Rept. Bk. No. 60/26
G.S. No. 3077
D.M. 2134/59

DEPARTMENT OF MINES
SOUTH AUSTRALIA

CHOWILLA DAM, RIP-RAP INVESTIGATION

LOWBANK QUARRY SITE

PROGRESS GEOLOGICAL REPORT, FEBRUARY, 1965

by

D.H. Stapledon
Senior Geologist

and

J.P. Trudinger
Geologist

D.M. 2134/59

12th February, 1965

Rept. Bk. No. 60/26
G.S. No. 3077
D.M. 2134/59

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING & SOILS GEOLOGY SECTION

CHOWILLA DAM, RIP-RAP INVESTIGATION LOWBANK QUARRY SITE

PROGRESS GEOLOGICAL REPORT, FEBRUARY, 1965

CONTENTS

	PAGE
ABSTRACT	1
INTRODUCTION	1
GENERAL DESCRIPTION OF THE SITE	2
GEOLOGY OF THE SITE	2
Geological Structure	3
Weathering	3
Groundwater	4
POSSIBLE RIP-RAP QUALITY MATERIALS	4
PRELIMINARY ESTIMATES	5
Types A, B and C as Usable Rip-Rap	6
Overburden	6
Type A only as Usable Rip-rap	6
Overburden	7
Ratio of Rip-rap to Overburden	7
FUTURE INVESTIGATIONS	7
REFERENCES	8
APPENDIX A	9
Logs of Diamond Drill Holes	
APPENDIX B	10
Logs of Cliff Sections	

by
D.H. Stapledon
Senior Geologist

and
J.P. Trudinger
Geologist

FIGURES

Figure No.	Title	Reference No.
1	Chowilla Project. Possible Rip-Rap Sources.	S4076 G + J
2	Chowilla Project. Lowbank Quarry Site. Location of Exploration and Summarized Logs of Drill Holes.	65-28 G + J
3	Chowilla Project. Lowbank Quarry Materials Probably suitable as Rip-Rap.	S4087 G + J

Rept.Bk. 60/26
G.S. 3077
D.M. 2134/59

DEPARTMENT OF MINES
SOUTH AUSTRALIA

CHOWILLA DAM, RIP-RAP INVESTIGATION

LOWBANK QUARRY SITE

PROGRESS GEOLOGICAL REPORT, FEBRUARY, 1965.

ABSTRACT

A quarry site near Lowbank has been geologically mapped and partly explored by 14 diamond drill holes totalling 702 feet in depth. Marine sandy limestone and calcareous sandstone of the Norwest Bend Formation form a resistant capping about 20 feet thick at the top of the Murray cliffs, which are 120 feet high. The beds are almost horizontal, and continuously exposed for 3000 feet along the cliff. Drilling suggests that the most competent materials, limestone and well-cemented sandstone, occur in a bed 4 to 15 feet thick, which appears to be continuous over the greater part of the explored area. Overburden on this material ranges from zero to 10 feet at the cliff edge, up to a maximum of more than 40 feet, and consists partly of clays and clayey sands, and partly of sandstone and limestone of poorer quality than the competent bed.

Preliminary estimates are as follow:-

(a) Assuming both sandstone and limestone to be of acceptable quality.
Rip-rap 480,000 cu.yds.
Overburden 2,160,000 cu.yds.

(b) Assuming the limestone only to be acceptable.
Rip-rap 180,000 cu.yds.
Overburden 810,000 cu.yds.

A considerable amount of further exploratory work, including diamond drilling and trial quarries, will be required if it is proposed to adopt the site as a rip-rap source.

INTRODUCTION

The proposed Lowbank Quarry Site is located on the south bank of the Murray River, seven miles to the ~~west~~ east of Waikerie (Figure 1). The site is adjacent to the Sturt Highway, and approximately 64 road miles from the Chowilla Dam site.

The results of geological mapping of cliff exposures, and of three initial diamond drill holes put down at the site, are described in the progress report dated November, 1964 (Ref.1). It was concluded that the Lowbank site should be further investigated by diamond drilling.

Fourteen drill holes, mostly about 50 feet deep, have now been completed. Holes L1 to L11 inclusive were drilled in a broad pattern to check the continuity of hard rock beds indicated by

surface mapping. Holes L4A, L7A and L10A were drilled a few feet away from Holes L4, L7 and L10 respectively to obtain samples for laboratory testing.

This report describes the results of the drilling. Figure 2 shows summarized logs of the drill holes, indicating the material considered probably usable as rip-rap. Detailed logs of the individual holes are in Appendix A, and of the cliff sections, in Appendix B.

DESCRIPTION OF THE SITE

The site consists of an undulating plateau about 3000 feet long and 1800 feet wide bounded on the northern side by cliffs at the edge of the Murray Valley, and on the southern side by the Sturt Highway (Figs. 1 and 2).

The cliffs are up to 120 feet high and rise at 60° to 70° from the water edge. They are capped by relatively hard rocky bands totalling about 15 feet in thickness. These are continuous for more than 3000 feet along the cliff line, apparently thinning out rapidly upstream and downstream, where re-entrant gullies occur. The plateau surface above the cliffs is almost flat, sloping very gently upwards away from the river, and is mostly covered by sandy soil with kunkar fragments.

The area explored so far is 3000 feet long and 600 feet wide (Fig. 2), and does not extend completely over the site area.

GEOLOGY OF THE SITE

The succession as indicated by cliff mapping and diamond drilling is as follows:-

Thickness & Occurrence	Age	Unit Name	Description
0 (at cliff edge) up to 20 feet in Drill Hole L10	?Recent		Terrestrial sandy clays and clayey sands.
20 to 32 ft. in drill holes	Pliocene	Norwest Bend Formation	Calcareous sandstone and sands, mostly coarse to very coarse grained and dense limestone, sandy in part. Fossil shells occur scattered throughout the rocks and also concentrated in lenticular bands.
More than 70ft. thickness in lower part of cliffs	Lower Miocene	Morgan Limestone	Bands of sandy bryozoal limestone up to 2 ft. thick alternating with soft sandy calcareous clay bands.

According to Ludbrook (Ref.2), both the Morgan Limestone and the Norwest Bend Formation are marine sedimentary deposits. The Morgan Limestone which is a member of the Murray Group, probably represents the maximum transgression of the sea in the Lower Miocene. The Norwest Bend Formation was formed by rapid sedimentation in an estuary which ranged from three to five miles wide, and was approximately parallel to the present course of the Murray River. Pliocene sediments from this estuary have been found as far downstream as Tailem Bend. The calcareous sandstone seen at Lowbank is poorly exposed in the cliffs for about eight miles upstream from the site, but in no other place does it form a continuous uniform rock cliff such as at the Lowbank site.

Geological Structure

The Norwest Bend Formation at the site is almost horizontal, but individual sandstone beds show pronounced current bedding, with dips of up to 40° towards the south.

Steeply dipping joints intersect the cliff face at intervals ranging from 10 to 30 feet, generally about 15 feet. Several near-horizontal partings are also present, along the bedding direction.

Weathering

The sub-surface effects of chemical weathering, including solution, are difficult to assess from the amount of exploration

carried out to date. In this type of calcareous rock it is possible to have disintegration or removal of the rock due to weathering and solution in some places, and a concentration of lime cement to form very dense limestone in other places. The only definite solution effect seen at the site is a vertical solution pipe up to 1 ft. diameter and more than 20 ft. deep, near Cliff Section D10. Some of the variations in degree of cementation of sandstone in the cores may be due to partial removal of cement by weathering, but it is also possible that they are the direct result of variations in the amounts of cement initially deposited.

The sandstone outcrops show pronounced fluting, that is, development of narrow lenticular slots or voids parallel to the bedding direction. It appears likely that the narrow slots represent poorer quality materials which have been removed by erosion. The drill cores show poorly cemented zones, and fossiliferous zones containing numerous voids, and these are considered to be equivalent to the slots in the surface exposures.

The exposed sandstones appear generally more strongly cemented than the probably equivalent materials recovered at depth in drill cores. This effect appears to be caused by concentration of calcareous cement near the surface during weathering. This process is loosely termed "case hardening," and is a common feature of the calcareous rocks of the Murray Basin.

Groundwater

Drilling water was lost throughout the progress of most of the drill holes, and the holes were empty on completion of drilling. It is concluded that the site is generally well-drained and above the water table.

POSSIBLE RIP-RAP QUALITY MATERIALS

The drill cores show rocky materials of three more or less distinct types, namely dense limestone, fine grained calcareous sandstone, and coarse grained calcareous sandstone. These have been distinguished by hachuring and written descriptions on the detailed logs, Appendices A and B.

On completion of drilling of all holes, the cores were laid out side by side, and a careful selection made of those rocky materials considered likely to provide rip-rap. The selection was made on consideration of density, core lengths and degree of cementation (Fig. 3).

It was found that most of the dense limestone, about half of the fine sandstone, and only small amounts of the coarse sandstone, could be classified as probably usable. For convenience, the probably usable materials of the three kinds have been referred to as Types A, B and C, as shown on Figure 3.

The dense limestone, Type A, is very similar physically to Pliocene limestone in the Adelaide area, which has an unconfined compressive strength of the order of 8000 lb./sq.in. It can therefore be classified as a hard rock ($q_u > 5000$ lb./sq.in.). It appears to be durable.

The two sandstones, Types B and C, are noticeably weaker and more porous. Although the selected materials should provide relatively strong blocks in the required sizes, there is some doubt about their long-term durability.

The locations of the Types A, B and C materials are shown by means of coloured strips on the detailed logs, and also by means of hachuring on the sections on Figure 2. The sections suggest that these materials occur mainly in an almost horizontal bed, ranging from 4 to 15 feet thick in the drill holes, and extending at least from Hole L4 to Hole L7 (2400 feet). The western half of this bed appears to be mainly fine sandstone, and the eastern half mostly dense limestone. (Section A-A', Fig.2).

In addition to this well-defined bed there are localized occurrences of types A, B and C materials at higher levels in the drill cores. These are considered to be either lenticular beds or isolated well-cemented patches.

PRELIMINARY ESTIMATES

Two separate estimates follow, the first assuming Types A. B and C will prove to be of satisfactory quality, and the second assuming that only Type A will be satisfactory.

Types A, B and C as Usable Rip-rap.

The following assumptions are made:

(a) All of the types A, B and C materials will be obtained from a single near-horizontal bed of 6 feet uniform thickness. It would not be practicable during quarrying to select material from localized patches or lenticular beds above the main bed.

(b) This uniform bed is continuous beneath an area extending 2400 feet along the site, and for 900 feet in from the cliff edge.

Then Q (Types A, B & C) = $\frac{2400 \times 900 \times 6}{27}$ cu. yds.

= 480,000 cu. yds. (solid)

Overburden

Overburden is of two types: sands and sandy clays near the ground surface, and poorly cemented sandstones and limestone at greater depths.

For the purpose of a preliminary estimate it is assumed that the maximum depth of overburden is 54 feet on the upslope edge of the quarry, and the minimum depth zero at the cliff edge. A uniform surface slope is also assumed.

Then Q (overburden) = $\frac{2400 \times 900 \times 54}{27 \times 2}$ cu.yds.

= 2,160,000 cu.yds. (solid)

Type A only as Usable Rip-rap.

The following assumptions are made:

(a) All of the material will be obtained from a single near-horizontal bed of 6 feet uniform thickness, on the eastern side of the site.

(b) This bed is continuous beneath an area extending 900 feet along the site, and 900 feet in from the cliff edge.

Then Q (Type A) = $\frac{900 \times 900 \times 6}{27}$ cu.yds.

= 180,000 cu.yds. (solid)

Overburden

It is again assumed that the maximum overburden depth will be 54 feet on the upslope edge, and the minimum zero at the cliff edge, with a uniform surface slope between.

Then Q (overburden) = $\frac{900 \times 900 \times 54}{27 \times 2}$ cu.yds.

= 810,000 cu.yds. (solid)

Ratio of Rip-rap to Overburden

It can be seen from these preliminary estimates that in each case the ratio $\frac{\text{rip-rap}}{\text{overburden}}$ is $\frac{1}{4.5}$

FUTURE INVESTIGATIONS

If the Lowbank site should be adopted as a rip-rap source, it is considered that a large amount of further exploratory work will be required. This will be to enable firm estimates to be made to determine means of quarrying to obtain the required grading, and to determine means of selection of usable materials.

The following are suggested:

(a) Additional diamond drilling in the area already investigated, to complete a pattern at approximately 250 foot centres. Extension of this pattern to the south and west as required.

(b) Trial quarries at two or more locations.

(c) Additional laboratory testing of material from diamond drill holes, and from the trial quarries.

D. H. Stapledon

D. H. STAPLEDON
SENIOR GEOLOGIST.

J. P. Trudinger

J. P. TRUDINGER
GEOLOGIST,
ENGINEERING AND SOILS GEOLOGY SECTION.

DHS:JPT:AWK:EMD
12.2.65.

REFERENCES

Stapledon, D.H. and Trudinger, J.P., 1964 - Chowilla Dam Embankment Materials. Rip-rap Investigation. Progress Geological Report, November, 1964. Department of Mines, S.A. Rept.Bk.No. 59/124, G.S. No. 3020.

Ludbrook, N.H., 1961 - Stratigraphy of the Murray Basin in South Australia. Department of Mines S.A. Bulletin 36.

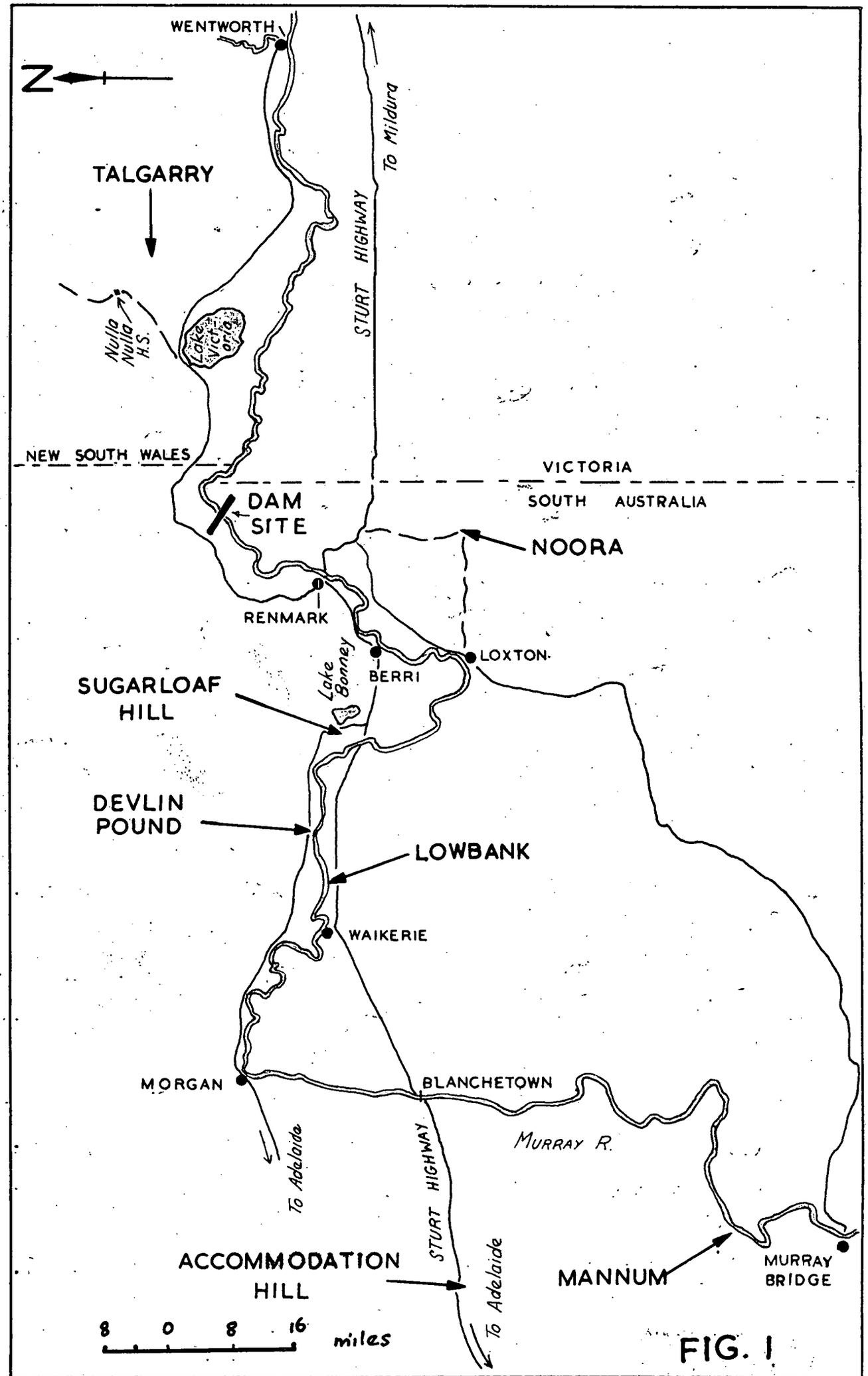
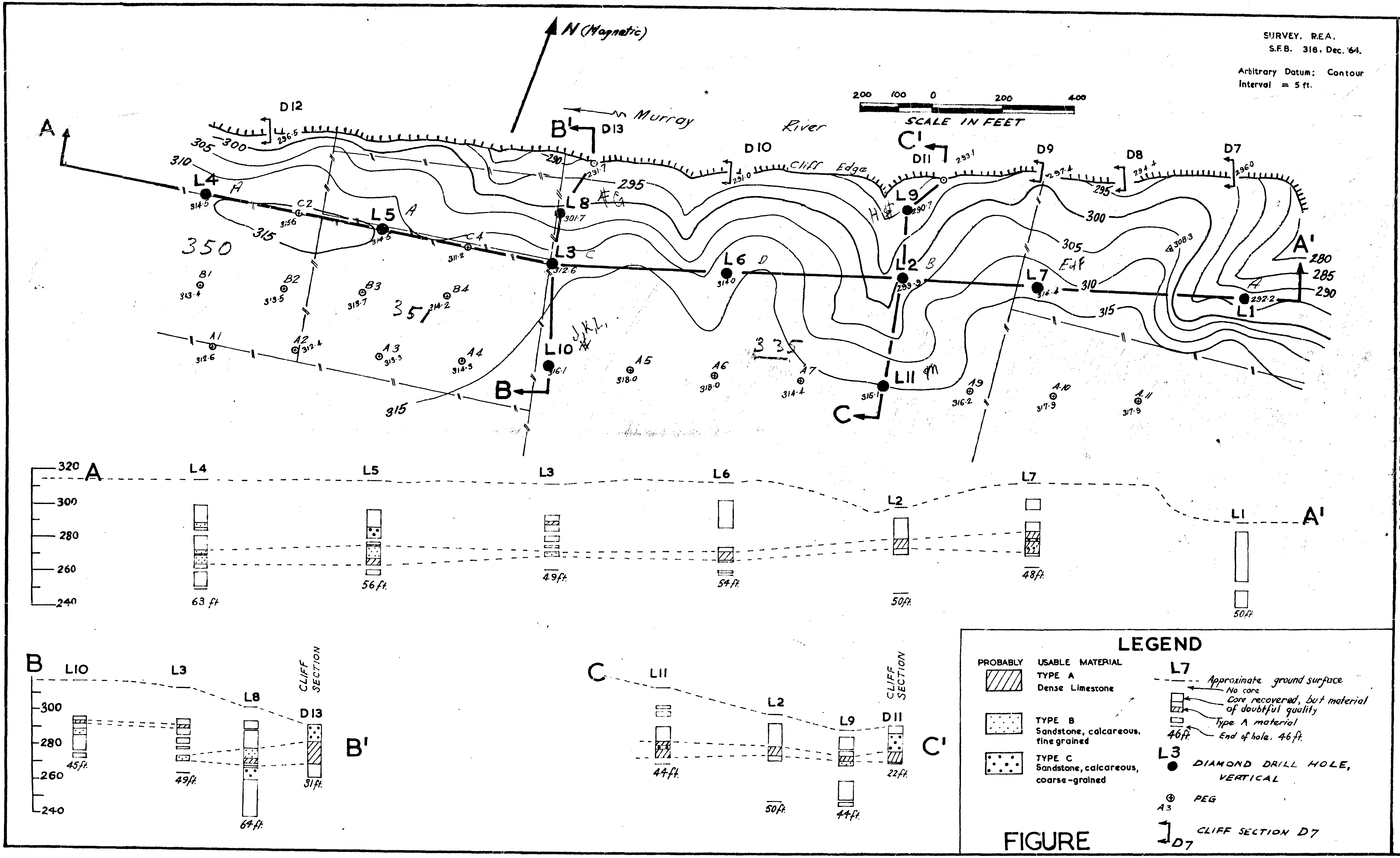


FIG. 1

S.A. DEPARTMENT OF MINES

	Passed	Drn. J.P.T.	CHOWILLA PROJECT	D.M.	Scale 1: 1,000,000
		Tcd. J.P.T.		Reg.	
		Ckd.	DISTRIBUTION OF POSSIBLE RIP RAP SOURCES		S 4076
		Exd.			G+J
					Date 20 Jan '65

300—6.60 6649



SA DEPARTMENT OF MINES

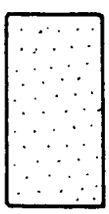
LOWBANK QUARRY SITE.

LOCATION OF EXPLORATION, AND SUMMARIZED LOGS OF DRILL HOLES

Scales	as Shown
	65-28
	G+J
Date	15 Jan '64
Dn	
Tcd	J.P.T.
Exd	
Approved	
Director	
No	
Amendment	
Exd	
Date	

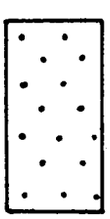
TYPE A. Dense Limestone.

MICROCRYPTOCRYSTALLINE CALCIUM CARBONATE,
SOME FINE TO COARSE SAND,
FOSSILIFEROUS IN BANDS, YELLOW BROWN
TO GREY,



TYPE B. Calcareous Sandstone, Fine,

SANDSTONE, MAINLY QUARTZ, SOME MICA,
CRYSTALLINE AND GRANULAR CEMENT,
SAND GRAINS MAINLY LESS THAN 0·6 mm
FEW FOSSILS,



TYPE C. Calcareous Sandstone, Coarse,

SANDSTONE, QUARTZ GRAINS, POORLY GRADED,
FROM 0·4 to 4 mm. MAINLY 2 mm., SUBROUNDED,
CRYSTALLINE CEMENT, YELLOW BROWN,
SOME FOSSILS,

EXPLANATION:

The diamond drill holes at Lowbank Site have recovered unconsolidated limey clays and sandy clays, clayey sands, and rocky materials including dense limestone and calcareous sandstone, both coarse and fine grained. The materials defined above as Types A, B and C are SELECTED from the rocky material.

Selection criteria : core lengths > 0·5ft. generally > 1ft.
: general absence of fossils and vaids
: well cemented; broken only by hammer blow.

FIG. 3

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. J.P.T.	CHOWILLA PROJECT	D.M.	Scale
		Tcd. J.P.T.	LOWBANK QUARRY SITE	Req.	S4087 G+J
		Ckd. D.H.S.	MATERIALS PROBABLY SUITABLE FOR RIP-RAP		
Director		Exd.			Date 22 Jan. '65

400—4.61 6469

BINDING MARGIN

APPENDIX A

LOGS OF DIAMOND DRILL HOLES

Hole No.	Depth (feet)	Drawing No.
L1	50	S3956 G + J
L2	50	S3948 G + J
L3	49	S3949 G + J
L4	63	S3987 G + J
L5	56	S4023 G + J
L6	54	S4024 G + J
L7	48	S4033 G + J
L8	64	S4048 G + J
L9	44	S4049 G + J
L10A	44	S4075 G + J
L11	44	S4050 G + J
L4A	48	S4038 G + J
L7A	42	S4039 G + J
L10A	46	S4040 G + J

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 1

GEOLOGICAL LOG OF DRILL HOLE

PROJECT	CHOWILLA DAM.	CO-ORDINATES		R.L.	292 FT
FEATURE	RIP-RAP.	HUNDRED	HOLDER.	DIRECTION	—
LOCATION	LOWBANK.	SECTION	10 B.	ANGLE FROM HORIZONTAL	90°

ROCK TYPE (Degree of Weathering Shown in Core)	DESCRIPTION	R.L.	Depth and Size of Core	Log	Lift and Core rec'y %	STRUCTURES (Joints, Veins, Seams, Faults, Crushed Zones)	WATER LEVEL	WATER PRESSURE TEST (GALLONS PER MINUTE LOSS 5 10)
NO CORE (Moderately to highly weathered)			NXC		5	Bedding dips 0° to 10°		
NORWEST BEND FORMATION. Calcareous sandstone, fossiliferous, pale grey, with few yellow brown patches. (Mainly fresh, slightly weathered in parts.)	Poorly graded sand, with calcareous cement. Grains from 0.2 to 6 m.m., mostly 2 m.m., well rounded. Irregular voids, from 2 to 12 m.m. are common throughout, limonite stained in part. These form up to 15% of the volume in the areas shown on the graphic log. In general the core cannot be broken by hand but tends to be friable on freshly broken surfaces.	Core in lengths less than 0.1 ft. / Core in 0.2 to 1.5 ft lengths mostly, 0.8 ft. breaks along bedding.	10, 20, 30 NMLC		100, 95, 100, 100, 100, 100, 60	Irregular voids. Joint with local limonite staining. Irregular voids. Joint, rough irregular surfaces and local limonite staining.	No water in hole (21 Oct '64)	No water return. Water returned after casing run to 13 ft. No water return after 19 ft.
MORGAN LIMESTONE. NO CORE		Core in 0.05 to 0.2 ft. lengths.			25			NOT WATER PRESSURE TESTED
Limestone, fossiliferous	Light grey, some fine to medium sand, solution cavities.		40					
NO CORE								
Marl, sandy	Light yellow brown, fine sand, Unconsolidated.				90			
Limestone, bryzoal (fresh)	Light grey to light yellow brown. Easily broken below 46 ft. Consists mainly of bryzoal remains.	Core in 0.05 to 0.8 ft. lengths			90			
NO CORE								

END OF HOLE. 49.5 ft.
RL. 242 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

FIGURE.

Drill No. 7	EXPLANATION	Logged J.P.T.
Type Mindrill E 1000	Sandstone, calcareous	Date 21 Oct '64
Driller T. Briggs	Limestone sandy in part.	Traced J.M.H.
Commenced 20 Oct '64	Marl (calcareous clay)	Checked J.P.T. (28 Oct '64)
Completed 21 Oct '64	WATER LEVEL ▼ DATE; °°°° gravel; macrofossils; voids; ~~ joint	Submitted

Vert. Scale 1 in = 10 ft.

Sheet 1 of 1

Drawing No. S 3956

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. **L2**

GEOLOGICAL LOG OF DRILL HOLE

PROJECT	CHOWILLA DAM	CO-ORDINATES	—	R.L.	300 FT
FEATURE	RIP-RAP	HUNDRED	HOLDER	DIRECTION	— °
LOCATION	LOWBANK	SECTION	10B	ANGLE FROM HORIZONTAL	90 °

ROCK TYPE (Degree of Weathering Shown in Core)	DESCRIPTION	Class	Depth and Size of Core	Log	Lit and Core rec'y %	STRUCTURES (Joints, Veins, Seams, Faults, Crushed Zones)	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NO CORE					0		No Water In Hole (5 Nov. '64.)	Not Water Pressure Tested
NORWEST BEND FORMATION. Calcareous Sandstone to sandy limestone, fossiliferous, yellow brown to yellow grey. MW / SW / NO CORE / Mainly fresh	Poorly graded quartz sand, with 0 to 25% calcite matrix. Grains up to 5mm, mainly 2mm, well-rounded. Porosity, mainly very high. Crystalline and chalky calcite matrix. Grading to— Crystalline limestone, 20 to 50% sand grains, from 0.2 to 2mm. Core cannot be broken by light hammer blow. Slightly porous.	Mainly crystalline matrix. Unbreakable by hand. Chalky. Readily matrix. Broken. Core in 0.1 to 0.5 ft lengths. Breaks along bedding. Core in lengths of 0.4 to 1.1 ft. Broken along voids and fossils. NMLC	10, 20, 30		70, 100, 0, 100, 100, 100, 100, 100	Bedding dips 0° to 30°. Cross bedding visible. Irregular voids up to 2mm wide. Numerous thin cavities formed by solution of fossils form less than 5% of the volume.		
NO CORE			40		2			
	Coarse quartz sand and fine gravel, carbonate matrix. Unbreakable in hand.	Core in lengths less than 0.15 ft.			10			

END OF HOLE 50.0 ft.
R.L. 250 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

FIGURE

EXPLANATION

Calcareous Sandstone; Sandy Limestone

WATER LEVEL ◄ DATE

Gravel; Voids; Fossils

Drill No.	D.M. 7	Logged	J.P.T.
Type	Mindrill. E. 1000	Sheet No.	5 Nov. '64
Driller	Briggs	Drawn	T.P.B.
Commenced	22 Oct '64	Checked	JPT
Completed	23 Oct '64	Submitted	DK

Vert. Scale 1in = 10ft

Sheet 1 of 1

S 3948

G+J

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L3

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM | CO-ORDINATES —— | R.L. 313 FT

FEATURE RIP-RAP | HUNDRED HOLDER | DIRECTION ——°

LOCATION LOWBANK | SECTION 10B | ANGLE FROM HORIZONTAL 90°

ROCK TYPE (Degree of Weathering Shown in Core)	DESCRIPTION	Casing	Class	Depth and Size of Core	Log	Lift and Core rec'y %	STRUCTURES (Joints, Veins, Seams, Faults, Crushed Zones)	WATER LEVEL	WATER PRESSURE TEST (GALLONS PER MINUTE LOSS 5 10)
NOR'WEST BEND FORMATION. Calcareous Sandstone and Sandy Limestone, fossiliferous, yellow brown to pale yellow grey. NO CORE		Core in lengths of 0.2 to 1 ft	NXC	0–10		0		No Water In Hole. (5 Nov. '64.)	Not Water Pressure Tested
				10		0			
SW. Fresh. Sand grains from 0.2 to 2mm, well rounded, variable crystalline and granular carbonate matrix.	Crystalline carbonate matrix. Mainly unbreakable by hand.			20	Sandstone	100	Voids form up to 30% of volume.		
	Crystalline carbonate cement. Unbreakable by light hammer blow.		NMLC				Numerous discontinuous voids up to 3m.m. wide.		
	Granular carbonate matrix. Mainly unbreakable by hand.					100	Some discontinuous voids		
NO CORE						40			
Fresh	Quartz grains from 0.2 to 2mm some mica, calcite grains less than 1mm. Unbreakable by hand. Core lengths less than 0.2ft.			30	Sandstone	60	Voids form approx. 10% of volume.		
NO CORE									
MORGAN LIMESTONE. Alternating sandy limestone and soft marl bands. Fresh	Fine quartz and calcite grains, mainly less than 0.6mm.	Core in lengths of 0.05 to 0.8 ft. Breaks along bedding			Limestone		Few small voids.		
NO CORE									
Fresh	Unbreakable by light hammer blow.			40	Limestone	45	No bedding visible. No voids.		
NO CORE									

END OF HOLE. 49 ft.
R.L. 264 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

FIGURE

Drill No. 7
Type Mindrill E.1000
Driller Briggs
Commenced 24 Oct '64
Completed

EXPLANATION

Sandstone | Limestone | Marl
WATER LEVEL ◄ DATE | Gravel (>2mm) | Voids | Fossils

Logged J.P.T.
Date 5 Nov '64
Traced T.P.S.
Checked JRJ
Submitted DRS

1 in. = 10 ft. Vert. Scale
Sheet 1 of 1
S3949
G+J
250—7.60 .8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L4

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM CO-ORDINATES R.L. 315 FT

FEATURE RIP-RAP HUNDRED HOLDER DIRECTION —

LOCATION LOWBANK SECTION 10B ANGLE FROM HORIZONTAL 90

ROCK TYPE (Degree of Weathering Shown in Core)	DESCRIPTION	Casing	Class	Depth and Size of Core	Log	Lift and Core rec'y %	STRUCTURES (Joints, Veins, Seams, Faults, Crushed Zones)	WATER LEVEL	WATER PRESSURE TEST (GALLONS PER MINUTE LOSS 5 10)
NO CORE						0		NO WATER IN HOLE 24 Nov. '64	Partial water return
				10		0			
MW		Core in fragments less than 0.1 ft.				100			
NO CORE	Coarse sand, with chalky lime matrix.			20		50			
Mainly Fresh	Quartz grains, mainly fine to medium grained, some coarser bands, some mica grains, mainly crystalline cement from 2 to 26 ft., granular cement from 26 to 30 feet. Very porous. Core breaks along fossils & thin uncemented bands. Some core lengths break with light hammer blow.	Core in 0.4 to 1.4 ft. lengths	NXC / NMLC			100, 100	Fossil voids up to 25% of volume of rock. Bedding dips up to 30°		No water return
NO CORE				30		50			
NO CORE						50	Fossil voids, up to 10% of rock.		
NO CORE		Core in lengths less than 0.5 ft.		40		100	Bedding horizontal.		
Mainly Fresh (NO CORE, NO CORE)	Quartz grains, mainly less than 0.4 mm. Numerous mica grains. Crystalline and granular cement. Porous except from 41 to 43 feet. Thin bands of poorly cemented sand at 43, 47.5, 49 & 51 feet.	Core in lengths from 0.2 to 1.1 ft. mainly 0.5 ft.		50		80, 90	Fossil voids, 15% of volume		
NO CORE									
Sandy Marl	Marl, with coarse sand and gravel. Some calcareous bands of lithified material but mainly unconsolidated					70, 80			
NO CORE									

NORWEST BEND FORMATION — Calcareous Sandstone, Pale yellow brown with white grey patches

NOT WATER-PRESSURE TESTED

END OF HOLE 63 ft.
R.L. 252 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7
Type Mindrill E1000
Driller Briggs
Commenced 19 Nov. 64
Completed 25 Nov. 64

EXPLANATION

Sandstone, Calcareous
Marl, Sandy
WATER LEVEL DATE
Voids
Fossils

Logged J.P.T. (24 Nov. 64)
Drawn J.P.T.
Traced G.M.
Checked DKS
Submitted

Vert. Scale 1 in = 10 ft.
Sheet 1 of 1
Drawing No. S 3987

250—7.60 6336

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 5

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM — CO-ORDINATES — — R.L. 315 FT

FEATURE RIP RAP — HUNDRED HOLDER — DIRECTION — °

LOCATION LOWBANK — SECTION 10 B — ANGLE FROM HORIZONTAL 90 °

ROCK TYPE (Degree of Weathering Shown in Core)	DESCRIPTION	Casing	Class.	Depth and Size of Core	Log	Lift and Core rec'y	STRUCTURES (Joints, Veins, Seams, Faults, Crushed Zones)	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS (5, 10)
NORWEST BEND FORMATION limestone, sandy brown and grey sandstone pale Calcareous grey pale	NO CORE		NXC	0				No Water in Hole (1 Dec '64)	Partial water return.
	NO CORE			10		0			
	Quartz grains, mainly coarse, up to 3mm, some fine and medium grains throughout and concentrated in patches. Mainly chalky lime matrix, patches of crystalline cement. High porosity except in crystalline patches. Core mainly unbreakable by hand. Breaks along bedding, fossils etc.		NMS	10		10 100 60	Core in lengths up to 0.5 Ft.		
	NO CORE			20		65	Voids from 5 to 20% of volume.		
	NO CORE					100 90	Core in lengths of 0.2 to 1 Ft, mainly 0.6 Ft. Bedding dips from 0 to 20°, cross bedded		NOT WATER PRESSURE TESTED.
	NO CORE			30		35			No water return.
	Quartz grains, some mica, mainly fine grained, some medium to coarse grains throughout. Mainly well cemented, with crystalline and granular cement. Mainly unbreakable with light hammer blow. Mainly moderate porosity. Core breaks along bedding			40		100 95	Core in lengths of 0.1 to 1 Ft, mainly 1 Ft. Few voids, less than 5% of volume.		
	NO CORE					100 100	Core from 0.1 to 3 mainly 0.1 to 1.5 Ft, mainly 1 Ft.		
Marly Sandstone	Quartz grains, mainly coarse, main size 2mm. Chalky lime and clayey matrix. Very porous. Breakable in hand.			50		45 100			

END OF HOLE - 56 Ft.

R.L. 259 Ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7

Type Mindrill E1000

Driller Briggs

Commenced 26 Nov. 64

Completed 29 Nov. 64

EXPLANATION

Sandstone. WATER LEVEL DATE

Limestone

Fossils

Voids

Marl

Logged J.P.T.

Date 1 Dec. 64

Drawn J.P.T.

Traced D.R.P.E.

Checked

1 inch to 10 feet Vert. Scale

Sheet 1 of 1

S4023 Drawing No.

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 6

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM — CO-ORDINATES —— — R.L. 314 FT

FEATURE RIP RAP — HUNDRED HOLDER — DIRECTION —— °

LOCATION LOWBANK — SECTION 10 B — ANGLE FROM HORIZONTAL 90 °

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	Casing	Core Loss	Depth and Size of Core	Lift and Core Loss	Lengths of core %	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones
	No Core	NXC		0			
NORWEST BEND FORMATION Calcareous Sandstones, Sandy Limestone and Marl / Sandy Marl	SOIL etc, red-brown — Sand, silt and clay.			10 NMS		95 Average 0·15 Ft.	
	NO CORE						
	Quartz grains up to 5mm., mainly 1mm., Marly, Carbonate content low. Slightly porous. Core broken by hand, breaks along bedding			10 20		15 Average 0·1 Ft.	Few Voids
	NO CORE					75 Average 0·25 Ft.	
	NO CORE			30		0	
	Coarse grains, mainly 2mm. Carbonate from 0 to 25% of volume. Slightly porous.					0	
Calcareous Sandstone to Sandy Limestone				40		40 Less than 0·1 Ft.	Voids up to 20% of volume near 37%
	Crystalline carbonate with 20 to 50% quartz grains from 0·2 to 2mm. Slightly porous. Core not broken by light hammer blow.					100 Average 0·5 Ft.	Few Voids
	NO CORE					25	
Sandy Marl	Coarse sand, chalky lime matrix, very porous. Broken by light hammer blow			50		20 Mainly 0·15 Ft.	Few Voids.
	NO CORE						

END OF HOLE - 54 Ft.

R.L. 260 Ft.

WATER LEVEL: No Water in Hole (4 Dec '64)

WATER PRESSURE TEST — GALLONS PER MINUTE LOSS (5, 10)

No water return.

NOT WATER PRESSURE TESTED.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7

Type MINDRILL E1000

Driller Briggs

Commenced 1 Dec '64

Completed 3 Dec '64

EXPLANATION

Sandstone — WATER LEVEL — DATE

Limestone — Fossils. — Voids. — Marl

Logged M.G.M.

Date 4 Dec. 64

Drawn J.P.T.

Traced D.R.P.E.

Checked JGJ

1 inch to 10 feet Vert. Scale

Sheet 1 of 1

S4024 Drawing No. G4J

250—7.69 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L7

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAMSITE — CO-ORDINATES — R.L. 314 FT

FEATURE RIP-RAP — HUNDRED HOLDER — DIRECTION —

LOCATION LOWBANK — SECTION 10 B — ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	Class	Depth and Size of Core	Log	Lift and Core rec'y %	Core Length	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	NOTES Water Level (Date) Drilling Water Return Character of Drill Cuttings	PERCOLATION TEST Depth (Ft.) From	To	Loss in GRM	Pressure PSI	Length of Test Min.
NO CORE			5										
	CLAY, finely sandy, grey green and red mottled. No fossils, Grain size less 0·2mm		10		100		Cracks due to drying out 0·1ft apart Not porous.						
NO CORE			0										
CALCAREOUS SANDSTONE Pale grey brown	Quartz grains from 0·2 to 2m.m. mainly 1m.m Calcareous cement, variable, crystalline and finely granular. Core broken by light hammer blow.		20		100		Crossbedding visible, Slightly porous Voids, elongated, near horizontal, form 5-10% total volume	No Water in hole (Dec 64)					
SANDY LIMESTONE	Crystalline limestone, some sand, mainly 0·5mm Not broken by light hammer blow.		30		100		Not porous · Few near horizontal joints, voids irregular 0-5% of total volume						
CLAY SAND	CLAY, 25% quartz grains, mainly 2mm		40		90								
NO CORE			0										

NORWEST BEND FORMATION

NOT WATER PRESSURE TESTED

END OF HOLE. 48ft.
R.L. 266ft.

Drill No. 7
Type E1000
Driller Briggs
Commenced 3 Dec 64
Completed 5 Dec 64

Limestone Fossils
Sandstone Voids

Logged M.G.M.
Date Dec '64
Drawn J.P.T.
Traced G.M.
Checked

Vert. Scale 1in = 10
Sheet 1 of 1
S 4033
Drawing No. G+J

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 8

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAMSITE — CO-ORDINATES — R.L. 302 FT

FEATURE RIP-RAP — HUNDRED HOLDER — DIRECTION —

LOCATION LOWBANK — SECTION — ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	Class	Depth and Size of Core	Log	Lift and Core rec'y %	Length Core	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NO CORE									
NORWEST BEND FORMATION CALCAREOUS SANDSTONE — Pale grey	Quartz grains, mainly 1·5 m.m. Carbonate cement, granular, approx. 30% of volume. Core readily broken by hand.	NMS	10		70		Slightly porous	No Water in Hole (8 Dec'64)	NOT WATER PRESSURE TESTED
NO CORE					40				
NO CORE									
NO CORE					50				
NO CORE			20		85		Voids 5-20% total volume (near horizontal)		
NO CORE									
NORWEST BEND FORMATION SANDY LIMESTONE — Pale grey	Limestone mainly crystalline. 20% quartz sand, mainly 0·5 m.m. Not broken by light hammer blow.				90		Mainly 0·25 ft. From 0·2 to 3·0 ft.		
			30		100		Not porous		
					100		Voids 0 to 5% total volume		
NORWEST BEND FORMATION CALCAREOUS SANDSTONE — Light grey to brown	Quartz grains, mainly 2 m.m., subrounded, crystalline and granular carbonate cement. Not broken by light hammer blow.						Mainly 1·0 ft. From 0·3 to 2·0 ft.		
			40		100		Porous		
							Voids 5-10% total volume		
MORGAN LIMESTONE LIMESTONE — Light grey to brown	Fossiliferous limestone, mainly granular carbonate, approx. 25% quartz grains, mainly 1·5 m.m. Broken in hand.				100		Mainly 0·5 ft. From 0·2 to 1·0 ft.		
							Not porous		
			50		100		Voids 5-15% total volume (Irregular)		
NO CORE					85				
MORGAN LIMESTONE SILTY LIMESTONE — Light grey	Mainly granular carbonate, marly in bands, sandy. Varying strength.						Mainly 0·25 ft. From 0·05 to 1·0 ft.		
NO CORE					100		Not porous		
NO CORE			60		80		Voids less 5% total volume		
	END OF HOLE						63·5 ft.		
	R.L.						238·5 ft.		

Drill No. 7
Type E 1000
Driller T. Briggs
Commenced 6 Dec'64
Completed 8 Dec'64

Limestone — Fossils
Sandstone — Voids

Logged M.G.M.
Date Dec'64
Drawn J.P.T.
Traced T.P.S.
Checked DMS

1 in. = 10 ft. Vert. Scale
Sheet 1 of 1
S4048 Drawing No. GJ

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 9

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAMSITE CO-ORDINATES R.L. 291 FT

FEATURE RIP-RAP HUNDRED HOLDER DIRECTION —

LOCATION LOWBANK SECTION ANGLE FROM HORIZONTAL 90°

ROCK TYPE / Degree of Weathering Shown in Core	DESCRIPTION	Casing	Class	Depth and Size of Core	Log	Lift and Core rec'y %	Core Length	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NO CORE		NXC	N/MS	10		10			No Water in Hole (10 Dec '64)	NOT WATER PRESSURE TESTED
FORMATION CALCAREOUS SANDSTONE — Pale grey	Quartz grains, mainly 1 m.m. Cementation variable, mainly granular, approx. 30% of volume. Partly breakable in hand.					90	From 0.05 ft. to 0.5 ft. Mainly 0.2 ft.	Near horizontal bedding visible. Voids horizontally elongated from 0 to 10% of volume. Slightly porous.		
NO CORE						50				
NO CORE						30				
BEND SANDY LIMESTONE — Pale grey	Limestone, crystalline, some fine sand, mainly 0.3 m.m. Core not broken by light hammer blow.					100	Mainly 1 ft.	Few voids. Not porous.		
	Weakly cemented. Broken by light hammer blow.			20		85		Slightly porous		DRILLER'S NOTES: "Drill washed" from 22 to 28.7 ft.
NO CORE						0				
NOR'WEST CALCAREOUS SANDSTONE — Light grey and brown	Quartz grains from 0.2 to 3 m.m., mainly 2 m.m., subrounded. Granular carbonate cement.			30		92	From 0.1 to 1 ft. Mainly 0.5 ft.	Voids form 20% of volume. Very porous.		
NO CORE	Broken by light hammer blow.					60				
NO CORE										
NO CORE LIMESTONE	Sandy, fossiliferous. Broken in hand.			40		60	Mainly 0.1 ft.	Voids form 25% of volume.		"Soft sand fell in behind barrell."
MORGAN LIMESTONE										

END OF HOLE 44 ft. R.L. 247 ft.

Drill No. 7
Type E 1000
Driller T. Briggs
Commenced 9 Dec 64
Completed 10 Dec 64

Limestone Fossils
Sandstone Voids

Logged	M.G.M.
Date	14 Dec 64
Drawn	J.P.T.
Traced	T.P.S.
Checked	DMS

1 in. = 10 ft. Vert. Scale

Sheet 1 of 1

S4049 Drawing No. G 2 J

250—7.66 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L 10

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM. CO-ORDINATES ..... R.L. 316 FT

FEATURE RIP-RAP. HUNDRED HOLDER DIRECTION —— °

LOCATION LOWBANK. SECTION 10B ANGLE FROM HORIZONTAL 90 °

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	Casing Class	Depth and Size of Core	Log	Lift and Core recovery	Core Lengths	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NO CORE		NXC	10	0				NO WATER IN HOLE. (13 Dec. '64)	NOT WATER PRESSURE TESTED.
NORWEST BEND FORMATION Mainly CALCAREOUS SANDSTONE, LIMESTONE. Some SANDY. Pale brown	Quartz grains, mainly 2mm., Crystalline carbonate matrix, Slightly porous, Core not broken by light hammer blow		20	NMS	100	From 0.1 to 0.7 ft, mainly 0.4 ft.	Voids form 10% of volume, near horizontal		
	Quartz grains, some mica flakes, mainly less than 0.5 mm. some coarser grains. Carbonate matrix, granular and crystalline. Moderately to highly porous. Mainly broken by light hammer blow. (Not broken with light hammer)		30		100	From 0.2 to 1 ft, mainly 0.3 ft.	Voids form approx. 5% of volume, dip up to 30°		
NO CORE					95	Less than 0.3 ft.	Voids form up to 10% of volume.		
Pale brown									
NO CORE	Oyster bed. Matrix of yellow-brown calcareous sandstone.		40		70	0.1 to 0.5 ft, mainly 0.3 ft.	Few voids		
NO CORE	Sand, micaceous, weakly cemented				65				

END OF HOLE 44 ft.
R.L. 272 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7
Type E 1000.
Driller BRIGGS
Commenced 11 Dec '64
Completed 13 Dec '64

EXPLANATION

Limestone
Sandstone, Coarse Fine
Clayey sand.
Fossils.
Voids.

Logged J.P.T.
Date 19 Jan. '65
Drawn J.P.T.
Traced J.P.T.
Checked

1 in = 10 ft
Vert. Scale

Sheet 1 of 1
S4075
Drawing No. G.W.

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L11

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAMSITE CO-ORDINATES R.L. 315 FT

FEATURE RIP-RAP HUNDRED HOLDER DIRECTION —

LOCATION LOWBANK SECTION ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	Casing	Class	Depth and Size of Core	Log	Lift and Core rec'y %	Core Length	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NO CORE		NXC		0						
SANDY CLAY	30% poorly sorted quartz grains, mainly 0·5 m.m.			10		80	Mainly 0·1 ft.			
NO CORE			NMS							
CLAYEY SAND	70% quartz grains partly kunkarized, broken in hand.					80	Mainly 0·3 ft.	Irregular voids. Upto 15% of volume. Not porous		
NO CORE				20		5				
Pale brown	Quartz grains from 0·2 to 2 m.m., mainly 1·5 mm. Calcareous cement, crystalline and granular, increasing with depth. Mainly unbroken with light hammer blow					60	Mainly 0·3 ft.	Irregular voids form 15% of sample volume. Porous. Bedding visible		
NO CORE						90		← Moderately porous		
Pale grey to pale brown	Limestone, crystalline sandy — particularly below 36 ft. Fossiliferous below 36 ft. Not broken by light hammer blow.			30		100	Mainly 0·4 to 2·5 ft.	Voids form 0 to 10% of sample volume Not porous.		
						100	Mainly 0·75 ft.	Voids form approx 5% of total volume Not porous.		
NO CORE				40		50	Mainly 0·1 ft.			
NO CORE	Core broken in hand →							Voids up to 15% Porous		

NOR'WEST BEND FORMATION
Calcareous Sandstone and Sandy Limestone

No Water in Hole (15 Dec '64)

NOT WATER PRESSURE TESTED

Driller noted; "occasional soft patches."

NO WATER RETURN

END OF HOLE 44 ft.
R.L 271 ft.

Drill No. 7
Type E 1000
Driller T. Briggs
Commenced Dec '64
Completed Dec '64

Limestone
Sandstone
Clay
Fossils
Voids

Logged	M.G.M.
Date	Dec '64
Drawn	J.P.T.
Traced	T.P.S.
Checked	D.M.

1 in = 10 ft Vert. Scale

Sheet 1 of 1

54050 Drawing No. G2J

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No: L4A

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: CHOWILLA DAM — CO-ORDINATES: — — ADOPTED R.L. 315 FT

FEATURE: RIP-RAP — HUNDRED: HOLDER — DIRECTION: — °

LOCATION: LOWBANK — SECTION: 10B — ANGLE FROM HORIZONTAL: 90° °

ROCK TYPE / Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Type and Size of Core	Depth	Log	Lift and Core rec'y %	Core Length	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NORWEST BEND FORMATION Calcareous Sandstone	NO CORE		NXC	0					No water in hole (21 Jan '65)	Not water Pressure Tested
	Sandy clay, moderate dry strength			10		45				
	Quartz grains, mainly 1mm, subrounded, poorly cemented with grandular carbonate. Mainly broken in hand, Numerous fossils			20	NMS	25		Voids form 25% of volume. Highly porous		
	Quartz grains, medium grained, subrounded, micaceous, granular and crystalline cement, thin limestone bands and frequent poorly cemented friable bands. Mainly broken by light hammer blow, Numerous fossils in bands.			30		100	Less than 0.2ft			
						80	Mainly 0.2ft	Voids, 5 to 20% total volume. Near horizontal bedding. Moderately to highly porous. Voids elongated, near horizontal. Joints irregular, indistinct. generally near horizontal.		
						40				
						45	Less than 0.2ft mainly 0.1ft			
				40		70				
	Quartz grains, fine to medium, micaceous, well cemented, few fossils, Not broken by light hammer blow.					50		No voids, slightly porous.		
						100	Mainly 0.8ft			

End of Hole 48ft. R.L. 367ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7

Type E 1000

Driller T. Briggs

Commenced 17 Jan '65

Completed 18 Jan '65

EXPLANATION

Calcareous Sandstone, fine to medium grained

Crystalline limestone, cc fossils, o/o voids

WATER LEVEL ◀ DATE

Logged M.G.M.

Date 21 Jan '65

Drawn J.P.T.

Traced B.L.S.

Checked [illegible]

Vert. Scale 1" to 10'

Sheet 1 of 1

S 4038

Drawing No. G.S.J.

250—7.69 6036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L7A

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM | CO-ORDINATES ADOPTED | R.L. 314 FT

FEATURE RIP RAP | HUNDRED HOLDER | DIRECTION —°

LOCATION LOWBANK | SECTION 10B | ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Type	Depth and Size of Core	Log	Lift and Core rec'y	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NORWEST BEND FORMATION Sandy limestone to Calcareous Sandstone	NO CORE		WXC	10		0			
	Pale grey brown Quartz grains, 40 to 90% of volume, mainly 1 to 2mm, subrounded. Calcareous cement, variable, granular and crystalline in bands, some core broken by light hammer blow.		NMS	20		0			Not Water Pressure Tested
	Fine crystalline carbonate, some quartz sand and sandy bands. Mainly not broken by light hammer blow.			30		100	Voids, elongated, near horizontal, up to 20% of volume in areas shown.	No Water in hole (27 Jan '65)	
	NO CORE			40		100			
						100			
						95	Bedding near horizontal, some current bedding visible. 0.1 to 2.0 ft. mainly 1.0 ft.		
	END OF HOLE 42 ft. RL 272 ft.								

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7
Type E 1000
Driller T. Briggs
Commenced 21 Jan '65
Completed 22 Jan '65

EXPLANATION
Calcareous sandstone, mainly coarse
Crystalline Limestone, sandy
WATER LEVEL ◀ DATE
Fossils
Voids

Logged M.G.M. J.P.T.
Date 27 Jan '65
Drawn J.P.T.
Traced B.L.S.
Checked

Vert. Scale 1" to 10'
Sheet 1 of 1
S4039
Drawing No. G1J

250—7.60 8036

DEPARTMENT OF MINES — SOUTH AUSTRALIA

Hole No. L10A

GEOLOGICAL LOG OF DRILL HOLE

PROJECT CHOWILLA DAM — CO-ORDINATES — — ADOPTED R.L. 316 FT

FEATURE RIP RAP — HUNDRED HOLDER — DIRECTION °

LOCATION LOW BANK — SECTION 108 — ANGLE FROM HORIZONTAL 90°

ROCK TYPE Degree of Weathering Shown in Core	DESCRIPTION	R.L.	Depth and Size of Core	Log	Lift and Core Recovery (Cum. Length)	STRUCTURES Joints, Veins, Seams Faults, Crushed Zones	WATER LEVEL	WATER PRESSURE TEST GALLONS PER MINUTE LOSS 5 10
NORTHWEST BEND FORMATION Calcareous sandstone					0			
No Core			10		0			
					0			
			20		0			Not Water Pressure Tested
No core	Quartz grains, mainly 1 to 2 mm, well rounded, crystalline matrix. Some core broken by light hammer blow.				10 80	Voids form 15% of volume	No Water in hole (20 Jan '65)	
No core	Quartz grains, mainly 0.2 to 0.7 mm., Some mica grains. Mainly granular carbonate cement. Moderately to highly porous, Mainly broken by light hammer blow.				Mainly 0.5 ft. 85			
Pale Brown			30		Less than 0.5 ft. 70	No bedding visible, voids about 5 to 15% of total volume, elongated near horizontal, probably formed by solution of fossils		
No Core					35			
No Core			40		Less than 0.3 ft. 35			
No Core					5			

End of Hole 46.0 ft.
R.L. 260 ft.

TEST PRESSURES SHOWN IN POUNDS PER SQ. INCH MEASURED AT GROUND SURFACE

Drill No. 7
Type E1000
Driller T Briggs.
Commenced 19 Jan '65
Completed 20 Jan '65

EXPLANATION
Calcareous sandstone, fine to medium
WATER LEVEL
DATE
Crystalline limestone, sandy
Fossils
Voids

Logged M.G.M., J.P.T.
Date 20 Jan '65
Drawn J.P.T.
Traced B.L.S.
Checked JPT

Vert. Scale 1" = 10 ft
Sheet 1 of 1
S4040
Drawing No. G+J

250—7.60 0336

APPENDIX B

LOGS OF CLIFF SECTIONS

Section No.	Depth (feet)	Drawing No.
D7	22	S3925 G + J
D8	16	S3926 G + J
D9	22	S 3927 G + J
D10	22	S3928 G + J
D11	21	S3929 G + J
D12	32	S3930 G + J
D13	31	S4078 G + J

GEOLOGICAL DESCRIPTION.	GRAPHIC LOG.	DEPTH.		STRUCTURES and WEATHERING.
CRYSTALLINE LIMESTONE, Some fine to medium sand, patches of chalky lime. Few shelly fossils.			Very strong, tough, very dense, Fractures across sand grains.	Weathering produces deep fluting,
SANDSTONE to CONGLOMERATE, calcareous matrix, occasional fossils throughout, very fossiliferous from 16 to 18 ft. Grades to a sandy crystalline limestone from 12 to 15 ft. Some crossbedding in upper part.		10	Very strong, very tough, very dense. Fractures across sand grains.	Vertical joints 8 to 30 ft apart. Little effect of weathering. Small cavities where fossils have been dissolved
			Moderately strong, fairly dense.	Numerous irregular cracks at the surface.
CALCAREOUS SAND, fine grained, clayey, micaceous.		20	Soft and crumbly.	Readily eroded.

END OF EXPOSURE. 22 ft.

Please leave 1 inch binding margin

Adopted R.L. of surface = 296 ft.

FIG.

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. JRJ	CHOWILLA PROJECT.	D.M.	Scale 1 inch = 10 ft.
		Tcd.	PROPOSED LOWBANK QUARRY SITE.	Req.	S3925 [redacted]
		Ckd.			G+J.
Director		Exd.	GEOLOGICAL SECTION. D7		Date 12 Aug '64

400—4.64 0469

GEOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH		STRUCTURE and WEATHERING.
SANDSTONE to CONGLOMERATE, Calcareous matrix, few fossils. Bedding is mainly horizontal with minor crossbedding.		10	Very strong, very tough, very dense. Fractures across the sand grains.	Vertical joints 15 to 30 ft apart. Continuous bed. Deep fluting in top 6 ft — follows the bedding.
CRYSTALLINE LIMESTONE, very fossiliferous			Moderately strong, dense	Numerous irregular crack
LIMESTONE, chalky, sandy.			Friable.	Readily eroded - cliff undercu

END OF EXPOSURE. 16 ft.

MARGIN

Adopted R.L. of surface = 294 ft

FIGURE

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. RJ	CHOWILLA PROJECT.	D.M.	Scale 1 inch = 10 ft.
		Tcd.	PROPOSED LOWBANK QUARRY SITE.	Req.	S3926 G+J [redacted]
		Ckd.			
Director		Exd.	GEOLOGICAL SECTION. D8		Date 12 Aug. '64.

400—4.64 6439

GEOLOGICAL DESCRIPTION	GRAPHIC LOG	DEPTH		STRUCTURE and WEATHERING
LIMESTONE (?) brown, cryptocrystalline (?), some coorse sand.			Strong, tough, fairly dense.	Small solution cavities. Vertical joints 15 to 35 ft apart. Deep fluting at diff face
LIMESTONE, some fine sand, crystalline, few fossils.		10	Very strong, very tough, very dense.	
SANDSTONE to CONGLOMERATE, calcareous matrix, few fossils.				Some shallow fluting.
CRYSTALLINE LIMESTONE, some fine sand.				
SANDSTONE to CONGLOMERATE, calcareous matrix, few fossils.				
CRYSTALLINE LIMESTONE; sandy, very fossiliferous.		20	Brittle, fairly dense.	Numerous irregular cracks.

END OF EXPOSURE. 22ft.

Adopted R.L. of surface = 297 ft.

FIGURE

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. JPJ	CHOWILLA PROJECT. PROPOSED LOWBANK QUARRY SITE. GEOLOGICAL SECTION. D9	D.M.	Scale 1 inch = 10 ft
		Tcd.		Req.	53927 [redacted]
		Ckd.			G.J.
Director		Exd.			Date 12 Aug. 64

400—4.64 6469

GEOLOGICAL DESCRIPTION.	GRAPHIC LOG.	DEPTH (Ft)		STRUCTURE and WEATHERING.
SANDSTONE to CONGLOMERATE, very calcareous, some shelly fossils.			Moderately strong and tough. Some soft patches at surface.	Numerous irregular cracks. Considerably weathered
LIMESTONE, crystalline, finegrained, some fine sand, very fossiliferous from 9 to 11 ft and 17 to 19 ft. Horizontal bedding.		10 20	Massive, very strong, tough, very dense.	Vertical joints spaced more than 20 ft apart. Small cavities occur where fossils dissolved on exposed face. Little sign of weathering on sheltered face.

END OF EXPOSURE. 22 ft.

Adopted R.L of surface = 291 ft.

FIGURE

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. JPD	CHOWILLA PROJECT.	D.M.	Scale 1 inch = 10 ft.
		Tcd.	PROPOSED LOWBANK QUARRY SITE.	Req.	S3928 [redacted]
		Ckd.			G+J.
Director		Exd.	GEOLOGICAL SECTION. DIO		Date 13 Aug. '64.

400—4.64 0189

GEOLOGICAL DESCRIPTION.	GRAPHIC LOG.	DEPTH.		STRUCTURE and WEATHERING.
SANDSTONE, chalky lime matrix, fine to medium grained.			Moderately soft to moderately hard.	Numerous irregular cracks. Considerably weathered.
SANDSTONE to CONGLOMERATE, calcareous matrix, some fossils. Minor cross bedding.		10	Very strong, very tough, Mainly fairly dense (variable)	Vertical joints up to 5 ft apart. Some discontinuous horizontal joints. Weathering shows as fluting – mainly shallow.
CRYSTALLINE LIMESTONE, Some coarse sand, very fossiliferous.		20	Very strong, tough, very dense	Severely cracked at the surface. Solution cavities where shells dissolved.

END OF EXPOSURE. 21 ft.

Adopted R.L. of surface = 293 ft.

FIGURE

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn JPJ	CHOWILLA PROJECT. PROPOSED LOWBANK QUARRY SITE. D11 GEOLOGICAL SECTION	D.M.	Scale 1 inch = 10 ft
		Tcd.		Req.	S3929 [redacted]
		Ckd.			G+J
Director		Exd.			Date 13 Aug '64

400—4.64 8409

GEOLOGICAL DESCRIPTION.	GRAPHIC LOG	DEPTH		STRUCTURE and WEATHERING.
SANDSTONE to CONGLOMERATE, calcareous matrix. Band of shelly fossils from 2.5 to 3.5 ft.			Moderately strong to very strong. Variable density.	In some places the
LIMESTONE, crystalline, some medium sand, few fossils.		10	Very strong, very dense where fresh. Bands of moderately soft weathered material.	rock has been weathered moderately soft. Deep surface fluting occurs in places along the cliff. Large cracks are frequent but not continuous.
Outcrop is obscured by rubble.				
LIMESTONE, crystalline, a little coarse sand, some fossils. Horizontally bedded.		20	Very strong, very dense.	
SAND, finegrained, micaceous.			Unconsolidated.	
LIMESTONE, crystalline, some coarse sand, very fossiliferous.		30	Very strong, dense	Small cavities by solution of fossils at the surface.

END OF EXPOSURE 32 ft.

R.L. of Surface (Adopted) = 297 ft.

FIGURE

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. JGJ	CHOWILLA PROJECT	D.M.	Scale 1 inch = 10 ft
		Tcd.	PROPOSED LOWBANK QUARRY SITE D12	Req.	S3930 [redacted] G.J.
Director		Ckd.	GEOLOGICAL SECTION		Date 13 Aug 64
		Exd.			

400—4.64 . 6469

GEOLOGICAL DESCRIPTN.	DEPTH	GRAPHIC LOG	STRENGTH and DENSITY	STRUCTURE and WEATHERING
CALCAREOUS SANDSTONE, mainly coarse sand, crystalline cement. Banded in beds less than 0·3 ft. Current bedded.	10		V. strong, fairly dense	Weathering produces deep fluting along the bedding.
CRYSTALLINE LIMESTONE, few fossils. Massive bed.	20		Very strong, very dense	Weathering has little effect.
SANDY LIMESTONE, Chalky lime matrix Sandy			Medium density, Slightly friable	Undercut in cliff. Relatively easily eroded.
CALCAREOUS SANDSTONE Chalky matrix, poorly cemented				

END OF EXPOSURE: 30·5 ft

FIG

RL. of Surface (Adopted) = 292 ft.

~~Please indicate approximate location of bore and return sketch to DEPARTMENT OF MINES, 169 RUNDLE ST., ADELAIDE~~

D.M.	J.P.T.	S.A. DEPT. OF MINES	SCALE 1 in = 10 ft.
Tcd.		CHOWILLA PROJECT PROPOSED LOWBANK QUARRY SITE	S 4078
Ckd.		GEOLOGICAL SECTION D13	G+J.
			Date 21 JAN '65