CURRENCY CREEK DAM - CATCHMENT AREA HYDROGEOLOGICAL INVESTIGATIONS

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
ENGINEERING DIVISION

CURRENCY CREEK DAM - CATCHMENT AREA HYDROGEOLOGICAL INVESTIGATIONS

Client: Engineering and Water Supply Department

by

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Eng. Geol. No. 1972/9

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

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ABSTRACT

Geological mapping shows that the catchment consists of two roughly equal areas. One comprises Cambrian arkose overlain by Permian glacial sands, and the other is composed of Cambrian phyllite and greywacke with thin slopewash cover.

Salinity measurements, taken during October 1972 from surface water sub-catchment areas, gave several values exceeding 1000 mg/l (maximum 4 900 mg/l). Higher salinity values occur in water derived from or flowing across the Cambrian phyllites and greywacke.

INTRODUCTION

It is proposed to build a small dam on Currency Creek. The dam would store water pumped from the River Murray during periods of low salinity. This water would be used to supply the south coast area of Fleurieu Peninsula during times of high salinity in the Murray.

Currency Creek is a small stream flowing easterly from the southern Mt. Lofty Ranges and the possible dam site is located about 10 km N.W. of Goolwa. (Fig. 2).

The quality of the water flowing in Currency Creek has shown great variability with salinities of up to 3 884 mg/l approximate total salts (A.T.S.) recorded at the damsite.

To investigate the sources of saline water and the effects of seasons on water quality a series of regular surface-water salinity measurements has been commenced within the catchment area.

The purpose of the present project was to provide a geological map of the catchment area at a scale of 1:25 000 (1 cm = 0.25 km) for use in interpretation of results of the salinity measurements. The catchment is about 57.9 km^2 in area and lies 50 km south of Adelaide. The area was previously mapped at a scale of 1:63 360 by Horwitz and Thompson (1960) when mapping the "Milang" sheet.

For the current survey, mapping was done directly onto airphotos of nominal scale of 1:25 000 using airphoto interpretation and field observation. The mapping was carried out between 11th September 1972 and 6th October 1972 by E.H. Kim, fellow of United Nations Development Program, with H.W. Dixon, of the Department of Mines. The western part of the catchment has not yet been mapped due to lack of suitable air photo cover.

REGIONAL GEOLOGY

Topography - Regional

Currency Creek drains a south eastern part of the Mount Lofty Ranges, and flows easterly to the Lower Murray River, (Fig. 2).

The Mt. Lofty Ranges are a series of horsts with relatively flat tops, bounded in this area by northeast-southwest trending fault scarps. To the north west of the ranges lie the plains of the Willunga Basin and to the southeast the plains of the southern Murray Basin.

The tops of the fault blocks are formed of low rounded hills and wide flat valleys. Steep-sided, deep valleys only occur where the creeks draining the tops of the ranges have cut back into the fault scarps.

Geology - Regional

The regional geology has been mapped by Thomspon and Horwitz (1962) and is shown in Figure 2.

The north western fault blocks are formed mainly of Upper Proterozoic slates, tillites and arkoses, and rise to about 390 m. The central, highest, block is comprised mainly of Lower Proterozoic schists and gneisses and rises to about 420 m above sea level. The south easterly blocks, rising up to 270 m and through which Currency Creek flows are formed mainly of slightly metamorphosed sedimentary rocks of Cambrian age. These rocks vary from arkosic grits to fine grained phyllites and greywackes.

In these Proterozoic and Cambrian rocks Permian glaciation eroded deep and wide valleys which were then filled with unconsolidated glacial and fluvioglacial sediments at least 130 m deep in some places. These consist of crossbedded silts, sands and clays containing occasional boulders and overlie much of the tops of the fault blocks in the southern Mt. Lofty Ranges. There has been extensive reworking of these deposits in Tertiary and Recent times. Scattered patches of ferruginized freshwater sands and gravels of Pliocene age also occur on the tops of the Ranges.

The wide flat creek valleys on top of the ranges are mainly confined to the old glacial valleys and contain extensive areas of alluvium, mainly reworked Permian deposits, whereas the steep sided valleys cut in the scarps of Cambrian bedrock have little alluvial material and frequent outcrop of bedrock.

The Basins north-west and south-east of the Ranges contain thick and extensive deposits of Tertiary to Recent marine limestones, sands, silts and clays.

GEOLOGY OF CATCHMENT AREA

Topography - Catchment area

The catchment of Currency Creek lies across and extends easterly from

the main Willunga-Victor Harbor Road, about 5 km south of Mt. Compass (Figs. 1 and 2). Most of the area lies above 180 m and is formed of the broad flat alluvial valleys and low rounded hills of the range-top with slopes generally less than 5^{o}. The area is almost wholly cleared and under pasture.

Below 180 m the creek cuts quickly through the fault scarp, producing a valley incised to a depth of about 140 m. Slopes in this area are of the order of 10^{o} to 30^{o} but are sometimes near vertical.

Geology - Catchment Area

The geology of the catchment area east of the main Willunga-Victor Harbour Road is shown in Figure 3.

Most of the catchment area is covered by shallow soils and unconsolidated sediment with only a few outcrops of fresh rock. Completely weathered rocks are exposed in road cuttings in many places.

(i) Rock and Soil Types

Fresh rocks are exposed only along the valley of the lower streams near the damsite in the east of the area. They can be subdivided into 3 units identified by Horwitz and Thompson (1960) as Kanmantoo group of Cambrian age. The soil cover can be divided into 5 mappable units. The Rock and Soil Types are described in Table 1.

(ii) Structure

In the arkose there is a prominent, well developed, near vertical joint set, striking northeast parallel to the bedding plane, and another set striking 120^{o} and dipping 20^{o}NE. There are three clearly developed sets of structure planes in the phyllite near the dam site. One is the foliation striking 30^{o} dipping nearly vertical and another is a prominent joint set striking 140^{o} dipping vertical and the last is a joint set nearly horizontal.

No evidence was observed of any significant and extensive faults or folds within the catchment area.

The infilled glacial valleys are confined to the north west of the area and their trend is unknown. Though depths of at least 130 m have been recorded near Mt. Compass it is unlikely that depths are greater than about 30 m in the catchment area.

TABLE I

Rock and Soil Types of the Currency Creek Catchment Area

Age	Units	Maximum Thickness	General Strike and dip	Description	General Locality
Recent	Alluvium	Few m	Flat lying	Black mantle, sometimes grey sandy material mixed with gravels.	In base of valleys but on some hilltops.
Recent	Slopewash	Few m	Parallel to ground surface	Sandy clay, brownish, with scattered angular rock fragments and disturbed outcrops of Cambrian bedrock.	Along hillsides.
Tertiary?	Lateritized residual soil	Few m	Parallel to ground surface	Mottled clay, dark orange, with angular rock fragments.	Mainly along hillsides and high ground in the west of area.
Tertiary, Pliocene	Clayey sand with gravels	up to 4 m	Flat lying	Interbedded clayey ferruginous sands, and waterwonn gravels.	One small occurrence on low spur in broad valley in northeast of area.
Permian?	Grey and brown sands	Unknown	Flat lying	Fine grained grey silty sands and brown clayey sands.	Within valleys and as low rounded hills in northwest of area.
Cambrian (Kanmantoo group)	Greywacke	Greater than 1 800 m	Steeply to vertically dipping, striking NE-SW.	Light grey, micaceous, grading to sandstone in places.	Outcrops of fresh rock along valleys in east of area and as scattered disturbed outcrop on hillsides in south and east of catchment area.
	Phyllite	1 500 m	"	Fine grained micaceous dark grey phyllites, often containing oxidized pyrite in lenticular aggregates up to 1 cm.	
	Arkose	Greater than 4 500	"	Fine grained, brownish grey feldspathic sandstone with fine grained, dark banding.	

HYDROGEOLOGY OF CATCHMENT

Groundwater

No field survey of existing boreholes was made during this project. A summary of borehole data held in the Department of Mines records is given in Table 2. The location of each bore is shown on Figure 3.

TABLE 2

Summary of borehole information

Section No.(1) Hd. Goolwa	Bore No.	Date of measurement day.month.yr.	Depth of hole m	Static Water Level m	A.T.S. mg/l(3)	Subcatchment area (2) Sample point
253	A(pit)	28.11.67	1.8	0.6	255	1
253	B(pit)	30.11.67	1.8	0.6	470	1
255	A(dam)	3.3.60	surface - dam		400	2
255	C	26.10.65	27.5	14.0	2 746	2
228	A	19.10.67	42.7	-	4 700	2
2 412	A	14.12.34	58.0	47.9	6 000	5
2 411	A	10.6.35	38.1	29.0	4 400	5
133S	A	3.9.48	39.5	36.3	160	6
247	A	14.4.50	27.4	9.1	170	7
248	A	29.8.57	4.5	1.2	3 900	7
248	B	30.8.57	3.7	1.5	860	7
248	C	3.9.57	4.3	1.8	690	7
303	A	6.4.64	surface - soak		200	7
236	01	18.2.70	106.6	4.0	170	8

Notes: (1) Land subdivision

(2) Bore lies adjacent to or within the subcatchment area sampled at this salinity sampling point (Fig. 3).

(3) mg/l = p.p.m.

Surface Water

No rainfall recording stations exist in the catchment area. The average annual rainfall would probably be a little greater than that of Finniss (Fig. 2) which averages 470 mm/a. However this station is at a lower altitude than the catchment area.

During the period of investigation most of the tributary creeks had a steady small flow of up to 0.005 m^3/s*. In the upper area of the catchment the gradients are gentle and there are numerous swampy areas, whereas in the east of the area in the gorges, the main creek had flows up to 0.020 m^3/s and there were only minor swamps.

For the salinity survey, the catchment has been divided into 8 sub-areas and the salinity of water was measured at the discharge of each (Fig. 3). The salinity of Currency Creek was also measured at various places. Two series of measurements have been made so far and are given in Table 3, along with a brief description of the geology of each sub-catchment area.

The Engineering and Water Supply Department has analysed the water flowing in Currency Creek and its main southern tributary near the dam site and two such analyses are given in Table 4. They have also measured the salinity of water at the dam site for various flows some of which are given in Table 5.

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* 1 m^3/s = 1 cumec = 1 000 l/s

i.e. 0.001 m^3/s = 1 l/s

TABLE 3

SALINITY OF WATER FROM SUBCATCHMENT AREAS

Measuring point	5 Sept. 1972		25 Oct. 1972		Notes on surface geology of subcatchment areas
	A.T.S. mg/l (1)	Flow (2)	A.T.S. mg/l (1)	Approximate flow (3) m^3/s	
1	440	small	520	0.002	Permian sands with some residual soils on arkose. Alluvium.
1 C.C.	-	-	420	0.004	Currency Creek adjacent to point 1.
2	1 070	very small	640	No flow	Residual soils on phyllite with Permian sands and alluvium.
2 C.C.	-	-	500	?	Currency Creek at 2. Very sluggish in centre of wide alluvial valley.
3	1 070	no flow	1 330	0.0001	Slopewash on phyllite with some alluvium.
4	3 950	small	4 900	0.0003	Slopewash on greywacke with disturbed outcrop and alluvium.
5	1 540	small	1 900	0.005	Slopewash on phyllite with disturbed outcrop and alluvium.
6	1 100	-	1 300	0.002	Slopewash and alluvium on phyllite and greywacke.
7	400	good	430	0.003	Permian sands and residual soils on arkose.
8	240	small	240	0.003	Permian sands and residual soils on arkose.
9	500	-	700	0.010	Currency Creek at beginning of gorge.
10	740	good	1 080	0.010	Currency Creek below subcatchment 4.
11	850	0.035 m^3/s	1 360	0.015	Currency Creek at dam site.

Notes:- (1) Salinity measurements using an electronic conductivity bridge with automatic temperature correction. (Electronic Switchgear, London. Model MC1, Mk.5).

(2) No accurate estimate of flow made.

(3) m^3/s = cubic metres per second (cumecs) = 1 000 l/s i.e. 0.001 m^3/s = 1 l/s.

TABLE 4

ANALYSIS OF WATER IN CURRENCY CREEK

Concentration in mg/l

Date:	North Branch (Cureency Creek proper) 13 Aug. '71	12 Jan. '72	South Branch 13 Aug. '71	12 Jan. '72
A.T.S.	257	929	361	918
SiO_2	3	2	4	2
Fe^{++}	1.8	2.5	1.1	2.5
Ca^{++}	12	53	20	54
Mg^{++}	9	35	15	37
Na^{+}	74	257	97	249
HCO_3^{-}	71	171	85	165
$SO_4^{=}$	3	12	10	10
Cl^{-}	126	485	172	485
F^{-}	0.2	0.38	0.17	0.38
NO_3^{-}	0.2	0.9	1.3	0.20

TABLE 5

SALINITY OF WATER AT DAM SITE

Date	Salinity mg/l	Flow m^3/s
29 August, 1972	702	0.40
31 August, 1972	605	0.31
8 September, 1972	393	0.70
14 September, 1972	417	0.40

CONCLUSIONS

At periods of flows less than about 0.03 m^3/s the salinity of water in Currency Creek exceeds 1000 mg/l and analysis has shown that most of this salinity is due to sodium chloride.

The mapping of the catchment area has shown that it is possible to divide it into two almost equal areas. The first is the northwesterly area consisting of Permian sands and lateritized residual soils overlying predominantly arkosic bedrock and is comprised of subcatchments 1, 7 and 8. This is drained by the main northerly branch, Currency Creek proper.

The second is the south easterly area which is comprised of slopewash with scattered outcrops of phyllite and greywacke and is in subcatchments 2,3,4,5 and 6.

From Table 3 it can be seen that the water draining from the northwesterly area as measured at points 1,7,8 and in Currency Creek at points 2 CC and 9 is considerably less saline than that from the southeastern area, for similar flows. Also the salinity of Currency Creek itself increases significantly between points 9 and 11 (the dam site) as it flows through the southeasterly area. The borehole information also indicates a similar broad relationship as shown in Table 2. Hence, it appears that the high salinity water is associated with the Cambrian rock type and is possibly caused by weathering of sodium and chlorine rich minerals within the phyllites and greywackes.

HWD:EHK:CMH
30th November, 1972

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REFERENCES

Horwitz, R.C. and Thompson, B.P., 1960. Milang map sheet, Geological Atlas of South Australia, 1:63 360 series, geol. Surv. S.Aust.

Thompson, B.P. and Horwitz, R.C., 1962. BARKER map sheet, Geological Atlas of South Australia, 1:250 000 series, geol. Surv. S.Aust.

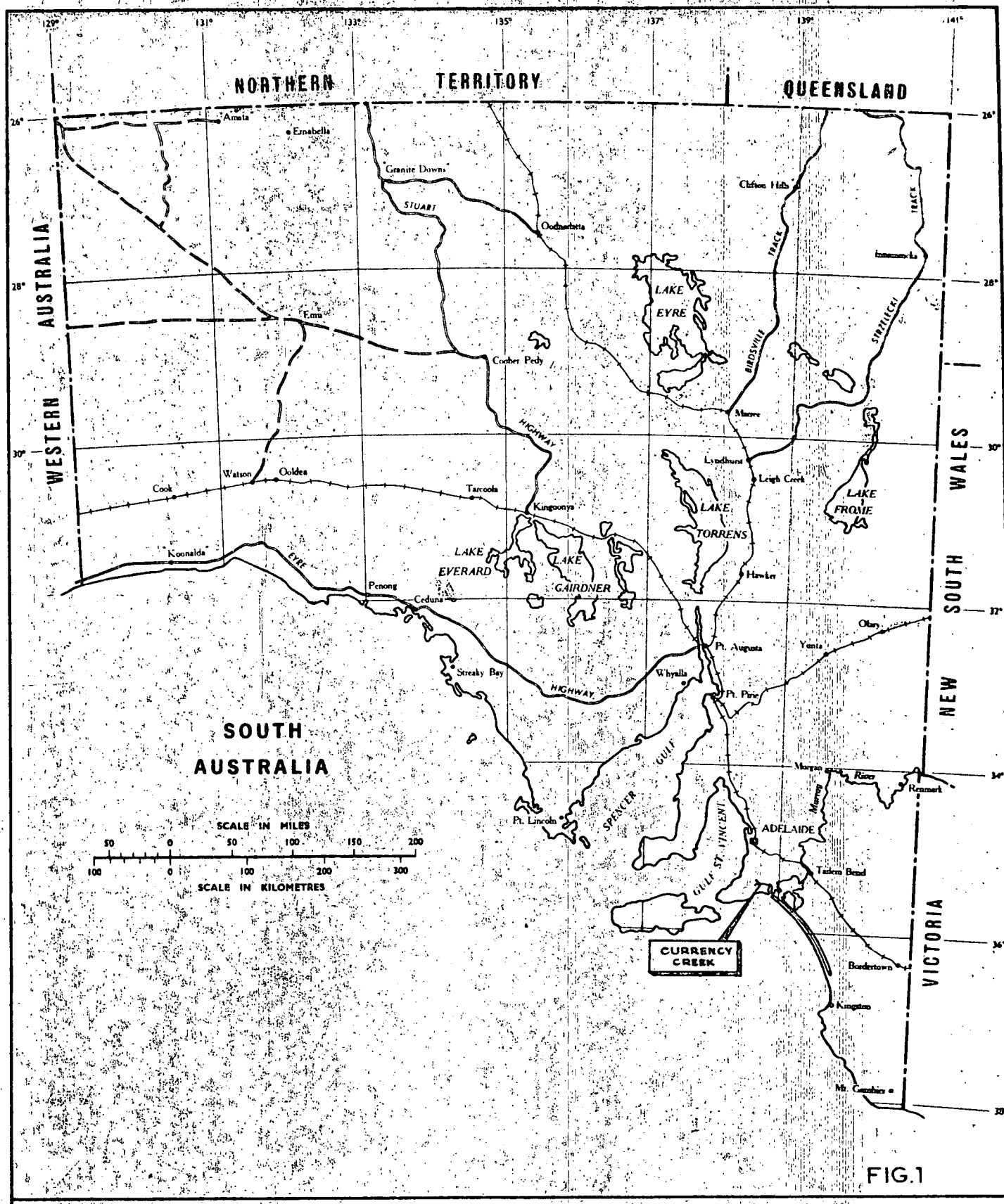


FIG.1

ENGINEERING GEOLOGY SECTION — DEPARTMENT OF MINES — SOUTH AUSTRALIA

Compiled H.DIXON

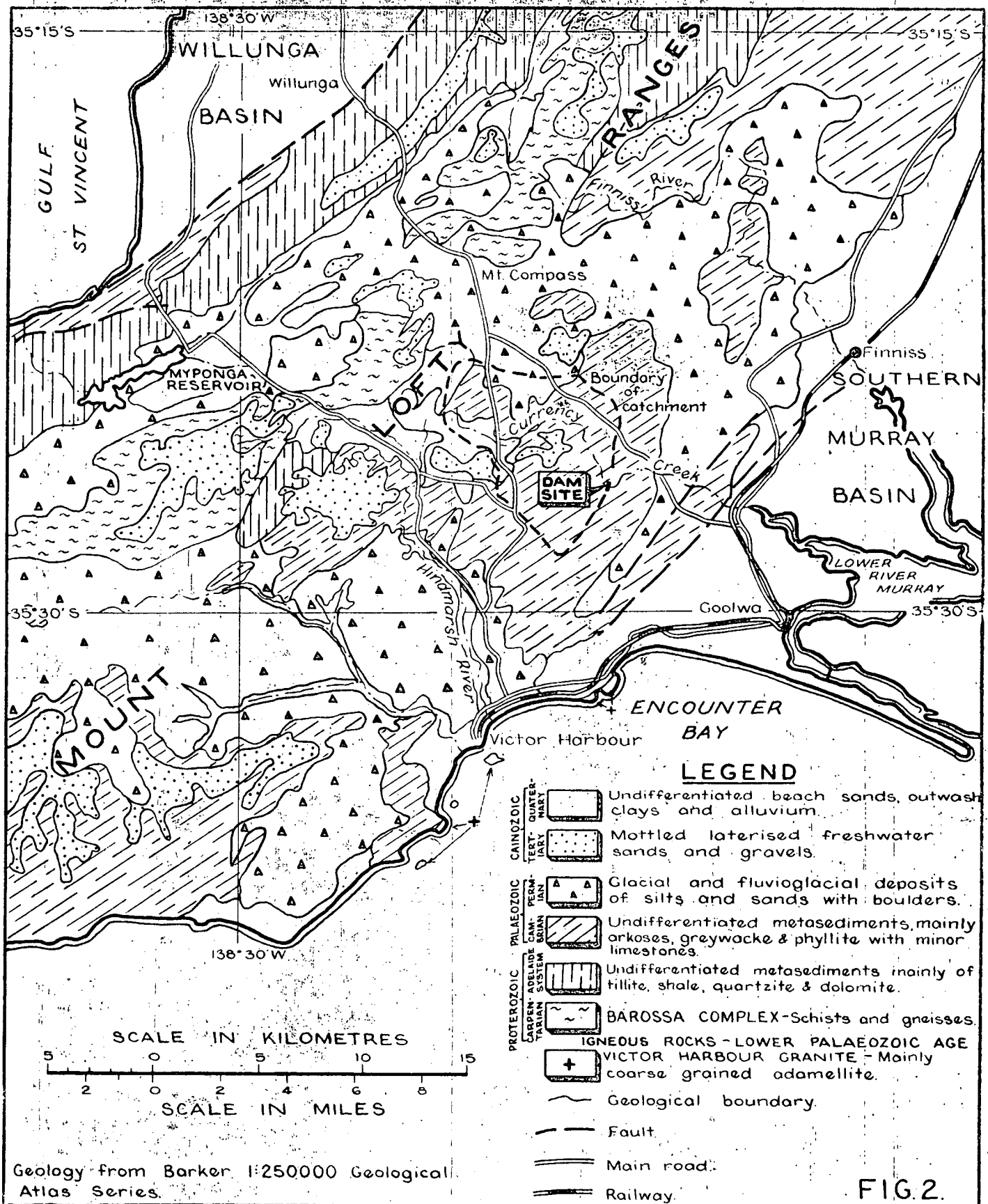
Drn. G.F.J.M. | Ckd. A.F.

CURRENCY CREEK LOCALITY PLAN

Date: 28 Nov. '72

Drg. No. S 10059 Hc 9

P.F. No. S5850 994.2



Geology from Barker 1:250000 Geological Atlas Series.

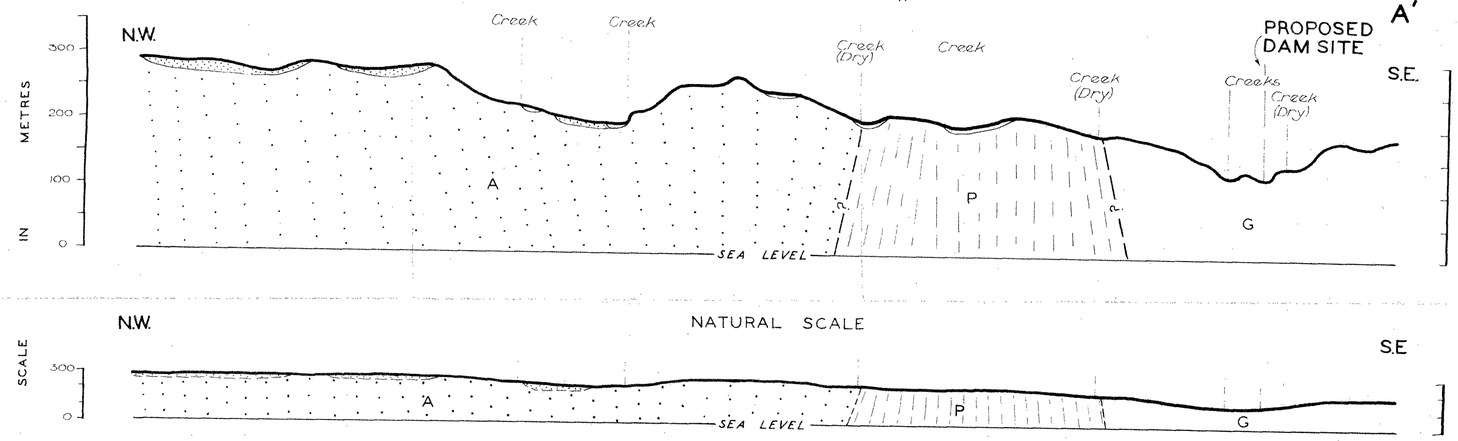
FIG. 2.

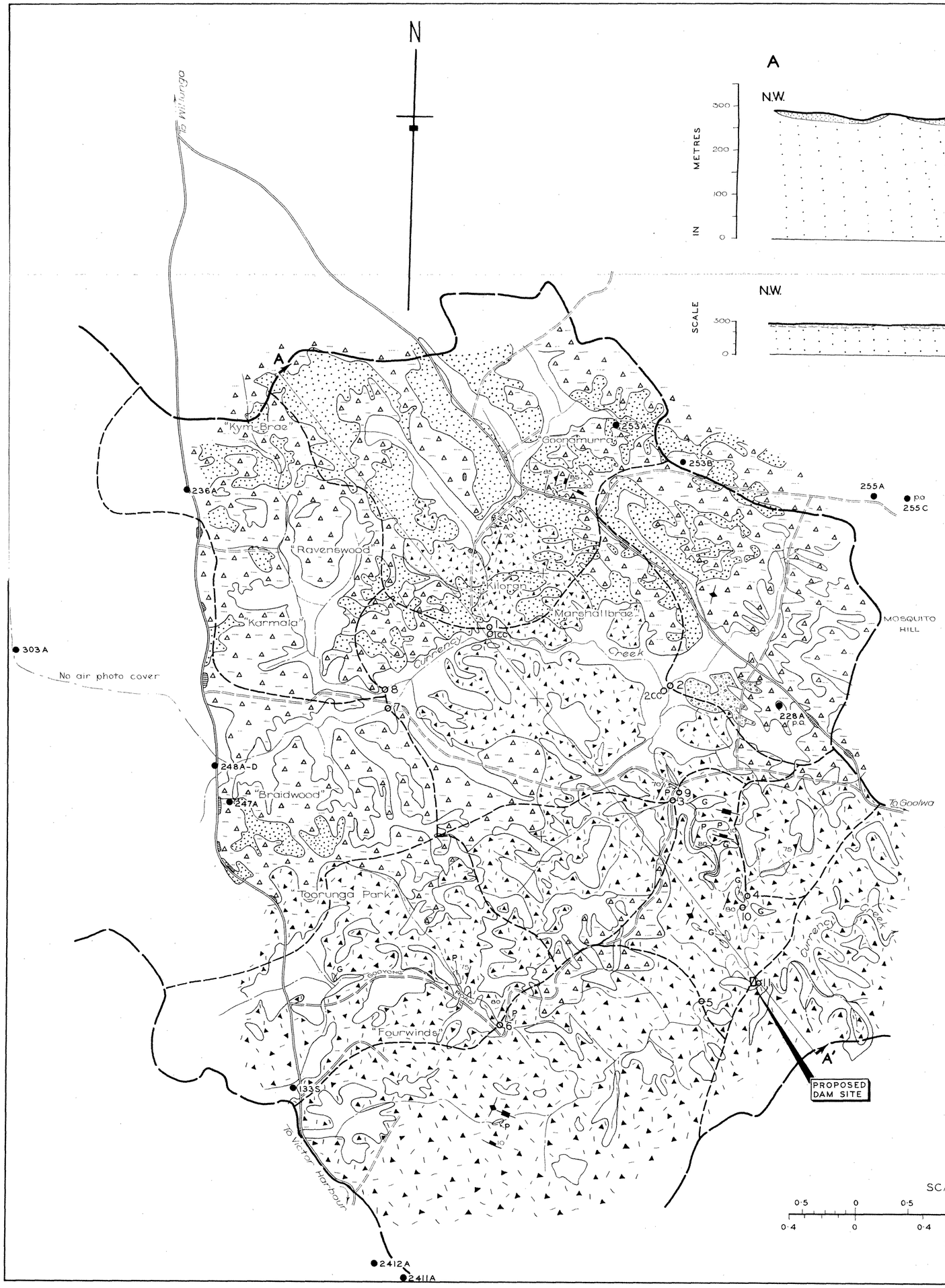
ENGINEERING GEOLOGY SECTION	DEPARTMENT OF MINES – SOUTH AUSTRALIA	Scale: 1:250000
Compiled: H. Dixon	CURRENCY CREEK DAM	Date: 5TH Dec. 1972
Drn. M.S. | Ckd. A.F.	CATCHMENT AREA	Drg. No. S10060 Hc9
	LOCALITY AND GENERALIZED REGIONAL GEOLOGY	

300–6.72 C5552

GEOLOGICAL SECTION A-A'

VERTICAL EXAGGERATION $\frac{V}{H} = \frac{4}{1}$





SCALE IN KILOMETRES

0·5 0 0·5 1·0 1·5 2·0 2·5 3·0

SCALE IN MILES

0·4 0 0·4 0·8 1·2 1·6 2·0

LEGEND

CAINOZOIC

QUATERNARY RECENT

ALLUVIUM : Black and grey sands, sandy silts and gravels. Includes high level sands probably from reworking of Permian and Tertiary deposits.

SLOPEWASH : Brownish sandy clay with mottled angular rock fragments.

TERTIARY

LATERITIZED RESIDUAL SOIL : Dark orange mottled clay with angular rock fragments, directly associated with underlying weathered Cambrian bedrock.

UNCONFORMITY

CLAYEY SANDS AND GRAVELS : Interbedded orange clayey sand and water worn gravels.

UNCONFORMITY

WEATHERED SURFACE : Off white to orange silty clays with lateritized bands developed by deep in-situ weathering of bedrock.

PALAEOZOIC

PERMIAN

SANDS : Grey and brown silty fine sands showing evidence of recent fluvial and aeolian reworking. Previously mapped as Permian fluvioglacial deposits.

UNCONFORMITY

CAMBRIAN

G GREYWACKE : Light grey, micaceous, fine grained, grading to sandstone.

P PHYLLITE : Dark grey, fine grained, micaceous and pyritiferous.

A ARKOSE : Brownish grey, fine sandstones with fine dark banding.

- Approximate geological boundary
- 80 Strike and dip of foliation, inclined
- Strike and dip of foliation, vertical
- 10 Strike and dip of joint, inclined
- Strike and dip of joint, vertical
- Boundary of catchment
- Boundary of subcatchment
- 03 Stream salinity sample point
- Creek
- ●248A p.o. Bore, section number, hole number or letter. Position approximate.
- Main road (Sealed)
- Minor road (Unsealed)
- Dam site
- Centre of air photograph
- "Karmala" Property name

NOTE : This map has been prepared by interpretation of air photographs and by field observation. The base map is an uncontrolled plot at photo-scale. (Nominally 1:25,000)
For regional relationships and topographic information reference has been made to Horwitz R.C. and Thompson B.P., 1960. Milang map sheet. Geological Atlas of S.A. 1:63,360 series. Geological Survey of S.A.

FIG.3

DEPARTMENT OF MINES — SOUTH AUSTRALIA

CURRENCY CREEK DAM
CATCHMENT AREA
GEOLOGICAL PLAN AND SECTION

ENGINEERING GEOLOGY SECTION	GEOLOGIST	Drn. E.H.K.	SCALE : AS SHOWN
		Tcd. A.G.R.	72-941 Hc9
		Ckd. A.S.F.	
Director of Mines	SEN. GEOLOGIST	Exd.	DATE : 26 OCT. 1972