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1987/55. Pump tests on water bores at Cygnet.

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Abstract

Two bores in lower Permian fossiliferous siltstone near Cygnet have been pumped at rates of about 66 and 94 litres per minute for three days. As the water storage is mainly in fractures it is not possible to safely extrapolate the pump test information because of possible fracture intensity variation. However with intermittent rather than continuous use, the bores should be capable of being pumped at these rates over long periods. The moderate rainfall should recharge the supply. Chemical analyses show that the water from each bore has similar amounts of dissolved solids, with relatively high proportions of calcium and sulphate for Permian rocks.

INTRODUCTION

Huon Valley Springs requested that the Department of Mines undertake pump tests on water bores installed by a private contractor in August.

There have been a number of holes drilled on the property previously and these, together with the more recent ones, are shown on Figure 1 (locations are approximate).

Each of the holes has been drilled into rocks of Permian age, which consist dominantly of dark grey siltstone. The rocks have been mapped as part of the Woody Island Siltstone which is in the lower part of the Permian sequence (Farmer, 1981). Fossiliferous horizons have been exposed in excavations on the property. The Permian rocks are generally flat bedded with minor tilting due to faulting, and have not been subjected to any significant folding.

K. Barrett measured drawdowns for Hole 1 while R. Armstrong collected the information for Hole 2.

DRILLING RESULTS

The contractor has supplied the following brief descriptions of the installed bores.

	Hole 1	Hole 2
Total depth (m)	54.9	24.4
Depth water struck (m)	10.7, 21.3	12.2
Output (approximate)	91 l/min	152 l/min
Casing 150 mm PVC (m)	54.9	24.4
Abbreviated log (m)	0 - 0.6 topsoil 0.6-12.2 clay 12.2-54.9 mudstone	0 - 0.9 topsoil 0.9- 9.1 clay 0.1-24.4 mudstone

GROUNDWATER OCCURRENCE

The groundwater encountered in the bores is the result of a proportion of the rainfall seeping underground. Transmission of the water is by an interconnection of joints and bedding planes. All of the bores on the property are likely to be withdrawing water from the same source, i.e. long

term pumping of any hole is likely to have at least some effect on the others. The size of the effect is likely to be related to the distance from the pumped bore.

PUMP TESTS

Pump tests lasting three days were requested for each of the two holes. Measurements of water levels with time are appended. Hole 1 is about two metres from an existing bore, while Hole 2 is about 42 m from Hole 1.

Hole 1

A pump (helical rotor type) was installed to about 36 m in the hole, together with 32 mm diameter pipe to measure water levels. The output of the bore varied over a range of about 64-68 l/min for most of the test. Unfortunately a nearby bore was pumped intermittently during about the first five hours of the test and produced abnormal drawdowns. When it was arranged to discontinue pumping this bore, the water level recovered, as shown on the accompanying plots (fig. 2). A relatively regular drawdown was produced for about the next 30 hours, when water levels in the bore began to fluctuate. It is not known what caused this but it may have been due to variations in the speed of the diesel motor used to drive the pump. It is assumed that the bore nearby was not pumped at this later stage of the test.

Although the driller reported that the lowest depth at which water was struck was 21.3 m it is probable that at least some extra water was picked up at deeper levels. As the drawdown after three days continuous pumping was only to about 24 m, it is likely that the bore could be pumped for significantly longer periods. The length of time that continuous pumping could be undertaken cannot be predicted with certainty however, as this will depend on the consistency of the permeability in the rock surrounding the bore. If the degree of fracturing, and openness and interconnection, is uniform over a wide area, the bore should be capable of being pumped continuously for extended periods. If the bore is rested at regular intervals this will help in counteracting any variations (particularly lower) in permeability in the vicinity of the bore.

Hole 2

The pump was installed to about 23.5 m and arranged to deliver about 144 litres per minute (1900 gallons per hour) of water. For the first hour it appeared that the bore would maintain this output for the proposed three days but soon after drawdown increased more rapidly (fig. 2), and after about 4.5 hours the water level was near the bottom of the pump and the pump test was stopped. It is apparent that the cone of depression extended into rock with a lower permeability than that of the material immediately surrounding the bore.

The output of the pump was slowed to deliver about 94 litres per minute (about 1240 gallons per hour). The bore was able to maintain this rate for the three days but towards the end the drawdown curve steepens and it may have not been able to maintain the rate much longer (fig. 3). However with non-continuous use, this rate should be possible for quite long periods. It is of interest to note that drawdown tends to stabilise in the overnight periods. This again may be due to spontaneous changes in the motor speed, as the throttle was not altered.

CHEMICAL ANALYSES

Samples of water were collected at the end of each test and analysed by the Department of Mines laboratory in Launceston (Appendix 2). The composition of these waters is very similar. The most significant aspects are the relatively high proportions of calcium and sulphate compared with other Permian-age rocks in Tasmania.

CONCLUSIONS

The two new bores at the Huon Valley Springs property near Cygnet have been pumped for three days at rates of about 66 and 94 litres per minute. It is not known how much longer the bores could sustain these rates because of the nature of the aquifer but as it is expected that they will be used intermittently and not continuously, it is probable that the bores could be pumped at these rates for quite a long period. Periods of non-pumping will allow the aquifer to recover, and the moderate rainfall will recharge the system.

The chemical analyses show that the water from both bores has a similar composition.

REFERENCE

FARMER, N. 1981. Geological atlas 1:50 000 series. Sheet 88 [8311N].
Kingborough. *Department of Mines, Tasmania*

[9 November 1987]

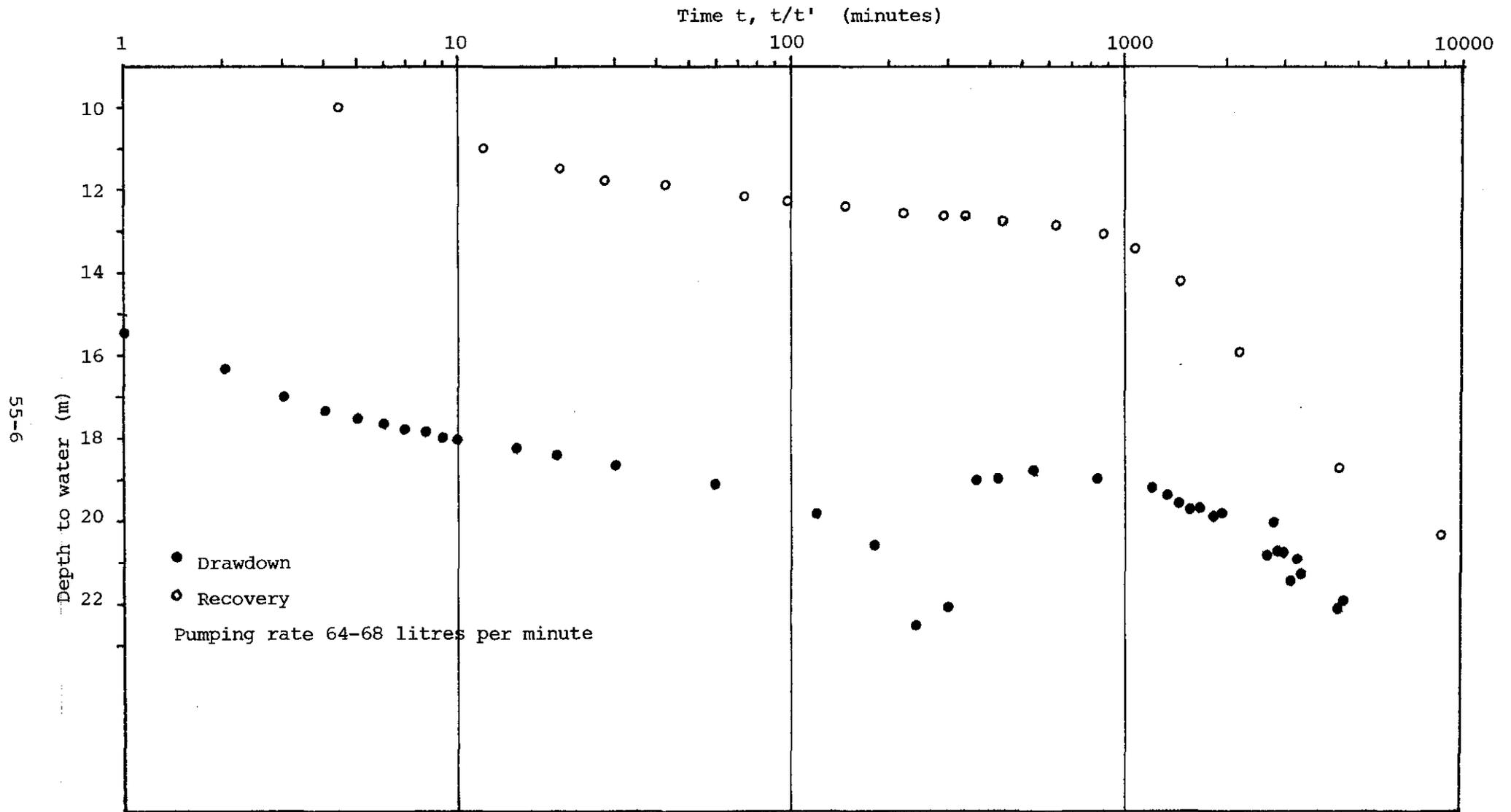


Figure 2. Drawdown and recovery curves, Hole 1

5 cm

HOLE 2

Pumping period 29 September 1987
Output 144 litres/minute

<i>PUMPED HOLE</i>		<i>OBSERVATION HOLE (Hole 1)</i>	
<i>Time</i>	<i>Water depth (m)</i>	<i>Time</i>	<i>Water depth (m)</i>
9.00 am Tuesday	14.18	9.00	11.48
9.01	15.78	9.05	11.48
9.02	16.51	9.12	11.51
9.03	16.84	9.31	11.63
9.04	17.12	9.47	11.70
9.06.5	17.54	10.02	11.75
9.08	17.79	10.35	11.86
9.10	17.91	11.02	11.965
9.17	18.25	12.05	12.13
9.27	18.56	1.35	12.36
9.30	18.59		
9.45	18.92		
10.00	19.12		
10.32	19.81		
11.00	20.22		
12 midday	21.30		
12.38 pm	21.68		
1.00	22.23		
1.30	22.98		

Test stopped when water level almost at maximum drawdown for pump. Test restarted at lower output.

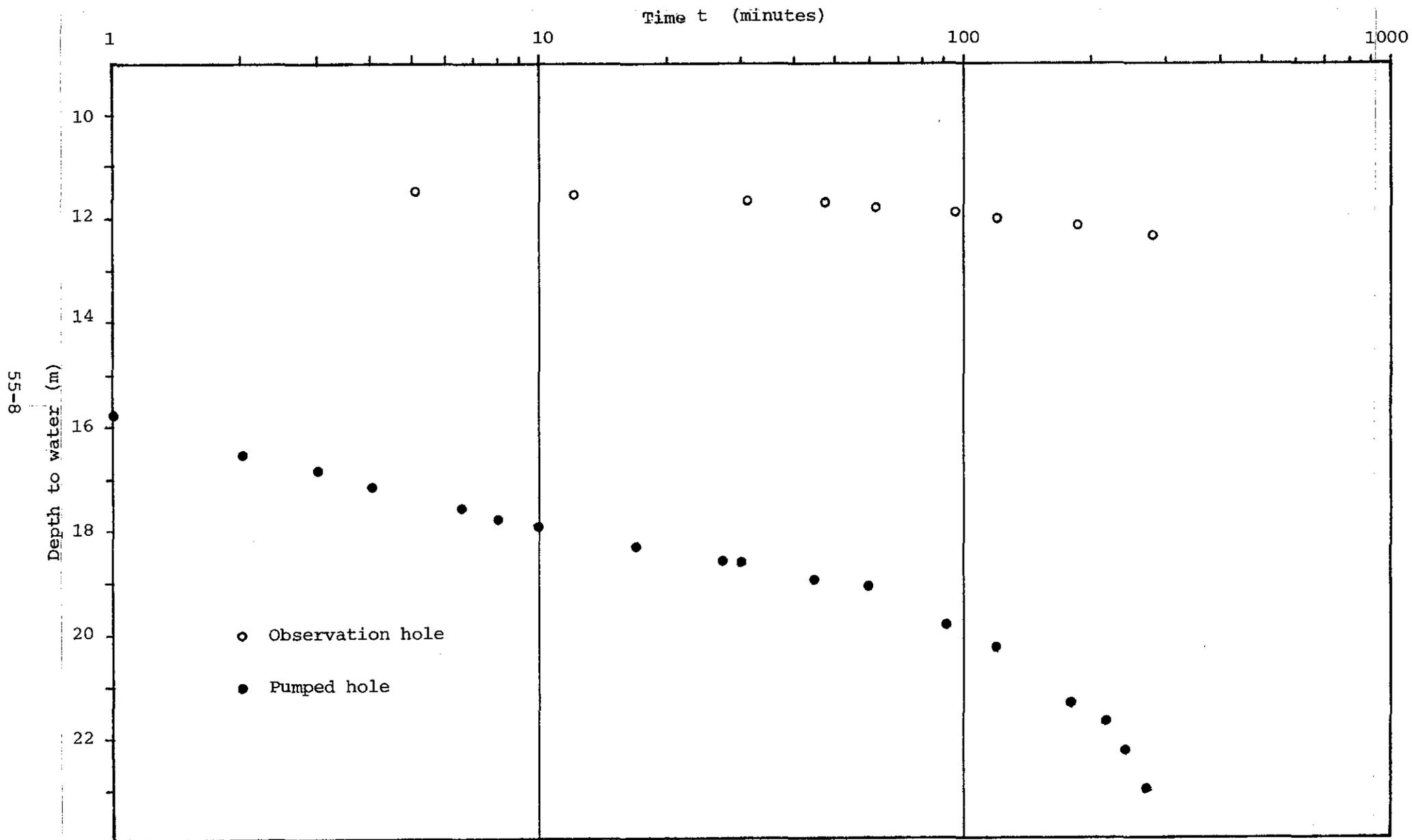


Figure 3. Drawdown curves, Hole 2 pump test (pumping rate 144 l/min)

HOLE 2

Pumping period 30 September to 3 October 1987
Output 94 litres/minute

<i>Time</i>	<i>Water level*</i> (m)	<i>Time</i>	<i>Water level</i> (m)
Pumped Stage			
7.50 am Wednesday	14.45	6 pm	18.53
7.51	15.48	10 pm	18.84
7.52	15.80	6 am Thursday	19.21
7.53	15.98	10 am	19.66
7.55	16.21	2 pm	19.85
7.57	16.35	6 pm	20.185
7.59	16.44	6 am Friday	20.22
8.00	16.48	10 am	20.76
8.04	16.58	11.49 am	20.79
8.06	16.62	2.00 pm	21.00
8.16	16.75	4.45	21.40
8.20	16.82	9.32	21.55
8.25	16.83	8.25 am Sat.	21.58
8.30	16.87	Recovery Stage	
8.40	16.99	8.26 am Sat.	19.23
8.50	17.11	8.27	19.07
9.00	17.18	8.28	18.52
9.15	17.23	8.29	18.11
9.30	17.31	8.30	17.94
9.45	17.39	8.36	17.58
10.00	17.42	8.42	17.46
10.30	17.58	9.08	17.08
11.00	17.74	9.42	17.00
12 midday	17.91	10.21	16.80
1 pm	18.03		
2 pm	18.19		
4 pm	18.38		

Measurements of observation hole (Hole 1)

Pumped Stage			
7.38 am Wednesday	11.63	2.05 pm	13.00
8.02	11.67	6.03	13.10
8.13	11.72	6.08 am Fri.	13.30
8.27	11.76	11.39	13.40
9.04	11.86	2.03 pm	13.42
9.35	11.92	4.50	13.50
10.34	12.00	9.43	13.55
11.07	12.05	8.20 am Saturday	13.64
12.05 pm	12.13	Recovery Stage	
1.04	12.16	8.25 am	13.64
2.04	12.24	8.33	13.63
4.04	12.35	9.10	13.48
6.03	12.43	9.45	13.40
10.04	12.57	10.25	13.33
6.04 am Thursday	12.81		
10.05	12.93		

APPENDIX 2

Analyses of water samples

	Hole 1	Hole 2
pH	7.0	7.0
Conductivity ($\mu\text{S}/\text{cm}$)	1000	920
<i>Item (mg/l)</i>		
CO_3	nil	nil
HCO_3	230	200
Cl	135	125
SO_4	61	65
Ca	105	88
Mg	10.0	8.6
Fe	<0.1	<0.1
Al	<0.2	<0.2
K	4.2	5.3
Na	98	105
TDS	650	600
Hardness - Permanent	115	89
- Temporary	190	165
Alkalinity as CaCO_3	190	165
NO_3	<5	<5
P	<0.01	<0.01

Analyses by Department of Mines laboratory, Launceston.