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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

ENGINEERING DIVISION

REPORT ON GROUNDWATER SUPPLIES - ANDAMOOKA OPALFIELD

Grid I.5

Lat. 30° - 31°, Long. 137° - 138°

by

G.T. ROBERTS
ASSISTANT SENIOR GEOLOGIST
HYDROGEOLOGY SECTION

70/72

Rept.Bk.No. 70/72

18th May, 1970

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6337 III

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SOUTH AUSTRALIA

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Lat. 30° - 31°, Long. 137° - 138°

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32° - 140°

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Rept.Book No.70/72
G.S.No. 4461
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D.M.No.1508/66

18th May, 1970

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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GROUNDWATER SUPPLIES - ANDAMOOKA OPAL FIELD

Grid I.5

Lat. 30° - 31°, Long. 137° - 138°

INTRODUCTION

Numerous attempts have been made over the past 25 years to augment the meagre supply of potable water for the miners at Andamooka Opal field.

This report provides a summary of the work carried out, mainly in the form of drilling, and assesses the potentiality for future exploration.

HISTORICAL BACKGROUND

The settlement was first established in 1927 with the discovery of precious opal. Originally the population remained low and sufficient water was obtained from shallow wells in Opal Creek.

After the 1939-45 war interest in the area increased and a larger but fluctuating population was attracted to the area, including both Europeans and Aboriginals. Troubles were encountered with the water supply from time to time, either because of a sudden rise in the population or the

persistence of a drought, and despite the expenditure of considerable funds, no satisfactory additions to the supply have been obtained from underground sources.

PREVIOUS WORK

Nixon (1958) reviewed the geology of the Andamooka opal field but the geology of the Andamooka region has been elucidated mainly through the work of Johns (1968), and the results are illustrated on the Andamooka 4-mile geological sheet.

Several contributions to the hydrogeology of the area surrounding the opal field have been made, notably by Barnes (1947), Johnson (1956), O'Driscoll (1957), Johns (1965) and Bleys (1958, 1968).

A summary of activities between August, 1947 and October 1968 is given in Appendix A.

PHYSIOGRAPHY AND DRAINAGE

Andamooka Opal field lies on the northern area of a tableland known as the Arcoona Plateau and approximately nine miles west of Lake Torrens.

The region is lacking in relief and drainage is generally ill defined with a series of small internal drainage areas. Near the opal field however, a defined creek system drains an area of about 40 sq. miles into Lake Torrens. Several small creeks including Opal Creek and Trig. Creek

flow in a northeasterly direction to join Teatree Creek, a structurally controlled channel which flows in a south-easterly direction to the lake.

North of Teatree Creek no drainage pattern is discernable and minor local runoff disappears into underlying limestones.

The low dune system which occurs widely around Andamooka, but is less well developed near the township, is oriented in a N.E. - S.W. or an E. - W. direction.

GEOLOGY

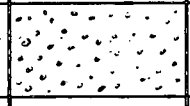
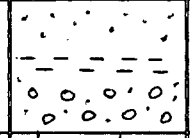
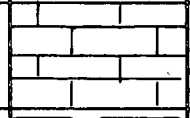
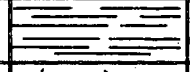
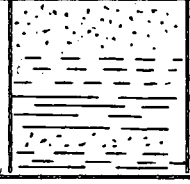
The area forms part of a stable and horizontal platform known as the Stuart Shelf. This is bounded to the east by the north-south trending Torrens Fault, approximately 18 miles east of the opal field.

Lack of major earth movements in the area has resulted in a series of flat or very gently dipping sediments. A single line of disturbance along Teatree Creek marks a change in environment from flat lying quartzites in the south to limestones which dip at 10-15^{o} into a basin to the north.

The geological succession is summarised in Table 1 and the regional geology is illustrated in Fig.1.

TABLE 1

Stratigraphic Sequence

AGE	FORMATION	GRAPHIC LOG	THICKNESS IN FEET	LITHOLOGY
Recent	Swamp deposits		0-20+	Clays, silts
Quaternary	Dunes		0-50+	Sands, quartz, red brown
Cretaceous	Undifferentiated		0-100	Sandstones, siltstones boulder beds
Cambrian	Andamooka Limestone		0-40	Limestone
Upper Proterozoic	Yarloo Shales		50	Purple shales
	Tent Hill Formation		?	Sandstone quartzite Siltstones, shales

HYDROGEOLOGY

Groundwater conditions have been tested in each geological formation and at most of the hydrogeologically favourable locations within six miles of the centre of the settlement. Boreholes were sited in each case to take any possible advantage of potential recharge to the groundwater from surface runoff.

The location of boreholes is given in Fig. 1; more detail of the development in Opal Creek near the township is shown as an insert.

Drilling results show that the regional groundwater table lies from 70 - 200 feet below the surface. No surface height control is available for any of the boreholes or wells and it is therefore impossible to assess the regional hydrogeological picture in detail. Two general interpretations may nevertheless be made:-

1. The region contains connate (fossil) water of high salinity which is practically stationary because of very low hydraulic gradients.

2. The zone west of Lake Torrens receives saline groundwater recharged by seepage through the lake floor.

It is considered that the first alternative is the more likely.

"Fresh" water pockets have been found in this generally saline environment either as shallow perched water or as a thin lens on the main groundwater body.

Perched water conditions appear to exist in Opal Creek; wells originally drawing water from a depth of less than 40 feet showed no significant improvement in supply after deepening.

South west of the opal field at Phillips Ridge and northwest at North Swamp higher quality water probably occurs as a lens. This situation has been noted

elsewhere on the Andamooka pastoral lease south of the opal field, and on several occasions attempts to increase the supply from a well or borehole have led to increasing salinity and abandonment of the point as a stock supply.

Appendix B summarises all the available information for the wells and boreholes in use at the present time or drilled and abandoned since 1946. Boreholes have been classified by environment under the following headings:-

Class A - Along drainage lines
Class B - Associated with swamps
Class C - In the Andamooka Limestone area.

In addition to boreholes drilled during government investigations drilling has also been carried out at various times for the Andamooka Pastoral Company (Bleys, 1958). Where details of this are known, results have been incorporated in the general study of the area.

Class A

The success achieved with shallow wells at the township in Opal Creek has not been repeated elsewhere. Here the supply is obtained from sandstones with a minor amount from very shallow valley alluvium and it is very doubtful if any extra boreholes or wells will augment the supply (O'Driscoll, 1957).

An additional problem exists in the high potential for pollution resulting from individual sewage disposal in the township.

Class B

Boreholes and wells have generally been very disappointing. A small supply is obtained from North Swamp but elsewhere, salinities exceed 12,000 parts per million and the production rates rarely exceed 100 gallons per hour on a short test.

Class C

Salinities are high in the area north of Andamooka.

Relatively high production rates of over 3,500 gallons per hour were achieved at two sites (Boreholes 102/105 and 104) but the salinity level of over 50,000 parts per million was considered too high for desalination purposes.

CONCLUSIONS

The area has been extensively tested by drilling and well sinking on behalf of the Government and the Andamooka Pastoral Company.

Hole siting has generally been based on sound hydrogeological principles and the following factors have been responsible for the poor results obtained:-

1. The groundwater is regionally highly saline.
2. Rainfall is low, with a mean annual average between 5 and 6 inches. More important however, are the low reliability and the wide annual variation, since recharge to groundwater is probably confined to rare intensive rain storms.
3. Poor topographic relief provides little concentration of overland flow.
4. The primary permeability of the potential aquifer host rocks is low to very low.
5. Secondary permeability in the form of joints and faults is not well developed in the Cretaceous and Upper Palaeozoic rocks because of the lack of folding and faulting on the stable Stuart Shelf.
6. Although there is evidence of secondary permeability as solution cavities in the Andamooka Limestone, there appears to be insufficient concentration of recharge to provide a high quality groundwater zone which can be readily located.

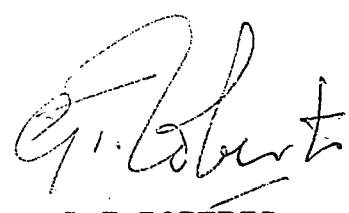
Production rates suitable for desalination purposes may only be expected in the Andamooka Limestone and drilling has shown that this strata contains regionally a very highly saline groundwater exceeding 60,000 parts per million.

In summary, it has been shown that high salinity groundwater is dominant throughout the region. Two reasons for this have been suggested; highly saline connate water and saline recharge from a groundwater mound generated under Lake Torrens. Local freshening has not been found in the most likely environment of the Andamooka Limestone. Elsewhere secondary permeability is poorly developed and fresh pockets are either unlikely to occur or are of very limited extent and unable to withstand development for a township supply.

RECOMMENDATIONS

The area has been thoroughly explored for potential groundwater supplies and further work is difficult to justify on hydrogeological grounds.

No further groundwater work is therefore proposed.



G.T.ROBERTS
ASSISTANT SENIOR GEOLOGIST
HYDROGEOLOGY SECTION

GTR:PMM
15.5.70

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APPENDIX A

SUMMARY OF ACTIVITIES AT ANDAMOOKA OPAL FIELD

Date	Activity
August 47	Visit by T. A. Barnes. Two borehole sites selected. Further work recommended at Gouger No.1 and 2 wells. Establishment of surface catchment facilities suggested. Possibility of pollution noted.
February 48	Drilling carried out on 2 borehole sites and in Gouger No.1 and 2 wells. One borehole site successful (Barnes No.2)
June 54	Further work suggested by T. A. Barnes: 1. Sink well on site of Barnes No.2 well. 2. Deepen Gouger No.2 well. 3. If 1 and 2 successful, deepen Gouger No.1 well.
August 54	Further work deferred.
August 56	Visit by W. Johnson. Reported on shortage of water Recommended active as suggested by T. A. Barnes if shortage develops.
April 57	Complaint of shortage due to influx of aborigines.
July 57	Visit by E. P. O'Driscoll. Recommended 1. Construction of artificial surface catchment and strong tanks. 2. Two new wells in Opal Creek. 3. One or two wells at three mile Swamp - 3 miles west of the Opal field.

December 59	Note from E. & W. S. that a 'new' well had been constructed.
July 61	Letter from Progress Association saying 'new' well on one of O'Driscoll's sites was unsatisfactory.
February 62	C. Bleys suggested drilling at Three Mile Swamp.
March 62	Drilling on 3 sites at Three Mile Swamp agreed.
May 62	D. of M. recommends use of Chimney Rock hole surface storage. - ¾ million gallons.
November 62	Three boreholes drilled at sites selected by D. of M. close to 3 Mile Swamp. All abandoned.
December 62	One borehole drilled near existing well at North Swamp.
August 63	Further studies requested by E. & W. S. Department
October 63	Four borehole sites selected by R. K. Johns.
April 65	Four boreholes drilled as recommended. Three produced high salinity water and one (North Swamp) produced a small supply, salinity 6930 p.p.m.
June 65	Report on drilling by R. K. Johns Rept. Bk. 60/116 Surface catchment and/or desalination suggested.
May 66	Request from E. & W. S. Dept. for supply of about 3000 gallons per hour suitable for a solar distillation plant.
September 66	Approval given for 10 scout boreholes.
March 67	Seven boreholes drilled one borehole with production rate of 3600 g.p.h. selected for pump testing and an observation borehole drilled.
June 67	Pump testing carried out. Project abandoned since salinity of 66,000 p.p.m. considered too high.
October 68	Summary re ort by C. Bleys.

APPENDIX B

BOREHOLE SUMMARY - GRID I.5

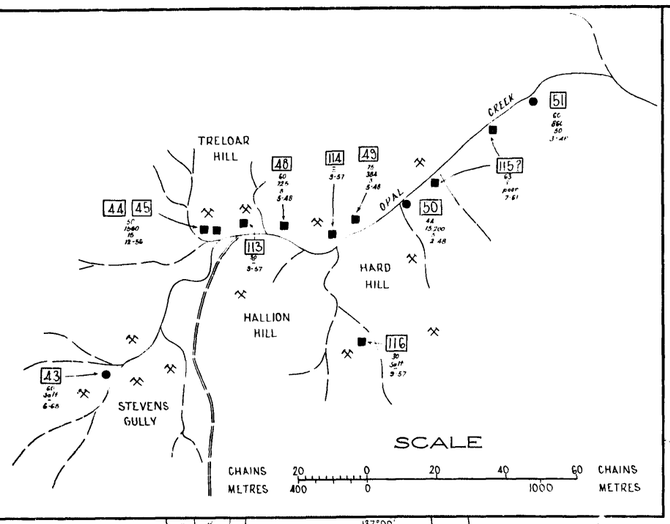
NUMBER		DATE	DEPTH (FEET)			SUPPLY GALLONS PER HOUR	SALINITY		OWNER	ENVIRONMENT CLASSIFICATION	REMARKS
BOREHOLE	WELL		TOTAL	WATER CUT	STATIC LEVEL		PARTS PER MILLION	ANALYSIS NO.			
1		Dec. 62 Feb. 63	150	76	72	25	490 1480	144/860 144/875	E.& W.S.	B	Intersected a drive from well 37.
2		Nov. 62	100	-	-	Dry	-	-	E.& W.S.	B	Abandoned
3		Nov. 62	100	-	-	Dry	-	-	E.& W.S.	B	Abandoned
4		Dec. 62	230	203	72	20	12200	141/2792	E.& W.S.	B	Abandoned
8		April 65	120	97	91	V.small	6930	164/1293	E.& W.S.	B	Abandoned
9		April 65	90	80	50	?	17100+	164/1294	E.& W.S.	A	Deepened to 201 feet April 67. Abandoned as dry.
10		April 65	15	5	4	?	17100+	164/1295	E.& W.S.	A	Abandoned.
11		April 65	115	72-76	51	?	17100+	164/1296	E.& W.S.	A	Abandoned
36		?	?	?	?	?	?	?	Andamooka Station	B	600ft. from well 37. Abandoned. Precise location unknown.
	37	Aug.47	200?	?	80	10	?	?	Andamooka Station	B	Known as North Swamp well.
38		1933	97	?	72	20	-	-	Andamooka Station	C	Reported as 'good stock' quality
	39	?	200	?	?	?	?	?	Andamooka Station	B	Abandoned. Probably too saline for stock.

NUMBER		DATE	DEPTH (FEET)			SUPPLY GALLONS PER HOUR	SALINITY		OWNER	ENVIRON-MENT CLASS-IFICATION	REMARKS
BORE-HOLE	WELL		TOTAL	WATER CUT	STATIC LEVEL		PARTS PER MILLION	ANALYSIS NO.			
40		Feb. 58	170	-	-	Dry	-	-	Andamooka Station	B	Abandoned
41		Feb. 58	110	-	-	Dry	-	-	Andamooka Station	B	Abandoned
43		June 65	60	-	-	Very poor	2	?	Andamooka Station	A	Reported as 'bad stock quality'.
	44	Aug. 47 Dec. 56	50	?	21	15	1,220 1,560	22/6446 E.& W.S	Andamooka Station	A	Known as Station well No. 1. Drives across creek line.
	45	Aug. 47	64	?	?	15			Andamooka Station	A	Adjacent to station well No.1 known as No. 2.
48		Aug. 47	28	21	21	6	?	?	Township	A	Known as Gouger No. 1.
			30	-	27	-	540	25/7326			
		May 48	60	55	27	2	725	25/7327			Borehole in well floor.
49		Aug. 47	35	21	21	2	?	?	Township	A	Gouger No. 2.
			30	-	25	-	315	24/7174			
			75	55	25	1	384	25/7224			Borehole in well floor.
50		Feb. 48	44	22	22	5	15,200	24/6987	E.& W.S.	A	Known as Barnes No. 1 Abandoned
51		Mar. 48	60	18,55	15	50	860	25/7223	E.& W.S.	A	Barnes No. 2
56		Mar. 58	44	40	34	5	22,400	107/1065	Andamooka Station	A	Abandoned.

NUMBER		DATE	DEPTH (FEET)			SUPPLY GALLONS PER HOUR	SALINITY		OWNER	ENVIRON-MENT CLASS-IFICATION	REMARKS
BORE-HOLE	WELL		TOTAL	WATER CUT	STATIC LEVEL		PARTS PER MILLION	ANALYSIS NO.			
57		Jan. 58	162	72	72	100	26,600	104/283	Andamooka Station	B	Abandoned
98		June 65	44	?	?	2	22,400	?	E.& W.S.	A	Abandoned
100		April 67	208	17	7	60	82,200	180/1339	E.& W.S.	A	Abandoned
101		May 67	260	183	173	70	16,300	179/300	E.& W.S.	B	Abandoned
102		May 67	106	49	40	?	34,600	180/1338	E.& W.S.	C	Observation borehole for pump test on 105. Abandoned
103		May 67	201	109	101	100	18,950	180/1342	E.& W.S.	C	Abandoned
104		June 67	149	102	68	3,600	57,200	180/1346	E.& W.S.	C	Abandoned
105		May 67	197	96	80	3,800	61,500	180/1337	E.& W.S.	C	Pump tested. Abandoned
106		June 65	180	?	?	?	Salt	-	Andamooka Station	C	Abandoned
107		June 65	150	?	?	?	Salt	-	Andamooka Station	C	Abandoned
108		June 65	270	?	?	?	Salt	-	Andamooka Station	B	Abandoned
	109	June 65	180	?	?	?	Salt	-	Andamooka Station	B	Abandoned
110		June 65	320	?	?	70	Salt	-	Andamooka Station	A	Abandoned
111		June 65	90	?	?	?	Salt	-	Andamooka Station	A	Abandoned
112		1938	114	?	?	50	Salt	-	Andamooka Station	A	Abandoned

NUMBER		DATE	DEPTH (FEET)			SUPPLY	SALINITY		OWNER	ENVIRON-MENT CLASS-IFICATION	REMARKS
BORE-HOLE	WELL		TOTAL	WATER CUT	STATIC LEVEL	GALLONS PER HOUR	PARTS PER MILLION	ANALYSIS NO.			
	113	Sept.57	30	?	?	Very small	?	?	Private	A	Howe's Well.
	114	Sept.57	?	?	?	Very small	?	?	Private	A	Albertoni's Well.
	115	July 61	63	25	25	Poor supply	?	?	Township	A	Location unsure
	116	Sept.57	30	?	?	?	Saline	?	?	A	

NUMBER		DATE	DEPTH (FEET)-			SUPPLY GALLONS PER HOUR	SALINITY		OWNER	ENVIRON-MENT CLASS-IFICATION	REMARKS
BORE-HOLE	WELL		TOTAL	WATER CUT	STATI LEVEL		PARTS PER MILLION	ANALYSIS NO.			
	73	June 65	90	?	?	small	2,300	?	Andamooka Station	C	Phillips Ridge
	74	June 65	60	?	?	small	1,140	?	Andamooka Station	C	
	75	June 65	50	?	?	small	1,260	?	Andamooka Station	C	



LEGEND

- RECENT — Lake deposits and swamps
- QUATERNARY — Alluvium
- QUATERNARY — Sand dunes
- CRETACEOUS — Sandstones, siltstones and boulder beds
- CAMBRIAN — ANDAMOOKA LIMESTONE
- UPPER PROTEROZOIC — YARLOO SHALE: Purple shales; TENT HILL FORMATION: Sandstones, quartzites, siltstones and shale
- Strike and dip of bedding
- Horizontal bedding
- Track
- Opal diggings
- Borehole — depth in feet; salinity in p.p.m.; supply in g.p.h.; month, year
- Well

PUMP TEST BORES

ANDAMOOKA OPAL FIELD

LAKE TORRENS

Dam, Bullshead Dam, Old Dam, Middle Dam, Swamp Dams, AIRSTRIP, Teatree Dam, Snake Gully Dam, Blue Dam, Chimney Rockhole, Three Mile Dam, Twelve Mile Dam, Pimba Ridge Dam, White Dam, Pine Ridge Dam, Canegrass Dam, Philip Ridge Hut, BILLS LOOKOUT, TRIG BLUFF, EDGE HILL, HORN RIDGE, PIMBA RIDGE, BICKFORD RIDGE, OPAL CREEK, TEATREE CREEK, TRIG CREEK, CROZIER CREEK

137°00' — REFERENCE GRID H5 / REFERENCE GRID I5

30°30'

SCALE
MILES 0 1 2 3 4 5 6 MILES
KILOMETRES 0 1 2 3 4 5 6 7 8 9 10 KILOS

Geology after R.K Johns

DEPARTMENT OF MINES — SOUTH AUSTRALIA

ANDAMOOKA OPAL FIELD GEOLOGY AND BOREHOLE LOCATIONS

HYDROGEOLOGICAL SECTION	GEOLOGIST	Drn. G.T.R.	SCALE As shown
		Trd. R.H.	70-293
		Ckd.	Cc
Director of Mines	SEN. GEOLOGIST	Exd.	DATE: 11 May 1970