UR83_24

1983/24. Subsurface geological investigation of cracked houses in the Mowbray area, Launceston

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Abstract

A subsurface investigation, comprising eight auger holes drilled to depths of between 5.2 and 6.1 m, was undertaken in the Mowbray area, Launceston, where severe house cracking has been reported. Locally this cracking is thought to be caused by vibrations from blasting at a quarry approximately one kilometre from the houses.

The area is underlain by highly plastic and expansive clay of the Tertiary Launceston Beds. The clay has a similar lithology, properties, and composition to clay occurring at three other locations in the Launceston area where house cracking has occurred during 1982-83. Expansive soils, combined with a low soil moisture content to a considerable depth resulting from the drought of 1982-83, is offered as an alternative explanation for house cracking in the Mowbray area.

INTRODUCTION

During the dry winter and summers of 1982-83, the Engineering Geology Section of the Department of Mines was asked to undertake subsurface investigations at several locations in the Greater Launceston area, where severe exterior wall cracking of brick or concrete block houses has occurred. One of these areas is in the Dobson-Caswell Street [EQ120157] and Clare Street areas of Mowbray [124154], where exterior wall cracking was reported on houses at 24 Dobson Street, 3 and 8 Caswell Street, and 25 Clare Street. The general belief by residents in this area is that the house cracking is caused by ground vibrations resulting from blasting in the Readymix quarry approximately one kilometre to the north-east.

The subsurface investigation was requested by J. Dempster, Mining Engineer, Launceston.

INVESTIGATION PROCEDURE

Seven holes were drilled around the block enclosed by Clark, Dobson, Conway, and Caswell Streets (fig. 1). The eighth hole was drilled at 25 Clare Street, 400 m to the east of Caswell Street. This hole was drilled on the nature strip close to the front fence, 16 m from the driveway.

A Triefus trailer-mounted drill was used with 102 mm diameter augers. The holes were drilled to a depth of 6.1 m unless the drill refused to penetrate, as in Hole 8 which stopped at 5.2 m depth. The augers were withdrawn every 0.8 m and a sample collected. These samples were tested in the Department of Mines soil laboratory for field moisture content, Atterberg limits, and linear shrinkage. X-ray analysis of representative clay samples was also undertaken.

LOCATION AND PHYSIOGRAPHY

Dobson, Conway, Caswell, and Clark Streets are located on the

Figure 1. *Location of study area, Mowbray*

5 cm

south-facing slope of a 25-30 m high terrace, on which most of the suburbs of Mowbray and Vermont are built. The terrace slope overlooks the Mowbray swamp, which is currently being used as the Launceston tip.

Conway Street is near the base of the terrace slope and Dobson and Caswell Streets traverse down this slope to join Conway Street. A break in slope occurs in Dobson Street below its junction with Crawford Street. Here the slope increases from 3° to 10°. This break in slope can be traced to Caswell Street, where it occurs between houses at 8 and 10 Caswell Street, and increases from 3° to 12°.

Of the two cracked houses inspected, 24 Dobson Street and 3 Caswell Street are situated above this break in slope on the low sloping area, and are not on the steeper sections of Dobson or Caswell Street. No evidence for any translational or landslide movement, such as the tilting of retaining walls and house walls, was seen in these two houses. No tilting of fences or walls on the steeper sections of Dobson and Caswell Streets was observed from the street. No tension cracks in the ground were seen on the driveways, footpaths, or on the lawns on or above this slope. No field evidence for any translational downslope movement was observed in Dobson or Caswell Streets.

The house at 25 Clare Street is 400 m east of the Dobson Street-Caswell Street block and on the same terrace slope, but is separated from Caswell Street by a narrow, dry NE-SW trending valley. This house is situated on the upper section of the terrace on a slope of 3°.

GEOLOGY

All seven holes drilled around the Dobson Street-Caswell Street block passed through a thin surface soil layer of organic silt and/or clay (OL-OC) and then into inorganic clay with a high plasticity (CH). This clay dominates the sedimentary sequence to the 6.1 m depth drilled.

A clay sequence was also present in Hole 8 at Clare Street, except between 2.5-5.2 m where thin gravel lenses or beds were mixed with the clay. It is thought that the drill was stopped by a thicker gravel layer at a depth of 5.2 m. The clay was highly plastic in all the samples tested and the colour varied from brown to orange to grey with red streaks. The clay is considered to belong to the Launceston Beds of Tertiary age (Longman, 1964).

Thin layers, possibly lenses of limonite nodules as well as fine quartz gravel, occur within the clay. Larger pebbles, rounded quartzite and occasionally dolerite, were also dispersed within the clay. These larger pebbles appeared to form gravel beds only in Hole 8 at Clare Street. The only lithological correlation possible between drill holes was a distinctive yellow soft clay layer with fine sand occurring at the bottom of Holes 3 and 4 on the south side of Conway Street.

SOIL SAMPLE TESTING RESULTS

The results of soil laboratory tests of samples from the eight holes drilled at Mowbray are given in Table 1.

All the clay samples tested were highly plastic (fig. 2). This figure also shows the results of samples collected from three other localities in the Launceston area, where similar subsurface investigations were undertaken during the 1982-83 dry period. These other areas are Beach

Table 1. SOIL TESTING RESULTS OF DRILL SAMPLES, MOWBRAY

Hole*	Depth (m)	MC (%)	LL	PL	PI	LI	LS (%)	X-ray diffraction+
1	1.5	30	127	28	99	0.02	25	M (strong)
	2.4	26	105	26	81	0	24	K (weak)
	3.4	23	-	-	-		-	
	4.3	20	-	-	-		-	
	5.2	21	-	-	-		-	
	6.1	17	-	-	-		-	
		Av=22.8						
2	0.6	24	-	-	-		-	
	1.5	36	134	30	104	0.06	26	
	2.4	33	96	27	69	0.09	23)	M (moderate)
							)	K (weak)
	3.4	31	-	-	-		-	
	4.3	28	79	25	54	0.06	20	
	5.2	26	-	-	-		-	
	6.1	29	78	24	54	0.09	20)	M (moderate)
							)	K (weak)
		Av=25.6						
3	0.6	5	-	-	-		-	
	1.5	34	150	32	118	0.02	28	
	2.4	36	99	26	73	0.14	24)	M (moderate)
							)	K (moderate)
	3.4	35	-	-	-		-	
	4.3	32	87	25	62	0.11	22)	M (weak)
							)	K (weak)
	5.2	37	-	-	-		-	
	6.1	37	81	26	55	0.16	19	
		Av=30.9						
4	0.6	13	-	-	-		-	
	1.5	19	-	-	-		-	
	2.4	34	120	29	91	0.05	25)	M (strong)
							)	K (moderate)
	3.4	29	71	23	48	0.13	18)	K (moderate)
							)	M (moderate)
	4.3	29	-	-	-		-	
	5.2	33	88	24	64	0.14	22)	M (moderate)
							)	K (weak)
	6.1	37						
		Av=27.7						
5	0.6	6	-	-	-		-	
	1.2	36	127	31	96	0.07	25	
	1.5	38	128	30	98	0.08	25)	M (moderate)
							)	K (moderate)
	2.4	21	63	24	39	0	16)	M (weak)
							)	K (weak)
	3.4	18	-	-	-		-	
	4.3	23	62	23	39	0	16	
	5.2	23	-	-	-		-	
	6.1	27	77	25	55	0.04	20)	M (moderate)
							)	K (moderate)
		Av=24.0						

Table 1. (continued)

Hole*	Depth (m)	MC (%)	LL	PL	PI	LI	LS (%)	X-ray diffraction+
6	0.9	32	107	28	99	0.04	21)	K (moderate)
							)	M (weak)
	1.5	19	-	-	-		-	
	2.4	33	94	27	67	0.09	20	
	3.4	34	95	-	-		-	
	4.3	32	-	-	-		-	
	5.2	37	96	28	68	0.13	19)	K (moderate)
							)	M (moderate)
	6.1	34	90	-	-		-	
		Av=31.6						
7	0.9	33	136	30	106	0.03	26	
	1.5	27	114	-	-		-	
	2.4	25	-	-	-		-	
	3.4	28	78	26	52	0.04	18)	K (weak)
							)	M (weak)
	4.3	35	-	-	-		-	
	5.2	28	-	-	-		-	
	6.1	36	67	27	40	0.02	16)	K (weak)
							)	M (trace)
		Av=30.3						
8	0.9	32	120					
	1.5	28	121	29	92	0	23)	K (moderate)
							)	M (weak)
	2.4	25	72	24	58	0.02	17)	K (weak)
							)	M (weak)
	3.4	20	-	-	-		-	
	4.2	20	76	25	51	0	18)	K (weak)
							)	M (weak)
	5.2	21	-	-	-		-	
		Av=24.3						

* Hole locations are:
1 - 24 Dobson Street (front lawn)
2 - 18 Dobson Street (vacant block)
3 - Junction of Conway and Dobson Streets
4 - Junction of Conway and Caswell Streets
5 - 12 Caswell Street
6 - 8 Caswell Street
7 - Corner of Clark and Caswell Streets
8 - 25 Clare Street

\+ M = montmorillonite
K = kaolinite

MC = moisture content; LL = liquid limit; PL = plastic limit;
PI = plasticity index; LI = liquidity index; LS = linear shrinkage

Holes 1-5 drilled 16 March 1983
Holes 6-8 drilled 19 April 1983

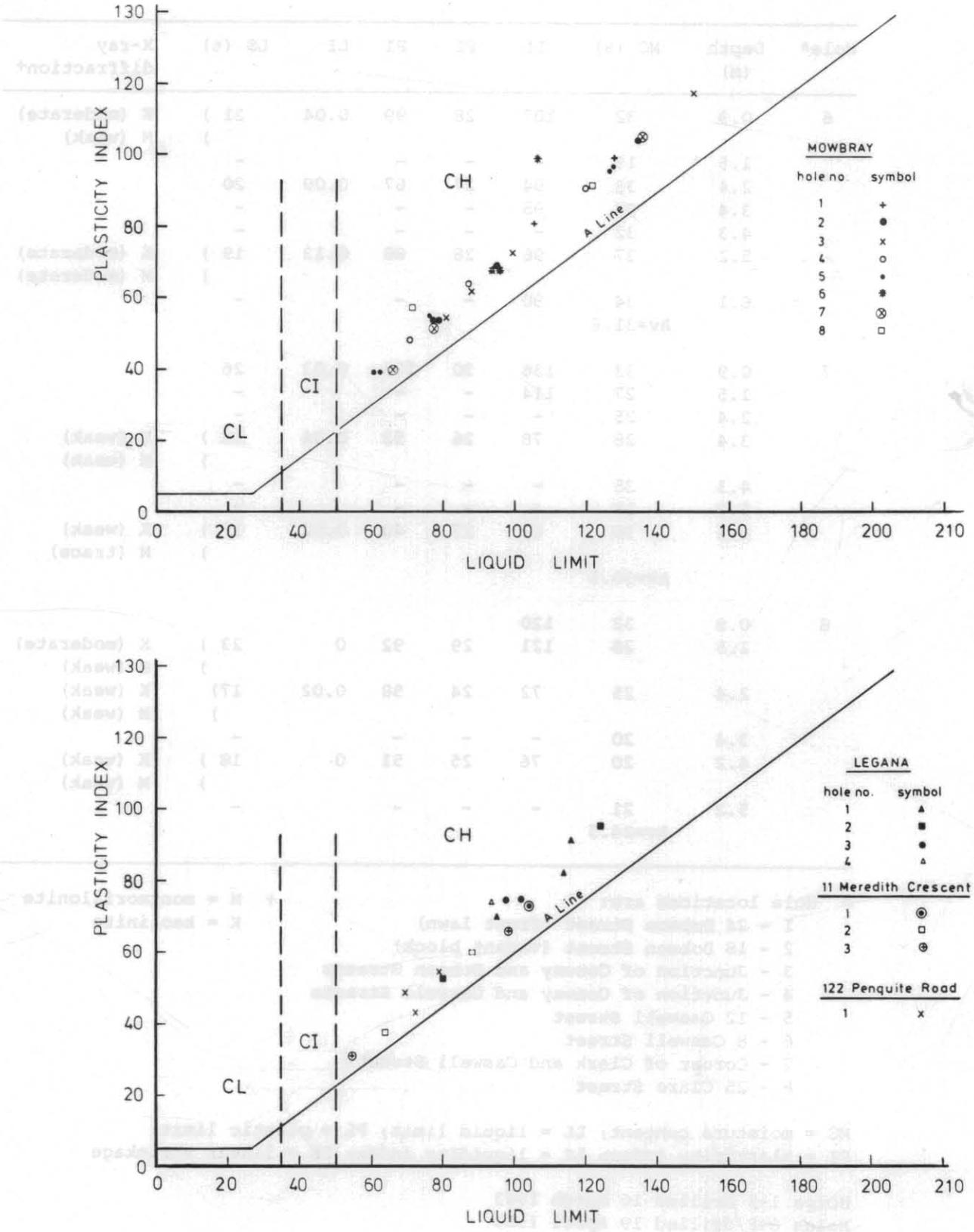


Figure 2. *Classification of clay samples, Launceston area*

5 cm

Road at Legana, where severe cracking of four houses (47 to 53 Beach Road) has occurred, and single houses at 11 Meredith Crescent and 122 Penquite Road, both in Launceston. The results of soil laboratory tests of the clay samples collected from drilling at these other locations are given in Tables 2, 3, and 4.

The field moisture content for Holes 1 to 5 (drilled on 15-16 March) and Holes 6 to 8 (drilled on 19 April) at Mowbray are plotted on Figure 3. Even though Holes 1 to 7 reached a depth of 6.1 m in similar clay, no constant moisture level was reached.

For each of these drill holes the field moisture content, the plastic index range, and the linear shrinkage of the samples collected are plotted in Figure 5. Similar figures are plotted for Beach Road, Legana (fig. 6), 11 Meredith Crescent (fig. 7), and 122 Penquite Road (fig. 8).

It had been planned to monitor the moisture content of the clay at Beach Road, Legana, by drilling another series of holes close to the original holes after the anticipated winter rains in 1982. As little rain fell in the winter of 1982, these holes were not drilled until May 1983, when a series of shallow hand-augered holes were drilled to refusal depth. The Triefus drill was not used because of the difficulty of access and the unavoidable mess that deeper drilling creates. Although not conclusive, the results from these holes (fig. 4) indicate that moisture contents in the clay were higher after the autumn rains had eased the drought of 1982-83. If a normal winter rainfall occurs in 1983, it is hoped that a series of deep holes will be drilled at Beach Road and the field moisture content of the clay tested. Similar higher moisture contents were obtained from shallow holes dug at Penquite Road in March 1983 (fig. 8), twelve months after initial testing at this locality.

The field moisture contents vary between each hole at each location (Tables 1-4) and it is difficult to make comparisons of the moisture content between different locations over any length of time. In general, all the clay samples tested from the holes drilled at the four locations in Launceston during 1982 and 1983 appear to have a low average moisture content (Table 5). This low average field moisture content is thought to reflect the lack of rain during 1982-83 and the depth to which the drying of the clay occurred during this dry period.

All the clay samples tested from the Mowbray area are highly plastic. They have very high liquid limits ranging from 76-150, with plastic limits between 24 and 32. The plasticity index range (51-118) of all the samples is wide. The Atterberg limits of the Mowbray clay samples cover a wider range than the other highly plastic clays at Beach Road, Meredith Crescent, and Penquite Road.

The linear shrinkage was also very high in the Mowbray clay, with a range of 16-28% and an average of 21.3% for the 27 samples tested.

All of the 18 samples X-ray analysed for clay mineral composition showed that the highly expansive montmorillonite and less expansive kaolinite families were present. Montmorillonite was strong or dominant in two samples, in nine its presence was moderate, and in six weak. In only one sample was montmorillonite present as only a trace.

The Beach Road clay has a similar range of linear shrinkages to the Mowbray clay, with a range of 19-24% and an average 20.7% for the eight samples tested. At Meredith Crescent the clay has a linear shrinkage range

from 13-23% with an average 17.6% for the 12 samples tested. At Penquite Road the clay has a 17-20% linear shrinkage range with an average of 18.7% for the three samples tested.

X-ray analysis of the clay from these three localities showed that the montmorillonite and kaolinite families were present in similar proportions to the Mowbray clay.

Based on the physical appearance and the soil laboratory test results, the clays drilled in the Dobson Street-Caswell Street block and at Clare Street are similar in lithology and have similar properties to clay at Legana, Meredith Crescent, and Penquite Road. All four localities have very similar subsurface geology and are underlain by clay of the Launceston Beds, these clays being highly plastic and expansive.

INVESTIGATION RESULTS

(1) The investigation drilling showed that all four locations are underlain by expansive soils and that no constant moisture content level was reached by the drilling.

(2) All four locations experienced severe house cracking during 1982-83, a period of exceptionally low rainfall in the Launceston area.

(3) Three of these localities (Meredith Crescent, Beach Road, and the southern half of Dobson-Caswell Streets and Clare Street) are on slopes above 10°. Monitoring of slope movement has only been undertaken at Beach Road, and no movement (either vertical or horizontal) has occurred since the houses were surveyed in February 1983. Some movement had occurred in January 1983, cracking glass slide monitors.

No downslope translational movement has been observed at either of these three localities, and landslide movement does not appear to be the explanation for house cracking.

(4) Indirect evidence of vertical movement from soil shrinkage has been observed on one or more of the houses that are cracked at all four localities.

CONCLUSIONS

(1) Given that 1982-83 were very dry years and that the soil moisture became very low to a considerable depth in these highly plastic and expansive clays, excessive soil shrinkage would appear to be the most likely common cause of house cracking in all four areas.

(2) Soil shrinkage because of the highly plastic and expansive clay beneath the Dobson Street-Caswell Street block and at Clare Street is an alternative explanation for the house cracking reported in this area, rather than vibrations caused by the blasting from the Readymix quarry one kilometre to the north-east.

RECOMMENDATIONS

It is recommended that some of the holes in the Dobson Street-

Caswell Street and Clare Street areas be redrilled to the same depth as previously drilled, and that the moisture content be remeasured after a normal winter rainfall has been experienced. House cracking should be monitored as at Beach Road, Legana.

ACKNOWLEDGEMENTS

Drilling was carried out by B.E. Cox and soil laboratory testing of all areas was done by R.N. Woolley. Houses in Beach Road, Legana, were surveyed by G. Benn, and monitoring of these houses has been carried out every two months by J. Mackey and A. Geddes.

REFERENCE

LONGMAN, M.J. 1964. Geological atlas one mile series. Sheet 39 (8315S). Launceston. *Department of Mines, Tasmania.*

[5 July 1983]

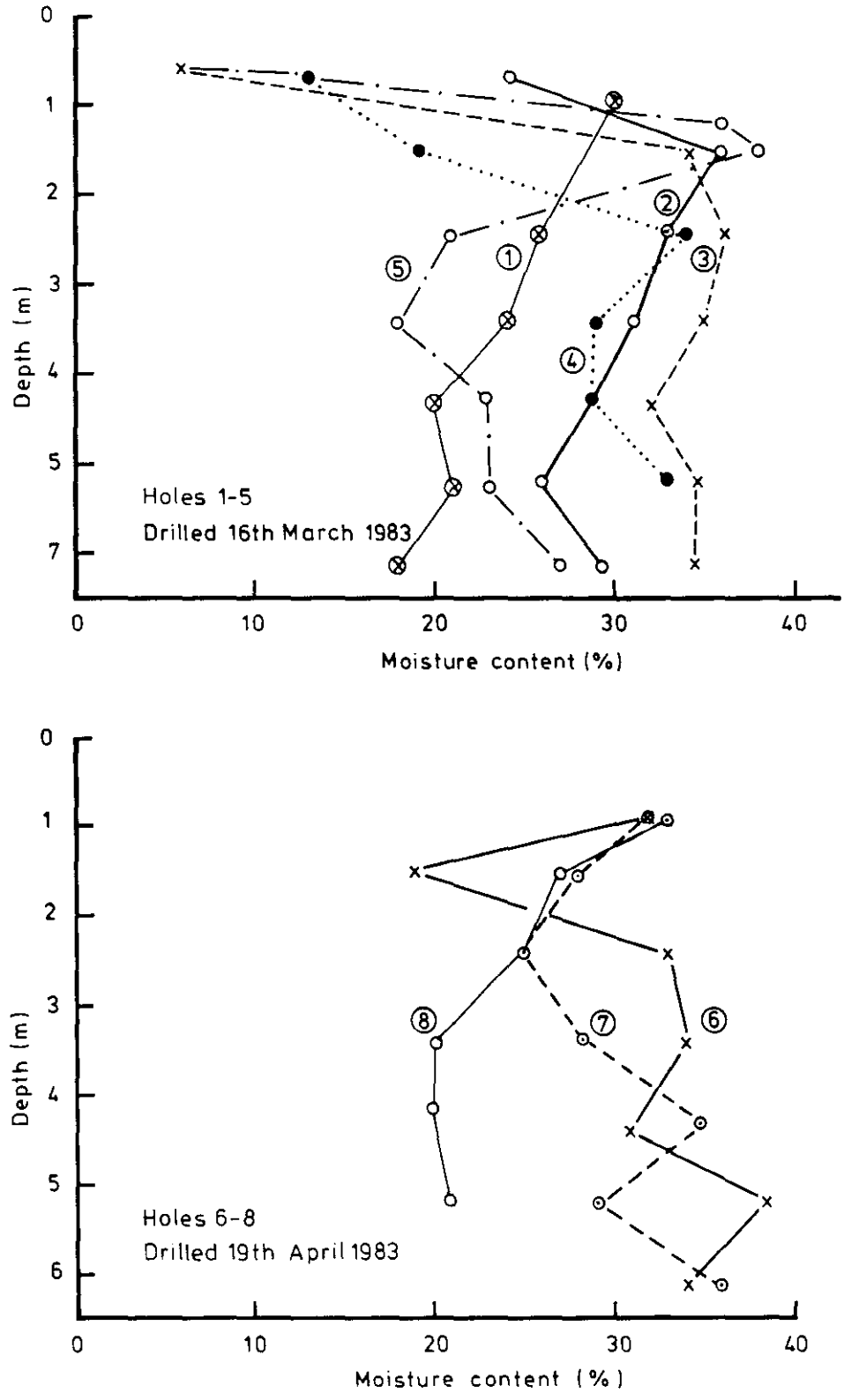


Figure 3. *Measured field moisture contents, Mowbray*

5 cm

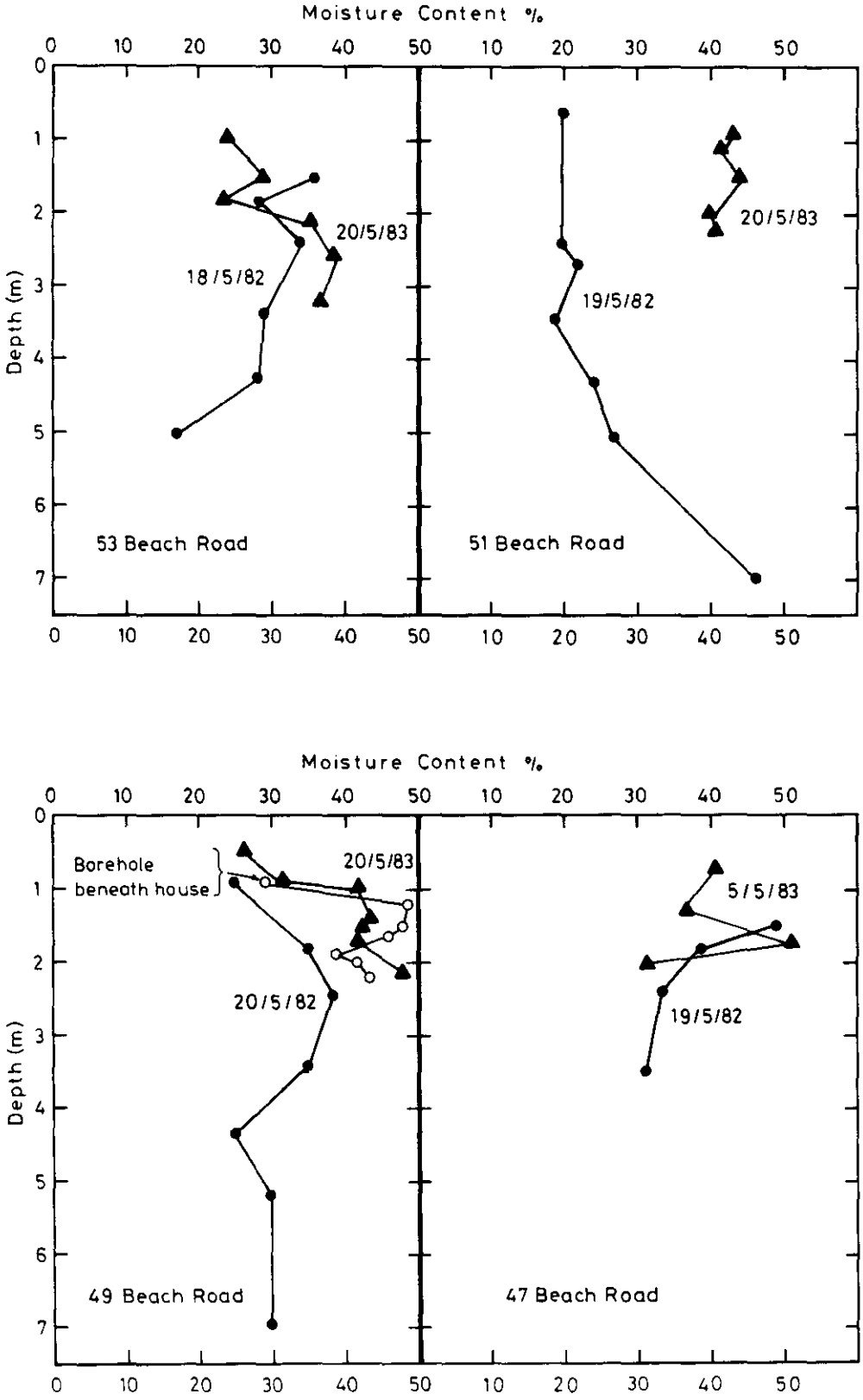
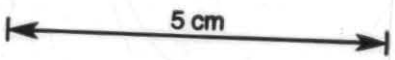
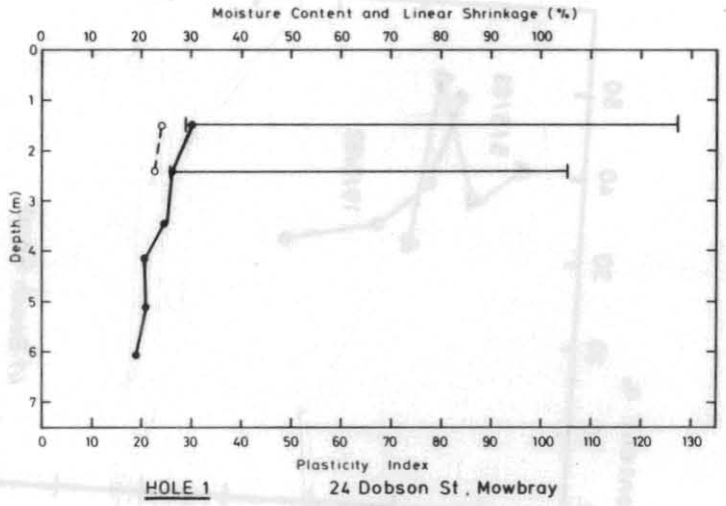
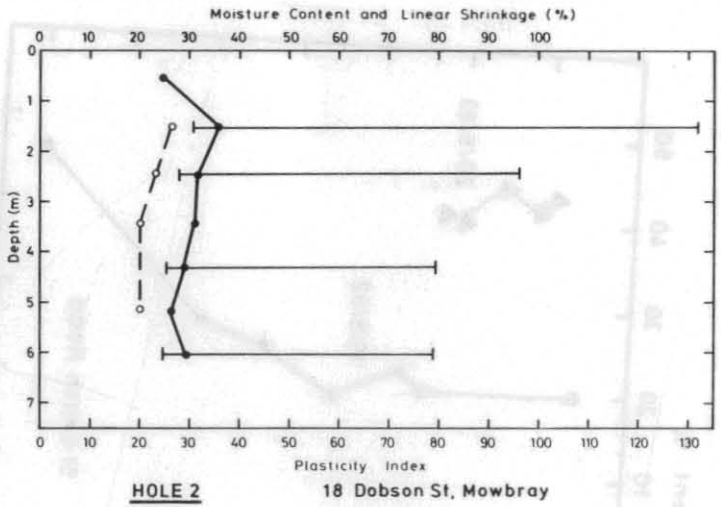


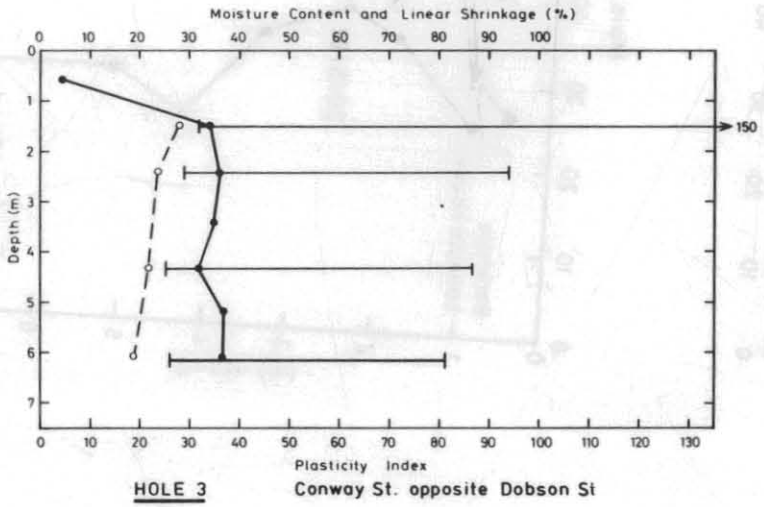
Figure 4. *Measured field moisture contents, Beach Road, Legana*

5 cm









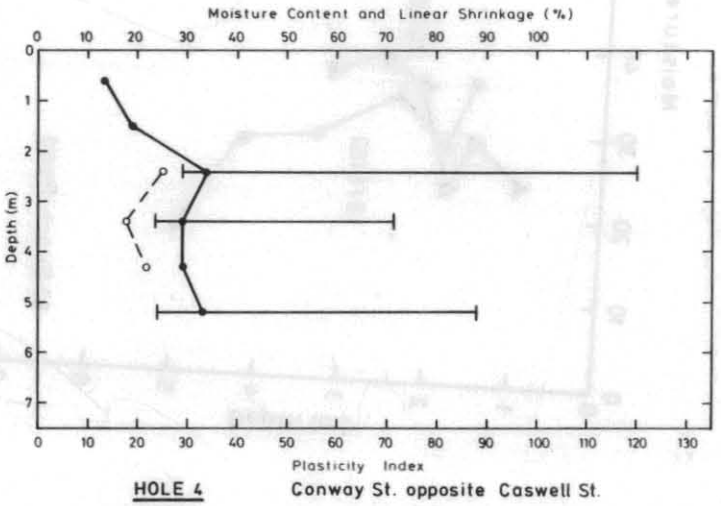


Figure 5.

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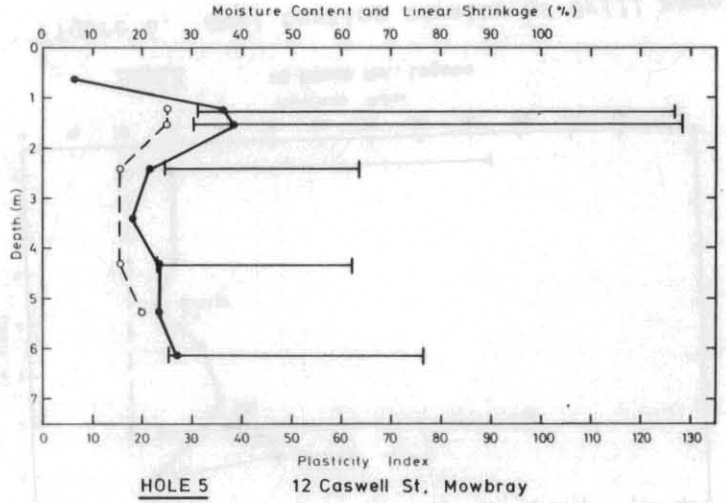
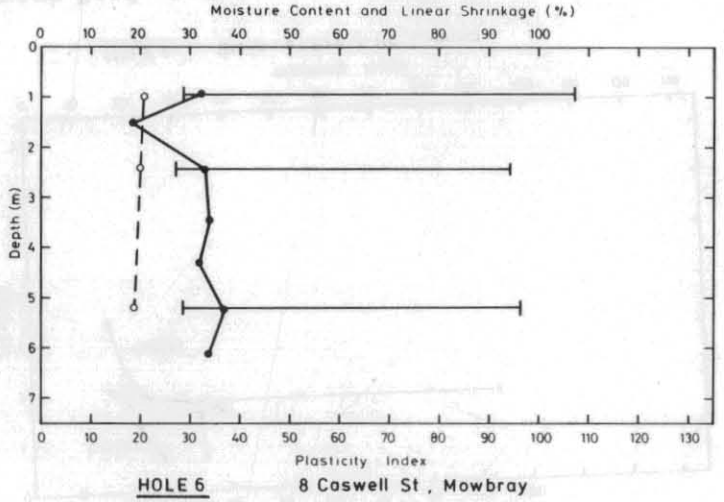
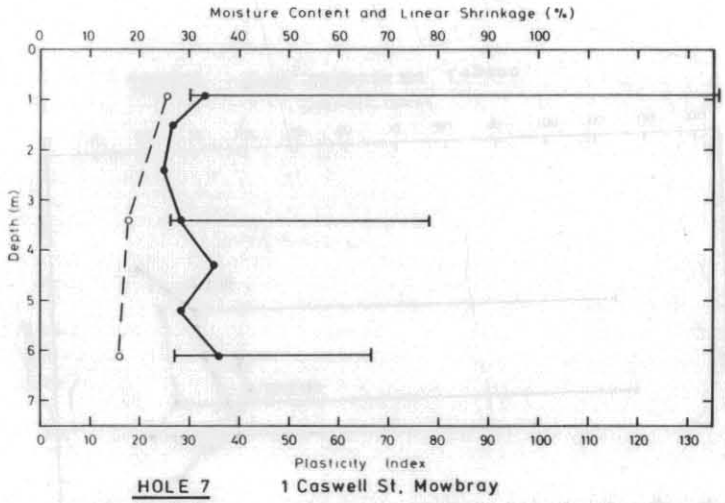






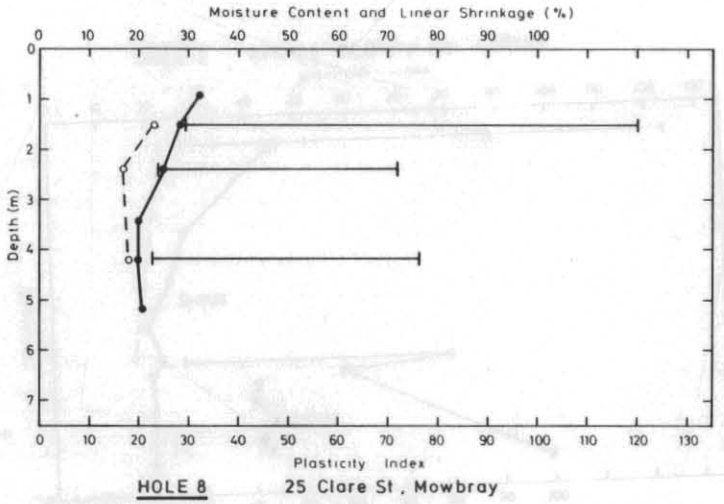
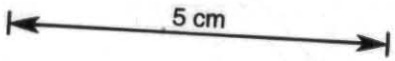


Figure 5. *Soil testing results of drill samples, Mowbray (for legend see page 19)*



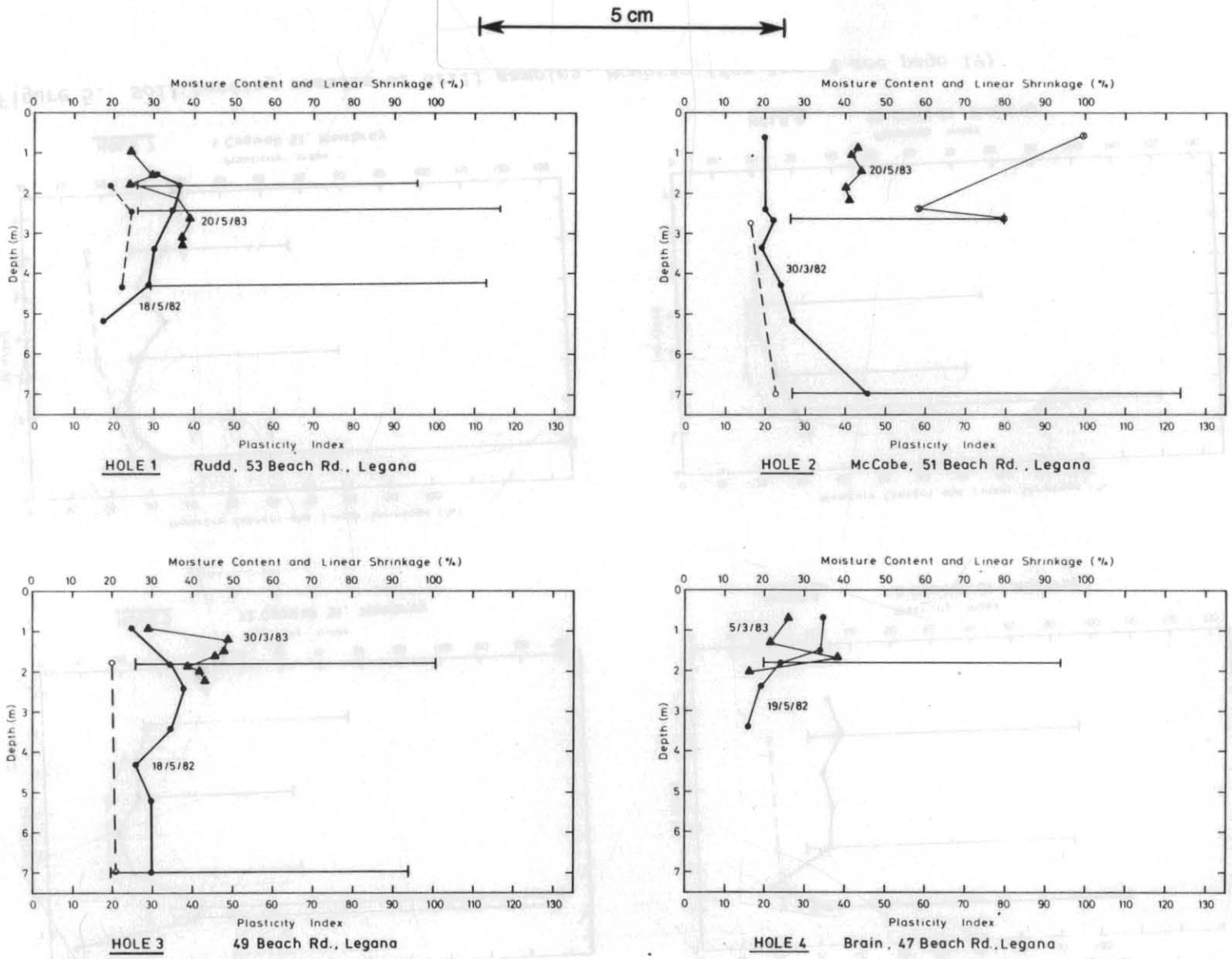


Figure 6. *Soil testing results of drill samples, Beach Road, Legana (for legend see page 19)*

Table 2. SOIL TESTING RESULTS OF DRILL SAMPLES, BEACH ROAD, LEGANA

Hole*	Depth (m)	MC (%)	LL	PL	PI	LI	LS (%)	X-ray diffraction+
1	1.5	28	-	-	-		-	
	1.8	36	95	25	70	0.04	19	K, MCa
	2.4	34	116	25	91	0.03	24	
	3.4	29						
	4.3	28	113	28	83	0.01	22	MCa, K
	5.2	17						
		Av=28.7						
2	0.6	20	100					
	2.4	20	58					
	2.7	22	80	26	54	0	17	K, MNa
	3.4	19	31					
	4.3	24	49					
	5.2	27	52					K, MNa
	7.0	46	124	27	97	0.2	23	MNa, K
		Av=25.4						
3	0.9	25						
	1.8	35	101	26	75	0.12	20	MNa, K
	2.4	38						
	3.4	35						
	4.3	26	67					
	5.2	30						
	7.0	30	98	23	75	0.09	21	MCa, K
		Av=31.3						
4	0.6	35	142					
	1.5	34	153					
	1.8	24	94	20	74	0.05	20	K, MCa
	2.4	19	81					
	3.4	16	60					
		Av=25.6						

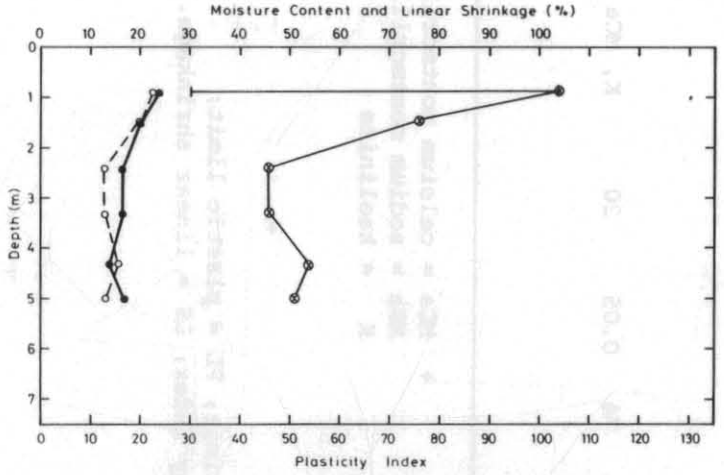
* Hole locations were:

Hole 1 - 53 Beach Road
2 - 51 Beach Road
3 - 49 Beach Road
4 - 47 Beach Road

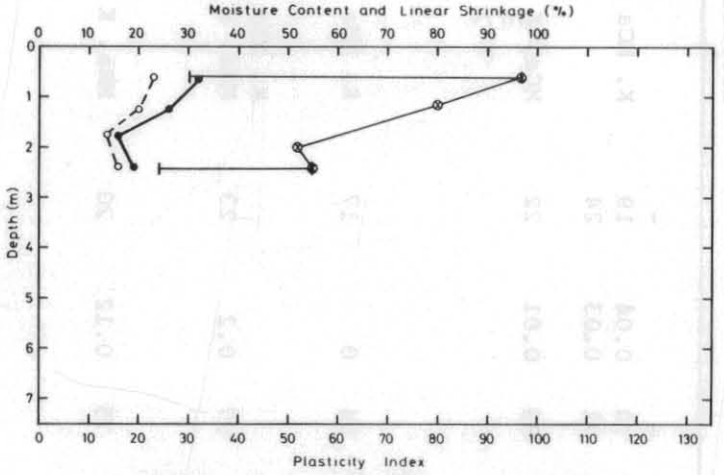
\+ MCa = calcium montmorillonite
MNa = sodium montmorillonite
K = kaolinite

MC = moisture content; LL - liquid limit; PL = plastic limit;
PI = plasticity index; LI = liquidity index; LS = linear shrinkage.

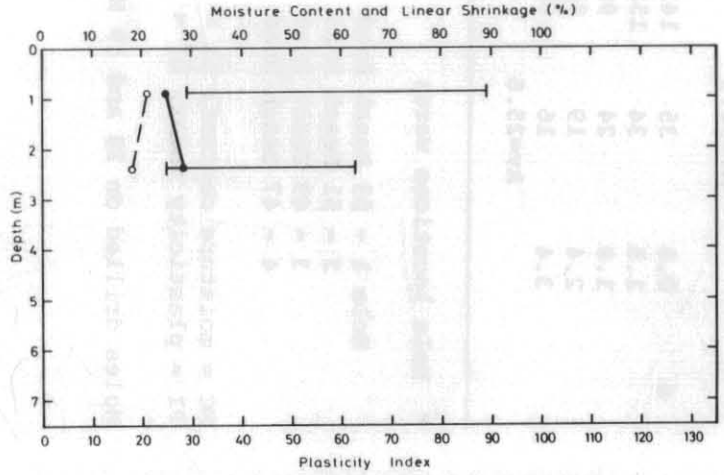
Holes drilled on 18 and 19 May 1982



HOLE 1 Downs, 11 Meredith Cres., Launceston



HOLE 3 Downs, 11 Meredith Cres., Launceston



HOLE 2 Downs, 11 Meredith Cres., Launceston

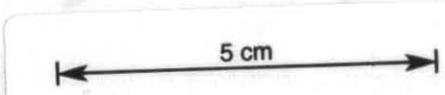


Figure 7. *Soil testing results of drill samples, 11 Meredith Crescent, Launceston (for legend see page 19)*

Table 3. SOIL TESTING RESULTS OF DRILL SAMPLES, 11 MEREDITH CRESCENT, LAUNCESTON

Hole*	Depth (m)	MC (%)	LL	PL	PI	LI	LS (%)	X-ray diffraction+
1	0.9	24	104	30	74	0	23	
	1.5	20	76	-	-		20	
	2.4	17	46	-	-		13)	K (weak)
							)	M (trace)
	3.3	17	46	-	-		13)	K (weak)
							)	M (weak)
	4.3	14	56	-	-		16)	K (weak)
							)	M (weak)
	5.0	17	51	-	-		13	
		Av=18.1						
2	0.9	25	89	29	60	0	21)	K (very weak)
							)	M (very weak)
	2.4	29	63	25	38		19)	K (moderate)
							)	M (very weak)
		Av=27.0						
3	0.6	32	97	30	67	0.03	23)	K (weak)
							)	M (very weak)
	1.2	27	80	-	-		20)	K (weak)
							)	M (weak)
	1.8	16	52	-	-		14	
	2.4	19	55	24	31		16)	K (weak)
							)	M (trace)
		Av=23.5						

* The hole locations and types of drill were:

Hole 1 - proline auger hole, front lawn
2 - hand auger hole, rear lawn
3 - hand auger hole, side of house

\+ K = kaolinite
M = montmorillonite

MC = moisture content; LL = liquid limit; PL = plastic limit; PI = plasticity index; LI = liquidity index; LS = linear shrinkage

Holes drilled on 16 and 17 February 1983

Table 4. SOIL TESTING RESULTS OF DRILL SAMPLES, 122 PENQUITE ROAD, LAUNCESTON

Hole*	Depth (m)	Moisture content (%)	Liquid limit	Plastic limit	Plasticity index	Linear shrinkage (%)	X-ray diffraction
1	1.7	28	79	24	55	19	Kaolinite>Montmorillonite>Quartz≅Gibbsite
	2.6	25	70	21	49	20	Kaolinite>Montmorillonite>Quartz≅Gibbsite
	3.5	31 Av = 28	72	28	44	17	

* Hole 1 drilled on rear lawn, south-west corner of house, on 2 March 1983.

Table 5. AVERAGE MOISTURE CONTENTS OF SAMPLES

Date drilled	Location	No. of holes drilled	Depth (m)	Average field moisture content (%)
2. 3.1982	122 Penquite Road	1	0-3.5	28
18-19. 5.1982	47-53 Beach Road, Legana	4	0-7.0	34
16-17. 2.1983	11 Meredith Crescent	3	0-5.0	23
16. 3.1983	Mowbray	5	0-6.1	26
19. 4.1983	Mowbray	3	0-6.1	29

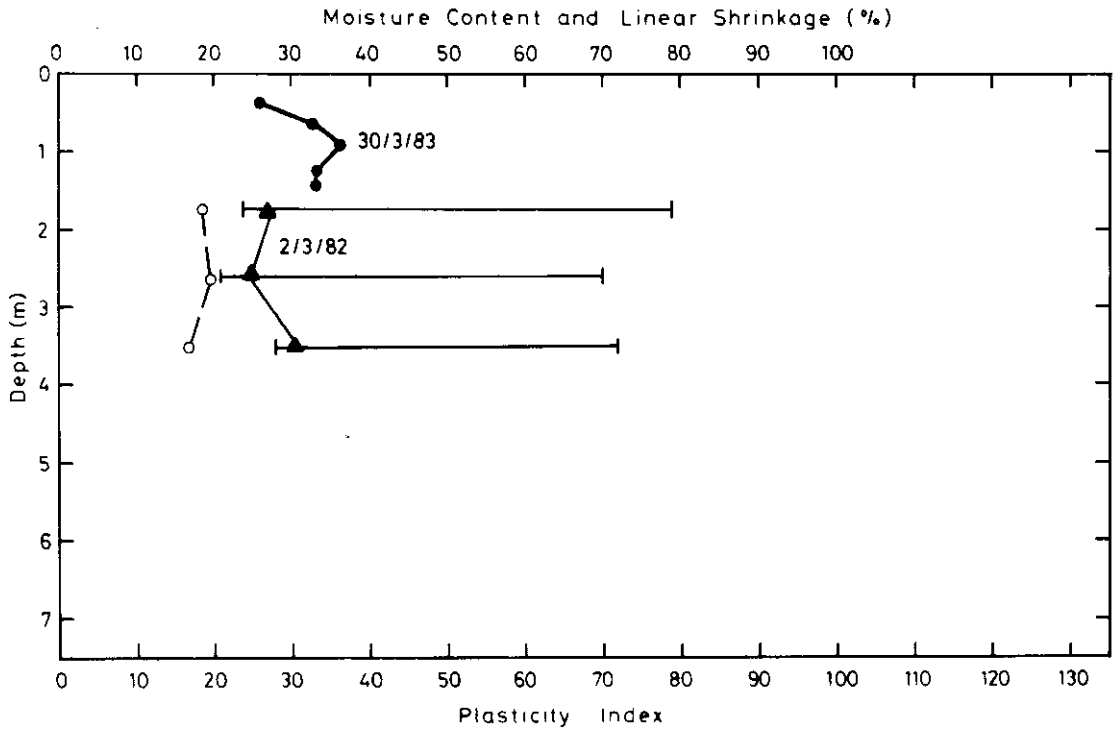
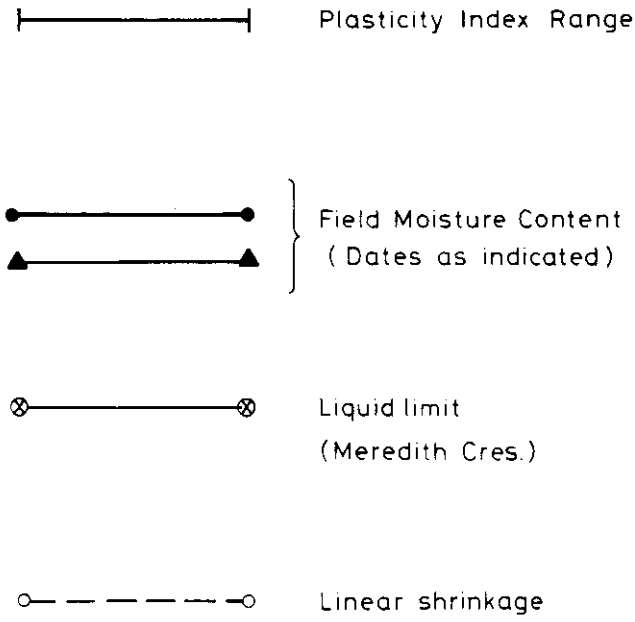
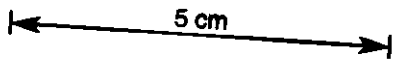


Figure 8. *Soil testing results of drill samples, 122 Penquite Road, Launceston*





Legend for Figures 5-8

APPENDIX 1

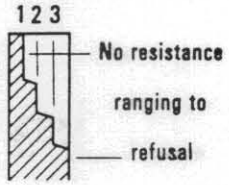
TASMANIA DEPARTMENT OF MINES

EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

5 cm

Penetration



Water

22 Jan, 80 Water level on date shown.

Water inflow.

Water outflow.

Notes - samples and tests

U50	Undisturbed sample. 50mm diameter.
D	Disturbed sample.
N	Standard penetrometer blow count for 300mm.
N*	SPT + sample.

Material classification

Based on Unified Soil Classification System.

In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

Moisture content

D	Dry, looks and feel dry.
M	Moist, no free water on hand when remoulding.
W	Wet, free water on hand when remoulding.
LL	Liquid limit.
PL	Plastic limit.
PI	Plasticity Index.

eg. M > PL – Moist, moisture content greater than the plastic limit.

Consistency

		hand penetrometer (kPa)
VS	Very soft.	< 25
S	Soft.	25 - 50
F	Firm.	50 - 100
St	Stiff.	100 - 200
VSt	Very stiff.	200 - 400
H	Hard.	> 400
Fb	Friable.	

Notes: X on log is test result

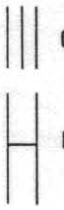
— is range of results.

Density index

		%
VL	Very loose.	0 - 15
L	Loose.	15 - 35
MD	Medium dense.	35 - 65
D	Dense.	65 - 85
VD	Very Dense	85 - 100

Cored borehole log

Case - lift



Casing used.

Barrel withdrawn.

Fluid loss

No loss

50% loss

100% loss.

Lugeons

Lugeon units (μL) are a measure of rock mass permeability. For a 46 to 74mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of 1×10^{-4} mm/sec.

Graphic log

No core.

Rock substances represented by clear, contrasting symbols consistent for each project.

Weathering

Fr	Fresh.
SW	Slightly weathered.
HW	Highly weathered.
EW	Extremely weathered.

Strength

		point load strength index $I_{s(50)}$ (MPa)
EL	Extremely low.	< 0·03
VL	Very low.	0·03 - 0·1
L	Low.	0·1 - 0·3
M	Medium.	0·3 - 1
H	High	1 - 3
VH	Very high.	3 - 10
EH	Extremely high.	> 10

Note: X on log is test result.

Significant defects

Significant defects shown graphically.

Joint.

Sheared zone.

Crushed seam.

Infill seam.

Extremely weathered seam.

21/28

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – BOREHOLE

borehole no. 1

sheet 1 of 1

project Cracked houses, Mowbray area location 24 Dobson Street, Mowbray

co-ordinates EQ118156
R.L. 22 m
inclination vertical
bearing

drill type Triefus
drill method Auger
drill fluid None

hole commenced 15 March 1983
hole completed 15 March 1983
drilled by B. Cox
logged by W.R.M.
checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
							OH	ORGANIC CLAY, dark grey, medium to high plasticity, roots and organic matter.	M			GARDEN TOPSOIL
	NONE	NONE	LL127 PL28 D		1		CH	CLAY, brown with white flecks, high plasticity, with nodules	D	H to Fb		CLAY SUBSOIL
			D		2		CH	CLAY, brown with white flecks, high plasticity with rounded quartzite pebbles up to 30 mm diameter		Fb		BROWN CLAY OF LAUNCESTON BEDS
			D		3			>10% pebbles, limonite and quartzite	M	St		
			D		4			with gravel >10% quartzite and angular dolerite, 10 to 20 mm diameter				
			D		5			rubbly appearance with brown mica, >20% gravel.		VSt		
			D		6			HOLE STOPPED AT REQUIRED DEPTH, 6.1 m				

22/28

TASMANIA DEPARTMENT OF MINES

5 cm

borehole no. 2

sheet 1 of 1

ENGINEERING LOG – BOREHOLE

project Cracked houses, Mowbray area location 18 Dobson Street

co-ordinates EQ118156 drill type Triefus hole commenced 16 March 1983

R.L. 20 m drill method Auger hole completed 16 March 1983

inclination vertical drill fluid None drilled by B. Cox

bearing logged by W.R.M.

checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
			D				OL	ORGANIC SILT with gravel, clay & roots. Silt dark grey with organic matter. Gravel has quartzite pebbles up to 40 mm.	D	F		CULTIVATED TOPSOIL
	NONE	NONE	D		1		CH	CLAY, dark brown with white flecks and mottled orange-red streaks. Some roots. Highly plastic.	M	V St	■	SUBSOIL
			D		2		CH	CLAY, orange, high plasticity. Uniform texture.	M	St	■	ORANGE CLAY OF LAUNCESTON BEDS
			D		3						■	
			LL79 PL25 D		4				D	V St.	■	
			D		5						■	
			LL78 PL26 D		6						■	
								HOLE STOPPED AT REQUIRED DEPTH, 6.1 m				

5 cm

TASMANIA DEPARTMENT OF MINES

ENGINEERING LOG – BOREHOLE

borehole no. 3

sheet 1 of 1

project Cracked houses, Mowbray area

location Junction of Conway and Dobson Streets

co-ordinates EQ118167

R.L. 10 m

inclination vertical

bearing

drill type Triefus

drill method Auger

drill fluid None

hole commenced 16 March 1983

hole completed 16 March 1983

drilled by B. Cox

logged by W.R.M.

checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
			D				OL OH	Organic SILT AND CLAY, dark grey - organic matter and roots.				TOPSOIL
	NONE	NONE	D		1		CH	CLAY with low % silt and ironstone nodules. Grey, highly plastic. Roots present.	D	H	■	CLAY SUBSOIL
			D		2			CLAY with ironstone nodules and white quartz and travertine grains. Mottled colour, dark brown, grey and red.			■	BROWN CLAY
			D		3			CLAY, brown with occasional pebbles.			■	
			D		4		CH	CLAY, orange with ironstone nodules.	M	St	■	MOTTLED GREY AND ORANGE CLAY
			D					Clay with fine sand <10%				
			D		5			Clay, orange-gray, mottled		F	■	
			LL81 PL21									
			D		6			Sand >10%			■	
								HOLE STOPPED AT REQUIRED DEPTH, 6.1 m				

24/28

TASMANIA DEPARTMENT OF MINES

5 cm

ENGINEERING LOG – BOREHOLE

borehole no. 4

sheet 1 of 1

project Cracked houses, Mowbray area — location Junction of Conway and Caswell Streets

co-ordinates EQ119156 — drill type Triefus — drill method Auger — hole commenced 16 March 1983 — hole completed 16 March 1983

R.L. 10 m — inclination vertical — bearing – — drill fluid None — drilled by B. Cox — logged by W.R.M. — checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
	NONE	NONE	D				OL	ORGANIC SILT, black with nodular clay. Poorly graded and friable.	D	Fb		TOPSOIL [PROBABLY INTRODUCED]
			D		1		CH	CLAY with minor sand, limonite nodules, bricks & gravel. Clay dark brown, high to medium plasticity. Gravel - small rounded quartz pebbles.	D	H	■	MIXTURE OF CLAY SUBSOIL & FILL
			LL120 PL29		2		CH	CLAY, brown-orange, high plasticity, limonite nodules.	M	V St	■	CLAY
			D									
			LL78		3			Clay, grey-brown		F	■	OF
			D									THE
					4					St	■	LAUNCESTON
			D									
			LL88 PL28							F	■	BEDS
			D		5							
							CH	Clay with minor sand. Clay orange. Sand fine, well-graded, <10% Correlates with 5.2-6.1 m BH3	M	S	■	
			D		6							
								HOLE REACHED REQUIRED DEPTH, 6.1 m				

25/28

TASMANIA DEPARTMENT OF MINES

5 cm

ENGINEERING LOG – BOREHOLE

borehole no. 5

sheet 1 of 1

project Cracked houses, Mowbray area location 12 Caswell Street

co-ordinates EQ119157
R.L. 18 m
inclination vertical
bearing –

drill type Triefus
drill method Auger
drill fluid None

hole commenced 16 March 1983
hole completed 16 March 1983
drilled by B. Cox
logged by W.R.M.
checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
			D					SILT, organic with gravel. Silt brown, friable. Organic content low. Gravel, quartz pebbles 10-30 mm.	D	Fb		TOPSOIL
	NONE	NONE	D		1		CH	CLAY, brown with plant roots.	D	H	■	CLAY
								Clay, pebbles and ironstone nodules.			■	SUBSOIL
			D									
					2			CLAY with gravel. Clay light brown. Gravel mainly small quartz pebbles, some large 30 mm+ pebbles and ironstone	D	Fb		GRAVEL BEDS & PEBBLES
			D									
					3		ML	SILTY CLAY. Clay yellow-brown. Silt estimated 30-40% visually				SILT HORIZON
			D									IN
								CLAY-SILT. Silt estimated 50% visually.				LAUNCESTON
			LL63 PL28		4		CH					BEDS
			D									
								CLAY with minor silt and limonite bands	D	Fb		CLAY
			D		5		CH	Clay brown with some grey. Silt <10%				WITH
			LL77 PL25					CLAY AND SILT. Silt >10%.	M			SILT
			D		6							
								DRILLED TO REQUIRED DEPTH 6.1 m.				

TASMANIA DEPARTMENT OF MINES

5 cm

ENGINEERING LOG – BOREHOLE

borehole no. 6

sheet 1 of 1

project Cracked houses, Mowbray area location 8 Caswell Street

co-ordinates EQ120157
R.L. 21 m
inclination vertical
bearing -

drill type Triefus
drill method Auger
drill fluid None

hole commenced 19 April 1983
hole completed 19 April 1983
drilled by B. Cox
logged by W.R.M.
checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
			LL127 PL29				CH	CLAY, orange with travertine white flecks and ironstone nodules.	M	V StF	■	TOPSOIL REMOVED FROM FOOTPATH
			D									
	NONE	NONE			1			CLAY with ironstone nodules, gravel & silt. Quartzite pebbles up to 20 mm.	D	H	■	SUBSOIL B HORIZON
			D									
			LL94 PL27		2			CLAY, grey with some red mottling. No pebbles. Uniform texture	M	V Stf	■	CLAY OF
			D									
							CH					LAUNCESTON
			LL95		3						■	
			D					Clay - dominantly orange				BEDS
					4							
			D					Clay - grey-red		StF		
			LL96 PL28							— V	■	
			D		5			Clay - orange		Stf		
			LL90 PL27							V Stf	■	
			D		6							
								DRILLED TO REQUIRED DEPTH, 6.1 m				

27/28

TASMANIA DEPARTMENT OF MINES

5 cm

borehole no. 7

sheet 1 of 1

ENGINEERING LOG – BOREHOLE

project Cracked houses, Mowbray area location 1 Caswell Street

co-ordinates EQ121157
R.L. 25 m
inclination vertical
bearing

drill type Triefus
drill method Auger
drill fluid None

hole commenced 19 April 1983
hole completed 19 April 1983
drilled by B. Cox
logged by W.R.M.
checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material: soil type: plasticity or particle characteristics, colour, secondary and minor components.	moisture condition	consistency density index	hand penetrometer kPa 25 50 100 200 400	structure, geology
	NONE	NONE	LL136 PL30 D				CH	CLAY with sand. Sand <10%. Clay orange with few ironstone nodules. Sand quartz, fine	D	V Stf		SURFACE CLAY
			LL114 D		1			CLAY, grey-orange mottled colour.		H		HORIZON
			D		2		CH	CLAY with pebbles. Clay grey-orange, mottled. Pebbles of quartzite up to 40 mm				PEBBLE HORIZON
			D		3			Pebbles more frequent, 5 mm-50 mm	M	H		
			D		4			Ironstone nodules and pebbles and travertine flecks.		VS		SOFT
			D		5			CLAY with fine gravel. Clay orange Gravel, small pebbles 1-5 mm, rounded		S		CLAY WITH
			LL67 PL27 D		6					V S		GRAVEL HORIZONS
								HOLE DRILLED TO REQUIRED DEPTH, 6.1 m				

28/28

TASMANIA DEPARTMENT OF MINES

5 cm

borehole no. 8

sheet 1 of 1

ENGINEERING LOG – BOREHOLE

project Cracked houses, Mowbray area location 25 Clare Street

co-ordinates EQ124154
R.L. 25 m
inclination vertical
bearing

drill type Triefus
drill method Auger
drill fluid None

hole commenced 20 April 1983
hole completed 20 April 1983
drilled by B. Cox
logged by W.R.M.
checked by A.T.M.

penetration 1 2 3	support	water	notes samples, tests	metres R.L.	metres depth	graphic log	classification symbol	material (soil type: plasticity or particle characteristics, colour, secondary and minor components.)	moisture condition	consistency density index	hand penetrometer kPa (25 50 100 200 400)	structure, geology
	NONE	NONE	LL126 D				CH	CLAY, dark brown, organic matter and roots. Few angular pebbles.		Fb		TOPSOIL
			LL121 PL29 D		1			Clay dark grey, orange streaks. Roots present.	D	V Stf		SUBSOIL B HORIZON
			LL72 PL24 D		2					V Stf — H		CLAY LAUNCESTON
			D		3		CH	CLAY AND GRAVEL Clay orange		Fb		BEDS WITH
			LL76 PL25 D		4		GC	Gravel small pebbles, quartz angular, 1-2 mm 30%-50%	M	V StF — H		GRAVEL HORIZONS
			D		5			Pebbles 1 mm-20 mm		V Stf		
								DRILL REFUSED - APPEARED TO BE IN GRAVEL AT 5.2 m				