Rangitaiki River Stopbanks

Review of Stability

Volume 2

Appendices

Prepared for

Environment Bay of Plenty

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ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

Appendix A

Stopbank Information Summary

Stopbank Information Summary

Left Bank

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
0	181		no stopbank								
240	300									rock	
890	2230	III									
890		III		1.0,0.7	3.0	3.0	3.0	5			
1400	1900	III									-1.5
1430		III		1.2,0.4	3.0	3.1	3.0	10			-1.5
1680		III		1.7,2.0	3.0	3.0	3.0	2			-1.5
1891	1153		no stopbank								-1.5
1900	2300	III									-1
2230		III		0.7,0.7	3.0	3.0	3.0	0			-1
2300	3400										-2
2350			old river channel								-2
2400		minor									-2
2550	3200		2001 borrow						to toe		-2
2630				1.2,0.7	3.0	3.3	3.9	3	to toe		-2
2737	2837		floodwall						to toe		-2
3040				1.6,0.9	3.0	3.0	3.0	8	to toe		-2
3430				-,3.0	3.5	1.25	3.0	0			
3600	3800										-1
3600	4000	III									
3800	4100										-2.5

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
3810		III	sand boils in paddock between house and road, floodwall,157m long	0.8		1.8		0			-2.5
3860	4260		1973 channel widening						borrow		
4100	5900										-1.5
4170			wall	0.9	1.7	2		0	borrow		-1.5
4200	4600	VIII									-1.5
4630		VIII		0.6	2.5	8	8	0			-1.5
4960				1.4,0.6	3.8	3.5	7	10			-1.5
5370				-,1.0	2.9	2.9	3.2	0			-1.5
5400	5900	IA									-1.5
5500	5800	IA								concrete rubble	-1.5
5542	5587	IA	floodwall								-1.5
5750	6920		1973, borrow						to toe		
5770		IA	road	-,1.8	3.0	1.1	1.7	0	to toe		
5900	6200								to toe		-1
6200	7900										-0.5
6340				-,0.9	3.5	2.5	3.5	0	to toe		-0.5
6390	6745		timber wall						to toe		-0.5
6480	6560								to toe		-0.5
6740						5.0		0	to toe		-0.5
6750	6870		1973 Snelling's Bend, surcharge								-0.5
7110				2.6,0.4	2.5	3.8		4			-0.5
7140	7590		2001 borrow						to toe		-0.5

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
7200	7320	VI	river bend,1973 Snelling's Bend, surcharge						to toe		
7430					3.0	5.0		0	to toe		-0.5
7450	8000	IX									
7680	8170		borrow						to toe		
7900	8300										-1.5
7940		IX		-,0.4	4.0	8.0		0	to toe		-1.5
8200								6			-1.5
8300	8800										-0.5
8400	9500		1993 borrow						to toe		
8530	8770								to toe	rock	-0.5
8750				1.7,1.2	3.0	2.9	2.5	24	to toe		-0.5
8800	9800										-1.5
9085	9240								to toe	rock	-1.5
9150				-,1.9	3.0	3.6	3.2	0	to toe		-1.5
9510				-,1.4	3.0	3.0	2.8	0			-1.5
9600	9700	VI									-1.5
9800	10100										-0.5
9890				1.2,3.8		5.0		14			-0.5
9900	10300		1972 borrow						to 9 to 14m from toe		
9945	10150		1993 borrow						to 5m toe		
10100	10200										-1.0
10200	10700			≈ 1.5							-1.5
10300	10350	III									-1.5
10365	10475		1993 floodwall to 1.4m high plus wall on inlandtoe								-1.5

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
10390				≈ 1.5		1.5		0			-1.5
10400	10550	IB									-1.5
10700	11190										-0.5
10600	11190		1972 borrow						to 9 to 14m from toe		-0.5
10740				3.0,2.1	3.5	3.5		45	to 9 to 14m from toe		-0.5
11000		minor							to 9 to 14m from toe		-0.5
11190	11540										-1.5
11200	11600	VIII	lateral spreading								-1.5
11340		VIII		-,2.7	3.0	2.2		0			-1.5
11350	11510	VIII	up to 1m fill placed in hollow behind stopbank								-1.5
11500	12100		1972 borrow						to 9 to 14m from stopbank		
11510		VIII		3.7,2.9	3.0	2.25	3.3	0 - 5	to 9 to 14m from stopbank	trees	
11540	12400										-0.5
11540		VIII		3.6,-		2.5		10	to 9 to 14m from stopbank		-0.5
11850				3.4,-	3.0	2.7		50	to 9 to 14m from stopbank		-0.5

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
12140				1.1 ?		3.6		40			-0.5
12210				3.4,2.3	4.0	2.5	3.1	30			-0.5
12400	12700										-1.5
12510				-,2.7		2.7		0			-1.5
12550	12600	III									-1.5
12660				2.8,2.9	3.0	2.1	1.5	0 - 5		tree,rock	-1.5
12700	12900										-1.0
12900	13900										-0.5
12950	13100	VIII	old bend? pylon on toe	4.3,3.0	3.5	2.6	2.9	30			-0.5
13100	13150	III									-0.5
13200	13300	VIII									-0.5
13280		VIII		3.8,3.2	2.5	1.3	1.8	0 - 5		some trees,rock	-0.5
13200	13360	VIII							to 3m from toe		-0.5
13360	13520							0		rock toe	-0.5
13560	14490								to 3m from toe		
13680				3.0	3.0	2.9		35	to 3m from toe		-0.5
13900	14400										-1.0
13920				3.8,2.2	3.3	2.6	2.0	20	to 3m from toe		-1.0
14080				3.5		2.9		30	to 3m from toe		-1.0

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
14350									to 3m from toe		-1.0
14450	14650										
14400	16500	III									-0.5
14470				-,2.5	3.0	1.9	2.1	0	to 3m from toe	trees,rock	-0.5
14570	14650							0		rock toe	-0.5
14890	15570								up to 100m wide, to 3m from toe		-0.5
14910				3.5,2.1	2.9	2.25	2.4	30			-0.5
15000		minor		4.0,1.7	3.0	2.6	2.6	60			-0.5
15450				4.0,1.9	3.0	2.5	3.3	15			-0.5
15960			road	2.0,2.5	6.0	1.25	1.1	4			-0.5
15600	15850	X									-0.5
15650	16010									rock toe	-0.5
15700		X								rock toe	-0.5
15770		X	wall in landward face	3.4,2.2	3.0	2.25	2.9	8		rock toe	-0.5
15800		X								rock toe	-0.5
15850	15900	VIII								rock toe	-0.5
16050	16200	III									-0.5
16100		III		-, 2.6	3.6	1.6	1.6	0		rock face	
16140	16240									rock toe	
16500		IV fault									
16590				4.6,3.2	3.7	2.6	3.5	0 - 10		trees,rock	
16900	17180								to 3m from toe		

Meterage		Earthquake damage	History	stopbank height* (m)	crest width (m)	river batter xH:1V	landward batter xH:1V	river berm (m)	berm excavation	toe protection	land grade (%)
17230				3.9,2.8	3.4	2.25	2.25	20 - 80		trees	
17780	18330								to 3m from toe		
17800	17850	IX, III									
17850		IX, III			3.5	2.5		0			
17940			Pryors, tomo	3.5,2.7	3.8	1.9	3.1	0		trees,rock	
18250	19000	IX, VII									
18250		IX, VII		3.5	4.0	2.8		30			
18610		IX, VII		4.0	3.0	2.7		50			
18720		IX, VII		3.2,3.2	3.2	2.75	2.75	50 - 80		trees	
18770 19120	19259		corner taken off river bank						up to 110m wide, to 3m from toe		
19120				2.8	6.6	4.8		120			
19340				2.9	3.5	2.3		90			
19560				3.0,1.0	5.0	2.5		60			
19700	19850	VII									
19830		VII		3.7,3.0	3.0	3.3	2.75	40		trees	
20000	20050	VII									
20080				4.5	3.0	3.0		10			
20360				1.4,1.6	4.0	2.9	3.4	0			
20390				3.0,1.6	3.3	2.75	2.75	0 - 5		bush	
20450	20950	VII	stream channel								

* river side, landward side

Right Bank

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
580				2.5		3.1					
890				1.5,1.2	9.0	3.3	4	0			
1100	1900										-1
1430			tributary	1.2,0.6	3.0	3.0	3.0	10			-1
1680				1.5,2.2	3.0	3.0	3.0	2			-1
1900	2500										-0.5
2230				0.9,0.9	3.0	2.4	3.6	0			-0.5
2500			tributary								
2500	2900										-1.5
2630			tributary	0.9,0.9	2.0	2.4	3.0	0			-1.5
2700	3820		1973 channel widening						borrow		
2900	3100								borrow		-2.5
3040			floodwall 81m long	1.7,1.0	3.0	3.0	3.0	0	borrow		-2.5
3100	3400								borrow		-1.5
3180	3660		1973 Reynold's Bend, surcharge, 45m						borrow		
3400			tributary						borrow		-1.5
3400	4600										-2.5
3430				0.9,1.0	3.5	3.0	3.0	5	borrow		-2.5
3700	3980		1973 Reynold's Bend, surcharge								-2.5
3810				1.9,1.3	3.5	3.0	3.0	6			-2.5
3850	4100		2002 borrow						to toe	somerock	-2.5
4170				-,1.0	5.0	2.6	2.9	0			-2.5
4390	5875		1973 channel widening						borrow		

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
4500	4630		river bend						borrow		
4600		II, V							borrow		-2.5
4630				-,1.0	3.5	2.3	4.5	0	borrow		
4700		tributary							borrow		
4800	5900								borrow		-2.5
4960				0.6,1.0	5.6	4.0	2.5	9			-2.5
5100	5600		2002 borrow						to toe		-2.5
5370		tributary		2.0,1.6	4.3	2.9	2.9	5		rock	-2.5
5650	5850		2002 borrow						to toe		-2.5
5770		VI	depressions	1.8,1.2	4.0	3.4	2.5	5			-2.5
5900	6700										-2.0
6080	6360		1973 Snelling's Bend surcharge, up to 130m wide								-2.0
6340				1.0,1.8	6.4	3.0	3.2	14			-2.0
6520	7600		1973 channel widening						borrow		
6700	7400								borrow		-1.0
6740				1.8,1.3	3.5	3.6	3.8	10	borrow		-1.0
7110				2.6,1.1	2.9	4.0	3.0	15	borrow		-1.0
7400	7800										-0.5
7430						7.0		7	borrow		-0.5
7800	8400										-1.0
7940				1.6,0.7	4	4.5	4.3	6			-1.0
8100	8300		1993 borrow						to toe		-1.0
8200				1.8,1.2	3.0	4.4	4.8	6	to toe		-1.0
8400	8950										-1.5
8750		III		-,1.0	4.3	1.5	5.7	0			-1.5
8950	9100			-,1.4							-2.0

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
9100	9250										-0.5
9100	10100								to 9 to 14m from stopbank toe		
9100	9900		1993 borrow						to toe		
9150				3.0,1.4	3.0	3.6	2.1	20	to toe		-0.5
9240	9390								to toe	rock	
9250	9400								to toe		-1.5
9280			some slumping	2.9,1.5	2.8	3.5	3.1	22	to toe		-1.5
9400	9850								to toe		-0.5
9470			drain at toe	2.3,1.8	3.0	3.1	3.5	11	to toe		-0.5
9510				3.1,2.3	3.0	3.0	3.0	15	to toe		-0.5
9740				3.0,1.75	3.8	3.1	3.1	48	to toe		-0.5
9850	10300										-1.5
9890				2.6,1.8	3.0	5.0	3.3	12	to toe		-1.5
9990	10040								to toe	rock	-1.5
10140			rubbish pit near toe	1.5,1.85	3.3	3.5	3.1	10		trees,flax	-1.5
10300		IX									-1.5
10300	10900										-0.5
10300	10700	1993 borrow							to toe		-0.5
10390				3.7,2.2	3.0	3.0	3.1	25	to toe		-0.5
10400	10800								to 9 to 14m from stopbank toe		-0.5
10590	10640								to toe	rock	-0.5
10600				3.5,2.0	3.5	2.9	2.9	30	to toe		-0.5
10740				1.6,1.8	3.0	4.0	3.0	14			-0.5

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
10900	11190										-1.5
10900	11000	IA	Fonterra	2.2,2.4	3.4	3.1	2.9	0			-1.5
11000	11150	IC									-1.5
11150	11190	IX									-1.5
11190	11850										-0.5
11190	11800								to 9 to 14m from toe		
11200			Fonterra crib at toe	2.2,2.4	3.4	3.1	2.9	0			-0.5
11200	11350		1989, borrow						to toe		-0.5
11340				2.7		3.3		110	to toe		-0.5
11450				3.2,1.6	3.9	2.5	1.9	70			-0.5
11540				3.0		3.8		90			-0.5
11750	11900	V									
11850	11950										-1.5
11850		V			3.0	3.0		0			-1.5
11900	12250		1989 borrow						to toe		
11950				2.1,1.9	3.7	2.5	2.75	0 - 5	to toe	trees	-1.5
11950	12250								to toe		-1.0
12140				3.5	3.5	2.6		10			-1.0
12250	13230										-0.5
12320			substation, toe loading	3.5,3.0	3.8	2.1	2.5	11		trees	
12510				2.9	3.5	2.8		0			
12670				3.5,3.0	3.8	2.1	2.5	11		trees	
12890 12990	13000		Mc Cracken's Bend, surcharge up to 45m wide, 2m deep	3.5,2.2	2.7	2.5	2.5	50-60			

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
12880	13300		soil removed from island in centre of bend and river berm for floodway construction, 1981						to 4m from river stopbank toe, 15m from landward toe		
13140	13280	VIII	Mc Cracken's Bend, surcharge up to 45m wide, 2m deep								
13230	13600										-1.0
13280	13880		1976						to 3m from toe		
13280	13400		1981, more river berm removed, including 3m previously left						to toe		-1.0
13550	14400		1989 borrow						to toe		
13600		VIII							to toe		-1.0
13600	13800								to toe		-1.5
13680			stream channel	3.5	3.0	2.7		15	to toe		-1.5
13710				3.4,2.1	3.3	2.4	2.1	15	to toe		-1.5
13800	14800										-1.0
14000	14800		1981, more river berm removed						to stopbank toe		-1.0
14080				3.4	4.3	2.6		20			-1.0
14360	14970		1976						to 3m from toe		-1.0
14590				3.5,2.1	3.3	2.75	2.0	50	to 3m from toe		-1.0

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
14800	14900								to 3m from toe		-1.5
14800	15000	X, VII									
14860			some erosion	1.8,2.1	3.7	2.75	2.5	20	to 3m from toe	some trees	-1.5
14900	15200										-1.0
14900	15000								to 3m from toe		-1.0
14980			building at toe	2.4,2.1	3.4	2.4	3.1	0	to 3m from toe	trees,rock	-1.0
15000		IV fault							to 3m from toe		-1.0
15000	15460		1978						to 3m from toe		
15110				≈2	3.5	2.3		0	to 3m from toe		-1.0
15100	15200		erosion	3.3,2.5	4.0	2.5	3.1	20 - 50	to 3m from toe		-1.0
15100	15200	V	timber wall on inside						to 3m from toe		-1.0
15200	17200										-0.5
15230			end of stopbank 1976								-0.5
15300	15450								to 3m from toe	rock	-0.5
15300	15700		1991 borrow						to toe		-0.5
15400	16900		1989 borrow						to toe		-0.5
15460	15780		1978						to stopbank toe		-0.5

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
15780	16770		1978						to 3m from toe		-0.5
15960				3.8	4.0	3.0		70			-0.5
16000				5.5,2.9	3.5	2.75	2.6	10		willow stumps	-0.5
16300	16550									rock	-0.5
16500	17000		1991 borrow						to toe		-0.5
16600		IX, X fault	tributary								-0.5
16670	16790		1978						to toe		-0.5
16750		VI									-0.5
16790	16820		1978 to 3m from toe, 1981						to toe		-0.5
17140				4.0,3.0	4.0	1.8		0			-0.5
17170			slumping	2.7,2.9	4.0	2.9	2.9	80		willows	-0.5
17300			tributary								
17460			tributary	3.0	3.6	2.9		50			
17530	18600		1978						to 3m from toe		
17550			stream, excavation behind stopbank for drainage								
17850				3.4	3.5	3.5		80			
18070				2.0,1.2	3.2	3.3	4.0	15		willows	
18250				2.0	2.0	4.0		50			
18610				3.6		4.5		20			
19120				2.0		3.7		20			
19230			stream								
19560				3.0		3.5		10			
19600			tributary								
19700	20000	VII	tributaries								

Meterage		Earthquake damage	history / comments	stopbank height	crest width	river batter	landward batter	river berm	berm excavation	toe protection	land grade
20100	20200	minor									
21200	21500	V									
21500	21600	minor									
22900	23000	VII									
23400	24100	IX,									
23510			slumping	3.05,3.25	3.0	3.3	3.3	45			
24000	24300		1981, river widened								
24150				4.0,2.3	3	3.3	3.3	70			

Appendix B

Available Drawings

Rangitaiki Stopbanks

Reference Drawings

Number	Sheet	Date	Description	Chainage	Meterage	
R209			CDE R191 Legal and sand ridges right of river			
R209 S1/4		??	Legal boundaries			
M2		??	land left of river, sand ridges, peat subsidence			
R450/3/1		1971	Rangitaiki River widening Stage 1, plan of plan locations			CD
R450/3/2	1	1971	plan river mouth- 1m 70.9ch	0 - 40c		CD
	2	1971	plan river mouth- 1m 70.9ch	0m 36c - 1m 04c		CD
	3	1971	plan river mouth- 1m 70.9ch	LB 1m - 1m 56c		CD
				RB1m06c - 71c		
	4	1971	Kopeopeo West Canal LB 0 - 1m			CD
	5	1971	Kopeopeo West Canal +Reid Central Canal			CD
	6	1971	Reid Central Canal			CD
	7	1971	Reid Central Canal			CD
	8	1971	Reid Central Canal			CD
R450/3/7		1971	borelogs locations on R450/3/2 sheets 1-8			CD
R450/3/3	1	1971	cross sections left bank 0-23ch	0-23	0 - 463	CD
	2	1971		24 - 35	483 - 704	CD
	3	1971		36 - 47	724 - 945	CD
	4	1971		48 - 59	966 - 1187	CD
	5	1971		60 - 71	1207 - 1428	CD
	6	1971		72 - 1m 03ch	1448 - 1669	CD
	7	1971		1m04 - 15	1689 - 1911	CD
	8	1971		1m16 - 28	1931 - 2172	CD
	9	1971		1m29 - 34	2192 - 2293	CD
	10	1971		1m35 - 39	2313 - 2394	CD
	11	1971		1m40 - 44	2414 - 2494	CD

R450/3/4	1	1971	cross section right bank			CD
	2	1971				CD
	3	1971				CD
	4	1971				CD
	5	1971				CD
	6	1971				CD
R233 S6/6		1963	plan of section locations			
R233 S1/9		1963	plan and borelog LHS, Moko and Thompson			
R233 S7/9		1963	plan and borelog RHS, Reynolds Gap			
R233 S9/9		1963	borelog RHS 1m 52.1c, Thornton School Petersens and cross sections			
R233S3/9		1963	stopbank around Edgecumbe substation and borelogs			CD
R450/11/10		1973	borelogs and meterages			CD
R450/3/5	1	1971	Floodway cross sections			CD
	2	1971				CD
	3	1971				CD
	4	1971				CD
	5	1971				CD
	6	1971				CD
	7	1971				CD
	8	1971				CD
	9	1971				CD
	10	1971				CD
	11	1971				CD
	12	1971	left bank cross section	1m51c - 56c	2635 - 2735	CD
	12a	1971	Floodway cross sections			CD
	13	1971				CD
	14	1971				CD
	15	1971				CD
	16	1971				CD
	17	1971				CD
	18	1971				CD
	19	1971				CD

	20	1971				CD
	21	1971				CD
	22	1971				CD
	23	1971				CD
R450/3/6	1	1971	Contract R1 major culverts			CD
	2	1971	Contract R1 major culverts floodway			CD
	3	1971	Contract R1 major culverts floodway			CD
	4	1971	Contract R1 major culverts			CD
	5	1971	headwall for 72" culvert			CD
	6	1971	timber floodgate for 72" culvert			CD
R450/3/7	1	1971	Rangitaiki River widening Stage 1 borelogs			CD
R450/3/8	1	1971	Rangitaiki River tidal records			CD
R450/3/9	1	1971	river cross sections at 4 chain intervals			CD
	2	1971	mouth			CD
	3	1971				CD
	4	1971				CD
	5	1971		1m 00c -16c	1609 - 1931	CD
	6	1971		1m 20c - 36c	2012 - 2334	CD
	7	1971		1m 40c - 52c	2414 - 2656	CD
R450/3/10	1	1971	Culvert Thornton Hall Rd			CD
R237		1964	Snellings Bend, LHS plan and cross sections			CD
RDB 246/1	1	1964	Snellings Bend long section			CD
RDB 246/2		1964	cross sections			CD
RDB 246/3		1964	cross sections			CD
R450/11/1	1	1973	Thornton to Edgecumbe Stage II Plan of plans			CD
R450/11/2	1	1973	Right bank plan, Reynold's Bend	1m 50c - 2m 38c		CD
	2	1973		2m 20c - 3m 00c		CD
	3	1973		2m 70c - 3m 60c		CD
	4	1973	Snellings Bend	3m 56c - 4m 28c	5953 - 6999	CD
	5	1973		4m 20c - 72c		CD
	6	1973		4m 60c - 5m 18c		CD
	7	1973	Floodway	2m 20c - 56c		CD
	8	1973		2m 52c - 3m 16c		CD

	9	1973		3m 16c - 64c		CD
	10	1973		3m 60c - 4m 32c		CD
	11	1973		4m 32c - 76c		CD
	12	1973		4m 72c - 5m 30c		CD
R450/11/3	1	1973	Right bank cross sections	1 m 54c - 78c		CD
	2	1973		2m 00c 24c		CD
	3	1973		2m 26c - 46c		CD
	4	1973		2m 48c - 3m 00c		CD
	5	1973		3m 02c - 3m 28c		CD
	6	1973		3m 30c - 60c		CD
	7	1973		3m 62c - 78c		CD
	8	1973		4m 00c - 30c		CD
	9	1973		4m 32c - 62c		CD
	10	1973		4m 66c - 5m 18c		CD
R450/11/4	3	1973	Left bank cross sections	2m 32 - 52c		CD
	4	1973		2m 54c - 3m 08c		CD
	5	1973		3m 00c - 44c		CD
	6	1973		3m 46c - 4m 00c		CD
	7	1973		4m 02c - 36c		CD
	8	1973		4m 38c - 72c		CD
	9	1973		4m 74c - 5m 14c		CD
	10	1973	surcharge area cross section			CD
R450/11/5	1	1973	Flood way cross sections	3m 03c		CD
	2	1973				CD
	3	1973		5m 28c		CD
R450/11/6	1	1973	Floodway, left bank cross sections	2m 48c		CD
	2	1973				CD
	3	1973				CD
	4	1973		5m 24c		CD
R450/11/7	1	1973	Floodway right bank culverts			CD
	2	1973	culvert details			CD

	3	1973	inlet details			CD
	4	1973	flapgate			CD
	5	1973	Floodway left bank culverts			CD
	6	1973	River left bank culverts			CD
	7	1973	River culverts			CD
R450/11/8	1	1973	Ramps on McLeans Rd and East Bank North Road			CD
	2	1973				CD
R450/11/11	1	1973	Full river cross section	1m 69c - 2m 04c		CD
	2	1973		2.m 28c - 44c		CD
	3	1973		2m 48c - 66c		CD
	4	1973		2m 70c - 3m 06c		CD
	5	1973		2m 08c - 2m 24c		CD
	6	1973		3m 10c - 16c		CD
	7	1973		3m18c - 30c		CD
	8	1973		3m 34c - 50c		CD
	9	1973		3m 54c - 70c		CD
	10	1973		3m 74c 0 4m 10c		CD
	11	1973		4m 14c - 30c		CD
	12	1973		4m 34c - 50c		CD
	13	1973		4m 54c - 70c		CD
	14	1973		4m 74c - 5m 16c		CD
R450/11/9	1	1973	Floodway right bank plan of plans	3m 52c - 5m 29c		CD
R450/11/2		1973	Snellings bend plan	3m 56c - 4m 28c	593 - 6999	CD
R450/11/12	1	1974	Thornton to Edgecumbe Stage II plan of plans			CD
R598	1	1988	Bay Milk products, stopbank and concrete wall, plan			CD
	3	1988	Bay Milk products, stopbank and concrete wall, sections			CD
R450/5/1	1	1972	Edgecumbe Stopbanks, site plan layout			CD
R450/5/2	1	1972	Edgecumbe Stopbanks, site plan			CD

	2	1972	Edgecumbe Stopbanks, site plan			CD
	3	1972	Edgecumbe Stopbanks, site plan			CD
R450/5/3	1	1972	Edgecumbe stopbanks left bank cross sections	6m 0c -19c	9654 - 10036	CD
	2	1972		6m 20c - 38c	10056 - 10418	CD
	3	1972		6m 40c - 56c	10459 - 10780	CD
	4	1972		6m 58c - 78c	10821 - 11223	CD
	5	1972		7m 0 - 10c	11263 - 11464	CD
	6	1972		7m 12 - 18c	11504 - 11625	CD
	7	1972		7m 20 - 42c	11665 - 12108	CD
	8	1972		7m 44 - 54c	12148 - 12349	CD
	9	1972		7m 54 - 70c	12349 - 12671	CD
	10	1972		7m 72 - 8m 08c	12711 - 13033	CD
	11	1972		8m 09 - 16c	13053 - 13194	CD
R450/5/4	1	1972	Edgecumbe stopbanks right bank cross section	6m 0 - 18c	9654 - 10016	CD
	2	1972		6m 20 -38c	10056 - 10418	CD
	3	1972		6m 40 - 58c	10459 - 10821	CD
	4	1972		6m 58 - 74c	10821 - 11143	CD
	5	1972		6m 76c-7m26c	11183 - 11786	CD
	6	1972		7m 26c - 46c	11786 - 12188	CD
	7	1972		7m 48c -?	12229 -	CD
R450/5/5	1	1972	Edgecumbe stopbanks culverts			CD
R450/5/7	1	1972	Edgecumbe river cross sections at 4c intervals	6m 0c - 7m 32c		CD
	2					CD
	3					CD
	4					CD
	5					CD
	6					CD
	7					CD
R457	1	1971	Stopbanks around substation, Edgecumbe			
	2	1971	cross sections			
	3	1971	cross sections			
R252			Edgecumbe substation site layout			

R450/22/1	1	1976	Edgecumbe to Te Teko stopbank plan layouts			CD
	2	1976				CD
	3	1976				CD
	4	1976				CD
	5	1976				CD
R450/22/2			Kokohinau Blk legal plan			CD
	1	1976	Edgecumbe to Te Teko plans			CD
	2	1976				CD
	3	1976				CD
	4	1976				CD
	5	1976				CD
	6	1976				CD
	7	1976	plan with owners and borrow areas			CD
R242			Mc Crackens Bend plan and cross sections			
R450/22/3	1	1976	Edgecumbe to Te`Teko right bank cross sections	7m 78c - 8m 06c	12832 - 12993	CD
	2	1976		8m 08 - 18c	13033 - 13234	CD
	3	1976		8m 20 - 28c	13274 - 13435	CD
	4	1976		8m 30 - 40c	13476 - 13677	CD
	5	1976		8m 42 - 52c	13717 - 13918	CD
	6	1976		8m 54 - 78c	13958 - 14441	CD
	7	1976		9m 00 - 08c	14481 - 14642	CD
	8	1976		9m 09 - 20c	14662 - 14883	CD
	9	1976		9m 22 - 37c	14924 - 15225	CD
R450/22/4	1	1976	Edgecumbe to Te Teko left bank cross sections	8m 18 - 36c	13234 - 13596	CD
	2	1976		8m 38 - 48c	13636 - 13838	CD
	3	1976		8m 49 - 58c	13858 - 14039	CD
	4	1976		8m 60 - 68c	14079 - 14240	CD
	5	1976		8m 70 - 9m 00c	14280 - 14481	CD
	6	1976		9m 02 - 24c	14521 - 14964	CD
	7	1976		9m 26 - 36c	15004 - 15205	CD
	8	1976		9m 38 - 44c	15245 - 15366	CD

	9	1976		9m 46 - 56c	15406 - 15607	CD
	10	1976		9m 56 - 10m 06c	15608 - 16211	CD
	11	1976		10m 08 - 30c	16251 - 16694	CD
	12	1976		10m 32 - 42c	16734 - 16935	CD
	13	1976		10m 44 - 52c	16975 - 17136	CD
	14	1976		10m 52 - 62c	17136 - 17337	CD
	15	1976		10m 64 - 72c	17377 - 17538	CD
	16	1976		10m 74 - 11m 04c	17582.1-17783.2	CD
	17	1976		11m 06 - 16c	17823.5 - 18024.6	CD
	18	1976		11m 18 - 28c	18064.9 - 18266.0	CD
	19	1976		11m 30 - 38c	8306.30 - 18467.2	CD
	20	1976		11m 40 - 50c	18507.5 - 18708.5	CD
	21	1976		11m 52 - 58c	18748.9 - 18869.6	CD
	22	1976		11m 59 - 66c	8892.70 - 19030.5	CD
	23	1976		11m 68 - 78c	19070.7 - 19271.9	CD
	24	1976		12m 00 - 10c	19312.1 - 19513.3	CD
	25	1976		12m 12 - 22c	19553.5 - 19865.3	CD
R450/22/5	1	1977	Floodway south of Edgecumbe railway right bank sections			CD
	2	1977				CD
	3	1977				CD
	4	1977			11500 - 11740m	CD
R450/22/6	1	1977	Floodway south of Edgecumbe railway left bank sections		8650 - 9290m	CD
	2	1977			9330 - 10010m	CD
	3	1977			10050 - 10650m	CD
	4	1977			10690 - 11260m	CD
	5	1977	Mc Cracken Rd return banks		0 - 60m	CD
R450/22/7	1	1976	Edgecumbe to Te Teko right bank existing cross sections Mc Crackens Bend			CD
R450/22/8	1	1976	Edgecumbe to Te Teko left bank culverts 3 to 7			CD
	2	1976	Edgecumbe to Te Teko left bank culverts 33 to 35			CD
R450/22/9	1	1981	Floodway south of railway culverts 8 to 17			CD
	2	1981	Floodway south of railway culverts 18 to 25			CD

	3	1981	Floodway south of railway culverts 26 to 33			CD
R450/22/10	1	1982	Floodway south of Edgecumbe railway Mc Cracken's Rd ramp over right stopbank			CD
R450/22/11	1	1981	Floodway south of Edgecumbe proposed stopbanks and culverts		8650 - 9210m	CD
	2	1981	borrow from Mc Cracken's bend		9210 - 9930m	CD
	3	1981	borrow from river berm		9930 - 10570m	CD
	4	1981	borrow from Sullivan's river berm		10570 - 11260m	CD
	5	1981	borrow from Sullivan's river berm		11500 - 11740m	CD
R450/22/12	1	1982	Floodway south of Edgecumbe Borrow A cross section 33 - 160			CD
	2	1982	Floodway south of Edgecumbe Borrow A cross section 180 - 368			CD
	3	1982	Floodway south of Edgecumbe Borrow B cross section 0 - 160			CD
	4	1982	Floodway south of Edgecumbe Borrow C cross section 20 - 180			CD
	5	1982	Floodway south of Edgecumbe Borrow C cross section 200 - 380			CD
	6	1982	Floodway south of Edgecumbe Borrow D cross section 0 - 280			CD
	7	1982	Floodway south of Edgecumbe Borrow E cross section 0 - 550			CD
R450/29/1	1	1978	Edgecumbe to Te Teko Right stopbank 15 to 19km layout plan		15 - 19km	CD
R450/29/2	1	1978	Edgecumbe to Te Teko Right stopbank 15 to 19km plan			CD
	2	1978				CD
	3	1978				CD
	4	1978				CD
R450/29/3	1	1978	Edgecumbe to Te Teko right stopbank 15 to 19km cross sections		15250 - 15420	CD
	2	1978			15450 - 15620	CD
	3	1978			15660 - 15820	CD
	4	1978			15860 - 16020	CD
	5	1978			16026 - 16140	CD
	6	1978			16180 - 16340	CD
	7	1978			16380 - 16540	CD
	8	1978			16580 - 16740	CD
	9	1978			16780 - 17140	CD

	10	1978			17180 - 17540	CD
	11	1978			17580 - 17740	CD
	12	1978			17750 - 17900	CD
	13	1978			17940 - 18100	CD
	14	1978			18140 - 18300	CD
	15	1978			18340 - 18500	CD
	16	1978			18540 - 18900	CD
	17	1978			18940 - 19220	CD
R573		1985	Realignment of stopbank - Sullivan, cross sections			
R450/29/4	1	1978	Edgecumbe to Te Teko right stopbank culverts 1 - 7		15 - 19km	CD
						CD
R450/41/1	1	1981	Te Teko section plan right bank 0 - 1100m			CD
R450/34/2	1	1979	Proposed borrow areas Edgecumbe			CD
	2	1979				CD
	3	1979				CD
	4	1979				CD
R450/35/2	1	1979	Proposed borrow area McCrackens Bend			CD
	2	1979				CD
	3	1979				CD
	4	1979				CD
R450/41/2	1	1981	Te Teko right bank cross sections 0- 500m			CD
	2	1981	600 - 1100m			CD
M535		1987	Rangitaiki Plains, changes in level following March 87 earthquake			
			contour plans around river			
R569	1	1985	Plan stopbank upgrading left bank upstream of Edgecumbe			CD
	2	1985	cross sections			CD
	3	1985	cross sections			CD

R602	1	1989	Post 1987 earthquake repairs right bank 11.2 - 14.6 km plan		11200 - 13700	CD
	2	1989	plan 13.7 - 14.6km		13700 - 14600	CD
	3	1989	cross sections 0 -250		11200 - 11450	CD
	4	1989	300 - 550		11500 - 11750	CD
	5	1989	600 - 850		11800 - 12050	CD
	6	1989	900 - 1150		12100 - 12350	CD
	7	1989	BM31R - 1450		12510 - 12650	CD
	8	1989	1490 - 1750		12690 - 12950	CD
	9	1989	1800 - 2050		13000 - 13250	CD
	10	1989	cross section 2100 - 2348		13300 - 13550	CD
	11	1989	2400 - 2650		13600 - 13850	CD
	12	1989	2700 - 2950		13900 - 14150	CD
	13	1989	3000 - 3300		14200 - 14500	CD
	14	1989	borrow area 1			CD
	15	1989	borrow area 4			CD
	16	1989	borrow area 4			CD
	17	1989	borrow area 4			CD
	18	1989	borrow area 4			CD
	19	1989	2100 - 2368		13300 - 13570	CD
R612	1	1989	Seepage at Thornton School			CD
	2	1989	Piezometer			CD
R638	1	1989	WDC stormwater culvert east bank			CD
R653	1	1991	Post 1987 earthquake restoration Black plan left bank			CD
	2	1991	Campbell			CD
	3	1991	Tangitu et al			CD
	4	1991	Wairi			CD
R654	1	1991	Post 1987 earthquake restoration Black et al plan right bank			CD
	2	1991				CD
R655	1	1991	Post 1987 earthquake restoration left bank plan Eruera et al			CD
	2	1991	Kokohinau Marae			CD

	3	1991	Ngaheu et al			CD
R656	1	1991	Post 1987 earthquake restoration right bank Ti Warbrick plan			CD
	2	1991	cross section			CD
	3	1991	-275 - -142			CD
	4	1991	100 - 350			CD
	5	1991	400 - 600			CD
	6	1991	650 - 850			CD
	7	1991	900 - 1100			CD
	8	1991	1150 - 1250 timber wall details			CD
	3	1991	-121 - 50 as built			CD
	4	1991	100 - 350 as built			CD
	5	1991	400 - 600 as built			CD
	6	1991	650 - 850 as built			CD
	7	1991	900 - 1100 as built			CD
	8	1991	1150 - 1250 timber wall details as built			CD
R664	1	1993	Post 1987 earthquake restoration left bank Edgecumbe plan		8200 - 11190	CD
	7	1993	cross sections 1433 - 1700		9633 - 9900	CD
	8	1993	1745 - 2000		9930 - 10065	CD
	9	1993	2030 - 2165		10230 - 10365	CD
	10	1993	2263 - 2500		10463 - 10700	CD
	11	1993	2567 - 2650		10767 - 10850	CD
	12	1993	2700 - 2750		10900 - 10950	CD
R674	1	1993	post 1987 earthquake restoration left ban flood wall Edgecumbe plan and detail		10365 - 10475	CD
	2	1993	wall 2 detail			CD
	3	1993	plan and long section			CD
	4	1993	wall 2 detail			CD
R675	1	1993	Post 1987 earthquake restoration downstream Edgecumbe bridge right and left banks		7940 - 10950	CD
	2	1993	left bank cross sections 0 - 250		7940 - 8440	CD
	3	1993	305 - 550		8245 - 8490	CD
	4	1993	590 - 830		8540 - 9047	CD
	5	1993	880 - 1107		9085 - 9243	CD
	6	1993	1145 - 1303		9085 - 9243	CD

	7	1993	right bank cross sections 0 - 240		7940 - 10940	CD
	8	1993	290 - 550		8230 - 8490	CD
	9	1993	600 - 846		8540 - 8786	CD
	10	1993	900 - 1150		8840 - 9090	CD
	11	1993	1200 - 1450		9140 - 9390	CD
	12	1993	1500 - 1700		9440 - 9640	CD
	13	1993	1750 - 1988		9690 - 9928	CD
	14	1993	2050 - 2300		9990 - 10240	CD
	15	1993	2350 - 2600		10290 - 10540	CD
	16	1993	2650 - 2826		10590 - 10766	CD
	17	1993	left bank borrow area 1A			CD
	18	1993	left bank borrow area 1A			CD
	19	1993	left bank borrow area 1A			CD
R728	1	2001	Stopbank restoration upstream from Thornton Left Bank		1950 - 3700	CD
	2	2001	cross section 50 - 500			CD
	3	2001	550 - 1000			CD
	4	2001	1050 - 1500			CD
	5	2001	1550 - 1850			CD
R730	2	2001	Stopbank restoration upstream from Thornton Left Bank		6340 - 5092	CD
	3	2001	cross section 2050 - 2456			CD
	4	2001	2500 - 2950			CD
	5	2001	3000 - 3250 wall details			CD
R734	2	2002	Stopbank Restoration upstream from Thornton Right Bank plan		3100 - 4300	CD
	3	2002	plan		5649 - 5999	CD
	4	2002	cross section 1100 - 1555			CD
	5	2002	1610 - 2050			CD
	6	2002	2100 - 2550			CD
	7	2002	2600 - 3050			CD
	8	2002	3100 - 3550			CD
	9	2002	5099			CD
R737	1	2002	Edgecumbe Substation stopbank improvements right bank, plan		12300 - 12700	CD
	2	2002	drain details			CD

	3	2002	long section			CD
	4	2002	drain details			CD
R739	2	2003	Stopbank upgrade upstream of Thornton right bank, plan		2000 - 3250	CD
	3	2003	cross sections			CD
	4	2003	cross sections			CD
R740	2	2003	Stopbank upgrade upstream of Thornton Laws Bend left bank		5300 - 6100	CD
	3	2003	cross section 3300 - 4100			CD
	4	2003	cross section 3300 - 4101			CD
R741	2	2003	Floodwalls upstream of Thornton left and right bank		3040 + 3810	CD
	3	2003	right bank wall details			CD
	4	2003	left bank wall details			CD

Appendix C

Subsurface Information Summary

Available subsurface information

positive offset on landward side of stopbank centreline
negative offset on river side of stopbank centreline

Left Bank

meterage	approx. offset (m)	source	depth (m)
483		Dwg R450/3/7	
1127		Dwg R450/3/7	
2340	-4	Thornton 1 HA1	1.5
2340	-9	Thornton 1 HA2	3.0
2340	15	Thornton 1 HA3	1.6
2413		Dwg R450/3/7	
2690	-16	Thornton 1 HA4	3.3
2690	16	Thornton 1 HA5	1.9
2790	-20	Thornton 1 HA6	1.9
3040	-21	Thornton 1 HA7	0.6
3040	0	Thornton 1 HA8	2.7
3390	-24	Thornton 1 HA9	1.9
3390	0	Thornton 1 HA10	3.2
3800		Liquefaction Morris	
3990	-13	Thornton 1 HA11	1.1
3990	1	Thornton 1 HA12	3.6
4590	0	Thornton 1 HA13	3.3
5090	-31	Thornton 1 HA14	3.1
5090	0	Thornton 1 HA15	3.7
5590	-19	Thornton 1 HA16	4.5
6390	0	Thornton 1 HA17	3.8
6390	-19	Thornton 1 HA18	1.5
7150	-16	Thornton 1 HA19	3.3
7150	-2	Thornton 1 HA20	4.3
10390		Edgecumbe B1	8.5
11200		Liquefaction Edgecumbe	16
11540		Edgecumbe B8	5.2
14125		Dwg R233 S1/9	
15900		Dwg R233 S1/9	
17850	18	Pryor P1	3.0
17850	44	Pryor P2	3.3
17850	76	Pryor P3	2.4
23800		Liquefaction Te Teko	15
23900		Liquefaction Keir	

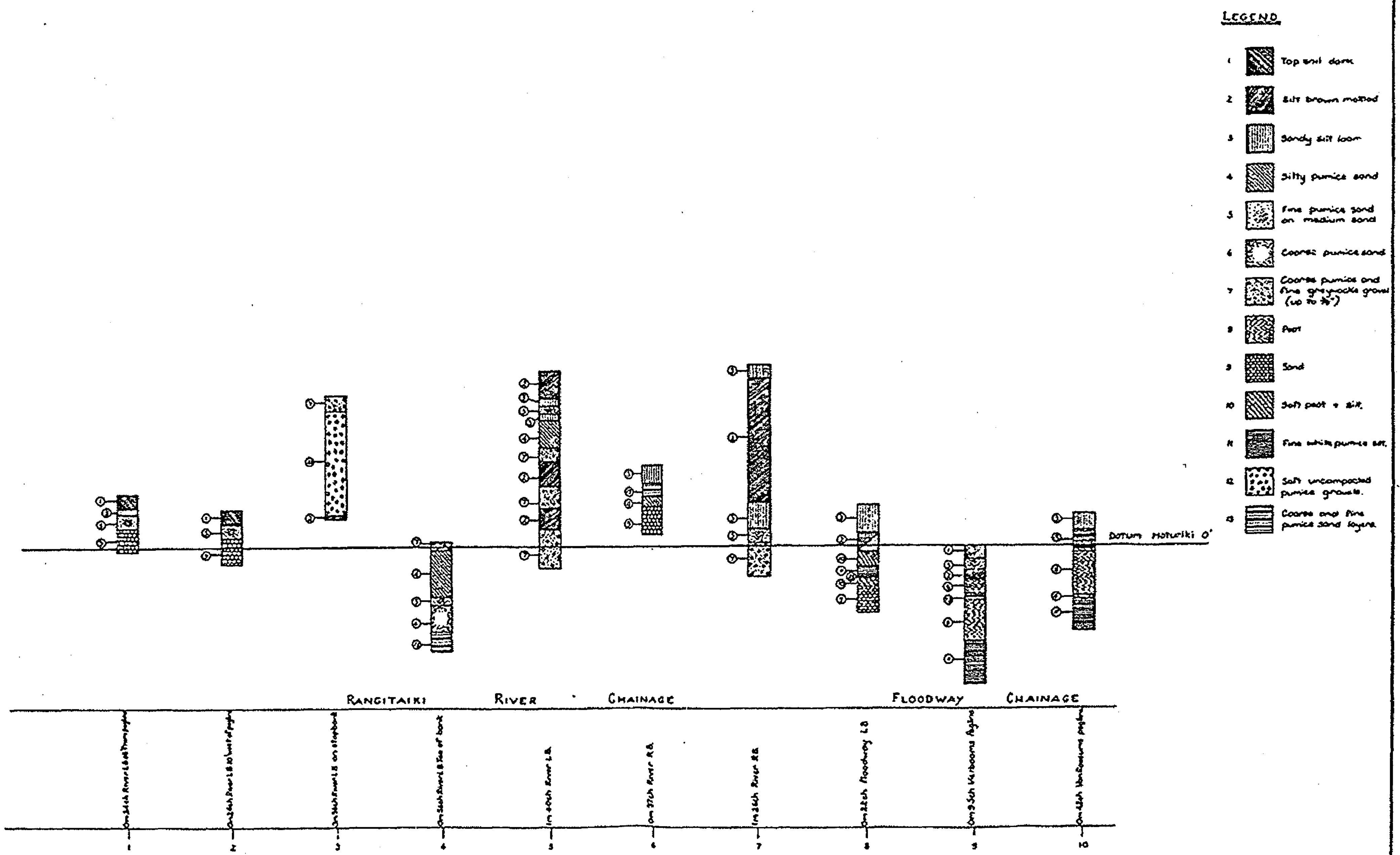
Right Bank

meterage	approx. offset (m)	source	depth (m)
744		Dwg R450/3/7	
2132		Dwg R450/3/7	
2490	15	Thornton School P1	3.5
2490	60	Thornton School P2	3.0
2490	90	Thornton School P3	3.0
2490	180	Thornton School P4	1.5
2640	30	Thornton School B1	3.0
2640	110	Thornton School B2	3.0
2640	195	Thornton School B3	3.0
2650		R233 S 9/9	
3020		Dwg R450/11/10	
3440	-1	Thornton 2 HA15	2.9
3440	-19	Thornton 2 HA16	3.3
3500		Dwg R450/11/10	
3990	-1	Thornton 2 HA13	2.8
3990	-12	Thornton 2 HA14	3.6
4500-4900		Dwg R233 S 7/9	
4670		Dwg R450/11/10	
4840	-3	Thornton 2 HA1	4.0
4840	-26	Thornton 2 HA2	2.6
4890	river berm	Thornton 2 HA3	3.5
5040	0	Thornton 2 HA4	3.6
5040	-20	Thornton 2 HA5	3.7
5110		Dwg R450/11/10	
5390	-1	Thornton 2 HA6	4.2
5390	-17	Thornton 2 HA7	3.6
5750		Dwg R450/11/10	
5990	-1	Thornton 2 HA8	4.3
5990	-12	Thornton 2 HA9	3.5
6890	0	Thornton 2 HA10	2.0
6890	-17	Thornton 2 HA11	3.0
6890	16	Thornton 2 HA12	3.5
6920		Dwg R450/11/10	
7100		Dwg R233 S6/9	
7560		Dwg R450/11/10	
11000		Liquefaction Awaroa	12
11000		Liquefaction Bay Milk	20
11070		Edgecumbe B3	3.3
11180		Edgecumbe B2	9.2
11200		Liquefaction Edgecumbe	16
11280		Edgecumbe B4	4.8
11280		Edgecumbe B5	9.3

12200-600		Dwg R233 S3/9	
12510		Edgecumbe B7	7.5
12620		Edgecumbe B6	6.4
12740	60	Blacks B6	2.6
12850	16	Blacks B4	1.8
12850	60	Blacks B5	1.4
12900	-10	Blacks B7	1.2
12900	10	Blacks B2	1.8
12900	60	Blacks B3	1.5
12960	80	Blacks B1	2.2
13110	12	Sullivans W4	5.0
13120	-12	Sullivans W3	7.0
13120	40	Sullivans BH2	15.0
13190	-12	Sullivans W2	5.0
13190	40	Sullivans BH1	15.0
13200	50	Sullivans W1	7.0

Laboratory Test Results

meterage	bank	soil	test	source
2300	LB	silt	grading	Matahina Site 28
2340	LB	sand	grading	Thornton 1 HA2
2340	LB	clayey sandy silt	grading	Thornton 1 HA1
3990	RB	gravely sand	grading	Thornton 2 HA14
4590	LB	sand	grading	Thornton 1 HA13
4590	LB	sand	grading	Thornton 1 HA13
4590	LB	sandy clayey silt	grading	Thornton 1 HA13
4840	RB	silty fine sand	grading	Thornton 2 HA1
4840	RB	sandy silt	grading	Thornton 2 HA1
4840	RB	sandy silt	grading	Thornton 2 HA2
4890	RB	sandy silt	grading	Thornton 2 HA3
5040	RB	sandy silt fill	compaction	Thornton 2
5090	LB	silt	grading	Thornton 1 HA14
5090	LB	silt fill	compaction	Thornton 1 HA14
5490	RB	sandy silt fill	compaction	Thornton 2
7150	LB	sandy silt	grading	Thornton 1 HA19
7150	LB	silt fill	compaction	Thornton 1 HA19
	LB	sandy silt fill	grading	Edgecumbe/Thornton 1
	LB	bulk fill	compaction	Edgecumbe/Thornton 1
10390	RB	silty sand	grading	Edgecumbe BH1
10390	RB	gravelly sand	grading	Edgecumbe BH1
11000	RB	silts,sands	grading	Liquefaction Awaroa
11280	RB	sand	permeability	Edgecumbe BH4
11180	RB	silty sand	grading	Edgecumbe BH2
11180	RB	silty coarse sand	grading	Edgecumbe BH2
11180	RB	sand	permeability	Edgecumbe BH2
11280	RB	silty med sand	grading	Edgecumbe BH4
11280	RB	silty fine sand	grading	Edgecumbe BH4
12510	RB	sand	permeability	Edgecumbe BH7
12510	RB	sandy silt	grading	Edgecumbe BH7
12620	RB	silt	grading	Edgecumbe BH6
12620	RB	sandy silt	grading	Edgecumbe BH6
13110	RB	silty sand fill	grading	Sullivans
13120	RB	Tarawera Ash	grading	Sullivans
13120	RB	sandy silt	grading	Sullivans
13120	RB	silty sand	grading	Sullivans
13120	RB	silty sand	grading	Sullivans
13200	RB	sandy silt	grading	Sullivans W1
13200	RB	stopbank fill	solid density	Sullivans
13200	RB	Tarawera Ash	solid density	Sullivans
15800	LB	sand	grading	Matahina Site 20
15800	LB	sand	triaxial	Matahina Site 20
23900	LB	sands, silts	grading	Liquefaction Keir



Note. For location refer to Plan R450/3/2 Sheet 1-8.

BAY OF PLENTY CATCHMENT COMMISSION							
RANGITAIKI & TARAWERA RIVERS MAJOR SCHEMES.	SURVEYED	L.T. Craig	7/71	APPROVED	SCALES	APPENDICES	PLAN NO.
RANGITAKI RIVER WIDENING STAGE I — BORE LOGS.	DRAWN	L.T. Craig	-	[signature]	4 ft to 1 inch Vertical		R450/3/7
	DESIGNED			CHIEF ENGINEER			Sheet 1 of 1 Sheets
	TRACED	C.J. Lunden	-				
	DESIGN CHECK						
	DR. CHECK	A.P. Gatten	-				

Beca Carter Hollings & Ferner Ltd (2001) Rangitaiki River Stopbank Assessment: Edgecumbe to Thornton.

(Thornton 1)

RECORD OF BOREHOLE	Sheet of	BH HA1
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 350m 3.5m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
			brown grey silty med pumice SAND, some pum. gravel → 3mm, damp						
0.5			0.4 light grey brown pum. SILT, damp	0.4	*				
			0.8 some orange staining.						
1.0			1.2 becoming damper, trace clay.						
1.5			1.4 blue grey angular gravel → 15mm 1.5 " old road " EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA2
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 350m 9.2m Coords: Elev.: Datum:	

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	SPT	Vane	Other	Lab Test
			brown grey SILT, fine fibrous roots, damp						
0.5			0.5 some fine pumice gravel → 2mm 0.6 grey/brown fine pumice SAND, moist, trace silt, becoming slightly coarser with depth, rare black specs	0.8	*				
1.0			0.9 grey med. pum SAND 1.08 blue grey fine pum SAND, trace clay, smell, liquefiable						
1.5			1.64 organic layer 1.75 grey clayey SILT, organic content						
2.0			2.05 soft fibrous organic material						
2.5			2.4 light grey pum SILT with organics, spongy. 2.6 white grey pum. SILT, liquefiable 2.7 white grey fine pum SAND 2.8 white grey med→coarse pum. SAND 2.9 grey SILT, firm						
3.0			3.0 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA3
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 350m -15.3m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown fine sandy SILT, some road gravel						
			0.4 orange mottled brown grey fine SAND						
			0.75 med → coarse pumice SAND						
1.0		D S							
			1.2 grey fine → med pum SAND						
			1.3 blue grey SILT with organic fibres & black fibrous peat bands						
1.5			1.6 EOB collapse						
2.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: N.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA4
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 700m. 15.8m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown fine silty SAND						
			0.45 brown silty med SAND						
1.0			0.7 brown fine SAND						
1.5		1.4 D S							
2.0			1.7 brown grey fine sandy SILT, some organics, spongy.						
2.5			2.4 some clay, greasy, increasing organic fibres						
3.0			2.9 30mm sandy layer, wood.						
3.5			3.3. EOB						

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA5
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 700 m -16 m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown & grey SILT						
			0.5 coarse dark grey SAND 0.53 brown & grey SILT, some fibre & organic layers, some greasy layers with clay.						
1.0		1.3 D S							
1.5									
2.0			1.9 EOB - squeezing						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA6
JOB NAME: Rangitaiki stopbank.	Location: 800 m 20 m	
CLIENT: EBOP	Coords:	
JOB NO.:	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			orange mottled grey fine sandy SILT/ silty SAND						
			0.6 becoming grey fine sandy SILT, some organics, spongy						
1.0									
1.5									
2.0			1.9 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.OH CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA7
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 1050 m 21m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
			brown grey silty fine SAND, fine roots						
			-0.2 brown silty angular gravel →3mm						
0.5		D	-0.45 some pumice →3mm.						
		S	-0.50 brown coarse pumice SAND & fine gravel, rare pumice →50mm						
			-0.6 EOB collapse						
1.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA8
JOB NAME: Rangitaiki Stopbank CLIENT: E Bop JOB NO.:	Location: 1050m 0m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown mottled grey SILT						
			0.6 some pumice						
			0.7 brown mottled grey SILT						
			0.8 becoming moist						
1.0			1.1 grey sandy SILT some pumice → 5mm.						
			1.3 light grey fine pumice SAND						
1.5			1.5 becoming coarse pumice SAND some finer grey SAND layers						
2.0		2.2 ▽ ?							
2.5			2.7 EOB						
3.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA9
JOB NAME: Rangitaiki Stopbank	Location: 1400m	
CLIENT: EBOP	24m	
JOB NO.:	Coords:	
	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			orange mottled grey fine sandy SILT						
			-0.6 grey fine silty SAND, organic fibres, liquefiable						
1.0			-0.9 becoming blue grey fine sandy SILT / silty SAND with organic fibres, liquefiable, spongy.						
1.5									
2.0			-1.9 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH H A10
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 1400m 0m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown grey fine sandy SILT						
			0.3 30mm grey med → coarse SAND layer						
1.0			0.7 becoming moist						
1.5			1.5 Light grey brown/orange fine sandy SILT / silty SAND, spongy, highly friable.						
		1.8 ▽ S							
2.0									
2.5			2.6 grey SILT some clay, some orange staining, soft						
3.0			3.15 EOB						
3.5									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample ⋐ undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 21/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA11

JOB NAME: Rangitaiki Stopbank	Location: 2000m 12.5m edge of road
CLIENT: EBOP	Coords:
JOB NO.:	Elev.: Datum:

Depth (m)	Strata			Sample		Field Tests			Lab Test
	LGD	SYM	Description	Depth (m)	Type	SPT	Vane	Other	
	x·o·x·o		brown sandy silt + road metal angular rock ≤200mm						
0.5									
1.0			0.9 becoming damper						
			1.1 EOB						
1.5									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01	CORE DIA:	RIG:
DATE FINISHED:	LOGGED BY: M.O.H	CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA12
JOB NAME: Rangitaiki stopbank CLIENT: EBOP JOB NO.:	Location: 2000 m - 1 m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.0			brown grey fine sandy SILT						
0.4			brown grey fine silty SAND, damp						
0.6			becoming moist						
1.0			1.1 becoming spongy with some organic fibres & iron staining.						
1.5									
2.0		2.0 B S							
			2.1 brown grey SILT, some clay, soft						
2.5			2.4 brown grey fine silty SAND, dilatant						
			2.8 grey fine SAND, dilatant						
3.0									
			3.3 - 100mm silt layer some organic material, roots						
3.5			3.6 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA13
JOB NAME: Rangitaiki Stopbank	Location: 2600m 0m	
CLIENT: EBOP	Coords:	
JOB NO.:	Elev.:	Datum:

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	Field Tests SPT	Field Tests Vane	Field Tests Other	Lab Test
0.5			light orange brown fine sandy SILT						
			0.4 becoming grey with orange mottles 0.5 becoming grey with orange veins fine sandy SILT, rare pum sand						
1.0			0.9 moist	0.8	*				
			1.2 becoming fine silty SAND						
1.5			1.4 grey fine pumice SAND 1.45 white coarse pumice SAND & fine GRAVEL, with grey fine SAND layers.	1.6	*				
2.0			2.2 becoming med → coarse pumice SAND, rare rounded hard gravel						
		3.0 D S	2.8 becoming wet						
3.0			3.3 EOB collapse						
3.5									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE	Dial No.	
DATE STARTED: 22/3/01 DATE FINISHED:	CORE DIA: LOGGED BY: N.O.H	RIG: CONTRACTOR:

Beca Carter Hollings & Ferner — Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA14
JOB NAME: Rangitaiki Stopbank	Location: 3100m 30.6m	
CLIENT: EBOP	Coords:	
JOB NO.:	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.0			brown silty fine SAND, some med → coarse sand						
0.5			0.6 orange mottled grey fine silty SAND						
1.0			1.2 grey fine pumice SAND						
1.5			1.5 grey med → coarse pumice SAND, some fine gravel, some orange staining.						
2.0			2.0 becoming coarse						
2.5		▽ S	2.4 becoming fine GRAVEL, wet						
3.0			3.1 EOB, collapse						
3.5									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H. CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA15
JOB NAME: Rangitaiki Stopbank	Location: 3100m	
CLIENT: EBOP	0m	
JOB NO.:	Coords:	
	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.0			brown silty fine SAND						
0.1			grey with orange mottles, silty fine SAND, damp						
0.5									
1.0									
1.2			becoming moist, spongy, dilatant						
1.5									
1.9			becoming fine sandy SILT, trace clay						
2.0									
2.4			grey fine pumice SAND, orange staining.						
2.5									
2.7			grey fine pumice SAND, wet spongy.						
3.0									
3.5			3.7 EOB, collapse						

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA16
JOB NAME: Rangitaiki Stopbank CLIENT: EBOB JOB NO.:	Location: 3600m 19m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			brown silty fine SAND, mixed med pumice SAND						
1.0			0.9 orange mottled grey silty fine SAND, spongy						
1.5									
2.0									
2.5			2.7 charcoal fragments						
3.0			2.9 orange grey fine sandy SILT, some clay. 3.2 grey with orange streaks clayey SILT some roots 3.6 grey fine pumice SAND, wet 4.5 becoming fine-med grey SAND						

OBSERVATIONS: EOB

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA17
JOB NAME: Rangitaiki Stopbank	Location: 4400m 0m	
CLIENT: EBOP	Coords:	
JOB NO.:	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
			brown fine silty SAND						
0.5									
			0.6 black medium → coarse SAND						
			0.65 orange mottled grey fine SAND						
1.0									
1.5									
2.0									
2.5									
			2.7 pumice pieces → 50mm						
3.0									
			3.3 mixed layers coarse orange stained pum. SAND + pum pieces → 50mm / grey med SAND / black fibrous org. SILT peat } mainly coarse SAND						
		3.6 ▽							
			3.8 EOB						

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01	CORE DIA:	RIG:
DATE FINISHED:	LOGGED BY: M.O.H	CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA18
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.:	Location: 4400 m 19 m Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
			orange mottled grey silty fine SAND						
			0.2 grey fine SAND						
0.5									
1.0			1.0 grey med SAND, wet						
1.5			1.5 EOB collapse						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M·O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA19
JOB NAME: Rangitaiki Stopbank	Location: 5166 m	
CLIENT: EBOP	16 m	
JOB NO.:	Coords:	
	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.0			grey with orange mottles silty fine SAND, firm		↓				
1.2			becoming darker grey & crumbly, stiff.						
1.4			light grey with orange mottles silty fine SAND						
2.0			wet, spongy						
2.4			grey fine silty SAND, some organics.						
2.9			grey fine SAND, becoming wet						
3.3			EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet of	BH HA20
JOB NAME: Rangitaiki Stopbank	Location: 5166 m 2m	
CLIENT: EBOP	Coords:	
JOB NO.:	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0.5			light brown silty fine SAND/ sandy SILT						
1.0									
			1.2 light grey brown fine→med silty SAND						
1.5									
			1.8 light grey brown fine silty SAND						
2.0			2.1 orange mottled grey fine sandy SILT, some clay.						
			2.4 light orange mottled grey silty fine SAND, moist						
2.5									
3.0									
			3.6 grey silty fine SAND, spongy, some org						
3.5			4.3 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/01 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

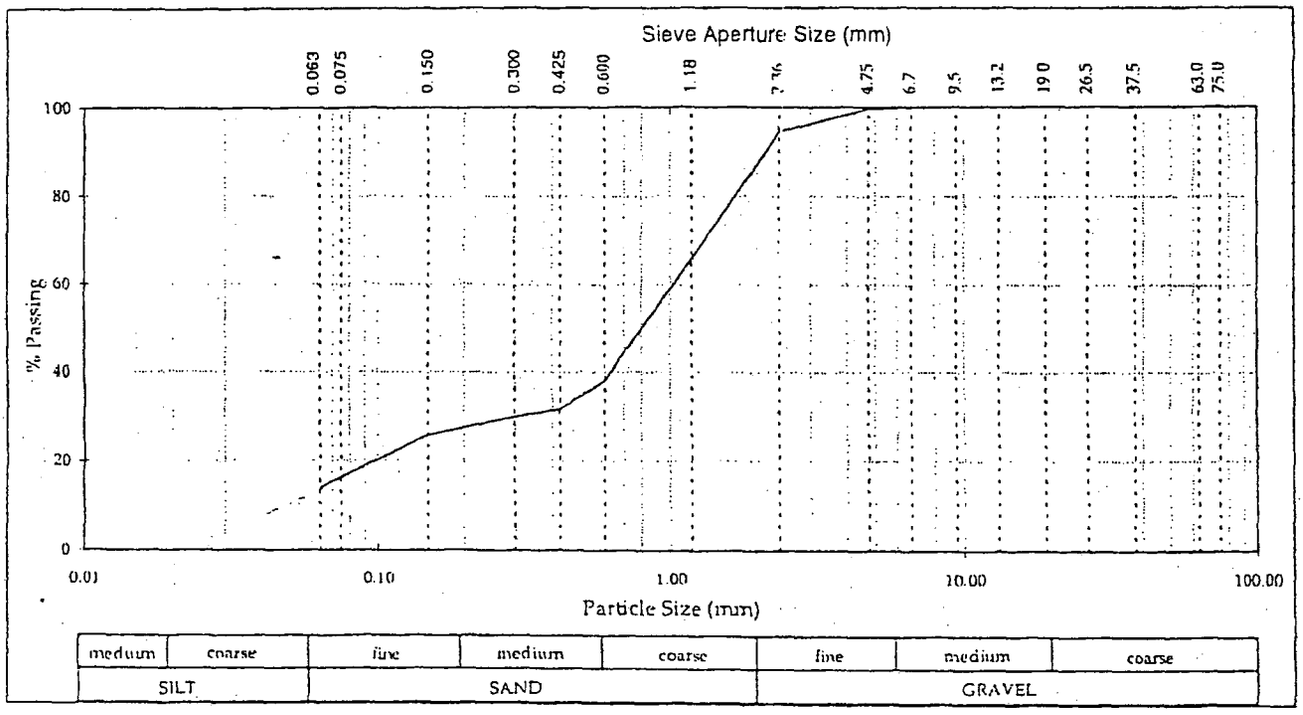
WET SIEVE ANALYSIS TEST REPORT

Project :	Rangitaiki Stopbanks
Location :	Unknown
Client :	Beca Carter Hollings and Ferner Ltd
Contractor :	N/A
Sampled by :	Dr M O'Halloran (Beca Carter)
Date sampled :	Unknown
Sampling method :	Unknown
Sample description :	Sand
Sample condition	Natural State
Bore hole no :	unknown
Depth (m) :	1.6m

Project No :	255545.04/0TL
Lab Ref No :	9585D
Client Ref :	2600m 1.6m

Sieve Analysis

Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
63.00	-	13.20	-	2.36	94	0.300	30
37.50	-	9.50	-	1.18	66	0.150	26
26.50	-	6.70	100	0.60	38	0.075	16
19.00	-	4.75	100	0.425	32	0.063	14



Test method	Notes
NZS 4402:1986 Test 2.8.1	History : Natural State Fraction tested : Whole Soil Dispersant: Sodium Hexametaphosphate Percentage passing finest sieve obtained by difference. This report may only be reproduced in full.

Date tested : 2 April 2001
Date reported : 10 April 2001

IANZ Approved Signatory M.B. Carter

PRELIMINARY REPORT
Subject to checking

Designation : *Laboratory Manager*
Date : 10 April 2001

CSF 2099 (5/00)

Opus International Consultants Limited
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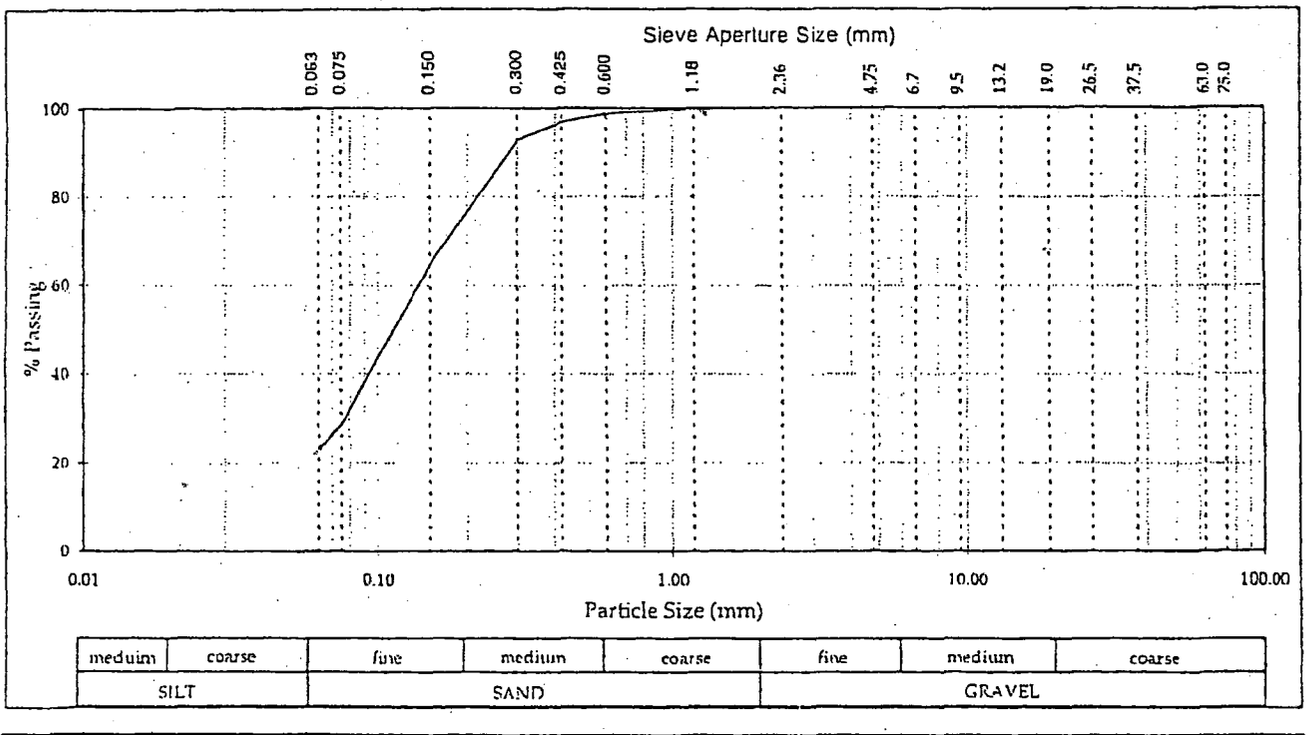
WET SIEVE ANALYSIS TEST REPORT

Project :	Rangitaiki Stopbanks
Location :	Unknown
Client :	Beca Carter Hollings and Ferner Ltd
Contractor :	N/A
Sampled by :	Dr M O'Halloran (Beca Carter)
Date sampled :	Unknown
Sampling method :	Unknown
Sample description :	Sand
Sample condition	Natural State
Bore hole no :	2
Depth (m) :	0.8m

Project No :	255545.04/0TL
Lab Ref No :	9585C
Client Ref :	HA2 0.8m

Sieve Analysis

Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
63.00	-	13.20	-	2.36	100	0.300	93
37.50	-	9.50	-	1.18	100	0.150	65
26.50	-	6.70	-	0.60	99	0.075	28
19.00	-	4.75	100	0.425	97	0.063	23



Test method	Notes
NZS 4402:1986 Test 2.8.1	History : Natural State Fraction tested : Whole Soil Dispersant: Sodium Hexametaphosphate Percentage passing finest sieve obtained by difference. This report may only be reproduced in full.

Date tested : 30 March 2001
Date reported : 10 April 2001

IANZ Approved Signatory m.g.

Designation : *Laboratory Manager*
Date : 10 April 2001

PRELIMINARY REPORT
Subject to checking

CSF 2099 (5/00)

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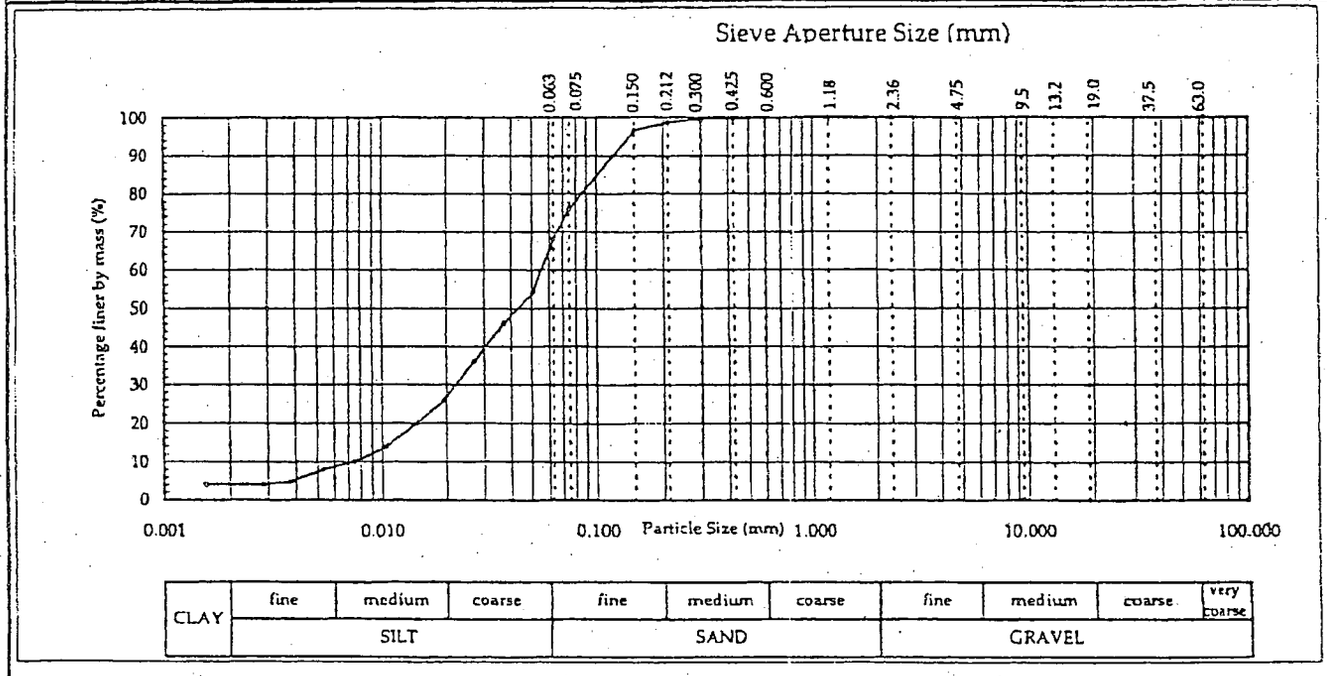
PARTICLE SIZE ANALYSIS TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Source:
Client : Beca Carter Hollings & Ferner Ltd, Tauranga
Client/Sample Ref : 9585E
Contractor : -
Sample ID: Silt (3100m)
Sampled by : M. O'Halloran
Date received : 03/04/01
Sampling method : Bulk sample
Sample condition : As received water content
Sample description : Greyish brown Silt.
Solid Particle Density (t/m^3): 2.60 assumed
Water Content (as received): 30.1 %

Project No: 2-55545.04
Lab Ref No: 01/317/002
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0509	54	0.0075	10
37.5	--	2.36	100	0.212	99	0.0370	46	0.0053	8
19.0	--	1.18	100	0.150	96	0.0270	36	0.0038	5
13.2	--	0.600	100	0.075	76	0.0197	26	0.0029	4
9.5	--	0.425	100	0.063	68	0.0146	20	0.0016	.4
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0105	14		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 05/04/01

Sampling is not covered by IANZ Accreditation

Date Reported: 06/04/01

This report may only be reproduced in full

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 06/04/01

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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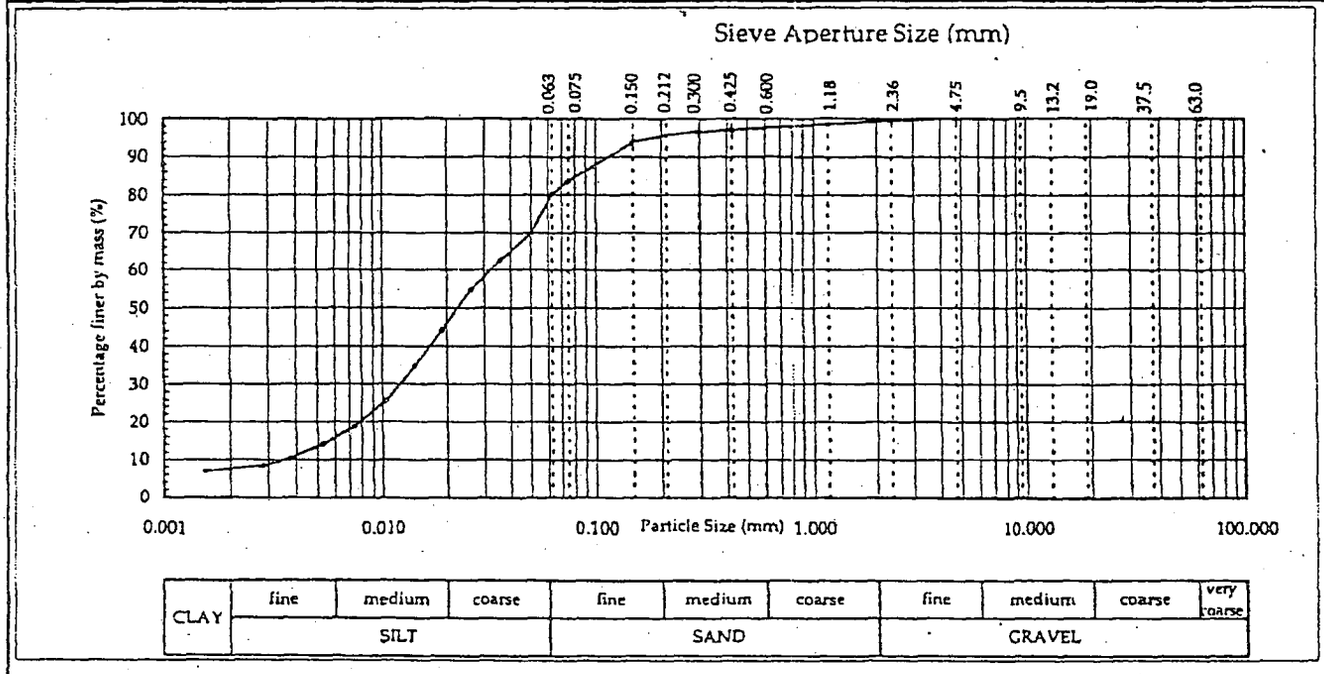
PARTICLE SIZE ANALYSIS TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Source:
Client : Beca Carter Hollings & Ferner Ltd, Tauranga
Client/Sample Ref : 9585F
Contractor : -
Sample ID: Silt (5166m)
Sampled by : M. O'Halloran
Date received : 03/04/01
Sampling method : Bulk sample
Sample condition : As received water content
Sample description : Greyish brown sandy Silt.
Solid Particle Density (t/m^3): 2.60 assumed
Water Content (as received): 36.2 %

Project No: 2-55545.04
Lab Ref No: 01/317/002
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	–	4.75	100	0.300	97	0.0498	70	0.0074	19
37.5	–	2.36	99	0.212	96	0.0360	63	0.0053	14
19.0	–	1.18	98	0.150	94	0.0260	55	0.0037	10
13.2	–	0.600	98	0.075	84	0.0190	44	0.0028	8
9.5	–	0.425	97	0.063	80	0.0142	35	0.0016	7
Note: "–" denotes sieve not used and/or hydrometer analysis not tested						0.0103	25		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 05/04/01

Date Reported: 06/04/01

Sampling is not covered by IANZ Accreditation

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IANZ Approved Signatory
Designation : *Senior Civil Engineering Technician*
Date : 06/04/01

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PARTICLE SIZE ANALYSIS TEST REPORT

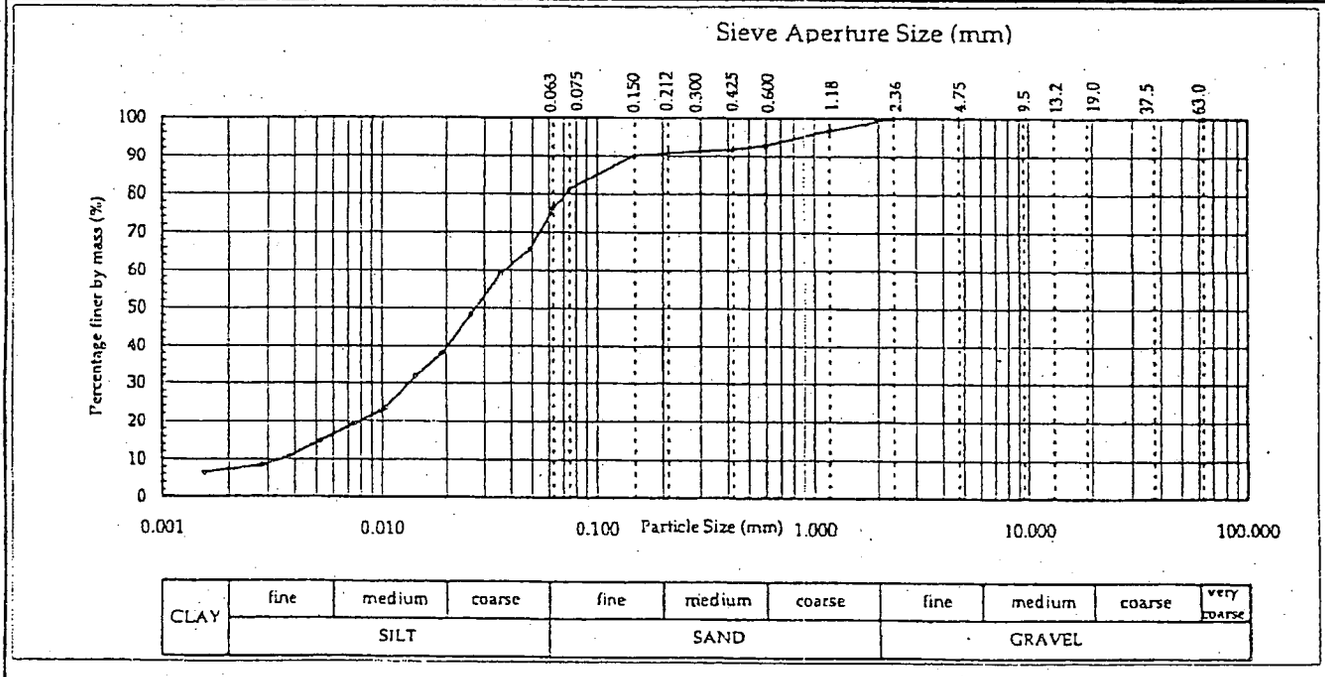
OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Source:
Client : Beca Carter Hollings & Ferner Ltd, Tauranga
Client/Sample Ref : 9610
Contractor : -
Sample ID: Sandy Silt Depth: - metres
Sampled by : M. O'Halloran
Date received : 03/04/01
Sampling method : Bulk sample
Sample condition : As received water content
Sample description : Greyish brown sandy Silt + Black nodules
Solid Particle Density (t/m^3): 2.60 assumed
Water Content (as received): 28.3 %

Edgecumbe

Project No: 2-55545.04
Lab Ref No: 01/317/002
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	–	4.75	100	0.300	91	0.0494	66	0.0074	19
37.5	–	2.36	100	0.212	91	0.0357	59	0.0053	15
19.0	–	1.18	97	0.150	90	0.0262	48	0.0037	11
13.2	–	0.600	93	0.075	81	0.0191	38	0.0028	8
9.5	–	0.425	92	0.063	76	0.0142	32	0.0016	6
Note: "–" denotes sieve not used and/or hydrometer analysis not tested						0.0103	23		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 05/04/01

Date Reported: 06/04/01

Sampling is not covered by IANZ Accreditation

IANZ Approved Signatory
Designation : Senior Civil Engineering Technician
Date : 06/04/01

Laboratory

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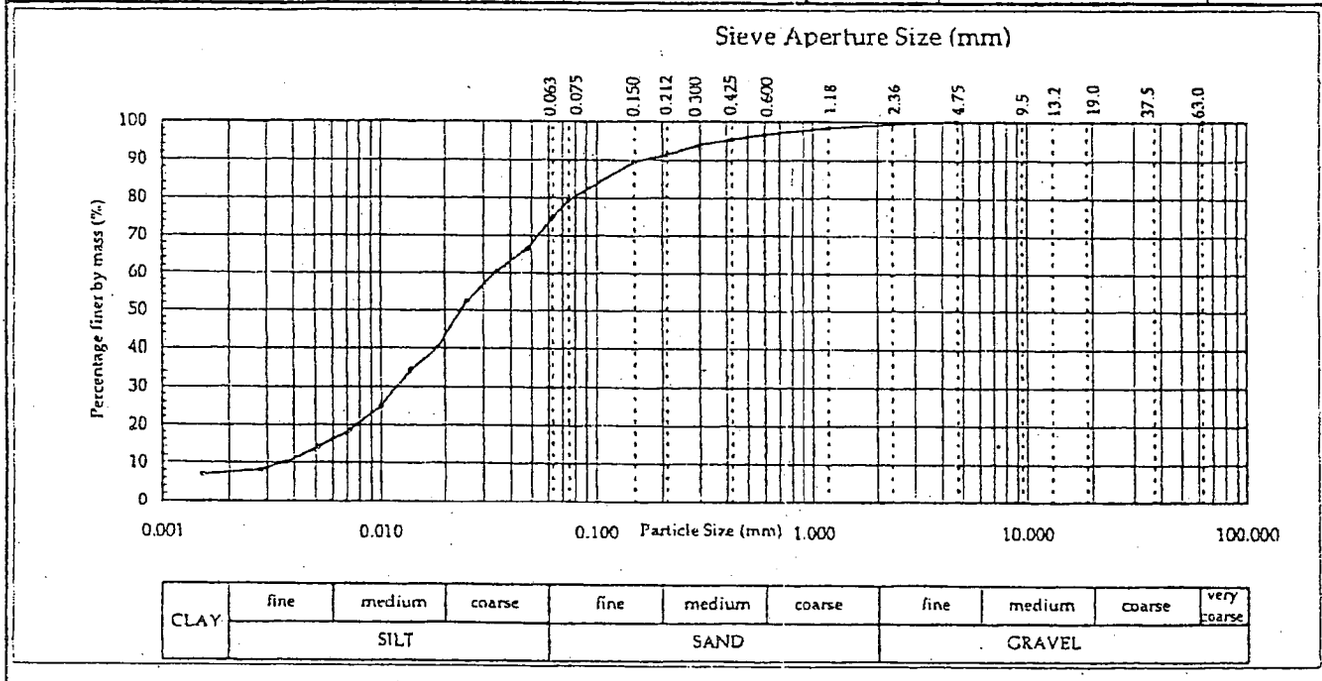
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Source:
Client : Beca Carter Hollings & Ferner Ltd, Tauranga
Client/Sample Ref :
Contractor : -
Sample ID: HA1 Depth: 0.40 metres 350 m
Sampled by : M. O'Halloran
Date received : 27/03/01
Sampling method : Bulk sample
Sample condition : As received water content
Sample description : Greyish brown clayey sandy Silt.
Solid Particle Density (t/m^3): 2.60 assumed
Water Content (as received): 30.9 %

Project No: 2-55545.04
Lab Ref No: 01/317/001
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	94	0.0478	66	0.0072	19
37.5	--	2.36	99	0.212	91	0.0346	60	0.0052	14
19.0	--	1.18	98	0.150	89	0.0252	52	0.0037	10
13.2	--	0.600	97	0.075	79	0.0185	40	0.0028	8
9.5	--	0.425	95	0.063	75	0.0138	34	0.0015	7
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0100	25		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole soil

Date Tested: 28/03/01

Sampling is not covered by IANZ Accreditation

Date Reported: 29/03/01

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IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 29/03/01

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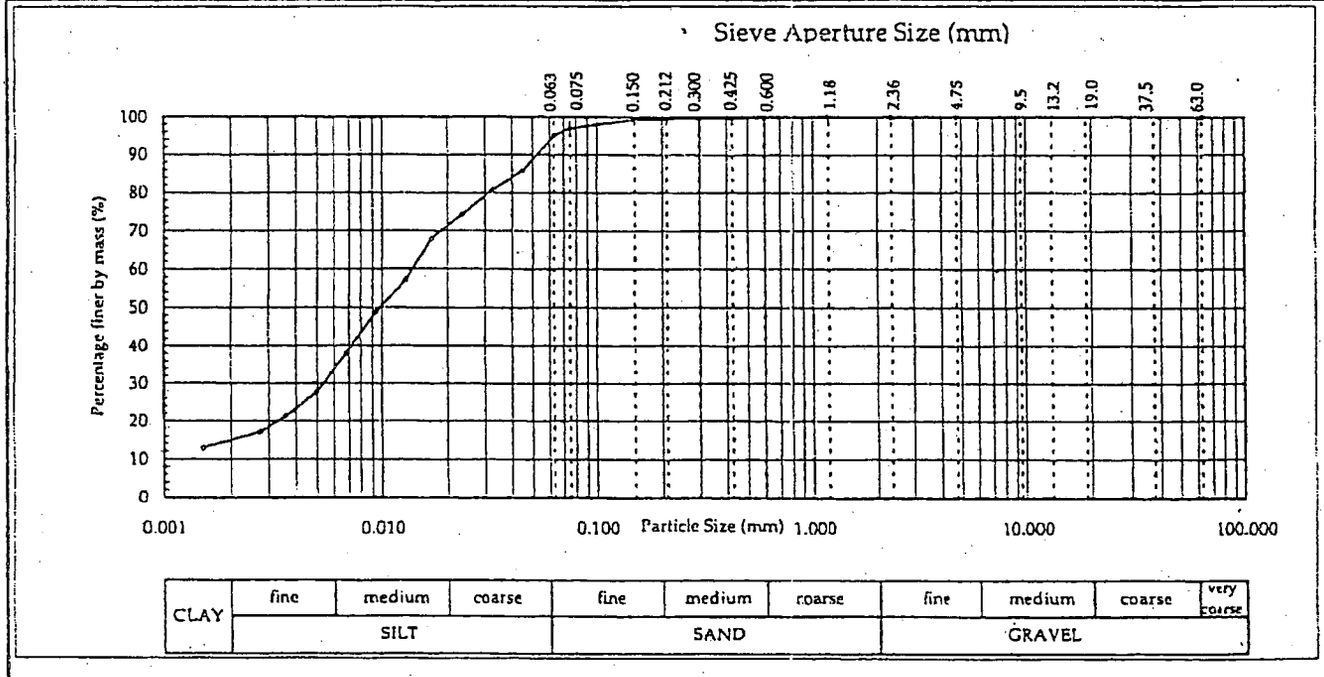
PARTICLE SIZE ANALYSIS TEST REPORT

Project : Rangitaiki Stopbanks
Source:
Client : Beca Carter Hollings & Ferner Ltd, Tauranga
Client/Sample Ref :
Contractor : -
Sample ID: 2600m Depth: 0.80 metres
Sampled by : M. O'Halloran
Date received : 27/03/01
Sampling method : Bulk sample
Sample condition : As received water content
Sample description : Greyish brown sandy clayey Silt.
Solid Particle Density (t/m^3): 2.60 assumed
Water Content (as received): 45.0 %

Project No: 2-55545.04
Lab Ref No: 01/317/001
Client Ref:

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	–	4.75	100	0.300	99	0.0450	86	0.0069	38
37.5	–	2.36	100	0.212	99	0.0325	81	0.0050	28
19.0	–	1.18	100	0.150	99	0.0235	74	0.0036	21
13.2	–	0.600	100	0.075	97	0.0170	68	0.0027	17
9.5	–	0.425	100	0.063	95	0.0129	57	0.0015	13
Note: "–" denotes sieve not used and/or hydrometer analysis not tested						0.0094	49		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested: Whole soil

Date Tested: 28/03/01

Sampling is not covered by IANZ Accreditation

Date Reported: 29/03/01

This report may only be reproduced in full

IANZ Approved Signatory
Designation : *Senior Civil Engineering Technician*
Date : 29/03/01

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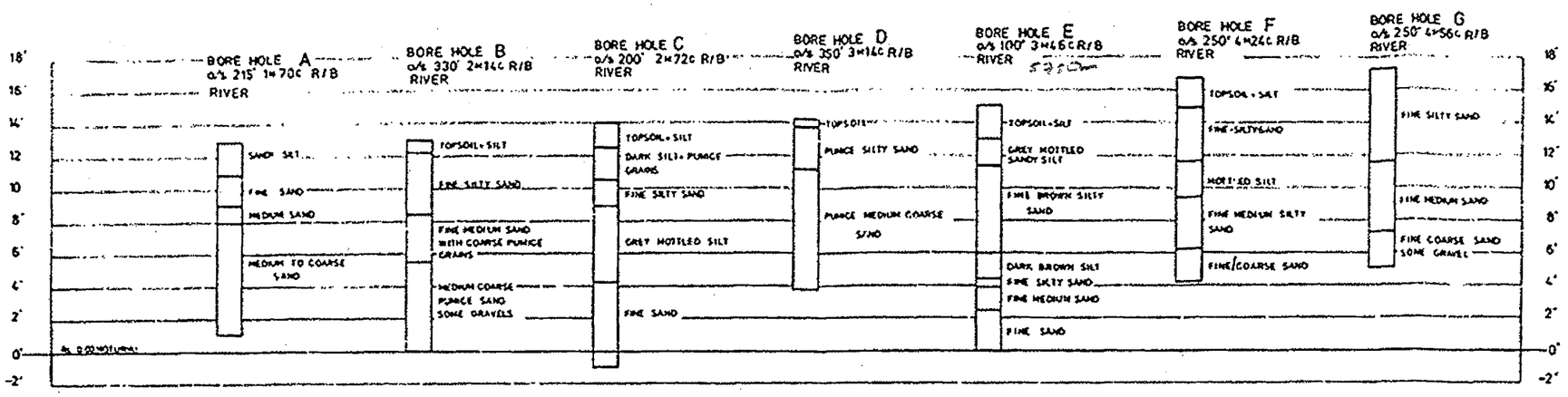
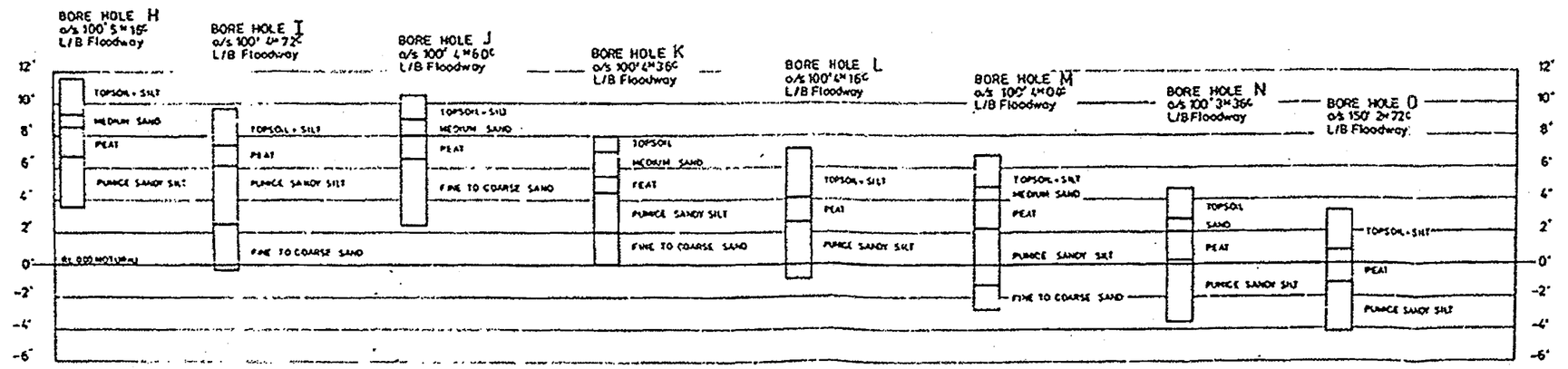
Facsimile +64 7 856 2873
Website www.opus.co.nz

Beca Carter Hollings & Ferner Ltd (2002) Rangitaiki River Stopbank Assessment: Edgecumbe to Thornton (RHS).

(Thornton 2)





BAY OF PLENTY CATCHMENT COMMISSION

RANGITAIKI TARAWERA RIVERS MAJOR SCHEME

RANGITAIKI RIVER WIDENING STAGE II

BORELOGS

SURVEYED	O G M	8/72	
DRAWN	-	-	
DESIGNED			
TRACED	D F A	1.73	
DESIGN CHECK			
DR CHECK	DFA	9/73	

APPROVED

CHIEF ENGINEER

SCALES: 4 feet to an inch vertical

REFERENCES: DATUM MOTUEKA

PLAN NO: R450/111/10

SHEET 1 OF 3 SHEETS

RECORD OF BOREHOLE | Sheet 1 of | BH 15

JOB NAME: Rangitaiki Stopbank

Location: 1450 m A.H.S. 1m from peg

CLIENT: EBOP

Coords:

JOB NO.: 93017391/01D

Elev.: Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			brown silty fine SAND, some fine pumice						
			0.3 orange brown mottled grey fine sandy SILT / silty SAND						
			0.5 orange brown mottled light grey fine SAND, fluffy.	0.6	*				
1.0									
			1.7 becoming darker grey & moist						
2.0			2.05 orange brown stained grey med-coarse SAND						
		275 D		2.2	*				
		S	2.7 black iron stained layer on top of coarse pumi SAND						
3.0			2.85 EOB						
4.0									

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 27/3/01 CORE DIA: RIG:

DATE FINISHED: LOGGED BY: R.O.H CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 16
JOB NAME: Rangitaiki Stopbanks	Location: 1450m RHS 19.2m from peg	
CLIENT: EBOP	Coords:	
JOB NO.: 9301739	Elev.:	Datum:

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	Field Tests SPT	Field Tests Vane	Field Tests Other	Lab Test
0			brown silty fine SAND/sandy SILT						
			0.3 orange mottled light grey fine SAND, fluffy						
1.0									
2.0			2.1 grey med → coarse SAND						
3.0		D	3.1 wet						
		S	3.2 grey coarse SAND						
			3.5 EOB						
4.0									

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 27/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: T.O'H CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 13
JOB NAME: Rangitaiki Stopbank	Location: 2000m RHS 1m	
CLIENT: EBOP	Coords:	
JOB NO.: 9301739 / 010	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
1.0			brown silty SAND, some pumice lapilli 0.5mm 0.6 orange brown mottled grey SILT, some sand & clay, plastic, damp 1.0 orange brown mottled grey fine sandy SILT/silty SAND 1.2 some fine lapilli & pumice ~20mm 1.7 orange brown mottled grey fine silty SAND, moist						
2.0			2.3 orange brown mottled grey fine SAND						
3.0		2.8 ▽	2.65 orange/yellow grey well graded pumice SAND, some fine gravel 2.8 EOB						
4.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 14
JOB NAME: Rangitaiki Stopbank	Location: 2000m RHS. 12m from peg	
CLIENT: EBOP	Coords:	
JOB NO.: 9301739/010	Elev.:	Datum:

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	Field Tests SPT	Field Tests Vane	Field Tests Other	Lab Test
0			Light brown fine silty SAND						
			0.6 orange brown mottled grey fine sandy SILT/silty SAND, damp	0.9	*				
1.0									
			1.6 orange brown mottled grey fine silty SAND	1.8	*				
2.0			2.15 orange brown mottled fine SAND, damp						
			2.9 orange stained grey med → coarse pum SAND						
3.0		3.2	3.15 grey med-coarse pum SAND & fine black gravel, rare pum >20mm	3.6	*				
			3.55 EOB						
4.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 27/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: CH CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 1
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.: 9301739/010	Location: Right bank 2850m 3.2 m from fence. Coords: Elev.: Datum:	

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	SPT	Vane	Other	Lab Test
			Light brown silty well graded pumice SAND						
			0.5 becoming damp, rare angular grey gravel → 12mm						
			0.75 orange stained dark grey fine sandy SILT						
1.0			1.2 trace of organic material becoming spongy						
2.0			2.3 grey silty fine SAND						
			2.65 light grey well graded pum SAND lapilli to 2mm						
3.0			2.7 Light grey fine SAND						
			3.2 grey well graded pum SAND						
			3.6 some fine black SAND						
			3.75 becoming wet						
4.0			3.9 grey coarse SAND & fine pum lapilli						
			4.0 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 DATE FINISHED:	CORE DIA: LOGGED BY: MOH	RIG: CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 72
JOB NAME: Rangitaiki Stopbanks	Location: 2850m RHS 2km from flume	
CLIENT: EBOP	Coords:	
JOB NO.: 3301737.000	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			light brown pumiceous silt	0.3	↓				
			0.3 light brown grey pumiceous silty fine SAND/ sandy silt						
1.0			0.7 light grey brown fine SAND						
			1.55 grey well graded pum SAND & fine lapilli						
			1.7 grey well graded pum SAND						
2.0			1.9 becoming moist						
			2.1 becoming wet						
			2.3 grey pum. sandy fine GRAVEL wet						
		D	2.5 fine pum GRAVEL coarse SAND some rounded to subangular gravel						
3.0		S	2.6 FOB grey well graded pum. SAND						
4.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
bulk sample	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/2/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 3
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.: 9301739 / 010	Location: 2900m RHS by orchard in front of stopbank Coords: Elev.: Datum:	

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	SPT	Vane	Other	Lab Test
			brown powdery SILT						
			0.3 light brown grey fine sandy SILT	0.5	U				
1.0			1.35 brown grey fine sandy SILT / silty fine SAND, damp, some organics						
			1.6 grey fine silty SAND						
2.0			2.55 trace organics						
			2.7 fine pumice GRAVEL, trace						
3.0			2.8 pum. → 30mm.						
			2.85 grey well graded SAND						
			3.1 fine pumice GRAVEL & coarse SAND						
			3.5 grey well graded SAND, wet						
4.0			EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: MDW CONTRACTOR: A.H

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 4
JOB NAME: Rangitaiki Stopbank	Location: 3050m RHS by peg	
CLIENT: EBOP	Coords:	
JOB NO.: 93017739/010	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
			brown silty fine SAND						
			0.35 dark grey brown organic SILT, damp	0.5	*				
1.0			0.85 light grey mottled orange fine sandy SILT	1.0	*				
			1.2 becoming wet, spongy						
2.0			2.3 grey silty fine SAND, some fine pum. Lapilli						
3.0			2.8 orange stained grey well graded fine gravel	3.0	*				
		3.5	3.35 grey well graded SAND						
			3.55 EOH						
4.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR: A H

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 5
JOB NAME: Rangitaiki Stopbank	Location: 3050m RHS 19.6m from peg	
CLIENT: EBOP	Coords:	
JOB NO.: 9301739/010	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			brown silty SAND some fine pumice 0.3 lapilli brown mottled grey, fine sandy SILT 0.6 becoming dark grey sandy SILT with organics, damp						
1.0			1.1 orange mottled grey fine sandy SILT, damp 1.6 grey fine SAND, trace fine lapilli						
2.0									
3.0			2.95 grey well graded pumiceous SAND 3.15 fine pumiceous lapilli with coarse SAND, some fine grey gravel						
4.0		3.7	3.7 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR: A H

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 6
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.: 9301230/000	Location: 3400m RHS 1m from peg. Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			Light brown fine sandy SILT / silty SAND						
			0.55 orange stained dark grey fine sandy SILT, damp						
1.0			0.75 orange stained dark grey SILT, some clay, some plasticity, damp						
			1.45 becoming lighter grey, spongy						
			1.75 orange mottled grey fine silty SAND / sandy SILT, spongy, damp → moist	1.9	*				
2.0									
3.0			3.1 grey fine SAND, spongy, wet	3.2	*				
			3.2 some timber fragments						
4.0			4.15 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: IT·DH CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 7
JOB NAME: Rangitaiki Stopbank	Location: 3400m RHS 17.1m from peg	
CLIENT: EBOP	Coords:	
JOB NO.: 9301739/010	Elev.:	Datum:

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			Light brown silty fine SAND, rare pumice < 15mm						
			0.7 dark grey SILT, some clay minor plasticity						
1.0			0.85 orange stained light grey silty fine SAND/sandy SILT						
2.0			2.1 orange stained light grey fine SAND, spongy						
3.0		D 1	3.2 wet						
			3.6 EOB						
4.0									

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: CONTRACTOR:

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 8
JOB NAME: Rangitoto Stephenson	Location: 4000m RHS 1m from peg	
CLIENT: E Bar	Coords:	
JOB NO.: 9301739/010	Elev.: Datum:	

Depth (m)	Strata			Sample		Field Tests			Lab Test
	LGD	SYM	Description	Depth (m)	Type	SPT	Vane	Other	
			brown fine sandy SILT, some fine gravel						
			0.6 light brown grey fine sandy SILT / silty SAND						
1.0			1.0 becoming silty fine SAND						
			1.2 light brown grey silty fine SAND/ sandy SILT, spongy, damp						
2.0									
			2.5 orange stained grey fine silty SAND / sandy SILT						
			2.65 light grey fine-med pum. SAND						
3.0			3.15 grey fine-med pum. SAND						
		SF	3.4 dark grey SILT						
		S	3.65 grey silty fine-med. SAND, wet						
4.0			@ 3.8m EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: MOH CONTRACTOR: A H

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 9
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.: 9301739/010	Location: 4000 m RH3 11.6 m from fence Coords: Elev.: Datum:	

Depth (m)	LGD	SYM	Strata – Description	Sample Depth (m)	Sample Type	SPT	Vane	Other	Lab Test
	x x		brown fine sandy SILT						
			– 0.5 light brown fine SAND, fluffy						
1.0			– 1.0 orange stained light grey fine SAND						
			– 1.4 becoming grey silty fine SAND / sandy SILT, spongy, damp	1.4	*				
	x x		1.8 trace fine gravel						
2.0			– 1.95 light grey fine SAND						
	x x		– 2.4 light grey fine sandy SILT / silty SAND, moist						
3.0			– 2.7 light grey well graded med. [illegible] SAND						
		3.35	– 3.35 light grey [illegible] SAND, moist						
			3.5 wet						
4.0			3.8 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 26/3/02 DATE FINISHED:	CORE DIA: LOGGED BY: MDH	RIG: CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 10
JOB NAME: Rangitaiki Stopbank	Location: 4900m RHS bg peg	
CLIENT: E BOP	Coords:	
JOB NO.: 9301739/010	Elev.:	Datum:

Depth (m)	Strata			Sample		Field Tests			Lab Test
	LGD	SYM	Description	Depth (m)	Type	SPT	Vane	Other	
1.0			Light brown fine sandy SILT 0.5 some rounded greywacke gravel ⇒20mm 0.7 grey fine sandy SILT & fine grey gravel - old road? 0.9 timber 1.2 dark grey fine sandy SILT/silty SAND, some fine pumice lapilli 1.6 fine grey SAND 1.7 dark grey silty med. SAND, rare gravel 2.0 EOB hard.	1.7	*				
2.0									
3.0									

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 22/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O'H CONTRACTOR: A M

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 11
JOB NAME: Rangitaiki Stopbank CLIENT: EBOP JOB NO.: 9201739/010	Location: 4900m RHS 17.4m from peg Coords: Elev.: Datum:	

Depth (m)	Strata: LGD	Strata: SYM	Strata: Description	Sample: Depth (m)	Sample: Type	Field Tests: SPT	Field Tests: Vane	Field Tests: Other	Lab Test
0			brown fine sandy SILT						
			0.6 dark grey/black mod gritty SAND						
			0.65 orange mottled grey SILT, some clay + plasticity, damp	0.7	*				
1.0			1.4 light orange mottled grey clayey SILT, plastic, moist, some black organic staining	1.4	*				
2.0			2.15 orange mottled light grey fine silty SAND/sandy SILT, moist, spongy						
		2.8	2.9 grey fine silty SAND/sandy SILT, wet spongy						
3.0		S	3.0 EOB						

OBSERVATIONS:	SAMPLES	FIELD TESTS
	* Small disturbed sample ↔ Large disturbed sample € undisturbed core sample ↓ SPT Split spoon sample	SPT = Standard penetration Test (blows/150mm, N=blows/300mm) C = Cohesion as mesured direct with shear vane (kPa) CR = Remoulded C CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 27/3/02 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: M.O.H CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

RECORD OF BOREHOLE	Sheet 1 of	BH 12
JOB NAME: Rangitaiki Stopbank	Location: 4.900m R.H.S	
CLIENT: EBOP	~15.5m from ...	
JOB NO.: ... 010	Coords:	
	Elev.:	Datum:

Depth (m)	LGD	SYM	Description	Sample Depth (m)	Sample Type	SPT	Vane	Other	Lab Test
			brown fine sandy SILT						
			0.5 grey/brown fine silty SAND/sandy SILT						
			0.8 orange mottled grey fine sand SILT/silty SAND						
1.0			0.9 dark brown fine sandy SILT, some clay & organics, some plasticity.						
			0.95 dark organic stems, moist						
2.0			2.0 grey SILT some clay, some plasticity, soft, moist, some organics						
		3.0 ▽	2.6 grey fine silty SAND						
3.0			3.1 grey fine SAND, wet						
			3.5 EOB						
4.0									

OBSERVATIONS:

SAMPLES
- * Small disturbed sample
- ↔ Large disturbed sample
- € undisturbed core sample
- ↓ SPT Split spoon sample

FIELD TESTS
SPT = Standard penetration Test (blows/150mm, N=blows/300mm)
C = Cohesion as mesured direct with shear vane (kPa)
CR = Remoulded C
CC = Corrected Reading (kPa)

PILCON VANE Dial No.

DATE STARTED: 27/3/00 CORE DIA: RIG:
DATE FINISHED: LOGGED BY: ... CONTRACTOR: AH

Beca Carter Hollings & Ferner Ph: (07) 578-0896

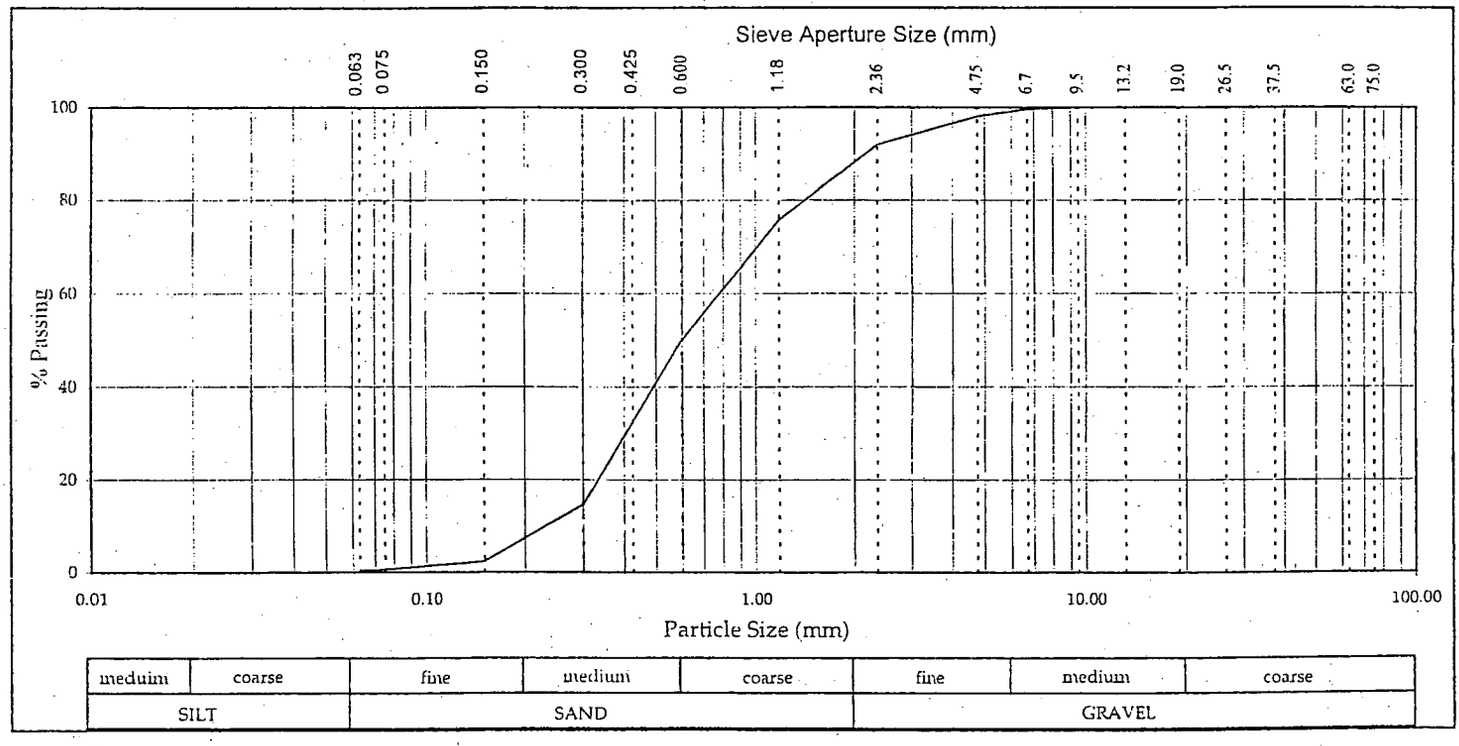
WET PARTICLE SIZE DISTRIBUTION TEST REPORT

Project :	Rangitaiki Stopbanks
Location :	Unknown
Client :	Beca Carter Hollings and Ferner
Contractor :	N/A
Sampled by :	Beca Carter Hollings and Ferner
Date sampled :	Unknown
Sampling method :	Unknown
Sample description :	Gravelly SAND
Sample condition	Natural State
Bore hole no :	14 2000
Depth (m) :	3.4m 3.90

Project No :	25545.04/0TL
Lab Ref No :	10138
Client Ref No :	-

Particle Size Distribution

Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing	Size (mm)	% Passing
75.00	-	13.20	-	2.36	92	0.300	15
63.00	-	9.50	100	1.18	76	0.150	2
37.50	-	6.70	100	0.600	50	0.075	1
19.00	-	4.75	98	0.425	33	0.063	0



Test method	Notes
NZS 4407 : 1991 Test 3.8.1	History : Natural State Fraction tested : Whole Soil Dispersant : Sodium Hexametaphosphate History : Natural State.

Date tested : 16 April 2002
Date reported : 16 April 2002

Percentage passing finest sieve obtained by difference.
This report may only be reproduced in full

IANZ Approved Signatory

Designation : *Laboratory Manager*
Date : 16 April 2002

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

CSF 2099 (1/01)

Opus International Consultants Limited
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Telephone +64 7 578 5425
Facsimile +64 7 578 3382
Website www.opus.co.nz

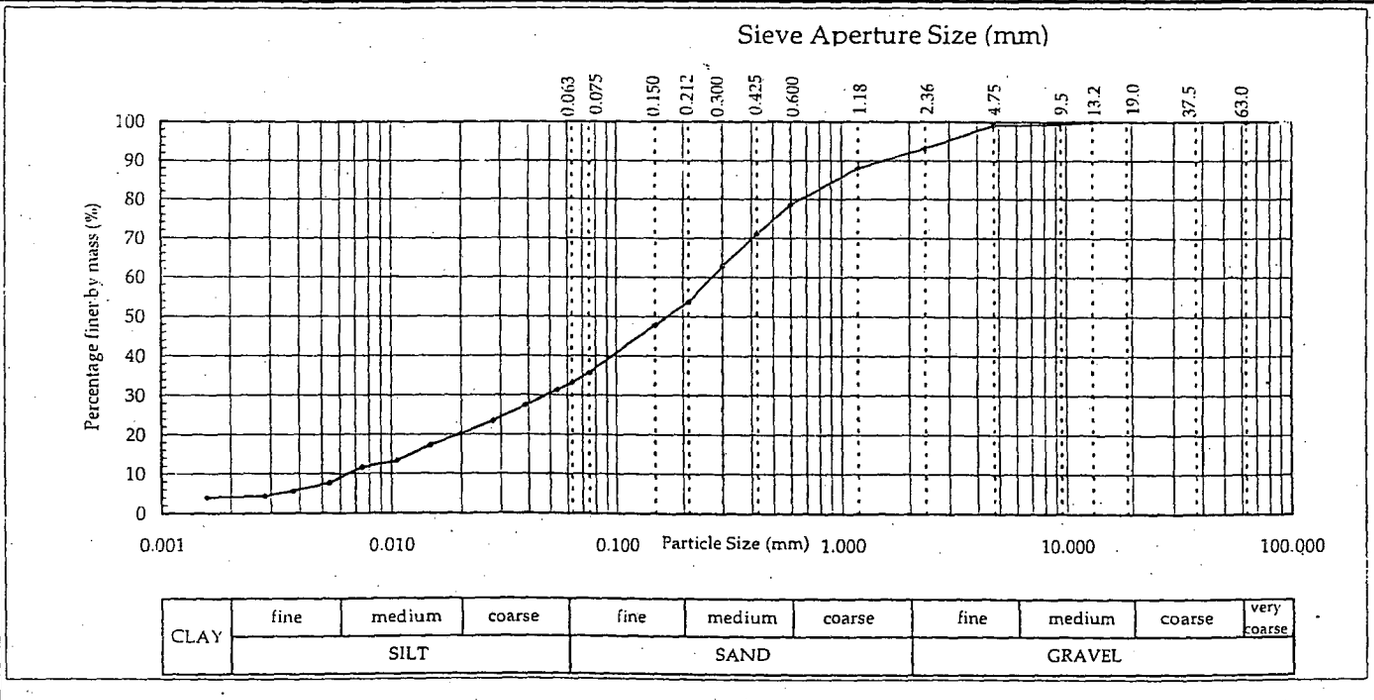
PARTICLE SIZE ANALYSIS
TEST REPORT

Project : Rangitaiki Stopbanks
Location: Unknown
Client : Beca Carter Hollings and Ferner Ltd
Client/Sample Ref.: -
Contractor : -
Bore/Test Pit No: BH1 Depth: 0.30 metres 2850 ~ 4840
Sampled by : Unknown
Date received : 03/04/02
Sampling method : Unknown
Sample condition : As received
Sample description : Light brown silty fine SAND
Solid Particle Density (t/m^3): 2.65 assumed
Water Content (as received): 8.3 %

OPUS INTERNATIONAL CONSULTANTS

Project No:	2-55545.04
Lab Ref No:	02/326/001
Client Ref:	10138

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	99	0.300	63	0.0541	31	0.0075	12
37.5	--	2.36	93	0.212	54	0.0389	27	0.0054	8
19.0	--	1.18	88	0.150	48	0.0279	23	0.0038	6
13.2	100	0.600	79	0.075	36	0.0199	20	0.0028	4
9.5	99	0.425	71	0.063	33	0.0147	17	0.0016	4
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0106	13		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 8.0

Date Tested: 09/04/02

Date Reported: 10/04/02

IANZ Approved Signatory
Designation : *Senior Civil Engineering Technician*
Date : 10/04/02

20 All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

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Hamilton Laboratory
Quality Management Systems Certified to ISO 9001
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Private Bag 3057
Hamilton, New Zealand
Telephone +64 7 856 2870
Facsimile +64 7 856 2873
Website www.opus.co.nz

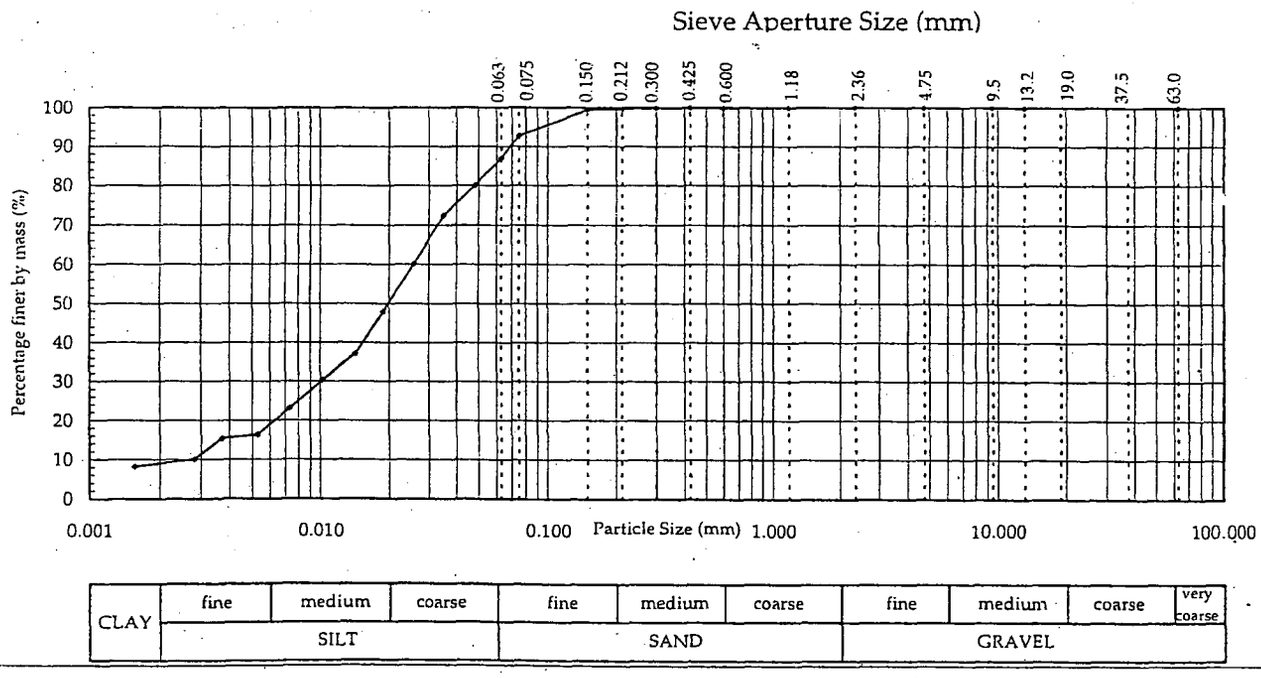
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Location: Unknown
Client : Beca Carter Hollings and Ferner Ltd
Client/Sample Ref : -
Contractor : -
Core/Test Pit No: BH1 Depth: 1.20 metres 2850m 4840
Sampled by : Unknown
Date received : 03/04/02
Sampling method : Unknown
Sample condition : As received
Sample description : Light brown sandy SILT
Solid Particle Density (t/m^3): 2.65 assumed
Water Content (as received): 38.8 %

Project No:	2-55545.04
Lab Ref No:	02/326/001
Client Ref:	10138

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	100	0.0482	80	0.0074	23
37.5	--	2.36	100	0.212	100	0.0350	72	0.0053	16
19.0	--	1.18	100	0.150	99	0.0257	60	0.0037	15
13.2	100	0.600	100	0.075	93	0.0189	48	0.0028	10
9.5	100	0.425	100	0.063	87	0.0142	37	0.0016	8
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0102	30		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 8.0

Date Tested: 09/04/02

Date Reported: 10/04/02

IANZ Approved Signatory
Signation : *Senior Civil Engineering Technician*
Date : 10/04/02

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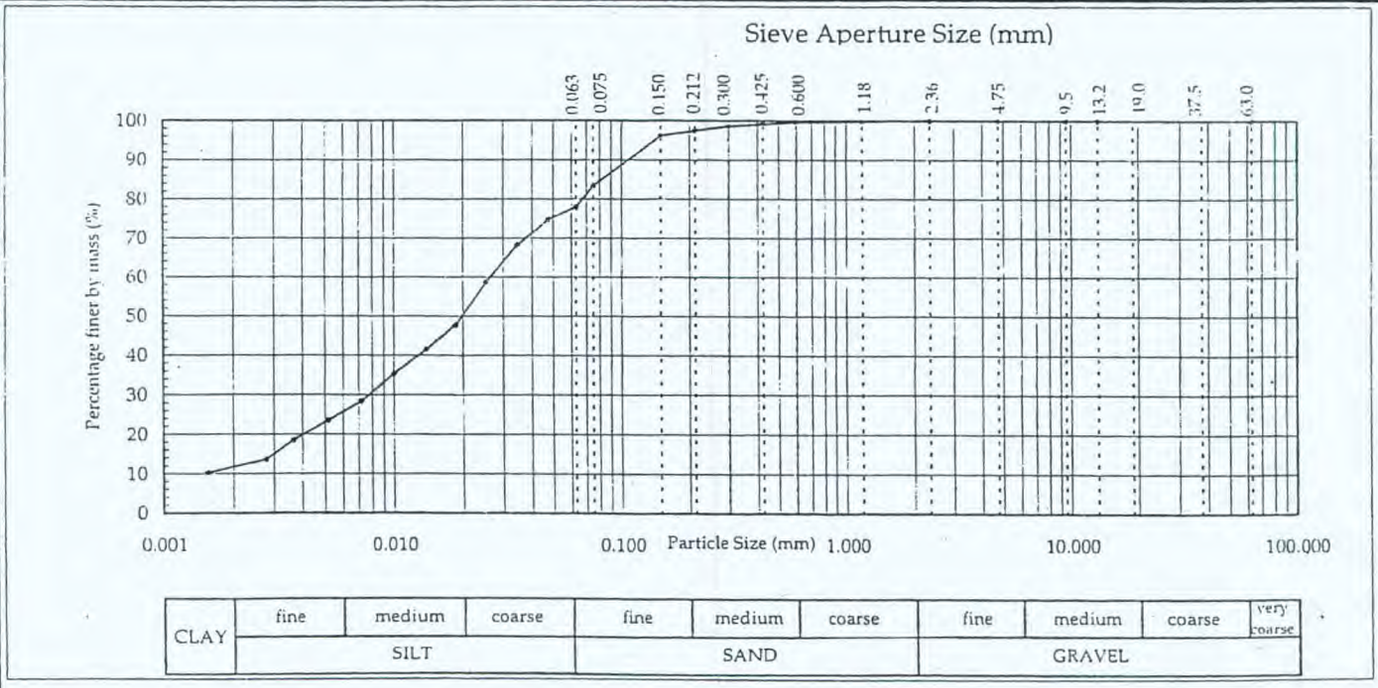
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbanks
Location: Unknown
Client : Beca Carter Hollings and Ferner Ltd
Client/Sample Ref : -
Contractor : -
Bore/Test Pit No: BH2 Depth: 0.30 metres 2.850m
Sampled by : Unknown
Date received : 03/04/02
Sampling method : Unknown
Sample condition : As received
Sample description : Light brown sandy SILT
Solid Particle Density (t/m^3): 2.65 assumed
Water Content (as received): 14.9 %

Project No:	2-55545.04
Lab Ref No:	02/326/001
Client Ref:	10138

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	99	0.0478	75	0.0072	28
37.5	--	2.36	100	0.212	97	0.0347	68	0.0052	23
19.0	--	1.18	100	0.150	96	0.0254	59	0.0037	18
13.2	100	0.600	100	0.075	83	0.0186	48	0.0028	14
9.5	100	0.425	99	0.063	78	0.0139	41	0.0016	10
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0100	35		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 8.0

Date Tested: 09/04/02

Date Reported: 10/04/02

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 10/04/02

20 laboratory

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

csf 2100 (3/99)

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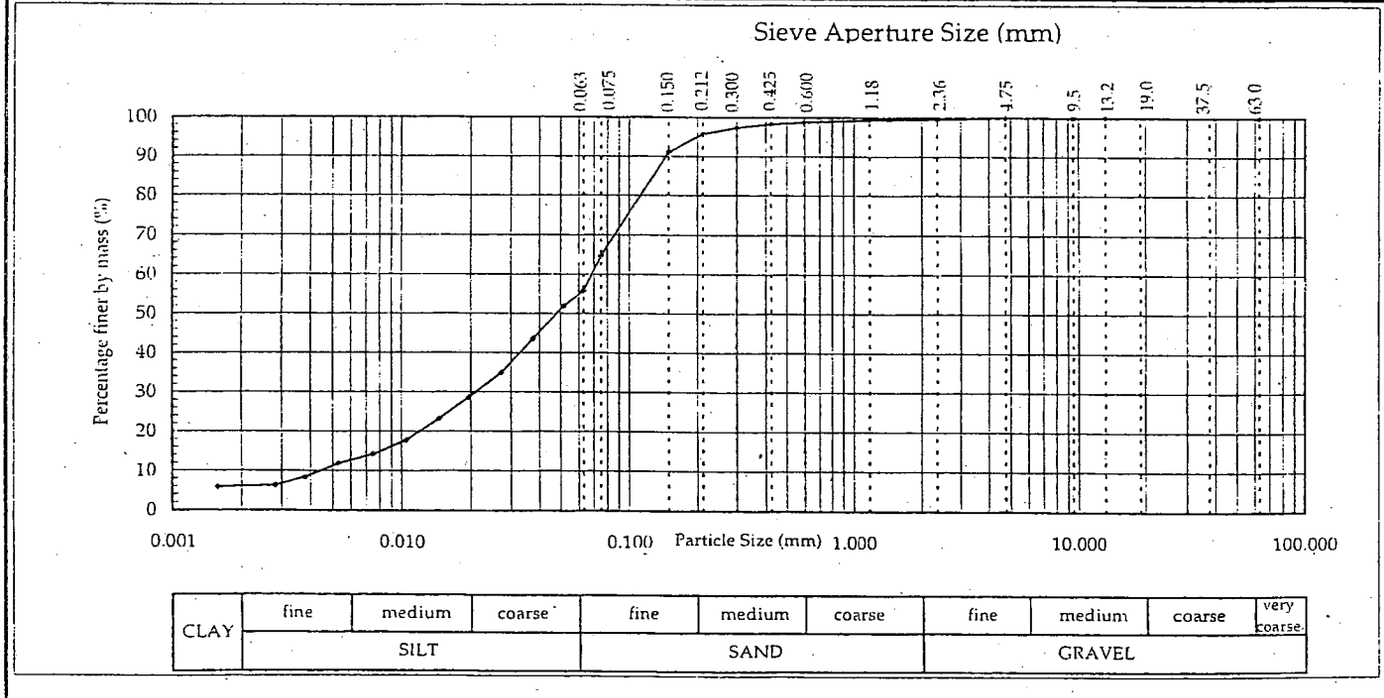
PARTICLE SIZE ANALYSIS
TEST REPORT

Project :	Rangitaiki Stopbanks
Location:	Unknown
Client :	Beca Carter Hollings and Ferner Ltd
Client/Sample Ref :	-
Contractor :	-
Bore/Test Pit No:	BH3 Depth: 0.50 metres 2.900 – 2.950
Sampled by :	Unknown
Date received :	03/04/02
Sampling method :	Unknown
Sample condition :	As received
Sample description :	Light brown sandy SILT
Solid Particle Density (t/m^3):	2.65 assumed
Water Content (as received):	10.4 %

OPUS INTERNATIONAL CONSULTANTS

Project No:	2-55545.04
Lab Ref No:	02/326/001
Client Ref:	10138

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	97	0.0515	52	0.0075	14
37.5	--	2.36	100	0.212	96	0.0375	44	0.0053	12
19.0	--	1.18	99	0.150	91	0.0273	35	0.0038	8
13.2	100	0.600	99	0.075	65	0.0197	29	0.0028	6
9.5	100	0.425	98	0.063	56	0.0146	23	0.0016	6
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						0.0105	18		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve)	Fraction Tested:Whole soil
Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	pH of suspension : 8.0

Date Tested: 09/04/02

Date Reported: 10/04/02

IANZ Approved Signatory

Designation : *Senior Civil Engineering Technician*

Date : 10/04/02

20 laboratory

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DRY DENSITY / WATER CONTENT RELATIONSHIP
DYNAMIC COMPACTION

Project :	Rangitaiki Stopbanks
Location :	3050m
Client :	Beca Carter Hollings and Ferner
Contractor :	N/A
Sampled by :	Beca Carter Hollings and Ferner
Date sampled :	Unknown
Sampling method :	Unknown
Sample description :	Brown Sandy SILT
Sample condition :	Natural State
Solid density :	2.65 (Assumed)

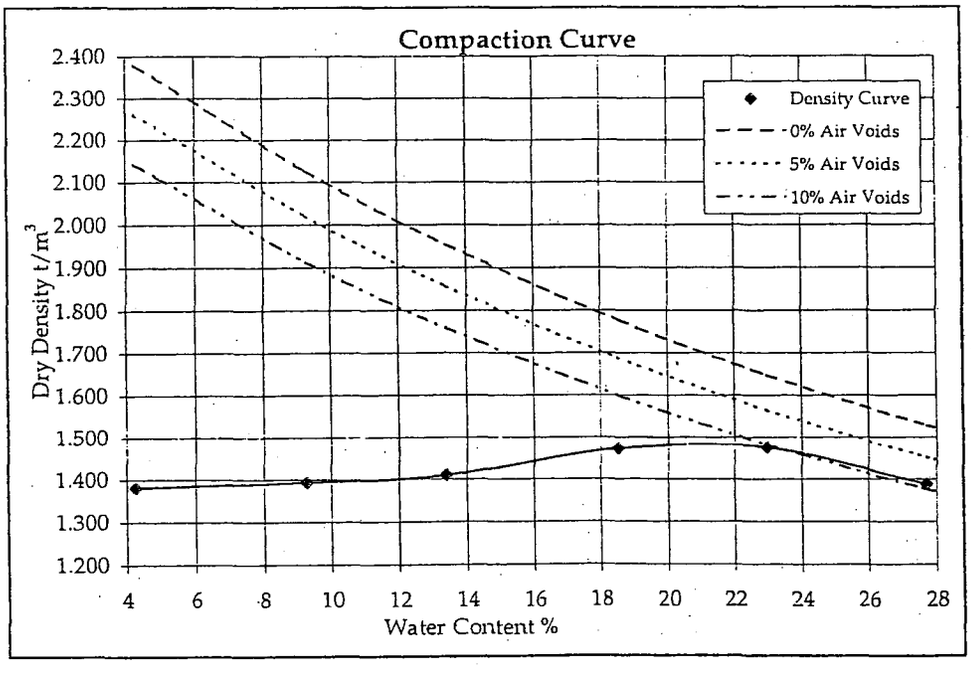
OPUS INTERNATIONAL CONSULTANTS

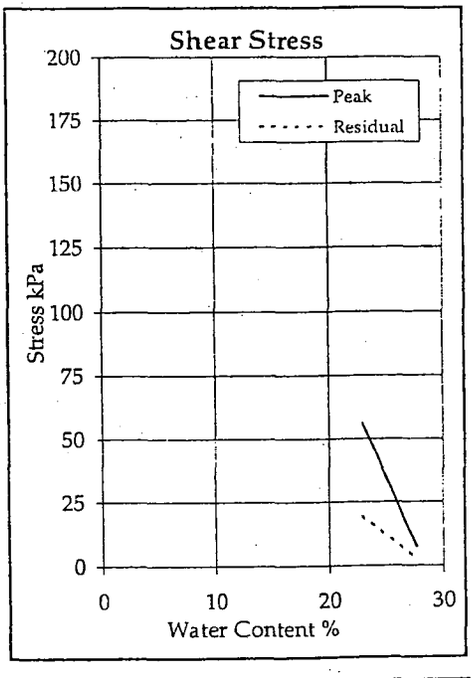
Project No :	255545.04/0TL
Lab Ref No :	10138
Client Ref No :	-

Test Results

Maximum dry density	1.48 t/m³	Natural water content	4.3 %
Optimum water content	21 %	Fraction tested	Passing 19mm

Sample ID		Natural	9	14	19	24	29	
Bulk density	t/m³	1.439	1.522	1.598	1.744	1.814	1.772	
Water content	%	4.3	9.3	13.4	18.5	23.0	27.7	
Dry density	t/m³	1.380	1.393	1.409	1.471	1.475	1.388	
Sample condition		Dry Loose	Dry Loose	Moist Hard	Moist Hard	Spongey Water Loss	Saturated Water Loss	
Peak stress	kPa	Too Loose	160	Too Hard	Too Hard	56	7	
Remoulded stre	kPa	Too Loose	29	Too Hard	Too Hard	20	2	





Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 Shear Strength using Pilcon Shear Vane, in house method TRL 1/84	This report may only be reproduced in full.

Date tested : 11 April 2002
Date reported : 16 April 2002

IANZ Approved Signatory

Designation : *Laboratory Manager*
Date : 16 April 2002

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

CSF 2025 (11/01)

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DRY DENSITY / WATER CONTENT RELATIONSHIP
DYNAMIC COMPACTION

OPUS INTERNATIONAL CONSULTANTS

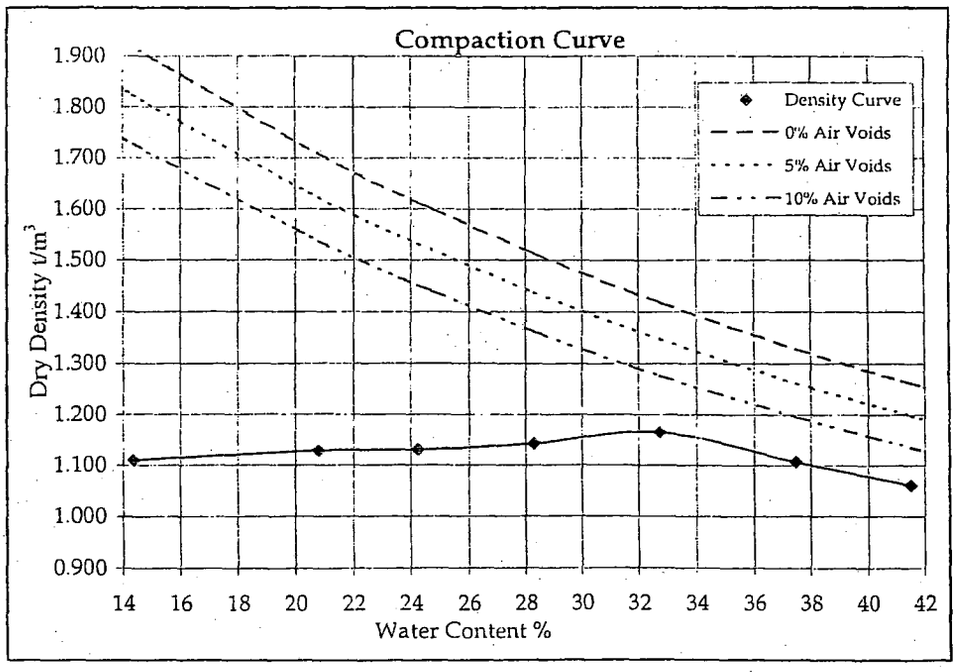
Project :	Rangitaiki Stopbanks
Location :	3400m
Client :	Beca Carter Hollings and Ferner
Contractor :	N/A
Sampled by :	Beca Carter Hollings and Ferner
Date sampled :	Unknown
Sampling method :	Unknown
Sample description :	Brown Sandy SILT
Sample condition :	Natural State
Solid density :	2.65 (Assumed)

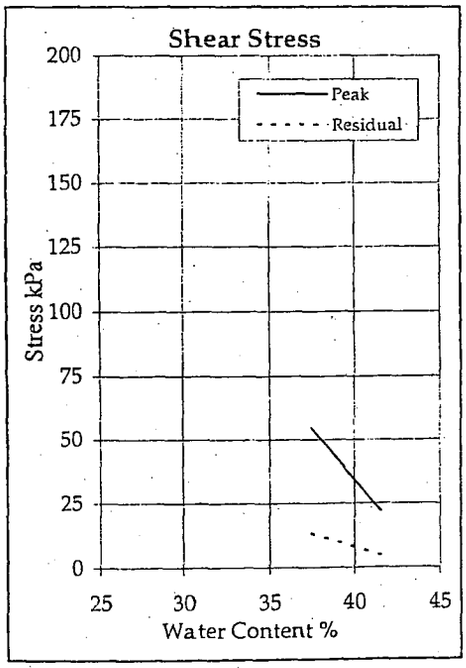
Project No :	255545.04/0TL
Lab Ref No :	10138
Client Ref No :	-

Test Results

Maximum dry density	1.17	t/m³	Natural water content	14.4 %
Optimum water content	32	%	Fraction tested	Whole Soil

Sample ID		Natural	19	24	29	34	39	41
Bulk density	t/m³	1.269	1.363	1.404	1.466	1.547	1.522	1.502
Water content	%	14.4	20.8	24.2	28.3	32.7	37.5	41.5
Dry density	t/m³	1.110	1.128	1.130	1.143	1.165	1.107	1.061
Sample condition		Dry Hard	Very Hard	Very Hard	Very Hard	Hard Water Loss	Spongy Water Loss	Spongy Water Loss
Peak stress	kPa	Too Hard	Too Hard	Too Hard	Too Hard	Too Hard	55	22
Remoulded stre	kPa	Too Hard	Too Hard	Too Hard	Too Hard	Too Hard	13	5





Test Methods	Notes
Compaction NZS 4402 : 1986 Test 4.1.1 Shear Strength using Pilcon Shear Vane, in house method TRL 1/84	This report may only be reproduced in full.

Date tested : 11 April 2002
Date reported : 16 April 2002

IANZ Approved Signatory M.E. [signature]

Designation : *Laboratory Manager*
Date : 16 April 2002

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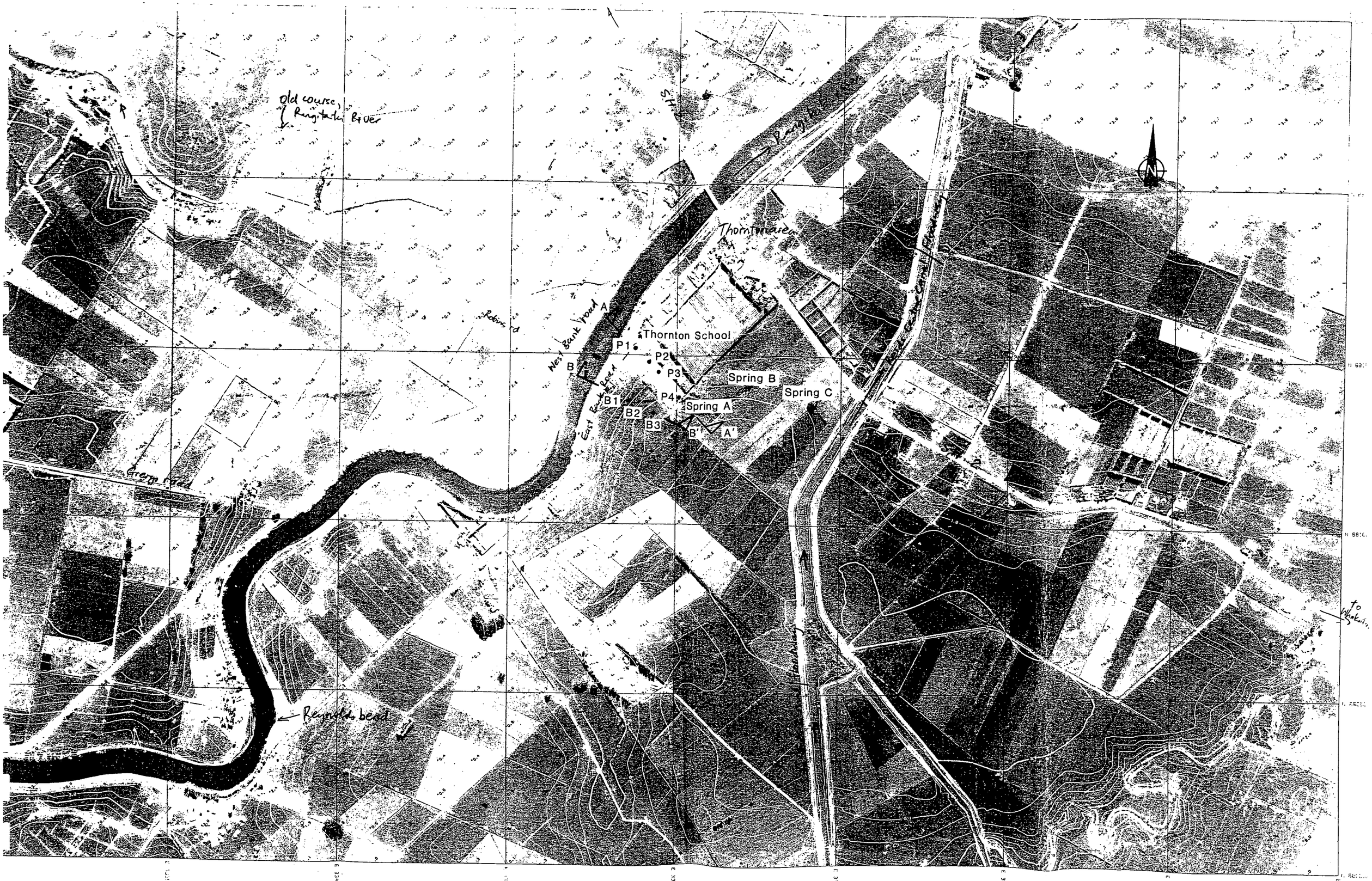
Website www.opus.co.nz

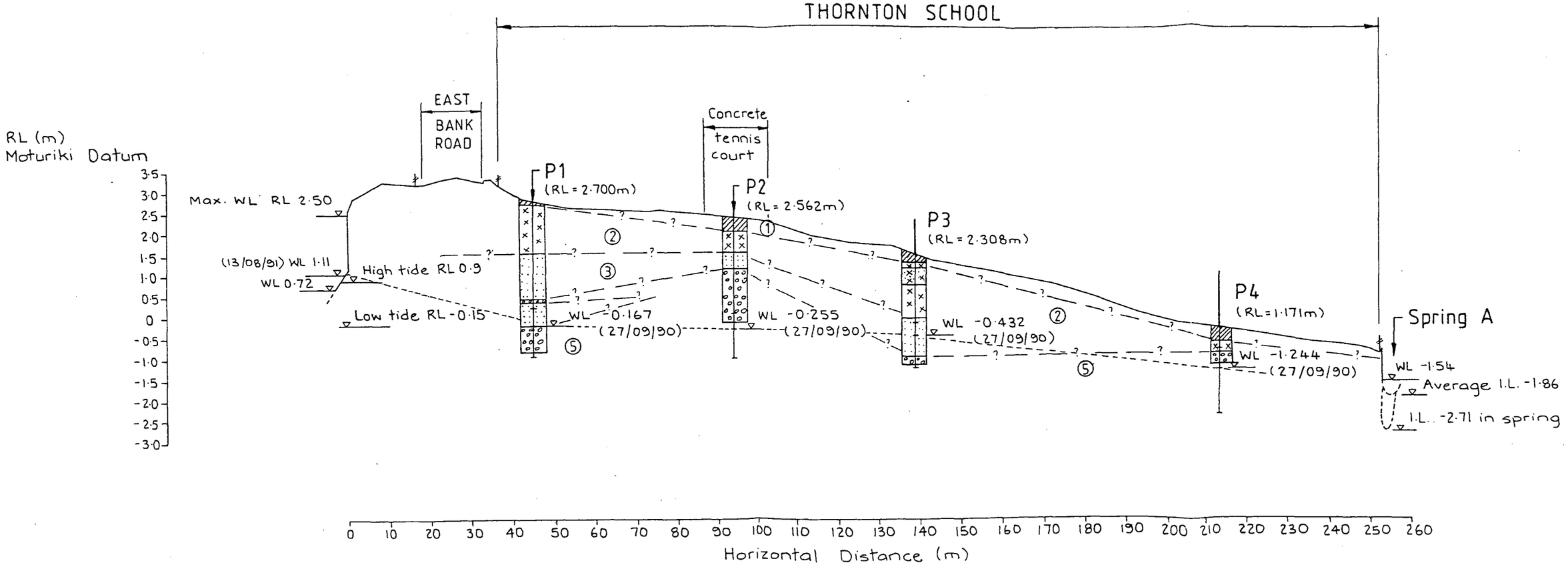
Beca Carter Hollings & Ferner Ltd (1992) Thornton Seepage Problem.

(Thornton School)



SITE PLAN

FIGURE 1



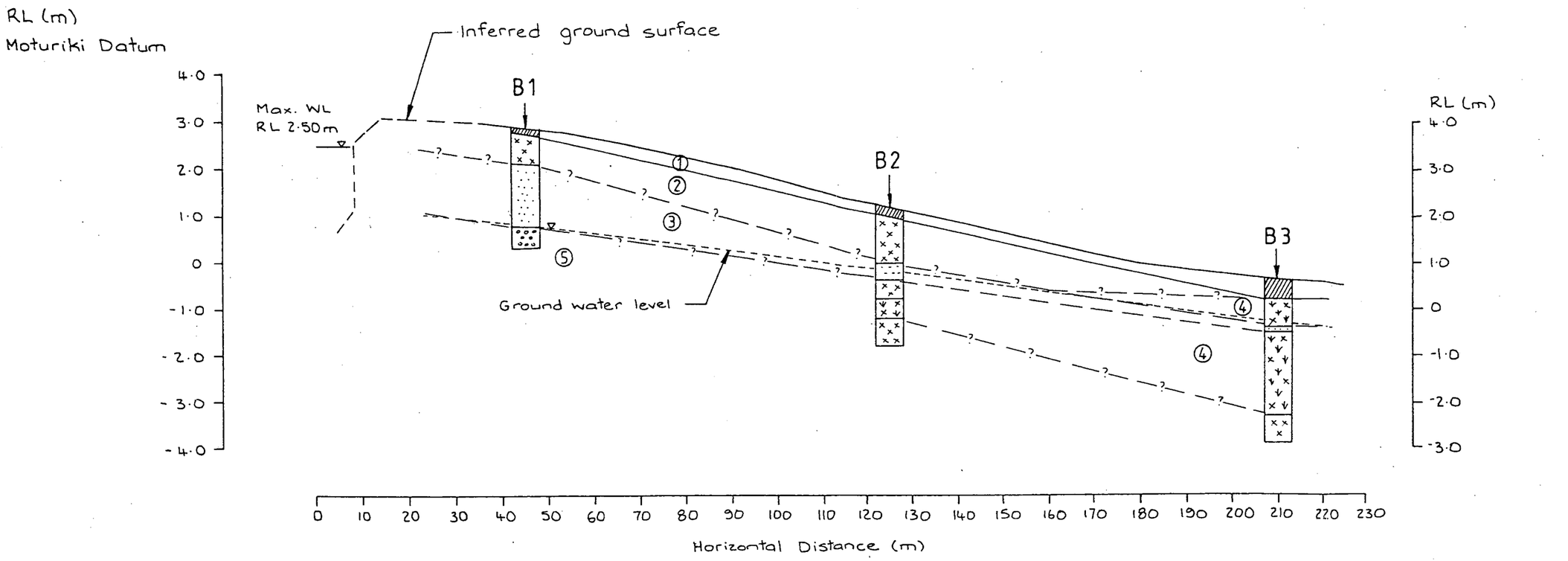
Vertical 1:100
Horizontal 1:1000
(x10 vertical exaggeration)

LEGEND

- Topsoil
- Silt
- Fine sand
- Coarse sand/fine gravel
- ① Layer number refer text, Section 5·2

CROSS - SECTION A - A

Figure 3



Vertical 1:100
Horizontal 1:1000
(x10 vertical exaggeration)

LEGEND

- Topsoil
- Silt
- Fine sand
- Peat
- Coarse sand / fine gravel
- ① Layer number refer text, Section 5·2

CROSS – SECTION B – B

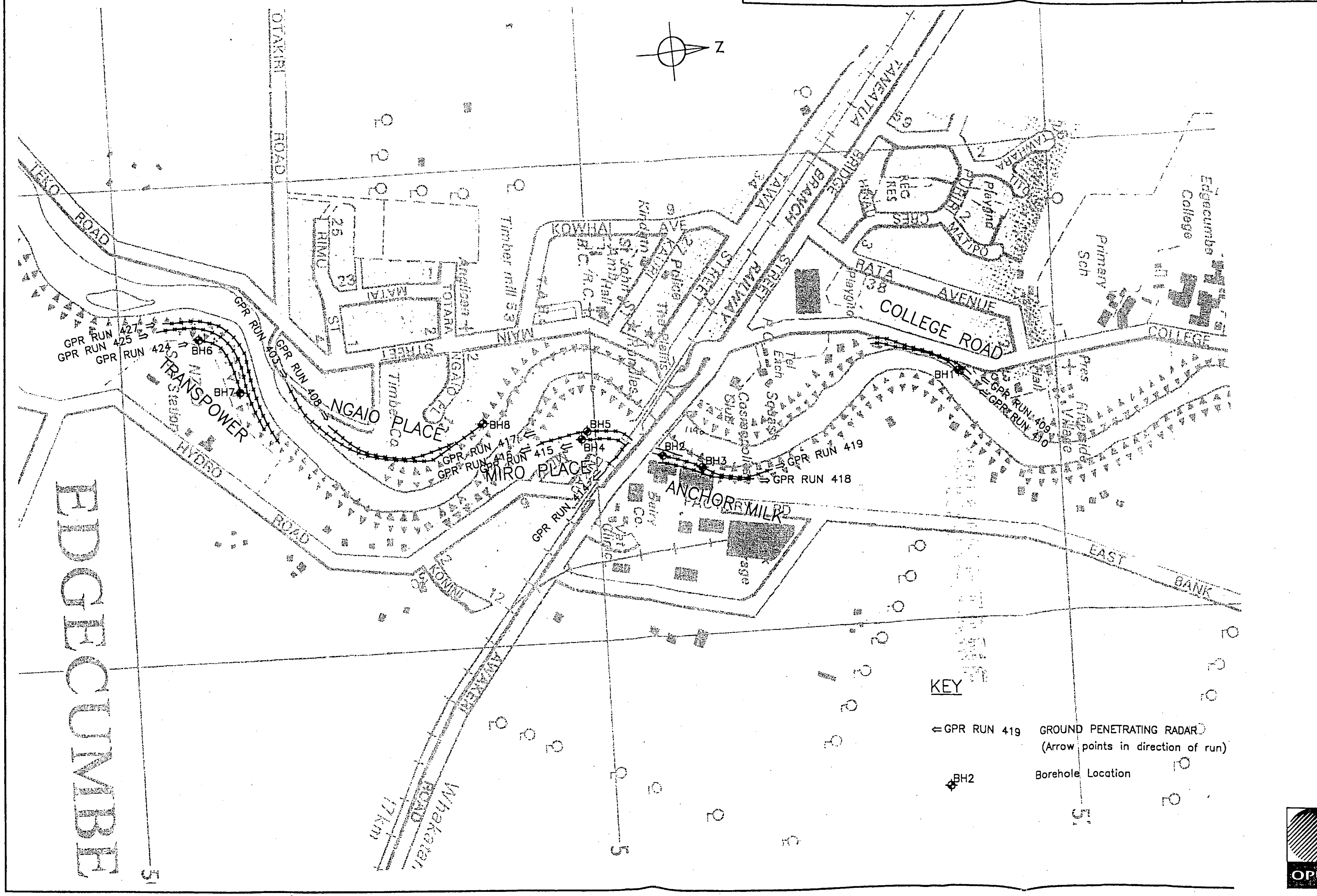
Figure 4

Opus International Consultants Ltd (2000) Stopbank assessment Rangitaiki River, Edgecumbe. Geotechnical Report No 2069.

(Edgecumbe)

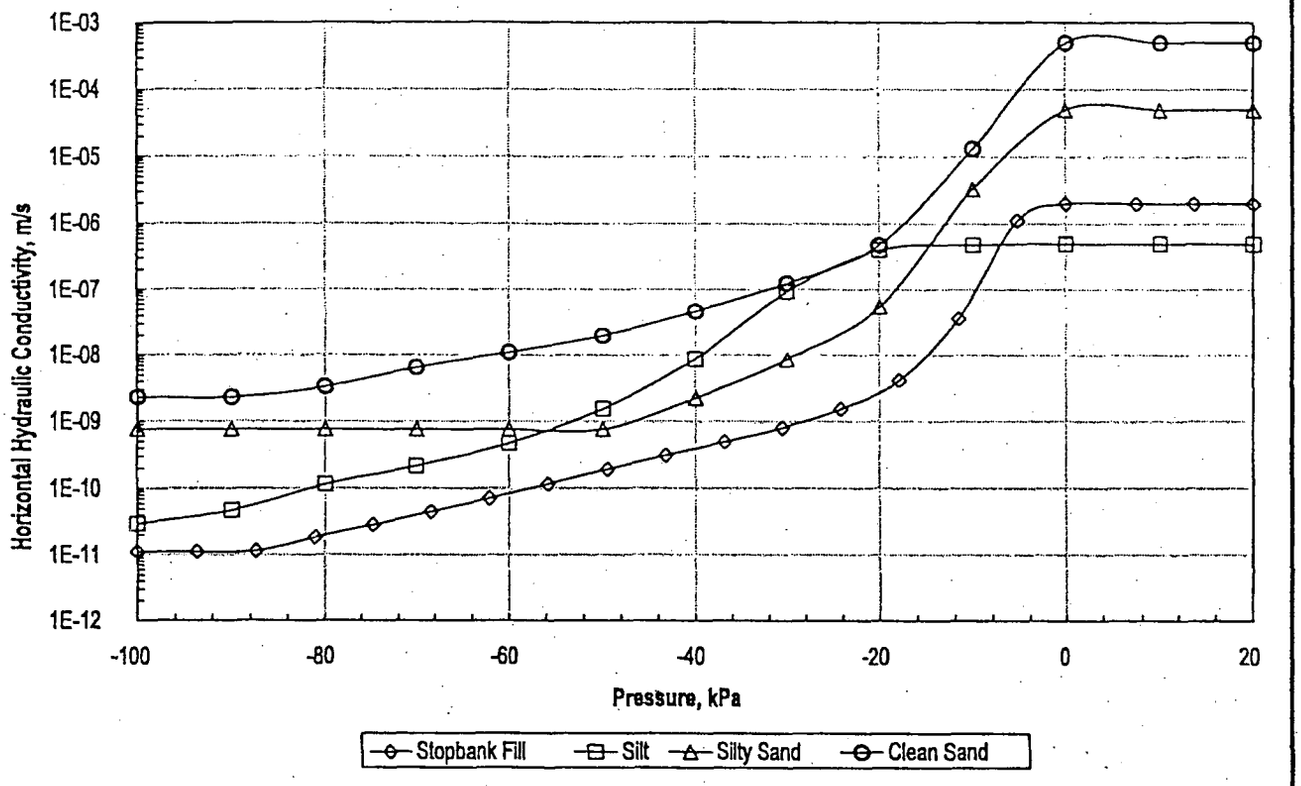
SITE LOCATION PLAN

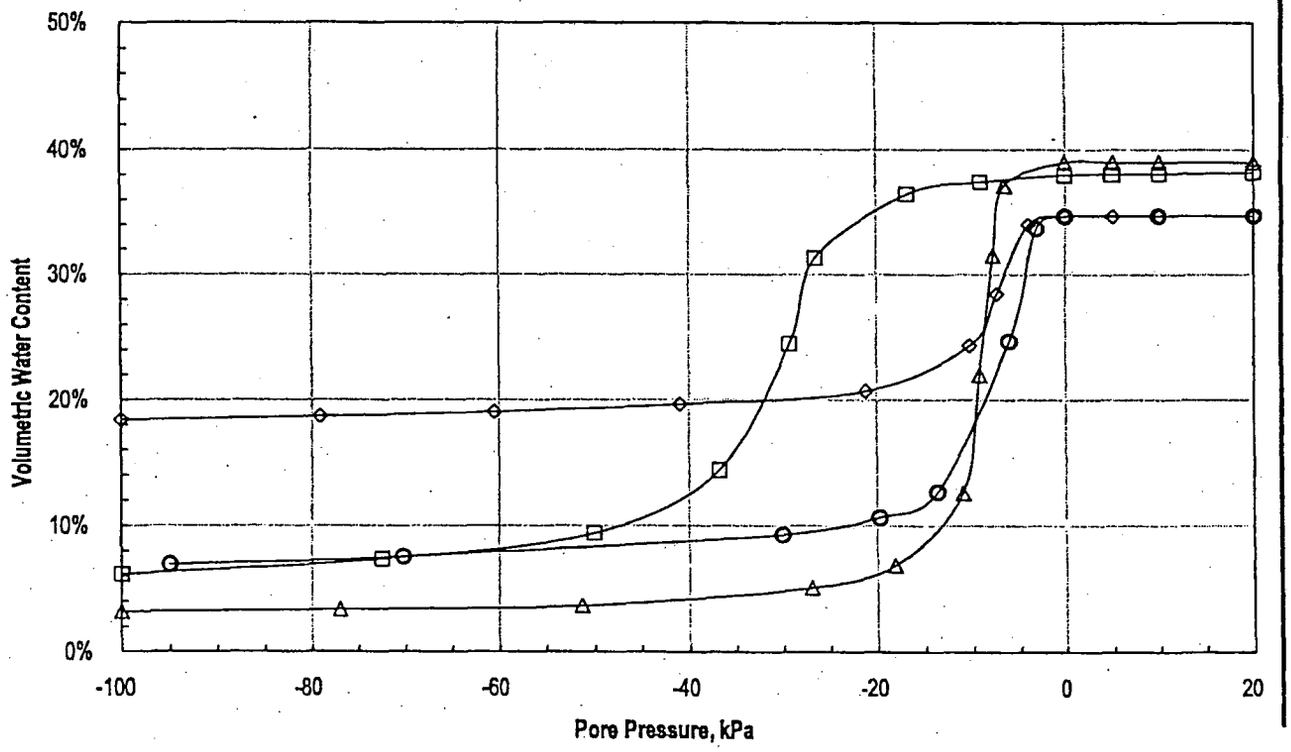
FIGURE 1



SOIL CHARACTERISTIC CURVES

FIGURE 2





BORE HOLE LOG

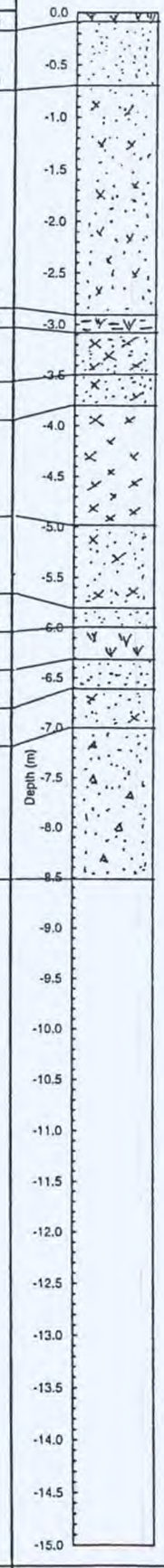
BORE HOLE NO: BH 1

PROJEC RANGITAKI STOPBANK INVESTIGATION
RL GROUND(m) :
DATUM (m) :

LOCATION : Top of Stopbank
CO - ORDINATES :

PROJECT NO: 2-89030.01
LAB REF NO: 000TC

CORE DESCRIPTION *Rock or Soil Type, Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones etc*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.05					
Light brown medium to coarse SAND, loose, dry, [FILL]	0.70					
Greyish brown silty fine SAND, medium dense, moist, pumiceous [FILL]	2.90					
Dark greyish brown organic CLAY, firm, moist [Old Topsoil Layer?]	3.10					
Greyish brown sandy SILT, firm, moist, non plastic, current bedded	3.50					
Greyish brown silty fine SAND, pumiceous, medium dense, moist, current bedded	3.80					
Light greyish brown SILT, firm, moist, minor organics, some iron staining, current bedded	5.00					
Dark grey sandy SILT, firm, moist, minor fine pumiceous sand current bedded	5.80					
Light grey medium SAND, uniformly graded, loose, moist to wet, current bedded	6.00		Water Table 6.0m	25/11/98		
Dark brown organic PEAT, firm, moist to wet	6.30					
Light grey medium SAND, uniformly graded, loose, wet, current bedded	6.60					
Light brown silty fine SAND, pumiceous, dense, wet	7.00					
Light grey gravelly coarse SAND, pumiceous, medium dense, saturated, some gravel up to 30mm dia.	8.50					
EOB - (Nil Core Recovery in Running Sands)						



Driller : Perry Drilling
Operator: G Wright
Started : 25/11/98
Finished : 25/11/98

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13 McLean Street
PO Box 646
Tauranga, New Zealand
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Fax: +64 7 578 2086

Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	25/11/98
Drawn by :	M Burt	MB	27/11/98

BORE HOLE LOG

BORE HOLE NO: BH 2

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Top of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES :
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type, Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.05					
Light brown silty fine SAND, medium dense, dry, [FILL]	1.50					
Light brown silty medium SAND, medium dense, dry, some gravel up to 10mm dia. [FILL] (2.5 - 3.0m some concrete rubble, coal and organics)	3.00					
Greyish brown SILT, firm, moist	3.10					
Greyish brown medium SAND, medium dense moist	3.20					
Greyish brown silty fine SAND, pumiceous, medium dense, moist, current bedded	5.10					
Dark grey fine sandy SILT, firm, moist	5.30					
Greyish brown silty medium SAND, medium dense, wet	6.30		Water Table 5.8m	25/11/98		
Greyish brown silty fine SAND, medium dense, wet	6.80					
Greyish brown silty medium to coarse SAND, loose to medium dense, wet to saturated, current bedded, some pumice gravel up to 5mm diameter	9.20					
EOB - (Nil Core Recover in Running Sands)						

Graphic Log: 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0, -14.5, -15.0
Depth (m)

Driller : Perry Drilling
Operator : G Wright
Started : 25/11/98
Finished : 25/11/98

OPUS INTERNATIONAL CONSULTANTS

Tauranga Office
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Fax: +64 7 578 2086

Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

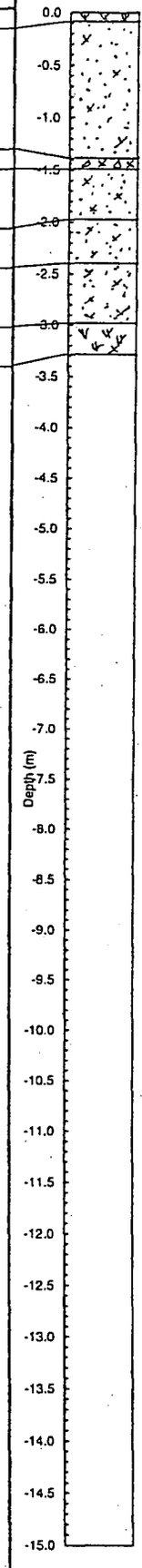
		Checked	Date
Logged by :	M Burt	MB	25/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: **BH 3**

PROJECT: RANGITAIKI STOPBANK INVESTIGATION **LOCATION :** Top of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : **CO - ORDINATES :**
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type ,* *Colour, Strength, Structure, Particle Size, Weathering* *Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.10					
Light brown silty fine SAND, medium dense, dry, [FILL]	1.40					
Light brown silty GRAVEL, dense, dry, up to 55mm dia. [FILL]	1.50					
Light brown silty fine SAND, medium dense, dry, [FILL]	2.00					
Brown silty medium SAND, medium dense, dry, some coal gravel up to 15mm diameter, paint flakes and organics [FILL]	2.40					
Light brown silty fine SAND, pumiceous, medium dense, moist	3.00					
Dark brown organic SILT, firm, moist, some gravel up to 20mm diameter	3.30					
EOB - (Refusal on Rubble)						



Driller : Perry Drilling
Operator : G Wright
Started : 25/11/98
Finished : 25/11/98

OPUS
INTERNATIONAL CONSULTANTS

Tauranga Office
13 McLean Street
PO Box 646
Tauranga, New Zealand
Ph: +64 7 578 2089
Fax: +64 7 578 2086

Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	25/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: BH 4

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Base of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES : LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type , Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.30					
Greyish brown silty fine SAND, pumiceous, medium dense, moist, current bedded	0.80					
Greyish brown SILT, firm, moist, non plastic, current bedded	1.20					
Greyish brown silty fine SAND, pumiceous, medium dense, moist to wet, current bedded	2.20					
Greyish brown medium SAND, medium dense, wet, current bedded	2.40					
Greyish brown silty fine SAND, medium dense, wet, current bedded	2.70		Water Table 2.7m	25/11/98		
Light grey silty fine to medium SAND, pumiceous, loose, saturated, current bedded, some pumice gravel up to 20mm diameter	4.70					
Light grey silty fine SAND, pumiceous, very dense, wet	4.80					
EOB -(Losing Core)						

Depth (m)

Driller : Perry Drilling
Operator : G Wright
Started : 25/11/98
Finished : 25/11/98

OPUS INTERNATIONAL CONSULTANTS

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Fax: +64 7 578 2086

Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	25/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: BH 5

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Top of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES :
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type, Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.10					
Light brown sandy SILT, firm, moist, some organics [FILL]	0.90					
Light brown silty medium SAND, pumiceous, loose, moist [FILL]	1.30					
Light brown silty fine SAND, pumiceous, medium dense, moist, [FILL]	3.10					
Light brown silty fine SAND, pumiceous, medium dense, moist, some organics and coal gravel [Old Topsoil Layer?]	3.30					
Greyish brown silty fine SAND, medium dense, moist, current bedded	3.90					
Greyish brown fine sandy SILT, firm, moist, current bedded	4.00					
Greyish brown silty fine SAND, pumiceous, medium dense, moist, current bedded, some iron staining Becoming more medium grained and loose with depth	5.60					
Black fiberous PEAT, firm, moist	5.80					
Grey fine SAND, loose to medium dense, wet	5.90		Water Table 6.0m	26/11/98		
Greyish brown medium to coarse SAND, loose, saturated, current bedded	9.30					
EOB - (Nil Core Recovery in Running Sands)						

Depth (m)

Driller : Perry Drilling
Operator : G Wright
Started : 26/11/98
Finished : 26/11/98

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Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	26/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: BH 6

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Base of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES :
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type , Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.10					
Light brown fine sandy SILT, pumiceous, firm, moist, current bedded	0.80					
Light brown silty fine to medium SAND, loose, moist, current bedded	1.10					
Greyish brown silty fine SAND, pumiceous, medium dense, moist, some iron staining, current bedded	1.50					
Light brown fine to medium SAND, pumiceous, loose to medium dense, moist, current bedded	2.50					
Greyish brown silty fine to medium SAND, loose to medium dense, moist, pumiceous, current bedded, minor iron staining	3.30		Water Table 3.0m	26/11/98		
Greyish brown medium to coarse SAND, loose to medium dense, wet, pumiceous, current bedded, minor iron staining, some pumice gravel up to 5mm dia.	5.60					
Grey silty very fine SAND, pumiceous, very dense, wet	6.40		SPT 5.50 - 5.95m SPT 5.95 - 6.40m			6//11/19 (N=20) 7//10/13 (N=23)
EOB - (Auger Refusal)						

Depth (m): 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0, -14.5, -15.0

Driller : Perry Drilling
Operator : G Wright
Started : 26/11/98
Finished : 26/11/98

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Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	26/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: BH 7

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Base of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES :
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type, Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.10					
Brown fine sandy SILT, firm, moist, current bedded	0.40					
Greyish brown SILT, firm, moist, minor sand, current bedded	1.00					
Greyish brown silty fine SAND, pumiceous, dense, moist, current bedded, some thin 10 - 20mm silt layers	3.20		Water Table 3.0m	26/11/98		
Dark grey silty fine SAND, dense, moist, current bedded	3.30					
LOST CORE						
Light grey medium to coarse SAND, loose to medium dense, pumiceous, current bedded	4.70					
Brown medium to coarse SAND, medium dense to dense, pumiceous, current bedded, minor gravel up to 5mm dia.	5.50					
Light greyish brown gravelly SAND, dense, saturated, curent bedded, pumice gravel up to 20mm dia.	6.50					
Light grey fine sandy SILT, very dense, wet, current bedded, some gravel up to 5mm dia.	7.50					
EOB - (Refusal)						

Graphic Log: Depth (m) 0.0, -0.5, -1.0, -1.5, -2.0, -2.5, -3.0, -3.5, -4.0, -4.5, -5.0, -5.5, -6.0, -6.5, -7.0, -7.5, -8.0, -8.5, -9.0, -9.5, -10.0, -10.5, -11.0, -11.5, -12.0, -12.5, -13.0, -13.5, -14.0, -14.5, -15.0

Driller : Perry Drilling
Operator : G Wright
Started : 26/11/98
Finished : 26/11/98

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Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	26/11/98
Drawn by :	M Burt	MB	30/11/98

BORE HOLE LOG

BORE HOLE NO: BH 8

PROJECT: RANGITAIKI STOPBANK INVESTIGATION LOCATION : Base of Stopbank
PROJECT NO: 2-89030.01
RL GROUND(m) : CO - ORDINATES :
LAB REF NO: 000TC
DATUM (m) :

CORE DESCRIPTION *Rock or Soil Type , Colour, Strength, Structure, Particle Size, Weathering Lithological Features, (bedding, foliation, texture, mineralogy, etc)*	Depth (m)	Graphic Log	ROCK DEFECTS / COMMENTS *Joints, bedding, seams, shear and crush Zones*	Water Level (Date)	Shear Strength (kPa)	SPT Values
Topsoil	0.10					
Light brown silty fine SAND, pumiceous, medium dense, dry, current bedded	0.70					
Greyish brown fine sandy SILT, firm, moist, current bedded, non plastic	1.10					
Brown medium SAND, loose, moist	1.20					
Greyish brown silty fine SAND, medium dense, moist, pumiceous, current bedded	1.80					
			Water Table 2.2m	26/11/98		
Greyish brown silty medium to coarse SAND, loose to medium dense, pumiceous, wet to saturated, current bedded, some pumice gravel up to 5mm dia.	5.00					
Light grey silty fine SAND, pumiceous, very dense, wet, minor pumice gravel up to 10mm dia.	5.20		SPT 4.75 - 5.20m			6//13/22(N= 35)
EOB - (Auger Refusal)						

Depth (m)

Driller : Perry Drilling
Operator : G Wright
Started : 26/11/98
Finished : 26/11/98

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Drilling Method: Hollow Stem Auger (100mm ID)
Sampling Method: Continuos Wire Line Split Spoon Sampling (750mm long x 75mm diameter)

		Checked	Date
Logged by :	M Burt	MB	26/11/98
Drawn by :	M Burt	MB	30/11/98

CONSTANT HEAD PERMEABILITY TEST REPORT

Project : Rangitiaki Stopbanks Structural Assessment.
Location :
Client : Opus International Consultants Tauranga
Contractor : N/A
Sampled by : M. Burt
Date sampled : Nov-98
Sampling method : Bagged samples.
Sample condition : As received
Date received : 08/12/98

Project No :	2-89031.01
Lab Ref No :	98/389/001
Client Ref No :	

SOIL PROPERTIES

Sample No:		S#1	S#2	S#3	S#4		
Depth	(m)	See Result	BH4(1.2-2.2)	BH2(6.8-9.2)	BH7(6.5-7.5)		
Specimen length	(mm)	136.7	134.7	32.5	135.0		
Specimen diameter	(mm)	70.8	70.63	203.31	70.75		
Specimen mass	(g)	822.93	691.23	1681.6	788.45		
Water content at test	(%)	25.2	38.2	45.1	56.2		
Wet density	(t/m^3)	1.53	1.31	1.60	1.49		
Dry density	(t/m^3)	1.22	0.95	1.10	0.95		
Post test water content	(%)	36.4	50.23	Saturated	59.4		
Target Density		NZ Std Comp	Med Dense	Med Dense	Very Dense		

PERMEABILITY TEST RESULT

CP=Cell Pressure; BP=Saturation Backpressure
φ'_3 = Effective confining pressure

			Bore No Depth (m)	Effective Head S#1,2 & 4(kPa) / S#3(cm)		Permeability (m/s)
Target Pb=1.57 t/m³	CP=	650 kPa	S#1	20		2.48×10^{-6}
by NZ Std Compaction.	BP=	500 kPa	BH 1 (0.7-2.9m) +	50		2.76×10^{-6}
Achieved 97.7% at test.	φ'_3=	150 kPa	BH 2 (1.5-3.0m) mixed 1:1	100		2.60×10^{-6}
Compacted to estimated	CP=	750 kPa	S#2	20		1.29×10^{-5}
"Medium Dense" for test	BP=	600 kPa	BH 4 (1.2-2.2m)	50		1.24×10^{-5}
(Water loss when compacted)	φ'_3=	150 kPa		100		8.86×10^{-6}
Tested in Laboratory Permeability Apparatus			S#3		2	1.51×10^{-4}
Compacted to estimated			BH 2 (6.8-9.2m)		4	1.44×10^{-4}
"Medium Dense"for test.				Out flow	10	8.80×10^{-5}
(Water loss when compacted)				dirty.	20	5.93×10^{-5}
Compacted to estimated	CP=	650 kPa	S#4	20		3.16×10^{-7}
"Very Dense" for test.	BP=	500 kPa	BH 7 (6.5-7.5m)	50		2.42×10^{-7}
(Water loss when compacted)	φ'_3=	150 kPa		100		1.92×10^{-7}

Test Method		Notes
Permeability Test :	Works Central Laboratories Report 2-82	**For S#1,2 & 4** - Tested in Triaxial apparatus
Based on :	Bishop & Henkel 1969-The Triaxial Test.	1 kPa=10cm eff. Head (e.g. 10 kPa=100 cm)
Lab Perm Apparatus:	In House Method.	**For S# 3** -Tested in Lab Perm apparatus.
Water Content :	NZS 4402 : 1986 Test 2.1	For S#3 - Flow slowing at higher heads due to fines flushing to top of sample.

Date tested : 10/12/98
Date reported : 11/12/98

Signatory :
Designation : *Senior Civil Engineering Technician*
Date : 11/12/98

HA 2425 (8/98)

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Formerly Works Consultancy Services Limited

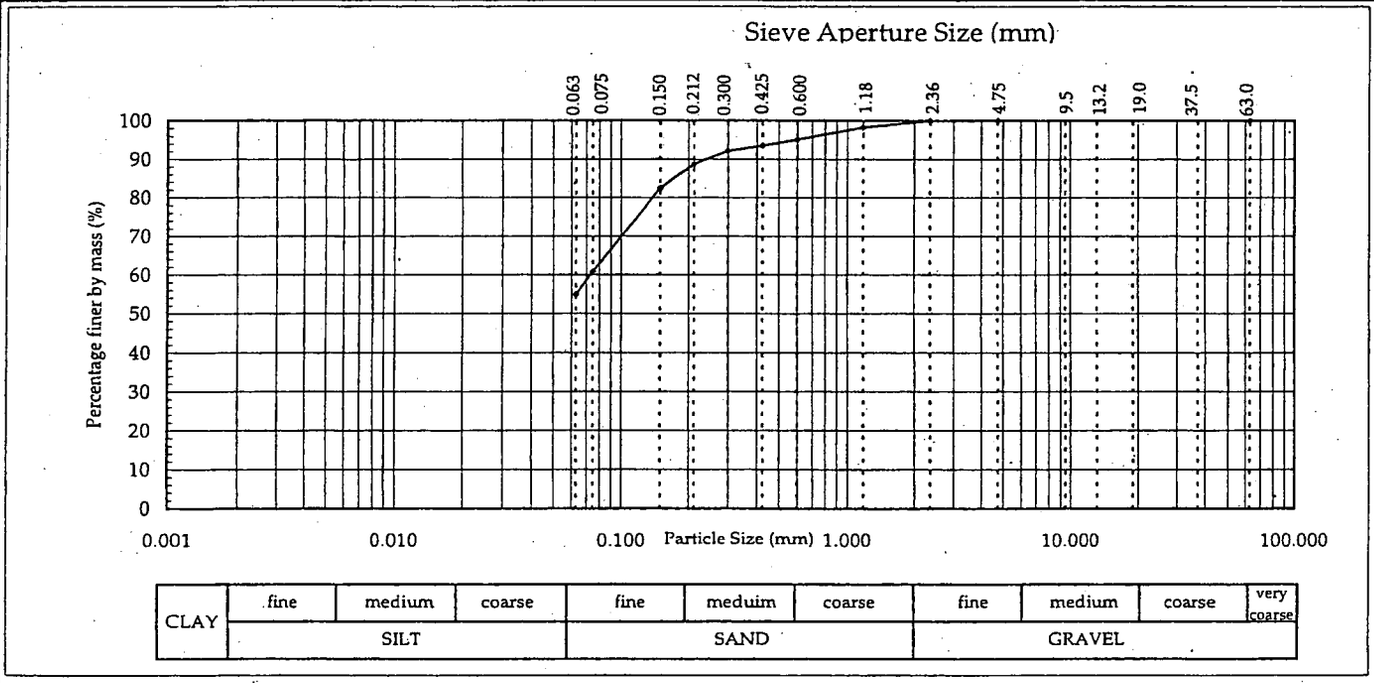
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbank Investigation
Location : Whakatane
Client : Opus Tauranga
Client/Sample Ref : 5
Contractor :
Bore No: BH1 Depth: 0.7 - 2.9 metres
Sampled by : M Burt
Date received : 8-Dec-98
Sampling method : Drilling
Sample condition : As received
Sample description : Greyish brown silty fine SAND, medium dense
Solid Particle Density (t/m^3):
Water Content (as received): 26.8 %

Project No: 289031.01
Lab Ref No: 98/389/001
Client Ref: 000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	92	--	--	--	--
37.5	--	2.36	100	0.212	89	--	--	--	--
19.0	--	1.18	98	0.150	83	--	--	--	--
13.2	--	0.600	95	0.075	61	--	--	--	--
9.5	--	0.425	93	0.063	55	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Date Reported: 10/12/98

IANZ Approved Signatory
Designation : Technician
Date : 11/12/98

Sampling is not covered by IANZ Accreditation

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All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

csf 2100 (11/98)

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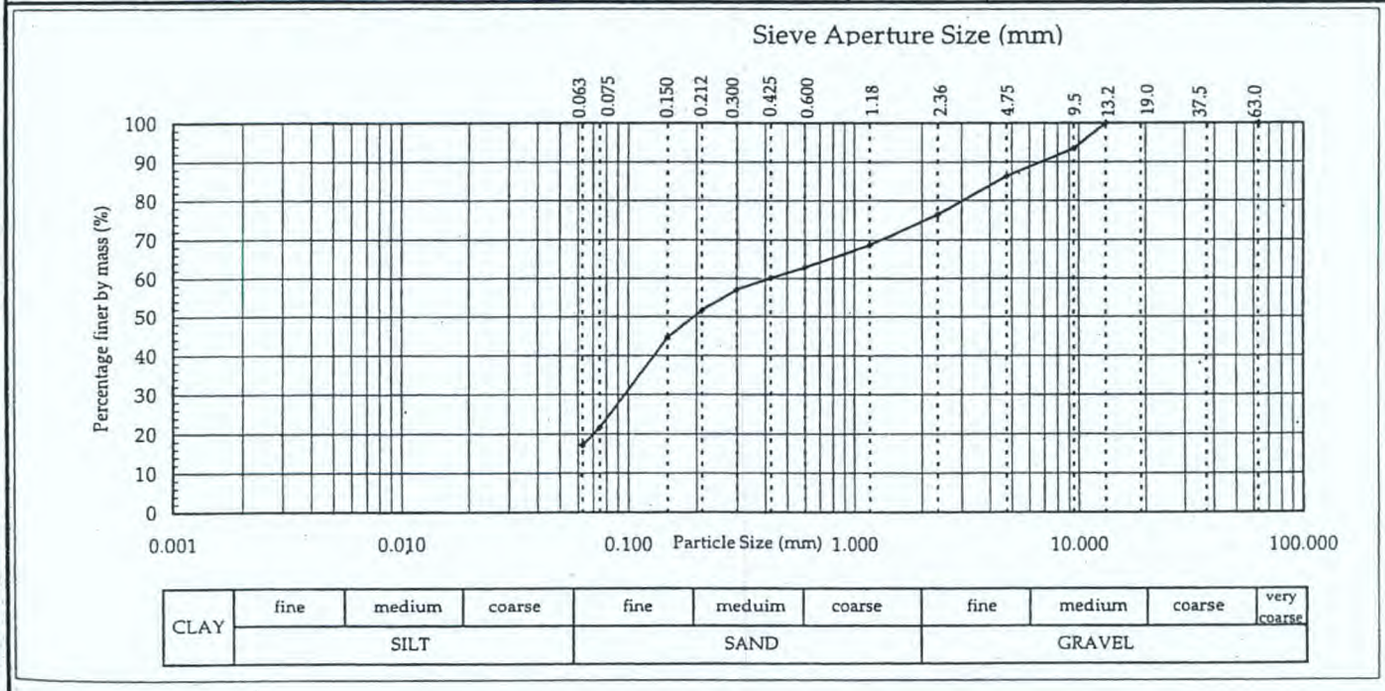
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbank Investigation
Location : Whakatane
Client : Opus Tauranga
Client/Sample Ref : 6
Contractor :
Bore No: BH1 Depth: 7.0 - 8.5 metres
Sampled by : M Burt
Date received : 8-Dec-98
Sampling method : Drilling
Sample condition : As received
Sample description : Light grey gravelly coarse SAND, medium dense
Solid Particle Density (t/m^3):
Water Content (as received): 104.0 %

Project No: 289031.01
Lab Ref No: 98/389/001
Client Ref: 000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	86	0.300	57	--	--	--	--
37.5	--	2.36	76	0.212	52	--	--	--	--
19.0	--	1.18	69	0.150	45	--	--	--	--
13.2	100	0.600	63	0.075	22	--	--	--	--
9.5	93	0.425	60	0.063	17	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Date Reported: 10/12/98

IANZ Approved Signatory
Designation : Technician
Date : 11/12/98

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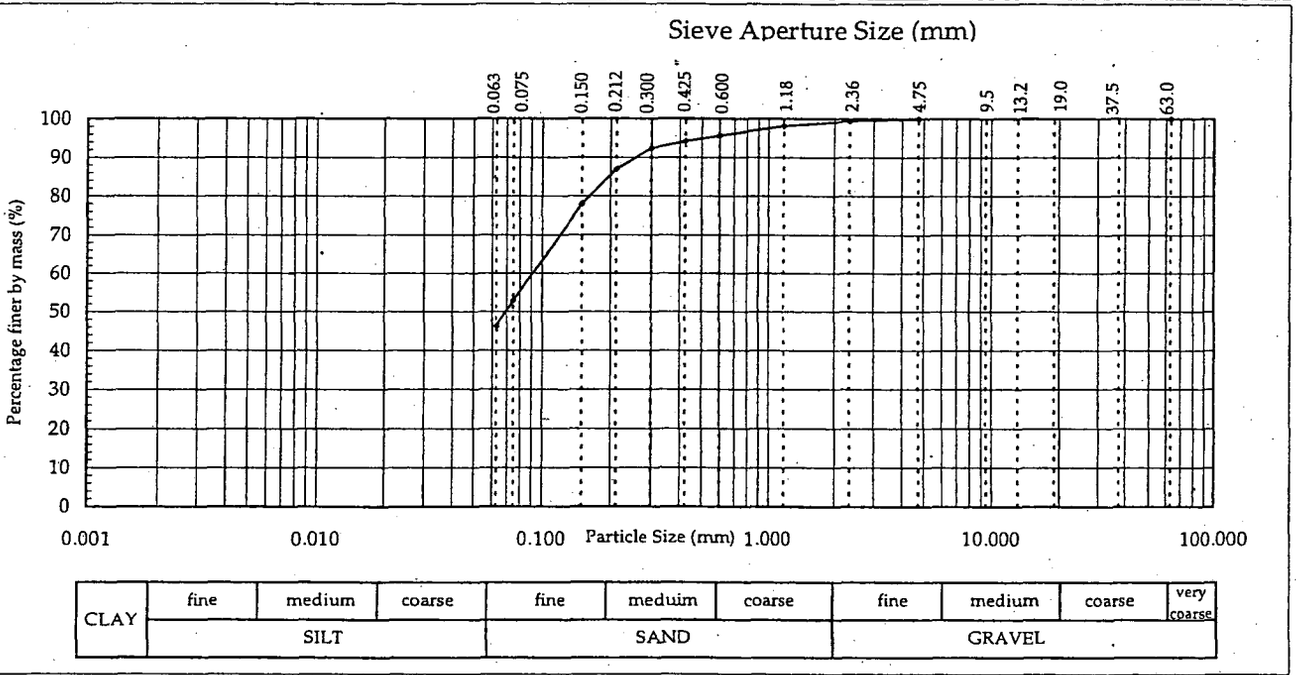
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbank Investigation
Location : Whakatane
Client : Opus Tauranga
Client/Sample Ref : 7
Contractor :
Bore No: BH2 Depth: 1.5 - 3.0 metres
Sampled by : M Burt
Date received : 8-Dec-98
Sampling method : Drilling
Sample condition : As received
Sample description : Light brown silty medium SAND, medium dense
Solid Particle Density (t/m^3):
Water Content (as received): 26.5 %

Project No: 289031.01
Lab Ref No: 98/389/001
Client Ref: 000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	92	--	--	--	--
37.5	--	2.36	99	0.212	87	--	--	--	--
19.0	--	1.18	98	0.150	78	--	--	--	--
13.2	--	0.600	96	0.075	53	--	--	--	--
9.5	--	0.425	94	0.063	46	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Sampling is not covered by IANZ Accreditation

Date Reported: 10/12/98

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IANZ Approved Signatory
Designation : Technician
Date : 11/12/98

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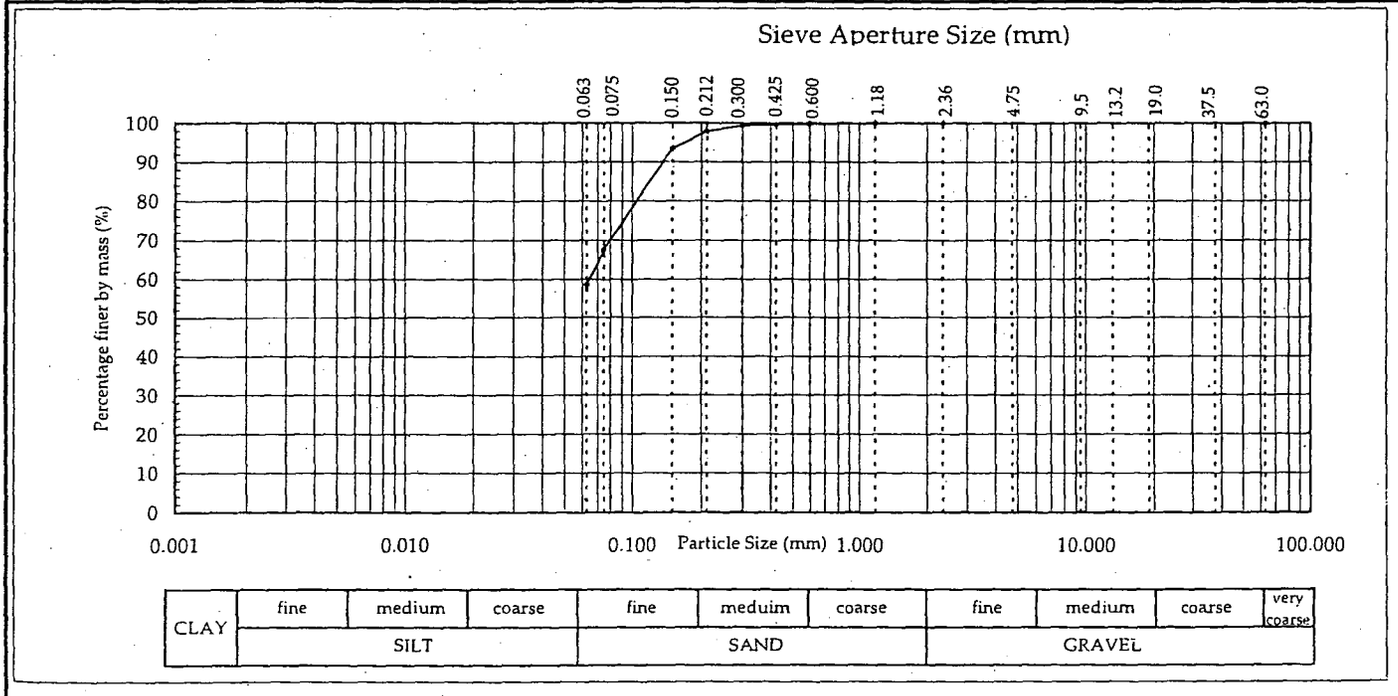
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project :	Rangitaiki Stopbank Investigation
Location :	Whakatane
Client :	Opus Tauranga
Client/Sample Ref :	8
Contractor :	
Bore No:	BH2 Depth: 3.2 - 5.1 metres
Sampled by :	M Burt
Date received :	8-Dec-98
Sampling method :	Drilling
Sample condition :	As received
Sample description :	Greyish brown silty fine SAND, medium dense
Solid Particle Density (t/m^3):	
Water Content (as received):	40.0 %

Project No:	289031.01
Lab Ref No:	98/389/001
Client Ref:	000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	--	--	--	--
37.5	--	2.36	100	0.212	98	--	--	--	--
19.0	--	1.18	100	0.150	93	--	--	--	--
13.2	--	0.600	100	0.075	68	--	--	--	--
9.5	--	0.425	100	0.063	58	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Sampling is not covered by IANZ Accreditation

Date Reported: 10/12/98

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Designation : Technician

Date : 11/12/98

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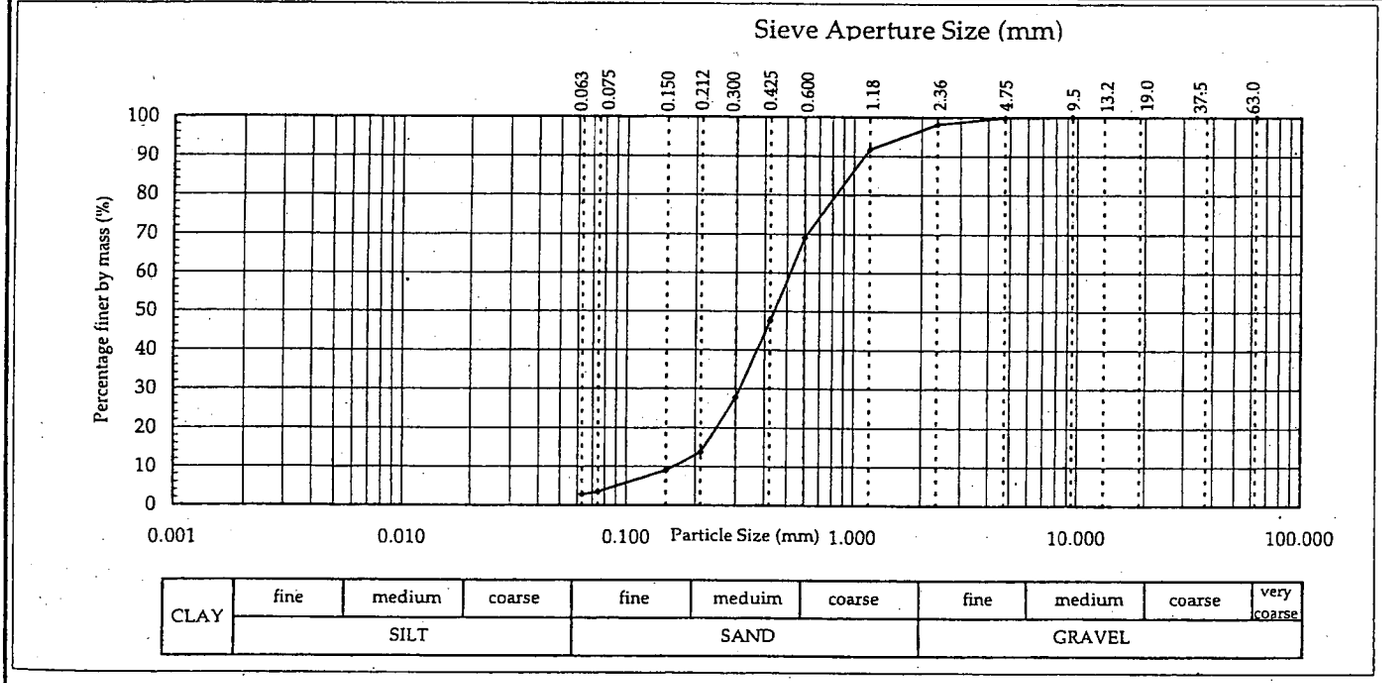
PARTICLE SIZE ANALYSIS
TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project :	Rangitaiki Stopbank Investigation
Location :	Whakatane
Client :	Opus Tauranga
Client/Sample Ref :	9
Contractor :	
Bore No:	BH2 Depth: 6.8 - 9.2 metres
Sampled by :	M Burt
Date received :	8-Dec-98
Sampling method :	Drilling
Sample condition :	As received
Sample description :	Greyish brown silty medium - coarse SAND
Solid Particle Density (t/m^3):	
Water Content (as received):	45.1 %

Project No:	289031.01
Lab Ref No:	98/389/001
Client Ref:	000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	28	--	--	--	--
37.5	--	2.36	98	0.212	14	--	--	--	--
19.0	--	1.18	92	0.150	9	--	--	--	--
13.2	--	0.600	69	0.075	3	--	--	--	--
9.5	100	0.425	47	0.063	3	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Date Reported: 10/12/98

IANZ Approved Signatory

Designation : Technician

Date : 11/12/98

Sampling is not covered by IANZ Accreditation

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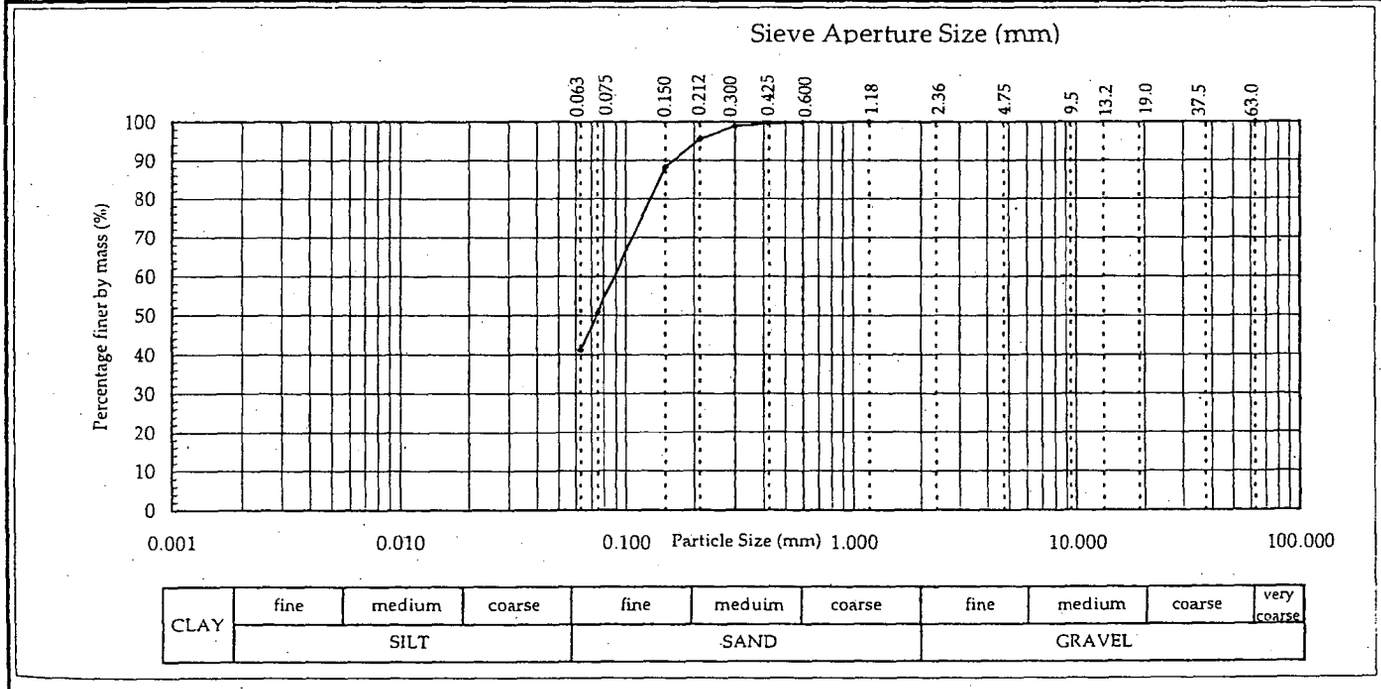
PARTICLE SIZE ANALYSIS TEST REPORT

Project : Rangitaiki Stopbank Investigation
Location : Whakatane
Client : Opus Tauranga
Client/Sample Ref : 10
Contractor :
Bore No: BH4 Depth: 1.2 - 2.2 metres
Sampled by : M Burt
Date received : 8-Dec-98
Sampling method : Drilling
Sample condition : As received
Sample description : Greyish brown silty fine SAND, medium dense
Solid Particle Density (t/m^3):
Water Content (as received): 38.7 %

OPUS INTERNATIONAL CONSULTANTS

Project No: 289031.01
Lab Ref No: 98/389/001
Client Ref: 000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	--	--	--	--
37.5	--	2.36	--	0.212	96	--	--	--	--
19.0	--	1.18	100	0.150	88	--	--	--	--
13.2	--	0.600	100	0.075	51	--	--	--	--
9.5	--	0.425	100	0.063	41	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Date Reported: 10/12/98

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Designation : Technician
Date : 11/12/98

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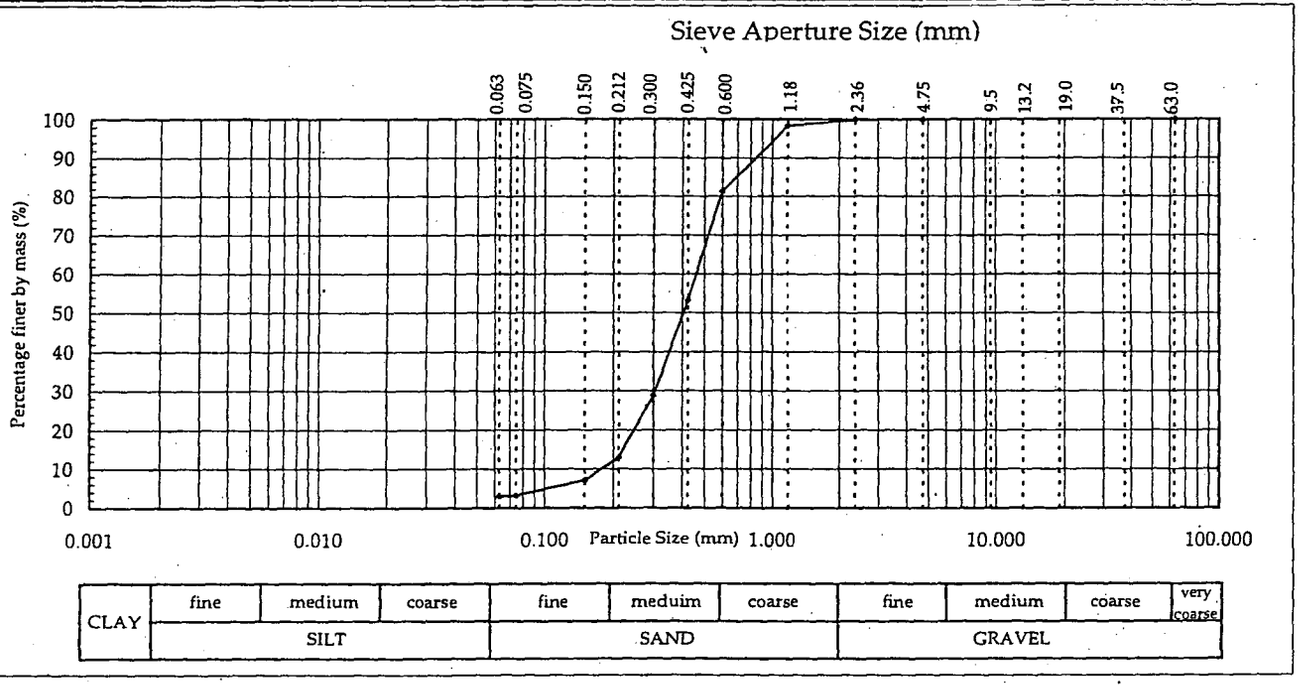
PARTICLE SIZE ANALYSIS TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project :	Rangitaiki Stopbank Investigation
Location :	Whakatane
Client :	Opus Tauranga
Client/Sample Ref :	11
Contractor :	
Bore No:	BH4 Depth: 2.7 - 4.7 metres
Sampled by :	M Burt
Date received :	8-Dec-98
Sampling method :	Drilling
Sample condition :	As received
Sample description :	Light grey silty fine - medium SAND, loose
Solid Particle Density (t/m^3):	
Water Content (as received):	30.3 %

Project No:	289031.01
Lab Ref No:	98/389/001
Client Ref:	000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	100	0.300	29	--	--	--	--
37.5	--	2.36	100	0.212	13	--	--	--	--
19.0	--	1.18	98	0.150	7	--	--	--	--
13.2	--	0.600	81	0.075	3	--	--	--	--
9.5	--	0.425	53	0.063	3	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Date Reported: 10/12/98

IANZ Approved Signatory

Designation : Technician

Date : 11/12/98

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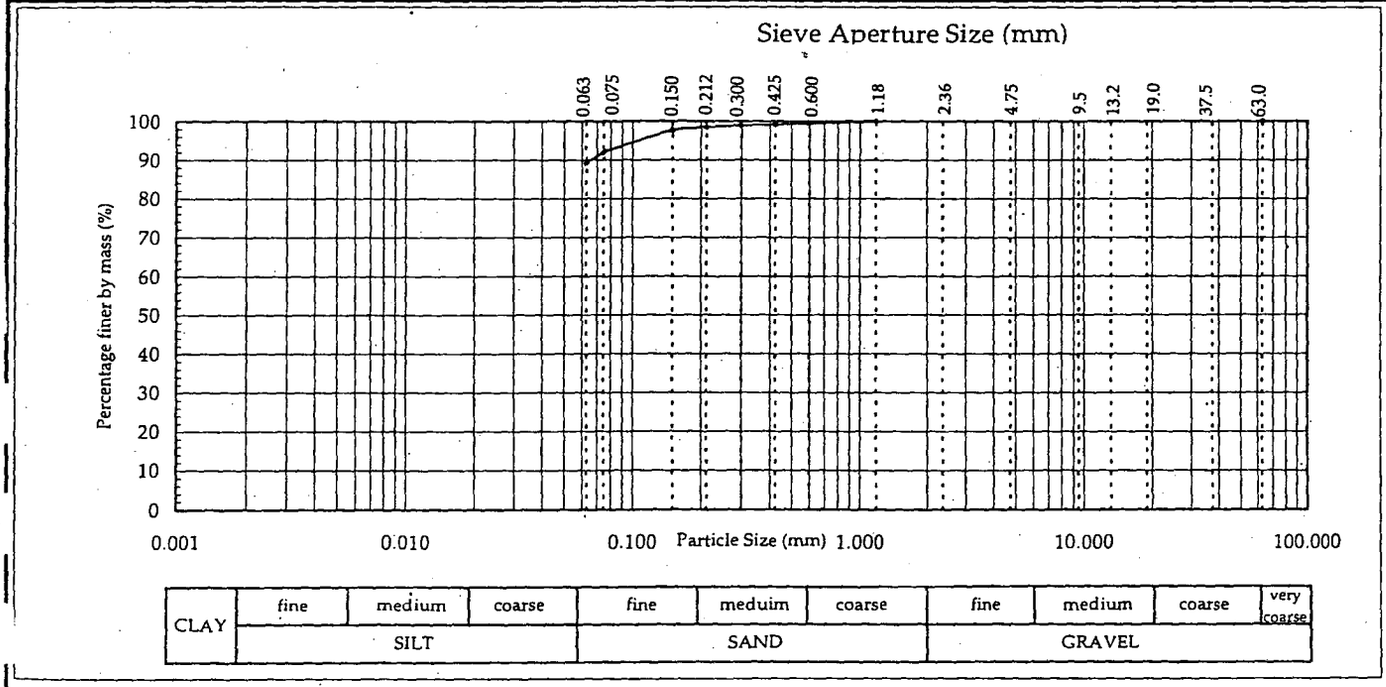
PARTICLE SIZE ANALYSIS TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project :	Rangitaiki Stopbank Investigation
Location :	Whakatane
Client :	Opus Tauranga
Client/Sample Ref :	12
Contractor :	
Bore No:	BH6 Depth: 0.8 - 1.1 metres
Sampled by :	M Burt
Date received :	8-Dec-98
Sampling method :	Drilling
Sample condition :	As received
Sample description :	Light brown SILT
Solid Particle Density (t/m^3):	
Water Content (as received):	46.5 %

Project No:	289031.01
Lab Ref No:	98/389/001
Client Ref:	000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	--	0.300	99	--	--	--	--
37.5	--	2.36	--	0.212	99	--	--	--	--
19.0	--	1.18	100	0.150	98	--	--	--	--
13.2	--	0.600	99	0.075	92	--	--	--	--
9.5	--	0.425	99	0.063	89	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

Sampling and testing is covered by IANZ Accreditation

Date Reported: 10/12/98

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Designation : Technician

Date : 11/12/98

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PARTICLE SIZE ANALYSIS TEST REPORT

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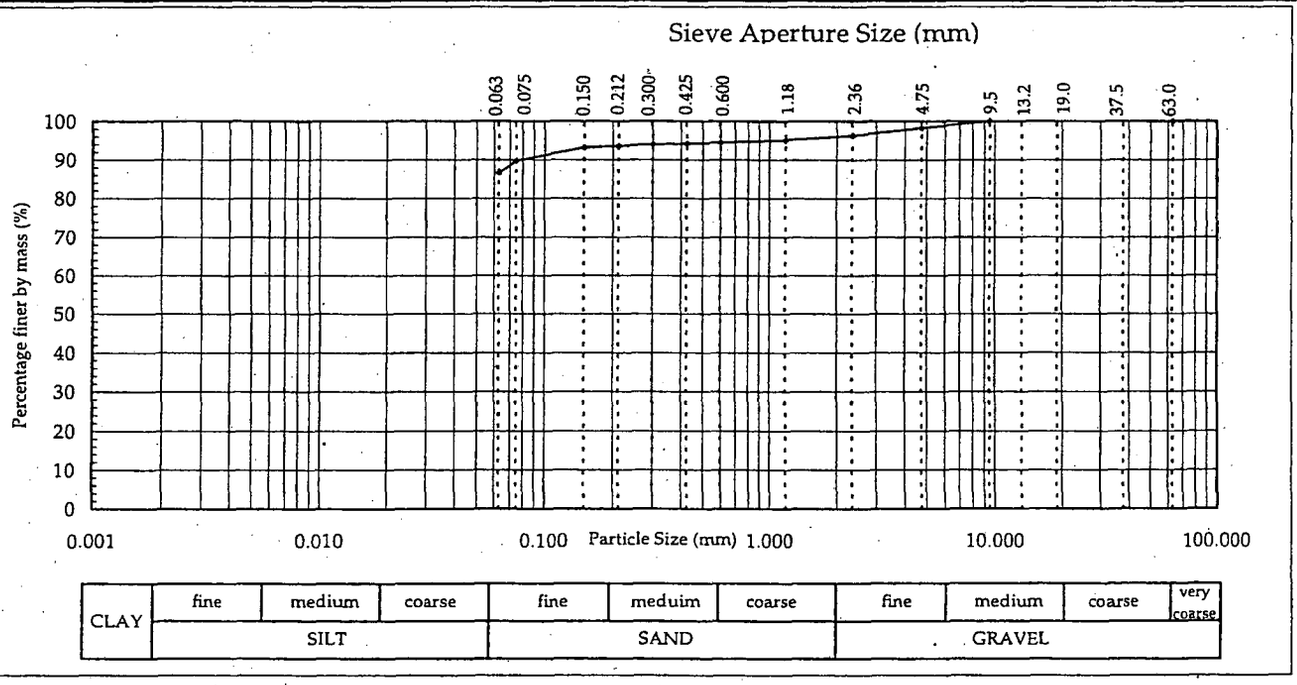
Project :	Rangitaiki Stopbank Investigation
Location :	Whakatane
Client :	Opus Tauranga
Client/Sample Ref :	13
Contractor :	
Bore No:	BH6 Depth: 5.6 - 6.4 metres
Sampled by :	M Burt
Date received :	8-Dec-98
Sampling method :	Drilling
Sample condition :	As received
Sample description :	Grey fine sandy SILT, very dense
Solid Particle Density (t/m^3):	
Water Content (as received):	62.7 %

Project No:	289031.01
Lab Ref No:	98/389/001
Client Ref:	000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	98	0.300	94	--	--	--	--
37.5	--	2.36	96	0.212	94	--	--	--	--
19.0	--	1.18	95	0.150	93	--	--	--	--
13.2	--	0.600	94	0.075	90	--	--	--	--
9.5	100	0.425	94	0.063	87	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

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Date Reported: 10/12/98

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Designation : Technician

Date : 11/12/98

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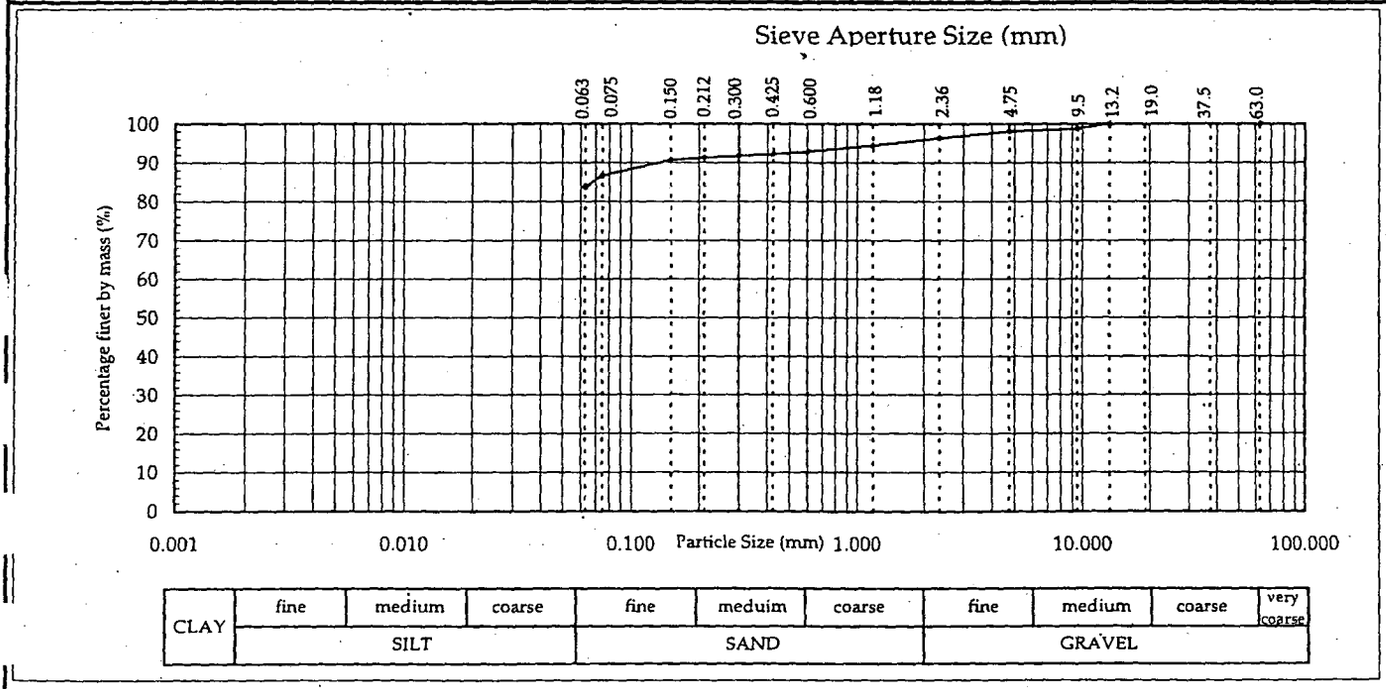
PARTICLE SIZE ANALYSIS TEST REPORT

OPUS INTERNATIONAL CONSULTANTS

Project : Rangitaiki Stopbank Investigation
Location : Whakatane
Client : Opus Tauranga
Client/Sample Ref : 14
Contractor :
Bore No: BH7 Depth: 6.5 - 7.5 metres
Sampled by : M Burt
Date received : 8-Dec-98
Sampling method : Drilling
Sample condition : As received
Sample description : Light grey fine sandy SILT. Very dense
Solid Particle Density (t/m^3):
Water Content (as received): 56.4 %

Project No: 289031.01
Lab Ref No: 98/389/001
Client Ref: 000HL

Sieve Analysis						Hydrometer Analysis			
Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Sieve Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)	Particle Size (mm)	Passing (%)
63.0	--	4.75	98	0.300	92	--	--	--	--
37.5	--	2.36	96	0.212	91	--	--	--	--
19.0	--	1.18	94	0.150	91	--	--	--	--
13.2	100	0.600	93	0.075	87	--	--	--	--
9.5	99	0.425	92	0.063	84	--	--	--	--
Note: "--" denotes sieve not used and/or hydrometer analysis not tested						--	--		



Test Methods	Notes
Particle Size Analysis: NZS 4402 1986 Test 2.8.1 (Wet Sieve) Particle Size Analysis: NZS 4402 1986 Test 2.8.4 (Hydrometer)	Fraction Tested:Whole sample

Date Tested: 09/12/98

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Date Reported: 10/12/98

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Designation : Technician

Date : 11/12/98

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Christensen, S.A. (1995) Liquefaction of cohesionless soils in the March 2, 1987 Edgecumbe Earthquake, Bay of Plenty, New Zealand and other earthquakes, Department of Civil Engineering, University of Canterbury, research report.

(Liquefaction)

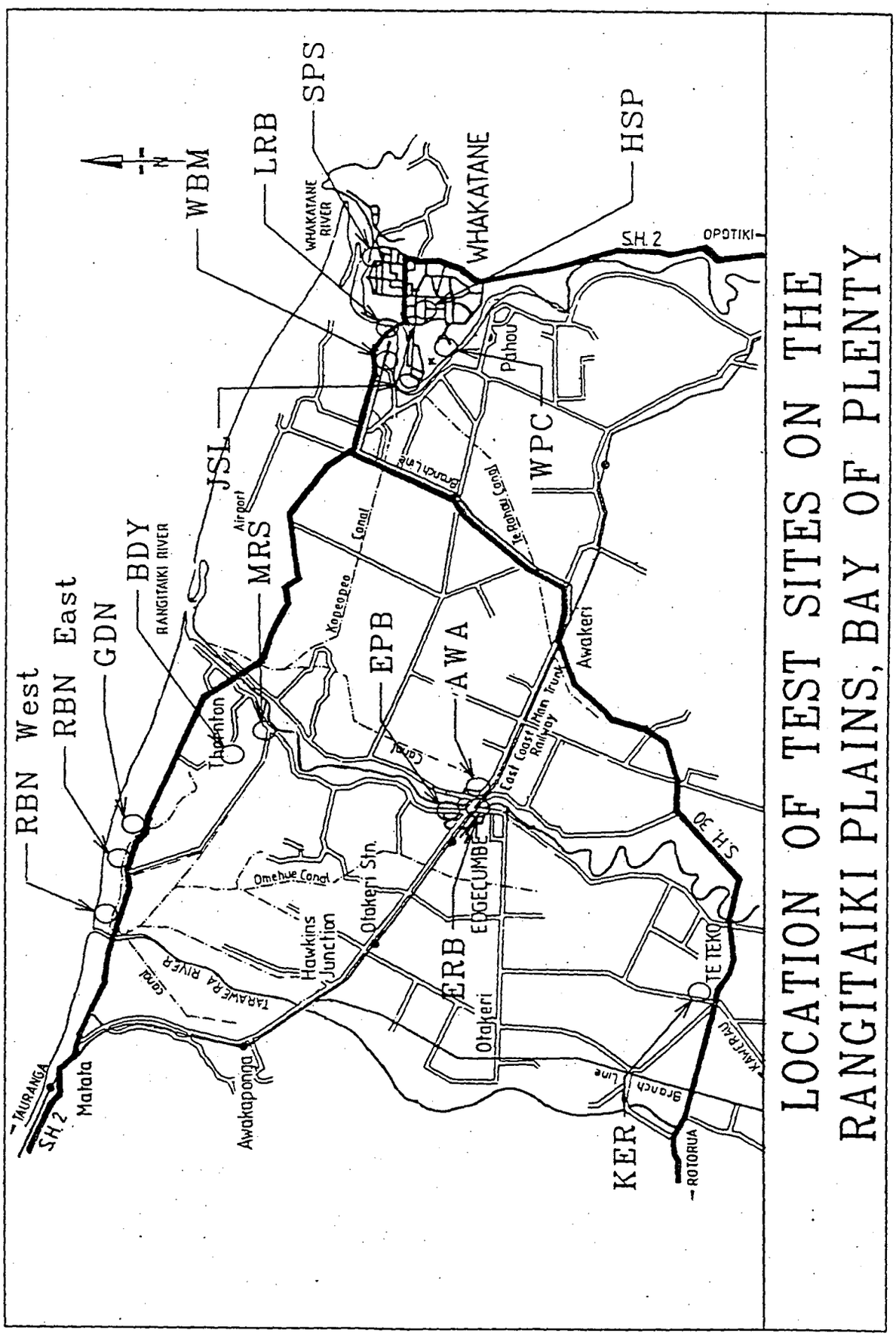

Figure 7.1 Location of sites studied in this report. (after RRU [59])

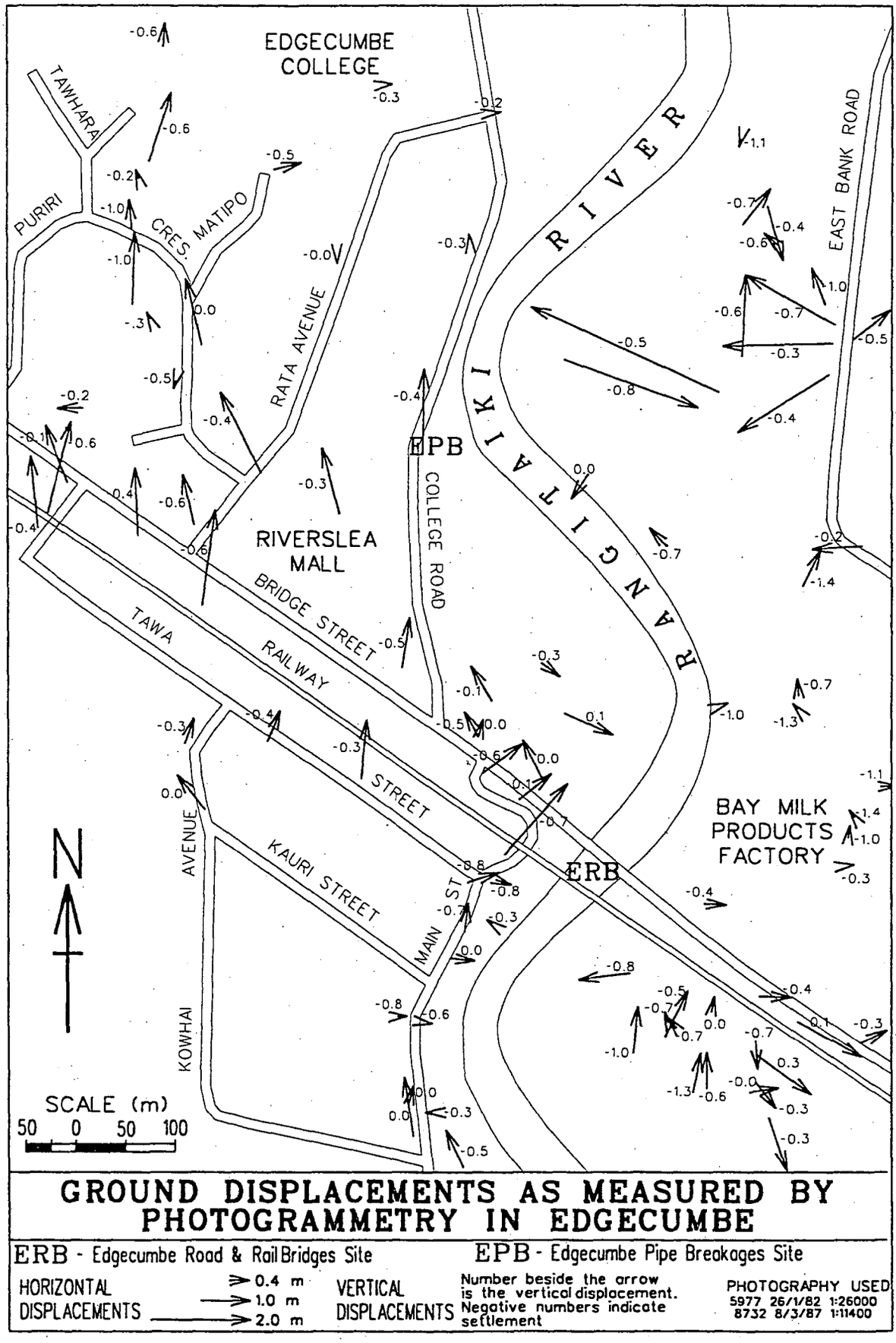

Figure 8.51 Displacements as measured by photogrammetry in the Edgecumbe area.

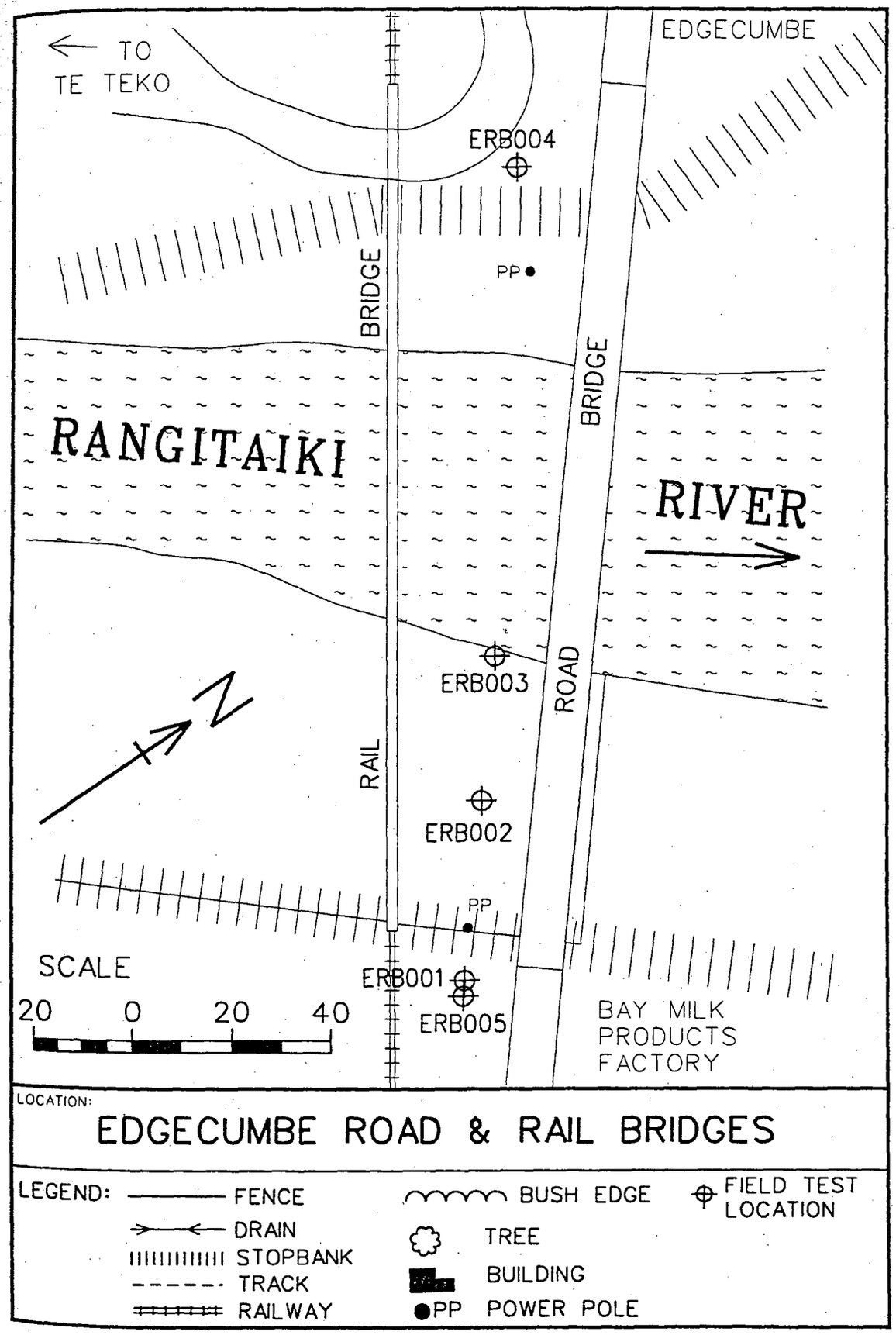

Figure 8.35 Map of the Edgecumbe Road and Rail Bridges site showing the in situ tests undertaken in 1993.

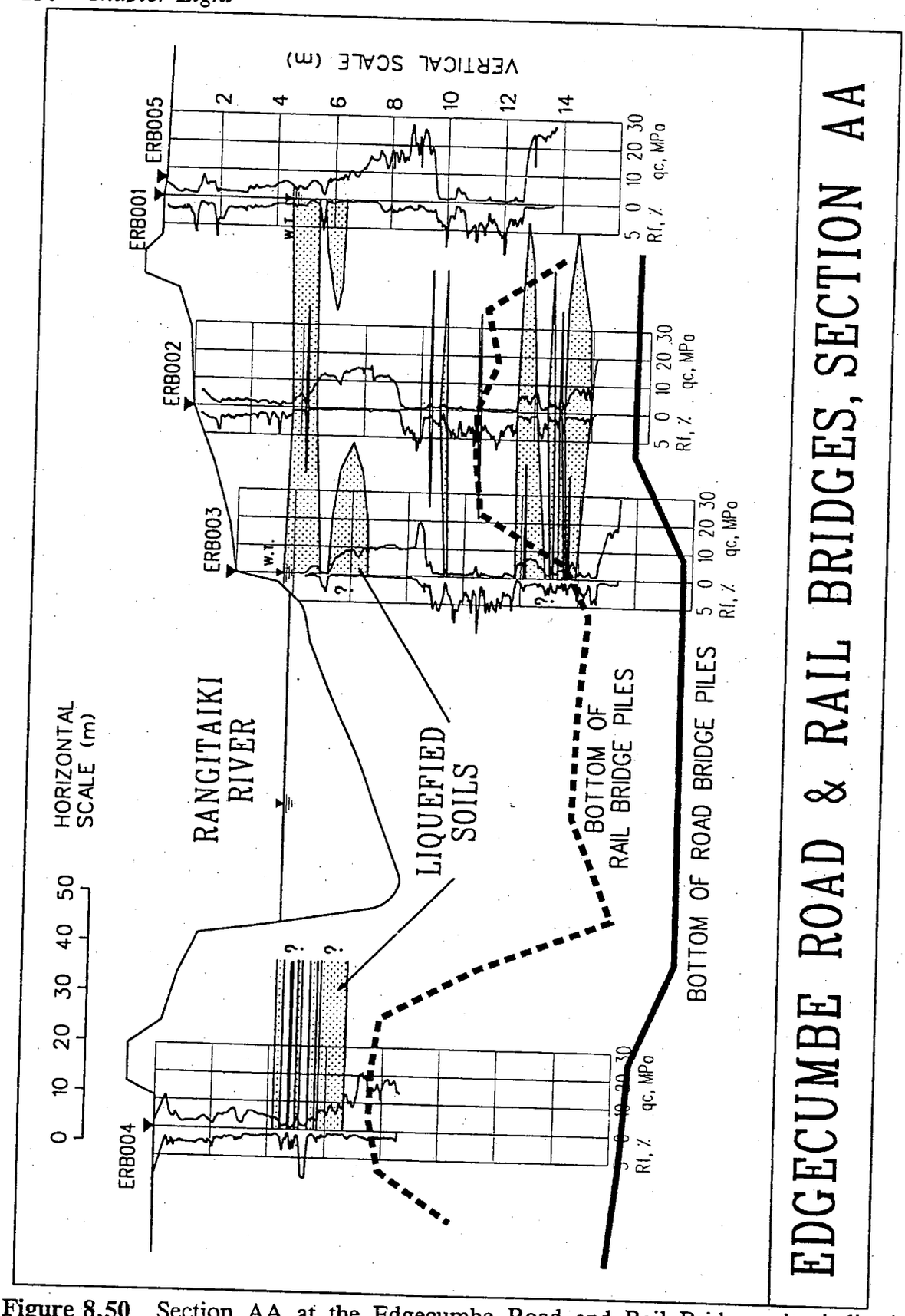

Figure 8.50 Section AA at the Edgecumbe Road and Rail Bridges site indicating the estimated liquefied strata and the depth to which the bridge piles have been driven.

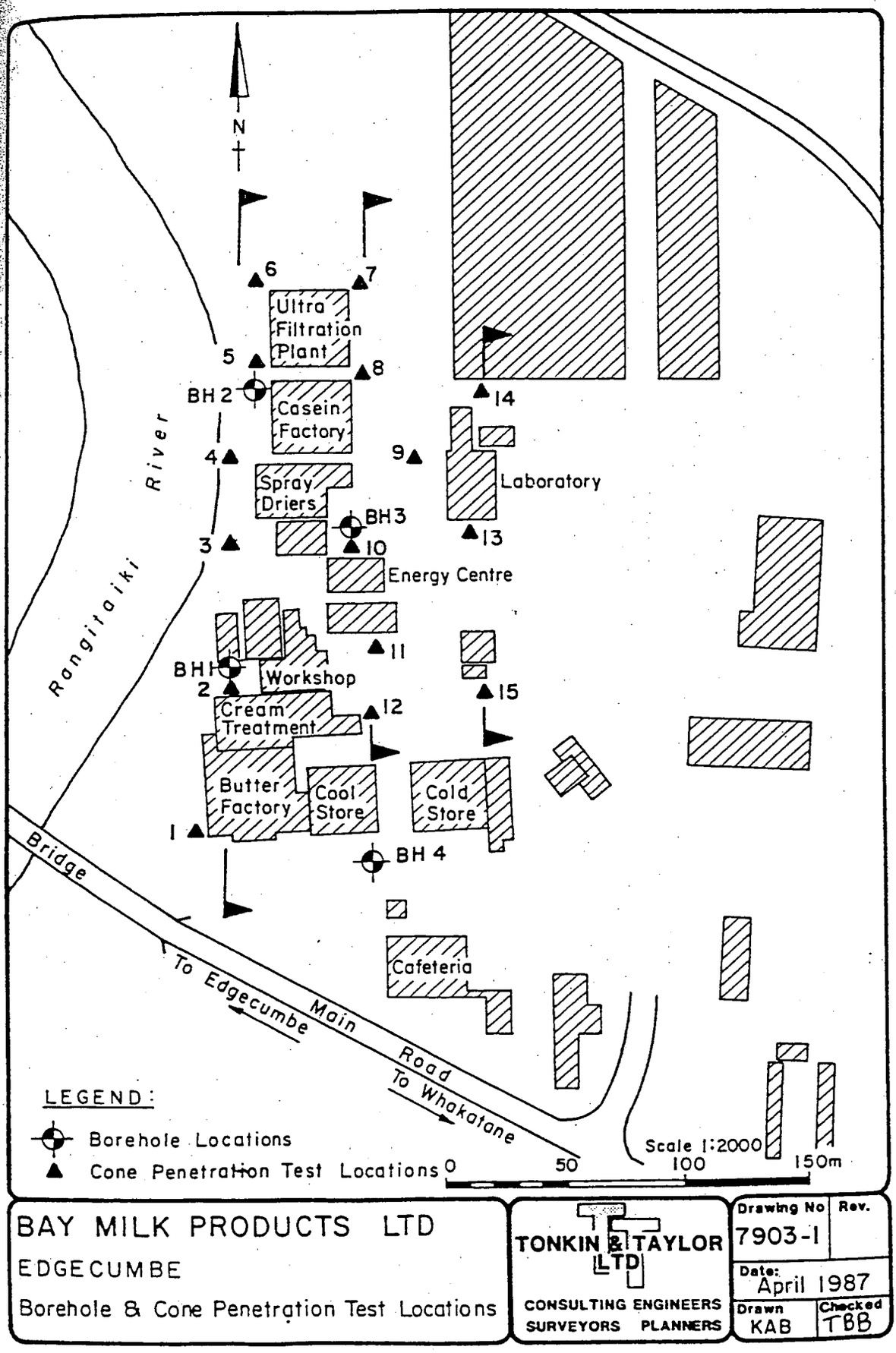

Figure D-1 Location of in situ tests at Bay Milk Products, Edgecumbe.

SITE: BAY MILK PRODUCTS, EDGECOMBE — **BOREHOLE No. 1**

JOB No: 7903 DATE DRILLED: 28/3/87 RL GROUND: 4·49 SHEET 1 OF 3

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT N BLOWS/300 MM	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) Wp W WL
LOST		1				
SILT, slightly clayey, sandy, greyish brown				3		
SAND, fine to medium, very loose, greyish brown		2		2		
LOST		3		2		
SAND, medium, very loose, dark grey ,medium to coarse, v.loose, dk.grey, fine to medium, very loose, dark grey with some brown fibrous organics		4		4 3 1		
PEAT, fibrous, dark brown		5		3		
SAND, medium, loose to medium dense, fine to medium, medium dense, light grey with pumiceous gravels		6		19 32		
as above, medium dense to dense		7		28 27		
fine, med. dense to loose, dark grey		8		35 31 17		
PEAT, dark brown						
SAND, medium to coarse, medium dense		9		14		
SILT, slightly clayey, soft to firm, grey and brown, some fibrous organics,medium sand layer at 9.7 m		10		4 12		
SAND, med dense, grey pumiceous gravels				11		
CLAY, silty, soft to firm, grey,		11		22		
SILT, sl.clayey, brown organics						
PEAT, dark brown, organics				13		
SILT, clayey, firm, greyish brown, light grey pumiceous sand ,sandy, firm greyish brown		12		8 26		
SAND, coarse, loose		13		10		
SILT, clayey, firm to stiff, greyish brown, some organics				11		

NOTES: DRILL METHOD:

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Figure D-4 Bore log BH1 performed at Bay Milk Products Limited, Edgecumbe.

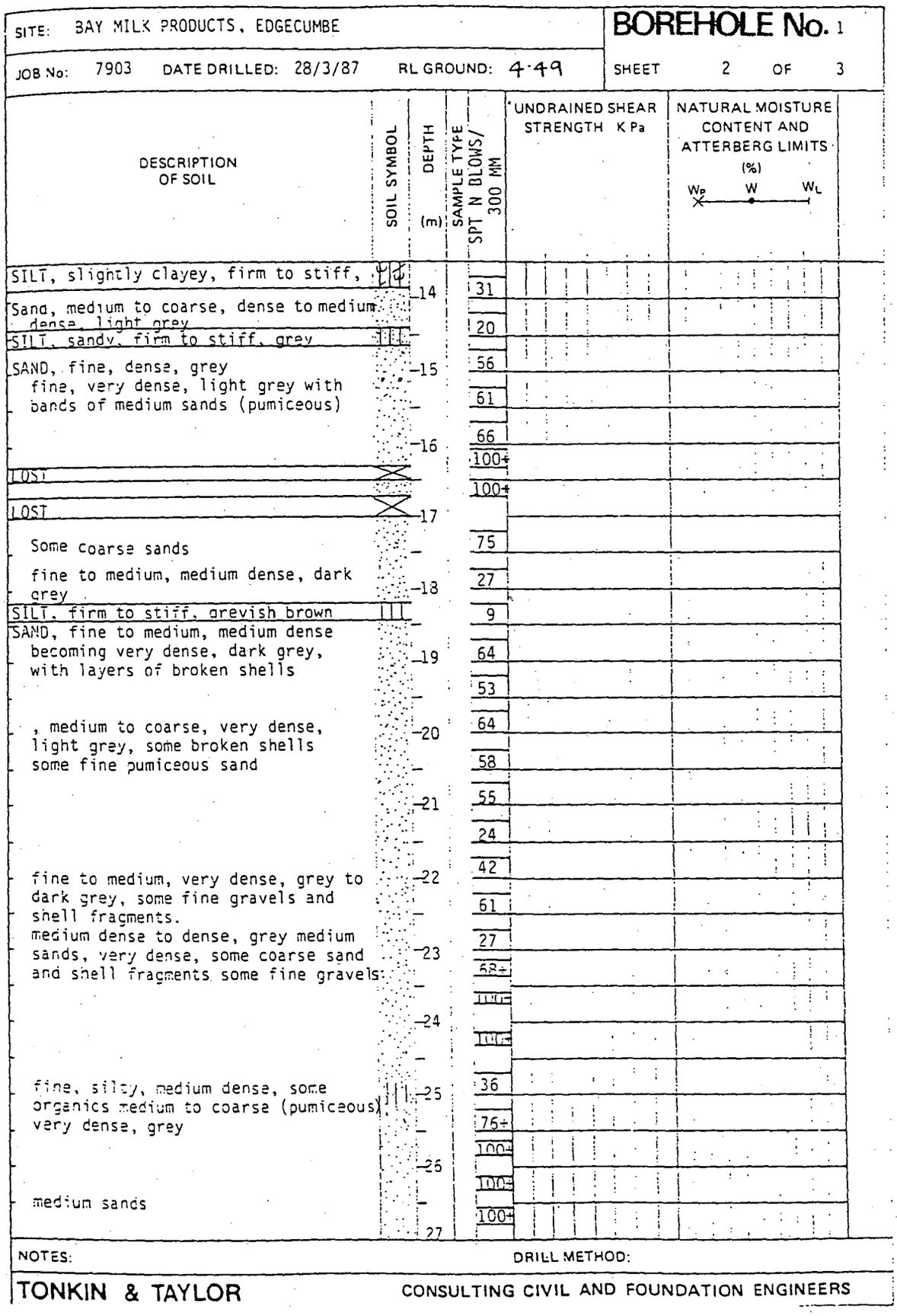

Figure D-5 Bore log BH1 performed at Bay Milk Products Limited, Edgecumbe.

SITE: BAY MILK PRODUCTS, EDGECUMBE

BOREHOLE No. 1

JOB No: 7903 DATE DRILLED: 28/3/87 RL GROUND: 4·49 SHEET 3 OF 3

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT 'N' Blows/300mm	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L
SAND, medium, very dense, some coarse sands, grey				100+		
				56		
- grades rare pumice gravels (fine), weakly cemented layers in places				60		
				77		
				77		
				65		
				75		
				76		
- grades some fine, uniform sands				75		
- layer SILT, hard, grey				100+		
LOST						
				100+		
End of Borehole 34.5 m						

NOTES: DRILL METHOD: MACHINE

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Figure D-6 Bore log BH1 performed at Bay Milk Products Limited, Edgecumbe.

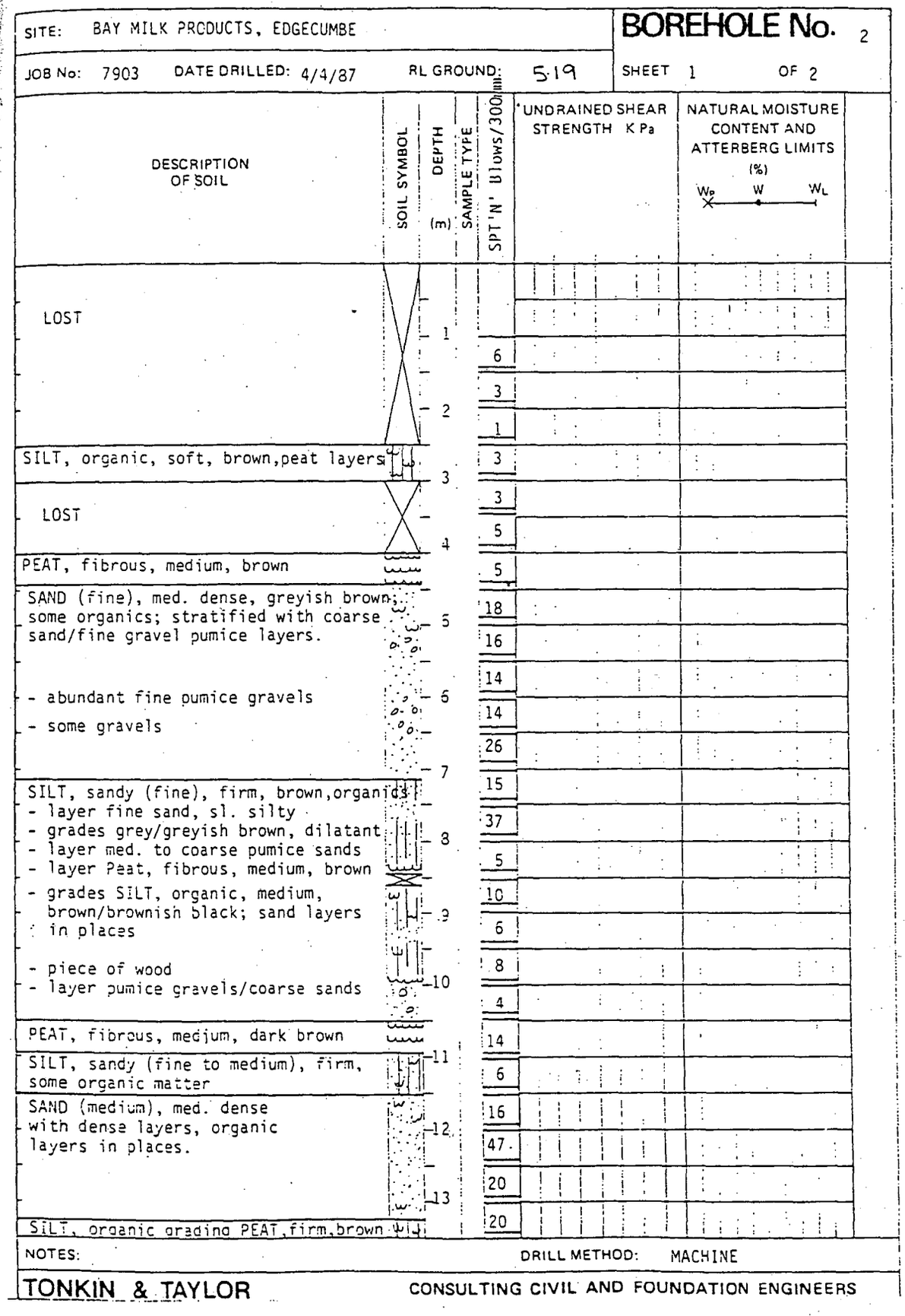

Figure D-7 Bore log BH2 performed at Bay Milk Products Limited, Edgecumbe.

SITE: BAY MILK PRODUCTS, EDGECUMBE

BOREHOLE No. 2

JOB No: 7903 DATE DRILLED: 4/4/87 RL GROUND: 5·19 SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L
SAND (med to coarse), dense or med dense, grey, rare pumice gravels; grading fine, dilatant sands, some organics, silty in places.		14	32		
			18		
			37		
- grades layers medium, uniform sands, med dense to very dense		15	45		
			62+		
- grades medium sands		16	36		
			37		
		17	45		
- grades rare pumic gravels, minor organic matter			50		
		18	50		
- grades many shell fragments, some fine sub-angular gravels.			37		
		19	55		
Borehole terminated @ 19.45 m		20			
		21			
		22			
		23			
		24			
		25			
		26			
		27			

NOTES: DRILL METHOD: MACHINE

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

Figure D-8 Bore log BH2 performed at Bay Milk Products Limited, Edgecumbe.

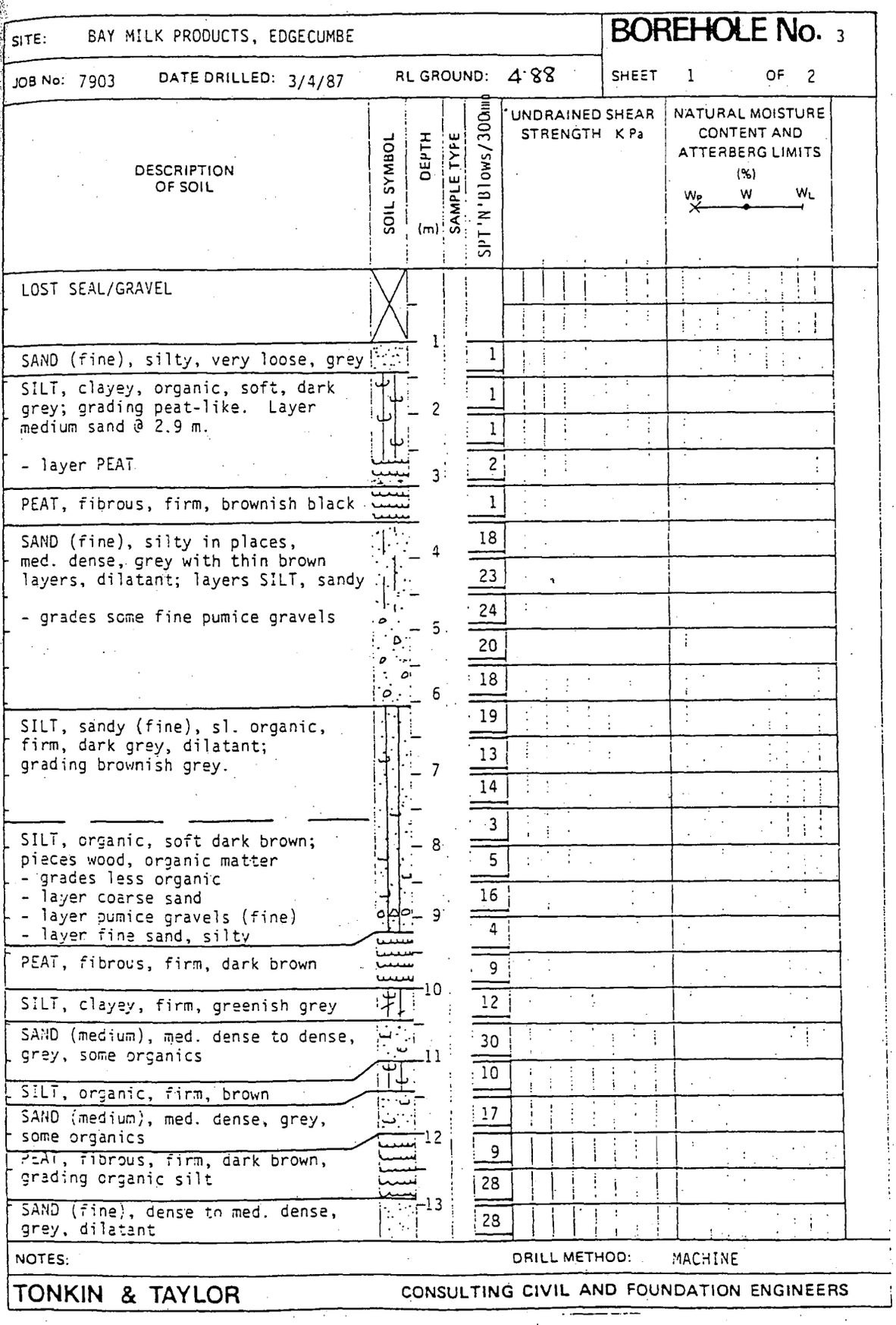

Figure D-9 Bore log BH3 performed at Bay Milk Products Limited, Edgecumbe.

SITE: BAY MILK PRODUCTS, EDGECUMBE

BOREHOLE No. 3

JOB No: 7903 DATE DRILLED: 3/4/87 RL GROUND: 4·88 SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT 'N' Blows/300mm	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) Wp W WL
some medium sands - some organic matter - grades very dense		14		33 60+		
- grades rare, fine pumice gravels, silty, dense to very dense		15		50 61+ 66+		
- layer SILT, sandy (fine)		16		51		
- layer coarse sands - grades medium sands, dark grey, some coarse sands, shell fragments; fine sub-angular gravels		17 18 19		55 29 49 53 55 53		
Borehole terminated @ 19.45 m		20				

NOTES: DRILL METHOD: MACHINE

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Figure D-10 Bore log BH3 performed at Bay Milk Products Limited, Edgecumbe.

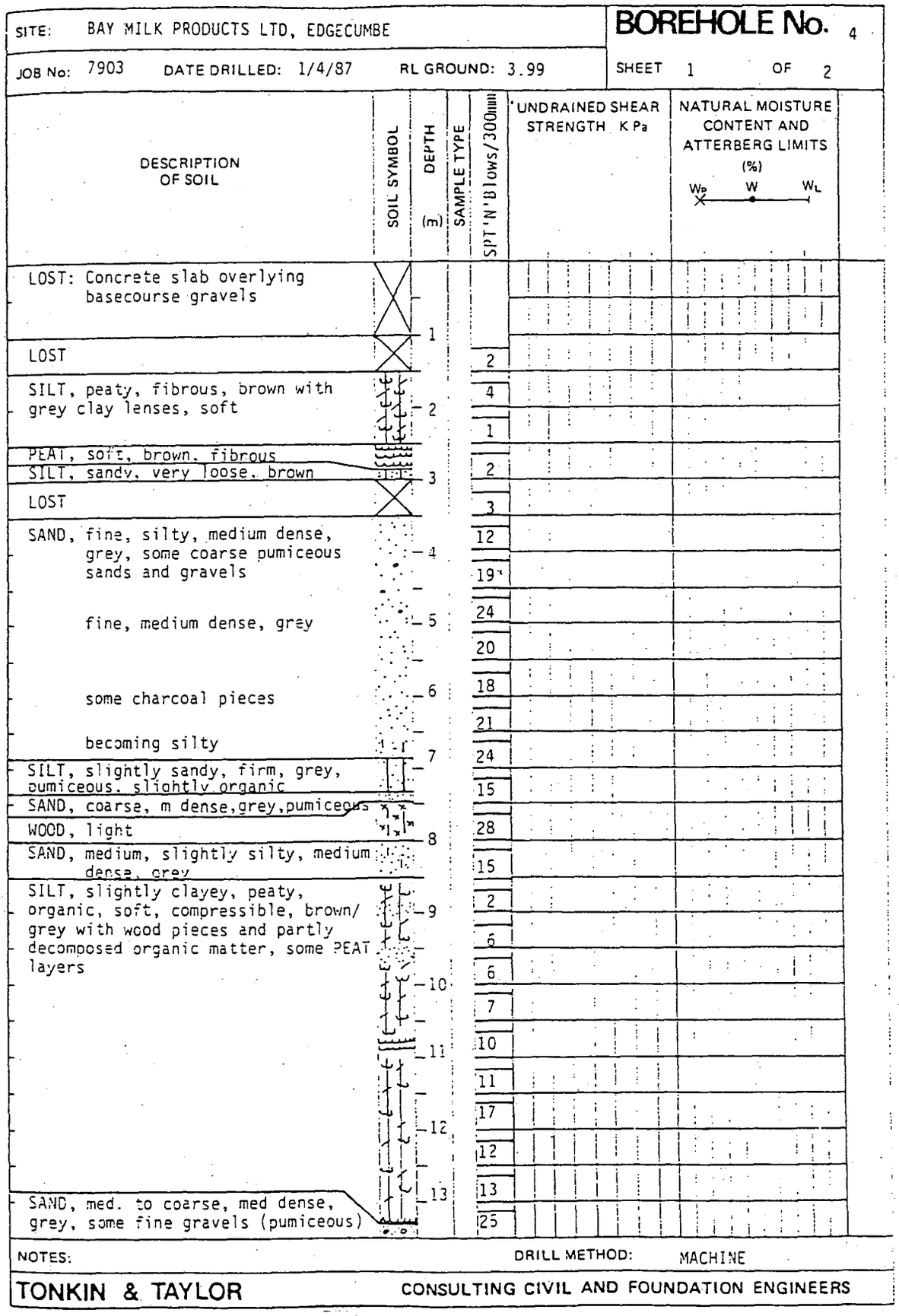


Figure D-11 Bore log BH4 performed at Bay Milk Products Limited, Edgecumbe.

SITE: BAY MILK PRODUCTS LTD, EDGECUMBE

BOREHOLE No. 4

JOB No: DATE DRILLED: RL GROUND:

SHEET 2 OF 2

DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	SPT 'N' Blows/300mm	UNDRAINED SHEAR STRENGTH K Pa	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS (%) W_P W W_L
SAND, fine, medium dense to dense, grey, with layers of sandy silt		14		25		
				42		
fine, dense to very dense, grey, some organic matter		15		59		
				64		
				70+		
- layer medium sands		16		72		
- layer SILT, hard, grey, friable						
- grades medium to coarse sand, medium dense to very dense, rare pumice gravels		17		58		
- layer shell fragments				22		
- grades some fine, sub-angular gravels; shell fragments		18		35		
				44		
				46		
		19		61		
				45		
		20		50		
				48		
		21				
Borehole terminated @ 21.0 m						

NOTES: DRILL METHOD: MACHINE

TONKIN & TAYLOR CONSULTING CIVIL AND FOUNDATION ENGINEERS

Figure D-12 Bore log BH4 performed at Bay Milk Products Limited, Edgecumbe.

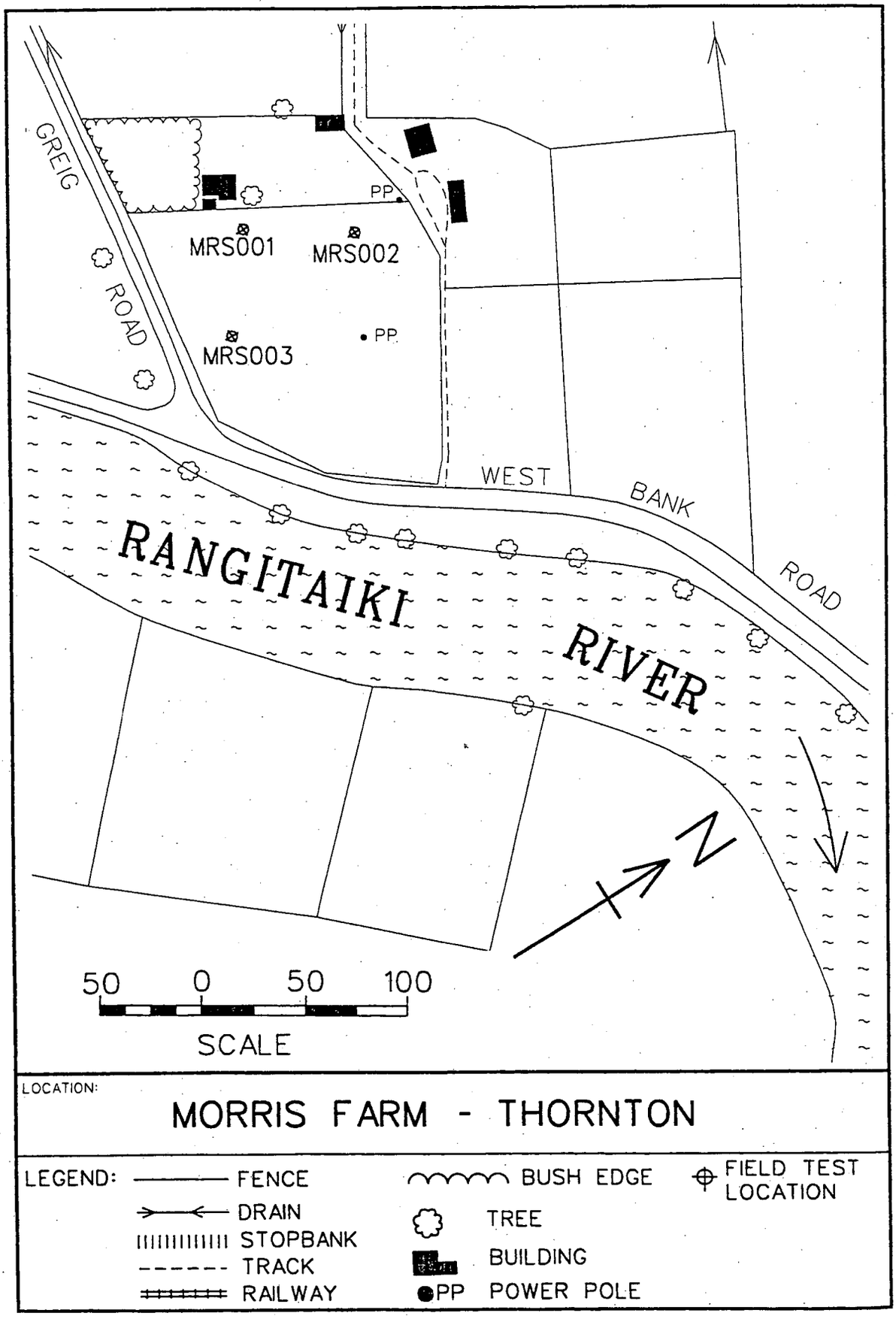


Figure 9.18 Schematic map of the Morris Farm showing the location of in situ testing.

Table 9.8 Estimated liquefied strata for the Morris Farm in the Edgecumbe earthquake.

CPT PROBE	WATER TABLE	LIQUEFIED LAYERS (m)	AVERAGE LIQUEFIED q_c, (MPa)	LIQUEFIED THICKNESS (m)
MRS001.PPT	1.63 m 18/01/93	2.95-3.80, 4.80-5.10, 7.15-9.20, 10.80-12.30, 12.60-12.90	7.0	5.00
MRS002.PPT	1.89 m 18/01/93	2.00-4.15, 6.10-6.90, 10.75-11.40, 11.80-11.95, 12.45-13.05	6.0	4.35
MRS003.PPT	2.08 m 18/01/93	2.80-3.70, 4.45-7.50	8.0	3.95

9.4.2 The Matata Earthquake

As there is no firm evidence of liquefaction at this site for the Matata earthquake and because of the possible density changes resulting from the preceding earthquakes only the speculative results of liquefaction prediction are presented here. An average critical cone resistance of 4 MPa was estimated using the following details and allowed the liquefied strata shown in Table 9.9 to be estimated.

Magnitude M_L = **5.4**
Epicentral Distance = **6.8 km**
Focal Depth = **10.5 km**
Modified Mercalli Intensity = **VII**
Estimated Peak Ground Acceleration = **0.15g**
Clay Content of Liquefied Soils = **0%**
Estimated Maximum Critical Cone Resistance = **4 MPa**

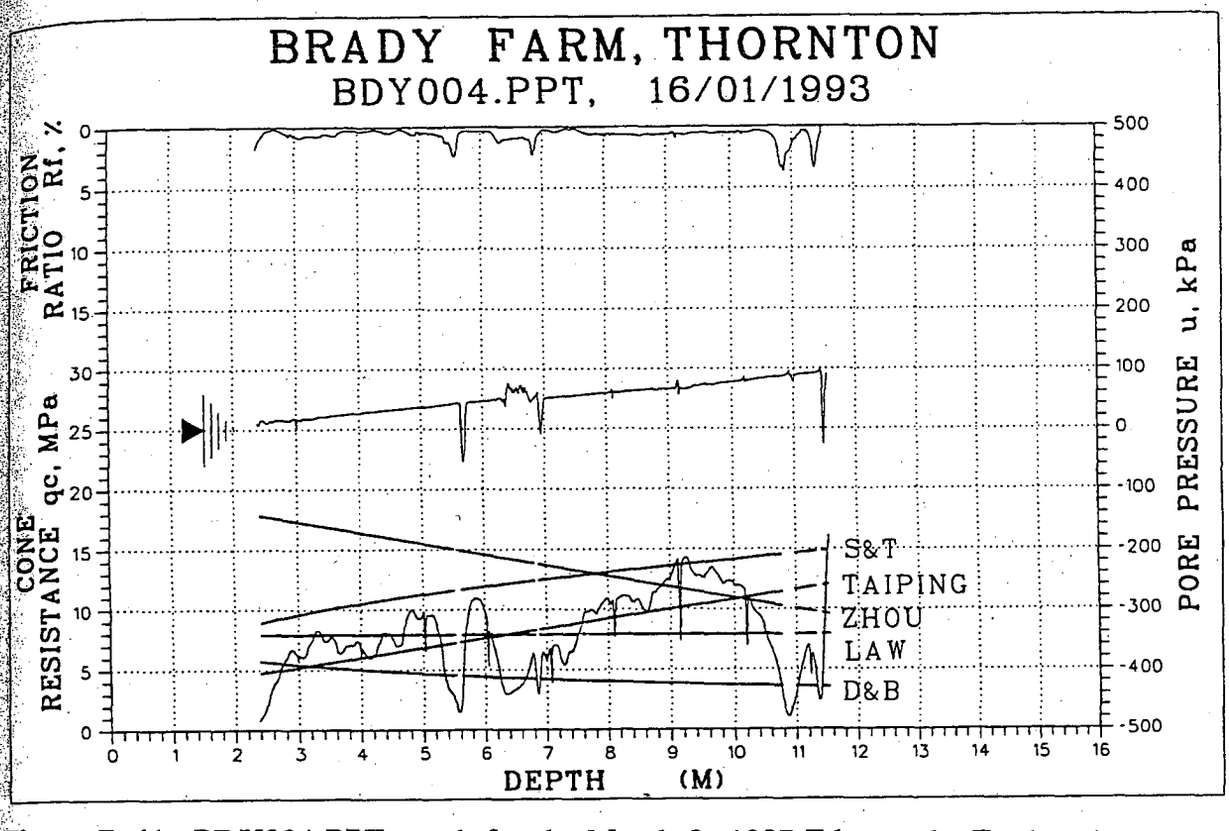


Figure B-41 BDY004.PPT graph for the March 2, 1987 Edgecumbe Earthquake.

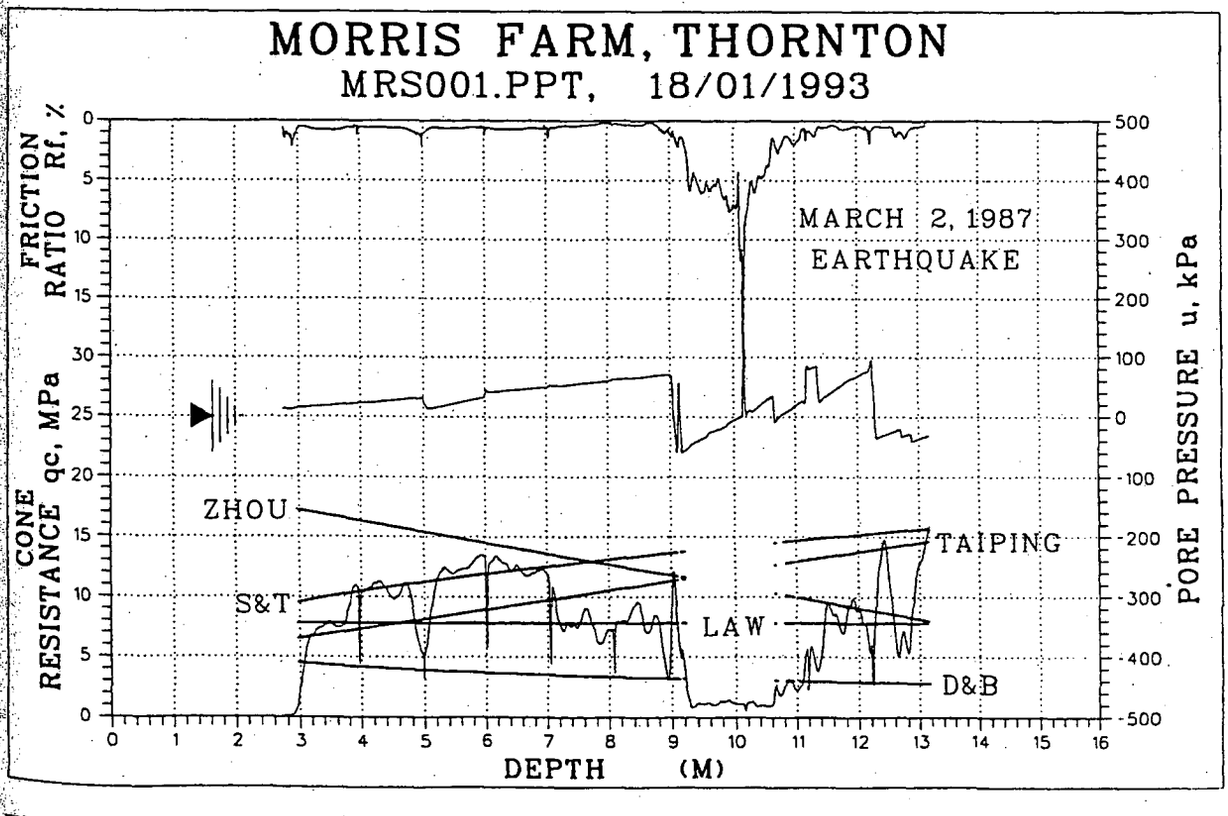


Figure B-42 MRS001.PPT graph for the March 2, 1987 Edgecumbe Earthquake.

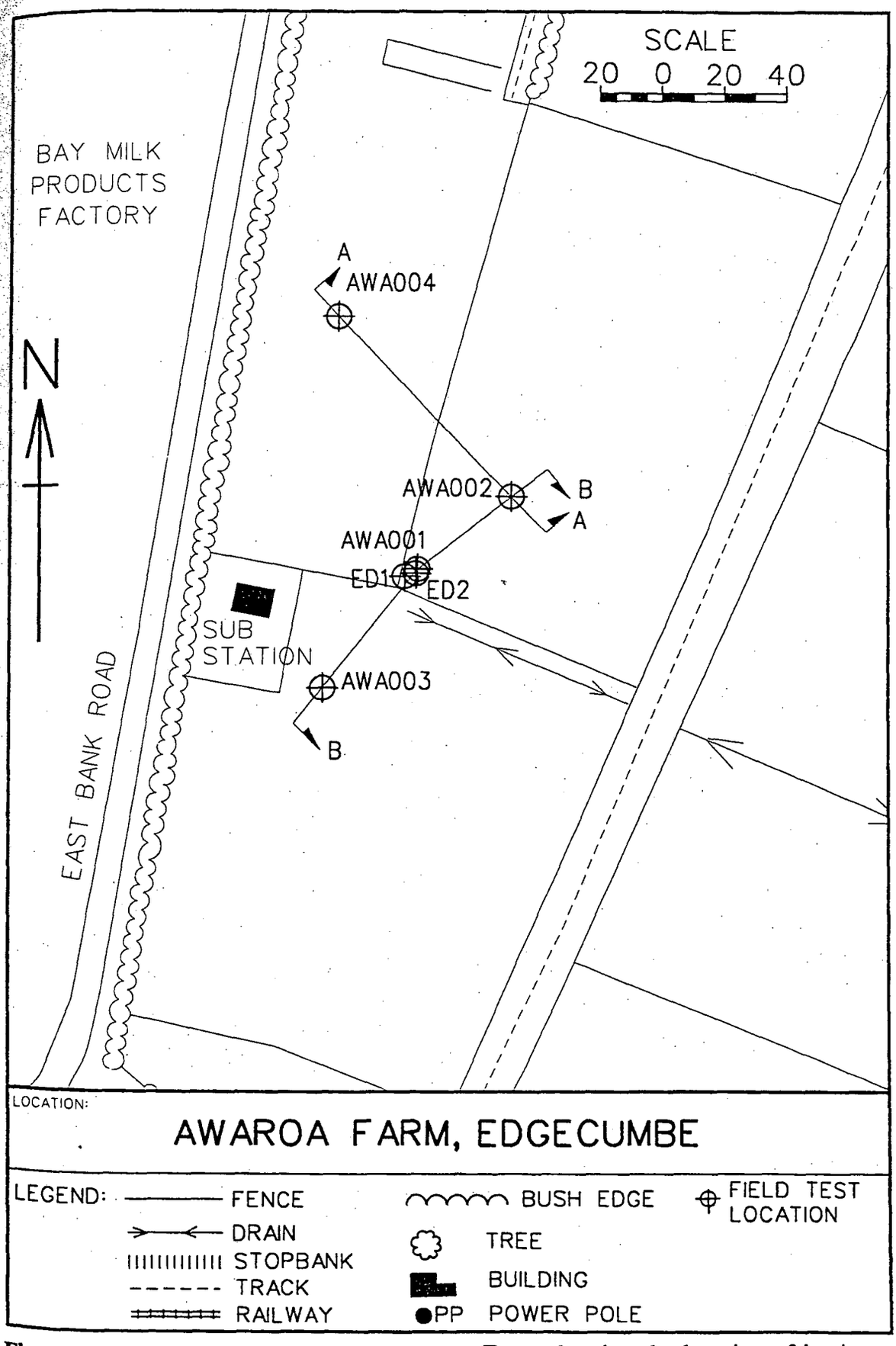


Figure 9.20 Schematic map of the Awaroa Farm showing the location of in situ testing.

BOREHOLE LOG

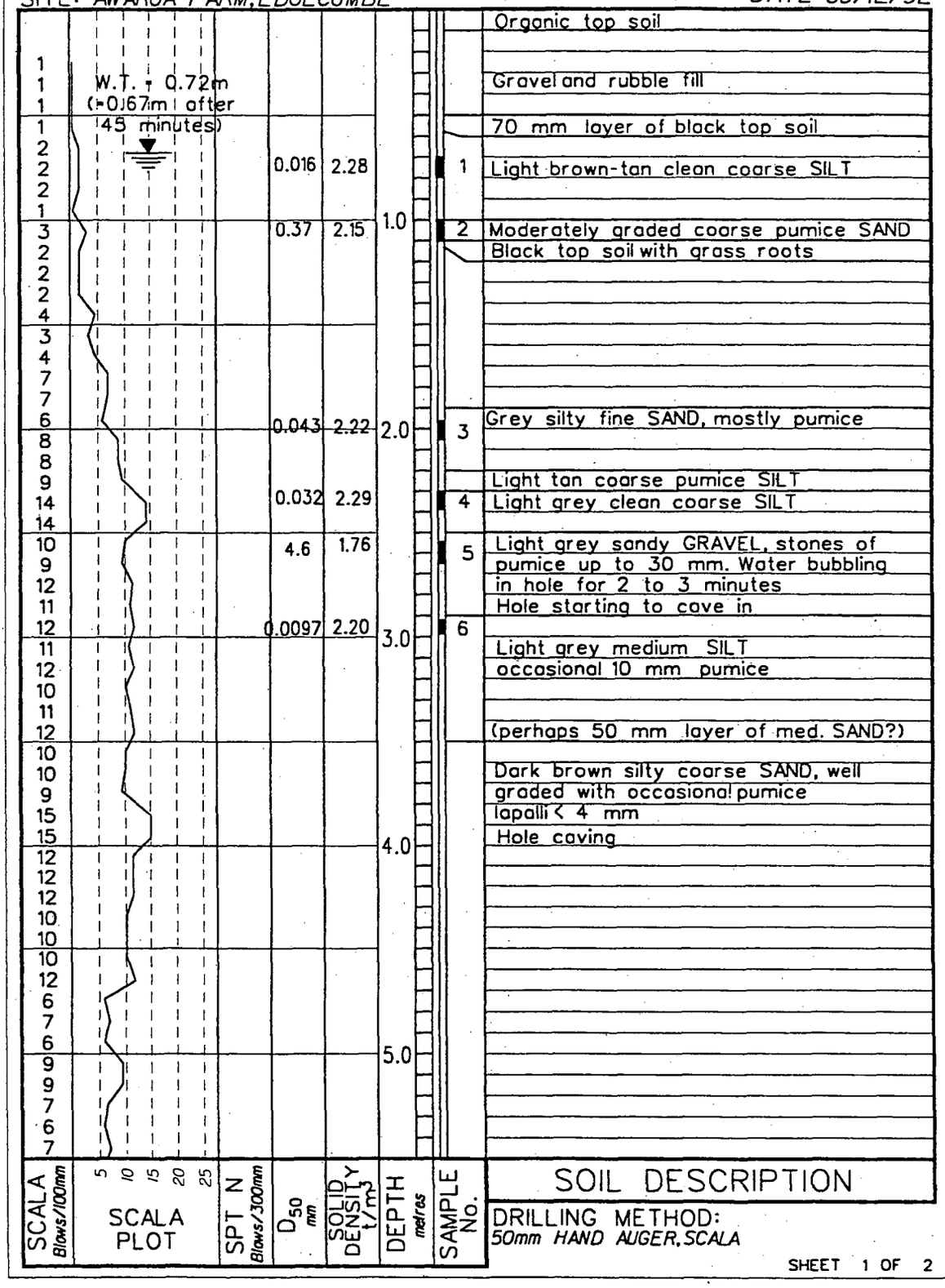
University of Canterbury

BORING: *ED1*

JOB: *1987 EDGECUMBE EARTHQUAKE*

SITE: *AWAROA FARM, EDGECUMBE*

DATE: *08/12/92*



DRILLING METHOD: *50mm HAND AUGER, SCALA*

SHEET 1 OF 2

Figure C-20 Bore log ED1 from the Awaroa Farm site.

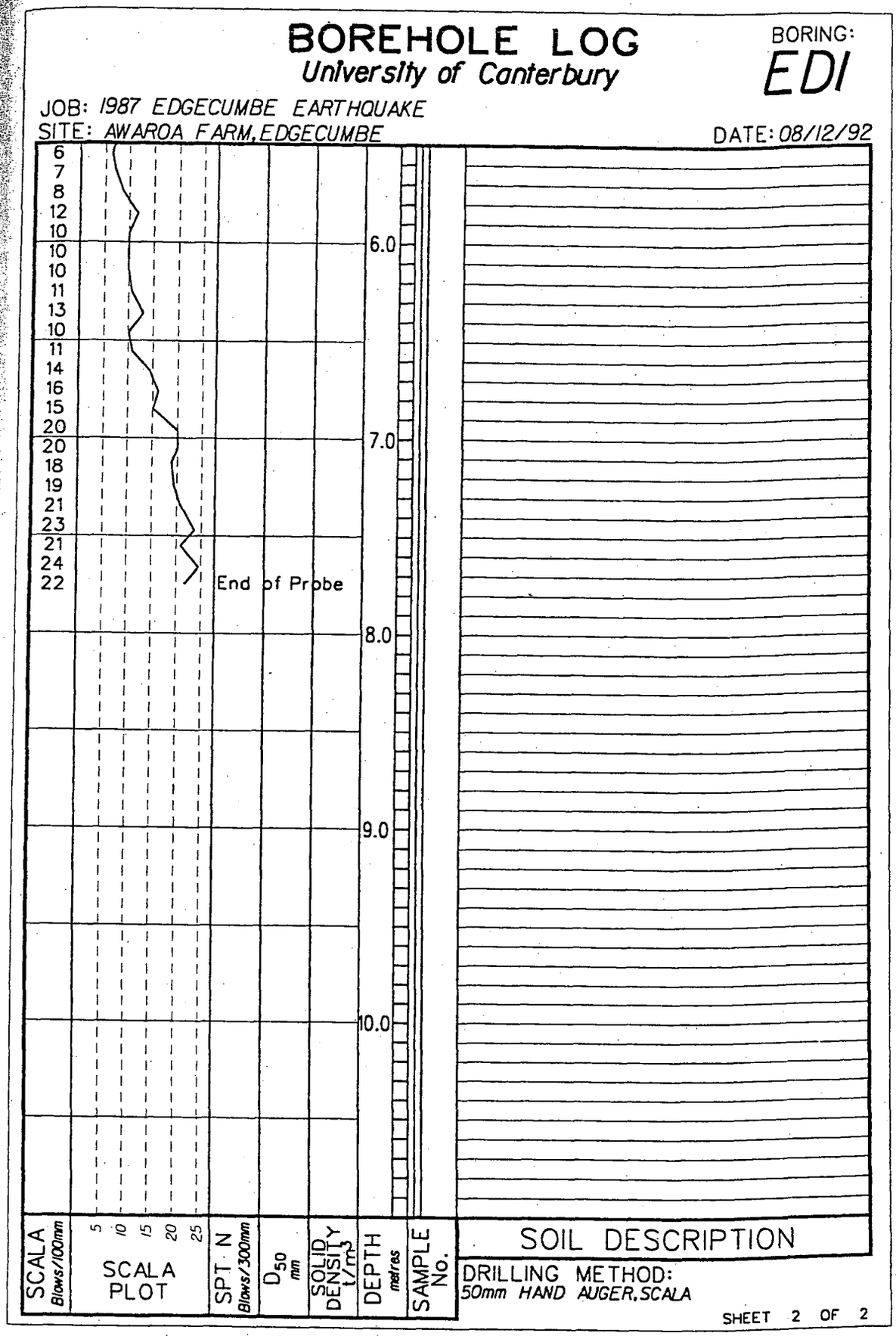


Figure C-21 Continuation of bore log ED1 from the Awaroa Farm site.

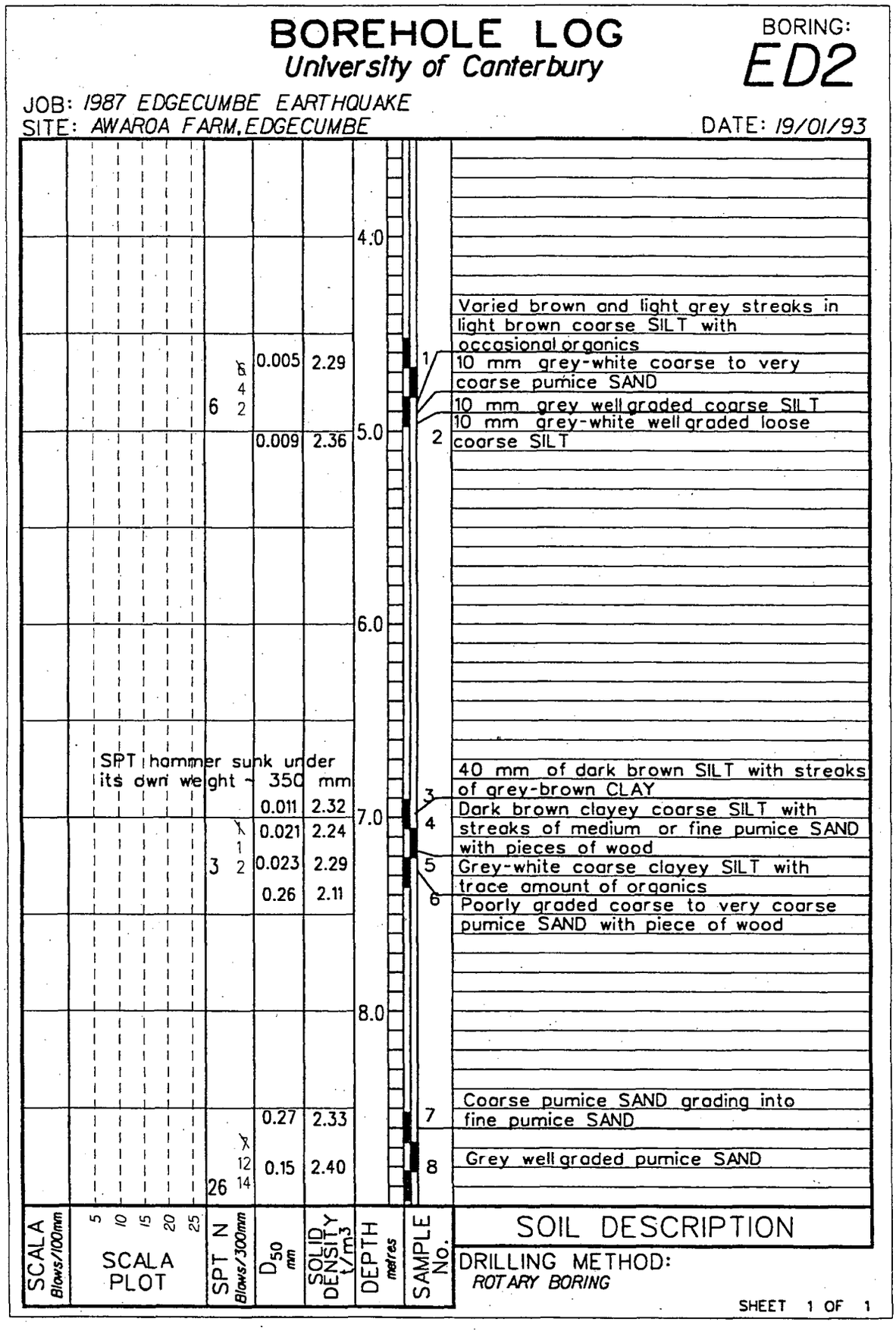


Figure C-22 Bore log ED2 from the Awaroa Farm site.

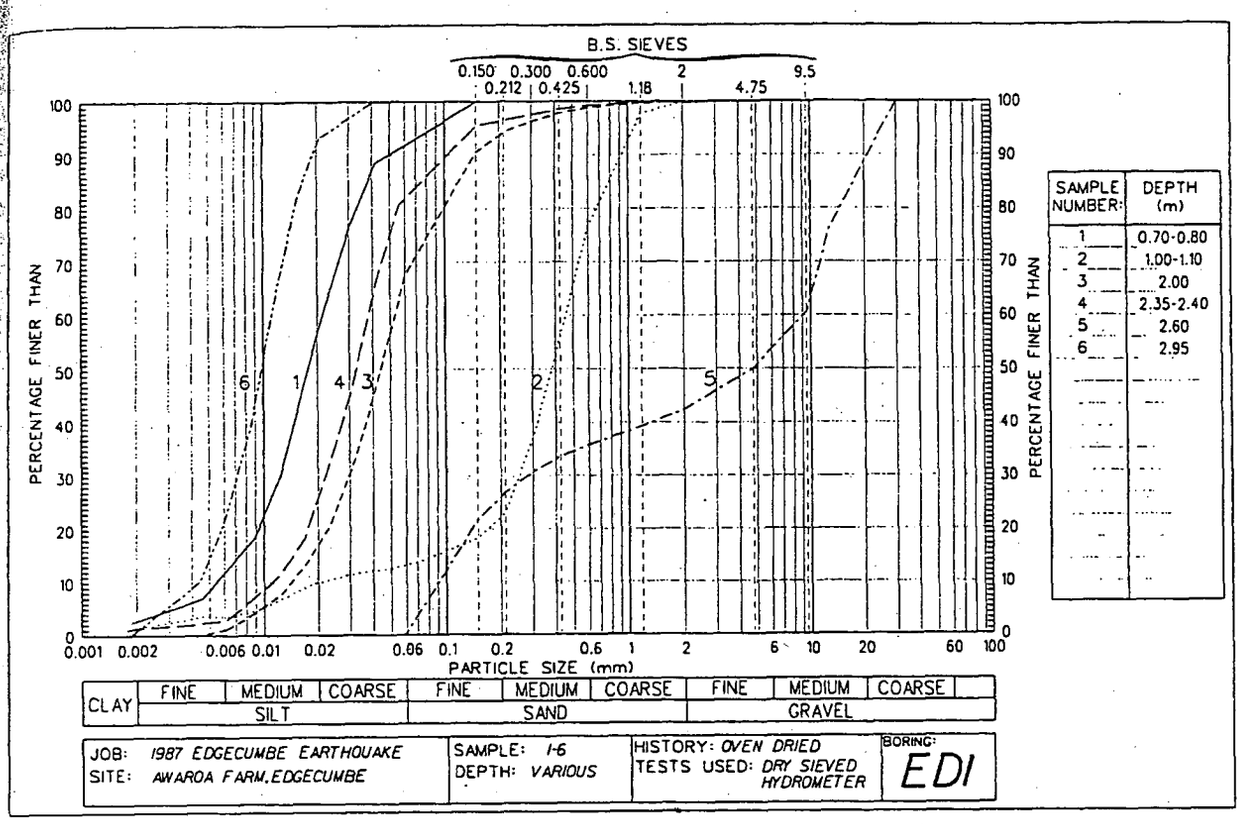


Figure C-23 PSDs from the ED1 bore log, Awaroa Farm site.

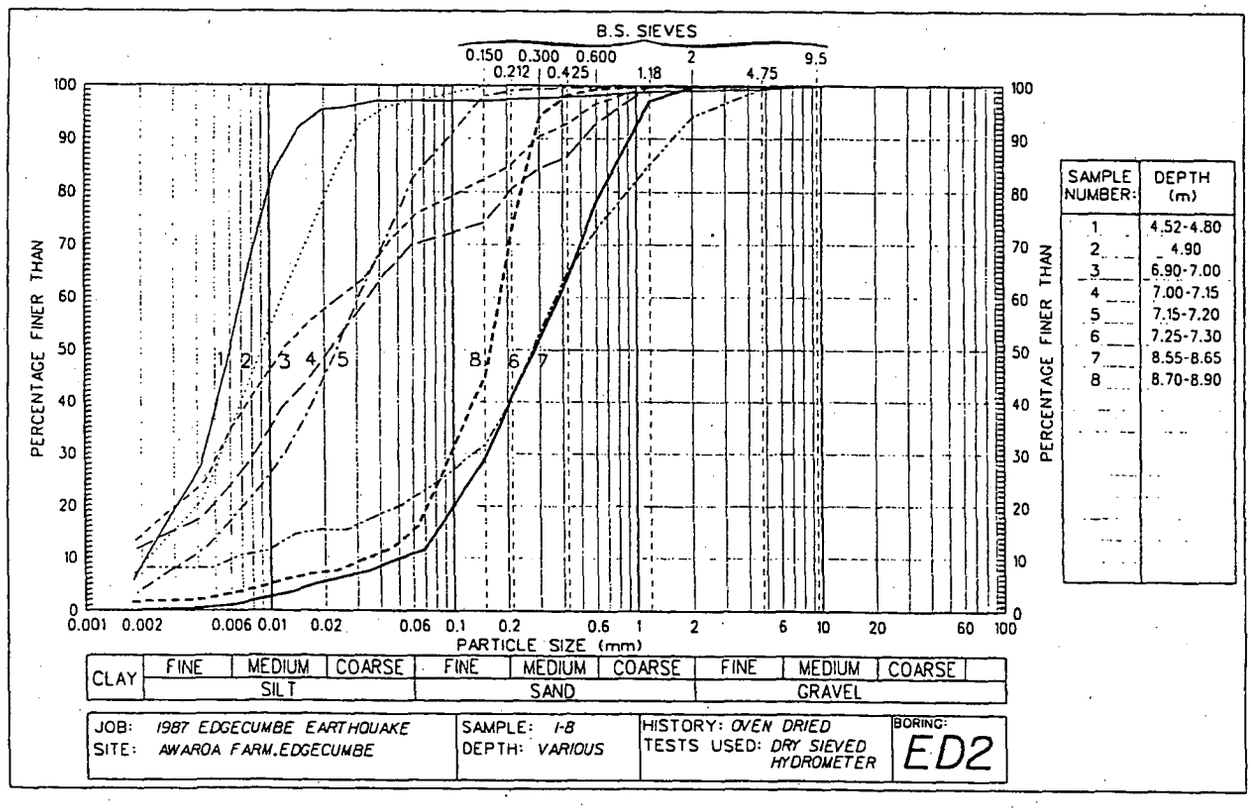


Figure C-24 PSDs from the ED2 bore log, Awaroa Farm site.

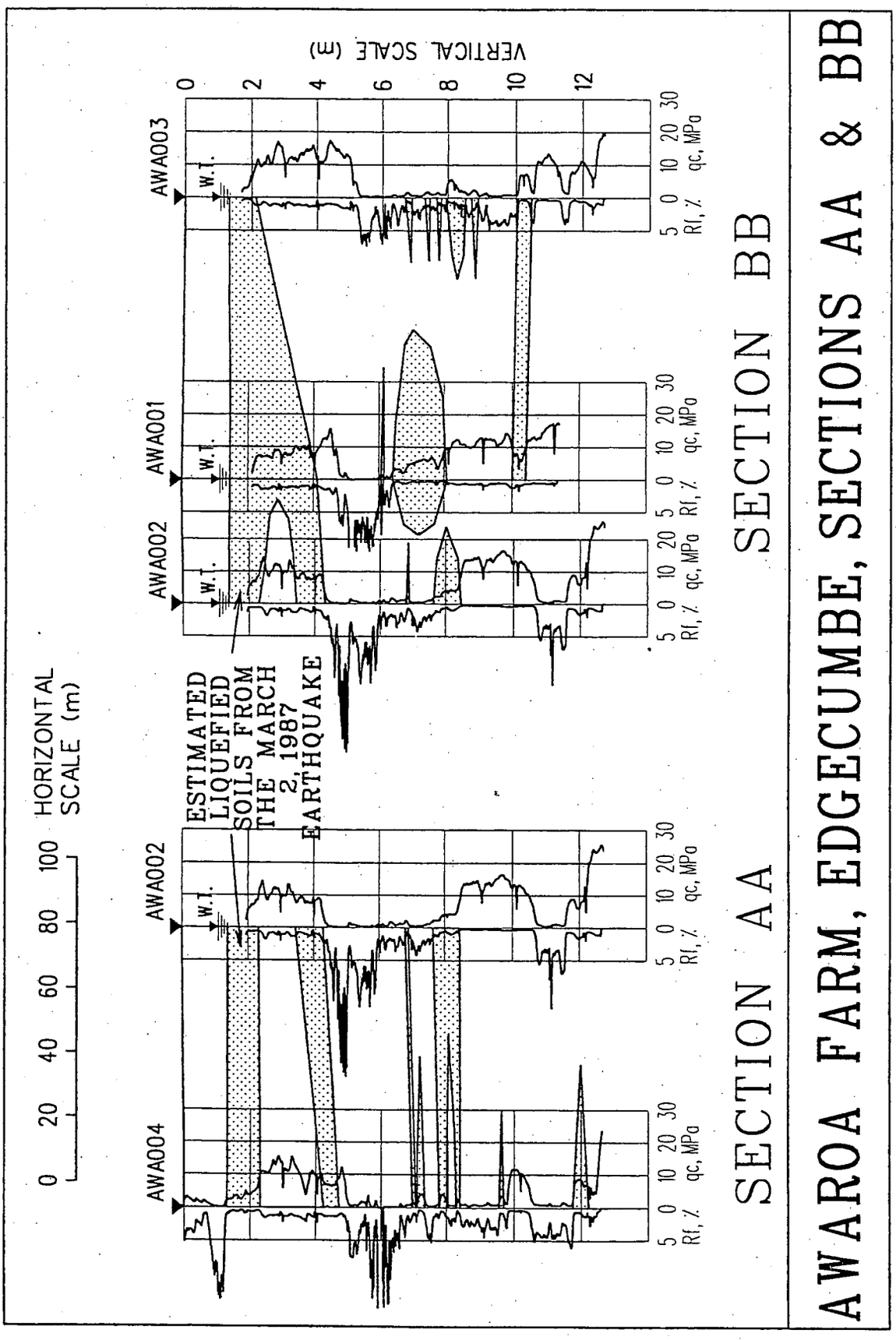


Figure 9.25 Schematic cross sections of the Awaroa Farm showing the estimated liquefied strata.

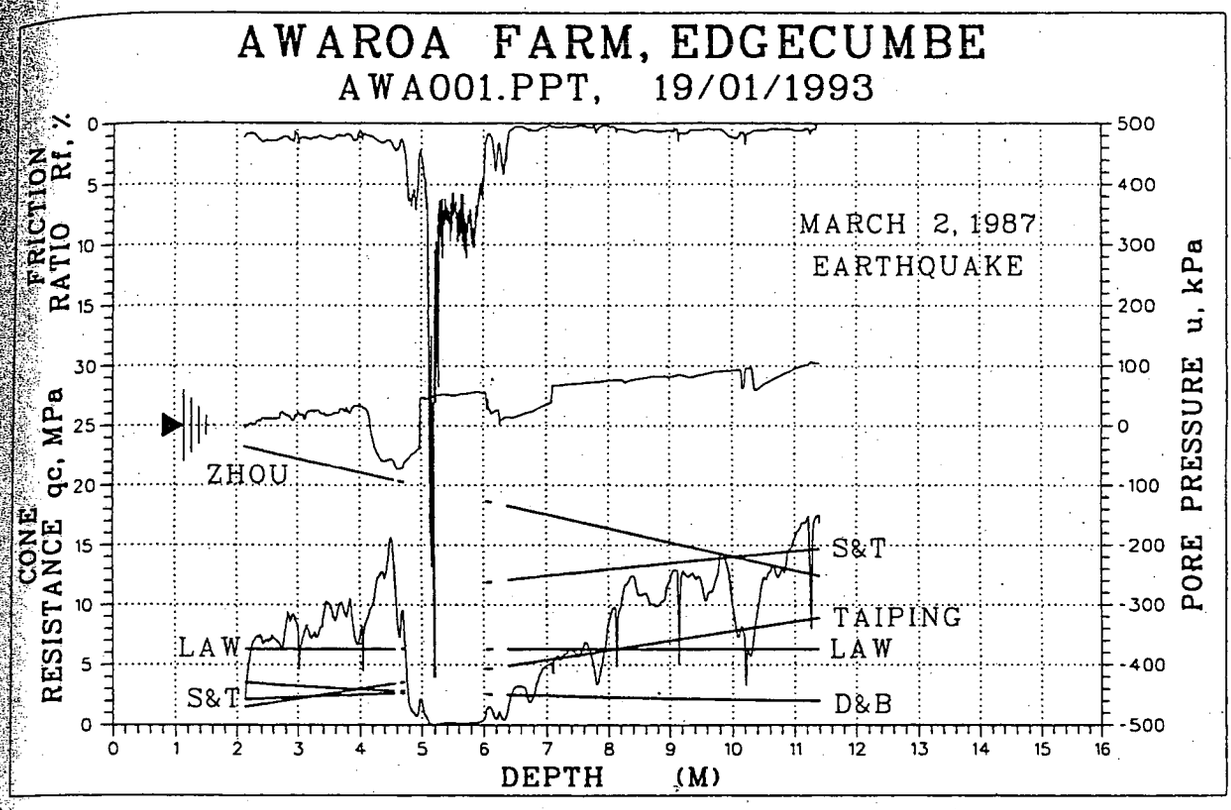


Figure B-45 AWA001.PPT graph for the March 2, 1987 Edgecumbe Earthquake.

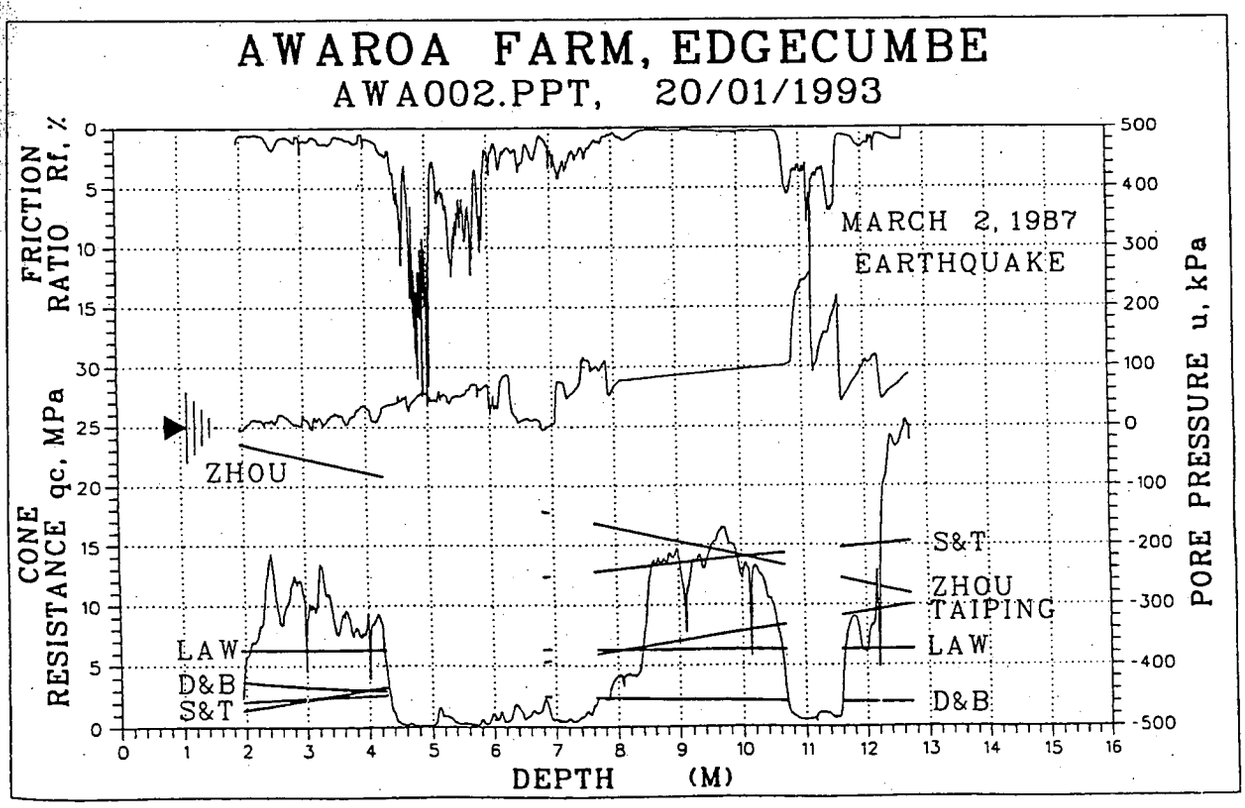


Figure B-46 AWA002.PPT graph for the March 2, 1987 Edgecumbe Earthquake.

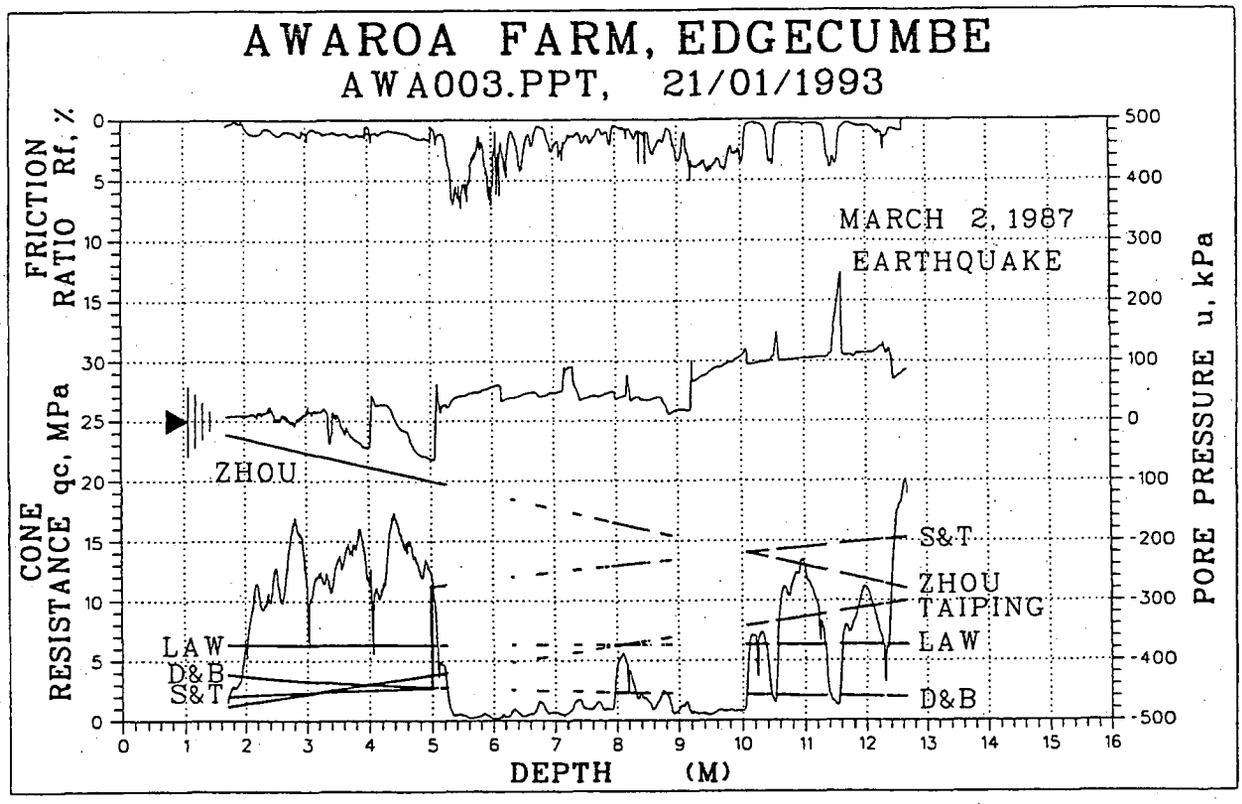


Figure B-47 AWA003.PPT graph for the March 2, 1987 Edgecumbe Earthquake.

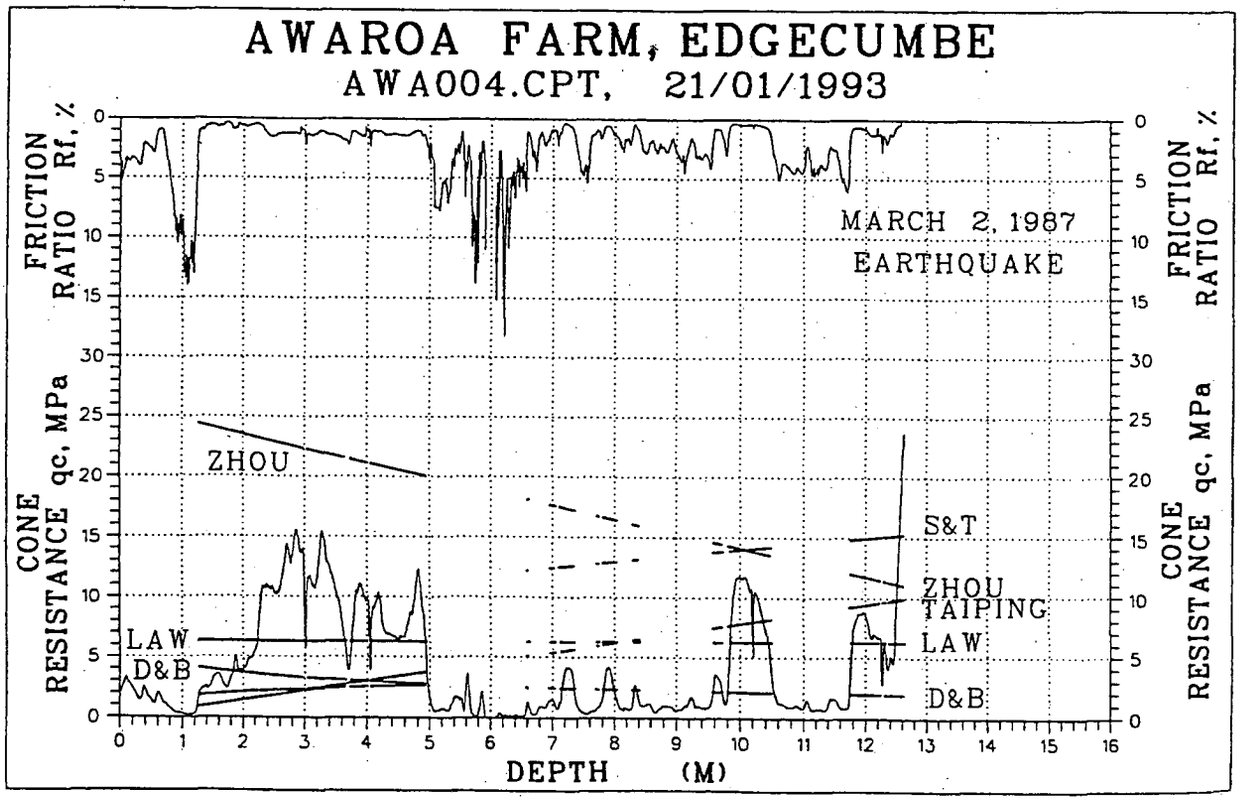


Figure B-48 AWA004.CPT graph for the March 2, 1987 Edgecumbe Earthquake.

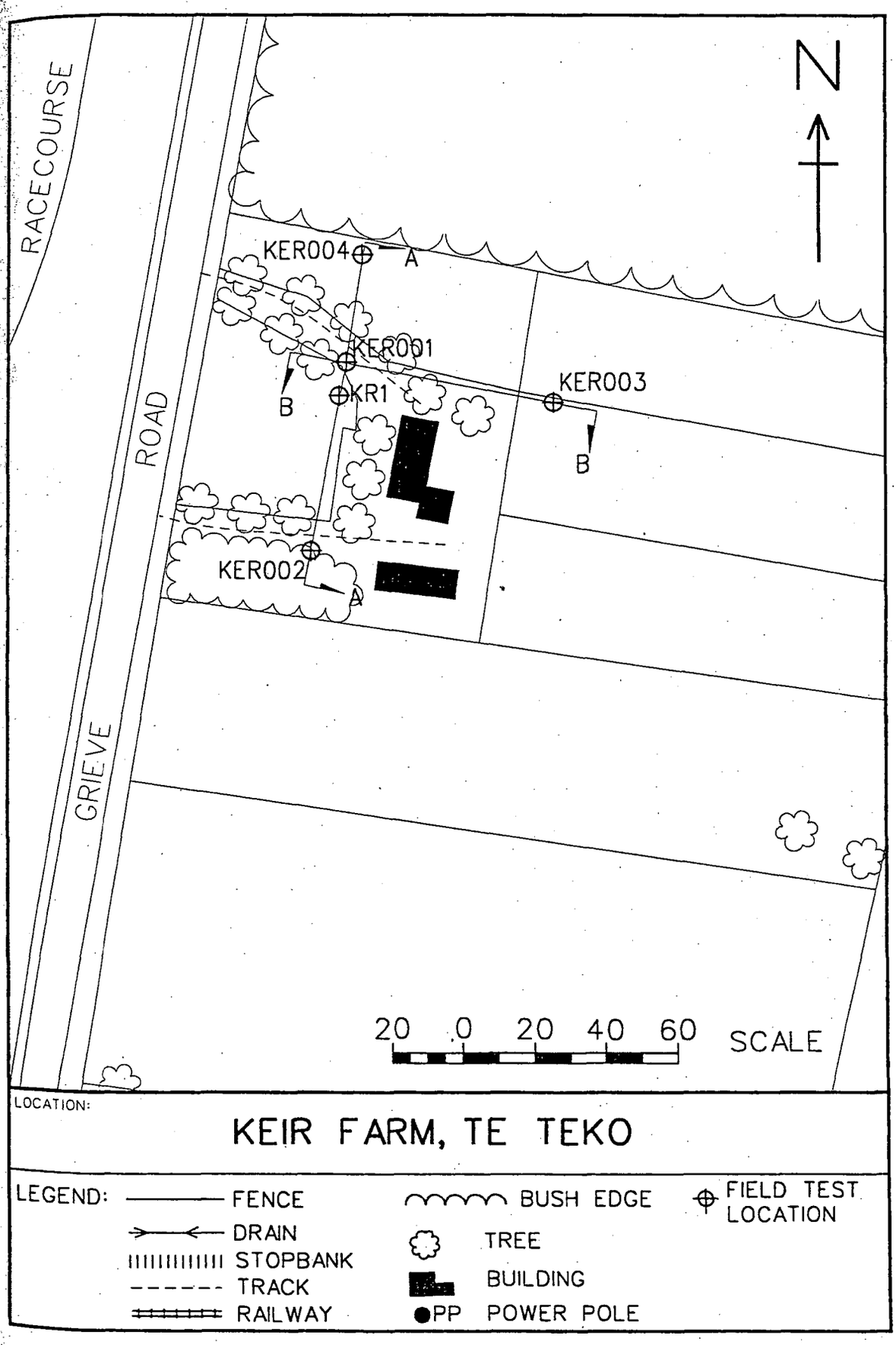


Figure 9.26 Schematic map of the Keir Farm showing the location of in situ testing.

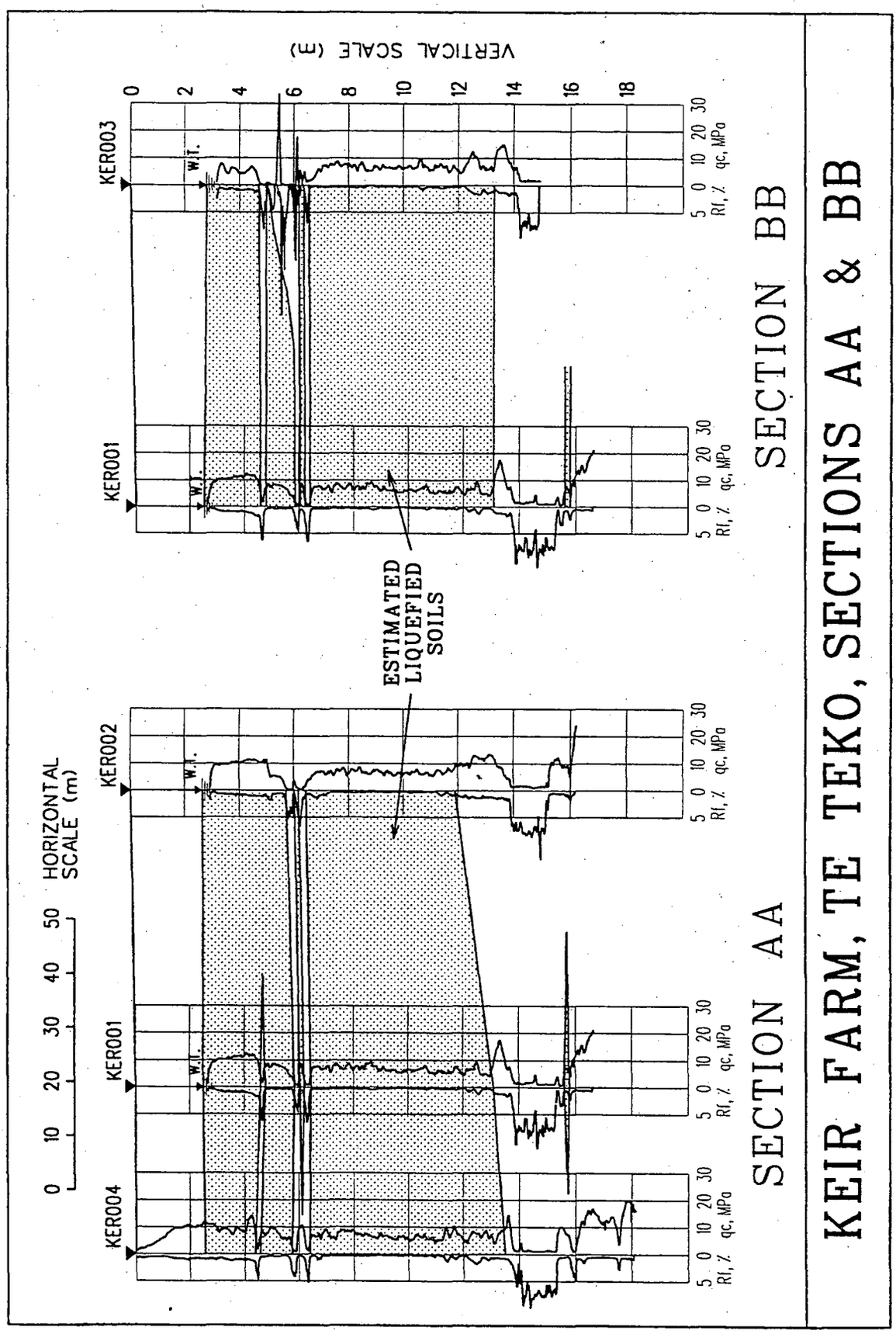


Figure 9.28 Schematic cross sections of the Keir Farm showing the estimated liquefied strata.

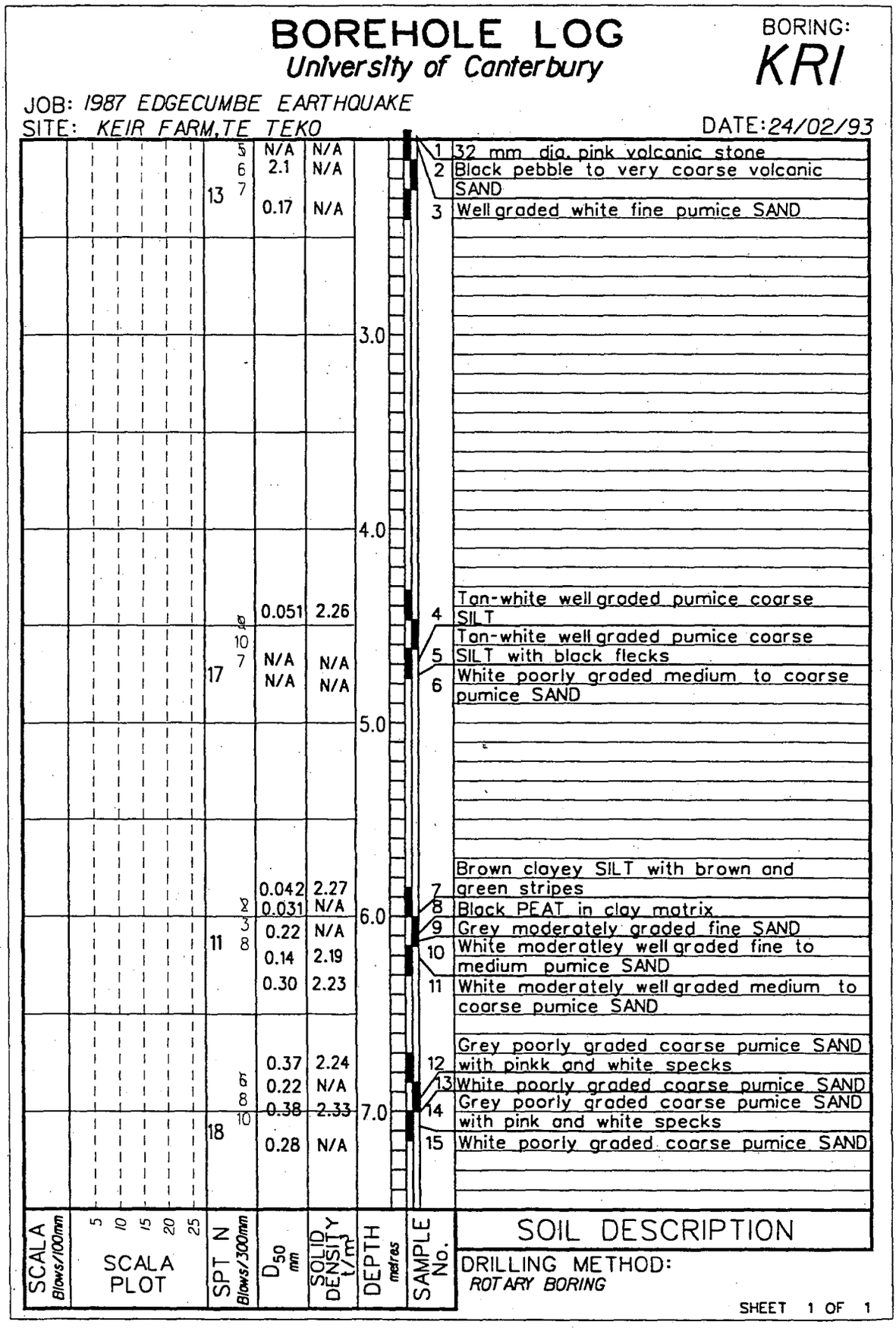


Figure C-25 Bore log KR1 from the Keir Farm site.

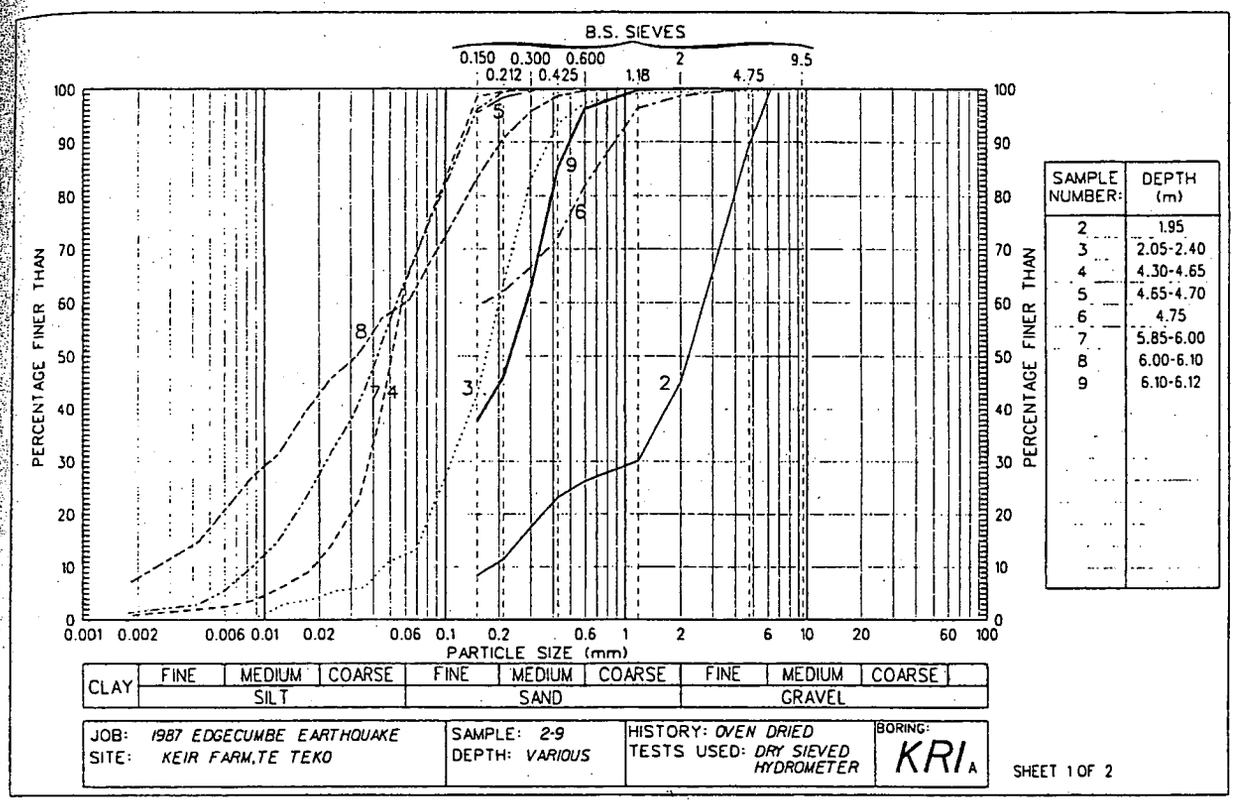


Figure C-26 PSDs from the KR1 bore log, Keir Farm site.

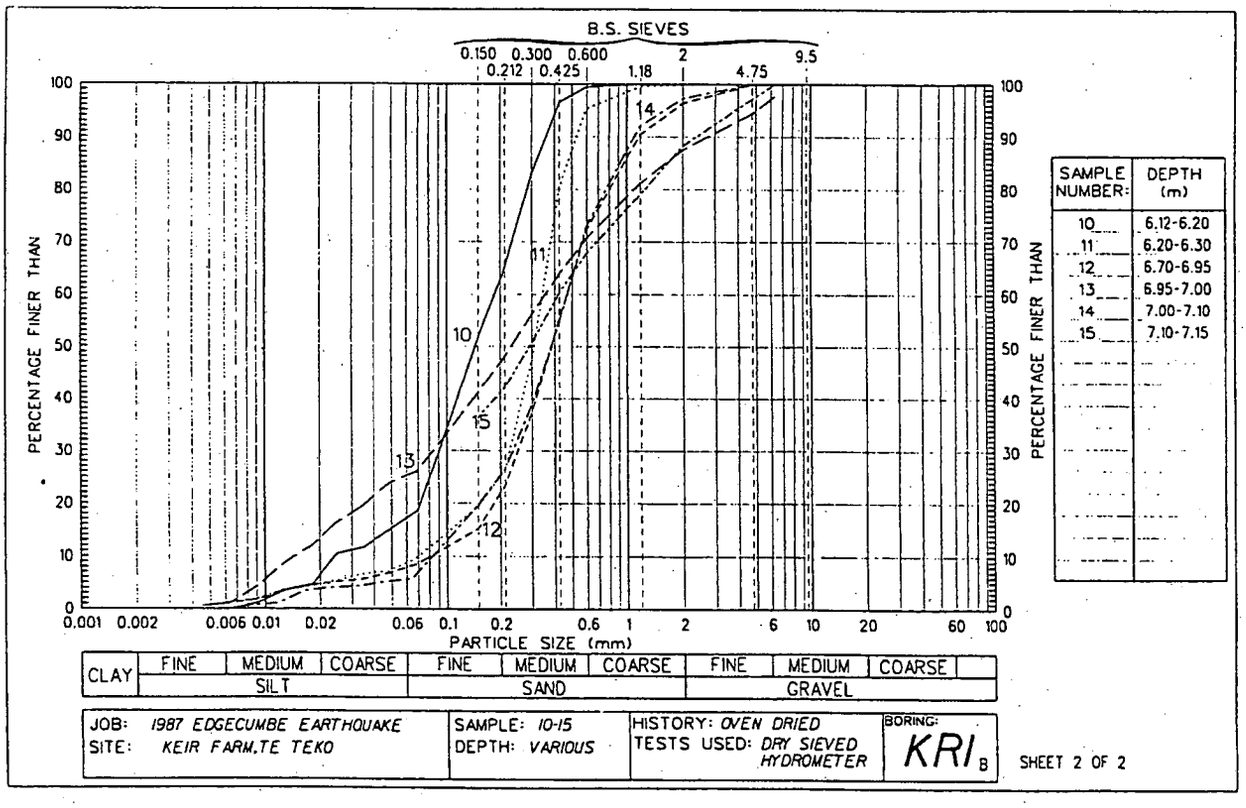


Figure C-27 Additional PSDs from the KR1 bore log, Keir Farm site.

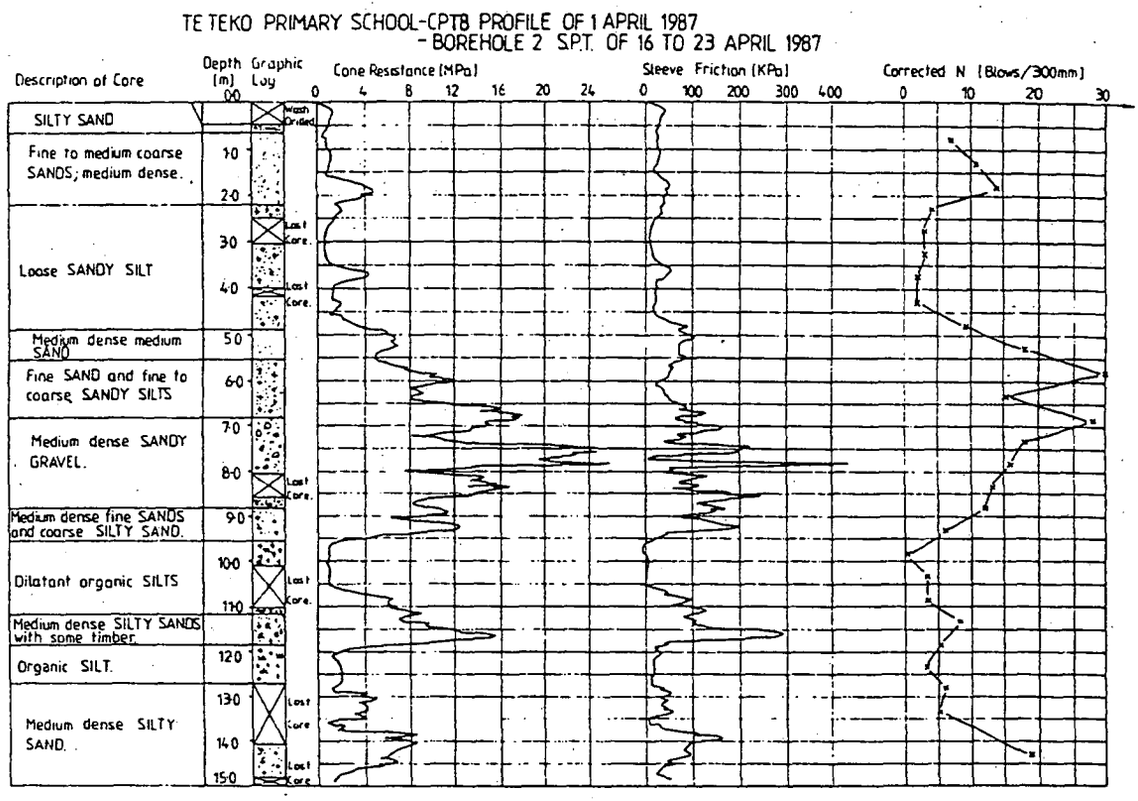


Figure F-1 Te Teko Primary School cone penetration and bore log (from Pender and Robertson [52]).

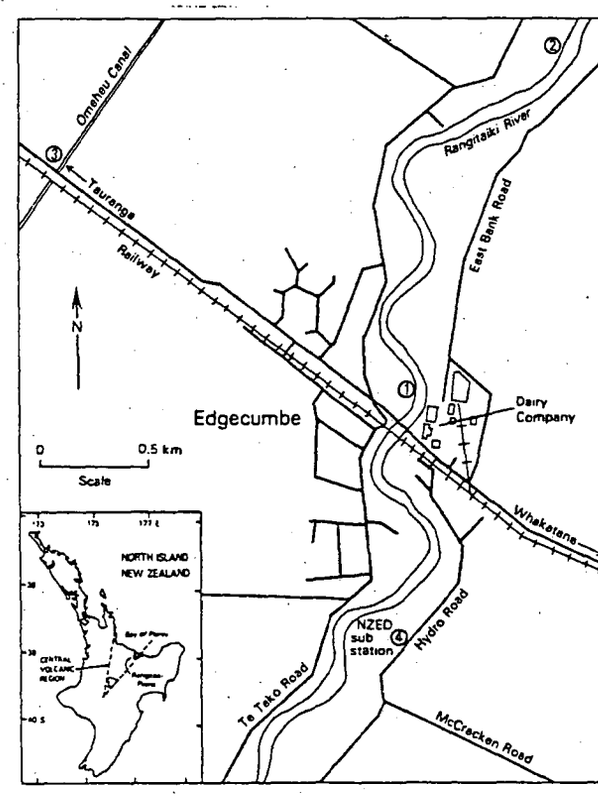


Figure F-2 Stephenson and Barker [72] test sites in Edgecumbe.

Electricity Corporation of New Zealand Ltd (June 1988) Preliminary investigation of the influence of Matahina Power Station on river bank stability along the Rangitaiki River.

(Matahina)

...ct Laboratory — ...article Size Analysis
Test Method NZS 4402 P.1. T.9d 1980

Job ... RANGITAIKI RIVER....
Location .SITE 28.....
Core ..... Depth.....

History of Sample Natural/~~Air Dried/Oven Dried~~/~~Unknown~~.
ph of Suspension .....
Dispersant used. Sodium Hexametaphosphate/....
.....

Job No. 87/315
Sample No. 1
Tested by: S.W.LIM Date. 9/87
Checked by: M.R.C. Date. 1/88

(1) SAMPLE TAKEN AT WATER LEVEL

PARTICLE SIZE-MILLIMETRES CLAY=21 % SILT=79% SAND= % GRAVEL= %

D_{10} < 0.0017
D_{85} = 0.0128 mm
D_{60} = 0.009 mm
$C_u = \frac{D_{60}}{D_{10}}$ > 5.3

PERCENTAGE BY WEIGHT PASSING EACH SIEVE

PARTICLE SIZE IN INCHES

B.S. 410: 1943 & NZS 196: 1949 NUMBERED SIEVES

ASTM E 11-39 NUMBERED SIEVES

ROUND OPENINGS OF EQUIVALENT AREAS — INCHES DIAMETER

CLAY	SILT			SAND			GRAVEL		
	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE
0.002	0.006	0.02	0.06	0.2	0.6	2	6	20	60

SOIL CLASSIFICATION: FROM NZS 1377 1986

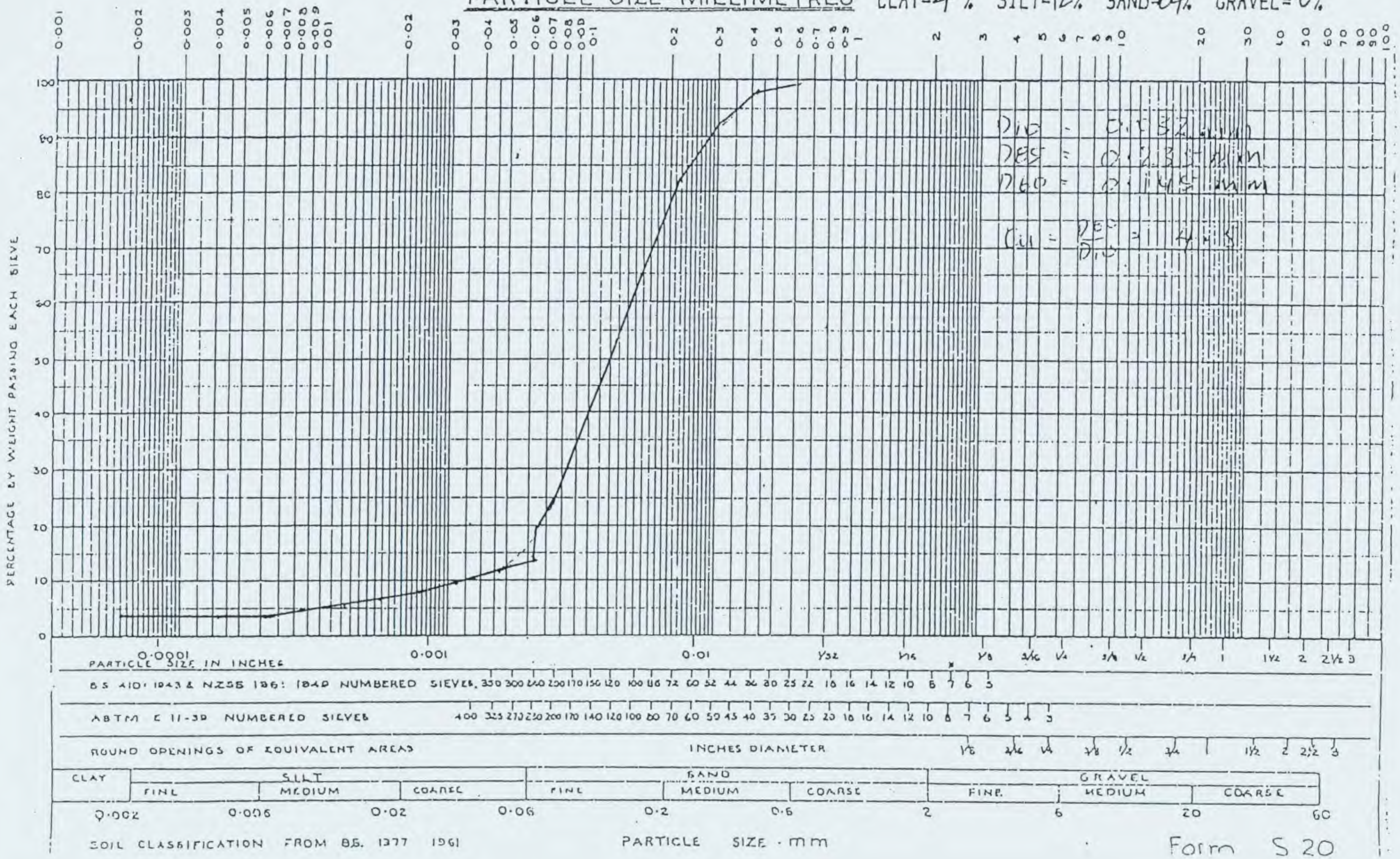
PARTICLE SIZE

...ethod NZS 4402 P... T.5a 1980

..RANGITAIKI RIVER....	History of Sample Natural/~~Air Dried/Oven Dried/~~ ~~Unknown~~.	Job No. 87/315
ion ..SITE 20.....	ph of Suspension ...	Sample No. 7
—— Depth ——	Dispersant used. Sodium Hexametaphosphate ✓/....	Tested by: S.W. LIM Date 9/87
		Checked by: M.R.E. Date 1/88

20' - SAMPLE TAKEN BANK MID HEIGHT

PARTICLE SIZE-MILLIMETRES CLAY=4 % SILT=12% SAND=84% GRAVEL=0%



Form S 20

MINISTRY of WORKS & DEVELOPMENT
HAMILTON DISTRICT LABORATORY

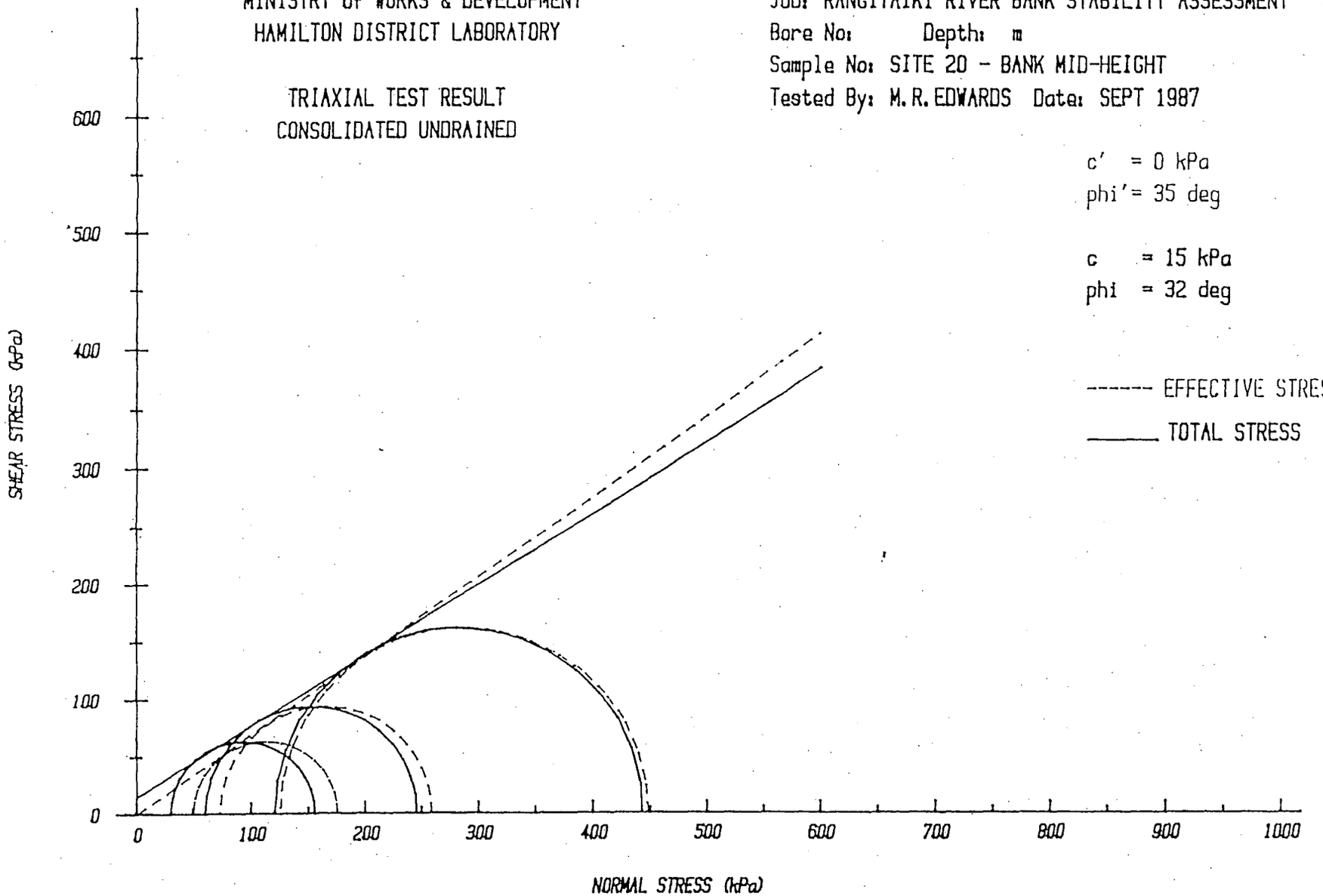
Job: RANGITAIKI RIVER BANK STABILITY ASSESSMENT 87/315
Bore No: Depth: m
Sample No: SITE 20 - BANK MID-HEIGHT
Tested By: M.R.EDWARDS Date: SEPT 1987

TRIAXIAL TEST RESULT
CONSOLIDATED UNDRAINED

c' = 0 kPa
phi'= 35 deg

c = 15 kPa
phi = 32 deg

------ EFFECTIVE STRESS
_____ TOTAL STRESS



Blacks Farm

ICE GEO & CIVIL
A division of CE CONSTRUCTION LTD

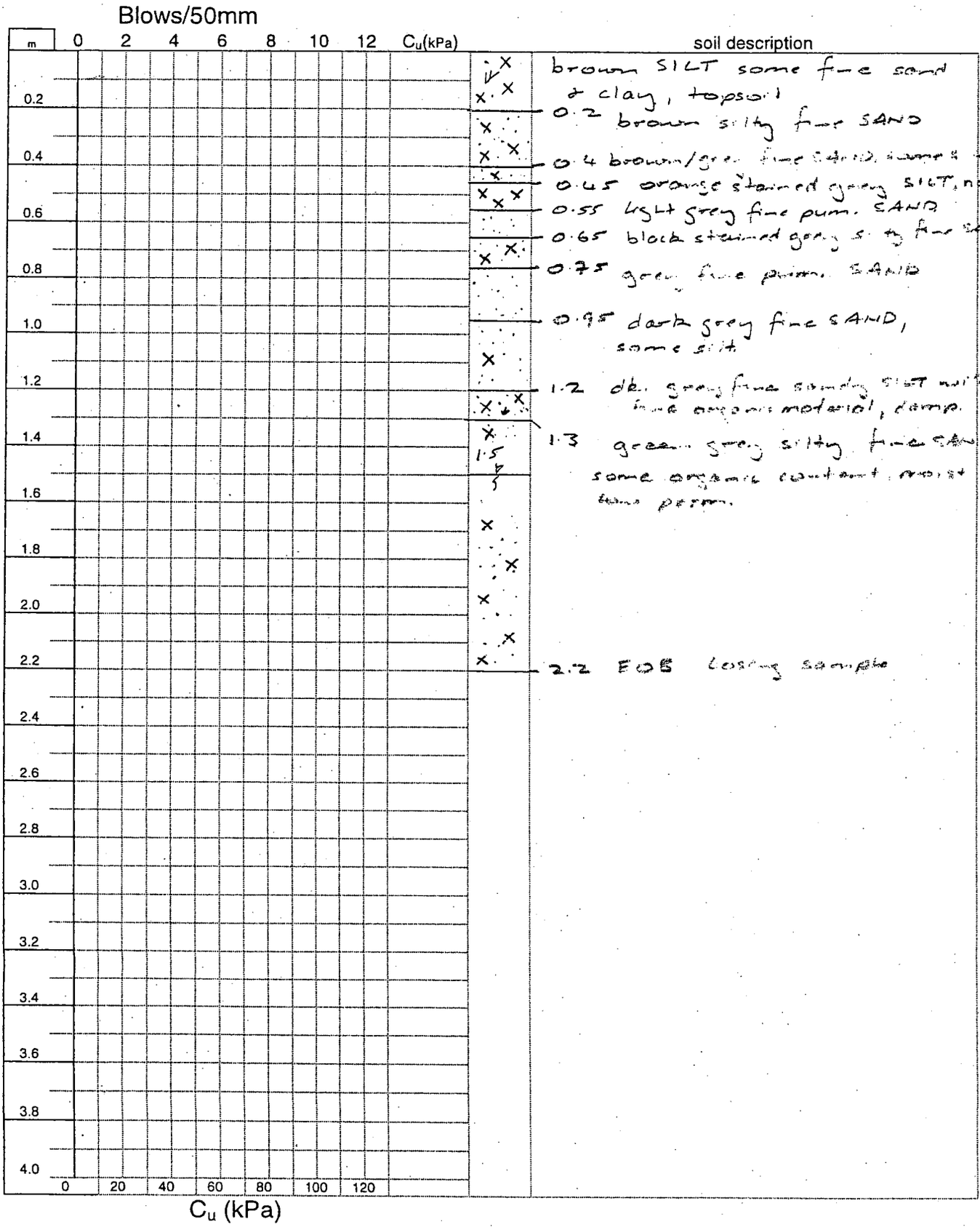
Hand Auger Log

Test Number: B1

Job Name: Black's Farm

Date: 17/9/04

Tested by: M.O'H



ICE GEO & CIVIL

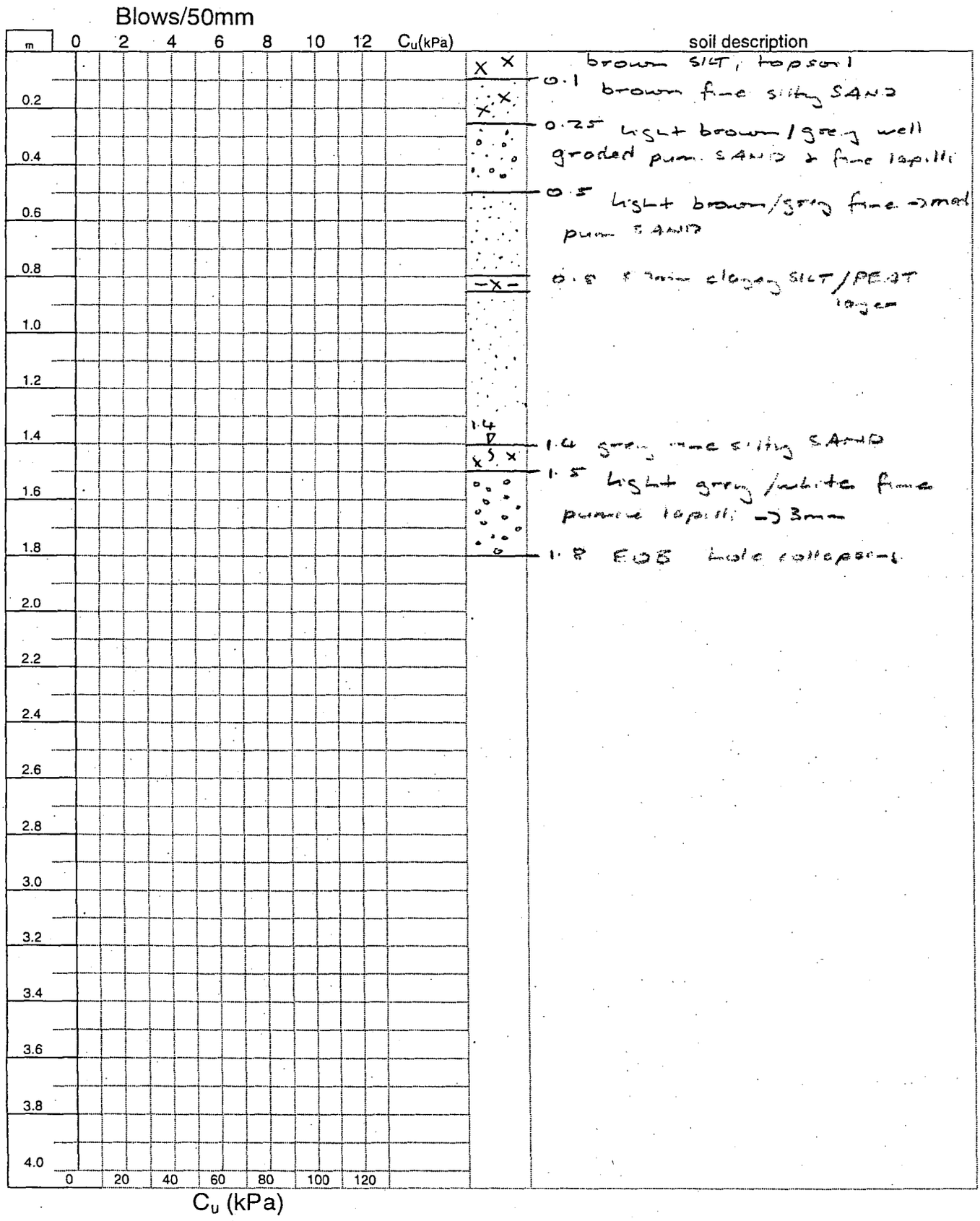
Hand Auger Log

Test Number: BZ

Job Name: Block's Farm

Date: 17/9/04

Tested by: M.O H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

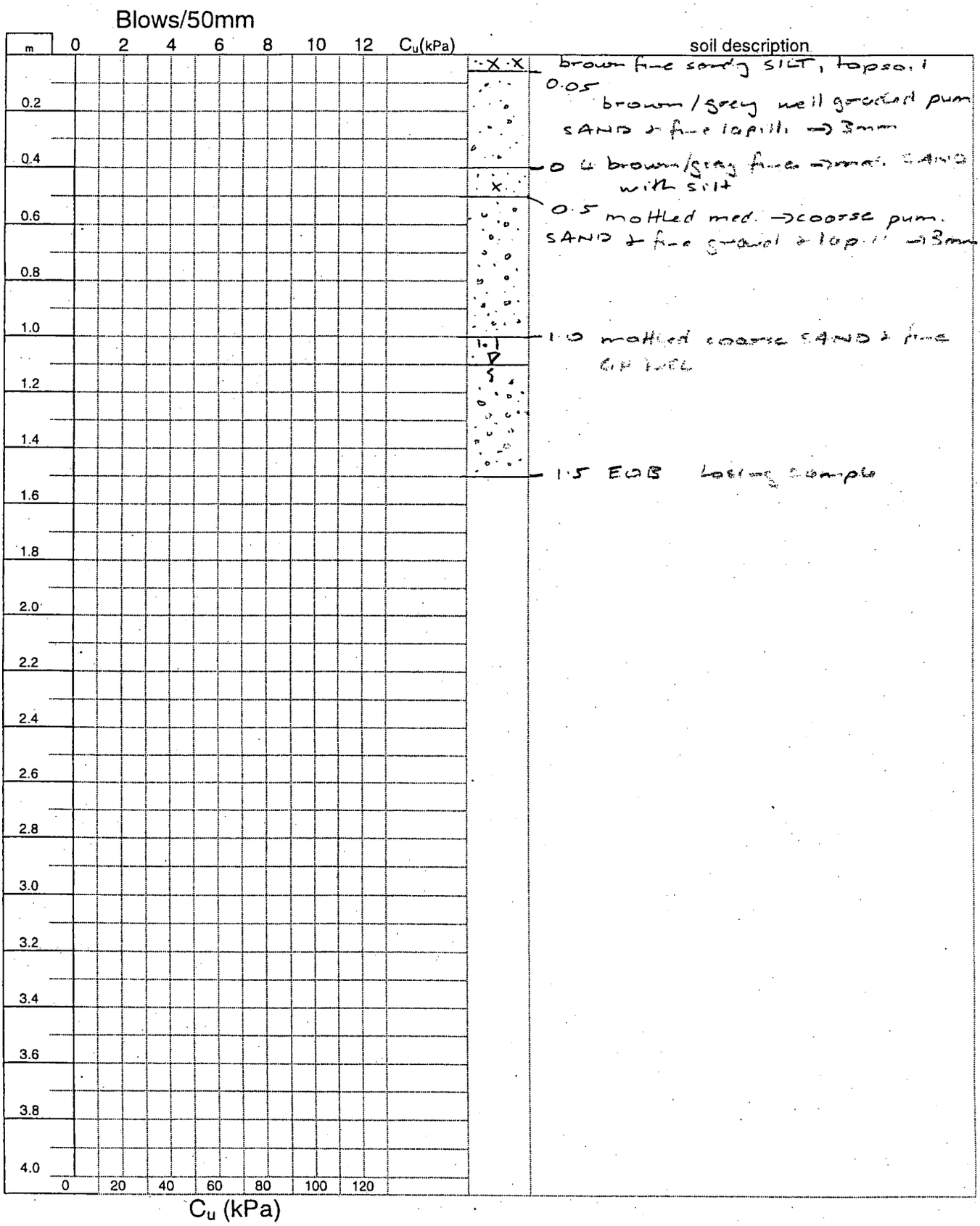
Hand Auger Log

Test Number: B3

Job Name: Block's Farm

Date: 17/9/04

Tested by: M.O'H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

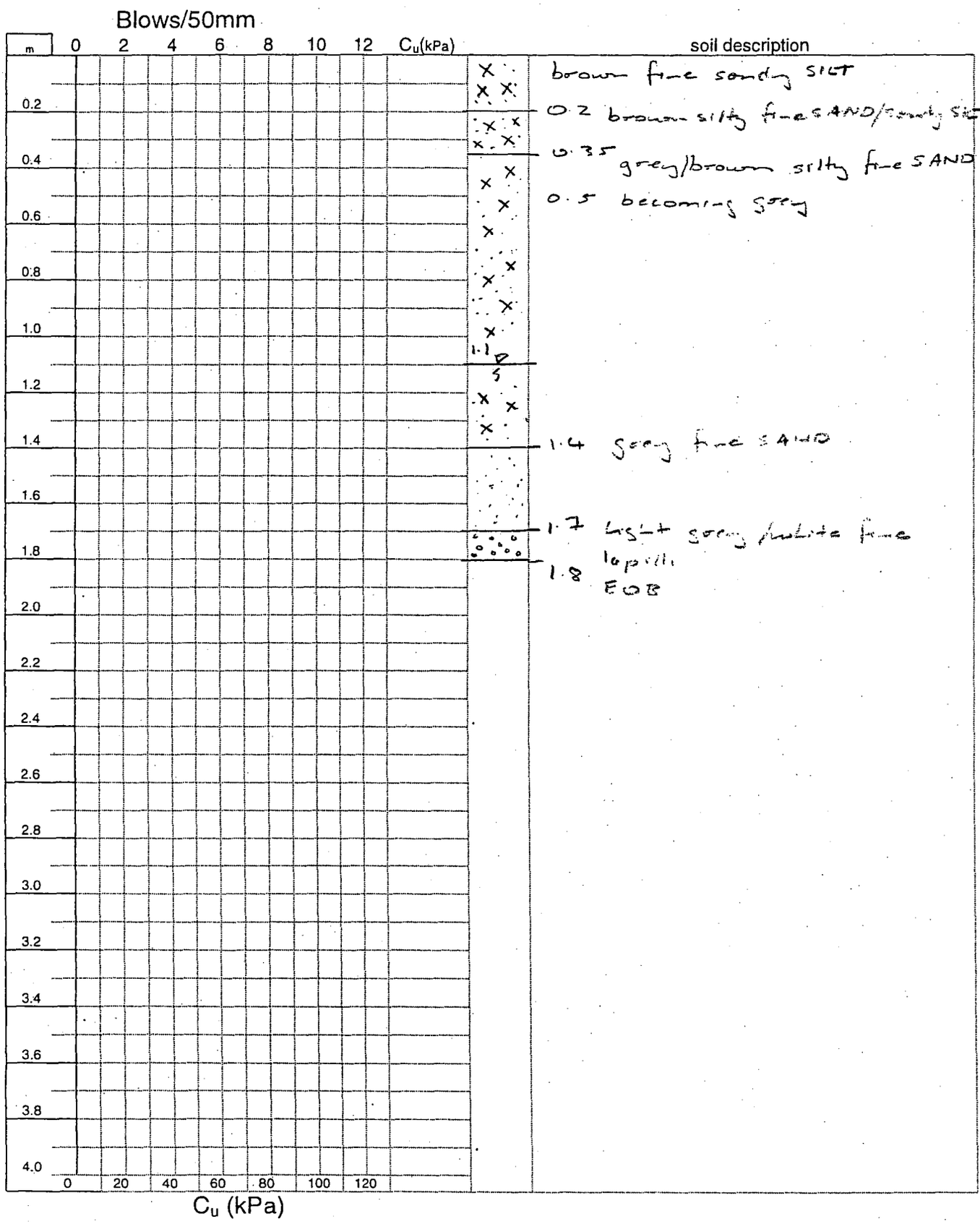
Hand Auger Log

Test Number: B4

Job Name: Blacks Farm

Date: 17/9/04

Tested by: D.O H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

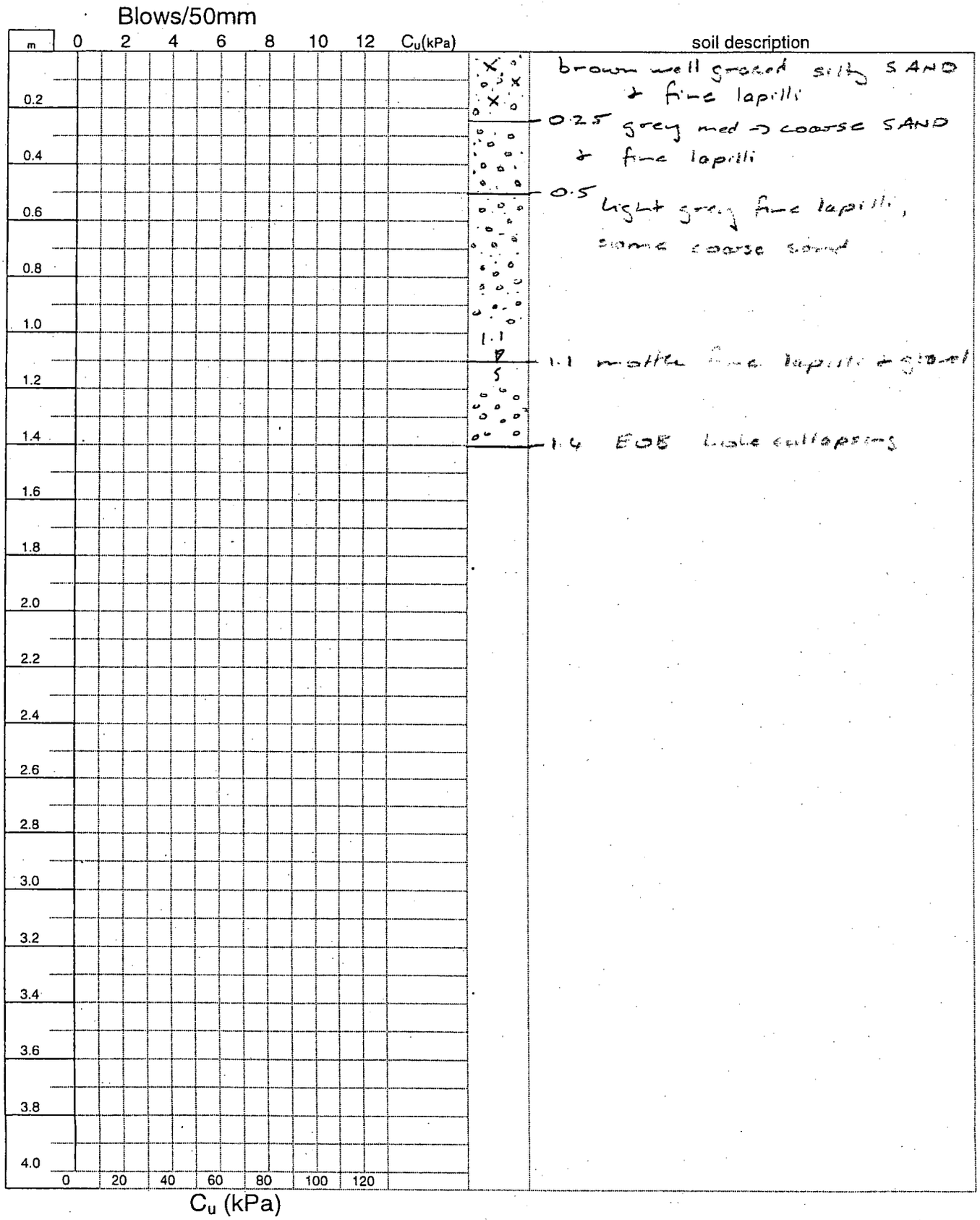
Hand Auger Log

Test Number: B5

Job Name: Blocks Farm

Date: 17/9/04

Tested by: M.O.H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

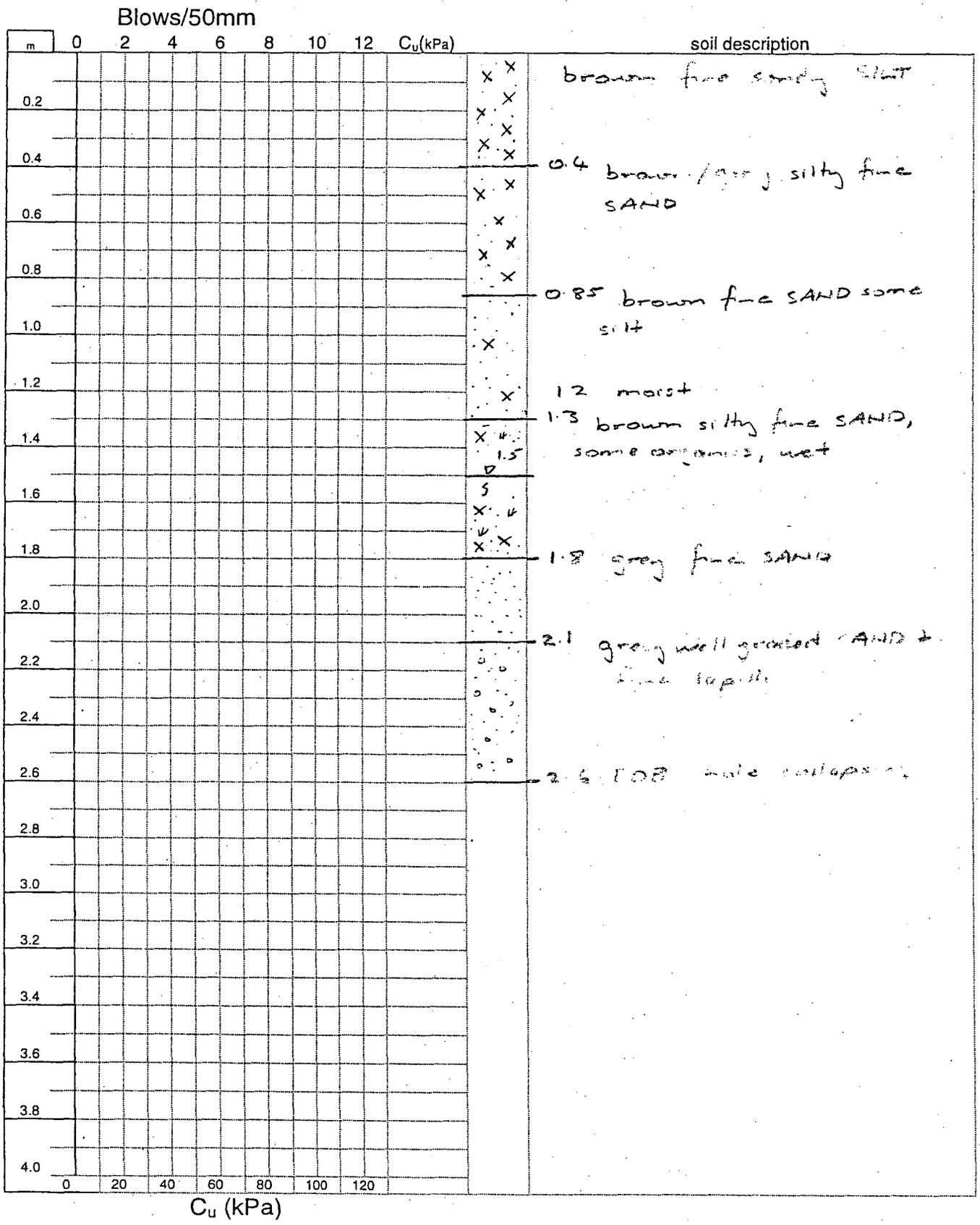
Hand Auger Log

Test Number: B6

Job Name: Black's Farm

Date: 17/9/04

Tested by: M.O'H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

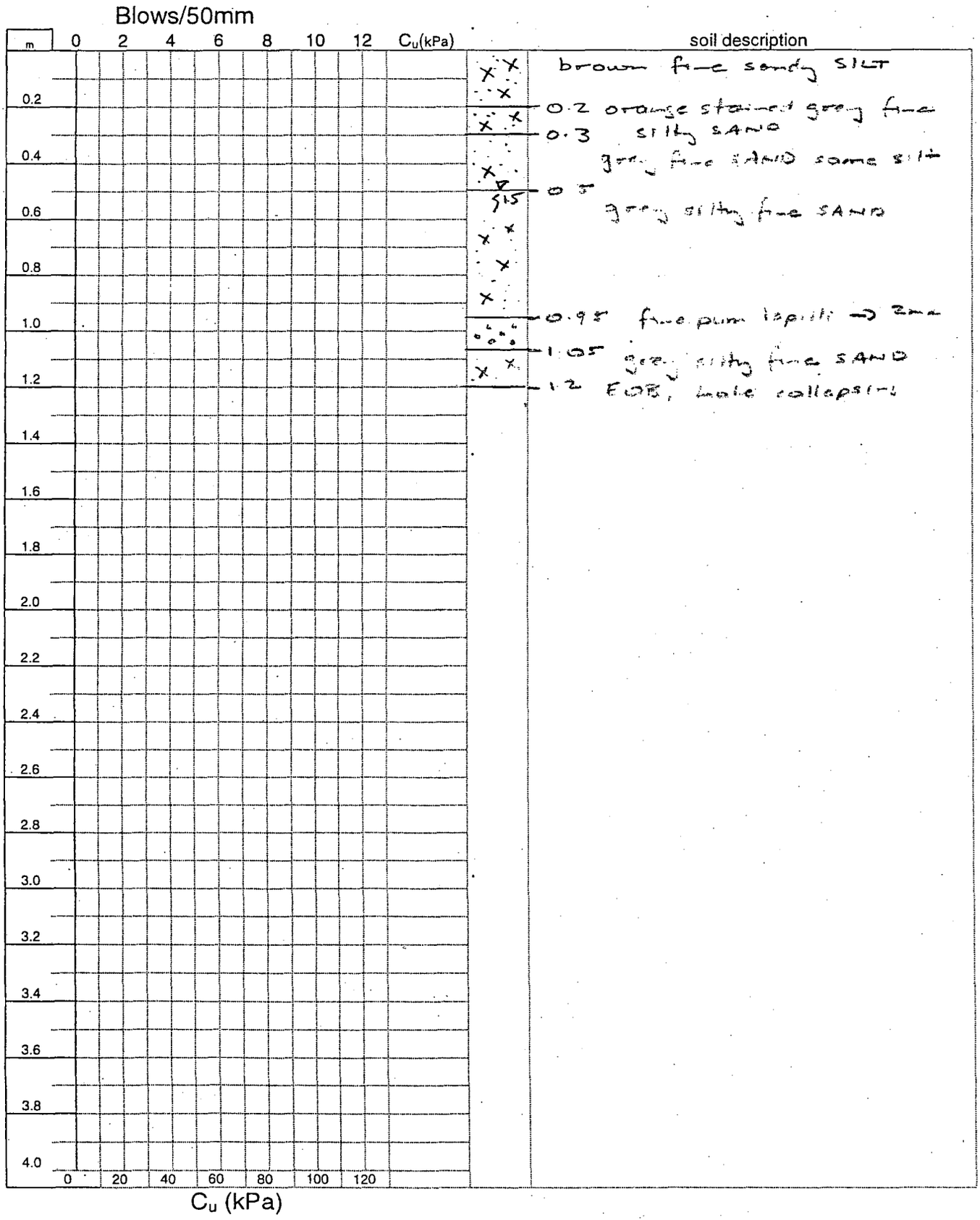
Hand Auger Log

Test Number: B7

Job Name: Black's Farm

Date: 17/9/04

Tested by: N.O.H



Pryors Bend

ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

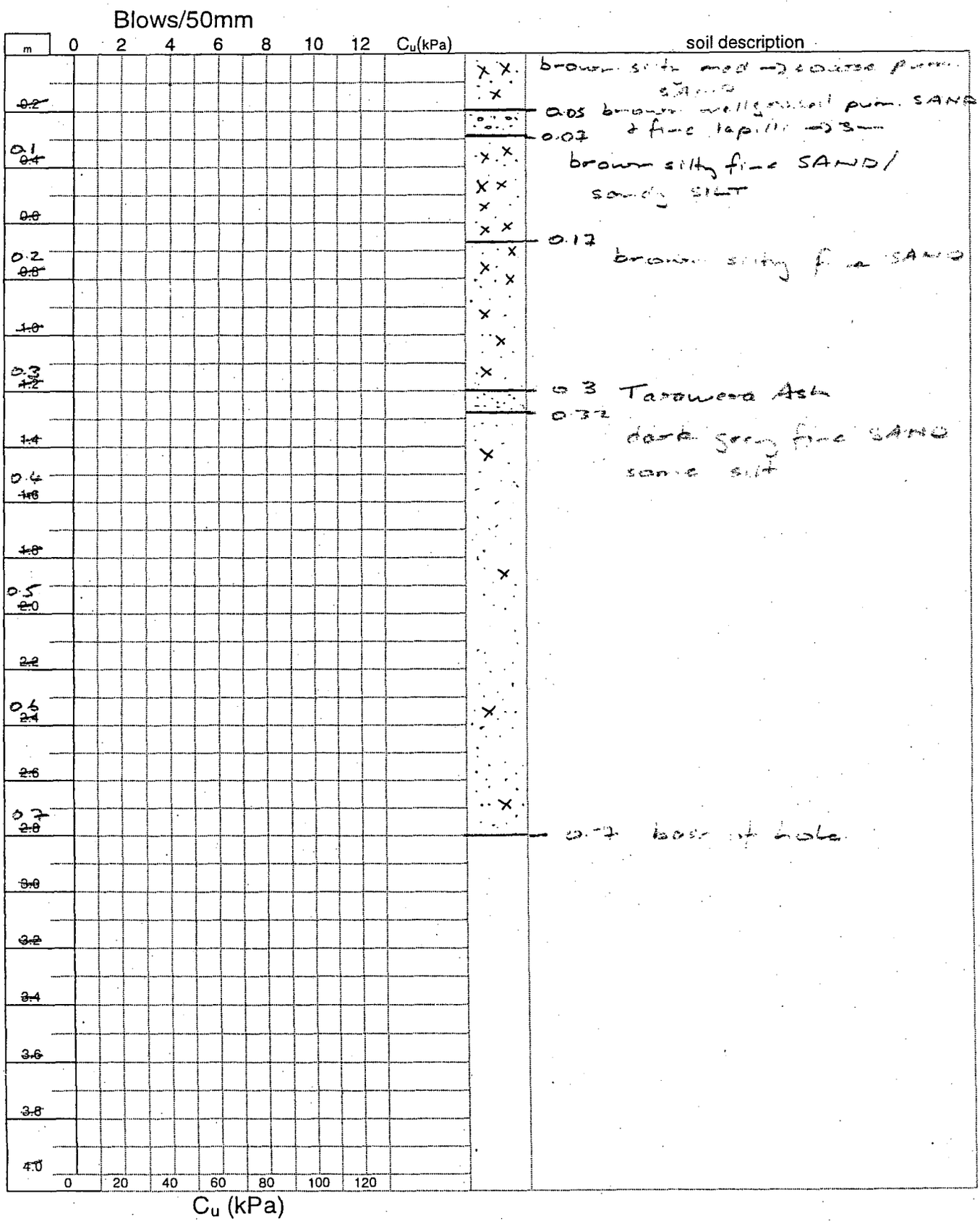
Hand Auger Log

Test Number: - Expand hole

Job Name: Pryor's Bend

Date: 15/9/04

Tested by: M O'H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD.

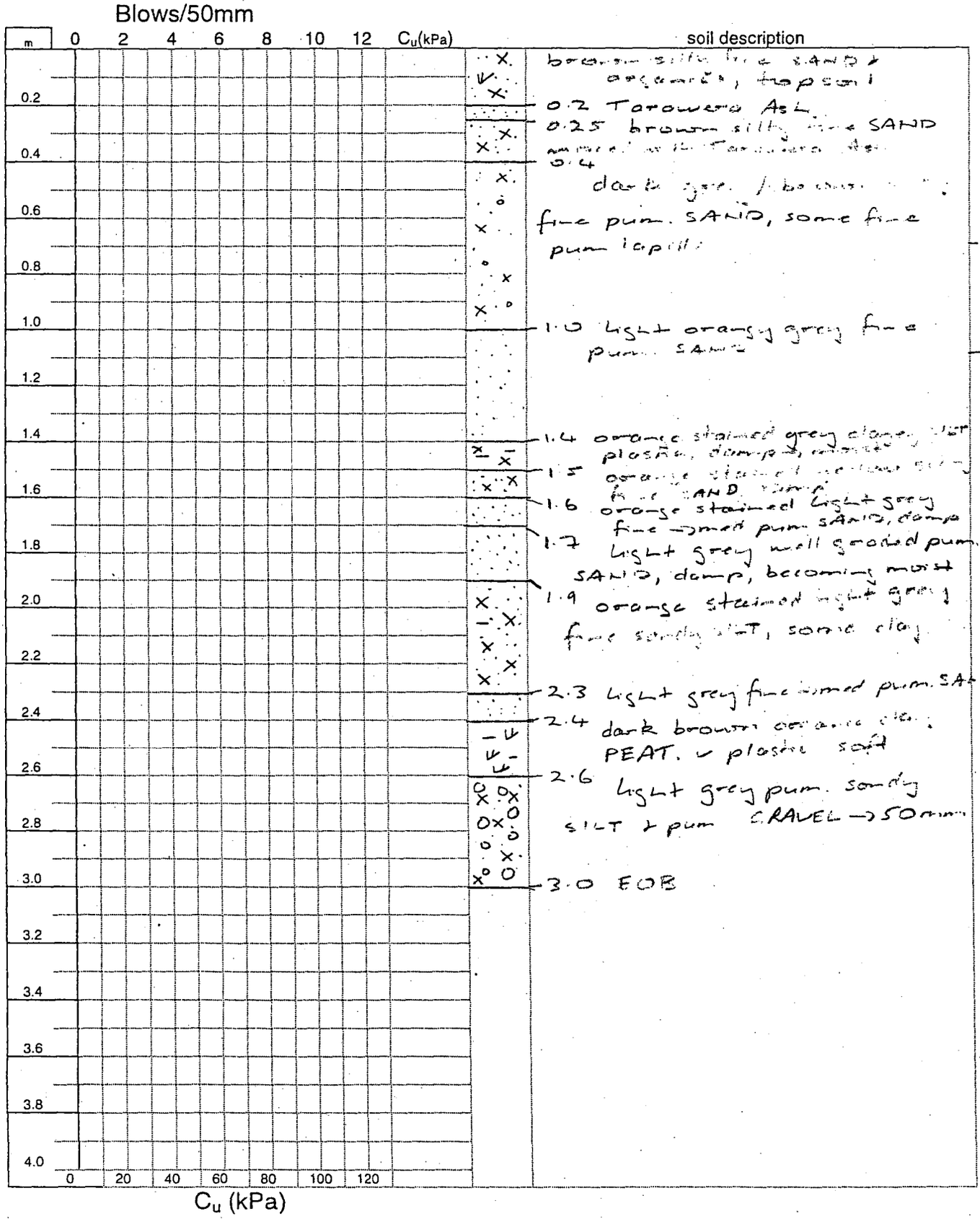
Hand Auger Log

Test Number: P1

Job Name: Pryor's Bend

Date: 15/9/04

Tested by: M.O.H



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

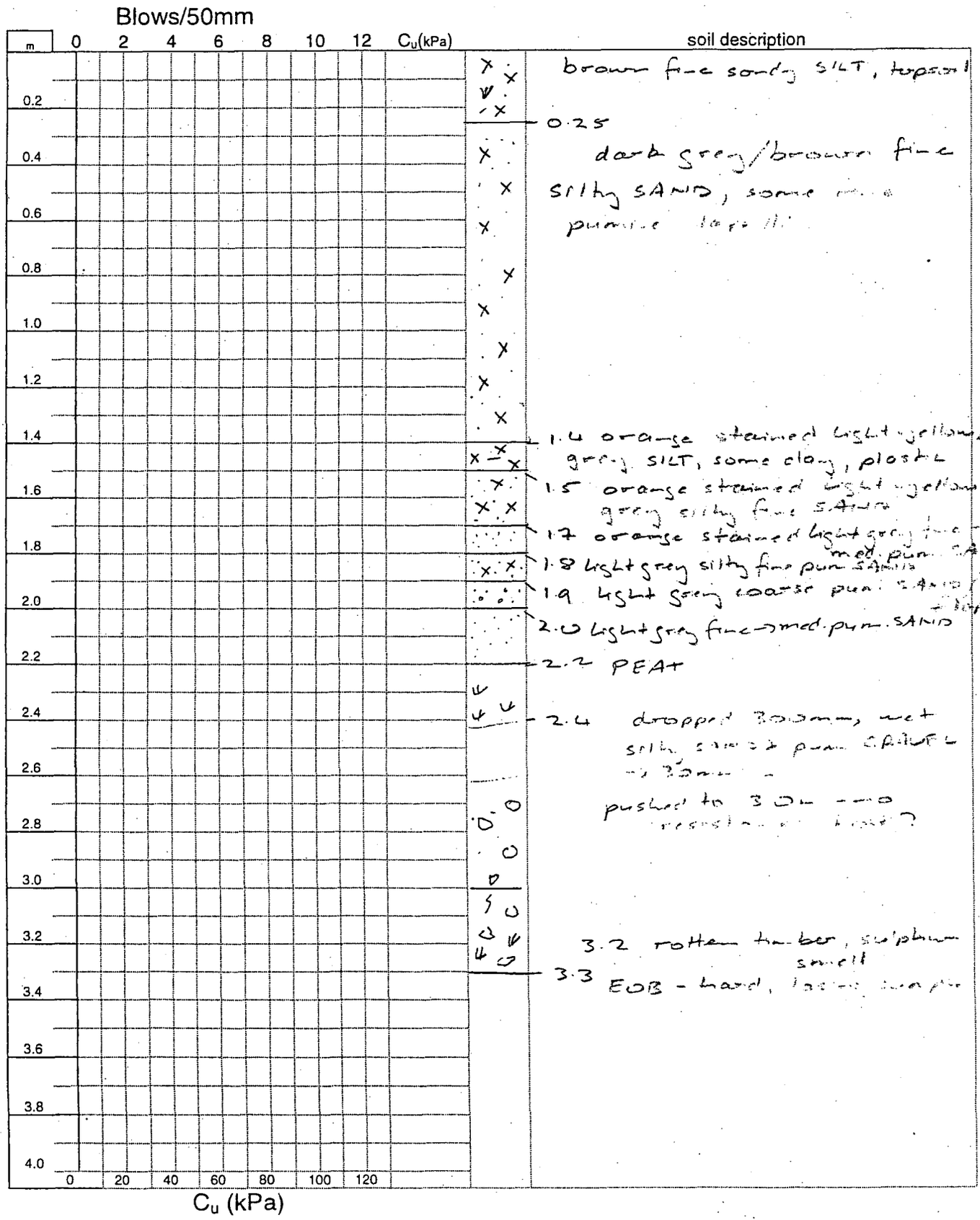
Hand Auger Log

Test Number: P2

Job Name: Pryor's Bend

Date: 15/9/04

Tested by: M. OH



ICE GEO & CIVIL
A division of ICE CONSTRUCTION LTD

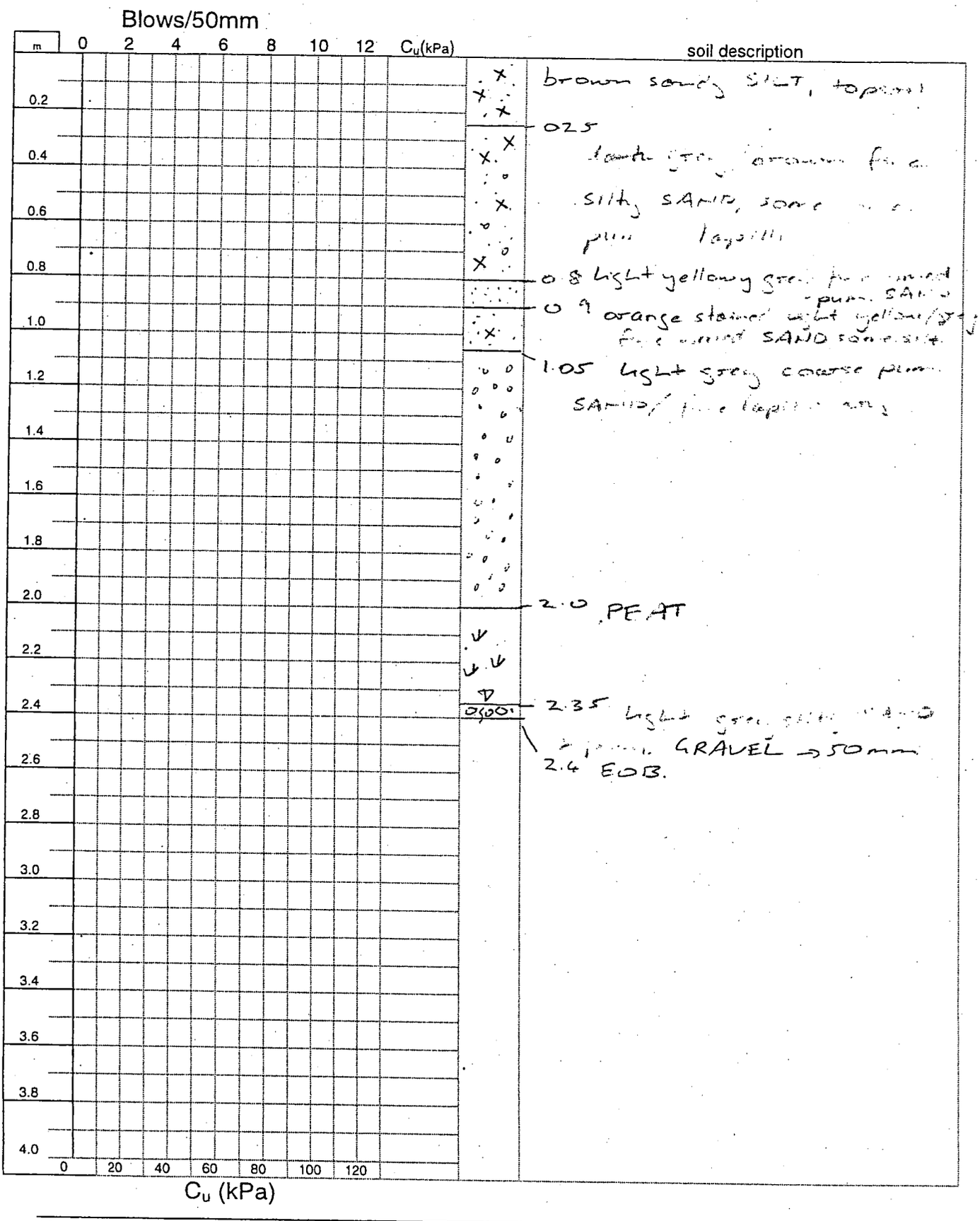
Hand Auger Log

Test Number: P3

Job Name: Pyotts Bend

Date: 15/9/04

Tested by: n OH



Appendix D

Questionnaire

To Landowners/Leaseholders/Sharemilkers/Rural Contractors

Background

As you will be aware from the events of July 2004 the stopbank systems within the Rangitaiki Plains can fail. Failures can be due to the soils on which the stopbanks are constructed and / or man made influences such as inappropriate pipes through stopbanks or excavation behind them. EBoP are continually reviewing the stopbank systems they control and have an ongoing programme of improvement. We seek your assistance in identifying possible problem areas to enable these areas to be addressed first. Attached is a questionnaire which we ask you to complete and return if you have noticed any of the things discussed below within 100m of a stopbank. An extra copy is attached in case you notice anything new following future floods. Please phone ??? at EBoP (ph???) if you have any queries or would like someone to come and discuss issues with you. You will be contacted on receipt of your form.

If you notice any of the things discussed below during a flood please phone ??? as soon as possible.

Sponginess and Seepage

Most of the soils within the Rangitaiki Plains are light and sandy and these soils have been used to build most of the stopbanks. Although these soils act satisfactorily when the stopbank is intact, if it is breached, cracked, or overtopped they erode away rapidly. Breaching and cracking usually occur when soil has been removed from the stopbank foundation by an action known as piping which allows river water to flow under the stopbank. Piping usually occurs when river water can burst through to the ground surface behind a stopbank taking soil particles with it.

Throughout the Rangitaiki Plains there is often only a thin layer of silt preventing river water reaching ground level behind the stopbanks. In small floods these layers may feel spongy to walk or drive on as they hold down water under pressure coming through coarser sand layers below. In bigger floods the water pressure may be sufficient to lift and burst the silt layer allowing piping and possibly causing a major stopbank failure. We therefore ask you to report any areas behind stopbanks which you have noticed to be spongy in floods of any size or if you have observed water seeping from the ground behind a stopbank. Seepage is often hard to differentiate from generally wetness in the middle of a storm. We also ask you to note if during your normal activities you have observed a silt layer less than say 1m thick overlying sand behind a stopbank.

Penetrations of Protective Layer

Sometimes the silt layer can be penetrated by fence posts, or poles and water can escape up the side of the post or pole. In a flood of significantly long duration this could lead to a hole large enough to allow piping under the stopbank to occur. Therefore we ask you to note any observations of water

bubbling up the sides of posts or poles, any movement of posts or poles, or gates which handle differently following a flood.

The present District and Regional Plans limit the type and amount of excavation and construction which can be carried out close to a stopbank in an effort to reduce the risk of piping failures. However you may have old structures or rubbish pits on your property which could penetrate the upper protective silt layer. If you have old pits or other excavations on your property within 100m of the stopbank, or have noticed movements in structures near stopbanks can you please note it.

Stopbank Penetrations

The holes dug by rabbits can shorten the flow path for water through and under a stopbank and lead to stopbank failure. We are therefore interested in the rabbit population observed near the stopbanks.

If backfill is poorly compacted around pipes installed through stopbanks seepage can occur along the side of the pipe. The sandy soils of which most of the stopbanks are constructed can be washed out with the water travelling along the outside of the pipe, leading to a hole, rapid erosion and stopbank collapse. Please note if you have any irrigation intake pipes, pipes to water troughs or other pipes which pass through the stopbank.

Stopbank Geometry

The width and side slopes of most of the stopbanks within the Rangitaiki Plains are sufficient to prevent the side slopes failing in their design floods. However in some areas stopbank construction has been constricted by roads and property boundaries and the side slopes are steeper than desirable. Failures can occur on the landward side of a stopbank due to a high water level within the stopbank during a flood, and on the river side of the stopbank if the river drops faster than the water level within the stopbank or the river bank is eroded. The initial indication of a failure is a crack running parallel to the top of the stopbank or in a curve. Please note if you have seen any of these cracks on any stopbanks.

Stopbank Observations

Please place this form into the return addressed envelope provided and into the mail. If you have any queries or would like someone to come and discuss issues with you please phone Peter West at Environment Bay of Plenty (0800 368 288 Extension: 9587).

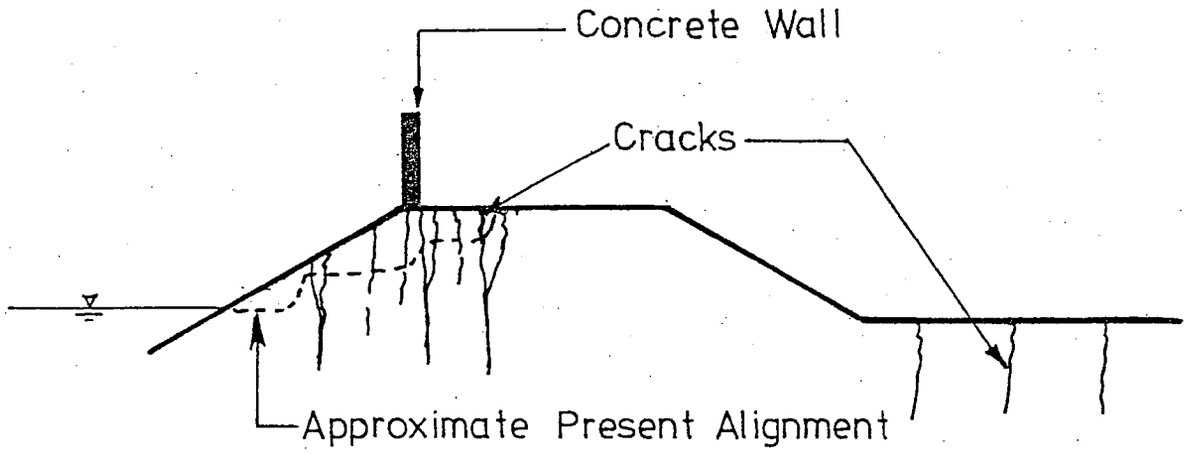
Name:	
Address:	
Phone No.	

Please tick where appropriate.

Have you noticed sponginess or seepage in paddocks behind stopbanks during floods?	
Have you noticed water coming up alongside any posts or poles or movement in posts, poles or gates?	
Have you noticed sand layers less than 1 metre below ground surface on the landward side of a stopbank?	
Have you noticed any rubbish pits or other excavations within 100m of the stopbank?	
Are there rabbit holes in or near the stopbank?	
Are there any pipes through your section of stopbank?	
Have you observed any cracks in the stopbank?	
Is there anyone else who is familiar with the history of the land? Please give contact details if known.	
Any other comments/observations	

Appendix E

Earthquake Damage Categories



TYPICAL CROSS SECTION

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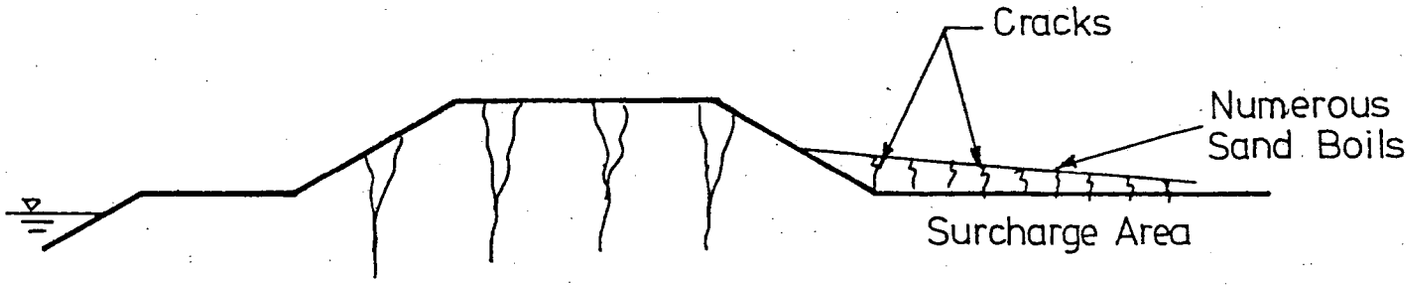
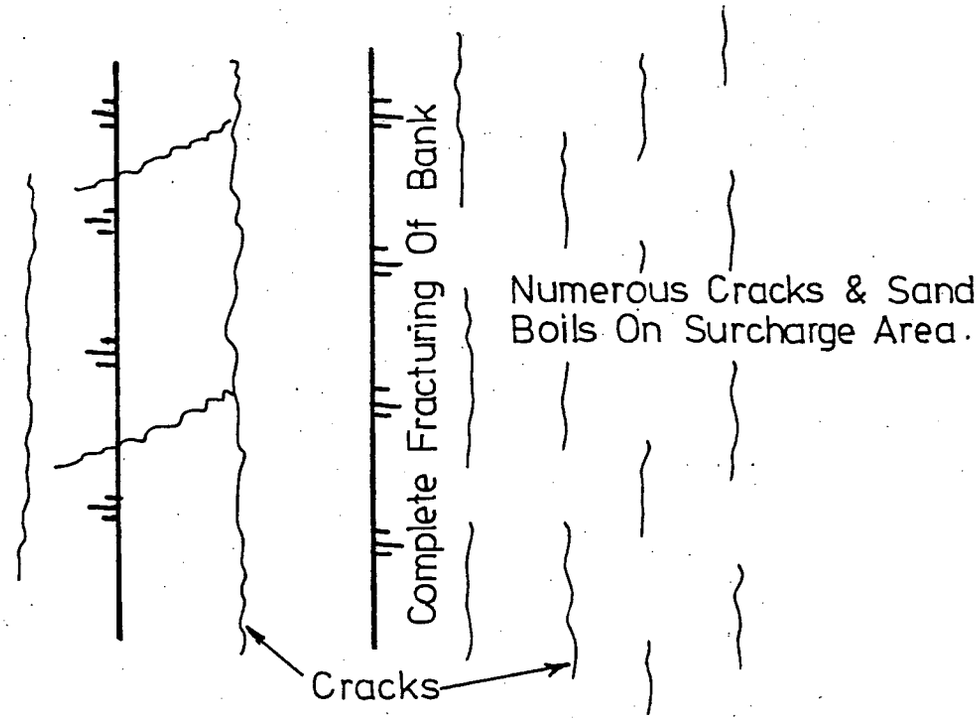
BAY OF PLENTY CATCHMENT COMMISSION

DAMAGE TYPE I Slumping Of Foundations With Structures On Top	Drawn	P.D.D	3·87	REFERENCE	PLAN NO.
	Traced	L.L.N	"		M 534
	Designed			SCALE	
	Checked	P.D.D	"	N.T.S	Sh. 1 of 8
	Approved				



TYPICAL CROSS SECTION



TYPICAL PLAN VIEW

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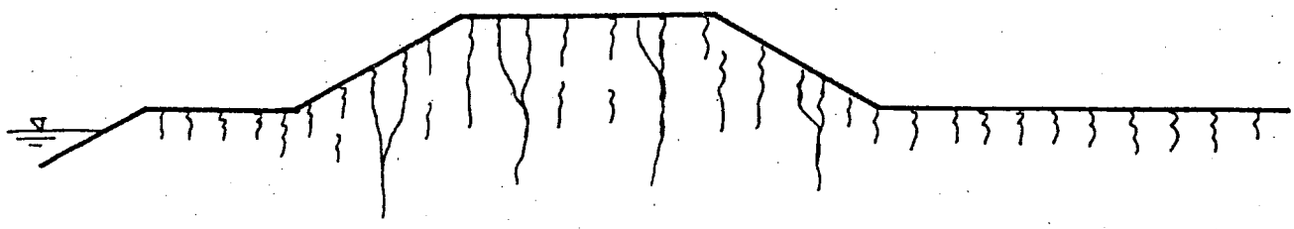
BAY OF PLENTY CATCHMENT COMMISSION

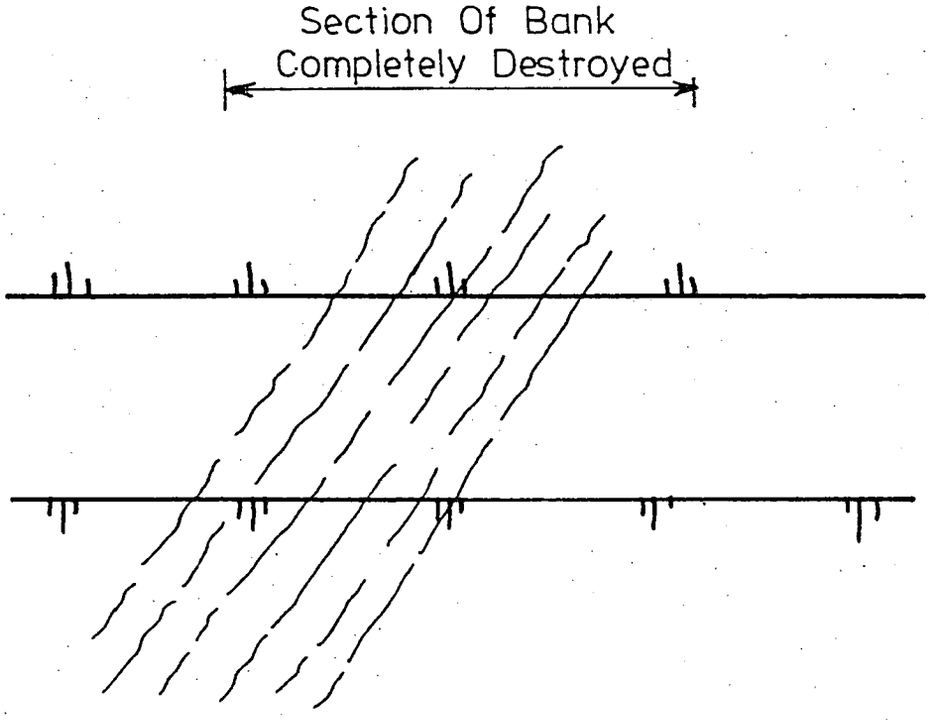
DAMAGE TYPE II

Failure Of Surcharge Area

Drawn	P.D.D	3-87	REFERENCE	PLAN NO.
Traced	L.L.N	"		M 534
Designed				
Checked	P.D.D	"	SCALE	
Approved			N.T.S	Sh. 2 of 8



TYPICAL CROSS SECTION



TYPICAL PLAN VIEW

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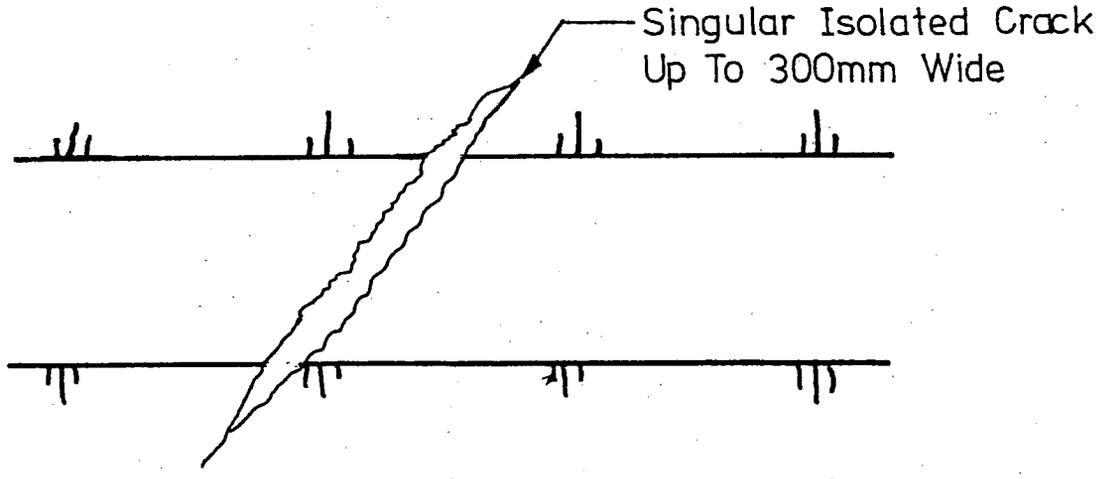
BAY OF PLENTY CATCHMENT COMMISSION

DAMAGE TYPE IV

Faultline Rupture Across Stopbank.

Drawn	P.D.D	3-87	REFERENCE	PLAN NO.
Traced	L.L.N	"		M 534
Designed			SCALE	
Checked	P.D.D	"	N.T.S	Sh. 3 of 8
Approved				



TYPICAL PLAN VIEW

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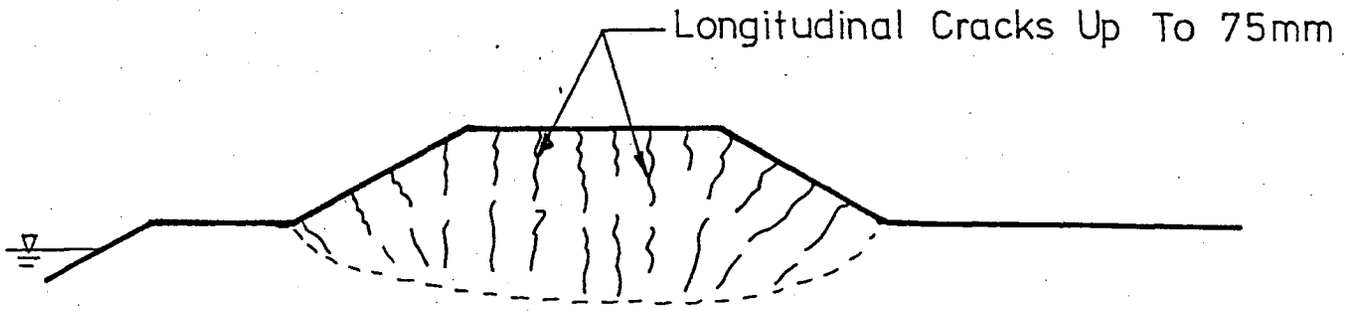
BAY OF PLENTY CATCHMENT COMMISSION

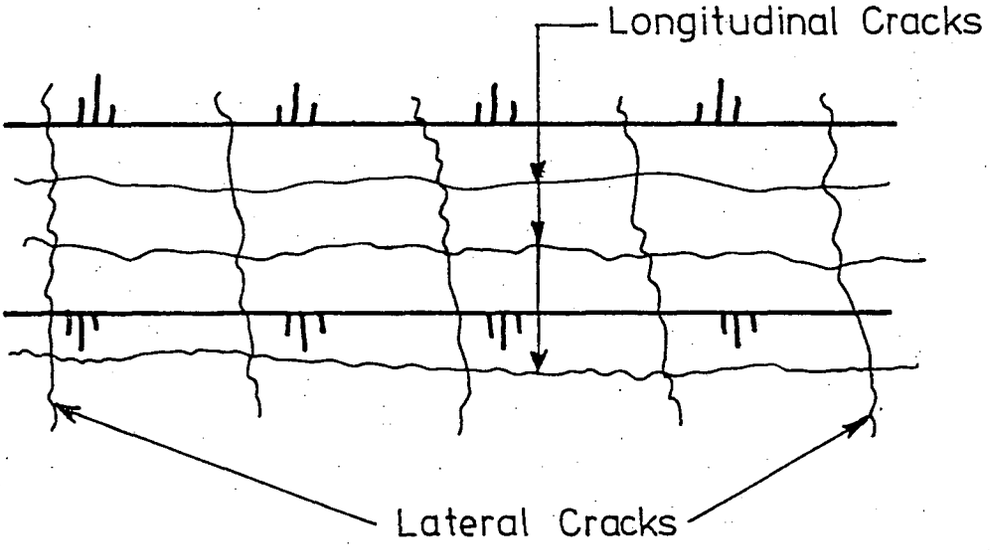
DAMAGE TYPE V

Cracking Of Bank Horizontally

Drawn	P.D.D	3-87	REFERENCE	PLAN NO.	
Traced	L.L.N	"		M 534	
Designed					
Checked	P.D.D	"	SCALE		
Approved			N.T.S	Sh. 4 of 8	



TYPICAL CROSS SECTION



TYPICAL PLAN VIEW

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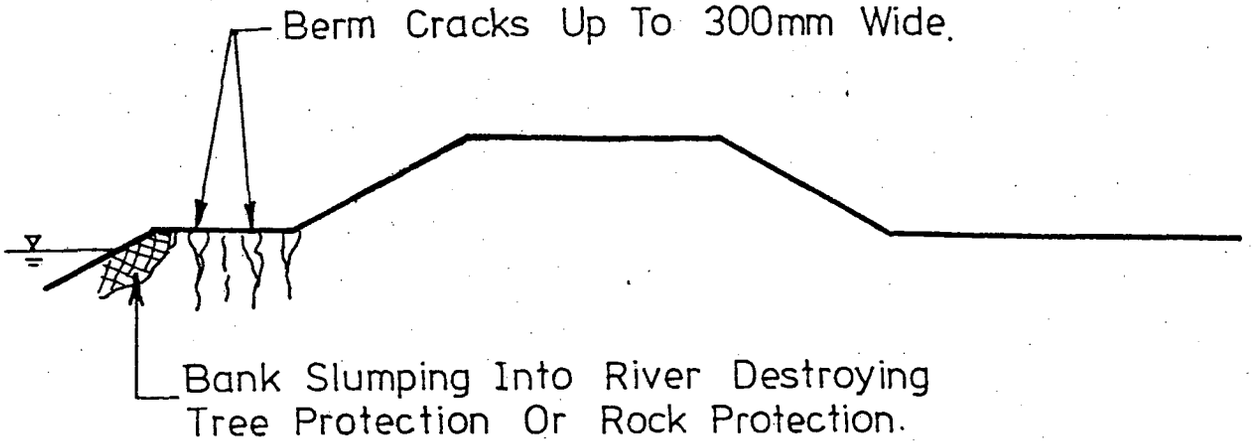
BAY OF PLENTY CATCHMENT COMMISSION

DAMAGE TYPE VII

General Small Cracking

In Both Planes.

Drawn	P.D.D	3-87	REFERENCE	PLAN NO.	
Traced	L.L.N	"		M 534	
Designed					
Checked	P.D.D	"	SCALE		
Approved			N.T.S	Sh. 5 of 8	



TYPICAL CROSS SECTION

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BAY OF PLENTY CATCHMENT COMMISSION

DAMAGE TYPE IX & X

Slumping & Cracking In Berms

Drawn	P.D.D	3-87	REFERENCE	PLAN NO.	
Traced	L.L.N	"		M 534	
Designed					
Checked	P.D.D	"	SCALE		
Approved			N.T.S	Sh. 6 of 8	