DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 79/76

NARACOORTE TOWN WATER SUPPLY COMPLETION REPORT FOR WELL NO. 10 E. & W.S. DEPARTMENT

GEOLOGICAL SURVEY

by

A.F. WILLIAMS

G.S. No. 6194
D.M. No. 406/75
Eng. No. 1978/NA

CONTENTS

TABLES

PLANS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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ABSTRACT

A new town water supply well, Naracoorte No. 10, intersected good confined aquifer sands at 160 m. Subsequent testing showed the well to have a yield of from 6 to 7 000 m^3/day at a recommended pump intake depth of 85 m with less than 30 m drawdown over a 24 hour period. Long term testing which could not be carried out due to noise restrictions is recommended when the well is fitted with a submersible pump by the Engineering and Water Supply Department after June 1979. Boundary effects caused by inhomogeneities should become evident during any such testing.

Water quality is similar to other town wells: total dissolved solids are 1250 mg/l, with bicarbonate levels ranging from 370-380 mg/l.

INTRODUCTION

In early 1977, the Regional Engineer (Southern) of the Engineering and Water Supply Department requested advice on additional well sites to augment the existing Naracoorte Town Supply. A review of existing data was carried out by the author (Williams, 1977) which recommended alternative new sites at the water tower within the Naracoorte Hospital grounds or near Memorial Oval (see Fig. 1). Subsequently a request for a new well at the former site was received from the Engineering and Water Supply Department. Discussion over the proposed well with the Drilling Branch resulted in a decision to drill an observation well at the Department of Mines and Energy's expense in order to explore the aquifer and give a realistic contract price for the production well drilling, as drilling conditions were known to be hazardous. This report describes the results of the

drilling and testing of both the observation and production wells. A summary of well details for the production well is given in Table I.

DRILLING AND COMPLETION PROCEDURES

a. Observation well NG46

Drilling commenced on 3/4/78 and was completed on 29/5/78. Problems were encountered with cavernous and unconsolidated strata (see Drilling Supervisor's report, Appendix 1) in the upper portion of the well. However, 28 m of aquifer sands were intersected between 159 and 187 m. Strata intersected and construction details appear in Fig. 2. Sieve analysis of the sands showed expected screen aperture size for the production well to be about 0.4-0.7 mm providing conditions were uniform between the two sites.

b. Production well Naracoorte No. 10

Drilling commenced on 30/5/78 and was completed (after step drawdown testing) on 23/10/78. Techniques were modified on the basis of experience with NG46 and mud circulation maintained continuously till the bottom of the clay confining bed was reached. The confined aquifer was then sampled with water circulation and much more rapid progress achieved (see Drilling Supervisor's report, Appendix 1). Construction details for each well are shown on Figs. 2 and 3. The aquifer proved to be more coarse than NG46 for reasons explained in Appendix 2.

GEOLOGY AND HYDROGEOLOGY

A summary of the stratigraphic intervals intersected in the observation well is as follows (only the aquifer sands were sampled in the Production well):

2.a.

TABLE 1

SUMMARY OF WELL DETAILS - PRODUCTION WELL NO. 10

Depth:	179.80 m
Casing:	250 mm I.D. casing from 0 to 151 m 152 mm I.D. casing from 140.12 to 166.09 m 154 mm I.D. s/s sandscreen from 166.09 to 179.88 m
Standing Water Depth (S.W.D.):	33.46 m (below ground level)
Interval tested:	166.09 to 179.88 m
Recommended Safe Yield:	6540 kl/day (60 000 gph)
Recommended pump intake depth:	80 - 85 m
Pumping Water Level:	25.5 m after 24 hrs.
Water salinity:	approx. 1260 mg/l
Aquifer:	unconsolidated sands and gravels (Dilwyn Formation)

Interval (m)	Thickness (m)	Unit
0- 46	46	Bridgewater Formation - sandy limestones and quartz sands fossiliferous - poor to well cemented. Unconfined aquifer.
46- 92	46	Gambier Limestone - coarse grained bryozoal limestone overlying calcareous sands similar to lower 36 m of above unit. Unconfined aquifer.
92- 96	4	Narrawaturk Marl - Mepunga Formation equivalents - silty sands, glauconitic, fossiliferous, grey-brown.
96-159	63	Dilwyn Formation - silts and clays - quartz rich, shelly, weakly cemented, dark brown, micaceous. Confining beds.
159-187	28	Dilwyn Formation - sands, weakly cemented, fine to coarse grained up to 15% silt. Confined aquifer.
187-118.2	1.2+	Palaeozoic? - weathered bedrock - probably schist.

Composite well logs of both NG46 and Naracoorte No. 10 are shown on Figs. 2 and 3.

WELL TESTING

A 5 x 40 minute step drawdown test was carried out on the production well No. 10 on 20/10/78. Analysis is presented in Appendix 4. The well equation is as follows:

$$St = (2.1 + 0.5 \log t)\, Q + 0.48\, Q^2$$

A plot of drawdown versus time for varying pumping rates is shown on Fig. 6. Supplies of 6 000 - 7 000 m^3/day appear quite attainable with drawdowns less than 30 m after one day's pumping.

As long term testing with above ground pumping equipment could not be used in the hospital environs for more than a few hours, no main test was carried out during the drilling and testing programme. It was decided to leave this test until late 1979 when a submersible pump should be inserted in the production well thus eliminating the noise problem. A normal 48 hour test utilizing the observation well NG46 should then

be carried out. Interference from nearby operating wells should be minimized by arranging for shut down of those nearest the No. 10 site.

WATER QUALITY DATA

Salinity and full analysis details are shown in Appendices 3 and 5 respectively. Water quality is similar to other town supply wells (Williams, 1977). Average salinity is 1230-1260 mg/l.

CONCLUSIONS

The new town supply well Naracoorte No. 10 should be capable of producing 6 to 7 000 m^3/day with drawdowns less than 30 m for a 24 hour period. Interference of say 1-3 m can be expected in other wells nearby such as No.'s 4, 6, 7 and 9 but should cause no real problem. A 48 hour test is required to assess boundary effects when a submersible pump is inserted in the new well.

for A.F. WILLIAMS

AFW:ZV

ACKNOWLEDGEMENTS

G. MacKenzie and P.C. Smith carried out the step drawdown test and P.C. Smith assisted with the test analysis.

REFERENCES

Hazel, C.P., 1973. Lecture Notes on Groundwater Hydraulics. Published by the Irrigation and Water Supply Commission, Queensland. Chapter VIII - 16.

Williams, A.F., 1977. Groundwater Resources available for South East Town Water Supplies. Review No. 3 - Naracoorte. S. Aust. Dept. Mines & Energy RB 77/50 - unpublished.

APPENDIX 1

DRILLING SUPERVISOR'S REPORT

A. Observation Well NG46

B. Production Well No. 10

a) TO THE CHIEF DRILLING & MECHANICAL ENGINEER: 8
Through the Drilling Engineer

Completion of drilling - Scout well NG46 for TWS No. 10
Dept. Mines - Naracoorte
Permit Not Required

The hole was drilled 203 mm to 74 m and cased to 34 m, then 152 mm casing was installed and drilling was continued 152 mm diameter with the casing kept close behind the bit to 117 m. Attempts to drill open hole failed due to loss of mud into the cavernous formations and loss of hole over weekends.

The 152 mm casing shoe was damaged on a hard bar at 117 m and the hole was reduced to 127 mm, using drilling mud to stabilize the open hole. To avoid loss of hole over weekends approval was granted to work 7 days a week, until drilling was completed.

The aquifer sands were sampled at 1 m intervals from 162.80 m to 188 m. A 76 mm sandscreen was installed, on 76 mm piping, from 167 m to 169 m, with seals to the 127 mm hole at 165 m.

The well was then cement grouted to surface and all steel casing removed.

Details of the well are tabulated below:-

Commenced	3/4/78
Completed	29/5/78
Depth drilled	188 m
Water cuts	29.80 m - 162.80 m
Static levels	27.00 m - 34.90 m
76 mm piping (I.D.)	+0.30 m to 167 m
76 mm screen (O.D.)	167 m to 169 m
76 mm piping tail (O.D.)	169 m to 188 m
Seals to 127 mm hole	165 m
Cement grouted	Surface to 165 m
Airlifted & developed	6 hours
Completed with screwed plug -	
Machine hours	345

Details of screen:

Type	Surescreen stainless steel
Length	2.32 m including couplings
	2.00 m effective length
I.D.	66 mm
O.D.	76 mm
Apertures	.5 mm

HW/WDW
7/6/78

W.D. WILSON
DRILLING SUPERINTENDENT

b) TO THE CHIEF DRILLING & MECHANICAL ENGINEER:
Through the Drilling Engineer

Completion of drilling — T.W.S. Well No. 10
E. & W.S. Dept. — Naracoorte
Permit No. 3782

A 260 mm production well was constructed on Section 1087 in the Hundred of Naracoorte to augment town water supply.

The well was drilled 375 mm diameter to 9 m and collared with 375 mm O.D. lockrib casing to 4 m, then reduced to 325 mm diameter to 47 m.

Whilst attempting to install 318 mm tubing to 47 m to shut off the top cavernous formation and prevent excessive mud loss, a welded joint at 26 m parted and the casing ends damaged. A 254 mm casing swedge was built up in stages and the parted ends were swedged out to 300 mm idameter.

Drilling was then continued open hole with 294 mm diameter drills to 160 m. Progress was slow and very difficult, with heavy mud losses and continual hole collapse.

260 mm I.D. tubing was installed to 151 m and pressure cemented to surface, 600 gallons of slurry was used, 5 - 1 mix. 203 mm casing was installed to penetrate and obtain bulk samples of the aquifer sands to 181 m.

A 154 mm I.D. Stainless Steel Sandscreen was set from 166.09 m to 179.88 m,with 154 mm I.D. steel piping from 140.28 m to the top of the screen.

The 203 mm casing was removed and a rubber banded seal piece, from 154 mm casing to the 260 mm tubing was placed into position at 140.09 m.

The screen was developed by simultaneously airlifting and surging the face of the screen for 99 hours.

After initial trouble with a defective pump rod, the well was pumped to develop for 8 hours, then 5 x 40 minute step drawdown tests were conducted.

Details of the well are as follows:-

Commenced	30/5/78
Completed	23/10/78
Depth drilled	181 m
Water cut	29.50 m & 158 m
Static level	33.46 m
375 mm lockrib casing	Surface to 4.23 m
318 mm steel tubing	" to 34.50 m
260 mm " "	" to 151.17 m
Rubber banded sealpiece (154 mm to 260 mm)	140.09 m
154 mm steel piping	140.28 m to 166.09 m
154 mm wire wound stainless steel sandscreen	166.09 m to 179.88 m
Tail piece, 152 mm Aust. casing	179.88 m to 180.88 m
Sandscreen developed for	99 hours

Details of 5 x 40 minute drawdown tests

Unit - Deutz No. 2

	G.P.G.	Pumping level	D.D.	R.P.M.
Step 1	7,130	34.92 m	1.46 m	1,800
Step 2	14,420	36.72 m	3.26 m	2,100
Step 3	19,920	38.65 m	5.19 m	2,400
Step 4	25,370	40.70 m	7.24 m	2,700
Step 5	30,740	42.97 m	9.51 m	2,950

Details of Screen and liner assembly

154 mm I.D. Steel piping - 4 lengths (from top)	6.41 m
	6.56 m
	6.48 m
	6.59 m
Top section of screen, 1.15 mm apertures, inc. couplings	5.12 m
Middle section of screen, 0.75 mm apertures, inc. couplings	4.12 m
Bottom section of screen, 0.50 mm apertures, inc. couplings	4.55 m
Tail piece, 152 mm Aust. casing, attached to blank end of screen	1.00 m
Overall length	40.83 m
Effective length	40.60 m

Sandscreen

Surescreen - wire wound - Stainless steel

I.D. 154 mm
O.D. 168 mm
O.D. of couplings 183 mm

Sealpiece - 154 mm to 260 mm

203 mm Aust. casing
length 3.01 m
Rubber banded to 260 mm
Internal machined seat to 154 mm piping - 19 cm below top

Machine hours 734

WDW/YMW
1/11/78

W.D. WILSON
DRILLING SUPERINTENDENT

APPENDIX 2

WELL SCREEN SELECTION

1. Observation Well NG46
2. Production Well No. 10

NARACOORTE NO. 10A (NG 46)

Interval	% retained - Cumulative						40% retained size (app)	90% retained size (app)	Coeff. of Uniformity	Selected aperture size
	1.17mm	0.83mm	0.59mm	0.42mm	0.30mm	0.21mm				
160-161	7.5	16.0	29.8	49.5			0.5	<0.15	>3	0.42
161-162	2.8	7.7	19.0	40.8	63.1		0.4	<0.15	>3	0.30
162-163	4.8	10.8	21.0	35.3	51.1		0.45	<0.15	>3	0.30
163-164	4.5	10.2	19.3	34.4	51.0		0.45	<0.15	>3	0.30
164-165	9.5	14.8	21.1	32.2	46.9		0.36	<0.15	>3	0.30
165-166	22.9	46.2	66.9				0.9	0.25	3.6	0.83
166-167	6.3	19.6	44.4	66.8			0.61	0.18	3.4	0.59
167-168	27.3	45.6	63.7				0.86	0.25	3.4	0.83
168-169	27.6	46.7	65.4				0.86	0.2	4.3	0.83
169-170	8.8	16.2	51.3	48.9	63.7		0.5	<0.15	>3	0.42
170-171	9.4	25.5	49.7	69.6			0.7	0.19	3.7	0.59
171-172	7.1	15.6	28.2	42.9	56.1		0.45	<0.15	>3	0.30
172-173	7.7	16.0	29.0	45.3	59.8		0.45	<0.15	>3	0.42
173-174	2.7	7.3	17.3	34.4	52.8		0.38	<0.15	>3	0.30
174-275	2.8	8.7	21.6	44.1	63.6		0.44	<0.15	>3	0.42
175-176	31.7	41.5	52.1	64.3			0.84	0.22	3.8	0.59
176-177	3.4	12.3	32.2	53.8			0.52	0.15	3.5	0.42
177-178	4.9	19.8	40.7	56.3			0.59	<0.15	>4	0.42
178-179	1.1	4.9	16.5	33.8	49.3	63.8	0.37	<0.15	>3	0.30
179-180	9.7	15.2	23.1	34.5	48.4	62.6	0.37	<0.15	>3	0.30
180-181	4.1	8.8	16.4	27.3	39.4	55.2	0.3	<0.15	>2	0.21
181-182	7.6	14.8	23.5	33.6	44.2	58.7	0.32	<0.15	>2	0.30
182-183	4.2	8.6	14.7	23.2	33.3	47.5	0.26	<0.15	>2	0.21
183-184	2.6	9.2	21.6	35.4	47.2	59.8	0.38	<0.15	>3	0.30
184-185	1.9	7.3	23.0	42.2	57.2		0.43	<0.15	>3	0.30
185-186	6.4	14.2	25.0	37.1	48.4	58.9	0.39	<0.15	>3	0.30
186-187	12.1	27.7	41.4	55.2			0.61	<0.15	>4	0.30

Overlying bed - soft - Coefficient of uniformity greater than 3 ie % retained of aquifer sand about 50%

Suggest screen interval above 178m in adjacent production well ie. 165 - 178 m

Aperture size 165 - 169 about 0.76 mm
169 - 178 about 0.51 mm

NARACOORTE NO. 10

Interval	% Retained - Cumulative					40% retained size (approx)	90% retained size (approx)	Coeff. of Uniformity	Selected aperture size
	1.65mm	1.17mm	0.83mm	0.59mm	0.41mm				
160-161	47.2	56.8	67.3	79.4	87.9	1.8	0.35	5	1.2
161-162	25.3	38.0	54.0	72.3	84.1	1.1	0.3	3.7	0.8
162-163	14.3	19.0	26.1	39.8	57.4	0.6	0.15	4	0.4
163-164	14.0	17.7	23.7	35.4	50.6	0.55	0.15	3.6	0.4
164-165	28.4	42.3	57.0	71.1	81.3	1.2	0.25	5	0.8
165-166	36.6	47.6	59.1	72.0	83.4	1.45	0.35	4	1.2
166-167	33.9	43.5	51.4	59.6	66.8	1.45	0.16	9	0.8
167-168	42.3	50.8	57.4	64.8	72.0	1.7	0.15	11	1.2
168-169	43.8	50.8	56.3	62.9	70.5	1.7	0.15	11	1.2
169-170	46.2	51.9	57.7	63.9	69.2	1.8	0.15	12	1.2
170-171	28.2	35.0	42.1	52.0	62.5	0.85	0.15	5.6	0.6
171-172	10.6	17.9	26.7	40.2	57.3	0.6	0.18	3.3	0.5
172-173	5.8	13.3	23.9	40.8	61.3	0.6	0.19	3.2	0.5
173-174	31.3	35.9	42.6	54.0	68.6	0.9	0.19	4.7	0.6
174-175	21.7	25.7	30.3	38.4	56.4	0.55	0.2	2.8	0.5
175-176	31.9	36.8	41.7	47.8	57.8	0.85	0.1	8.5	0.5
176-177	19.1	32.7	49.2	64.3	75.3	1.0	.2	5	0.8
177-178	25.9	38.6	50.3	61.4	70.9	1.1	0.16	6	0.8
178-179	32.6	46.7	57.2	65.9	72.2	1.3	.15	9	1.2
179-181	47.8	54.3	59.5	64.2	68.7	1.8	.18	10	1.2

Overlying bed soft; coefficient of uniformity > 6, i.e. % retained of aquifer sand is about 50%

These results show the best screening interval between 165 and 181 m. The following screen apertures were selected.

166.1 - 171.2 m	1.14 mm
171.2 - 175.3 m	0.75 mm
175.3 - 179.9 m	0.51 mm

The latter two lengths should have been assembled in reverse order but for some reason were not. This would result in longer development time for the middle section with retention of only about 30% of the aquifer material. In some circumstances this could cause aquifer collapse but here with enough coarse material (pebbles, etc.) in the aquifer the problem should not arise.

The transmitting capacities of the various sections of the screens are as follows (all Surescreen Standard Pattern Mark II).

Aperture (mm)	Length (m)	*Transmitting capacity	**Recommended entrance velocity m/sec	Total volume per hour m^3/hr.
1.14	5.12	33.2	0.02	68
0.76	4.12	33.4	"	55
0.51	4.55	25.2	"	46 i.e. about 170 total

* In m^3/hr/lineal m of screen at an entrance velocity of 0.05 m/sec.
** Based on hydraulic conductivity ofa bout 40 $m^3/day/m^2$.

Thus maximum pumping rate based on an aquifer hydraulic conductivity of 40 $m^3/day/m^2$ is about 4 100 kilolitres/day (or m^3/day). However this figure is low as the hydraulic conductivity of the aquifer around the developed well is greater than that in the undeveloped state. Higher pumping rates (6 to 7 000 kilolitres/day) are possible provided care is taken in developing the well gradually until desired rate is reached.

The transmitting capacities of the two sections of screen are as follows (Surescreen Standard Pattern Mark II).

Aperture (mm)	Length (m)	*Transmitting capacity	**Recommended entrance velocity m/sec	Total volume per hour m^3/hr.
0.76	4	33.4	0.036	96
0.51	9	25.2	"	163 i.e. total 260

* In m^3/hr/lineal m of screen at an entrance velocity of 0.05 m/sec.
** Based on hydraulic conductivity estimate of 100 $m^3/day/m^2$ (Williams, 1977).

Thus the maximum pumping rate based on aquifer hydraulic conductivity of 100 m^3/day is about 6 600 m^3/day (60 000 gph).

As the production well was drilled only 5 m away the screen dimensions were expected to be similar. However, when No. 10 was drilled, the aquifer interval was found to be much coarser than expected. This may be due to one or other of the following reasons - or a combination of both:

(a) facies change to coarser channel deposits.

(b) difference in drilling techniques. It is suspected the mud used in the observation well during drilling and sampling of the aquifer may not have allowed suspension of coarser material which remained compacted at the base of the hole. The only way this could be removed would be if it was pulverized to a much finer grain size. An abundance of angular grains and very slow drilling progress over this interval seems to support this suggestion. In contract to NG46, the aquifer interval in the production well was sampled using water circulation allowing retrieval of coarser material (well rounded pebbles to 20 mm).

APPENDIX 3

WELL LOGS

PROJECT: NARACOORTE TOWN WATER SUPPLY OBSERVATION WELL

MINES DEPARTMENT — SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: NG 46

UNIT / STATE NO: 7024480WI02697

DM 406/75

LOCATION OR COORDS: E.&W.S. Water tower, Ncte Hospital Grounds

EL Surface m

SEC. 1087 HD. NARACOORTE EL Ref. Point m Datum

AQUIFER SUMMARY:	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day*	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis No:
	29.8	27.0						1858	W— 3291/78
	75.0	"						1210	3292/78
	80.0	"						1190	3293/78
	85.0	"						1040	3294/78
	90.0	"						1095	3295/78

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE	DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)
0	10		LIMESTONE	Fine to coarse grained, fossiliferous, cream, uncemented to moderately well cemented. Some quartz.	BRIDGEWATER FORMATION		76 (ID)	0	167
									Pipe
									SCREENED
10	46		SAND	60-90% fine to medium quartz, some carbonate minor silt, fossiliferous, poorly to well cemented. Orange brown and yellow.	" "		76 (OD)	167	169
							76 (OD)	169	188
46	60		LIMESTONE	Coarse grained, fossiliferous, bryozoa, forams etc.	GAMBIER LIMESTONE				Pipe
60	92		SAND	V. similar to interval 10-46m. Could be caving but other logs in Naracoorte area show similar sequence.	" "				
92	96		SAND	Silty, ? glauconitic, fossiliferous, grey brown, uncemented.	MEPUNGA/NARAWATURK MARL ? EQUIVALENTS				
96	159		SILT/CLAY	20-30% quartz, shelly, weakly cemented, brown micaceous	DILWYN FORMATION				

REMARKS:

*NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE: Percussion

CIRCULATION: Mud/Water

SHEET 1 OF 2

COMPLETED: 29/5/78

LOGGED BY: A.F.W.

DATE: 21/11/78

PROJECT:

LOCATION OR COORDS:

SEC. HD.

EL Surface m

EL Ref. Point m Datum

MINES DEPARTMENT — SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO:

UNIT / STATE NO

DM

AQUIFER SUMMARY:	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day*	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis No:
	159	33.5 (approx)			End 1st day's development			1230	W— 3600/78
	"	"			" 2nd	"	"	1265	3296/78
	"	"			" 3rd	"	"	1270	3297/78
	"	"			" 4th	"	"	1265	3298/78
	"	"			" 5th	"	"	1263	3299/78

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE	DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)
159	187		SAND	Fine to coarse grained, silty up to 15%, micaceous, pyritic, glauconitic, weakly cemented, fossiliferous.	DILWYN FORMATION				
187	188.2		SILT/WEATHERED BEDROCK	Greasy, micaceous, fine quartz, mid grey	PALAEOZOIC	188.2 to 188.2			

REMARKS:

* NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE:

CIRCULATION:

SHEET 2 OF 2

COMPLETED:

LOGGED BY:

DATE:

8

PROJECT: NARACOORTE TOWN WATER SUPPLY
PRODUCTION WELL NO.10

MINES DEPARTMENT — SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: N'CTE NO. 10

UNIT / STATE NO: 7028-480 [illegible] 3598

DM 406/75

LOCATION OR COORDS: E.&W.S. Water Tower, Ncte Hospital Grounds

SEC. 1087 HD. NARACOORTE EL Surface / EL Ref. Point m Datum

AQUIFER	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day*	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	TOTAL DISSOLVED SOLIDS Analysis No:
	160	43.2	166.1	179.9	6540	3.3	Step D/D End of test	1260 (F)	W— 4738/78
SUMMARY:		33.7					Start test	1245 (F)	4737/78
		"					" "	1235	4733/78
		35.2					10 mins after start	1235	4734/78

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE	DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)
0	160			See log for NG 46			375	0	4.23
160	181		SAND	Quartz, fine to coarse grained, silty 10-20%, weakly cemented, pyritic, shelly, glauconitic, micaceous	DILWYN FORMATION		318	0	34.5
							260	0	151.2
							154	140.3	179.9
							Screened		
							154	166.1	179.9

REMARKS:

* NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE: Percussion

CIRCULATION: Water

SHEET 1 OF 2

COMPLETED: 23/10/78

LOGGED BY: AFW

DATE: 21/11/78

PROJECT: NARACOORTE TOWN WATER SUPPLY

MINES DEPARTMENT — SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: NC TE NO. 10

UNIT / STATE NO

DM 406/75

LOCATION OR COORDS:

SEC. HD. EL Surface m EL Ref. Point m Datum

AQUIFER SUMMARY:	DEPTH TO WATER CUT (m)	DEPTH TO STANDING WATER (m)	INTERVAL TESTED From:	INTERVAL TESTED To:	SUPPLY kilolitres/day *	SUPPLY Test Length (hrs)	SUPPLY Method	TOTAL DISSOLVED SOLIDS milligrammes/litre	Analysis No:
	160				100 mins after start		1235		W— 4735/78
	"				200 mins after start		1240		4736/78

DEPTH (m) From	DEPTH (m) To	GRAPHIC LOG	ROCK / SEDIMENT NAME	GEOLOGICAL DESCRIPTION	FORMATION / AGE	DEPTH CORE SAMPLE	CASING Dia(mm)	CASING From(m)	CASING To(m)

REMARKS:

* NOTE: 110 kl / day = 1000gals / hr.

DRILL TYPE:

CIRCULATION:

SHEET 2 OF 2

COMPLETED:

LOGGED BY:

DATE:

20

APPENDIX 4

STEP DRAWDOWN TEST ANALYSIS

(By P.C. Smith & Author)

Five Stage Drawdown Test

A 5 x 40 minute continuous test was carried out on 20/10/78 at pumping rates of 0.54, 1.08, 1.59, 2.02 and 2.44 m^3/min. Results are plotted on Fig. 4 from recalculated data (graphical technique see Hazel VIII-16, 1973).

The basic well equation is as follows:

$$St = (a + b \log t)\, Q + C\, Q^n$$

where a b c and n are constants (see Hazel VIII-16). To obtain n (which should equal 2 if the well is properly developed, the procedure was as follows:

1. Plot values of St/Q vs Q for t = 1, 10 mins. on ordinary graph paper (Fig. 5)

Stage	Q(m^3/min.)	St=1	St=1/Q	St=10	St=10/Q
1	0.54	1.27	2.35	1.42	2.63
2	1.08	2.87	2.66	3.10	2.87
3	1.59	4.55	2.86	4.94	3.11
4	2.02	6.17	3.05	6.75	3.34
5	2.44	7.78	3.19	8.63	3.54

2. Both plots are reasonable fits to straight lines, i.e. n = 2 (if n ≠ 2, plots would lie on a smooth curve).

3. Taking the intercept at Q = 0 gives a + b = 2.6 and a = 2.1, i.e. b = 0.5.

4. The slope (c) is given by any two sets of values:
   i.e. Q = 0.5, St/Q = 2.6.
   Q = 1.5, St/Q = 3.08.

   slope $c = \frac{3.08 - 2.6}{1.5 - 0.5} = 0.48$

   i.e. well equation is $St = (2.1 + 0.5 \log t)\, Q + 0.48\, Q^2$.

Comment

The set of S/Q values for the various stages (see Fig. 5) which should be constant, vary from 0.21 to 0.35 with a general increase throughout the test. This indicates inhomogeneity within the aquifer and most probably a discharging boundary within the radius of influence of the well. Its presence should be ascertained with a main aquifer test conducted over say 48 hours.

APPENDIX 5

FULL ANALYSIS DETAILS

NG46
NARACOORTE NO. 10

WATER ANALYSIS REPORT

SAMPLE No. W3299/78 JOB No. 1137-79

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE mg/ℓ	MILLEQUIVS. PER LITRE me/ℓ
CATIONS			
CALCIUM	(Ca)	56	2.8
MAGNESIUM	(Mg)	46	3.8
SODIUM	(Na)	350	15.2
POTASSIUM	(K)	20	.5
IRON	(Fe)		
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO_3)		
BICARBONATE	(HCO_3)	380	6.2
SULPHATE	(SO_4)	140	2.9
CHLORIDE	(Cl)	463	13.0
FLUORIDE	(F)		
NITRATE	(NO_3)	1	.0
PHOSPHATE	(PO_4)		

TOTALS AND BALANCE				
CATIONS	(me/ℓ)	22.3	DIFF =	.1
ANIONS	(me/ℓ)	22.2	SUM =	44.5

DIFF 100 / SUM = .2%

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.) MICRO-S/cm AT 25 DEG.C

TOTAL DISSOLVED SOLIDS	MILLIGRAMS PER LITRE mg/ℓ
A. BASED ON E.C.	
B. CALCULATED (HCO_3=CO_3)	1263.
C. RESIDUE ON EVAP. AT 180 DEG.C	

TOTAL HARDNESS AS $CaCO_3$	329.
CARBONATE HARDNESS AS $CaCO_3$	312.
NON-CARBONATE HARDNESS AS $CaCO_3$	17.
TOTAL ALKALINITY AS $CaCO_3$	312.
FREE CARBON DIOXIDE (CO_2)	
SUSPENDED SOLIDS	
SILICA (SiO_2)	
BORON (B)	

	UNITS
REACTION - pH	7.8
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	

SODIUM TO TOTAL CATION RATIO(me/ℓ) 68.2%

Sampled at end of fourth days' development
Water level approx 33m - Confined Aquifer
Dilwyn Formation

NAME - S.A.D.M.E.
ADDRESS Naracoorte
DATE COLLECTED 8/6/78
SAMPLE COLLECTED BY: W. Kahl

FIELD TEMP. °C
FIELD pH @ °C
FIELD COND. µ-S/cm

OBS. No. NG 46
HOLE No. Naracoorte No. 10A
D.M. No. 406/75

WATER ANALYSIS REPORT

SAMPLE No. W3291/78 JOB No. 1137-79

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE mg/ℓ	MILLEQUIVS. PER LITRE me/ℓ
CATIONS			
CALCIUM	(Ca)	113	5.6
MAGNESIUM	(Mg)	40	3.3
SODIUM	(Na)	523	22.8
POTASSIUM	(K)	7	.2
IRON	(Fe)		
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO_3)		
BICARBONATE	(HCO_3)	353	5.8
SULPHATE	(SO_4)	190	4.0
CHLORIDE	(Cl)	800	22.6
FLUORIDE	(F)		
NITRATE	(NO_3)	11	.2
PHOSPHATE	(PO_4)		

TOTALS AND BALANCE				
CATIONS	(me/ℓ)	31.9	DIFF =	.6
ANIONS	(me/ℓ)	32.5	SUM =	64.3

DIFF 100 / SUM =

DERIVED AND OTHER DATA

	MILLIGRAMS PER LITRE mg/ℓ
CONDUCTIVITY (E.C.) MICRO-S/cm AT 25 DEG.C	
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO_3=CO_3)	1858.
C. RESIDUE ON EVAP. AT 180 DEG.C	
TOTAL HARDNESS AS $CaCO_3$	447.
CARBONATE HARDNESS AS $CaCO_3$	289.
NON-CARBONATE HARDNESS AS $CaCO_3$	157.
TOTAL ALKALINITY AS $CaCO_3$	289.
FREE CARBON DIOXIDE (CO_2)	
SUSPENDED SOLIDS	
SILICA (SiO_2)	
BORON (B)	

	UNITS
REACTION - pH	7.9
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	

SODIUM TO TOTAL CATION RATIO(me/ℓ) 71.4%

Water level 29.8m - shallow unconfined aquifer Bridgewater Formation

NAME - S.A.D.M.E.
ADDRESS Naracoorte
DATE COLLECTED 11/4/78
SAMPLE COLLECTED BY: W. Kahl

FIELD TEMP. °C
FIELD pH @ °C
FIELD COND. µ-S/cm

OBS. No. NG 46
HOLE No. Naracoorte No. 10A
D.M. No. 406/75

22

WATER ANALYSIS REPORT

SAMPLE No. W4398/78 JOB No. 1529-79

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE mg/ℓ	MILLEQUIVS. PER LITRE me/ℓ
CATIONS			
CALCIUM	(Ca)	35	1.7
MAGNESIUM	(Mg)	12	1.0
SODIUM	(Na)	358	15.6
POTASSIUM	(K)	25	.6
IRON	(Fe)		
ANIONS			
HYDROXIDE	(OH)		
CARBONATE	(CO_3)	20	.7
BICARBONATE	(HCO_3)	57	.9
SULPHATE	(SO_4)	180	3.7
CHLORIDE	(Cl)	473	13.3
FLUORIDE	(F)		
NITRATE	(NO_3)	3	.0
PHOSPHATE	(PO_4)		

TOTALS AND BALANCE

CATIONS	(me/ℓ)	18.9	DIFF = .2
ANIONS	(me/ℓ)	18.7	SUM = 37.7

DIFF 100 / SUM = 6%

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/cm AT 25 DEG.C 2002

	MILLIGRAMS PER LITRE mg/ℓ
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO_3=CO_3)	1133
C. RESIDUE ON EVAP. AT 180 DEG.C	
TOTAL HARDNESS AS $CaCO_3$	137
CARBONATE HARDNESS AS $CaCO_3$	47
NON-CARBONATE HARDNESS AS $CaCO_3$	90
TOTAL ALKALINITY AS $CaCO_3$	80
FREE CARBON DIOXIDE (CO_2)	
SUSPENDED SOLIDS	
SILICA (SiO_2)	
BORON (B)	

	UNITS
REACTION - pH	9.1
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	

SODIUM TO TOTAL CATION RATIO(me/ℓ) 82.2%

Sample from confined aquifer (164m) - during drilling. Note obvious contamination by cement.

NAME - E. & W. S.
ADDRESS NARACOORTE
DATE COLLECTED 29/8/78
SAMPLE COLLECTED BY: W. Kahl

FIELD TEMP. °C
FIELD pH @ °C
FIELD COND. µ-S/cm

OBS. No.
HOLE No. NARACOORTE NO. 10
D.M. No. 406/75

22

WATER ANALYSIS REPORT

SAMPLE No. W4737/78 JOB No. 1936-79

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE mg/ℓ	MILLEQUIVS. PER LITRE me/ℓ
CATIONS			
CALCIUM	(Ca)	54.00	2.694
MAGNESIUM	(Mg)	49.00	4.030
SODIUM	(Na)	348.00	15.138
POTASSIUM	(K)	20.00	.512
IRON	(Fe)	1.36	.049
ANIONS			
HYDROXIDE	(OH)	.00	.000
CARBONATE	(CO_3)	.00	.000
BICARBONATE	(HCO_3)	367.8	6.029
SULPHATE	(SO_4)	140.0	2.915
CHLORIDE	(Cl)	450.8	12.714
FLUORIDE	(F)	1.10	.058
NITRATE	(NO_3)	.04	.000
PHOSPHATE	(PO_4)	.07	.002

TOTALS AND BALANCE

CATIONS	(me/ℓ)	22.423	DIFF = .705
ANIONS	(me/ℓ)	21.717	SUM = 44.140

$\frac{\text{DIFF } 100}{\text{SUM}}$ = 1.6%

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/cm AT 25 DEG.C 2250

	MILLIGRAMS PER LITRE mg/ℓ
TOTAL DISSOLVED SOLIDS	
A. BASED ON E.C.	
B. CALCULATED (HCO_3=CO_3)	1245.27
C. RESIDUE ON EVAP. AT 180 DEG.C	
TOTAL HARDNESS AS $CaCO_3$	338.91
CARBONATE HARDNESS AS $CaCO_3$	301.51
NON-CARBONATE HARDNESS AS $CaCO_3$	37.40
TOTAL ALKALINITY AS $CaCO_3$	301.51
FREE CARBON DIOXIDE (CO_2)	
SUSPENDED SOLIDS	
SILICA (SiO_2)	1.28
BORON (B)	

	UNITS
REACTION - pH	7.5
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	

SODIUM TO TOTAL CATION RATIO(me/ℓ) 67.5%

Sample from confined aquifer - start of drawdown test.

NAME - E. & W. S.
ADDRESS NARACOORTE
DATE COLLECTED 20/10/78
SAMPLE COLLECTED BY: G.A.M.

FIELD TEMP. °C
FIELD pH @ °C
FIELD COND. µ-S/cm

OBS. No.
HOLE No. NARACOORTE NO. 10
D.M. No. 406/75

22

WATER ANALYSIS REPORT

SAMPLE No. W4738/78

JOB No. 1936-79

CHEMICAL COMPOSITION

		MILLIGRAMS PER LITRE mg/ℓ	MILLEQUIVS. PER LITRE me/ℓ
CATIONS			
CALCIUM	(Ca)	54.00	2.695
MAGNESIUM	(Mg)	49.00	4.030
SODIUM	(Na)	348.00	15.138
POTASSIUM	(K)	20.00	.512
IRON	(Fe)	.20	.007
ANIONS			
HYDROXIDE	(OH)	.00	.000
CARBONATE	(CO_3)	.00	.000
BICARBONATE	(HCO_3)	372.9	6.112
SULPHATE	(SO_4)	140.0	2.915
CHLORIDE	(Cl)	463.1	13.059
FLUORIDE	(F)	1.10	.058
NITRATE	(NO_3)	2.00	.032
PHOSPHATE	(PO_4)	.29	.009

TOTALS AND BALANCE

CATIONS	(me/ℓ)	22.381	DIFF = .196
ANIONS	(me/ℓ)	22.185	SUM = 44.566

$\frac{\text{DIFF } 100}{\text{SUM}}$ = 4%

DERIVED AND OTHER DATA

CONDUCTIVITY (E.C.)
MICRO-S/cm AT 25 DEG.C 2258

TOTAL DISSOLVED SOLIDS	MILLIGRAMS PER LITRE mg/ℓ
A. BASED ON E.C.	
B. CALCULATED (HCO_3=CO_3)	1261.07
C. RESIDUE ON EVAP. AT 180 DEG.C	

TOTAL HARDNESS AS $CaCO_3$	336.83
CARBONATE HARDNESS AS $CaCO_3$	305.68
NON-CARBONATE HARDNESS AS $CaCO_3$	31.16
TOTAL ALKALINITY AS $CaCO_3$	305.68
FREE CARBON DIOXIDE (CO_2)	
SUSPENDED SOLIDS	
SILICA (SiO_2)	1.18
BORON (B)	

	UNITS
REACTION - pH	7.7
TURBIDITY (JACKSON)	
COLOUR (HAZEN)	

SODIUM TO TOTAL CATION RATIO(me/ℓ) 67.6

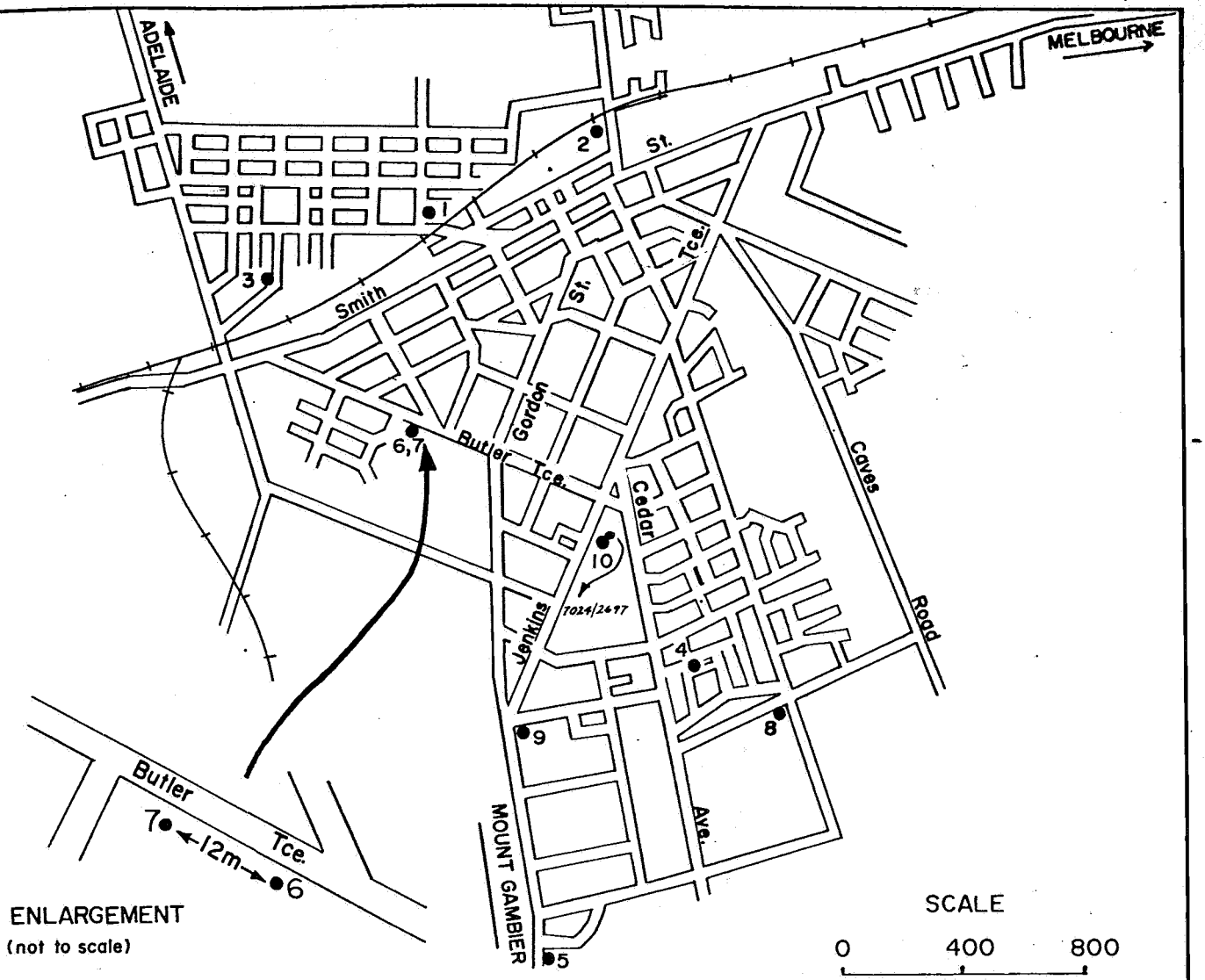
Sample from confined aquifer - 200 mins after start of step drawdown test

NAME - E. & W. S.
ADDRESS NARACOORTE
DATE COLLECTED 20/10/78
SAMPLE COLLECTED BY: G.A.M.

FIELD TEMP. °C
FIELD pH @ °C
FIELD COND. µ-S/cm

OBS. No. 1
HOLE No. TWS NO. 10
D.M. No. 406/75

82



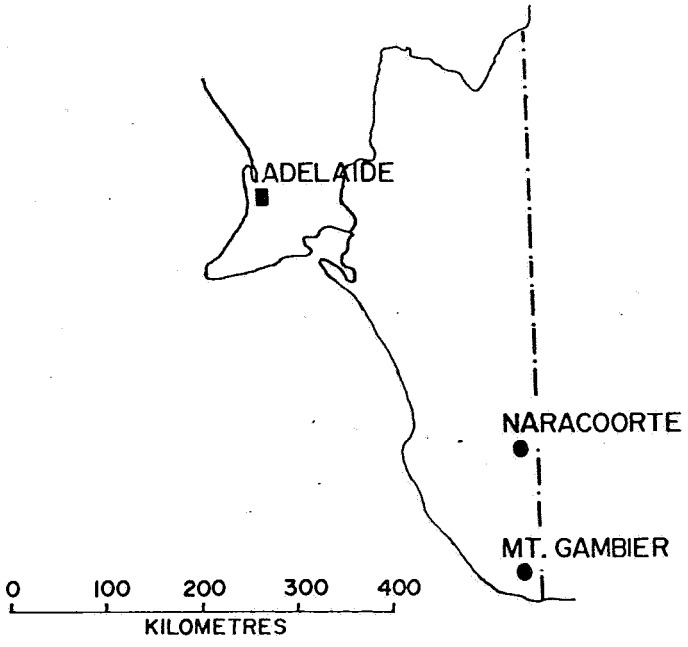


FIG. 1

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE AS SHOWN
COMPILED A.F.W.	NARACOORTE TOWN WATER SUPPLY	DATE MAY 1979
DRN E.C. CKD	LOCALITY PLAN	PLAN NUMBER S 14074

1369

1369

DEPARTMENT OF MINES & ENERGY – SOUTH AUSTRALIA
ENGINEERING DIVISION

COMPOSITE WELL LOG – GROUNDWATER

HOLE No. NG 46
UNIT/STATE No. 7024480WW02697
SERIAL No. 138/78
FOLDER No. 81245
DRG. No. 79-377
SHEET 1 OF 1

CONSTRUCTION DETAILS

DRILLING TECHNIQUE: CABLE TOOL
CIRCULATION MUD 34-74, MUD 74-117, MUD 117-188
START: 3/4/78
FINISH: 29/5/78
TOTAL DEPTH 188·2

	Inches	m.m	From(m)	To(m)
HOLE DIAMETER		203	0	74
		152	74	117
		127	117	165
CASING DIAMETER (Cemented)		76	0	167
CASING DIAMETER (Uncemented)				
SCREEN DETAILS Make / Model Dimensions		66mm ID, 76 OD SURESCREEN – STAINLESS STEEL, WIRE WOUND. APERTURE 0.5mm.	167	169

PROJECT NARACOORTE TOWN WATER SUPPLY
LOCATION ADJACENT WATER TOWER, NARACOORTE HOSPITAL
SECTION 1087 HUNDRED NARACOORTE
CO-ORDINATES
REFERENCE ELEV. LOGGED BY A.F. WILLIAMS
SURFACE ELEV. DATE
DATUM TRACED BY E.R. CALABIO
DATE MAY 1979

TYPE OF LOG	16 IN. NORMAL	64 IN. NORMAL	6FT LATERAL	S.P.	POINT RESISTIVITY	NEUTRON	GAMMA RAY	TEMPERATURE	
DATE OF RUN						30/5/78	30/5/78		
FIRST READING (m)						169	169		
LAST READING (m)						27	0		
INTERVAL MEASURED(m)						142	169		
CASING: LOGGER (m)						169	169		
CASING: DRILLER (m)						169	169		
DEPTH REACHED (m)						169	169		
BOTTOM: DRILLER (m)						188	188		
MUD TYPE						—	—		
MUD RESISTIVITY						—	—		
RECORDED BY						E. YOUNG	E. YOUNG		

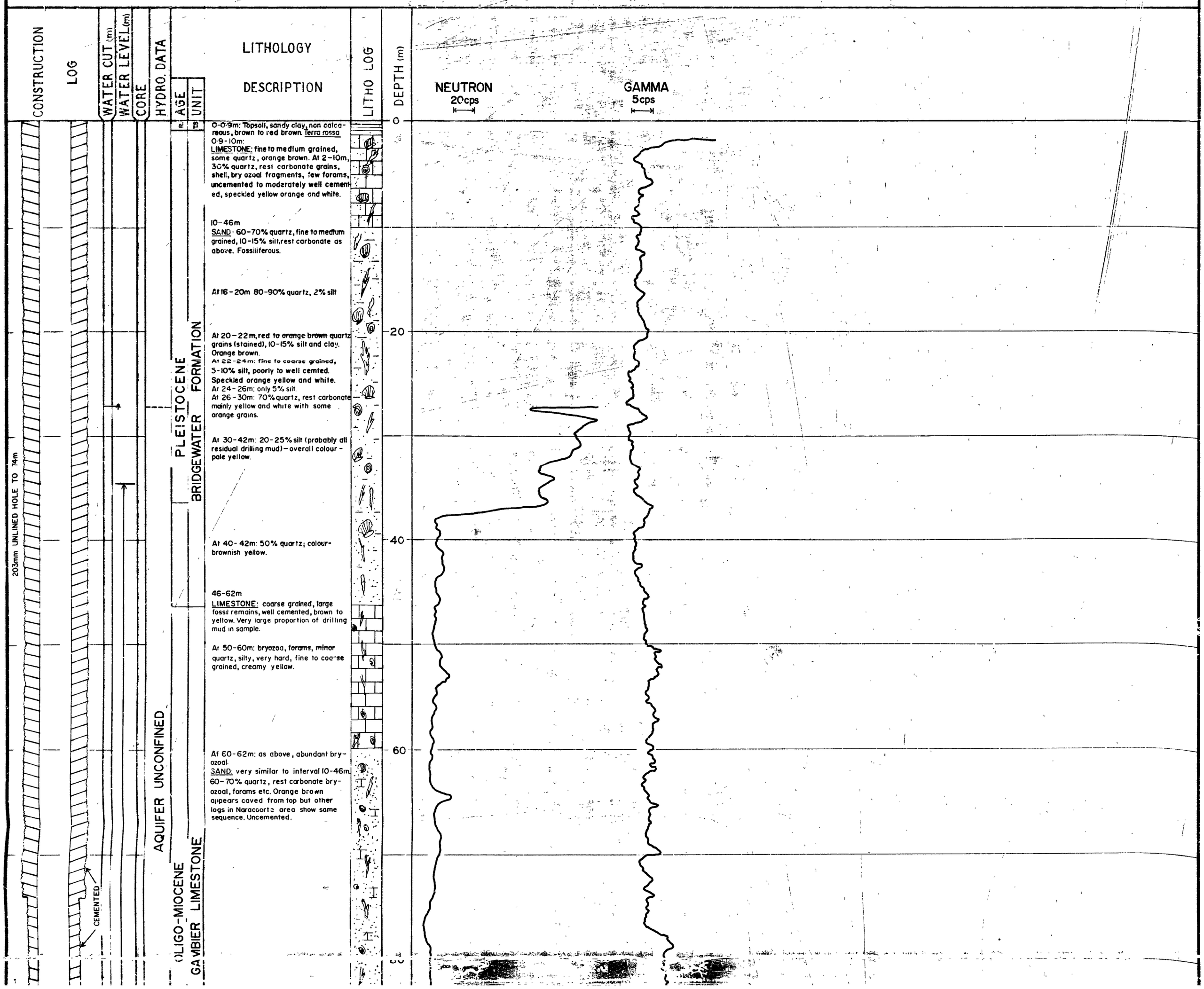
WELL SYMBOLS

CONSTRUCTION LOG
- Casing seal
- Casing shoe
- Wire wound screen
- Slotted casing
- Cemented Interval
- Gravel packed Interval

HYDROGEOLOGICAL LOG
- Core Interval
- Aq Aquifer
- Cb Confining bed
- T Transmissivity m^3/day m^{-1}
- S Storage Coefficient/Specific Yield
- θ Porosity
- K Hydraulic conductivity m/day

DEPTH TO WATER(m)	DEPTH TO S.W.L.(m)	YIELD m^3/day	YIELD Method of Test	TOTAL DISSOLVED SOLIDS mg/litre	TOTAL DISSOLVED SOLIDS Analysis W No.
29·8	27·0		N/T	1858(F)	W3291/78
75·0	"		"	1210	W3292/78
80·0				1190	W3293/78
85·0				1040	W3294/78
90·0				1095	W3295/78
160	33(approx.)		End 2nd day's development	1265	3296/78
"	"		" 3rd " "	1270	3297/78
"	"		" 4th " "	1265	3298/78
"	"		" 4th " "	1263(F)	3299/78
"	"		" 1st " "	1230	3600/78

REMARKS:



203mm UNLINED HOLE TO 74m

152mm UNLINED HOLE TO 117m

127mm UNLINED HOLE TO 165m

76mm I.D. STEEL PIPE FROM 0 to 167m

76mm OD SURESCREEN WIREWOUND S/S SANDSCREEN from 167.0 to 169.0m I.D. 66mm APERTURE 0.5 mm

76mm. O.D. STEEL PIPE 169 – 188m.

LINATEX SEAL FROM 127mm HOLE to 76mm PIPE (I.D.)

CEMENTED

CEMENTED

PLEISTOCENE

BRIDGEWATER FORMATION

AQUIFER UNCONFINED

OLIGO-MIOCENE

GAMBIER LIMESTONE

CONFINING BED

EOCENE

DILWYN FORMATION

AQUIFER CONFINED

CONFINING BED

EP

KAN Gp.

10–46m
SAND- 60–70% quartz, fine to medium grained, 10–15% silt, rest carbonate as above. Fossiliferous.

At 16–20m 80–90% quartz, 2% silt

At 20–22m, red to orange brown quartz grains (stained), 10–15% silt and clay. Orange brown.
At 22–24m: fine to coarse grained, 5–10% silt, poorly to well cemted. Speckled orange yellow and white.
At 24–26m: only 5% silt.
At 26–30m: 70% quartz, rest carbonate mainly yellow and white with some orange grains.

At 30–42m: 20–25% silt (probably all residual drilling mud) – overall colour – pale yellow.

At 40–42m: 50% quartz; colour – brownish yellow.

46–62m
LIMESTONE: coarse grained, large fossil remains, well cemented, brown to yellow. Very large proportion of drilling mud in sample.

At 50–60m: bryozoa, forams, minor quartz, silty, very hard, fine to coarse grained, creamy yellow.

At 60–62m: as above, abundant bryozoal.
SAND: very similar to interval 10–46m. 60–70% quartz, rest carbonate bryozoal, forams etc. Orange brown appears caved from top but other logs in Naracoorte area show same sequence. Uncemented.

At 88–92m: greyish yellow.

At 92–96m:
SAND: quartz shell fragments, forams as above, uncemented, some dark grains – glauconite? Greyish brown.
At 94–96m: 30–40% silt, clay.
CLAY & SILT: 10–20% quartz and carbonate, some mica, glauconite shell fragments, weakly cemented, dark greyish brown.

At 100–140m:
SILT: as above

At 140–159:
SILT & CLAY: 20–30% quartz, shelly, forams, sticky, weakly cemented. Greyish brown.
At 142–143m: some coarser quartz.
At 143–157m: as above

At 157–158m: very sticky
At 158–159m: quartz up to 50%.
At 159–187m:
SAND: fine to coarse quartz, silt and clay 20–30%, grey to brown, weakly cemented. Some pyrite and glauconite. Quartz angular to sub angular. Bryozoal.
At 161–162m: mainly fine, 2% silt.
At 162–163m: some well rounded quartz to 20mm.
At 163–165m: grains to 4mm.
At 165–166m: few mica flakes.
At 166–167m: 10% silt & clay, few fossils.
At 167–168m: 7% silt & clay, coarser grain.
At 168–170m: as for 166–167m, 5% fossil fragments.
At 170–171m: as above, slightly coarser.
At 171–175m: mainly fine to medium grained, some coarse – 20% silt & clay.
At 175–176m: fine to 15mm., large mica flakes to 6mm., silt < 10%.
At 176–177m: silt < 1%.
At 177–180m: similar to 171–175m., no large grains and 10% silt

At 180–184m: predominantly fine grained with minor medium fraction.
At 184–185m: as above with pebbles to 20mm in coarser fraction.
At 185–187m: no pebbles but grains to 3mm.
At 187–188m: SILT, 70–80% mica? fine quartz – very greasy & medium grey.

Note: CORE SAMPLE (NX) poor recovery 188m.
SILT, greasy, micaceous, some quartz, layered, probably highly weathered basement – QUARTZ MICA SCHIST OR QUARTZ FELDSPAR MICA GNEISS

20
40
60
80
100
120
140
160
180
200

FIG 2

DEPARTMENT OF MINES & ENERGY – SOUTH AUSTRALIA
ENGINEERING DIVISION

COMPOSITE WELL LOG – GROUNDWATER

HOLE No. NCTE No.10
UNIT/STATE No. 7024480WW02698
SERIAL No. 32/78
FOLDER No. 81244
DRG. No. 79-378
SHEET 1 OF 1

CONSTRUCTION DETAILS

DRILLING TECHNIQUE: CABLE TOOL
CIRCULATION: MUD TO 160m, WATER TO 181m
START: 30/5/78
FINISH 23/10/78
TOTAL DEPTH 181m

	Inches	m.m	From(m)	To(m)
HOLE DIAMETER				
CASING DIAMETER (Cemented)		260	0	151·17
CASING DIAMETER (Uncemented)		375 318 154 "	0 0 140·28 179·88	4·23 34·50 166·09 180·88
SCREEN DETAILS Make / Model Dimensions		154	166·09	179·88

PROJECT NARACOORTE TOWN WATER SUPPLY
LOCATION NARACOOTE HOSPITAL GROUNDS
SECTION 1087 HUNDRED NARACOORTE
CO-ORDINATES
LOGGED BY A.F. WILLIAMS
REFERENCE ELEV.
DATE 21/11/78
SURFACE ELEV.
TRACED BY E. R. CALABIO
DATUM
DATE MAY 1979

TYPE OF LOG	16 IN. NORMAL	64 IN. NORMAL	6FT LATERAL	S.P.	POINT RESISTIVITY	* NEUTRON	* GAMMA RAY	TEMPERATURE	* DENSITY
DATE OF RUN						12/9/78	12/9/78		12/9/78
FIRST READING (m)						180m	180m		180m
LAST READING (m)						1m	1m		1m
INTERVAL MEASURED(m)						179m	179m		179m
CASING: LOGGER (m)						180m	180m		180m
CASING: DRILLER (m)						180m	180m		180m
DEPTH REACHED (m)						180m	180m		180m
BOTTOM: DRILLER (m)						180m	180m		180m
MUD TYPE						water	water		water
MUD RESISTIVITY						— —	—		—
RECORDED BY									A.W. YOUNG
						* old neutron probe	* small den/gamma probe		* small den/gamma probe

WELL SYMBOLS

CONSTRUCTION LOG
- Casing seat
- Casing shoe
- Wire wound screen
- Slotted casing
- Cemented Interval
- Gravel packed Interval

HYDROGEOLOGICAL LOG
- Core Interval
- Aq Aquifer
- Cb Confining bed
- T Transmissivity m²/day m⁻¹
- S Storage Coefficient/Specific Yield
- θ Porosity
- K Hydraulic conductivity m/day

* DEPTH TO WATER(m)	DEPTH TO S.W.L.(m)	YIELD m³/day	YIELD Method of Test	TOTAL DISSOLVED SOLIDS mg/litre	TOTAL DISSOLVED SOLIDS Analysis W No
160	33·7	770	STEPTEST-START	1245 (F)	W 4737/78
"	"	"	" - "	1235	W 4733/78
"	35·2	"	" -10mins after start	1235	W 4734/78
"	38·9	2150	" -100" " "	1235	W 4735/78
"	43·2	3320	" -200" " "	1240	W 4736/78
"	"	"	- " " " "	1261 (F)	W 4738/78

REMARKS * WATER LEVEL DURING STAGE TEST

CONSTRUCTION LOG | WATER CUT (m) | WATER LEVEL (m) | CORE | HYDRO. DATA AGE UNIT | LITHOLOGY DESCRIPTION | LITHO LOG | DEPTH (m)

375mm LOCKRIB CASING to 4·23m
PLEISTOCENE
BRIDGEWATER FORMATION

Topsoil, sandy clay, non calcareous, brown to redbrown. Terra rossa

LIMESTONE: fine to medium grained, same quartz, orange brown. At 2–10m, 30% quartz, rest carbonate grains, shell, bryozoal fragments, few forams, uncemented to moderately well cemented, speckled yellow orange and white

10–46m
SAND - 60–70% quartz, fine to medium grained, 10–15% silt, rest carbonate as above. Fossiliferous.

At 10–20m 80–90% quartz, 2% silt

At 20–22m, red to orange brown quartz grains (stained), 10–15% silt and clay. Orange brown.
At 22–24m: fine to coarse grained, 5–10% silt, poorly to well cemted. Speckled orange yellow and white.
At 24–26m: only 5% silt.
At 26–30m: 70% quartz, rest carbonate mainly yellow and white with some orange grains.

At 30–42m: 20–25% silt (probably all residual drilling mud) – overall colour – pale yellow.

At 40–42m: 50% quartz; colour – brownish yellow.

46–62m
LIMESTONE: coarse grained, large fossil remains, well cemented, brown to yellow. Very large proportion of drilling mud in sample.

At 50–60m: bryozoa, forams, minor quartz, silty, very hard, fine to coarse grained, creamy yellow.

At 60–62m: as above, abundant bryozoal.
SAND, very similar to interval 10–46m, 60–70% quartz, rest carbonate bryozoal, forams etc. Orange brown appears caved from top but other logs in Naracoorte area show same sequence. Uncemented.

38mm STEEL TUBING to 34·5m
PRESSURE CEMENTED
AQUIFER UNCONFINED
CLIGO–MIOCENE
GAMBIER LIMESTONE
60mm TUBING to 151m

DENSITY | NEUTRON | GAMMA

50c/s | 25c/s | 12·5 c/s | 5c/s

0 | 20 | 40 | 60 | 80

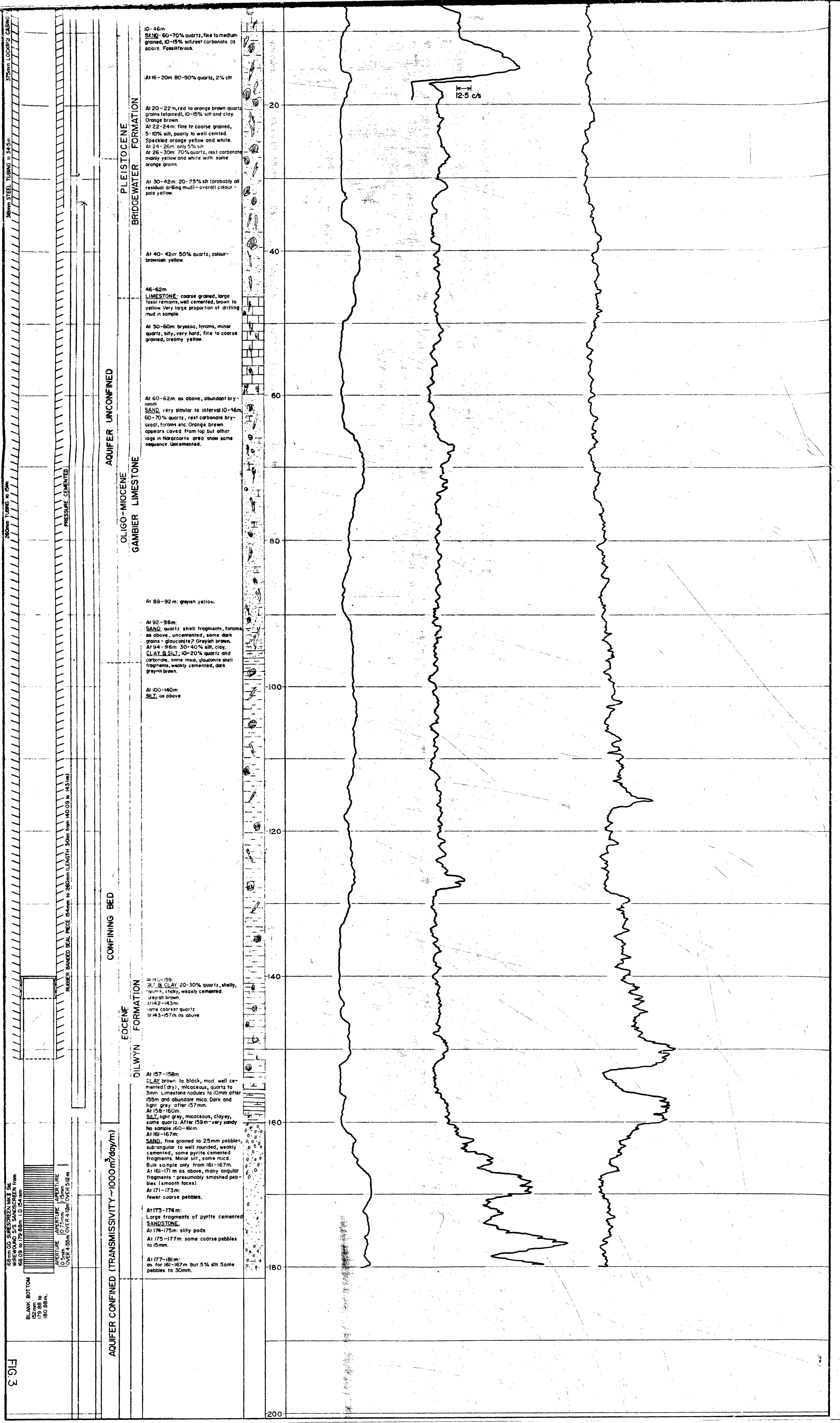
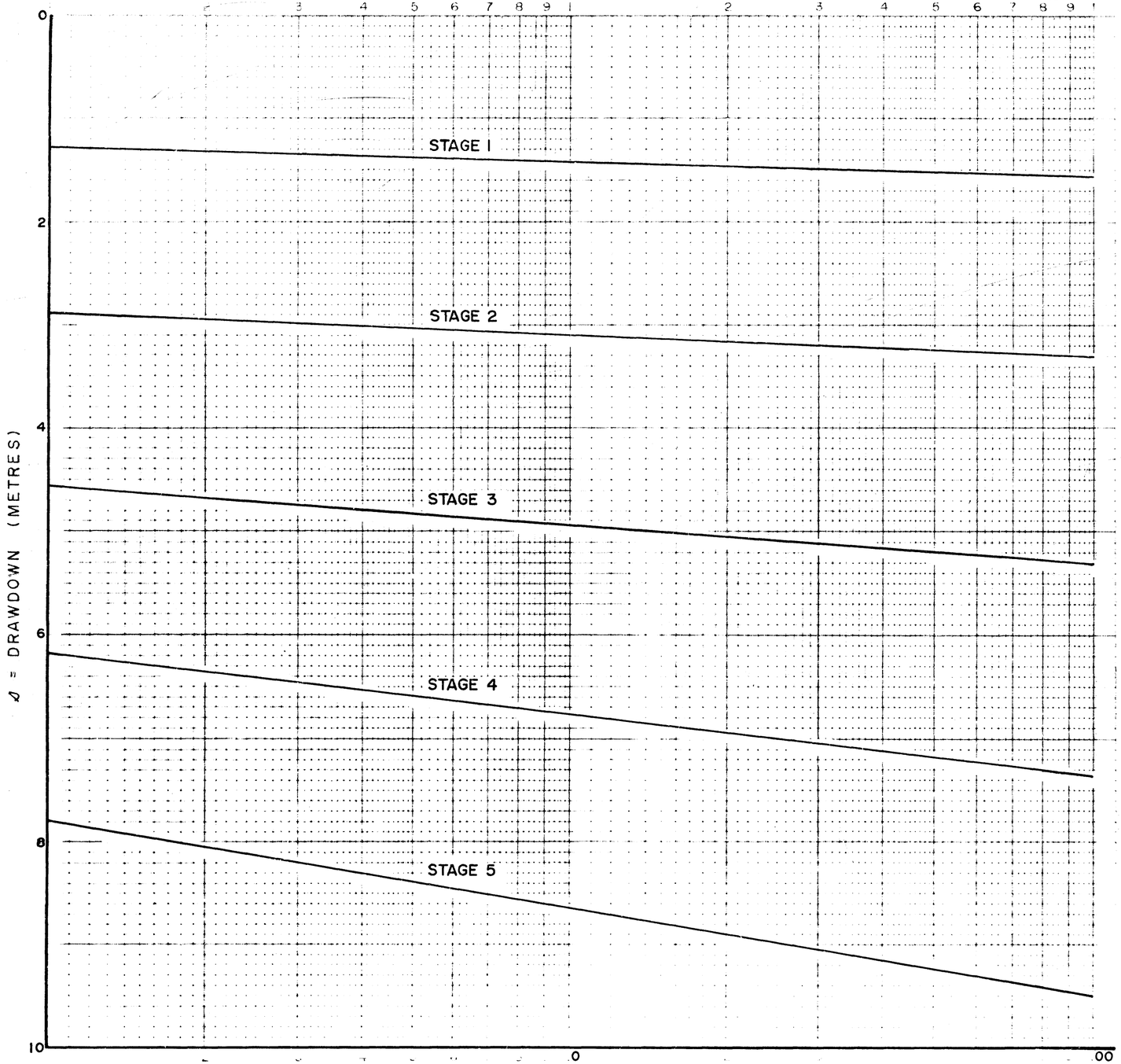

375mm LOCKRIG CASING
38mm STEEL TUBING to 34.5m
260mm TUBING to 15m
PRESSURE CEMENTED
RUBBER BANDED SEAL PIECE 154mm to 260mm (LENGTH 30m from 140.09 to 143.1m)
168mm O.D. SURESCREEN MK II Std. WIREWOUND S/S SANDSCREEN from 166.09 to 179.88m I.D 154mm
APERTURE 0.5mm OVER 4.55m
APERTURE 0.75mm OVER 4.12m
APERTURE 1.15mm OVER 5.12m
BLANK BOTTOM 152mm 179.88 to 180.88m.
AQUIFER UNCONFINED
CONFINING BED
AQUIFER CONFINED (TRANSMISSIVITY~1000m³/day/m)
PLEISTOCENE
BRIDGEWATER FORMATION
OLIGO-MIOCENE
GAMBIER LIMESTONE
EOCENE
DILWYN FORMATION
10-46m
SAND- 60-70% quartz, fine to medium grained, 10-15% silt, rest carbonate as above. Fossiliferous.
At 16-20m 80-90% quartz, 2% silt
At 20-22m, red to orange brown quartz grains (stained), 10-15% silt and clay. Orange brown.
At 22-24m: fine to coarse grained, 5-10% silt, poorly to well cemted. Speckled orange yellow and white.
At 24-26m: only 5% silt
At 26-30m: 70% quartz, rest carbonate mainly yellow and white with some orange grains.
At 30-42m: 20-25% silt (probably all residual drilling mud) - overall colour - pale yellow.
At 40-42m: 50% quartz; colour-brownish yellow.
46-62m
LIMESTONE: coarse grained, large fossil remains, well cemented, brown to yellow. Very large proportion of drilling mud in sample.
At 50-60m: bryozoa, forams, minor quartz, silty, very hard, fine to coarse grained, creamy yellow.
At 60-62m: as above, abundant bryozoa.
SAND, very similar to interval 10-46m, 60-70% quartz, rest carbonate bryozoa, forams etc. Orange brown appears caved from top but other logs in Naracoorte area show same sequence. Uncemented.
At 88-92m: greyish yellow.
At 92-96m:
SAND: quartz shell fragments, forams as above, uncemented, some dark grains - glauconite? Greyish brown.
At 94-96m: 30-40% silt, clay.
CLAY & SILT: 10-20% quartz and carbonate, some mica, glauconite shell fragments, weakly cemented, dark greyish brown.
At 100-140m:
SILT, as above
At 140-159:
SILT & CLAY 20-30% quartz, shelly, forams, sticky, weakly cemented. Greyish brown.
At 142-143m:
some coarser quartz
At 143-157m as above
At 157-158m:
CLAY brown to black, mod. well cemented (dry), micaceous, quartz to 3mm. Limestone nodules to 10mm after 155m and abundant mica. Dark and light grey after 157mm.
At 158-160m:
SILT, light grey, micaceous, clayey, some quartz. After 159m - very sandy
No sample 160-161m.
At 161-167m:
SAND, fine grained to 25mm pebbles, sub-angular to well rounded, weakly cemented, some pyrite cemented fragments. Minor silt, some mica. Bulk sample only from 161-167m.
At 161-171 m as above, many angular fragments - presumably smashed pebbles (smooth faces).
At 171-173m:
fewer coarse pebbles.
At 173-174m:
Large fragments of pyrite cemented SANDSTONE.
At 174-175m: silty pods
At 175-177m: some coarse pebbles to 15mm.
At 177-181m:
as for 161-167m but 5% silt. Some pebbles to 30mm.
20
40
60
80
100
120
140
160
180
200
12.5 c/s

FIG. 3



BOREHOLE STATE/UNIT No. 7024480WW02698

REF. PT. ..... (m) above ground

AQUIFER FROM 160 TO 188 (m)

HOLE DEPTH 181 (m)

TYPE OF PUMP DEUTZ TURBINE

LENGTH OF TEST 3hrs. 20mins.

DEPTH WATER LEVEL AT TEST START (ℓ_2) 33·72 (m)

DEPTH PUMP INTAKE (ℓ_1) 72·1 (m)

* AVAILABLE DRAWDOWN 38·4 (m)

EQUATIONS

$$T = \frac{0.183 \times Q}{\Delta_\Delta} \qquad S = \frac{2.25 \times T t_o}{r^2}$$

In which

T = Transmissivity (m^3/day/m)

Q = Pumping Rate (m^3/day)

Δ_Δ = Drawdown per log cycle (m)

S = Storage Coefficient

t_o = Zero drawdown time (mins)

r = Distance to Observation Bore (m)

1 day = 8.64×10^4 secs.

STAGE	Q(m^3/min)	Δt = 1	Δt = 1/Q	Δt = 10	Δt = 10/Q	Δs	Δs/Q	T(m^3/day/m)
1	0·54	1·27	2·35	1·42	2·63	0·15	0·28	950
2	1·08	2·87	2·66	3·10	2·87	0·23	0·21	1240
3	1·59	4·55	2·86	4·94	3·11	0·39	0·25	1070
4	2·02	6·17	3·05	6·75	3·34	0·58	0·29	920
5	2·44	7·78	3·19	8·63	3·54	0·85	0·35	760

NOTE (1) lines opposite drawn from above table as original plot and recalculated plot mislaid.

(2) inhomogeneity in aquifer as evidenced by changing Δs/Q values with time.

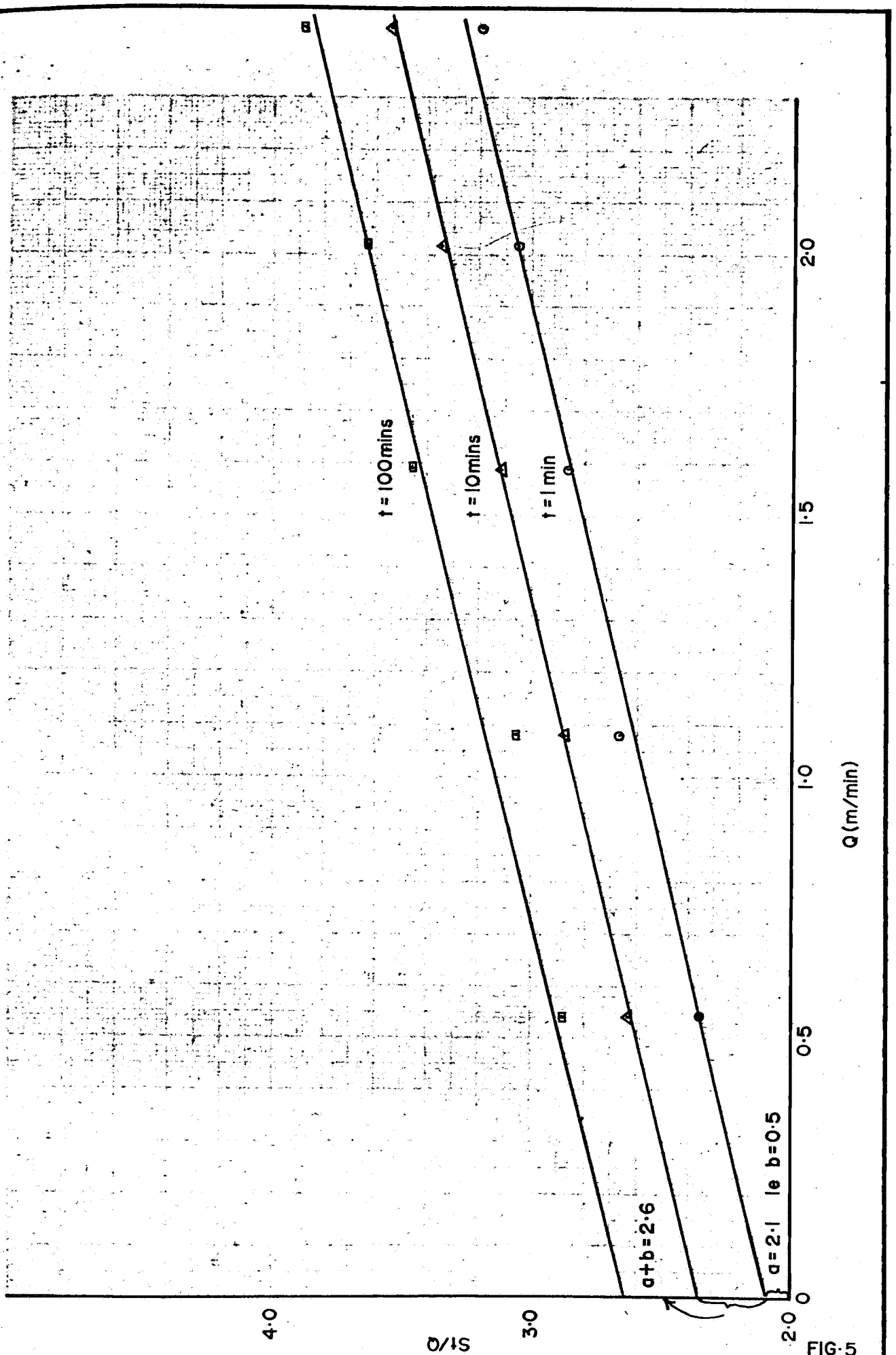
* Available drawdown = $\ell_1 - \ell_2$ t = time unit.

FIG. 4

D.M. 406/75	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE
DRAWN A.F.W.	NARACOORTE TOWN WATER SUPPLY NARACOORTE No. 10 WELL STEP DRAWDOWN TEST RESULTS	DATE MAY 1979
TRACED E.R.C.		PLAN NUMBER 79–379

1369

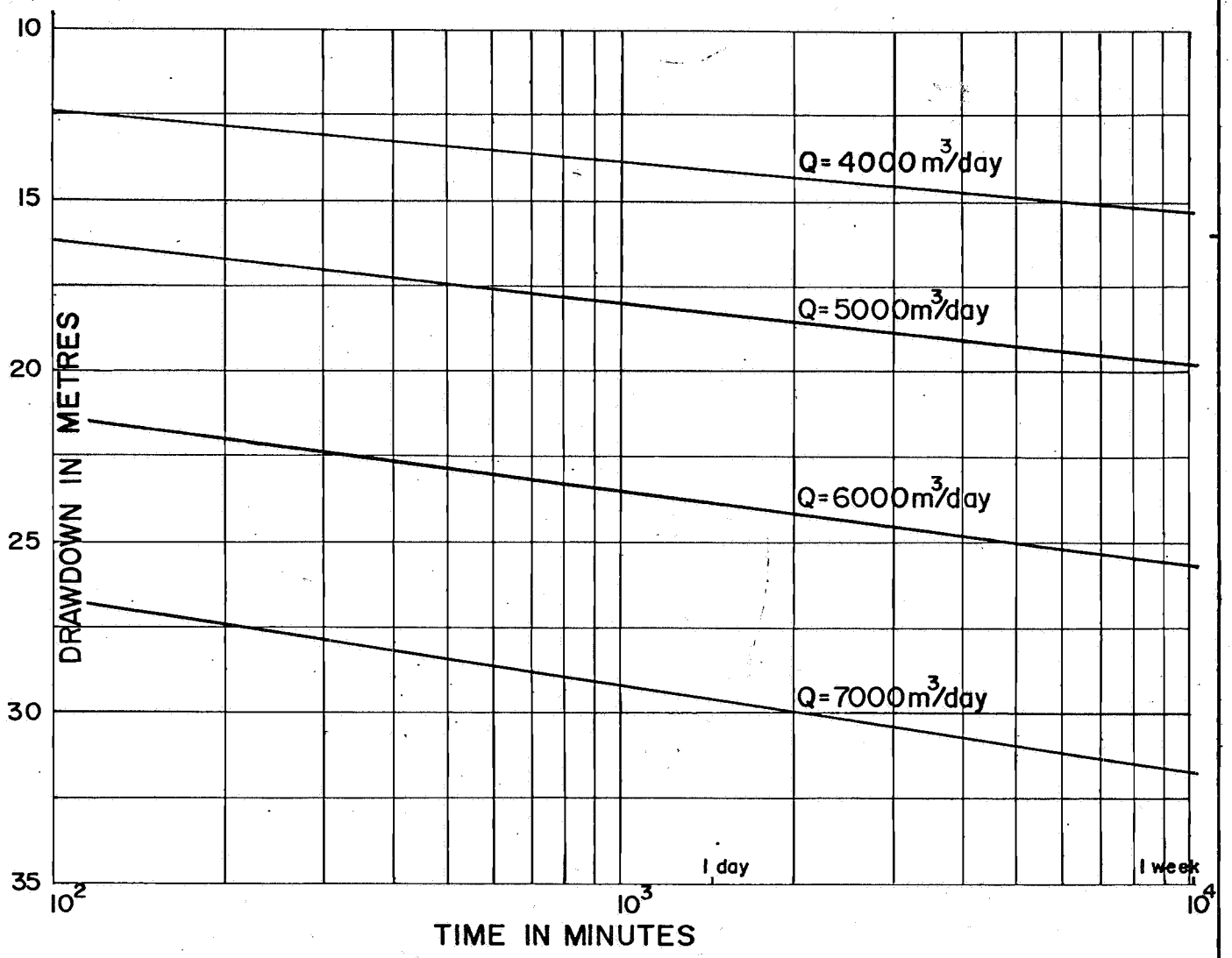
P.F. No. 69–953 MH



FIG·5

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE
COMPILED A.F.W.	NARACOORTE TOWN WATER SUPPLY	DATE MAY 1979
DRN E.C. CKD	NARACOORTE No.10 WELL 7024480WW02698	PLAN NUMBER
	PLOT OF St/Q vs Q	S 14075

1369



NOTE-PREDICTION BASED ONLY ON STEP DRAWDOWN RESULTS. LONG TERM TEST NEEDED TO CONFIRM PRESENCE OR ABSENCE OF BOUNDARIES.

FIG. 6

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE
COMPILED A.F.W.	NARACOORTE TOWN WATER SUPPLY	DATE MAY 1979
DRN E.C. CKD	NARACOORTE No.10 WELL 7024480WW02698 PREDICTED DRAWDOWN FOR VARYING PUMPING RATES	PLAN NUMBER S 14076