.8	DG					/								
TP 107	1.8	2.0	DG					/								
TP 108	0.3	0.7	DG					/								
TP 108	1.7	2.0	DG					/								

Test Required (/) — Test Performed (X)

Relinquished by: Laboratory	Name	Signature	Date	Received By: Laboratory	Name	Signature	Date
GEOENVIRO P/L	L. MELICHAREK	[signature]	29.5.02	SAL	P. MAGRO	P. Magro	30/5/02

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample

U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle

Y keep Sample
N discard sample

GEOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

2/2

Job Details:
Job Number: 3C000109
Client:
Project: ACID SULFATE SOIL TESTING
Location: SECTOR 8, WARRIEWOOD

Sample Date: 27.5.2002
Sampled By: VM
Project Manager: SL
Store Location: BLACKTOWN

External Laboratory Details:
Laboratory name:
Address: SAL
Contact: LAB

Sampling Details			Sample Type		Test Required (\)														Test Performed(X)															
Location	Depth (m)		Soil	Water	GCMS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg	Metals Sb Be Co Mn Se Sn	pH (per 25 g)	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide																		Keep Sample
	From	To																															
TP 108	3.0	3.5	X					/																									
TP 109	0.8	1.1	X					/																									
TP 109	1.7	2.0	X					/																									
TP 109	3.0	3.3	X					/																									
TP 110	0.7	1.0	X					/																									
TP 110	1.7	2.0	X					/																									
TP 110	2.6	3.0	X					/																									
TP 111	0.6	0.9	X					/																									
TP 111	1.9	2.2	X					/																									
TP 112	0.3	0.8	X					/																									
TP 112	1.2	1.5	X					/																									

Relinquished by				Received By			
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
GEOENVIRO P/L	L. MELICHAR		29.5.02	SAL	P. MAGNO	P. Magno	30/5/02

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample
U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle
Y keep Sample
N discard sample

c:\\Labworksheet\w019-1

Appendix C

Explanatory Note and Graphical Symbols

EXPLANATORY NOTES

Introduction

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

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

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

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

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

Classification	Undrained Shear Strength kPa
Very Soft	less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	greater than 200

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

Relative Density	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-MPA)
Very Loose	less than 5	less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	>50	>25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering, strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling

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

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

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods

The following is a brief summary of investigation methods currently carried out by this Company and comments on their use and application.

Hand Auger Drilling

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits

These are excavated with a tractor mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure to accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pengo)

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

Continuous Spiral Flight Augers

The hole is advanced by using 90mm-115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Continuous Spiral Flight Augers(continued)
Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively lower reliability due to remoulding, mixing or softening of samples by groundwater, resulting in uncertainties of the original sample depth.

The spiral augers are usually advance by using a V-bit through the soil profile to refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of recovered rock fragments and through observation of the drilling penetration resistance.

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

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible form separate intact sampling (eg SPT and U_{50} samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rocks and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances, a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of Testing Soils for Engineering Purposes"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

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

as 4, 6, 7
N = 13

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

as 15,30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test method is used to obtain samples in 50mm diameter thin walled sample tubes in clays. In these circumstances, the test results are shown on the borelogs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N_c' on the borelogs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 Test F5.1.

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

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records. The information provided on the charts comprises:

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

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

Cone Penetrometer Testing and Interpretation continued

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

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

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

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

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

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)

Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows per successive 100mm increment of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (As1289 Test F3.2).

Laboratory Testing

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

Engineering Logs

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Groundwater

Where groundwater levels are measured in boreholes, there are several potential problems:

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

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

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, perhaps a 3 storey building, the information and interpretation may not be relevant if the design proposal is changed, say to a 20 storey building. If this occurs, the Company will be pleased to review the report and sufficiency of the investigation work.

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

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

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

Site Anomalies

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

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institute of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available.

In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purposes, at a nominal charge.

Site Inspection

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

Review of Design

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.

Graphic Symbols For Soil and Rock

SOIL


Fill


Topsoil


Gravel (GW , GP)


Sand (SP, SW)


Silt (ML, MH)


Clay (CL, CH)


Clayey Gravel (GC)


Silty Sand (SM)


Clayey Sand (SC)


Sandy Silt (ML)


Gravelly Clay (CL, CH)


Silty Clay (CL, CH)


Sandy Clay (CL, CH)


Peat or Organic Soil

ROCK


Shale


Sandstone


Siltstone,Mudstone,Claystone


Granite, Gabbro


Dolerite, Diorite


Basalt, Andesite

Other Materials


Concrete


Bitumen, Asphaltic Concrete, Coal


Ironstone Gravel


Organic Material

22/1054/--

GeoEnviro Consultancy Pty Ltd
Unit 43/11 Romford Road, Blacktown, NSW 2148, Australia
PO Box 1543, Macquarie Centre, North Ryde, NSW 2113
ACN 084 294 762
ABN 62 084 294 762
Tel: (02) 9679 8733
Fax: (02) 9679 8744

Report

Preliminary Contamination Assessment and Geotechnical Investigation Proposed Residential Development Lot 2 DP 18303 & Lots A, B and C DP 328260 Sector 8, Macpherson Street Warriewood, NSW

Prepared for
Australand Holdings Ltd
Australand House
242 Beecroft Road
EPPING NSW 2121

Ref: JC00010A
July 2000

GeoEnviro Consultancy Pty Ltd
Unit 43/11 Romford Road, Blacktown, NSW 2148, Australia
PO Box 1543, Macquarie Centre, North Ryde, NSW 2113
ACN 084 294 762
ABN 62 084 294 762
Tel: (02) 9679 8733
Fax: (02) 9679 8744

17th July 2000

Our Ref: JC00010A-l1

Australand Holdings Limited
Australand House
242 Beecroft Road
EPPING NSW 2121

Attention: Mr Ross Blancato

Dear Sir

Re: **Lot 2 DP 18303 & Lots A to C DP 328260**
Sector 8, Macpherson Street, Warriewood
Preliminary Contamination and Geotechnical Investigation.

We are pleased to submit our report on preliminary contamination assessment and geotechnical investigation for the proposed residential development to be located at the above address. The following is a summary of our conclusions;

Preliminary Contamination Assessment

The investigation consisted a review of site history, a site inspection and soil sampling and analysis program. Sampling was carried out at forty-two locations at surface and at depth. Selected samples were analysed for a range of potential contaminants consisting of heavy metals, organochlorine pesticides, organophosphorus pesticides and soil pH. The results were interpreted by comparison with guideline Criteria recommended by the NSW EPA.

The concentrations of heavy metals were reported to be below the ANZECC/NHMRC and proposed NSW EPA phototoxicity Criteria in all samples analysed except zinc in the following test locations;

Sample	Zinc Concentration (mg/kg)
TP 10 (0-0.2m)	230
TP 21 (0-0.2m)	970
TP 23 (0-0.2m)	370
TP 33 (0-0.2m)	250
TP 39 (0-0.2m)	360

We note that the elevated concentrations of zinc encountered in TP 10 and 33 was probably due to corrosion of metal pieces in the fill material. Elevated concentrations in the other test pits could be due to corrosion of corrugated metals from sheds and glass houses.

All concentrations of heavy metals were found to be well below the NEHF 'A' guidelines. The laboratory test results indicated all concentrations of organochlorine and organophosphorus pesticides to be below the detection limits.

Within the context of the scope of work carried out, the results of the preliminary contamination assessment indicate that the likelihood of gross ground contamination on the site is generally considered low for the purpose of the proposed residential development.

Some buried fill material containing building rubble, metal pieces and car parts were encountered in TP 10, 17 and 33 which were located near the creek. For residential development, the buried fill material should be removed off site to an EPA approved landfill. Though asbestos was not encountered in the test pits, it may exist elsewhere within the fill as asbestos was commonly used in buildings in the past. Should asbestos be encountered in the fill, all asbestos should be appropriately disposed of in accordance with regulatory requirements.

Some elevated concentrations of zinc were encountered in TP 21, 23 and 39 encountered in the vicinity of sheds and glasshouses. We recommend that additional soil sampling and laboratory analysis in these areas be carried out after removal of sheds and buildings to further assess concentrations of zinc. If similar concentrations are encountered, site remediation by on-site capping with topsoil may be required. Higher concentrations of zinc (ie. concentration three times above phototoxicity levels) will require disposal to an EPA landfill.

Excavated soil to be disposed off site will need to be categorised in accordance with the NSW EPA guidelines. Validation sampling and testing of soil beneath existing buildings/structures after removal of floor slabs should be carried out.

Preliminary Geotechnical Investigation

The field investigation indicated that the Subject Site is generally underlain by sandy profile with variable relative density at the upper 2.0m ranging from very loose to medium dense. The subsurface profile was found to be more clayey at lower depths. The investigation infers medium dense sand or very stiff clay at lower depths. At the rear of Lot 2, residual soil profile consisting of silty clay was encountered.

Based on information from the preliminary investigation, we assessed that the major portion of the Subject Site as it currently exists would be classified as Class 'P' in accordance with AS2870, "Residential Slabs and Footings". Suitable footings for the site would be pier and beam or pier and slab footings taken through loose sand and into medium dense sand or very stiff clay founded at least 2.0m below ground surface. Additional geotechnical investigation by borehole drilling using truck mounted drill rigs would be required to provide recommendations on depths of piers required and allowable bearing capacities.

At the rear of Lot 2 where residual silty clay was encountered, typical site classification would be Class 'M' and shallow footings may be suitable. From the test pit investigation and judging from the site topography, the area suitable for Class 'M' site is anticipated to be restricted to a relative small area with respect to the Subject Site.

Upgrading of the site classification to allow shallow footings may be possible by densification of the upper loose sand. This may be more difficult to achieve in areas if ground water table is found to be higher than those encountered in the current investigation. There is a potential for ground water table level to fluctuate depending on weather conditions and drainage improvement.

Pavement construction will require the upper 1.0m to 1.5m of the sandy soil to be adequately compacted.

Should you have any queries, please contact the undersigned.

Yours faithfully,
GeoEnviro Consultancy Pty Ltd

Solern Liew CPEng (NPER-3)
Director

Enclosed: 3 copies of Report.

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1. INTRODUCTION

This report presents the results of a geotechnical and preliminary contamination assessment at the property identified as Lot 2 DP 18303 & Lots A, B and C DP 328260 located within Sector 8 Macpherson Street, Warriewood, as shown on Drawing No 1. The investigation was commissioned by Mr Ross Blancato of Australand Holdings Ltd in his letter dated 9th June 2000, following our proposal Ref PC00219A dated 5th June 2000.

We understand that the proposed development is to subdivide the site for residential purposes. A contamination assessment is required as a prerequisite to the processing of a Development Application for subdivision of the site. The objective of this preliminary contamination assessment was to determine if significant subsurface contamination is likely to exist on site. The objective of the geotechnical investigation was to provide general recommendations on geotechnical issues for the proposed development.

General comments on the remainder of Sector 8 are also provided in this report.

2. SCOPE OF WORK

2.1 Preliminary Contamination Assessment

The preliminary contamination assessment was performed in general conformance with our understanding of the guidelines by the Australian and New Zealand Conservation Council (ANZECC) and the NSW Environment Protection Authority (NSW EPA).

The scope of work conducted consisted of:

- obtaining available information on the site history from, NSW Land Information System, Department of Lands, Aerial Photographs and personnel familiar with the site,
- an inspection of the site to identify apparent or suspected areas of contamination,
- a review of published information on the subsurface conditions in the general area,
- conducting a limited sampling and analysis program to detect the presence or otherwise of the contaminants of concern,

- screening of the soil samples for volatile ionisable compounds using a photoionisation detector (PID),
- preparing a report containing the results of the investigation.

2.2 Geotechnical Investigation

The scope of work for geotechnical investigation included;

- Excavation of some deeper test pits, in particular in the proposed pavement areas.
- Dynamic Cone Penetrometer testing to assess the strength of the subsurface profile,
- Preparing a report providing comments and general guidelines on issues such as earthworks, site preparation, suitable foundation systems, allowable bearing capacities and indicative site classifications to AS2870.

3. SITE INFORMATION

3.1 Site Location

Sector 8 is located at the south western corner of Mapherson Street and Garden Street at Warriewood. The overall site which contains 9 lots (Lot 1 & 2 DP 18303, Lots A, B & C DP 328260, Lot 1 DP 593363, Lot B DP 334543, Lot 12 DP 659528 and Lot 11 DP 5464) measures about 550m east-west and 360m north-south. Refer to Drawing No 1 for site locality plan.

The Subject Site which is accessible to the current site investigation consists of Lot 2 DP 18303 & Lots A, B and C DP 328260. Total site area of the subject site is about 4 hectares.

The site is within the jurisdiction of Pittwater Council, Parish of Narrabeen and County of Cumberland and is located in a mixed residential and commercial area.

3.2 Geological Setting

The western portion of Sector 8 (eg. Lot 1 DP 18303) and southern portion of Lot 2 DP 18303 is located near the foothill of a gentle hill with ground surface sloping to the east at angles less than 6 degrees. On the remaining major portion of Sector 8, ground surface is approximately level. Based on the survey plan provided, ground surface level of the site

ranges from about reduced level (RL) 28m Australian Height Datum (AHD) on the western extremities to about RL 12m AHD on the eastern extremities of the site.

Fern Creek transects Lot 2 in the middle and runs along the rear boundary of Lots A to C. At the time of the site investigation, Fern Creek water level was about 2.0m below the top of banks.

The 1:100,000 Soil Landscape of Sydney Series 9130 prepared by the Soil Conservation Services of NSW indicates the site to be underlain by swamp soil belonging to the Warriewood landscape grouping. Typically soil profile in the general area is deep and consists of sandy humus Podzols and dark mottled Siliceous sands overlying acid peats in depression and pale siliceous sands.

The 1:100,000 geological map of Sydney indicated the major portion of the site to be underlain stream alluvial and estuarine sediments consisting of silty to peaty quartz sand, silt and clay with ferruginous and humic cementation in places. On the western portion of Sector 8 (eg. Lot 1 DP 18303) and southern portion of Lot 2 DP 18303, interbedded laminite shale and quartz to lithic quartz sandstone underlies the site.

Permanent groundwater table on the low lying flats is expected to be at relatively shallow depths.

3.3 Site Inspection and Description

A site visit was carried out on the 26th June 2000 by a senior engineer to observe existing site features and identify obvious or suspected areas of potential contamination.

Refer to Drawing No 1 for existing site features. The following is a summary of our site observation of the Subject Site.

Lot 2 DP 18303

Lot No 2 is located on the western extremity of the Subject Site. At the time of the site investigation, there was no specific landuse other than residential. There were a number of buildings and structures at the front portion of the property. The buildings and site features may be described as follows;

Site Feature No	Description
1	A timber house in fair condition and is currently occupied by tenants.
2	Metal shed with corrugated roofing for storage of feeds and equipment.
3	Breeding ground for chickens with two metal sheds for shelters.
4	A trailer used for storage of building material.
5	A metal shed which was locked. A number of building material was stored around the shed.

The remaining portion of Lot 2 consisted of open grassed areas. There were no obvious signs of gross ground contamination in the form of oil staining, discolouration, and odour.

Lot A DP 328260

Lot A is located immediately to the east of Lot 2. At the time of the site investigation, the lot was mainly used for residential. There were a number of glass houses and sheds at the rear of the houses. The buildings and site features may be described as follows;

Site Feature No	Description
6	A fibro and timber house currently being tenanted.
7	A metal shed.
8	A fibro and timber garage.
9	A metal shed.
10	A number of disused glass houses in very poor condition. Some with glass panels removed.
11	A vacant metal shed.

The rear portion of Lot A consists of vacant land which was covered with grass. There were no obvious signs of gross contamination in the form of oil staining, discolouration and odour.

Lot B DP 328260

Lot B is located immediately to the east of Lot A. At the time of the site investigation, the lot was used for cultivation of ornamental plants for nurseries. There were a number of buildings and site features which may be described as follows;

Site Feature No	Description
12	A timber and corrugated metal shed.
13	A brick house with tenants.
14	A double garage.
15	Glasshouses used for cultivation of ornamental plants.
16	Glasshouses used for cultivation of ornamental plants.
17	Glasshouses used for cultivation of ornamental plants.
18	Glasshouses used for cultivation of ornamental plants.

Away from the glass houses, there were numerous potted plants stored on the Lot. At the rear portion of the site, there was an area used for storage of roof tiles. There were no obvious signs of gross contamination in the form of oil staining, discolouration and odour.

Lot C DP 328260

Lot C is located on the eastern extremity of the Subject Site. At the time of the site investigation, the front portion of the site was used for residential. There were a number of buildings and site features on site as described below;

Site Feature No	Description
19	Open sandy area used for cultivation of plants.
20	House which was occupied by tenants.
21	Garage.
22	Open sandy area used for cultivation of plants.
23	Glass houses. Some in very poor condition. Only about three glass houses were used for cultivation of vegetable plants.

There were no obvious signs of gross contamination in the form of oil staining, discolouration and odour.

3.4 Site History

We understand from a tenant of Lot 2 that he lived on the lot for about 17 years and the whole of Sector 8 was originally used for cultivation tomatos and cucumbers for many decades. Cultivation of tomatos and cucumbers on Lot 2 ceased in about 1983 and was used as semi-rural residential since.

Historical information on the previous owners of the site was obtained from the Department of Lands. The information can often be linked to possible land uses and provides and indication of potential contamination on the site.

Title Reference	**Dealing No**	**Registered**	**Registered Proprietor**
Lot 2 DP 18303			
Vol 3348 Fol 178	D116065	16/3/1942	Mattel Tanzabel, a farmer
Vol 5325 Fol 173	K990294	4/4/1968	Josippa Tanzabel, a widow
Vol 5325 Fol 173	L890796	29/6/1970	Mattsons Pty Ltd
Vol 5325 Fol 173	Q153610	18/4/1977	Kulnamock Pastoral Pty Ltd
Vol 5325 Fol 173	T83696	17/11/1983	Iija Lakajev and Gloria Lakajev
F.I.2/18303	O3612	8/2/1995	Iiia Lakaev and Gloria Lakaev

Title Reference	**Dealing No**	**Registered**	**Registered Proprietor**
Lot A DP 328260			
Vol 2045 Fol 47		19/3/1910	Warriewood Limited
Vol 3483 Fol 30	A969542	18/7/1923	Rita Charlotte Farrand wife of William Oscar Farrand, farmer
Vol 4553 Fol 200	No intervening transfers		
Vol 4680 Fol 65	C314950	29/3/1935	Edward McDonald , a gardener
Vol 4680 Fol 65	G11685	2/2/1954	Nikola Fabrio , a farmer
F.I.A/328260	No further transfer		

Title Reference	Dealing No	Registered	Registered Proprietor
Lot B DP 328260			
Vol 2045 Fol 47		19/3/1910	Warriewood Limited
Vol 3483 Fol 30	A969542	18/7/1923	Rita Charlotte Farrand wife of William Oscar Farrand, farmer
Vol 4553 Fol 200	C314950	12/3/1935	Joseph Parnell, an engineer
Vol 4680 Fol 54	J59776	11/5/1962	Nikola Grbic , a market gardener and Miolka Grbic
F.I.A/328260	No further transfer		

Title Reference	Dealing No	Registered	Registered Proprietor
Lot C DP 328260			
Vol 2045 Fol 47		19/3/1910	Warriewood Limited
Vol 3483 Fol 30	A969542	18/7/1923	Rita Charlotte Farrand wife of William Oscar Farrand, farmer
Vol 4553 Fol 190	C143360	11/11/1932	Milton Marshall , a gardener
Vol 4553 Fol 190	D209519	15/6/1943	Nicholas Rogley, carrier
F.I.C/328260	No further transfer		

3.5 Aerial Photographs

A review of aerial photographs from 1951 to 1982 was carried out. The following is a summary of the observations made from the review;

Year	Reference	Description
1951	471-13, Run 27, May 1951	The residential dwelling (Site Feature 1) and metal shed (Site Feature 2) were constructed in Lot 2. Between the buildings and Fern Creek, the area was fully occupied with glass houses. Further to the rear of Lot 2, on the south side of the creek, the area was extensively used for agricultural activities with a number of glass houses constructed close to the creek. In Lot A, the house (Site Feature 6), the garage (Site Feature 8) and the metal shed (Site Feature 7) were constructed. The rear portion of Lot A was occupied by a number of glass houses. The whole of Lot B was occupied with glass houses. In Lot C, the house (Site Feature 20) and garage (Site Feature 21) were constructed. The remaining portion of Lot C was vacant with no obvious signs of agricultural activities. Surrounding sites were extensively used for agricultural activities with a lot of glass houses built in the area.
1961	NSW 1052-5158, Run 22E, 1961	A number of glasshouses were removed from Lot 2. Some land cultivation appears to have occurred at the front portion of Lot 2. There appeared no significant changes in the building and glasshouses layout in Lots A and B. In Lot C, the glasshouses which currently exist were constructed.
1982	NSW 3260 108, Run 14, 27/10/82	The site layout appeared similar to current. Agricultural activities in Lot 2 appeared to have ceased. There was a general decline in agricultural activities in the Warriewood valley. Properties to the north of site were extensively developed into residential subdivision.

3.6 Current Status

Verification certificates obtained from the NSW Land Information System, Central Register of Restrictions for the site state that there are no statutory notices under the provisions of the Unhealthy Building Land Act issued by the NSW Environment Protection Authority. Copies of the certificates are presented in Appendix A.

4. FIELDWORK

The fieldwork for the investigation was carried out on the 26th June 2000 and consisted of excavation of 42 test pits (TP 1 to TP 42) using a tractor mounted backhoe. The test pit locations are shown on Drawing 2.

The test pits were generally excavated through topsoil and into natural soil profile to depths varying of about 0.4m to 2.9m below existing ground surface.

To assess the strength of the subsurface soil, eight Dynamic Cone Penetration (DCP) tests were carried out adjacent to TP 1, 5, 8, 11, 13, 16, 30 and 38 to depths varying from 3.0m to 4.3m below existing ground surface.

The test pits were observed for groundwater during and upon completion of the excavation. The field results together with details of the strata encountered are presented in Table 1. The DCP test results are attached in Appendix D.

Environmental samples were collected in duplicate from surface and at intervals of depth. GeoEnviro Consultancy 's standard procedures were used for sampling and field screening. This included using a photoionisation detector (PID) in the field to identify the presence of volatile ionisable compounds in the samples collected. More information on the procedures used and the PID are provided in Appendix B.

A number of samples were composited in groups of three for the purpose of laboratory analysis. Care was taken to ensure that the samples composited were similar in geology. Deeper composite samples were prepared in the fill near the creek. A composite schedule is presented in Table 2.

5. LABORATORY ANALYSIS

Selected soil samples were analysed for the contaminants of concern consisting of;

- Heavy metals - Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg), Lead (Pb), Nickel (Ni) and Zinc (Zn).
- Organochlorine Pesticides (OCP's).
- Organophosphorus Pesticides (OPP's)
- pH.

The above contaminants include those which are commonly encountered on agricultural sites. The analytical program is presented in Table 2. Laboratory results are summarised in Table 3 to 6.

Analysis for heavy metals and pH were performed by Sydney Analytical Laboratories (SAL) and for OCP's and OPP's, by Australian Environmental Laboratories (AEL). Both laboratories are accredited by the National Association of Testing Authorities (NATA) for the tests performed. The analytical results and methods employed are presented in the laboratory certificates in Appendix C.

6. RESULTS OF THE INVESTIGATION

6.1 Subsurface Conditions

With the exception of one test pit TP 14 excavated at the rear of Lot 2, a typical subsurface profile consisting of topsoil overlying a silty sand profile was encountered. TP 14 which was excavated on the lower foothills of a gentle hill encountered topsoil overlying silty clay overlying sandstone bedrock.

The following is a summary of soil profile encountered excluding TP 14.

Fill

Fill was encountered in TP 10, 17 and 33 which were excavated near Fern Creek. The fill consists predominantly of fine to medium grained silty sand with topsoil mixture. In TP 10, some buried car parts, glass and ropes were encountered mixed in the fill. In TP 17 and 33, the fill contained a significant amount of glass and ceramic pieces, timber, steel pieces and rubbish.

Topsoil

Topsoil was encountered in most test pits consisting mainly of fine to medium grained silty sand.

Natural Soil

Underlying the topsoil, typical natural soil consists of a layer of fine to medium grained light grey silty sand with thickness ranging from about 300mm to 1.5m overlying yellow brown and dark brown slightly cemented silty sand/clayey sand.

The soil profile appears to become more clayey at lower depths. Sandy Clay/Clayey Sand of medium plasticity was encountered in the deeper test pits (ie. TP 1 to 5, 8, 12, 13, 15 to 17, 30 and 38) at depths varying from 1.0 to 2.0m below existing ground surface.

From the DCP test results, the upper 1.8m of the subsurface profile was found to be variable. Based on empirical correlation of strength for cohesionless soil with DCP blow counts, the upper 1.8m of the sandy profile was assessed to have relative density ranging from very loose to medium dense.

The DCP blow counts were found to be more consistent and relatively higher at depths below 2.0m. The higher blow counts obtained at lower depths infer medium dense sand or very stiff clay.

In general, the moisture content of the upper 1.0m of the subsurface soil profile was found to be dry to moist. At lower depths of between about 1.0m to 2.0m, moisture content of the sandy profile increases to moist and at lower depths below 2.0m, the soil profile becomes moist to wet.

Groundwater

Ground water was encountered in TP 4, 10, 17 and 30 at depths typically about 2.0m to 2.4m below existing ground surface. In TP 4 and 30, the ground water table was only apparent after a few hours due to very slow ground water seepage inflow. TP 17 and 33 which were excavated near Fern Creek encountered instantaneous groundwater seepage during test pit excavation.

Reference should be made to Table 1 for details of the subsurface profile encountered.

6.2 Field Screening for Volatile Ionisable Compounds

The PID results in all samples were less than 10ppm and do not indicate significant presence of volatile ionisable compounds in the samples screened. This is consistent with the absence of odour in any of the samples collected.

The PID results are summarised on Table 1.

7. RESULTS OF LABORATORY ANALYSIS

7.1 Assessment Criteria

The results of laboratory analyses for this investigation were compared with published Australian contamination assessment criteria. These Criteria are presented in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, January 1992 (ANZECC/NHMRC Guidelines, Reference 1). The guidelines recommend the use of Dutch Level B criteria for parameters for which an Australian criterion is not published. The NSW EPA endorses the use of these guidelines for the assessment of contaminated sites.

Other guidelines such as those published by the National Environmental Health Forum (NEHF) and the NSW EPA guidelines are commonly used to assess contaminant concentrations. The NEHF criteria are recently published (Reference 2) health based soil investigation levels for different exposure settings. In the present case, the criteria adopted are those for a standard residential setting with garden/accessible soil and are considered appropriate for the present investigation. The NSW EPA "Guidelines for Assessing Service Station Sites" (Reference 3) are used for assessing hydrocarbon related contamination.

The NSW EPA (Reference 4) recommends the use of these criteria and in addition, the analysis of surface soil should be compared with the provisional phytotoxicity-based investigation levels. These criteria assure plant growth (as well as protecting human health). We have used the NSW EPA and NEHF criteria as further references to assess the laboratory results.

The results of laboratory analysis of individual samples have been directly compared with the Criteria. The results of laboratory analysis for the composites have been compared with 'modified criteria' by dividing the Criteria by the number of subsamples forming the composite. The relevant criteria are presented in the summary table of results (Table 3 to 6).

7.2 Metals

Fourteen composite samples (C1 to C14) and five individual samples (TP11 [0-0.2m], TP11 [0.4-0.6m], TP16 [0.0-0.2m], TP32 [0.0-0.2m] and TP40 [0-0.2m] were initially analysed for a range of heavy metals consisting of Cu, Pb, Zn, Cd, Cr, Ni, As and Hg. The initial laboratory test results indicated all concentrations of heavy metals in composite samples analysed to be within the modified ANZECC Criteria except the following which were found to be above the criteria;

- Zn encountered in C5, C7 to C11 and C14 with concentrations ranging from 100mg/kg to 425mg/kg, above the modified ANZECC criteria and Proposed NSW EPA phototoxicity criteria of 67mg/kg. All the concentrations were found to be below the NEHF 'A' Guideline.

- Copper in C9 with a concentration of 21mg/kg, marginally above the modified ANZECC criteria of 20mg/kg. Such a concentration was found to be below the modified proposed NSW EPA phototoxicity criteria of 33.3mg/kg and NEHF 'A' Guideline of 333mg/kg.

Laboratory analysis of individual samples indicated all the heavy metals of concern to be within the ANZECC criteria and proposed NSW EPA phototoxicity criteria except for zinc in the following samples;

Sample	Zinc Concentration (mg/kg)
TP 10 (0-0.2m)	230
TP 21 (0-0.2m)	970
TP 23 (0-0.2m)	370
TP 33 (0-0.2m)	250
TP 39 (0-0.2m)	360

The above concentrations of zinc were all found to be well below the NEHF 'A' criteria. The results are summarised in Table 3 and 4.

7.3 Organochlorine Pesticides

Seven composite samples (C2, C4, C6, C8, C11, C13 and C14) and four individual samples (TP11 [0-0.2m], TP11 [0.4-0.6m], TP16 [0.0-0.2m] and TP32 [0.0-0.2m]) were analysed for a range of organochlorine pesticides. All concentrations were reported to be below laboratory detection limits and therefore within acceptable limits. The results are summarised in Table 5.

7.4 Organophosphorus Pesticides

Seven composite samples (C2, C4, C6, C8, C11, C13 and C14) and four individual samples (TP11 [0-0.2m], TP11 [0.4-0.6m], TP16 [0.0-0.2m] and TP32 [0.0-0.2m]) were analysed for a range of organophosphorus pesticides. All concentrations were reported to be below laboratory detection limits and therefore within acceptable limits. The results are summarised in Table 6.

7.5 pH

Fourteen samples were tested for soil pH. The results which range from 4.9 to 6.7 (Table 4). A pH of 4.9 is considered mildly acidic but could be commonly encountered in natural soil.

7.6 Quality Assurance/ Quality Control (QA/QC)

The fieldwork for this investigation was carried out in accordance with GeoEnviro Consultancy Standard procedures. This included collection of samples in new glass jars, preservation of samples in ice chests and transport of samples to the contract laboratory under chain of custody documentation.

Two duplicate samples (Duplicate A1 and B1) were prepared from TP 11(0-0.2m) and TP 20(0-0.2m) respectively for analysis of metals by SAL. Duplicate A2 was prepared from TP 11 (0-0.2m) for analysis of OCP's and OPP's by AEL.

The Relative Percentage Difference (RPD) values between primary and duplicate samples were calculated to assess the results. A zero RPD means perfect agreement of results

between the primary and duplicate sample whilst an RPD above 200% indicates total disagreement in results.

For heavy metals , the maximum RPD obtained was 40% (for Ni) in Duplicate A1, which is below the targeted 50% and is considered to be acceptable. The RPDs for OCP's and OPP's could not be calculated because the results were below laboratory detection limits in both primary and duplicate samples. Refer to Table 7 for details.

The internal laboratory QA/QC results are presented with the laboratory certificates (Appendix C) and are considered acceptable based on the duplicate and control samples analysed. The overall results suggest that the laboratory analysis carried out for this investigation were reliable.

8. ASSESSMENT AND RECOMMENDATIONS

8.1 Preliminary Contamination Assessment

This preliminary contamination assessment of the property referred to as Lot 2 DP 18303 & Lots A, B and C DP 328260, Sector 8 Macpherson Street, Warriewood was performed by GeoEnviro Consultancy in order to investigate the likelihood of ground contamination on the site. The investigation consisted a review of site history, a site inspection and soil sampling and analysis program.

Sampling was carried out at forty-two locations at surface and at depth. Selected samples were analysed for a range of potential contaminants consisting of heavy metals, organochlorine pesticides, organophosphorus pesticides and soil pH. The results were interpreted by comparison with guideline Criteria recommended by the NSW EPA.

The concentrations of heavy metals were reported to be below the ANZECC/NHMRC and proposed NSW EPA phototoxicity Criteria in all samples analysed except zinc in the following test locations;

Sample	Zinc Concentration (mg/kg)
TP 10 (0-0.2m)	230
TP 21 (0-0.2m)	970
TP 23 (0-0.2m)	370
TP 33 (0-0.2m)	250
TP 39 (0-0.2m)	360

We note that the elevated concentrations of zinc encountered in TP 10 and 33 was probably due to corrosion of metal pieces in the fill material. Elevated concentrations in the other test pits could be due to corrosion of corrugated metals from sheds and glass houses.

All concentrations of heavy metals were found to be well below the NEHF 'A' guidelines.

The laboratory test results indicated all concentrations of organochlorine and organophosphorus pesticides to be below the detection limits.

Within the context of the scope of work carried out, the results of the preliminary contamination assessment indicate that the likelihood of gross ground contamination on the site is generally considered low for the purpose of the proposed residential development.

Some buried fill material containing building rubble, metal pieces and car parts were encountered in TP 10, 17 and 33 which were located near the creek. For residential development, the buried fill material should be removed off site to an EPA approved landfill. Though asbestos was not encountered in the test pits, it may exist elsewhere within the fill as asbestos was commonly used in buildings in the past. Should asbestos be encountered in the fill, all asbestos should be appropriately disposed of in accordance with regulatory requirements.

Some elevated concentrations of zinc were encountered in TP 21, 23 and 39 encountered in the vicinity of sheds and glasshouses. We recommend that additional soil sampling and laboratory analysis in these areas be carried out after removal of sheds and buildings to further assess concentrations of zinc. If similar concentrations are encountered, site

remediation by on-site capping with topsoil may be required. Higher concentrations of zinc (ie. concentration three times above phototoxicity levels) will require disposal to an EPA landfill.

Excavated soil to be disposed off site will need to be categorised in accordance with the NSW EPA guidelines (Reference 6).

Validation sampling and testing of soil beneath existing buildings/structures after removal of floor slabs should be carried out.

8.2 Preliminary Geotechnical Recommendations

8.2.1 Drainage Improvement

In general, the moisture content of the upper 1.0m of the subsurface soil profile was found to be dry to moist. At lower depths of between about 1.0m to 2.0m, moisture content of the sandy profile increases to moist and at lower depths below 2.0m, the soil profile becomes moist to wet.

Ground water was encountered in some test pits at depths typically about 2.0m to 2.4m below existing ground surface.

We recommend that prior to residential subdivision development, drainage improvement by construction of drains and upgrading of the creek should be carried out.

8.2.2 Foundation

The field investigation indicated that the Subject Site is generally underlain by sandy profile with variable relative density at the upper 2.0m ranging from very loose to medium dense. The subsurface profile was found to be more clayey at lower depths. The investigation infers medium dense sand or very stiff clay at lower depths. At the rear of Lot 2, residual soil profile consisting of silty clay was encountered.

Based on information from the preliminary investigation, we assessed that the major portion of the Subject Site as it currently exists would be classified as Class 'P' in accordance with AS2870, "Residential Slabs and Footings". Suitable footings for the site would be pier and beam or pier and slab footings taken through loose sand and into medium dense sand or very stiff clay founded at least 2.0m below ground surface. Additional geotechnical

investigation by borehole drilling using truck mounted drill rigs would be required to provide recommendations on depths of piers required and allowable bearing capacities.

At the rear of Lot 2 where residual silty clay was encountered, typical site classification would be Class 'M' and shallow footings may be suitable. From the test pit investigation and judging from the site topography, the area suitable for Class 'M' site is anticipated to be restricted to a relative small area with respect to the Subject Site.

Upgrading of the site classification to allow shallow footings may be possible by densification of the upper loose sand. This may be more difficult to achieve in areas if ground water table is found to be higher than those encountered in the current investigation. There is a potential for ground water table level to fluctuate depending on weather conditions and drainage improvement

Densification works would involve excavation of the loose material to depths in the order of 1.5m and rolling with a heavy roller. We note that depending on ground water table level at the time of compaction, rolling with vibration may result in moisture pumping up into the zone of filling resulting in difficulty in achieving the required density.

All backfill material should be compacted to a minimum 70% density index. The insitu sand material will be suitable for reuse as compacted fill. Due to high ground water table present on site, clayey fill is not recommended. All structural fill should be controlled and compacted in layers not exceeding 250mm thickness compacted to the above specified compaction level. Any imported fill should be of good quality material such as ripped shale or sandstone with a maximum particle size of 75mm.

Earthworks should be closely monitored by a geotechnical consultant and should include field density testing of fill at an appropriate frequency and level of supervision as detailed in AS3798 -1996.

8.2.3 Pavements

Pavement construction will require the upper 1.0m to 1.5m of the sandy soil to be adequately compacted. It is anticipated that pavement subgrade preparation will include;

- Excavation of the loose sand to a depth of about 1.0m below proposed subgrade level.
- Rolling of the base of the excavation with a minimum 8 passes of a roller (minimum 10 tonne). Vibration from roller may result in rising of water table and therefore should be carried out under strict supervision.
- Any soft areas identified during rolling should be further excavated and replaced with ripped sandstone fill. Geotextile may be used to provide a stable working platform for subsequent filling.
- The excavated sandy material may be reused as filling beneath pavements. Some moisture reconditioning of the material by drying will be required. The sandy material should be compacted in layers not exceeding 250mm loose thickness compacted to a minimum 70% density index. The upper 300mm of fill forming the subgrade should be compacted to a minimum 90% density Index.

8.3 Remaining Portion of Sector 8

8.3.1 Contamination Issues

The current investigation did not encounter significant contamination as a result of previous agricultural landuse. As the remaining portion of Sector 8 consisted of similar landuse, it is anticipated that similar conclusions to that of the Subject Site may be drawn for the remaining part of Sector 8.

8.3.2 Geotechnical Issues

The geological maps indicated that the major portion of the site is underlain by stream alluvial and estuarine sediments with the western portion of Sector 8 (eg. Lot 1 DP 18303) and southern portion of Lot 2 DP 18303 underlain by residual soil over sandstone.

From our local knowledge of the area, we expect the subsurface ground conditions on the eastern portion of Sector 8 (Lot 1 DP 593363, Lot 12 DP 659528 and Lot 11 Section C DP 5464) to be underlain deep alluvial soil with more significant profiles affected by soft ground. We recommend that additional investigation using a truck-mounted drill be carried

out to assess the subsurface ground condition. The investigation should include monitoring of groundwater table by installation of PVC standpipes.

Suitable footings for residential dwellings on residual site may consist of shallow footings. On alluvial site, deep footings will be suitable. For alluvial site, densification of the upper loose sandy material may be carried out but the feasibility of such works will be governed by the depths of loose soil and the height of ground water.

9. CLOSURE

The findings contained in this report are the results of discreet/specific sampling methodologies used in accordance with normal practices and standards.

There is no investigation which is thorough enough to preclude the presence of material which presently, or in future, may be considered hazardous to the site. As regulatory evaluation criteria are constantly updated, concentrations of contaminants presently considered low, may in the future fall short of regulatory standards that require further investigation/redemption.

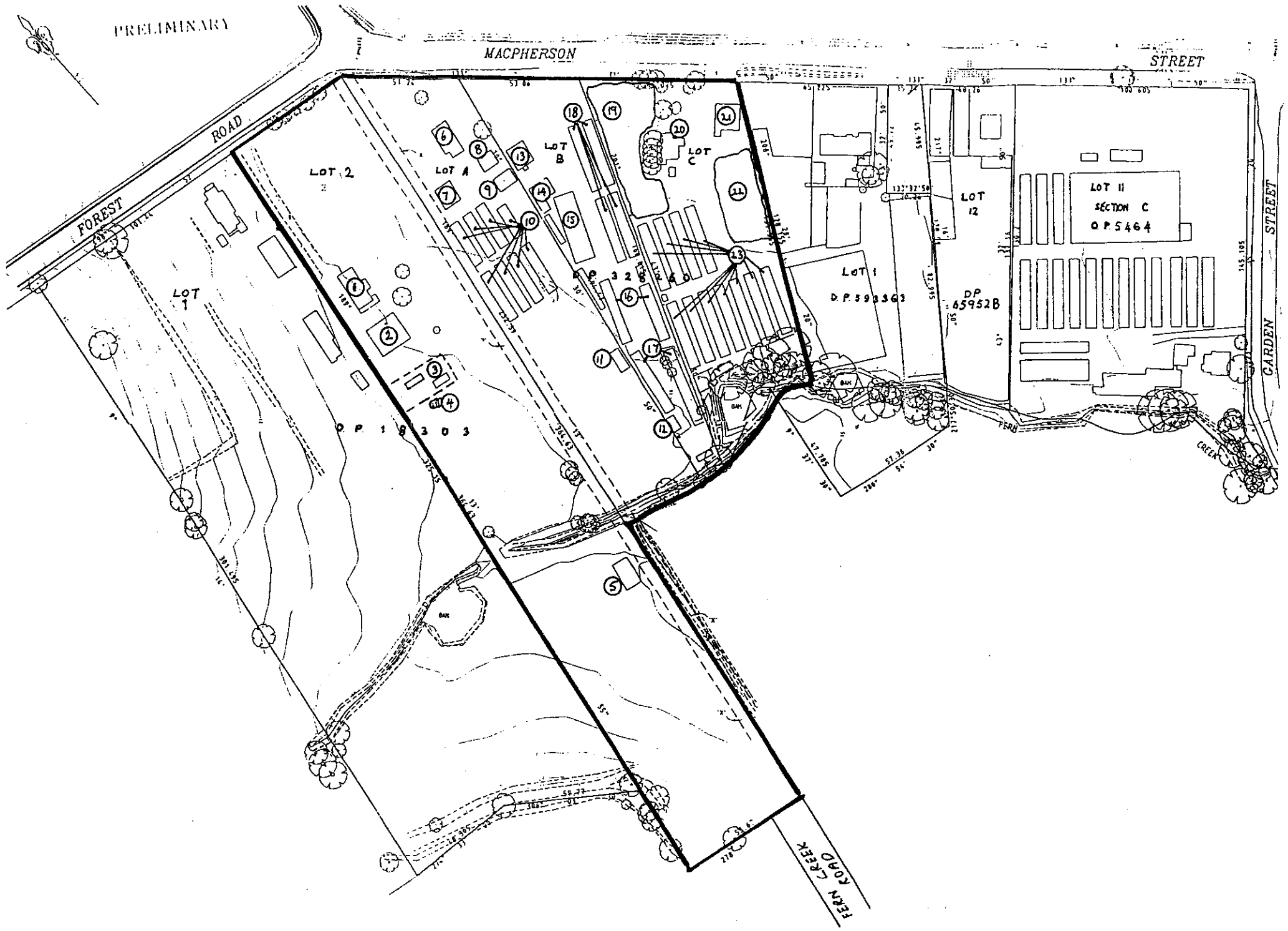
The statements presented in these documents are intended to advise you of what should be your realistic expectations of this report, and to present you with recommendations on how to minimise the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by GeoEnviro Consultancy Pty Ltd, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Attached in Appendix F are documents entitled "Important Information about Your Environmental Site Assessment" in conjunction with which this report must be read, as it details important limitations regarding the investigation undertaken and this report.

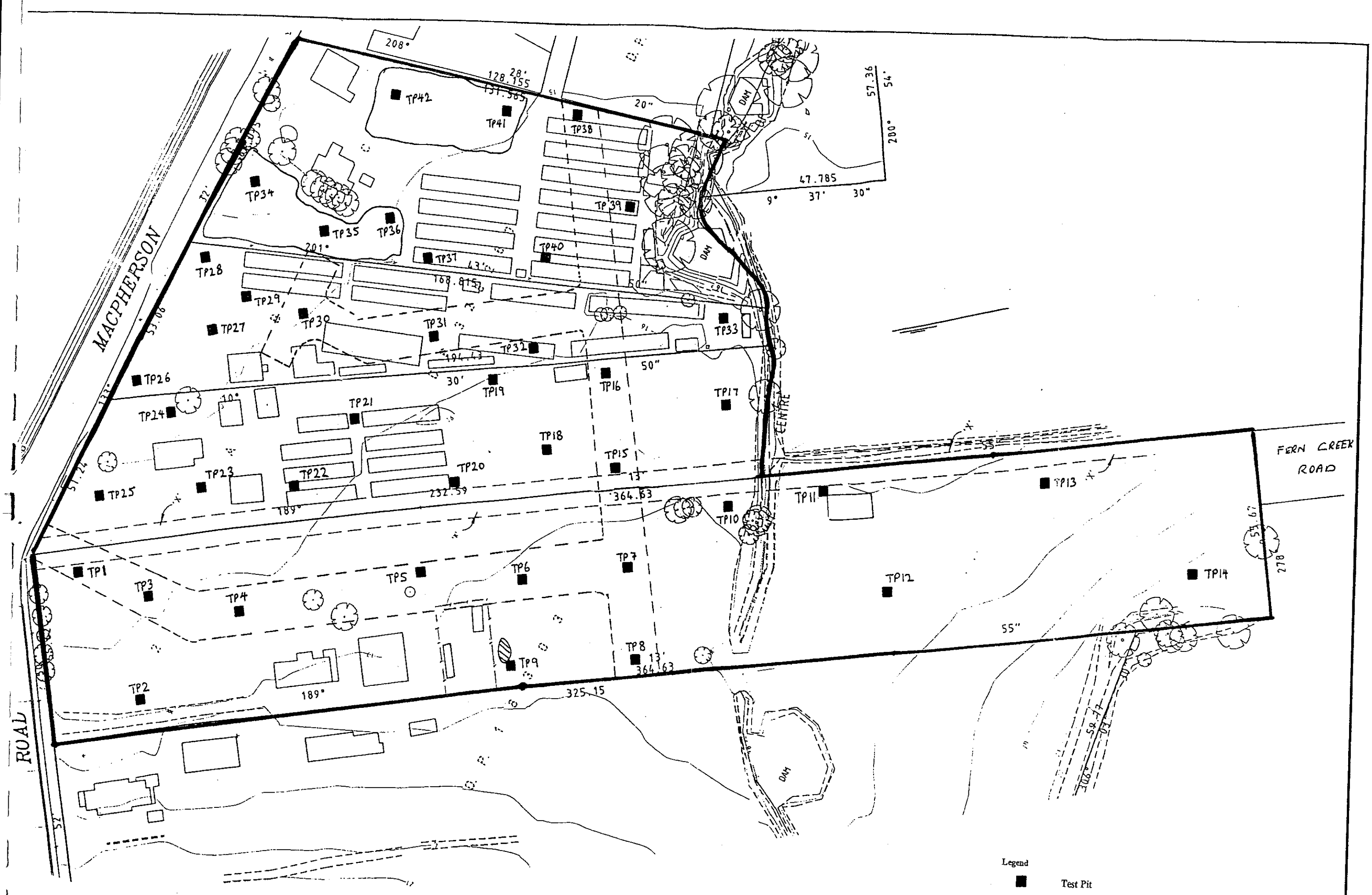
REFERENCES

1. *Australian & New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Australian and New Zealand Conservation Council and National Health and Medical Research Council, 1992.*
2. *Health Based Soil Investigation Levels, National Environmental Health Forum Monographs Soil series No. 1 – 1996*
3. *Guidelines for Assessing Service Station Sites – NSW EPA 1994*
4. *Guidelines for the NSW Auditor Scheme, NSW EPA February 1998*
5. *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-liquid Wastes – NSWEPA 1999*

Site Feature	Description
1	Timber house
2	Metal shed with corrugated roofing
3	Breeding ground for chickens with two metal sheds
4	A trailer with some building material
5	Metal shed with a lot of building material stored along the sides
6	Firbo and timber house
7	Metal shed
8	Fibro garage
9	Metal shed
10	Glass houses - not in used
11	Metal shed - vacant
12	Timber and corrugated metal shed
13	Brick house
14	Double garage
15	Glass house still in use for ornamental plants
16	Glass houses still in use for ornamental plants
17	Glass houses still in use for ornamental plants
18	Glass houses still in use for ornamental plants
19	Open sandy area bare of vegetation
20	House
21	Garage
22	Open sandy area bare of vegetation
23	Glass houses - mainly not in used.



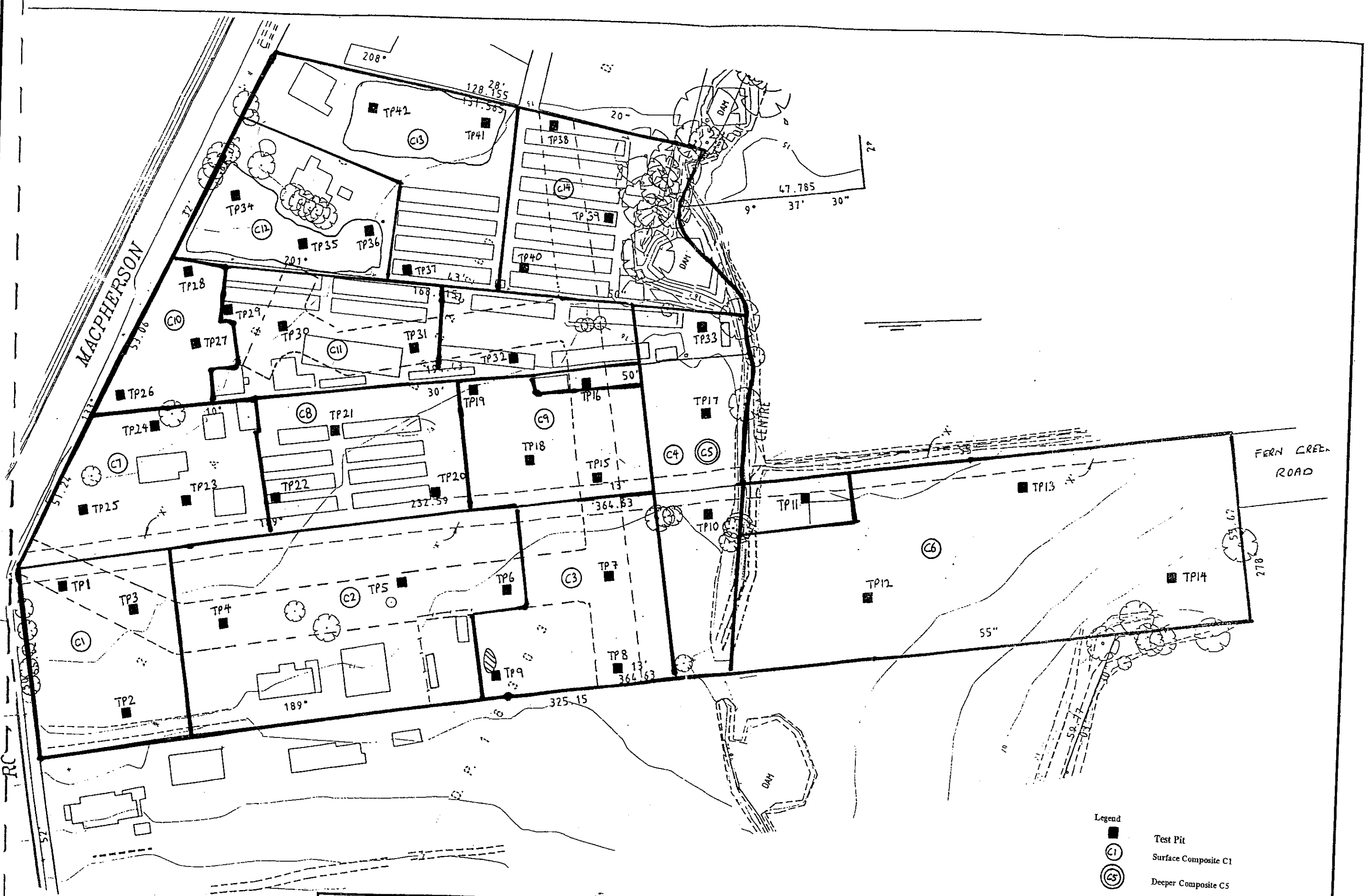
GeoEnviro Consultancy	Drawn By: SL	Date : 12/7/00	Australand Holdings Ltd
	Checked By: SL	Date : 12/7/00	Sector 8 Macpherson Street, Warriewood
	Revision By:	Date:	Site Features and Locality Plan
	Scale: 1:2000	A3	Project No: JC000010A / Drawing No: 1



Legend

■ Test Pit

GeoEnviro Consultancy	Drawn By: SL	Date : 12/7/00	Australand Holdings Ltd
	Checked By: SL	Date : 12/7/00	Sector 8 Macpherson Street, Warriewood
	Revision By:	Date:	Test Pit Location Plan
	Scale: 1:1000	A3	Project No: JC00010A / Drawing No: 2



GeoEnviro Consultancy

Drawn By: SL	Date : 12/7/00	Australand Holdings Ltd	
Checked By: SL	Date : 12/7/00	Sector 8 Macpherson Street, Warriewood	
Revision By:	Date:	Composite Sample Plan	
Scale: 1:1000	A3	Project No: JC00010A	Drawing No: 3

Test Pit Number	Depth (m)	Profile Type	Description	Sample Depth (m)	PID (ppm)
1	0.0-0.4	Topsoil/Fill	Silty Sand: fine to medium grained, dark grey , dry with some roots	0.0-0.2	0.2
	0.4-0.6	Fill	Silty Sand: fine to medium grained, grey and dark grey with some bands of topsoil.	0.4-0.6	0.0
	0.6-1.1	Natural	(SC/CI) Sandy Clay/Silty Sand: fine to medium grained, brown and yellow brown, dry, loose, MC=PL		
	1.1-1.6	Natural	As above but medium dense, dry to moist , PP 250 to 300 kPa		
	1.6-2.5	Natural	(CI) Sandy Clay: medium plasticity, yellow brown mottled red with some cemented zones.		
2	0.0-0.5	Topsoil	Silty Sand: fine to medium grained, dark grey , dry	0.0-0.2	0.4
	0.5-1.0	Natural	(SM) Silty Sand: fine to medium grained, light brown, slightly cemented.	0.4-0.6	0.1
	1.0-1.6	Natural	(CI) Sandy Clay: medium plasticity, yellow brown mottled red with some ironstone gravels, MC> =PL, PP 200kPa		
3	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, dark grey and brown with some roots	0.0-0.2	0.3
	0.4-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry to moist	0.4-0.6	0.0
	0.7-1.3	Natural	As above but yellow brown, moist with some clay.		
	1.3-1.7	Natural	(SC) Silty Clayey Sand: fine to medium grained, yellow brown with some cemented zones and ironstone gravels, MC> =PL, moist to wet		
4	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, dark grey with some roots	0.0-0.2	0.6
	0.3-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, moist to dry	0.4-0.6	0.1
	0.6-1.6	Natural	As above but yellow brown, with some clay, slightly cemented.		
	1.6-1.7	Natural	(CI/SC) Sandy Clay/Clayey Sand: medium plasticity, medium plasticity, grey brown mottled red with some ironstone gravels, moist to wet.		
	1.7-2.9	Natural	(CI) Sandy Clay: medium plasticity, brown, very stiff, MC>PL, PP 280kPa		
			Ground water table at 2.4m after 4 hours		
5	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.3-0.75	Natural	(SM) Silty Sand: fine to medium grained, light grey, loose to medium dense	0.4-0.6	0.1
	0.75-1.2	Natural	As above but brown and dark brown, slightly cemented with some clay		
	1.2-2.2	Natural	(CI) Sandy Clay: medium plasticity, yellow brown, MC> =PL, PP 250 kPa		
6	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.3
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, loose to medium dense	0.4-0.6	0.0
	0.7-1.5	Natural	As above but brown and dark brown, slightly cemented , moist to dry		
7	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.3-0.8	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.2
	0.8-1.8	Natural	As above but yellow brown, slightly cemented , medium dense		
	1.8-2.0	Natural	As above but with some clay, very stiff		

Notes:

MC= Moisture Content

PL=Plastic Limit

GeoEnviro Consultancy

TABLE 1
SUMMARY OF SOIL PROFILE AND PID RESULTS (Pg 1 of 5)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL 17/07/00
Checked By: ____ Date: 17/7/00

Test Pit Number	Depth (m)	Profile Type	Description	Sample Depth (m)	PID (ppm)
8	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.8
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry, loose	0.4-0.6	0.2
	0.7-1.3	Natural	As above but brown and dark brown, slightly cemented, loose to medium dense		
	1.3-1.8	Natural	As above but very loose to loose		
	1.8-2.2	Natural	(SC/CI) Sandy Clay/Clayey Sand: medium plasticity, fine to medium grained, yellow brown, MC> =PL. very stiff, Medium dense		
9	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.9
	0.3-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry, loose	0.4-0.6	0.1
10	0.0-1.5	Fill	Silty Sandy Clay and Topsoil mixture, low plasticity with some burried car parts, with some glass and ropes	0.0-0.2	0.2
	1.5-1.7	Natural	(SM) Sitly Sand: fine to medium grained, light grey	1.0-1.2	0.1
	1.7-2.5	Natural	As above but yellow brown, moist to wet,	1.5-1.7	0.0
			Groundwater at 2.0m		
11	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-1.4	Natural	(SM) Silty Sand: fine to medium grained, light grey. Very loose, dry	0.4-0.6	0.4
	1.4-1.7	Natural	As above but brown, with slight cementation, medium dense		
12	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.5
	0.3-0.8	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
	0.8-1.6	Natural	As above but brown and dark brown, slightly cemented		
	1.6-1.8	Natural	(SC/CI) Sandy Clay/Clayey Sand: medium plasticity, brown and dark brown, dry to moist		
13	0.0-0.35	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.35-0.65	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry, very loose	0.4-0.6	0.1
	0.65-1.1	Natural	As above but brown and dark brown, slightly cemented, loose to medium dense		
	1.1-1.5	Natural	(SC/CI) Sandy Clay/Clayey Sand: medium plasticity, brown and dark brown, dry to moist, medium dense, very stiff		
14	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.7
	0.3-1.7	Natural	(CI) Silty Clay: medium plasticity, brown and grey, MC=PL, very stiff, PP 400kPa	0.1-0.6	0.2
	1.7-2.1	Natural	As above but light grey mottled red with some ironston gravels, MC=PL, very stiff		
	2.1-2.3	Bedrock	Sandstone: fine to medium grained, extremely weathered, extremely low strength, brown		
15	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.3-0.65	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.1
	0.65-1.6	Natural	As above but brown		
	1.6-2.3	Natural	(SC/CI) Sandy Clay: medium plasticity, yellow brown, MC> =PL, PP 200 kPa, very stiff		

Notes:

MC= Moisture Content

PL=Plastic Limit

GeoEnviro Consultancy

TABLE 1
SUMMARY OF SOIL PROFILE AND PID RESULTS (Pg 2 of 5)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL 17/07/00
Checked By: JC Date: 17/7/00

Test Pit Number	Depth (m)	Profile Type	Description	Sample Depth (m)	PID (ppm)
16	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.75	Natural	(SM) Silty Sand: fine to medium grained, light grey, very loose	0.1-0.6	0.0
	0.75-1.8	Natural	As above but yellow brown and dark brown, slightly cemented, very loose		
	1.8-2.0	Natural	(SC) Sandy Clay/Clayey Sand: fine to medium grained, medium plasticity, very stiff. MC> =PL, PP 200 to 350kPa		
17	0.0-2.0	Fill	Silty Sand and topsoil mixture: with some concrete, timber and sandstone pieces. Concrete pieces up to 1.5m	0.0-0.2	0.3
	2.0-2.9	Topsoil	Silty Sand: fine to medium grained, dark grey with some glass and ceramics, wet	1.0-1.2	0.1
	2.9-3.1	Natural	(SM) Silty Sand/Silty Sandy Clay: fine to medium grained, light grey, MC> >PL, soft		
			Groundwater at 2.7m		
18	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.2
19	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.4	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.2
20	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.2
	0.3-0.65	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
21	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
22	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
23	0.0-0.3	Topsoil/Fill	Silty Sand: fine to medium grained, grey, dry with some timber	0.0-0.2	0.9
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.5-0.6	0.3
24	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.3-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
25	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.3
	0.3-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
26	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.0
	0.4-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		

Notes:

MC= Moisture Content

PL=Plastic Limit

GeoEnviro Consultancy

TABLE 1
SUMMARY OF SOIL PROFILE AND PID RESULTS (Pg 3 of 5)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL 17/07/00
Checked By: ___ Date: 17/7/00

Test Pit Number	Depth (m)	Profile Type	Description	Sample Depth (m)	PID (ppm)
27	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.2
	0.4-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
28	0.0-0.35	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.2
	0.35-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
29	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.1
	0.4-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
30	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.4-1.1	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry, medium dense	0.4-0.6	0.1
	1.1-1.7	Natural	As above but yellow brown and dark brown, slightly cemented, very loose		
	1.7-2.0	Natural	As above but medium dense		
	2.0-2.4	Natural	(Cl/SC) Sandy Clay/Clayey Sand: fine to medium grained, yellow brown, MC > =PL, moist, medium dense		
	2.4-2.6	Natural	As above but moist to wet, Groundwater at 2.3m		
31	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.4-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.2
	0.7-1.7	Natural	As above but brown and dark brown , slightly cemented		
32	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.7
	0.4-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry	0.4-0.6	0.0
33	0.0-2.1	Fill	Silty Sand and topsoil mixture, fine to medium grained, dark grey dry with some concrete, steel pieces, glass, timber and rubbish	0.0-0.2	0.3
	2.1-2.3	Natural	(SM) Silty Sand: fine to medium grained, light grey, moist to wet	1.0-1.2	0.0
34	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.6
	0.3-0.4	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
35	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.5
	0.3-0.4	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
36	0.0-0.3	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.8
	0.3-0.4	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		

Notes:

MC = Moisture Content

PL =Plastic Limit

GeoEnviro Consultancy

TABLE 1
SUMMARY OF SOIL PROFILE AND PID RESULTS (Pg 4 of 5)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL 17/07/00
Checked By: JC Date: 17/7/00

Test Pit Number	Depth (m)	Profile Type	Description	Sample Depth (m)	PID (ppm)
37	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.3
	0.4-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
38	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey	0.0-0.2	0.3
	0.3-0.7	Natural	(SM) Silty Sand: fine to medium grained, light grey, medium dense	0.4-0.6	0.1
	0.7-1.7	Natural	As above but grey brown, slightly cemented, dry, medium dense with loose bands		
	1.7-2.0	Natural	(SC/Cl) Sandy Clay/Clayey Sand: fine to medium grained, brown		
39	0.0-0.35	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.2
	0.35-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
40	0.0-0.4	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.0
	0.4-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
41	0.0-0.35	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.2
	0.35-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		
42	0.0-0.35	Topsoil	Silty Sand: fine to medium grained, grey, dry with some roots	0.0-0.2	0.4
	0.35-0.6	Natural	(SM) Silty Sand: fine to medium grained, light grey, dry		

Notes:

MC = Moisture Content

PL = Plastic Limit

GeoEnviro Consultancy

TABLE 1
SUMMARY OF SOIL PROFILE AND PID RESULTS (Pg 5 of 5)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL 17/07/00
Checked By: ___ Date: 17/7/00

Sample	Depths	Sample Date	Sample Type	Sample Composition			Analysis									OCP	OPP
							Heavy Metals										
							pH	Cu	Pb	Zn	Cd	Cr	Ni	As	Hg		
C1	0.0-0.2	26/06/00	Soil	TP1(0.0-0.2)	TP2(0.0-0.2)	TP3(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C2	0.0-0.2	26/06/00	Soil	TP4(0.0-0.2)	TP5(0.0-0.2)	TP6(0.0-0.2)		0	0	0	0	0	0	0	0		
C3	0.0-0.2	26/06/00	Soil	TP7(0.0-0.2)	TP8(0.0-0.2)	TP9(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C4	0.0-0.2	26/06/00	Soil	TP10(0.0-0.2)	TP17(0.0-0.2)	TP33(0.0-0.2)		0	0	0	0	0	0	0	0		
C5	1.0-1.2	26/06/00	Soil	TP10(1.0-1.2)	TP17(1.0-1.2)	TP33(1.0-1.2)		0	0	0	0	0	0	0	0	0	0
C6	0.0-0.2	26/06/00	Soil	TP12(0.0-0.2)	TP13(0.0-0.2)	TP14(0.0-0.2)		0	0	0	0	0	0	0	0		
C7	0.0-0.2	26/06/00	Soil	TP23(0.0-0.2)	TP24(0.0-0.2)	TP25(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C8	0.0-0.2	26/06/00	Soil	TP20(0.0-0.2)	TP21(0.0-0.2)	TP22(0.0-0.2)		0	0	0	0	0	0	0	0		
C9	0.0-0.2	26/06/00	Soil	TP15(0.0-0.2)	TP18(0.0-0.2)	TP19(0.0-0.2)		0	0	0	0	0	0	0	0		
C10	0.0-0.2	26/06/00	Soil	TP26(0.0-0.2)	TP27(0.0-0.2)	TP28(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C11	0.0-0.2	26/06/00	Soil	TP29(0.0-0.2)	TP30(0.0-0.2)	TP31(0.0-0.2)		0	0	0	0	0	0	0	0		
C12	0.0-0.2	26/06/00	Soil	TP34(0.0-0.2)	TP35(0.0-0.2)	TP36(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C13	0.0-0.2	26/06/00	Soil	TP37(0.0-0.2)	TP41(0.0-0.2)	TP42(0.0-0.2)		0	0	0	0	0	0	0	0	0	0
C14	0.0-0.2	26/06/00	Soil	TP38(0.0-0.2)	TP39(0.0-0.2)	TP40(0.0-0.2)		0	0	0	0	0	0	0	0		
TP1	0.0-0.2	26/06/00	Soil				0										
TP4	0.0-0.2	26/06/00	Soil				0										
TP9	0.0-0.2	26/06/00	Soil	From Composite C5			0			0							
TP10	1.0-1.2	26/06/00	Soil				0	0	0	0	0	0	0	0	0	0	0
TP11	0.0-0.2	26/06/00	Soil				0	0	0	0	0	0	0	0	0	0	0
TP11	0.4-0.6	26/06/00	Soil														
TP13	0.0-0.2	26/06/00	Soil				0										
TP15	0.0-0.2	26/06/00	Soil	From Composite C9				0		0							
TP16	0.0-0.2	26/06/00	Soil				0	0	0	0	0	0	0	0	0	0	0
TP17	1.0-1.2	26/06/00	Soil	From Composite C5			0			0							
TP18	0.0-0.2	26/06/00	Soil	From Composite C9				0		0							
TP19	0.0-0.2	26/06/00	Soil	From Composite C9			0	0		0							
TP20	0.0-0.2	26/06/00	Soil	From Composite C8						0							
TP21	0.0-0.2	26/06/00	Soil	From Composite C8						0							
TP22	0.0-0.2	26/06/00	Soil	From Composite C8						0							
TP23	0.0-0.2	26/06/00	Soil	From Composite C7						0							
TP24	0.0-0.2	26/06/00	Soil	From Composite C7			0			0							
TP25	0.0-0.2	26/06/00	Soil	From Composite C7						0							
TP26	0.0-0.2	26/06/00	Soil	From Composite C10						0							
TP27	0.0-0.2	26/06/00	Soil	From Composite C10						0							
TP28	0.0-0.2	26/06/00	Soil	From Composite C10						0							
TP29	0.0-0.2	26/06/00	Soil	From Composite C11			0			0							
TP30	0.0-0.2	26/06/00	Soil	From Composite C11						0							
TP31	0.0-0.2	26/06/00	Soil	From Composite C11						0							
TP32	0.0-0.2	26/06/00	Soil				0	0	0	0	0	0	0	0	0	0	0
TP33	1.0-1.2	26/06/00	Soil	From Composite C5						0							
TP34	0.0-0.2	26/06/00	Soil				0										
TP38	0.0-0.2	26/06/00	Soil	From Composite C14			0	0		0							
TP39	0.0-0.2	26/06/00	Soil	From Composite C14				0		0							
TP40	0.0-0.2	26/06/00	Soil	From Composite C14				0		0							
Duplicate A1			Soil					0	0	0	0	0	0	0	0	0	0
Duplicate A2			Soil														
Duplicate B1			Soil														

TABLE 2
Analytical Program and Compositing Schedule

GeoEnviro Consultancy

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By:SL Date: 17/07/00
checked by___ Date: 17/7/00

Jc00010a
17/07/00

Sample	Depths	pH	Copper	Lead	Zinc	Cadmium	Chromium	Nickel	Arsenic	Mercury
C1	0.0-0.2		10	21	36	<0.5	6	4.5	4	0.025
C2	0.0-0.2		12	26	58	<0.5	6.5	2.5	4.5	0.04
C3	0.0-0.2		11	28	61	<0.5	8	2	4.5	0.06
C4	0.0-0.2		9	40	41	<0.5	7	2.5	5	0.04
C5	1.0-1.2		13	62	***165***	<0.5	10	3	5.5	0.03
C6	0.0-0.2		11	19	35	<0.5	4	1.5	4.5	0.02
C7	0.0-0.2		20	46	***145***	<0.5	8	2.5	6	0.02
C8	0.0-0.2		19	55	***425***	<0.5	9	3	7	0.065
C9	0.0-0.2		***21***	52	***115***	<0.5	16	4	4.5	0.08
C10	0.0-0.2		15	17	***100***	<0.5	7.5	3	5.5	0.03
C11	0.0-0.2		17	27	***110***	<0.5	11	3.5	6	0.06
C12	0.0-0.2		10	20	40	<0.5	5	3	3.5	0.015
C13	0.0-0.2		16	33	53	<0.5	5	3.5	4	0.02
C14	0.0-0.2		25	55	***200***	<0.5	7	2.5	4	0.035
Modified ANZECC/NHMRC or Dutch Level B Criteria			**20**	**100**	**67**	**1**	**17**	**20**	**7**	**0.33**
Modified Proposed NSW EPA Phytotoxicity Criteria			**33.3**	**300**	**67**	**1**	**133/0.33***	**20**	**7**	**0.33**
Modified NEHF Guidelines 'A'			**333**	**100**	**2333**	**7**	**33**	**200**	**33**	**5**

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics exceed the ANZECC/NHMRC Level B criteria or modified criteria

3) Figures in bold italics that have been underlined exceed the Phytotoxicity Criteria or the modified Criteria

4) Figures in bold italics that have been underlined and shaded exceed the NEHF 'A' Criteria or the modified Criteria

4) * 400mg/kg for Chromium (III) and 1mg/kg for Chromium (VI)

GeoEnviro Consultancy

TABLE 3

Summary of Analytical Results - pH & Heavy Metals (Composite Samples)

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared By: SL Date: 17/07/00
Checked By: JL Date: 17/7/00

Sample	Depths	pH	Copper	Lead	Zinc	Cadmium	Chromium	Nickel	Arsenic	Mercury
TP1	0.0-0.2	4.9								
TP4	0.0-0.2	5.8								
TP9	0.0-0.2	6.1								
TP10	1.0-1.2				***230***					
TP11	0.0-0.2	6.1	14	30	81	<0.5	11	3	3	0.03
TP11	0.4-0.6	6.3	1.5	1	10	<0.5	2	1.5	3	0.01
TP13	0.0-0.2	6								
TP15	0.0-0.2		17		85					
TP16	0.0-0.2	6.2	19	41	85	<0.5	18	3	4	0.035
TP17	1.0-1.2	6.3			33					
TP18	0.0-0.2		26		110					
TP19	0.0-0.2	6.3	27		135					
TP20	0.0-0.2				105					
TP21	0.0-0.2				***970***					
TP22	0.0-0.2				180					
TP23	0.0-0.2				***370***					
TP24	0.0-0.2	5.4			26					
TP25	0.0-0.2				63					
TP26	0.0-0.2				52					
TP27	0.0-0.2				140					
TP28	0.0-0.2				130					
TP29	0.0-0.2	6.3			180					
TP30	0.0-0.2				93					
TP31	0.0-0.2				84					
TP32	0.0-0.2	6.7	17	34	135	<0.5	10	2.5	5	0.045
TP33	1.0-1.2				***250***					
TP34	0.0-0.2	5.9								
TP38	0.0-0.2	5.8	21		78					
TP39	0.0-0.2		30		***360***					
TP40	0.0-0.2		26		150					
Duplicate A1			16	30	85	<0.5	10	2	3	0.025
Duplicate A2										
Duplicate B1			19	37	145	<0.5	12	3	5.5	0.05
ANZECC/NHMRC or Dutch Level B Criteria			**60**	**300**	**200**	**3**	**50**	**60**	**20**	**1**
Proposed NSW EPA Phytotoxicity Criteria			**100**	**600**	**200**	**3**	**400/1***	**60**	**20**	**1**
NEHF Guidelines 'A'			**1000**	**300**	**7000**	**20**	**100**	**600**	**100**	**15**

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics exceed the ANZECC/NHMRC Level B criteria or modified criteria

3) Figures in bold italics that have been underlined exceed the Phytotoxicity Criteria or the modified Criteria

4) Figures in bold italics that have been underlined and shaded exceed the NEHF 'A' Criteria or the modified Criteria

4) * 400mg/kg for Chromium (III) and 1mg/kg for Chromium (VI)

GeoEnviro Consultancy

TABLE 4

Summary of Analytical Results - pH & Heavy Metals (Individual Samples

Australand Holdings Limited

Preliminary Contamination & Geotechnical Assessment

Lot 1 DP 505480, Lot 885 DP 821608 and Lot 1 DP 224098 Warrimoo Avenue, St Ives

Prepared By: SL Date: 17/07/00
Checked By: SL Date: 17/7/00

Composite Samples

Sample	Depths	HCB	alpha-BHC	beta-BHC	gamma-BHC(Lindane)	delta-BHC	Heptachlor	Aldrin	Dieldrin	Endrin	Oxychlordane	Heptachlor Epoxide	alpha-Endosulfan	trans-Chlordane	cis-Chlordane	trans-Nonachlor	p,p'-DDE	o,p'-DDE	o,p'-DDD	p,p'-DDD	p,p'-DDT	o,p'-DDT	beta-Endosulfan	Endrin Aldehyde	Endosulfan Sulphate	Endrin Ketone	Methoxychlor	Total OCP
C2	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C4	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C6	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C8	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C11	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C13	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
C14	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
Modified ANZECC/NHMRC or Dutch Level B Criteria		0.16			0.16		0.16	0.16	0.06	0.16		0.16					0.16	0.16										0.33
Modified NEHF Guidelines 'A'							3.33	3.33											66.67									

Individual Samples

Sample	Depths	HCB	alpha-BHC	beta-BHC	gamma-BHC(Lindane)	delta-BHC	Heptachlor	Aldrin	Dieldrin	Endrin	Oxychlordane	Heptachlor Epoxide	alpha-Endosulfan	trans-Chlordane	cis-Chlordane	trans-Nonachlor	p,p'-DDE	o,p'-DDE	o,p'-DDD	p,p'-DDD	p,p'-DDT	o,p'-DDT	beta-Endosulfan	Endrin Aldehyde	Endosulfan Sulphate	Endrin Ketone	Methoxychlor	Total OCP
TP11	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
TP11	0.4-0.6	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
TP16	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
TP32	0.0-0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
Duplicate A2		<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-
ANZECC/NHMRC or Dutch Level B Criteria		0.50			0.50		0.50	0.50	0.2	0.5		0.50					0.5	0.5										1
NEHF Guidelines 'A'							10		10										200									

Notes

1) All results are expressed as mg/kg and pH (units).

2) Figures in bold italics exceed the ANZECC/NHMRC Level B criteria

3) Figures in bold italics that have been underlined exceed the NEHF Guidelines

GeoEnviro Consultancy

TABLE 5

Summary of Analytical Results - OCP

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared by: SL Date: 17/07/00
Checked: R Date: 17/7/00

Composite Samples

Sample	Depths	Chlorpyrifos	Fenitrothion	Bromofos Ethyl	Ethion	Total OPP
C2	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C4	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C6	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C8	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C11	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C13	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
C14	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND

Individual Samples

Sample	Depths	Chlorpyrifos	Fenitrothion	Bromofos Ethyl	Ethion	Total OPP
TP11	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
TP11	0.4-0.6	<0.10	<0.10	<0.10	<0.10	ND
TP16	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
TP32	0.0-0.2	<0.10	<0.10	<0.10	<0.10	ND
Duplicate A2		<0.10	<0.10	<0.10	<0.10	ND

GeoEnviro Consultancy

Table 6: Summary of Analytical Results - OPP

Australand Holdings Limited
Preliminary Contamination & Geotechnical Assessment
Sector 8, Macpherson Street, Warriewood

Prepared by : SL Date: 17/07/00
Checked by: JL Date: 17/7/00

Sample	Depths	Metals								OCP	OPP
		Copper	Lead	Zinc	Cadmium	Chromium	Nickel	Arsenic	Mercury		
TP11	0.0-0.2	14	30	81	<0.5	11	3	3	0.03	-	-
Duplicate A1		16	30	85	<0.5	10	2	3	0.025	-	-
Relative Percentage Difference (RPD)		13.3	0.0	4.8	NA	9.5	40.0	0.0	18.2	-	-
TP20	0.0-0.2	17	34	135	<0.5	10	2.5	5	0.045	-	-
Duplicate B1		19	37	145	<0.5	12	3	5.5	0.05	-	-
Relative Percentage Difference (RPD)		11.1	8.5	7.1	NA	18.2	18.2	9.5	10.5	-	-
TP11	0.0-0.2	-	-	-	-	-	-	-	-	ND	ND
Duplicate A2		-	-	-	-	-	-	-	-	ND	ND
Relative Percentage Difference (RPD)		-	-	-	-	-	-	-	-	NA	NA

Notes

1) All results are expressed as mg/kg .

2) ND - Not Detected

3)NA - Not Applicable

GeoEnviro Consultancy

TABLE 7

Summary of Analytical Results - Quality Assurance

Australand Holdings Limited

Preliminary Contamination & Geotechnical Assessment

Sector 8, Macpherson Street, Warriewood

Prepared by : SL Date: 17/07/00
Checked: .....Date: 17/7/00

APPENDIX A

NSW Land Information System Certificates

NetBroker Online Information System

NSW Central Register of Restrictions

Date	*21 Jun 2000*
Our Reference	*1262770*
Receipt Number	*E35876*
Your Reference	*200638*

Parcel Reference	*A/328260*	*Local Govt. Area*	*PITTWATER*
Parish	*NARRABEEN*	*County*	*CUMBERLAND*
Proprietors	*NIKOLA FABRIO*		

THE FOLLOWING AUTHORITIES HAVE NO INTEREST RECORDED IN THE ABOVE PROPERTY.

Environment Protection Agency *($10.00) GST Exempt*

The Environment Protection Authority currently has no statutory notices issued under the provisions of the Unhealthy Building Land Act.

THE FOLLOWING AUTHORITIES HAVE A POSSIBLE OR ACTUAL INTEREST IN THE ABOVE PROPERTY.
EACH OF THESE SHOULD BE APPROACHED FOR A DIRECT RESPONSE.

RECEIVED
BY JR DATE 24/6

NetBroker Online Information System

NSW Central Register of Restrictions

Date	*21 Jun 2000*
Our Reference	*1262755*
Receipt Number	*E35875*
Your Reference	*200638*

Parcel Reference	*2/18303*	*Local Govt. Area*	*PITTWATER*
Parish	*NARRABEEN*	*County*	*CUMBERLAND*
Proprietors	*ILIA LAKAEV* *GLORIA LAKAEV* *AS JOINT TENANTS*		

THE FOLLOWING AUTHORITIES HAVE NO INTEREST RECORDED IN THE ABOVE PROPERTY.

Environment Protection Agency *($10.00) GST Exempt*

The Environment Protection Authority currently has no statutory notices issued under the provisions of the Unhealthy Building Land Act.

THE FOLLOWING AUTHORITIES HAVE A POSSIBLE OR ACTUAL INTEREST IN THE ABOVE PROPERTY.
EACH OF THESE SHOULD BE APPROACHED FOR A DIRECT RESPONSE.

NetBroker Online Information System

NSW Central Register of Restrictions

Date	*21 Jun 2000*
Our Reference	*1262780*
Receipt Number	*E35877*
Your Reference	*200638*

Parcel Reference	*B/328260*	*Local Govt. Area*	*PITTWATER*
Parish	*NARRABEEN*	*County*	*CUMBERLAND*
Proprietors	*NIKOLA GRBIC* *MIOLKA GRBIC* *AS JOINT TENANTS*		

THE FOLLOWING AUTHORITIES HAVE NO INTEREST RECORDED IN THE ABOVE PROPERTY.

Environment Protection Agency *($10.00) GST Exempt*

The Environment Protection Authority currently has no statutory notices issued under the provisions of the Unhealthy Building Land Act.

THE FOLLOWING AUTHORITIES HAVE A POSSIBLE OR ACTUAL INTEREST IN THE ABOVE PROPERTY.
EACH OF THESE SHOULD BE APPROACHED FOR A DIRECT RESPONSE.

NetBroker Online Information System

NSW Central Register of Restrictions

Date	*21 Jun 2000*
Our Reference	*1262793*
Receipt Number	*E35878*
Your Reference	*200638*

Parcel Reference	*C/328260*	*Local Govt. Area*	*PITTWATER*
Parish	*NARRABEEN*	*County*	*CUMBERLAND*
Proprietors	*NICHOLAS ROGLEY*		

THE FOLLOWING AUTHORITIES HAVE NO INTEREST RECORDED IN THE ABOVE PROPERTY.

Environment Protection Agency *($10.00) GST Exempt*

The Environment Protection Authority currently has no statutory notices issued under the provisions of the Unhealthy Building Land Act.

THE FOLLOWING AUTHORITIES HAVE A POSSIBLE OR ACTUAL INTEREST IN THE ABOVE PROPERTY.
EACH OF THESE SHOULD BE APPROACHED FOR A DIRECT RESPONSE.

APPENDIX B

Sampling Procedures and PID Headspace Screening

SOIL SAMPLING

Soil samples recovered from the testpits were collected directly from the backhoe bucket. Immediately after collection, samples were placed in new jars and stored in cooled conditions while in the field and in transit to the laboratory.

Samples were collected in duplicate at all intervals of depth. The primary sample was retained for selection of samples for laboratory analysis whilst the duplicate samples were used for PID screening for volatile compounds. The instrument used was MiniRae fitted with a 10.6 eV lamp supplied by Envirorent Pty Ltd. The instrument was calibrated by Envirorent Pty Ltd prior to use.

HEADSPACE SCREENING USING THE PHOTOIONISATION DETECTOR (PID)

GENERAL PRINCIPLES

The photoionisation detector (PID) is used to detect the presence of volatile compounds especially hydrocarbons and chlorinated solvents which are commonly encountered as contaminants.

Although the PID is useful in detecting 'hot spots' and provides qualitative information on the potential for contamination with volatile compounds, the technique has the following limitations:

- The PID works on the principle of ionisation of a compound using an ultraviolet lamp. It is important for the lamp to have an energy higher than the ionisation potential of the compound to be detected. The ionisation potential of a compound is the minimum energy that the compound needs to be ionised. Hence if the PID is fitted with a lamp with an energy of 10.6 eV, it will ionise compounds with ionisation potentials less than this value. Therefore it is important to have some prior indication of the contaminants of concern on the site to interpret the PID readings.

- The PID will respond cumulatively to several compounds simultaneously which means that the reading is the additive concentrations of all the compounds present. Hence even if the PID reading is relatively high, the concentrations of the several individual compounds which have contributed to the reading may be relatively low.

- Each compound will have what is termed a 'response factor' which is the response obtained per mole of the compound being detected. Depending upon the degree of ionisation, the number of ions produced and hence the response of the PID will vary for different compounds. The PID used on this site was calibrated with isobutylene at 92 ppm.

- The geology of the soil is and important factor in the process of partitioning the contaminant between the soil matrix and the headspace. For example the concentration of a contaminant in the headspace will be much higher in a sample of contaminated sand from which the contaminant is easily released compared with the concentration of the contaminant in a clay to which the contaminant may be more strongly adsorbed.

- The method of screening varies and there is currently no standard established. The method used for the present assessment is presented below and has been found to provide results that are appropriate for the information required from screening.

INSTRUMENT AND METHODOLOGY

The PID instrument used was a HNU DL 101-4 fitted with a 10.6 eV lamp. Prior to use the instrument was calibrated by Envirorent Pty Ltd

The soil sample was collected in a 250 ml glass jar to half its capacity. The jar was immediately covered with aluminium foil and capped. The jar was then shaken and was allowed to stand for at least 15 minutes. The lid of the jar was unscrewed and the inlet of the PID nose tube introduced through a small hole made in the aluminium foil. The maximum reading on the display was then recorded.

APPENDIX C
Environmental - Laboratory Certificates

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:

GEOENVIRO CONSULTANCY PTY LTD

PO BOX 1543
MACQUARIE CENTRE 2113

ATTN: SOLERN LIEW

JOB NO: SAL8972

CLIENT ORDER: JC00010A

DATE RECEIVED: 28/06/00

DATE COMPLETED: 04/07/00

TYPE OF SAMPLES: SOILS

NO OF SAMPLES: 46

NATA Endorsed Test Report
This document may not be reproduced except in full.

.....
Issued on 08/07/00
Lance Smith
(Chief Chemist)

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL8972
CLIENT ORDER: JC00010A

	SAMPLES	pH 1:5	Cu mg/kg	Pb mg/kg	Zn mg/kg	Cd mg/kg
1	C1/0-0.2		10	21	36	<0.5
2	C2/0-0.2		12	26	58	<0.5
3	C3/0-0.2		11	28	61	<0.5
4	C4/0-0.2		9.0	40	41	<0.5
5	C5/1.0-1.2		13	62	165	<0.5
6	C6/0-0.2		11	19	35	<0.5
7	C7/0-0.2		20	46	145	<0.5
8	C8/0-0.2		19	55	425	<0.5
9	C9/0-0.2		21	52	115	<0.5
10	C10/0-0.2		15	17	100	<0.5
11	C11/0-0.2		17	27	110	<0.5
12	C12/0-0.2		10	20	40	<0.5
13	C13/0-0.2		16	33	53	<0.5
14	C14/0-0.2		25	55	200	<0.5
15	TP1/0-0.2	4.9				
16	TP4/0-0.2	5.8				
17	TP9/0-0.2	6.1				
18	TP11/0-0.2	6.1	14	30	81	<0.5
19	TP11/0.4-0.6	6.3	1.5	1.0	10	<0.5
20	TP13/0-0.2	6.0				
21	TP16/0-0.2	6.2	19	41	85	<0.5
22	TP17/1.0-1.2	6.3			33	
23	TP19/0-0.2	6.3	27		135	
24	TP24/0-0.2	5.4			26	
25	TP29/0-0.2	6.3			180	
26	TP32/0-0.2	6.7	17	34	135	<0.5
27	TP34/0-0.2	5.9				
28	TP38/0-0.2	5.8	21		78	
29	DUPLICATE A1		16	30	85	<0.5
30	DUPLICATE B1		19	37	145	<0.5
31	TP10/1.0-1.2				230	
32	TP33/1.0-1.2				250	
33	TP23/0-0.2				370	
34	TP25/0-0.2				63	
35	TP20/0-0.2				105	
36	TP21/0-0.2				970	
37	TP22/0-0.2				180	
38	TP15/0-0.2		17		85	
39	TP18/0-0.2		26		110	
40	TP26/0-0.2				52	
	MDL	0.1	0.5	0.5	0.5	0.5
	Method Code	WA1	M1	M1	M1	M1
	Preparation	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL8972
CLIENT ORDER: JC00010A

SAMPLES	pH 1:5	Cu mg/kg	Pb mg/kg	Zn mg/kg	Cd mg/kg
41 TP27/0-0.2				140	
42 TP28/0-0.2				130	
43 TP39/0-0.2		30		360	
44 TP40/0-0.2		26		150	
45 TP30/0-0.2				93	
46 TP31/0-0.2				84	
DUPLICATES:					
21 TP16/0-0.2	6.2	20	42	90	<0.5
40 TP26/0-0.2				55	
BCSS-1/1		18	22	130	<0.5
BCSS-1/2		18		125	
MDL	0.1	0.5	0.5	0.5	0.5
Method Code	WA1	M1	M1	M1	M1
Preparation	P3	P3	P3	P3	P3

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL8972
CLIENT ORDER: JC00010A

	SAMPLES	Cr mg/kg	Ni mg/kg	As mg/kg	Hg mg/kg
1	C1/0-0.2	6.0	4.5	4.0	0.025
2	C2/0-0.2	6.5	2.5	4.5	0.040
3	C3/0-0.2	8.0	2.0	4.5	0.060
4	C4/0-0.2	7.0	2.5	5.0	0.040
5	C5/1.0-1.2	10	3.0	5.5	0.030
6	C6/0-0.2	4.0	1.5	4.5	0.020
7	C7/0-0.2	8.0	2.5	6.0	0.020
8	C8/0-0.2	9.0	3.0	7.0	0.065
9	C9/0-0.2	16	4.0	4.5	0.080
10	C10/0-0.2	7.5	3.0	5.5	0.030
11	C11/0-0.2	11	3.5	6.0	0.060
12	C12/0-0.2	5.0	3.0	3.5	0.015
13	C13/0-0.2	5.0	3.5	4.0	0.020
14	C14/0-0.2	7.0	2.5	4.0	0.035
18	TP11/0-0.2	11	3.0	3.0	0.030
19	TP11/0.4-0.6	2.0	1.5	3.0	0.010
21	TP16/0-0.2	18	3.0	4.0	0.035
26	TP32/0-0.2	10	2.5	5.0	0.045
29	DUPLICATE A1	10	2.0	3.0	0.025
30	DUPLICATE B1	12	3.0	5.5	0.050
DUPLICATES:					
21	TP16/0-0.2	20	4.0	4.5	0.045
	BCSS-1/1	90	52	12	0.13
MDL		0.5	0.5	0.5	0.005
Method Code		M1	M1	M7	M3
Preparation		P3	P3	P3	P1

RESULTS ON DRY BASIS

LABORATORY DUPLICATE REPORT

JOB NO: SAL8972
CLIENT ORDER: JC00010A

Sample Number	Analyte	Units	MDL	Sample Result	Duplicate Result	%RPD
TP16/0-0.2	pH		0.1	6.2	6.2	0
TP16/0-0.2	Copper	mg/kg	0.5	19	20	5
TP16/0-0.2	Lead	mg/kg	0.5	41	42	2
TP16/0-0.2	Zinc	mg/kg	0.5	85	90	6
TP26/0-0.2	Zinc	mg/kg	0.5	52	55	6
TP16/0-0.2	Cadmium	mg/kg	0.5	<0.5	<0.5	0
TP16/0-0.2	Chromium	mg/kg	0.5	18	20	11
TP16/0-0.2	Nickel	mg/kg	0.5	3.0	4.0	29
TP16/0-0.2	Arsenic	mg/kg	0.5	4.0	4.5	12
TP16/0-0.2	Mercury	mg/kg	0.005	0.035	0.045	25

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

CERTIFIED REFERENCE MATERIAL

JOB NO: SAL8972
CLIENT ORDER: JC00010A

CRM Number	Analyte	Units	CRM Result	Certified Value	%Recovery	Acceptance Criteria %
BCSS-1/1	Copper	mg/kg	18	18.5	97	90-115
BCSS-1/2	Copper	mg/kg	18	18.5	97	90-115
BCSS-1/1	Lead	mg/kg	22	22.7	97	90-110
BCSS-1/1	Zinc	mg/kg	130	119	109	90-110
BCSS-1/2	Zinc	mg/kg	125	119	105	90-110
BCSS-1/1	Cadmium	mg/kg	<0.5	0.25	-	-
BCSS-1/1	Chromium	mg/kg	90	123	73	60-80
BCSS-1/1	Nickel	mg/kg	52	55.3	94	90-110
BCSS-1/1	Arsenic	mg/kg	12	11.1	108	90-120
BCSS-1/1	Mercury	mg/kg	0.13	0.129	101	85-110

All results are within the acceptance criteria

Note: The hot acid digest does not always determine 'total' metals. Refractory elements such as Iron and Aluminium and some base metals (particularly Chromium) show lower recoveries depending on their form within the sample matrix. Silicates and oxides are normally less soluble than elements in metallic or salt forms. The acceptance criteria for this reference material is based on histories of analyte recoveries using the nitric acid based digestion procedures.

SYDNEY ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB NO: SAL8972
CLIENT ORDER: JC00010A

METHODS OF PREPARATION AND ANALYSIS

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

P3	Sample dried, jaw crushed and sieved at 2mm
P1	Analysis performed on sample as received
WA1	pH - 1:5 soil/water extract Determined by APHA 4500HB
M1	Base Metal - Digestion Method 3050 (HNO_3/H_2O_2) Element determined by APHA 3111B (Flame AAS)
M7	Hydride Element - Digestion Method 7061 (HNO_3/H_2SO_4) Element determined by APHA 3114B (Hydride Generation AAS)
M3	Mercury - Digestion Method 7471 (HNO_3/HCl) Determined by APHA 3112B (Cold Vapour AAS)

A preliminary report was faxed on 04/07/00

SAL 8972

GEOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC00010A
Client:
Project:
Location SECTOR 8 WARRIEWOOD

Sample Date: 26/6/00
Sampled By: SC
Project Manager: SC
Store Location:

External Laboratory Details:
Laboratory name: SAL
Address:
Contact LANCE

Sampling Details			Sample Type		Test Required (\) / Test Performed(X)																											
Location	Depth (m)		Soil	Water	GC/MS Scan (TPH, PAH, Phenolics)	Metals (As Cd Cr Cu Pb Zn Ni Hg	Metals Sb Be Co Mn Se Sn	pH	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide																	Keep Sample
	From	To																														
C1	0	0.2	DG			\																										
C2	0	0.2	"			\																										
C3	0	0.2	"			\																										
C4	0	0.2	"			\																										
C5	1.0	1.2	"			\																										
C6	0	0.2	"			\																										
C7	0	0.2	"			\																										
C8	0	0.2	"			\																										
C9	0	0.2	"			\																										
C10	0	0.2	"			\																										
C11	0	0.2	"			\																										
C12	0	0.2	"			\																										
C13	0	0.2	"			\																										
C14	0	0.2	"			\																										

Relinquished by				Received By			
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
GEOENVIRO CONSULTANCY	SOLEKN		27/6/00	SAL	P. MAGRA		28/6/00

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample
U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle
Y keep Sample
N discard sample

GEOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC00010A
Client:
Project:
Location SECTOR 8 WARRIEWOOD

Sample Date: 26/6/00
Sampled By: SC
Project Manager: SC
Store Location:

External Laboratory Details:
Laboratory name: SAL
Address:
Contact LANCE

Sampling Details			Sample Type		Test Required (\) / Test Performed(X)																												
Location	Depth (m)		Soil	Water	GCMS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg	Metals Sb Be Co Mn Se Sn	pH	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide																			Keep Sample
	From	To																															
TP 1	0	0.2	DG					/																									
TP 4	0	0.2	"				-	/																									
TP 9	0	0.2	"					/																									
TP 11	0	0.2	"			/		/																									
TP 11	0.4	0.6	"			/		/																									
TP 13	0	0.2	"					/																									
TP 16	0	0.2	"			/		/																									
TP 17	1.0	1.2	"					/																									
TP 19	0	0.2	"					/																									
TP 24	0	0.2	"					/																									
TP 29	0	0.2	"					/																									
TP 32	0	0.2	"			/		/																									
TP 34	0	0.2	"			/		/																									
TP 38	0	0.2	"			/		/																									
DUPLICATE A1						/																											
DUPLICATE B1						/																											

Relinquished by				Received By			
Laboratory	Name	Signature	Date	Laboratory	Name	Signature	Date
GEOENVIRO CONSULTANCY	SOLEEN		27/11/00	SAL	P. MAGRO	P. Magro	28/6/00

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample

U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle

Y keep Sample
N discard sample

1/2

GSOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC00010A
Client:
Project:
Location: SECTOR 8 WARRIEWOOD

Sample Date: 26/6/00
Sampled By: SL
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: SAL 8972
Address:
Contact: LANCE

Test Required (✓) / Test Performed (X)

	Location	Depth (m) From	Depth (m) To	Soil	Water	GC/MS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg)	Metals Sb Be Co Mn Se Sn	pH	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide	Cu Zn	Keep Sample
C5	TP10	1.0	1.2														/	
	TP17	1.0	1.2														/	
	TP33	1.0	1.2														/	
C7	TP23	0	0.2														/	
	TP24	0	0.2														/	
	TP25	0	0.2														/	
C8	TP20	0	0.2														/	
	TP21	0	0.2														/	
	TP22	0	0.2														/	
C9	TP15	0	0.2													/	/	
	TP18	0	0.2													/	/	
	TP19	0	0.2													/	/	
C10	TP26	0	0.2													/	/	
	TP27	0	0.2														/	
	TP28	0	0.2														/	

Relinquished by: Laboratory	Name	Signature	Date	Received By: Laboratory	Name	Signature	Date
Relinquished	on 27/6/00			SAL	P. MAGRO	P. Magro	6/7/00

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample
U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle
Y keep Sample
N discard sample

c:\lab\worksheet\w019-1

Form No. W019-1/Ver02/06/99

2/2

GEOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC00010A
Client:
Project:
Location: SECTOR 3 WARRIEWOOD

Sample Date: 26/6/00
Sampled By: SK
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: SAL 8972
Address:
Contact: LANCE

Test Required (✓) / Test Performed (X)

	Location	Depth (m) From	To	Sample Type Soil	Water	GC/MS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg)	Metals Sb Be Co Mn Se Sn	pH	TPH	BTEX	PAH	OCP	PCB	Halogenated Volatile Organics	Cyanide	Cu	Zn	Keep Sample
C14	TP38	0	0.2	DG													/	/	
	TP39	0	0.2	"													/	/	
	TP40	0	0.2	"													/	/	
C11	TP29	0	0.2	"													/	/	
	TP30	0	0.2	"													/	/	
	TP31	0	0.2	"													/	/	

Relinquished by Laboratory	Name	Date	Signature
[illegible]	CA	27/6/00	

Received By Laboratory	Name	Signature	Date
SAL	P. MAGNO	P. Magno	6/7/00

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample

U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle

Y keep Sample
N discard sample

c:\Lab\worksheet\w019-1

Australian
Environmental
Laboratories

RECEIVED
BY [illegible] DATE 12/7/00

7 July 2000

Geo Enviro Consultancy
PO Box 1543
Macquarie Centre
NORTH RYDE
NSW 2113

Your Reference: JC00010A Warriewood
Report Number: 13941

Attention: Solern Liew

Dear Solern
The following samples were received from you on the date indicated.

Samples: Qty.	12 Soils
Date of Registration	29/06/00
Date of Receipt of Samples:	29/06/00
Date of Receipt of Instructions:	29/06/00
Date Preliminary Report Faxed:	7/07/00

These samples were analysed in accordance with your written instructions.
A copy of the instructions is attached with the analytical report.

The results and associated quality control are contained in the following pages of this report. Unless otherwise stated, solid samples are expressed on a dry weight basis (moisture has been supplied for your information only), air and liquid samples as received.

Should you have any queries regarding this report please contact the undersigned.

Yours faithfully
AUSTRALIAN ENVIRONMENTAL LABORATORIES

Tania Notaras
Laboratory Manager

Yvonne Dickson
Operations Manager

(Analabs Pty. Ltd.) ACN 004 591 664
Botany Industrial Park, Gate 3, Denison St. Matraville NSW 2036
P.O. Box 256, Matraville NSW 2036
Telephone: (61 2) 9666 1426 Facsimile: (61 2) 9666 1364

OC Pesticides in Soil Our Reference: Your Reference Depth	UNITS ---------- ----------	13941-1 C2 0-0.2	13941-2 C4 0-0.2	13941-3 C6 0-0.2	13941-4 C8 0-0.2	13941-5 C11 0-0.2	13941-6 C13 0-0.2	13941-7 C14 0-0.2	13941-8 TP11 0-0.2	13941-9 TP11 0.4-0.6	13941-10 TP16 0-0.2
HCB	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
alpha-BHC	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
gamma-BHC(Lindane)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Heptachlor	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Aldrin	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
beta-BHC	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Oxychlordane	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
delta-BHC	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Heptachlor Epoxide	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
o,p'-DDE	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
alpha-Endosulfan	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
trans-Chlordane	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
cis-Chlordane	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
trans-Nonachlor	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
p,p'-DDE	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Dieldrin	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endrin	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
o,p'-DDD	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
o,p'-DDT	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
beta-Endosulfan	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
p,p'-DDD	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
p,p'-DDT	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endosulfan Sulphate	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endrin Aldehyde	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Methoxychlor	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Endrin Ketone	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	98	95	97	95	97	99	89	93	93	94

OC Pesticides in Soil Our Reference: Your Reference Depth	UNITS ---------- ----------	13941-11 TP32 0-0.2	13941-12 Duplicate A2 -
HCB	mg/kg	<0.10	<0.10
alpha-BHC	mg/kg	<0.10	<0.10
gamma-BHC(Lindane)	mg/kg	<0.10	<0.10
Heptachlor	mg/kg	<0.10	<0.10
Aldrin	mg/kg	<0.10	<0.10
beta-BHC	mg/kg	<0.10	<0.10
Oxychlordane	mg/kg	<0.10	<0.10
delta-BHC	mg/kg	<0.10	<0.10
Heptachlor Epoxide	mg/kg	<0.10	<0.10
o,p'-DDE	mg/kg	<0.10	<0.10
alpha-Endosulfan	mg/kg	<0.10	<0.10
trans-Chlordane	mg/kg	<0.10	<0.10
cis-Chlordane	mg/kg	<0.10	<0.10
trans-Nonachlor	mg/kg	<0.10	<0.10
p,p'-DDE	mg/kg	<0.10	<0.10
Dieldrin	mg/kg	<0.10	<0.10
Endrin	mg/kg	<0.10	<0.10
o,p'-DDD	mg/kg	<0.10	<0.10
o,p'-DDT	mg/kg	<0.10	<0.10
beta-Endosulfan	mg/kg	<0.10	<0.10
p,p'-DDD	mg/kg	<0.10	<0.10
p,p'-DDT	mg/kg	<0.10	<0.10
Endosulfan Sulphate	mg/kg	<0.10	<0.10
Endrin Aldehyde	mg/kg	<0.10	<0.10
Methoxychlor	mg/kg	<0.10	<0.10
Endrin Ketone	mg/kg	<0.10	<0.10
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	100	108

OP Pesticides in Soil Our Reference: Your Reference Depth	UNITS --- ---	13941-1 C2 0-0.2	13941-2 C4 0-0.2	13941-3 C6 0-0.2	13941-4 C8 0-0.2	13941-5 C11 0-0.2	13941-6 C13 0-0.2	13941-7 C14 0-0.2	13941-8 TP11 0-0.2	13941-9 TP11 0.4-0.6	13941-10 TP16 0-0.2
Chlorpyrifos	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Fenitrothion	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Bromofos Ethyl	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Ethion	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	98	95	97	95	97	99	89	93	93	94

OP Pesticides in Soil Our Reference: Your Reference Depth	UNITS --- ---	13941-11 TP32 0-0.2	13941-12 Duplicate A2 -
Chlorpyrifos	mg/kg	<0.10	<0.10
Fenitrothion	mg/kg	<0.10	<0.10
Bromofos Ethyl	mg/kg	<0.10	<0.10
Ethion	mg/kg	<0.10	<0.10
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	100	108

Moisture Our Reference: Your Reference Depth	UNITS ---------- ----------	13941-1 C2 0-0.2	13941-2 C4 0-0.2	13941-3 C6 0-0.2	13941-4 C8 0-0.2	13941-5 C11 0-0.2	13941-6 C13 0-0.2	13941-7 C14 0-0.2	13941-8 TP11 0-0.2	13941-9 TP11 0.4-0.6	13941-10 TP16 0-0.2
Moisture	%	7.1	9.6	8.3	7.2	9.5	4.5	5.7	6.4	5.4	9.7

Moisture Our Reference: Your Reference Depth	UNITS ---------- ----------	13941-11 TP32 0-0.2	13941-12 Duplicate A2 -
Moisture	%	9.7	6.8

Method ID	Methodology Summary
SEO-005	OC/OP/PCB - Determination of a suite of Organchlorine Pesticides, Chlorinated Organo-phosphorus Pesticides and Polychlorinated Biphenyls (PCB's) by sonication extraction using dichloromethane for waters or acetone / hexane for soils followed by Gas Chroma
SEP-001	Air Dry - Cover air drying at 40 C, moisture content at 103 C - 105 C, wet slurrying, compositing and preparation of a 1:5 soil suspension.

PROJECT: JC00010A Warriewood **REPORT NO: 13941**

QUALITY CONTROL OC Pesticides in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base Sample:Duplicate	Spike Sm#	Matrix Spike Duplicate + RPD % Recovery
HCB	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
alpha-BHC	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
gamma-BHC(Lindane)	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Heptachlor	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	92 || 91 || RPD: 1
Aldrin	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	87 || 88 || RPD: 1
beta-BHC	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Oxychlordane	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
delta-BHC	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	86 || 87 || RPD: 1
Heptachlor Epoxide	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	89 || 90 || RPD: 1
o,p'-DDE	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
alpha-Endosulfan	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
trans-Chlordane	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
cis-Chlordane	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
trans-Nonachlor	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
p,p'-DDE	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Dieldrin	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	107 || 113 || RPD: 5
Endrin	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
o,p'-DDD	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
o,p'-DDT	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
beta-Endosulfan	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
p,p'-DDD	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
p,p'-DDT	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	108 || 105 || RPD: 3
Endosulfan Sulphate	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Endrin Aldehyde	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Methoxychlor	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Endrin Ketone	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	-	SEO-005	95	13941-2	95 || 90	13941-1	94 || 94 || RPD: 0

QUALITY CONTROL OP Pesticides in Soil	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate Base Sample:Duplicate	Spike Sm#	Matrix Spike Duplicate + RPD % Recovery
Chlorpyrifos	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	93 || 91 || RPD: 2
Fenitrothion	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Bromofos Ethyl	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
Ethion	mg/kg	0.1	SEO-005	<0.10	13941-2	<0.10 || <0.10	13941-1	Nil Spike
2,4,5,6-Tetrachloro-*m*-xylene *Surrogat*	% Recovery	-	SEO-005	95	13941-2	95 || 90	13941-1	94 || 94 || RPD: 0

QUALITY CONTROL Moisture	UNITS	PQL	METHOD	Blank
Moisture	%	0	SEP-001	0.00000

Result Codes

[INS]	:	Insufficient Sample for this test	[HBG]	:	Results not Reported due to High Background Interference
[NA]	:	Not Requested	*	:	Not part of NATA Registration
[NT]	:	Not tested			

Result Comments

Date Organics Extraction Commenced: 3/07/00

Quality Control Protocol

Reagent Blank: Sample free reagents carried through the preparation/extraction/digestion procedure and analysed at the beginning of every sample batch analysis. For larger projects, a reagent blank is prepared and analysed with every 20 samples.

Duplicate: A separate portion of a sample being analysed which is treated the same as the other samples in the batch. A duplicate is prepared at least every 20 samples.

Matrix Spike Duplicates: Sample replicates spiked with identical concentrations of target analyte(s). The spiking occurs during the sample preparation and prior to the extraction/digestion procedure. They are used to document the precision and bias of a method in a given sample matrix. Where there is not enough sample available to prepare a spiked sample, another known soil/sand or water (or Milli-Q water) may be used. A duplicate spiked sample is prepared at least every 20 samples.

Surrogate Spike: Added to all samples requiring analysis for organics (where relevant) prior to extraction. Used to determine the extraction efficiency. They are organic compounds which are similar to the target analyte(s) in chemical composition and behaviour in the analytical process, but which are not normally found in environmental samples.

Internal Standard: Added to all samples requiring analysis for organics (where relevant) after the extraction process; the compounds serve to give a standard of retention time and response, which is invariant from run-to-run with the instruments.

Control Standards: Prepared from a source independant of the calibration standards. At least one control standard is included in each run to confirm calibration validity.

Additional QC Samples: A calibration standard and blank are run after every 20 samples of an instrumental analysis run to assess analytical drift.

Statistical Analysis of QC Data: Quality control data is plotted on control charts using the APHA procedure with warning and control limits at 2 and 3 standard deviations respectively.

Certified Reference Materials: Certified Reference Materials and Standards are regularly placed in the system as blind samples. These materials/standards have certified reference values for various parameters.

GEOENVIRO CONSULTANCY Pty Ltd

Laboratory Test Request/Chain of Custody Record

Job Details:
Job Number: JC00010A
Client:
Project:
Location SECTOR 8 WARRIEWOOD

Sample Date: 26/6/00
Sampled By: SL
Project Manager: SL
Store Location:

External Laboratory Details:
Laboratory name: AEL
Address:
Contact TANYA

29600 NG 9 0 0 0

6/7/00 4D 13941

Location	Depth (m) From	To	Sample Type Soil	Water	GCMS Scan (TPH, PAH, Phenols)	Metals (As Cd Cr Cu Pb Zn Ni Hg)	Metals Sb Ba Co Mn Se Sn	pH	TPH	BTEX	PAH	OCP/OPP	PCB	Halogenated Volatile Organics	Cyanide	Keep Sample
13941																
1 C2	0	0.2	DG									/				
2 C4	0	0.2	"									/				
3 C6	0	0.2	"									/				
4 C8	0	0.2	"									/				
5 C11	0	0.2	"									/				
6 C13	0	0.2	"									/				
7 C14	0	0.2	"									/				
8 TP11	0	0.2	"									/				
9 TP11	0.4	0.6	"									/				
10 TP16	0	0.2	"									/				
11 TP32	0	0.2	"									/				
12 DUPLICATE A2			"									/				

Relinquished by Laboratory	Name	Signature	Date	Received By Laboratory	Name	Signature	Date
GeoEnviro Consultancy	SOLEN	[signature]	27/6/00	AEL	NICOLE	[signature]	29/6

Legend
DB Disturbed Sample (Bulk, Plastic bag)
DS Disturbed Sample (Small, Plastic bag)
DG Disturbed Sample (Glass Jar)
STP Standard Penetration Test Sample

U50 Undisturbed sample, 50mm tube
U75 Undisturbed sample, 75mm tube
WG Water sample, Amber glass jar
WP Water sample, Plastic bottle

Y keep Sample
N discard sample

c:\Lab\worksheet\w019-1

Form No. W019-1/Ver02/06/99

APPENDIX D
Geotechnical – Field Results

GeoEnviro Consultancy Pty Ltd

Dynamic Cone Penetration Test Report

Job No: JC00010A

Client:	Australand Holdings Ltd	Date:	14-07-00
Project:	Proposed Residential Subdivision	Tested By:	AF
Location:	Sector 8 , Macpherson Street, Warriewood	Checked By:	SL

Test Procedure: AS 1289 6.3.2

Test Data

Test No:1				Test No:2			
Test Location: TP 1 (See Drawing No 1)				Test Location: TP 5 (See Drawing No 1)			
RL: -				RL: -			
Soil Classification: Refer To Table 1				Soil Classification: Refer to Table 1			
Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0-0.1	-	3.0-3.1	12	0.0-0.1	-	3.0-3.1	7
0.1-0.2	2	3.1-3.2	9	0.1-0.2	1	3.1-3.2	8
0.2-0.3	1	3.2-3.3	10	0.2-0.3	2	3.2-3.3	15
0.3-0.4	5	3.3-3.4	12	0.3-0.4	2	3.3-3.4	15
0.4-0.5	9	3.4-3.5	12	0.4-0.5	2	3.4-3.5	12
0.5-0.6	13	3.5-3.6	12	0.5-0.6	9	3.5-3.6	8
0.6-0.7	6	3.6-3.7	Terminated	0.6-0.7	10	3.6-3.7	9
0.7-0.8	2	3.7-3.8		0.7-0.8	2	3.7-3.8	12
0.8-0.9	3	3.8-3.9		0.8-0.9	2	3.8-3.9	12
0.9-1.0	3	3.9-4.0		0.9-1.0	5	3.9-4.0	15
1.0-1.1	2	4.0-4.1		1.0-1.1	4	4.0-4.1	Terminated
1.1-1.2	4	4.1-4.2		1.1-1.2	2	4.1-4.2	
1.2-1.3	7	4.2-4.3		1.2-1.3	2	4.2-4.3	
1.3-1.4	14	4.3-4.4		1.3-1.4	2	4.3-4.4	
1.4-1.5	17	4.4-4.5		1.4-1.5	1	4.4-4.5	
1.5-1.6	10	4.5-4.6		1.5-1.6	1	4.5-4.6	
1.6-1.7	5	4.6-4.7		1.6-1.7	2	4.6-4.7	
1.7-1.8	5	4.7-4.8		1.7-1.8	4	4.7-4.8	
1.8-1.9	4	4.8-4.9		1.8-1.9	4	4.8-4.9	
1.9-2.0	6	4.9-5.0		1.9-2.0	4	4.9-5.0	
2.0-2.1	7	5.0-5.1		2.0-2.1	2	5.0-5.1	
2.1-2.2	7	5.1-5.2		2.1-2.2	3	5.1-5.2	
2.2-2.3	10	5.2-5.3		2.2-2.3	3	5.2-5.3	
2.3-2.4	12	5.3-5.4		2.3-2.4	4	5.3-5.4	
2.4-2.5	12	5.4-5.5		2.4-2.5	4	5.4-5.5	
2.5-2.6	13	5.5-5.6		2.5-2.6	4	5.5-5.6	
2.6-2.7	10	5.6-5.7		2.6-2.7	6	5.6-5.7	
2.7-2.8	9	5.7-5.8		2.7-2.8	4	5.7-5.8	
2.8-2.9	10	5.8-5.9		2.8-2.9	4	5.8-5.9	
2.9-3.0	11	5.9-6.0		2.9-3.0	6	5.9-6.0	

Remarks:

Weight:	9kg
Drop:	510mm
Rod Diameter:	16mm

GeoEnviro Consultancy Pty Ltd

Dynamic Cone Penetration Test Report

Job No: JC00010A

Client:	Australand Holdings Ltd	Date:	14-07-00
Project:	Proposed Residential Subdivision	Tested By:	AF
Location:	Sector 8 , Macpherson Street, Warriewood	Checked By:	SL

Test Procedure: AS 1289 6.3.2

Test Data

Test No: 3				Test No:4			
Test Location: TP 8 (See Drawing No 1)				Test Location: TP 11 (See Drawing No 1)			
RL: -				RL: -			
Soil Classification: Refer to Table 1				Soil Classification: Refer to Table 1			
Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0-0.1	-	3.0-3.1	20	0.0-0.1	-	3.0-3.1	12
0.1-0.2	1	3.1-3.2	Terminated	0.1-0.2	2	3.1-3.2	12
0.2-0.3	2	3.2-3.3		0.2-0.3	2	3.2-3.3	10
0.3-0.4	3	3.3-3.4		0.3-0.4	4	3.3-3.4	12
0.4-0.5	2	3.4-3.5		0.4-0.5	5	3.4-3.5	12
0.5-0.6	3	3.5-3.6		0.5-0.6	4	3.5-3.6	16
0.6-0.7	2	3.6-3.7		0.6-0.7	4	3.6-3.7	Terminated
0.7-0.8	7	3.7-3.8		0.7-0.8	4	3.7-3.8	
0.8-0.9	10	3.8-3.9		0.8-0.9	12	3.8-3.9	
0.9-1.0	3	3.9-4.0		0.9-1.0	2	3.9-4.0	
1.0-1.1	2	4.0-4.1		1.0-1.1	1	4.0-4.1	
1.1-1.2	4	4.1-4.2		1.1-1.2	1	4.1-4.2	
1.2-1.3	5	4.2-4.3		1.2-1.3	1	4.2-4.3	
1.3-1.4	2	4.3-4.4		1.3-1.4	2	4.3-4.4	
1.4-1.5	1	4.4-4.5		1.4-1.5	3	4.4-4.5	
1.5-1.6	2	4.5-4.6		1.5-1.6	3	4.5-4.6	
1.6-1.7	1	4.6-4.7		1.6-1.7	8	4.6-4.7	
1.7-1.8	1	4.7-4.8		1.7-1.8	6	4.7-4.8	
1.8-1.9	2	4.8-4.9		1.8-1.9	5	4.8-4.9	
1.9-2.0	2	4.9-5.0		1.9-2.0	5	4.9-5.0	
2.0-2.1	6	5.0-5.1		2.0-2.1	5	5.0-5.1	
2.1-2.2	5	5.1-5.2		2.1-2.2	5	5.1-5.2	
2.2-2.3	4	5.2-5.3		2.2-2.3	7	5.2-5.3	
2.3-2.4	8	5.3-5.4		2.3-2.4	7	5.3-5.4	
2.4-2.5	8	5.4-5.5		2.4-2.5	8	5.4-5.5	
2.5-2.6	8	5.5-5.6		2.5-2.6	8	5.5-5.6	
2.6-2.7	8	5.6-5.7		2.6-2.7	8	5.6-5.7	
2.7-2.8	12	5.7-5.8		2.7-2.8	8	5.7-5.8	
2.8-2.9	12	5.8-5.9		2.8-2.9	12	5.8-5.9	
2.9-3.0	16	5.9-6.0		2.9-3.0	11	5.9-6.0	

Remarks:

Weight:	9kg
Drop:	510mm
Rod Diameter:	16mm

GeoEnviro Consultancy Pty Ltd

Dynamic Cone Penetration Test Report

Job No: JC00010A

Client:	Australand Holdings Ltd	Date:	14-07-00
Project:	Proposed Residential Subdivision	Tested By:	AF
Location:	Sector 8 , Macpherson Street, Warriewood	Checked By:	SL

Test Procedure: AS 1289 6.3.2

Test Data

Test No: 5				Test No: 6			
Test Location: TP 13 (See Drawing No 1)				Test Location: TP 16 (See Drawing No 1)			
RL: -				RL: -			
Soil Classification: See Table 1				Soil Classification: See Table 1			
Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0-0.1	-	3.0-3.1	6	0.0-0.1	-	3.0-3.1	12
0.1-0.2	1	3.1-3.2	8	0.1-0.2	1	3.1-3.2	19
0.2-0.3	1	3.2-3.3	7	0.2-0.3	↓	3.2-3.3	Terminated
0.3-0.4	1	3.3-3.4	8	0.3-0.4	1	3.3-3.4	
0.4-0.5	1	3.4-3.5	9	0.4-0.5	2	3.4-3.5	
0.5-0.6	2	3.5-3.6	8	0.5-0.6	9	3.5-3.6	
0.6-0.7	4	3.6-3.7	8	0.6-0.7	2	3.6-3.7	
0.7-0.8	8	3.7-3.8	8	0.7-0.8	2	3.7-3.8	
0.8-0.9	2	3.8-3.9	10	0.8-0.9	1	3.8-3.9	
0.9-1.0	1	3.9-4.0	10	0.9-1.0	↓	3.9-4.0	
1.0-1.1	1	4.0-4.1	8	1.0-1.1	1	4.0-4.1	
1.1-1.2	4	4.1-4.2	14	1.1-1.2	1	4.1-4.2	
1.2-1.3	5	4.2-4.3	17	1.2-1.3	↓	4.2-4.3	
1.3-1.4	4	4.3-4.4	Terminated	1.3-1.4	1	4.3-4.4	
1.4-1.5	4	4.4-4.5		1.4-1.5	1	4.4-4.5	
1.5-1.6	5	4.5-4.6		1.5-1.6	1	4.5-4.6	
1.6-1.7	12	4.6-4.7		1.6-1.7	1	4.6-4.7	
1.7-1.8	13	4.7-4.8		1.7-1.8	↓	4.7-4.8	
1.8-1.9	14	4.8-4.9		1.8-1.9	1	4.8-4.9	
1.9-2.0	8	4.9-5.0		1.9-2.0	2	4.9-5.0	
2.0-2.1	7	5.0-5.1		2.0-2.1	2	5.0-5.1	
2.1-2.2	8	5.1-5.2		2.1-2.2	3	5.1-5.2	
2.2-2.3	5	5.2-5.3		2.2-2.3	3	5.2-5.3	
2.3-2.4	6	5.3-5.4		2.3-2.4	4	5.3-5.4	
2.4-2.5	5	5.4-5.5		2.4-2.5	6	5.4-5.5	
2.5-2.6	6	5.5-5.6		2.5-2.6	8	5.5-5.6	
2.6-2.7	6	5.6-5.7		2.6-2.7	7	5.6-5.7	
2.7-2.8	6	5.7-5.8		2.7-2.8	9	5.7-5.8	
2.8-2.9	7	5.8-5.9		2.8-2.9	10	5.8-5.9	
2.9-3.0	5	5.9-6.0		2.9-3.0	16	5.9-6.0	

Remarks:

Weight:	9kg
Drop:	510mm
Rod Diameter:	16mm

GeoEnviro Consultancy Pty Ltd

Dynamic Cone Penetration Test Report

Job No: JC00010A

Client:	Australand Holdings Ltd	Date:	14-07-00
Project:	Proposed Residential Subdivision	Tested By:	AF
Location:	Sector 8 , Macpherson Street, Warriewood	Checked By:	SL

Test Procedure: AS 1289 6.3.2

Test Data

Test No: 7				Test No: 8			
Test Location: TP 30 (See Drawing No 1)				Test Location: TP 38 (See Drawing No 1)			
RL: -				RL: -			
Soil Classification: See Table 1				Soil Classification: See Table 1			
Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0-0.1	-	3.0-3.1	14	0.0-0.1	-	3.0-3.1	
0.1-0.2	2	3.1-3.2	11	0.1-0.2	1	3.1-3.2	
0.2-0.3	3	3.2-3.3	14	0.2-0.3	2	3.2-3.3	
0.3-0.4	3	3.3-3.4	16	0.3-0.4	3	3.3-3.4	
0.4-0.5	3	3.4-3.5	Terminated	0.4-0.5	3	3.4-3.5	
0.5-0.6	4	3.5-3.6		0.5-0.6	5	3.5-3.6	
0.6-0.7	3	3.6-3.7		0.6-0.7	5	3.6-3.7	
0.7-0.8	4	3.7-3.8		0.7-0.8	5	3.7-3.8	
0.8-0.9	6	3.8-3.9		0.8-0.9	11	3.8-3.9	
0.9-1.0	7	3.9-4.0		0.9-1.0	6	3.9-4.0	
1.0-1.1	11	4.0-4.1		1.0-1.1	2	4.0-4.1	
1.1-1.2	3	4.1-4.2		1.1-1.2	2	4.1-4.2	
1.2-1.3	2	4.2-4.3		1.2-1.3	9	4.2-4.3	
1.3-1.4	1	4.3-4.4		1.3-1.4	4	4.3-4.4	
1.4-1.5	1	4.4-4.5		1.4-1.5	1	4.4-4.5	
1.5-1.6	1	4.5-4.6		1.5-1.6	2	4.5-4.6	
1.6-1.7	2	4.6-4.7		1.6-1.7	3	4.6-4.7	
1.7-1.8	1	4.7-4.8		1.7-1.8	3	4.7-4.8	
1.8-1.9	1	4.8-4.9		1.8-1.9	4	4.8-4.9	
1.9-2.0	2	4.9-5.0		1.9-2.0	5	4.9-5.0	
2.0-2.1	6	5.0-5.1		2.0-2.1	7	5.0-5.1	
2.1-2.2	6	5.1-5.2		2.1-2.2	6	5.1-5.2	
2.2-2.3	5	5.2-5.3		2.2-2.3	6	5.2-5.3	
2.3-2.4	4	5.3-5.4		2.3-2.4	7	5.3-5.4	
2.4-2.5	4	5.4-5.5		2.4-2.5	6	5.4-5.5	
2.5-2.6	5	5.5-5.6		2.5-2.6	7	5.5-5.6	
2.6-2.7	5	5.6-5.7		2.6-2.7	9	5.6-5.7	
2.7-2.8	5	5.7-5.8		2.7-2.8	16	5.7-5.8	
2.8-2.9	8	5.8-5.9		2.8-2.9	20	5.8-5.9	
2.9-3.0	9	5.9-6.0		2.9-3.0	22	5.9-6.0	
					Terminated		

Remarks:

Weight:	9kg
Drop:	510mm
Rod Diameter:	16mm

APPENDIX E
Brief Explanation on Site Classification

A BRIEF EXPLANATION OF SITE CLASSIFICATION

1. Introduction

The intention of the Australian Standard 2870-1996, "Residential Slabs and Footings" is to provide guidance on footing design for residential buildings with a particular emphasis on reactive clay sites. Footing design and construction involves the following steps:

- site classification
- selection of an appropriate footing system
- structural design
- construction in accordance with the required design details and construction methods
- proper site maintenance after construction

The classification assessed in this report is the first step in providing an economical footing system for a residence which will limit cracking of footings, floor slabs and masonry walls to an extent normally considered acceptable. (Performance expectations are explained in AS 2870- 1996). It is necessary that each subsequent step be diligently observed to achieve acceptable performance.

It is imperative when applying the site classifications presented in this report to residential footing design, that these performance expectations are acceptable to the home owner.

2. What is a Reactive Soil?

A reactive soil undergoes appreciable volume change when its moisture content changes. This causes ground surface movements which can result in fooling movements. The extent of ground movement that can occur depends on the clay mineralogy, the depth of clay in the soil profile, the depth of potential moisture variation in the soil and the change in soil suction that occurs from dry to wet soil conditions. AS2870 provides a classification system to quantify the range of ground surface movements anticipated (defined as having less than 5% chance of being exceeded in the design life of the structure).

3. How are Sites Classified in the Sydney Region

Experiment and observation within the Sydney Region indicates a high variability in the potential for reactive movements, which is not clearly related to soil association, terrain location or visual appearance and may not be accurately predicted by simple soil tests. Intense, complex and expensive testing is required at a site to accurately predict its potential for reactive behaviour. To avoid this, a simplified classification procedure for the Sydney region has been devised which is based on the depth of clay in the soil profile. This procedure is detailed in AS2870 – 1996.

4. What is a Class P Site?

Footing design may need to consider other factors beside reactive soils. Such factors include the presence of filling, the presence of compressible or collapsible soils, or the need to consider slope stability aspects. When these or other factors need to be considered the site may be classified P. The footing "solution" for Class P sites requires special engineering consideration. On many sites the "solution may the straight forward and may not necessarily incur major cost increases.

5. Filled Sites

The most common "problem" associated with residential lots is the presence of fill, compacted or otherwise, overlying the natural soils. If the fill is uncompacted, or if there are no records of adequate compaction, a piered footing system is usually adopted which penetrates the fill and found on natural ground.

AS2870 - 1996 indicates that a compacted fill site may be given a less severe classification than P if assessed in accordance with engineering principles. Subdivision developments often include areas of compacted filling which will usually have been required to have been compacted to the relevant Council Specifications. Adequately compacted filling will usually provide sufficient bearing capacity for residential footing loads, but the clay in the fill will also experience reactive soil movements. Depending on the moisture content at which the fill is placed and the compaction which has been achieved, reactive soil movements may exceed those experienced by the natural soil from which the fill has been derived. As a result, classification of compacted fill sites sometimes needs to be conservative.

6. Site Classifications should be Project Specific

Many Councils require that all lots within a new subdivision be classified prior to subdivision approval. This practice precludes a consideration of the impact of site preparation works on the classification. Sites which are not level are often cut and filled to provide a level platform for floor slab construction. AS2870 specifies that the classification shall be reconsidered if:

(a) the depth of cut exceeds 500mm, or
(b) the depth of compacted fill exceeds 400mm for clay (or 800mm for sand).

Where the classification provided in this report is carried out prior to the site development details being known it is a condition of this report that plans for future development of the block be reviewed by a geotechnical engineer to assess the impact of proposed site works and also the impact of work which may have occurred on adjacent sites since the date of this classification. Altering the site classification may be required in some cases.

7. Site Maintenance

The classifications presented in this report have been assessed for moisture variations caused by climatic and "normal" garden conditions. More severe moisture variation can be caused by other common factors, such as removing or planting trees, leaking plumbing, irrigation systems etc. Guidelines to appropriate site maintenance are provided in CSIRO 10-91 "A Guide to Home Owners on Foundation Maintenance and Footing Performance". Most Damage to residences on reactive sites is due to poor site maintenance. Footings designed to AS2870 may not perform satisfactorily if sites are not properly maintained.

APPENDIX F
Important Information about your Environmental Site Assessment
Explanatory Notes

GeoEnviro Consultancy Pty Ltd

IMPORTANT INFORMATION REGARDING YOUR ENVIRONMENTAL SITE ASSESSMENT

These notes have been prepared by GeoEnviro Consultancy Pty Ltd, using guidelines prepared by ASFE. The Association of Engineering Firms Practising in the Geosciences. The notes are offered as an aid in the interpretation of your environmental site assessment report.

REASONS FOR AN ENVIRONMENTAL SITE ASSESSMENT

Environmental site assessments are typically, though not exclusively, performed in the following circumstances:

- As a pre- acquisition assessment on behalf of either a purchaser or a vendor, when a property is to be sold
- As a pre-development assessment, when a property or area of land is to be redeveloped, or the land use has change, eg from a factory to a residential subdivision
- As a pre-development assessment of greenfield sites, to establish baseline conditions and assess environmental, geological and hydrological constraints to the development of, eg, a landfill
- As an audit of the environmental effects of previous and present site usage

Each circumstance requires a specific approach to the assessment of soil and groundwater contamination. In all cases the objective is to identify and if possible, quantify the risks which unrecognised contamination poses to the ongoing or proposed activity. Such risk may be both financial (clean-up costs or limitations in site use) and physical (health risks to site users or the public).

ENVIRONMENTAL SITE ASSESSMENT LIMITATIONS

Although information provided by an environmental site assessment can reduce exposure to the risk of the presence of contamination, no environmental site assessment can eliminate the risk. Even a rigorous professional assessment may not detect all contamination within a site. Contaminants may be present in areas that were not surveyed or sampled, or may migrate to areas which did not show signs of contamination when sampled. Contaminant analysis cannot possibly cover every type of contaminant which may occur, only the most likely contaminants are screened.

AN ENVIRONMANTAL SITE ASSESSMENT REPORT IS BASED ON A UNIQUE SET OF PROJECT SPECIFIC FACTORS

Your environmental assessment report should not be used;

- When the nature of the proposed development is changed, eg, if a residential development is proposed, rather than a commercial development

- When the size or configuration of the proposed development is altered, eg, if a basement is added

- When the location or orientation of the proposed structure is modified
- When there is a change of land ownership, or
- For application to an adjacent site

In order to avoid costly problems, you should ask your consultant to assess any changes in the project since the assessment and the implications, if any, to recommendations made in the assessment.

ENVIRONMENTAL SITE ASSESSMENT FINDINGS ARE PROFESSIONAL ESTIMATES

Site assessment identifies actual sub-surface conditions only at those points where samples are taken, when they are taken. Data obtained from the sampling and subsequent laboratory analyses are interpreted by geologists, engineers or scientist and opinions are drawn about the overall subsurface conditions, the nature and extent of contamination, the likely impact on any proposed development and appropriate remediation measures. Actual conditions may differ from those inferred, because no professional, no matter how qualified and no sub-surface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, however, steps can be taken to help minimise the impact. For this reason, site owner should retain the services of their consultants throughout the development stage of the project in order to identify variances, conduct additional tests which may be necessary and to recommend solutions to problems encountered on site.

Soil and groundwater contamination is a field in which legislation and interpretation of legislation by government departments is changing rapidly. Whilst every attempt is made by GeoEnviro Consultancy Pty Ltd to be familiar with current policy, our interpretation of the investigation findings should not be taken to be that of the relevant authority. When approval from a statutory authority is required for a project, that approval should be directly sought.

STABILITY OF SUB-SURFACE CONDITIONS

Sub-surface conditions can change by natural processes and site activities. As an environmental site assessment is based on conditions existing at the time of the investigation, project decisions should not be based on environmental site assessment data which may have been affected by time. The consultant should be requested to advise if additional tests are required.

ENVIRONMENTAL SITE ASSESSMENTS ARE PERFORMED FOR SPECIFIC PURPOSES AND CLIENTS

Environmental site assessments are prepared in response to a specific scope of work required to meet the specific needs or specific individuals. An assessment prepared for a consulting civil engineer may not be adequate to a construction contractor or another civil engineer.

An assessment should not be used by other persons for any purpose, or by the client for a different purposes. No individual, other than the client, should apply an assessment, even for its intended purposes, without first conferring with the consultant. No person should apply an assessment for any purposes other than that originally contemplated, without first conferring with the consultant.

MISINTERPRETATION OF ENVIRONMENTAL SITE ASSESSMENTS

Costly problems can occur when design professionals develop plans based on misinterpretation of an environmental site assessment. In order to minimise problems, the environmental consultant should be retained to work with appropriate design professionals, to explain relevant findings and to review the adequacy of plans and specifications relative to contamination issues.

LOGS SHOULD NOT BE SEPARATED FORM THE REPORT

Borehole and test pit logs are prepared by environmental scientists, engineers or geologist, based upon interpretation of field conditions and laboratory evaluation of field samples. Field logs normally provided in our reports and these should not be redrawn for inclusion in site remediation or other design drawings, as subtle but significant drafting errors or omissions may occur in the transfer process. Photographic reproduction can eliminate this problem, however, contractors can still misinterpret the logs during bid preparation if separated from the test of the assessment. Should this occur, delays and disputes , or unanticipated costs may result.

To reduce the likelihood of boreholes and test pit logs misinterpretation, the complete assessment should be available to persons or organisations involved in the project, such as contractors, for their use. Denial of such access and disclaiming responsibility for the accuracy of sub-surface information does not insulate an owner from the attendant liability. It is critical that the site owner provides all available site information to persons and organisations, such as contractors.

READ RESPONSIBILITY CLAUSES CLOSELY

An environmental site assessment is based extensively on judgement and opinion, therefore, it is necessarily less exact than other disciplines. This situation has resulted in wholly unwarranted claim being lodged against consultants. In order to aid in prevention of this problem, model clauses have been developed for use in written transmittals. These are definitive clauses, designed to indicate consultant responsibility. Their use helps all parties involved recognise individual responsibilities and formulate appropriate action. Some of these definitive clauses are likely to appear in the environmental site assessment and you are encouraged to read them closely. Your consultant will be happy to give full and frank answers to any questions you may have.

EXPLANATORY NOTES

Introduction

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

Geotechnical reports are based on information gained from finite sub-surface probing, excavation, boring, sampling or other means of investigation, supplemented by experience and knowledge of local geology. For this reason they must be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code, in general descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions. Identification and classification of soil and rock involves to a large extent, judgement within the acceptable level commonly adopted by current geotechnical practices.

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

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

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

Classification	Undrained Shear Strength kPa
Very Soft	less than 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	greater than 200

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

Relative Density	SPT 'N' Value (blows/300mm)	CPT Cone Value (q_c-MPA)
Very Loose	less than 5	less than 2
Loose	5 - 10	2 - 5
Medium Dense	10 - 30	5 - 15
Dense	30 - 50	15 - 25
Very Dense	>50	>25

Rock types are classified by their geological names, together with descriptive terms on degrees of weathering, strength, defects and other minor components. Where relevant, further information regarding rock classification, is given on the following sheet.

Sampling

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

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

Undisturbed samples are taken by pushing a thin walled sample tube (normally known as U_{50}) into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils. Details of the type and method of sampling are given in the report.

Field Investigation Methods

The following is a brief summary of investigation methods currently carried out by this Company and comments on their use and application.

Hand Auger Drilling

The borehole is advanced by manually operated equipment. The diameter of the borehole ranges from 50mm to 100mm. Penetration depth of hand augered boreholes may be limited by premature refusal on a variety of materials, such as hard clay, gravels or ironstone.

Test Pits

These are excavated with a tractor mounted backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3.0m for a backhoe and up to 6.0m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Care must be taken if construction is to be carried out near, or within the test pit locations, to either adequately recompact the backfill during construction, or to design the structure to accommodate the poorly compacted backfill.

Large Diameter Auger (eg Pengo)

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

Continuous Spiral Flight Augers

The hole is advanced by using 90mm-115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be highly mixed with soil of other stratum.

Continuous Spiral Flight Augers(continued)
Information from the drilling (as distinct from specific sampling by SPT or undisturbed samples) is of relatively lower reliability due to remoulding, mixing or softening of samples by groundwater, resulting in uncertainties of the original sample depth.

The spiral augers are usually advance by using a V-bit through the soil profile to refusal, followed by Tungsten Carbide (TC) bit, to penetrate into bedrock. The quality and continuity of the bedrock may be assessed by examination of recovered rock fragments and through observation of the drilling penetration resistance.

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

Rotary Mud Stabilised Drilling
This is similar to rotary drilling, but uses drilling mud as a circulating fluid, which may consist of a range of products, from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is again only possible form separate intact sampling (eg SPT and U_{50} samples).

Continuous Core Drilling
A continuous core sample is obtained using a diamond tipped core barrel. Providing full core recovery is achieved (which is not always possible in very weak rocks and granular soils) this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush.

Portable Proline Drilling
This is manually operated equipment and is only used in sites which require bedrock core sampling and there is restricted site access to truck mounted drill rigs. The boreholes are usually advanced initially using a tricone roller bit and water circulation to penetrate the upper soil profile. In some instances, a hand auger may be used to penetrate the soil profile. Subsequent drilling into bedrock involves the use of NMLC triple tube equipment, using water as a lubricant.

Standard Penetration Tests
Standard penetration tests are used mainly in non-cohesive soils, but occasionally also in cohesive soils, as a means of determining density or strength and of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289 "Methods of Testing Soils for Engineering Purposes"- Test F31.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 769mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N" value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

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

as 4, 6, 7
N = 13

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

as 15,30/40mm

The results of the tests can be related empirically to the engineering properties of the soil. Occasionally the test method is used to obtain samples in 50mm diameter thin walled sample tubes in clays. In these circumstances, the test results are shown on the borelogs in brackets.

Dynamic Cone Penetration Test
A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The cone can be continuously driven into the borehole and is normally used in areas with thick layers of soft clays or loose sand. The results of this test are shown as 'N_c' on the borelogs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing and Interpretation
Cone penetrometer testing (sometimes referred to as Dutch Cone-CPT) described in this report, has been carried out using an electrical friction cone penetrometer and the test is described in Australian Standard 1289 Test F5.1.

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

As penetration occurs (at a rate of approximately 20mm per second) the information is output on continuous chart recorders. The plotted results given in this report have been traced from the original records. The information provided on the charts comprises:

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

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

Cone Penetrometer Testing and Interpretation continued

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

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

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

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

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

Interpretation of CPT values can also be made to allow estimate of modulus or compressibility values to allow calculation of foundation settlements. Inferred stratification, as shown on the attached report, is assessed from the cone and friction traces, from experience and information from nearby boreholes etc.

This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties and where precise information or soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometer (AS1289)

Portable Dynamic Cone Penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows per successive 100mm increment of penetration.

There are two similar tests, Cone Penetrometer (commonly known as Scala Penetrometer) and the Perth Sand Penetrometer. Scala Penetrometer is commonly adopted by this company and consists of a 16mm rod with a 20mm diameter cone end, driven with a 9kg hammer, dropping 510mm (As1289 Test F3.2).

Laboratory Testing

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

Engineering Logs

The engineering logs presented herein are an engineering and/or geological interpretation of the sub-surface conditions and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, however, this is not always practicable or possible to justify economically. As it is, the boreholes represent only a small sample of the total sub-surface profile. Interpretation of the information and its application to design and construction should take into account the spacing of boreholes, frequency of sampling and the possibility of other than "straight line" variations between the boreholes.

Groundwater

Where groundwater levels are measured in boreholes, there are several potential problems:

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

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

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, perhaps a 3 storey building, the information and interpretation may not be relevant if the design proposal is changed, say to a 20 storey building. If this occurs, the Company will be pleased to review the report and sufficiency of the investigation work.

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

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

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

Site Anomalies

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

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institute of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available.

In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or make additional copies of the report available for contract purposes, at a nominal charge.

Site Inspection

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

Review of Design

Where major civil or structural developments are proposed, or where only a limited investigation has been completed, or where the geotechnical conditions are complex, it is prudent to have the design reviewed by a Senior Geotechnical Engineer.