DEPARTMENT OF MINES
SOUTH AUSTRALIA

CHOWILLA PROJECT

RESERVOIR

GEOLOGICAL INVESTIGATIONS, PROGRESS REPORT NO. 1

Co. Hamley

Client - Engineering and Water Supply Department

by

W.R.P. Boucaut
Assistant Senior Geologist
ENGINEERING GEOLOGY SECTION

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Rept. Bk. No. 63/107
G.S. No. 3582
D.M. 1498/66

8th November, 1966

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DEPARTMENT OF MINES
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INTRODUCTION

A reconnaissance inspection of the Chowilla Reservoir area was carried out between 22nd and 24th August, 1966, to determine the geological conditions around the rim, particularly of the strata below top water level, and the possibility of leakage from the reservoir into these strata.

Mapping carried out was mainly based on previous work by geologists of the Department.

TOPOGRAPHY

The River Murray has a low gradient and meanders back and forth across a broad, flat flood plain (Fig. 1).

There are two forms to the boundaries of the plain.

.... Form I - Steep (slopes of 45° to 90°) cliffs from 20 to 100ft. high, with either the present or an old river channel close to the base of the cliff.

.... Form II - Gentle slopes (less than 20°) rising from the flood plain.

Form I gives an almost continuous exposure of the geological strata, but often the base of the cliff is obscured by talus deposits many feet thick.

In Form II geological exposures are sparse or absent.

GEOLOGY

Exposures in the cliffs are of nearly horizontal clays and sands. Two distinct geological units are recognized, as follows:-

Reduced Level		
From:	To:	
above (210-230)	290	Blanchetown Clay Formation.
170	(210-230)	Parilla Sand Formation. (Mainly below Full Supply Level).

Underlying the Parilla Sand Formation is the Loxton Sand Formation which is approximately 150ft. thick, but this formation is not exposed in cliffs in the reservoir area, except possibly in a limited area near the dam axis on the left abutment.

The Blanchetown Clay Formation. This consists mainly of a greenish, highly plastic clay in beds generally between 10ft. and 20ft. thick, separated by sand in beds generally between 1ft. and 10ft. thick. These sand interbeds usually contain more than 10 percent of clayey fines, probably derived from the adjacent clay beds. The base of the Blanchetown Clay Formation is generally at about R.L. 210, that is about 5ft. above full supply level.

The Parilla Sands Formation. This has been explored in some detail as it is the source for granular fill for the dam embankment (Borrow Areas A and B). It has also been explored in somewhat less detail by drilling beneath the Tilmy Flat area. Some of the results of this work are shown in Table 1. The Parilla Sands are mainly uniformly graded quartz sand, containing generally between 5 and 15 percent of silt and clay fines. Although the sand in most exposures and drill holes is uniformly graded, there is some variation, both laterally and vertically in the predominant grain sizes.

TABLE 1

ANALYSES OF SAMPLES FROM PARILLA SANDS FORMATION

LOCALITY	SAMPLE R.L. (ft.)	SOURCE C = CLIFF D = DRILL HOLE	PREDOMINATE GRAIN SIZE (m.m.)	PERCENTAGE FINES (< # 300 Mesh)
Left Bank near Chowilla Dam Axis	226	D (D.H.G4)	0.3 to 0.6	5
	207	D (D.H.G4)	0.3 to 0.6	4
	200	D (D.H.G4)	0.3 to 0.6	1
	187	D (D.H.G4)	0.3 to 0.8	3
	176	D (D.H.G4)	0.3 to 0.8	2
	169	D (D.H.G4)	0.3 to 0.6	5
	156	D (D.H.G4)	0.3 to 0.6	5
Right Bank - Near Chowilla Dam Axis	218	D (D.H.G23)	0.2 to 0.6	10.5
	210	D (D.H.G23)	0.2 to 0.6	6
	191	D (D.H.G23)	0.2 to 1.0	3.5
	185	D (D.H.G23)	0.15 to 1.0	4.5
	175	D (D.H.G23)	0.2 to 1.0	5
Border Cliffs Homestead	205(approx.)	C	Not tested	10.4
	190(approx.)	C	Not tested	8.3
Berribee Homestead	208	C	Not tested	5.1
Moorna Homestead	212	C	Not tested	12.3

Logs of relevant drill holes are included as Appendix A, and results of mechanical analyses of Parilla Sand samples are included as Appendix B.

PERMEABILITY OF MATERIALS

Tables 2 and 3, extracted from the Summary Report of Soil Mechanics Ltd. (Ref. 1), summarize the results of permeability tests carried out so far at Chowilla Dam site.

TABLE 2

RESULTS OF PRELIMINARY PERMEABILITY TESTS

Formation	No. of Tests	In situ Average	Permeability*(cm/sec) Max.	Min.
Detritus (Talus)	1	5×10^{-4}		
Reworked Lacustrine (Parilla) Sand	1	1.2×10^{-3}		
In situ Lacustrine Sand (Parilla Sand)	9	2.0×10^{-3}	3.1×10^{-3}	9×10^{-4}
Upper Estuarine Sand (Loxton Sand)	15	5.1×10^{-3}	2.4×10^{-2}	5×10^{-4}

*Results based upon the highest recorded value for each individual test position:-

TABLE 3

LATEST PERMEABILITY TESTS, PROGRESS RESULTS

Test No.	Co-ordinates of Pump Well	Formation	Permeability cm/sec.
Q19	Ch.68,310E 100,315N	In situ Lacustrine Sand (Parilla Sand) R.L.125 to 145	9×10^{-3}
Q10	Ch.65,330E 99,344N	Upper Estuarine Sand. (Loxton Sand).	3×10^{-3}

It can be seen from these tables that the permeabilities of talus (detritus) and reworked Parilla (Lacustrine) Sands are generally lower than that of the undisturbed in situ Parilla Sand. Unfortunately only one test each was made on the talus and reworked Parilla Sand. However field observations of these materials also suggest that their permeability is lower than that of in situ Parilla Sand.

The permeability of 9×10^{-3} cm/sec. for Parilla Sand at the Q19 site (Table 3) appears to be abnormally high. It is much higher than in previous tests (Table 2). The reason for this is not known. All of the tests carried out so far have been below the water table (approx. R.L. 160) and the sands at these levels may be more permeable than those above R.L. 160 and thus exposed in cliffs.

Parilla (Lacustrine) Sands from R.L. 200 to 225 in Borrow Areas A and B near the dam site, when compacted in thin layers in trial embankments, produced material with permeabilities of the order of 10^{-6} cms./sec.

RESERVOIR RIM CONDITIONS

Table 4, attached at the end of this report, gives a summary of conditions around the rim of the reservoir. Typical geological sections are shown on Figs. 2 to 9. The location of the sections, and reference points used on Table 4 are shown on Fig. 1.

The information on Table 4 is summarized further as follows:-

Material Forming Reservoir Rim at Full Supply Level		Approx. Length (Miles)
River Flats, silt and clay covered		100
Cliffs	(a) Talus blanket	25
	(b) Parilla Sand exposed	10
	(c) Blanchetown Clay exposed	5

CONCLUSIONS

.... Leakage through the silt- and clay-covered flood plain should be small.

.... The talus deposits at the foot of cliffs consist of clays, silts and sands, reworked, heterogeneous, and periodically saturated, and in most places appear relatively impermeable.

.... These talus deposits should be increased in thickness with collapse of cliffs above due to saturation and to wave action.

.... Cleaner sands of the Parilla Sands Formation appear permeable, but this permeability should decrease rapidly due to an increase in the percentage of fines near the surface. This increase would be due to (a) deposition of fines carried in the reservoir water during floods (b) deposition of fines derived from re-working of the surface layers of Parilla Sand, and (c) deposition of fines derived from collapse of clays above. The effects (a), (b) and (c) are observed commonly in drainage wells and drill holes.

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WRPB:SMA
8.11.1966

REFERENCES

1. SOIL MECHANICS LIMITED, Report, Chowilla Dam, South Australia, Summary of the Site Investigations, prepared for Engineering and Water Supply Department, South Australian Government, June 1966, No. 4400/102.

2. UNITED STATES BUREAU OF RECLAMATION, Earth Manual, 1st.

TABLE 4

CONDITIONS AT RESERVOIR RIM

From	To	Approx. Distance (Miles)	Topographic Form (as above)	Typical Section No. and Fig. No.	Remarks
A and at J	B	6 2	I	7 (Figs. 2 and 9)	Full Supply Level from 0 to 15ft. above base of Parilla Sand exposure. Talus deposits of mixed sand and clay at foot of cliff appear relatively impermeable. Parilla Sands above talus are permeable and some lateral leakage will occur. Extensive collapse of the cliffs under wave action will probably occur, and should decrease leakage due to deposition of clay from above. Similar sections also occur at location J on the banks of the Lindsay River, in an area which will form an island in the reservoir (Section 1, Figs. 2 and 3). Full Supply Level is either below or up to 5ft. above the base of Parilla Sand exposure.
B	C	38	II	-	Flood plain is blanketed with silts and clays deposited during floods. Leakage should be small.
C	D	3	I	2 (Figs. 2 and 4)	Cliffs up to 30ft. high around bend in river. Full Supply level at top of cliffs. Blanchetown Clays exposed over whole of section, and side leakage should be negligible.
D	E	18	II	-	Head of reservoir, south side. At Full Supply Level water does not extend far over the flood plain.
E	F	12	I	3 (Figs. 2 and 5)	Head of reservoir, north side. Cliffs up to 50ft. high, but full supply level is only up to 10ft. above base of cliff, and only covers talus deposits over Parilla Sands. Leakage should be small. Some minor collapse could occur due to undermining of the cliffs.
F	G	26	II	-	Flood plain is blanketed with silts and clays deposited during floods. Leakage should be small.
G	H	15	I some II	4 (Fig. 6) 5 (Figs. 2 and 7) 6 (Figs. 2 and 8)	Cliffs from 20 to 100ft. high. Full Supply Level from well below to 15ft. above base of Parilla Sands exposure.
H	I	18	II	-	Flood plain is blanketed with silts and clays deposited during floods. Leakage should be small.

APPENDIX A

LOGS OF SELECTED DRILL HOLES

Docket No. 52/63

LOG OF PERCUSSION DRILL HOLE

G4

SHEET 1 OF 2

CHOWILLA DAM

LEFT BANK BORROW AREA 'A'

EMBANKMENT MATERIALS AREA

Hirer E & W.S. DEPT.

Sec. 19 Hd MURTHO

Depth 110 ft R.L. 260 ft Coords 68700E

SOIL TYPE & DESCRIPTION	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY	MOISTURE CONTENT	WATER LEVELS	PENETRATION DATA BLOWS/FOOT 20 40 60 80	PENETROMETER
PLIO-PLEISTOCENE DEPOSITS	0		SM	SAND, fine grained, excess silty fines to clayey fines, light brown to red-brown	C L	Damp Humid			
	10		CL	CLAY, low plasticity, very sandy red-brown, pockets of loamy sand, calcareous.	Firm	Damp			
			SC to CL	SAND fine grained, excess clayey fines, some silty fines, light reddish-brown, some irregular pale grey mottling Grading to	Compact	Humid			
	20		SM	SAND, fine grained, excess silty fines, some clayey fines red-brown to pale yellow-brown.					
SANDSTONE CAPPING. subangular quartz grains poorly cemented by siliceous cement			SP to rock	Contains cemented lumps up to 0.1 ft. diam. SAND, medium-grained, some fines, pale brown, cemented.	Hard			Drilled. No sample taken	
LACUSTRINE SAND Quartz grains, clean, well-rounded to subangular up to 0.05 inch dia.	30			SAND, poorly graded, few silty and clayey fines, pale grey.					
	40			No Fines.	Compact	Damp			
				Few fines					
Colour apparently due to presence of ferruginous fines.	50			To end of hole, sand as above, ranges from pale brown to red-brown, few fines.					
	60		SP						
	70								
Some larger grains up to 0.1 in. diameter.	80					Moist			
Grains up to 0.12 inch, very well rounded.	90						April '64	Samples taken using 'D' type shoe.	
	100					Saturated			

TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE			
Open Tube	Water cut 91 ft.	V.S. Very Soft	V.L. Very loose	H. Humid.	Plant No. 24	Logged	J.P.T.
Sealed Tube	Static level 91 ft.	S. Soft	L. Loose	D. Damp.	Type	Date	14 Apr 64
Auger barrel	Supply	F. Firm	C. Compact	M. Moist.	Driller Farrow	Drawn	J.P.T.
Slush pump	Analysis (pts. p. million	St. Stiff	D. Dense	W. Wet	Date comm. 9 Apr 64	Checked	D.H.S.
				S. Saturated	Date comp. 13 Apr 64	Passed	

Serial No. [illegible]
Docket No. [illegible]

DEPARTMENT OF MINES - SOUTH AUSTRALIA

LOG OF PERCUSSION DRILL HOLE

HOLE NO. G4
SHEET 2 OF 2

PROJECT CHOWILLA DAM — Hirer E&WS DEPT.
LOCATION LEFT BANK BORROW AREA 'A' — Sec. 19 Hd. MURTHO
FEATURE EMBANKMENT MATERIAL — Depth 110ft. R.L. 260ft. Coords 687936 5007180N

SOIL TYPE GEOLOGICAL DESCRIPTION	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY	MOISTURE CONTENT	WATER LEVELS	PENETRATION DATA BLOWS/FOOT 20 40 60 80 100	PENETROMETER
LACUSTRINE SANDS			SP	SAND well graded, few silty and clayey fines, pale brown	Compact	Saturated			
	110			END OF HOLE at 110 feet R.L. 150 ft.					

Samples for Mechanical Analysis.
34 to 35 ft.
53 to 54 ft.
60 to 61 ft.
73 to 74 ft.
84 to 85 ft.
91 to 92 ft.
104 to 105 ft.

TYPE OF SAMPLE
Open Tube
Sealed Tube
Auger barrel
Slab

HYDROLOGY
Water cut 91ft.
Static level 91ft.
Supply —

CONSISTENCY: V.S. Very Soft; S. Soft
REL. DENSITY: V.L. Very loose; L. Loose

MOISTURE: H. Humid.; D. Damp.; M. Moist.

Plant No. 24
Type
Driller Forrow
Date comm.

Logged J.P.T.
Date 14 Apr. 64
Drawn J.P.T.
Checked DHS

DEPARTMENT OF MINES - SOUTH AUSTRALIA

HOLE NO. G23

SHEET 1 OF 1

LOG OF PERCUSSION DRILL HOLE

PROJECT CHOWILLA DAM Hirer E & W S DEPT.

LOCATION RIGHT BANK - BORROW AREA "B" COUNTY HAMLEY

FEATURE EMBANKMENT MATERIALS Depth 80 feet R.L. 238 ft. Coords 46276 E, 93172 N.

SOIL TYPE GEOLOGICAL DESCRIPTION	CASING R.L. (FEET)	DEPTH (FEET)	GRAPHIC LOG	GROUP SYMBOL	SOIL DESCRIPTION GROUP NAME	CONSISTENCY REL. DENSITY	MOISTURE CONTENT	WATER LEVELS	PENETRATION DATA BLOWS/FOOT 20 40 60 80 100
WIND BLOWN SAND				SM	SAND, fine grained, excess silt fines, red-brown, Lime from 1 to 3 feet Rock fragments from 2-3 feet.		M		
SANDSTONE CAPPING Quartz grains, siliceous cement, strongly cemented.	230	10		ROCK	SANDSTONE, fine grained, pale brown				Drilled No Sample Taken
LACUSTRINE SAND Quartz grains, mainly subangular some dark grains; thin bands with ferruginous fines show horizontal bedding	220	20		SP	SAND, poorly graded, fine to medium-grained, some clay fines coating grains, light yellow-brown medium dry strength. Grains up to 1·3mm	Compact			
Quartz grains, subangular to subrounded, few dark grains, Bedding horizontal.	210	30		SP	SAND, poorly graded fine to medium grained, some clay fines - unevenly distributed in horizontal bands, pale grey-brown to light yellow-brown slight to medium dry strength. Grains up to 1·3mm	Loose			
PLIO-PLEISTOCENE LACUSTRINE SANDS.	6 inch	40		SP	SAND, poorly graded, fine to medium grained, ferruginous fines coating grains, light yellow-brown, medium dry strength. Grains up to 1·5mm		Damp		All samples taken with "A" shoe
Quartz grains, subangular, numerous dark grains.	190	50		SP	SAND, poorly graded, fine to medium grained, few fines pale yellow brown, slight dry strength. Grains up to 1·3mm				
	180			SP	SAND, poorly graded, fine to medium grained excess (?) clay fines, yellow brown, medium to high dry strength Grains up to 1·5mm.				
Quartz grains, subangular. Occasional coloured grains. Concentrations of fines and variations in grain size show horizontal bedding	170	60		SP	SAND, poorly graded, medium-grained, clay fines - unevenly distributed, red brown to light grey brown, slight to high dry strength. Grains up to 2·5mm.	Compact			
	160	70		SP	SAND, variable grading, medium grained, excess clay fines red-brown, to light yellow brown, high dry strength Grains up to 2·5mm.		Moist	June '64	
		80			END of HOLE 80 feet. R.L. 158 feet.				

Samples for Mechanical Analysis.
20 to 21 ft.
28 to 29 ft.
47 to 48 ft.
53 to 54 ft.
63 to 64 ft.

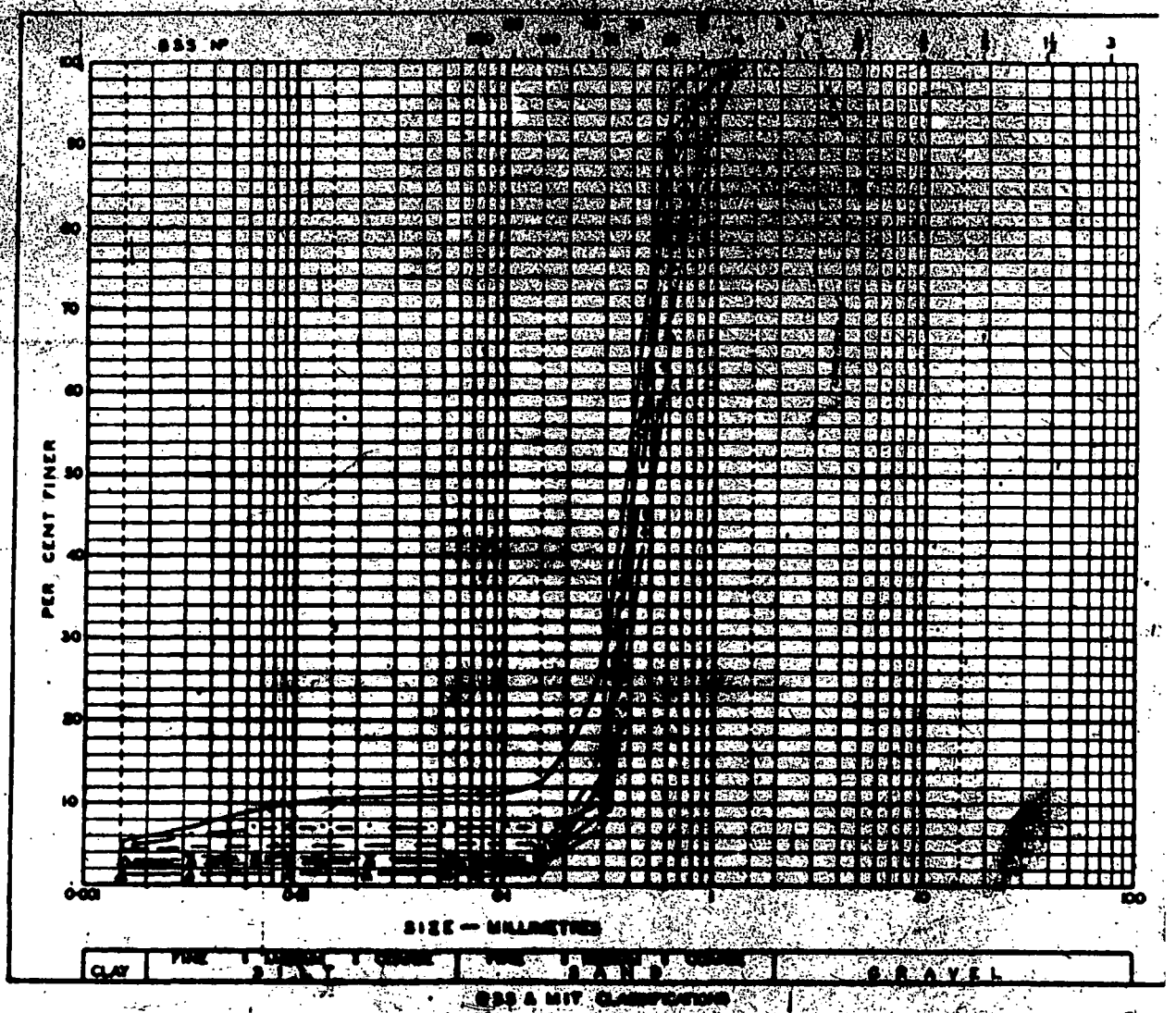
TYPE OF SAMPLE	HYDROLOGY	CONSISTENCY	REL. DENSITY	MOISTURE
Open Tube	Water cut 80 ft.	VS-Very Soft	VL-Very Loose	H-Humid
Sealed Tube	Static level —	S-Soft	L-Loose	D-Damp
Auger barrel	Supply —	F-Firm	C-Compact	M-Moist
Tush pump	Analysis (p.p.m) —	St-Stiff	D-Dense	W-Wet

Plant No 24 Logged J.R.T.
Type Percussion Date 6 June '64
Driller Farron Drawn J.P.T.
Started 2 June '64 Traced B.L.S.
Finished 4 June '64 Checked

APPENDIX B

RESULTS OF MECHANICAL ANALYSES OF PARILLA SANDS SAMPLES

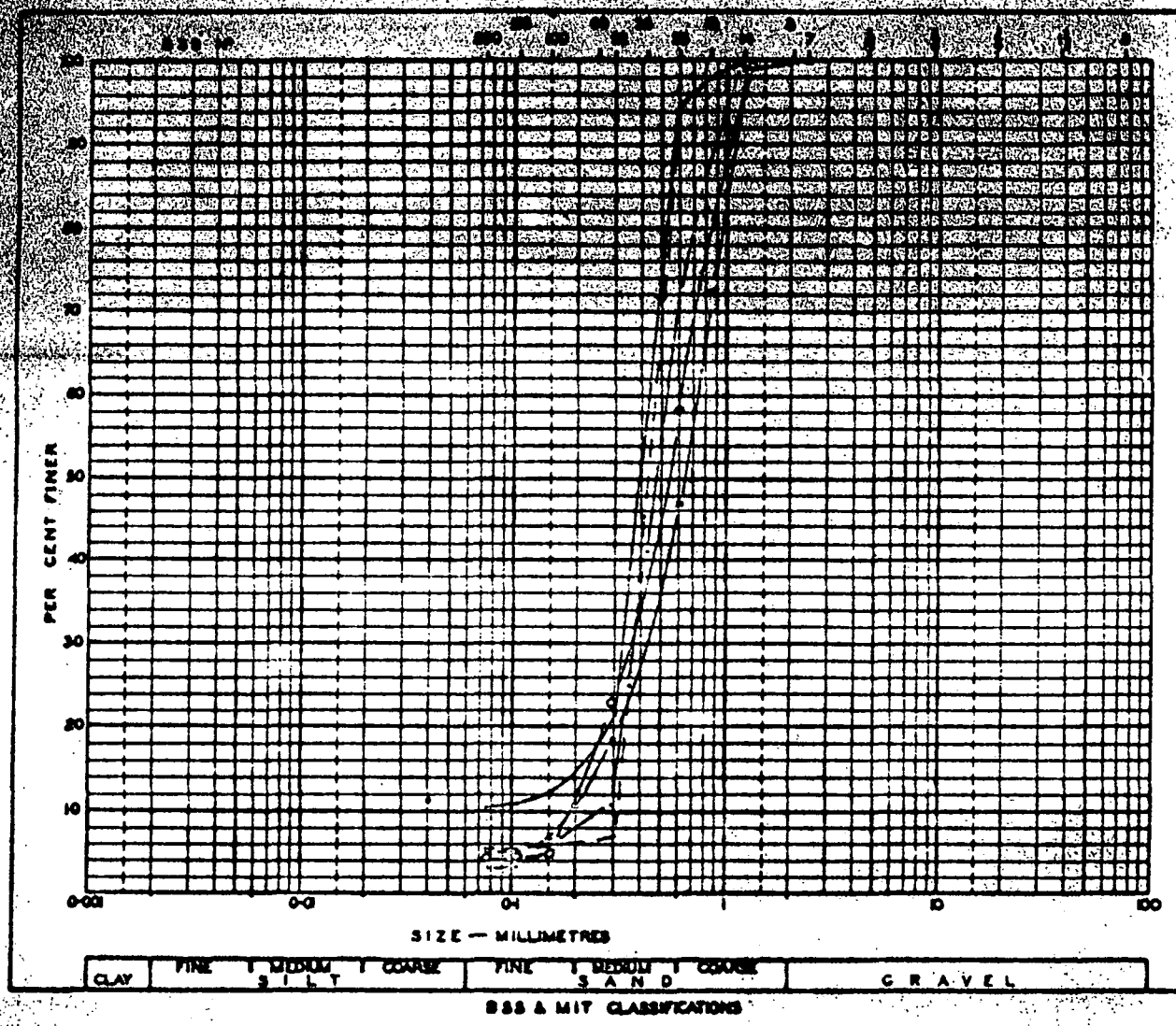
SAMPLE No G4



JOB CHOWILLA STORAGE	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION LEFT BANK. BORROW AREA A.	MECHANICAL ANALYSIS
REFERENCE	
DATE 3. 8. 64	SAMPLE No G4 (PARILLA SANDS)
OPERATOR AK.	

Depth ft.	Line Symbol	% clay	% silt	% Sand	Sand % coarse	Sand % med.	Sand % fine	
34 to 35	———	6	5	89	4	80	5	Off-white med. Sand
53 to 54	— —	4	1	95	4	87	4	Yellow med. Sand
60 to 61	- . — .	5	2	93	14	78	1	Orange med. Sand w/ a
73 to 74	— x —	3	0	97	25	69	3	Yellow med. Sand w. coa
84 to 85	— o —	3	0	97	54	61	2	Pink med. Sand w/ coar
91 to 92	— □	2	0	98	71	86	5	Grey med. Sand
104 to 105	— △	1	0	99	11	83	5	Brown med. Sand.

SAMPLE No. G23



JOB CHOWILLA STORAGE	THE ENGINEERING AND WATER SUPPLY DEPARTMENT
LOCATION RIGHT BANK BORROW AREA 3E	MECHANICAL ANALYSIS
REFERENCE	
DATE 7. 8. 64	SAMPLE No. G·23 (PARILLA SAND)
OPERATOR AK.	

Depth	Line	%coarse	%med	%Fine	%-200	
20'-21'	———	5	80	4.5	10.5	Orange-brown silty med. Sand
28'-29'	– – – –	5	89	0	6	Fawn med. Sand
47'-48'	—·—·—	29	63	4.5	3.5	Orange-brown med. Sand w/- some coarse
53'-54'	o—o—o—	42	46	7.5	4.5	Orange brown med. to coarse Sand
63'-64'	x—x—x—	53	36	6	5	Fawn coarse Sand w/- some med.

PARTICLE SIZE DISTRIBUTION

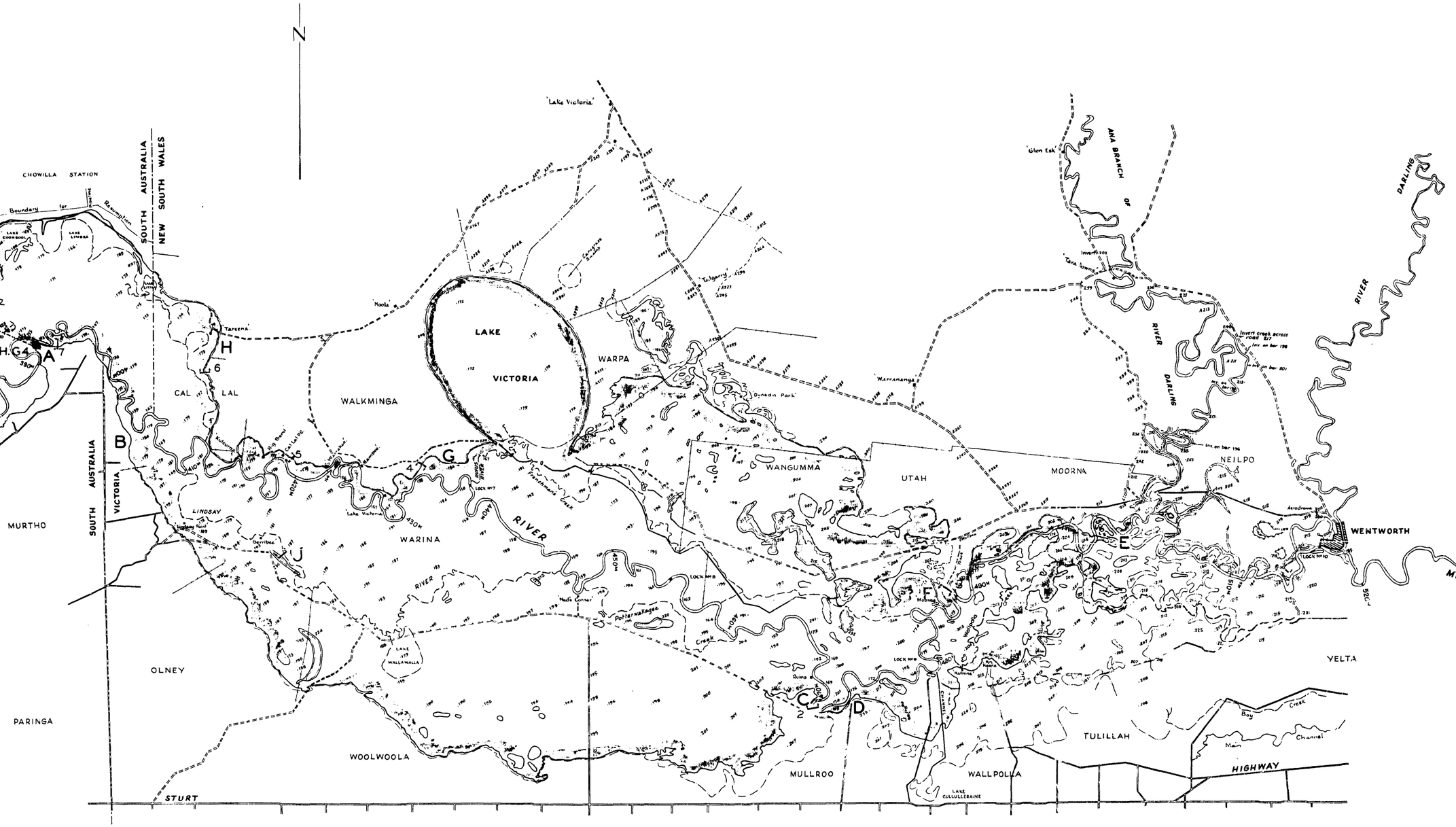
(ANALYSES CARRIED OUT BY AMDEL)

Nominal Screen Aperture -microns	Mesh BSS	Cumulative Weight Retained %			
		P989	P990	P992	P997
	¼ in.	-	-	-	-
150	100	94.1	85.1	91.1	77.0
75	200	94.7	89.4	91.6	86.9
53	300	94.9	89.6	91.7	87.7

Location of Samples:- P989 - Near Berribee Homestead

P990 and 992 - Near Border Cliffs Homestead

P997 - Near Moorna Homestead



LEGEND

- C ~ D — Geological Section
- Cliff location
- RL 205 Contour – Full Supply Level
- RL 310 Contour
- Contour
- 179 Spot Levels
- ·A279 Approximate Levels
- River and river mileage
- Major creeks
- Roads
- Buildings
- Control Banks

SCALE IN MILES 5 0 0 2 4 6 8 10 — SCALE IN KILOMETRES 5 0 5 10 15

(19)

SCALE Miles 0 3 4 5 9 Miles

FIG. 1

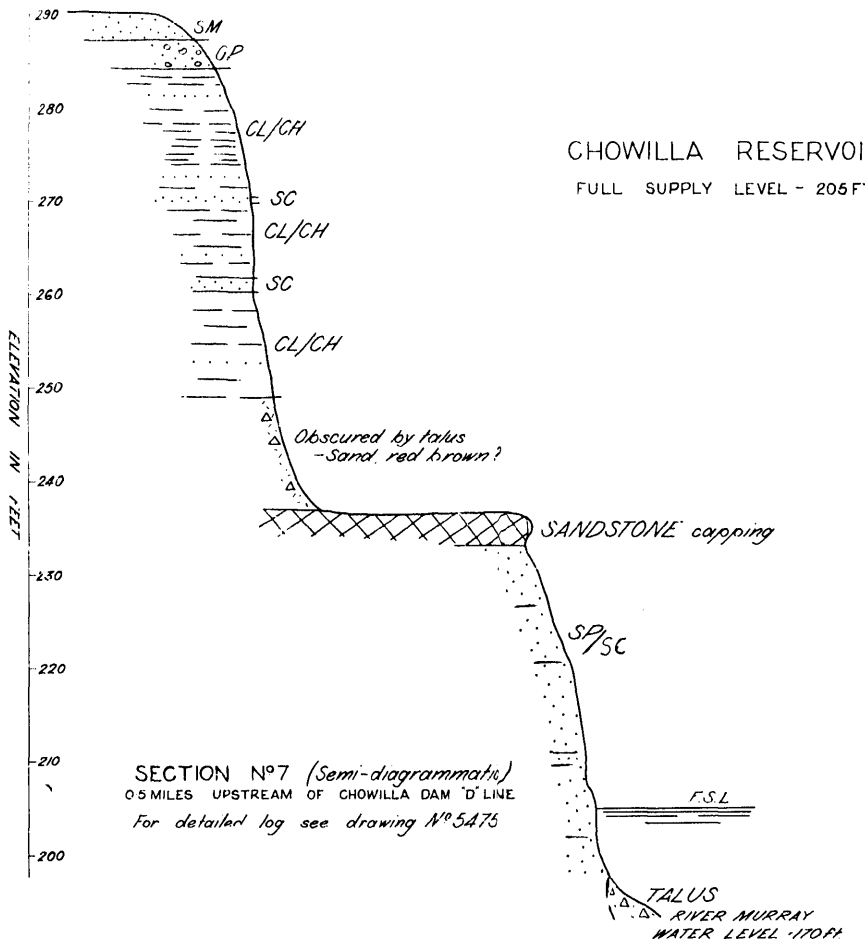
DEPARTMENT OF MINES – SOUTH AUSTRALIA

CHOWILLA PROJECT
RESERVOIR AREA
GEOLOGICAL SECTIONS AND CLIFF LOCATIONS

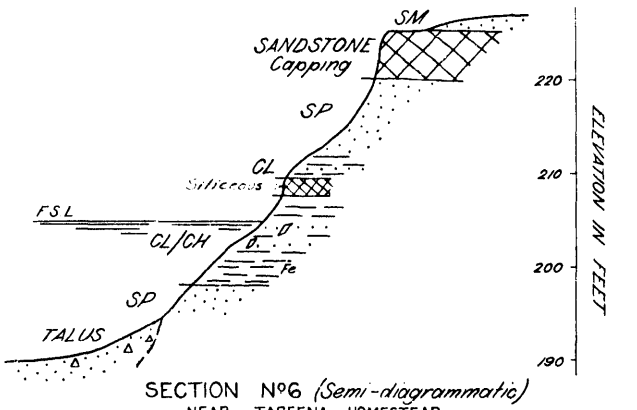
ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. WRPB	SCALE: AS SHOWN
		Tcd. RAJ	66-774
		Ckd. WHH	994·2+4/5
DIRECTOR OF MINES	SUP. GEOLOGIST	Encl. WK	DATE: 23 AUGUST 1966

CHOWILLA RESERVOIR

FULL SUPPLY LEVEL - 205 FT.

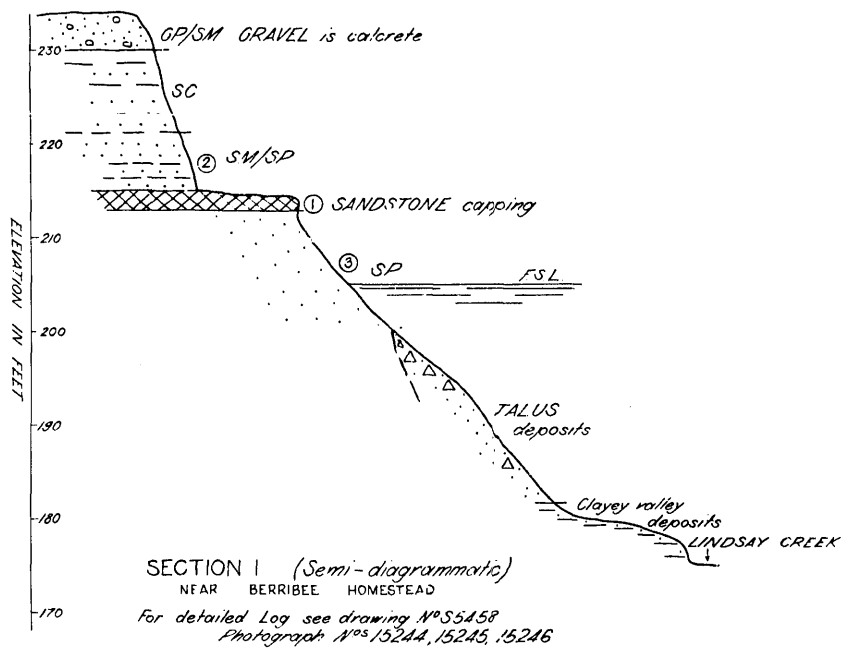


SECTION N°7 (Semi-diagrammatic)
0.5 MILES UPSTREAM OF CHOWILLA DAM 'D' LINE
For detailed log see drawing N°S.475



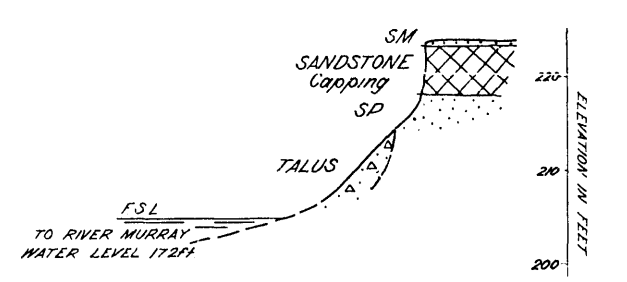
SECTION N°6 (Semi-diagrammatic)
NEAR TAREENA HOMESTEAD

Note: Levels approximate - may be up to 10 Ft too low
For detailed log see drawing N°S.5465
Photograph N°s 15166 - 15168



SECTION 1 (Semi-diagrammatic)
NEAR BERRIBEE HOMESTEAD

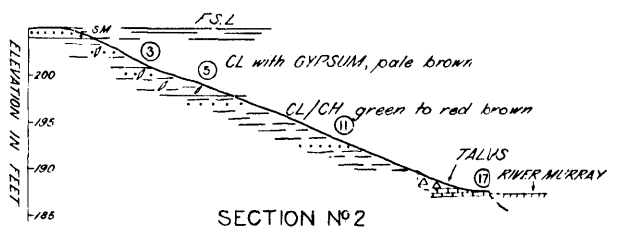
For detailed Log see drawing N°S.5458
Photograph N°s 15244, 15245, 15246



SECTION N°5 (Semi-diagrammatic)
NEAR CAL-LAL TOWNSHIP

River Mileage 419 M

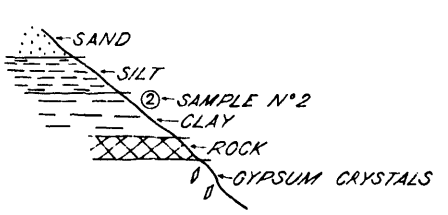
For detailed log see drawing N°S.5464
Photograph N°s 15165



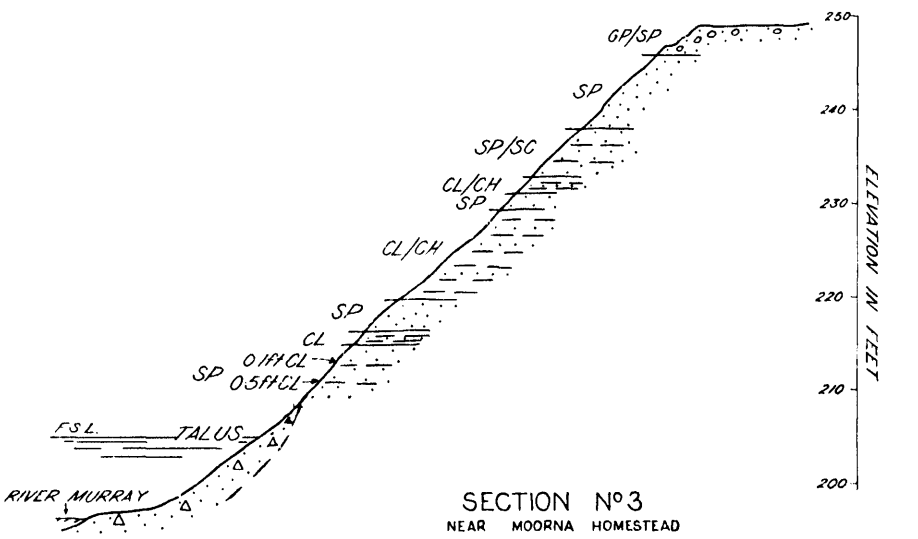
SECTION N°2
NEAR OLD NEDS CORNER RUINS
River Mileage 471 M

For detailed Log see drawing N°S.5459
Photograph N°s 15146, 15148, 15149

LEGEND



All sections looking downstream



SECTION N°3
NEAR MOORNA HOMESTEAD

River Mileage 487.5 M

For detailed Log see drawing N°S.5460
Photograph N°s 15155 - 15156

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CHOWILLA PROJECT

RESERVOIR RIM

ELEVATIONS OF GEOLOGICAL SECTIONS

Director of Mines	ENGINEERING GEOLOGY SECTION	Drn. W.B	SCALE: Vert. Inch. 10 Feet
	GEOLOGIST	Trd. R.P.H	
	SUPERVISING GEOLOGIST	Chkd. L.V.K.	
		Exd.	DATE: 13-9-66

66-767 G-J

FIG. 2

SECTION No. 1

BERRIBEE
HOMESTEAD

GEOLOGICAL SECTION

GEOLOGICAL DESCRIPTION	R.L. FEET	DEPTH	LOG	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
GRAVEL is CALCRETE	230	0		GP/SM	GRAVEL and SAND, red-brown. Fragments to 0·5 Ft.
BERRIBEE CLAYS		10		SC	SAND with excess clayey Fines, Fine to medium grained. Red.
	220			SM/SP	SAND poorly graded to excess silty fines, fine to medium grained, brown. Particle Size Distribution in sample 91·7% Sand 8·3% Fines. Bands of CLAYSOIL, low plasticity, grey to 0·5ft
		20			SANDSTONE capping, chalcedonic and quartzitic, Breaks across grains, very brittle. Ferruginous.
CHOWILLA SANDS	210 F.S.L.	30		SP	SAND poorly graded, Fine to medium grained, white to orange. Particle Size Distribution in sample 94·9% Sand 5·1% Fines
	Sample Nos				BASE OF EXPOSURE 33FT.

FOR CLIFF PROFILE
SEE DRAWING No. 66-767

FIG. 3

ENGINEERING GEOLOGY AND SOILS SECTION		DEPARTMENT OF MINES – SOUTH AUSTRALIA
DRAWN W.R.P.B	GEOLOGIST	CHOWILLA PROJECT
TRACED R.H.C	SENIOR GEOLOGIST	RESERVOIR RIM
CHECKED		GEOLOGICAL SECTION No 1

SECTION No.....2.....

OLD NED'S.....
CORNER RUINS
River Mileage 471miles.

GEOLOGICAL SECTION

GEOLOGICAL DESCRIPTION	R.L.	DEPTH FEET	LOG	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
BLANCHETOWN CLAY	FSL			SM	SAND with excess silty fines, red-brown numerous gypsum crystals
Gypsum crystals form 50% Crystals to 0·3 ft.	200	10		CL	CLAYSOIL low to moderate plasticity Sandy pale brown with few black (Mn?) markings.
					SAND, silty, bedded — 0·3 Ft. thick. Green to brown mottled — increasing plasticity with depth. Red-brown vertical sand dykes to 0·1 ft. Numerous vertical cracks open to 0·1 ft.
	190			CL/CH	
LIMESTONE, nodular, grey					

BASE OF EXPOSURE 18FT.

FOR CLIFF PROFILE
SEE DRAWING No. 66-767

FIG. 4

ENGINEERING GEOLOGY AND SOILS SECTION		DEPARTMENT OF MINES – SOUTH AUSTRALIA
DRAWN W.R.P.B.	GEOLOGIST	CHOWILLA PROJECT
TRACED R.H.C	SENIOR GEOLOGIST	RESERVOIR RIM
CHECKED L.V.W.	CH GEOLOGIST	GEOLOGICAL SECTION No 2
		DATE 31- · WIN No. 3 54 9 G+J

SECTION No. 3

MOORINA
HOMESTEAD
River Mileage 447.5 miles

GEOLOGICAL SECTION

DESCRIPTION	R.L. FEET	DEPTH FEET	LOG	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
ALLUVIA TO COLLUVIA		0		GRV. SP	GRAVEL and SAND, red-brown. Fragments to 0.8 ft.
					SAND, poorly graded, silty clayey. Fine to medium grained. Pale brown to red-brown. Particle Size Distribution of samples N°11 78.3% Sand 21.7% Fines N°13 86.0% Sand 14.0% Fines
	250	10		SP/SC	Increasing clay content
				CL/CH	CLAYSOIL, medium to high plasticity, sandy in part green to red-brown mottled. Shattered structure. Numerous vertical cracks open to 0.1 ft.
				SP	SAND, poorly graded fine to medium grained, yellow-brown, clayey.
Sand is quartz rounded to sub-rounded	230	20		CL/CH	As from 16 or 17 Feet. Sand content increases locally in bands to 0.7 ft thick Particle Size Distribution of sample 25 (Sandy Bed) 66.8% Sand 33.2% Fines
	220	30		SP	SAND, poorly graded, fine to medium grained bedded, Yellow-brown, Few black (Mn?) areas.
				CL	CLAYSOIL, low plasticity, sandy, bedded, Grey-brown. Prismatic to cuboid structure.
	210	40		SP	As from 18-19 feet. Grains to 1m.m., Few >1m.m. Particle Size Distribution of sample 37 87.7% Sand, 12.3% Fines
	ESL				BASE OF EXPOSURE 40 feet. FOR CLIFF PROFILE SEE DRAWING N° 66-767

FIG. 5

ENGINEERING GEOLOGY AND SOILS SECTION	
DRAWN W.P.D.	GEOLOGIST
TRACED R.M.C.	SENIOR GEOLOGIST

DEPARTMENT OF MINES - SOUTH AUSTRALIA

CHOWILLA PROJECT
RESERVOIR RIM
GEOLOGICAL SECTION N° 3

SECTION No. 4

LAKE VICTORIA
HOMESTEAD

GEOLOGICAL SECTION

DESCRIPTION	R.L.	DEPTH FEET	LOG	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
				GRAVEL	GRAVEL fragments to 0.2 ft. in SAND with excess silt matrix, red-brown.
				CL	CLAYSOIL low to moderate plasticity, green to red-brown.
				ML	SILTSOIL low plasticity. Sand-clay-silt mixture. Laminated. White to grey.
	250	Sample 50		CL	CLAYSOIL low to moderate plasticity green to red-brown mottled. Numerous vertical cracks open to 0.1 ft.
				SC	SAND with excess clayey fines. White to yellow.
	F.S.L.			CL	As from 30–65 ft.
	200			SP	SAND poorly graded yellow

BASE OF EXPOSURE 90FT.

See photo Nos
15157 – 15162

Sample :-
Particle Size Distribution
7·7% Sand
92·3% Fines

FIG. 6

ENGINEERING GEOLOGY AND SOILS SECTION		DEPARTMENT OF MINES – SOUTH AUSTRALIA
DRAWN W.R.P.B.	GEOLOGIST	CHOWILLA PROJECT
TRACED R.H.C.	SENIOR GEOLOGIST	RESERVOIR RIM
CHECKED		GEOLOGICAL SECTION No. 4

SECTION No. 5

CAL-LAL
TOWNSHIP
(RIVER MILEAGE 410 m)

GEOLOGICAL SECTION

DESCRIPTION	R.L.	DEPTH FEET	LOG	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
					SAND excess silty fines. Red-brown
SANDSTONE calcareous cement	220			ROCK	SANDSTONE medium grained grey to white
	214	10		SP	SAND poorly graded, fine to medium grained pale yellow.
					BASE OF EXPOSURE 10 Ft.

FOR CLIFF PROFILE
SEE DRAWING No 66-767

Reservoir F.S.L. - R.L. 205

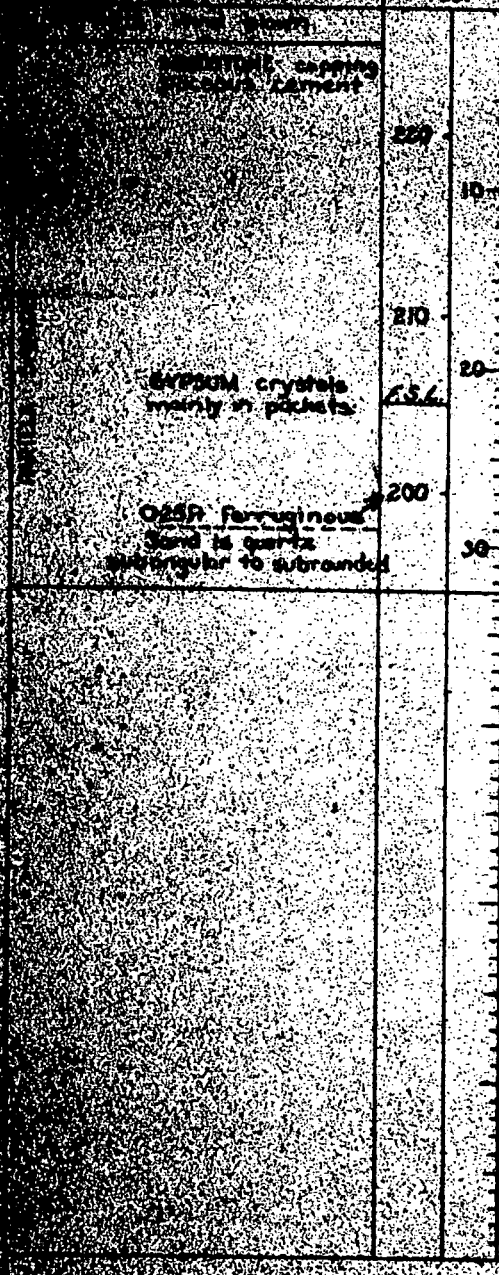
FIG. 7

ENGINEERING GEOLOGY AND SOILS SECTION		DEPARTMENT OF MINES - SOUTH AUSTRALIA
DRAWN W.R.P.B.	GEOLOGIST	CHOWILLA PROJECT
TRACED R.H.C.	SENIOR GEOLOGIST	RESERVOIR RIM
		GEOLOGICAL SECTION No 5

SECTION No. 6

TAREENA HOMESTEAD

GEOLOGICAL SECTION



DESCRIPTION	GROUP SYMBOL	GROUP NAME AND DESCRIPTION
[illegible] capping ferruginous cement	SM	SAND with excess silt. Red-Brown.
	ROCK	SANDSTONE, medium grained, white to yellow-brown, cemented.
	SP	SAND poorly graded, fine to medium grained white to yellow.
	CL	CLAYSOIL, low plasticity, sandy, green to brown.
		LIMESTONE, mustard yellow, earthy.
GYPSUM crystals mainly in pockets.	CL	CLAYSOIL, low plasticity, sandy, often in lenses, Green to red-brown mottled, shattered structure.
		Yellow
OCCR ferruginous Sand is quartz subangular to subrounded	SP	SAND, poorly graded medium to coarse grained. Few fines.
		BASE OF EXPOSURE 32·5 FT.
		FOR CLIFF PROFILE SEE DRAWING No. 66-767

Sample No 65 collected about 1 mile upstream of section line from red-brown sand overlying sandstone capping (Approx R.L 230) - that is in Blanchetown Clay formation. Particle Size Distribution 84·3% Sand 15·7% Fines

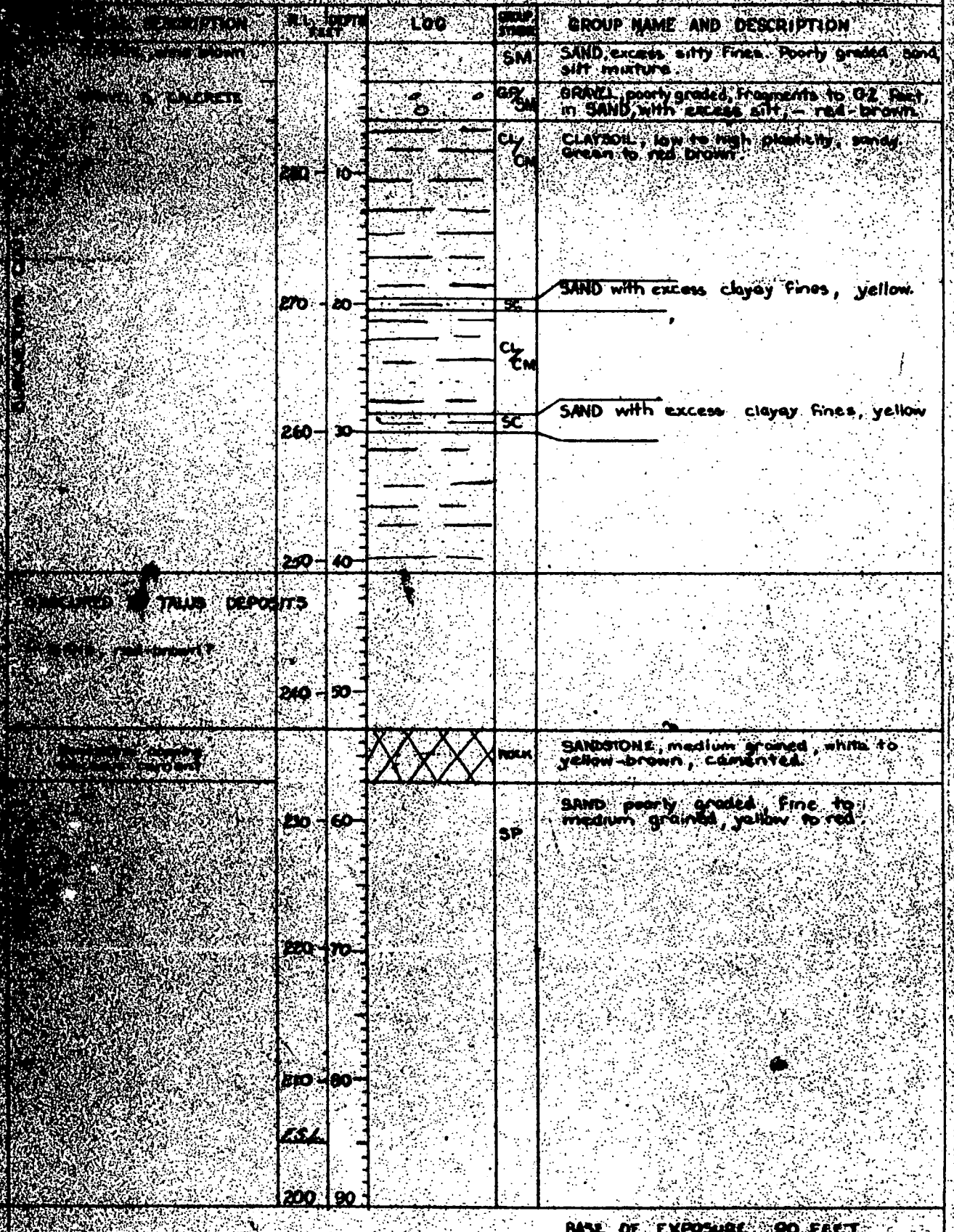
FIG. 8

ENGINEERING GEOLOGY AND SOILS SECTION	DEPARTMENT OF MINES - SOUTH AUSTRALIA
DRAWN W.R.P.B.	GEOLOGIST
TRACED	SENIOR GEOLOGIST
	CHOWILLA PROJECT RESERVOIR RIM

SECTION No. 7

0.5 Mile Upstream of CHOWILLA DAM 'D' LINE

GEOLOGICAL SECTION



BASE OF EXPOSURE 90 FEET

FOR CLIFF PROFILE SEE DRAWING No. 66-762

FIG. 9

ENGINEERING GEOLOGY AND SOILS SECTION	
DRAWN W.R.P.B.	GEOLOGIST
TRACED R.N.C.	SENIOR GEOLOGIST

DEPARTMENT OF MINES - SOUTH AUSTRALIA

CHOWILLA PROJECT

RESERVOIR RIM

GEOLOGICAL SECTION No. 7