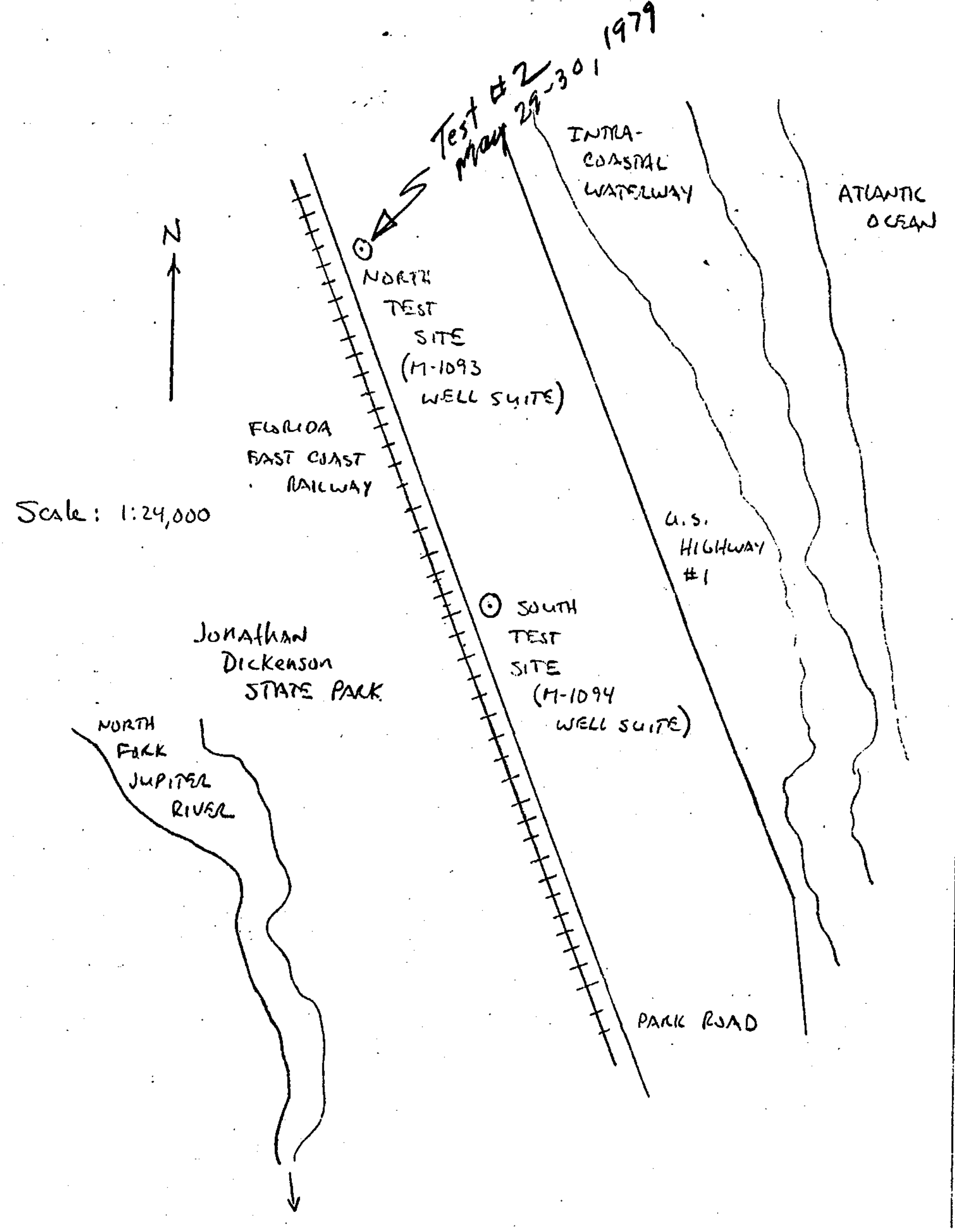
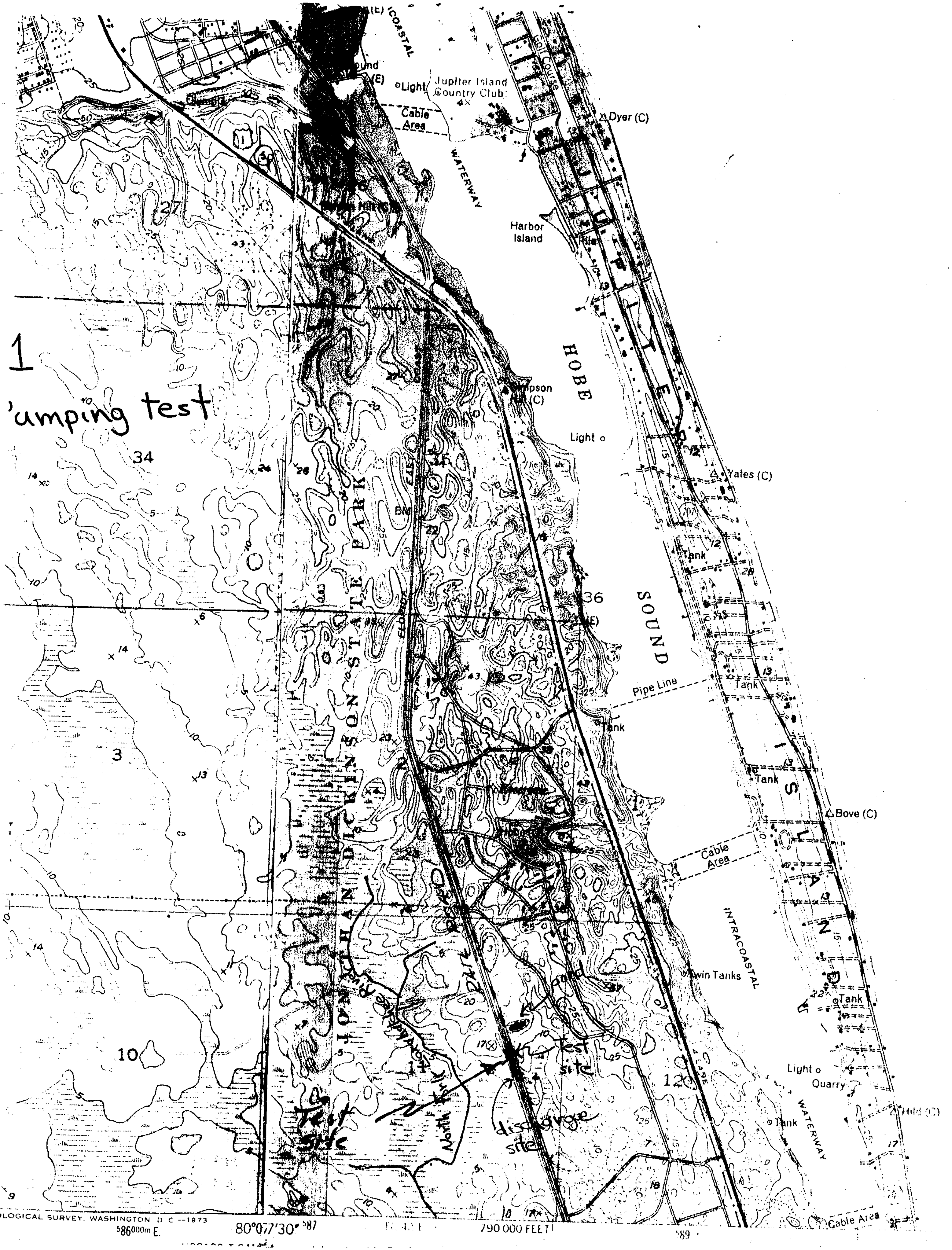


Figure 1.. Area sketch, Aquifer test, Jon. Dickenson State Park, MARTIN County Florida, 23-26 MARCH 1976.


1
'umping test
COASTAL
Jupiter Island Country Club
Light
Cable Area
Dyer (C)
WATERWAY
Harbor Island
HOBE
SOUND
Light
Yates (C)
Tank
JONATHAN DICKINSON STATE PARK
Pipe Line
Tank
Bove (C)
Cable Area
INTRACOASTAL
Twin Tanks
Tank
Test site
discharge site
Test site
North
Light
Quarry
Tank
WATERWAY
Hild (C)
Cable Area
EOLOGICAL SURVEY, WASHINGTON D C --1973
586000m E.
80°07'30" 587
790 000 FEET
589

JONATHAN DICKINSON STATE PARK

AQUIFER TEST REPORT (NORTH SITE)

BY: GEORGE W. HILL

I. Summary

A. Location. -- Site is located in Township 40 South, Range 42 East, in SW¼, SE¼, NE¼ Section 11, in the southeast corner of Jonathan Dickinson State Park, near Tequesta, Florida. Site is referred to as the North Site.

B. Date of Test. -- May 29-30, 1979.

C. Length of Test. -- Pumping: 16.6 hours;
Recovery: 2.1 hours.

D. Discharge. -- 312 GPM

E. Hydraulic Coefficients. --

Transmissivity -- 9,000 ft^2/day

Storage Coefficient -- 1.1×10^{-4}

Leakance -- 0.09/day

F. Analytical Model. -- Hantush-Jacob for leaky confined aquifers with vertical movement, nonsteady flow.

G. Computations -- by Ralph Wilcox

H. Remarks. -- This test was run in March 1976 by Larry Land, but results were not accepted by region, presumably, because of the very low pumping rate and possibly other factors. Transmissivity ranged from 13,000 ft^2/day to 34,000 ft^2/day.

II. Narrative

A. Introduction

1. Test Purpose. -- To determine the aquifer properties of the best producing zone of the so-called shallow aquifer in this particular area. The test is part of a reconnaissance study of the aquifer properties of the Upper East Coast Planning Area which includes Martin and St. Lucie Counties and eastern Okeechobee County, Florida. The investigation is in cooperation with South Florida Water Management District.

2. Personnel. -- The test was designed and equipment was installed by Larry Land, USGS, in March 1976. Larry Land also supervised the first test.

This test was supervised by Ralph Wilcox. Others involved in the test were Bill Long and Jay Wendorf.

Computations were done by Wilcox; Hill wrote the report and Fred Meyer reviewed the analyses.

B. Physical Aspects

1. Site Location. -- The test site is in the southeast corner of Jonathan Dickinson State Park near Tequesta, Florida, Township 40 South, Range 42 East, in SW¼, SE¼, NE¼, Section 11, about 2.5 miles north of the Martin County Line (Exhibit I).

2. Exploratory Drilling and Geophysical Logs. -- Lithologic and geophysical log data were obtained by Mr. Land and used in design and setting of the production and observation wells. See geophysical and lithologic log for well M-1093 in Exhibit III.

3. Aquifer Description. -- The so-called shallow aquifer is mainly composed of sand, clay, silt and shell of Pleistocene and Pliocene epochs. Sediments forming the aquifer system are components of the Fort Thompson and Anastasia Formations overlain by Pamlico Sand (W. Miller, 1979). Shell and sand lenses in the Caloosahotchee Marl are also present. Many facies changes appear. Generally the aquifer system is unconfined and under water-table conditions, but localized artesian conditions have been noted by other investigators (Parker 1955) in the vicinity of Fort Pierce and Indiantown where discontinuous clay lenses act as confining units.

Wells set in the producing zone were screened in shell and fine sand overlain by slightly indurated sandstone with shell fragments (Exhibit II, III).

4. Well Description. -- All wells were drilled to a depth of about 90 feet. The production well is 4-inch ID PVC and screened from 70-90 feet (LSD). Observation wells O, and O_2 are 2-inch ID, PVC and screened from 70-90 feet (LSD); radii are 25.5 and 100 feet respectively (Exhibit II).

5. Pump. -- The production well was pumped with a 4-inch, gasoline driven, centrifugal pump.

6. Instrumentation and Measurement of Background, Drawdown and Recovery Data. -- Keck surface followers in conjunction with Stevens F-type recorder were used to obtain water-level data.

Observation Well O, was used to obtain background W/L data from March 16-29. Records are poor because of recorder malfunctions. The record does indicate a rising trend in W/L just prior to beginning the test (ExhibitVI).

The recorder charts for drawdown and recovery data were for periods of a day with a gear ratio of 5:1.

When the test was first started a sizeable leak in the discharge pipe occurred and the test was temporarily halted and restarted after approximately 30 minutes. After 998 minutes the pump ran out of gas.

The drawdown data is complete for the period of pumping, but both charts indicate poor response of the Keck surface follower and especially that for Well O_2. A railroad track is located near the test site and passing freight trains resulted in numerous "loading" marks on each chart. Much of the time, the pen trace did not come back to the alignment of the pen prior to the passing train on both well charts. Maximum deviation of pen alignment on well O_2 before and after each train was about .04 ft. - sometimes settling downward and sometimes upward. This could be responsible for the upward trend on O_2 log-log plot of t/r^2 in the final hours of pumping.

No corrections were made to the d/d data for W/L fluctuations or trends during the test. Likewise, no corrtions were made for mechanical problems and changes in barometric pressure (negligible).

Rainfall during the test was about 0.03 inches.

Exhibit VI includes all W/L field data.

7. Discharge. -- The production well was pumped at approximately 312 GPM. Discharge was measured by using a circular orifice plate weir (6-inch pipe, 4-inch orifice) with a piezometer mounted in the side of the pipe. A gate valve was not used, but discharge remained constant throughout the test. Well performance was the limiting factor controlling the discharge rather than the pump itself (Exhibit V).

Discharge was piped 330 feet southward along the road where it was fed into a ditch which flows southward into a flat marshy area.

8. Anticipated Boundary Conditions. -- Potential boundary conditions exist both east and west of the test site. The N.F. Loxahatchee River is 1000 feet to the west. The Intracoastal Waterway is approximately 3,500 ft. northeast of the site. A pond is located just north of the test site about 600 feet. Unfortunately no drawdown data were obtained for the pond.

An approximation of the distance to a recharge source can be made using the Image Well Theory after Stallman (PL. 9, P.P. 708). By the use of the equation

$$r_i = r \times k$$

the distance from the production well to the recharge boundary can be estimated. The results of this procedure is shown below.

Well No.	Radius From Pumped Well (r)	K Factor	Radius of Image Well (r_i)	Distance to Recharge Boundary ($\frac{r_1}{2}$)
0-1	25.5	11	280	140
0-2	100	3.5	350	175

The calculated boundary distances show no relationship to the pond which is around 600 feet from the production well.

C. Computations

1. Computations and curves are included in Exhibit VIII. Four methods were considered by Wilcox. 1) Hantush-Jacob method for leaky confined aquifer with vertical movement. 2) Theis Recovery Method. 3) Boulton's delayed yield from storage solution. 4) Theim Method II.

The Theis Recovery and Theim Method II methods result in T values which are probably much too great. The Hantush-Jacob and Boulton's Delayed Yield methods yield very similar T values. The latter hours of pumping give some hint of a delayed yield situation, but because of mechanical problems in recording of data, especially for Well 0_2, caution should be taken in considering drawdown for the last few hours of the test. Too, the test was not run long enough to verify a delayed yield response.

The loading effect on the drawdown data caused by passing trains suggest a leaky artesian system. Therefore, results of the Hantush-Jacob Method for a leaky confined aquifer with vertical movement is the most reasonable solution.

2. Transmissivity. -- 9,000 ft^2/day (rounded).

3. Storage Coefficient. -- 1.1×10^{-4}.

4. Leakance. -- 0.09/day.

TO: Ralph Wilcox, Jupiter - 7-9-79

From: Fred Meyer, Miami

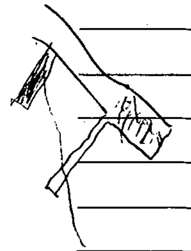
Subject: Dickinson Park Tests - Comments. (1)

Figure 2. - is X-section North-South or East-West. Where is pond relative to the wells? Is this same site as the northsite in previous tests in 1976? Show plat with wells and pond - w/scale and oriented.

P. 7 Background W/L data shows rise at beginning of the test (figure 3A) but W/L data 5/16 - 5/29 shows decline in stage with diurnal ET drawdown (figure 3-b). Also figure 3B shows strong effects of loading by passing trains, which suggests artesian aquifer (confined or semi-confined). Note W/L at test end not corrected to taped W/L.

P. 10 Was pump engines used to hold Q constant? Figure 4 shows that piezometer was fairly stable at 23-24 inches? Was the reference point for piezometer changed (see measurements 1745 - 2103)?

Figures 5a & 5b show loading effects and (~.05 ft) slight diurnal ET effect. Also looks like W/L was generally falling. Note high initial head drop in both observation wells - this probably represents true drawdown of the aquifer while the flat portion represents the recharge by leakage. Note that recharge occurs within a few seconds after startup. The other possibility is that there is a delay in response due to storage.



P. 14 - The pump should not have run out of gas if the test were planned properly. Obviously this probably has an adverse effect on the reliability of times for the recovery data.

P.14- You should have installed a recorder on the wells at the test site in the southern part of the park to show that the effects of rainfall etc. are negligible.

figures 6a & 6b- Note the diurnal ET response and decline in wl. You can add or subtract these effects and improve the flat part of the curves.

Semi-log analysis (Jacob, 1950) suggests that T < 220,000, and that recharge occurs very early in test.

figures 7a & 7b - are recovery data and they should be corrected for the natural decline in water levels and for diurnal effects. Although the "residuals" are based on the beginning of the test, the rate of change in the early part of ~~the~~ recovery is the basis for slope and probably has very little effects of the natural decline. The slope of the early data $10^2 > T/t' < 10^3$ is probably more representative of T.

If you plotted the expected natural fluctuations on figures 5a and 5b, then you would have corrected for the natural fluctuations by subtracting the drawdown curve from the expected curve.

Figure 8. - your analyses is based on $t \cong 1000$ min, but data show steady state very early. If $t \cong 11$ min then $T \cong 73,400$ gpd/ft. The ~~storage~~ leakage is the cause of early steady state as ~~that~~

the Thiem method is not valid. However, the method does yield a significantly smaller value than the previous methods.

Figure 9. — Hantush's analysis —

the ratio of $r_1 : r_2$ is $\approx$ 25:100 or 1:4 hence ratio of $r_1/B : r_2/B$ is 1:4.

the match pts for early data on $r_1/B = 0.1$ and $r_2/B = 0.4$ are good. I plotted new match points and calculated $T \approx$ 55,900 gpd/ft $\approx$ 7500 ft²/day

MP# (1) $S_{e_{early}} = \dfrac{4(7500\ ft^2 d^{-1})(\frac{.85}{1440})}{(25.5^2)(10^2)}$ $S_{e_{late}} = \dfrac{4(7500)(\frac{.85}{1440})}{(25.3^2)(.1)}$

$= 0.00027$ $= 0.27$

MP# (2) $S_e = \dfrac{4(7500)(\frac{.44}{1440})}{(100^2)(10)}$ $S_e = \dfrac{(4)(7500)(\frac{.44}{1440})}{(100^2)(.01)}$

$= .00009$ $= .09$

$\gamma_1 = 1 + \dfrac{S_l}{S_e} = 1 + \dfrac{.27}{.00027} = 1000 / (so\ \gamma_1) 100$

$\gamma_2 = 1 + \dfrac{.09}{.00009} = 1001$ so $\gamma_2 > 100$

Both observation wells show an apparent increase in drawdown near the end of the test which could be an indication that delayed storage effects were approaching zero and the drawdown was now related to T and S of the aquifer. However, I believe the corrections for natural decline in water levels will cause water levels to flatten in both wells. The flattening tends to place the analysis in the semi-confined ~~drawn~~ leaky aquifer category.

Perhaps increasing the pumping time would have yielded better information to determine the delayed yield effect, but I believe the transition from early to late curves would be early in the tests. Therefore the method is inapplicable for the data.

I compared figure 10 with the Boulton curves (see fig 9A) and noted how well the data from both wells compared with $r/B = 0.1$ and $r/B = 0.4$. The ratios again are related to the radii (25' and 100').

I selected a new match point which corresponded to that on figure 10 and calculated a T for both observation wells ($T \approx 67,500$ gpd/ft $\approx 9,020$ $ft^2 d^{-1}$)

$$S_{early} = \frac{4\,(9020\ ft^2 d^{-1})(3.0 \times 10^{-8}\ d\ ft^{-2})}{10}$$

$$= 1.08 \times 10^{-4}$$

The early data yield same ~~tt~~ T and S as that for figure 10 (leaky aquifer). I would stress the fact that elasticity (hence confined characteristics) are apparent from the loading by passing trains. Therefore the leaky confined aquifer approach would be more appropriate.

Figure 10 — Hantush-Jacob leaky aquifer analysis is probably the best approach. Please note that I have matched slightly different on the basis of the ratios of the radii. Stress loading effects - elastic properties etc. Stress the flat part of drawdown curves is characteristic of leaky aquifer with little or no water from storage in confining

Ralph — Additional analyses needed → Check on the image well (method) — recharge from the pond nearby. Is the radius near enough to

Is the radius from pumped well to pond's ~~greater than~~ image recharge well greater than the distance from the observation wells to the image well??

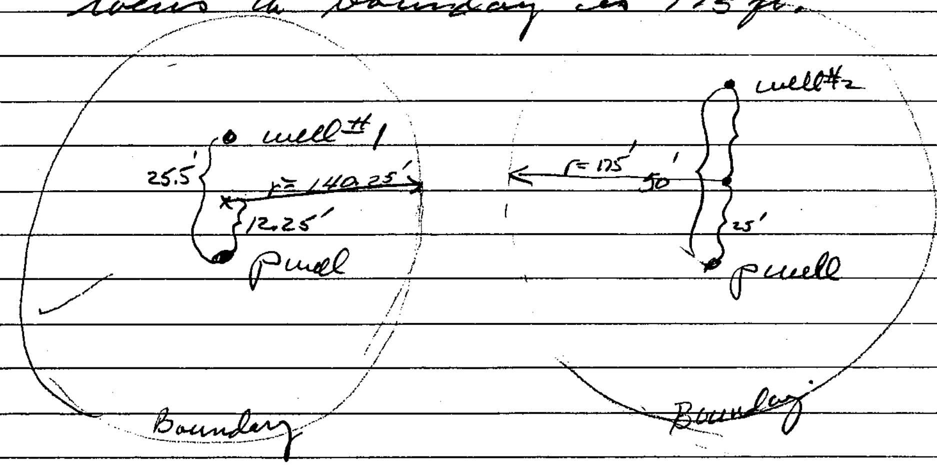
I matched the data figure 10 on the image well family of curves (Plate 9 PP 108) and found

Obs well #1 $r = 25.5$ $K \cong 11$ $r_i = 280.$
obs well #2 $r = 100$ $K \cong 3.5$ $r_i = 350'$

this allows us to estimate the locus of the recharge boundary from the mid points for observation wells and pumped well. ~~Obs well #1~~ (see WSP 1536-E p.165).

Obs. well #1 — midpoint between obs. well #1 and pumped well = 12.25 ft, locus to boundary is 140.25 ft.

Obs. well #2 — midpoint is 50' and locus to boundary is 175 ft.



I checked your sketch (figure 1) and measured about 500' to the pond — Is there another source within about 200 feet of the observation wells? If not, then mention in text that the computed boundaries compared poorly to the ~~hypothetical source~~ distance from the pumped well to the hypothetical source (pond).

Summary —

(1) Improve location sketch fig. 1
(2) Adjust drawdowns for ET and recession. Show or reconstruct w/l data during test to adjust drawdowns.
(3) The semi-log analyses ~~and~~ and all others should follow the results of Hantush-Jacob leaky aquifer analysis. Stress the method that you believe gave you the best results.

(4) Check image well (recharge) boundary to see if the pond is a possible source

(5) Rewrite the text analysis and have it typed • clean up figures - good penciled copy is OK for review.
(6) On summary page use only results of the method you feel is appropriate.

(7) Return text to me as soon as possible and I will send it on to District → Region.

Good work on your first test.
Ted Meyer

DRAWDOWN CALCULATIONS

Calculations

TYPE CURVE: USGS PROF. PAPER # 708, PLATE 3.

North test site

Q = 120 GPM

r = 25 ft

MATCH POINT : u = 0.01

$L(u,v) = 10$

$s = 1.4$ ft

$t/r^2 = 2.75 \times 10^{-7}$

$$T = \frac{114.6\,Q}{s} L(u,v)$$

$$= \frac{(114.6)(120)(10)}{1.4}$$

$= 98{,}228.6$ GAL/DAY/ft ≈ 98,000 GAL/DAY/ft

13,100 ft²/day

$$S = \frac{Tut}{1.87 r^2}$$

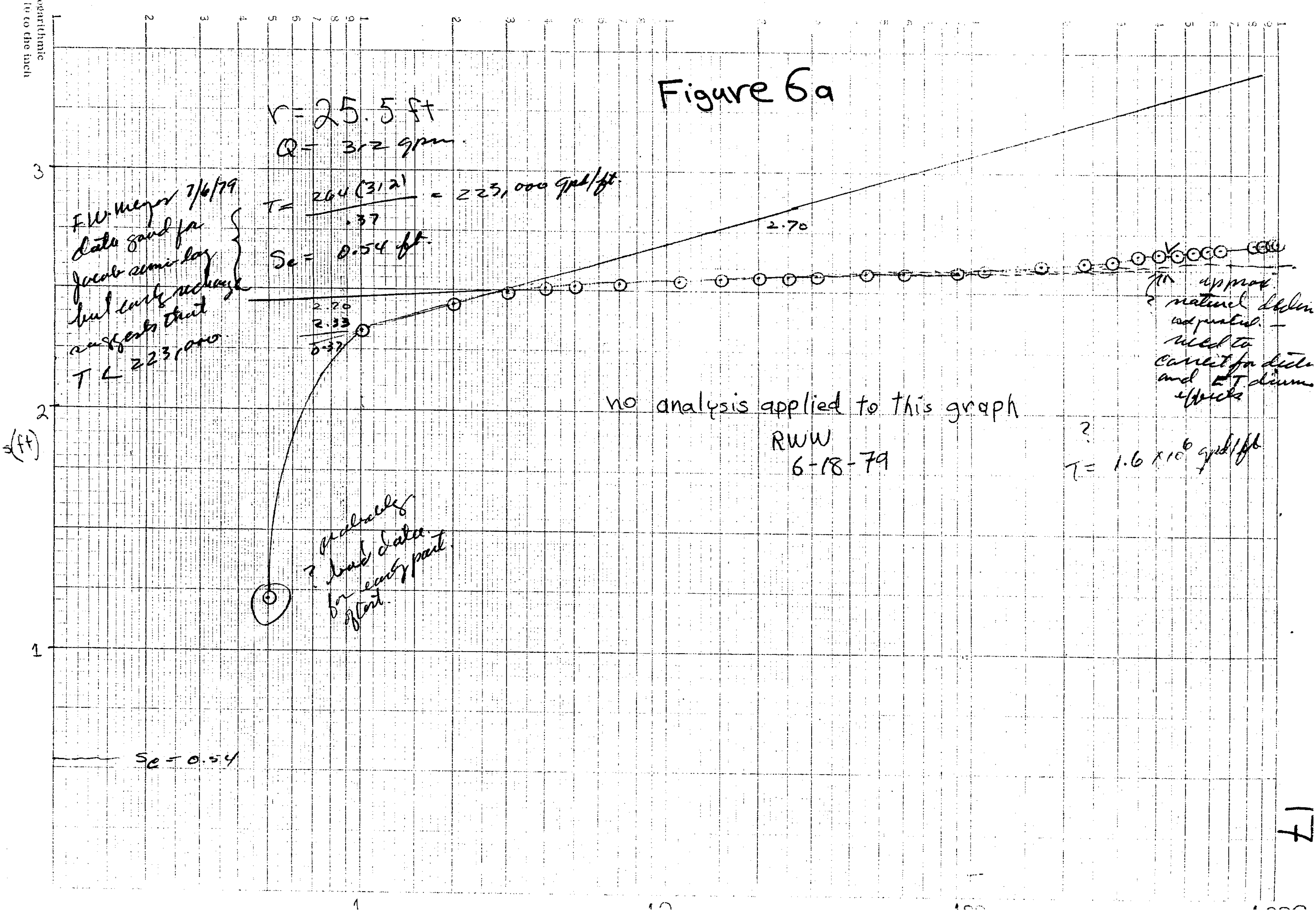
$$= \frac{(9.8 \times 10^4)(0.01)(2.75 \times 10^{-7})}{1.87}$$

$= 1.4 \times 10^{-4}$

O-1

J.D. Park pump test
5-79

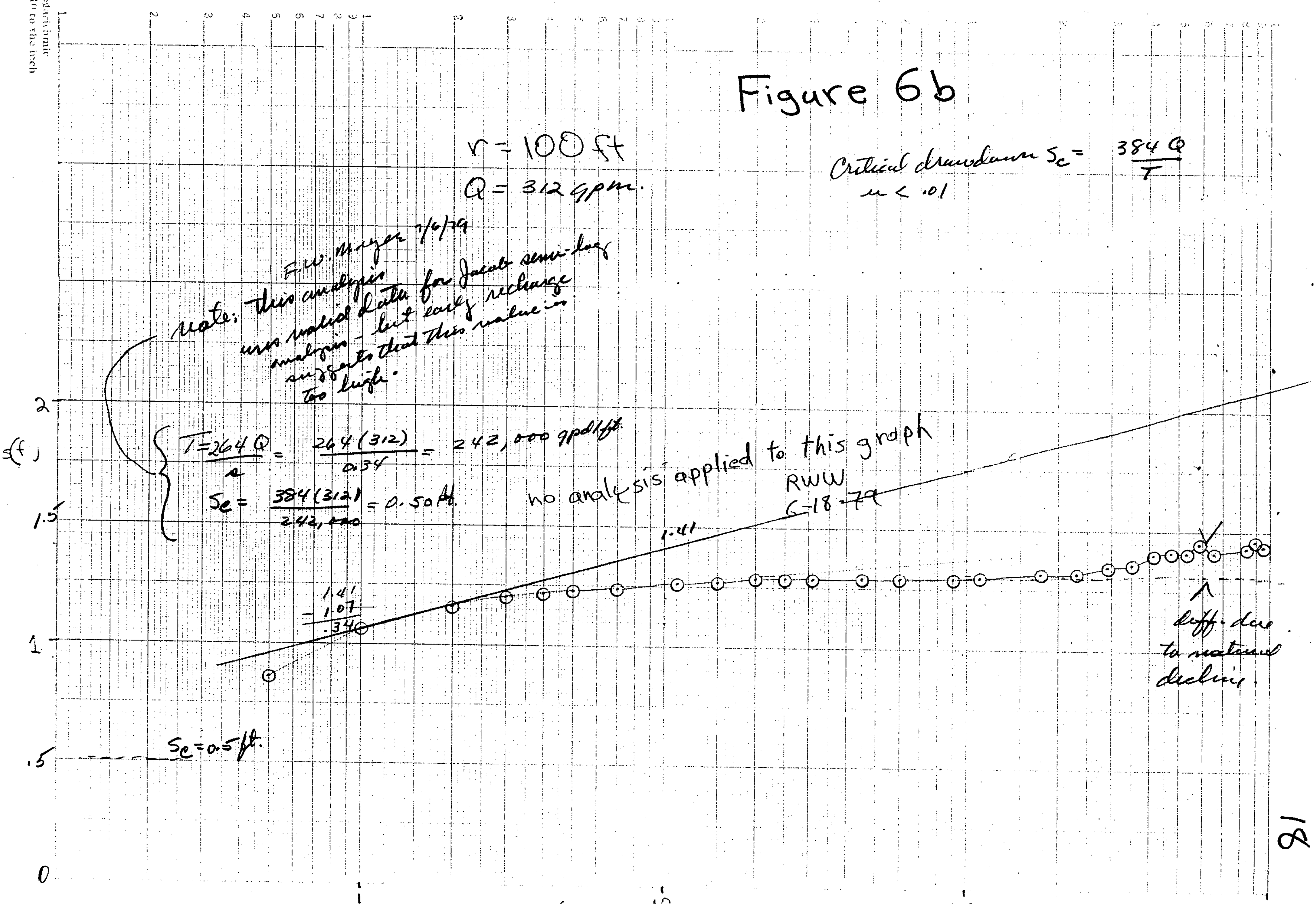
RWW
5-31-79



J-D Park pump test 5-79

RWW 5-31-79

O-2

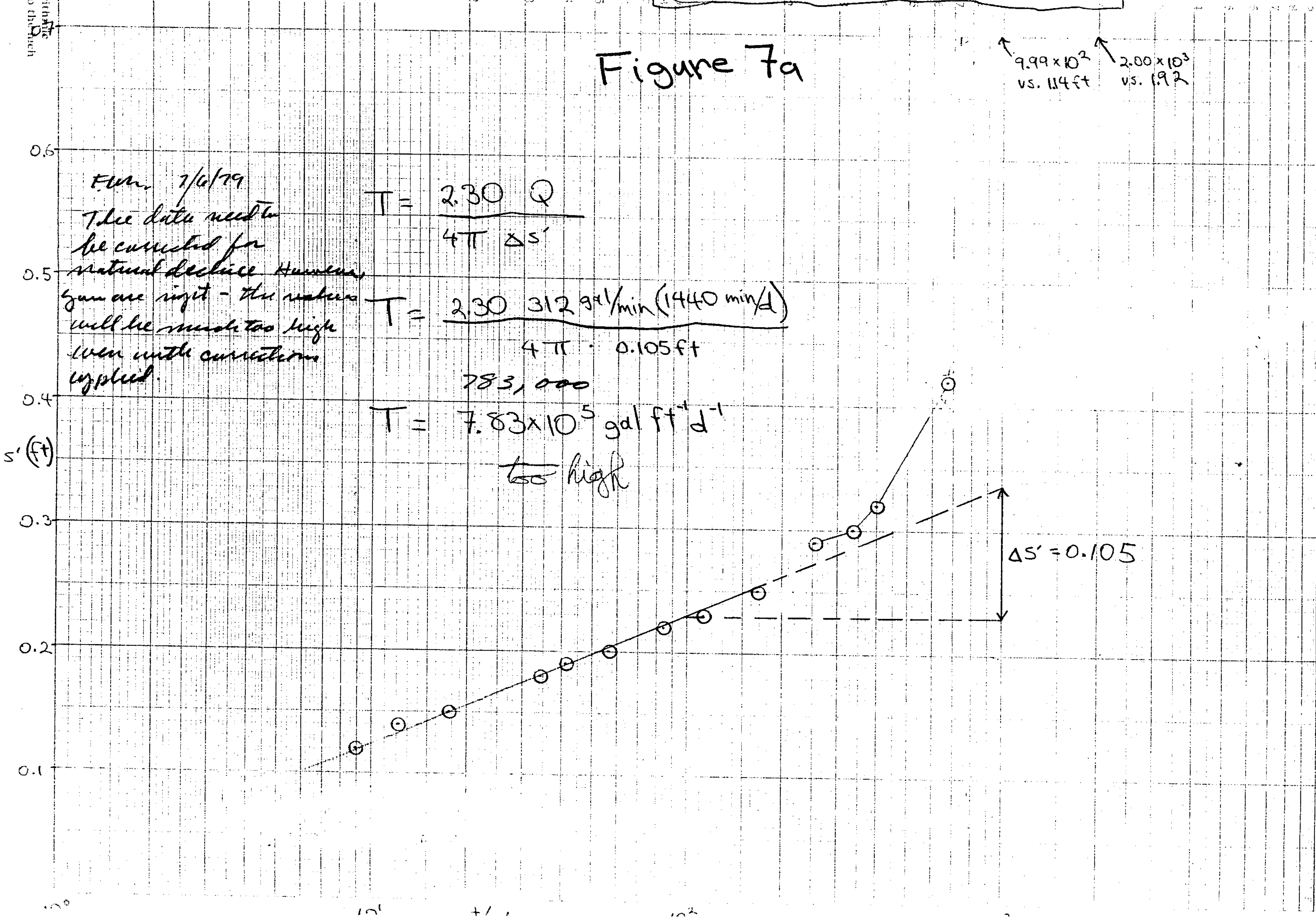


J.D. Park pumping test, 5-79

RWW 6-6-79

O-1

(Theiss) 1935 recovery method — ILRI pp 65-68

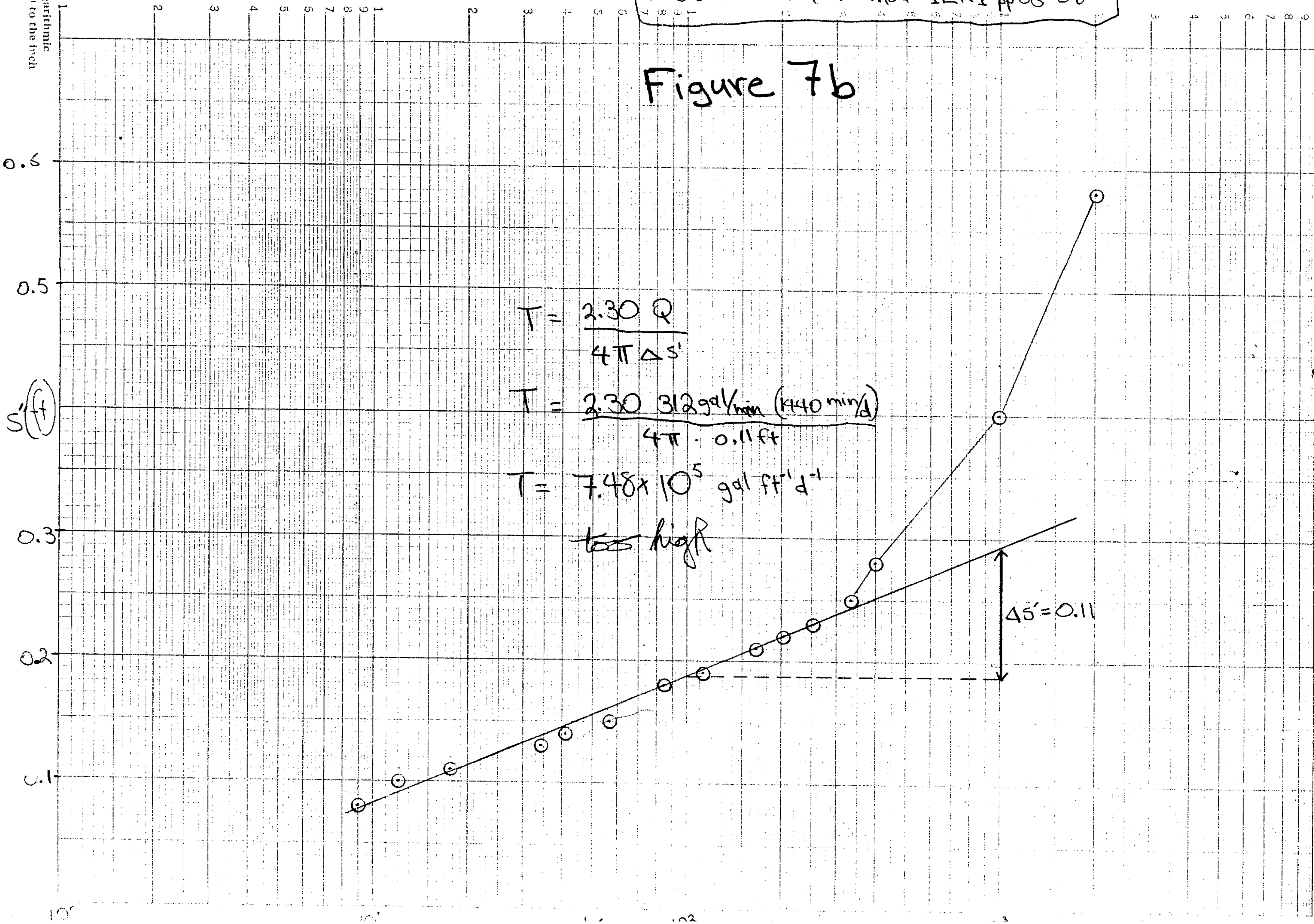


O-2

J.D. Park pumping test, 5-79

RWW 6-6-79

Theis's 1935 recovery method - ILRI pp 66-68



20

C-D Park pump test

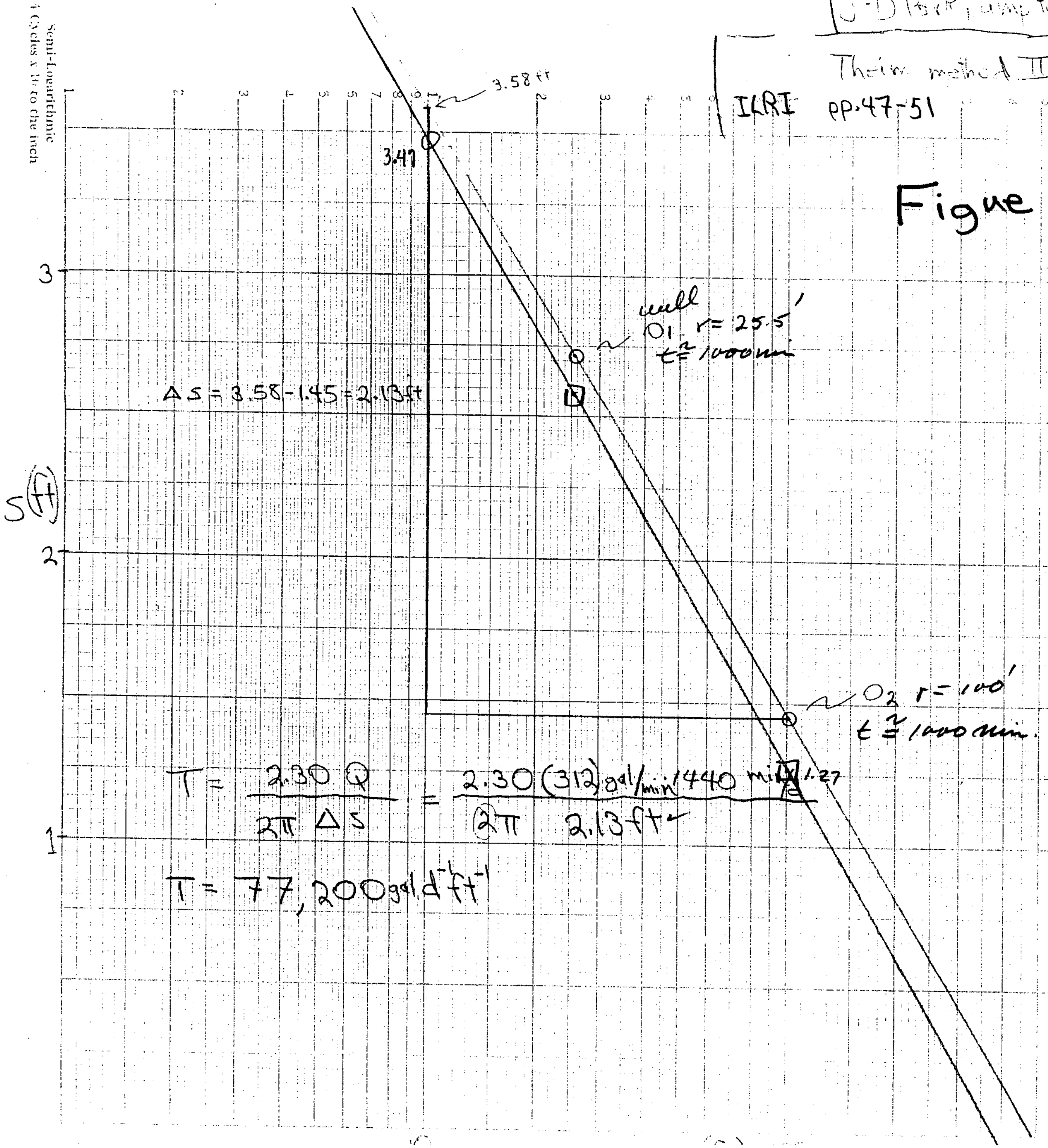
Theim method II

ILRI pp. 47-51

RWW

5-31-79

Figure 8



$$T = \frac{2.30\,Q}{2\pi\,\Delta S} = \frac{2.30\,(312)\,\text{gal/min}\cdot 1440\ \text{min}}{2\pi\quad 2.13\ \text{ft}}$$

$T = 77{,}200\ \text{gal}\,d^{-1}\,ft^{-1}$

3.58
- .45
2.13

EXPLANATION

r_1 = ▢ well 01
t = 11 min
s = 2.59

r_2 = ▢ well 02
t = 11 min
s = 1.26

$$T = \frac{527.7\,Q\,\log_{10}(r_2/r_1)}{s_1 - s_2}$$

$$T = \frac{527.7(312)\log_{10}\left(\frac{100}{25.5}\right)}{2.59 - 1.26}$$

$$= \frac{528(312)(.593)}{1.33}$$

= 73,450 gpd/ft.

J-D Park pump test, Martin Co. 5-29&30-79

RWW
6-15-7

Boulton's method [from pp. 34-40 of P.P. 708]

Figue 9

● 0-2 r = 100 ft
● 0-1 r = 25.5 ft

$$T_{O_2} = \frac{Q}{4\pi s} = \frac{312\ \text{gal/min}\ 1440\ \text{min/d}}{4\pi\ 0.55\ \text{ft}} \approx 65{,}000\ \text{gal d}^{-1}\text{ft}^{-1} \approx 8700\ \text{ft}^2/\text{d}$$

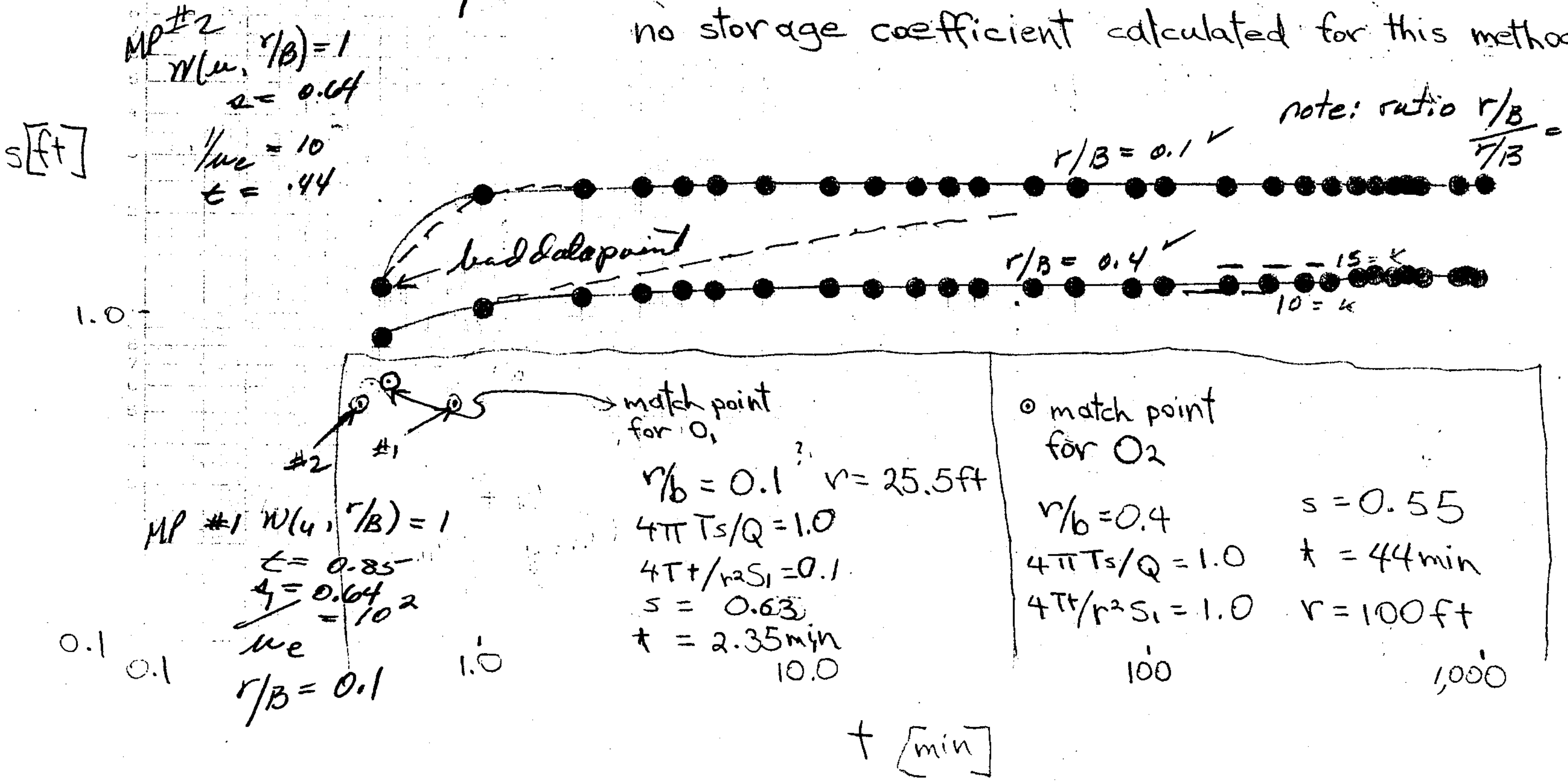
$$T_{O_1} = \frac{312\ \text{gal/min}\ 1440\ \text{min/d}}{4\pi\ 0.63\ \text{ft}} \approx 57{,}000\ \text{gal d}^{-1}\text{ft}^{-1} \approx 7{,}600\ \text{ft}^2/\text{d}$$

$$T = \frac{(1.0)(312)(1440)}{4\pi(0.64)}$$
≃ 55,900 gpd/ft
≃ 7500 ft²/day

no storage coefficient calculated for this method

$\bar{T}$ = 61,000 gal d⁻¹ ft⁻¹

note: ratio $\frac{r/B}{r/B} = \frac{.1}{.4} = \frac{r_1}{r_2} = \frac{25}{100} = \frac{1}{4}$



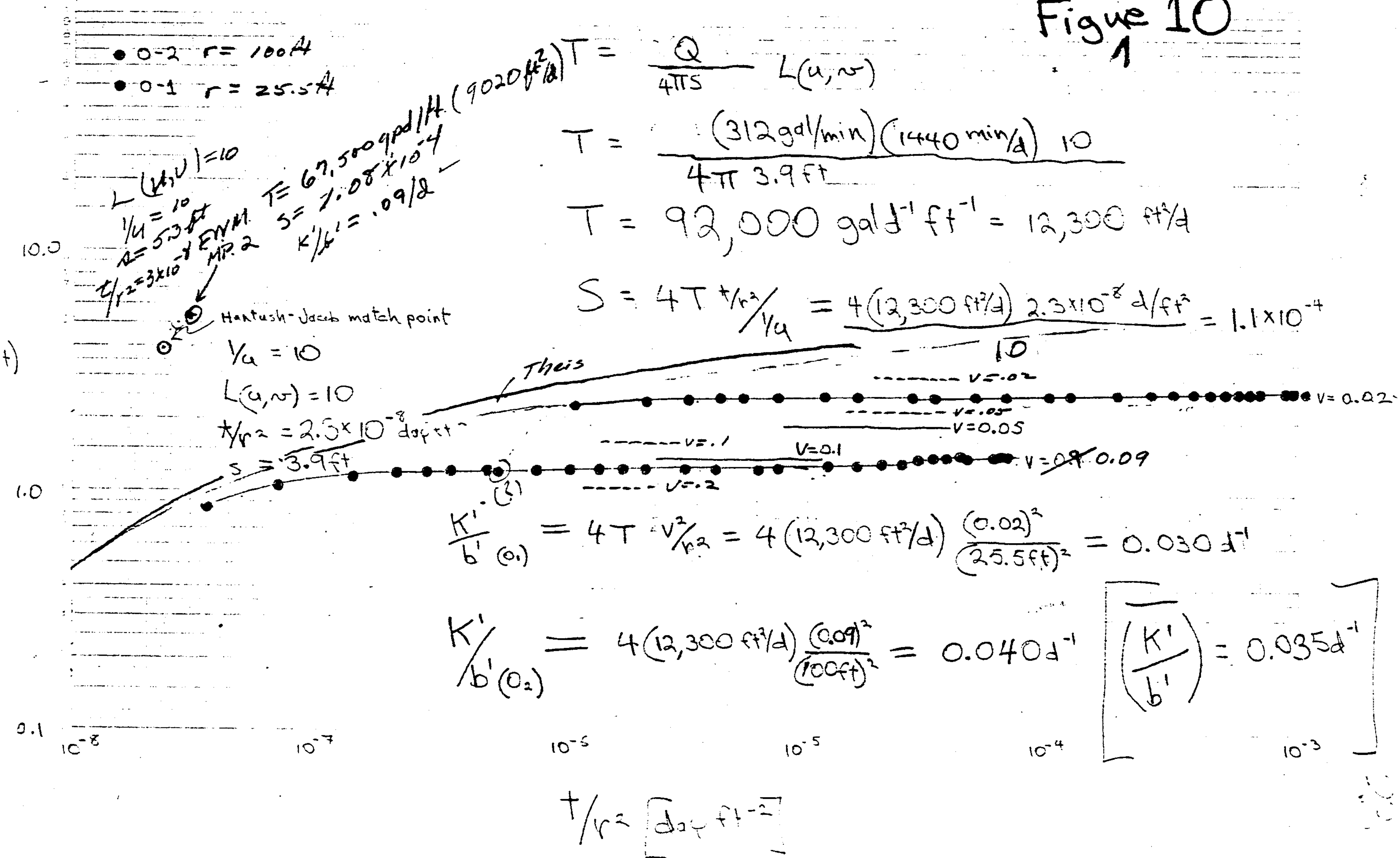
2

RWW 6-1-79

J. D. Park pump test, Martin Co. 5-29&30-79

Hantush-Jacob method [from pp. 30-32 of P.P. 708]

Figure 10 R1



$$T = \frac{Q}{4\pi s} L(u,v)$$

$$T = \frac{(312\ \text{gal/min})(1440\ \text{min/d})\ 10}{4\pi\ 3.9\ \text{ft}}$$

$$T = 92{,}000\ \text{gal d}^{-1}\ \text{ft}^{-1} = 12{,}300\ \text{ft}^2/\text{d}$$

$$S = 4T\frac{t/r^2}{1/u} = \frac{4(12{,}300\ \text{ft}^2/\text{d})\ 2.3\times10^{-8}\ \text{d/ft}^2}{10} = 1.1\times10^{-4}$$

$$\frac{K'}{b'}_{(O_1)} = 4T\ v^2/r^2 = 4(12{,}300\ \text{ft}^2/\text{d})\frac{(0.02)^2}{(25.5\ \text{ft})^2} = 0.030\ \text{d}^{-1}$$

$$\frac{K'}{b'}_{(O_2)} = 4(12{,}300\ \text{ft}^2/\text{d})\frac{(0.09)^2}{(100\ \text{ft})^2} = 0.040\ \text{d}^{-1}$$

$$\left(\overline{\frac{K'}{b'}}\right) = 0.035\ \text{d}^{-1}$$

Test # March, 1976

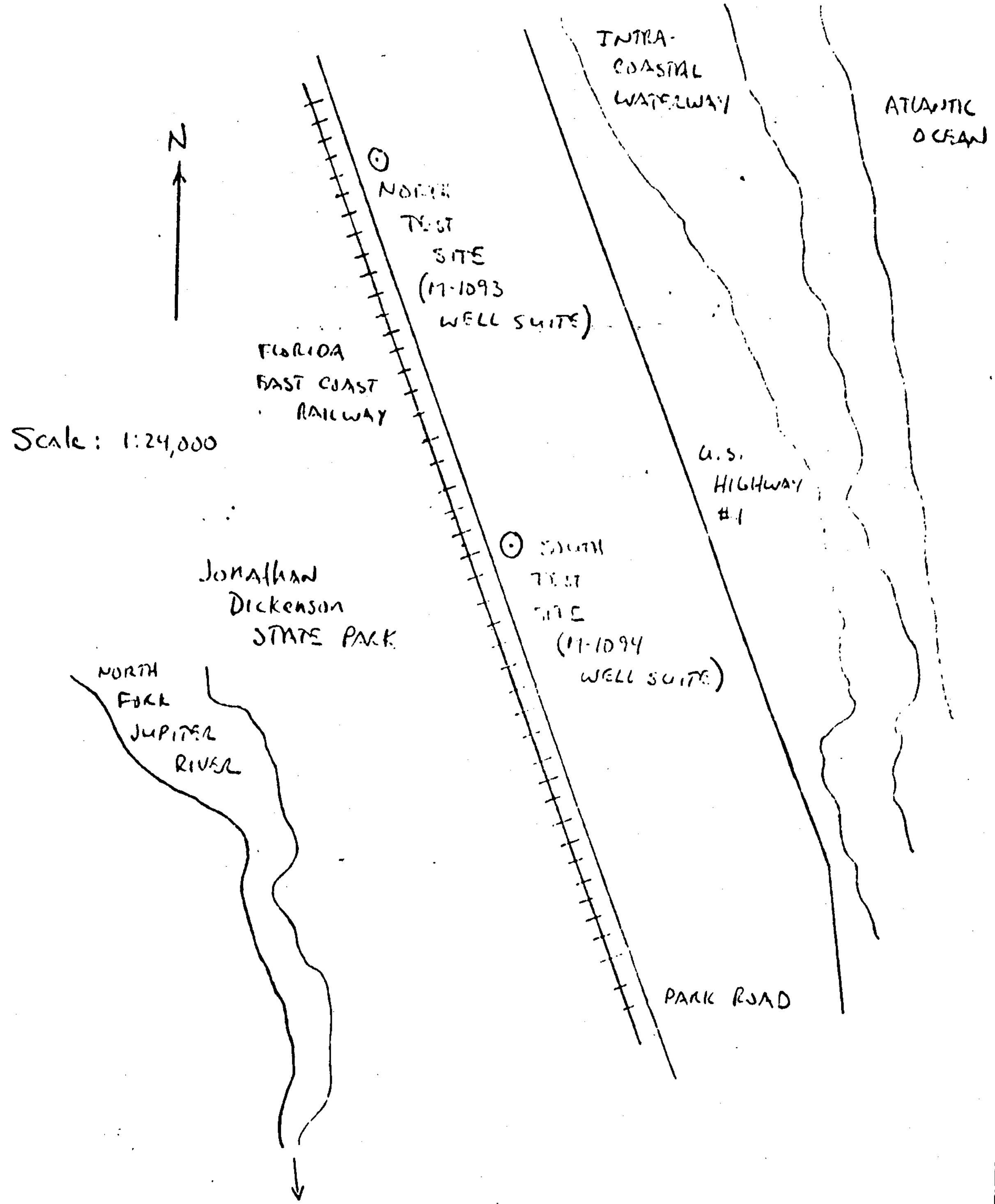
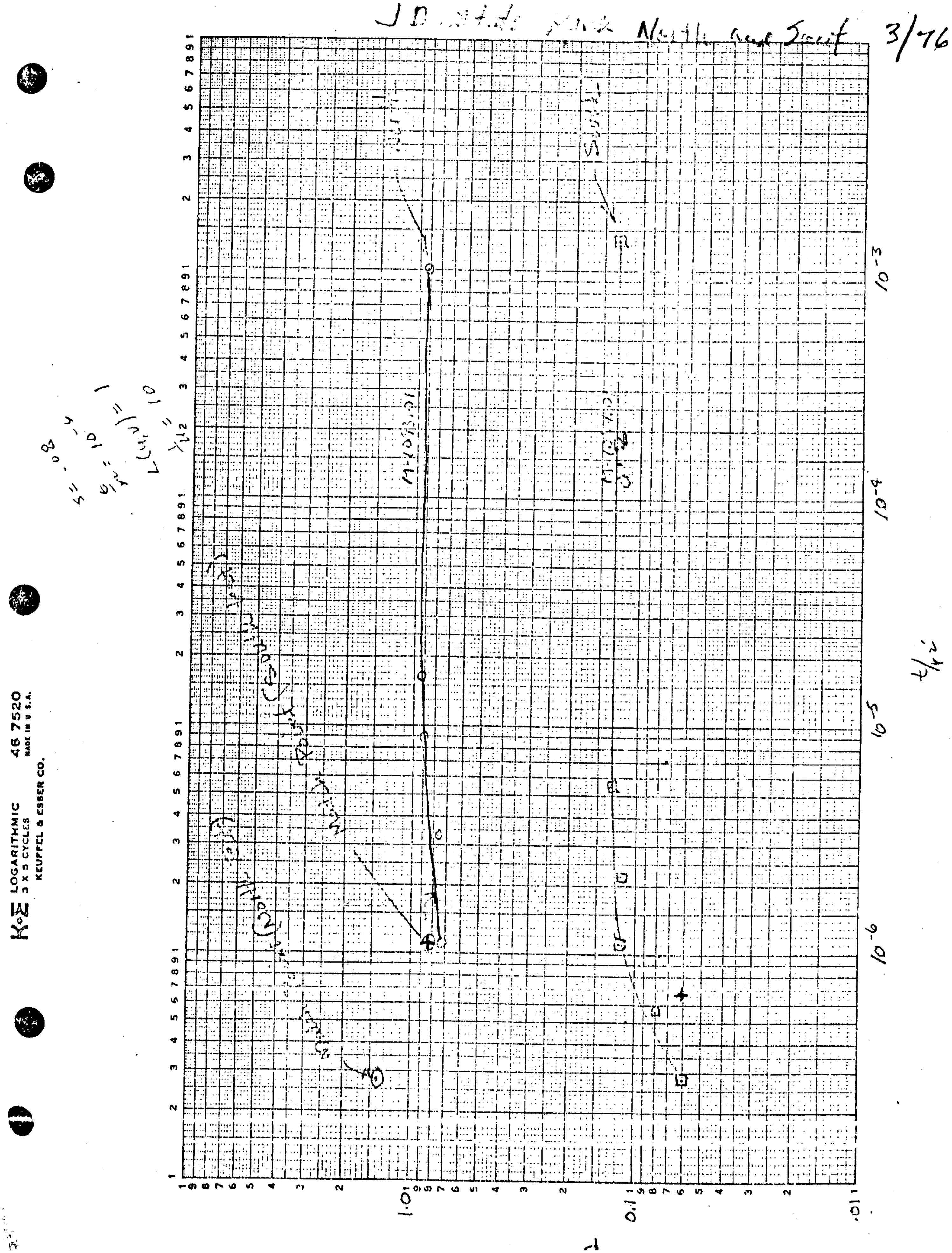


Figure 1. Area sketch, Aquifer test, Jon. Dickenson State Park, MARTIN County, Florida, 23-26 MARCH 1976.

FIGURE 11. FUNCTION DATA PLOT.

TYPE CURVE: USGS PROFESSIONAL PAPER 708, PLATE 3.



South test site

$Q = 34$ GPM

$r = 25$ ft

Match Point: $u = 0.10$

$L(u,v) = 10$

$s = 0.82$ ft

$t/r^2 = 1.1 \times 10^{-6}$

$$T = \frac{114.6}{s} Q \cdot L(u,v)$$

$$= \frac{(114.6)(34)(10)}{0.82}$$

$$= 47{,}517.1 \text{ GAL/DAY/ft} \approx \underline{\underline{47{,}500 \text{ GAL/DAY/ft}}}$$

6350 ft^2/day

$$S = \frac{Tut}{1.87 r^2}$$

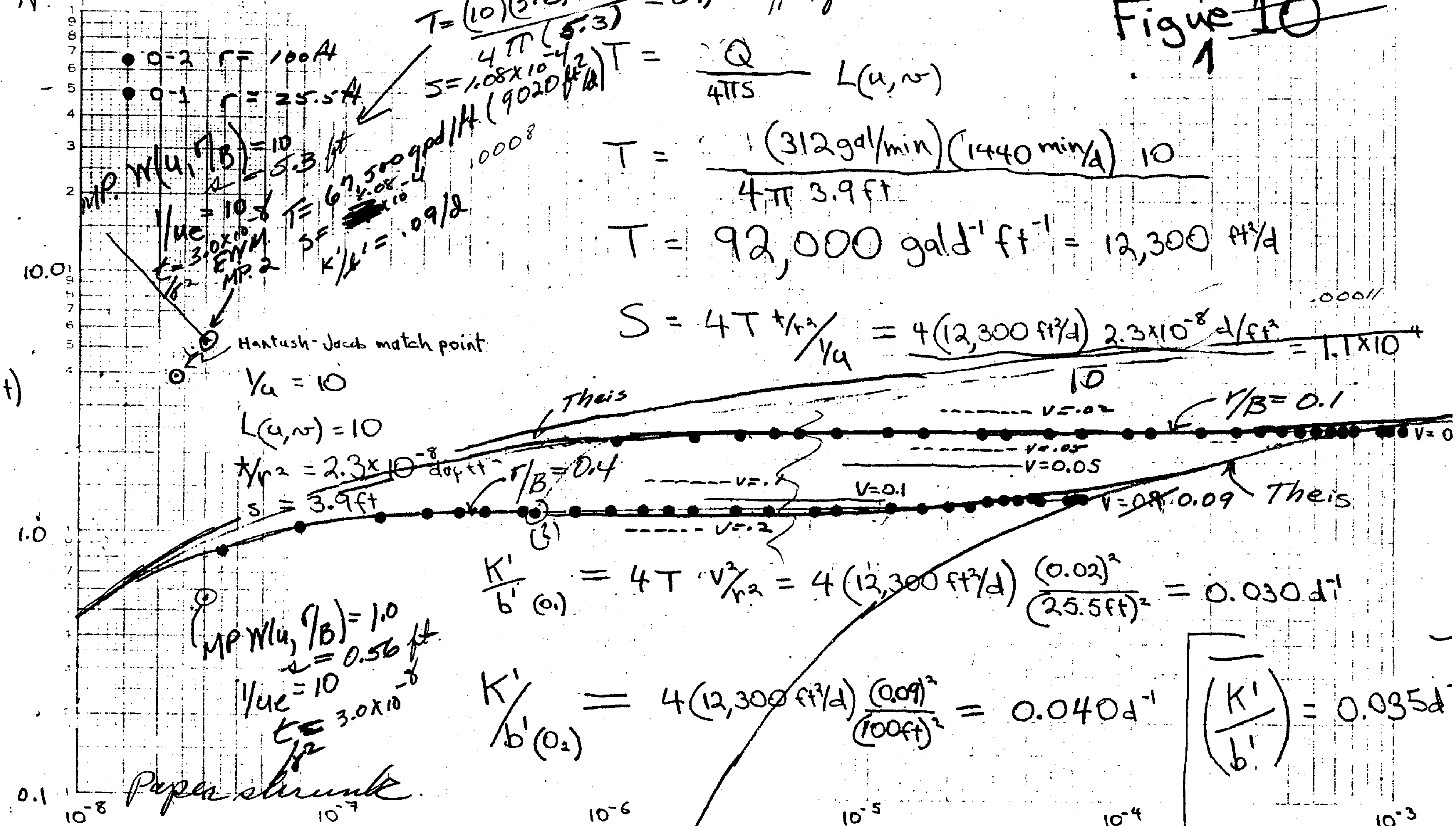
$$= \frac{(47{,}500)(0.10)(1.1 \times 10^{-6})}{1.87}$$

$$= \underline{\underline{6.37 \times 10^{-3}}}$$

Hantush-Jacob method [from pp. 30-32 of P.P. 708]

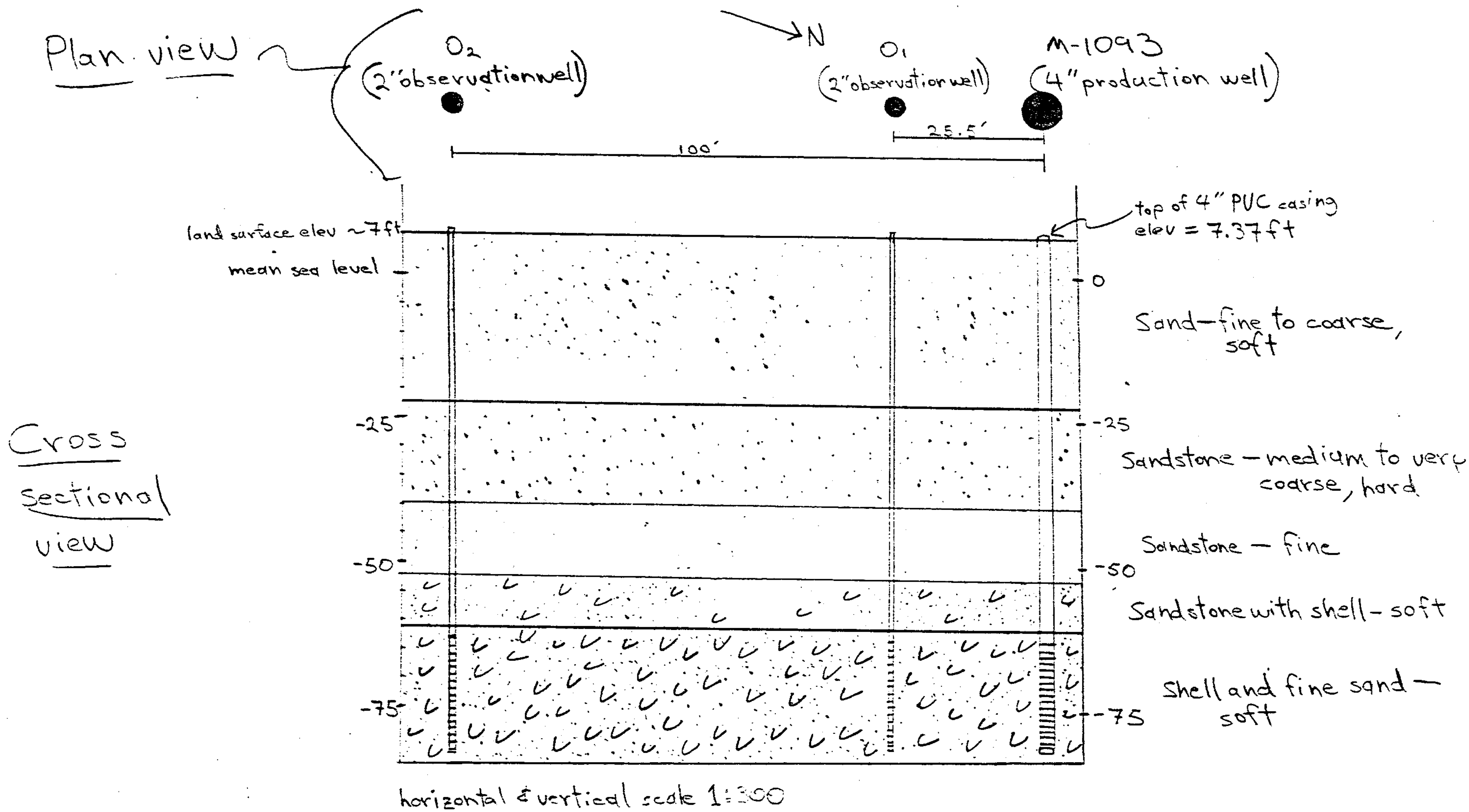
9A

Figure ~~10~~ R1



$$T \cong \frac{(1.0)(312)(1440)}{4\pi(0.56)} = 63{,}800 \text{ gpd/ft}$$ [day ft⁻²]

or 8,500 ft²/day

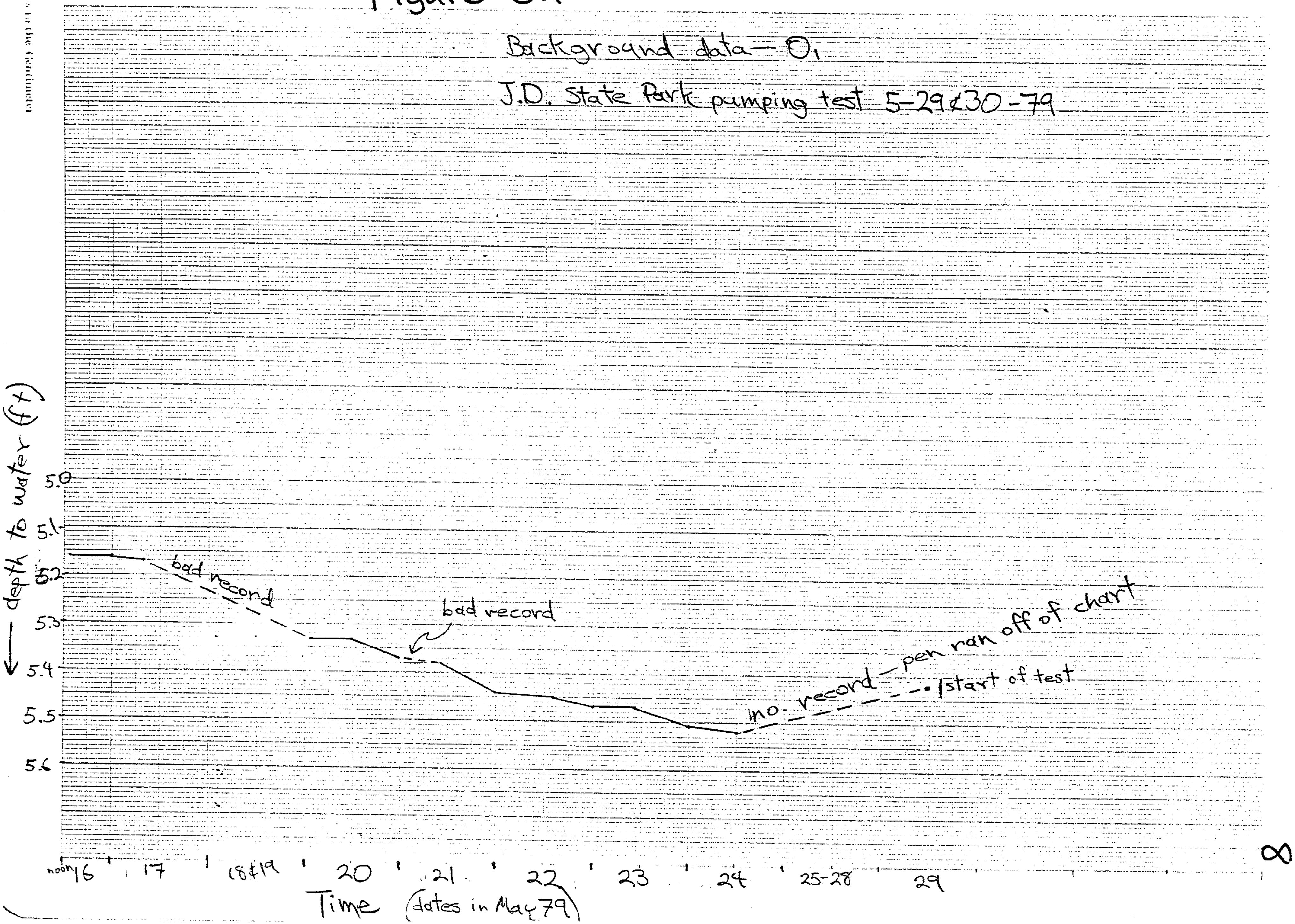


All wells 90 feet deep, screened from 70 to 90 foot depth.
Cross section constructed from lithologic log for M-1093 only.

Figure 2 Plan view & Cross sectional view of Pumping test site.

10 Millimeters to the Centimeter

Figure-3a



9-195
(July 1949)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Figure 4 – Discharge measurements made during test

WATER LEVEL MEASUREMENTS (Office)

Field No. ______

Owner: J-D [illegible] Test

Office No. ______

Location ______

Project ______

Measuring Point ______

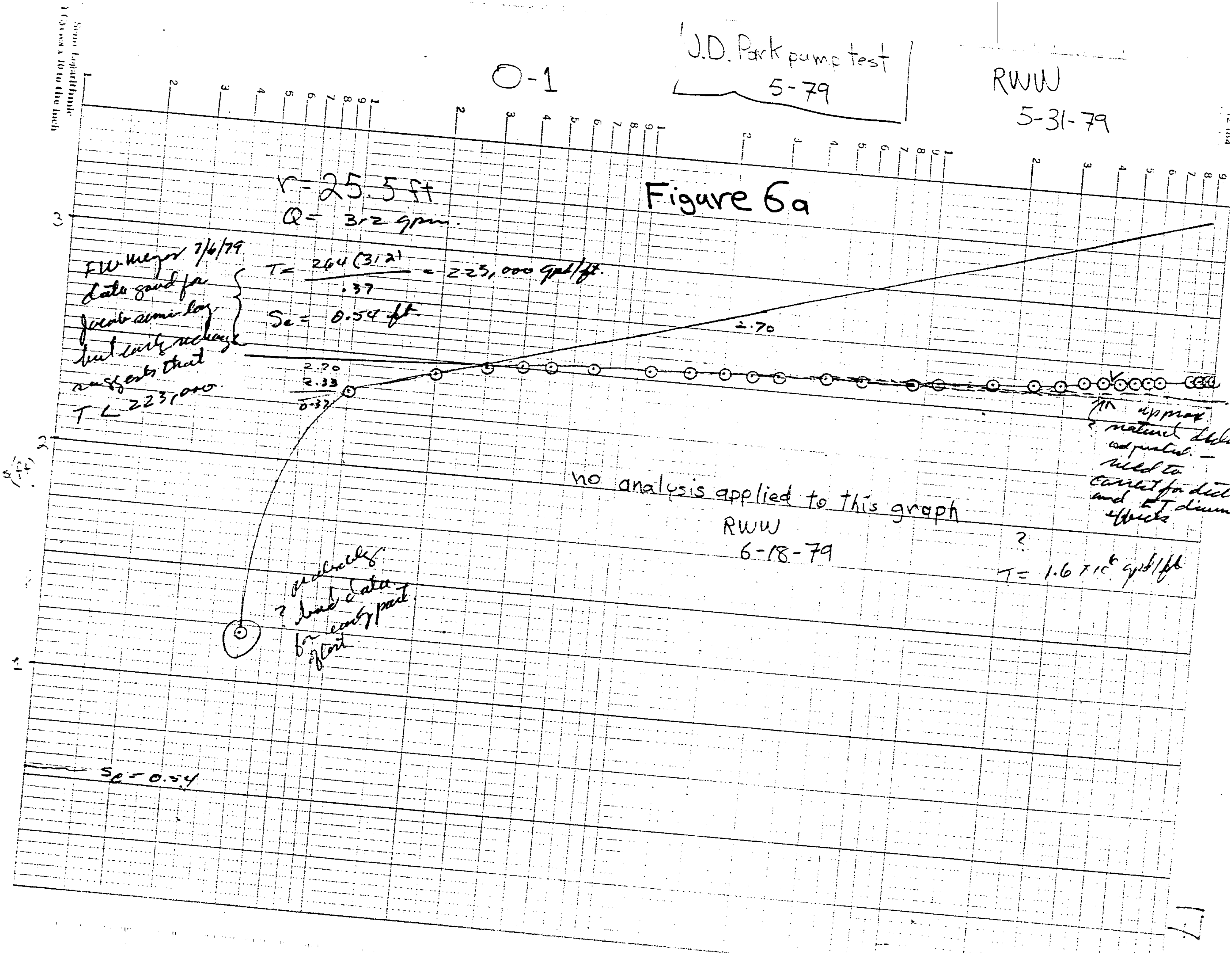
Elevation of Measuring Point: gpm

4 in. orifice
6 in. pipe

Date	Hour	~~Depth to~~ Height of Water	Elev. of Water Surface (g.p.m.)	Meas. by	Remarks (Nearby wells pumping, etc.)	
5/29/7?	1513	23 7/8	308+5?	[illegible]	[illegible]	
	15[illegible]	[illegible]	[illegible]	[illegible]	raised [illegible]	
	15[illegible]	23 3/4	307+5	[illegible]	@ 6 min	
	1558	23 5/8	307+5	JSW		
	1611	23 5/8	307+5	JSW		
	1650	23 5/8	307+5	WAL		
	1745	1.97	308	RWW		23.64
	1855	1.95	307	RWW		23.4
	2005	1.95	307	RWW		23.4
	2103	1.95	307	RWW		23.4
	2215	23.50	307	WAL		
	2304	23 5/8	307	WAL		
	2402	23 5/8	307	WAL		
5-30-79	0102	23 1/2	307	JSW		
	0207	23.5	307	JSW		
	0504	23 3/8	307	JSW		
	0604	23 3/8	307	JSW		
	0703	23 3/8	307			

Q = 312 gpm

U.S. GOVERNMENT PRINTING OFFICE : 1953 O—[illegible]
886-583

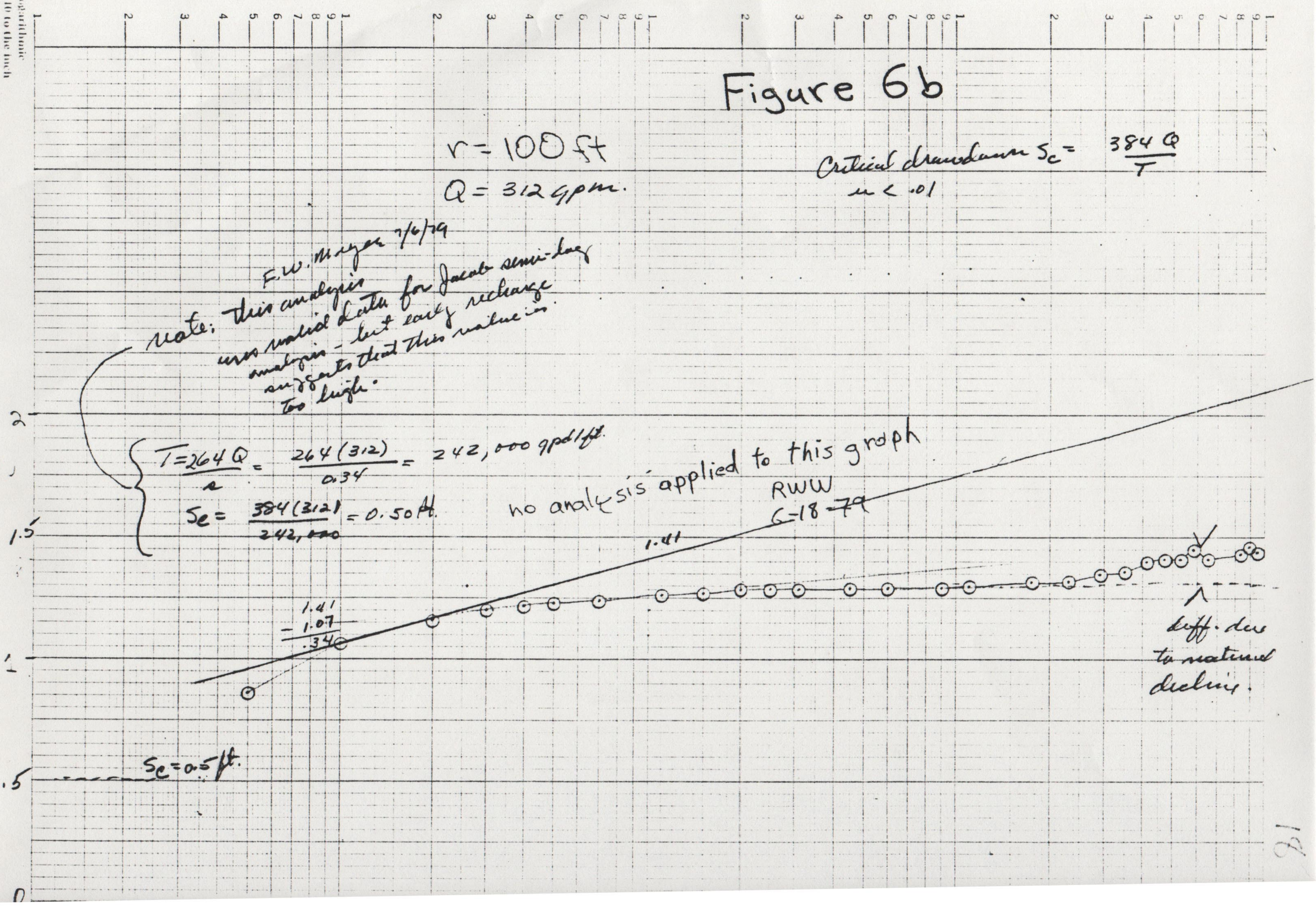


J.D. Park pump test
5-79
O-1
RWW
5-31-79
r = 25.5 ft
Figure 6a
Q = 312 gpm.
T = 264 (31.2) / .37 = 223,000 gpd/ft.
Se = 0.54 ft.
2.70
2.70
2.33
0.37
s (ft)
no analysis applied to this graph
RWW
6-18-79
?
T = 1.6 × 10^6 gpd/ft
Se = 0.54

J-D Park pump test 5-79

RWW 5-31-79

O-2



19

O-1

(Theis's) 1935 recovery method — ILRI pp 55-68

Figure 7a

Elm 7/6/79
These data need to be corrected for natural decline. However, you are right - the values will be much too high even with corrections applied.

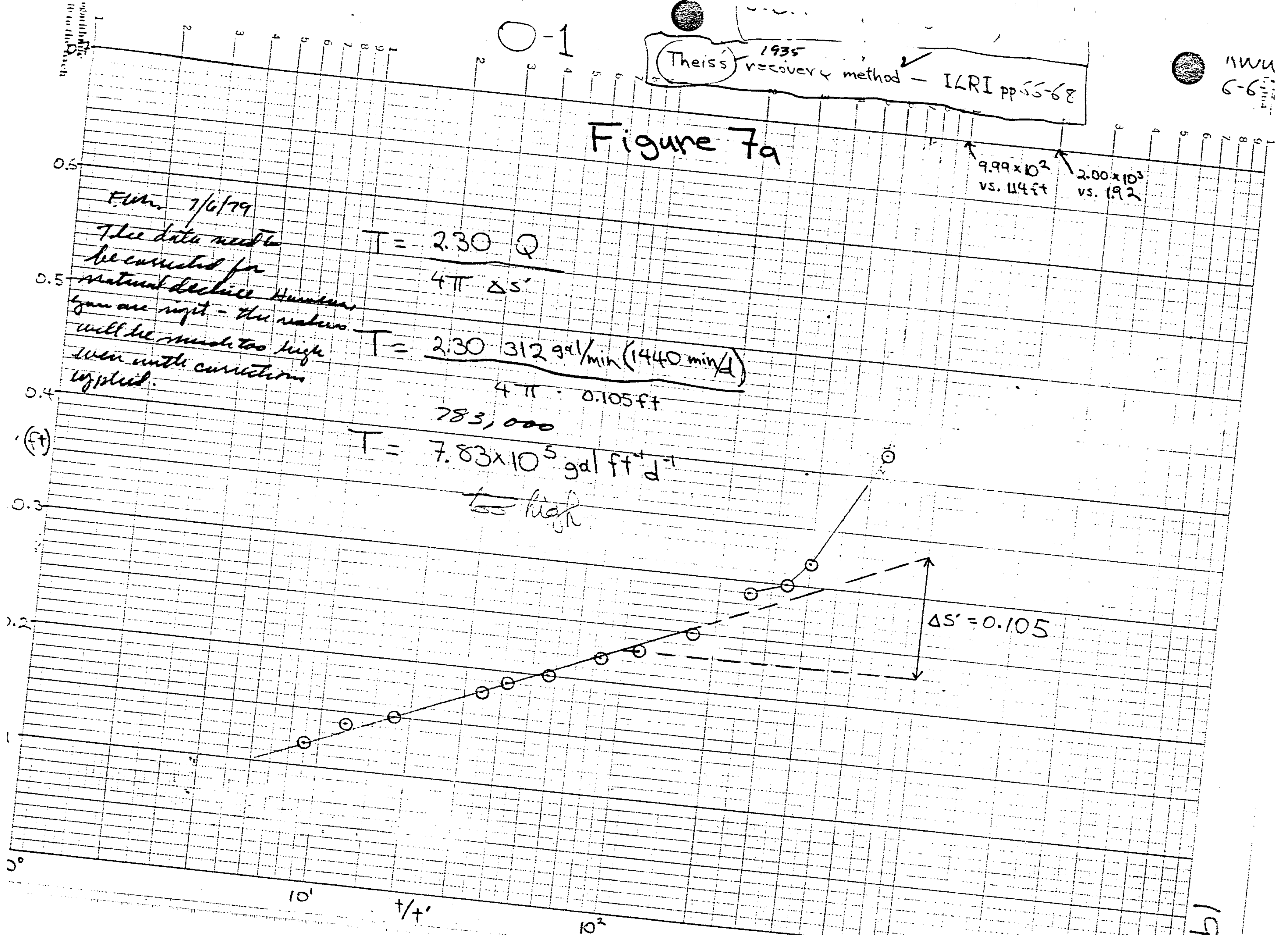
$$T = \frac{2.30\ Q}{4\pi\ \Delta s'}$$

$$T = \frac{2.30\ 312\ \text{gal/min}\ (1440\ \text{min/d})}{4\pi \cdot 0.105\ \text{ft}}$$

783,000

$$T = 7.83 \times 10^5\ \text{gal ft}^{-1}\text{d}^{-1}$$

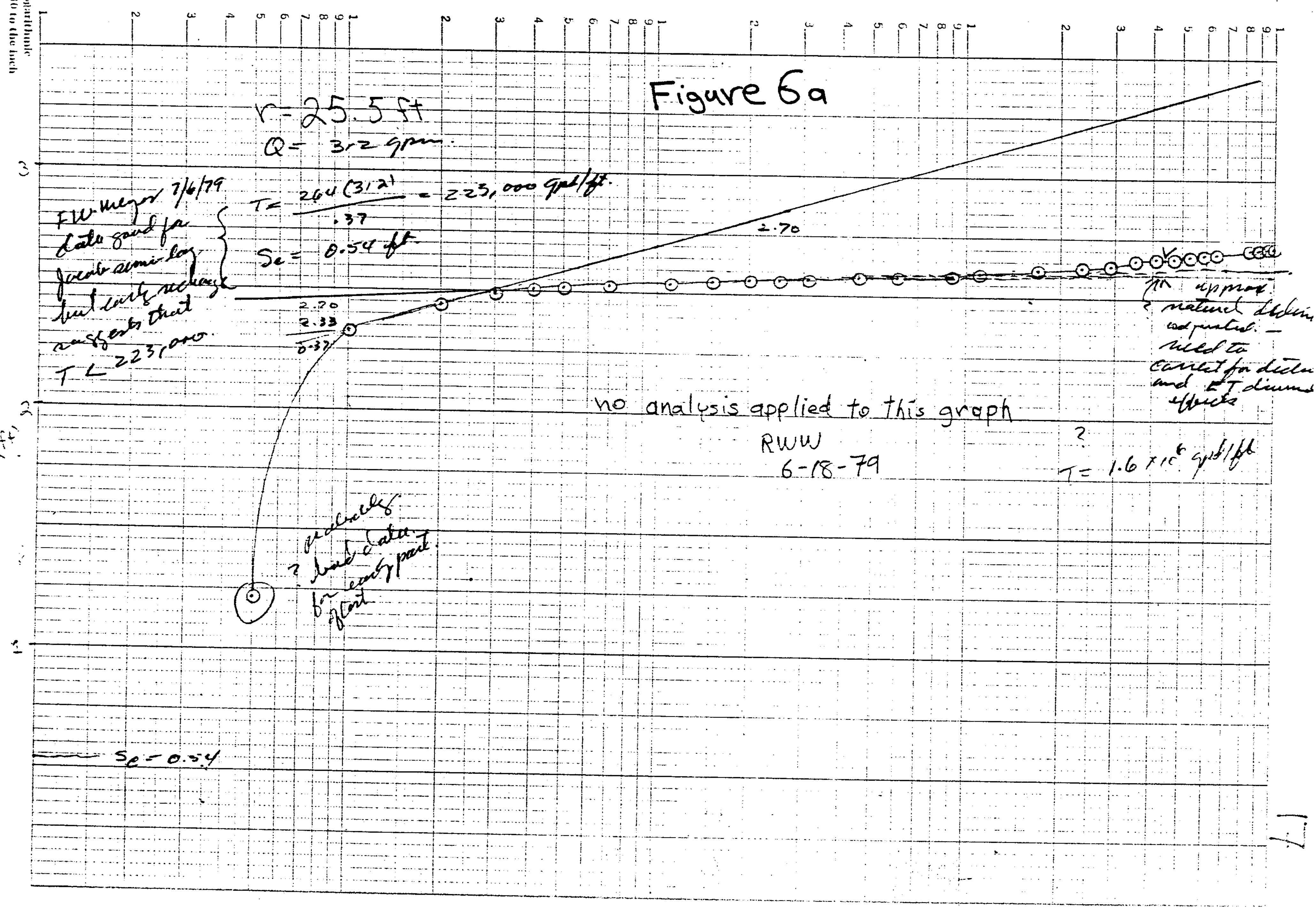
too high



O-1

J.D. Park pump test
5-79

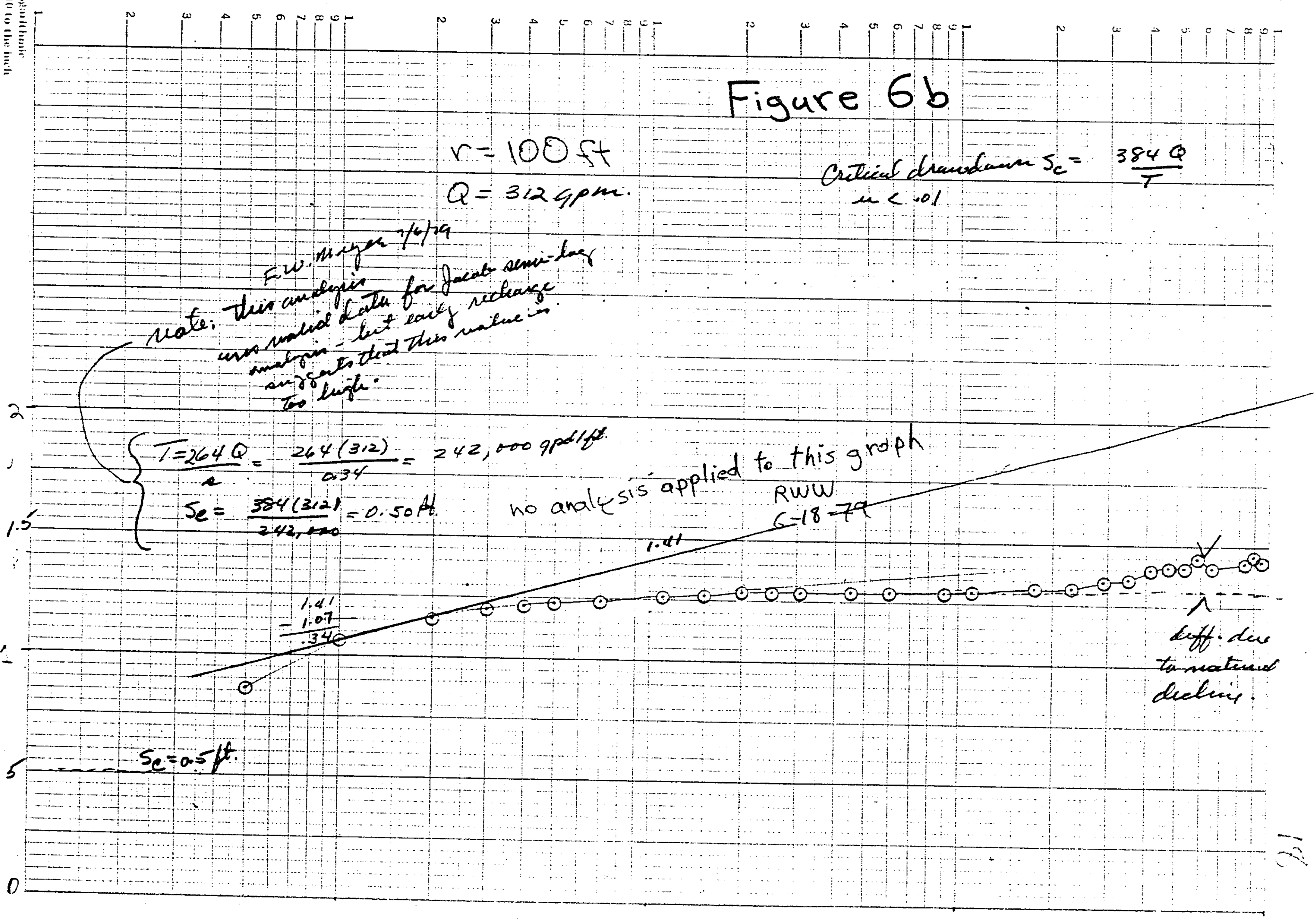
RWW
5-31-79



J-D Park pump test
5-79

RWW 5-31-79

O-2



O-1

Theis's 1935 recovery method — ILRI pp 55-68

RWW 6-6-79

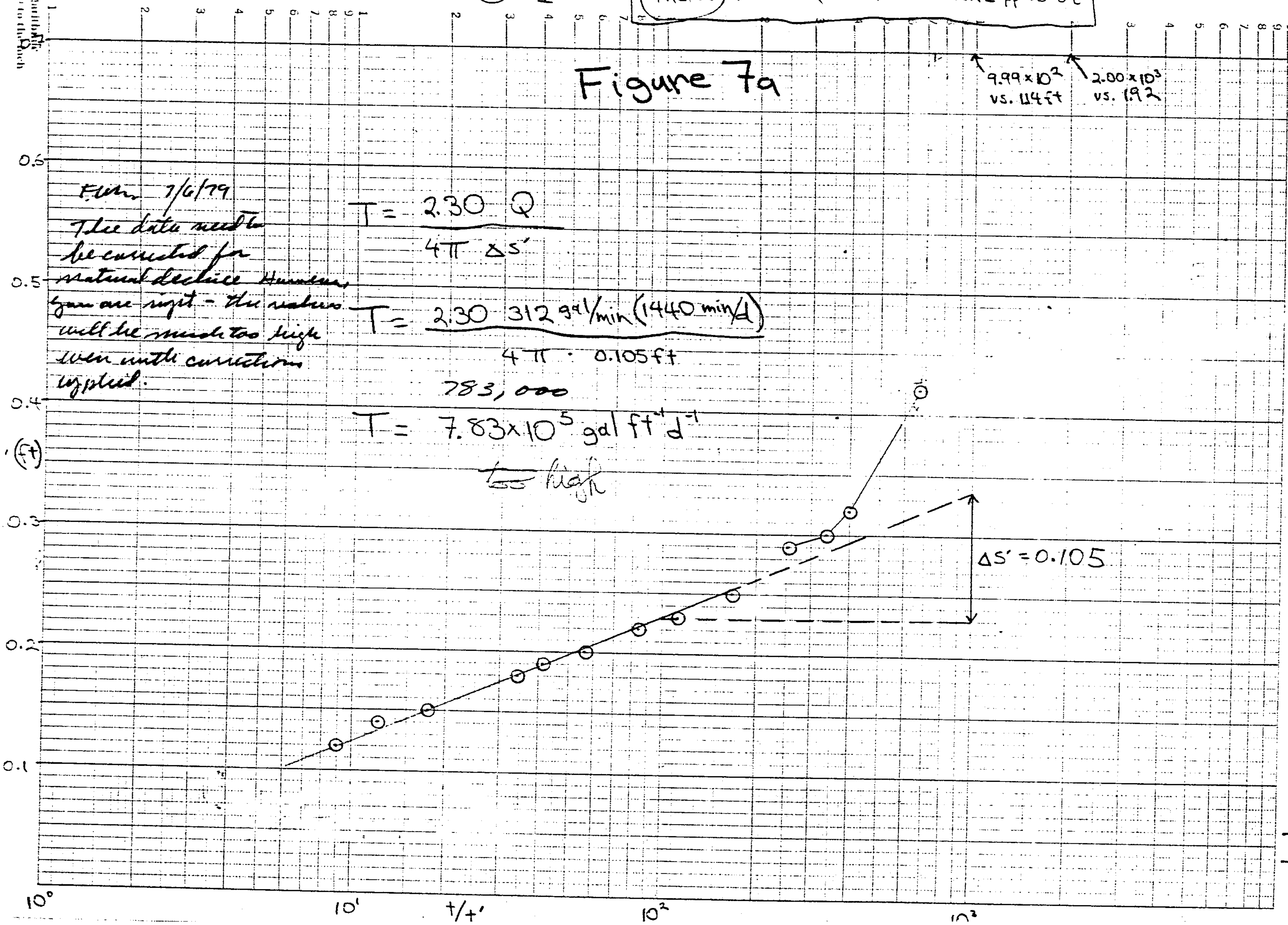


Figure 7a

$T = \frac{2.30\,Q}{4\pi\,\Delta s'}$

$T = \frac{2.30 \cdot 312\ \text{gal/min}\,(1440\ \text{min/d})}{4\pi \cdot 0.105\ \text{ft}}$

783,000

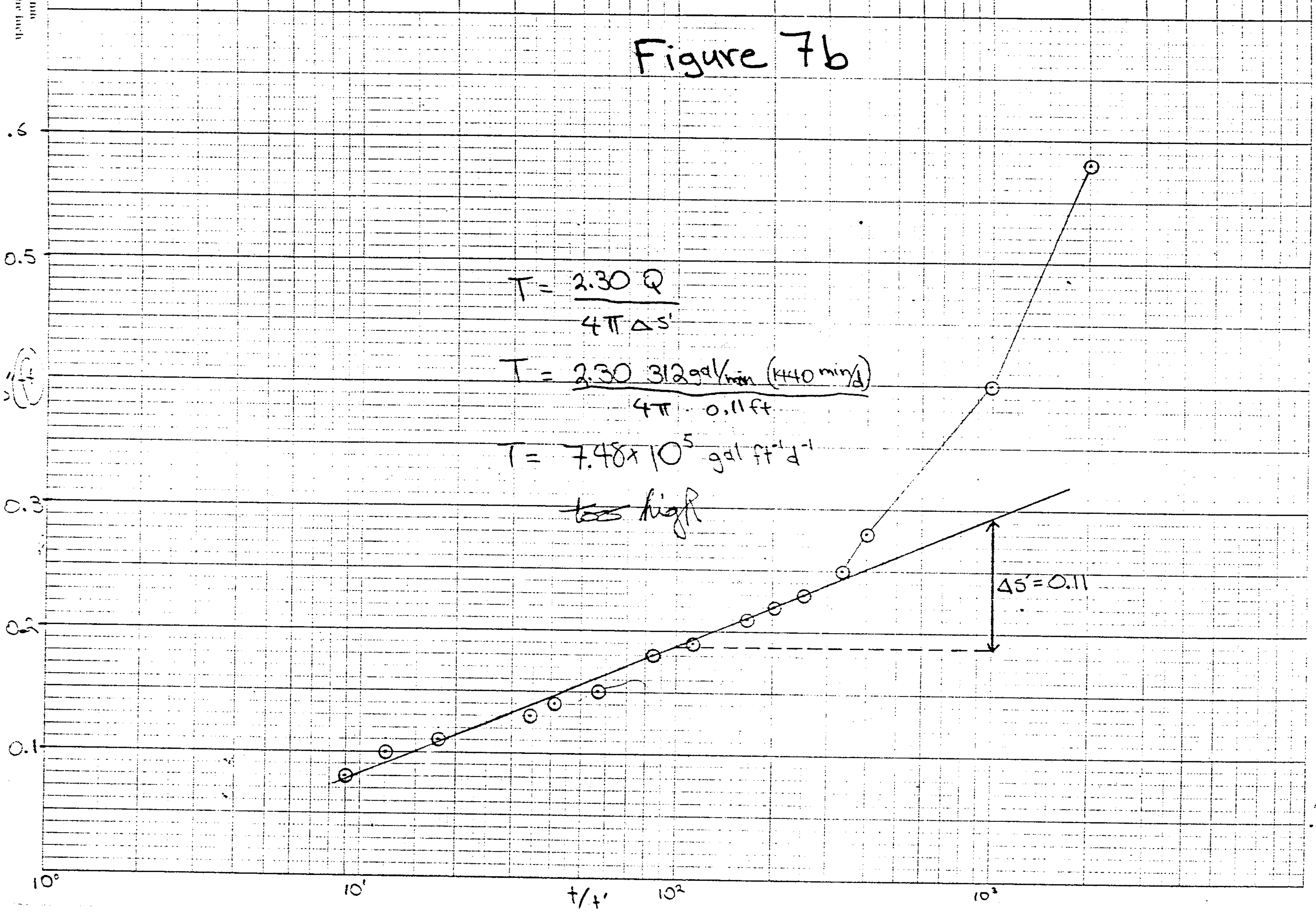
$T = 7.83 \times 10^{5}\ \text{gal ft}^{-1}\,\text{d}^{-1}$ (too high)

O-2

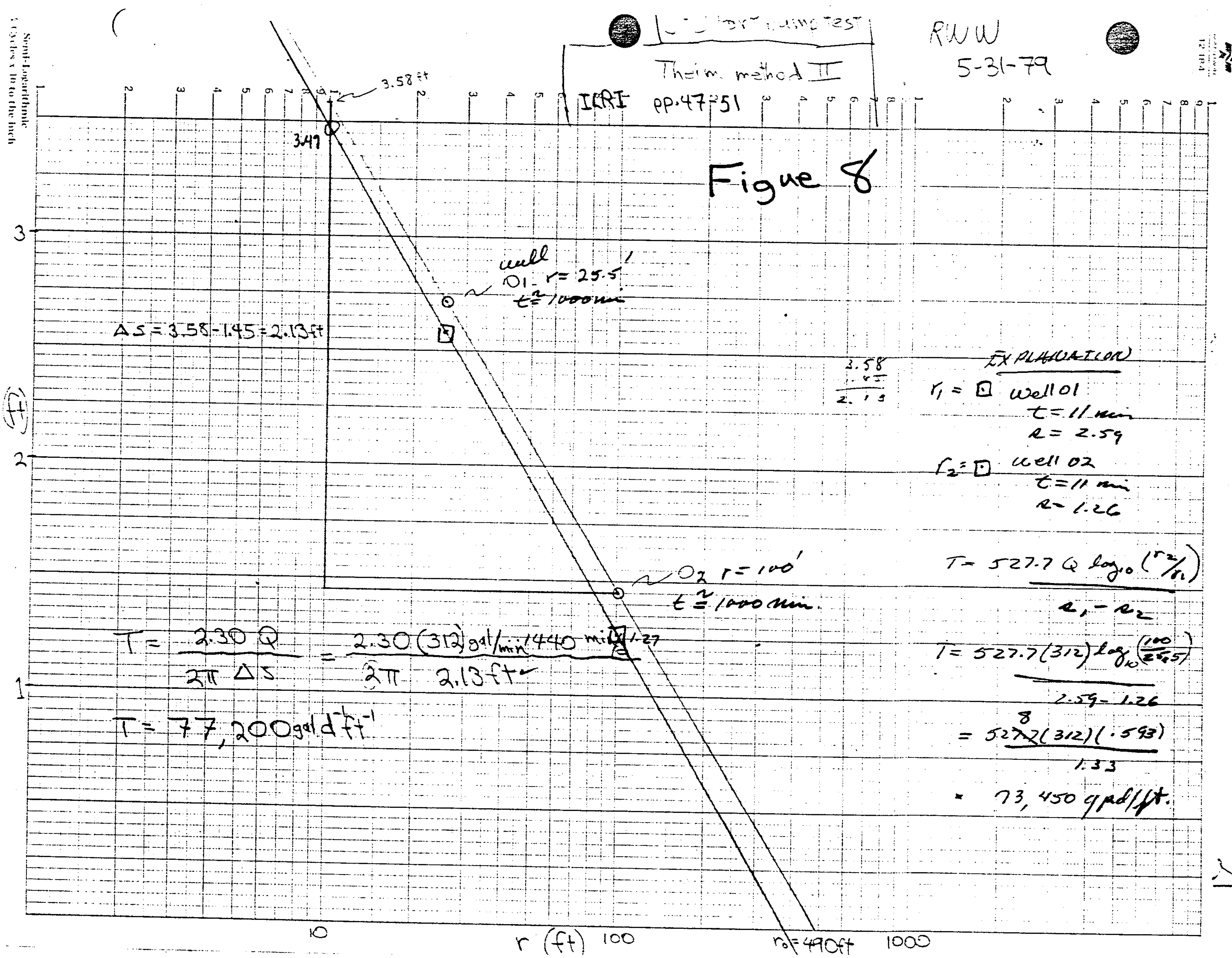
Theis's 1935 recovery method - ILRI pp 66-68

6-6-79

Figure 7b



RWW 5-31-79



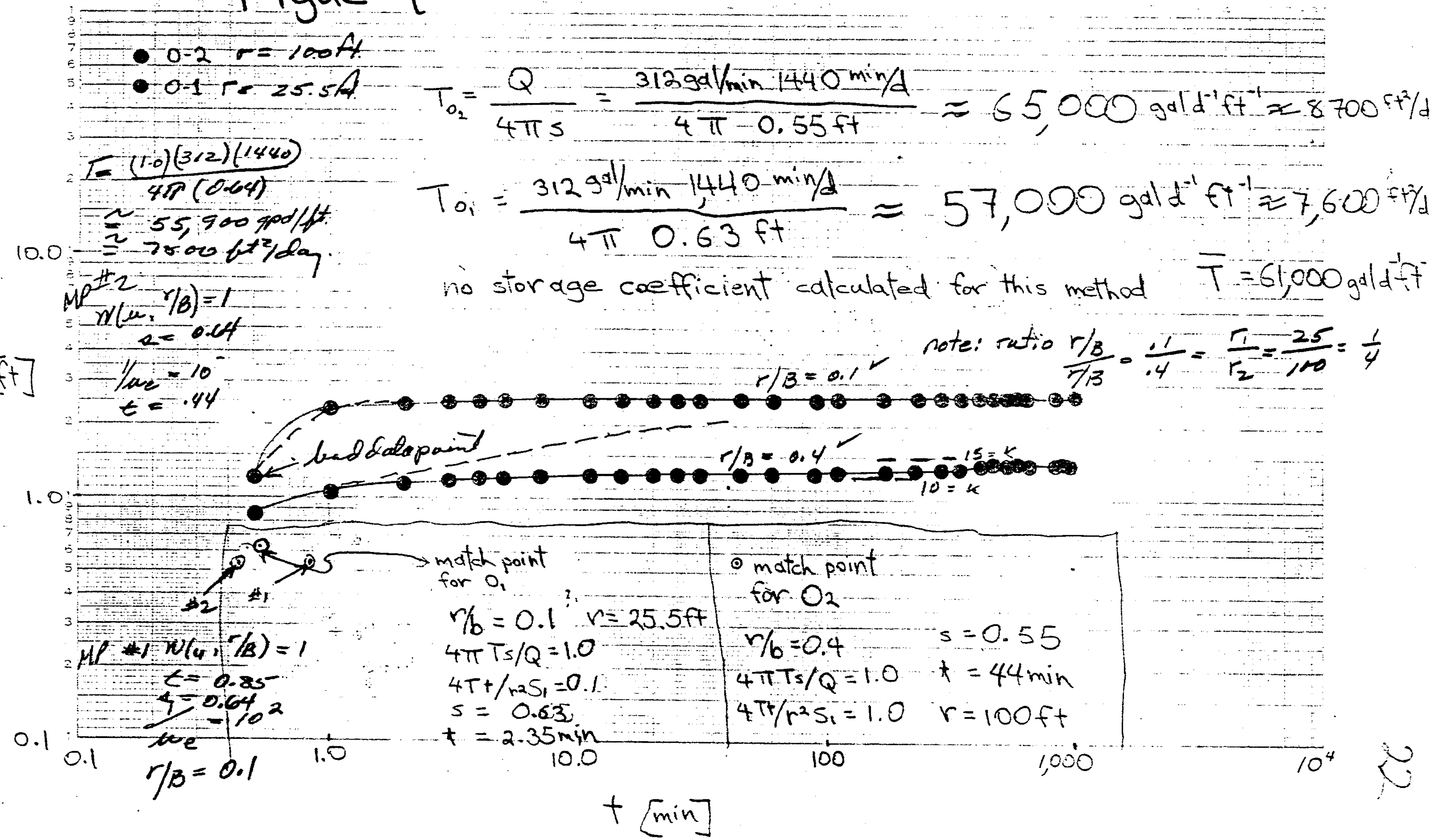
Theim method II
ICRI pp.47-51
Figue 8
3.58 ft
3.49
well 01 - r = 25.5'
t ≈ 1000 min
ΔS = 3.58 - 1.45 = 2.13 ft
3.58
1.45
2.13
EXPLANATION
r1 = ☐ well 01
t = 11 min
s = 2.59
r2 = ☐ well 02
t = 11 min
s = 1.26
02 r = 100'
t ≈ 1000 min
1.27
T = 2.30 Q / 2π ΔS = 2.30 (312) gal/min 1440 min/d / 2π 2.13 ft
T = 77,200 gal d⁻¹ ft⁻¹
T = 527.7 Q log10 (r2/r1) / s1 - s2
T = 527.7 (312) log10 (100/25.5) / 2.59 - 1.26
= 527.8 (312)(.593) / 1.33
= 73,450 gpd/ft.
s (ft)
3
2
1
10
r (ft) 100
r0 = 490 ft
1000
Semi-Logarithmic 3 Cycles x 10 to the Inch

J.D. Park pump test, Martin Co. 5-29&30-79

RWW
6-15-79

Boulton's method [from pp. 34-40 of P.P. 708]

Figue 9

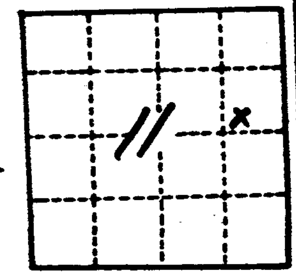


U.S. GEOLOGICAL SURVEY — WELL LOG

WELL NUMBER 270028 0800643.0 (latitude - longitude) LOCAL# M1093 COUNTY Martin

OWNER OR NAME U.S. Geological Survey

LOCATION T 40s R 42E SEC 11, SW 1/4 SE 1/4 NE 1/4



WELL DEPTH 92 ft., CASED 90 ft., DIAMETER 4 in.

DEPTH LOGGED 92 ft., TOP ____ ft., BOTTOM ____ ft., DATE COMPLETED 3-76

FORMATION ____, FORMATION TOP reference to LSD ____ MSL ____

AQUIFER ____, WATER LEVEL reference to LSD ____ MSL ____

ELEVATION LSD 8 ft. MSL SPEED OF LOGGING 25 ft/min.

TOP OR START OF LOG at ft. ~~above~~ LSD ~~below~~ OPERATOR W A Long

TYPE LOG

- ☐ DRILLING TIME
- ☐ CASING-COLLAR
- ☐ CALIPER (diameter)
- ☐ DRILLER'S
- ☒ ELECTRIC
- ☐ FLUID-CONDUCTIVITY (RESISTIVITY)
- ☒ GEOLOGIST OR SAMPLE
- ☐ MAGNETIC
- ☐ INDUCTION
- ☐ GAMMA-RAY
- ☐ DIPMETER (inclinometer)
- ☐ LATER
- ☐ MICRO
- ☐ MICROLATER
- ☐ NEUTRON
- ☐ PHOTOGRAPHIC (TV, still, movie)
- ☐ RADIOACTIVE-TRACER
- ☐ RADIATION
- ☐ SONIC
- ☐ TEMPERATURE
- ☐ TEMPERATURE (FLUID-CONDUCTIVITY)
- ☐ FLUID-VELOCITY

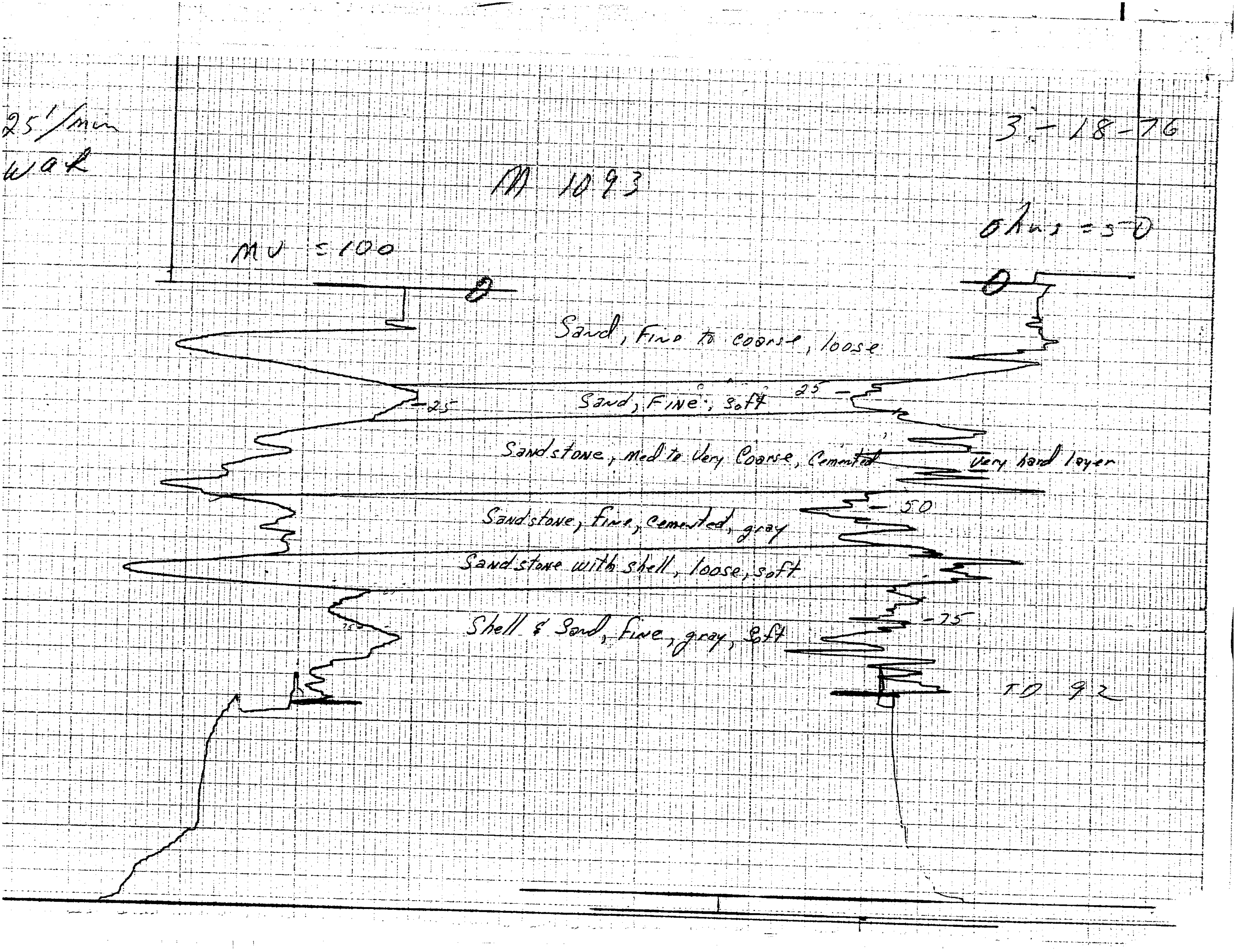
USE OF WELL

- ☐ ANODE
- ☐ DRAINAGE
- ☐ DESTROYED
- ☒ OBSERVATION
- ☐ OIL-GAS
- ☐ RECHARGE
- ☒ TEST
- ☐ UNUSED
- ☒ WITHDRAWAL
- ☐ WASTE

QW SAMPLE ☒ NO ☐ YES DATE SAMPLED ____ DEPTH(S) SAMPLED ____

LOG SCALES HORIZ ____, VERT ____ LOGGED ☒ UP ☐ DOWN

S.P. MV = 100 DEPTH RESISTIVITY Ohms = 50


25'/min
wak
3-18-76
M 1093
MV = 100
Ohms = 50
0
0
Sand, Fine to coarse, loose
-25
25
Sand, Fine, soft
Sandstone, med to Very Coarse, Cemented
Very hard layer
-50
Sandstone, fine, cemented, gray
Sandstone with shell, loose, soft
-75
Shell & Sand, fine, gray, soft
TD 92

J.D. Park pump test (5-79) JDS1

Table 1

O-1 r=25.5 ft

time	(t) min. since start of test	d.t.w. (ft)	(s) drawdown (ft)	t/r² day ft⁻²
1510	0	5.43	0	
	0.5	6.65	1.22	5.34×10^{-7}
	1	7.76	2.33	1.07×10^{-6}
	2	7.87	2.44	2.14×10^{-6}
	3	7.92	2.49	3.20×10^{-6}
	4	7.94	2.51	4.27×10^{-6}
	5	7.95	2.52	5.34×10^{-6}
	7	7.96	2.53	7.48×10^{-6}
	11	7.97	2.54	1.17×10^{-5}
	15	7.98	2.55	1.60×10^{-5}
	20	7.99	2.56	2.14×10^{-5}
	25	7.99	2.56	2.67×10^{-5}
	31	8.00	2.57	3.31×10^{-5}
	45	8.01	2.58	4.81×10^{-5}
1610	60	8.01	2.58	6.41×10^{-5}
1640	90	8.02	2.59	9.61×10^{-5}
1700	110	8.03	2.60	1.17×10^{-4}
1800	170	8.05	2.62	1.82×10^{-4}
1903	233	8.06	2.63	2.49×10^{-4}
2000	290	8.07	2.64	3.10×10^{-4}
2100	350	8.09	2.66	3.74×10^{-4}
2200	410	8.10	2.67	4.38×10^{-4}
2300	470	8.10	2.67	5.02×10^{-4}

time	min since start of test	min since shutdown (t')	d.t.w.	drawdown / residual drawdown s'	t/r² day ft^{-2}	t/t'
2400 ([illegible]-79)	530		8.11	2.68	5.66×10^{-4}	
[illegible]100	590		8.12	2.69	6.30×10^{-4}	
[illegible]00	650		8.12	2.69	6.94×10^{-4}	
[illegible]00	830		8.14	2.71	8.86×10^{-4}	
0600	890		8.14	2.71	9.50×10^{-4}	
0700	950		8.15	2.72	1.01×10^{-3}	
0748	998		8.15	2.72	1.07×10^{-3}	at 0748 test shutdown
JDS1R	998.5	0.5	7.35	1.92		2.00×10^{3}
	999	1	6.57	1.14		9.99×10^{2}
	999.5	1.5	5.85	0.42		6.66×10^{2}
	1000.5	2.5	5.75	0.32		4.00×10^{2}
	1001	3	5.73	0.30		3.34×10^{2}
	1002	4	5.72	0.29		2.51×10^{2}
	1004	6	5.68	0.25		1.67×10^{2}
	1007	9	5.66	0.23		1.12×10^{2}
0800	1010	12	5.65	0.22		8.42×10^{1}
	1018	18	5.63	0.20		5.64×10^{1}
	1023	25	5.62	0.19		4.09×10^{1}
0818	1028	30	5.61	0.18		3.43×10^{1}
0848	1058	60	5.58	0.15		1.76×10^{1}
	1088	90	5.57	0.14		1.21×10^{1}
	1123	125	5.55	0.12		8.93×10^{0}

J-D. Park pump test (5-79)

Table 2

O-2 r = 100 ft JDS2

[illegible] (…79)	(t) min. since start of test	d.t.w. (ft)	(s) drawdown (ft)	t/r^2 day ft^{-2}
10	0	3.54	0	
	0.5	4.40	0.86	3.47×10^{-8}
	1	4.60	1.06	6.94×10^{-8}
	2	4.70	1.16	1.39×10^{-7}
	3	4.74	1.20	2.08×10^{-7}
	4	4.76	1.22	2.78×10^{-7}
	5	4.77	1.23	3.47×10^{-7}
	7	4.78	1.24	4.86×10^{-7}
	11	4.80	1.26	7.64×10^{-7}
	15	4.81	1.27	1.04×10^{-6}
	20	4.82	1.28	1.39×10^{-6}
	25	4.82	1.28	1.74×10^{-6}
	31	4.82	1.28	2.15×10^{-6}
	45	4.83	1.29	3.13×10^{-6}
10	60	4.83	1.29	4.17×10^{-6}
640	90	4.83	1.29	6.25×10^{-6}
700	110	4.84	1.30	7.64×10^{-6}
105	175	4.86	1.32	1.22×10^{-5}
[illegible]00	230	4.86	1.32	1.60×10^{-5}
[illegible]00	290	4.89	1.35	2.01×10^{-5}
100	350	4.90	1.36	2.43×10^{-5}
200	410	4.94	1.40	2.85×10^{-5}
300	470	4.95	1.41	3.26×10^{-5}

time	min. since start of test	min since shutdown (t')	d.t.w.	drawdown	t/r² day ft⁻²	
00 (11-7?)	530		4.95	1.41	3.68×10^{-5}	
00	590		4.99	1.45	4.10×10^{-5}	
00	650		4.95	1.41	4.51×10^{-5}	
500	830		4.97	1.43	5.76×10^{-5}	
	891		5.00	1.46	6.19×10^{-5}	
	950		4.98	1.44	6.60×10^{-5}	
	998		4.98	residual drawdown (s')		at 0748 but shutdown t/t'
JDS2R	998.5	0.5	4.13	0.58		2.00×10^{3}
	999	1	3.95	0.40		9.99×10^{2}
	1000.5	2.5	3.83	0.28		4.00×10^{2}
	1001	3	3.80	0.25		3.34×10^{2}
	1002	4	3.78	0.23		2.51×10^{2}
	1003	5	3.77	0.22		2.01×10^{2}
	1004	6	3.76	0.21		1.67×10^{2}
	1007	9	3.74	0.19		1.12×10^{2}
00	1010	12	3.73	0.18		8.42×10^{1}
	1016	18	3.70	0.15		5.64×10^{1}
	1023	25	3.69	0.14		4.09×10^{1}
	1028	30	3.68	0.13		3.43×10^{1}
	1058	60	3.66	0.11		1.76×10^{1}
	1088	90	3.65	0.10		1.21×10^{1}
	1123	125	3.64	0.08		8.98×10^{0}

Hantush – Jacob method (leaky confined, unsteady-state)

$T = 92{,}000 \text{ gal d}^{-1} \text{ ft}^{-1}$

$S = 1.1 \times 10^{-4}$

well $O_1 \rightarrow K'/b' = 0.030 \text{ d}^{-1}$ $\overline{K'/b'} = 0.035 \text{ d}^{-1}$

well $O_2 \rightarrow K'/b' = 0.040 \text{ d}^{-1}$

The data plots plus field observations indicate that this is a leaky-confined aquifer. Therefore, the results of the Hantush – Jacob method are adopted.

Preparer — Ralph Wilcox

J-D State Park Test
May 29 – 30, 1979

Hantush - Jacob method, P.P. 708, Plate 3B

Wells O_1 and O_2

$Q = 312$ gpm

Match Point data:

$L(u,v) = 10$

$1/u = 10$

$s = 5.3$ ft.

$t/r^2 = 3 \times 10^{-8}$

O_1 $r = 25.5$ ft

O_2 $r = 100$ ft

$$T = \frac{(312) \times (1440) \times (10)}{(4\pi) \times (5.3)}$$

$= 67,500$ gpd/ft

$= 9,020$ ft²/d

$$S = \frac{4(9,020)(3 \times 10^{-8})}{10}$$

$= 1.08 \times 10^{-4}$

$$\frac{K'}{b'}(O_1) = 4T \frac{v^2}{r^2} = 4(9,020) \frac{(0.04)^2}{(25.5)^2} = 0.09/d$$

$$\frac{K'}{b'} O_2 = 4(9020) \frac{(0.15)^2}{(100)^2} = 0.08/d$$

George Hill
12/3/79

Jonathan Dickinson Park Pumping Test

Summary Sheet

Date test began — 5-29-79
Length of test — 16 hrs. 38 min.
Discharge — 312 gal/min

Hydraulic coefficient results

Theis recovery method (confined, unsteady-state)
well $O_1 \rightarrow T = 7.83 \times 10^5$ gal d^{-1} ft^{-1}
well $O_2 \rightarrow T = 7.48 \times 10^5$ gal d^{-1} ft^{-1}

Theim method (confined, steady-state)
$T = 77{,}000$ gal d^{-1} ft^{-1}

Boulton method (unconfined-delayed yield, unsteady-state)
well $O_1 \rightarrow T = 57{,}000$ gal d^{-1} ft^{-1}
well $O_2 \rightarrow T = 65{,}000$ gal d^{-1} ft^{-1}

Introduction

The purpose of this pumping test is to determine the transmissivity and storage coefficient of the main producing zone of the so-called shallow aquifer at this site. Determination of these parameters in Martin and St. Lucie Counties, Fl is an objective of the Upper East Coast Project (459826800). This is a cooperative project with South Florida Water Management District. A pumping test was previously run by the U.S.G.S. with this suite of wells in 1975, but regional approval of the results was not achieved, presumably because the discharge rate was too low, 120 gal/min.

Personnel conducting test — Ralph Wilcox, Bill Long, Jay Wendorf

Physical Conditions

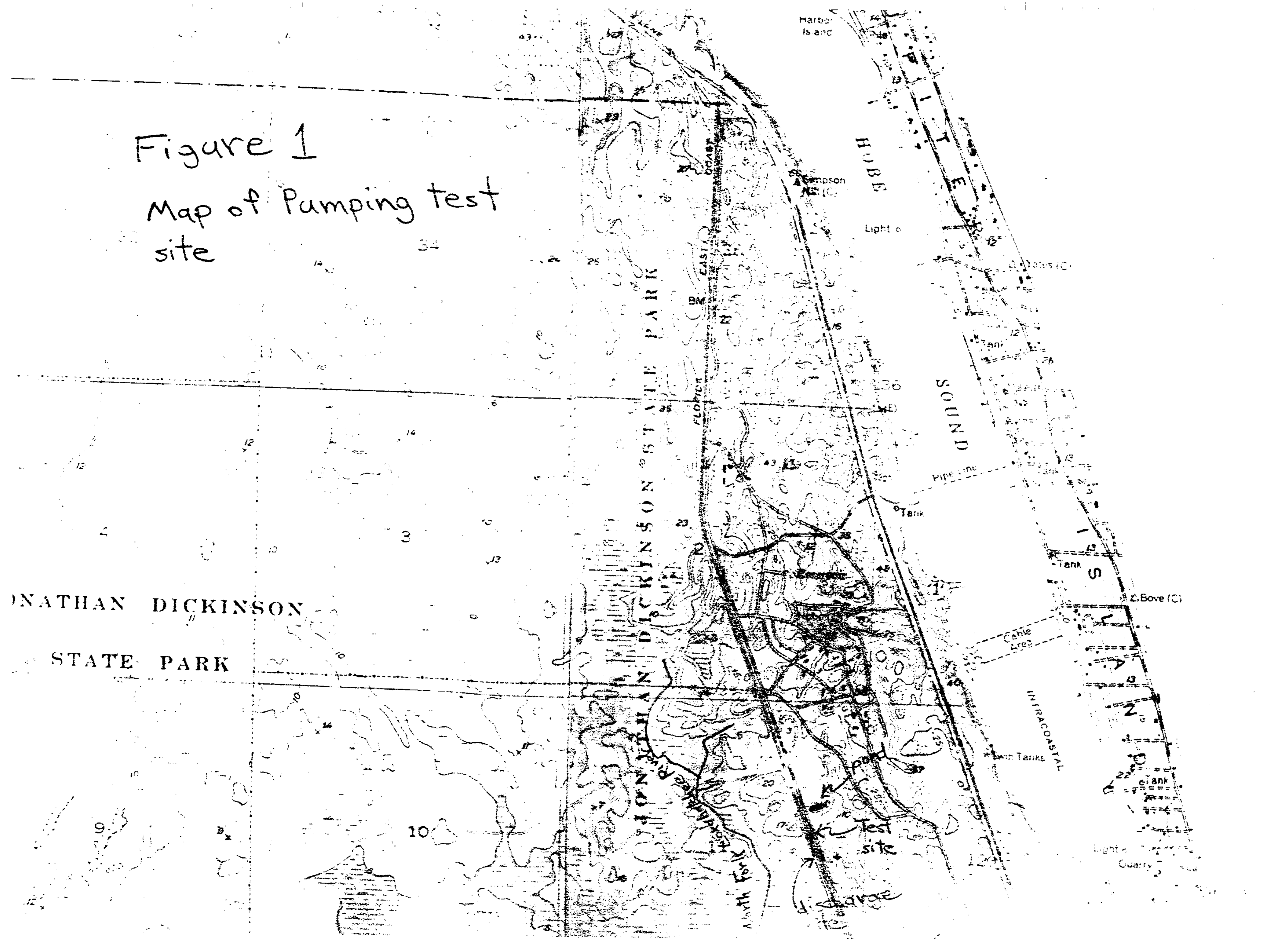
The test site is located in Jonathan Dickinson State Park approximately three miles north of Jupiter, Fl. The lat-long. of the production well is N. 27° 00' 26", W. 080° 06' 45" (T.40S., R.42E., Sec 11, SW SE NE) (figure 1).

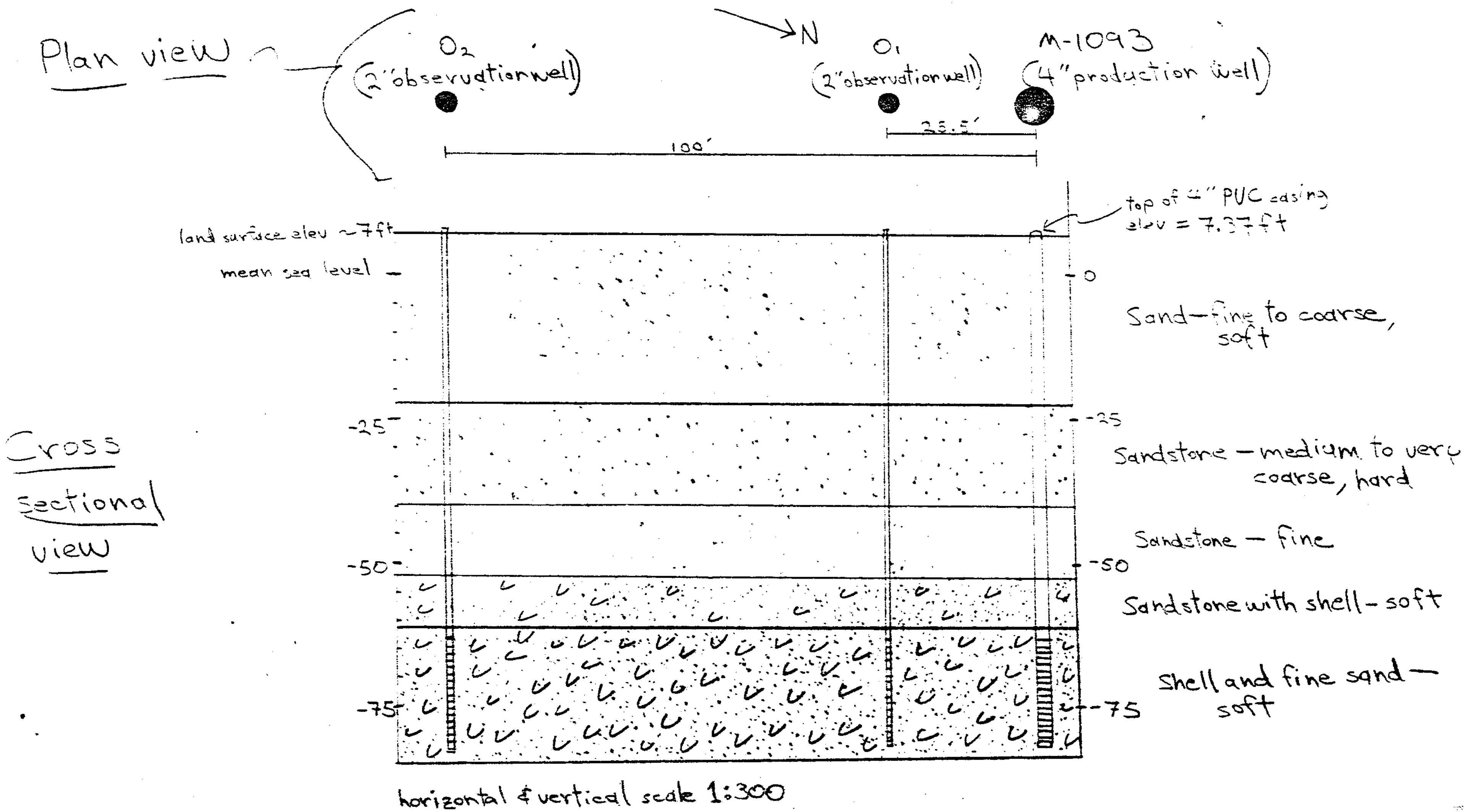
The aquifer is composed of shell and fine sand with an overlying roof rock of slightly indurated sandstone with shell fragments (figure 2).

Anticipated boundary conditions exist both east and west of the test site. About 1,000 feet west of the test site is the north fork Loxahatchee River. This is considered as a linear recharge boundary. The intercoastal waterway is approximately 3,500 feet northeast of the test site. The landward dipping freshwater - saltwater interface roughly paralleling the shore of the intercoastal waterway is an aquifer boundary. The small pond just north of the test site could be point source of recharge for the aquifer.

Figure 1

Map of Pumping test site





All wells 90 feet deep, screened from 70 to 90 foot depth.
Cross section constructed from lithologic log for M-1093 only.

Figure 2 Plan view & Cross sectional view of Pumping test site.

The test setup consists of a four inch production well and two two-inch observation wells (figure 2). All three wells are 90 feet deep, and screened from the 70 to 90 foot depth. The radii from the production well are 25.5 feet for well O_1 and 100 feet for well O_2.

A Keck water level finder used in conjunction with a Stephens F-type recorder with a chart period of eight days was placed on well O_1 on 5-16-79 (figure 3 a+b). This background water level data while not complete does show the overall trends. However, since there is no record for the five days prior to the start of the test there is no way of determining the direction of head fluctuation before the test. The same instrument was used on well O_1 to measure drawdown during the pumping test, and the same type instrument was used on well O_2. The recorder chart periods were one day, and water level gear ratios were 5 to 1. During the test the charts were ticked at known time intervals.

Figure-3a

Background data — O1

J.D. State Park pumping test 5-29&30-79

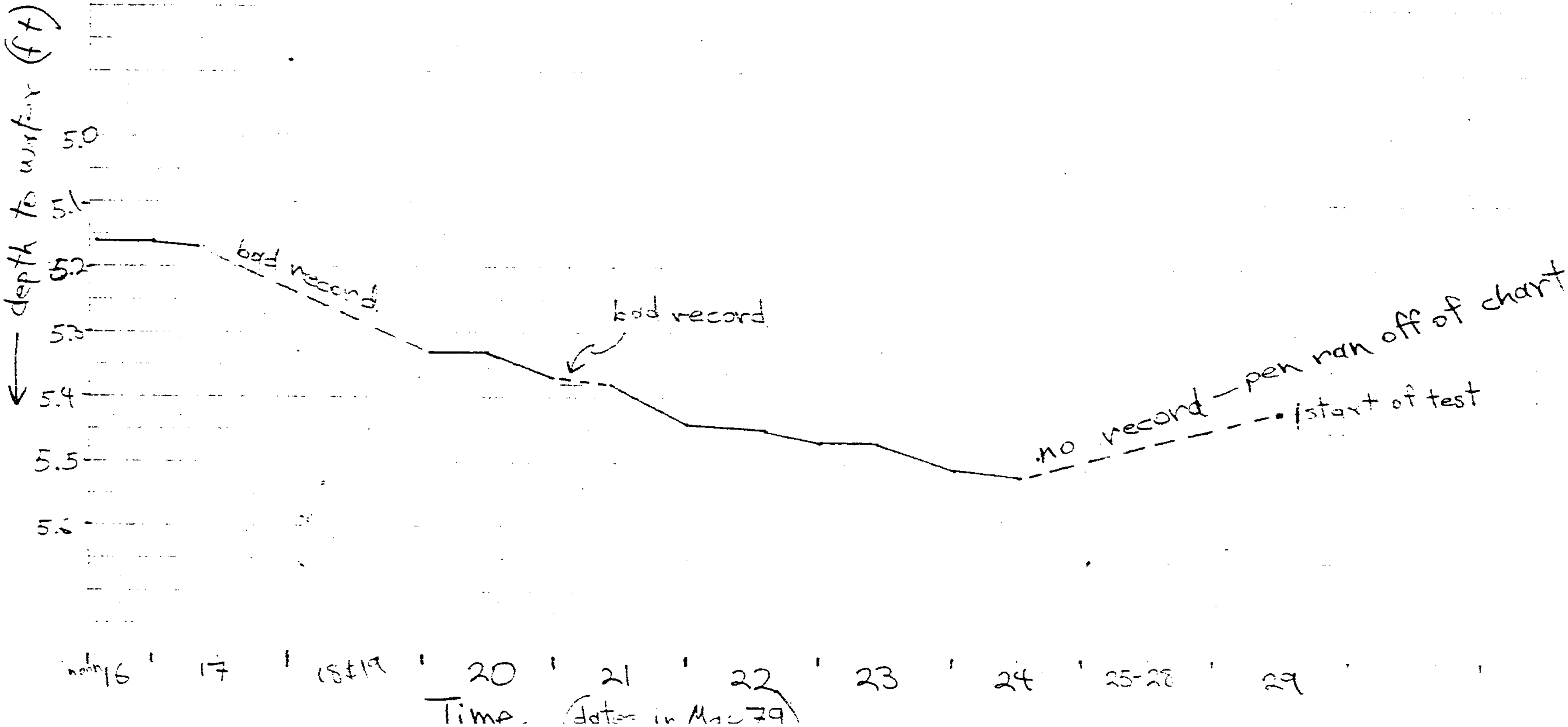
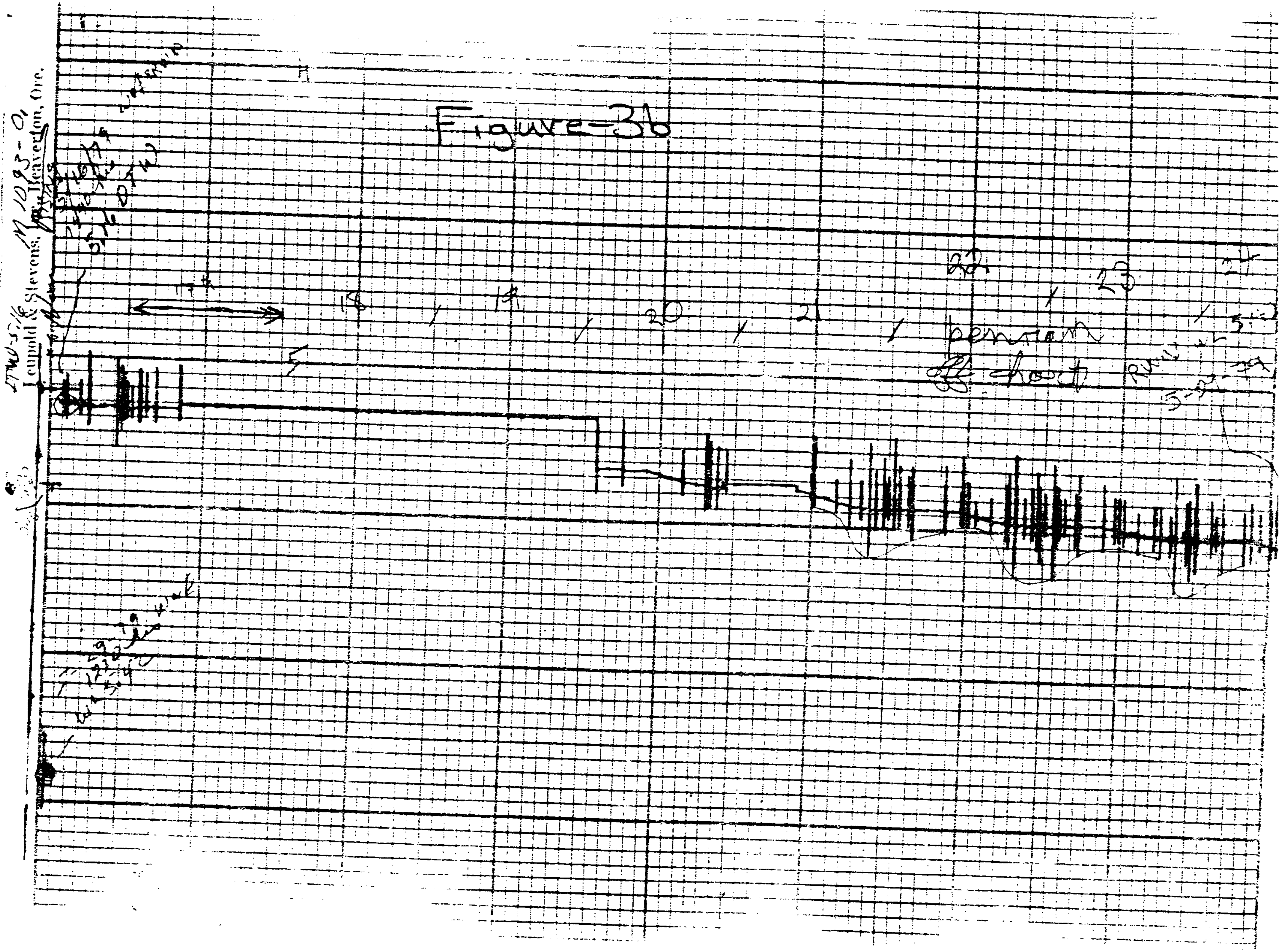


Figure-3b



The production well was pumped with a 4x4 inch centrifugal pump. Discharge was piped 330 feet southward along the road where it was fed into a ditch thence flowing further southward, and spreading out in a flat marshy area. Discharge was measured by using a circular orifice weir (6 in pipe, 4 in orifice) with a piezometer mounted in the side of the pipe. A gate valve was not employed for this test, but discharge remained constant throughout the test. Well performance was the limiting factor controlling discharge, rather than pump performance. Discharge was 312 gal/min for the test (figure 4).

When the test was first started a sizeable leak in the discharge pipe occurred. The test was shut down to repair the leak and restarted in half an hour. Water levels had recovered to pretest marks in this half hour interim, (figure 5a+b).

9-195
(July 1949)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

Figure 4 — Discharge measurements made during test

WATER LEVEL MEASUREMENTS (Office)

FIELD No. ____________

OWNER J-D Park Test

OFFICE No. ____________

LOCATION ____________

PROJECT ____________

MEASURING POINT ____________

ELEVATION OF MEASURING POINT gpm

4 in. orifice
6 in. pipe

DATE	HOUR	~~Depth to~~ Head to Water	ELEV. OF WATER ~~SURFACE~~ gpm	MEAS. BY	REMARKS (Nearby wells pumping, etc.)	
5/29/79	1513	23 7/8	30[illegible]	[illegible]	[illegible]	
	15[illegible]	[illegible]	[illegible]	[illegible]	raised RPM to 6 min	
	15[illegible]	23 3/4	307 + 5	[illegible]		
	1558	23 5/8	307 + 5	JSW		
	1611	23 3/4	307 + 5	JSW		
	1650	23 5/8	307 + 5	WCL		
	1745	1.97	308	RWW		23.~~4~~4
	1855	1.95	307	RWW		23.4
	2005	1.95	307	RWW		23.4
	2103	1.95	307	RWW		23.4
	2215	23.50	307	WCL		
	2304	23 5/8	307	WCL		
	2402	23 5/8	307	WCL		
5-30-79	0102	23 1/2	307	JSW		
	0207	23.5	307	JSW		
	0504	23 3/8	307	JSW		
	0604	23 3/8	307	JSW		
	0703	23 3/4	307			

$Q = 312$ gpm

U.S. GOVERNMENT PRINTING OFFICE : 1949 O—[illegible]

526-688

Figure 9a
Recorder chart for O1
6
6.5
7
Leupold & Stevens, Inc., Beaverton, Ore.
Water Level Recorder — Type F

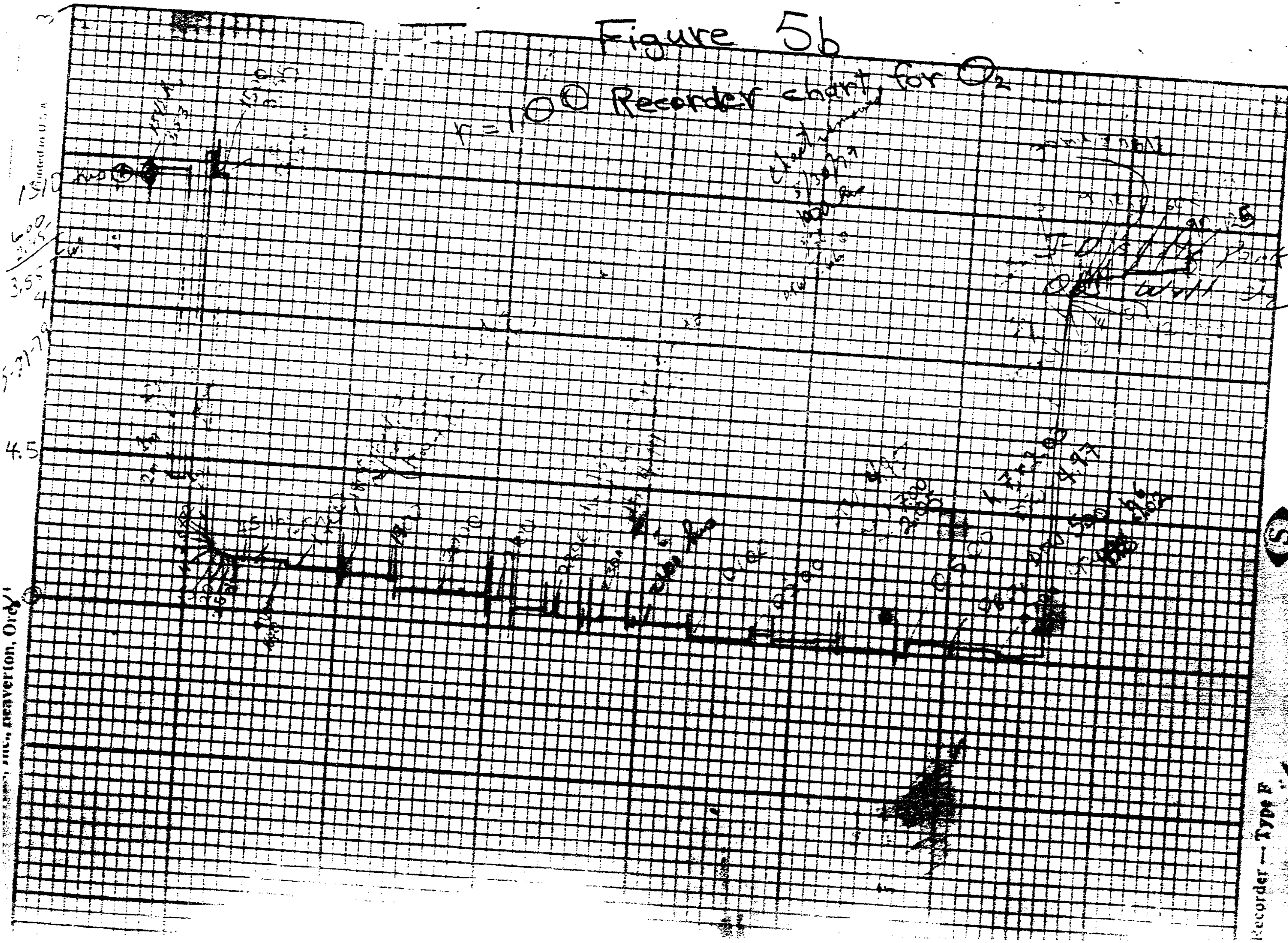


Figure 5b
r = 10Ω Recorder chart for O2
4
4.5
Recorder — Type F

The pumping test was shut down at 0748 on 5-30-79 when the pump unexpectedly ran out of gas. Recovery measurements were made for two hours. Precipitation during the test amounted to 0.03 in. Barometric pressure changes were negligible.

Figures 6a&b — drawdown vs. log time graphs

No solutions have been applied to this data since the linear portions of the graphs are nearly flat. This means extremely high transmissivity values would be calculated using these figures.

Figures 7a&b — drawdown vs. log t/t' (t = time since start of test, t' = time since end of test). These graphs show the same behavior as the figures 6a&b, i.e. linear portions of the graphs are nearly flat. Transmissivity values were calculated from these figures (Theis Recovery method), and they seem much too high.

Figure 8 — drawdown vs. log radial distance graph
This method (Theim) assumes steady state, which is questionable for this test, but this method gives an approximation of transmissivity.

Figure 9 — log drawdown vs. log time graph
This method (Boulton) is for an unconfined aquifer with delayed yield, which is not the case for this test. The results of this method give a ball park transmissivity value.

Figure 10 — log drawdown vs. log (time/radial distance squared) This method (Hantush-Jacob) is applicable to semiconfined aquifers. Water levels rose in observation wells as much as 0.2 feet when a train would pass about 100 feet west of the wells. The water levels returned to normal levels after the train had passed. This indicated a confined aquifer,

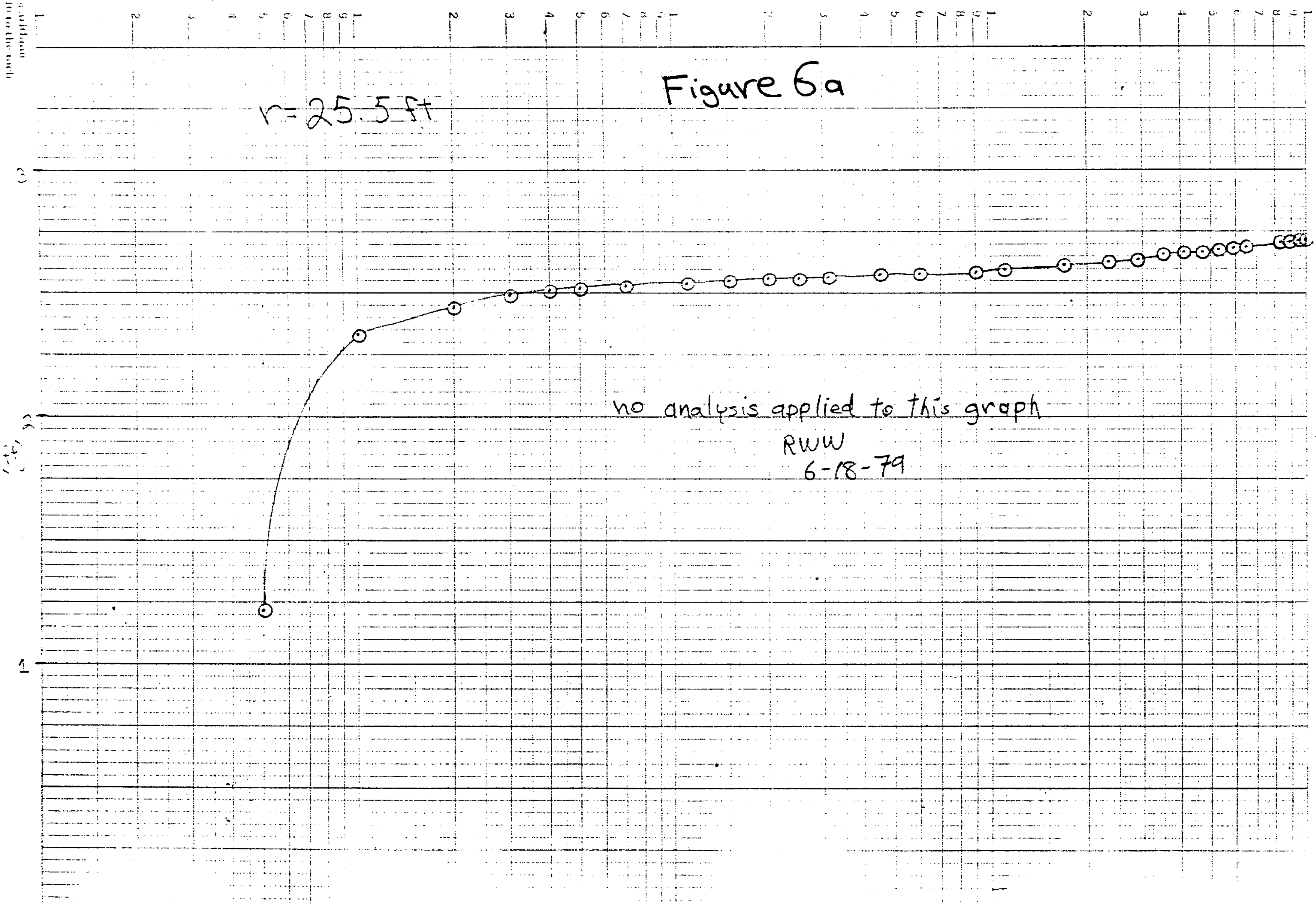
but there was no shallow observation well to determine if the aquifer is leaky. However, since most of the overlying strata is sand and sandstone with, perhaps low, but not negligible permeability the aquifer is leaky confined. Therefore, the results of this method best approximate the aquifer hydraulic parameters.

RWW 6-20-79

O-1

J.D. Park pump test
5-79

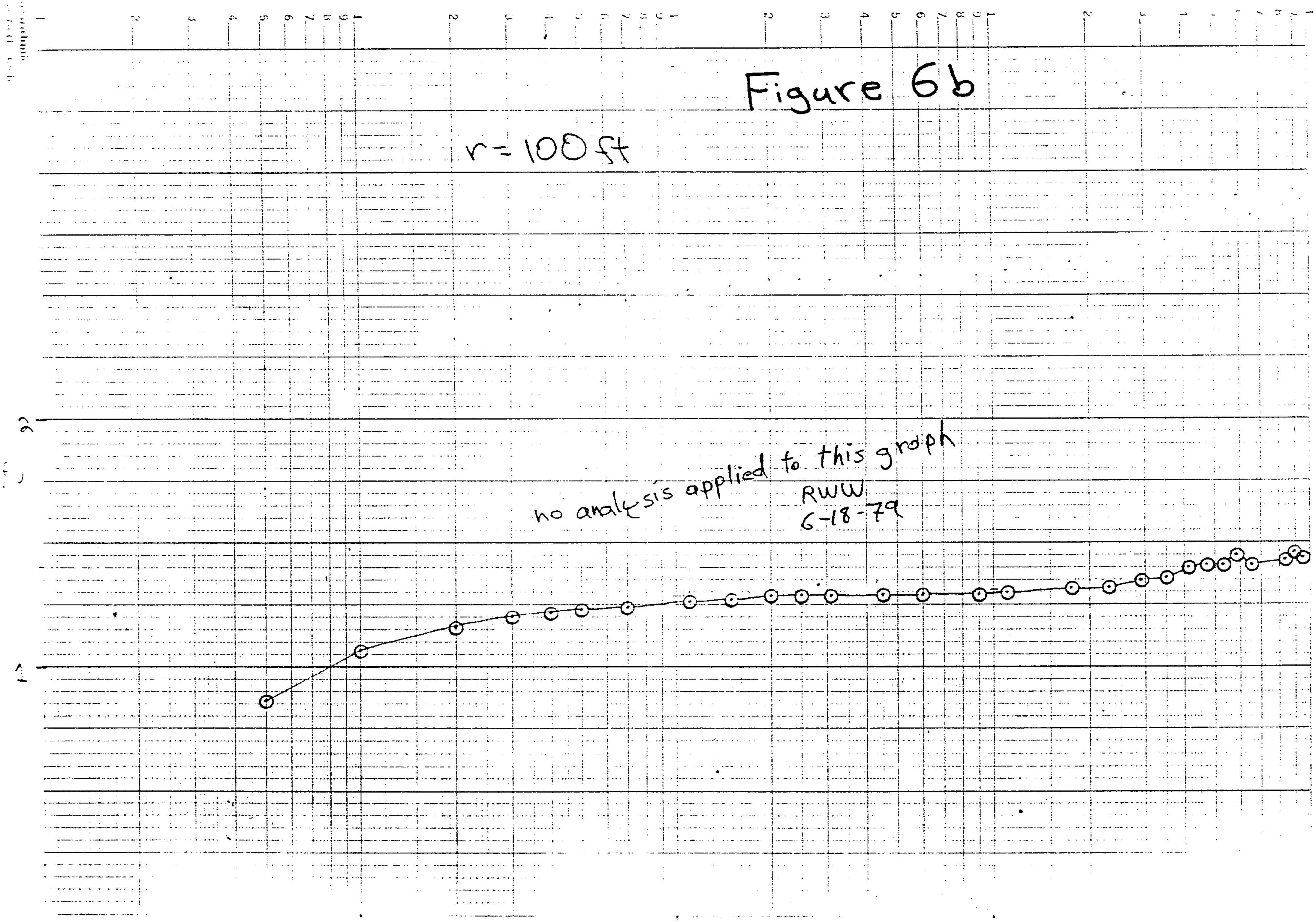
RWW
5-31-79



J-D Park pump test 5-79

RWW 5-31-79

O-2

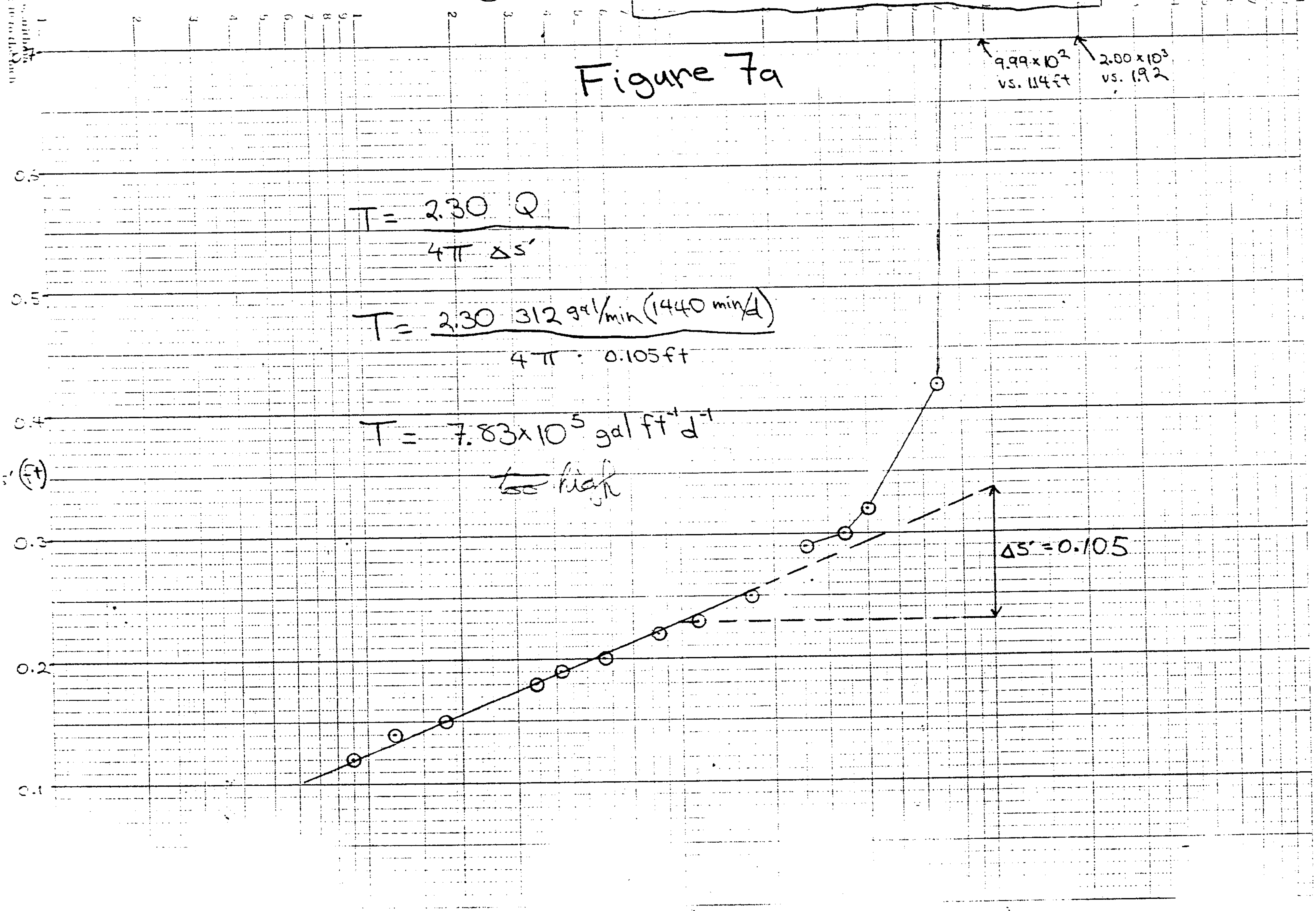


J.D. Park pumping test, 5-79

RWW
6-6-79

O-1

Theis's recovery method — ILRI pp 55-68



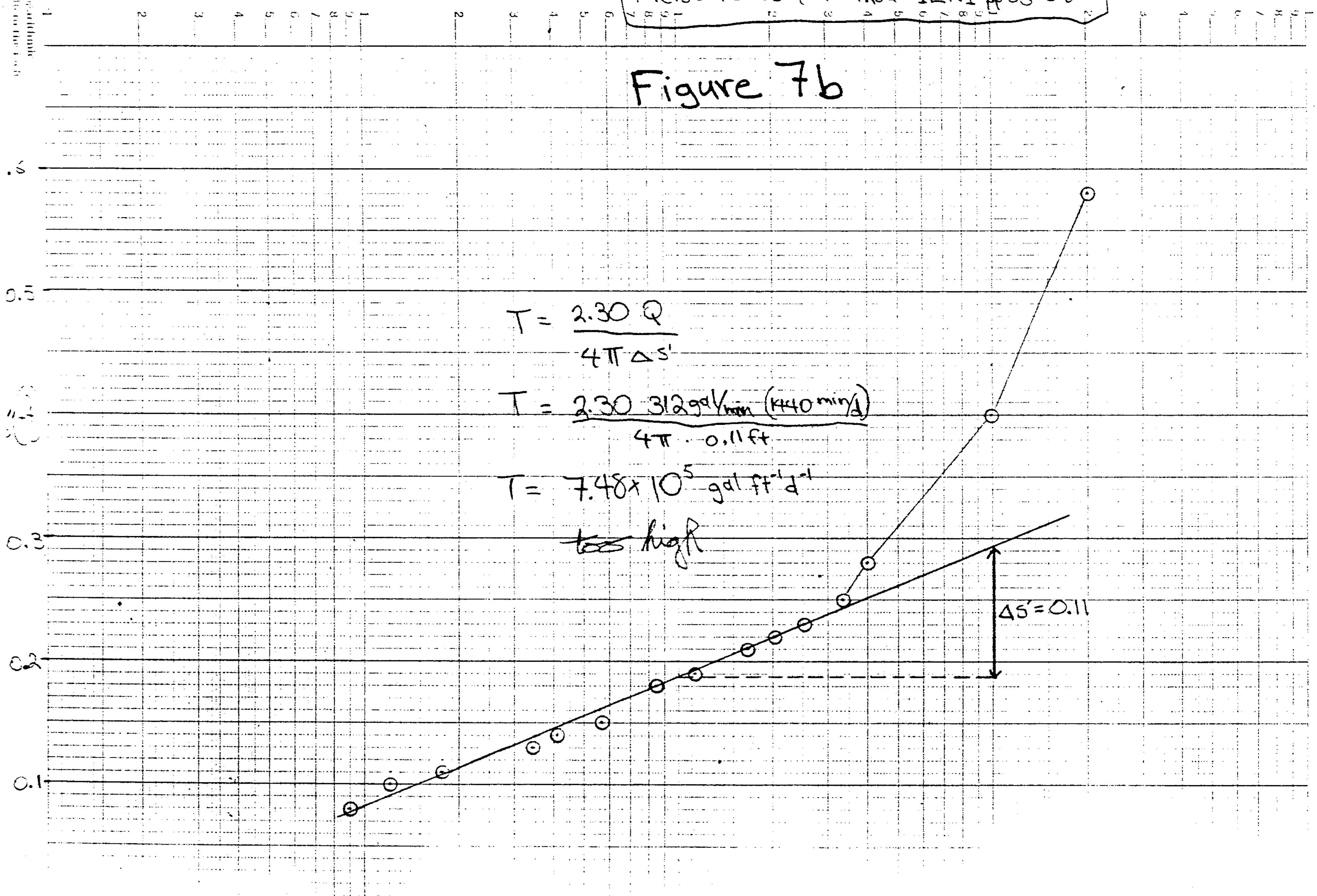
J.D. Park pumping test, 5-79

RWW
6-6-79

O-2

Theis's recovery method - ILRI pp 66-68

Figure 7b

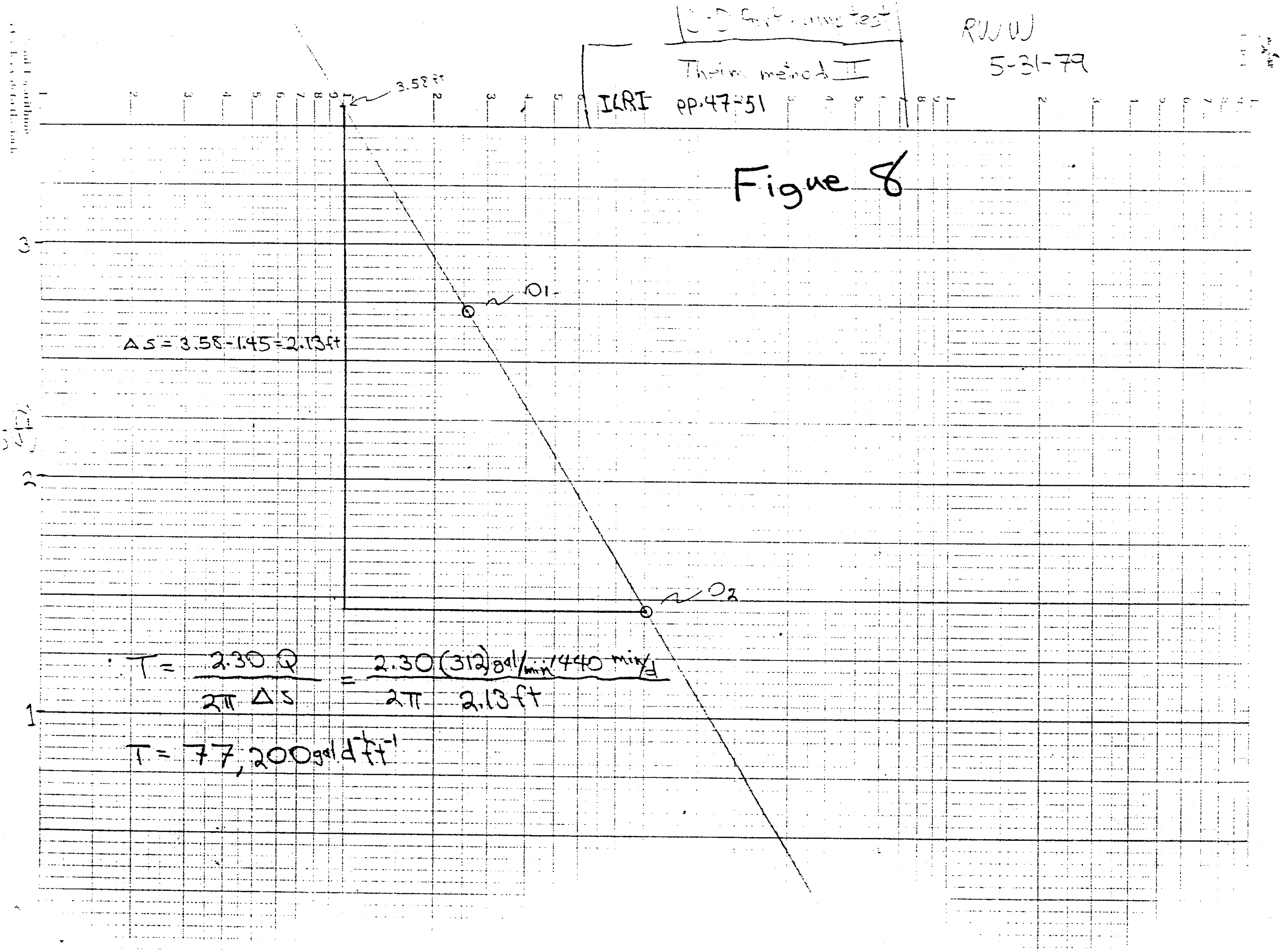


$$T = \frac{2.30\ Q}{4\pi\ \Delta s'}$$

$$T = \frac{2.30 \cdot 312\ \text{gal/min}\ (1440\ \text{min/d})}{4\pi \cdot 0.11\ \text{ft}}$$

$$T = 7.48 \times 10^5\ \text{gal ft}^{-1}\text{d}^{-1}$$

~~too~~ high


Theim method II
ILRI pp.47-51
RWW
5-31-79
Figue 8
3.58 ft
O1
O2
ΔS = 3.58 - 1.45 = 2.13 ft
T = 2.30 Q / 2π ΔS = 2.30 (312) gal/min 1440 min/d / 2π 2.13 ft
T = 77,200 gal d⁻¹ ft⁻¹

J-D Park pump test, Martin Co. 5-29&30-79

RWW
6-15-79

Boulton's method [from pp. 34-40 of P.P. 708]

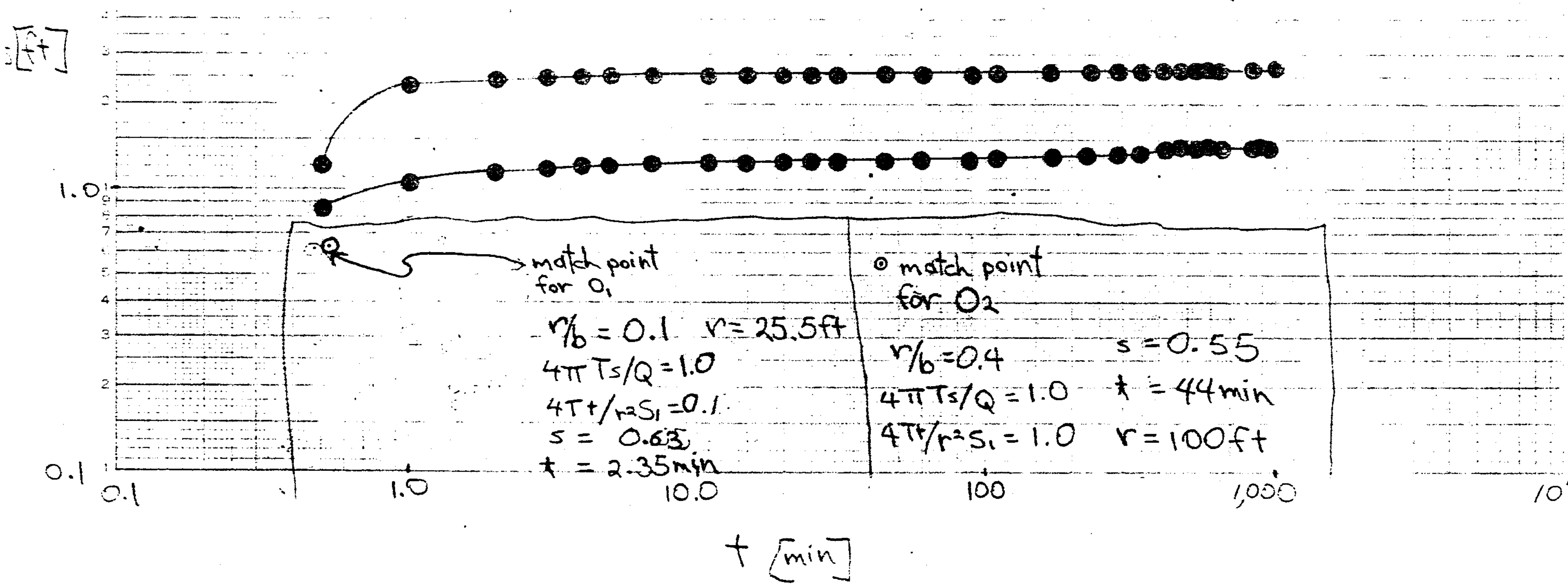
Figue 9

● O-2
● O-1

$$T_{O_2} = \frac{Q}{4\pi s} = \frac{312\ \text{gal/min}\ 1440\ \text{min/d}}{4\pi\ 0.55\ \text{ft}} \approx 65{,}000\ \text{gal}\,d^{-1}\,ft^{-1} \approx 8700\ ft^2/d$$

$$T_{O_1} = \frac{312\ \text{gal/min}\ 1440\ \text{min/d}}{4\pi\ 0.63\ \text{ft}} \approx 57{,}000\ \text{gal}\,d^{-1}\,ft^{-1} \approx 7{,}600\ ft^2/d$$

no storage coefficient calculated for this method $\bar{T} = 61{,}000\ \text{gal}\,d^{-1}\,ft^{-1}$



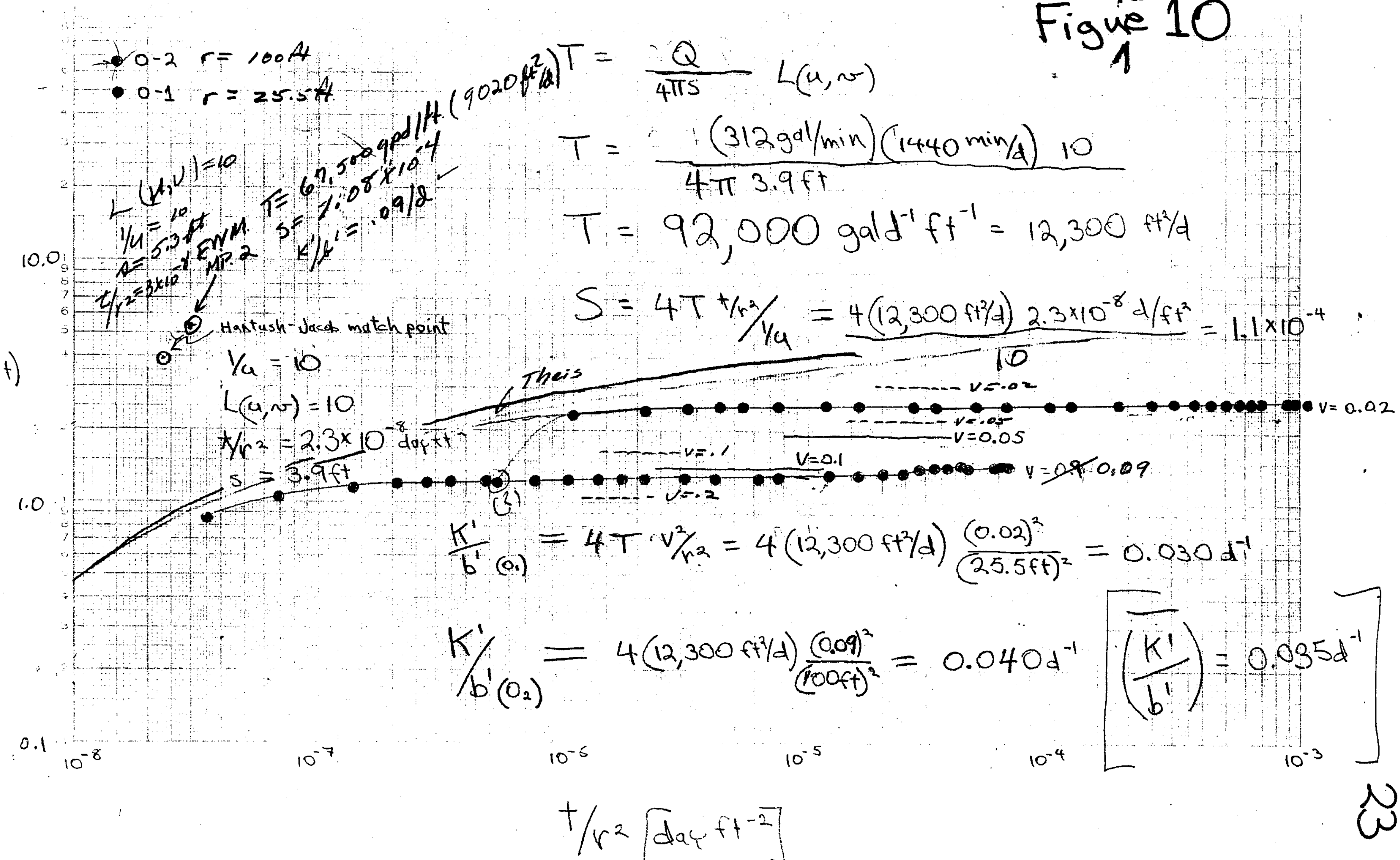
(r=25.5)

RWW 6-1-79

J. D. Park pump test, Martin Co. 5-29&30-79

Hantash-Jacob method [from pp. 30-32 of P.P. 708]

Figure R10 / Figure 10



$$T = \frac{Q}{4\pi s} L(u,v)$$

$$T = \frac{(312\ \text{gal/min})(1440\ \text{min/d})\ 10}{4\pi\ 3.9\ \text{ft}}$$

$$T = 92{,}000\ \text{gal d}^{-1}\text{ft}^{-1} = 12{,}300\ \text{ft}^2/\text{d}$$

$$S = 4T\frac{t/r^2}{1/u} = \frac{4(12{,}300\ \text{ft}^2/\text{d})\ 2.3\times10^{-8}\ \text{d/ft}^2}{10} = 1.1\times10^{-4}$$

$$\frac{K'}{b'}_{(O_1)} = 4T\frac{v^2}{r^2} = 4(12{,}300\ \text{ft}^2/\text{d})\frac{(0.02)^2}{(25.5\ \text{ft})^2} = 0.030\ \text{d}^{-1}$$

$$\frac{K'}{b'}_{(O_2)} = 4(12{,}300\ \text{ft}^2/\text{d})\frac{(0.09)^2}{(100\ \text{ft})^2} = 0.040\ \text{d}^{-1}$$

$$\left[\overline{\left(\frac{K'}{b'}\right)} = 0.035\ \text{d}^{-1}\right]$$