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RECORDS:

1963/147

COMPLETION REPORT ON BORE 62/9 ALICE SPRINGS TOWN BASIN

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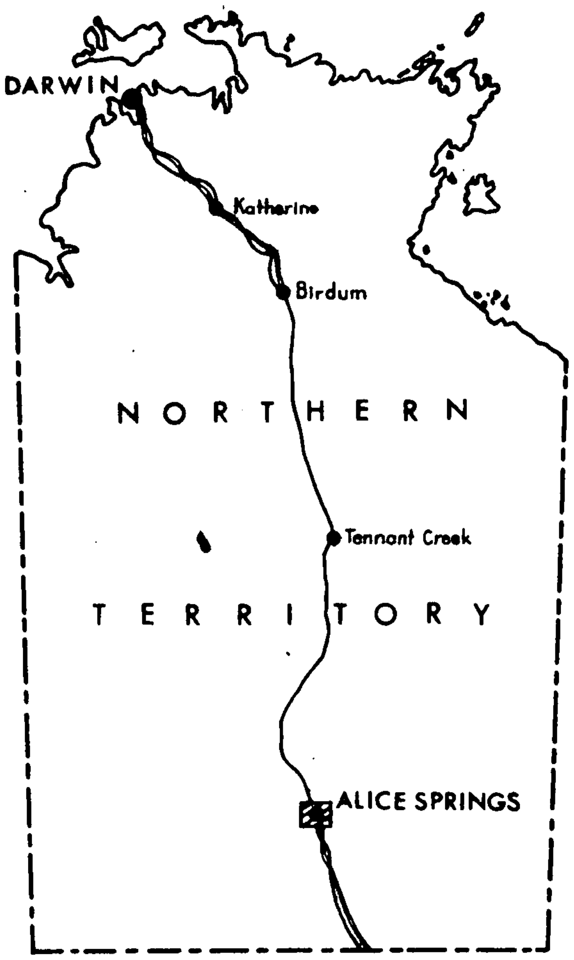
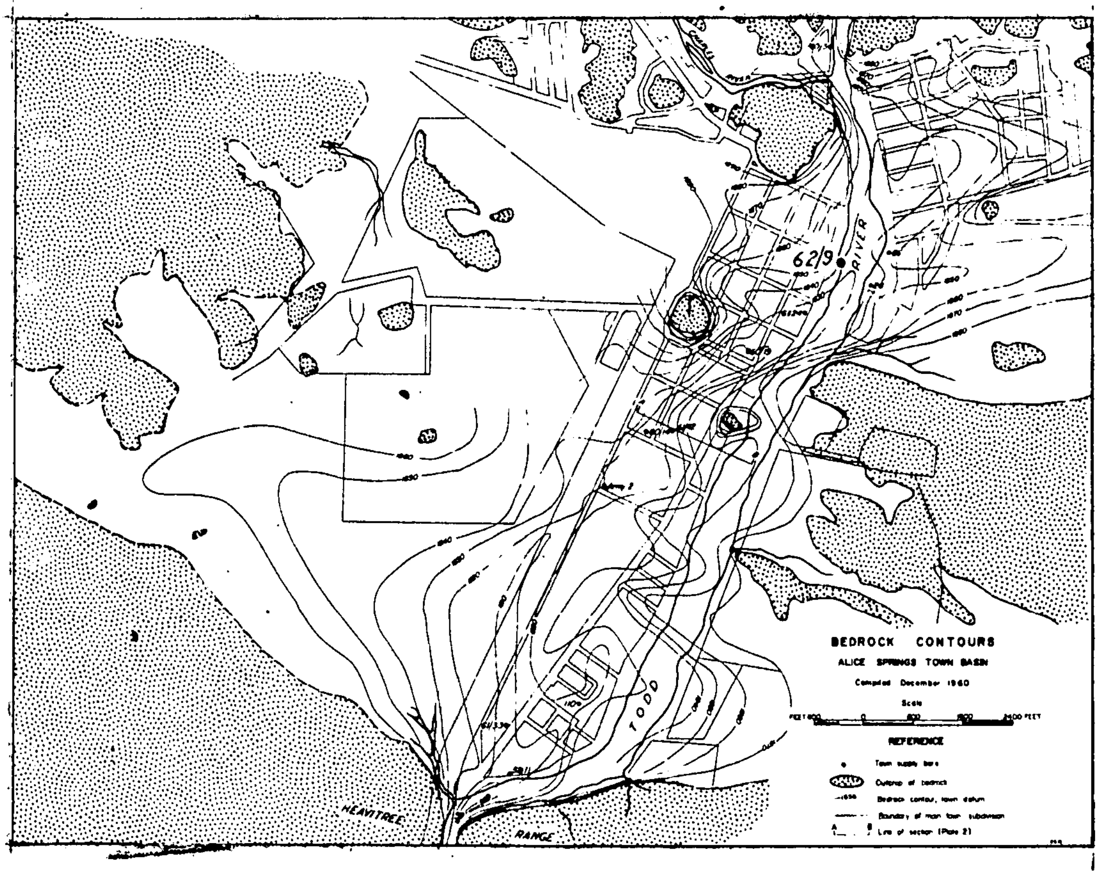




COMPLETION REPORT ON BORE 62/9 ALICE SPRINGS TOWN BASIN

by

T. QUINLAN and D. WOOLLEY

INTRODUCTION

Bore 62/9 was drilled in the middle of the Todd River approximately 800 feet south of the East Side Causeway, and adjacent to 62/8, the six inch test hole. Bore 62/10, 100 feet east of 62/9, was completed as an observation hole with slotted water pipe 2 inches in diameter.

The bore was designed and constructed to withdraw groundwater from shallow aquifers in the vicinity of the Todd River for a period of approximately 3 months following river flow.

GEOLOGY

The geology and the occurrence of groundwater in the Town Basin has been discussed by Quinlan and Woolley (1962).

The logs of bores 62/8 and 62/9 are shown in Fig. 1.

CONSTRUCTION

The bore was constructed with four lengths of 0.072 inch screens, 8 inches in diameter, screwed up to 8 inch diameter casing. The string was set using an undercut bit. One length of 0.036 inch screen 6 inches in diameter was wedged to the shoe of the 8 inch casing. This screen was placed to control the entry of sand into the bore caused by entry of water to the bore around the shoe from the aquifer at 38 feet. Subsequent measurements of drawndown during pumping indicated that this aquifer was shut off by sloughing of silt and clay in the interval 46 feet to 50 feet.

The positions at which the screens were set are shown in Fig. 1.

It had been proposed to set five lengths of 8 inch screen in the hole, but an inspection of the screens before they were set showed that one length had a buckled cage and that the windings had sprung. A replacement was not available.

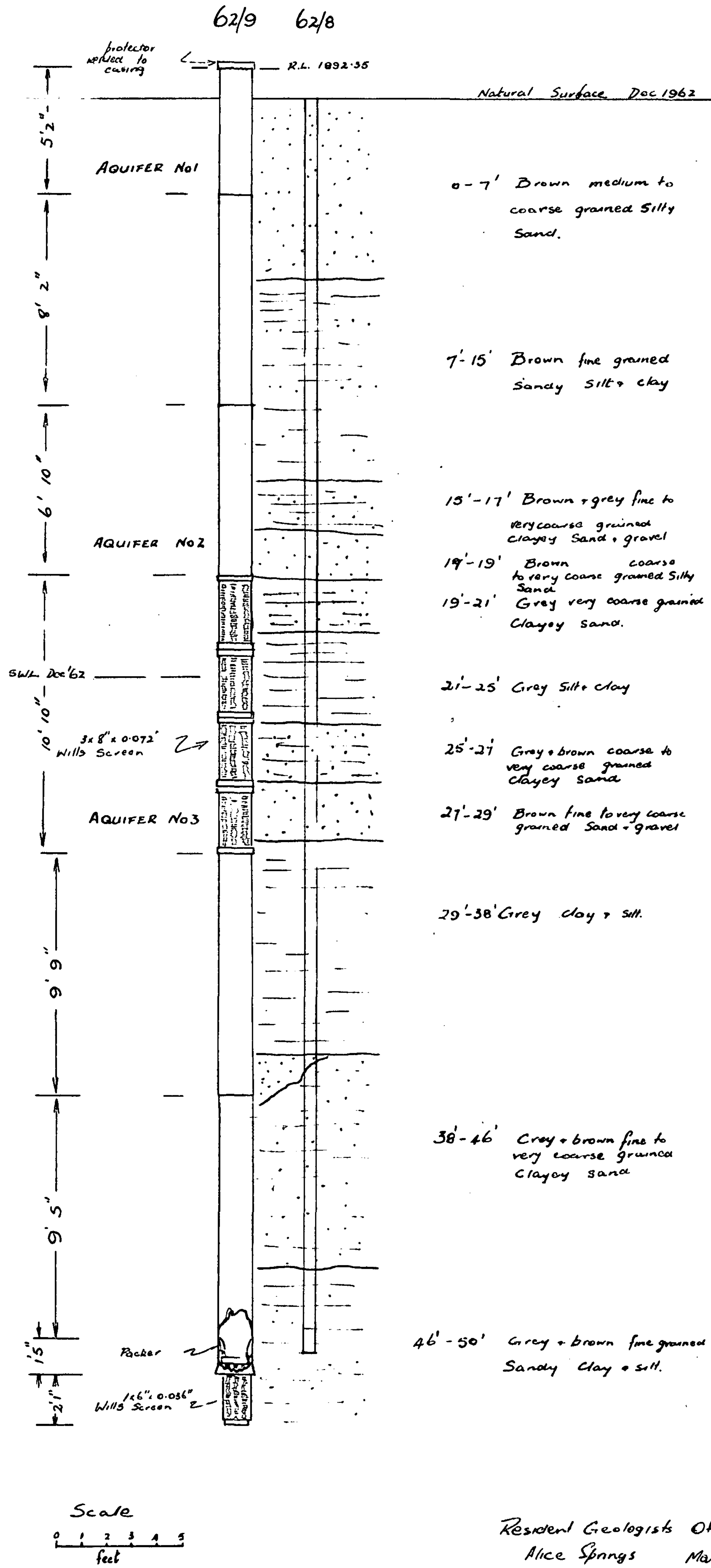
DEVELOPMENT

The bore was developed by pumping with an axial flow turbine pump at discharge rates varying up to 5000 gph and for periods of up to four hours. Periods of pumping were alternated with short periods of backwashing, the latter being ~~accompanied~~ accomplished by stopping and starting the pump at short intervals.

RESULTS

The relation between drawdown and yield for this bore was computed from the drawdowns measured during a short period of pumping.

FIG 1 INTERPRETATIVE LOG AND DETAILS OF CONSTRUCTION OF BORE 62/9



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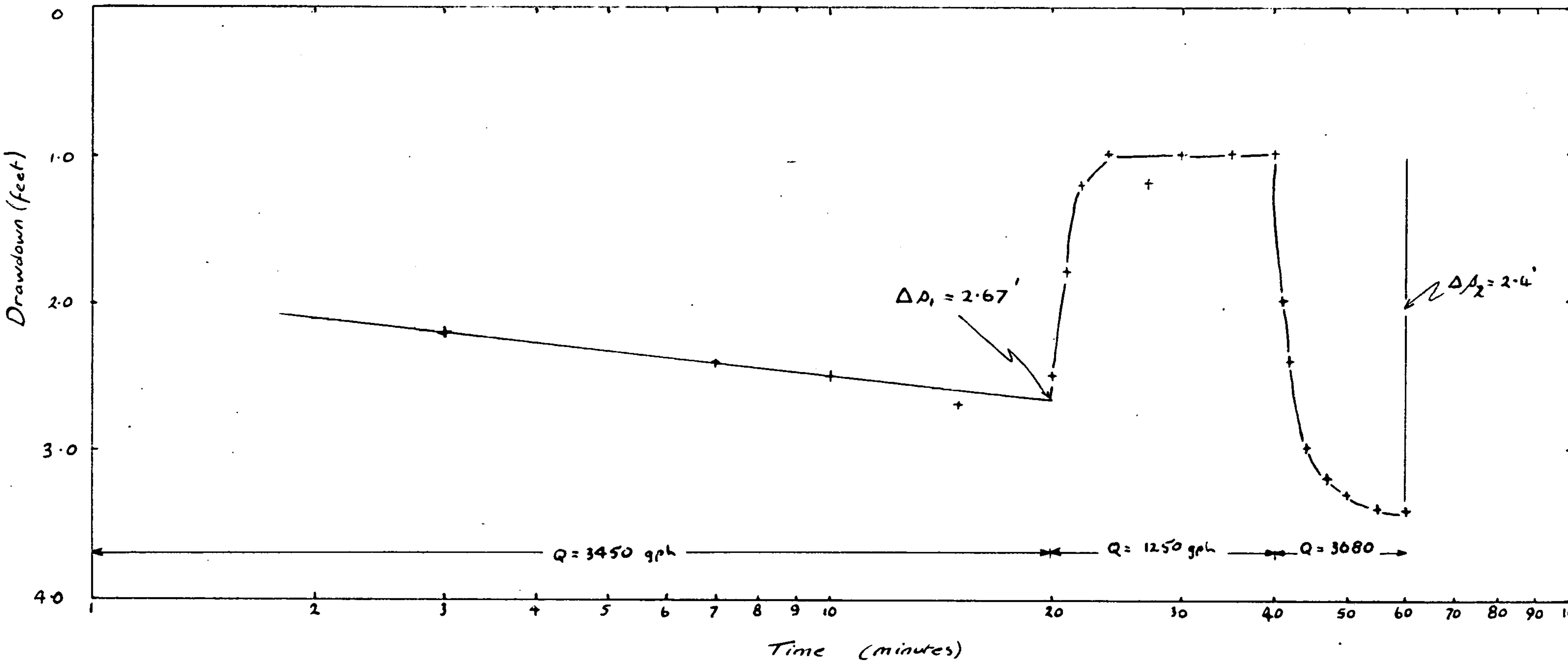

FIG 2 STEP DRAWDOWN TEST, BORE 62/9

Q = yield in gallons per hour Δs_1, Δs_2 = incremental drawdown

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FIGURE 2

The well loss is given by the equation -

$s_w = CQ^2$......(1) where s_w is the drawdown due to well loss (feet)

Q is the discharge in gph

C is the well loss constant

The value of C can be calculated from a step drawdown test, from the following which can be derived from equation (1).

$$C = \frac{(s_2/Q_2 - (s_1/Q_1)}{Q_1 + Q_2} \text{ ....(2)}$$

where s_1 and s_2 are the drawdown increments for the first and second steps respectively and Q_1 and Q_2 are the discharge increments for the first and second steps.

Fig. 2 shows graphically the results of a step drawdown test, carried out on bore 62/9, in which there were three steps having discharge rates of 3450, 1250 and 3680 gph respectively. Using the first and third steps as step 1 and step 2 for the purpose of equation (2) -

$$s_1 = 2.67 \text{ ft}$$
$$s_2 = 2.4 \text{ ft}$$
$$Q_1 = 3450 \text{ gph} = 0.153 \text{ cusecs}$$
$$Q_2 = 3680 - 1250 = 2430 \text{ gph} = 0.108 \text{ cusecs}$$

and $$C = \frac{2.4/2430 - 2.67/3450}{2430 + 3450} \quad \text{hours}^2/\text{feet}^5$$

$$= 3.74 \times 10^{-8} \quad \text{hours}^2/\text{feet}^5$$

Recalculating this value using fundamental units (s in feet, and Q in cusecs)

$$C = \frac{\frac{2.4}{0.108} - \frac{2.67}{0.153}}{0.153 + 0.108} = 18.4 \quad \text{sec}^2/\text{ft}^5$$

This value is high and indicates clogging of the screens. (Values of C below 5 indicate satisfactory development, Walton 1962).

The drawdown s due to withdrawal of groundwater from a leaky artesian aquifer is given by the equation (Hantush and Jacob 1955) -

$$s = \frac{1.91Q}{T} W(u, \beta) \quad \text{.........(3)}$$

when Q is discharge in Imp g.p.h.
s is measured in feet
T = coefficient of transmissibility, in Imp gpd/ft

The term $W(u, \beta)$ is the well function for a leaky artesian aquifer. β is a term expressing the degree of departure from non-leaky conditions and u is given by the equation -

Figure 3

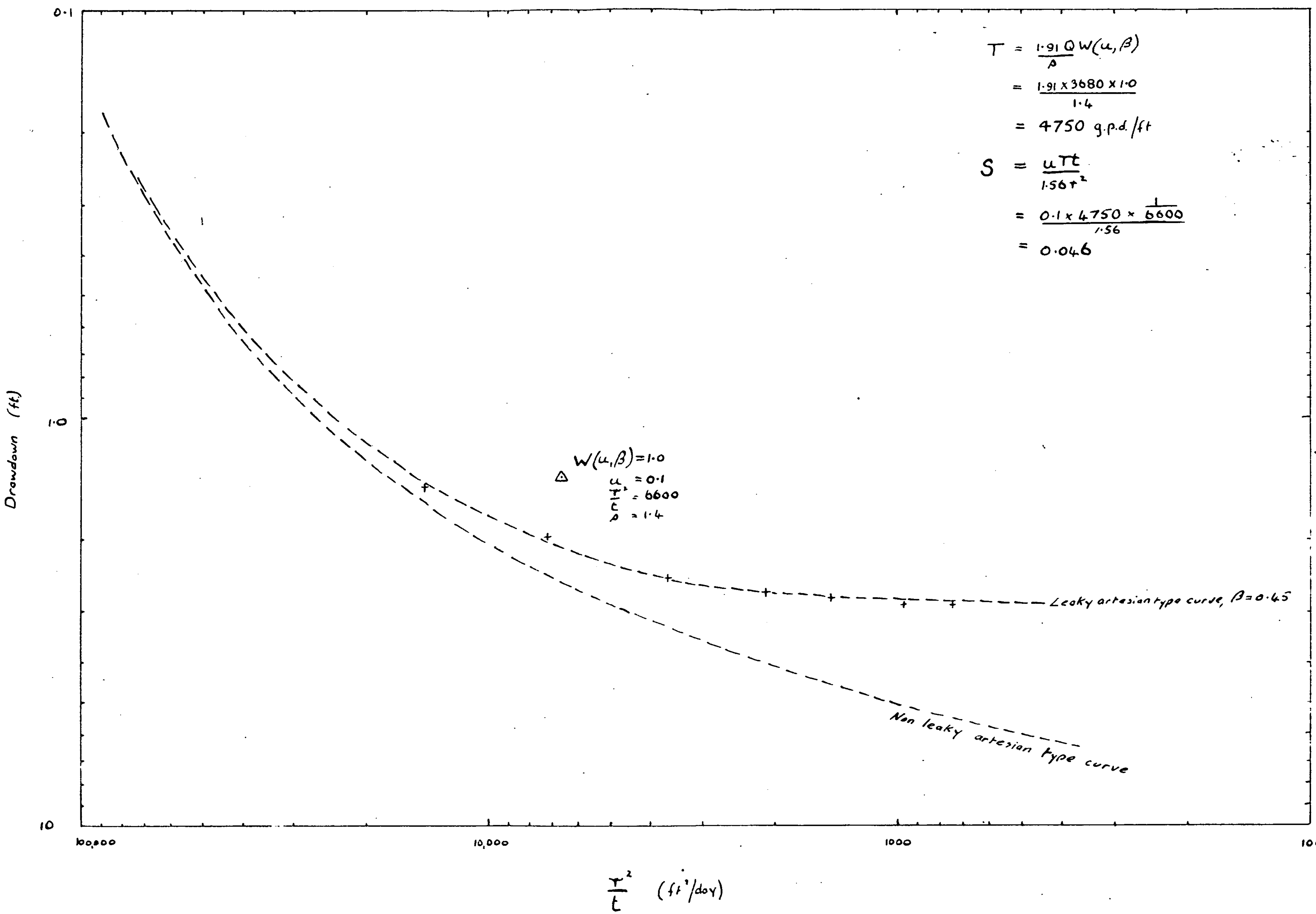

FIG. 3 PLOT OF OBSERVED ρ AGAINST $\frac{1}{t}$, SHOWING FIT WITH LEAKY ARTESIAN TYPE CURVE

(see text for explanation of symbols)

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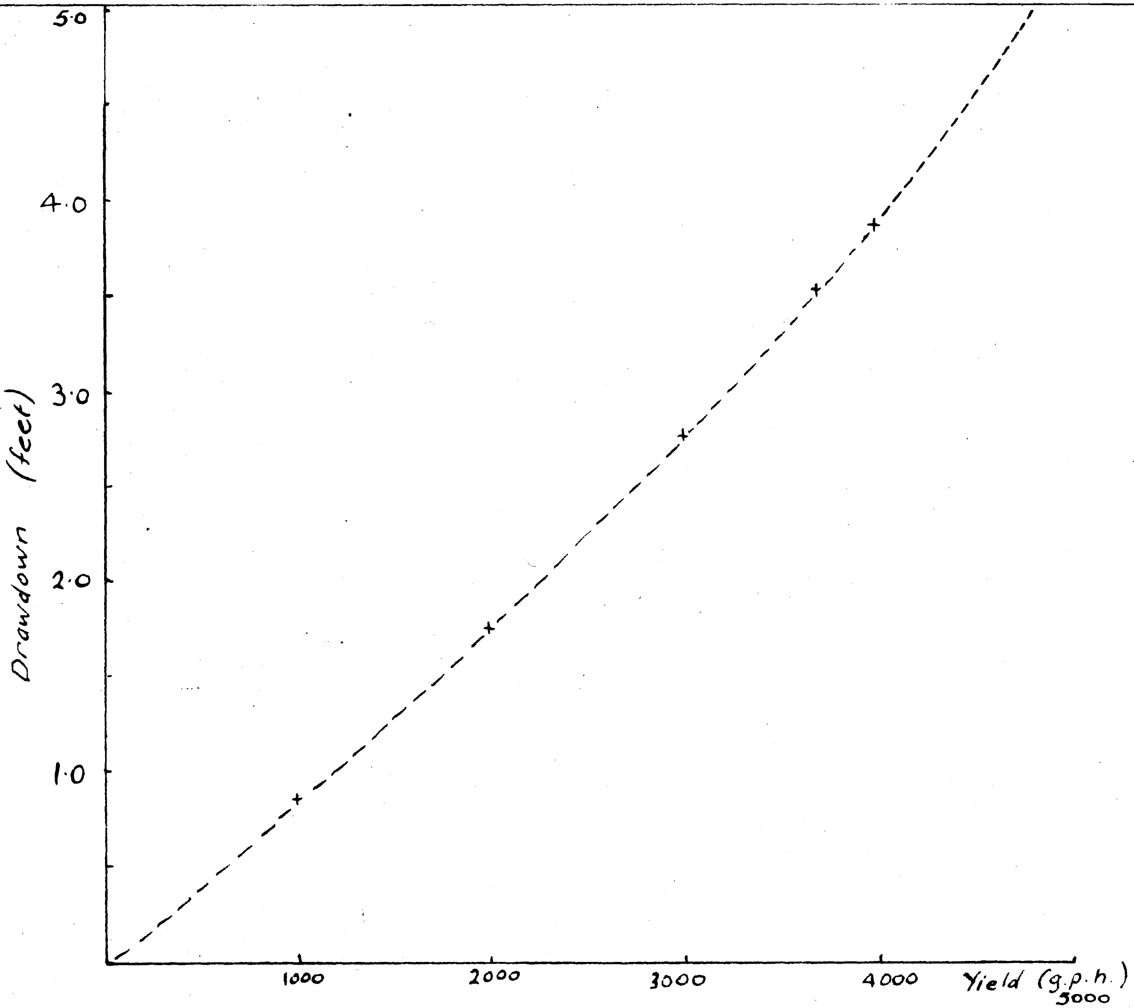

FIG 4 CALCULATED DRAWDOWN AFTER 90 DAYS PUMPING, BORE 62/9

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$$u = 1.56\, r^2 S \qquad \ldots\ldots\ldots\ldots(4)$$

where r = distance from pumped well in feet

S = coefficient of storage

T = coefficient of transmissibility in Imperial gallons per day per foot

t = time since pumping started, in days

Tables of values for the function $W(u, \beta)$ are given by Walton (1962). Values of T and S can be obtained by plotting Δ against $\frac{1}{t}$ on logarithmic paper, and finding the best fit between this curve and one of a family of type curves plotted for various values of β. This has been done in Fig. 3, the observed data have been fitted to a leaky artesian type curve for $\beta = 0.45$. (Values of the drawdown plotted in Fig.3 have been corrected for well loss. These values are shown in Table 1). Using the values obtained at the match point for $W(u, \beta)$ and u, Δ, and $\frac{1}{t}$, values were calculated for T and S (Computation shown on Fig.3) using equations (3) and (4).

These values are

$$T = 4750 \text{ gpd/ft}$$
$$S = 0.046$$

TABLE 1

For $Q = 3680$ gph, well loss $\Delta w = 3.74 \times 10^{-8} Q^2 = 0.5$ ft.

Time since pumping started (minutes)	Observed drawdown	Corrected drawdown
1	2.0	1.5
2	2.4	1.9
4	3.0	2.5
7	3.2	2.7
10	3.3	2.8
15	3.4	2.9
20	3.4	2.9

Equation (3) can be rewritten in the form $\Delta = BQ$ where $B = \frac{1.91}{T} W(u, \beta)$

when $t = 90$ days

$$u = \frac{1.56\, r^2 S}{Tt} = \frac{1.56 \times 0.046}{4750 \times 90} = 0.17 \times 10^{-8}$$

Also, $\beta = 0.45$

Whence $W(u, \beta) = 2.0258$

Hence $B = \frac{1.91}{4750} \times 2.0258 = 8.15 \times 10^{-4}$

and the total drawdown Δ, after a period of 90 days pumping, is given by

$$= 8.15 \times 10^{-4} Q + 3.74 \times 10^{-8} Q^2$$

Values of Q and Δ derived from this equation are shown graphically in Fig.4.

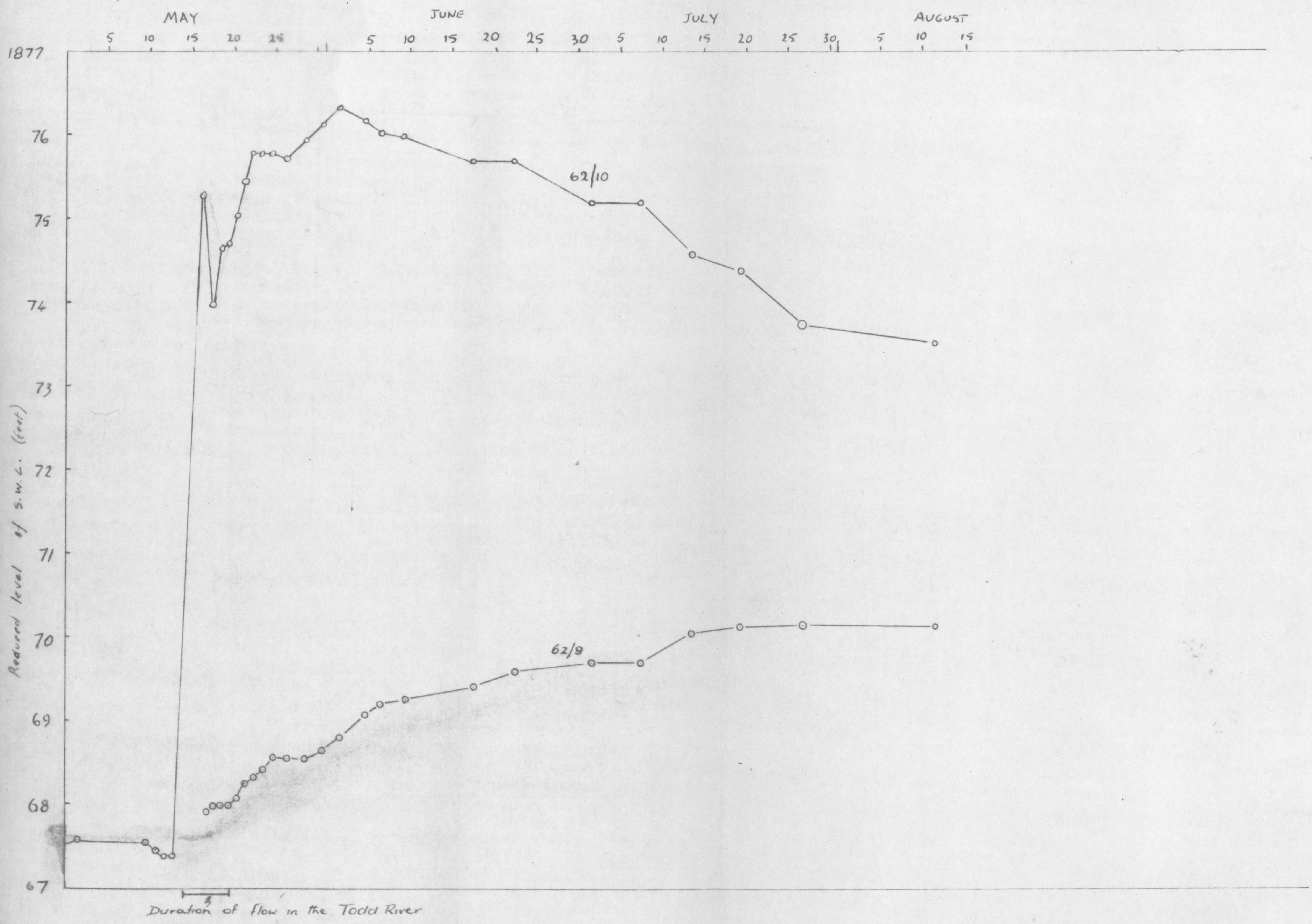

FIG 5 WATER LEVELS, BORES 62/9 and 62/10

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WATER LEVELS

The water levels which have been measured in bores 62/9 and 62/10 for the period 1st May to 1st August are plotted on Fig.5. The difference in the reduced levels of the piezometric surface between the two bores indicates that the aquifer No.2, between 17 and 19 feet (Fig.1), is cased off in bore 62/9 but is open to bore 62/10.

The water level in 62/10 rose rapidly following river flow and then after approximately three weeks fell steadily at a rate of 1.25 feet per month. This rate of fall will be continued until Aquifer No.2 is dewatered. At this point in time recharge to Aquifer No.3 will cease and the piezometric surface in this aquifer will start to fall. The movement of recharge water from Aquifer No.2 to No.3 can either be by vertical movement through material of low permeability, or by a devious path of interconnection between the aquifers.

Figure 5 illustrates the rise of the piezometric surface in Aquifer No.3 following a period of recharge under natural conditions. Withdrawal of groundwater from this squifer can be expected to modify the rate of rise and more particularly the rate of fall of the piezometric surface. Induced recharge because of the increase in head between the two aquifers under conditions of withdrawal may be a compensating factor during the period when the piezometric surface is rising. Moreover the reduced levels of the piezometric surfaces of the two aquifers will depend in large part on the time since the last period of recharge.

In spite of these intangible factors it would seem reasonable on the evidence available (Figures 4 and 5) that groundwater could be withdrawn from bore 62/9 at a rate of 3000 gallons per hour for a period of three months following river flow. The minimum allowable pumping level would be at reduced level of 1865.5 feet.

It is recommended that bore 62/9 be equipped and pumped at a discharge rate which varies between the economic minimum (say 2000 gallons per hour) and a maximum rate which will depend on the available drawdown (say 4500 gallons per hour) for a period of not less than 3 months following river flow.

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