Appendix 2

Holmes and Holmes Pty Ltd

Preliminary Acid Sulphate Soil Investigation South of Lake Cathie
December 1998

Lennies + Account 1 ... 7/1/98

HOLMES & HOLMES PTY. LTD.

CHARTERED ENGINEERS (AUSTRALIA)
A.C.N. 001 266 271

P.O. Box J 159, Coffs Harbour Jetty, 2450
Reg. Laboratory No. 5702
40 Rippingale Road, Korora, 2450

Phone/Fax (066) 53 6457

15th December 1998
(972 615)

Attention of Mr. B. Tierney
c/o Luke & Company
PORT MACQUARIE
NSW 2444

Dear Sirs,

PRELIMINARY ACID SULPHATE SOIL INVESTIGATION
SOUTH OF LAKE CATHIE (FORMERLY RAINBOW PACIFIC SITE

We have now collated the information obtained from the drilling, sampling and testing of six test holes in the low areas of this site.

The boreholes were located, levelled and staked by Luke & Company, as Borehole 101 to Borehole 106, (inclusive) and these numbers have been adopted in this Report.

The results are summarised on the attached Plan, indicating a depth of overburden (clayey material) and the R.L. to which excavation can proceed without encountering significant acid sulphate soil problems. Testing of samples throughout the depth of the profile (to five metres depth) suggests that the material at depth is the prime source of potentially acid sulphate soil.

Inspection of the Plan also indicates that significant depths of clayey overburden occur on the western side of the site, with the ridge line (with the access road) and the area to the east, providing the better area for the winning of dredgeable sediments.

Acid sulphate soil problems are also less significant on the eastern side of the area investigated, with Boreholes 1 and 2 providing about four metres depth of material which can be won without generating significant quantities of acid such as would require remediation.

Continued................

Preliminary Acid Sulphate Soil
Investigation, south of Lake Cathie

It is therefore recommended that, if the investigation of a fill material source in this area is to be further pursued, the area between the access road and the creek line to the east, is the area in which the investigation should be concentrated.

Yours faithfully,

W. H. G. HOLMES, B.E., MIE(AUST)
HOLMES & HOLMES PTY. LTD.

RECORD OF BOREHOLES W1 & W2

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia. of boring: BD mm

Type of boring: hand auger Lining tubes: Stand pipe

Bore hole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 1 26-11-02 5.74						Sandy silty CLAY, grey, moist/dry, firm
						CLAY, high plasticity Dk. grey moist, firm
				1.0		CLAY, high plasticity Lt. grey with yellow brown mottlings moist, firm
				2.0	W.L	CLAY, moderate plasticity with a little gravel (fine) Lt. grey mottled greenish yell. br. wet, firm.
						End of Hole
BH 2 5.14						Sandy silty CLAY, grey, moist, firm
						CLAY high plasticity Dk. grey moist, firm
				1.0		CLAY, high plasticity Lt. grey with yellow brown mottlings moist, firm
					W.L	CLAY with a little fine gravel, moist/wet
				2.0		CLAYEY SAND Light grey wet, firm/soft
						End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample
D – disturbed sample.
N ( ) – standard penetration test.
No. in brackets gives
No of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)
W.L as measured on 6.12.02

RECORD OF BOREHOLES W3 & W4

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia. of boring: 80 mm

Type of boring: hand auger Lining tubes: Stand pipe

Borehole Number	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
BH 3 26.11.02 5.16						SILTY CLAY Grey, dry.
						CLAY high plasticity Dk. grey moist, firm
				1.0		CLAY high plasticity Lt. grey with yellow brown mottlings moist, firm
					W.L	CLAY high plasticity Grey, moist firm
				2.0		CLAY, moderate plasticity Slightly sandy, grey wet, soft/firm
						CLAY, moderate plasticity Mottled lt. grey & yell. brown moist/wet, firm. End of Hole
BH 4 4.74						CLAY, high plasticity Gray dry/moist, firm
				1.0	W.L	CLAY, high plasticity Grey mottled yellow-brown moist, firm
						CLAY, mod. plasticity, lt. grey, moist
				2.0		CLAY, moderate plasticity, slightly sandy, lt. grey, moist/wet, firm
						CLAY, moderate plasticity slightly sandy Mottled lt. grey & yell. br. with some red br. mottles moist/wet, firm End of Hole 3200

Key to type of sample
U (50) — 50 mm. dia. undisturbed sample
D — disturbed sample.
N ( ) — standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks (Observations on ground water, etc.)
W.L as measured on 6/12.02

RECORD OF BOREHOLE Nº W5 & W6

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia of boring: 80mm

Type of boring: hand auger Lining tubes: Stand pipe

Date	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
3.12.02 BH5 4.5						CLAY, high plasticity Grey with yell. br. mottlings moist, firm
				1.0		CLAY, moderate plasticity Grey & lt. grey moist/wet, firm
					W.L	
				2.0		SAND, fine-grained, poorly graded. Slightly silty/clayey Grey wet medium dense
						End of Hole
BH6 5.43						SILTY SAND, fine grained, poorly graded Grey, moist, loose
				1.0		SAND, fine-grained, poorly graded Slightly silty Dirty white moist, becoming wet medium dense.
					W.L	
				2.0		
						End of Hole

Key to type of sample.
U (60) — 50 mm. dia. undisturbed sample.
D — disturbed sample.
N ( ) — standard penetration test.
No. in brackets gives
No. of blows/300 mm. penetration

Remarks (Observations on ground water, etc.)

W.L as measured on 6.12.02

RECORD OF BOREHOLE Nº W7 & W8

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia of boring: 80mm

Type of boring: hand auger Lining tubes: Stand pipe

Date	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
3-12-02 BH 7 4.79						CLAY, high plasticity Grey moist, firm
				1.0		CLAY, high plasticity Grey-brown, moist, firm.
					W.L	SAND fine grained, poorly graded Slightly Silty Grey moist, becoming wet medium dense
				2.0		End of Hole
BH 8 4.79						CLAY, high plasticity Mottled grey & yellow brown moist, firm
				1.0	W.L	CLAY, high plasticity Grey moist/wet, firm
				2.0		SAND, fine grained, poorly graded Grey wet, medium dense
						End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks. (Observations on ground water, etc.)

W.L as measured on 6-12-02

RECORD OF BOREHOLE Nº W9 & W10

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level:..... Dia of boring: 80 mm

Type of boring: hand auger Lining tubes: Stand pipe

Date	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
3.12.02 BH 9 5.04						SANDY CLAY moderate plasticity Grey moist, firm
						CLAYEY SAND fine grained Grey-brown moist, soft/firm
				1.0	W.L	SAND, fine grained poorly graded Slightly silty Grey wet loose/med. dense
				2.0		End of Hole
BH 10 4.81						CLAY, high plasticity Grey with yellow-brown mottles moist, firm/soft
				1.0	W.L	SAND fine grained, poorly graded Slightly silty Grey wet loose/med. dense
				2.0		End of Hole

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks. (Observations on ground water, etc.)

W.L as measured on 6.12.02

RECORD OF BOREHOLE Nº W11 & W12

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia of boring: 80mm

Type of boring: hand auger Lining tubes: Stand pipe

Date	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
3-12-02 BH 11 5.49				1.0		CLAY high plasticity Grey moist/wet firm
					W.L	
				2.0		SAND, fine grained, poorly graded Slightly Silty Grey wet, medium dense
						End of Hole
BH 12 5.11				1.0		CLAY high plasticity Grey with some yellow mottles moist firm
					W.L	
				2.0		CLAYEY SAND, fine grained Yellow-brown wet soft/firm
						SAND, fine grained, poorly graded Slightly silty Yellow, wet, loose. End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks. (Observations on ground water, etc.)

W.L as measured on 6.12.02

RECORD OF BOREHOLE Nº W13

CLIENT: LUKE & COMPANY

PROJECT: Rainbow Beach, Bonny Hills

Ground level: ..... Dia. of boring: 80 mm

Type of boring: hand auger Lining tubes: - Stand pipe

Date	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: A.H.D Level	Description of Strata
3.12.02 BH 13						CLAY, moderate plasticity Mottled yell: br. and grey moist, soft/firm
				1.0	W.L	CLAY, high plasticity Grey moist/wet soft/firm
				2.0		CLAYEY SAND, fine grained Yellow wet soft
						SAND, fine grained, poorly graded Lt. Yellow wet, loose/med. dense End of Hole

End of Hole

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample.
D – disturbed sample.
N ( ) – standard penetration test.
No. in brackets gives
No. of blows/300 mm. penetration

Remarks: (Observations on ground water, etc.)

W.L as measured on 6.12.02

Coffs Harbour City Council
Environmental Laboratory

38 Gordon Street
Coffs Harbour NSW 2450

Telephone (02) 6648 4460
Fax: (02) 6648 4466

ANALYTICAL REPORT

CLIENT: HOLMES & HOLMES
P.O. BOX J159
COFFS HARBOUR JETTY NSW 2450

BATCH NUMBER: 2098
No of SAMPLES: 16
DATE COLLECTED: 06.12.02
DATE RECEIVED: 09.12.02
TIME RECEIVED 9:00 AM

SAMPLE – WATER

ANALYSIS	METHOD NO.	UNITS	W1 2098/1	W2 2098/2	W3 2098/3	W4 2098/4	W5 2098/5	W6 2098/6	W7 2098/7	W8 2098/8	W9 2098/9	W10 2098/10	W11 2098/11	W12 2098/12	W13 2098/12	W14 2098/12
pH	EL12		5.6	4.1	6.6	5.0	5.3	4.3	5.1	5.8	5.5	5.3	5.0	5.7	6.4	7.2
Conductivity	EL5	uS/cm	9460	8820	1447	6050	4230	141.6	1283	13000	229.7	237.0	1105	6570	2507	448
Total Dissolved Solids (estimation by conductivity)	EL 7b	mg/L	4730	4410	724	3025	2115	71	642	6500	115	119	553	3285	1254	224
Alkalinity as $CaCO_3$	EL3	mg/L	65	<1	97	4	21	<1	7	105	21	9	7	37	181	17
Sulphate	EL10	mg/L	733	857	951	481	142	2.2	69.6	767	13.2	36.7	166	627	683	32.5
Chloride	EL10	mg/L	3600	2990	331	1830	1360	30.3	371	5740	44.8	43.8	254	2020	392	127
Calcium	EL9	mg/L	159	161	14.8	41.6	58.6	26.1	24.4	210	10.1	8.82	11.5	118	43.6	10.4
Magnesium	EL9	mg/L	470	302	17.0	127	105	7.88	46.7	671	4.55	7.37	23.2	190	61.7	9.69
Sodium	EL9	mg/L	1060	902	198	586	463	25.5	108	1250	24.1	22.4	125	786	369	60.5
Iron	EL9	mg/L	153	31.4	3.65	5.07	85.7	7.59	25.5	76.8	9.58	37.5	9.74	22.2	0.547	0.642
Aluminium	EL9	mg/L	45.8	5.6	8.40	3.19	305	97	187	159	21.9	161	17.0	1.61	0.59	0.85
Manganese	EL9	mg/L	14.3	2.77	0.087	0.233	0.348	0.251	1.06	3.56	0.052	0.059	0.111	0.461	0.267	0.039

ANALYSIS	METHOD NO.	UNITS	W9 1153/9	W10 1153/10	W11 1153/11	W12 1153/12	W13 1153/13	W14 1153/14	W15 1153/15	W16 1153/16
pH	EL12		5.8	3.5	5.5	4.3	7.1	6.6	6.2	6.4
Conductivity	EL5	µS/cm	190	321	1144	7130	2873	179	133	308
Total Dissolved Solids (estimation by conductivity)	EL76	mg/L	95	161	572	3565	1437	90	67	154
Alkalinity as $CaCO_3$	EL3	mg/L	16	<1	18	<1	177	10	8	13
Sulphate*	NW_B14	mg/L	1.2	38	150	580	580	6.9	4.4	7.4
Chloride*	NWB2_B14	mg/L	49	39	240	1400	350	41	27	85
Calcium	EL9	mg/L	5.51	2.78	7.54	74.3	20.2	3.82	2.41	3.46
Magnesium	EL9	mg/L	3.45	2.47	21.9	194	54.4	3.31	2.48	4.92
Sodium	EL9	mg/L	16.4	13.9	132	931	430	18.3	15.3	32.4
Iron	EL9	mg/L	4.34	3.03	2.71	1.74	0.890	1.37	2.57	0.869
Aluminium	EL9	mg/L	1.22	2.71	0.232	0.373	0.694	1.45	5.35	0.464
Manganese	EL9	mg/L	0.017	0.009	0.060	0.267	0.120	0.022	0.027	0.007
Potassium	EL9	mg/L	0.668	1.16	1.40	2.45	1.53	1.54	1.53	1.41

This final report replaces the interim report dated 25.07.03.

* Samples dispatched to AGAL (NATA Accreditation No:198) for analysis. O/N: E05542.

Samples collected by client and analysed as received.

Analysis performed according to "Standard Methods for the Examination of Water & Wastewater", 20th Edition, 1998, APHA.

All pages of this report have been checked and approved for release.

for

B J Wadleigh
Laboratory Manager
CHCC Environmental Laboratory

4-8-03
Date

Surface water flowing through culverts from S. W of site (Ocean Beach)

Surface water flowing through culvert from W of site (near Ocean Beach)

This Laboratory is accredited by the National Association of Testing Authorities, Australia.
[Accreditation Numbers: 12359 (Chemical)]

NATA endorsed test report. This document shall not be reproduced, except in full.

HOLMES & HOLMES PTY. LTD.

CHARTERED ENGINEERS (AUSTRALIA)

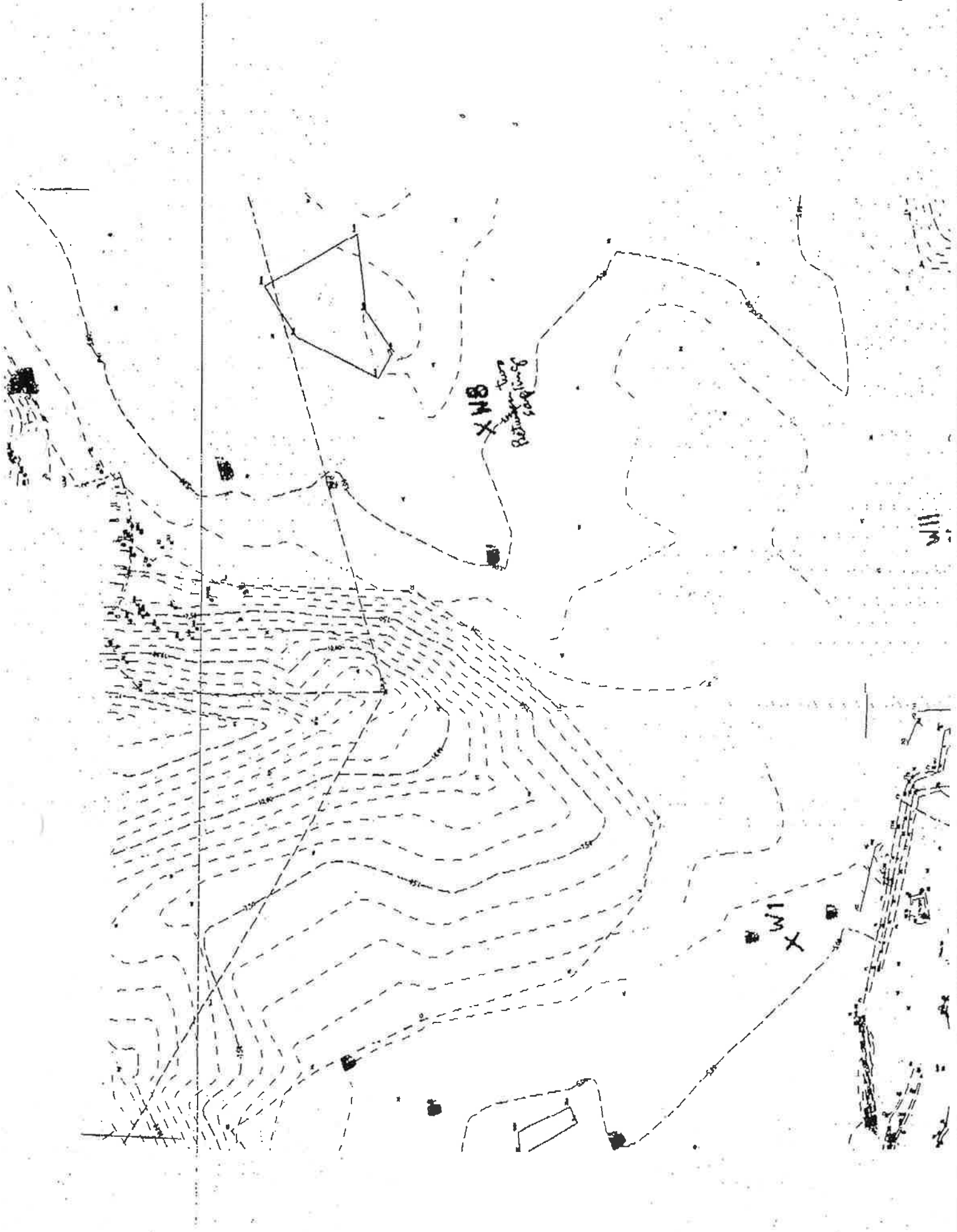
A.C.N. 001 266 271

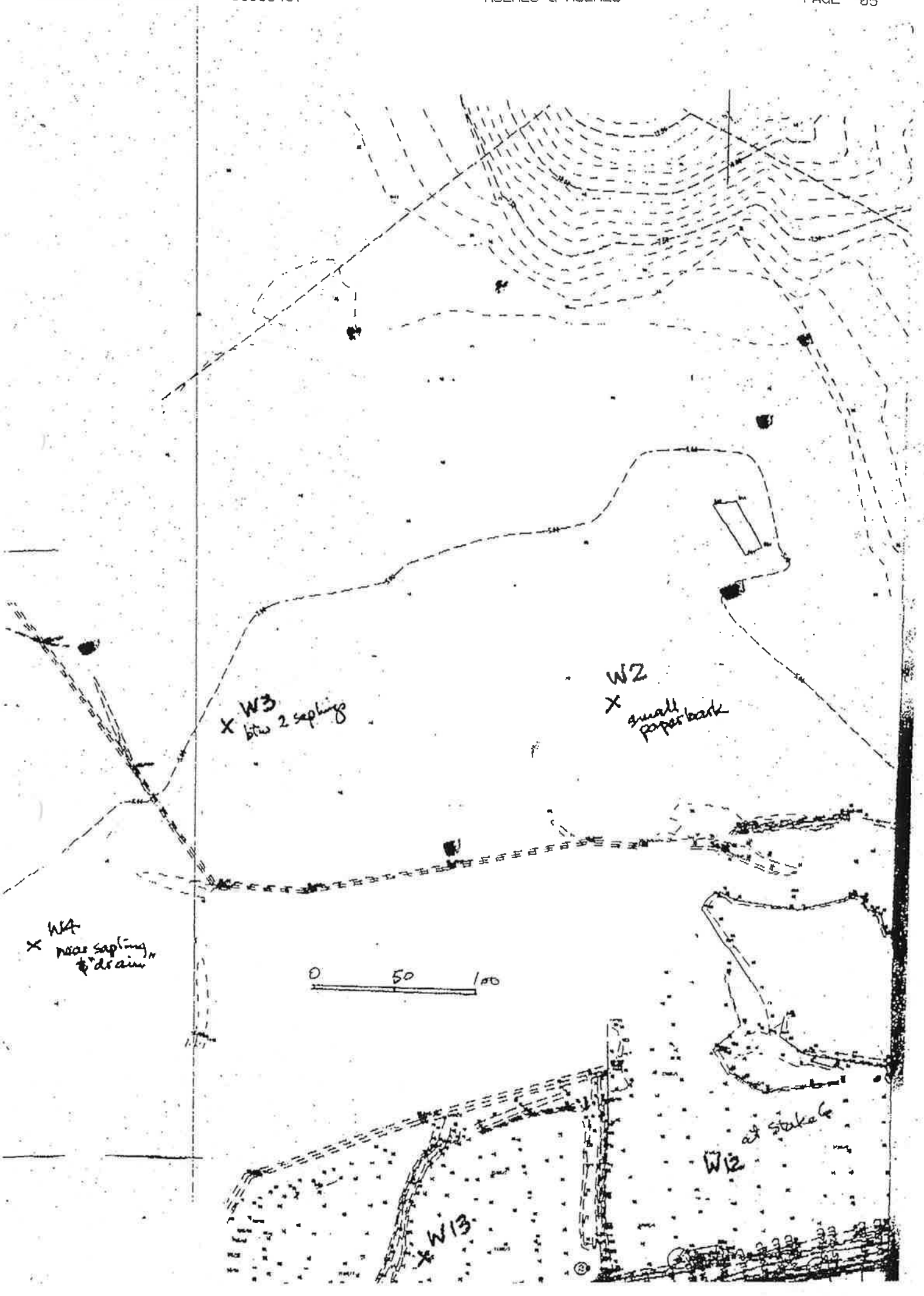
P.O. Box J 159, Coffs Harbour Jetty, 2450
40 Rippingale Road, Korora, 2450

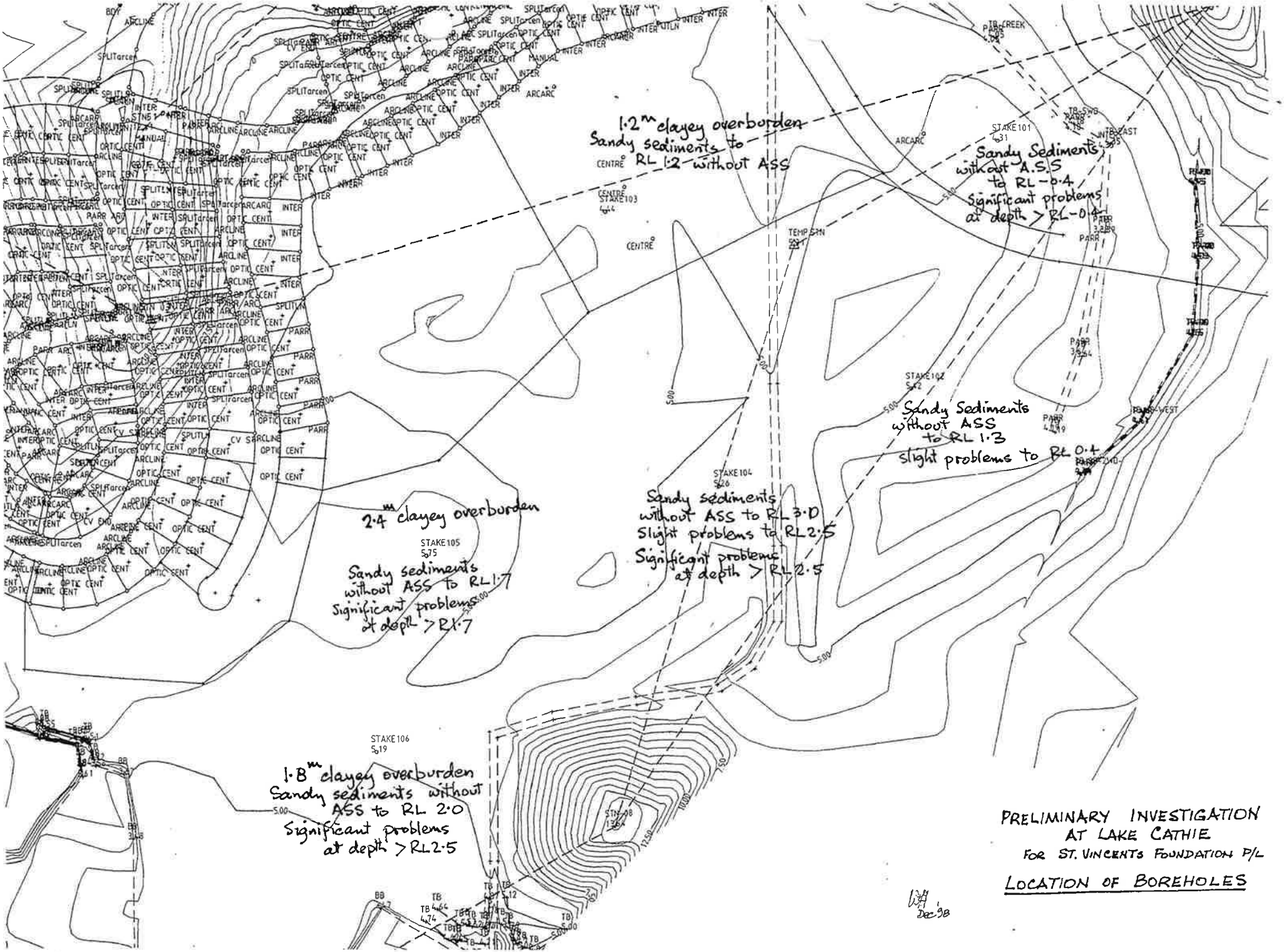
Phone/Fax 66 53 6457

RAINBOW BEACH GROUNDWATER LEVELS

W	1	2	3	4	5	6	7	8	9	10	11	12	13	14 (Dam near outlet)	
RL. G.L	5.74	5.14	5.16	4.74	4.50	5.43	4.79	4.79	5.04	4.81	5.47	5.11			
	120	245	115	205	105	95	100	100	95	215	205	190	330		
RL Top of Pipe	5.86	5.39	5.28	4.95	4.61	5.53	4.89	4.89	5.14	5.03	5.70	5.30			
Date	6th December 2002														
	2890	2575	3110	3520	2480	2570	2695	2780	2415	2270	3185	3090	3230		
	630	690	1530	2100	1080	670	1035	1630	1080	1145	1115	1330	1380		
Depth to W.L below Top of pipe	2260	1885	1580	1420	1400	1900	1660	1150	1435	1125	2070	1760	1850		
RL. W.L	3.60	3.51	3.70	3.53	3.21	3.63	3.23	3.74	3.71	3.91	3.63	3.54			
Date	21st January 2003														
	2890	2575	3110	3520	2480	2570	2695	2780	2415	2270	3185	3090	3230		
	620	915	1695	2340	1060	760	1145	1630	1125	1045	1075	1370	2030		
Depth to W.L below Top of pipe	2270	1660	1415	1180	1420	1810	1550	1150	1290	1225	2110	1720	1200		
RL W.L	3.59	3.73	3.87	3.77	3.19	3.72	3.34	3.74	3.85	3.81	3.59	3.58			
Date	31st March 2003														
Depth to W.L below Top of pipe	2065	625	605	310	780	1285	865	830	715	540	1450	1060	625	60mm above outlet	
RL W.L	3.80	4.77	4.68	4.64	3.83	4.25	4.03	4.06	4.43	4.49	4.25	4.24			
Length of Pipe	2890	2575	3110	3520	2480	2570	2695	2780	2415	2270	3185	3090	3230		
RL Btm of Pipe	2.97	2.82	2.17	1.43	2.13	2.96	2.20	2.11	2.73	2.76	2.52	2.21			


BM
W1


W3
btw 2 saplings
W2
small paper bark
W4
near sapling
& drain
0
50
100
W12
at stake
W13



PRELIMINARY INVESTIGATION
AT LAKE CATHIE
FOR ST. VINCENTS FOUNDATION P/L

LOCATION OF BOREHOLES

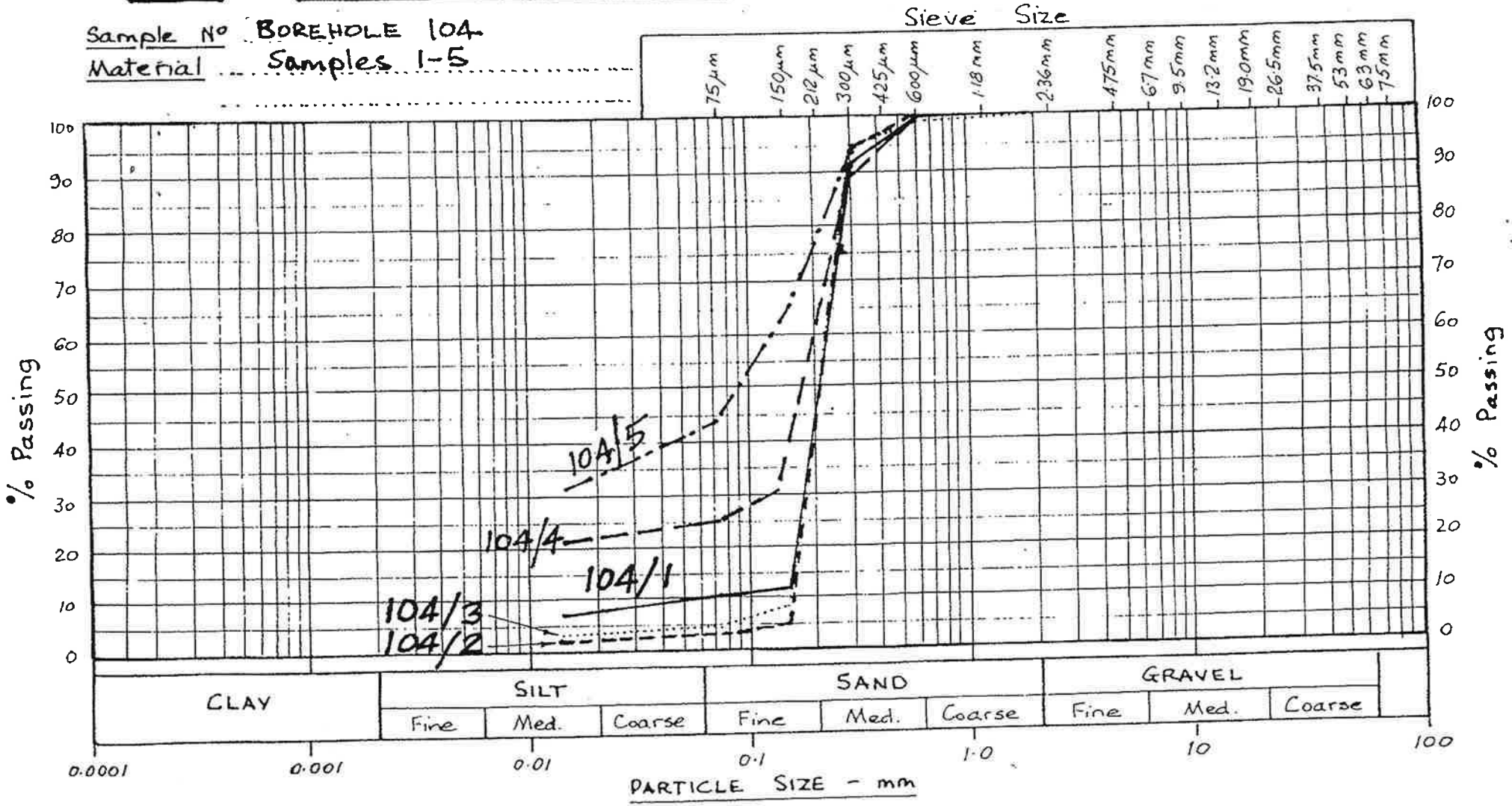
Dec '98

MECHANICAL ANALYSIS

Job N° 972615

CLIENT LUKE AND COMPANY
PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample N° BOREHOLE 104
Material ... Samples 1-5



RECORD OF BOREHOLE No. 105

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 5.75 AHD Dia. of boring: 80 mm

Type of boring: Aimil Pty Ltd Toyota-mounted continuous flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Type or %	Change of Strata: Legend	Depth	AHD. Level	Description of Strata	A.S.S Potential
21.10.98	Sample No.				5.4	Dk. grey clayey Topsoil.	
	105/1			1.0		Esturine CLAY with some peaty remnants and humus. wet, soft.	
	105/2				4.0		
	105/3			2.0		CLAY, slightly sandy Lt. grey & yellow mottled wet, soft.	Potential Slight no remediation required
					3.3	FINE SAND, slightly clayey Lt. grey wet, loose.	
	105/4			3.0	2.7	FINE clayey SAND Light grey wet, loose	
	105/5			4.0			High potential requires management
				5.0	0.7	End of Hole	

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D " – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground-water, etc.)

WT @ 2.0 m below G.L. (3.75 AHD)

MECHANICAL ANALYSIS

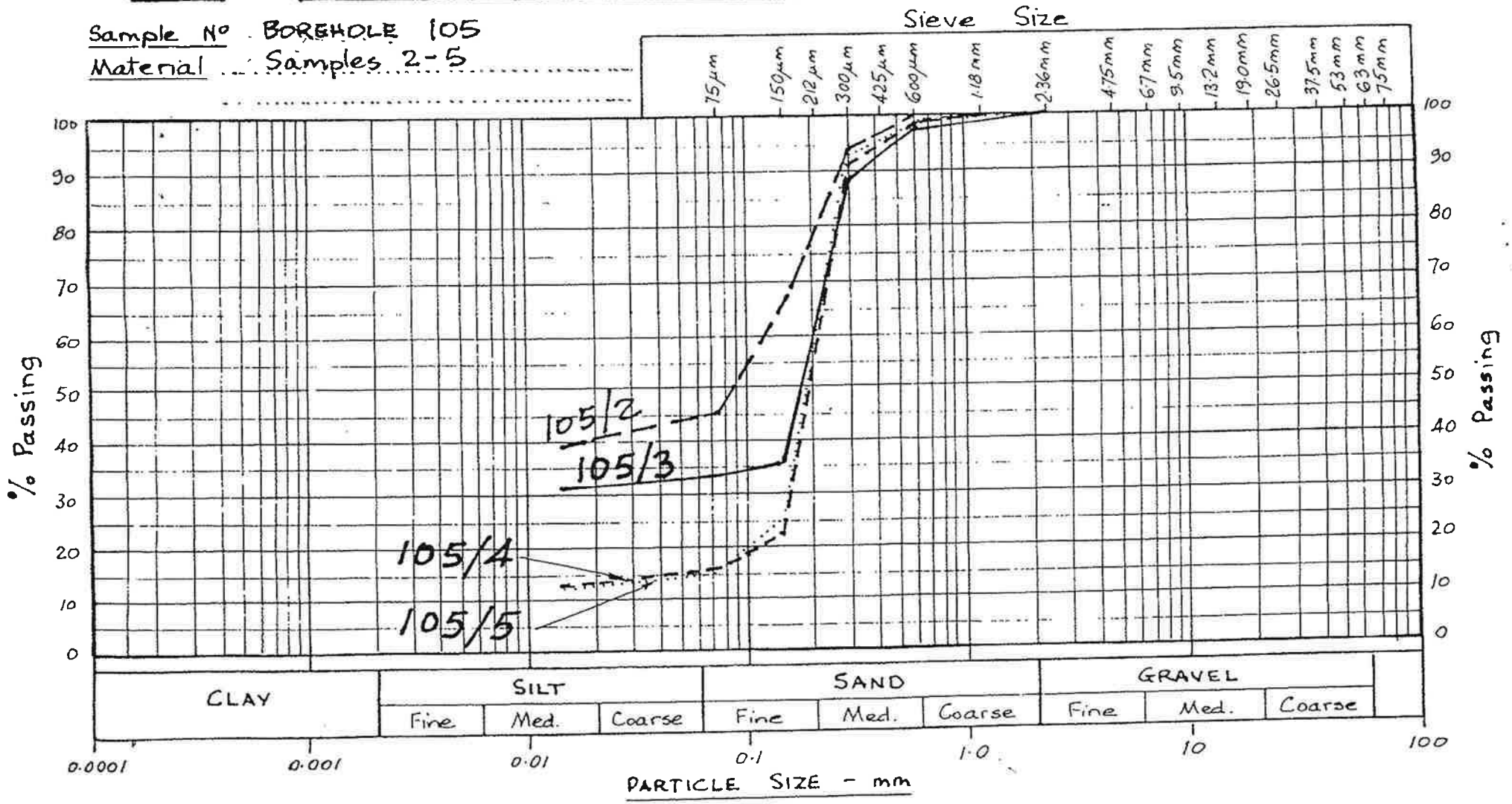
Job No. 972615

CLIENT LUKE AND COMPANY

PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample No BOREHOLE 105

Material Samples 2-5



RECORD OF BOREHOLE No. 106

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 5.19 AHD Dia. of boring: 80 mm

Type of boring: Aimil Pty Ltd Toyota-mounted continuous flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD. Level	Description of Strata	A.S.S Potential
21.10.98	Sample No.				4.8	Dk. grey clayey Topsoil	Very Slight Potential no remediation required.
	106/1			1.0	4.2	Mixed sand & clay.	
	106/2				3.4	Estuarine CLAY, Dk. grey with yellow mottlings. wet, soft.	
	106/3			2.0		FINE SAND, v. silty Lt. grey saturated, loose.	
	106/4			3.0	2.0	FINE Clayey SAND Grey - brown v. wet, soft.	High Potential requires management
				4.0	0.7	CLAY (Residual) mottled red & yellow, wet, firm	
				5.0	0.2	End of Hole	

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks: (Observations on ground-water, etc.)

WT @ 1300 below G.L. (3.9 AHD)

MECHANICAL ANALYSIS

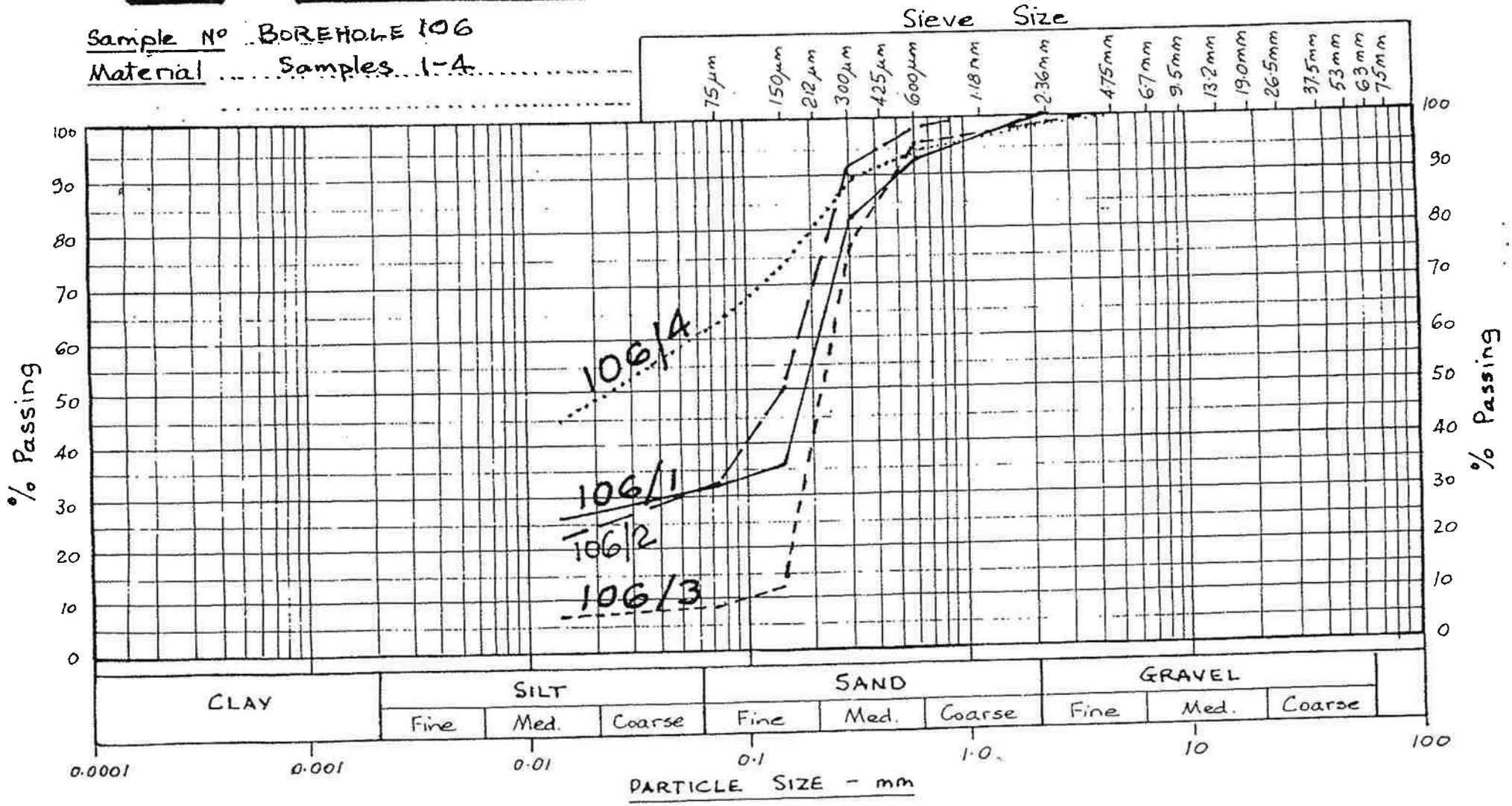
Job. N° 972615

CLIENT LUKE AND COMPANY

PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample N° BOREHOLE 106

Material ..... Samples 1-4 .....



Environmental Analysis Laboratory
Centre for Coastal Management

PO BOX 5125, EAST LISMORE NSW 2480 AUSTRALIA
TELEPHONE: (02) 6620 3678
FACSIMILE: (02) 6620 3957

Laboratory
Certified Laboratory Practice
REG. NO.: CLP0052

Job Number	J3523
Sample Accession No.	Samples 1 - 29
Sample Type	SOIL
No. of samples	29
Date supplied	6th November, 1998
Invoice Number	22204

23rd November, 1998

Att/ Mr Bill Holmes
Holmes & Holmes Pty Ltd
PO Box J159
COFFS HARBOUR JETTY NSW 2450

Dear Bill,

Herewith are the analysis results of 29 soil samples supplied on 6th November, 1998. Results were previously supplied by facsimile.

The sample which ranged from sand to clay showed a clear distinction between surface and depth. The samples collected at depth for many sites showed to be clearly potential acid sulphate soils however none of the surface samples would be regarded as potential acid sulphate based on the 1998 criteria (ie. the new guidelines use >0.03%Sox for sands: >0.06%Sox for clay/sands; and >0.1%Sox for clays).

Treatment of the potential acid sulphate soils using the TSA results should be sufficient: but note that some of the surface soils have high actual acidity and low water pH which is likely to have resulted from the oxidation of potential acid sulphate soils.

Please contact the laboratory if you have any queries.

Yours faithfully,

G J Lancaster

Graham Lancaster,
Laboratory Manager

Analysis performed according to "Standard Methods for the Examination of Water & Wastewater", 19th Edition 1995, APHA, except where stated otherwise.

ACID SULPHATE SOIL ANALYSIS RESULTS (page 1 of 4)

Samples supplied by Holmes & Holmes P/L on 6th November, 1998 - Lab. Job No. J3523

Analysis requested by Bill Holmes - Your Order No. M0029

Sample Site	Description	pH (1:5 water)	Conductivity (1:5 water) dS/m	Extractable Sulphate Sulphur %Skcl	Oxidisable Sulphur %Sox (as %Sp - %Skcl)	POSA Kg H2SO4/ Tonne soil	Total Sulphur % S	Total Carbon % C
101/1	sand	5.56	0.022	0.005	<0.001	<0.1	0.01	0.80
101/2	sand	5.54	0.012	0.003	0.009	0.3	0.01	0.58
101/3	sand	5.42	0.018	0.009	<0.001	<0.1	0.02	0.92
101/4	clayey sand	6.22	0.055	0.009	0.016	0.5	0.11	0.18
101/5	clayey sand	6.11	0.088	0.013	0.161	5.0	0.36	0.31
102/1	sand	5.67	0.020	0.008	0.027	0.9	0.03	1.05
102/2	sand	6.27	0.008	0.003	0.006	0.2	0.01	0.10
102/3	sand	4.54	0.029	0.015	<0.001	<0.1	0.02	1.34
102/4	sand	5.20	0.027	0.019	0.016	0.5	0.03	0.67
102/5	sand	5.24	0.032	0.012	0.034	1.0	0.05	0.35
103/1	clay	5.12	0.210	0.045	<0.001	<0.1	0.06	4.62
103/2	clay	4.40	0.375	0.056	<0.001	<0.1	0.09	0.48
103/3	clayey sand	5.56	0.054	0.008	0.005	0.1	0.01	0.07
103/4	clayey sand	5.86	0.035	0.007	<0.001	<0.1	0.01	0.12
103/5	clayey sand	4.67	0.277	0.037	0.480	15.0	0.97	0.46

NOTE:

1- All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2- Methods from Ahern CR, Blunden B and Stone Y (Eds) (1998). **Acid Sulphate Soils Laboratory Methods Guidelines.** ASSMAC, Wollongbar, NSW.

3- Total carbon and total sulphur determined using a **LECO CNS 2000** analyser

4- Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5- Neutralising Requirement (based on POSA, NAGP, chromium reducible sulphur, TPA or TSA) = Kg H2SO4/tonne x bulk density

6- The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

7- Oxidisable Sulphur was determined using peroxide oxidation and analysis of sulphate = peroxide sulphur - KCL extractable sulphate sulphur

8- POSA (Potentially Oxidisable Sulphuric Acidity) (Kg H2SO4/tonne soil) = %Sox * 30.59

9- Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

checked: .....

Environmental Analysis Laboratory

ACID SULPHATE SOIL ANALYSIS RESULTS (page 2 of 4)

Samples supplied by Holmes & Holmes P/L on 6th November, 1998 - Lab. Job No. J3523

Analysis requested by Bill Holmes - Your Order No. M0029

Sample Site	Description	TAA pH	Total Actual Acidity (TAA) mole / Kg	TPA pH	Total Potential Acidity (TPA) mole / Kg	Total Sulphidic Acidity (TSA) Kg H2SO4/tonne	Lab. Bulk Density tonne DW/m3	Neutralising Requirement Kg Lime/m3 (based on POSA)	Neutralising Requirement Kg Lime/m3 (based on TPA)	Neutralising Requirement Kg Lime/m3 (based on TSA)
101/1	sand	4.63	0.006	6.12	0.000	-0.3	1.50	0.0	0.0	0.0
101/2	sand	4.67	0.006	7.73	0.000	-0.3	1.52	0.4	0.0	0.0
101/3	sand	4.62	0.012	5.23	0.004	-0.4	1.36	0.0	0.3	0.0
101/4	clayey sand	5.10	0.002	3.66	0.012	0.5	1.70	0.8	1.0	0.8
101/5	clayey sand	5.08	0.002	2.60	0.104	5.0	1.72	8.7	8.8	8.6
102/1	sand	4.94	0.002	8.56	0.000	-0.1	1.21	1.0	0.0	0.0
102/2	sand	5.73	0.000	8.53	0.000	0.0	1.43	0.3	0.0	0.0
102/3	sand	3.89	0.018	5.77	0.000	-0.9	1.43	0.0	0.0	0.0
102/4	sand	4.57	0.010	6.24	0.000	-0.5	1.45	0.7	0.0	0.0
102/5	sand	4.71	0.004	4.78	0.004	0.0	1.51	1.6	0.3	0.0
103/1	clay	4.21	0.078	4.51	0.072	-0.3	1.05	0.0	3.7	0.0
103/2	clay	3.42	0.076	3.42	0.040	-1.8	1.28	0.0	2.5	0.0
103/3	clayey sand	4.67	0.004	6.82	0.000	-0.2	1.36	0.2	0.0	0.0
103/4	clayey sand	4.82	0.003	6.84	0.000	-0.2	1.49	0.0	0.0	0.0
103/5	clayey sand	4.53	0.005	1.95	0.324	15.7	1.45	21.8 Refer Note 5&6	23.1 Refer Note 5&6	22.7 Refer Note 5&6

NOTE:

1- All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2- Methods from Ahern CR, Blunden B and Stone Y (Eds) (1998). **Acid Sulphate Soils Laboratory Methods Guidelines.** ASSMAC, Wollongbar, NSW.

3- Total carbon and total sulphur determined using a **LECO CNS 2000** analyser

4- Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5- Neutralising Requirement (based on POSA, NAGP, chromium reducible sulphur, TPA or TSA) = Kg H2SO4/tonne x bulk density

6- The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

7- Oxidisable Sulphur was determined using peroxide oxidation and analysis of sulphate = peroxide sulphur - KCL extractable sulphate sulphur

8- POSA (Potentially Oxidisable Sulphuric Acidity) (Kg H2SO4/tonne soil) = %Sox * 30.59

9- Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

checked: .....

Environmental Analysis Laboratory

ACID SULPHATE SOIL ANALYSIS RESULTS (page 3 of 4)

Samples supplied by Holmes & Holmes P/L on 6th November, 1998 - Lab. Job No. J3523

Analysis requested by Bill Holmes - Your Order No. M0029

Sample Site	Description	pH (1:5 water)	Conductivity (1:5 water) dS/m	Extractable Sulphate Sulphur %Skcl	Oxidisable Sulphur %Sox (as %Sp - %Skcl)	POSA Kg H2SO4/ Tonne soil	Total Sulphur % S	Total Carbon % C
104/1	clayey sand	5.31	0.020	0.017	0.003	0.1	0.02	1.15
104/2	sand	5.16	0.013	0.010	<0.001	<0.1	0.01	0.30
104/3	sand	4.51	0.032	0.012	0.015	0.5	0.03	1.28
104/4	sand	5.18	0.046	0.013	0.046	1.4	0.07	0.60
104/5	clay	3.91	0.808	0.086	0.817	25.5	2.24	0.96
105/1	clay	5.61	0.170	0.040	0.013	0.4	0.10	3.57
105/2	clay	5.47	0.149	0.031	0.026	0.8	0.12	3.07
105/3	clay	5.19	0.068	0.024	<0.001	<0.1	0.02	0.25
105/4	clayey sand	5.88	0.073	0.020	<0.001	<0.1	0.01	0.14
105/5	clayey sand	5.80	0.102	0.016	0.142	4.4	0.20	0.27
106/1	clayey sand	5.61	0.123	0.021	0.008	0.2	0.04	1.56
106/2	clay	4.83	0.197	0.044	<0.001	<0.1	0.08	0.48
106/3	sand	6.01	0.038	0.006	<0.001	<0.1	0.01	0.07
106/4	clay	5.40	0.192	0.027	0.340	10.6	0.62	0.99

NOTE:

1- All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2- Methods from Ahern CR, Blunden B and Stone Y (Eds) (1998). **Acid Sulphate Soils Laboratory Methods Guidelines.** ASSMAC, Wollongbar, NSW.

3- Total carbon and total sulphur determined using a **LECO CNS 2000** analyser

4- Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5- Neutralising Requirement (based on POSA, NAGP, chromium reducible sulphur, TPA or TSA) = Kg H2SO4/tonne x bulk density

6- The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

7- Oxidisable Sulphur was determined using peroxide oxidation and analysis of sulphate = peroxide sulphur - KCL extractable sulphate sulphur

8- POSA (Potentially Oxidisable Sulphuric Acidity) (Kg H2SO4/tonne soil) = %Sox * 30.59

9- Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

checked: .....

Environmental Analysis Laboratory

ACID SULPHATE SOIL ANALYSIS RESULTS (page 4 of 4)

Samples supplied by Holmes & Holmes P/L on 6th November, 1998 - Lab. Job No. J3523

Analysis requested by Bill Holmes - Your Order No. M0029

Sample Site	Description	TAA pH	Total Actual Acidity (TAA) mole / Kg	TPA pH	Total Potential Acidity (TPA) mole / Kg	Total Sulphidic Acidity (TSA) Kg H2SO4/tonne	Lab. Bulk Density tonne DW/m3	Neutralising Requirement Kg Lime/m3 (based on POSA)	Neutralising Requirement Kg Lime/m3 (based on TPA)	Neutralising Requirement Kg Lime/m3 (based on TSA)
104/1	clayey sand	4.57	0.006	7.58	0.000	-0.3	1.44	0.2	0.0	0.0
104/2	sand	4.63	0.004	8.00	0.000	-0.2	1.43	0.0	0.0	0.0
104/3	sand	3.93	0.024	7.73	0.000	-1.2	1.31	0.6	0.0	0.0
104/4	sand	4.47	0.008	4.82	0.012	0.2	1.32	1.9	0.8	0.3
104/5	clay	3.98	0.019	1.70	0.684	32.6	1.19	30.3	39.8	38.7
105/1	clay	4.66	0.008	5.03	0.008	0.0	0.94	0.4	0.4	0.0
105/2	clay	4.32	0.040	4.59	0.020	-1.0	0.92	0.8	0.9	0.0
105/3	clay	4.22	0.020	4.30	0.004	-0.8	1.56	0.0	0.3	0.0
105/4	clayey sand	4.78	0.004	6.56	0.000	-0.2	1.80	0.0	0.0	0.0
105/5	clayey sand	5.30	0.002	2.83	0.052	2.5	1.51	6.7	3.8	3.7
106/1	clayey sand	4.63	0.008	5.11	0.004	-0.2	1.53	0.4	0.3	0.0
106/2	clay	3.71	0.056	3.63	0.024	-1.6	1.14	0.0	1.3	0.0
106/3	sand	5.03	0.002	7.02	0.000	-0.1	1.54	0.0	0.0	0.0
106/4	clay	4.66	0.004	2.91	0.094	4.4	1.41	15.0 Refer Note 5&6	6.5 Refer Note 5&6	6.2 Refer Note 5&6

NOTE:

1- All analysis is Dry Weight (DW) - samples dried and ground immediately upon arrival (unless supplied dried and ground)

2- Methods from Ahern CR, Blunden B and Stone Y (Eds) (1998). **Acid Sulphate Soils Laboratory Methods Guidelines.** ASSMAC, Wollongbar, NSW.

3- Total carbon and total sulphur determined using a **LECO CNS 2000** analyser

4- Bulk density was determined immediately on arrival to laboratory (insitu bulk density is preferred)

5- Neutralising Requirement (based on POSA, NAGP, chromium reducible sulphur, TPA or TSA) = Kg H2SO4/tonne x bulk density

6- The neutralising requirement does not include a safety margin for complete neutralisation (a factor of 1.5 is often recommended)

7- Oxidisable Sulphur was determined using peroxide oxidation and analysis of sulphate = peroxide sulphur - KCL extractable sulphate sulphur

8- POSA (Potentially Oxidisable Sulphuric Acidity) (Kg H2SO4/tonne soil) = %Sox * 30.59

9- Conductivity 1 dS/m = 1 mS/cm = 1000 µS/cm

checked: .....

Environmental Analysis Laboratory

RECORD OF BOREHOLE No. 101

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 4.31 AHD Dia. of boring: 80 mm

Type of boring: Aimil Pty Ltd Toyota-mounted continuous flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Type or %	Change of Strata: Legend	Depth	AHD. Level	Description of Strata	A.S.S Potential
21.10.98	Sample No. 101/1				4.0	Dark grey clayey Topsoil.	
				1.0	3.2	FINE SAND, silty grey & lt. grey. moist, loose.	
	101/2					FINE SAND, soft indurated Black & Dark Brown, Saturated, med. dense.	No potential
	101/3			2.0	1.8		
	101/4			3.0		FINE SAND, slightly silty Grey saturated, loose.	Slight Potential no remediation reqd
				4.0			
					-0.4	CLAY, Lt. grey, v wet, v soft	
	101/5			5.0	-0.7	End of Hole	High Potential requires managemt

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground-water, etc.)

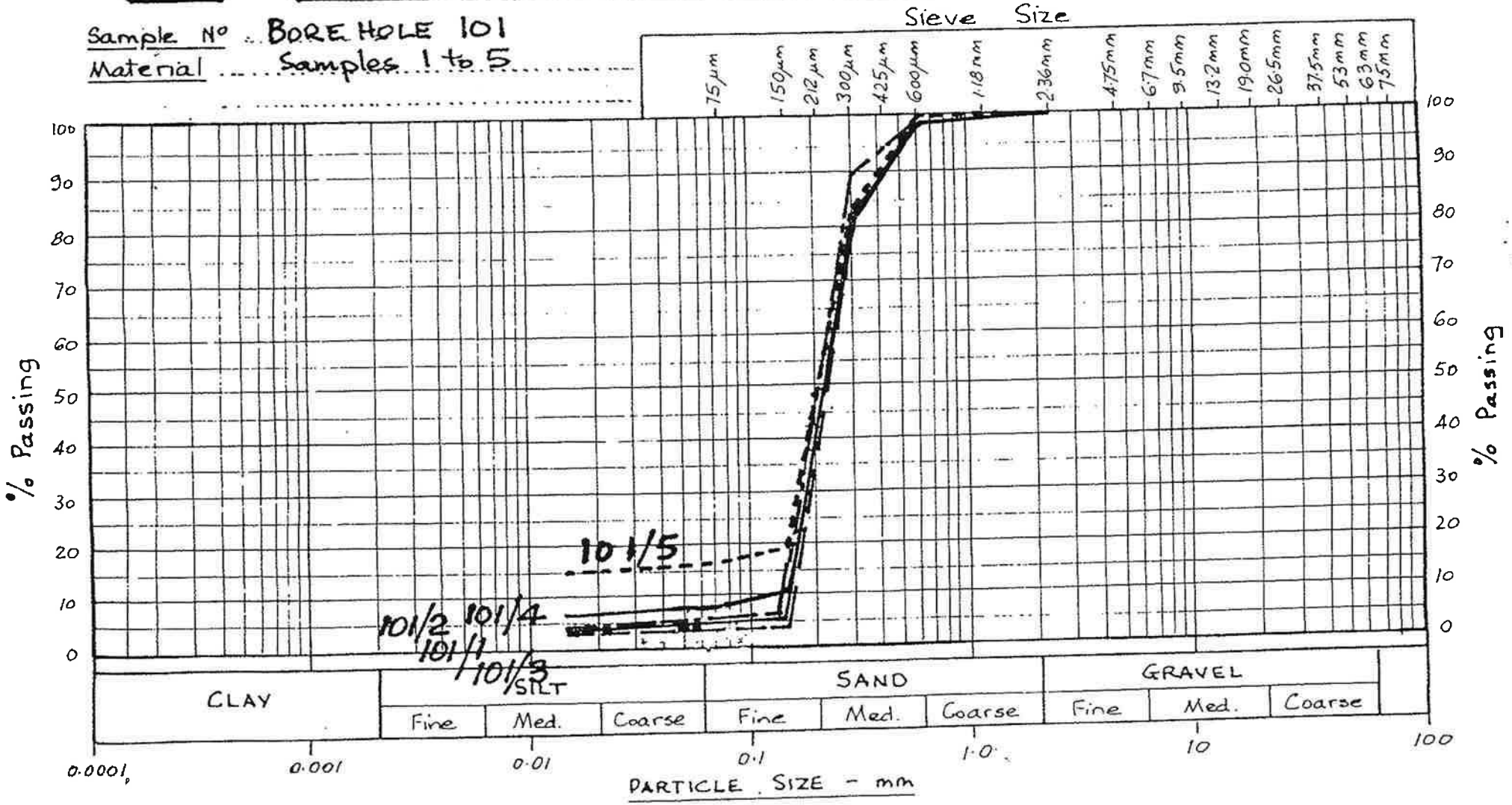
WT@ 900 below G.L. (3.4 AHD)

MECHANICAL ANALYSIS

Job N° 972615

CLIENT LUKE AND COMPANY
PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample N° BORE HOLE 101
Material Samples 1 to 5



RECORD OF BOREHOLE No. 102

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 5.42 AHD Dia. of boring: 80 mm

Aimil Pty Ltd Toyota-mounted

Type of boring: continuous flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Type or %	Change of Strata: Legend	Depth	AHD. Level	Description of Strata	A.S.S Potential
21.10.98	Sample No.				5.2	Grey sandy Topsoil	Slight Potential almost requires management
	102/1			1.0		FINE SAND, slightly silty	
	102/2			2.0		Grey & Lt. grey wet, loose.	
					3.2	FINE SAND, soft indurated Black/dk. brown saturated, med. dense.	Slight Potential no remediation required
	102/3			3.0	2.5	hard indurated, dense	
	102/4			4.0	1.3	FINE SAND with a little fine gravel. Grey, saturated, med. dense.	
	102/5			5.0	0.4	FINE SAND slightly silty Grey Saturated loose	Slight Potential requires management
						End of Hole	

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D " – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm penetration

Remarks: (Observations on ground-water, etc.)

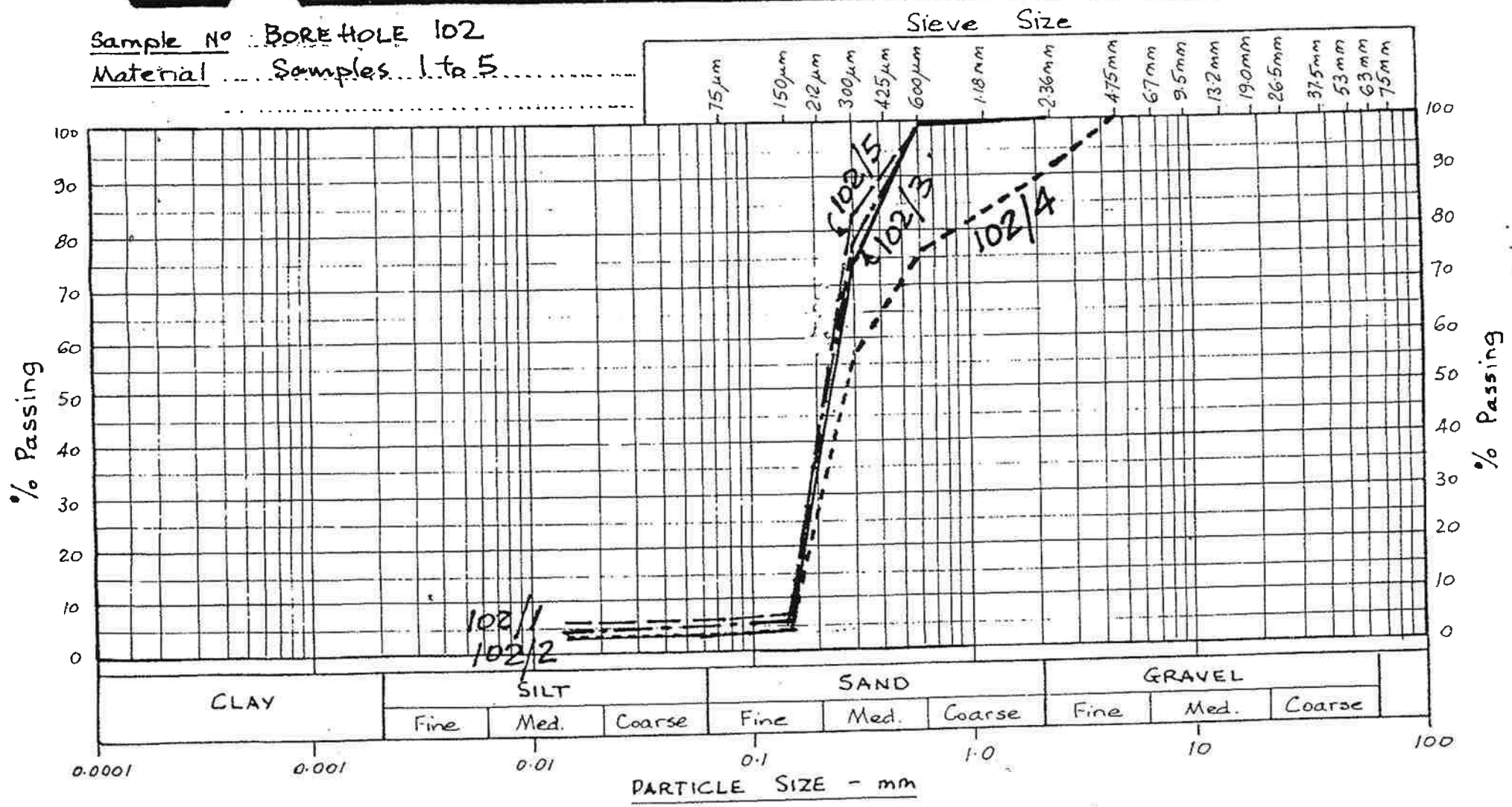
WT @ 1000 below G.L. (4.4 AHD)

MECHANICAL ANALYSIS

Job N°972615

CLIENT LUKE AND COMPANY
PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample N° : BOREHOLE 102
Material .... Samples 1 to 5 .....



RECORD OF BOREHOLE No. 103

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 4.44 AHD Dia. of boring: 80 mm

Aimil Pty Ltd Toyota-mounted

Type of boring: continuous flight auger Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Type or %	Change of Strata: Legend	Depth	AHD. Level	Description of Strata	A.S.S Potential
21.10.98	Sample No. 103/1				3.8	Dk. grey clayey Topsoil	
	103/2			1.0	3.2	Esturine CLAY, mottled grey & yellow wet, soft.	Negligible potential no remediation required
	103/3					FINE SAND, slightly clayey Light grey saturated, loose.	
	103/4			2.0			
				3.0	1.2	CLAYEY SAND dark grey v. wet, soft.	High Potential requires management
	103/5				0.6	CLAY (Residual) mottled red brown & grey becoming yellow-green wet, soft.	Residual Clay no A.S.S.
	103/6 (not tested)			4.0			
				5.0	-0.6	End of Hole	

Key to type of sample
U (50) – 50 mm. dia. undisturbed sample
D " – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground water, etc.)

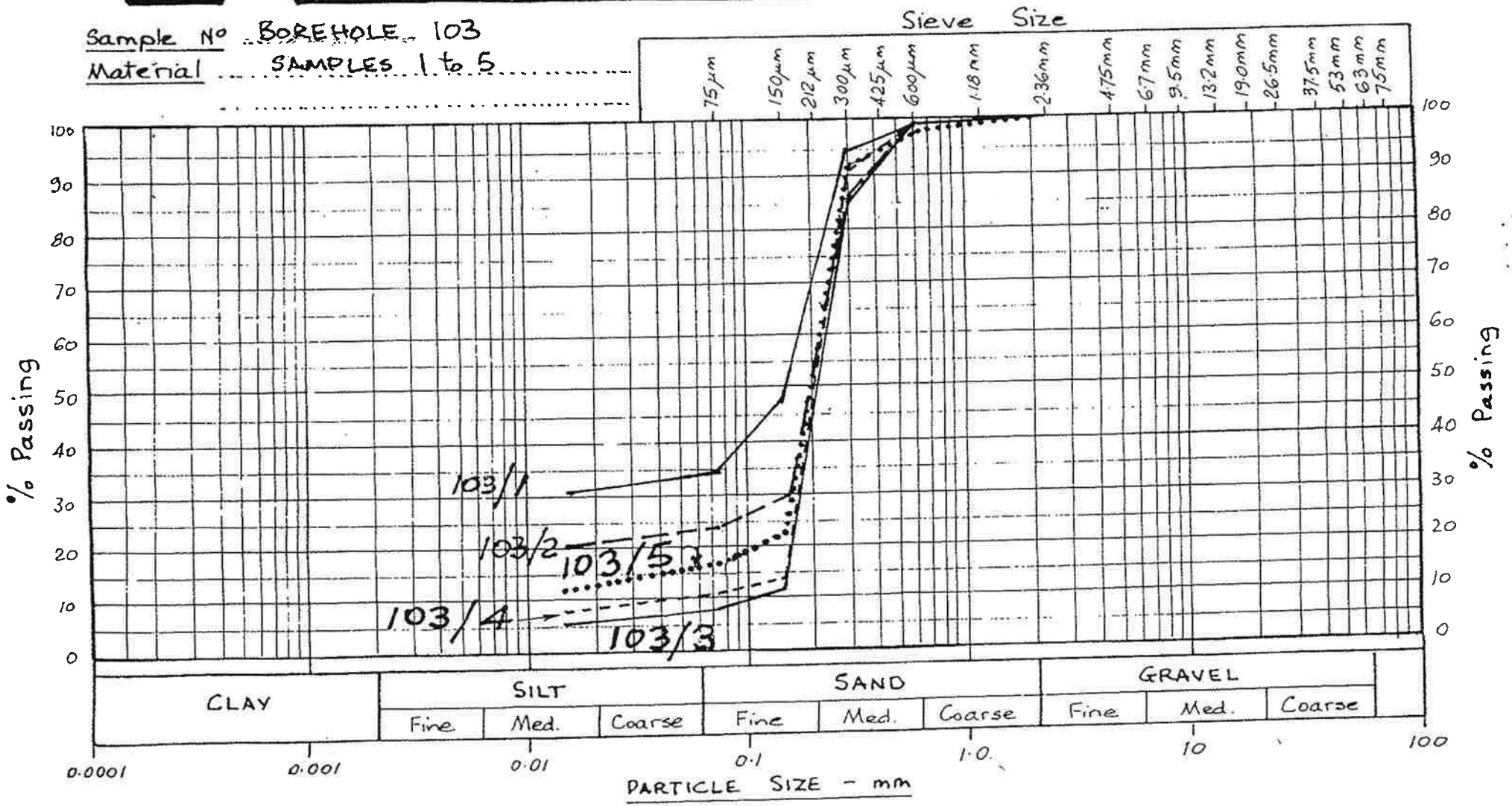
WT @ 1.4 m below G.L. (3.0 AHD)

MECHANICAL ANALYSIS

Job No. 972615

CLIENT LUKE AND COMPANY
PROJECT OCEAN FIELDS ESTATE, BONNY HILLS

Sample No BOREHOLE 103
Material SAMPLES 1 to 5



RECORD OF BOREHOLE No. 104

CLIENT: Luke & Company

PROJECT: Preliminary A.S.S Assessment, Lake Cathie

Ground level: 5.26 AHD (Aimil Pty Ltd Toyota-mounted) Dia. of boring: 80 mm

Type of boring: continuous flight auger. Lining tubes: nil

Daily Progress	Samples or Core Recovery: Depth	Samples or Core Recovery: Type or %	Change of Strata: Legend	Change of Strata: Depth	Change of Strata: AHD. Level	Description of Strata	A.S.S Potential
21-10-98	Sample No.				5.1	Grey sandy Topsoil.	
	104/1				4.8	FINE SAND silty, grey.	
				1.0	4.3	FINE SAND slightly silty Brown, loose, wet.	
	104/2			2.0	3.1	FINE SAND, silty Grey & Lt. grey saturated, loose	Slight potential / no remediation required
	104/3				2.5	FINE silty SAND with a little fine gravel. Dk. grey, saturated, loose.	Slight potential requires management
				3.0			
	104/4			4.0		FINE SAND slightly silty, Dk. brown. Saturated, med. dense.	High Potential requires management
	104/5				0.8	Esturine CLAY, Lt. grey v. wet, v. soft.	High Potential requires management
				5.0	0.3	End of Hole	Very

Key to type of sample
U (50) – 50 mm. dia undisturbed sample
D ' – disturbed sample.
N ( ) – standard penetration test. No. in brackets gives No. of blows/300 mm. penetration

Remarks: (Observations on ground-water, etc.)

WT@ 800 below G.L. (4.4 AHD)