

70/120

6829
6929
A
K

DEPARTMENT OF MINES SOUTH AUSTRALIA



GEOLOGICAL SURVEY
ENGINEERING DIVISION

PROGRESS REPORT NO. 16

A summary of Drainage Investigations
in the Waikerie District of the River Murray
Irrigation Areas, South Australia during the
period July 1967 through June 1970

by

G.T. ROBERTS
ASSISTANT SENIOR GEOLOGIST
HYDROGEOLOGY SECTION

10th August, 1970.

Rept.Bk.No. 70/120

DEPARTMENT OF MINES
SOUTH AUSTRALIA

PROGRESS REPORT NO. 16

A summary of Drainage Investigations
in the Waikerie District of the River Murray
Irrigation Areas, South Australia during the
period July 1967 through June 1970

by

G.T. ROBERTS
ASSISTANT SENIOR GEOLOGIST
HYDROGEOLOGY SECTION

<u>CONTENTS</u> - Volume I	<u>PAGE</u>
INTRODUCTION	1
CONCLUSIONS	1
RECOMMENDATIONS	2
INVESTIGATION PROGRAMME	3
Observation Borehole Network	3
Drainage Testing	5
Test Procedures	5
Test Failures	9
Exploratory Drilling	9
Geophysical Logging	10
HYDROGEOLOGY	11

APPENDICES - Volume II

- A - Drain and Pump-In Test Data - Figs. Nos. 68-970/6, 68-969/6,
69-888, 69-889, 69-890.
- B - Geological Log - Borehole 27.W
- C - Calculations

<u>No.</u>	<u>FIGURES</u> <u>Title</u>	<u>Reference No.</u>
1	Potentiometric Contours as at June 1970	
2	Summary of Water Levels-July 1966 through June 1970	70-653
3	Location Sketch Plan	S.6818
4	Geological Cross Sections A-B & C-D	68-893
5	Surface Installations. Pump-In Test-Borehole 28.W.	S.6942
6	Details of Borehole and Strata Failure	S.6820
7	Borehole 27 W. Suggested Screen Design Buccleuch and Renmark Beds	70-646
8	Geophysical Logs of Borehole 28W	70-645
9	Hydraulic Model of Drainage Processes	S.7898

Rept. Bk No. 70/120
G.S. No. 4509
Hyd. No. 2260
D.M. No. 1487/1/68

10th August, 1970.

None - 1st report - No 121

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 70/120
G.S. No. 4509
Hyd. No. 2260
D.M. No. 1487/1/68

A summary of Drainage Investigations
in the Waikerie District of the River Murray
Irrigation Areas, South Australia during the
period July 1967 through June 1970

INTRODUCTION

A programme of investigation into the problems
associated with underground drainage in the Waikerie district
has been in progress for nearly ~~8~~^{six} years. An earlier report
(Roberts and Cramsie, 1969) summarised activities and results
up to June 1967 and the present report completes a review of
the investigation to June 1970.

CONCLUSIONS

1. Evidence from water level readings made over a four
year period from July 1966 through June 1970 indicates that
the 'mound' created on the groundwater table below the Waikerie
Irrigation Area has a complex response to drainage of surplus
irrigation water.

A significant rise in the mound can be detected on
the western side of the Waikerie Irrigation Area but no definite
correlation can be established between this rise and the
activities of the private irrigation areas, Golden Heights and
Ramco Heights.

The peak of the drainage mound is maintained by a single borehole with less than two years record. In the summer irrigation season the water rises to within 45 feet of the surface but no forecast can be made of the rate of rise of this peak level through the next few years because of the cyclic nature of the record (Fig.2).

2. Drain and pump-in tests on Borehole 28W showed that discharges of at least 1 cusec could be achieved over short periods. However, the problems of long term use are not understood in detail and much more testing would be necessary before the technical feasibility of a major scheme was established.

Difficulties exist in the design of high hydraulic heads and the possibility of strata failure and subsequent loss of drainage control are severe because of the thin cover of strata over the main aquifer limestones.

3. The presence of sand aquifers has been confirmed in strata of Eocene age to a depth of 1070 feet.

Preliminary design work has been carried out for drainage testing at two main horizons (Fig.8).

RECOMMENDATIONS

1. Servicing of the observation borehole network to ensure that valid measurements are obtained in the future.
2. Continuation of weekly readings at all the observation boreholes.
3. Remove the water level recorder from Borehole 22.W and instal on Borehole 31.W to study change near

the peak of the groundwater mound.

4. Instal a water level recorder on Borehole 26.R to study the growth of the groundwater mound towards the west.
5. An exhaustive review of design and operational problems associated with deep borehole drainage before further work is undertaken on Boreholes 27W and 28W.

INVESTIGATION PROGRAMME

Observation Borehole Network

Following an early assessment of the mound created on the groundwater table of the Miocene Limestone aquifer by underground drainage activities in the Waikerie district, further boreholes were drilled and other boreholes incorporated to create a network of 13 observation points (Fig.1). In addition readings were commenced at ^{three} ~~3~~ boreholes located along the northern edge of the irrigated zone to monitor water level changes in the shallow aquifer complex associated with the Recent dune sands and North-west Bend Formation west of Ramco.

Since 1966 three reports have been issued (Roberts, 1967, 1969 and 1970), containing details of water level changes as recorded in the observation boreholes.

Details of the present borehole network are contained in Table 1 and the available water level readings for the period July 1966 through June 1970 are summarised in graphical form in Fig.2.

TABLE I

OBSERVATION BOREHOLE SCHEDULE

BORE HOLE NO.	DATE DRILLED	METHOD OF DRILLING	DEPTH IN FEET	COMPLETION DETAILS	DRAINAGE HORIZON MEASURED	REMARKS
2W ✓	Aug. 65	Cable Tool	150	150ft. of 2" galvanised pipe incl. 50ft. of slotted pipe.	Morgan Limestone	Cleaned out and casing re-set. Oct. 68
16W ✓	Feb. 66	"	120	96ft. of 6" steel casing.	"	-
17W ✓	Feb. 66	"	140	79ft. " " " "	"	Cleaned out Oct. 68
18W ✓	Mar. 66	"	155	145ft. " " " "	"	-
19W ✓	Mar. 66	"	160	152ft. " " " "	"	-
20W ✓	April 66	"	140	112ft. " " " "	"	-
21W ✓	April 66	"	115	100.5ft. " " " "	"	-
22W	May 66	"	135	114ft. of 6" steel casing. 28ft. of 5" slotted casing.	"	Continuous water level record began Feb. 68
23W ✓	July 66	"	360	130ft. of 8" steel casing	Morgan-Mannum Limestone	-
25W ✓	Nov. 67	Rotary	90	80ft. of 2" plastic casing 10ft. of screen.	Norwest Bend Formation	-
25AW ✓	Aug. 68	Cable Tool	130	115ft. of 6" steel casing.	Morgan Limestone	-
31W ✓	Mar. 69	"	120	83ft. of 6" steel casing.	"	-
1R ✓	Feb. 65	"	250	186 ft. of 6" steel casing	Para Limestone	-
26R ✓	Mar. 66	"	140	115.5ft. of 6" steel casing.	Morgan Limestone	-
27R	Nov. 67	Rotary	90	70ft. of 2" plastic casing + 10ft. of screen.	Norwest Bend Formation	-
28R	Nov. 67	"	90	62ft. of 2" plastic casing + 10ft. of screen	"	-

16 holes listed

Drainage Testing

As a result of the series of pumping and drain-in tests carried out in the Miocene limestones at several localities, further and more elaborate tests were conducted at a site near the peak of the groundwater mound. The tests consisted of drain-in and pump-in tests with the use of observation boreholes to obtain better values for the aquifer parameters.

The location of the test site is given in Fig.3 and the geological relationships are illustrated in two cross-sections in Fig.4.

During the first two series of tests (serial Nos. 270868 and 050968) a single observation borehole was used (Borehole 27W.) Subsequently a second observation borehole (29W) was constructed.

Table 2 summarises the aquifer characteristics obtained from the first and second test series and detailed test data are given in Appendix A.

Test Procedures

The procedures employed during drain-in and pump-in tests were basically similar to those used in normal pumping tests. The surface equipment is illustrated in Fig.5.

Some difficulties were experienced in accurately measuring the pressure head applied to the aquifer during the pump-in tests despite the utilisation of a battery of pressure gauges.

TABLE 2

TESTS AT BOREHOLE 28 W.

Location: Section 553, Hd. Waikerie.

Owner: Mines Department.

Borehole 28W

Depth 350 feet

Casing diameter 6 inches

R.L. surface = 109.37

Casing length 106 feet

R.L. water = 62(varying)

Borehole 27W (observation)

Depth 380 feet

Casing diameter 8 inches

R.L. surface = 108.69

Casing length 125 feet

R.L. water = 54(varying)

Borehole construction: The 6 inch casing in Borehole 28W was pressure cemented for the whole length.

TEST SERIAL NO.270868

TEST DATA

STAGE	PHASE	DURATION IN MINUTES	DRAINAGE RATE		MAXIMUM HEAD APPLIED	
			g.p.h.	cusecs	lbs./sq.in.at surface	in feet
1	Build-up	100	1,800	0.08	-	7.26
	Recovery	80	-	-	-	-
2	Build-up	310	3,420	0.152	-	35.2
	Recovery	400	-	-	-	-
3	Build-up	265	6,900	0.307	12.4	75.0
	Recovery	300	-	-	-	-

AQUIFER CHARACTERISTICS

STAGE	OBSERVATIONS AT BOREHOLE NUMBER	ANALYSIS		AQUIFER CHARACTERISTICS	
		METHOD	SEGMENT	TRANSMISSIVITY IN CU SECS/FT.	STORAGE COEFFICIENT
1	28 W	Jacob	Build-up (max.) Build-up (min.) Recovery	2.1×10^{-3} 1.4×10^{-2} 2.4×10^{-2}	- - -
	27 W	N O C H A N G E I N W A T E R L E V E L			
2	28 W	Jacob Modified) Jacob Jacob	Build-up Build-up Recovery	6.2×10^{-3} 3.9×10^{-2} 1.3×10^{-2}	- - -
	27 W	Jacob	Recovery	8.4×10^{-2}	-
3	28 W	Jacob	Build-up (mean) Build-up (max.) Recovery	1.3×10^{-2} 5.0×10^{-3} 1.2×10^{-2}	- - -
	27 W	Theis) Matching curve) Jacob	Build-up (early) Build-up (late) Build-up Recovery	2.0×10^{-2} 7.0×10^{-2} 1.0×10^{-1} 8.5×10^{-2}	1.3×10^{-3} 2.1×10^{-3} 1.7×10^{-3} -
Notes: The validity of results obtained at the observation borehole (27W) are questionable because of 1. the distance between 27W and 28W (200 feet). 2. the very small changes of water level in 27W (<1.0 ft. total) and 3. the slope of the potentiometric surface between the two boreholes (approximately 1 in 25). The second stage was abandoned because of a plant breakdown.					

TEST SERIAL NO.050968.

TEST DATA

STAGE	PHASE	DURATION IN MINUTES	DRAINAGE RATE		MAXIMUM HEAD APPLIED	
			g.p.h.Hour	cusecs	lbs./sq.in at surface	in feet
1	Build-up Recovery	250	24,100	1.074	70	209
		415	-	-	-	-
2	Build-up Recovery	440	27,200	1.21	85.5	245
		810	-	-	-	-

AQUIFER CHARACTERISTICS

STAGE	Observations at Borehole No.	ANALYSIS		AQUIFER CHARACTERISTICS	
		Method	Segment	Transmissivity in cusecs/ft.	Storage Coefficient
1	28 W	Jacob	Build-up	2.1×10^{-2}	-
			Recovery	2.0×10^{-2}	-
	27 W	Jacob	Build-up	8.0×10^{-2}	1.6×10^{-4}
		Theis Matching Curve	Recovery	1.0×10^{-1}	-
2	28 W	Jacob	Build-up	2.8×10^{-2}	1.6×10^{-3}
			Recovery	2.8×10^{-2}	-
	27 W	Jacob	Recovery(early)	8.5×10^{-3}	-
			Recovery(late)	1.5×10^{-2}	-
2	28 W	Jacob	Build-up	1.6×10^{-1}	5.9×10^{-4}
			Recovery	9.6×10^{-1}	-
	27 W	Theis Matching Curve	Build-up	1.1×10^{-1}	7.8×10^{-3}
			Recovery	1.1×10^{-1}	-

Notes: Stage 1 of the test was abandoned because of plant breakdown.
 Stage 2 progressed satisfactorily for 340 minutes. At this time it is
 believed that a structural failure took place in either the strata or the
 pressure cementing around the casing in Borehole 28 W.

Water was drawn from the nearest irrigation channel and care taken to avoid the intake of silt laden water which could produce a clogging effect in the aquifer.

Test Failures

The basic experimental set-up proved relatively satisfactory and breakdowns were generally mechanical in origin.

During the second step of the second test series beginning 5th September, 1968, a critical problem arose after 340 minutes with the apparent rupture of the pressure cement seal around the 6 inch casing in Borehole 28W. This led to a leakage of water from the drainage aquifer at 80 feet up to a series of thin shallow aquifers associated with the Nor'west Bend Formation and Recent strata above 40 feet.

The probable mechanism of failure is illustrated in Fig.6. Repair work was carried out at 28W by reaming out the hole and pressure cementing 8 inch casing to a total depth of 150 feet. In addition a second observation hole was drilled to improve the quality of readings obtained.

A third series of tests was commenced on 8th October 1968 but results were unsatisfactory. The behaviour of Borehole 27W during the third test suggested that strata rupture had also taken place during the second test and that this had not been 'healed' by the second pressure cementing process. As a consequence, the test programme was abandoned.

Exploratory Drilling

From the regional geology of this part of the Murray Basin as evaluated by Ludbrook (1960) potential drainage aquifers

were believed to exist at an economic depth below Waikerie. This was in part confirmed by Borehole 2W which was drilled to a depth of 772 feet in July 1965 and passed through three sand horizons in Oligocene-Eocene strata. (Lindsay, 1965). On this basis Borehole 27W was drilled to a depth of 1,080 feet to sample potential drainage horizons preparatory to the conducting of tests. Mr. W.K. Harris (pers. comm.) has established from a provisional palynological examination that the borehole was completed in middle-upper Palaeocene sediments and that the base of the Tertiary could be expected at about 1,300 feet.

A geological log of Borehole 27W is included in Appendix B and Fig.7 illustrates the results of sieve analyses carried out on certain of the sand horizons intersected. The analyses have been used to design casing and screen strings to enable the borehole to be tested in two separate zones.

Preparations for testing are now complete, including the drilling and casing of Borehole 28W to 1,070 feet to act as an observation borehole.

Geophysical Logging

Logging was carried out at Borehole 28W on four occasions to investigate the effects of draining 'fresh' water into an aquifer containing highly saline water. The type of logging carried out included:-

16 inch normal resistivity

64 " " "

6 ft. " "

Micro-Inverse resistivity

Point Resistivity

Self Potential

Gamma

Neutron

Caliper.

The relative permeability of the Miocene limestone aquifer sequence between 110 and 360 feet is well illustrated by resistivity logs shown in Fig.8. The general conclusion may be drawn that the highest effective permeabilities lie between 110 and 280 feet. Little drainage appears to have taken place in the basal 80 feet of the aquifer.

HYDROGEOLOGY

Morgan - Mannum Limestone Aquifer

The hydraulic situation created by the drainage of underground water in the Waikerie district contains two elements:-

1. The rise and decay of a 'mound' created on the original groundwater table.
2. The effect of the drainage mound on the movement of underground water towards the main valley of the River Murray.

1. Fig. 1 illustrates the potentiometric surface in existence in June 1970 while Fig. 2 summarises water level fluctuations at observation boreholes in the area affected by underground drainage over the period July 66 through June 70.

An examination of water level trends shows an overall

rise over the period of record or seasonal fluctuations which tend to mask the general trend.

A steady rise is most easily discernable on the western side of the drainage mound (Boreholes 17W, 1R and 26R.)

The maximum recorded rise occurs in Borehole 26R, located on the boundary between the Waikerie Irrigation Area and the private irrigation area of Golden Heights. At present there is no direct evidence to suggest that irrigation at Golden Heights since its inception in 1959, has been the prime cause of this rise. No drainage boreholes are in use at Golden Heights but the sub-surface geology (Roberts and Cramsie 1969) suggests that shallow seepage water may migrate in an easterly direction from high ground near the centre of the irrigation area. Private observation points are maintained by the Golden Heights Irrigation Area to check this possibility but the records have not been consulted for this report.

High seasonal fluctuations occur near the peak of the drainage mound (Boreholes 22W and 31W) and along the edge of the river valley (Boreholes 18W and 19W). Without more detailed knowledge of the irrigation pattern, the reasons for the greater seasonal fluctuations in these boreholes compared with other observation points are difficult to elucidate. A major factor may be the variation in transmissivity in the limestone aquifers with a lower value leading to a more marked response in water level.

Table 4 provides a summary of water quantities delivered to the Waikerie Irrigation Area since the investigation began.

TABLE 4

YEAR	RAINFALL IN INCHES	AREA UNDER IRRIGATION IN ACRES.	QUANTITY DELIVERED IN ACRE/FEET
1964/65	11.24	3,925	15,900
1965/66	8.45	3,925	17,000
1966/67	6.55	3,925	17,600
1967/68	9.36	4,150	16,600
1968/69	10.47	4,150	15,400
1969/70	7.45	4,150	16,700

Assuming that 25% of the water applied during irrigation is not used by plants or is lost by evaporation, approximately 4,000 acre/feet is contributed to the groundwater each year, which is equivalent to a steady drainage rate of 5.5 cusecs.

Drainage is achieved via a number of different flow paths which are illustrated in diagrammatic form in Fig.9. The basic flow equation is:-

$$I = E + D + L.S. + V.S.$$

where I = Increment from irrigation and rainfall

E = Evapotranspiration

D = Drainage by boreholes.

L.S. = Lateral Seepage

V.S. = Vertical Seepage.

Calculations given in Appendix C indicate that steady state conditions would be maintained in the drainage mound

below the Waikerie Irrigation Area by a steady increment of about 2.4 cusecs (D + V.S.) Thus, about 3.1 cusecs is drained by lateral seepage (L.S.) through the upper aquifers.

The above figures must be treated as very approximate since they are dependent on ill-defined aquifer parameters, especially the storage coefficient(s).

2. Contributions from underground drainage in the irrigation areas to the main River Murray valley cannot be determined with accuracy at this stage. Calculations given in Appendix C suggest that the flow may have increased by a factor of at least five since irrigation began, but in absolute terms the discharge is not high.

The problems of quantification are illustrated by the discharges obtained from calculations in Appendix C. Refinement of the transmissivity value (T) for discharges along the river valley is not possible and considerable gaps in the observation borehole network make slope assessment (i) hazardous.



G.T. ROBERTS
ASSISTANT SENIOR GEOLOGIST
HYDROGEOLOGY SECTION

GTR:CF
10.8.70

REFERENCES

- LINDSAY, J.M. 1965. River Murray Drainage Investigation Prog. Rept.No.4. Stratigraphy and Micropalaeontology of Waikerie Bore No.2 South Aust. Dept. Mines Rept.Bk.No.61/79 (unpub.)
- LUDBROOK, N.H. 1961. Stratigraphy of the Murray Basin in South Australia. Geol. Surv. S.Aust. Bull.No.36.
- ROBERTS, G.T. 1967. Drainage Investigations in River Murray Irrigation Areas Prog. Rept. No.12. Static Water Levels in the Waikerie District for the Period July 1966 through June 1967. South Aust.Dept. Mines Rept. Bk.No.65/32 (unpub.)
- 1969 Drainage Investigations in the River Murray Irrigation Areas. Prog. Rept. No. 14. Static Water Levels in the Waikerie District for the period July 1967 through June 1969. South Aust.Dept. Mines Rept.Bk.No.69/49 (unpub.)
- 1970 Drainage Investigations in the River Murray Irrigation Areas. Prog. Rept. No.15. Water Levels in the Waikerie District for the period July 1969 through June 1970. South Aust. Dept. Mines Rept. Bk.No. 70/104 (unpub.)
- ROBERTS, G.T. and CRAMSIE J.H., 1969. A summary of Drainage Investigations in the Waikerie District of the River Murray Irrigation Areas, South Australia during the period November, 1964 through June, 1967. Min. Res. Rev. Adelaide, 131 (in press).

APPROXIMATE TOTAL SALTS SUMMARY

Purpose of Bore DRAINAGE TESTING

Hundred WAIKERIE

Sec. 5503

State No 667055303

Owner E. & W.S. DEPT.

Address ADELAIDE

Bore Serial No 420/68

Driller E. JAMIESON

Project No 27W

Commenced 14.5.68 Completed 15.5.69

Docket No 1487/68

Drill type CABLE TOOL Circulation R.L. SURFACE 108.69

Depth 1081'

Casing 10, 8 & 6ins.

SAMPLING DEPTH FEET	WATER LEVEL FEET	PROGRESSIVE DEPTH FEET	ANALYSIS NO	A.T.S. P.P.M	REMARKS
75-100	4	10	2606/68	1200	FULL
80-90	7	90	2608/68	11185	
123-150	50	150	2610/68	10700	
190-200	50.5	200	2612/68	10785	
210-230	50	230	2614/68	11430	
?	59.5	400	5144/68	11985	
499-500		500	5146/68	12100	
"	115	500	5147/68	14718	
638-650	108	650	5655/68	15000	
768-770	128	770	610/69	15000	
"	"	"	611/69	17132	FULL FULL - doubtful result DILUTION "
928-930	70.5	930	3080/69	3361	
955-960	111	960	3082/69	18200	
1000-1020	110	1020	3113/69	22800	
1000-1080	70	1080	3733/69	10785	

43	5.93		860	1800		
35	5.33		620	1800		
30	4.96		470	1800		
28	4.82		410	1800		
26	—		350	1650		
24	4.75		295	1800	0.08	
22	4.62		235	1800		
20	4.53		175	1650		
18	4.47		120	1650		
16	4.33		065	1800		
14	4.26		506005	1350		
12	4.17		960	1200		
10	4.11		920			
9	4.00			1200		
8	3.98		880			
7	4.00			1200		
6	3.91		840			
5	3.74			1200		
4	3.59		800			
3	3.51			900		
2	3.32		770			
1	2.79			1200		
0			505730			
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM...90...TO...350...FT. WATER LEVEL BELOW REF.PT...49.50...FT.
 REF.PT. ABOVE GR. LEVEL...20...FT.
 MILITARY SHEET.....
 AERIAL SURVEY NO.....
 RUN.....PHOTO NO.....
 OWNER...MINES DEPT.....
 SECTION...553.....
 HUNDRED...LAKE...
 PROJECT...RIVER MURRAY DRAINAGE...
 INVESTIGATION

FLOW PUMP STARTED AT 19:50 ON 27 AUG 68
 FLOW PUMP STOPPED AT 21:30 ON 27 AUG 68
 PUMP SETTING.....FEET
 TEST SERIAL NO...27086/1
 PUMPED HOLE NO...28W
 OBS. HOLE NO'S...27W
 OBS. AT HOLE NO...28W

DRAINAGE PUMPING TEST

RECOVERY TEST

OBS. AT HOLE NO. 28W
 TEST SERIAL NO. 270818/1
 FLOW PUMP STOPPED AT 21:30 ON 27 Aug 68
 WATER LEVEL BELOW REF. PT. 42.24 FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
101	1	101	2.40				
102	2	51	1.47				
103	3	34	1.14				
104	4	26	0.93				
105	5	21	0.86				
106	6	18	0.79				
107	7	15	0.53				
108	8	14	0.50				
109	9	12	0.47				
110	10	11	0.58				
111	11	10	0.37				
113	13	8.7	0.40				
116	16	7.2	0.33				
118	18	6.5	0.31				
120	20	6	0.29				
122	22	5.5	0.26				
124	24	5.2	0.26				
126	26	4.8	0.25				
128	28	4.6	0.23				
130	30	4.3	0.22				
135	35	3.9	0.19				
140	40	3.5	0.15				
145	45	3.2	0.14				
150	50	3.0	0.13				
160	60	2.7	0.08				
170	70	2.4	0.05				
180	80	2.25	0.05				

180	0.42				
160	0.42				
140	0.41				
120	0.41				
100	0.40				
90	0.39				
80	0.39				
70	0.38				
60	0.36				
55	0.35				
50	0.34				
45	0.32				
40	0.30				
35	0.26				
30	0.23				
28	0.22				
26	0.20				
24	0.18				
22	0.16				
20	0.13				
18	0.12				
16	0.07				
14.5	0.04				
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs
TIME	DRAWDOWN		DISCHARGE		

AQUIFER FROM. 90. TO. 350. FT. WATER LEVEL BELOW REF. PT. 51.16. FT.
REF. PT. ABOVE GR. LEVEL. 1.29. FT.

MILITARY SHEET..... PUMP STARTED AT 9.30. ON. 28 Aug 68.

AERIAL SURVEY NO..... PUMP STOPPED AT 14.30. ON. 28 Aug 68.

RUN..... PHOTO NO..... PUMP SETTING..... FEET

OWNER. E. H. S. Dept..... TEST SERIAL NO. 270868/2

SECTION. 553..... PUMPED HOLE NO. 28W

HUNDRED. 1000..... OBS. HOLE NO'S. 27W

PROJECT. Drainage Investigation..... OBS. AT HOLE NO. 27W

PUMPING TEST

RECOVERY TEST

OBS. AT HOLE NO. 27W
 TEST SERIAL NO. 270868/2
 PUMP STOPPED AT 1430 ON 28 Aug 68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
311	1		—	510	200	2.5	0.10
312	2		—				
313	3	1.04	0.44				
314	4	.78	0.43				
315	5	.63	0.45				
316	6	.53	0.43				
317	7	.45	0.42				
318	8	.40	0.42				
319	9	.35	—				
320	10	.32	0.41				
322	12	.27	—				
324	14	.23	0.40				
326	16	.20	0.40				
328	18	.182	0.39				
330	20	.165	0.38				
335	25	.134	0.36				
340	30	.113	0.31				
350	40	.87	0.30				
360	50	.72	0.26				
370	60	.62	0.25				
380	70	.54	0.24				
390	80	.49	0.22				
401	91	.44	0.21				
410	100	.41	0.20				
430	120	.36	0.17				
450	140	.32	0.15				
470	160	.29	0.14				
490	180	.27	0.12				

24	0.38					
22	0.36					
20	0.34					
19	0.32					
18	0.31					
17	0.30					
16	0.28					
15	0.27					
14	0.25					
13	0.23					
12	0.21					
11	0.18					
10	0.16					
9	0.14					
8	0.11					
7	0.09					
6	0.06					
5	0.03					
4	0.02					
3	-					
2						
1						
0						
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM 90 TO 350 FT. WATER LEVEL BELOW REF. PT. 54.38 FT.
 REF. PT. ABOVE GR. LEVEL 1.5 FT. *approx*
 MILITARY SHEET..... PUMP STARTED AT 11:15 ON 29 Aug 68
 AERIAL SURVEY NO..... PUMP STOPPED AT 15:40 ON 29 Aug 68
 RUN..... PHOTO NO..... PUMP SETTING..... FEET
 OWNER E. W. S. De/ot TEST SERIAL NO. 270868/3
 SECTION 553 PUMPED HOLE NO. 28W
 HUNDRED Winkene OBS. HOLE NO'S 27W
 PROJECT Drainage Investigation OBS. AT HOLE NO. 27W
Winkene Area

Test abandoned because of a plant breakdown

265 0.90

255 0.88

200 0.85

180 0.83

160 0.82

140 0.79

120 0.77

100 0.73

90 0.71

80 0.68

70 0.64

60 0.60

55 0.59

50 0.57

45 0.54

40 0.51

35 0.48

30 0.44

28 0.42

20 0.40

Mins.
After
Start

Observed

Adjusted

Meter
Readings

Galls
per
Hour

Cusecs

TIME

DRAWDOWN

DISCHARGE

TEST SERIAL NO. 270862/3
OBS. AT HOLE NO. 27W

PUMPING TEST

Continuation Sheet

RECOVERY TEST

OBS. AT HOLE NO. 27W
 TEST SERIAL NO. 270268/3
 PUMP STOPPED AT. 15.40 ON. 29 Aug 68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
265	0	—	0.90	365	100	3.65	0.30
267	2	—	—	385	120	3.20	0.26
269	4	67	0.89	405	140	2.90	0.21
270	5	54	0.88	430	165	2.6	0.16
271	6	45	0.87	445	180	2.48	0.14
272	7	38.8	0.86	465	200	2.32	0.10
273	8	34.1	0.84	515	250	2.06	0.05
274	9	30.5	0.83	565	300	1.88	
275	10	27.5	0.82				
277	12	23.1	0.79				
279	14	20.0	0.77				
281	16	17.6	0.74				
283	18	15.7	0.72				
285	20	14.3	0.70				
287	22	13.0	0.69				
289	24	12.0	0.67				
291	26	11.2	0.65				
293	28	10.5	0.63				
295	30	9.8	0.62				
300	35	8.6	0.58				
305	40	7.6	0.55				
310	45	6.9	0.52				
315	50	6.3	0.50				
320	55	5.8	0.47				
325	60	5.4	0.42				
335	70	4.8	0.40				
345	80	4.3	0.37				
355	90	3.95	0.33				

40	31.82		720	3540	0.158	20 x 10
35	31.59		425	3540	0.158	20 0
30	31.29		130	3600	0.16	19.6
28	31.21		510 010	3600	0.16	19.5
26	31.09		890	3750	0.167	18.7
24	30.55		765	3600	0.16	19.1
22	30.48		645	3600	0.16	19.0
20	30.30		525	3600	0.16	18.9
18	30.02		405	3600	0.16	18.7
16	29.81		285	3450	0.154	19.4
14	29.74		509 160	3600	0.160	18.6
12	29.53		940	900	0.04	7.36
10	29.39		910		0.167	17.6
9	27.91			3750	0.167	16.7
8	17.96		785		0.114	15.7
7	11.81			2550	0.114	10.4 x 10
6	5.88		700			
5	4.21			1500		
4	3.75		650			
3	—			900		
2	2.26		620			
1	1.84			600		
0	0		508600			
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	$\frac{1}{9} \frac{\text{in}}{\text{ft/cusecs}}$
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM. 90. TO... 350... FT. WATER LEVEL BELOW REF. PT. 51.00 FT.
 REF. PT. ABOVE GR. LEVEL. 3.50 FT.
 MILITARY SHEET.....
 AERIAL SURVEY NO.....
 RUN..... PHOTO NO.....
 OWNER..... Mines Dept.
 SECTION..... 553
 HUNDRED..... Wakenue
 PROJECT..... Rwe Murray Drainage Investigation
 FLOW STARTED AT 0930 ON 28 Aug 68
 FLOW STOPPED AT 1430 ON 28 Aug 68
 PUMP SETTING..... FEET
 TEST SERIAL NO. 270868/2
 DRAINAGE HOLE NO. 28W
 OBS. HOLE NO'S. 27W
 OBS. AT HOLE NO. 28W
 DRAINAGE TEST

TEST SERIAL NO. 270868/2
OBS. AT HOLE NO. 28W

DRAINAGE
PUMPING TEST

RECOVERY TEST

OBS. AT HOLE NO. 28W
 TEST SERIAL NO. 270868/2
 PUMP STOPPED AT 1440 ON 28 Aug 68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
311	1	311	11.87	470	160	2.9	0.62
312	2	156	—	490	180	2.7	0.54
313	3	104	6.13	510	200	2.5	0.49
314	4	78	4.68	710	400	1.8	0.06
315	5	63	4.11				
316	6	53	3.73				
317	7	45	3.46				
318	8	40	3.26				
319	9	35	3.08				
320	10	32	3.17				
322	12	27	2.72				
324	14	23	2.53				
326	16	20	2.39				
328	18	18	2.28				
330	20	16.5	2.18				
332	22	15	2.09				
334	24	14	2.03				
336	26	13	1.94				
338	28	12	1.89				
340	30	11.3	1.83				
350	40	8.8	1.59				
370	60	6.2	1.28				
380	70	5.4	1.14				
390	80	4.9	1.08				
400	90	4.4	1.00				
410	100	4.1	0.93				
430	120	3.6	0.84				
450	140	3.2	0.71				

40	11.20	72.8	4600	6960		
35	11.25	73.0	4020	7080		
30	10.90	72.2	3430	7200	3.20	
28	10.80	71.9	3190	6900		
26	10.90	72.2	2960	7200		
24	10.75	71.8	2720	6900		
22	10.55	71.4	2490	7200		
20	10.50	71.2	2250	6900		
18	10.25	70.7	2020	7200		
16	10.0	70.1	1790	7200		
14	9.90	69.9	1550	6900		
12	9.85	69.8	1320	7200		
10	9.75	69.5	41080	7200		
9						
8	9.5	69.0	0840	7200	3.20	
7						
6	9.125	68.1	0610	7200		
5						
4	8.5	66.6	0370	7200		
3						
2	7.5	64.3	40130	6900	3.07	
1						
0			1539900			
Mins. After Start	Observed Gauge Pressure	Adjusted Head of Water	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM. 90 TO. 350 FT. WATER LEVEL BELOW REF. PT. 50.47 FT.
 REF. PT. ABOVE GR. LEVEL. 35 FT.
 MILITARY SHEET..... PUMP STARTED AT. 11.15 ON. 29 Aug. '68
 AERIAL SURVEY NO..... PUMP STOPPED AT. 15.40 ON. 29 Aug. '68
 RUN..... PHOTO NO..... PUMP SETTING..... FEET
 OWNER. E + W.S. Dept. TEST SERIAL NO. 270868/3
 SECTION. 553 PUMPED HOLE NO. 28W
 HUNDRED. Waikerie OBS. HOLE NO'S. 27W
 PROJECT. Drainage Investigation OBS. AT HOLE NO. 28W
Waikerie area

PUMPING TEST



RECOVERY TEST

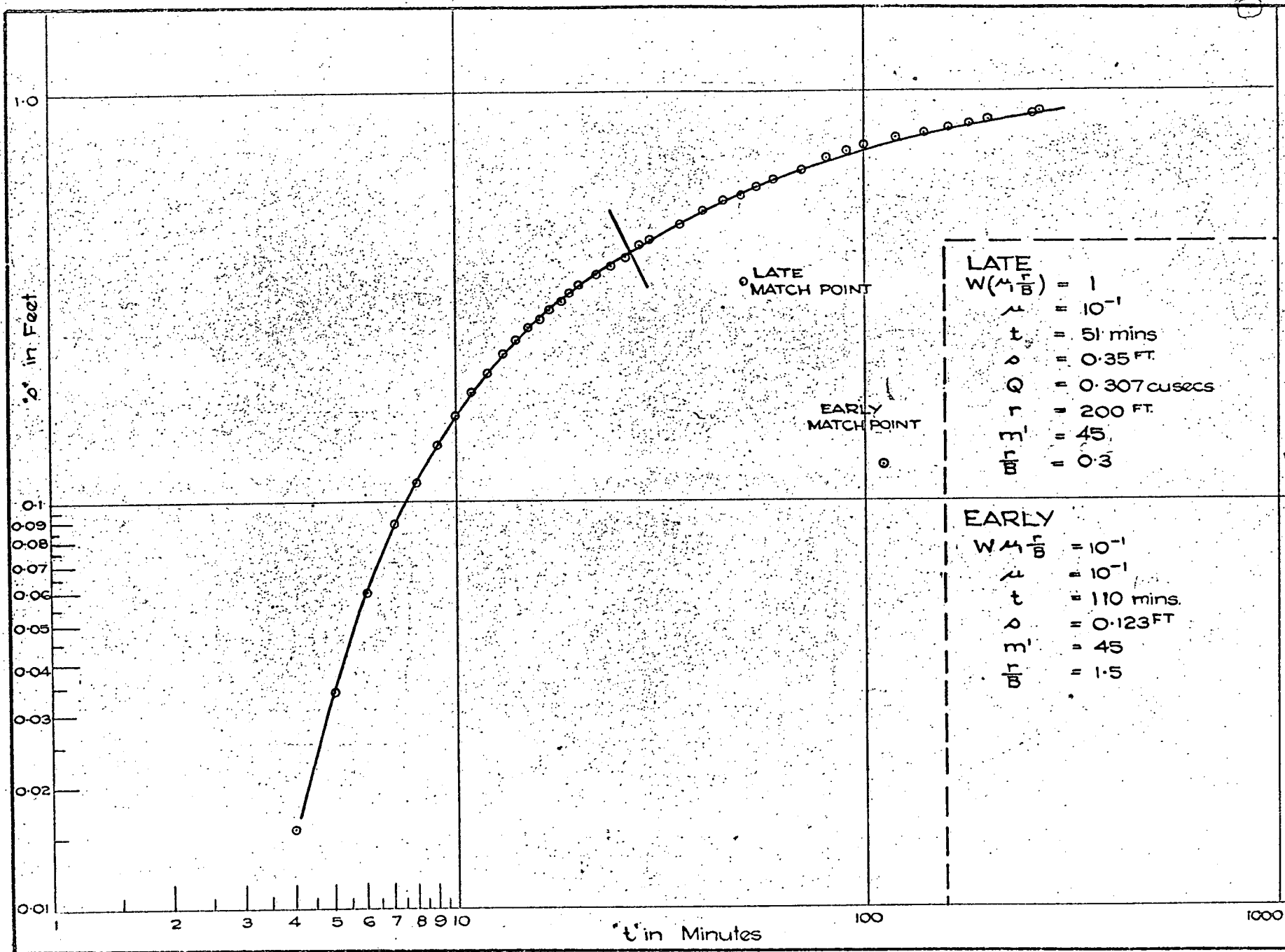


OBS. AT HOLE NO. 28W
 TEST SERIAL NO. 270866/3
 PUMP STOPPED AT 15.40 ON 29 Aug 68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
265	0	-	79.1	365	100	3.65	1.10
268	3	89	8.89	385	120	3.12	0.88
269	4	67	8.04	405	140	2.9	0.71
270	5	54	7.16	435	170	2.56	0.50
271	6	45	6.52	445	180	2.47	0.45
272	7	39	6.06	465	200	2.32	0.32
273	8	34	5.72	515	250	2.06	0.14
274	9	30	5.50	565	300		
275	10	27.5	5.24				
276	11	25	5.04				
277	12	23	4.85				
279	14	20	4.52				
281	16	17.5	4.25				
283	18	15.7	4.05				
285	20	14.3	3.92				
287	22	13	3.68				
291	26	11.2	3.40				
293	28	10.5	3.28				
295	30	9.8	3.16				
300	35	8.6	2.84				
305	40	7.6	2.63				
310	45	6.9	2.26				
315	50	6.3	2.09				
320	55	5.8	1.97				
325	60	5.4	1.86				
335	70	4.8	1.63				
345	80	4.3	1.42				
355	90	3.95	1.25				

TEST SERIAL NO. 270868/3
OBS. AT HOLE NO. 28^W

Continuation Sheet /



LATE
 $W(u, \frac{r}{B}) = 1$
 $u = 10^{-1}$
 $t = 51 \text{ mins}$
 $s = 0.35 \text{ FT.}$
 $Q = 0.307 \text{ cusecs}$
 $r = 200 \text{ FT.}$
 $B = 45$
 $\frac{B}{r} = 0.3$

EARLY
 $W(u, \frac{r}{B}) = 10^{-1}$
 $u = 10^{-1}$
 $t = 110 \text{ mins.}$
 $s = 0.123 \text{ FT.}$
 $B = 45$
 $\frac{B}{r} = 1.5$

LATE

$$T = \frac{Q \cdot W(u)}{4 \pi \cdot s}$$

$$= \frac{0.307 \times 1}{4 \times 3.14 \times 0.35}$$

$$= 7.0 \times 10^{-2} \text{ cusecs/ft.}$$

$$S = \frac{4 \cdot T \cdot u \cdot t}{r^2}$$

$$= \frac{4 \times 7.0 \times 10^{-2} \times 10^{-1} \times 51 \times 60}{200 \times 200}$$

$$= 2.14 \times 10^{-3}$$

$$P = \frac{T \cdot m'(\frac{B}{r})^2}{r^2} = \frac{7.0 \times 10^{-2} \times 45 \times (0.3)^2}{(200)^2} = 7.1 \times 10^{-5} \text{ cusecs/ft.}^2$$

EARLY

$$T = \frac{0.307 \times 10^{-1}}{4 \times 3.14 \times 0.123}$$

$$= 2.0 \times 10^{-2} \text{ cusecs/ft.}$$

$$S = \frac{4 \times 2.0 \times 10^{-2} \times 10^{-1} \times 110 \times 60}{200 \times 200}$$

$$= 1.3 \times 10^{-3}$$

$$P = \frac{T \cdot m'(\frac{B}{r})^2}{r^2} = \frac{2.0 \times 10^{-2} \times 45 \times (1.5)^2}{(200)^2} = 5.1 \times 10^{-5} \text{ cusecs/ft.}^2$$

DEPARTMENT OF MINES - SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

WAIKERIE DISTRICT

SECTION 553 HD. WAIKERIE

DRAWDOWN CURVE TEST No. 270929/3

BOREHOLE 27W

HYDRO-GEOLOGY
SECTION

Robert

S7526 GW

DATE 6-DEC-82

40	1.99				1.12	1.78
35	1.87				1.14	1.64
30	1.73				1.15	1.50
28	1.66				1.14	1.46
26	1.58				1.15	1.38
24	1.50				1.15	1.30
22	1.41				1.16	1.22
20	1.30				1.16	1.12
18	1.18				1.15	1.03
16	1.05				1.15	0.91
14	0.92				1.15	0.80
12	0.76				1.11	0.68
10	0.58					
9	0.50				1.10	0.45
8	0.42					
7	0.32				1.15	0.28
6	0.24					
5	0.14				1.07	0.14
4	0.08					
3	0.03					
2	—					
1	—					
0	—					
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	$\frac{S}{P}$ in ft/cusecs
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM. 90. TO. 350. FT. WATER LEVEL BELOW REF. PT. 54.08. FT.
 REF. PT. ABOVE GR. LEVEL. FT.
 MILITARY SHEET. PUMP STARTED AT. 0930 ON. 5 Sept 68
 AERIAL SURVEY NO. PUMP STOPPED AT. 1340 ON. 5 Sept 68
 RUN. PHOTO NO. PUMP SETTING. FEET
 OWNER. F. W. S. Department TEST SERIAL NO. 050968/1
 SECTION. 553 PUMPED HOLE NO. 28W
 HUNDRED. Waukena OBS. HOLE NO'S. 27W
 PROJECT. River Murray Drainage Investigation - Waukena OBS. AT HOLE NO. 27W
 PUMPING TEST

	1.99					
	1.97					
	1.95					
	1.93					
	1.91					
	1.89					
	1.87					
	1.85					
	1.83					
	1.81					
	1.79					
	1.77					
250	3.01				1.05	2.86
225	2.88					
200	2.77				1.05	2.64
190	2.75					
180	2.72				1.05	2.65
170	2.70					
160	2.68				1.06	2.53
150	2.66					
140	2.64				1.07	2.47
130	2.61					
120	2.58				1.07	2.41
110	2.52					
100	2.47				1.07	2.31
90	2.41				1.06	2.28
80	2.37				1.05	2.26
70	2.35				1.06	2.22
60	2.28				1.10	2.07
55	2.23				1.11	2.01
50	2.16				1.12	1.93
45	2.08				1.12	1.86
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	$\frac{S}{Q}$ in ft/cusecs
TIME	DRAWDOWN		DISCHARGE			

TEST SERIAL NO.....050968/1.....
OBS. AT HOLE NO.....27/W.....

PUMPING TEST

RECOVERY TEST

OBS. AT HOLE NO.....27W.....
 TEST SERIAL NO.....050968/1.....
 PUMP STOPPED AT.....13.42.....ON.....55.47+68.....
 WATER LEVEL BELOW REF.PT.....51.07.....FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residu- al Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
262	12	21.8	2.69				
264	14	18.9	2.66				
266	16	16.6	2.61				
268	18	14.9	2.56				
270	20	13.5	2.50				
275	25	11.0	2.39				
280	30	9.4	2.30				
290	40	7.25	2.07				
310	60	5.16	1.79				
320	70	4.57	1.67				
330	80	4.12	1.59				
340	90	3.78	1.51				
350	100	3.5	1.46				
360	110	3.28	1.40				
370	120	3.08	1.31				
380	130	2.92	1.26				
390	140	2.79	1.23				
410	160	2.56	1.15				
430	180	2.40	1.05				
450	200	2.25	0.99				
470	220	2.14	0.93				
475	225	2.11	0.90				
490	240	2.04	0.85				
510	260	1.96	0.81				
600	350	1.72	0.63				
665	415	1.60	0.58				

40	67	202	20,800	25,200	1.12	
35	67	202	18,700	25,440	1.14	
30	66.5	201	6580	25800	1.15	
28	66.5	201	5720	25500	1.14	
26	66	199	4870	25800	1.15	
24	66	199	4010	25,800	1.15	
22	66	199	3150	26100	1.16	
20	66	199	2280	26100	1.16	
18	66	199	11410	25800	1.15	
16	66	199	10550	25800	1.15	
14	65	197	9690	25800	1.15	
12	63	193	8830	24900	1.11	
10	61	188	08000			
9				24600	1.10	
8	56	176	07180			
7				25,800	1.15	
6	61	188	06320			
5				24000	1.07	
4	54	172	05520			
3				26400	1.13	
2	56	176	04640			
1				21900	0.98	
0			49303910			
Mins. After Start	Observed Pressure in lbs/sq in	Adjusted Head in feet	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM. 90 TO 350 FT. WATER LEVEL BELOW REF. PT. 47.5 FT.
 REF. PT. ABOVE GR. LEVEL FT.
 MILITARY SHEET PUMP STARTED AT 09:30 ON 5 Sept 68
 AERIAL SURVEY NO. PUMP STOPPED AT 13:40 ON 5 Sept 68
 RUN PHOTO NO. PUMP SETTING FEET
 OWNER E. W. S. DEPARTMENT TEST SERIAL NO. 050968/1
 SECTION 553 PUMPED HOLE NO. 28W
 HUNDRED WANKERIE OBS. HOLE NO'S 27W
 PROJECT RIVER MURRAY DRAINAGE OBS. AT HOLE NO. 28W
 INVESTIGATION

PUMPING TEST

250	70	209	404380	23600	1.05	
225						
200	70	209	84720	23520	1.05	
190						
180	69.5	207	76880	23640	1.05	
170						
160	69	206	69000	23880	1.06	
150						
140	69	206	61040	24030	1.07	
130						
120	69	206	53030	24030	1.07	
110						
100	67.75	204	45020	24000	1.07	
90	67.5	203	41020	23880	1.06	
80	65	197	37040	23640	1.05	
70	67	202	33100	23820	1.06	
60	67	202	29130	24720	1.10	
55	67.5	203	7070	24960	1.11	
50	67.5	203	324990	25200	1.12	
45	67.5	203	49322890	25080	1.12	
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

TEST SERIAL NO.....05968/1.....
OBS. AT HOLE NO.....28W.....

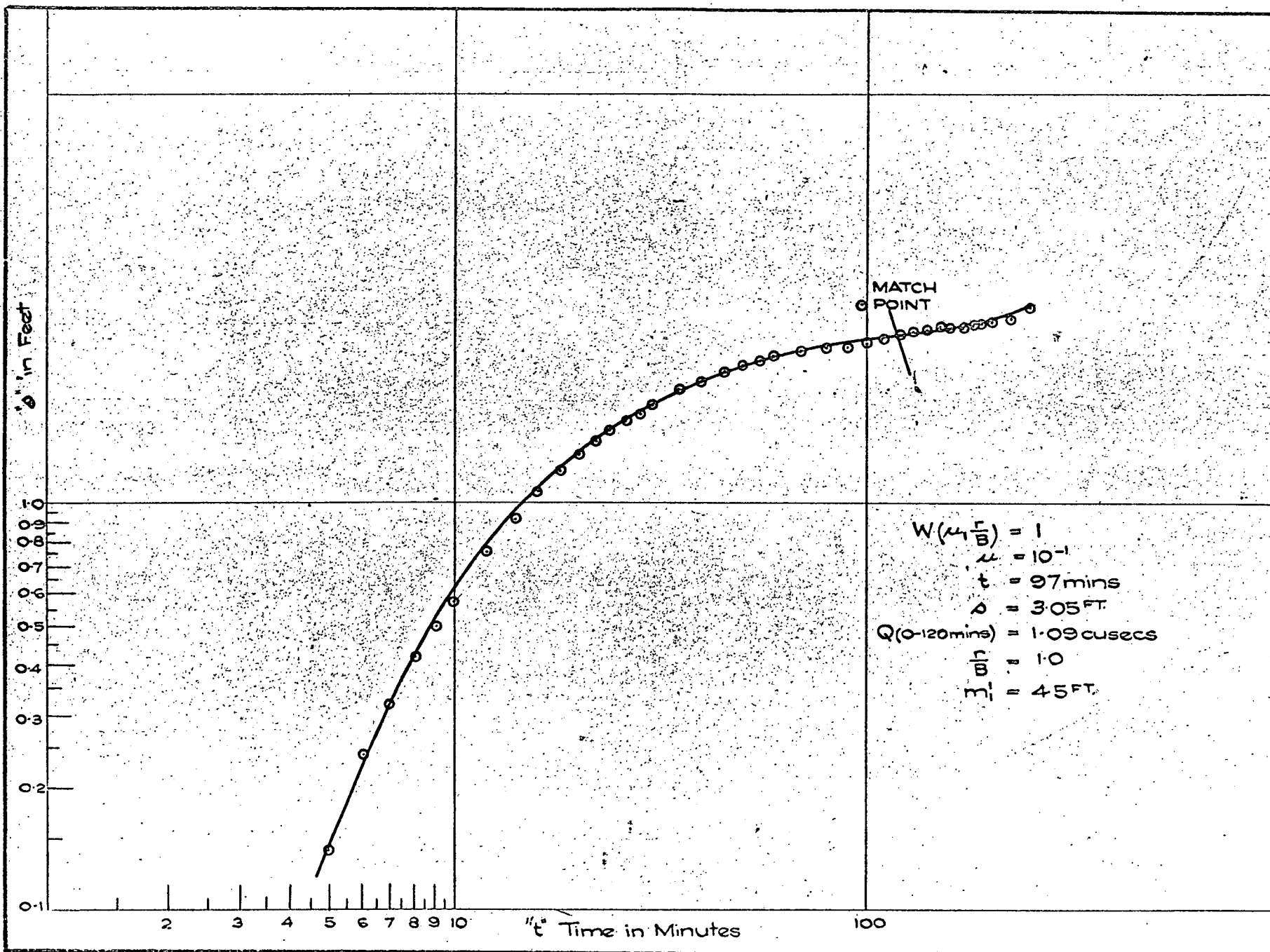
PUMPING TEST

Continuation Sheet

RECOVERY TEST

OBS. AT HOLE NO. 28W.
 TEST SERIAL NO. 050968/1
 PUMP STOPPED AT 13.40 ON 52/2+68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
266	16	183	17.72	350	100	3.5	5.16
268	18	14.9	16.22	355	105	3.38	5.08
270	20	13.5	16.00	360	110	3.28	4.90
273	23	11.9	14.04	370	120	3.08	4.48
276	26	10.6	12.33	380	130	2.92	4.45
278	28	9.9	11.53	390	140	2.78	4.16
280	30	9.3	10.86	400	150	2.66	4.18
282	32	8.8	10.41	410	160	2.56	4.03
284	34	8.35	10.04	420	170	2.46	3.78
286	36	7.95	9.68	430	180	2.40	3.65
288	38	7.6	9.29	440	190	2.32	3.46
290	40	7.25	8.99	450	200	2.25	3.37
292	42	6.95	8.70	460	210	2.20	3.20
294	44	6.7	8.51	470	220	2.14	3.08
296	46	6.45	8.16	480	230	2.08	3.11
298	48	6.2	7.95	490	240	2.04	2.94
300	50	6.0	7.86	500	250	2.00	2.89
302	52	5.8	7.59	510	260	1.96	2.75
304	54	5.65	7.43	530	280	1.89	2.62
306	56	5.45	7.39	550	300	1.84	2.54
311	61	5.1	7.03	570	320	1.78	2.44
316	66	4.8	6.70	590	340	1.74	2.27
320	70	4.55	6.57	615	365	1.69	2.10
325	75	4.35	6.23				
330	80	4.1	5.97				
335	85	3.94	5.80				
340	90	3.78	5.63				
345	95	3.63	5.40				



$$\begin{aligned}
 W(u, \frac{r}{B}) &= 1 \\
 u &= 10^{-1} \\
 t &= 97 \text{ mins} \\
 s &= 3.05 \text{ FT.} \\
 Q(0-120 \text{ mins}) &= 1.09 \text{ cusecs} \\
 \frac{h}{B} &= 1.0 \\
 M_1 &= 45 \text{ FT.}
 \end{aligned}$$

$$\begin{aligned}
 T &= \frac{Q W(u)}{4 \pi s} \\
 &= \frac{1.09 \times 1}{4 \times 3.14 \times 3.05} \\
 &= 2.8 \times 10^{-3} \text{ cusecs/ft.}
 \end{aligned}$$

$$\begin{aligned}
 S &= \frac{4 T u t}{r^2} \\
 &= \frac{4 \times 2.8 \times 10^{-3} \times 10^{-1} \times 97 \times 60}{(200)^2} \\
 &= 1.6 \times 10^{-3}
 \end{aligned}$$

$$\begin{aligned}
 P' &= \frac{T M_1 (\frac{r}{B})^2}{r^2} \\
 &= \frac{2.8 \times 10^{-3} \times 45 \times 1}{4 \times 10^4}
 \end{aligned}$$

$$= 3.2 \times 10^{-5} \text{ cusecs/ft}^2$$

DEPARTMENT OF MINES - SOUTH AUSTRALIA
 RIVER MURRAY DRAINAGE INVESTIGATION
 WAIKERIE DISTRICT
 SECTION 553. HD. WAIKERIE
 DRAWDOWN CURVE TEST No. 050968/1
 BOREHOLE 28W

HYDRO-GEOLOGY
 SECTION

[Signature]

57527
 J23
 DATE 21/02/63

50	76	223	32500	27480		
45	75.5	221	30210	27480		
40	75.5	221	27920	27720		
35	75	220	25610	27600		
30	75	220	23310	27900		
28	75	220	22380	27600		
26	75	220	21460	27900		
24	75	220	20530	27900		
22	75	220	19600	27600		
20	75	220	18680	27900		
18	75	220	17750	28200		
16	75	220	16810	28200		
14	75	220	15870	27900		
12	74.5	219	14940	28200		
11						
10	74.5	219	14000	27900		
9						
8	74.5	219	13070	28200		
7						
6	75	220	12130	29100		
5						
2	71	211	10190	29400		
0			49409210			
Mins. After Start	Observed Pressure lbs/sq. in.	Adjusted Head in feet	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM. 92 TO. 350.....FT. WATER LEVEL BELOW REF.PT. 47.5..FT.
 REF.PT. ABOVE GR. LEVEL.....FT.
 MILITARY SHEET..... PUMP STARTED AT. 2035 ON. 5 Sept 68.....
 AERIAL SURVEY NO..... PUMP STOPPED AT. 0355 ON. 6 Sept 68.....
 RUN.....PHOTO NO..... PUMP SETTING..... FEET
 OWNER..... E. W. S. Dept..... TEST SERIAL NO. 050968/2.....
 SECTION..... 553..... PUMPED HOLE NO. 28W.....
 HUNDRED..... Waukena..... OBS. HOLE NO'S..... 27W.....
 PROJECT..... River Murray Drainage Investigation..... OBS. AT HOLE NO. 28W.....

PUMPING TEST

			5961120			
440	85.5	244	609290	27,120		
420	85	243	600250	27,240		
400	85.5	244	591170	27,240		
380	85.5	244	82090	27,240		
360	85	243	73010	27,390		
340	82.5	238	563880	27,420		
320	82.5	238	54740	27,480		
300	81	234	45580	26,760		
280	79.5	231	36660	26,790		
260	79	230	27730	27,150		
240	79.5	231	518680	27,030		
220	79.5	231	509670	27,060		
200	78	227	49500650	26,910		
180	78	227	91680	27,060		
160	78	227	82660	27,210		
140	78	227	73590	27,120		
120	76.5	224	64550	27,960		
110			59890	26,820		
100	76	223	55420	27,300		
90	76	223	50870	27,480		
80	76	223	46290	27,540		
70	76	223	41700	27,720		
60	76	223	37080	27,360		
55	76	223	34800	27,600		
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

TEST SERIAL NO...050968/2.....
OBS. AT HOLE NO.....28W.....

PUMPING TEST

Continuation Sheet

RECOVERY TEST

OBS. AT HOLE NO. 28 W
 TEST SERIAL NO. 050968/2
 PUMP STOPPED AT 03.55 ON 68/68
 WATER LEVEL BELOW REF. PT. FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
441	1	441	61.91	530	90	5.9	22.80
442	2	221	60.40	540	100	5.4	11.81
443	3	148	58.21	560	120	4.67	11.47
444	4	111	56.14	580	140	4.14	10.29
445	5	89	53.13	600	160	3.75	9.86
446	6	74	51.75	620	180	3.44	9.44
447	7	64	50.59	640	200	3.20	9.31
448	8	56	49.86	660	220	3.00	9.36
449	9	49.9	46.67	680	240	2.83	8.77
450	10	45.0	45.02	700	260	2.69	7.70
452	12	37.7	43.61	720	280	2.56	6.86
454	14	32.4	42.72	740	300	2.47	6.59
456	16	28.5	41.87	760	320	2.38	6.78
458	18	25.4	40.20	780	340	2.30	6.03
460	20	23.0	38.56	800	360	2.22	6.24
462	22	21.0	38.22	850	410	2.07	5.86
464	24	19.3	37.43	905	465	1.95	5.44
466	26	17.9	36.69	950	510	1.86	5.31
468	28	16.7	35.59	1050	610	1.72	5.21
470	30	15.7	35.30	1100	660	1.67	4.98
475	35	13.6	33.21	1250	810	1.54	4.30
480	40	12.0	32.23				
485	45	10.8	30.43				
490	50	9.8	29.41				
495	55	9.0	28.19				
500	60	8.3	27.26				
510	70	7.3	25.97				
520	80	6.5	24.36				

440	2.57					
420	2.54					
400	2.47					
380	2.40					
360	2.34					
340	2.28					
320	2.19					
300	2.10					
280	2.06					
260	1.99					
240	1.93					
220	1.85					
200	1.77					
180	1.69					
160	1.60					
140	1.52					
120	1.43					
110	—					
100	1.32					
90	1.24					
80	1.18					
70	1.10					
60	1.01					
55	0.96					
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

TEST SERIAL NO.....050968/2.....
OBS. AT HOLE NO.....27W.....

PUMPING TEST

Continuation Sheet /

50	0.91					
45	0.84					
40	0.77					
35	0.69					
30	0.60					
28	0.57					
26	0.52					
24	0.48					
22	0.44					
20	0.39					
18	0.35					
16	0.30					
14	0.25					
12	0.20					
11	0.18					
10	0.16					
9	0.13					
8	0.11					
7	0.08					
6	0.06					
5	0.03					
2	—					
0	—					
Mins. After Start	Observed	Adjusted	Meter Readings	Galls per Hour	Cusecs	
TIME	DRAWDOWN		DISCHARGE			

AQUIFER FROM 20 TO 35 FT. WATER LEVEL BELOW REF. PT. 53.50 FT.
 REF. PT. ABOVE GR. LEVEL..... FT.
 MILITARY SHEET..... PUMP STARTED AT 2035 ON 5 Sept 68
 AERIAL SURVEY NO..... PUMP STOPPED AT 0355 ON 6 Sept 68
 RUN..... PHOTO NO..... PUMP SETTING..... FEET
 OWNER E. W. S. Dept TEST SERIAL NO. 050968/2
 SECTION 553 PUMPED HOLE NO. 28W
 HUNDRED Waikanae OBS. HOLE NO'S. 27W
 PROJECT River Murray Drainage Investigation OBS. AT HOLE NO. 27W

PUMPING TEST

RECOVERY TEST

OBS. AT HOLE NO. 27w
 TEST SERIAL NO. 050968/2
 PUMP STOPPED AT 03:55 ON 6 Sept 68
 WATER LEVEL BELOW REF. PT. 50.93 FT

TIME				TIME			
Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown	Mins. After Start(t)	Mins. After Stop(t ₁)	$\frac{t}{t_1}$	Residual Drawdown
440	0	—	2.57	520	80	6.5	1.46
441	1	441	2.56	530	90	5.9	1.39
442	2	221	2.56	540	100	5.4	1.33
443	3	148	2.58	560	120	4.7	1.20
444	4	111	2.56	580	140	4.1	1.09
445	5	89	2.54	600	160	3.75	1.00
446	6	74	2.53	620	180	3.45	0.91
447	7	64	2.51	640	200	3.2	0.85
448	8	56	2.49	660	220	3.0	0.79
449	9	50	2.46	680	240	2.8	0.73
450	10	45	2.44	700	260	2.7	0.68
452	12	38	2.39	720	280	2.6	0.63
454	14	32	2.33	740	300	2.5	0.59
456	16	28.5	2.29	760	320	2.4	0.55
458	18	25.5	2.24	780	340	2.3	0.52
460	20	23	2.20	800	360	2.2	0.48
462	22	21	2.16	850	410	2.1	0.42
464	24	19.4	2.12	905	465	1.95	0.39
466	26	18	2.08	950	510	1.85	0.32
468	28	16.7	2.04	1000	560	1.79	0.28
470	30	15.7	2.01	1050	610	1.72	0.24
475	35	13.6	1.93	1200	760	1.58	0.10
480	40	12	1.86	1250	810	1.54	0.06
485	45	10.8	1.80				
490	50	9.8	1.73				
495	55	9	1.69				
500	60	8.3	1.64				
510	70	7.2	1.55				

s" in Feet

1.0

0.8

0.6

0.4

0.2

0

2

4

6

8

10

"t" Time in Minutes

100

○ MATCH
POINT

$$\begin{aligned} \Delta &= 0.91 \text{ FT} \\ t &= 118 \text{ mins} \\ W(u, \frac{r}{B}) &= 1 \\ u &= 10^{-1} \\ m' &= 45 \text{ FT} \\ \frac{r}{B} &= 0.4 \end{aligned}$$

$$\begin{aligned} T &= \frac{Q}{4\pi s} W(u) \\ &= \frac{1.21 \times 1}{4 \times 3.14 \times 0.91} \\ &= \frac{1.1 \times 10^{-1} \text{ cusecs/ft}}{r^2} \\ S &= \frac{4Tut}{r^2} \\ &= \frac{4 \times 1.1 \times 10^{-1} \times 10^{-2} \times 118 \times 60}{(200)^2} \\ &= \frac{7.8 \times 10^{-3}}{r^2} \\ D &= \frac{Tm'(\frac{r}{B})^2}{r^2} \\ &= \frac{1.1 \times 10^{-1} \times 45 \times (0.4)^2}{(200)^2} \\ &= \underline{2.0 \times 10^{-5} \text{ cusecs/ft}^2} \end{aligned}$$

DEPARTMENT OF MINES - SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

WAIKERIE DISTRICT

SECTION 553. HD. WAIKERIE

DRAWDOWN CURVE TEST No. 050968/2

BOREHOLE 28W

HYDRO-GEOLOGY
SECTION*Edwards*S7528
Ja3
DATE 21 OCT 1962

OBSERVATION BOREHOLE 27W

Section 553, Hundred Waikerie

Bore log

Depth		Description
From feet	To feet	
0 -	1	Sand, very clayey, fine to coarse, dark red.
1 -	7	Sand, clayey fine to coarse, subrounded grains becoming marly below 4ft.
7 -	20	Limestone, sandy, quartz grains fine to medium, some recemented pinkish brown.
20 -	35	Sandstone, clacareous, subrounded quartz fine to medium yellow brown.
35 -	80	Morgan Limestone-Mannum Marl, silty, yellow-brown 35-55', greyish 55-65', yellow-brown 65-80'. Driller reports 'Limestone'.
80 -	100	Limestone, v. slightly sandy, soft friable buff with some red-brown stains. Bryozoal, Driller reports 'collapsed'.
100 -	123	Limestone, slightly marly. Limestone in hard bands. Very fossiliferous - bryozoal. Fawn and buff.
123 -	190	Limestone, slightly marly 5% sand, fine grain bryozoal and shelly. Some hard cemented bands. Grey and yellowish grey.
190 -	270	Limestone, slightly marly some cemented layers, fossiliferous. Finely sandy in places. Yellow brown to yellowish grey.
270 -	300	Limestone, small increase in marly content? fossiliferous, grey.
300 -	310	Limestone, hard, cemented shelly, grey and grey-brown.
310 -	330	As for 270 - 300'.
330 -	355	Limestone, marly, probably some hard bands fossiliferous, grey. Driller reports "Marl" from 350'.

Depth From To feet feet	Description
355 - 385	Ettrick Formation, Mainly Marl, with some limestone, yellowish grey.
390 - 460	Silt, calcareous, and marl. with 20% fine quartz sand. Microfossils, Buff and light grey.
460 - 470	Clay and Marl, glauconitic. Glauconite grains increasing down section. Medium greenish grey.
470 - 485	Mainly clay, calcareous with fine sand and plentiful glauconite grains. Also rare medium grain pink quartz.
485 - 498	Clay, slightly calcareous, a few glauconite grains. Dark grey.
498 - 499	Sandstone, calcareous, very shelly strongly cemented. Grains quartz subrounded max. 1mm. Grey.
499 - 505	Sand, fine to coarse, max. 1.5mms. (rare).
505 - 558	Sand, samples taken for sieve analysis throughout. See results for details.
Notes on tubes:	
505-506 feet.	Contains sandstone, nodules 5 cms. across strongly cemented, rounded fossiliferous
515-516 feet.	Sand/clay mixture dark grey.
527-529 feet.	As above.
529-530 feet.	Sand, clayey.
551-554 feet.	Sand, clayey.
557-558 feet.	Sand, clayey and with patches of clay and lignite.
558 - 578	Sand, clayey, fine to coarse grain, subrounded quartz. max. 1.0mm. Clay content decreasing down from very to slightly clayey. Medium grey.
578 - 600	Sand, slightly clayey throughout. Mainly fine to medium grain with scattered coarse grains to max. 1mm. Subangular to subrounded quartz light to medium grey.

Depth From To feet feet	Description
600 - 627	Sand, mainly medium grain about 0.4mm. subrounded quartz, light grey. Clean sand 600-605ft. 620-625ft. Slightly clayey 605-620ft. 625-627ft.
627 - 638	Sand, and silt, slightly sandy. 630-635ft. dark grey.
638 - 640	Sand, very shelly, medium to coarse grain quartz, subrounded max. size 2.0mm. Grey. Driller reports "Blew".
640 - 672	Samples Probably not reliable as for 638-640ft. but samples very clayey. Washed sample 655-665ft. and contain hard claystone pellets 2cm. across and strongly cemented sandstone nodules rounded up to 2cm. diameter. Driller reports 'layers of brown shale, sand, sandrock - 640 to 672ft.
672 - 695	Clay, shelly, silty and sandy. 685-690ft., dark grey and greenish grey.
695 - 715	Clay, silty and sandy lignitic. Quartz grains rounded to maximum 1.5mm. Fossiliferous, traces of pyrites. Med-dark grey.
715 - 745	Clay, lignitic, silty slightly fossiliferous minor quantities of subrounded quartz to max 1.5mm. Pyrites. Dark grey.
745 - 755	As for 695-715ft.
755 - 765	As for 715-745ft.
765 - 801	Logged from cores at 768-771ft., 790-791ft., 800-801ft. Sand, fine grain, mainly 0.2mm., clayey and lignitic with thinly bedded clay, lignitic, dark grey at intervals.
801 - 830	Clay, sandy and silty, lignitic sand mainly fine grain quartz max. 0.4mm. Sand content increasing to about 50% below 820ft. Dark grey.

Depth From To feet feet		Description
830 -	831	Sand, clayey, fine to medium grain. Clay as thin beds and pockets. Lignitic. Dark grey.
831 -	840	Sludge sample - as for 830-831 with high clay content.
840 -	842	Mainly clay, lignitic with thinly bedded fine to medium grain sand dark grey.
842 -	860	Sludge Samples. Clay, sandy. Probably as for 840-842 feet.
860 -	862	Clay, lignitic. Thinly interbedded mainly dark grey with light grey.
862 -	880	Clay, dark grey becoming lighter down Section. Slightly sandy at top.
880 -	915	Clay, lignitic probably silty in part. Grey 885-890 feet. Dark grey to black 890-915.
915 -	925	Clay, dark grey.
928 -	932	Sand, clayey and with discrete lumps of clay mainly coarse sand to fine gravel. max. 5.0mm. sub-rounded quartz. Shell fragments. Clay increasing below 930ft. Grey to dark grey.
932 -	934	Clay, dark grey.
934 -	955	Clay, light grey.
955 -	966	Sand, medium to coarse grain max. 72.0mm. subangular and subrounded quartz. Slightly clayey 955-960 feet. Clayey 960-966 feet. Few shell fragments 955-957 feet. Slightly incaceous. Light grey becoming darker down section.
966 -	1000	Clay, light grey and medium grey, slightly sandy 995-1000 feet.
1000-	1015	Sand, clayey throughout very clayey 1002-1003 feet. medium to coarse grain with fine gravel to max. 20mm. subrounded to subangular quartz. Medium grey.

Depth		Description
From feet	To feet	
1015 - 1025		Mixture of clay, grey to dark grey and black with varying quantities of sand, mainly fine to medium but with some coarse grain.
1025 - 1033		Sand, clayey. Fine to coarse grain. Max 2.0mm. Subangular to subrounded quartz medium-dark grey.
1033 - 1039		Sand, slightly clayey mainly fine to medium grain with some coarse and fine gravel to 1.5mm. medium grey becoming dark grey 1037-39 feet.
1039 - 1045		Sand, mainly medium to coarse grain with gravel to 2mm. plentiful and rare to 4mm. Becoming increasingly coarse down section and increasing quantities of gravel. Slightly clayey to 1041, with clay increasing down section. Quartz mainly subrounded to subangular.
1045 - 1047		Sand, medium grey and clayey and lignitic fine to coarse grain with scattered gravel. Quartz dark grey.
1047 - 1050		As for 1039-1045 feet with gravel to 10mm.
1050 - 1060		Clay, sandy. Dark grey.
1060 - 1070		Clay, sandy. Medium grey.
1070 - 1075		As for 1047-1050 feet, gravel - rare 10mm.
1075 - 1081		Sand, clayey, mainly fine to medium grain with some coarse grain quartz subrounded. Grey-brown.

APPENDIX C
Calculations

CALCULATION SHEET

PROJECT: River Murray Drainage Investigation

SUBJECT: Wikerie District

CALCULATED: G.T. Robert

CHECKED:

PAGE 1

REFERENCE

1487/1/68

DATE

31 July 70

Progress Report No 16

Reference Fig.

Assume $T = 2.0 \times 10^{-2}$ wecs/ft (Drainage testing results).measured length of 60ft contour (L_1) = 6 miles
= 3.17×10^4 ft" " 10ft " (L_2) = 3.5 miles
= 1.85×10^4 ftMean distance between contours (Δr) = 0.35 miles
= 2.12×10^3 ftContour interval (Δh) = 10 ft.

$$T = \frac{2Q}{(L_1 + L_2) \frac{\Delta h}{\Delta r}}$$

$$Q = \frac{T \Delta h (L_1 + L_2)}{2 \Delta r}$$

$$= \frac{2.0 \times 10^{-2} \times 10 \times 5.02 \times 10^4}{2 \times 2.12 \times 10^3}$$

$$= 2.36 \text{ wecs.}$$

CALCULATION SHEET

PROJECT: River Murray Drainage Investigation

SUBJECT: Waikeke Drift

PAGE 2

REFERENCE 14-61/1/62

CALCULATED G. E. H. K.

CHECKED

DATE 29 Dec 70

Potential contribution of groundwater
flow to the River Murray valley adjacent
to the irrigation areas

length of flow path
Ramsay to Waikeke (L) = 5 miles
= 26,500 ft

Transmissivity (T) = 2.0×10^{-2} cusecs/ft

1. Before irrigation began

Estimated slope of groundwater table (i) = 1.5 ft per mile

$$Q = T i L$$

$$= 2.0 \times 10^{-2} \times \frac{5}{5780} \times 5 \times 5780$$

$$= \underline{0.5 \text{ cusecs}}$$

2. 1970

Estimated mean slope of
groundwater table (i) = 10 ft in 0.35 miles

$$Q = 2.0 \times 10^{-2} \times \frac{10}{0.35 \times 5780} \times 5 \times 5780$$

$$= \underline{2.85 \text{ cusecs}}$$

Purpose of Bore	DRAINAGE TESTING	State No	687055303
Hundred	WAIKERIE	Bore Serial No	420/68
Owner	RIVER MURRAY DRAINAGE COMMITTEE	Project No	27W
Driller	E. JAMIESON	Docket No	1487/68
Commenced	14.5.68	Depth	1081'
Completed	15.5.68	Co-ords E	
Drill type	CABLE TOOL		
Logged by	G. T. ROBERTS		
Circulation	R. L. Surface		
Date	25.6.68		
Casing	10", 8", & 6"		

WATERS CUT

REMARKS

CASING	WATER CUT	WATER LEVEL	DEPTH FEET	CORE	GRAPHIC LOG	AGE	UNIT	PENETRATION RATE	DESCRIPTION
1	2	3	4	5	6	7	8	9	10
			0						0 - 1' <u>SAND</u> , very clayey, fine to coarse, dark red.
			1						1 - 7' <u>SAND</u> , clayey fine to coarse, subrounded grains becoming marly below 4ft.
			7						7 - 20' <u>LIMESTONE</u> , sandy, quartz grains fine to medium, some recemented pinkish brown.
			20						20 - 35' <u>SANDSTONE</u> , calcareous, subrounded quartz fine to medium yellow brown.
			30						
			35						35 - 80' <u>MARL</u> , silty, yellow-brown 35 - 55' greyish 55 - 65' yellow-brown 65 - 80'
			40						Driller reports 'Limestone
			50						

60

170

1802

190

200

210-

220

230.

240.

250

190 - 270' LINESTONE, slightly marly some cemented layers, fossiliferous. Finely sandy in places. Yellow brown to yellowish grey.

1	2	3	4	5	6	7	8	9	10	STATE NO. 667055303	SHEET 5 OF 12
										355 - 385' <u>MAINLY MARL</u>, with some LIMESTONE, yellowish grey.	
			360								
			370								
			380								
			390							390 - 460' SILT, calcareous, and MARL. with 20% fine quartz sand. Microfossils. Buff and light grey.	
			400								
			410								
			420								
			430								
			440								
			450								

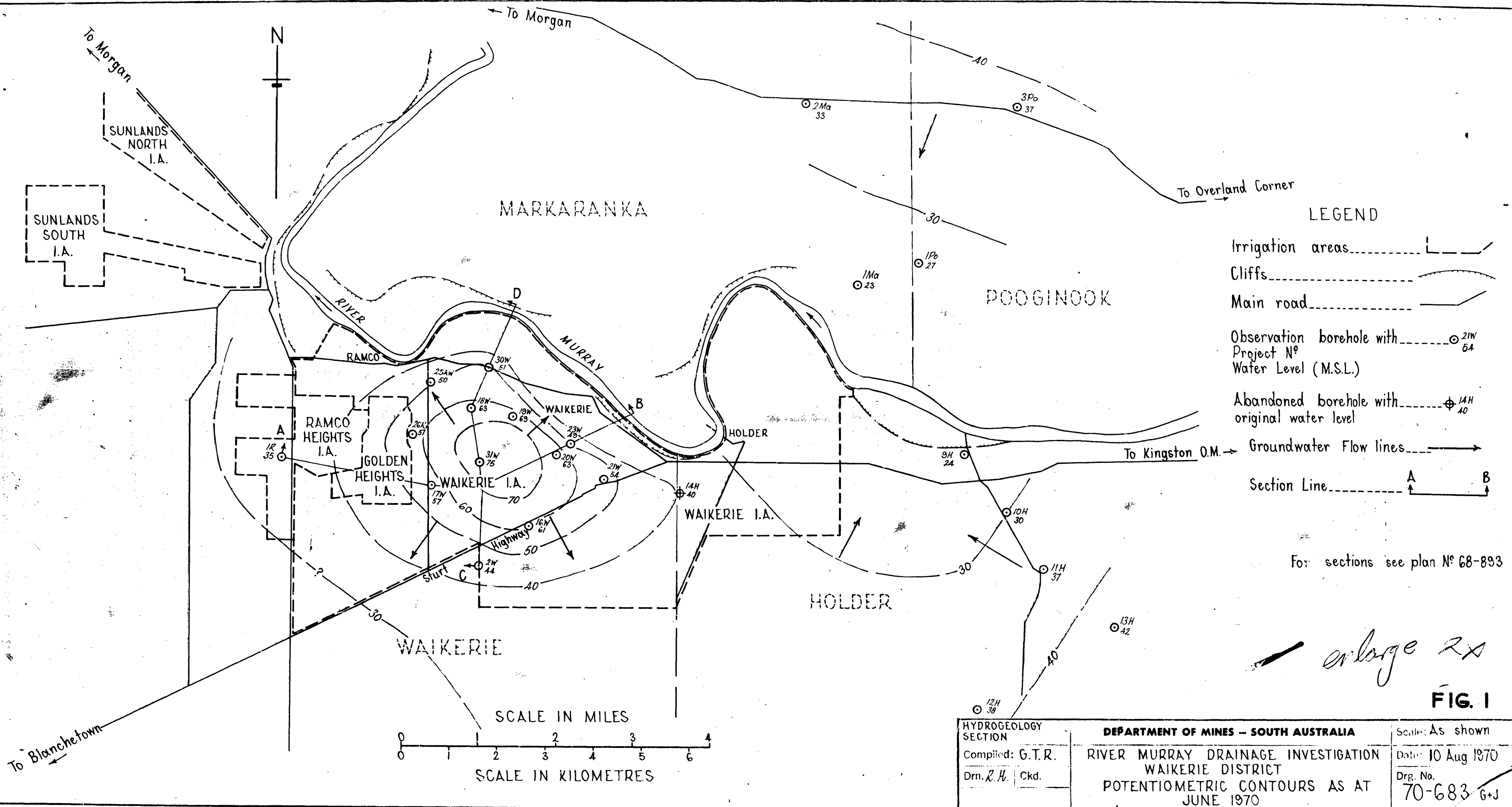
1	2	3	4	5	6	7	8	9	10	STATE NO. 667055303	SHEET 6 of 12
				460					460 - 470'	<u>CLAY</u> and <u>MARL</u> , glauconitic. Glauconite grains increasing down section. Medium greenish grey.	
				470					470 - 485'	Mainly <u>CLAY</u> , calcareous with fine sand and plentiful glauconite grains. Also rare medium grain pink quartz.	
				480							
				490					485 - 498'	<u>CLAY</u> , slightly calcareous, a few glauconite grains. Dark grey.	
				500					498 - 499'	<u>SANDSTONE</u> , calcareous, very shelly strongly cemented. Grains quartz subrounded max. 1mm. Grey.	
				510					499 - 505'	<u>SAND</u> , fine to coarse, max. 1.5mms. (rare)	
				520					505 - 558'	<u>SAND</u> , samples taken for sieve analysis throughout. See results for details.	
				530					Notes on tubes		
				540					505-506feet. Contains <u>SANDSTONE</u> , nodules .5 cms. across strongly cemented, rounded fossiliferous		
				550					515-516feet. <u>SAND/CLAY</u> mixture dark grey.		
									527-529feet. as above.		
									529-530feet. <u>SAND</u> , clayey.		

1	2	3	4	5	6	7	8	9	10	STATE NO. 667055303.	SHEET 7 OF 12
									551-554ft.	SAND, clayey.	
									557-558ft.	SAND, clayey and with patches of clay and lignite.	
				560					558 - 578'	<u>SAND</u> , clayey, fine to coarse grain, subrounded quartz. max. 1.0mm. Clay content decreasing down from very to slightly clayey. Medium grey.	
				570							
				580					578 - 600'	<u>SAND</u> , slightly clayey throughout. Mainly fine to medium grain with scattered coarse grains to max. 1mm. Subangular to subrounded quartz light to medium grey.	
				590							
				600					600-627'	<u>SAND</u> , Mainly medium grain about 0.4mm. subrounded quartz, light grey.	
									Clean sand	600-605ft.	
										620-625ft.	
									Slightly clayey	605-620ft.	
				610						625-627ft.	
				620							
									627 - 638'	<u>SAND</u> , and <u>SILT</u> , slightly sandy. 630-635ft. dark grey.	
				630							
									638 - 640'	<u>SAND</u> , very shelly, medium to coarse grain quartz, subrounded max. size 2.0mm. Grey.	
				640						Driller reports 'BLEW'	
									640 - 672'	<u>SAMPLES PROBABLY NOT RELIABLE</u> as	
										for 638-640ft. but samples very clayey. Washed sample 655-665ft. and contain hard claystone	
				650							

1	2	3	4	5	6	7	8	9	10	STATE NO. 667055303	SHEET 8 of 12
										pellets 2cm. across and strongly cemented sandstone nodules rounded up to 2cm. diameter. Driller reports 'layers of brown shale, sand, sandrock - 640 to 672ft. 672 - 695' <u>CLAY</u>, shelly, silty and sandy. 685-690ft., dark grey and greenish grey. 695 - 715' <u>CLAY</u>, silty and sandy lignitic. Quartz grains rounded to maximum 1.5mm. Fossiliferous, traces of pyrites. Med-dark grey. 715 - 745' <u>CLAY</u>, lignitic, silty slightly fossiliferous minor quantities of subrounded quartz to max 1.5mm. Pyrites. Dark grey. 745 - 755' As for 695 - 715 ft.	
			660								
			670								
			680								
			690								
			700								
			710								
			720								
			730								
			740								
			750								

[illegible]

1	2	3	4	5	6	7	8	9	10	STATE No 667055303 . . .	SHEET 12 of 12
										Slightly clayey to 1041, with clay increasing down section. Quartz mainly subrounded to subangular.	
			1060						1045 - 1047'	<u>SAND</u> , Medium grey and clayey and lignitic fine to coarse grain with scattered gravel. Quartz dark grey.	
									1047 - 1050'	as for 1039 - 1045 feet with gravel to 10mm.	
			1070						1050 - 1060'	<u>CLAY</u> , sandy. Dark grey.	
									1060 - 1070'	<u>CLAY</u> , sandy. Medium grey.	
									1070 - 1075'	as for 1047 - 1050 feet, gravel - rare > 10mm.	
			1080						1075 - 1081'	<u>SAND</u> , clayey, mainly fine to medium grain with some coarse grain quartz subrounded. Grey-brown.	
			1090								
			1100								
			1110								
			1120								
			1130								
			1140								
			1150								



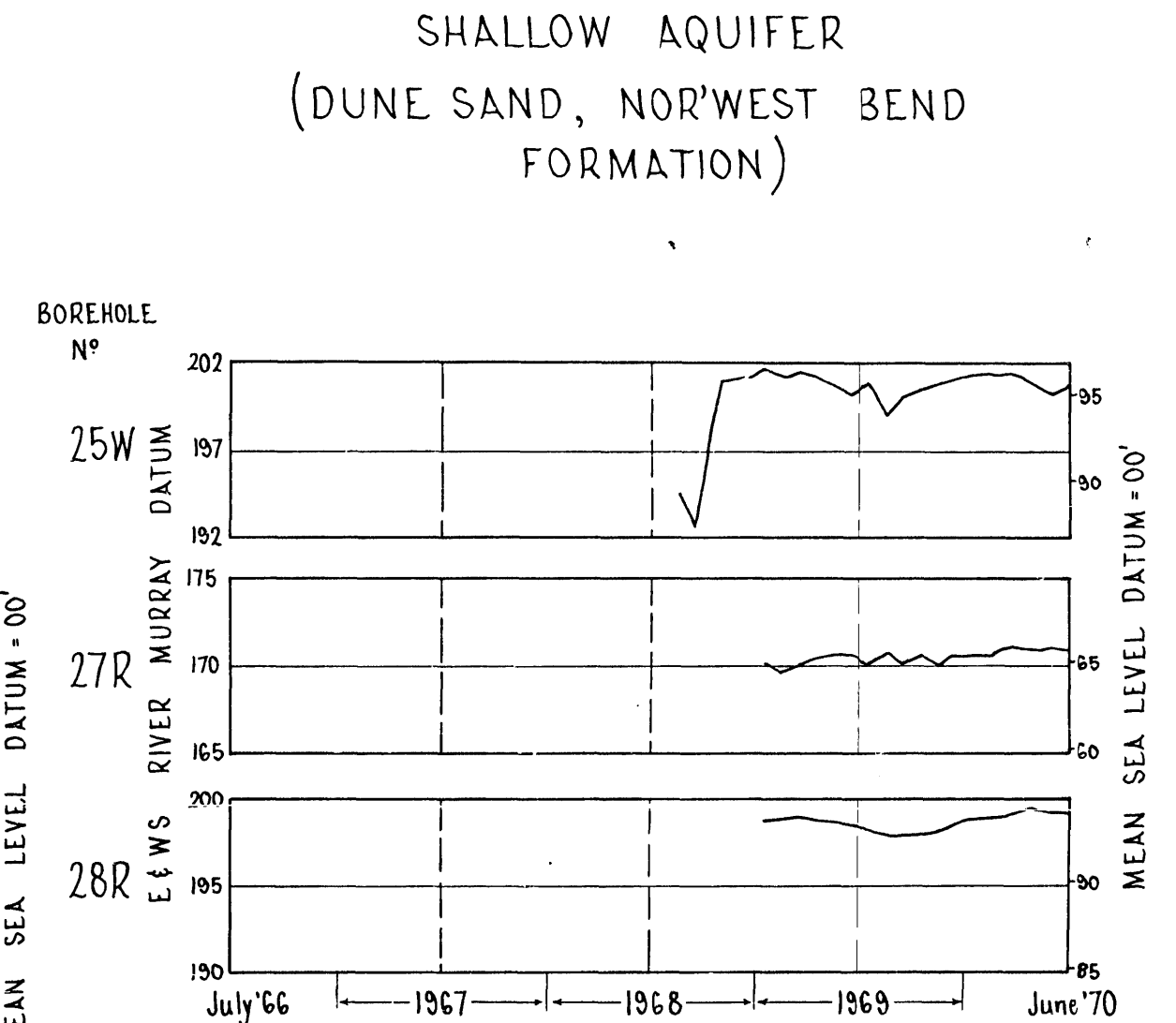
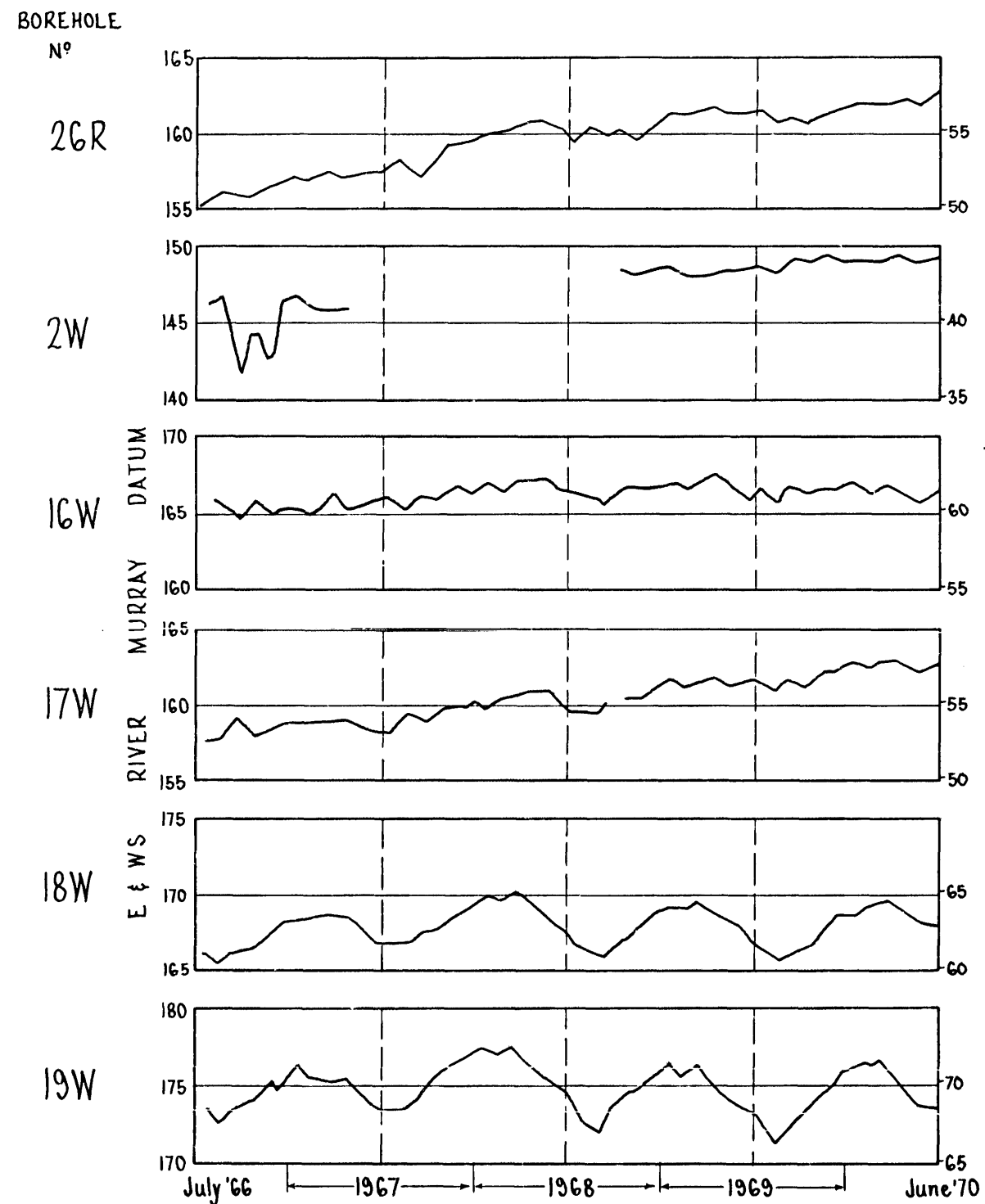
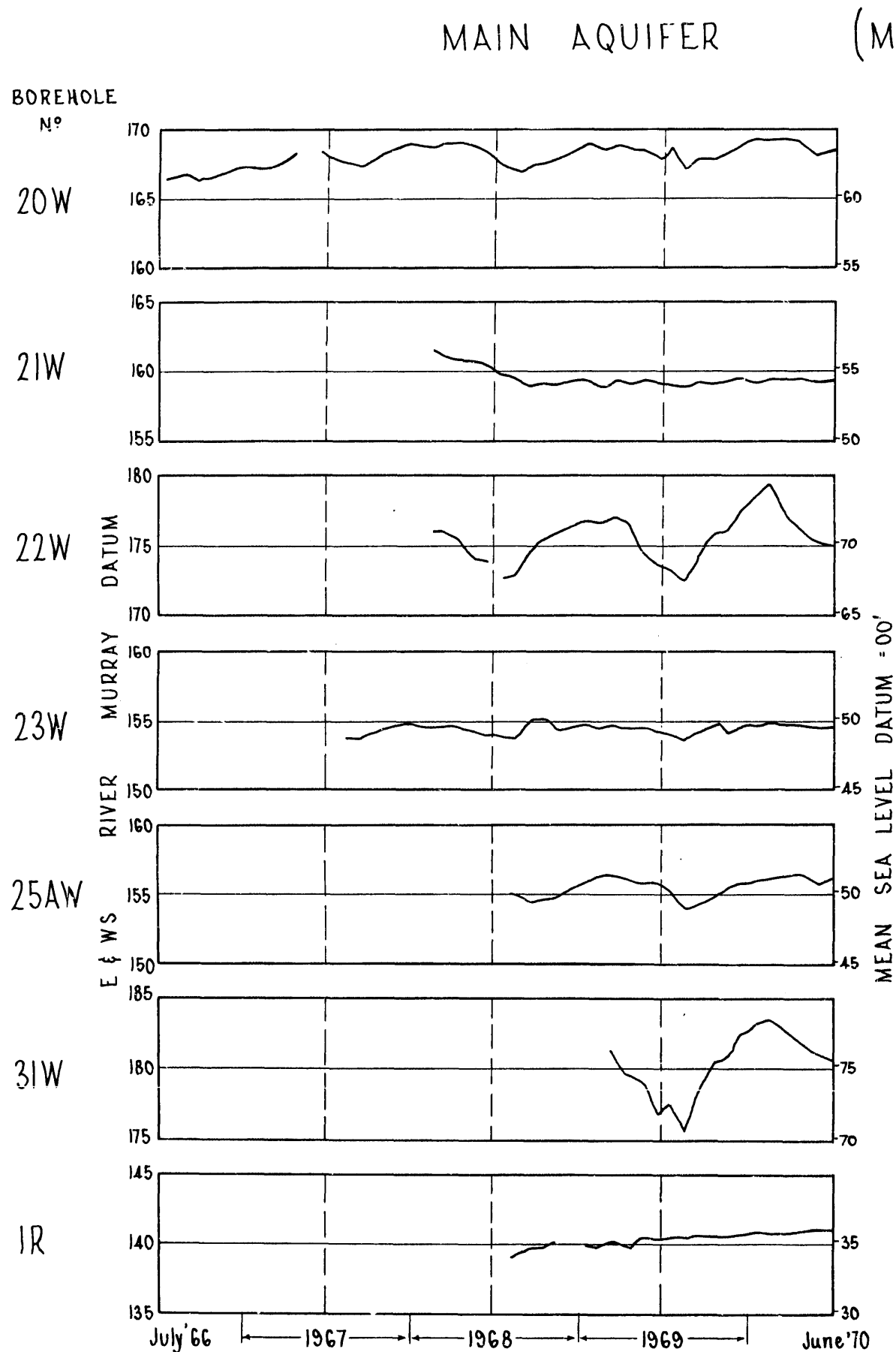


FIG.2

HYDROGEOLOGY SECTION	DEPARTMENT OF MINES - SOUTH AUSTRALIA	Scale: 1 in. = 10 ft. (vert.)
Compiled: G.T.R.	RIVER MURRAY DRAINAGE INVESTIGATIONS	Date: 21 July 1970
Drn. R.H. Ckd.	WAIKERIE DISTRICT	Drg. No.
	SUMMARY OF WATER LEVELS	70-653 G+J
	JULY 1966 THROUGH JUNE 1970	

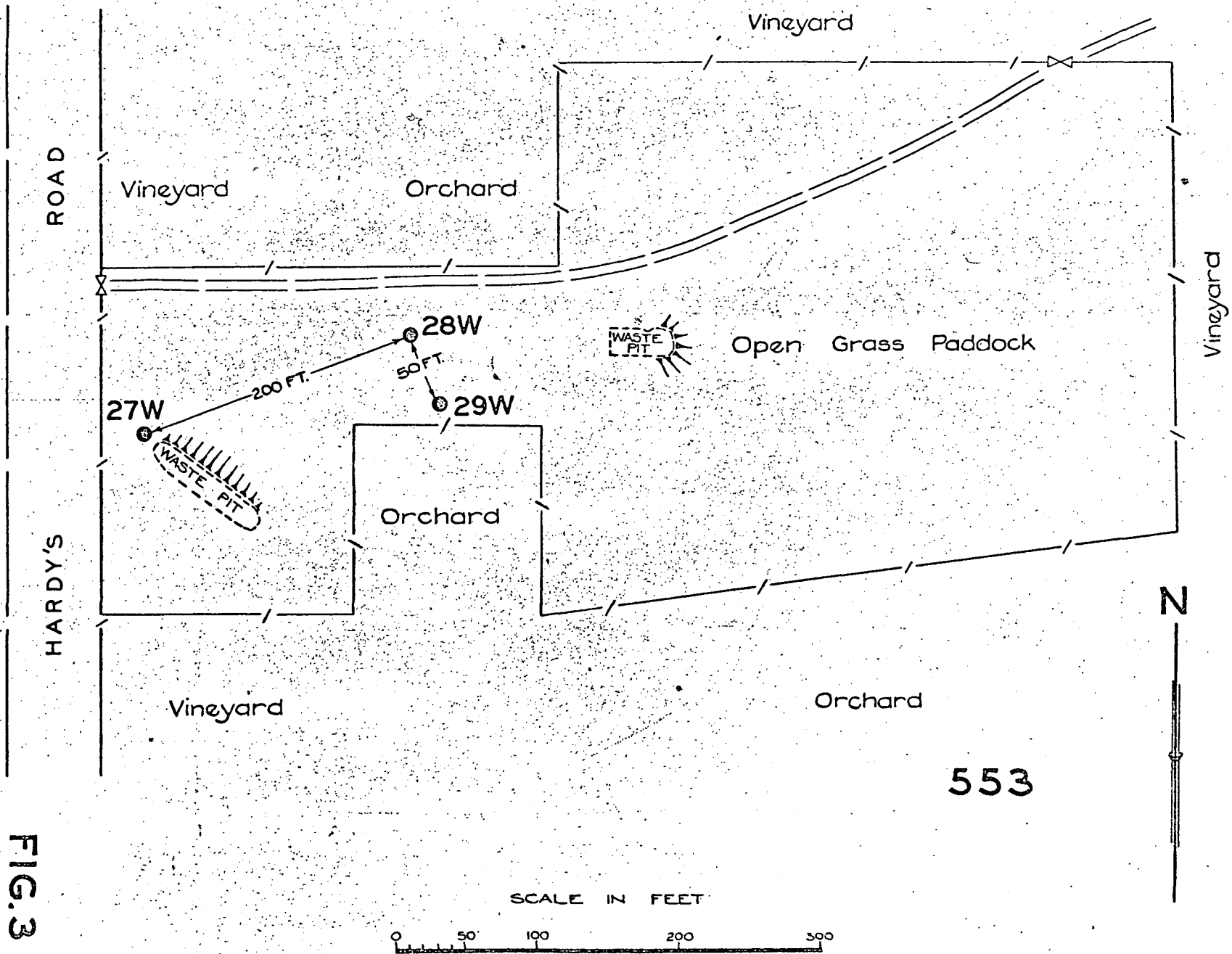


FIG.3

DEPARTMENT OF MINES - SOUTH AUSTRALIA

Scale: 1 IN. REP. 100 FT.

Compiled: G. ROBERTS

RIVER MURRAY DRAINAGE INVESTIGATION

Drm. A.G.R. Ckd. L.V.W.

BOREHOLES 27W, 28W & 29W

SEC. 553, HD. WAIKERIE

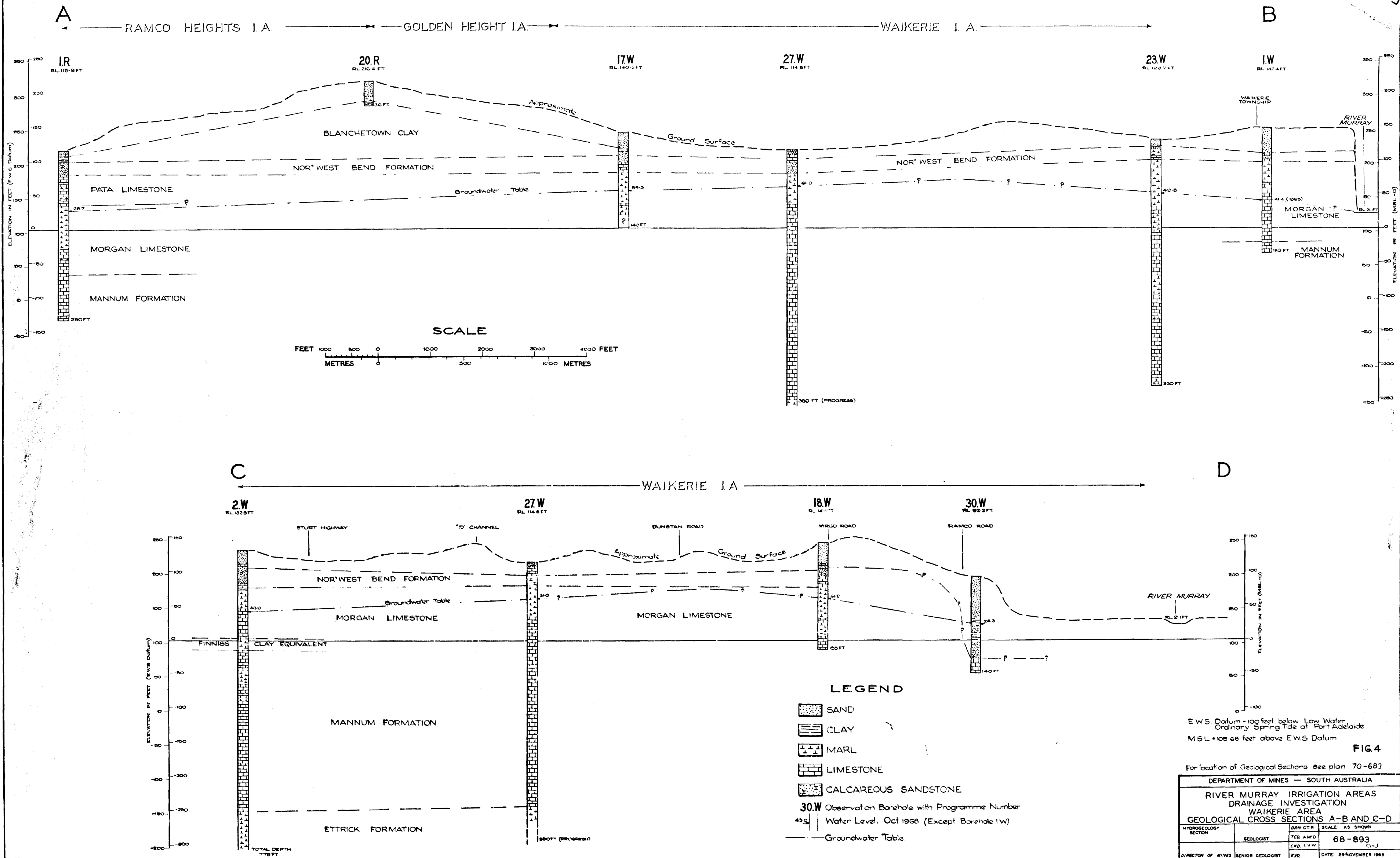
LOCATION SKETCH PLAN

Drg. No.

S6818

Date: 10TH SEP. 1968

Jas



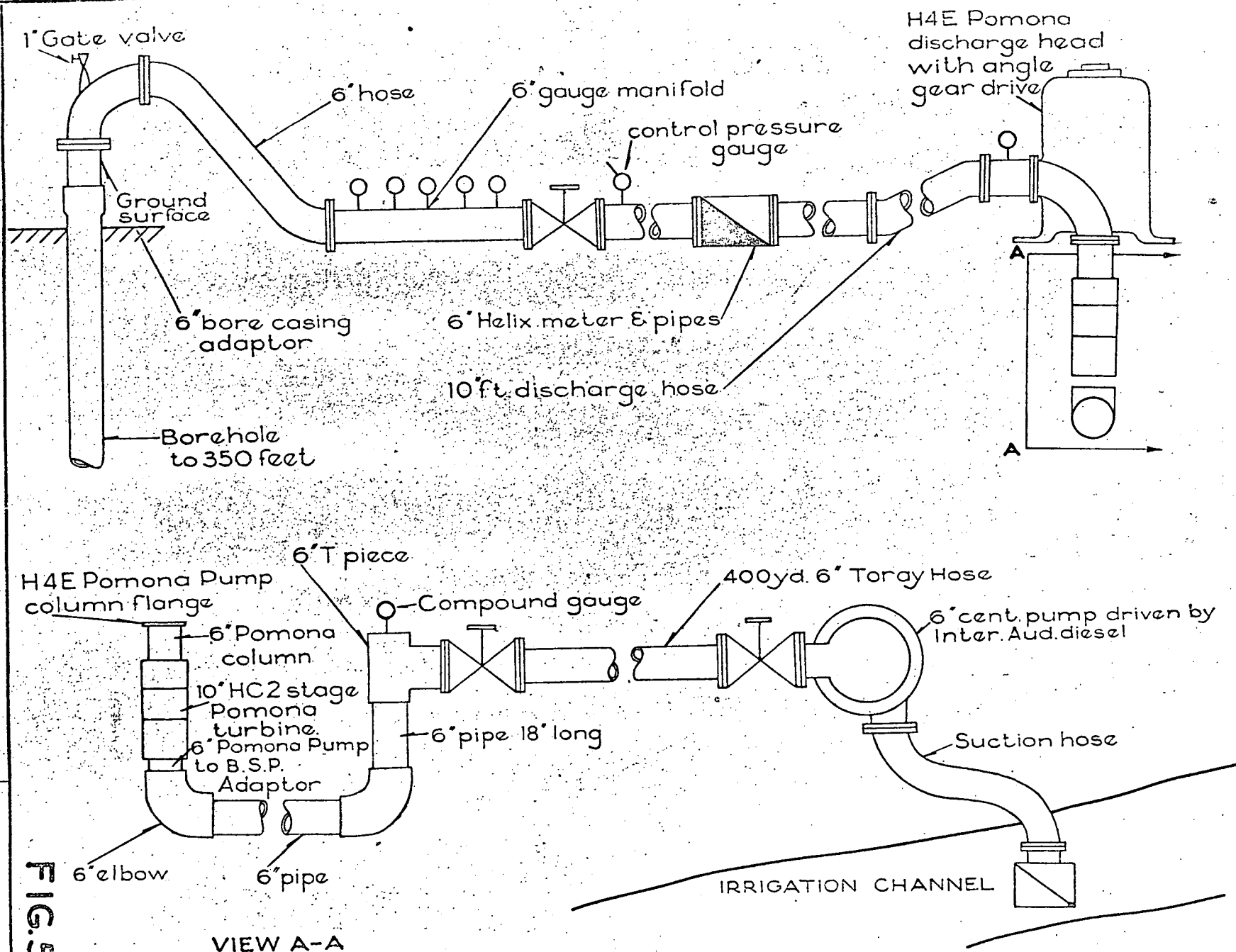


FIG. 5

VIEW A-A

DEPARTMENT OF MINES - SOUTH AUSTRALIA

Compiled: G.R.

Drn. G.M. Ckd. L.V.W.

RIVER MURRAY DRAINAGE INVESTIGATION

WAIKERE DISTRICT

SURFACE INSTALLATIONS

PUMP-IN TEST BOREHOLE 28W

Scale: Diagrammatic

Date: 17th Oct 1970

Dwg. No. S6942

G.V.

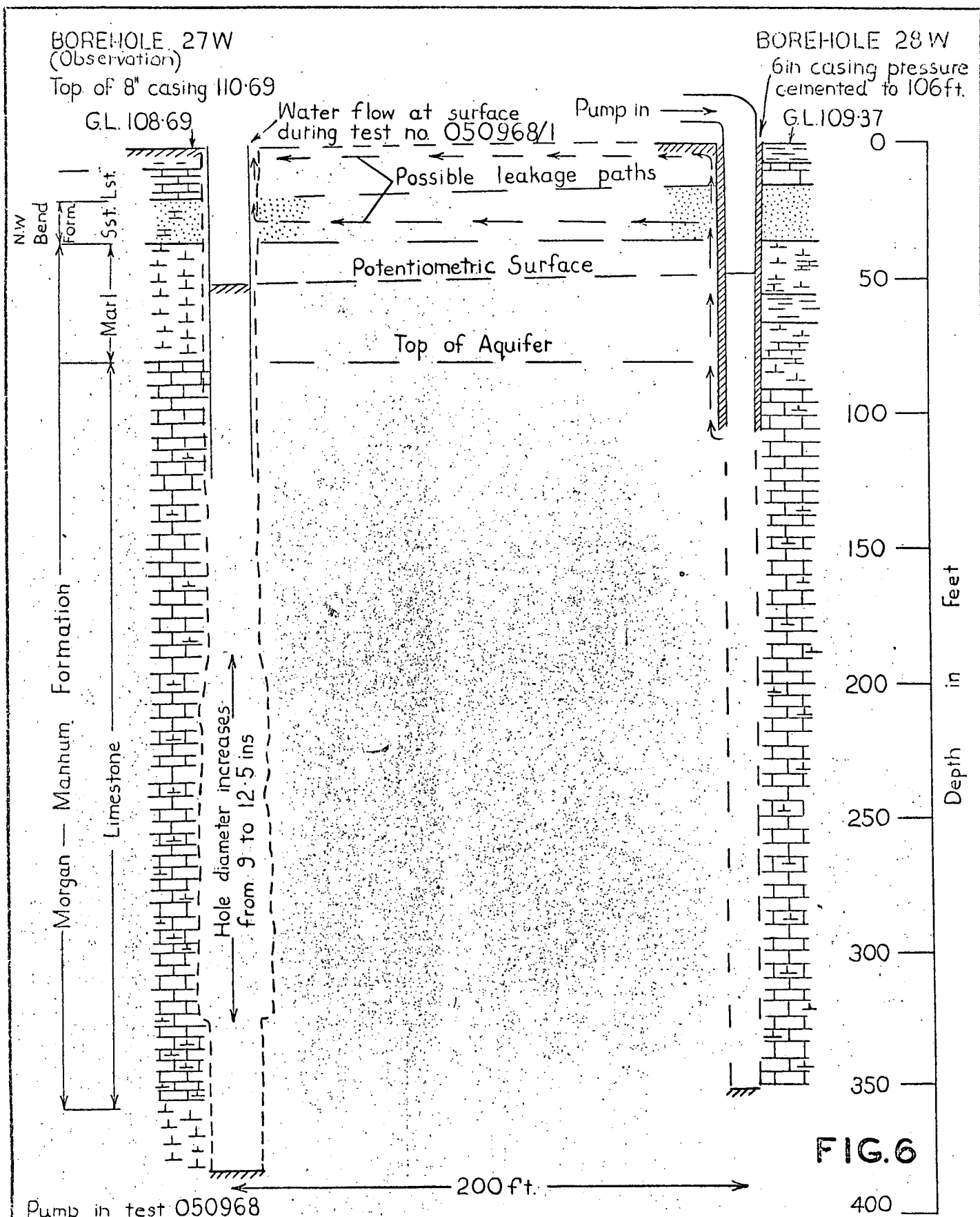


FIG. 6

HYDROGEOLOGY SECTION	
Compiled: G.T.R.	
Drn. J.H.	Ckd. L.V.W.

DEPARTMENT OF MINES — SOUTH AUSTRALIA	
RIVER MURRAY DRAINAGE INVESTIGATION WAIKERIE DISTRICT BOREHOLES 27W AND 28W SECT 553 HD WAIKERIE DETAILS OF BOREHOLE AND STRATA FAILURE	

Scale: 1 inch = 50 Feet. (VERTICAL)
Date: 4 th Aug. 70
Drg. No. 56820 Ja3

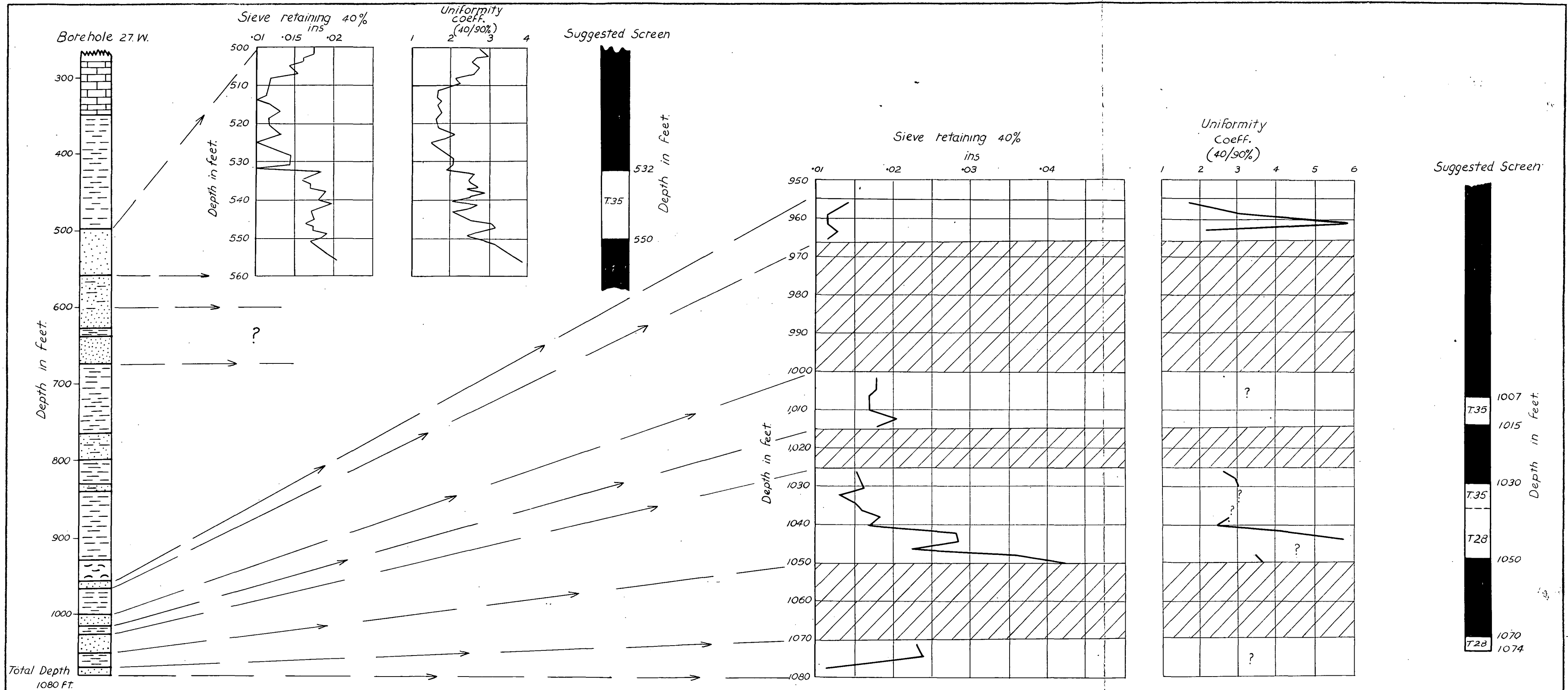


FIG.7

Hydrogeology Section		DEPARTMENT OF MINES — SOUTH AUSTRALIA		Scale: As Shown
Compiled: G.T.R.		RIVER MURRAY IRRIGATION AREAS		Date: 20 - 7 - 70
Drn. J.H.	Ckd.	DRAINAGE INVESTIGATIONS-WAIKERIE DISTRICT		Org. No.
		BORE HOLE 27W SUGGESTED SCREEN DESIGN		70-646
		BUCCLEUCH AND RENMARK BEDS		J ₂₃

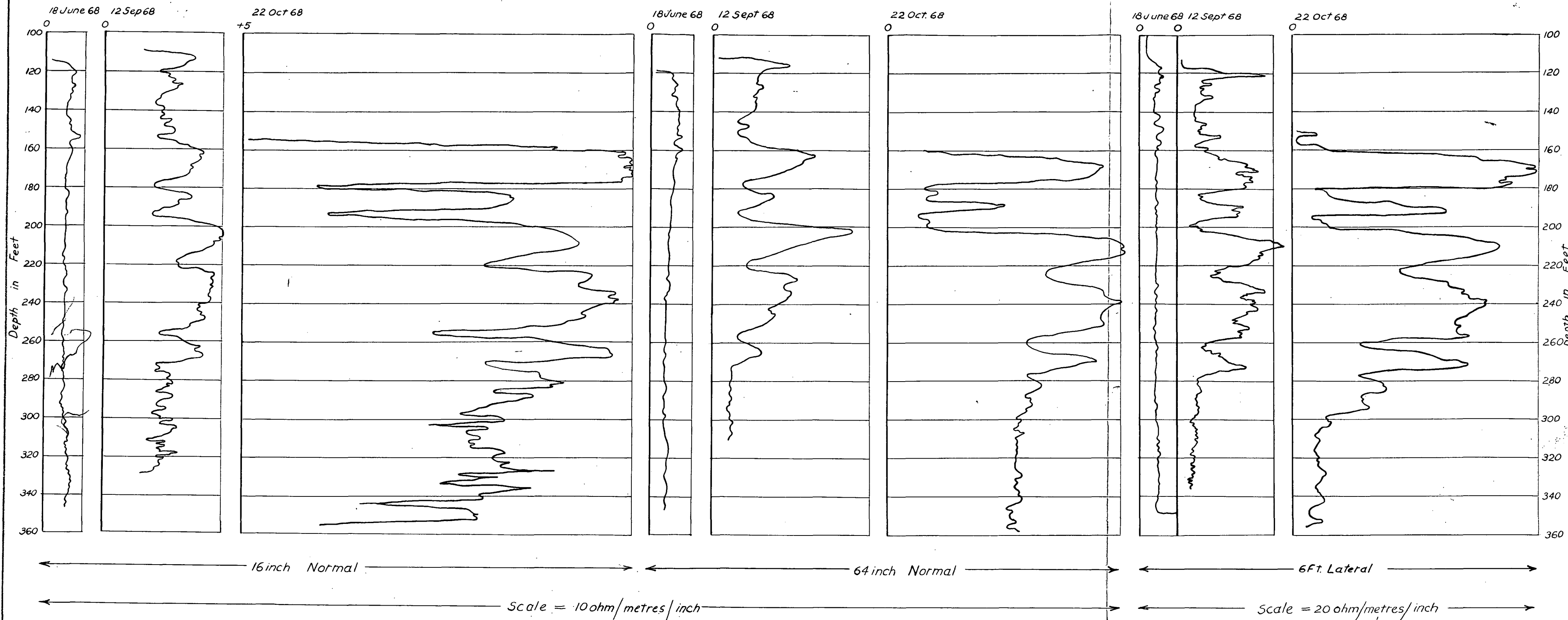
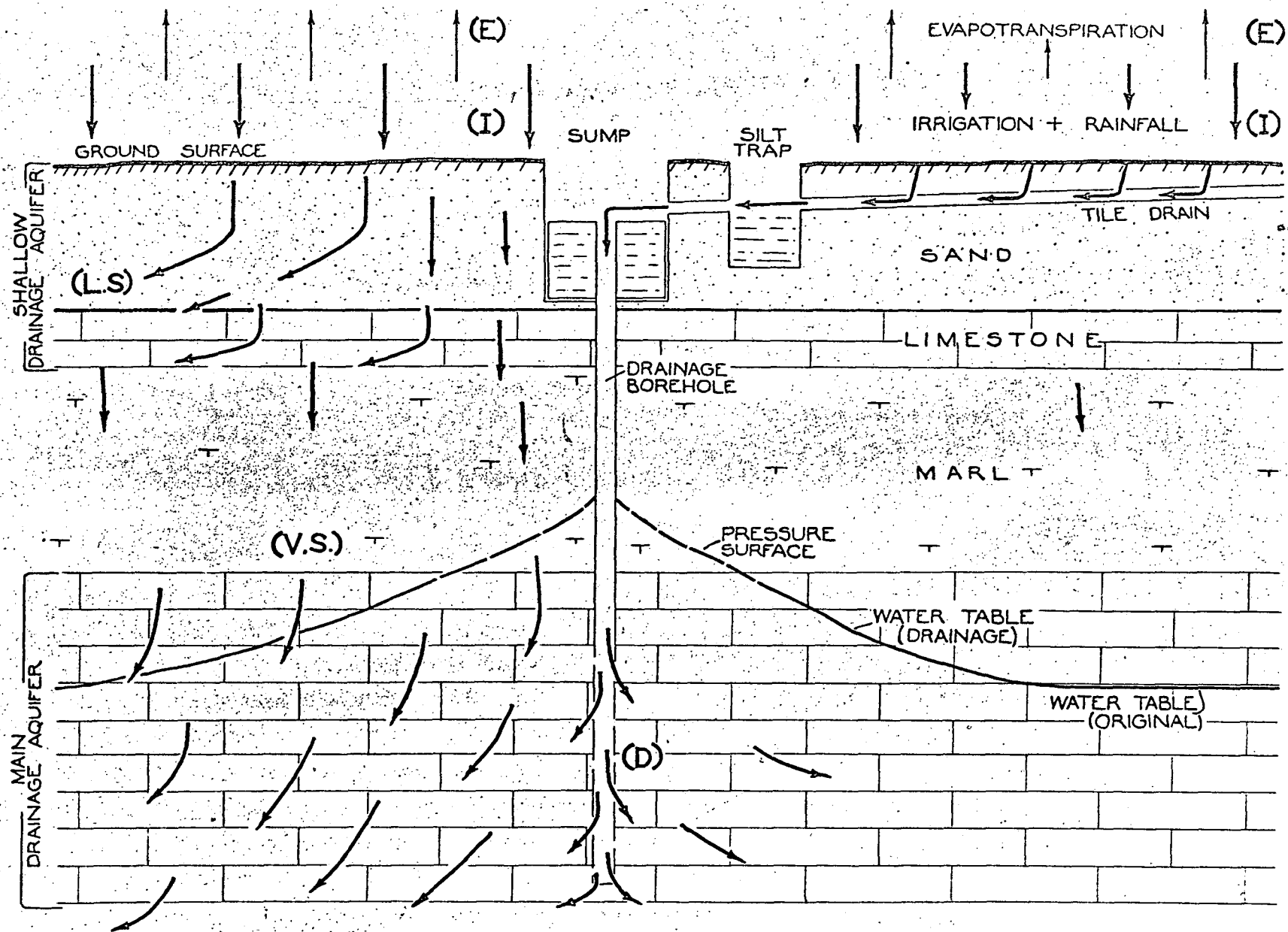


FIG.8

HYDROGEOLOGY SECT.		DEPARTMENT OF MINES - SOUTH AUSTRALIA		Scale: As Shown
Compiled: G. T. R.		RIVER MURRAY IRRIGATION AREAS		Date: 15 - 7 - 70
Drn. J. H.	Ckd.	DRAINAGE INVESTIGATIONS		Drg. No.
		WAIKERIE DISTRICT		70 - 645
		GEOPHYSICAL LOGS OF BOREHOLE 28W		Ja



FLOW EQUATION

$$I = E + D + L.S. + V.S.$$

I = IRRIGATION + RAINFALL

D = BOREHOLE DRAINAGE

E = EVAPORATION

L.S. = LATERAL SEEPAGE

V.S. = VERTICAL SEEPAGE

FIG. 9

DEPARTMENT OF MINES - SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

WAIKERIE DISTRICT

HYDRAULIC MODEL OF DRAINAGE PROCESSES

Scale: DIAGRAMMATIC

Date: 7TH AUG. 1970

Drg. No.

S 7898

Jcs

Compiled: G.T.R.

Drm. AGR Cld. LWW.