DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIB 69/111

BLUE-GREY SILICEOUS LIMESTONE - LINWOOD QUARRY

Sections 197, 248, 249 Hd. Noarlunga, Co. Adelaide

(Quarry Industries Ltd.)

by

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PLANS

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Rept.Bk.No. 69/111
G.S. No. 4366
D.M. No. 394/66

17th November, 1969.

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- Quarry Industries Ltd. -

ABSTRACT

The sediments in the vicinity of Linwood Quarry are calcareous, and belong to the Sturtian and Marinoan Series of the Adelaide System. A buff-coloured limestone bed 20 to 40 ft. thick was used as a marker horizon. Blue-grey, siliceous limestone occurring immediately below it in the sequence is at present being quarried for crushed aggregate.

Drilling of 18 Rotary-Percussion drill holes, showed that quarry development should take place in a south-southwesterly direction along the strike into sections 248 and 249, where good quality stone and an acceptable depth of overburden have been proven.

INTRODUCTION

Linwood Quarry, operated by Quarry Industries Ltd., at present occupies an area within sections 196, 197, 215, 245, 246, 247, Hundred of Noarlunga. Crushed rock from this quarry constitutes an important source of road surfacing material, being used extensively by the Highways Department.

Under section 36 of the Planning and Development Act, 1966-67, the City of Marion recommended that the Extractive Industry Zone on Section 197 should be limited to the western portion of the Section, and that Section 249 should be zoned as Residential.

Two series of exploratory holes were drilled in these areas to determine the quality of the underlying rock, so as to provide a factual basis on which to consider the zoning proposals. The drilling was carried out under the author's supervision using a rotary-percussion machine provided by Quarry Industries Ltd. Details of the drilling are given in a later section, and the location of the holes is shown on the accompanying plan.

A geological reconnaissance of the area was carried out in conjunction with the drilling.

GEOLOGY

The rocks in the area are sediments belonging to the Marinoan and Sturtian Series of the Adelaide System, and can be divided into two main groups.

The area in the west of Section 215 and 247 is underlain by laminated purple siltstones and shales of the Marinoan Series.

To the east, the sequence consists predominantly of blue-grey, siliceous limestone belonging to the Sturtian Series.

A buff-coloured dolomitic limestone bed approximately 30 to 40 ft. thick separates the two groups of sediments, and has been used by Nixon (1957) and the present author as a marker horizon. The bed forms part of the Brighton Limestone, which was described by Sprigg (1942) as consisting of,

50 ft. (max). Buff dolomite passing below into greyish dolomitic limestones in some localities.

50 ft. (max). Pinkish oolitic, slightly dolomitic limestone.

Underlying this is a thick sequence of blue-grey siliceous limestones which become more siliceous and banded towards the base. The buff-coloured marker horizon is exposed in the quarry face 400 yards southwest of the weighbridge.

Because of consumer preference for blue-grey siliceous limestone, quarrying is restricted to the east of the marker horizon where it is the predominant rock type. The blue-grey siliceous limestone contains interbeds of two distinct rock types.

Brown calcareous or dolomitic siltstone occurs in interbeds varying in thickness from a few inches to more than 30 feet. Rocks of this type are generally quite hard and suitable for aggregate. Drilling in section 197, 248 and 249 has shown that these interbeds occur in increasing amounts eastwards towards Ocean Boulevard.

Within the blue-grey sequence there are occasional interbeds of soft, friable brown to orange siltstones which are unsuitable for aggregate.

Most of these interbeds are less than a foot thick, but some have been observed with thicknesses up to 30 feet. One of these is a prominent feature in the southern face of the present quarry. Several such interbeds were encountered in drilling, and more of this material is exposed in the old Brighton Cement quarry in Section 197.

Folding in the area is of a characteristic type which can be observed in several of the quarry faces. Easterly-dipping limbs of the folds are relatively short and have shallow dips, but the westerly-dipping limbs are much longer and have fairly steep dips, generally of the order of 60 to 70 degrees.

The overall picture is of a westerly-dipping sedimentary sequence striking 015 to 025 degrees with minor flexures which appear to have a gentle southerly pitch of approximately 5 degrees along the strike.

DRILLING

The purpose of the drilling was to establish the depth of overburden and the quality of stone beneath it. The results are illustrated in the plans accompanying this report, and detailed logs are included in the appendix.

Drilling was carried out using a Gardner-Denver rotary-percussion drill owned and operated by Quarry Industries Ltd. Eight holes totalling 630 feet were drilled in section 197 on the 18th and 19th August, 1969, and a further two holes, totalling 110 feet were drilled on 29th September, 1969. A series of eight holes totalling 530 feet was drilled on sections 248 and 249 between 29th September and 1st October, 1969.

The overburden throughout most of the area consists of a relatively thin layer of brown topsoil with minor amounts of calcrete, underlain by a varying thickness of soft, yellow, red and orange silt with occasional clayey patches and chips of weathered bedrock. The soft, weathered material usually passes relatively abruptly into fresh or only slightly weathered rock.

Probably the most important factor determining the depth of overburden is the nature of the underlying rock. The blue-grey siliceous limestone is more resistant to weathering than the other rock types and is quite commonly observed in outcrop (e.g. near the western part of the southern line of drill

holes). Although the soft, friable brown and orange siltstones only constitute a small volume of the total rock, it is thought that they play an important part in the development of overburden. Much of the rapid variation in overburden thickness over short distances may be attributed to the presence of interbeds of this material. The siltstones weather to a considerable depth, which contrasts strongly with the more resistant blue-grey siliceous limestone. Where the siltstone beds are steeply dipping they give rise to narrow bands of very deep weathering, but where the beds are folded and shallowly dipping near the surface, wider bands of fairly deep weathering will occur, especially where brecciation has taken place within the cores of folds.

While drilling was in progress, drilling times were recorded for each 5 ft. interval as a rough guide to the relative hardness of the various rock types. The hardest, and best quality material encountered was the blue-grey siliceous limestone. Although the interbeds of brown calcareous siltstone are generally slightly softer than the blue-grey rock, they are still quite hard enough for use as crushed aggregate. In fact, much of the material crushed at present comes from these brown interbeds and has been found quite satisfactory.

CONCLUSIONS AND RECOMMENDATIONS

In section 197, drilling disclosed overburden ranging from 10 to 51 feet in depth overlying a relatively unweathered sequence of interbedded blue-grey siliceous limestone and brown calcareous siltstone. However, interbedded within this are bands of deeply weathered siltstone. Most of the unweathered bedrock sequence would be suitable for aggregate.

In sections 248 and 249 the hard blue-grey siliceous limestone lies within a few feet of the surface in the zone corresponding to the southerly strike direction of the beds worked in the present quarry. Rock of high quality extends to the bottom of all holes drilled, and would extend indefinately below this.

To the east of the hole no. L.Q. 15 overburden depth increases to greater than 20 feet, with a considerable proportion of the bedrock sequence below consisting of rock too weathered for use.

The most suitable area for further quarry development is south-southwesterly along the strike of the beds at present being worked, where good quality stone and an acceptable depth of overburden have been proven.

Bands of soft, friable siltstone may be encountered, but Quarry Industries Ltd. have already shown their ability to cope with them.

Regional mapping has shown that the Reynella quarries operated by the same company lie in the same stratigraphic horizon, and high quality rock will extend from Linwood along strike to the Reynella area.

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AMP:JMM:JKD
17.11.1969

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APPENDIX

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 1

Section 197 Hundred of Noarlunga R.L. 464.3'

Date Drilled: 18.8.1969 Depth: 60'

Logged by: L.C. Barnes

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	1	0-5ft.	Brown massive calcrete in pale brown limey soil.
5 - 10ft.	2	5-10ft.	Brown limey soil with some grey, moderately hard, fissile siltstone near the base of the interval.
10 - 15ft.	3	10-15ft.	Massive, grey siliceous limestone with minor amounts of interbedded soft brown laminated siltstone.
15 - 20ft.	2	15-20ft.	Massive blue-grey siliceous limestone interbedded with laminated, grey-brown, weathered, moist shaley siltstone.
20 - 25ft.	10	20-21ft.	Laminated, grey-brown, weathered, moist shaley siltstone.
		21-25ft.	Hard, grey siliceous limestone.
25 - 30ft.	7	25-30ft.	Hard, grey siliceous limestone.
30 - 35ft.	10	30-32ft.	Massive, hard, blue-grey siliceous limestone.
		32-33ft.	Soft, orange-brown weathered siltstone.
		33-35ft.	Massive, hard, blue-grey siliceous limestone.
35 - 40ft.	8	35-40ft.	Massive, hard, blue-grey siliceous limestone, with minor interbeds of soft, orange-brown weathered siltstone.
40 - 45ft.	10	40-45ft.	Hard, blue-grey siliceous limestone with thin interbeds of weathered siltstone and minor brown dolomitic limestone near the base of the interval.
45 - 50ft.	5	45-47ft.	Hard, blue-grey siliceous limestone.
		47-50ft.	Dark grey-brown soft weathered laminated siltstone.
50 - 55ft.	10	50-52ft.	Soft orange and grey siltstones.
		52-55ft.	Massive, blue-grey siliceous limestone and laminated siltstone.
55 - 60ft.	10	55-60ft.	Blue-grey siliceous limestone with minor silty interbeds.

DEPTH OF OVERBURDEN = 10'

Rotary Percussion Drilling
Kinwood Quarry

Hole No. L.Q.2

Section 197 Hundred of Noarlunga R.L. 448.2'

Date Drilled: 18.8.1969 Depth: 60'

Logged by: L.C. Barnes

Sample Interval	Drilling Time (Minutes)		Log
0 - 10ft.	3	0-10ft.	Brown soil overlying red-brown and grey-green mottled moist plastic clay.
10 - 15ft.	3	10-15ft.	Red clay, mottled in part with some soft brown siltstone.
15 - 20ft.	4	15-20ft.	Bright red, fine silt with some clay band and minor amounts of highly weathered buff siltstone.
20 - 25ft.	5	20-25ft.	Fine red silt with some mottled red-brown and grey-green clay. Minor amounts of weathered, buff siltstone.
25 - 30ft.	5	25-29ft. 29-30ft.	Red silt and brown to grey clays. Massive blue-grey siliceous dolomitic siltstone.
30 - 35ft.	8	30-33ft. 33-35ft.	Massive blue-grey siliceous dolomitic siltstone. Soft, weathered, grey siltstone and red silt and clay.
35 - 40ft.	6	35-38'6" 38'6"-40ft.	Soft, brown weathered siltstones. Blue-grey siliceous limestone.
40 - 45ft.	5	40-42ft. 42-45ft.	Hard, massive blue-grey siliceous dolostone. Soft clayey grey-brown and red siltstone.
45 - 50ft.	2	45-50ft.	Soft, orange-yellow and dark grey weathered, laminated siltstone.
50 - 55ft.	5	50-52ft. 52-55ft.	Weathered clays and silts. Yellow to chocolate clay and silt.
55-60ft.	3	55-60ft.	No Sample.

DEPTH OF OVERBURDEN = 29feet.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 3

Section: 197 Hundred of Noarlunga R.L.: 438.2'

Date Drilled: 18.8.1969 Depth: 60'

Logged By: L.C. Barnes

Sample Interval	Drilling Time (Minutes)	Log
0 - 10ft.	6	0-10ft. Moist, plastic white and red mottled clay. Minor brown siltstone near bottom of interval.
10 - 15ft.	5	10-15ft. Alternating bands of red-brown clayey silt and fine, white limey silt.
15 - 20ft.	3	15-20ft. Red-brown, fine, calcareous silt with some white limey silt.
20 - 25ft.	3	20-25ft. Very fine light brown calcareous silt with occasional fragments of light grey clay.
25 - 30ft.	4	25-30ft. Very fine, light reddish-brown silt with occasional soft white lumps of fine calcareous silt.
30 - 35ft.	7	30-32ft. Very fine, light reddish-brown silt as above. 32-35ft. Fairly hard, massive chocolate-brown dolomitic siltstone with some laminated orange-grey clayey silt.
35 - 40ft.	6	35-40ft. Chocolate-brown dolomitic siltstone with small amounts of weathered siltstone.
40 - 45ft.	6	40-45ft. Chocolate dolomitic siltstone with abundant interbeds of soft, weathered grey and red clayey siltstone.
45 - 50ft.	6	45-50ft. Chocolate dolomitic siltstone. Soft, weathered grey and red clayey siltstone interbeds decrease in abundance with depth.
50 - 55ft.	6	50-55ft. Chocolate dolomitic siltstone.
55 - 60ft.	6	55-60ft. Light brown to grey dolomitic siltstone with minor thin calcite veins.

DEPTH OF OVERBURDEN = 32feet.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 4

Section: 197 Hundred of Noarlunga R.L.: 426.5'

Date Drilled: 18.8.1969 Depth: 80'

Logged By: A.M. Pain

Sample Interval	Drilling Time (Minutes)		Log
0 - 10ft.	5	0-10ft.	Grey and brown moist clay and clayey silt overlying fine, white and red-brown limey, slightly clayey silt.
10 - 15ft.	5	10-13ft.	Red-brown clayey silt with bands of fine white silt.
		13-15ft.	Moist, plastic grey-brown clay with white silty clay pellets.
15 - 20ft.	4	15-16ft.	Moist plastic grey-brown clay with white silty clay pellets.
		16-20ft.	Fine, orange-brown silt.
20 - 25ft.	5	20-25ft.	Fine orange-brown silt with minor red and white clay pellets.
25 - 30ft.	5	25-29ft.	Fine orange-brown silt with minor red and white clay pellets.
		29-30ft.	Chocolate-brown calcareous siltstone.
30-35ft.	8	30-35ft.	Grey and brown variegated massive calcareous siltstones with minor calcite veinlets. Occasional thin interbeds of soft red-brown clayey silt.
35 - 40ft.	7	35-40ft.	Grey dolomitic siltstone with minor calcite veinlets and occasional thin interbeds of soft red-brown clayey silt.
40 - 45ft.	9	40-45ft.	Interbedded grey siliceous limestone and fairly soft brown dolomitic siltstones. Minor light brown clay.
45 - 50ft.	5	45-50ft.	Predominantly brown dolomitic siltstone with minor interbeds of blue-grey siliceous limestone.
50 - 55ft.	5	50-55ft.	Brown dolomitic siltstones with minor calcite veinlets.
55 - 60ft.	5	55-60ft.	Brown dolomitic siltstones with minor calcite veinlets.
60 - 65ft.	7	60-65ft.	Brown dolomitic siltstones with minor calcite veinlets.
65 - 70ft.	8	65-70ft.	Brown dolomitic siltstones with minor interbeds of grey siliceous limestone. Some soft, fine reddish-brown clayey silt and fine white calcareous clay.
70 - 75ft.	10	70-75ft.	Brown and grey calcareous siltstones with minor amounts of soft, fine reddish-brown clayey silt and fine, white calcareous clay.

Hole No. L.Q. 4 contd.

Sample Interval	Drilling Time (Minutes)		Log
75 - 80ft.	5	75-80ft.	Brown calcareous siltstone showing some fissility. Minor amounts of soft, fine reddish-brown clayey silt.
			DEPTH OF OVERBURDEN = 29feet.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 5

Section: 197 Hundred of Noarlunga R.L.: 424.6'

Date Drilled: 19.8.1969 Depth: 70'

Logged By: A.N.Pain

Sample Interval	Drilling Time (Minutes)		Log
0 - 10ft.	5	0-8ft.	Reddish-brown clayey soil with some red mottled clay.
		8-10ft.	Fine, soft, white calcareous silt.
10 - 15ft.	3	10-11ft.	Fine, soft white calcareous silt.
		11-15ft.	Fine, orange-red silt with some red clay and minor fragments of weathered siltstone.
15 - 20ft.	5	15-17ft.	Fine orange-red silt, as above.
		17-20ft.	Brown calcareous siltstone with minor quartz and calcite chips.
20 - 25ft.	6	20-25ft.	Brown calcareous siltstone with minor calcite veinlets and minor amounts of softer, light brown siltstone.
25 - 30ft.	6	25-30ft.	Brown calcareous siltstone showing slight fissility, with grey laminations in parts.
30 - 35ft.	5	30-35ft.	Brown calcareous siltstone with minor clay.
35 - 40ft.	6	35-40ft.	Brown calcareous siltstone with occasional thin bands of lighter brown, more friable siltstone.
40 - 45ft.	6	40-45ft.	Brown calcareous siltstone.
45 - 50ft.	6	45 -50ft.	Grey-brown calcareous siltstone with slight fissility minor calcite veinlets
50 - 55ft.	6	50-55ft.	Greyish-brown calcareous siltstone, as above.
55 - 60ft.	4	55-60ft.	Greyish-brown calcareous siltstone with minor intercalations of soft, white weathered calcareous siltstone.
60 - 65ft.	5	60-65ft.	Greyish-brown calcareous siltstone.
65 - 70ft.	5	65-70ft.	Greyish-brown calcareous siltstone.

DEPTH OF OVERBURDEN = 17 feet

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 6

Section 197 Hundred of Noarlunga R.L.: 425.2'

Date Drilled: 19.8.1969 Depth.: 100'

Logged by: A.N. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 10ft.	5	0-10ft.	Light brown to light grey silty clay with abundant calcrete from 0 to 4 feet.
10 - 15ft.	4	10-15ft.	Orange-brown silty loam with occasional patches of reddish-brown clay.
15 - 20ft.	3	15-20ft.	Very fine, light orange-brown silt with occasional fragments of soft, brown weathered siltstone.
20 - 25ft.	4	20-25ft.	Light brown silty clay with fragments of grey to brown dolomitic siltstone between 21 and 23 feet.
25 - 30ft.	4	25-30ft.	Light brown silty clay with minor fragments of brown and grey siliceous limestones.
30 - 35ft.	3	30-35ft.	Light brown silty clay with minor fragments of brown and grey siliceous limestones.
35 - 40ft.	4	35-40ft.	Brown to light grey calcareous siltstones, laminated in parts. Minor red clay bands.
40 - 45ft.	4	40-45ft.	Brown calcareous siltstones with minor red-brown clay bands.
45 - 50ft.	4	45-50ft.	Brown calcareous siltstones.
50 - 55ft.	7	50-55ft.	Blue-grey siliceous limestone with some thin interbeds of brown to light grey calcareous siltstone. Minor calcite veinlets.
55 - 60ft.	6	55-60ft.	Blue-grey siliceous limestone with minor thin interbeds of brown calcareous siltstone
60 - 65ft.	6	60-65ft.	Light brown calcareous siltstone with occasional blue-grey interbeds.
65 - 70ft.	7	65-69ft.	Blue-grey siliceous limestone with minor brownish interbeds.
		69-70ft.	Reddish-brown silty clay.
70 - 75ft.	3	70-72ft.	Reddish-brown silty clay.
		72-75ft.	Brown to light grey calcareous siltstone with some blue-grey siliceous limestone intercalations.
75 - 80ft.	4	75-79ft.	Brown calcareous siltstone with minor blue-grey siliceous limestone intercalations.
		79-80ft.	Soft, friable, slightly clayey siltstone.

Hole No. L.Q. 6 contd.

Sample Interval	Drilling Time (Minutes)	Log	
80 - 85ft.	4	80-85ft.	Brown calcareous siltstone with occasional blue-grey siliceous limestone and soft friable siltstone interbeds.
85 - 90ft.	4	85-90ft.	Interbedded blue-grey siliceous limestones and brown calcareous siltstone with occasional light grey bands and minor calcite veinlets.
90 - 95ft.	6	90-95ft.	Interbedded blue-grey siliceous limestones and brown calcareous siltstone.
95 - 100ft.	5	95-100ft.	Predominantly blue-grey and light grey siliceous limestones with minor brown calcareous siltstone interbeds.

DEPTH OF OVERBURDEN = 35 feet

Rotary Percussion Drilling
Linwood Quarry

Hole No. L.Q.7

Section: 197 Hundred of Noarlunga R.L.: 415.7'

Date Drilled: 19.8.1969 Depth: 100'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	3	0-5ft.	Reddish-brown plastic clay with occasional fragments of weathered, laminated red siltstone.
5 - 10ft.	2½	5-10ft.	Fine, soft orange-brown silt with occasional patches of red-brown clay.
10 - 15ft.	2	10-15ft.	Fine, soft orange-brown silt with occasional chips of weathered siltstone.
15 - 20ft.	2	15-20ft.	Fine, soft orange-brown silt.
20 - 25ft.	3	20-25ft.	Fine, soft orange-brown silt with minor fragments of soft, friable siltstone.
25 - 30ft.	2	25-30ft.	Fine, soft orange-brown silt with minor fragments of soft, friable siltstone.
30 - 35ft.	3	30-35ft.	Fine, soft orange-brown silt with minor fragments of soft, friable siltstone.
35 - 40ft.	3	35-40ft.	Brick red, soft clayey silt with some small orange clay patches.
40 - 45ft.	2	40-45ft.	Brick red, soft clayey silt with some small orange clay patches.
45 - 50ft.	3	45-50ft.	Brick red, soft clayey silt with some small orange clay patches.
50 - 55ft.	6	50-51ft.	Brick red, soft clayey silt with some small orange clay patches.
		51-55ft.	Interbedded blue-grey siliceous limestone and chocolate-brown calcareous siltstones.
55 - 60ft.	5	55-60ft.	Blue-grey siliceous limestone.
60 - 65ft.	6½	60-65ft.	Blue-grey siliceous limestone.
65 - 70ft.	5	65-70ft.	Blue-grey siliceous limestone with minor chocolate-brown calcareous siltstone interbeds.
70 - 75ft.	6	70-75ft.	Chocolate-brown calcareous siltstone with some blue-grey to light grey siliceous limestone interbeds.
75 - 80ft.	3½	75-80ft.	Chocolate-brown calcareous siltstones with some blue-grey to light grey siliceous limestone interbeds.

Hole No. L.Q. 7 contd.

Sample Interval	Drilling Time (Minutes)		Log
80 - 85ft.	3	80-85ft.	Chocolate-brown calcareous siltstone with some blue-grey to light grey siliceous limestone interbeds.
85 - 90ft.	3½	85-90ft.	Brown to light grey calcareous siltstone.
90 - 95ft.	4	90-95ft.	Brown calcareous siltstone.
95 - 100ft.	4	95-100ft.	Brown calcareous siltstone with minor blue-grey interbeds.

DEPTH OF OVERBURDEN = 51 feet

Rotary Percussion Drilling
Linwood Quarry

Hole No. L.Q.8

Section: 197 Hundred of Noarlunga R.L.: 401.0

Date Drilled: 19.8.69 Depth: 100'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	3	0-5ft.	Brown silty clay with occasional brown and grey clay bands. Boulder of blue-grey siliceous limestone between 2 and 3 feet.
5 - 10ft.	2	5-10ft.	Fine, soft orange-brown silt with minor red silty clay.
10 - 15ft.	2	10-15ft.	Fine, soft orange-brown silt.
15 - 20ft.	2	15-20ft.	Fine, soft orange-brown silt.
20 - 25ft.	2	20-25ft.	Fine, soft orange-brown silt with occasional fragments of weathered siltstone.
25 - 30ft.	3	25-30ft.	Fine, soft reddish-brown clayey silt with occasional fragments of weathered siltstone.
30 - 35ft.	3½	30-32ft. 32-35ft.	Fine, soft reddish-brown clayey silt. Blue-grey siliceous limestone with some brown calcareous siltstone beds and rare thin brown clay bands.
35 - 40ft.	4	35-40ft.	Blue-grey siliceous limestone with some brown calcareous siltstone interbeds.
40 - 45ft.	5	40-45ft.	Chocolate-brown calcareous siltstone with minor bands of blue-grey siliceous limestone.
45 - 50ft.	5	45-47ft. 47-50ft.	Chocolate-brown calcareous siltstones. Soft, friable, siltstones.
50 - 55ft.	5	50-55ft.	Brown calcareous siltstones with interbeds of blue-grey siliceous limestone.
55 - 60ft.	3	55-57ft. 57-59ft. 59-60ft.	Brown calcareous siltstone. Soft, friable siltstone. Blue-grey siliceous limestone.
60 - 65ft.	4	60-65ft.	Chocolate-brown calcareous siltstone with minor blue-grey siliceous limestone interbeds with minor amounts of soft, friable brown siltstone.
65 - 70ft.	3	65-68ft. 68-69ft. 69-70ft.	Chocolate-brown calcareous siltstone with minor calcite veinlets. Soft, friable brown siltstone. Chocolate-brown calcareous siltstone.

Hole No. L.Q. 8 contd.

Sample Interval	Drilling Time (Minutes)		Log
70 - 75ft.	5	70-73ft.	Chocolate-brown calcareous siltstone.
		73-73'6"	Soft, friable red-brown siltstone.
		73'6"-75ft.	Chocolate-brown calcareous siltstone with minor intercalations of blue-grey siliceous limestone.
75 - 80ft.	4	75-77ft.	Brown calcareous siltstones with minor intercalations of blue-grey siliceous limestone.
		77-80ft.	Brown calcareous siltstone.
80 - 85ft.	5	80-84ft.	Blue-grey siliceous limestone.
		84-85ft.	Brown calcareous siltstone with minor clayey interbeds.
85 - 90ft.	4	85-87ft.	Brown calcareous siltstone.
		87-88ft.	Blue-grey siliceous limestone.
		88-90ft.	Brown calcareous siltstone with minor blue-grey intercalations.
90 - 95ft.	4½	90-95ft.	Brown calcareous siltstone with minor blue-grey intercalations and minor interbeds of friable brown siltstone.
95 - 100ft.	5	95-97ft.	Blue-grey siliceous limestone.
		97-100ft.	Brown calcareous siltstone with minor blue-grey intercalations.

DEPTH OF OVERBURDEN = 32 feet.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q. 9

Section: 197 Hundred of Noarlunga R.L.: 456' approx.

Date Drilled: 29.9.1969 Depth: 70'

Logged By: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	3	0-5ft.	Red-brown silty loam with minor calcrete in upper 2 feet. Occasional chips of blue-grey siliceous limestone.
5 - 10ft.	3	5-10ft.	Red-brown silty loam; moist, slightly plastic.
10 - 15ft.	3	10-12ft. 12-15ft.	Red-brown loam. Red-brown to light orange very fine silt with minor amounts of weathered brown siltstone.
15 - 20ft.	3	15-20ft.	Red-brown silt with some fine orange silt and minor chips of blue-grey siliceous limestone. Slightly clayey in parts.
20 - 25ft.	2	20-25ft.	Red-brown and orange fine silt. Rare weathered siltstone chips.
25 - 30ft.	3	25-30ft.	Red-brown and orange fine silt. Rare weathered siltstone chips.
30 - 35ft.	3	30-35ft.	Red-brown fine silt with occasional chips of weathered siltstone and blue-grey to grey siliceous limestone.
35 - 40ft.	4	35-37ft. 37-40ft.	Red-brown fine silt. Interbedded chocolate-brown calcareous siltstone and blue-grey to light grey siliceous limestone.
40 - 45ft.	5	40-45ft.	Interbedded chocolate-brown calcareous siltstone and blue-grey to light grey siliceous limestone.
45 - 50ft.	3	45-50ft.	Predominantly chocolate-brown calcareous siltstone with some blue-grey to light grey siliceous limestone.
50 - 55ft.	6	50-55ft.	Interbedded chocolate-brown calcareous siltstone and blue-grey to light grey siliceous limestone.
55 - 60ft.	3	55-60ft.	Predominantly chocolate-brown calcareous siltstone with some blue-grey to light grey siliceous limestone.
60 - 65ft.	4	60-65ft.	Massive blue-grey siliceous limestone with interbeds of chocolate-brown calcareous siltstone near top of interval.

Hole No. L.Q. 9 contd.

Sample Interval	Drilling Time (Minutes)		Log
65 - 70ft.	4	65-70ft.	Blue-grey siliceous limestone with increasing amounts of chocolate-brown calcareous siltstone towards the base of the interval.

DEPTH OF OVERBURDEN = 37ft.

Hole No. L.Q.10

Rotary Percussion Drilling
Kinwood Quarry

Section 197 Hundred of Noarlunga R.L.: 444'

Date Drilled: 29.9.1969 Depth: 40'

Logged By: A.M. Pain

Sample Interval	Drilling Time (Minutes)		Log
0 - 5ft.	2	0-5ft.	Moist red-brown slightly plastic silty loam with occasional chips of laminated chocolate-brown siltstone.
5 - 10ft.	2	5-10ft.	Moist, red-brown slightly plastic clayey loam with light grey clay pellets and occasional brown laminated siltstone fragments.
10 - 15ft.	2	10-12ft.	Moist red-brown slightly plastic clayey loam.
		12-15ft.	Fine mustard-orange silt with occasional weathered orange siltstone fragments.
15 - 20ft.	2	15-19ft.	Fine mustard-orange silt with occasional weathered orange siltstone fragments.
		19-20ft.	Massive blue-grey and brown siliceous limestone.
20 - 25ft.	5	20-24ft.	Predominantly chocolate-brown calcareous siltstones with minor light to medium grey siliceous limestone intercalations. Occasional thin interbeds of soft friable siltstone.
		24-25ft.	Soft, friable chocolate-brown to orange siltstone.
25 - 30ft.	5	25-26ft.	Soft, friable chocolate-brown to orange siltstone.
		26-30ft.	Interbedded blue-grey siliceous limestone and chocolate to medium brown calcareous siltstones.
30 - 35ft.	3½	30-35ft.	Medium-brown to chocolate-brown calcareous siltstones with minor amounts of grey siliceous limestone and light brown friable siltstone.
35 - 40ft.	3	35-40ft.	Medium brown to medium grey calcareous siltstone showing slight fissility in parts.

DEPTH OF OVERBURDEN = 19ft.

Rotary Percussion Drilling
Linwood Quarry

Hole No. L.Q.11

Section 249 Hundred of Noarlunga R.L.: 425.5'

Date Drilled: 29.9.69 Depth: 100'

Logged By: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	1	0-5ft.	Fine yellow-orange silt with minor fragments of soft, weathered, friable yellow-orange siltstone.
5 - 10ft.	2	5-10ft.	Red-brown silty clay with minor fragments of brown calcareous siltstone.
10 - 15ft.	2	10-15ft.	Red-brown silty clay with minor fragments of brown calcareous siltstone.
15 - 20ft.	2	15-20ft.	Red-brown silty clay with minor fragments of brown calcareous siltstone.
20 - 25ft.	2	20-25ft.	Fine, red-brown slightly clayey silt with minor fragments of hard, blue-grey siliceous limestone.
25 - 30ft.	2	25-30ft.	Fine red-brown slightly clayey silt with minor fragments of hard, blue-grey siliceous limestone.
30 - 35ft.	2	30-35ft.	Fine, red-brown slightly clayey silt with minor fragments of hard, blue-grey siliceous limestone.
35 - 40ft.	5	35-37ft. 37-40ft.	Fine red-brown slightly clayey silt. Hard, massive blue-grey siliceous limestone with a few interbeds of fairly hard chocolate-brown calcareous siltstone.
40 - 45ft.	6	40-45ft.	Hard, massive blue-grey siliceous limestone with occasional interbeds of fairly hard chocolate-brown calcareous siltstone.
45 - 50ft.	5½	45-50ft.	Hard, massive blue-grey siliceous limestone.
50 - 55ft.	5	50-55ft.	Interbedded blue-grey siliceous limestone and brown dolomitic siltstone.
55 - 60ft.	5½	55-57ft. 57-60ft.	Hard, massive blue-grey siliceous limestone. Moderately hard chocolate-brown calcareous siltstone.
60 - 65ft.	3½	60-63ft. 63-65ft.	Chocolate-brown to red calcareous siltstones with thin interbeds of soft, friable siltstone. Hard, massive blue-grey siliceous limestone.

Hole No. L.Q. 11 contd.

Sample Interval	Drilling Time (Minutes)		Log
65 - 70ft.	5½	65-70ft.	Hard, massive blue-grey siliceous limestone with minor light grey bands and occasional brown calcareous siltstone interbeds.
70 - 75ft.	4	70-72ft.	Massive, blue-grey siliceous limestone.
		72-74ft.	Brown calcareous siltstone.
		74-75ft.	Hard, massive blue-grey siliceous limestone.
75-80ft.	6½	75-80ft.	Hard, massive blue-grey siliceous limestone.
80 - 85ft.	5	80-82ft.	Hard, massive blue-grey siliceous limestone.
		82-83'6"	Chocolate-brown to medium-brown calcareous siltstones with minor soft friable silty interbeds.
		83'6"-85ft.	Hard, massive blue-grey siliceous limestone with minor calcite chips.
85 - 90ft.	4¼	85-88ft.	Blue-grey to medium grey siliceous limestone.
		88-90ft.	Blue-grey to medium grey siliceous limestone with thin interbeds of brown calcareous siltstone.
90 - 95ft.	5	90-91ft.	Hard, massive blue-grey siliceous limestone with minor interbeds of fairly hard brown calcareous siltstones.
		91-95ft.	Hard, massive blue-grey siliceous limestone.
95 - 100ft.	7	95-100ft.	Hard, massive blue-grey siliceous limestone.

DEPTH OF OVERBURDEN = 37ft.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.12

Section: 249 Hundred of Noarlunga R.L.: 468.5'

Date Drilled: 30.9.1969 Depth: 70'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	1	0-1ft. 1-5ft.	Grey-brown soil with plant roots. Very fine mustard-yellow silt.
5 - 10ft.	2	5-10ft.	Fine mustard-yellow silt with occasional thin bands of light grey slightly clayey silt.
10 - 15ft.	1½	10-15ft.	Fine orange silt with occasional thin bands of light grey slightly clayey silt. Occasional chips of soft, friable weathered orange siltstone.
15 - 20ft.	2	15-20ft.	Fine orange silt with occasional chips of friable weathered siltstone.
20 - 25ft.	2	20-25ft.	Fine orange silt with occasional chips of friable weathered siltstone.
25 - 30ft.	2	25-30ft.	Fine reddish-orange silt with occasional yellow-orange patches.
30 - 35ft.	4	30-32ft. 32-35ft.	Fine reddish-orange silt. Hard, massive, blue-grey siliceous limestone.
35 - 40ft.	5½	35-40ft.	Massive, hard, blue-grey siliceous limestone.
40 - 45ft.	6½	40-45ft.	Hard, massive blue-grey siliceous limestone with occasional light grey interbeds.
45 - 50ft.	6	45-50ft.	Hard, massive blue-grey siliceous limestone with occasional light grey interbeds.
50 - 55ft.	5½	50-55ft.	Hard, massive blue-grey siliceous limestone with occasional light grey interbeds.
55 - 60ft.	6	55-60ft.	Hard, massive blue-grey siliceous limestone.
60 - 65ft.	6	60-65ft.	Hard, massive blue-grey siliceous limestone.
65 - 70ft.	6	65-70ft.	Hard, massive blue-grey siliceous limestone.

DEPTH OF OVERBURDEN = 32 feet

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.15

Section 249 Hundred of Noarlunga R.L.: 494.5'

Date Drilled: 30.9.69 Depth: 60'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)		Log
0 - 5ft.	3	0-6in.	Brown soil with plan roots.
		6"-3'6"	Hard, massive blue-grey siliceous limestone.
		3'6"-5ft.	Fine, soft orange silt.
5 - 10ft.	3½	5-8ft.	Fine, soft orange silt.
		8-10ft.	Hard, massive blue-grey siliceous limestone.
10 - 15ft.	4	10-10'6"	Hard, massive blue-grey siliceous limestone.
		10'6"-12ft.	Massive, blue-grey siliceous limestone with patches of fine orange silt.
		12-15ft.	Hard, massive blue-grey siliceous limestone with some lighter grey patches and minor intercalations of brownish-grey laminated calcareous silts.
15 - 20ft.	5	15-19'6in.	Hard, massive, blue-grey siliceous limestone
		19'6"-20ft.	Fine, red-brown soft silt.
20 - 25ft.	4	20-22ft.	Fine red-brown and light grey soft silt.
		22-25ft.	Hard, massive blue-grey siliceous limestone.
25 - 30ft.	5½	25-30ft.	Hard, massive blue-grey siliceous limestone with minor amounts of light grey siliceous limestone and rare brownish-grey intercalations.
30 - 35ft.	5½	30-35ft.	Hard, massive blue-grey to medium grey siliceous limestone.
35 - 40ft.	5½	35-39ft.	Hard, massive blue-grey siliceous limestone.
		39-40ft.	Soft, fine friable orange-yellow silts.
40 - 45ft.	4	40-42ft.	Soft, fine friable orange-yellow silts.
		42-43'6in.	Moderately hard chocolate-brown calcareous siltstones.
		43'6-45ft.	Hard, massive blue-grey siliceous limestone.
45 - 50ft.	6	45-50ft.	Hard blue-grey to medium grey siliceous limestone with minor intercalations of softer, brown calcareous siltstones from 49-50ft.
50 - 55ft.	5½	50-55ft.	Hard, blue-grey to medium grey siliceous limestone with minor intercalations of softer, brown calcareous siltstones from 50-51ft.
55 - 60ft.	5	55-60ft.	Hard, massive blue-grey siliceous limestone.

DEPTH OF OVERBURDEN = 6 inches

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.14

Section: 249 Hundred of Noarlunga R.L.: 513.5'

Date Drilled: 30.9.69 Depth: 60'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	3	0-1ft.	Brown soil with plant roots and minor calcrete.
		1-5ft.	Hard, blue-grey to medium grey siliceous limestone.
5 - 10ft.	4	5-10ft.	Hard, blue-grey to medium grey siliceous limestone.
10 - 15ft.	4	0'13'6in.	Hard, blue-grey to medium grey siliceous limestone.
		13'6"-14ft.	Soft, friable brown siltstone.
		14-15ft.	Hard, blue-grey to medium grey and light grey siliceous limestone with minor brown calcareous siltstone interbeds.
15 - 20ft.	4	15-20ft.	Hard blue-grey to medium grey and light grey siliceous limestone with minor brownish-grey laminated intercalations from 18 to 19ft.
20 - 25ft.	5	20-25ft.	Hard blue-grey to medium grey siliceous limestone with minor brownish grey intercalations in parts.
25 - 30ft.	6	25-30ft.	Hard blue-grey to medium grey siliceous limestone with minor brownish-grey intercalations.
30 - 35ft.	5½	30-35ft.	Hard, blue-grey to medium grey and light grey siliceous limestone with minor brownish intercalations.
35 - 40ft.	7	35-40ft.	Hard, blue-grey to medium grey siliceous limestone with minor brownish intercalations.
40 - 45ft.	7½	40-45ft.	Hard, blue-grey siliceous limestone.
45 - 50ft.	7	45-50ft.	Hard, blue-grey siliceous limestone.
50 - 55ft.	5½	50-55ft.	Hard, blue-grey siliceous limestone.
55 - 60ft.	6	55-60ft.	Hard, blue-grey siliceous limestone.

DEPTH OF OVERBURDEN = 1ft.

Rotary Percussion Drilling
Limwood Quarry

Hole No.L.Q.15

Section 249 Hundred of Noarlunga R.L.: 527.0

Date Drilled: 1.10.1969 Depth: 50'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	3	0-2ft.	Brown soil with plant roots.
		2-5ft.	Hard, blue-grey siliceous limestone.
5 - 10ft.	4	5-6ft.	Hard, blue-grey and brownish-grey siliceous limestone.
		6-7'6in.	Brown to orange, soft, fine silt.
		7'6"-8'6"	Hard, blue-grey and brownish-grey siliceous limestone.
		8'6"-10ft.	Soft, brown to orange fine silt.
10 - 15ft.	6	10-15ft.	Hard, blue-grey siliceous limestone with minor brownish intercalations.
15 - 20ft.	5½	15-20ft.	Hard, blue-grey siliceous limestone.
20 - 25ft.	5½	20-25ft.	Hard, blue-grey siliceous limestone.
25 - 30ft.	6½	25-30ft.	Hard, blue-grey siliceous limestone.
30 - 35ft.	5	30-32ft.	Brownish-grey to brown, fairly hard calcareous siltstones.
		32-35ft.	Hard, massive blue-grey to medium grey siliceous limestone.
35 - 40ft.	5	35-40ft.	Hard, blue-grey to medium grey siliceous limestone with minor brown calcareous siltstone intercalations from 38 to 40ft.
40 - 45ft.	5½	40-45ft.	Hard, blue-grey to medium grey siliceous limestone with minor brown calcareous siltstone intercalations from 40 to 42ft.
45 - 50ft.	5	45-50ft.	Hard blue-grey siliceous limestone with brown calcareous siltstone intercalations from 47 to 48ft.

DEPTH OF OVERBURDEN = 2ft.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.16

Section: 249 Hundred of Noarlunga R.L.: 533.0

Date Drilled: 1.10.69 Depth: 45'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)		Log
0- 5ft.	1	0-6"	Brown soil with plant roots.
		6"-1'6"	White to light grey calcrete with some soil.
		1'6"-5ft.	Fine, soft light orange silt, slightly clayey in parts.
5 - 10ft.	2	5-10ft.	Fine orange slightly clayey silt with reddish-brown mottled clayey patches.
10 - 15ft.	1½	10-15ft.	Fine soft orange-brown silt, slightly clayey in parts. Minor fragments of soft friable red and orange siltstone.
15 - 20ft.	2	15-20ft.	Fine, soft orange-brown silt.
20 - 25ft.	2	20-25ft.	Fine, soft orange-brown silt.
25 - 30ft.	2	25-30ft.	Fine, soft orange-brown silt.
30 - 35ft.	2	30-35ft.	Fine, soft reddish-brown slightly clayey silt.
35 - 40ft.	2	35-40ft.	Fine, soft reddish-brown slightly clayey silt.
40 - 45ft.	3	40-45ft.	Moist red plastic clay.

Hole abandoned at 45ft. Drill could not penetrate moist red plastic clay.

DEPTH OF OVERBURDEN = MORE THAN 45ft.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.17

Section: 249 Hundred of Noarlunga R.L.: 530.0

Date Drilled: 1.10.69 Depth: 60'

Logged by: A.M. Pain

Sample Interval	Drilling Time (Minutes)		Log
0 - 5ft.	1	0-6"	Dark brown clayey soil with plant roots.
		6"-5ft.	Fine, soft, slightly clayey orange silt.
5 - 10ft.	2	5-10ft.	Fine, soft slightly clayey orange and brown silt with occasional small patches of mottled white and grey calcareous clay.
10 - 15ft.	2	10-15ft.	Fine, soft slightly clayey orange and brown silt.
15 - 20ft.	2	15-20ft.	Fine, soft slightly clayey orange and brown silt.
20 - 25ft.	2	20-25ft.	Fine, soft slightly clayey brown silt with occasional small patches of white and grey calcareous clay.
25 - 30ft.	5	25-30ft.	Interbedded, hard, blue-grey siliceous limestone and chocolate-brown calcareous siltstones.
30 - 35ft.	3	30-31ft.	Chocolate-brown calcareous siltstone.
		31-35ft.	Fine, soft brown silt; slightly clayey in parts.
35 - 40ft.	2	35-40ft.	Very soft, fine, brown and orange-brown silt.
40 - 45ft.	2	40-45ft.	Very soft, fine, brown and orange-brown silt.
45 - 50ft.	2	45-50ft.	Very soft, fine, brown and orange-brown silt.
50 - 55ft.	4	50-55ft.	Interbedded, blue-grey siliceous limestone and chocolate-brown calcareous siltstone.
55 - 60ft.		55-58'6in.	Hard, massive, blue-grey siliceous limestone.
		58'6"-60ft.	Chocolate-brown calcareous siltstone with minor intercalations of blue-grey siliceous limestone.
			Hole abandoned at 60ft. due to caving.
			DEPTH OF OVERBURDEN = 25 feet.

Rotary Percussion Drilling
Linwood Quarry

Hole No.L.Q.18

Section: 249 Hundred of Noarlunga R.L.: 525.4

Date Drilled: 1.10.69 Depth: 75'

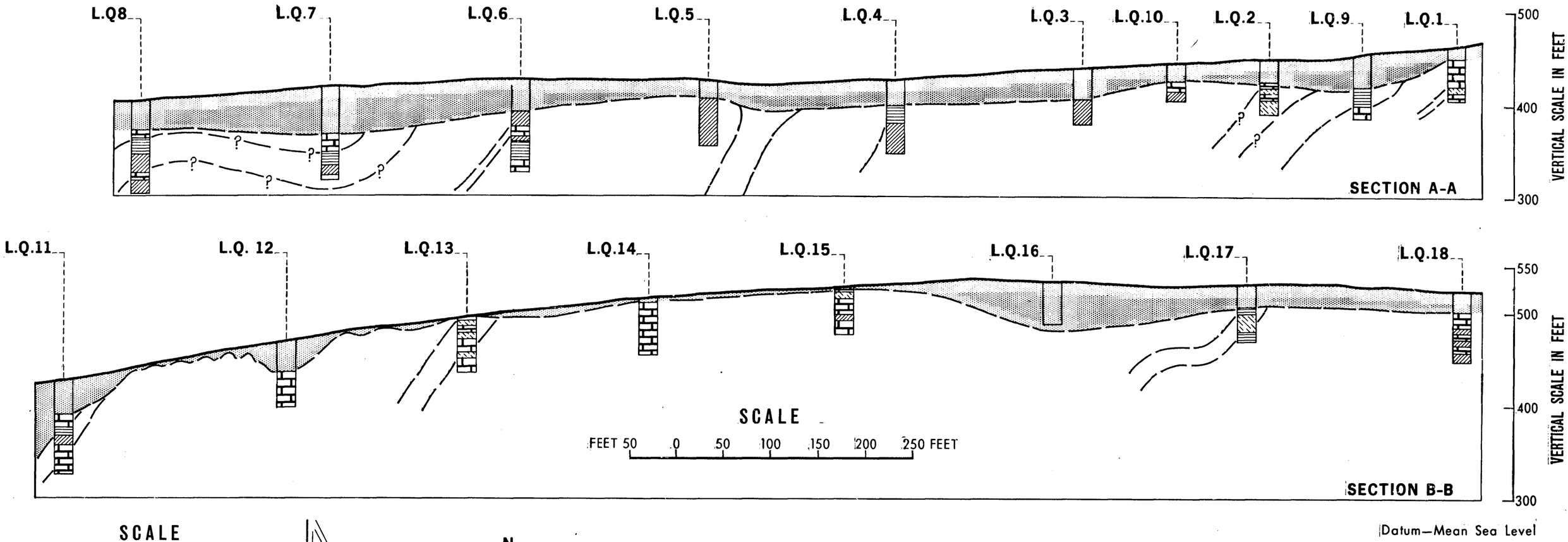
Logged by: A.N. Pain

Sample Interval	Drilling Time (Minutes)	Log	
0 - 5ft.	1	0-6"	Dark brown soil with plant roots.
		6"-5ft.	Fine, soft orange silt; slightly clayey in parts.
5 - 10ft.	2½	5-6ft.	Chocolate-brown, fairly soft, weathered calcareous siltstones.
		6-7'6in.	Fine, soft orange silt.
		7'6"-10ft.	Chocolate-brown fairly soft weathered calcareous siltstones.
10 - 15ft.	2	10-15ft.	Fine, slightly clayey mustard-orange to reddish-orange silt.
15 - 20ft.	2	15-18ft.	Fine, slightly clayey reddish-orange silt.
		18-20ft.	Soft, friable slightly weathered brown calcareous silts.
20 - 25ft.	4	20-22ft.	Fine, slightly clayey reddish-orange silt.
		22-25ft.	Hard blue-grey siliceous limestone.
25 - 30ft.	3½	25-27ft.	Hard blue-grey siliceous limestone.
		27-30ft.	Very soft, fine, orange and reddish-brown silts.
30 - 35ft.	3½	30-33ft.	Very soft, fine, orange and reddish-brown silts.
		33-35ft.	Chocolate-brown calcareous siltstone.
35 - 40ft.	3½	35-38ft.	Hard, blue-grey siliceous limestone.
		38-40ft.	Chocolate-brown calcareous siltstone with minor intercalations of soft brown to orange silt.
40-45ft.	3½	40-43ft.	Chocolate-brown calcareous siltstone.
		43-45ft.	Fine brown and reddish-brown slightly clayey silt.
45 - 50ft.	5	45-49'6in.	Hard, massive blue-grey siliceous limestone.
		49'6"-50ft.	Fine, orange, slightly clayey silt.
50 - 55ft.	4	50-52ft.	Hard, blue-grey siliceous limestone.
		52-53ft.	Soft, brown friable clayey siltstone.
		53-55ft.	Brown calcareous siltstones with minor blue-grey siliceous limestone intercalations.
55 - 60ft.	4½	55-59ft.	Brown calcareous siltstones with minor soft, friable brown silty interbeds.
		59-60ft.	Blue-grey siliceous limestone.

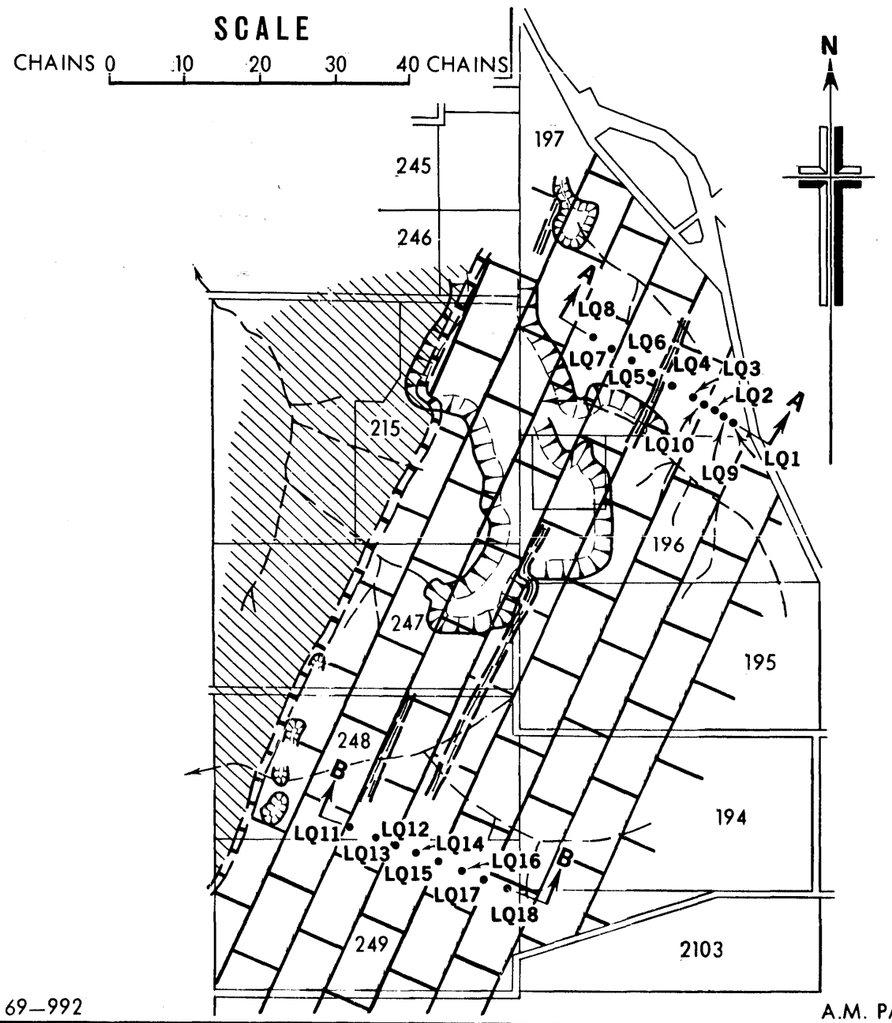
Hole No.L.Q.18 contd.

Sample Interval	Drilling Time (Minutes)		Log
60 - 65ft.	4½	60-65ft.	Blue-grey siliceous limestone with minor brown calcareous intercalations between 62 and 63ft.
65 - 70ft.	4	65-66ft. 66-70ft.	Blue-grey siliceous limestone. Brown calcareous siltstones with soft, friable brown silty interbeds.
70 - 75ft.	5	70-75ft.	Chocolate-brown calcareous siltstones with soft friable silty brown intercalations between 73 and 75ft.

DEPTH OF OVERBURDEN = 22 feet.



Datum—Mean Sea Level



LEGEND

FOR CROSS SECTIONS

"Overburden"— silt, soil and weathered rock

Grey and blue—grey siliceous limestone

Brown calcareous siltstone

Soft, friable siltstones of various colours

Interbedded blue—grey siliceous limestone and brown calcareous siltstone

FOR PLAN

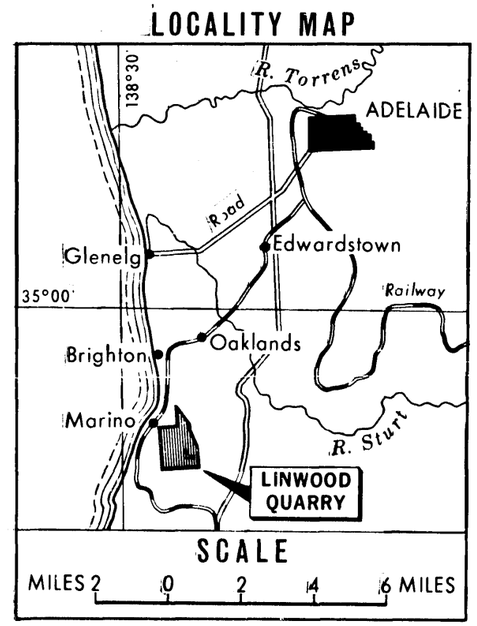
Laminated purple siltstones and shale

Buff—coloured dolomitic limestone

Blue—grey siliceous limestone with interbeds of brown calcareous or dolomitic siltstone

Soft, friable, brown to orange siltstone interbeds within the blue—grey sequence.

Rotary-percussion drill ——— LQ4 •



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A.M. PAIN Geologist

S.A. Dept. of Mines