BARKER, OSHA & ANDERSON, INC.
ENGINEERS - PLANNERS
860 U.S. HIGHWAY ONE
NORTH PALM BEACH, FLORIDA 33408
305/626-4653

50-01007-W

November 11, 1983

Florida Water Service, Inc.
Suite 205
4360 Northlake Boulevard
Palm Beach Gardens, FL 33410

Attn: Mr. Sande S. Kurland
Vice President

Re: Aquifer and Well Performance
Seminole Manor Wells

Gentlemen:

Transmitted herewith is a condensation of test data and analyses relative to the pumpage tests which were conducted on November 3, 1983 of the recently constructed Well No. 3 at the Seminole Manor Water Treatment Plant.

The test indicates excellent aquifer characteristics and extremely high efficiency of the new well, for which a 500 gpm pump has been ordered, and will be installed in early December. After further testing and bacteriological clearance, it is possible that the well could be placed in service before the end of the year. It is also noted that the new well will not interfere with the productivity of the two existing wells to any significant degree, since the pumping head at these wells will be increased by only about ½-foot when Well No. 3 is in operation.

The relatively low yield of Wells Nos. 1 and 2, which presently operate at about only 20% efficiency, indicates severe incrustation and clogging of the formation and screen at these wells, which may be expected to grow progressively worse with continued pumping. At such time as the casing drawdown reaches the pump setting depth, the well will cease to function. Also, it is estimated that improvement of the efficiency of these wells to 90% would result in about $1,000 per year less power costs at present water usage rates.

It is thus strongly recommended that each of these wells be properly cleaned and redeveloped, as soon as reliable service of Well No. 3 is established, since neither of these wells is capable of meeting current demands with the other out of service.

Please advise me of any question you may have regarding these matters.

Very truly yours,

BARKER, OSHA & ANDERSON, INC.

James H. Angel
Project Engineer

JHA/jmd

Enclosure
cc: Pat Gleason, SFWMD
Rudy Roth, AECOA

BARKER, OSHA & ANDERSON, INC.
ENGINEERS - PLANNERS

November 3, 1983

AQUIFER AND WELL PERFORMANCE TEST

SEMINOLE MANOR WATER PLANT

FLORIDA WATER SERVICE, INC.

A. Description of Wells

1. Wells Nos. 1 & 2 (existing): 8" casing, 8" telescope screen, set between 100' and 120' depth, equipped with DWT shafted pumps, discharging approximately 300 gpm at applied head.

2. Well No. 3 (well constructed, pump not installed): 12" casing, 12" x 30' x .030" slot SS telescope screen set between 88' and 118' depth, to be equipped with 8", 1-stage submersible DWT discharging 500 gpm against applied head of 72'. (Tested @ 1000 gpm.)

3. Test hole (monitoring well): 2" PVC casing, with .030" slot PVC screen set between 105' and 115' depth.

B. List of Exhibits

1. Site sketch.
2. Plate I: Time-drawdown graph at test hole with Well No. 1 pumping at 300 gpm.
3. Plate II: Distance-drawdown graph (extrapolated) with Well No. 1 pumping at 300 gpm.
4. Plant III: Semi-log graph of time-drawdown data at test hole, with Well No. 3 pumping at 1000 gpm.
5. Plate IV: Time-drawdown graph at test hole of data extrapolated from Plate III.
6. Plate V: Time-drawdown graph of Well No. 3 pumping at 1000 gpm (pumped well).
7. Plate VI: Distance-drawdown graph (extrapolated) of Well No. 3 pumping at 1000 gpm.
8. Test data (two pages).

C. Method of Analyses: "Groundwater Resource Evaluation", Walton, 1970 Edition, Section 4.6.

D. Indicated Aquifer Characteristics

Type: Leaky artesian, severe confinement.
Transmissivity:
Well No. 1 Test: 237,000 gpd/ft
Well No. 3 Test: 260,000 gpd/ft
Storativity:
Well No. 1 Test: .00015
Well No. 3 Test: .0013
Aquitard Permeability (P'/m'):
Well No. 1 Test: .015 - .020 gpd/sq.ft.
Well No. 3 Test: .50 gpd/sq. ft.

E. Steady State Well Yield

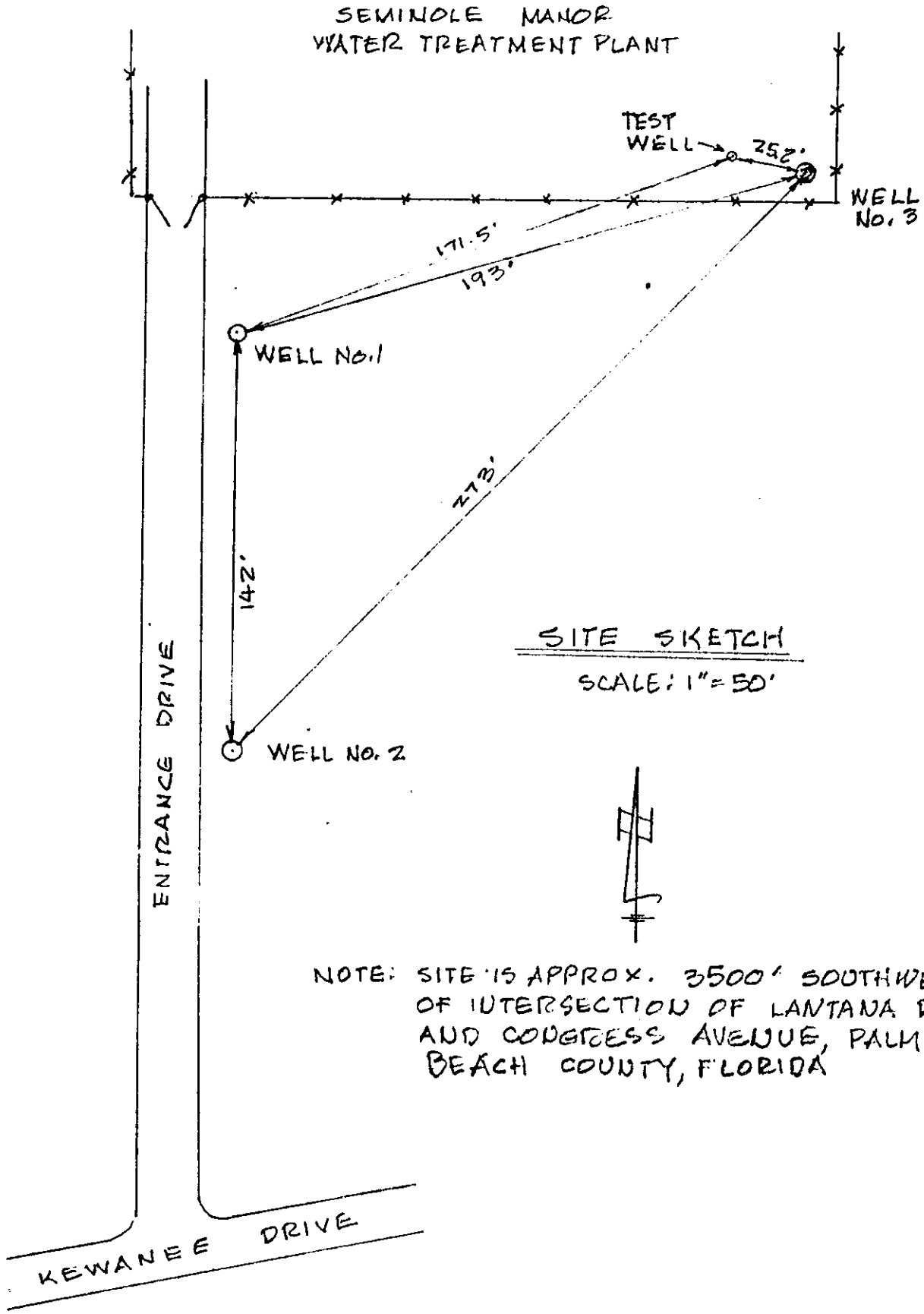
Well No. 1: 300/14.5' = 21 gpm/ft
Well No. 3: 1000/3.88 = 258 gpm/ft

F. Well Efficiency

Well No. 1: 2.7/14.5 = 19%
Well No. 3: Indeterminate; approaching 100%

G. Comments

Driller's and electric logs indicate dense strata at 82, 99, 104, and 136 feet depth. Loss of drilling fluid between 85' and 90' depth also indicates zone of high permeability. The proximity of the screened depth of Wells 1 and 3 to these strata appears to correlate with the differences noted in the transmissivity, storativity, and aquitard permeability between tests of these two wells.



SITE SKETCH

SCALE: 1" = 50'

NOTE: SITE IS APPROX. 3500' SOUTHWEST OF INTERSECTION OF LANTANA ROAD AND CONGRESS AVENUE, PALM BEACH COUNTY, FLORIDA

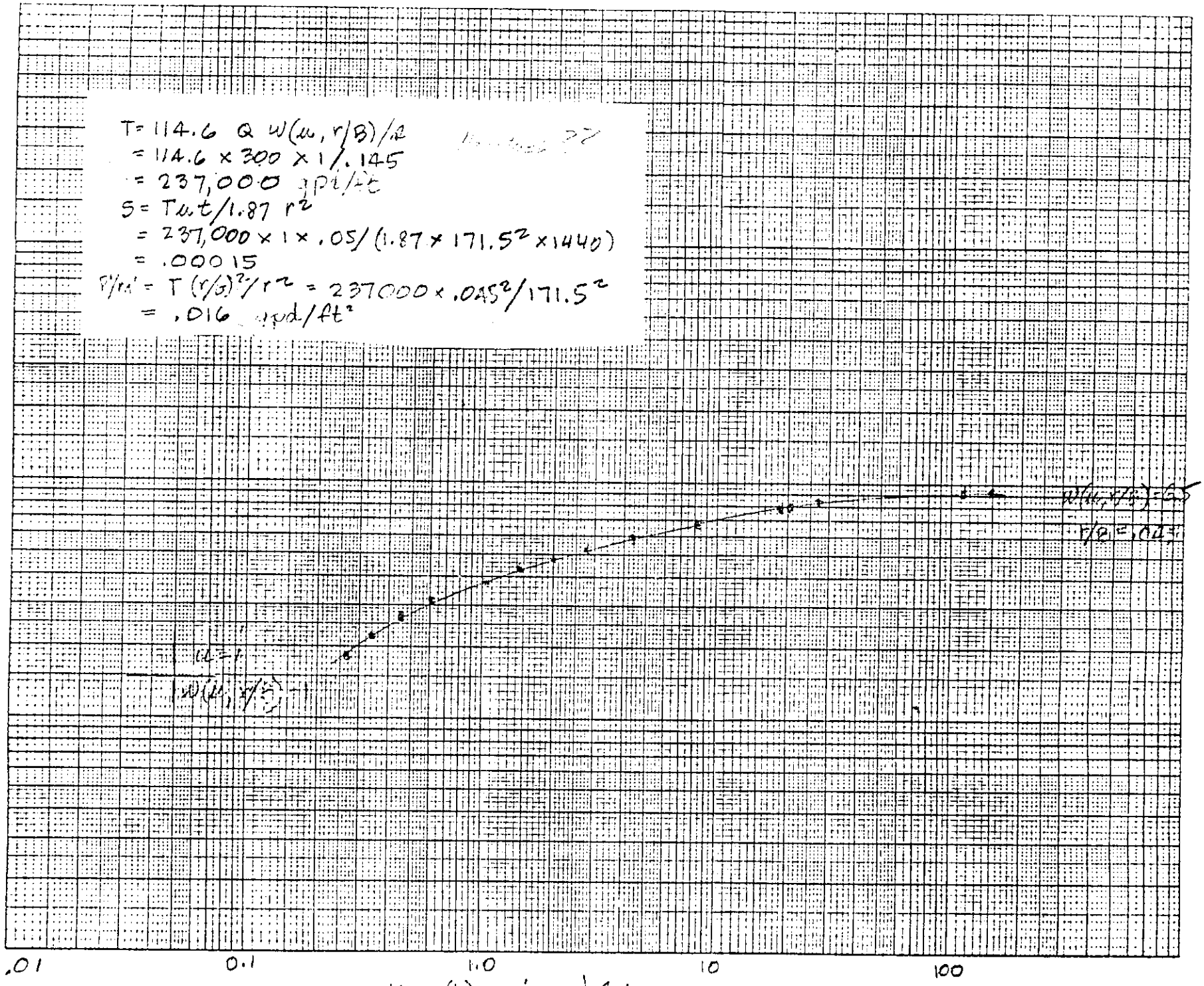


PLATE I

TW PW-1

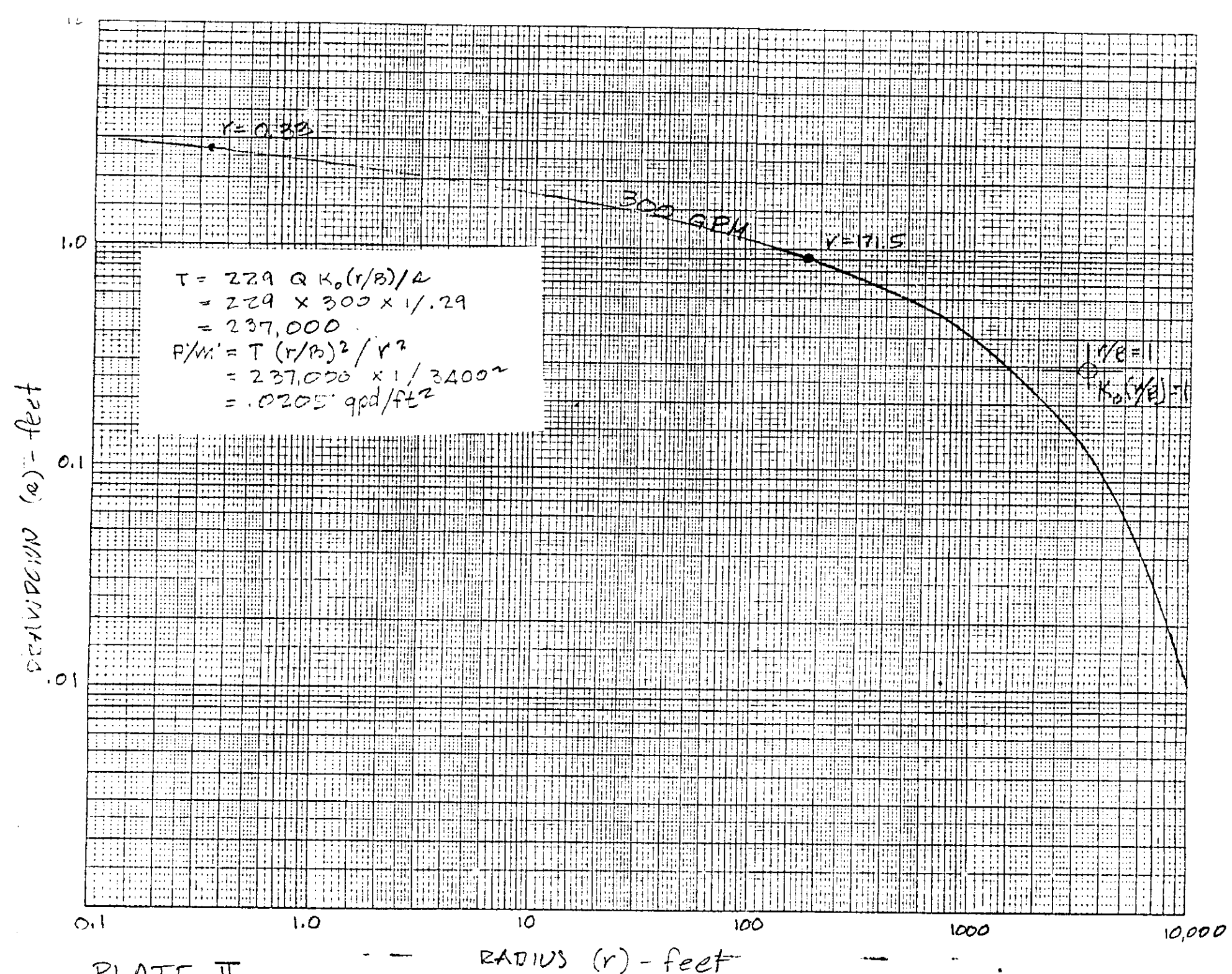
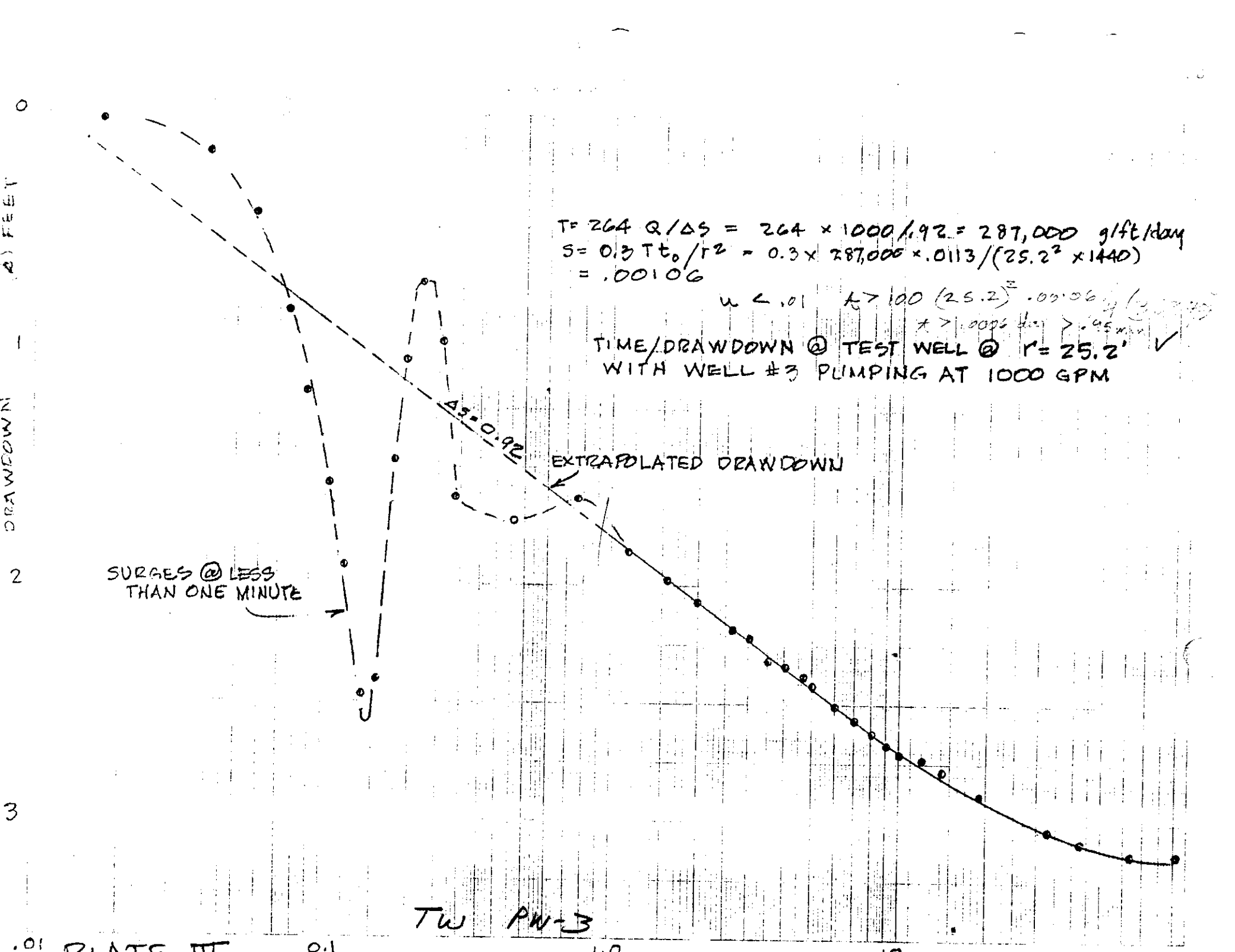

r = 0.33
302 GPM
r = 71.5
T = 229 Q K₀(r/B)/L
= 229 × 300 × 1/.29
= 237,000
P'/M' = T (r/B)² / r²
= 237,000 × 1/3400²
= .0205 gpd/ft²
r/B = 1
K₀(r/B) = 1
1.0
0.1
.01
0.1
1.0
10
100
1000
10,000
DRAWDOWN (s) - feet
RADIUS (r) - feet

PLATE II


0
1
2
3
DRAWDOWN (s) FEET
T= 264 Q/Δs = 264 × 1000/1.92 = 287,000 g/ft/day
S= 0.3 Tt₀/r² = 0.3 × 287,000 × .0113/(25.2² × 1440)
= .00106
u < .01 t > 100 (25.2)² .00106
t > .0005 day > .45 min
TIME/DRAWDOWN @ TEST WELL @ r= 25.2'
WITH WELL #3 PUMPING AT 1000 GPM
Δs = 0.92
EXTRAPOLATED DRAWDOWN
SURGES @ LESS THAN ONE MINUTE
TW PW-3
.01
1.0

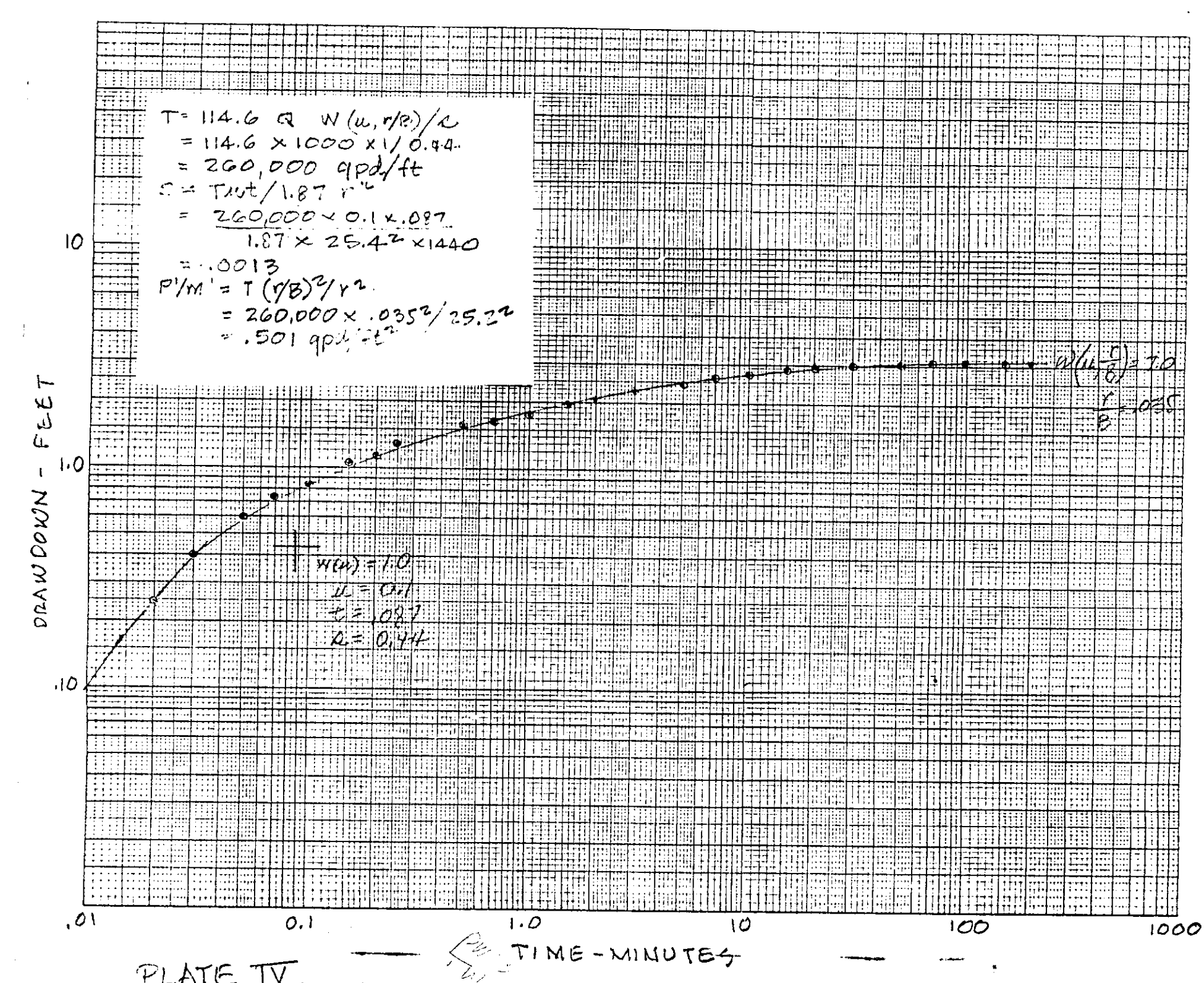

T = 114.6 Q W(u, r/B)/s
= 114.6 x 1000 x 1/ 0.44
= 260,000 gpd/ft
S = Tut/1.87 r²
= 260,000 x 0.1 x .087
1.87 x 25.4² x 1440
= .0013
P'/M' = T (r/B)²/r²
= 260,000 x .035²/25.3²
= .501 gpd/ft²
W(u) = 1.0
u = 0.1
t = .087
Q = 0.44
W(u, r/B) = 1.0
r/B = .035
DRAWDOWN - FEET
10
1.0
.10
.01
0.1
1.0
10
100
1000
TIME - MINUTES

PLATE IV

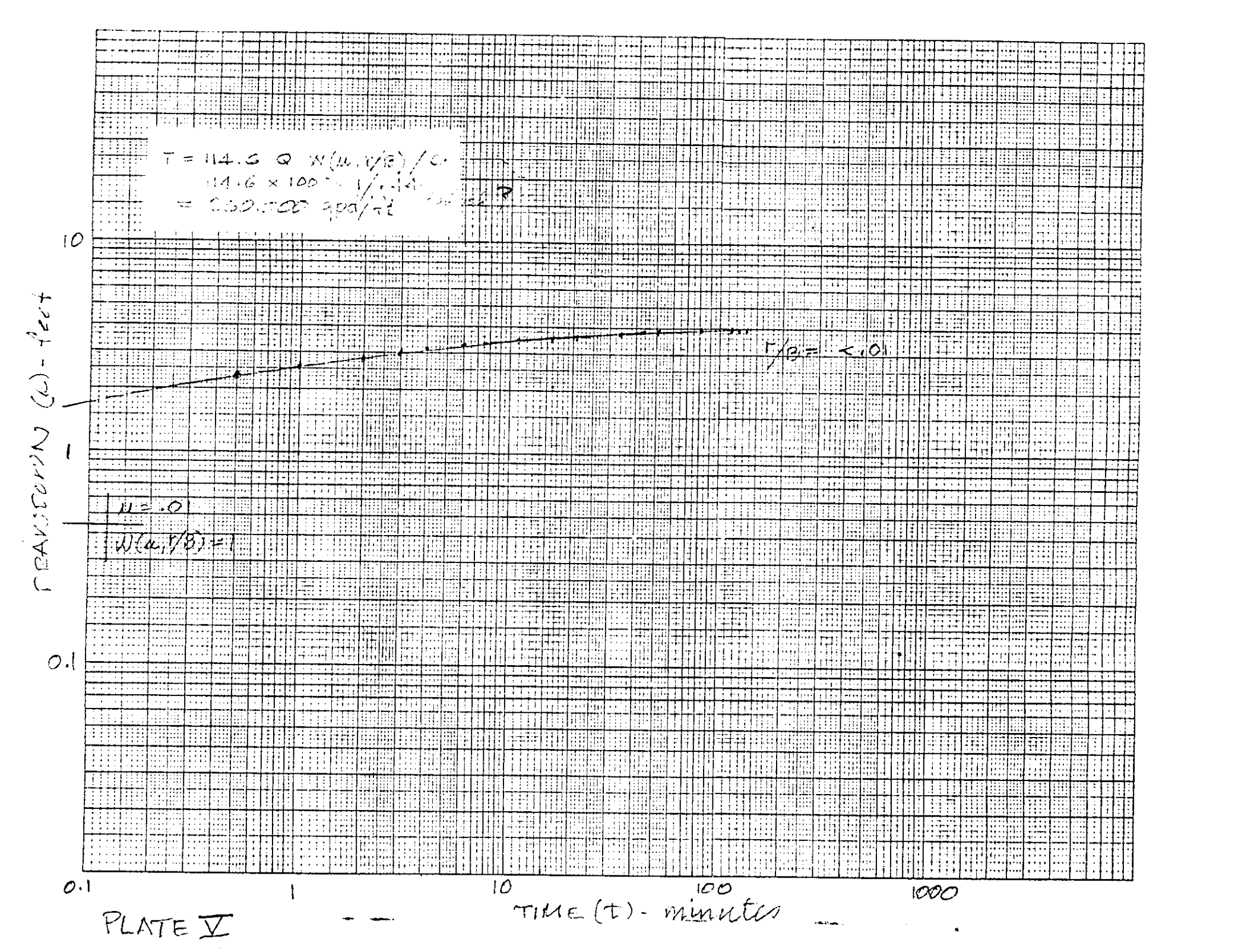

T = 114.6 Q W(u, r/B) / s
10
1
0.1
DRAWDOWN (s) - feet
u = .01
W(u, r/B) = 1
r/B = < .01
0.1
1
10
100
1000
TIME (t) - minutes

PLATE V

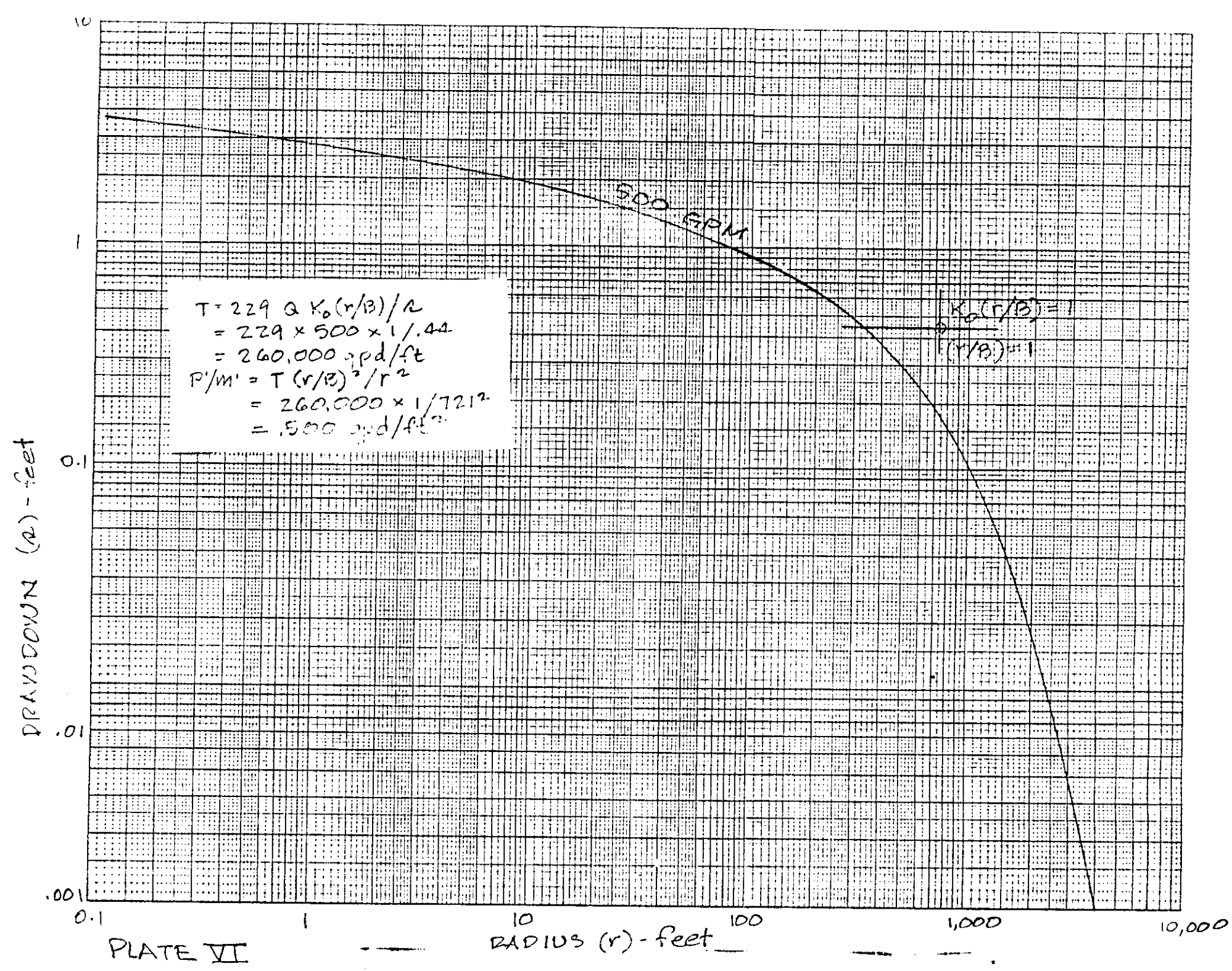

500 GPM
$K_o(r/B) = 1$
$(r/B) = 1$
$T = 229\ Q\ K_o(r/B)/s$
$= 229 \times 500 \times 1/.44$
$= 260{,}000$ gpd/ft
$P'/M' = T(r/B)^2/r^2$
$= 260{,}000 \times 1/7212$
$= 500$ gpd/ft²
10
1
0.1
.01
.001
DRAWDOWN (s) - feet
0.1
1
10
100
1,000
10,000
RADIUS (r) - feet

PLATE VI

TIME-DRAWDOWN DATA AT TEST WELL (@ r=171.5') WITH WELL NO 1 PUMPING @ 300 GPM (SEE PLATE I & II)

TIME	ELAPSED TIME	PROBE DEPTH	DRAWDOWN
2:05:34.2	0.00 MIN	62.2"	0.000 FT.
50.3	0.27	60.0"	0.183
53.3	0.32	59.0"	0.267
06: 01.1	0.45	58.8"	0.283
10.9	0.61	58.5"	0.308
38.0	1.06	57.6"	0.383
07: 00.6	1.44	57.0"	0.433
33.1	1.98	56.5"	0.475
08: 19.6	2.76	56.0"	0.516
10: 00.5	4.43	55.0"	0.600
12: 54.7	8.34	54.0"	0.683
24: 06.3	18.53	53.0"	0.767
28: [illegible]	20.5	52.8	0.783
32: [illegible]	27.5	52.0	0.850
4: 01: 00	118.5	51.7	0.917
4: 35: 00	149.5	51.2	0.917

TIME-DRAWDOWN DATA AT WELL NO. 3 PUMPING AT 1000 GPM (SEE PLATE II)

TIME	ELAPSED TIME	DTW	DRAWDOWN
11:09	0 MIN	8-11½	0
11:09.5	0.5	11-3½	2.33
10	1	11-6	2.54
11	2	11-9	2.79
12	3	11-11½	3.00
13	4	12-0½	3.08
15	6	12-2	3.21
20	11	12-5	3.48
25	16	12-6	3.54
30	21	12-7	3.62
45	36	12-9	3.79
17:09	51	12-9½	3.83
:30	81	12-10	3.86
1:05	116	12-10	3.88
1:10	121	12-10	3.88
1:15	126	12-10	3.88

TIME - DRAWDOWN DATA AT TEST WELL (@ r = 25.2')
WITH WELL NO. 3 PUMPING @ 1000 GPM (SEE PLATES III & IV)

TIME	ELAPSED TIME	PROBE DEPTH	DRAWDOWN	EXTRAPOLATED DRAWDOWN	
				MIN	D.D.
0:00:00.0	0.00 MIN	100.0 IN.	0.000 FT.	.015	.11
0:01.0	.0.017	99.7	.025	.020	.23
02.4	0.040	98.2	.150	.03	.40
03.5	0.058	94.8	.433	.05	.60
04.5	0.075	90.0	.833	.07	.73
05.3	0.088	86.0	1.167	.10	.82
06.2	0.103	81.2	1.567	.15	1.03
07.2	0.120	78.2	1.82	.20	1.15
08.2	0.137	76.4	1.97	.30	1.31
09.2	0.153	77.2	1.90	.50	1.52
10.6	0.177	82.5	1.46	.70	1.65
11.6	0.193	87.7	1.03	1.0	1.79
13.1	0.22	91.5	0.71	1.5	1.95
15.?	0.26	88.5	0.96	2	2.07
17.1	0.29	80.6	1.62	3	2.23
46.0	0.77	80.4	1.63	5	2.43
0:01:07.5	1.13	77.7	1.86	7	2.57
:30.8	1.51	76.4	1.97	10	2.70
0:02:00.5	2.01	75.2	2.07	15	2.83
38.9	2.65	73.7	2.19	20	2.92
0:03:01.3	3.02	73.2	2.23	30	3.02
30.6	3.51	72.3	2.31	50	3.11
0:04:00.6	4.0	72.0	2.33	70	3.15
40.0	4.7	71.3	2.39	100	3.16
0:05:00.6	5.0	71.0	2.42	150	3.17
6:00.5	6.0	70.0	2.50	200	3.17
7:00.4	7.0	69.2	2.57		
8:00.4	8.0	68.6	2.62		
9:00.4	9.0	68.0	2.67		
10:00.6	10.0	67.5	2.71		
12:00.4	12.0	67.2	2.73		
14:12.5	14.2	66.5	2.79		
18:00	18	65.5	2.88		
33:0	33	63.5	3.04		
43:0	43	63.0	3.08		
1:03:0	63	62.4	3.13		
1:33:0	93	62.2	3.15		
1:38:0	98	62.1	3.16		
1:48:0	108	62.0	3.17		
2:52:0	172	62.0	3.17		

SURGING

APT ANALYSIS

SITE: Seminole Manor WTP

REPORT: Transmittal Letter: Barker, Osha, Anderson, Inc as found in Water Use Permit file 50-01007-W

GEOLOGIC DATA: Comments from Consultant: Loss of drilling fluid between 85' and 90'

WELL DESCRIPTIONS:

Well	Dia	TD	Cased Depth	Screen/Open	r,	v
PW-1	8"	120'	100'	Screen	PW	1
PW-3	12"	118'	88'	Screen	193'	A
TW	2"	115'	105'	Screen	171.5	25.

INFLUENCING FACTORS:

1) All wells are probably screened through trumpike interval noted in TW

CONSULTANT APT:

PW-3

Started: 11/3/83
Duration: ≈ 172 min
Discharge: 1000 gpm, method of measurement undefine
Recovery: None

PW-1

Started: 11/3/83 (?)
Duration: 149.5 min
Discharge: 300 gpm, method of measurment undefined

COMMENTS: 1) Max drawdown for APT on PW-3

PW3 3.88' ← seems low !!

TW 3.17 r = 25.2'

2) Max drawdown for APT on PW-1

TW = .92' r = 171.5'

3) No mention of where discharge went (1000 GPM on PW-3)

4) Pump surging on PW-3 test

CONSULTANT ANALYSIS

APT PW-3

METHOD: HANTUSH ? w/ no storage in aquitard ?

Results (TW data) T = 260,000 gpd/ft (34,760 ft²/day)

S = 0.003

K = 0.067 ft/day

(PW-3 data) T = 260,000 gpd/ft (34,760 ft²/day)

APT PW-1

METHOD: Jacob

CONSULTANT ANALYSIS: APT on PW-3

Obs Well = TW, Q = 1000

METHOD: Jacob

Results: $T = 38,368$ Ft²/day

$S = 0.00106$

COMMENTS 1) Major fluctuations present in all dat points earlier than one minute.

2) Pretty good straight line approximation is/was possible;

3) From straight line extrapolation, consultant chose values for early time data points to be used in curve matching analysis.

Method (Hantush? No storage in Agitard?)

Results: $T = 34,760$ Ft²/day
$S = 0.0013$
$L = 0.067$ Ft/day

} Don't USE!! see comment #3 above

Comments

1) Curve matching techniques are not reliable for this data if the points plotted earlier than 1 min are eliminated.

PW-3 data

Method: Hantush?

Results: T = 34,760 Ft²/day

Comments

1) Difficult curve match due to lack of data earlier than .5 minutes

2) Could have potential for Jacob analysis

3) Well loss not considered in analysis

APT on PW-1

TW data

Method: Hantush

Results T = 31,684 Ft²/day

S = 0.00015

L = 0.002 Ft/day

Comments

1) Looks like pretty good curve match considering limited amount of drawdown

2) Good candidate for Jacob analysis

Comments: 1) Average values for observation well data for both Tests

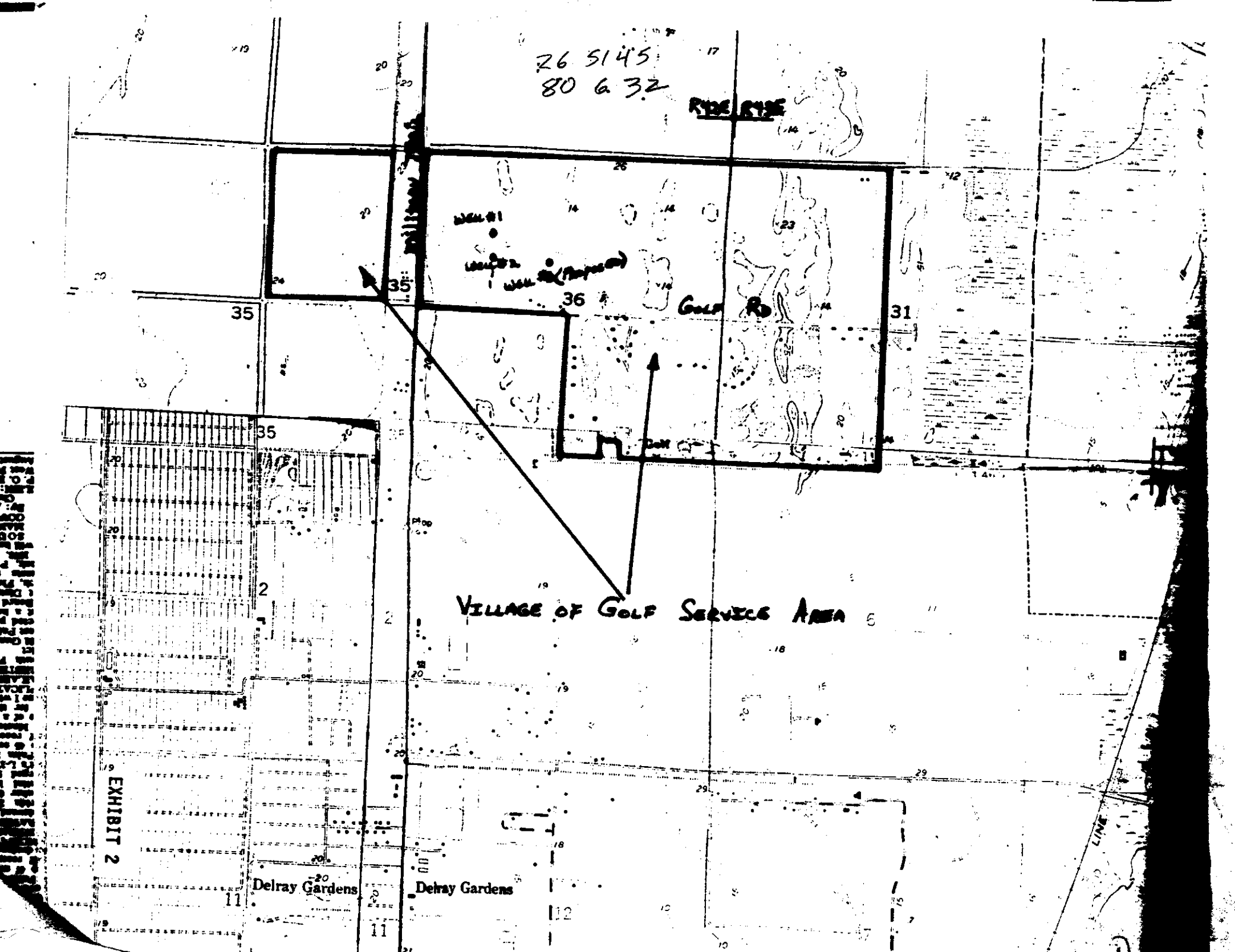
$T = 35,026$ Ft²/day

$S = 0.000605$

$L = 0.002$ Ft/day

2) Need geological data for K evaluations

3) T values for PW-3 tests w/ 30' of screen are larger than T values for PW-1 tests where there is 20' of screen in the production well


R6 5145
80 G 32
WELL #1
35
36
31
GOLF RD
35
2
VILLAGE OF GOLF SERVICE AREA
EXHIBIT 2
Delray Gardens
Delray Gardens
11
12
11