DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO.88/70

FREGON WATER SUPPLY - 1987 DRILLING

GEOLOGICAL SURVEY

by

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GROUNDWATER AND ENGINEERING

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SOUTH AUSTRALIA

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FREGON WATER SUPPLY - 1987 DRILLING

ABSTRACT

Three wells were drilled at Fregon to locate a replacement production well for a well which had been contaminated with diesel fuel. The first well had too small a yield, the second was too saline (1705 mg/L) while the third has an estimated long term yield of 2.5 L/s and salinity of 1160 mg/L. Analyses from existing production wells show that the salinity has been stable for 17 years.

INTRODUCTION

Fregon is an Aboriginal Community in the Pitjantjatjara Homelands in the northwest of the State (Fig. 1).

In 1987 three wells were drilled to provide a production well to replace 5344WW19 which had become contaminated with diesel.

HISTORY

The history of Fregon water supply is documented in Read (1986).

DRILLING

Details of the three wells drilled in 1987 and earlier wells are in Table 1. Locations are in Figure 2.

TEST PUMPING

The successful well, 4344WW47 was test pumped by a Pitjantjatjara Council crew. Details are discussed in Appendix A.

TABLE 1 - WELL DETAILS

Unit No.*	Pit. Council No.	Date Drilled	Drilled by	Drilling Method**	Depth (m)	SWL (m)	Salinity (Mg/L)	Supply (L/s)	Remarks
3	FRG4	pre 1961?	?	C?	11.9?	5.8	3 000 app	1	First bore at Fregon.
6	FRG3	1964?	?	C	20?	11.0?	2 700	?	
7	FRG2	1968?	?	C	21.7?	13.7	1 100	0.9+	
9	FRG1	1970?	?	C	23.2	11.6	1 200	1	Still in use. (Double Bore).
13		11/5/71)		R	4.5				Abandoned, hard drilling.
14		11/5/71)	F. Pignitter	R	6				Abandoned, hard drilling.
15	FRG11	11/5/71)	SADME	R	35	-	-	Dry	Abandoned.
19	FRG5	8/5/71)		R	35	11.5	1 500	3	'E4', still in use.
22	FRG6	11/7/76	L. Hausler SADME	C	36	10.6	1 119	1.2	'Farm Bore'
28	FRG10	12/8/78	W. Boyd SADME	R	39	8.4	1 380	0.3	Cased, but not used because of small supply.
31	FRG7	2/5/83	Gorey & Cole	R	48	12	1 130	3.1	Centre Bore.
45	FRG12	22/4/87	Gorey & Cole	R	42	12	1 395	1.5	
46	FRG13	22/4/87	Gorey & Cole	R	30	8.5	1 705	5	Too saline
47	FRG14	23/4/87	Gorey & Cole	R	30	10.4	1 160	3	Test-pumped (See Appendix A).

* Add prefix 5344WW

** C is cable-tool, R-rotary

*** Yields shown are generally bailed (cable-tool) or air-lift (rotary).

HYDROGEOLOGY

The aquifers occur in weathered crystalline rocks (saprolite) and the underlying zone of fractured crystalline rock.

The aquifer is relatively thin and there is little evidence of vertical stratification of salinity. Salinity changes markedly over relatively short horizontal distances (Fig. 2). By contrast salinities of pumped wells have remained remarkably constant (Table 2). These facts suggest that the aquifer is divided into poorly connected compartments which restrict horizontal movement of the saline water.

None of the production wells have shown any discernible trend in salinity over periods of up to seventeen years (Table 2).

The aquifer's continued satisfactory performance shows that extraction is being balanced by recharge. Read (1986) attributed recharge to direct infiltration from rainfall. It is more likely that recharge results from over-bank flow of Officer Creek. The assumptions used by Read (1986) to estimate recharge by chloride balance are therfore incorrect and average recharge rates could be higher than estimated.

A brief study was made of water chemistry. Sodium and chloride are the dominant ions in all cases.

Bicarbonate and calcium are highest in the low salinity waters, indicating that evaporative concentration is occurring, accompanied by precipitation of calcium carbonate.

DISCUSSION

The new information from the drilling requires a re-assessment of the aquifer. The relatively low yield from 5344WW45 is to be expected from this type of aquifer. More surprising is the high salinity of 5344WW46. The two nearby wells (5344WW19 and 5344WW31) have been pumped for years without appreciable change in salinity (Table 2).

5344WW46 appears to be in a compartment with higher salinity and little connection with the pumped wells.

TABLE 2 - WATER ANALYSES

Unit No.*	Pitjantjatjara Council No.	Analysis No.	Date	TDS	Cond.	Na^+	K^+	Ca^{2+}	Mg^{2+}	Cl^-	SO_4^{2-}	NO_3^-	HCO_3^-	F^-
3	FRG4	W523/61	20/11/61	2870										
3	FRG4	W524/61	20/11/61	2530										
3	FRG4	W786/62	12/3/62	3040	-	887	-	96	103	1158	523	53	223	-
3	FRG4	W787/62	12/3/62	2860	-	887	-	63	83	1060	493	41	231	-
3	FRG4	W188/62	28/3/62	2730										
3	FRG4	W308/62	16/8/62	2030										
3	FRG4	W131/64	8/7/64	3070	-	934	-	81	93	1160	536	50	218	-
3	FRG4	W38/68	9/1/68	3377										
3	FRG4	W128/70	5/7/70	4145										
6	FRG3	W132/64	8/4/64	2720	-	860	-	48	75	1040	461	50	186	-
7	FRG2	W282/68	5/5/68	1115	-	279	-	48	48	405	90	25	290	
7	FRG2	W476/68	13/12/68	1070										
7	FRG2	W5349/69	29/7/69	1045										
7	FRG2	W5350/69	29/7/69	1045										
9	FRG1	W132/70	5/7/70	1115										
9	FRG1	W1834/71	28/4/71	1160	1960	271	3	49	47	410	90	-	290	-
9	FRG1		8/12/83	1300	2580	320	26	62	60	498	151	35	297	2
9	FRG1		30/1/85	1200	2160	314	25	53	49	468	125	40	292	1.4
9	FRG1		24/4/86	1200	2150	297	24	49	48	430	126	42	288	1.4
9	FRG1		29/1/87	1200	2110	301	21	57	49	435	140	41	290	1.5
19	FRG5		8/5/71	1496	2560	327	27	82	65	625	125	20	240	-
19	FRG5**		30/1/85	1500	2670	365	27	80	72	626	174	39	294	1.2
19	FRG5		24/4/86	1300	2430	318	20	69	56	525	141	53	254	1.3
19	FRG5		29/1/87	1400	2470	334	20	73	60	560	334	25	256	-
22	FRG6		6/7/76	1119		299	25	43	42	415	111	32	310	-
22	FRG6		29/9/76	1090		289	21	45	42	400	110	29	313	
22	FRG6**		30/1/85	1100	1950	285	14.5	48	45	404	106	40	294	1.4
28	FRG10		12/8/78	1386	2356	479	21	9	8	392	170	115	390	
31	FRG7		24/4/83	1130	1960	296	35	37	48	380	141	45	292	1.4
31	FRG7		24/4/86	1100	1950	269	23	46	44	390	114	46	270	1.3
31	FRG7		29/1/87	1100	2000	283	20	50	48	408	120	50	292	
45	FRG12		22/4/87	1395	2500	312	18	65	53	495	129	44	256	1.0
46	FRG13		22/4/87	1705	3100	372	23	88	77	679	159	38	263	1.0
47	FRG14		23/4/87	1160	1890	276	17	51	42	369	118	23	311	1.3

* Add Prefix 5344WW

** These analyses were filed under the opposite wells, but have been swapped over in the light of previous analyses.

The good performance of the well-field shows that extraction is being balanced by recharge.

DEVELOPMENT OF THE EAST BANK

Some development on the east bank of the Officer Creek has already occurred. This is almost certainly too far away to pose any threat to the production wells.

Further development in this area should be avoided if possible for the following reasons:

i/ The production wells already have relatively high salinity and nitrate levels close to the WHO limit of 45 mg/L.

ii/ The aquifer system is complex and not understood in detail. While records show that saline water has not migrated to production wells as rapidly as would be expected it must be remembered that this may be due to the presence of boundaries whose location and orientation cannot be determined.

iii/ Even if houses are connected to the common effluent system there is still a risk of leaks contributing nitrates to the aquifer. Also gardens and evaporative air-coolers could recycle salt to the aquifer.

CONCLUSIONS & RECOMMENDATIONS

1. The new well (FRG 14 or 5344WW47) should be equipped to pump about 2.5 to 3 L/s.

2. Water from the diesel contaminated well (FRG5 or 5344WW19) should be used for construction purposes.

3. Although the salinity of production wells has been stable regular sampling should be continued.

4. The aquifers appear capable of continuing to meet Fregon's requirements.

5. Because of uncertainty as to the aquifer's extent development on the east bank should be limited.

R.E. Read

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SENIOR GEOLOGIST

REFERENCE

Read, R.E., 1986. Fregon water supply. South Aust. Dept. Mines and Energy unpubl. report 86/97.

APPENDIX A

Pump-testing 5344 WW 47

Figure		Plan No.
A-1	5344WW47, well drawdowns (semi log)	S20007

The well was pumped at 2.7 L/s for 24 hours and recovery observed for 72 hours.

The semi-log plot of drawdown (Fig. A-1) appears to follow a straight-line with 'delta-s' of 0.2 m.

The t/t_1 plot of recovery appears to be following a straight-line passing through the origin with 'delta-s' of 0.28 m.

From the above, 2 year drawdown is estimated to be about 5 m or 15 m from the surface. The top of the aquifer as recorded by the driller was 18 m, suggesting that safe yield is higher than the test rate.

Testing of 5344 WW 31 (Read 1987) suggested a long term yield of 3.9 L/s, while in practise yield has been found to be about 3 L/s.

Therefore it is considered that the long-term yield is about the test-rate, around 2.5 L/s.

Unlike 5344 WW 31 where the response suggested delayed yield 5344 WW 47 had a response characterisitc of radial flow. However the 'delta-s' of the straight line corresponds to a transmissivity of 190 m^2/day which is very high for fractured crystalline rock.

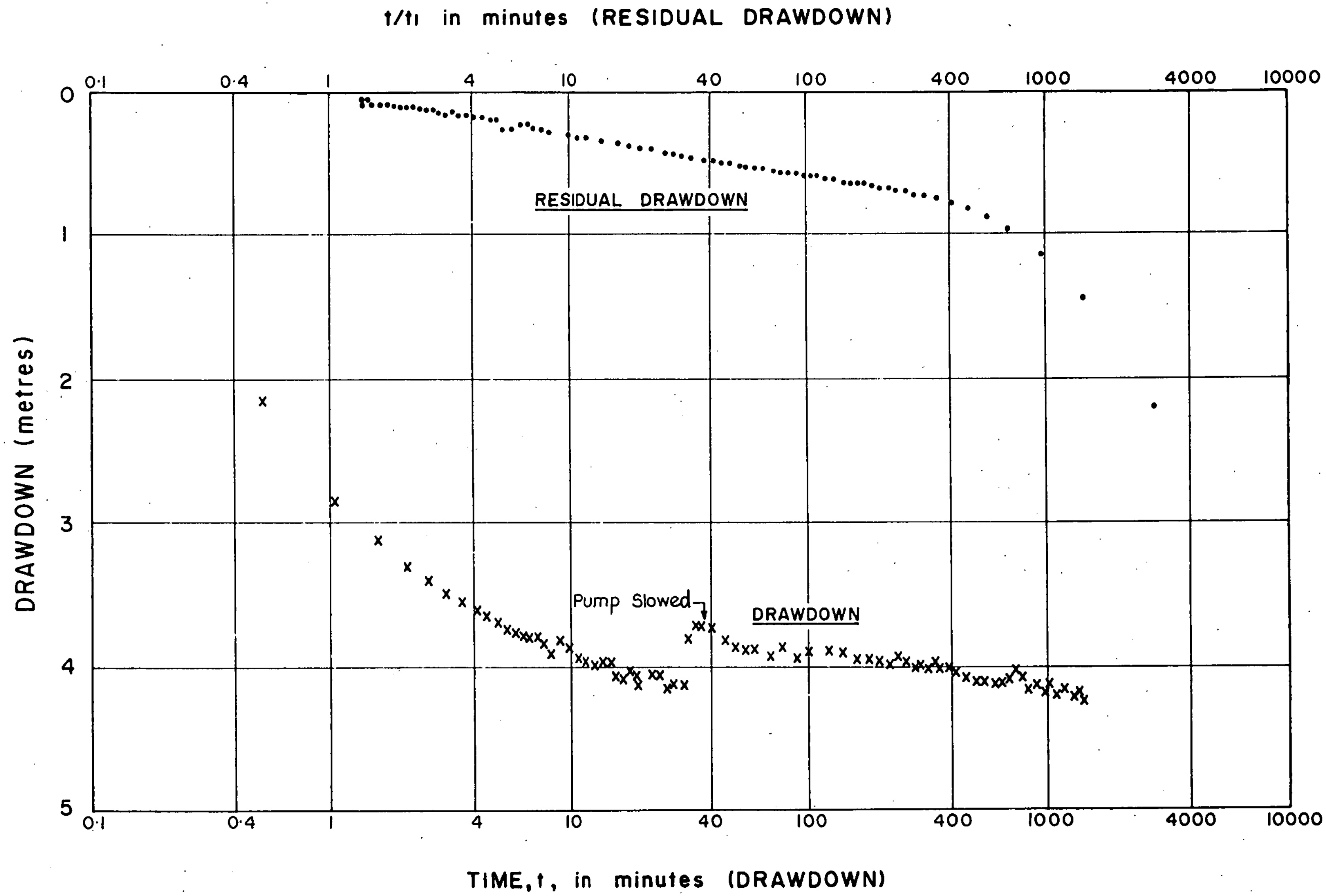


Figure A-1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

FREGON WATER SUPPLY — 1987 DRILLING
WELL 5344000WW00047
WELL DRAWDOWNS (SEMI-LOG)

COMPILED	R. E. Read
DRAWN	B. Donovan
DATE	April '88
CHECKED	
C D O	20·9·88 (DATE)
SCALE	As shown
PLAN NUMBER	S 20007

APPENDIX B

DIESEL CONTAMINATION OF 5344WW19

Contamination of 5344WW19

Since mid-1985 the water from this well is reported to have been contaminated with diesel fuel. This may have been introduced by one or both of the following:

i/ There is a 1000L fuel tank along side the pump-engine and well. Reportedly on several occasions the hose from the tank was disconnected and about 500L allowed to drain onto the ground.

ii/ The hose from the tank was connected to a copper pipe which ran under the concrete apron around the well head. This pipe may have cracked beneath the concrete.

In either case dieseline must have run down the annulus between the wall of the hole and the casing.

Difficulty was experienced removing the pump from the well and a front end loader was used to raise the column with the result that the casing was lifted at the same time. It was reported that the diesel contamination became much more noticeable after this.

It is hypothesized that dieseline was sitting in the annulus outside the casing above the water table, presumably held by a clay layer that had formed a tight seal against the casing. Movement of the casing allowed the dieseline to move downwards more rapidly than previously.

Although non-toxic, dieseline taints water and makes it unpleasant to drink.

An attempt was made to solve the problem by reducing the pumping rate. It was reasoned that if the oil was floating on the water keeping the water, level above the slots in the casing should prevent the oil from entering the well.

This was not successful, possibly because the oil is entering the well as fine droplets entrained in the water.

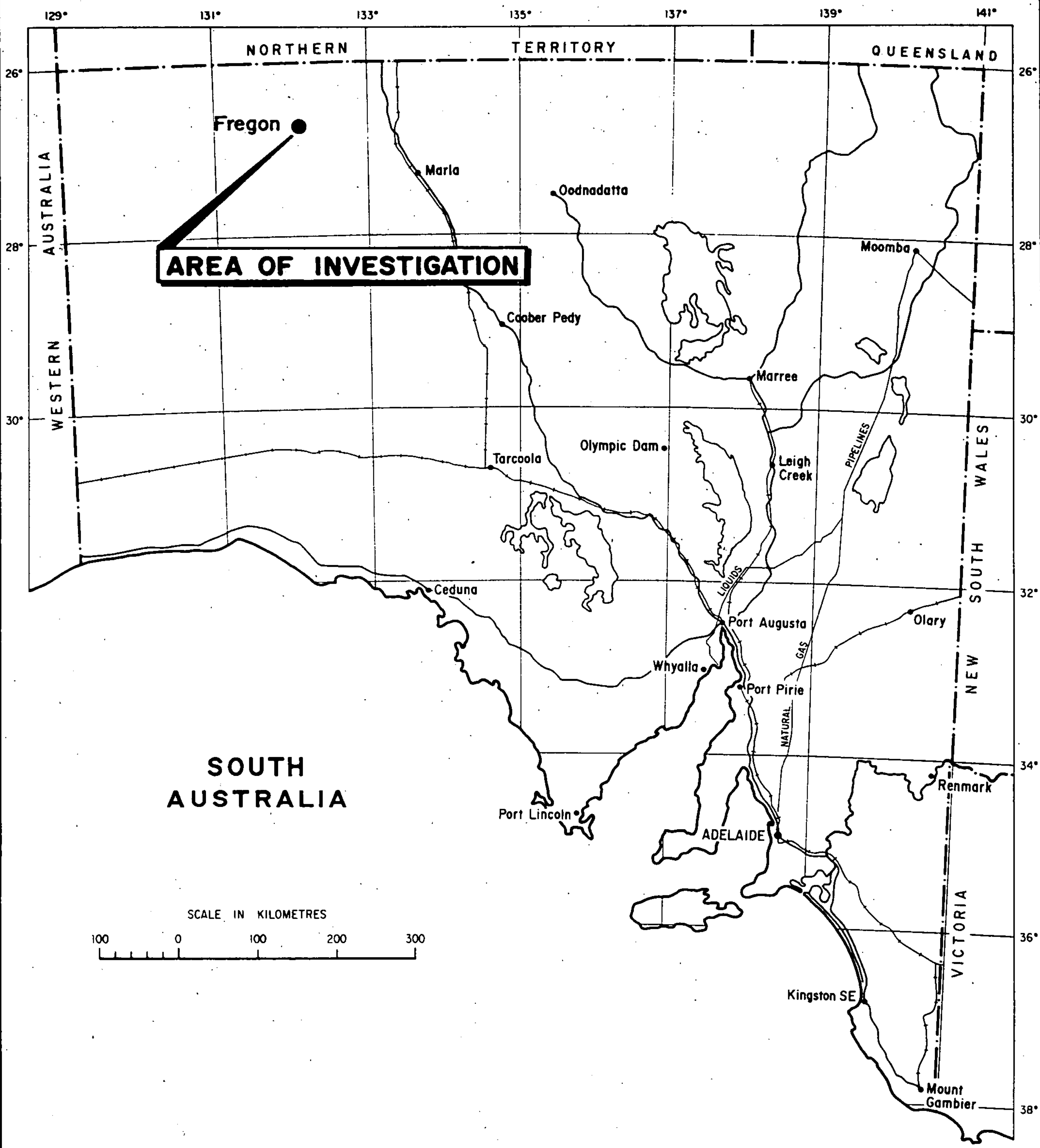


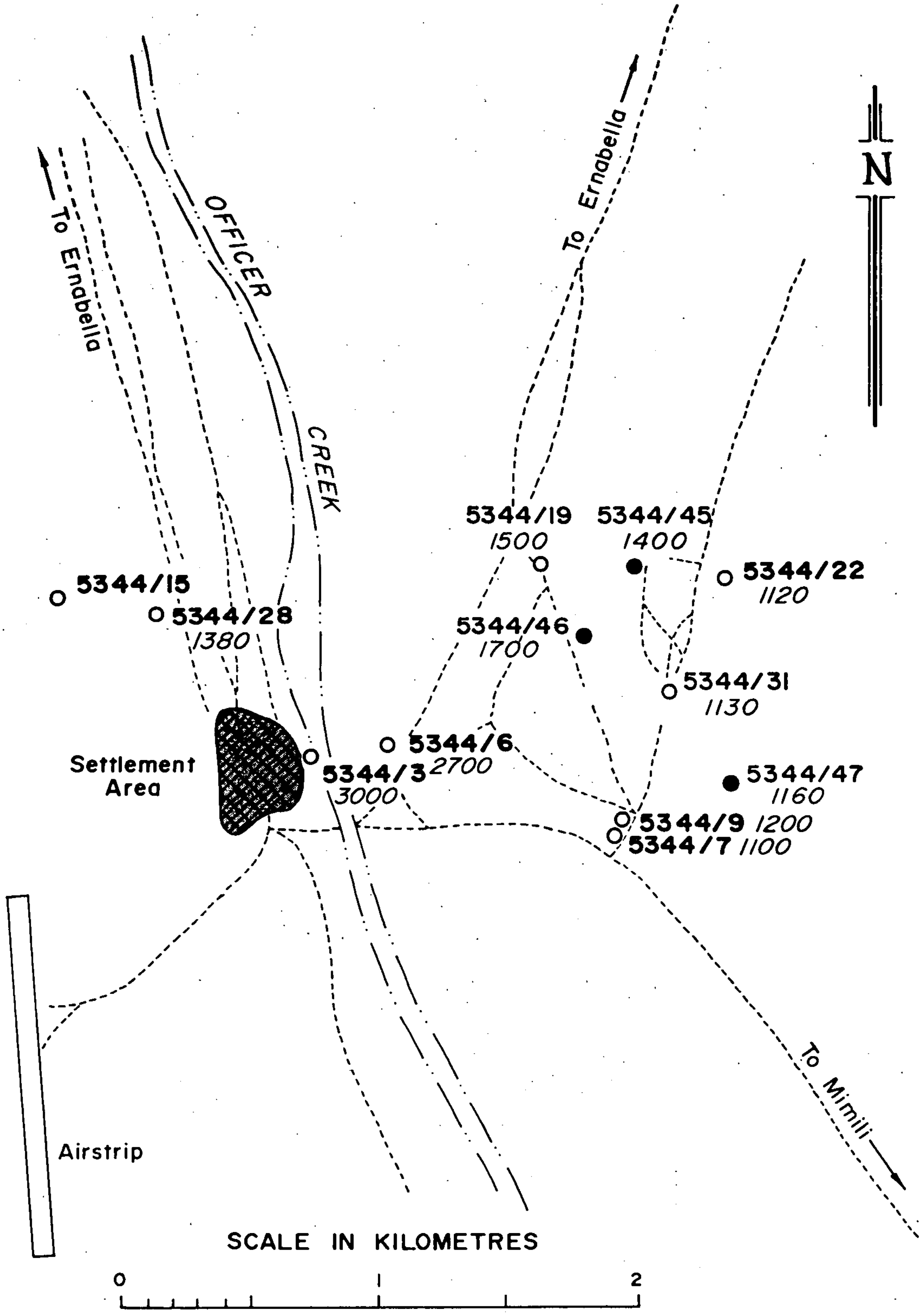
Figure......1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

FREGON WATER SUPPLY
LOCALITY PLAN

COMPILED R. Read	C.D.O.	DATE 19.1.87
DRAWN E. Calabio	SCALE 1:7,000,000	
DATE Oct.' 86	PLAN NUMBER	
CHECKED	S 18947	

4245



● **5344/47**........Well location for 1987 Drilling.

○ **5344/6**.......Well location and abbreviated unit number.

2700............Salinity in mg/L.

Figure...... 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED *R. Read*	C.D.O 20·9·88 DATE
FREGON WATER SUPPLY — 1987 DRILLING	DRAWN *B. Donovan*	SCALE *1: 25,000*
WELL LOCATION PLAN	DATE *April '88* / CHECKED	PLAN NUMBER S 20002