

## **Appendix 10**

### **Geotechnical Report (prepared by Cook Costello)**



# **Attachment 10**

## **Geotechnical Report**



Consulting Engineers



## GEOTECHNICAL REPORT



*For Sandways Developments Ltd*

**cook | costello**

Consulting Engineers

**25 October, 2005**

**Project Number: 10416**

Sandways Developments Ltd  
Molesworth Drive

Cook I Costello  
Consulting Engineers

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## 1. INTRODUCTION

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Cook Costello Ltd. have been instructed by Sandways Developments Ltd to provide a Geotechnical Report to accompany the proposed commercial development of Lot 1 DP 352077 and Lot 80 DP 170309.

The development involves the commercial rezoning of Lot 1 DP 352077 and Lot 80 DP 170309 into commercial land. The requirements of this Geotechnical Report are:

- The geological history of the surrounding area.
- Subsoil investigations.
- Geotechnical issues for the proposed development.
- Further geotechnical investigations required.

This report has been prepared based on site visits, test pits and earthwork as-builts provided by Cook Costello Ltd.

## 2. SITE DESCRIPTION

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Lot 1 DP 352077 and Lot 80 DP 170309 is located near the southwestern outlet of the central Mangawhai peninsula catchment (22.57ha). Prior to development this area consists of a peaty swamp overlying accreting sand dune hills of the Mangawhai peninsula. To the east of Lot 1 and Lot 80 the low-lying area had collected alluvial deposits of silt and peat which over time formed a swamp of dense Manuka and Tee Tree.

The topography of the sections prior to earthworks consisted of a sand dune hill that ran north to south from the central region of Lot 80 to the east side of Lot 1. Lot 1 and 80 were not covered in the peat found on the adjoining sections due to their elevations. Refer to Appendix 1 for the site plan.

## 3. GEOLOGY

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The Geology of the property from the New Zealand Land Inventory Map NZMS 290 sheet R08/09 (scale 1:100,000) edition 1 1980 are soils of the coastal sand dune complex that are referred to as red hill sandy loam (RLH).

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The Lithology of the area from the New Zealand Land Inventory Map NZMS 290 sheet R08/09 (scale 1:100,000) edition 1 1980 are a combination of two types of rocks.

The predominant soil type is sand: feldspathic with some quartz, minor dark minerals and clay, forming fixed dunes; unconsolidated to very soft. Unweathered or weathered that is brown stained very soft silty sand to depths of 5m.

There are very small pockets of alluvium located over the southern end of Lot 1. This material is located in relatively shallow pockets. It is thought to be deposited here from diverted storm water flows from past developments on Lot 7 DP 170309. The material is thought to be alluvium: mud, sand and minor peat. Unconsolidated to very soft. Unweathered, or weathered to brown stained material to depths of 2m (A1<sub>3</sub>)

#### **4. SITE INVESTIGATIONS**

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Site investigations were initially performed on Lot 1 DP 352077 in June 2003. The investigations comprised of two hand augered boreholes over the adjacent peaty swamp to ascertain peat volumes for earthworks. The site investigations conducted on Lot 1 consisted of a site walkover and observation of cut faces and geological records of the area.

##### **4.1. Lot 1**

Lot 1 typically was covered in estuarine sand, loosely packed, uniformly graded, with localised cemented pockets of underlying sandstone stratum. The water table was observed at the base of the sand dune hill prior to earthworks commencing. Now that the earthworks are completed the water table has dropped between 0.5–2.5m depth over Lot 1. The water table increased with depth the further south test pits were performed. Numerous test pits have been performed over Lot 1 for the purpose of establishing the water table for effluent disposal.

Test pit 1 was excavated on the northern side of Lot 1 near Molesworth Drive. The test pit revealed silty SAND to a depth of about 0.4m. From 0.4-0.8m was a dark grey gravelly SAND, dry, loosely packed, gap graded. The layer is a mixture of fill material with blue metal mixed amongst it. It is believed to be fill material placed along the roadside berm when Molesworth Drive was

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constructed. From the depth of 0.8-2.0m is a dark brown/black Sandstone, tightly packed, slightly weathered, dry. The watertable was located at depth 0.5m.

Test pit 2 revealed silty SAND approximate 0.4m deep. The material was loosely packed, dry slightly weathered and sub-horizontal. Between the depths 0.4-0.8m was a dark grey gravelly SAND, loosely packed gap graded, sub-horizontal. This was the same fill material found in test pit 1. From 0.8-2.0m was a dark brown/black Sandstone tightly packed, dry and slightly weathered. The water table was located at 0.9m depth.

Test pit 3 was performed on the northern side of Lot 1. The test pit revealed there to be about 0.9m of dark grey silty SAND. The material was loosely packed, dry and uniformly graded. The second stratum of soil from 0.9-2.0m was dark brown/black Sandstone, tightly packed, dry, uniformly graded, gently inclined, angular shaped particles. This layer appeared to be impervious with ground water draining out of the above light grey sand layer. The sand in this layer has started to cement together due to the iron oxide in the subsurface water. From the depth of 0.8-1.5m depth is a yellow loosely packed SAND. The test was finished at 2.0m depth.

The test pits revealed there to be thin layers of cemented sandstone under the site ranging in depth from 2.0-2.5m. This layer of cemented sand is not considered to be one consistent layer. This impervious layer of cemented sand, more probably pockets of sandstone, which forms pan that were only found on site where the hill had been.

From test pits excavated in the adjacent peat swamp there was a layer of peat located approximately 1.0m below the sand roadway. In relation to the test pits excavated on site no peat was found under lot 1 however, this should not rule out deeper deposits of ancient peat beds at further depths. It is recommended that deep boreholes should be excavated to at least 10m depth on Lot 1 and to confirm no peat is present underneath the proposed building sites.

Any fill that is to be placed on site shall be laid and compacted in layers no thicker than 300mm with a vibrating roller. All fill shall be tested for compaction in accordance with NZS 4431:(1989).



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#### **4.2. Lot 80**

Lot 80 currently has one garage located centrally on it. There is a stockpile of topsoil in the north eastern side of the property. Lot 80 is now elevated above the neighbouring property to the east that was covered in a peat swamp. Due to the earthworks that have taken place on site it cannot be verified by contour records if Lot 80 was also covered in this peat swamp.

Lot 80 to date has had no test pits or deep boreholes excavated on site. Looking at the past topography of the site the peat swamp may have covered the northern end of this site. It is recommended further site investigations be performed under the existing stockpile of topsoil to verify subsoil ground conditions.

### **5. RECOMMENDATIONS**

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The fill material from the Lot 1 and Lot 80 that was laid and compacted on the adjacent property have shown soil strengths greater than 100Kpa of allowable bearing pressure however, deeper subsoil conditions will need to be verified prior to design to eliminate the probability of any underlying peat layers. The sand has shown to be relatively workable. Numerous soil tests performed on compacted layer on the adjacent property give well in excess of 100Kpa allowable bearing pressure.

No cut slope on site are to be steeper than 30° unless designed by a geotechnical engineer.

Despite these historical records the underlying soils should be checked for allowable bearing pressure prior to design under the proposed location of the commercial development. This is to minimise design assumptions and confirm ground conditions for the proposed buildings.

Close visual inspections should also be observed for any building being constructed on the southern end of the Lot 1. Small amounts of peaty sand have been located in this area due to past storm water diversions.

Further subsoil investigations will need to be undertaken on Lot 80 to verify the extent of the peaty swamp and to verify if there is any underlying peat layers that could be detrimental effects. It is recommended that deep boreholes be performed under the proposed building sites on Lot 80.

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All earthworks should be performed to the standards specified in Auckland Regional Councils TP-90 "Erosion & Sediment Control".

## **6. CONCLUSION**

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Lot 1 and Lot 80 are considered suitable for commercial development subject to the following recommendations:

- All fill on site shall be tested in accordance with NZS 4431:1989
- No cut slopes on site are to be steeper than 30° unless designed by a geotechnical engineer or Chartered Professional Engineer with the appropriate experience.
- Deep boreholes should be performed to depths of at least 10m under the proposed building sites to verify there is no underlying peat stratum.
- All earthworks performed should be performed in accordance with Auckland Regional Council's TP-90 "erosion & sediment control".

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## **7. LIMITATIONS**

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This report has been prepared for the benefit of Sandways Developments Ltd as our client with respect to geotechnical conditions on site and for Kaipara District Councils approval of the proposal as defined in the brief. It shall not be relied upon for any other purpose. The reliance by other parties on the information or opinions contained in this report shall, without our prior review and agreement in writing, be at such parties' sole risk.

Opinions and judgments expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgments are to be relied on they should be independently verified with appropriate legal advice.

Recommendations and opinions in this report are based on data from site visits, test pits and research from geological maps. The nature and continuity of subsoil conditions away from the test pits are inferred and it must be appreciated that actual conditions could vary considerably from the assumed model.

During excavation and construction the site should be examined by an Engineer or Engineering Geologist competent to judge whether the exposed subsoils are compatible with the inferred conditions on which the report has been based. It is possible that the nature of the exposed subsoils may require further investigation and the modification of the design based on this report.

Cook Costello Ltd would be pleased to provide this service to Sandways Developments Ltd and believe that the project would benefit from such continuity. In any event it is essential that the firm is if there is any variation in subsoil conditions from those described in the report as it may affect the design parameters recommended in the report.

Cook Costello Ltd. have performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

There is no investigation which is thorough enough to preclude the presence of materials at the site which presently, or in the future, may be considered hazardous. Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable now

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may in the future become subject to different regulatory standards which cause them to become unacceptable and require further remediation for this site to be suitable for the existing or proposed land use activities.

Hamish Peters  
BE (Hons)

Philip Cook  
Chartered Professional Engineer  
BE (Hons), Dip.Ag  
M.IPENZ, M.ACENZ, M.IOD, IntPE

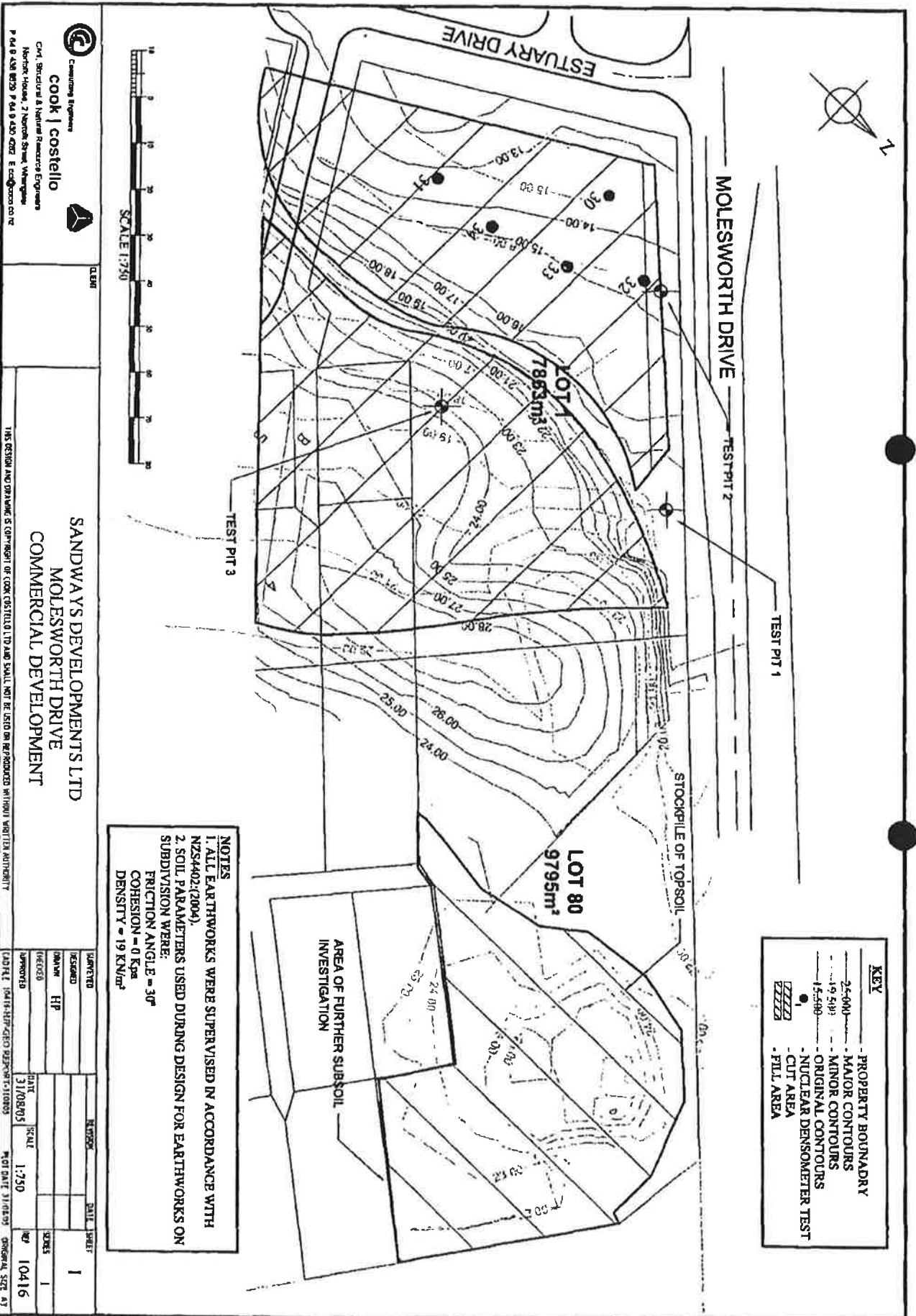
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## **8. APPENDIX 1: SITE PLAN**

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## **9. APPENDIX 2: NUCLEAR DENSOMETER TESTS AND TEST PIT BORELOGS**

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## AUGERHOLE LOG AND TEST SHEET

NZGS November 1988



Lab Job No.:

Client: Metcalf Developments Ltd

Job: Metcalf Subdivision

Location: Lot 1

Augerhole No TP 1

Drilling Methc 12 ton Excavator

Driller: United Carriers

REF: 7924

Report No.:

Logger: HP

Date: 9/08/2004

Checked:

Date:

Page: 1

Soil Description	Legend	Soil Symbol	Depth (m)	Water Level	Vane Shear Strength maximum/residual corrected - kPa	Soil Sensitivity	Sample Number	Other Tests
Dark grey silty SAND, loosely packed, dry, uniformly graded, slightly weathered, sub horizontal, very thick bedded		SP	0.0					
Dark grey gravelly SAND, loosely packed, dry, uniformly graded, slightly weathered, sub horizontal, very thick bedded		SW	-0.4 -0.5					
Dark brown/black, SANDSTONE tightly packed, dry, uniformly graded, freshly weathered, sub horizontal, assumed very thick, angular		SP	-0.8 -1.0 -1.5 -2.0					
EOD								
Remarks: Water table at 0.5m.					Topsoil		Sand	
					Fill		Gravel	
					Clay		Peat	
					Silt		Rock	





# AUGERHOLE LOG AND TEST SHEET

NZGS November 1988

Lab Job No.:  
 Client: Metcalf Developments Ltd  
 Job: Metcalf Subdivision  
 Location: Lot 1  
 Augerhole No TP 4  
 Drilling Methc 12 ton Excavator  
 Driller: United Carriers Ltd

REF: 7924  
 Report No.:  
 Logger: HP  
 Date: 9/08/2004  
 Checked:  
 Date:  
 Page: 4

Soil Description	Legend	Soil Symbol	Depth (m)	Water Level	Vane Shear Strength maximum/residual corrected kPa	Soil Sensitivity	Sample Number	Other Tests
Dark grey silty SAND, loosely packed, dry, uniformly graded, slightly weathered, sub horizontal, very thick bedded		SP	0.0					
Dark grey gravelly SAND, loosely packed, dry, uniformly graded, slightly weathered, sub horizontal, very thick bedded		SW	-0.4					
Dark brown/black, SANDSTONE tightly packed, dry, uniformly graded, freshly weathered, sub horizontal, assumed very thick, angular		SP	-0.8					
			-1.0					
			-1.5					
			-1.9					
EOD			-2.0					
Remarks: Water table at 1.9m.					Topsoil		Sand	
					Fill		Gravel	
					Clay		Peat	
					Silt		Rock	



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# AUGERHOLE LOG AND TEST SHEET

NZGS November 1988



Lab Job No.:  
Client: Metcalf Developments Ltd  
Job: Metcalf Subdivision  
Location: Lot 1  
Augerhole No TP 11  
Drilling Methc 12 ton Excavator  
Driller: United Carriers Ltd

REF: 7924  
Report No.:  
Logger: HP  
Date: 9/08/2004  
Checked:  
Date:  
Page: 11

Soil Description	Legend	Soil Symbol	Depth (m)	Water Level	Vane / Shear Strength maximum (residual) corrected kPa	Soil Sensitivity	Sample Number	Other Tests
Dark grey silty SAND, loosely packed, dry, uniformly graded, slightly weathered, sub horizontal, very thick bedded		SP	0.0					
			-0.5					
Dark brown/black, SANDSTONE, tightly packed, dry, uniformly graded, freshly weathered, gently inclined, assumed very thick, angular			-0.9					
			-1.0					
			-1.3					
			-1.7					
			-1.8					
EOD			-2.0					
Remarks: Water table at 0.9m.					Topsoil		Sand	
					Fill		Gravel	
					Clay		Peat	
					Silt		Rock	

NORTHLAND SOIL MECHANICS  
AND TESTING LABORATORY LTD

2 Norfolk Street  
Whangarei  
PH 09 4389529

NUCLEAR DENSOMETER READINGS  
NZS 4407:1991 Test 4.2.1, 4.2.2

Lab Job No: 8020-415  
Client: Cook Costello Ltd  
Job: Metcalfe Developments  
Location: Mangawhai  
REF: 7924  
Report No: 04-22

Tested By: D. Krissansen  
Date: 12/12/2003  
Checked By: *[Signature]*  
Date: 8/3/04  
Page: 36 of 42

Solid Density: 2.7 t/m<sup>3</sup> (assumed) Maximum dry density: 1660 kg/m<sup>3</sup>

Date	Site No	Test No	Bulk Density kg/m <sup>3</sup>	Dry Density kg/m <sup>3</sup>	Moisture Content %	% Air Voids	% Compaction	Depth Below Ground mm	Vane Shear Strength (corrected) kPa
12/12/2003	-	30	1630	1730	6.0	25.8	104.1	250	-
12/12/2003	-	31	1630	1740	5.5	26.3	104.7	250	-

NSMTL Test 25

6/03/2004

8020-415,7924,metcalfe, mangawhai, 19-11-03 SS33-Issue No: 1


*[Signature]*  
D. Krissansen  
Approved Signatory

NORTHLAND SOIL MECHANICS  
AND TESTING LABORATORY LTD

2 Norfolk Street  
Whangarei  
PH 09 4389529

NUCLEAR DENSOMETER READINGS  
NZS 4407:1991 Test 4.2.1, 4.2.2

Lab Job No: 8020-415  
Client: Cook Costello Ltd  
Job: Metcalfe Developments  
Location: Mangawhai  
REF: 7924  
Report No: 04-22

Tested By: D. Krissansen  
Date: 18/12/2003  
Checked By:   
Date: 18/12/2003  
Page: 37 of 42

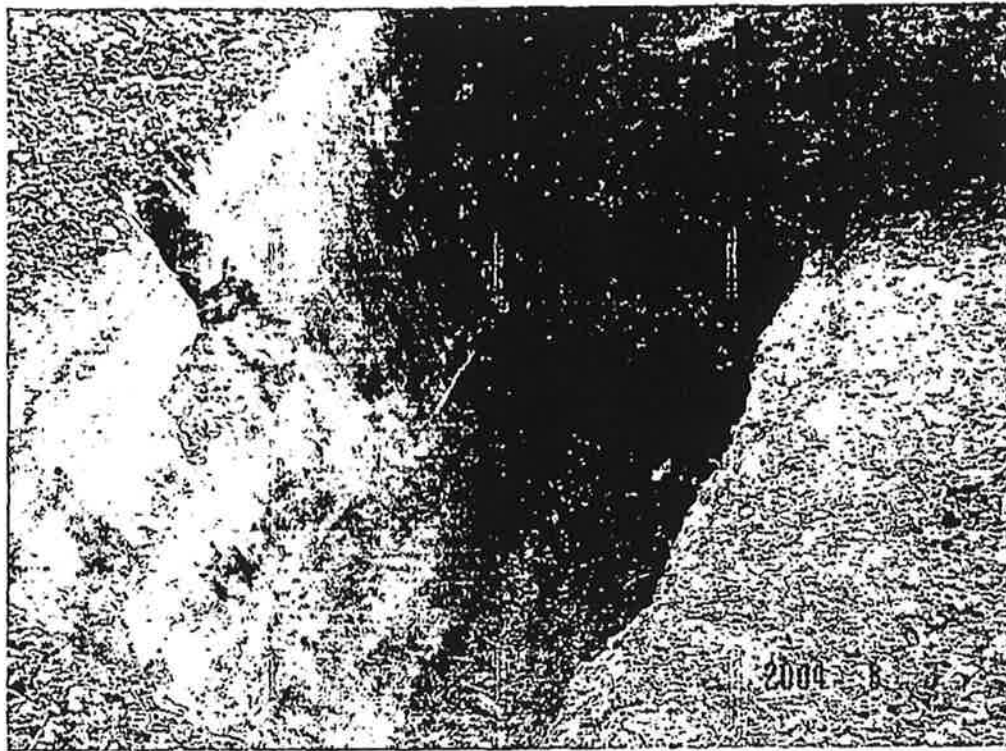
Solid Density:  $2.7 \text{ t/m}^3$  (assumed) Maximum dry density:  $1660 \text{ kg/m}^3$

Date	Site No	Test No	Bulk Density kg/m <sup>3</sup>	Dry Density kg/m <sup>3</sup>	Moisture Content %	% Air Voids	% Compaction	Depth Below Ground mm	Vane Shear Strength (corrected) kPa
18/12/2003	-	32	2000	1760	13.5	10.6	106.0	250	
18/12/2003	-	33	1900	1760	8.0	20.8	105.8	250	
18/12/2003	-	34	1780	1670	6.0	27.6	100.8	250	

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## 10. APPENDIX 3: TEST PITS PHOTOS



*Photo 1: Test Pit 1*

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*Photo 2: Test Pit 4*



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*Photo 3: Test Pit 11*

