DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 87/124
REPORT ON DRILLING & TESTING OF PRIVATE IRRIGATION - RECHARGE WELL LANGHORNE CREEK

GEOLOGICAL SURVEY

by

S.R. HOWLES
GROUNDWATER AND ENGINEERING

OCTOBER, 1987

DME.166/79

CONTENTS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 87/124
DME NO. 166.79
DISK NO. 71

REPORT ON DRILLING AND TESTING OF PRIVATE IRRIGATION - RECHARGE WELL LANGHORNE CREEK

ABSTRACT

An 80 m irrigation-recharge well, with 50 m open to a confined limestone aquifer has been drilled at Langhorne Creek in South Australia. Pump testing indicates a yield of 43 ls^{-1} may be sustained for 70 Days. Conservative values of aquifer parameters give a Transmissivity of 700-1000 $m^3d^{-1}m^{-1}$ and a storage coefficient of $3x10^{-4}$.

INTRODUCTION

A vigneron in Langhorne Creek (fig. 1) approached the SADME Groundwater & Engineering Branch in 1987 for technical advice on design of a dual purpose irrigation-recharge well. Such wells are being increasingly utilised in the surrounding Angas-Bremer irrigation area, where a salinity problem is developing.

The client was advised the well should be designed to maximise the yield from the confined limestone aquifer, thus enabling recharge from a nearby swamp to be more effective.

Drilling contractors were engaged to drill an 80 m deep, 200 mm diameter well with 50 m open hole in the limestone.

After completion of drilling partial collapse of the hole occured requiring some re-drilling.

The SADME subsequently performed a pump test as part of the continuing hydrogeological investigation of the area in relation to artifical recharge wells.

During the discharge testing it was found that the hole had collapsed below 36 m. The collapsed material was drilled out by SADME and the discharge test restarted.

A summary of the well specifications is given in Table 1.

Table 1 well specifications

Permit No.	94748
Unit No.	6727-31-WW-2303
Hd	Freeling
Sect	3571
completed	9/6/87
Total depth	79.5 m
casing	0 -32.7 m, 204 mm welded steel and pressure cemented
open hole	32.7 - 79.5 m, 193 mm diameter
water cut	31.2 m
seasonal fluctuation	5.7 m
salinity	2032 mgl^{-1}
Aquifer	sandy limestone
safe yield	43 ls^{-1}
specific capacity	4.6 $ls^{-1}m^{-1}$
S.W.L.	13.9 m (June, 1987)

Hydrogeology

The well is located in the northern area of the Tertiary limestone confined aquifer underlying the Angas-Bremer irrigation area.

The well log, Appendix A, shows that the sandy limestone in this area is effectively separated from the unconfined aquifer by 12 m of clayey sand and silt.

Water sampling during drilling (Table 2) indicates a decrease in salinity with depth from 2175 mgl^{-1} at 36 m to 1800 mgl^{-1} at 79 m.

Table 2 Salinity results during drilling (June 1987)

depth	TDS mg l^{-1}	Analysis No.
36	2175	w 3726/87
43	2175	w 3727/87
49	2140	w 3728/87
55	2060	w 3729/87
61	2015	w 3730/87
66	1965	w 3731/87
73	1925	w 3732/87
79	1800	w 3733/87

Pump Testing

A step drawdown test was performed to determine the well equation and a constant discharge test to determine the aquifer parameters and long term yield of the well.

Tests results also allow quantification of the difference between real and theoretical recharge rates, necessary for the SADME to provide technical advice on artifical recharge.

The step test was initially started with a low capacity pump at 10.45 ls^{-1}. It became quickly clear that the well capacity was in excess of 40 ls^{-1}, leading to the instalation of a large capacity pump.

During the change over of the pump it was discovered that partial hole collapse had occurred at 36m. This was drilled out by a SADME cable tool rig.

The well developed quickly at high discharge, producing sand free water within 10 minutes of pumping within each step.

Results and analytical methods are outlined in Appendix B. Drawdown and residual drawdown were monitored in the wells listed in Table 3.

Table 3 Observation wells

Well	aquifer monitored	distance to production Well (m)
FRL 32	confined	575
FRL 62	confined	780
FRL 140	confined	1 050
FRL 225	unconfined	780
Production Well	confined	-

Well Performance:

The available drawdown, considering seasonal effects and allowing 3 m of water above the pump set at 32 m, ie within the casing, is 9.4 m.

A yield of 43 ls^{-1} then allows the well to be pumped for 10^5 minutes before maximum drawdown is reached.

This result is believed to be a conservative value since the well equation gives slightly greater drawdowns than were observed in the constant discharge test (9.04 m at 1440 minutes from equation compared to 8.40 m at 1440 minutes from test). The time-drawdown curves for different discharge rates are shown in fig. 2, the test result suggests that a discharge rate of 47.6 ls^{-1} may be sustained for a longer period than the test length of 1440 minutes.

Over periods of 1440 minutes it is possible that the discharge rate may be increased, however there exists the possibility of collapse of the soft limestone aquifer, therefore the pump should be set within the casing.

Aquifer Parameters:

Transmissivity and storage coefficient values are outlined in full in Appendix B, the most conservative values indicate a transmissivity of 700-1000 m^3d^{-1} m^{-1}, and a storage coefficent of 3×10^{-4}.

Salinity:

Salinity decreased throughout the constant discharge test, finishing at 2060 mgl^{-1} at 1 200 minutes.

Results are shown in Table 4, full analysis for the final sample is given in Appendix A.

Table 4: Salinity results during constant discharge test (June 1987)

Time (minutes)	TDS mgl^{-1}	Analysis No
0	2140	W3767/87
100	2110	W3768/87
200	2095	W3769/87
300	2090	W3770/87
1200	2060	W3772/87
1440	2032	W3780/87

Variation of salinity with depth, in early August 1987 prior to any artificial recharge is shown in Table 5.

Table 5: Salinity versus depth prior to recharge

Depth from surface (m)	TDS mgl^{-1} (Tested on site August 1987 using MARTEK downhole probe)
13.1	2000
23	2100
35	2400
43	2000
47	1380
55	1200
67	1200
78	1150

Conclusion

The construction of a high yield irrigation-recharge well at Langhorne Creek is expected to encourage installation of similar wells on other properties in the area.

Reference

Hazel, C.P., (1975), Groundwater Hydraulics, Lecture notes AWRC groundwater school Adelaide 1975

D.R. Howles

Appendix A

amdel

Water Analysis Report Job No. 0142/88 Method W2/1 Page W2

Sample ID. W3780/87

Chemical Composition		mg/L	me/L
Cations			
Calcium	(Ca)	175.0	8.733
Magnesium	(Mg)	87.0	7.160
Sodium	(Na)	470.0	20.444
Potassium	(K)	18.0	0.460
Anions			
Hydroxide	(OH)		
Carbonate	(CO3)		
Bi-Carbonate	(HCO3)	411.4	6.744
Sulphate	(SO4)	140.0	2.915
Chloride	(Cl)	904	25.461
Nitrate	(NO3)	4.1	0.066

Other Analyses

Reaction - pH	7.1
Conductivity (E.C) (micro -S/cm at 25°C)	3650
Resistivity Ohm.M at 25°C	2.740

Derived Data	mg/L
Total Dissolved Solids	
A. Based on E.C.	2032
B. Calculated (HCO3=CO3)	2004
Total Hardness	795
Carbonate Hardness	374
Non-Carbonate Hardness	421
Total Alkalinity (Each as CaCO3)	374

Totals and Balance			
Cations (me/L)	36.8	Diff=	1.61
Anions (me/L)	35.2	Sum =	71.98
Diff*100/Sum		=	2.24%
Sodium / Total Cation Ratio			55.6%

Remarks

PERMIT NO:94748

Note: mg/L = Milligrams per litre
me/L = MilliEqivs.per litre

Name: P.PATERSON
Address: DEPT OF MINES&ENERGY
P.O BOX 151
EASTWOOD S.A. 5063

Date Collected 17-6-87
Date Received 14-7-87
Collected by PATTO

Section 3571
Hole No. 6727-12303
Supply 42 l/s
Water Cut 31.2 m
Water Level 13.9 m
Depth Hole 79 m

PROJECT: R. NURSE, RECHARGE/PRODUCTION BORE

MINES DEPARTMENT — SOUTH AUSTRALIA
ENGINEERING DIVISION

WATER WELL LOG

HOLE NO: PN 94748

LOCATION OR COORDS: LANGHORNE CREEK

UNIT / STATE NO: 6727-03/-wl- 2303

SEC 3571 HD. Freeling

EL Surface m

EL Ref. Point m Datum

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:
	31-2	13-9			4114	24	Pump	2060	W — 3772/87

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	3		CLAYEY SAND	Brown, fine (0.2mm), subangular, quartz grains in brown clay matrix. (20% clays).			204mm STEEL	0	32.7
3	6		SILT & SAND	Brown, fine (0.2mm), subangular, quartz & mica grains in silt & clay matrix. (<10% clays).					
6	9		SILTY CLAY	Brown & green-grey, silt, quartz & mica (>50% clays).		Pressure Cemented		0	32.7
9	12		SAND	Grey-brown, fine (0.05-0.1mm) subangular, predominantly quartz, minor mica (10% clays).					
12	24		CLAYEY SAND & SILT	Brown, fine (0.05-0.1mm), subangular, predominantly Quartz, minor mica (50% clay & silt).					
24	30		SAND	Grey, fine-medium (0.1-0.3mm), subangular-subrounded, quartz (clear), clean.					

REMARKS:

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

DRILL TYPE: ROTARY

CIRCULATION: MUD / AIR

SHEET 1 OF 3

COMPLETED: -/6/87

LOGGED BY: S.R.H

DATE:

DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

WATER WELL LOG

CONTINUATION SHEET

HOLE NO PN 94748

UNIT / NO

DME

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)
30	33		SANDY LIMESTONE (31.2m)	Yellow, medium-coarse (0.5-2mm), subrounded-rounded quartz (clear) 10-20%, predominantly yellow & white ? calcite & carbonate (Hard cap to limestone, soft below).					
33	36			As above, some clayey limestone, some Fe stained patches → 1 cm diameter.					
36	39		LIMESTONE	Yellow, 10% quartz (0.5-2mm), Tr fossils, calcite (0.1-0.5mm), in carbonate cement, some clayey bands.					
39	48		SANDY LIMESTONE	Yellow brown, fine (0.1-0.2mm), subrounded-sub-angular, quartz (clear) 80%, calcite 20%, Tr fossils, (soft).					
48	54			Yellow brown, fine-medium (0.1-0.5mm), subangular-subrounded, quartz (clear) 50%, calcite 20%, Tr fossils, in carbonate matrix. Some clayey bands, some indurated bands, generally soft.					
54	72			Yellow-brown, predominantly fine (0.1-0.2mm), minor coarse (→0.5mm), subangular-angular, quartz (clear) 50%, calcite grains & carbonate cement 50%, Tr fossils. Some indurated bands, generally soft.					
				As above, Tr glauconite					
				" "					
				" "					
				" "					

SHEET 2 OF 2

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DEPARTMENT OF MINES AND ENERGY - SOUTH AUSTRALIA

WATER WELL LOG

CONTINUATION SHEET

HOLE NO: PN 94748

UNIT / NO

DME

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)
72	79.5			Grey-brown, fine-medium (0.1-0.5mm) predominantly 0.2-0.3mm, subangular-subrounded, quartz (clear) 50%, calcite grains & carbonate cement 50%, Tr fossils, Tr glauconite, Tr mica below 75 m (soft).					

SHEET 3 OF 3

Appendix B
Well discharge test Results & Analytical Methods

Contents — Page

Well discharge tests

Stepdrawdown test

step 1	50 minutes at Q =	10.4 ls^{-1}	12/6/87
step 2	60	5.7	16/6/87
step 3	80	30.3	16/6/87
step 4	70	45.2	16/6/87

steps 2-4 were performed with no recovery between steps.

Results from the step drawdown test allow determination of the non-linear head loss associated with the discharging well, and the well equation relating drawdown, discharge rate & time.

Well equation $St = aQ + b \log_{10} tQ + cQ^2$

where St = drawdown (m)

Q = discharge rate ($m^3\ min^{-1}$)

t = time (mins)

a&b= constants related to laminar flow in aquifer

c = constant related to turbulent well loss.

A plot of $\frac{St}{Q}$ vs Q (Fig. B-1) allows calculation of a & c.

The intercept of the t=10 line with the St/Q axis gives a value of $a + b \log_{10} t$, where $\text{Log}_{10}\ 10 = 1$.

hence: $a + b = 1.07$

and since average $b = \frac{\Delta s}{Q} = 0.32$

$$a = 0.75$$

c is given by the slope of the t = 10 line, and is 0.49.

This leads to the determination of the well equation as $St = 0.75\ Q + 0.32 \log_{10} tQ + 0.49\ Q^2$.

This equation gives values slightly greater values than those measured during the test.

ie at a time of t = 1440 minutes

and discharge of Q = 2.86 $m^3\ min^{-1}$

St = 9.04m, compared to 8.40 m from the test.

Constant Discharge Test

Discharge 1440 mins (24 hours) at Q = 47.6 ls^{-1} 18.30 16/6/87 - 18.30 17/6/87.
Recovery 360 mins 18.30 17/6/87 - 0030 18/6/87.
Discharge 30 mins at Q = 47.6 ls^{-1} 10.00 18/6/87 - 10.30 18/6/87

Results from the constant discharge test allow estimation of the long term safe yield, and calculation of the aquifer parameters.

Analyses for production and observation wells using Jacobs equation are presented in fig. B-2 - B-6.

Analysis by use of Theis type curve solution for FRL 62 is difficult, however Fig. B-7 indicates no leakage through the test duration (confirmed by the results from FRL 225, Fig. B-8).

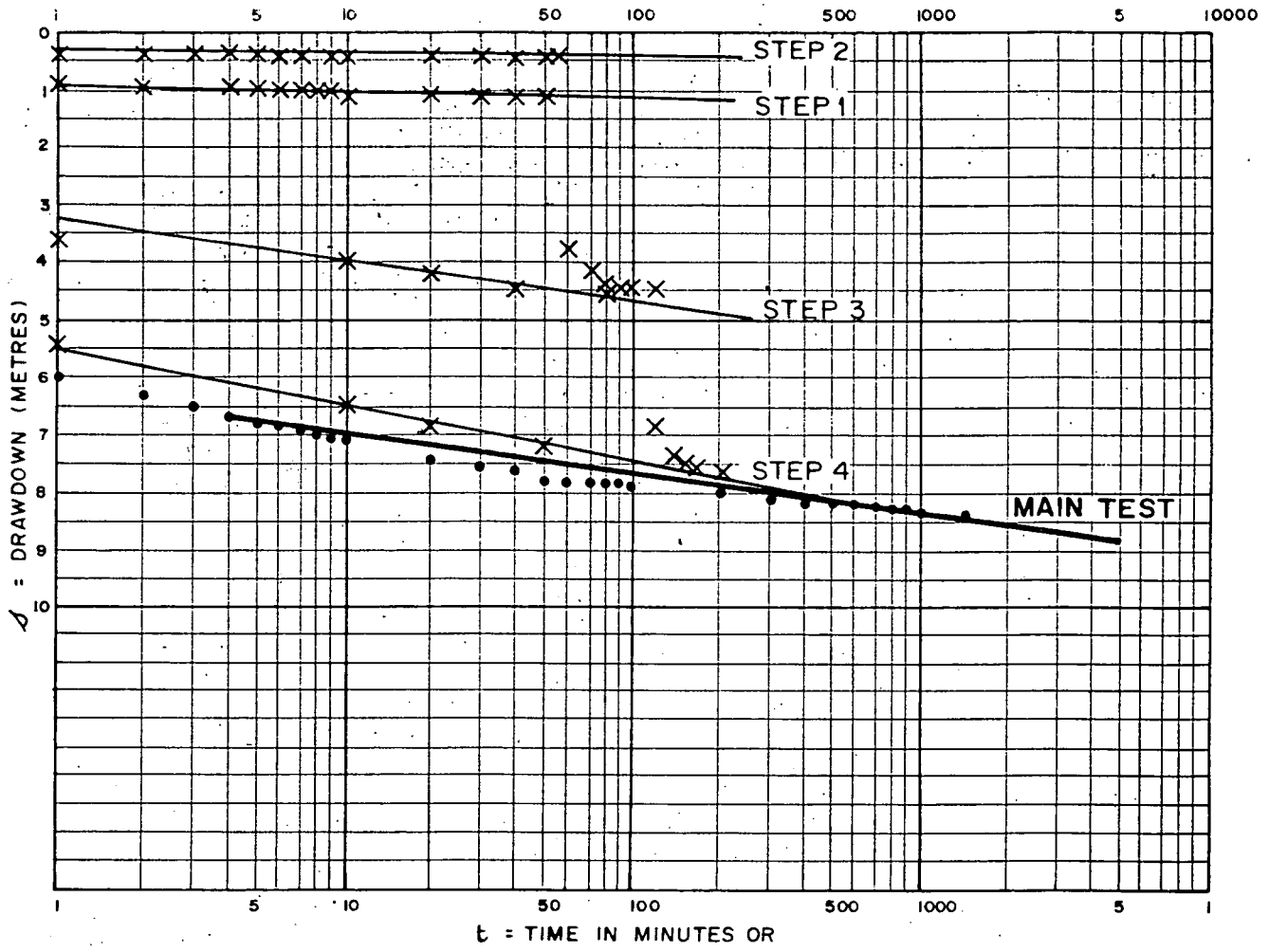
Maximum possible leakage may be estimated by assuming that deviation from the Theis curve occurs at the end of the test, this leads to an estimate of vertical hydraulic conductivity for the confining layer of 2.2×10^{-3} md^{-1} (Fig. B-7).

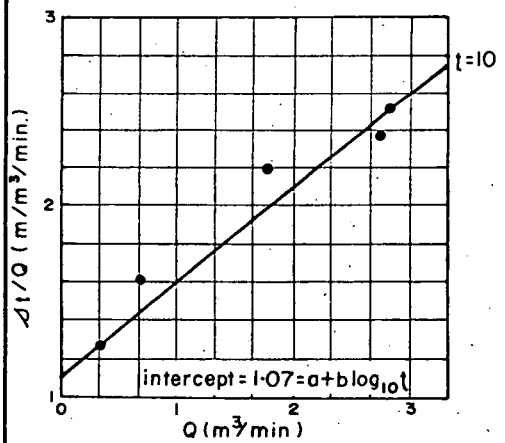
Type curve analysis of FRL 32, Fig. B-9, indicates marked deviation from the Theis curve suggesting the possibility of transmissivity changes effecting a strip aquifer in the well area.

Aquifer Parameters from the tests are outlined in Table B-1, safe yield is discussed in the main Text.

Table B-1 Aquifer Parameters

Method	Fig.	Well	Transmissivity ($m^3d^{-1}m^{-1}$)	Storage Coeficient (-)
semi-log s vs t	B-3	FRL 32	1 800	3×10^{-4}
B-4	FRL 62	1 900	1×10^{-3}	
B-2	Production Well		1 000	
semi-log	B-3	FRL 32	2 400	
S Resid vs t	B-4	FRL 62	2 100	
B-5	FRL 140	2 100		
B-2	Production Well		700	
semi-log r vs s	B-6	FRL 32, 62, Production Well	1 000	1×10^{-3}
log-log s vs t	B-7	FRL 62	1 300	2×10^{-3}





STEP	Q (m³/min)	Δt = 1	Δt = 1 / Q	Δt = 10	Δt = 10 / Q	Δt = 100	Δt = 100 / Q	Δs	Δs / Q	T*
1	0·63			1·02	1·61	1·13	1·79	0·14	0·22	
2	0·34			0·43	1·26	0·48	1·41	0·145	0·43	
3	1·82			3·98	2·19	4·63	2·54	0·65	0·36	
4	2·71			6·47	2·39	7·5	2·77	0·97	0·35	
MAIN	2·86			7·14	2·5	7·93	2·77	0·72	0·25	
								Ave. b = 0·32		

* JACOB EQUATION : $T = \frac{0 \cdot 183 . Q}{\Delta s}$

STATE / UNIT No. 6727-2303

INTERVAL TESTED

From 31 m. to 78 m.

HOLE DEPTH 78 m.

AQUIFER

From 30 m. to 78 m.

LENGTH OF TEST 210 minutes

DEPTH OF PUMP INTAKE 31 m.

DEPTH OF WATER LEVEL

AT START OF TEST 14·48 m.

AVAILABLE DRAWDOWN ____ m.

WELL EQUATION : $s = aQ + cQ^2 + b.Q.\log_{10} t$

OR $\frac{\Delta t}{Q} = a + cQ + b.\log_{10} t$

From $\frac{\Delta t}{Q}$ versus Q, a = 0·75

b = 0·32

c = 0·49

Therefore $\Delta t = 0{\cdot}75Q + 0{\cdot}49Q^2 + 032Q\log_{10} t$

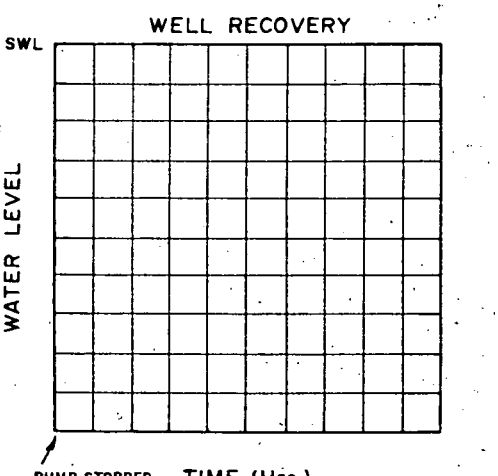


Figure B1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED S. Howles | C.D.O. | 14.1.88 DATE

DRAWN E. Calabio | SCALE ——

DATE Nov. 1987 | CHECKED

PLAN NUMBER S 19661

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

WELL No. 6727310WW02303

STEP DRAWDOWN TEST

4506

MF 88

4506

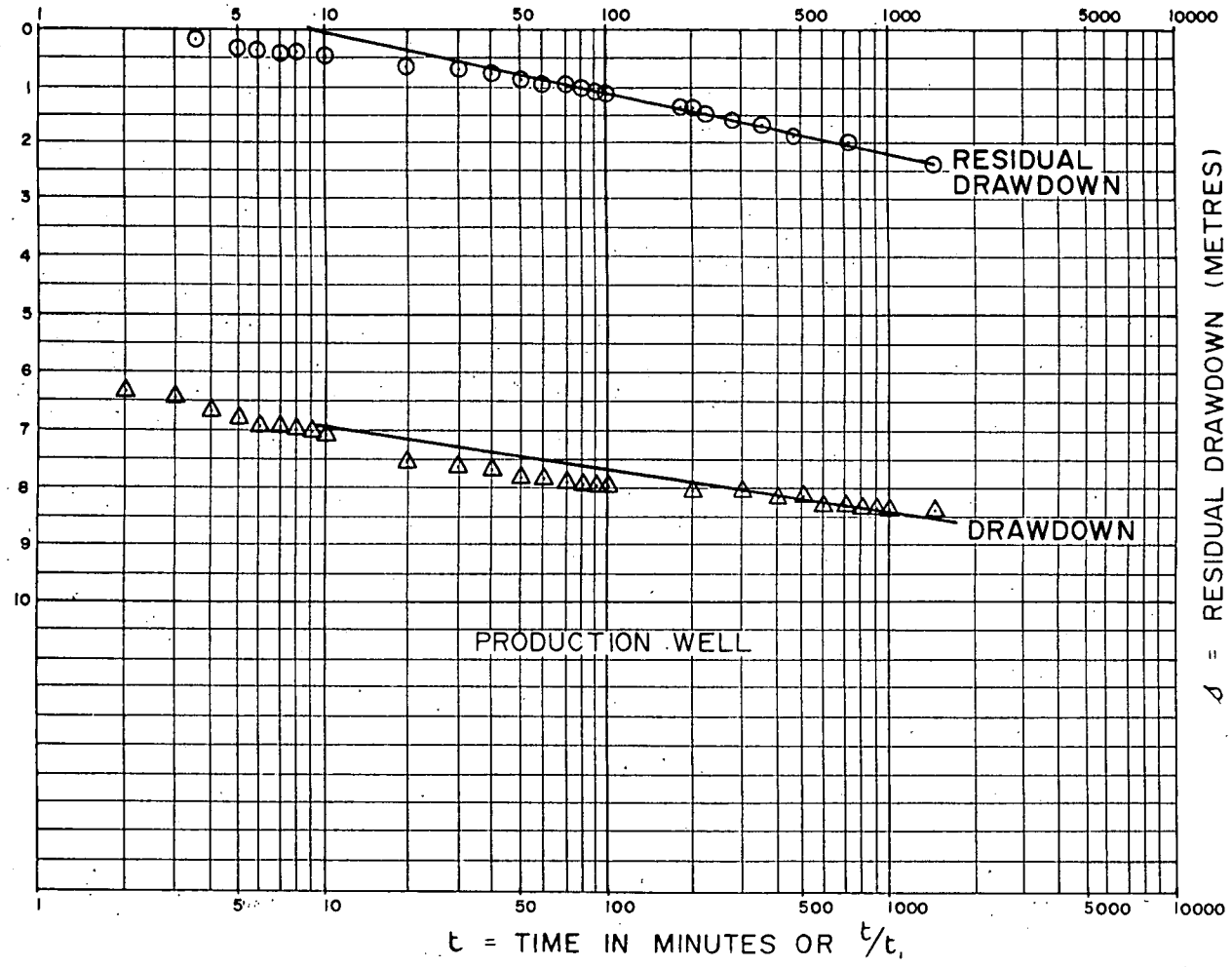
MF 89

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

IRRIGATION RECHARGE WELL – LANGHORNE CREEK

WELL No. 6727310WW02303

CONSTANT DISCHARGE TEST



STATE/UNIT No. 6727310WW02303

PRODUCTION/OBSERVATION WELL

INTERVAL TESTED

From 32 m. to 78 m.

HOLE DEPTH 78 m.

AQUIFER THICKNESS ..... m.

DEPTH OF PUMP INTAKE 31 m.

DEPTH OF WATER LEVEL

AT TEST START 14:48 m.

AVAILABLE DRAWDOWN ..... m.

JACOB EQUATIONS*

$$T = \frac{0.183 \times Q}{\Delta s} \quad \text{in which}$$

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

Q = Pumping rate (m^3/day)

Δs = Drawdown per log cycle (m.)

$$S = \frac{2.25 \times Tto}{1440\, r^2} \quad \text{in which}$$

S = Storage coefficient

to = Zero drawdown time (minutes)

r = Distance to Observation Well (m.)

DATA

Q	Δs	to	r
$4114\ m^3 d^{-1}$	0·72 m	——	——
$4114\ m^3 d^{-1}$	1·1 m	——	——

CALCULATIONS

Drawdown ..... $T = \frac{0.183 \times 4114}{0.72} = 1046\ m^3 d^{-1} m^{-1}$

Residual Drawdown ... $T = \frac{0.183 \times 4114}{1.1} = 685\ m^3 d^{-1} m^{-1}$

* Check applicability of this method

COMPILED	DRAWN	CHECKED	DATE	SCALE	PLAN NUMBER
S. Howles	E. Calabio		Nov. '87		S 19662

C.D.O. 14/1/88 DATE

Figure B2

MF 89

IRRIGATION RECHARGE WELL – LANGHORNE CREEK

WELL No. 6727310WW01705

CONSTANT DISCHARGE TEST

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED	DRAWN	SCALE	PLAN NUMBER
S. Howles	E. Calabio		S 19663
DATE CHECKED: Nov '87	C.D.O	DATE: 14/1/88	

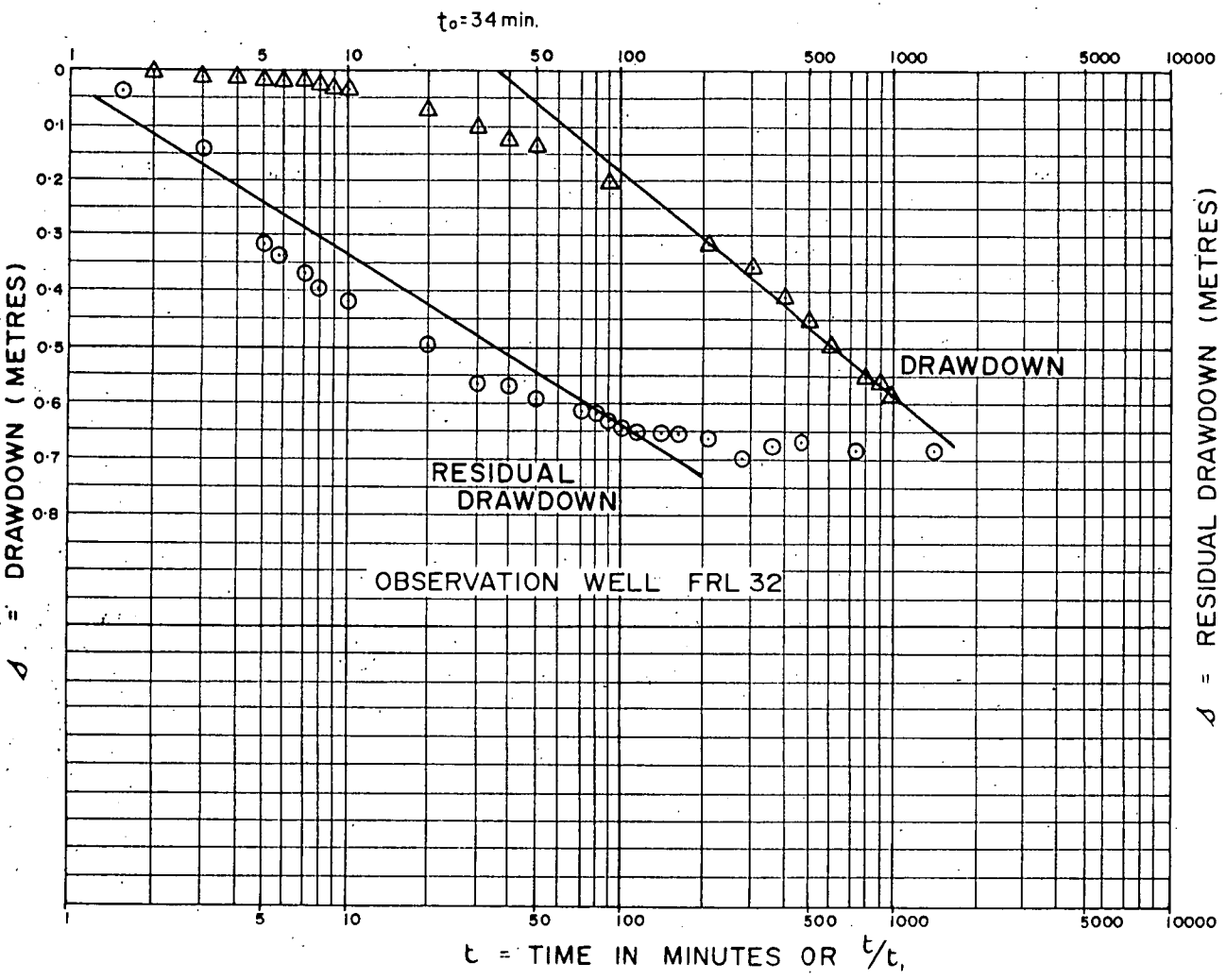


Figure B3

STATE/UNIT No. 6727310WW01705

PRODUCTION/OBSERVATION WELL

INTERVAL TESTED

From ____ m. to ____ m.

HOLE DEPTH ____ m.

AQUIFER THICKNESS ____ m.

DEPTH OF PUMP INTAKE ____ m.

DEPTH OF WATER LEVEL

AT TEST START 14·71 m.

AVAILABLE DRAWDOWN ____ m

JACOB EQUATIONS*

$$T = \frac{0{\cdot}183 \times Q}{\Delta s}$$ in which

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

Q = Pumping rate (m^3/day)

Δs = Drawdown per log cycle (m.)

$$S = \frac{2{\cdot}25 \times Tto}{1440\, r^2}$$ in which

S = Storage coefficient

to = Zero drawdown time (minutes)

r = Distance to Observation Well (m.)

DATA

Q	Δs	to	r
$4114\ m^3d^{-1}$	$41{\cdot}5 \times 10^{-2}$ m	0·024 days	575m
$4114\ m^3d^{-1}$	31×10^{-2} m	———	575m

CALCULATIONS

Drawdown..... $T = \frac{0{\cdot}183 \times 4114}{41{\cdot}5 \times 10^{-2}} = 1814\ m^3d^{-1}m^{-1}$

$$S = \frac{2{\cdot}25 \times 1814 \times 0{\cdot}024}{575^2} = 0{\cdot}0003$$

Residual Drawdown.... $T = \frac{0{\cdot}183 \times 4114}{31 \times 10^{-2}} = 2429\ m^3d^{-1}m^{-1}$.

* Check applicability of this method

4506

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

WELL No. 6727310WW01679

CONSTANT DISCHARGE TEST

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED S. Howles | DRAWN E. Calabio | DATE CHECKED Nov. '87 | SCALE | C.D.O. | DATE 14/1/88 | PLAN NUMBER S 19664

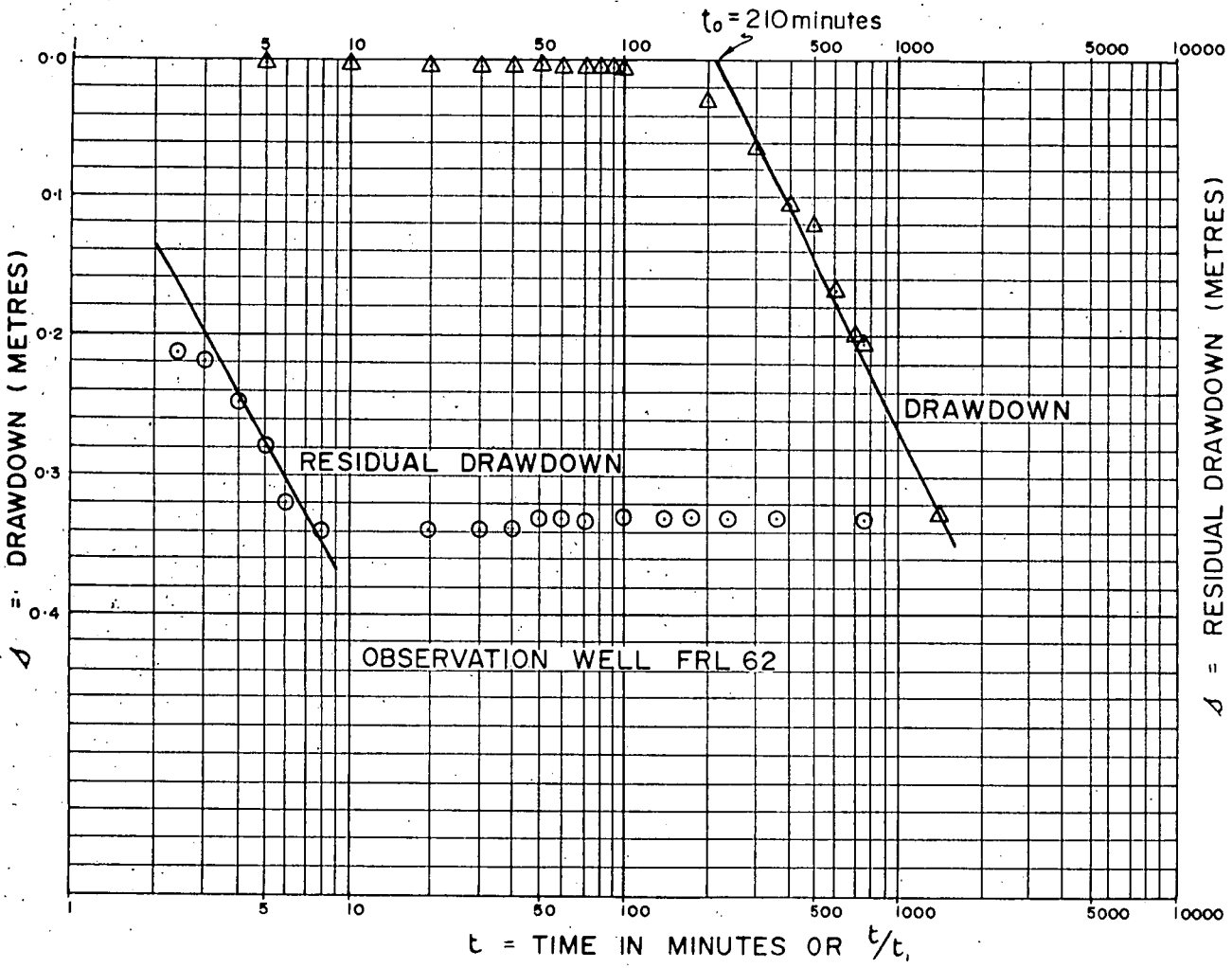


Figure B4

STATE/UNIT No. 6727310WW01679
PRODUCTION/OBSERVATION WELL
INTERVAL TESTED
From ____ m. to ____ m.
HOLE DEPTH ____ m.
AQUIFER THICKNESS ____ m.
DEPTH OF PUMP INTAKE ____ m
DEPTH OF WATER LEVEL
AT TEST START 14·18 m.
AVAILABLE DRAWDOWN ____ m.

JACOB EQUATIONS*

$$T = \frac{0{\cdot}183 \times Q}{\Delta s} \quad \text{in which}$$

T = Transmissivity (m^3/day/m.)
Q = Pumping rate (m^3/day)
Δs = Drawdown per log cycle (m.)

$$S = \frac{2{\cdot}25 \times T t_o}{1440\, r^2} \quad \text{in which}$$

S = Storage coefficient
t_o = Zero drawdown time (minutes)
r = Distance to Observation Well (m.)

DATA

	Q	Δs	t_o	r
Drawdown	$4114\ m^3d^{-1}$	40×10^{-2}m	0·146 days	780m
Residual Drawdown	$4114\ m^3d^{-1}$	35×10^{-2}m	——	780 m

CALCULATIONS

Drawdown

$$T = \frac{0{\cdot}183 \times 4114}{40\times10^{-2}} = 1880\ m^3d^{-1}m^{-1}$$

$$S = \frac{2{\cdot}25 \times 1880 \times 0{\cdot}146}{780^2} = 0{\cdot}001$$

Residual Drawdown

$$T = \frac{0{\cdot}183 \times 4114}{35\times10^{-2}} = 2151\ m^3d^{-1}m^{-1}$$

* Check applicability of this method

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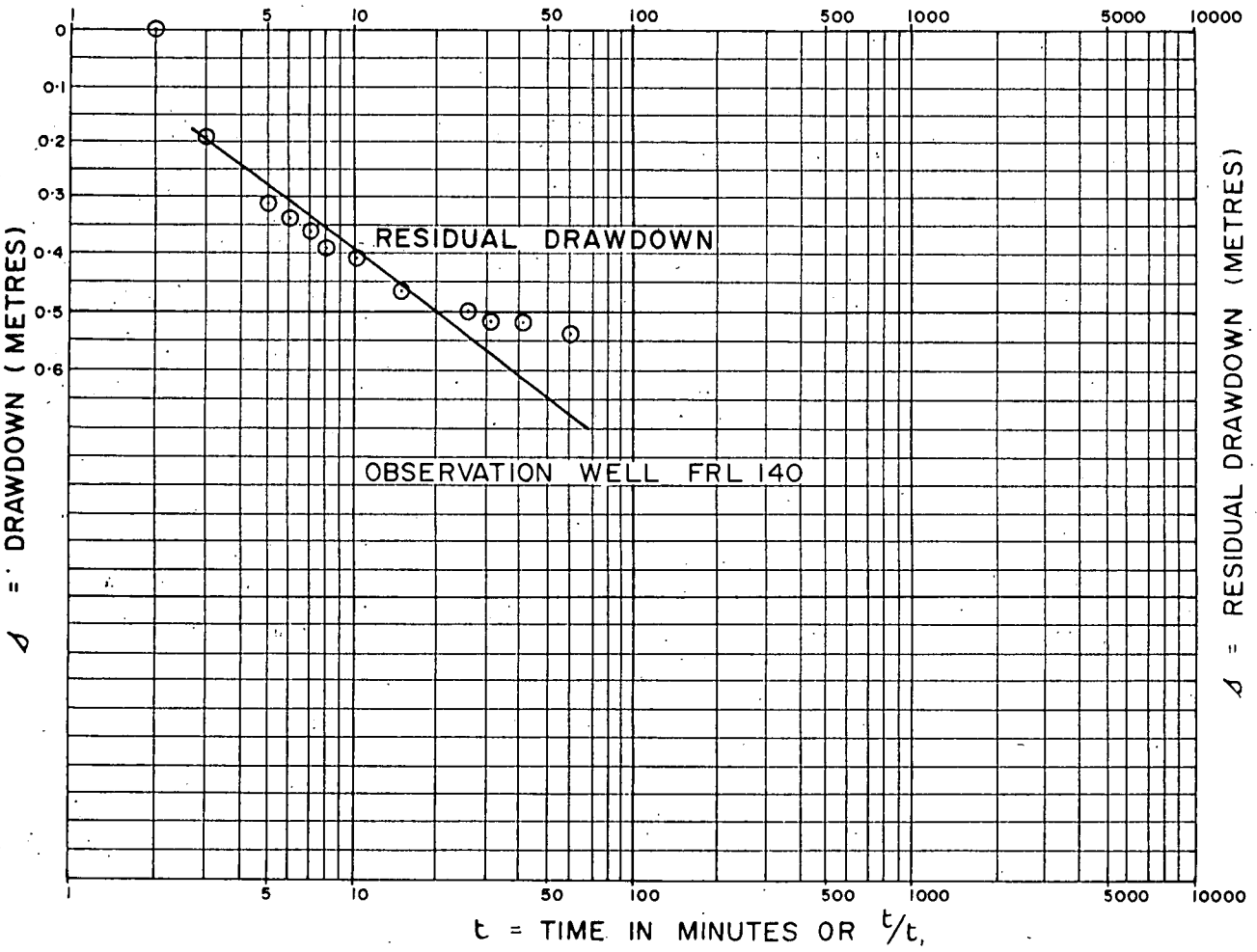
MF 89



STATE/UNIT No. 6727310WW02254

PRODUCTION/OBSERVATION WELL

INTERVAL TESTED

From _____ m. to _____ m.

HOLE DEPTH _____ m.

AQUIFER THICKNESS _____ m.

DEPTH OF PUMP INTAKE _____ m.

DEPTH OF WATER LEVEL

AT TEST START 12:06 m.

AVAILABLE DRAWDOWN _____ m.

JACOB EQUATIONS*

$$T = \frac{0{\cdot}183 \times Q}{\Delta\Delta}$$ in which

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

Q = Pumping rate (m^3/day)

$\Delta\Delta$ = Drawdown per log cycle (m.)

$$S = \frac{2{\cdot}25 \times Tto}{1440\, r^2}$$ in which

S = Storage coefficient

to = Zero drawdown time (minutes)

r = Distance to Observation Well (m.)

DATA

Q	$\Delta\Delta$	to	r
$4114 m^3 d^{-1}$	35×10^{-2} m	1050m	

CALCULATIONS

Residual Drawdown $T = \frac{0{\cdot}183 \times 4114}{35 \times 10^{-2}} = 2151\ m^3 d^{-1} m^{-1}$

* Check applicability of this method

Figure B5

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

WELL No. 6727310WW02254

CONSTANT DISCHARGE TEST

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED	DRAWN	DATE CHECKED	SCALE	PLAN NUMBER
S. Howles	E. Calabio	Nov. '87		S 19665

C.D.O. 14.1.88 DATE

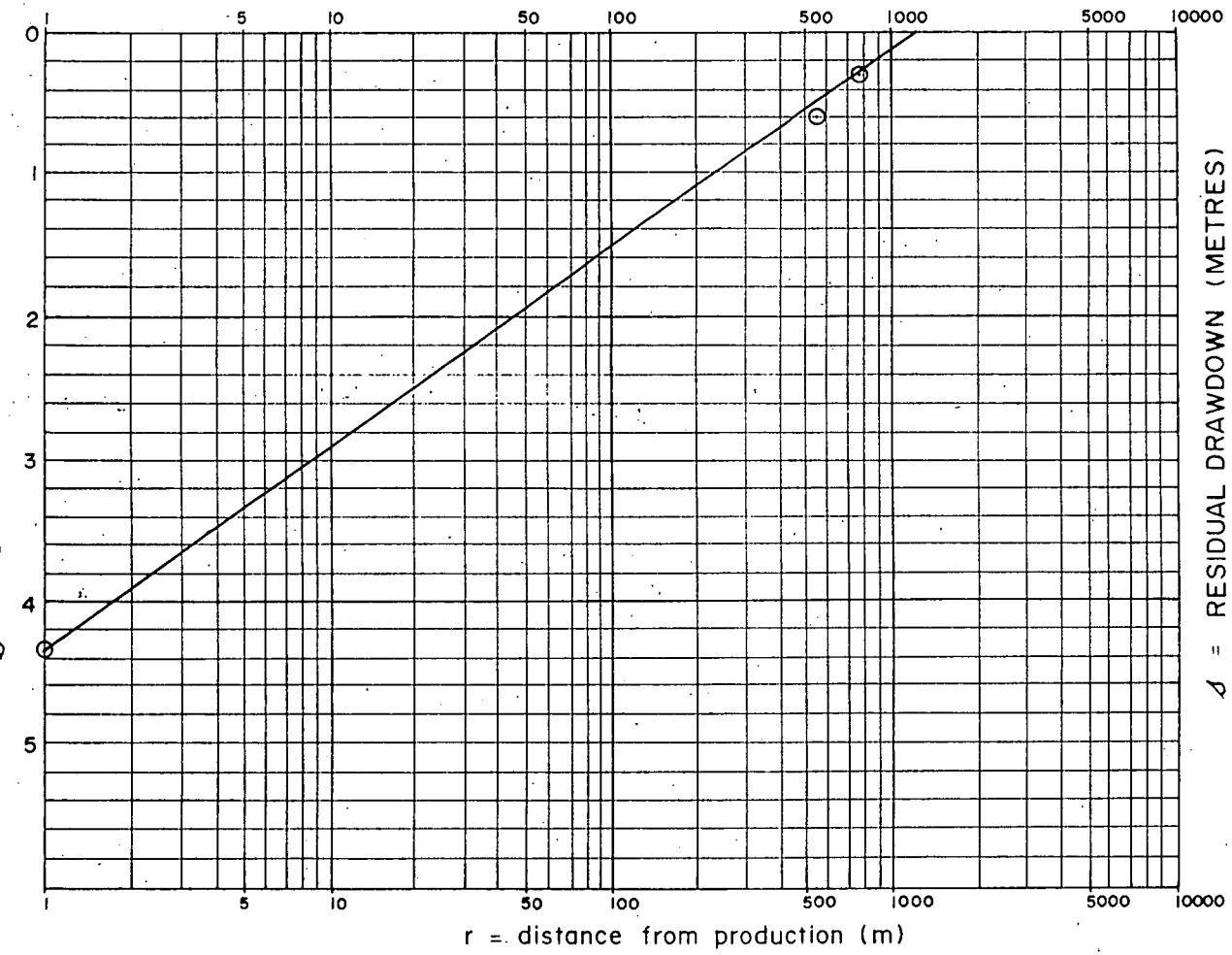
4506

MF 89

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

DISTANCE DRAWDOWN PLOT AT t = 1000 m

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA



STATE/UNIT No. _____

PRODUCTION/OBSERVATION WELL

INTERVAL TESTED

From _____ m. to _____ m.

HOLE DEPTH _____ m.

AQUIFER THICKNESS _____ m.

DEPTH OF PUMP INTAKE _____ m.

DEPTH OF WATER LEVEL

AT TEST START _____ m

AVAILABLE DRAWDOWN _____ m.

JACOB EQUATIONS*

$$T = \frac{-0.37 \times Q}{\Delta s'}$$ in which

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

Q = Pumping rate (m^3/day)

$\Delta s'$ = Drawdown per log cycle (m.)

$$S = \frac{2.25 \times Tt}{10^{\left(\frac{-2.4}{\Delta s'}\right)} r^2}$$ in which

S = Storage coefficient

t = Time (days)

r = Distance (m) from Production Well

s = Drawdown at distance r from Production Well.

DATA

Q	$\Delta s'$	t	r	s	$\Delta s'$
$4114 m^3 d^{-1}$	1·42 m	0·69 days	100 m	1·55 m	−1·45

CALCULATIONS

$$T = \left(\frac{-0.37 \times 4114}{-1.45}\right) = 1003\ m^3 d^{-1} m^{-1}$$

$$S = \left(\frac{2.25 \times 1003 \times 0.69}{10^{\left(\frac{-3.1}{-1.45}\right)} \times 100^2}\right) = 1.1 \times 10^{-3}$$

* Check applicability of this method

Figure B6

COMPILED	DRAWN	DATE	SCALE	PLAN NUMBER
S. Howles	E. Calabio	Nov. '87		S 19666

C.D.O. 14/1/88 DATE

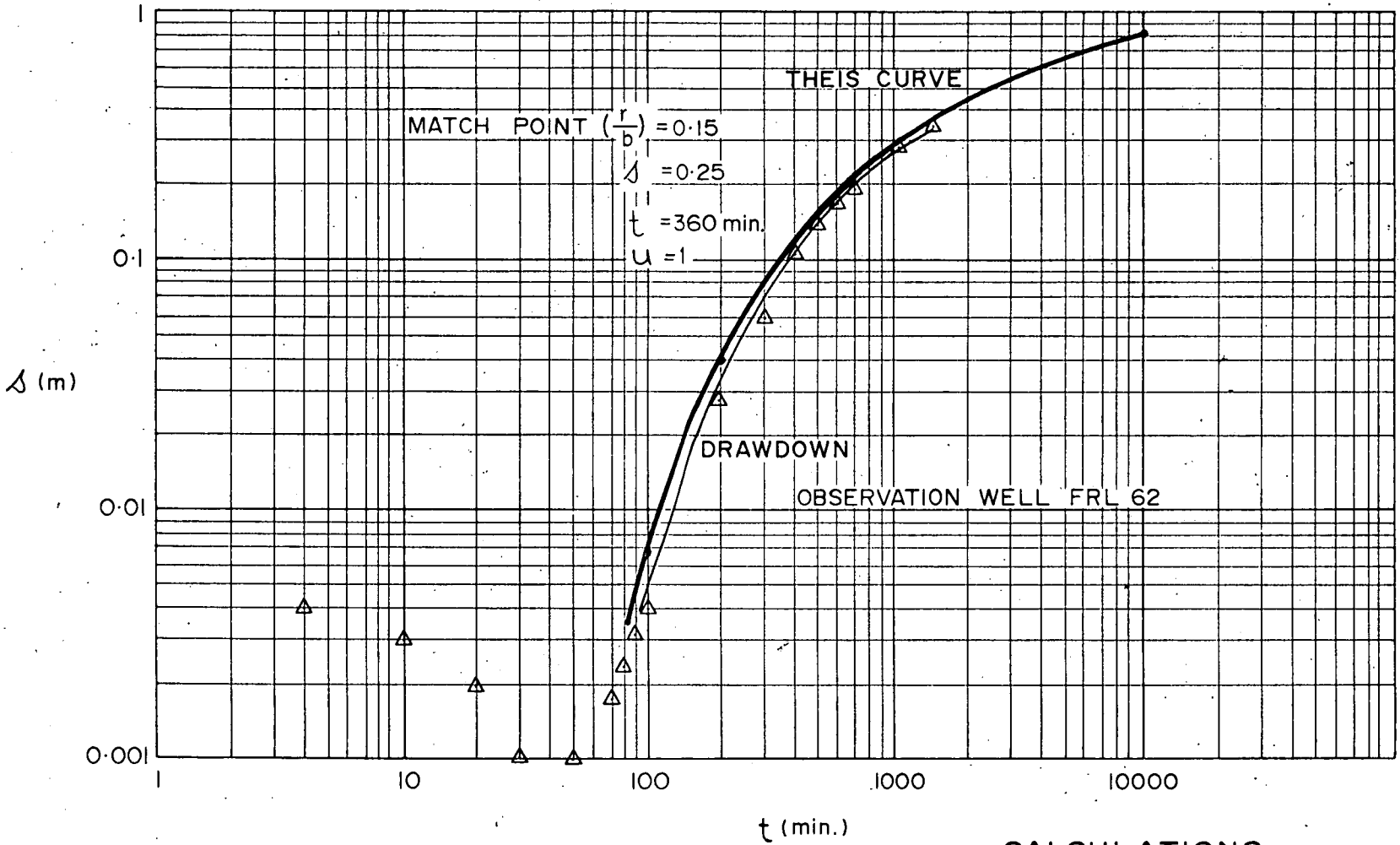
MF 87

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

WELL No. 6727310WW01679

LOG - LOG PLOT OF DRAWDOWN



WELL No. 6727310WW01679

TYPE OF PUMP

DISCHARGE STARTED AT 6:30p.m. ON 16/6/87

DISCHARGE STOPPED AT 6:30p.m. ON 17/6/87

INTERVAL TESTED ____ m. to ____ m.

HOLE DEPTH ____ m.

CALCULATIONS

$$T = \frac{Q}{4\pi s} \cdot W(u) = 1310\ m^3 d^{-1} m^{-1}$$

$$S = \frac{4Tut}{r^2} = 2{\cdot}2 \times 10^{-3}$$

$$K'_{max.} = \frac{Tb\left(\frac{r}{b}\right)^2}{r^2} = 6 \times 10^{-4}\ m\,d^{-1}$$

where s = drawdown (m)
t = time days
Q = pumping rate ($m^3 d^{-1}$)
r = distance to Production Well (780m)
b' = Thickness of aquitard (12m)

COMPILED	DRAWN	DATE CHECKED	PLAN NUMBER
S. Howles	E. Calabio	Nov. '87	S 19667

C.D.O. 14/1/88 DATE

SCALE

FIG. B7

4506

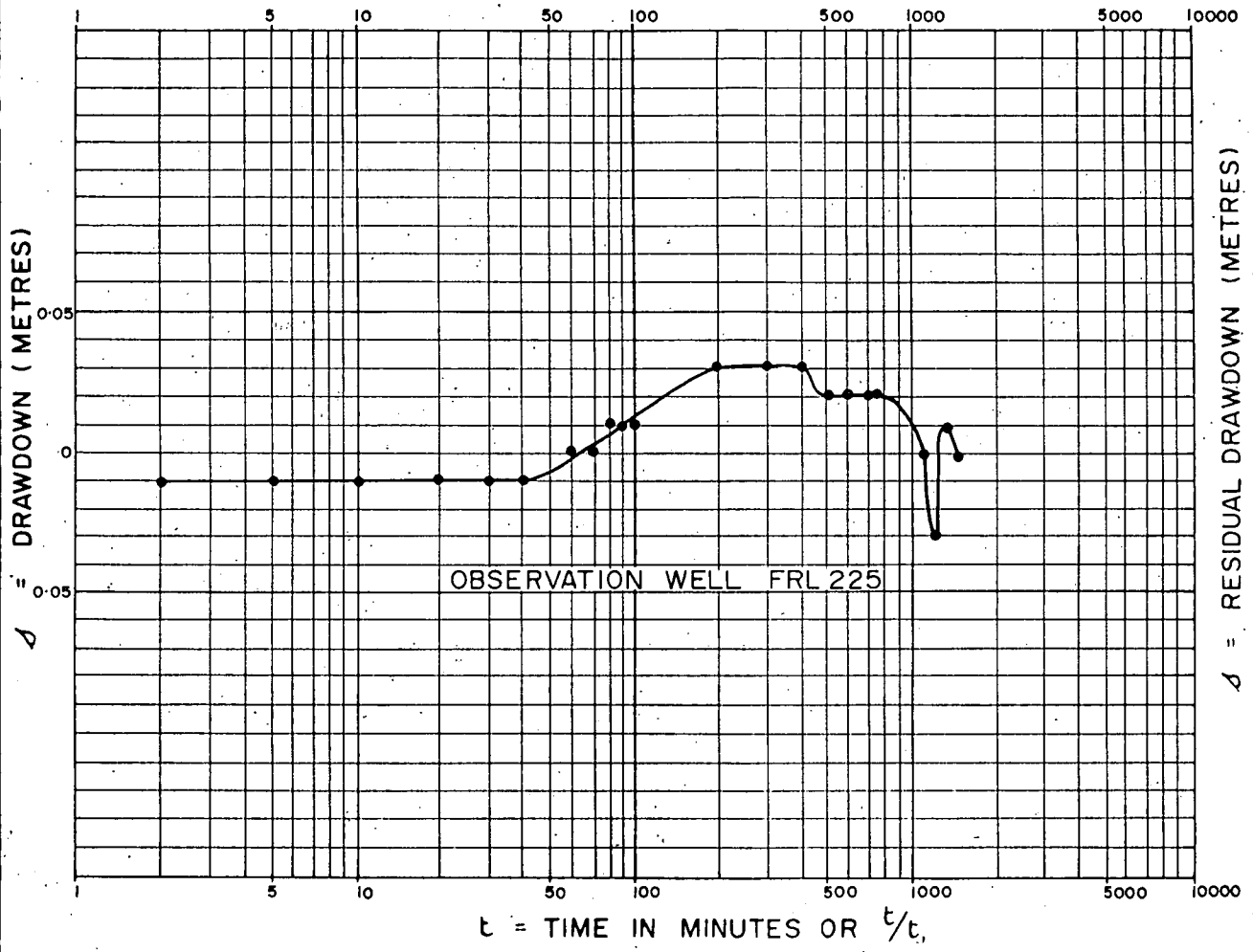
MF 89

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

IRRIGATION RECHARGE WELL – LANGHORNE CREEK

WELL No. 6727310WW01680

CONSTANT DISCHARGE TEST



STATE/UNIT No. 6727310WW01680

PRODUCTION/OBSERVATION WELL

INTERVAL TESTED

From _____ m. to _____ m.

HOLE DEPTH _____ m.

AQUIFER THICKNESS _____ m.

DEPTH OF PUMP INTAKE _____ m.

DEPTH OF WATER LEVEL

AT TEST START 5·11 m.

AVAILABLE DRAWDOWN _____ m.

JACOB EQUATIONS*

$$T = \frac{0{\cdot}183 \times Q}{\Delta s} \quad \text{in which}$$

T = Transmissivity (m^2/day/m.)

Q = Pumping rate (m^3/day)

Δs = Drawdown per log cycle (m.)

$$S = \frac{2{\cdot}25 \times Tto}{1440\ r^2} \quad \text{in which}$$

S = Storage coefficient

to = Zero drawdown time (minutes)

r = Distance to Observation Well (m.)

DATA

Q Δs to r

CALCULATIONS

* Check applicability of this method

COMPILED S. Howles	DRAWN E. Calabio	DATE Nov. '87 CHECKED	PLAN NUMBER S 19668
C.D.O 14/1/88 DATE	SCALE		

Figure B8

4506

MF 87

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

WELL No. 6727310WW01705

LOG - LOG PLOT OF DRAWDOWN

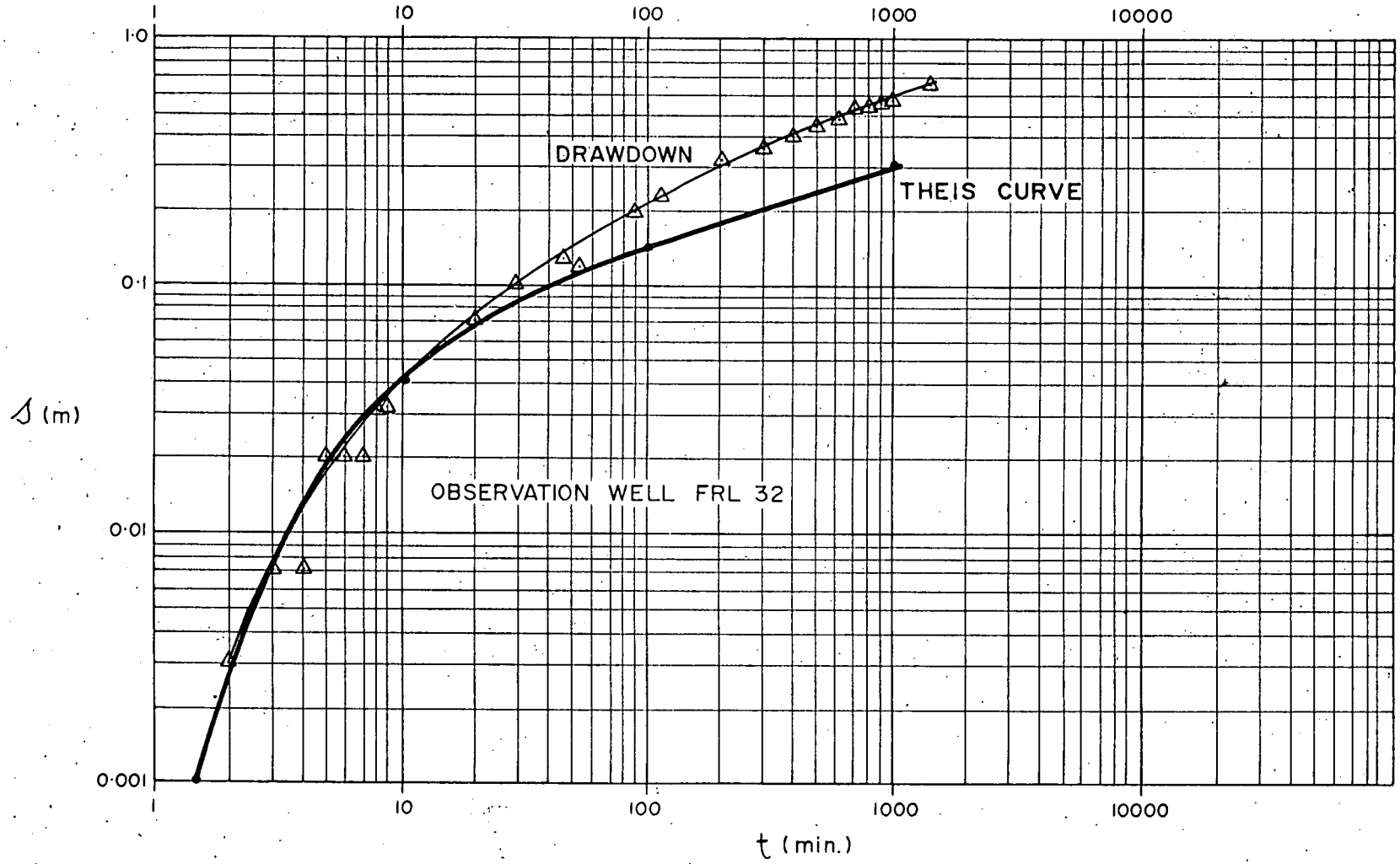


FIG. B9

CALCULATIONS

WELL No. 6727310WW01705

TYPE OF PUMP

DISCHARGE STARTED AT 6:30p.m. ON 16/6/87

DISCHARGE STOPPED AT 6:30p.m. ON 17/6/87

INTERVAL TESTED _____ m. to _____ m.

HOLE DEPTH _____ m.

COMPILED	DRAWN	DATE CHECKED	SCALE	PLAN NUMBER
S. Howles	E. Calabio	Nov '87		S19669

C.D.O. 14/1/88 DATE

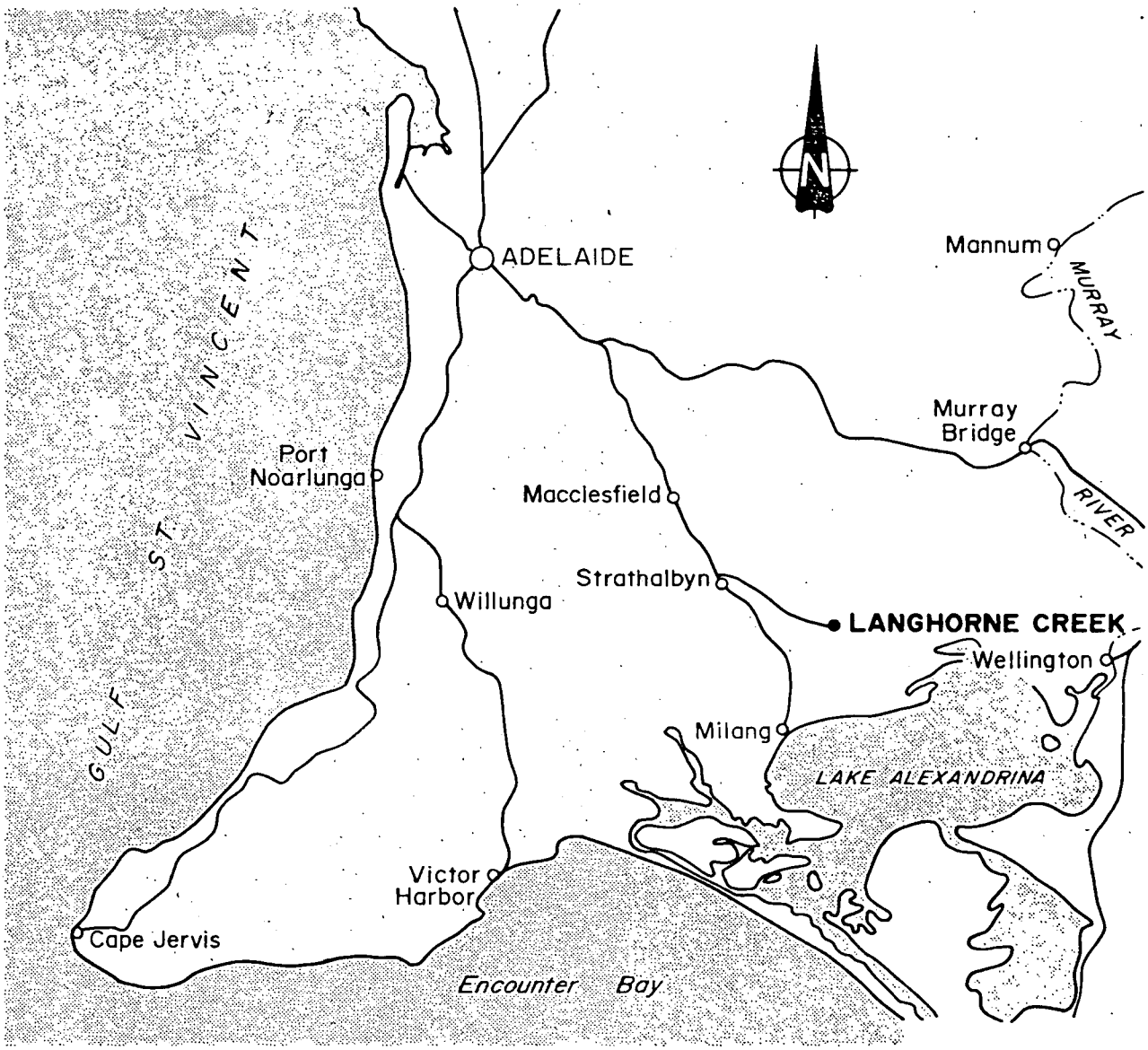


FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

LOCALITY PLAN

COMPILED S. Howles	C.D.O. 14/1/88 DATE
DRAWN E. Calabio	SCALE As shown
DATE Nov. '87	PLAN NUMBER S 19659
CHECKED	

4506

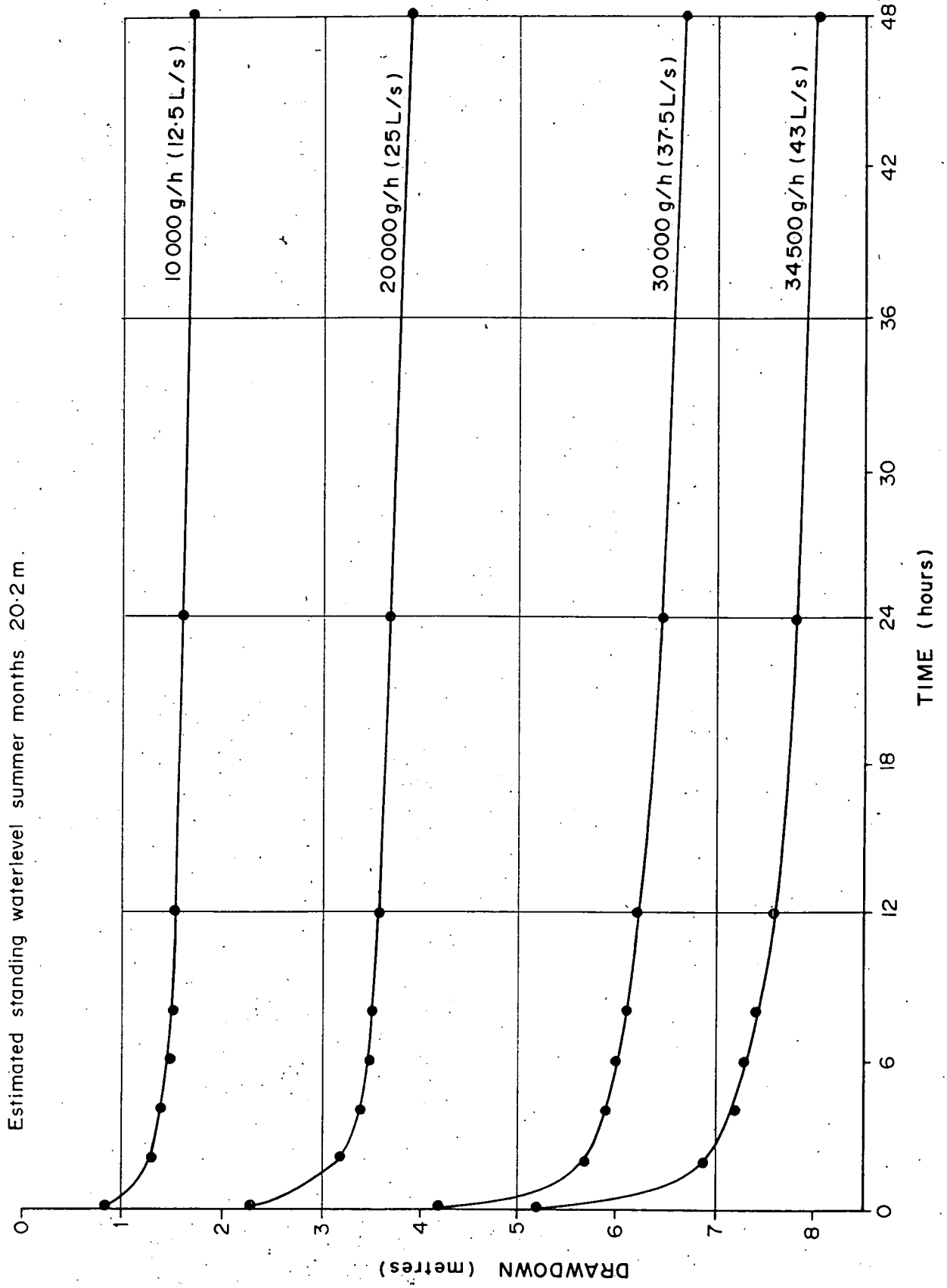


FIG. 2

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED S. Howles	C.D.O.	14·1·88 DATE
DRAWN E. Calabio	SCALE	
DATE Nov. '87	PLAN NUMBER	
CHECKED	S 19660	

IRRIGATION RECHARGE WELL — LANGHORNE CREEK

DRAWDOWN VS TIME CURVE OF PRODUCTION WELL

VARYING DISCHARGE RATE

4506