DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

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REPT.BK.NO. 81/101

STUART OVAL WATER WELL COMPLETION REPORT

GEOLOGICAL SURVEY

by

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DME.544/2/76

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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 81/101
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Disk No. 21

STURT OVAL WATER WELL COMPLETION REPORT

ABSTRACT

A production well was successfully completed into the Tertiary Port Willunga Beds in the Hundred of Noarlunga, Section 119.

Although the well capacity is considered to be in excess of 2.5 L/sec, the recommended pumping rate should not exceed 2.25 L/sec. Higher rates will lead to significant silt/sand entry through the slotted casing.

Approximate total dissolved solid content of the groundwater is 1130 mg/L, which is slightly too high for bowling greens.

INTRODUCTION

The Marion Council is planning to install bowling greens in an area adjoining the Sturt Recreation Ground, Hd. of Noarlunga Sec. 119. Total water requirements for the proposal is a peak of 190 m^3/day, to be applied at 9 L/sec from a storage tank of about 230 m^3.

A request was received for this Department to assess the groundwater prospect in the area and subsequently to drill a production water well.

Drilling operations were carried out between the 24th March and 13th April 1981 and the 7 hr. well discharge test was completed on 27th May 1981.

HYDROGEOLOGY

The drilling target was the Tertiary Port Willunga Beds of the Adelaide Plains basin. This extensive aquifer consists of limestone and shelly sands and is sub-artesian in the region of

interest, water rising to within 20 m of the ground level from a depth of about 54 m.

Results from previously drilled wells in the immediate vicinity of Sturt Recreation ground indicate that potential yields from the sandy limestone aquifer can exceed 6 L/sec, with a mean salinity of about 1000 mg/L. However, adequate well completion has been difficult to achieve due to the occurrence of very fine sands and silts, and long term yields of sand free water are generally less than 3 L/sec.

WELL CONSTRUCTION

The hole was initially rotary drilled, Ø 215.9 mm, with mud circulation to a depth of 54 m into the top of the limestone aquifer. In order to obtain uncontaminated aquifer samples, HQ coring (Ø 104.7 mm) was carried out from 54 to 74.2 m into fine shelly sands.

Geophysical down hole logging (gamma, neutron, normal, lateral, S.P.) was run prior to pressure cementing 52 m of 152 m.m. I.D. black pipe.

Based on the cored samples, part of which was subjected to sieve analysis, and the geophysical logs, a 4 m x 127 mm x 0.17 mm aperture screen was set across the 58-62 m depth interval. However, the airlifted supply of clear water did not exceed 0.3 L/sec throughout the 10 hr. development.

The screen was subsequently removed, the hole reamed to 71 m and lined with a 22.35 m length of 127 mm casing, slotted from 51.65 to 71 m.

The well was airlifted from above the slots for a period of 10 hrs. at an estimated yield of 1.9 L/sec. A great quantity of fines was initially pumped but the water gradually cleared until relatively sand free water was obtained towards the end of the airlifting.

Summary of well details is tabulated below and the composite geological/geophysical logs and completion details are shown in Fig. 4.

TABLE 1

SUMMARY OF WELL DETAILS

DME UNIT No:	66270100W06234
PERMIT NO:	8565
Depth:	74 m
Casing:	152 mm I.D. black pipe from surface to 52 m, pressure cemented. 127 mm liner from 48.6 m to 71 m, slotted from 51.65 to 71 m, sealed with lead wedge.
SWL:	20.7 m
Recommended Pumping Rate:	not greater than 2.25 L/sec* (1800 g.p.h.)
Recommended pump depth:	50 m
Recommended pump:	Vertical Line Shaft Turbine without Non-Return valve.
Pumping water level:	32-35 m
Water Salinity:	1140 mg/L
Aquifer:	sandy limestone and fine sands.

*pumping at greater rates will result in significant sand/silt entry.

WELL DISCHARGE TEST

A Mono pump was initially used in the test. However, due to excessive sand entry during development, prior to testing operations, the pump was damaged and replaced by a more sand tolerant vertical line shaft turbine pump.

Although the well was pumped for over 16 hrs. and the pumped water was essentially free of fine sand at a pump rate less than 2.25 L/sec, it is considered that the well was not fully developed. This is confirmed by the fact that a small amount of silt was pumped at the commencement of each pumping cycle and that pumping in excess of 2.25 L/sec resulted in significant silt/sand entry.

A 7 hr. test was subsequently carried out in 3 continuous stages, the first 2 stages were of 30 minutes at pumping rates of 1.13 and 1.72 L/sec respectively, followed by a 6 hr. third stage at 2.68 l/sec.

The purpose of increasing the pumping rate in stages is to obtain the well loss and aquifer constants that are required to quantify the well capacity. This is best expressed in the form of a well drawdown equation from which expected well drawdowns can be calculated for various pumping rates and times.

The standard plot of drawdown versus the logarithm of pumping time is shown in Fig. 2, which also includes the derivation of the drawdown equation.

The plot of the 3rd stage results show some drawdown irregularities which are probably associated with continuing development of the well and some possible leakage contribution from other aquifers. In determining the aquifer constants, more emphasis was placed on the results from the first two stages which exhibited larger rates of drawdown (drawdown per log cycle). As such the drawdown equation can only be used to give an approximate but conservative estimate of the well capacity. Similarly an approximate transmissivity value of 17-21 m^3/day was calculated.

Well Drawdown Equation

$$s = 45Q + 208\ Q^2 + 15Q \log t$$

where s = drawdown in metres

Q = pumping rate in m^3/minute

t = pumping period in minutes

Example: for Q = 0.161 m^3/min.

t = 400 minutes

s (calculated with equation) = 18.9 m

s (observed during pump test) = 17.5 m.

Using the equation, the expected drawdowns at various pumping rates for 30 hr. pumping periods is shown in Fig. 3.

Although the long term capacity of the well is in excess of 2.5 L/sec, testing has shown that at this stage of well development, pumping rates in excess of 2.25 L/sec (1800 g.p.h.) will lead to silting problems.

WATER QUALITY

The total dissolved solid content of the groundwater from the production well ranged from 1105 to 1140 mg/L during the 7 hr. pump test, with no upward trend being detected. Water salinity in adjoining wells range from 830 to 1000 mg/L.

The above average salinity value of 1130 mg/l is considered to be somewhat too high for direct application to the bowling greens and the groundwater will be diluted with mains water to obtain a salinity of about 700 mg/L.

DISCUSSION AND RECOMMENDATIONS

Difficulties were experienced in trying to develop the well due to the presence of very fine silty sediments within the aquifer. Previous experience with this type of material in the region has shown that it is difficult to effectively screen and maintain an adequate well yield. In both the current hole and an adjoining existing well, effective screening out of the fines with wire wound screens, aperture varying from 0.17 mm to 0.58 mm, resulted in reduction of yields to less than 0.3 L/sec, even after prolonged chemical treatment and surging. In view of the further possibility that a more permeable water bearing zone was in fact screened out, it was considered that a casing liner, slotted throughout the drilled aquifer interval, would be adequate at moderate pumping rates to produce in the long term essentially clear water. If this does not eventuate, completion with gravel packing or resin-bonded screen must be considered.

As previously mentioned, the well is not fully developed and pumping in excess of 2.25 L/sec will result in significant sand entry. A small amount of silt will also be pumped at the commencement of each pumping cycle. It is considered that full development will require prolonged pumping and further work by this Department is therefore not warranted in terms of cost. As it is intended to pump and dilute the groundwater in a settling tank that can be periodically cleaned out, additional development can be effected while the well is in operation.

To reduce silt intake, the pumping rate should be set below the well capacity but at a rate sufficient to minimize intermittent pump operations. Therefore, although the well has a capacity in excess of 2.5 L/sec, the recommended maximum pumping rate is 2.25 L/sec. Allowing for 50% dilution with mains water the peak daily requirement of 185 m^3, requiring 90-100 m^3/day of groundwater, can be obtained by pumping at the following rates:

(1) 1.15 L/sec for 24 hours.

(2) 2.25 L/sec for 12 hours.

During the periods when the well is not in use, periodic pumping (1-2 hrs/week) is recommended to prevent any accumulation of silt in the well.

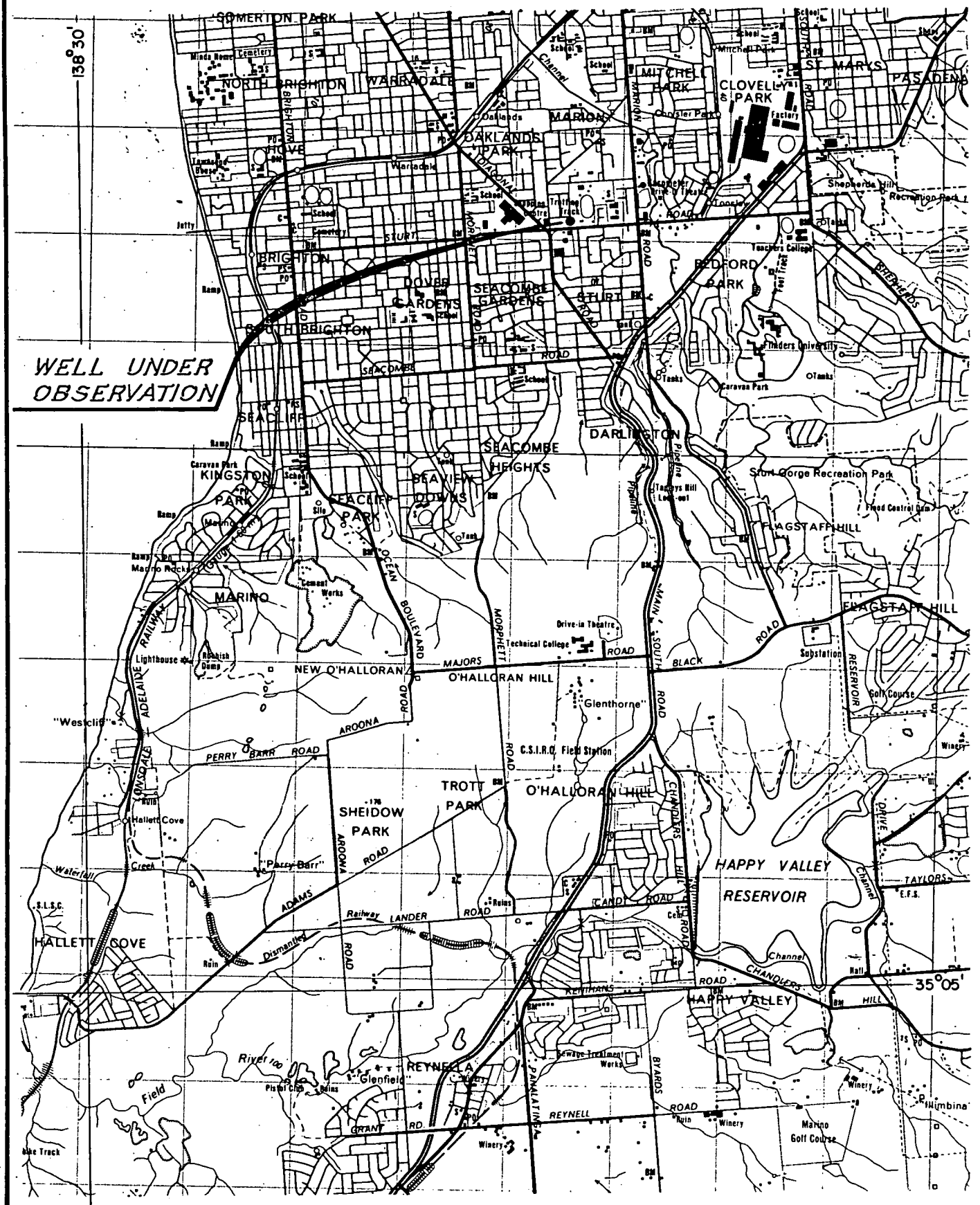
X.P. Sibenaler

Geologist II

APPENDIX A

WATER ANALYSES
Water samples obtained during well discharge test

Analysis No.	Conductivity ( ) s at 25°C)	Salinity (mg/l)	pH	Remarks
W4428/81	2040	1140	7.4	Stage 1, after 2 minutes
4429/81	1960	1105	7.4	End stage 1
4430/81	1960	1105	7.4	Stage 2, start
4431/81	1990	1120	7.4	Stage 2, final
4418/81	2040	1140	7.3	Stage 3, start
4419/81	2040	1140	7.4	Stage 3, 60 minutes
4432/81	1990	1120	7.4	Stage 3, 120 minutes
4433/81	2010	1130	7.4	Stage 3, 180 minutes
4416/81	2020	1135	7.3	Stage 3, 250 minutes
4417/81	2030	1135	7.3	Stage 3, 300 minutes
4420/81	2050	1150	7.3	Stage 3, 360 minutes



Well unit no. 6627010OW06234

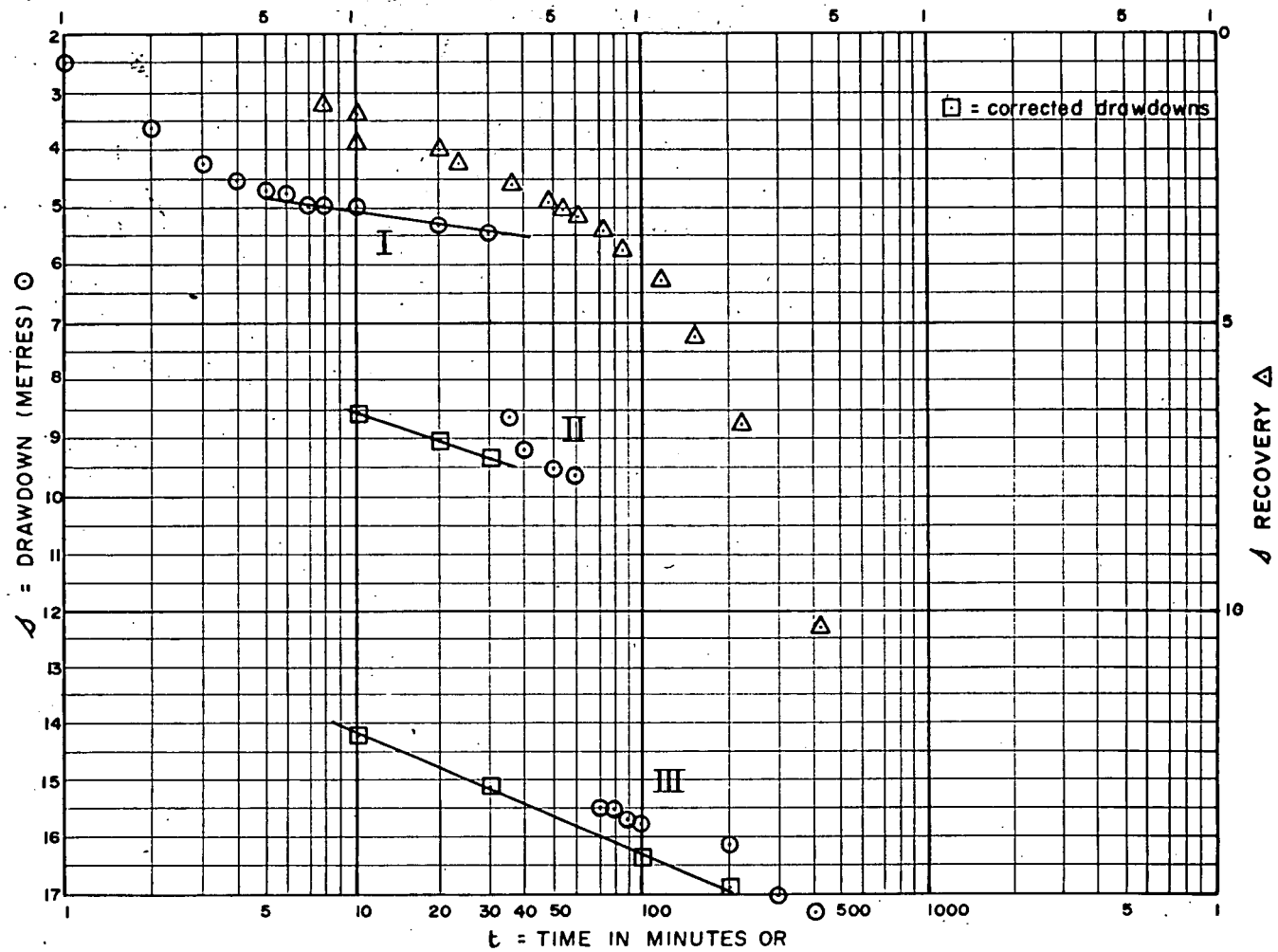
SCALE

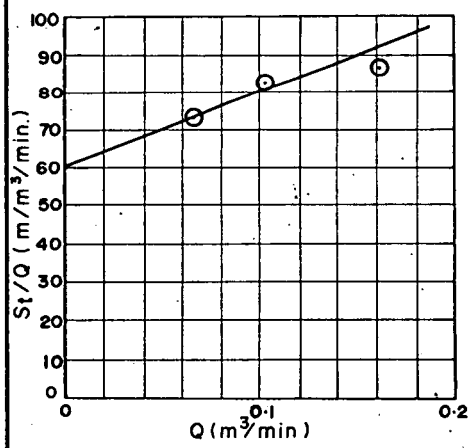
METRES 1000 0 1 2 3 KILOMETRES

FIG. 1

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED X.P.Sibenaler	10·2·82 C.D.O. DATE
	DRAWN E.R. Calabio	SCALE 1:50,000
STURT RECREATION GROUND WATER SUPPLY WELL LOCALITY PLAN	DATE Aug. 1981	PLAN NUMBER S 15746
	CHECKED	

2559





STEP	Q (m³/min)	$S_t = 1$	$\frac{S_t=1}{Q}$	$S_t = 10$	$\frac{S_t=10}{Q}$	$S_t = 100$	$\frac{S_t=100}{Q}$	Δs	$\frac{\Delta s}{Q}$	T*
1	·068			5	73·5			1	14·7	18
2	·103			8·6	83·5			1·6	15·5	17
3	·161			14·2	88·2			2	12·4	21

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

PERMIT No. 8565

STATE / UNIT No. 6627010OW06234

INTERVAL TESTED

From 54 m. to 71 m.

HOLE DEPTH 71 m.

AQUIFER

From 52 m. to ..... m.

LENGTH OF TEST 7 hours

DEPTH OF PUMP INTAKE 49 m.

DEPTH OF WATER LEVEL

AT START OF TEST 21·8 m.

AVAILABLE DRAWDOWN 25 m.

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

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

From $\frac{S_t}{Q}$ versus Q, a = 45

b = 15

c = 208

Therefore $S_t = 45Q + 208Q^2 + 15Q\log_{10}t$

WELL RECOVERY

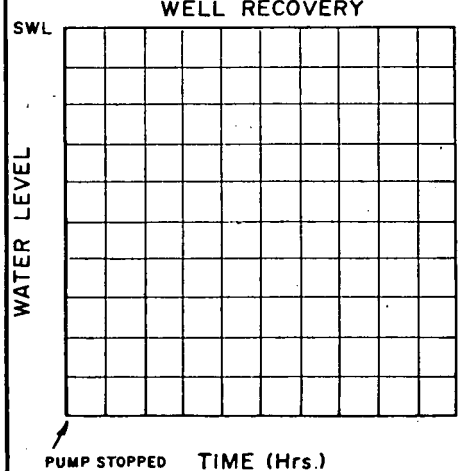
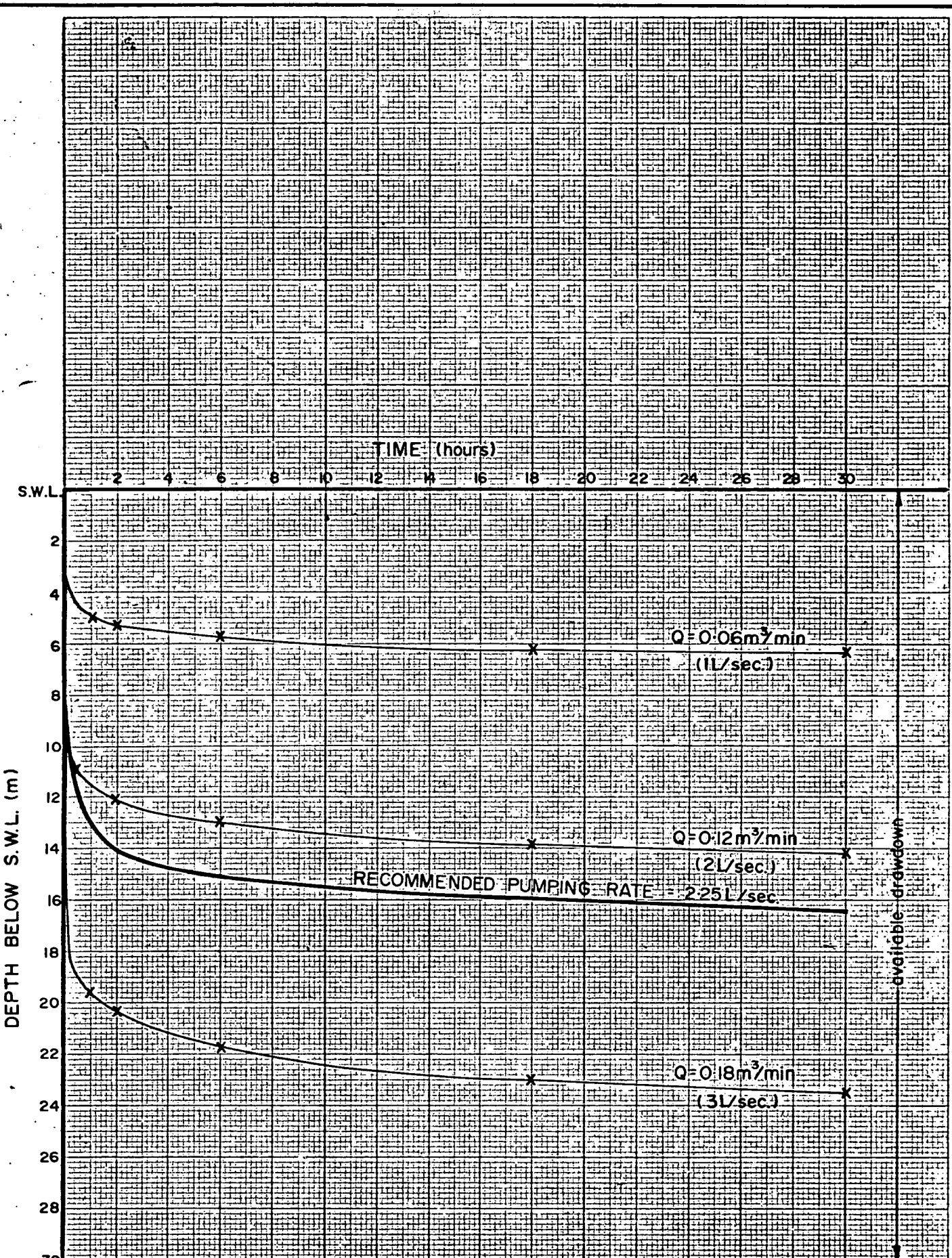


FIG. 2

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE
COMPILED X. P. Silbenaler	STURT RECREATION GROUND	DATE AUGUST 1981
DRN E.R.C. CKD	WELL No. 6627010OW06234	PLAN NUMBER
	STEP DRAWDOWN TEST	S 15747

2559

MF 88



Well unit no. 6627010OW06234

FIG. 3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

COMPILED X.P. Sibenaler

C.D.O. 10·2·81 DATE

DRAWN E. CALABIO

SCALE

DATE SEPT. 1981

CHECKED

PLAN NUMBER S 15748

STURT RECREATION GROUND
WATER SUPPLY WELL
ANTICIPATED WELL CAPACITY RATING

2559

DEPARTMENT OF MINES & ENERGY – SOUTH AUSTRALIA
ENGINEERING DIVISION

COMPOSITE WELL LOG – GROUNDWATER

PERMIT No. 8565
UNIT/STATE No. 6627O100W06234
SERIAL No. 1047/81
FOLDER No.
DRG. No. 81-620
SHEET 1 OF 1

CONSTRUCTION DETAILS

DRILLING TECHNIQUE: ROTARY TO 54m, CORED HQ 104·77mm to 74m
CIRCULATION: BENTONITE (Reamed to 71m)
START: 24/3/81
FINISH: 13/4/81
TOTAL DEPTH: 74·2m

		m.m	From(m)	To(m)
HOLE DIAMETER		215·9	0	54
		152	54	71
CASING DIAMETER (Cemented)		152	0	52
CASING DIAMETER (Uncemented)		127	48·5	71
			slotted: 51·65	71
SCREEN DETAILS Make / Model Dimensions				

PROJECT STURT RECREATION GROUND
MARION COUNCIL
LOCATION
SECTION HUNDRED
CO-ORDINATES
LOGGED BY R. Turner
REFERENCE ELEV. DATE 27/3/81
SURFACE ELEV. TRACED BY E.R. CALABIO
DATUM DATE AUGUST 1981

TYPE OF LOG	16 IN. NORMAL	64 IN. NORMAL	6FT. LATERAL	S.P.	POINT RESISTIVITY	NEUTRON	GAMMA RAY	TEMPERATURE	
DATE OF RUN	27/3/81	27/3/81	27/3/81	27/3/81		27/3/81			
FIRST READING (m)	0	0	0	0		0	0		
LAST READING (m)	76	76	76	70		75·2	75·2		
INTERVAL MEASURED(m)									
CASING : LOGGER (m)									
CASING : DRILLER (m)									
DEPTH REACHED (m)	74	74	74	74		74	74		
BOTTOM : DRILLER (m)	73	73	73	73		73	73		
MUD TYPE	BENTONITE	BENTONITE	BENTONITE	BENTONITE					
MUD RESISTIVITY	2·7 at 21°C	2·7 at 21°C	2·7 at 21°C	2·7 at 21°C					
RECORDED BY									

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.
	20·73	200	7 hour well discharge test	1130	W4433/81

REMARKS :

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

QUATERNARY – RECENT

0–3m: dark brown silty sands.

3–6m: dark brown gritty clay.

6–12m: mainly fine gravels and minor coarse sands of quartz and rock fragments (siltstone).

12–30m: as above with 5–10% light brown clay matrix. Fine to coarse gravels, with light brown clay inter-beds, increasing with depth.

30–48m: sandy (fine, less than 10%) malleable soft light brown clay.

As above, mottled grey (less than 5% fine sands).

Light grey, mottled light brown malleable soft clay.

48–51m: gritty (calcareous sandstone) brown clay

?

TERTIARY

51–54m: fine grained calcareous sandstone (grey brown, indurated).

54–56·27m: No Core

56·27–56·3m: brown silty gritty clay, contamination ?
56·3–56·4m: fawn brown calcareous, very fine (0·2mm) sands with indurated limestone fragments.
56·4–57m: indurated calcareous sandstone, fossiliferous, broken, with cavities.
57–58m: mainly friable, fawn brown calcareous, very fine sandy limestone, minor indurated calcareous sandstones, strongly fossiliferous.
58–59·2m: No Core
59·2–60·8m: moderately indurated, fossiliferous (strong), fawn to dark grey and fine calcareous sandstone with fine friable fawn brown sands, fossiliferous.
60·8–62·2m: No Core
62·2–63m: friable (very weakly indurated) calcareous grey fawn, fine quartz sands, minor opaques.
63–65·2m: No Core
65·2–67·7m: dark grey to grey, very fine calcareous quartz sands, 15–25% opaques, including semi-opaque (oxidized glauconite), clayey in parts, poorly to strongly fossilized.
67·7–68·2m: No Core
68·2–71m: As from 65·2 to 67·7
71–71·2m: No Core.
71·2–72m: greenish grey, poor to strongly fossilized, calcareous fine sands, friable in places, glauconitic.
72–74m: No Cores

GAMMA 5c.p.s. | NEUTRON 12·5c.p.s. | 6' LATERAL 5mV | 16"–64" NORMAL 16" 5Ω 64" 2·5Ω | SELF – POTENTIAL 5mV

0 20 40 60 80

FIG. 4