3R - 249

REPORTS

PUMP TESTS

DATE: 1986

Even though vertical components of flow are sufficiently small at late times to make horizontal flow approximation valid, the small vertical flow may still substantially reduce the apparent S_y from the value that would be obtained after a very long pumping period

McWhorter & Sunada (1977)
pg 187

Flora Vista Capture Zone

$i = \frac{0.8\ ft}{112\ ft} = 0.0071\ (5/21)$

Data

$i = \frac{0.8\ ft}{102\ ft} = 0.0078\ (4/21)$

$Q = 65\ gpm$

$T = 15000\ gpd/ft$

Calculations

$$X_L = -\frac{Q}{2\pi T i} = -\frac{(65\ gal/min)\left(\frac{60\ min}{hr}\right)\left(\frac{24\ hr}{day}\right)}{2\pi(15000\ gpd/ft)(0.0078)} = -127.3\ ft$$

$$Y_L = \pm\frac{Q}{2Ti} = \pm\frac{(65\ gal/min)\left(\frac{60\ min}{hr}\right)\left(\frac{24\ hr}{day}\right)}{2(15000\ gpd/ft)(0.0078)} = \pm 400\ ft$$

$$-\frac{y}{x} = \tan\left(\frac{2\pi T i}{Q} y\right)$$

or

$$x = -\frac{y}{\tan\left(\frac{2\pi T i}{Q} y\right)} = -\frac{y}{\tan\left(\frac{2\pi(15000\ gpd/ft)(0.0078)}{(65\ gpm)\left(\frac{60\ min}{hr}\right)\left(\frac{24\ hr}{day}\right)}\frac{360}{2\pi} y\right)}$$

conversion from radians to degrees

$$= -\frac{y}{\tan(0.45\ y)}$$

upstream inflow zone $= 2\pi X_L = 799.8\ ft$

y(ft)	x(ft)
0	-127.3
1	-127.3
50	-120.7
75	-112.2
100	-100.0
150	-62.1
200	0
250	103.5
300	300.0
350	845.0
400	

Flora Vista Capture Zone at 35 gpm

Data

$Q = 35 \text{ gpm} \left(1440 \frac{\text{min}}{\text{day}}\right) = 50400 \text{ gpd}$ $\quad i = 0.0078 \quad (4/21)$

$T = 15000 \text{ gpd/ft}$

Calc.

$$X_L = -\frac{Q}{2\pi T i} = -\frac{50400 \text{ gpd}}{2\pi (15000 \text{ gpd/ft})(0.0078)} = -68.6 \text{ ft}$$

$$Y_L = \pm \frac{Q}{2Ti} = \frac{50400 \text{ gpd}}{2(15000 \text{ gpd/ft})(0.0078)} = \pm 215.4 \text{ ft}$$

Upstream inflow zone $= 2\pi X_L = 431$ ft

$$-\frac{y}{x} = \tan\left(\frac{2\pi T i}{Q} y\right)$$

$$x = -\frac{y}{\tan\left(\frac{2\pi T i}{Q} y\right)} = -\frac{y}{\tan\left(\frac{2\pi (15000 \text{ gpd/ft})(0.0078)}{(65 \text{ gpm})(60 \frac{\text{min}}{\text{hr}})(24 \frac{\text{hr}}{\text{day}})}\left(\frac{360}{2\pi \text{ radians}}\right) y\right)}$$

$$x = -\frac{y}{\tan(0.836\, y)}$$

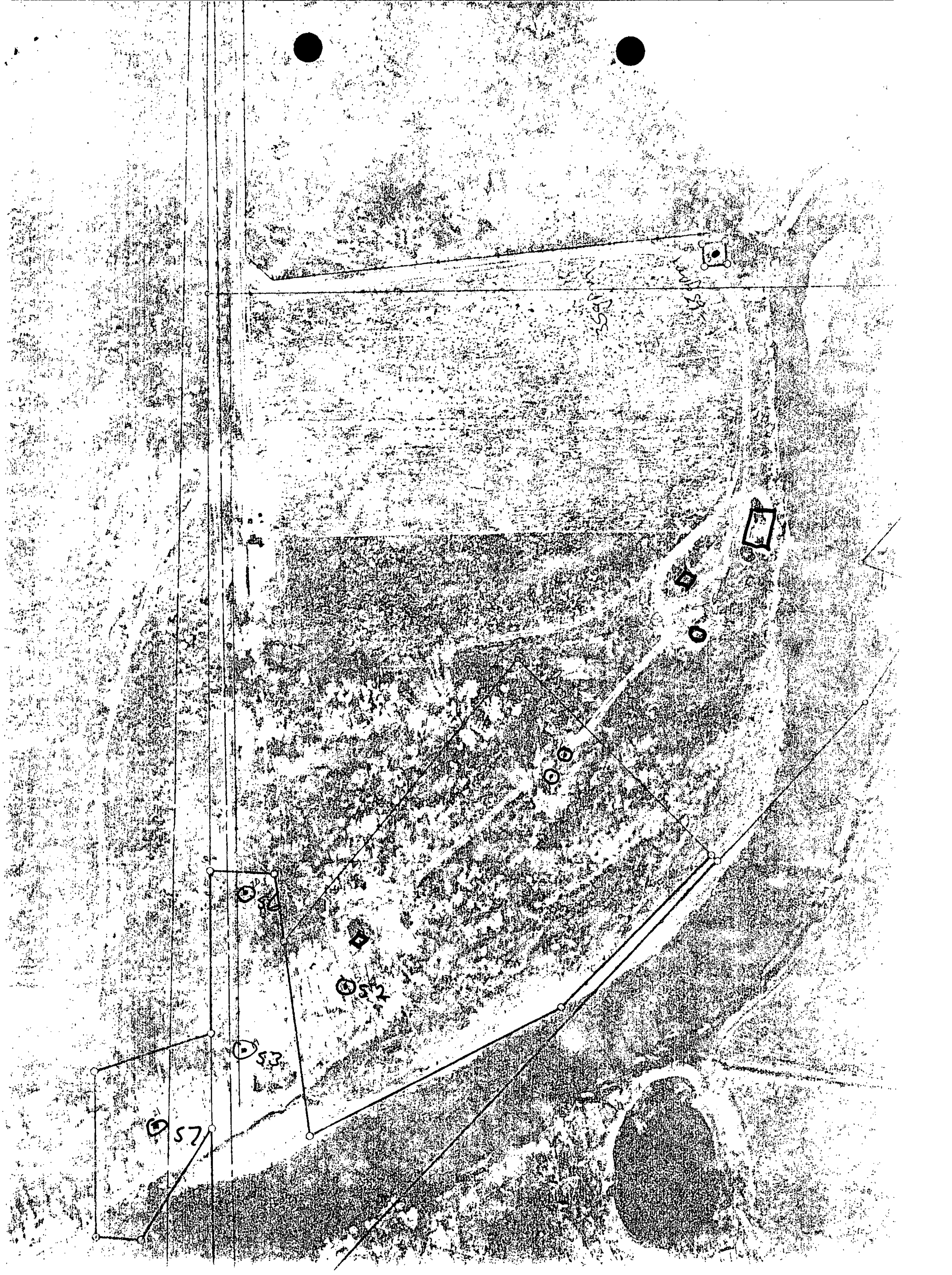
y(ft)	x(ft)	
0	-68.6	
25	-65.5	
50	-55.9	55.9
75	-38.7	11.3
100	-11.3	106.4
125	32.2	
150	106.4	
175	261.9	
200	876.2	

EFFICIENCY® LINE NO. 6636

Remarks	#6 S1 Time	DTW	#11 Test well 1 M1 Time	DTW	#12 TW2 M2 Time	DTW	#8 TW3 M3 Time	DTW	#10 TW4 M4 Time	DTW	#4 TW5 M5 Time	DTW
Measuring point S1 0.465 ft above survey Mark	4/21 0918	5.408	4/21 0856	6.213	4/21 0901	6.560	4/21 0833	6.456	4/21 0816	3.852	4/21 0838	4.923
	4/22 1157	5.440	4/22 1149	6.252	4/22 1154	6.642	4/22 1133	6.469	4/22 1207	3.835	4/22 1125	4.920
	4/23 2101	15.080	4/23 2106	7.149	4/23 2110	6.699	4/23 2115	9.505	4/23 Dry		4/23 2124	5.923
	4/25 ~~[illegible]~~ 0824	~~[illegible]~~ 6.017	4/25 0826	6.607	4/25 0828	6.613	4/25 0831	7.061	4/25 0833	5.094	4/25 0835	4.165
	4/24 1245	15.269	4/24 1240	7.259	4/24 1241	6.725					4/24 1244	6.056
	5/21 0802	4.760	5/21 0806	5.635	5/21 0808	6.040	5/21 0800	5.800	5/21 0817	3.135	5/21 0814	4.135
	4/22 2032	15.4	4/22 2035	6.66	4/22 2037	6.595	4/22 2039	8.504	4/22 2044	4.629	4/22 2041	5.446
	#14		#7									

S5 Time	DTW	SX1 Time	DTW
4/21 0905	6.45-	4/21 0925	5.812
4/		4/22 1207	4.81-
		4/23 2056	9.304
		4/25 1032	5.338
		4/24 1239	9.480
5/21 0811	5.740	5/21 0803	4.190
		4/22 2031	8.53

4/21 Previous day to Test
4/22 1157 - one hour previous to Test
4/23 2100 - Last reading prior to M3 dry
4/24 1245 - " " prior to end of pumping
4/25 0830 - 18 hrs Recovery
5/21 ones month


S6
S2
S3
S7

7/13/96 FLORA VISTA

WATER LEVELS OVERCAST SNOWY, COLD 35°

55 1.4
22.4
23.8 WELL DEPTH

8.00 8.000 Hold
1.29 CUT 1.295 cut
6.71 6.705

MW2 7.6 + 1.4 = 9.0 WELL DEPTH

7.00 7.40 7.400
0.08 0.465 0.465
6.92 6.935 6.935

MW1 WELL DEPTH = 7.2+1.4 = 8.6'

7.000 7.00
0.360 0.36
6.640 6.64

MW3 WELL DEPTH = 8.1+1.4 = 9.5

7.500 7.500
0.550 0.545
6.950 6.955

MW5 WELL DEPTH = 6.2+1.4 = 7.6

6.00 6.00
0.51 0.515
5.49 5.485

MW4 WELL DEPTH = 4.42+1.4 = 5.82

~~4.40~~ 4.40 4.40
0.02 0.02
4.38 4.38

Bill - I just found these
Please plot up,
Thd

Sept S 12° E

Oct S 19° E

Jan S 19° E

Feb S 19° E

April S 6° E

May S 5° E

AMPAD EFFICIENCY® LINE NO. 6636

Remarks	S1 Time	S1 DTW	M1 Time	M1 DTW	M2 Time	M2 DTW	M3 Time	M3 DTW	M4 Time	M4 DTW	M5 Time	M5 DTW	13
Measuring point 5.0ft S1 0.465ft above Survey Mark	4/21 0918	5.408	4/21 0856	6.213	4/21 0901	6.560	4/21 0833	6.456	4/21 0846	3.852	4/21 0838	4.923	
	4/22 1157	5.440	4/22 1149	6.252	4/22 1154	6.642	4/22 1133	6.469	4/22 ~~1[illegible]~~ 1207	3.835	4/22 1125	4.920	
	4/23 2101	15.080	4/23 2106	7.149	4/23 2110	6.699	4/23 2115	9.505	4/23 Dry		4/23 2124	5.973	
	4/25 1034 → 0824	1.084 6.017	4/25 0826	6.609	4/25 0828	6.613	4/25 0831	7.061	4/25 0833	5.094	4/25 0835	4.165	
	5/21 0802	4.760	5/21 0806	5.635	5/21 0808	6.040	5/21 0800	5.800	5/21 0817	3.135	5/21 0814	4.135	

	S5	DTW	SX1	DTW
	4/21 0905	6.45-	4/21 0925	5.812
	4/		4/22 1201	4.81-
			4/23 2056	9.304
			4/25 1032	5.338
	5/21 0811	5.740	5/21 0803	4.120

Memo

From

DAVID G. BOYER

Hydrogeologist

To

September	0.0080	Slightly E of S
October	0.0081 / 0.0105	25° E of S.
January	0.0080 / 0.0097	Slightly E of S
February	0.0086	
April	0.0079 / 0.0078	
May	0.0071 / 0.0071	

Oil Conservation Division
P.O. Box 2088 Santa Fe, N.M. 87501

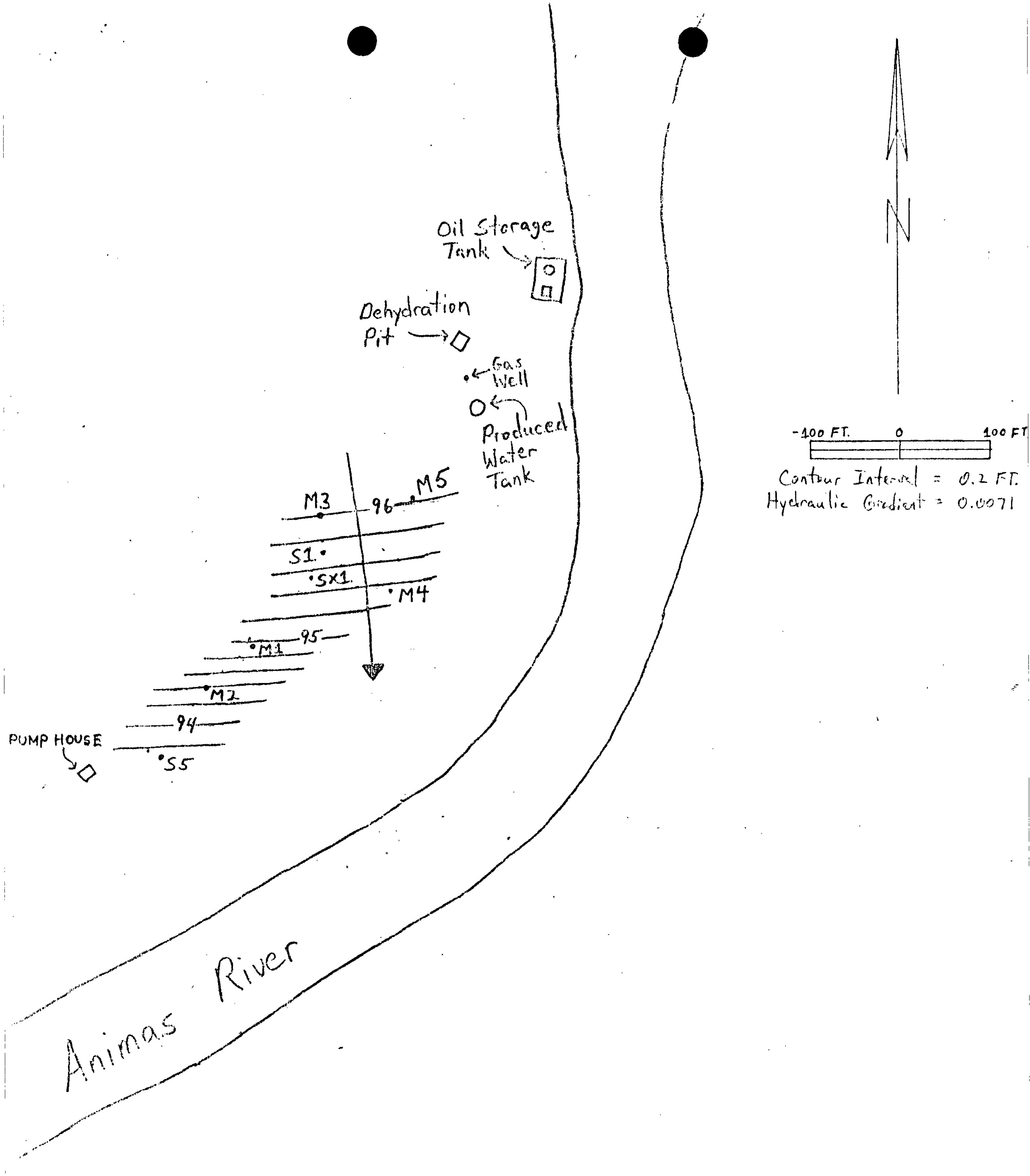
For Flora Vista pump test

Water Table Elevations

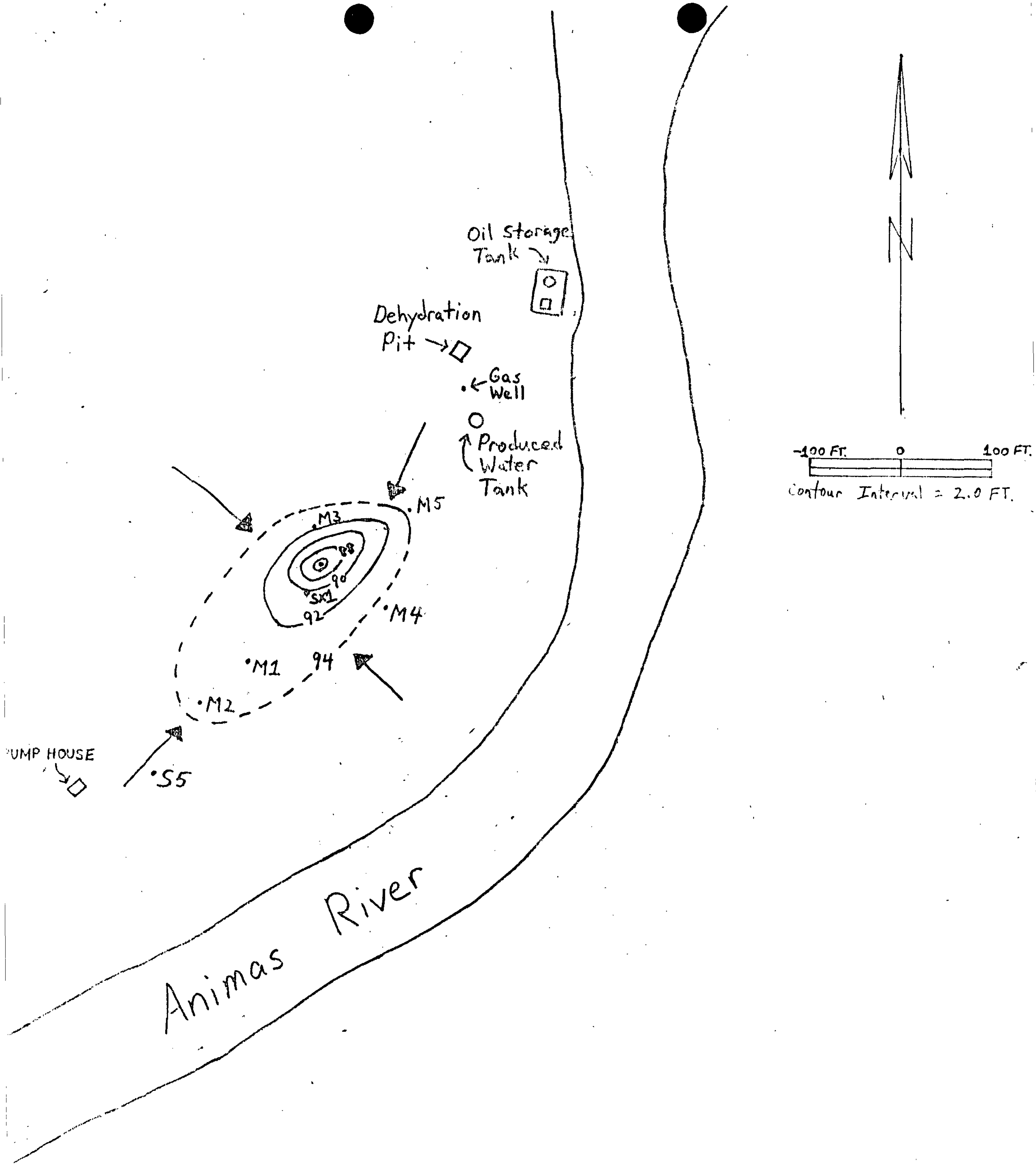
probably should be 94.928

Time	# 4 (M5)	# 6 (S1)	# 7 (SX2)	# 8 (M13)	# 10 (M4)	# 11 (M1)
4/21	95.257	95.052	93.928	95.444	94.658	94.397
4/22 2000	94.734	85.06	91.21	93.396	93.881	93.95
4/23	94.207	85.38	90.436	92.395	Dry	93.461
4/24	94.124	85.191	90.26	Dry ?	Dry	93.351
4/25	96.015	94.443	94.402	94.839	93.416	94.001
5/21	96.045	95.70	95.55	96.1	95.375	94.975
2/13/86	94.69			94.948	94.13	93.97

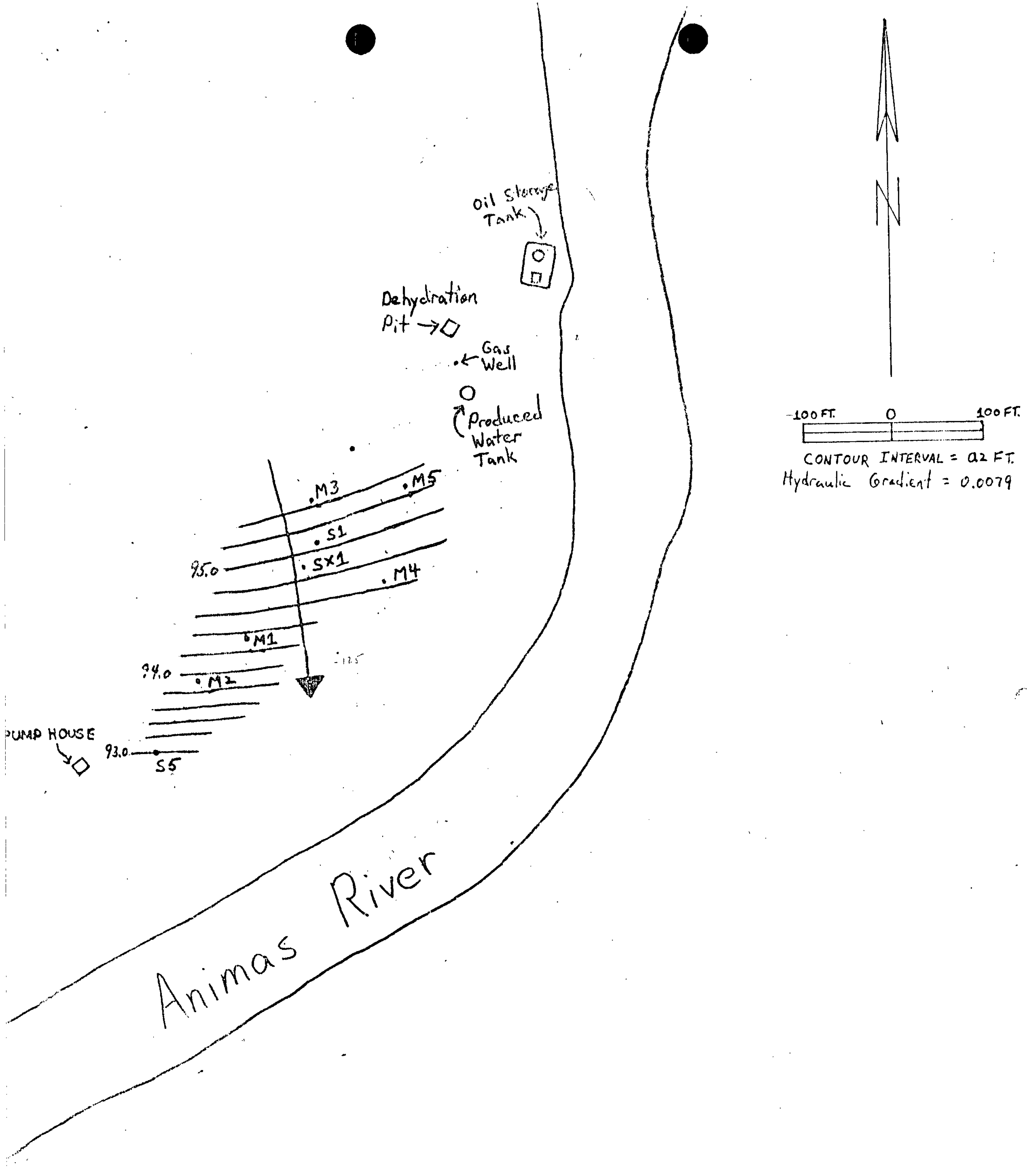
Time	# 12 (M12)	# 14 (S5)
4/21	93.9	93.0
4/22 2000	93.865	
4/23	93.761	
4/24	93.735	
4/25	93.847	
5/21	94.42	93.71
2/13/86	93.525	92.74



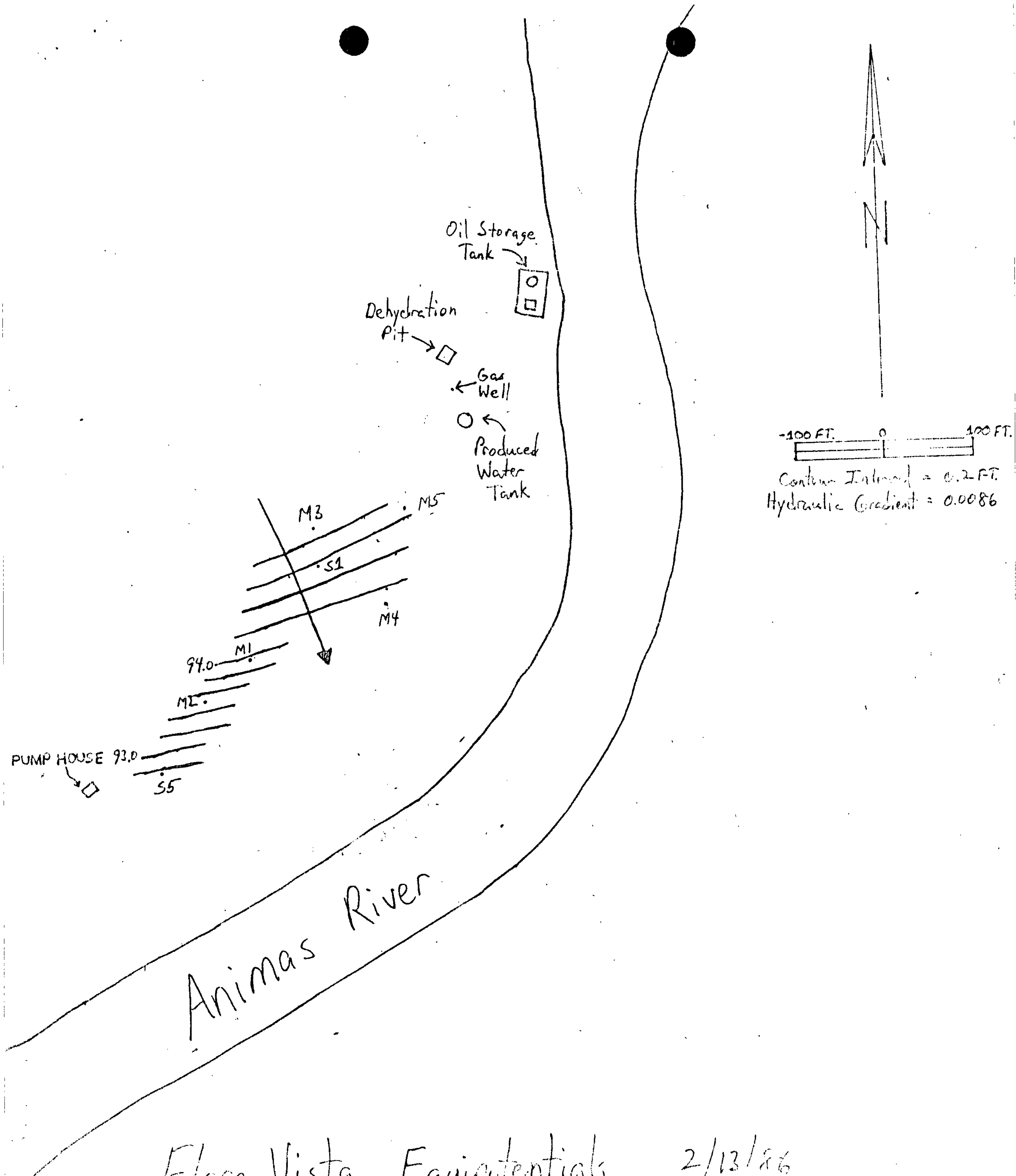
Flora Vista Equipotentials 1 Month After Pumping



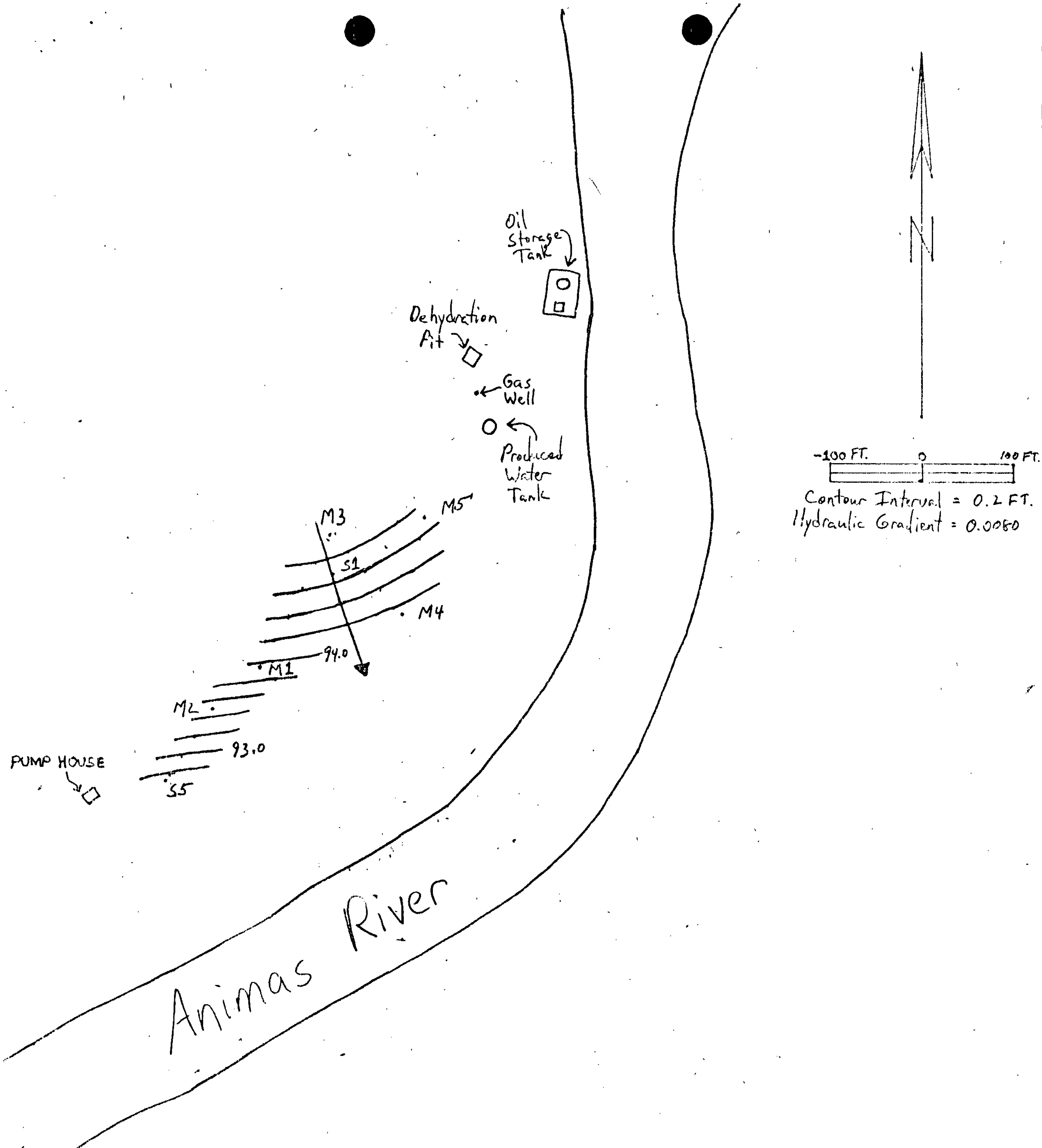
Flora Vista Pumping Equipotentials 4/23/..



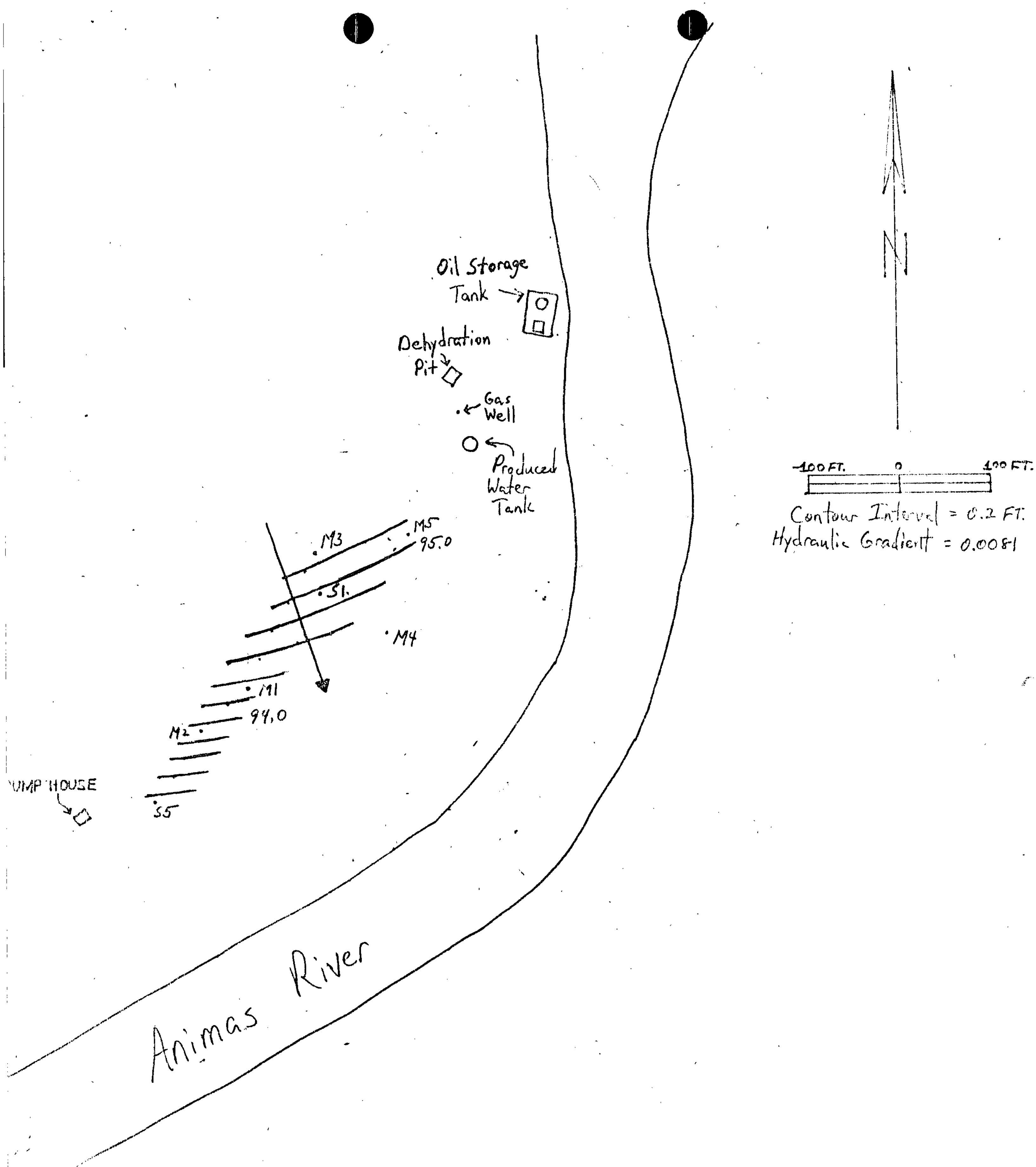
Flora Vista Prepumping Equipotentials 4/[illegible]



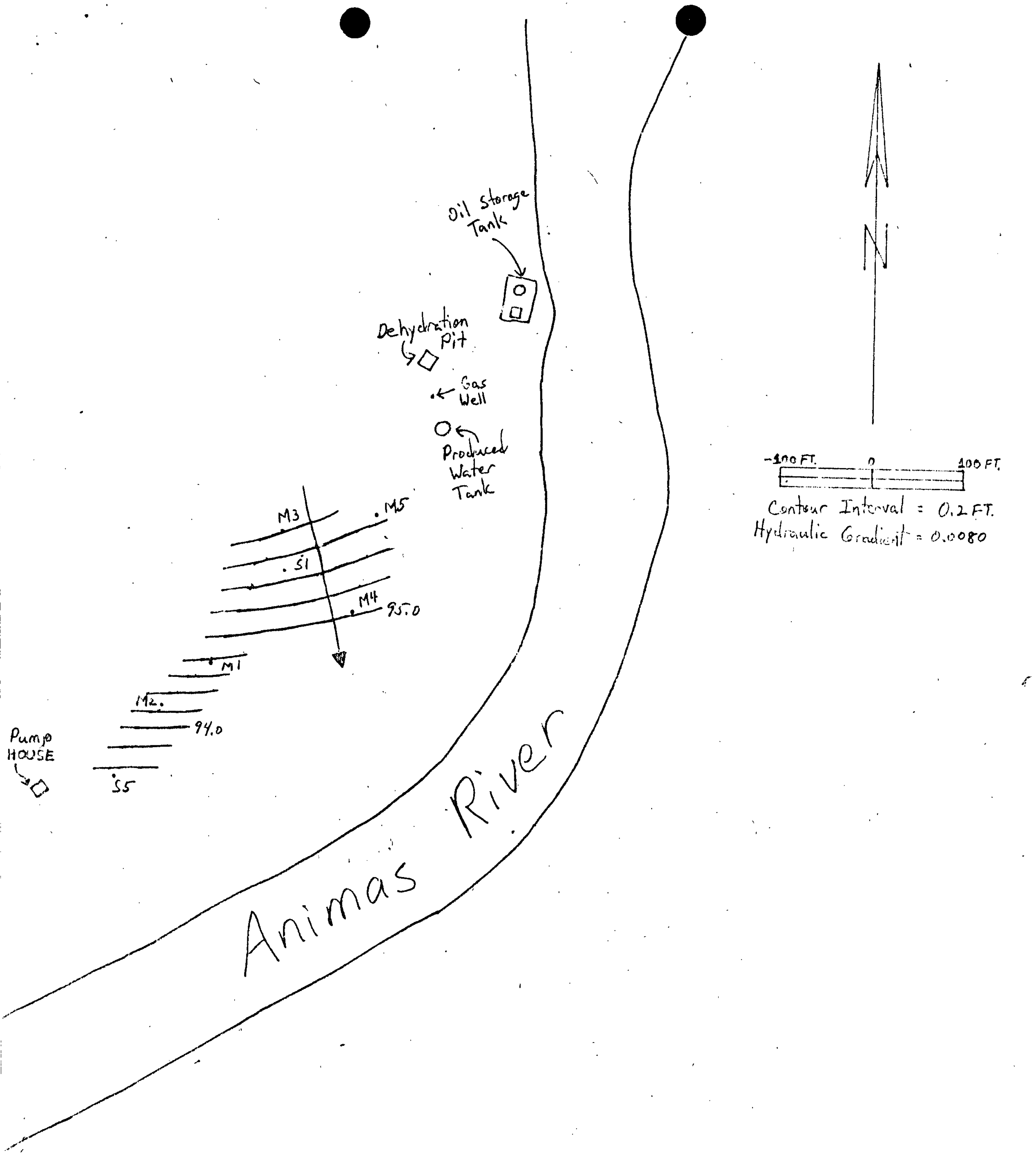
Flora Vista Equipotentials 2/13/86



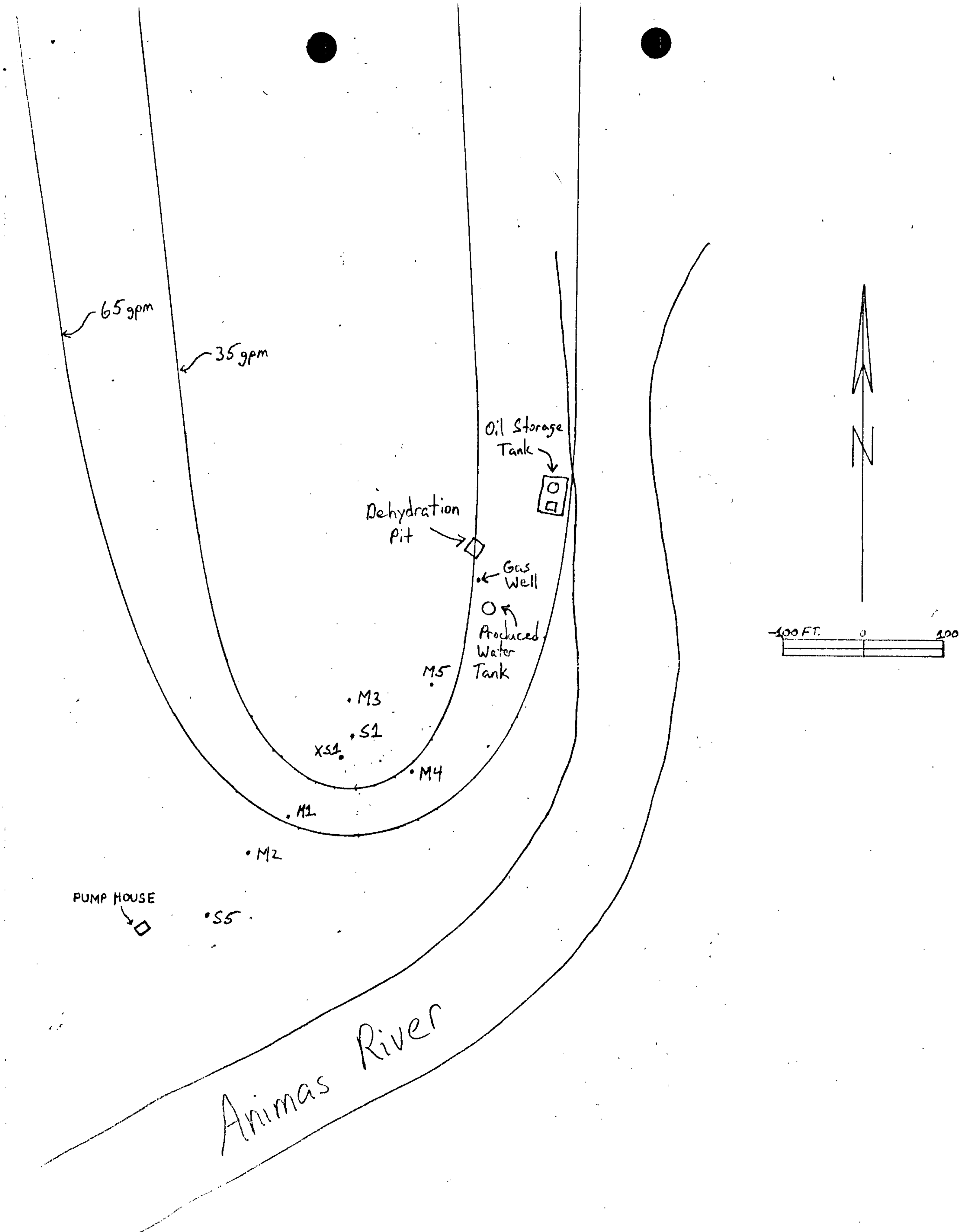
Flora Vista Equipotentials 1/1/[illegible]



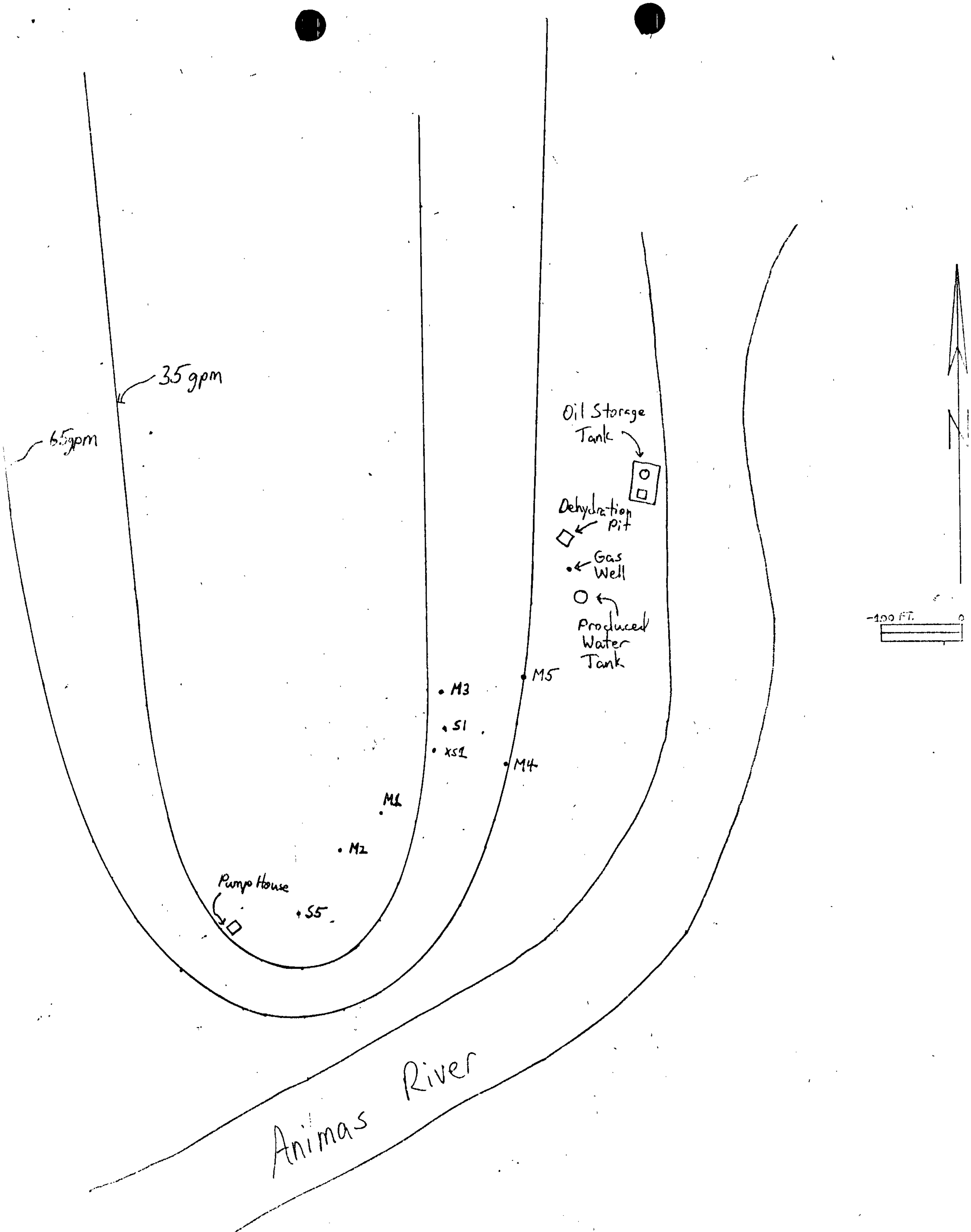
Flora Vista Equipotentials



Flora Vista Equipotentials 9/20/



Flora Vista Capture Zones For Well #1.



Flora Vista Capture Zones For Well S.

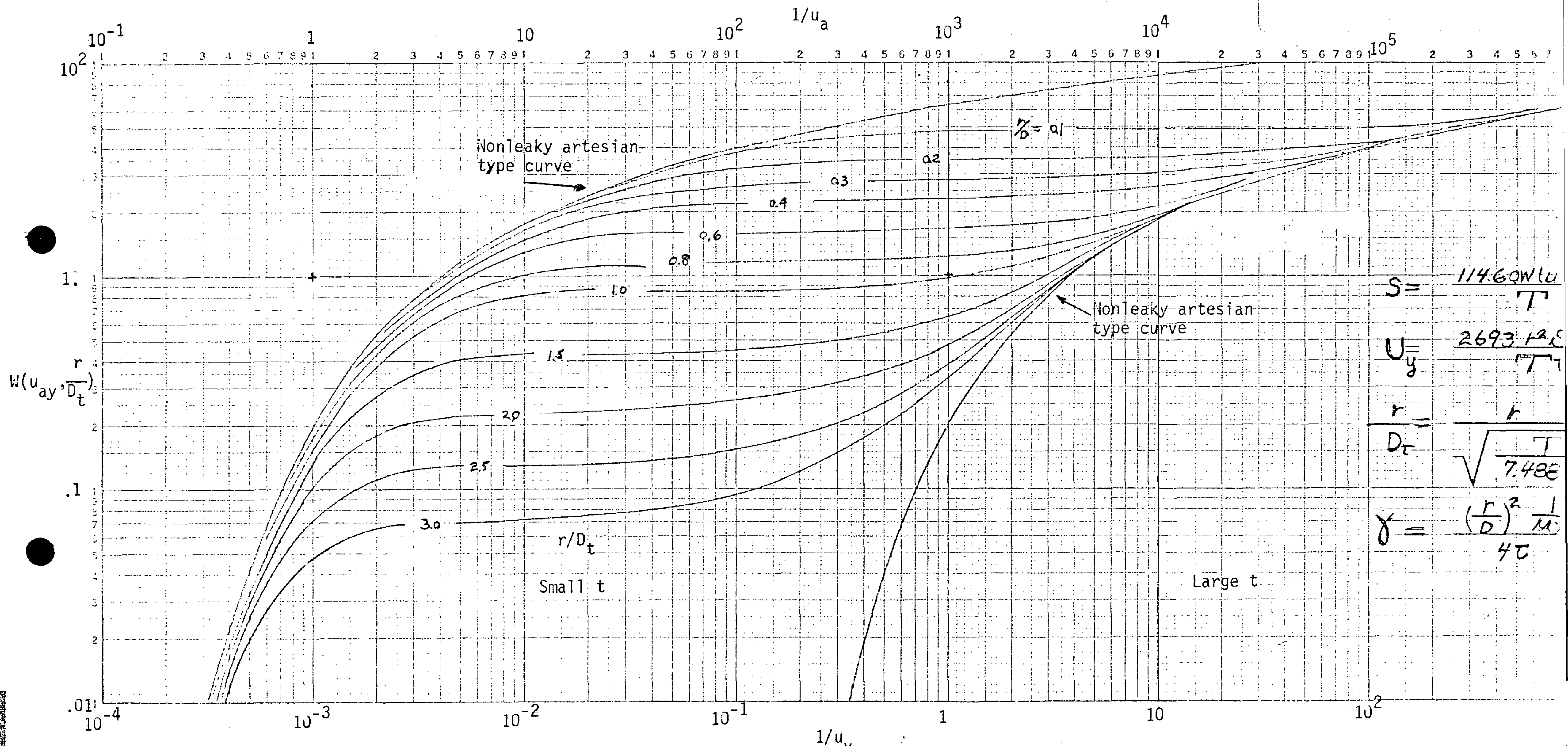


Fig. 4.12 Water-table, fully penetrating, constant-discharge, time-drawdown type curves. (From Walton, 1970)

Memo

From
DAVID G. BOYER
Hydrogeologist

To

Q_n = 108.4 from 4/22 13:00:30 To 20:32

Q_n = 102.8 from 21:36 to 4/23 01:57

Q_n = 88.6 from 03:44 To 21:01

Q_n = 85.9 from 0:126 To end of Recovery

$V = \pi r^2 h$

" $h = 5'$

$= \pi (36.5)\left(\frac{7.48\ gal}{ft^3}\right) \times \frac{bbl}{42\ gal} = 100\ bbl$

20

Oil Conservation Division
P.O. Box 2088 Santa Fe, N.M. 87501

(1)

$Q_c = 1.05 \frac{\Delta V}{\Delta t}$

Stopwatch

Clock Time (mh:s)		1 t(m s.00)	2 Δt(min)	3 Σt(clock)	4 V(gal)	5 ΔV(gal)	6 Σ V(gal)	7 Q	8 Qc	9 Remarks	10
4/22/86	1										
13:00:30	2	—	—	—	3580630	—	—	—	—	Start Test	
:01:31	3	0:00.00	1.02	1.02	3580700	70		68.9	72.3		
	4	1:00.00	1.00	1.00	0760	60		60.0	63.0	Calibration Read.	
13:07:42	5	—	6.18		3581370	670		108.4	113.8		
13:08:30	6	—	0.80		3581453	83		103.7	108.9		
13:09:30	7	—	1.00		3581570	117		117.0	122.9		
	8	0:00.00	—	—	1700	—	—	—	—		
	9	:53.45	0.89	—	1800	100	—	112.3	117.9	CR.	
13:15:50	10	—	6.33	15.33	3582300	730	1670	115.3	121.0	($\bar{Q}_c$=114.4)	
	11	0	—	—	2400	~	—	—	—		
	12	0:57.00	0.95	~	2500	100	—	105.3	110.5	CR	
13:21 —	13	0	—	—	2800	—	—	—	—		
	14	0:57.00	0.95	—	2900	100	—	105.3	110.5	CR	
	15	0	—	—	3200	—	—	—	—		
	16	0:56.98	0.95	—	3300	100	—	105.3	110.6	CR	
13:28:00	17	—	12.17	27.5	3583671	1371	3041	112.7	118.3		
	18	0	—	—	3400	—	—	—	—		
	19	3:48.08	3.80	—	3800	400	—	105.2	110.5	CR	
13:37:00	20	—	9.00	36.5	3584515	844	3885	93.8	98.5	(?)	
	21	0	—	—	4600	—	—	—	—		
	22	0:57.11	0.95	—	4700	100	—	105.1	110.3	CR	
13:41:00	23	—	4.00	40.5	3584933	418	4303	104.5	109.7		
	24	0	—	—	5100	—	—	—	—		
	25	00:57.27	0.95	—	5200	100	—	104.8	110.0	CR	
14:16:08	26	—	35.00	75.5	3588771	3838	8141	109.7	115.1		
	27	0	—	—	8900	—	—	—	—		
	28	01:56.34	1.94	—	9100	200	—	103.1	108.3	CR	

(2)

Stopwatch

Clock Time (mhs)		1 T(m & .00)	2 ΔT(min)	3 ΣT(clock)	4 V(gal)	5 ΔV(gal)	6 ΣV(gal)	7 Q	8 Qc	9 Remarks
4/27 14:16—	1	0	—	—	3589200	—	—	—	—	
	2	0:58,20	0.97	—	9300	100	—	103.1	108.2	CR
15:05:00	3	—	49.00	124.5	3593715	4944	13085	100.9	105.9	
	4	0	—	—	3800	—	—	—	—	
	5	01:15.54	1.26	—	3930	130	—	103.3	108.4	CR
	6	0	—	—	4000	—	—	—	—	
	7	00:57,94	0.97	—	4100	100	—	103.6	108.7	CR
	8	0	—	—	4200	—	—	—	—	
	9	00:57.76	0.96	—	4300	100	—	103.9	109.1	CR
17:20—	10	0	—	—	3607600	—	—	—	—	
	11	00:58.80	0.98	—	7700	100	—	102.0	107.1	CR
	12	0	—	—	7740	—	—	—	—	
	13	00:59,04	0.98	—	7840	100	—	101.6	106.7	CR
17:21:00	14	—	136.00	260.5	3607916	14201	27286	104.4	109.6	
	15	0	—	—	7960	—	—	—	—	
	16	0:59.34	0.99	—	8060	100	—	101.1	106.2	CR
17:27—	17	0	—	—	8100	—	—	—	—	
	18	0:58.95	0.98	—	8200	100	—	101.8	106.9	CR
	19	0	—	—	9500	—	—	—	—	
17:42—	20	00:57.13	0.95	—	9600	100	—	105.0	110.3	CR
	21	0	—	—	9650	—	—	—	—	
	22	0:57.31	0.96	—	9750	100	—	104.7	109.9	CR
17:43:00	23	—	22.00	282.5	3609857	1941	29227	88.2	92.6	(P.)
	24	0	—	—	3610040	—	—	—	—	
	25	0:57.20	0.95	—	10140	100	—	104.9	110.1	CR
19:38—	26	0	—	—	3621800	—	—	—	—	
	27	0:58.29	0.97	—	1900	100	—	102.9	108.1	CR
	28									

(7)

Clock Time (hms)	#	1 T (m,s,.01) Stopwatch	2 ΔT (min)	3 Σ T (Clock)	4 V gal	5 ΔV (gal)	6 Σ V (gal)	7 Q	8 Qc	9 Remarks	10
19:40:00	1	—	117	399.5	3621970	12113	41340	103.5	108.7	Pump Rate from Start	
21:30 —	2	0	—	—	3633100	—	—	—	—		
	3	00:59.08	0.98	—	3200	100	—	101.6	106.6	CR to 21:32:	
21:32:00	4	—	112	511.5	3633448	11478	52818	102.5	107.6	$\bar{Q}_{c_1}$ = 108.4 gpm	
23:30 —	5	0	—	—	—	—	—	—	—		
	6	01:00.91	1.02	—	—	100	—	98.[illegible]	103.4	CR	
23:46 —	7	0	—	—	3646700	—	—	—	—		
	8	01:00.96	1.02	—	6800	100	—	98.4	103.3	CR	
23:47:00	9	—	135	646.5	3646890	13442	66260	99.6	104.5		
23:57 —	10	0	—	—	47910	—	—	—	—		
	11	01:00.90	1.02	—	48010	100	—	98.5	103.4	CR	
4/23 00:23 —	12	0	—	—	3650700	—	—	—	—		
	13	01:01.22	1.02	—	—	100	—	98.0	102.9	CR	
00:54 —	14	0	—	—	3653400	—	—	—	—		
	15	01:01.78	1.03	—	3500	100	—	97.1	102.0	CR	From Start
00:56:00	16	—	69	715.5	3653631	6741	73001	97.7	102.6	Avg Q to 24?	
01:23 —	17	0	27	—	3656300	2669	—	98.9	103.8	106.3 gpm	
	18	01:02.01	1.03	—	56400	100	—	96.8	101.6	CR	
01:47 —	19	0	24	—	58600	2300	—	95.8	100.6	Rate from	
	20	01:02.57	1.04	—	8700	100	—	95.9	100.7	CR 21:32 to	
02:42 —	21	0	55	—	3663800	5200	—	94.5	99.3	02:47:	
	22	01:03.19	1.05	—	3900	100	—	95.0	99.7	CR $\bar{Q}_{c_2}$ = 102.8	
02:47	23			826.5				~85 gpm		Dropped [illegible]	
	24									Drawdown [illegible]	
03:06 —	25	0	24	850.5	3665930	2130	85300	88.8	93.2		
	26	01:10.09	1.17	—	6030	100	—	85.6	89.9	CR	
	27										
	28										

$$Q_c = 1.05 \frac{\Delta V}{\Delta \tau}$$

Clock Time (hms)		1 τ(m, s, .00)	2 Δτ/min	3 Στ (clock)	4 V_{gal}	5 ΔV_{gal}	6 ΣV (gal)	7 Q	8 Q_c	9 Remarks	#
4/23 04:59:00	1	—	113	958.5	3675680	9750	95050	86.3	90.6		
	2	01:10.30	1.17	—	—	100	—	85.3	89.6	CR	
07:12:00	3	—	133	1091.5	3687190	11510	106560	86.5	90.9		
	4	01:10.37	1.17	—	—	100	—	85.3	89.5	CR	
08:28:00	5	—	76	1167.5	3693360	6170	112730	81.2	85.2		
	6	01:11.15	1.19	—	—	100	—	84.3	88.5	CR	
~~09:10:00~~	~~7~~	~~—~~	~~42~~		~~3697210~~	~~3850~~		~~91.7~~	~~96.3~~		
	8	01:10.47	1.17	—	—	100	—	85.1	89.4	CR	
11:07:00	9	—	159	1326.5	3707040	13680	126410	86.0	90.3		
	10	01:10.78	1.18	—	—	100	—	84.8	89.0	CR	
14:55:00	11	—	228	1554.5	3726060	19020	145430	83.4	87.6		
	12	01:15.08	1.25	—	—	100	—	79.9	83.9	CR	
16:50 –	13	0	—	—	3735730	—	—	—	—		
	14	01:10.52	1.18	—	5830	100	—	85.1	89.3	CR	
16:57:00	15	—	122	1676.5	3735949	9889	155319	81.1	85.1		
16:57 –	16	0	—	—	—	—	—	—	—		
	17	01:10.40	1.17	—	—	100	—	85.2	89.5	CR	
18:30:00	18	—	93	1769.5	3743850	7901	163220	85.0	89.2		Rate from
	19	01:10.76	1.18	—	3950	100	—	84.8	89.0	CR	02:47 to
20:03:00	20	—	93	1862.5	3751700	7850	171070	84.4	88.6		23:49 8
	21	01:10.62	1.18	—	1800	100	—	85.0	89.2	CR $\bar{Q}_{c3}$ = 88.6 gpm	
	22										
23:49 –	23	—	220	2082.5	3770900	19200	190270	87.3	91.6	Approx time –	
23:55:00	24	—	12	2094.5	3770900			0	0	Pump Quit!	
23:55:25	25	—	232	2094.5	3770900	19200	190270	82.8	86.9	$\bar{Q}$ since Last meas.	
4/24 01:30 –	26	—	—	—	—	—	—	—	—	(Pump off	23:49 -23:55)
	27	01:10.62	1.18	—	—	100	—	85.0	89.2	CR 30-60 sec	DS @ 1:43
	28										

(5)

$Q_c = 1.05 \frac{\Delta V}{\Delta T}$

Clock Time (hms)		1 T (min.00) Stopwatch	2 ΔT (min)	3 ΣT (clock)	4 V (gal)	5 ΔV (gal)	6 ΣV (gal)	7 Q	8 Q_c	9 Remarks	10
4/24 01:50 –	1	0	—	—	—	—	—	—	—		
	2	01:09.50	1.16	—	—	100	—	86.3	90.6	CR	
	3										
02:22:00	4	—	147	2241.5	3782940	12040	200310	81.9	86.0		
	5	01:10.61	1.18	—	3040	100	—	85.0	89.2	CR	
02:22:00	6	—	—	379	—	—	31240	82.4	86.5	Q since 20:03	
03:39:00	7	—	77	2318.5	3789220	6280	206590	81.6	85.6	02:50-Pump off; 03:10- "	
	8	01:10.38	1.17	—	—	100	—	85.3	89.5	CR	
05:20:00	9	—	101	2419.5	3797520	8300	216890	82.2	86.3		
	10	01:11.60	1.19	—	620	100	—	83.8	88.0	CR	
05:25 –	11	0	—	—	—	—	—	—	—		
	12	01:10.53	1.18	—	—	100	—	85.1	89.3	CR	
07:05:00	13	—	105	2524.5	3806540	9020	225910	85.9	90.2		
	14	01:10.59	1.18	—	640	100	—	85.0	89.2	CR	
~~07:33:00~~	15	~~—~~	~~28~~		~~3809480~~	~~2940~~		~~105.0~~	~~110.2~~	Pump Quit 7:27-7:33	
	16	01:10.07	1.17	—	580	100	—	85.6	89.9	CR	
09:06:00	17	—	121	2645.5	3816550	10010	235920	82.7	86.9		
	18	01:12.79	1.21	—	650	100	—	82.4	86.6	CR	
09:16: —	19	0	—	—	3817380	—	—	—	—	Q since 7:33	
	20	01:11.63	1.19	—	480	100	—	83.8	88.0	CR	
09:18: —	21	0	—	—	3817320	—	—	—	—	Q since 7:33	
	22	01:10.23	1.17	—	420	100	—	85.4	89.7	CR	
09:33:00	23	—	27	2672.5	3818710	2160	238080	80.0	84.0	Pump Quit 09:30-9:32	
	24	01:10.68	1.18	—	810	100	—	84.9	89.1	CR	
12:48:00	25	—	195	2867.5	3834600	15890	253970	81.5	85.6		
	26	01:13.24	1.22	—	—	100	—	81.9	86.0	CR	
13:28:00	27	—	40	2907.5	3837920	3320	257290	83.0	87.1		
	28	01:13.41	1.22	—		100	—	81.7	85.8	CR	

(6)

Clock Time	1	2 ΔT(min)	3 ΣT(clock)	4 V(gal)	5 ΔV(gal)	6 ΣV(gal)	7 Q	8 Qc	9 Remarks	10
4/24 13:34	Pump	off	2913.5	3838421		257791			End Test	
4/22 13:00:30	Start Test			3580630					$\bar{Q}_{c4}$ = 85.9 gpm	
4/24 61:34:00	Finish	2913.5		3838421	257791		88.5	92.9	Avg Q	Test
13:00:30	Start			3580630						
26:42:00	Drop Rate	821.5		3663800	83170		101.2	106.3	$\bar{Q}$ First	1/4
27:06:00				3665930						
61:34:00		2068		3838421	172491		83.4	87.6	$\bar{Q}$ Last	3/4

Program 1
Q from Clock time (h:m:s)

```
g LBL 01
f fix 04
RCl 01 (old Time)
R/S Enter New Time
STO 01
g →H
x↔y
g →H
-
60
×
STO 2
f fix 2
R/S Read ΔT (min)
RCl 3
R/S Enter New Volume*
STO 3
x↔y
-
R/S Read ΔV (uncorrected)
RCL 2
GSB 3
GTO 01.
(R/S)
```

Program 2
Q from Stopwatch (m:s.00)

```
g LBL 02
0
f fix 4
R/S Enter Time (m:s.00)
100
÷
g →H
60
×
STO 04
f fix 2
R/S Read ΔT (min)
RCL 05
R/S Enter New Vol
STO 05
RCL 04
GSB 03
GTO 02
(R/S)
```

```
g LBL 03
÷
f fix 01
R/S Read Q (uncorrected)
1.05
×
R/S Read Q (corrected)
f fix 4
g RTN
```

* or enter 1st Vol 4 2nd Vol

43250

Well	Transmissivity (gpd/ft): Theis	Jacob	Adjusted Time Drawdown	Recovery	Dimensionless Time Recovery	From Theis Method: S_y	S	
S1	8014	7196 ~~7314~~	(1) 9429 (2) 5500 (3+4) 9962	~~15529~~	15529			
XS1	14614 S = 0.027	16704 S = 0.019	13200 0.041 S_y	~~10308~~	(A) 12279 (B) 11186 (C) 7765	Thiem ~~Semi~~ End	0.027 0.041	} from adjusted time drawdown
M1 (early) M1 (late)	~~14677~~ ~~14966~~ 15617 ~~15925~~					0.101	0.008	
M3 (early) M3 (late)	12100 ~~12122~~ 14855 ~~15148~~ ~~15227~~	12752	0.070			0.08	0.074	
M4	~~15527~~					0.094		
M5 (early) M5 (late)	11074 ~~11292~~ 14671 ~~14966~~					.099 ~~0.10~~	0.012	

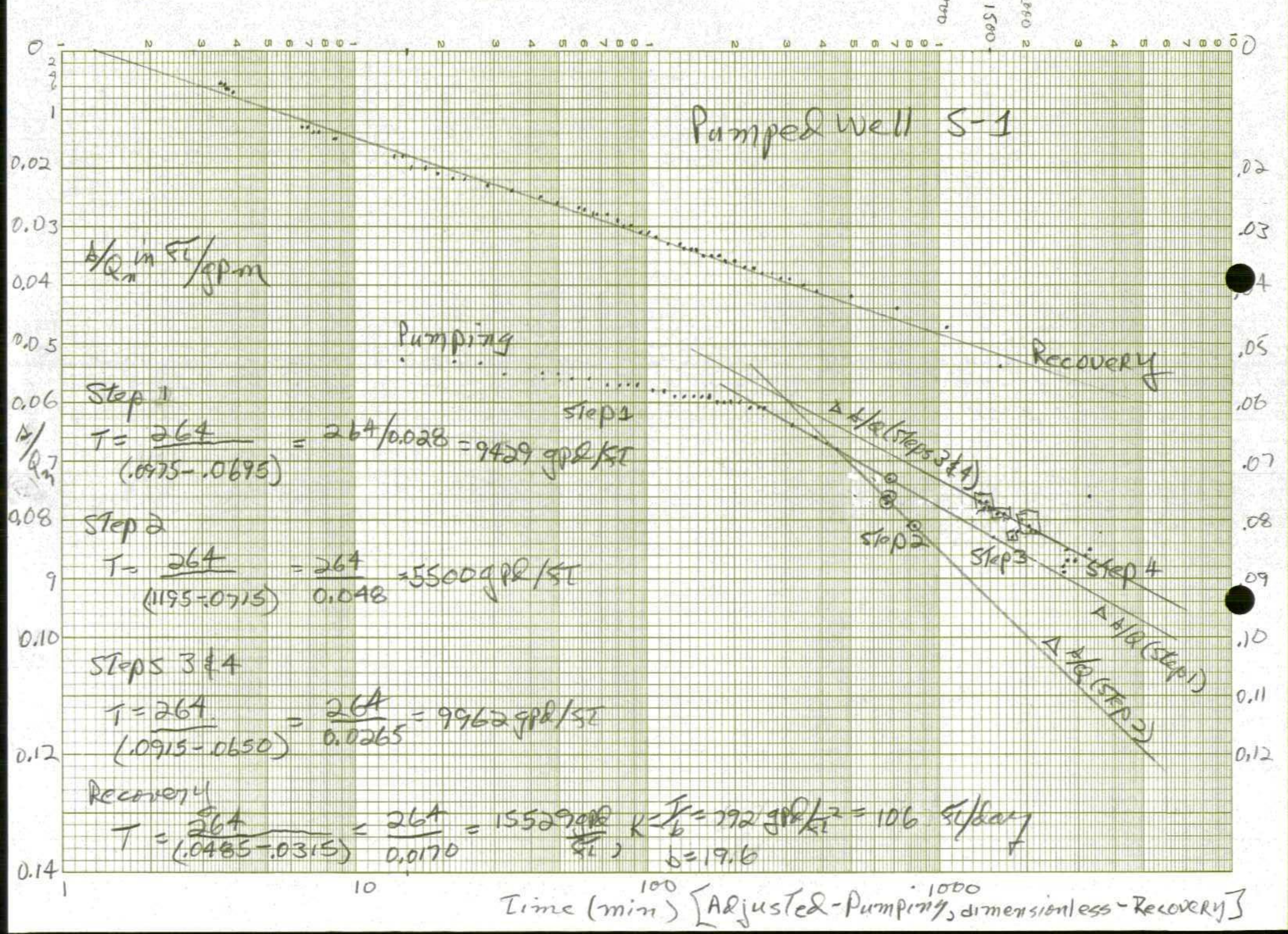
Gradient through S1 : $i = \frac{0.8\text{ ft}}{102\text{ ft}} = 0.0078$ (4/21)

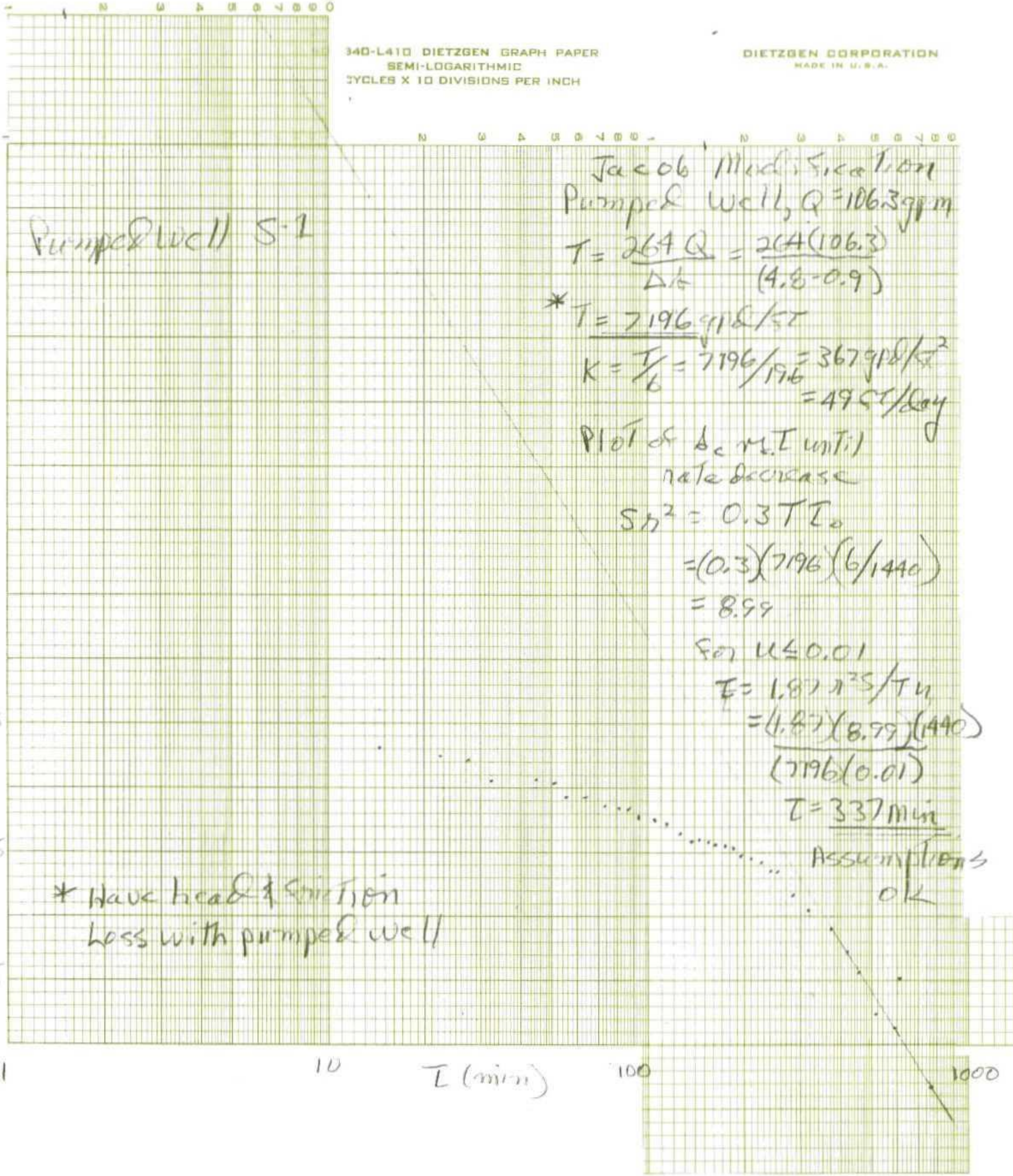
$i = \frac{0.8\text{ ft}}{112\text{ ft}} = 0.0071$ (5/21)

T values using 106.3 gpm (vs 108.4)

NO. 340-L410 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.





Pumped Well S-1

Jacob Modification
Pumped Well, Q = 106.3 gpm

$T = \frac{264\,Q}{\Delta h} = \frac{264(106.3)}{(4.8-0.9)}$

* $\underline{T = 7196}$ gpd/ft

$K = T/b = 7196/19.6 = 367$ gpd/ft^2
$= 49$ ft/day

Plot of s_c vs. t until rate decrease

$Sr^2 = 0.3\,T\,t_o$
$=(0.3)(7196)(6/1440)$
$= 8.99$

For $u \leq 0.01$
$t = 1.87\,r^2S/Tu$
$= \frac{(1.87)(8.99)(1440)}{(7196)(0.01)}$
$\underline{t = 337\text{ min}}$

Assumptions OK

* Have head & friction Loss with pumped well

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SEMI-LOGARITHMIC
3 CYCLES X 10 DIVISIONS PER INCH

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Well XS1 - Jacob

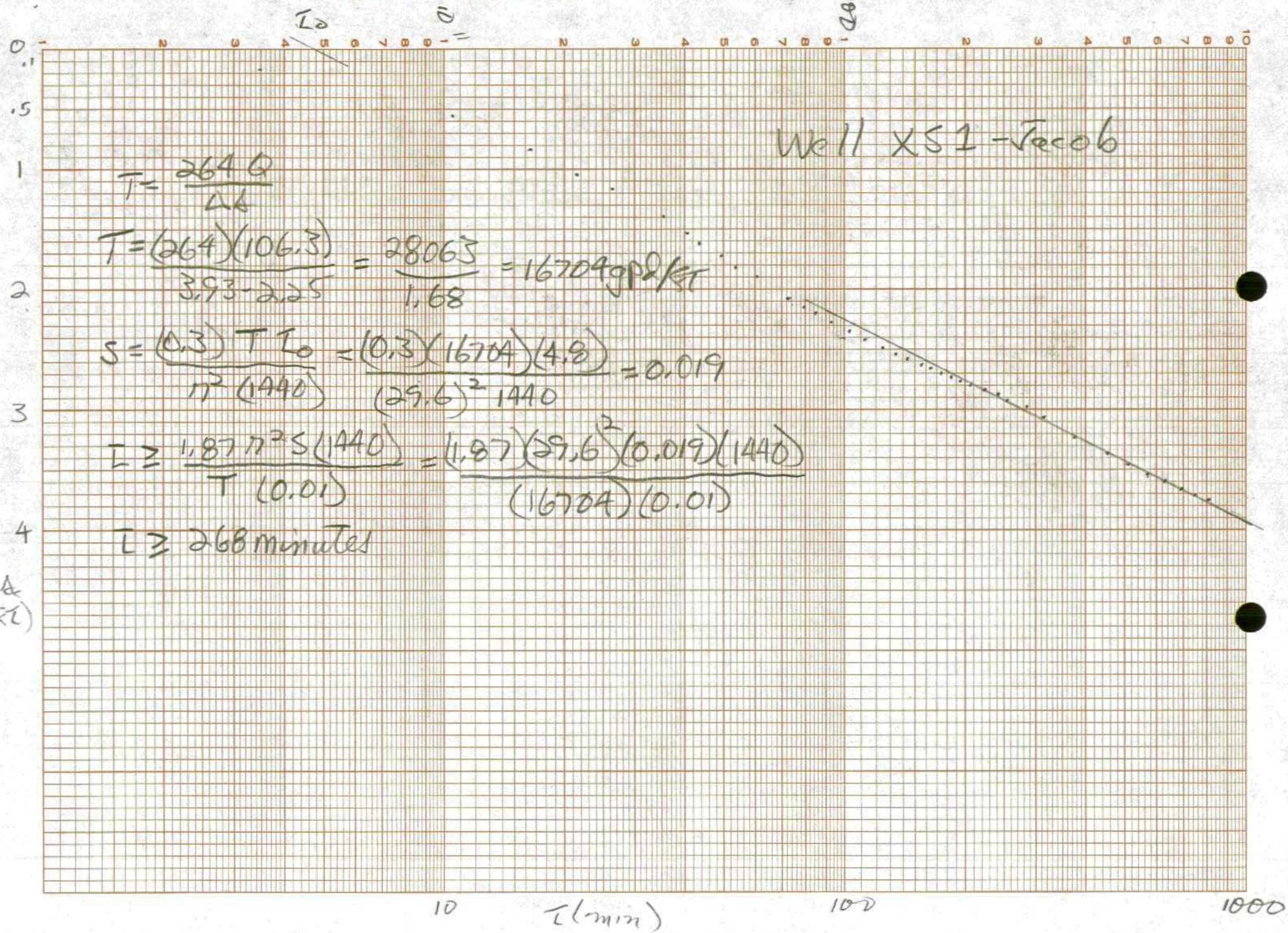
$$T = \frac{264\,Q}{\Delta s}$$

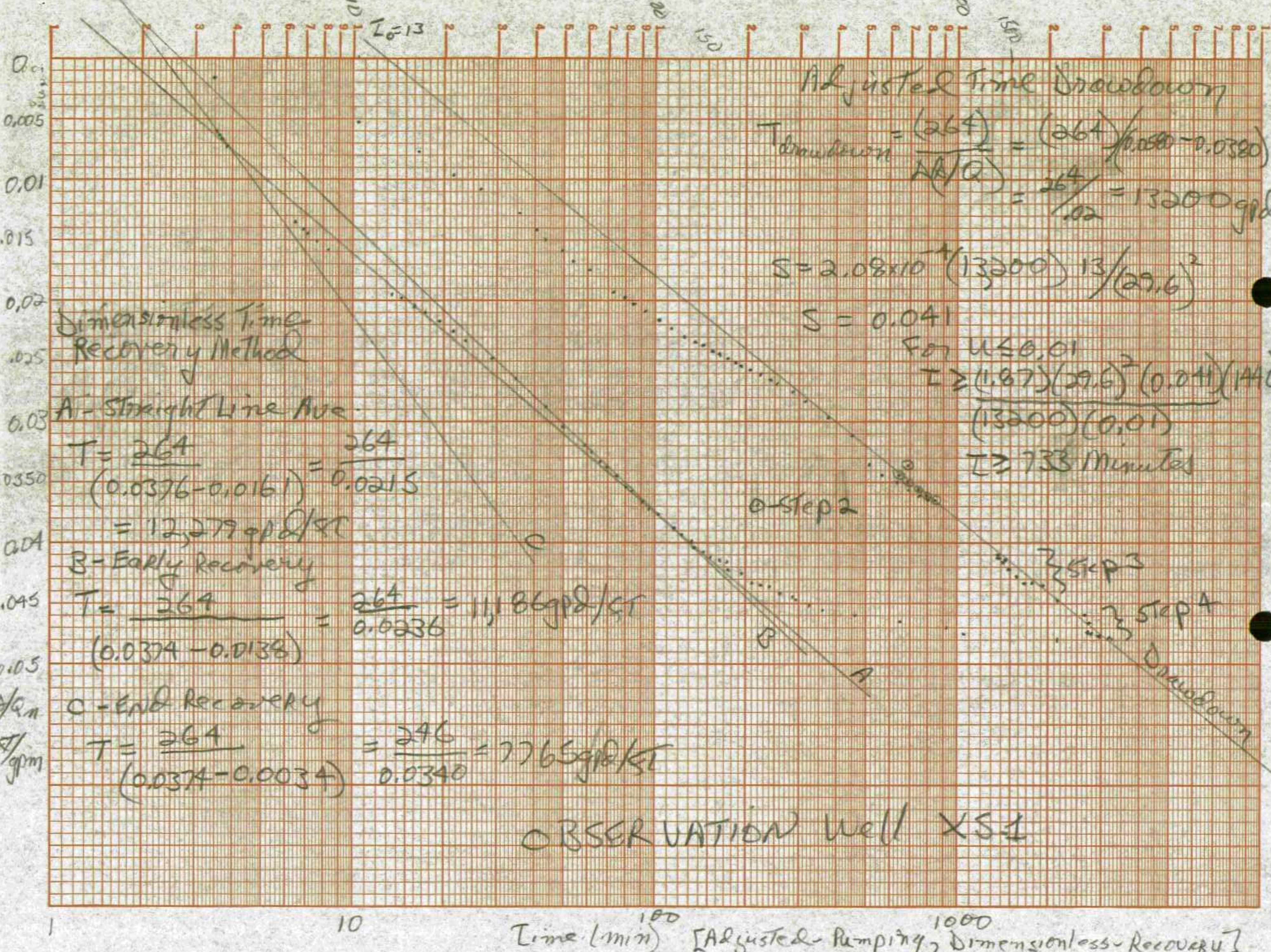
$$T = \frac{(264)(106.3)}{3.93 - 2.25} = \frac{28063}{1.68} = 16704 \text{ gpd/ft}$$

$$S = \frac{(0.3)\,T\,t_0}{r^2\,(1440)} = \frac{(0.3)(16704)(4.8)}{(29.6)^2\,1440} = 0.019$$

$$t \geq \frac{1.87\,r^2\,S\,(1440)}{T\,(0.01)} = \frac{(1.87)(29.6)^2(0.019)(1440)}{(16704)(0.01)}$$

$t \geq 268$ minutes





Adjusted Time Drawdown

$$T_{drawdown} = \frac{(264)}{\Delta(s/Q)} = (264)/(0.0580 - 0.0380) = \frac{264}{.02} = 13200 \text{ gpd/ft}$$

$$S = 2.08 \times 10^{-4} (13200)\ 13/(29.6)^2$$

$$S = 0.041$$

For $u \leq 0.01$

$$t \geq \frac{(1.87)(29.6)^2(0.041)(1440)}{(13200)(0.01)}$$

$$t \geq 733 \text{ Minutes}$$

Dimensionless Time Recovery Method

A - Straight Line Ave

$$T = \frac{264}{(0.0376 - 0.0161)} = \frac{264}{0.0215}$$

$$= 12,279 \text{ gpd/ft}$$

B - Early Recovery

$$T = \frac{264}{(0.0374 - 0.0138)} = \frac{264}{0.0236} = 11,186 \text{ gpd/ft}$$

C - End Recovery

$$T = \frac{264}{(0.0374 - 0.0034)} = \frac{246}{0.0340} = 7765 \text{ gpd/ft}$$

OBSERVATION Well XS1

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SEMI-LOGARITHMIC
4 CYCLES X 10 DIVISIONS PER INCH

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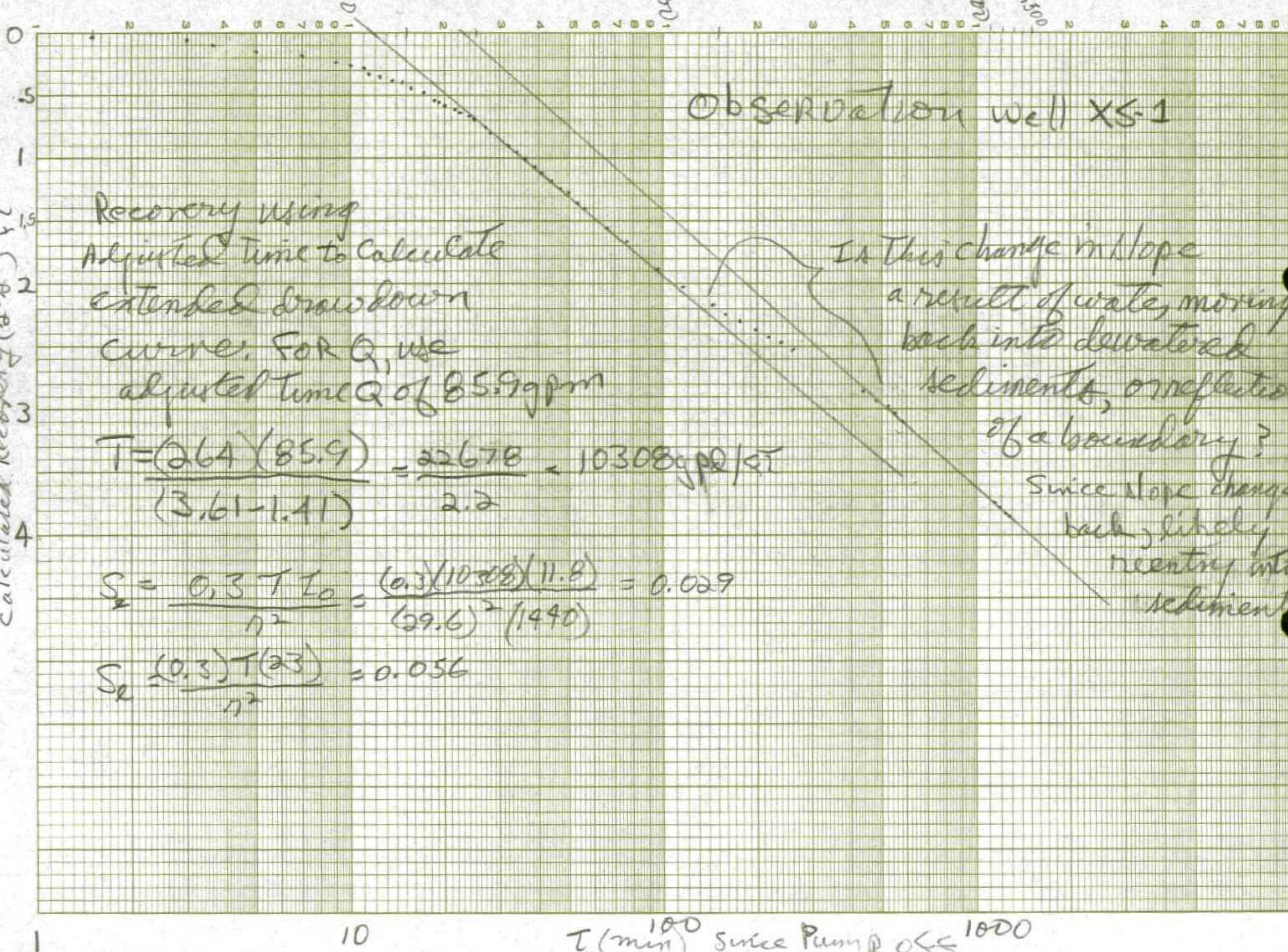
Observation well XS-1



Recovery using Adjusted Time to calculate extended drawdown curve. For Q, use adjusted time Q of 85.9 gpm

$T = \frac{(264)(85.9)}{(3.61-1.41)} = \frac{22678}{2.2} = 10308 \text{ gpd/ft}$

$S_x = \frac{0.3\ T\ t_0}{r^2} = \frac{(0.3)(10308)(11.8)}{(29.6)^2(1440)} = 0.029$

$S_e = \frac{(0.3)\ T(23)}{r^2} = 0.056$

Is this change in slope a result of water moving back into dewatered sediments, or reflection of a boundary?

Since slope changes back, likely reentry into sediments

Analysis of Flora Vista Pump Test (for pumped well)

1.) $Q = 108.4$ gpm

$S_y = 0.2$ (assumed)

• match pt. $W(u_A, u_B, \frac{r}{B}) = 1.0$

$1/u_B = 1.0$

$s = 85$ ft

$t_B = 8200$ min $= 5.69$ days

$\frac{r}{B} = 3.0$

gal = 0.134 ft³

$$T = \frac{Q}{4\pi s} W(u_A, u_B, \tfrac{r}{B})$$

$$= \frac{108.4 \text{ gal/min}}{4\pi \; 85 \text{ ft}} (1.0)\left(60 \tfrac{\text{min}}{\text{hr}}\right)\left(\tfrac{24 \text{ hr}}{\text{day}}\right) = \underline{146.1 \text{ gpd/ft}}$$

$$r = \sqrt{\frac{u_B \, 4 T t_B}{S_y}}$$

$$= \sqrt{\frac{(1.0)(4)(146 \text{ gpd/ft})(5.69 \text{ day})\left(\frac{0.134 \text{ ft}^3}{\text{gal}}\right)}{0.2}}$$

$\underline{r = 47 \text{ ft.}}$

NO

Analysis of Flora Vista Pump Test (for pumped well)

2.) $Q = 108.4$ gpm

$S_y = 0.2$ (assumed)

Best Fit

x-match pt $W(u_A u_B r/B) = 1.0$ $r/B = 0.2$

$1/u_B = 1.0$

$s = 1.55$ ft

$t_B = 1.8$ min $= 1.25 \times 10^{-3}$ days

$$T = \frac{108.4 \text{ gal/min}}{4\pi(1.55 \text{ ft})}(1.0)\left(60 \frac{\text{min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right) = 8014 \text{ gpd/ft}$$

$$r = \sqrt{\frac{(1.0)(4)(8014 \text{ gpd/ft})(1.25\times10^{-3} \text{ day})\left(0.134 \frac{\text{ft}^3}{\text{gal}}\right)}{0.2}} = 5.18 \text{ ft}$$

3.) $Q = 108.4$ gpm

$S_y = 0.2$

Good Fit

o-match pt. $W(u_A u_B r/B) = 1.0$

$1/u_B = 10$ $(u_B = 0.1)$

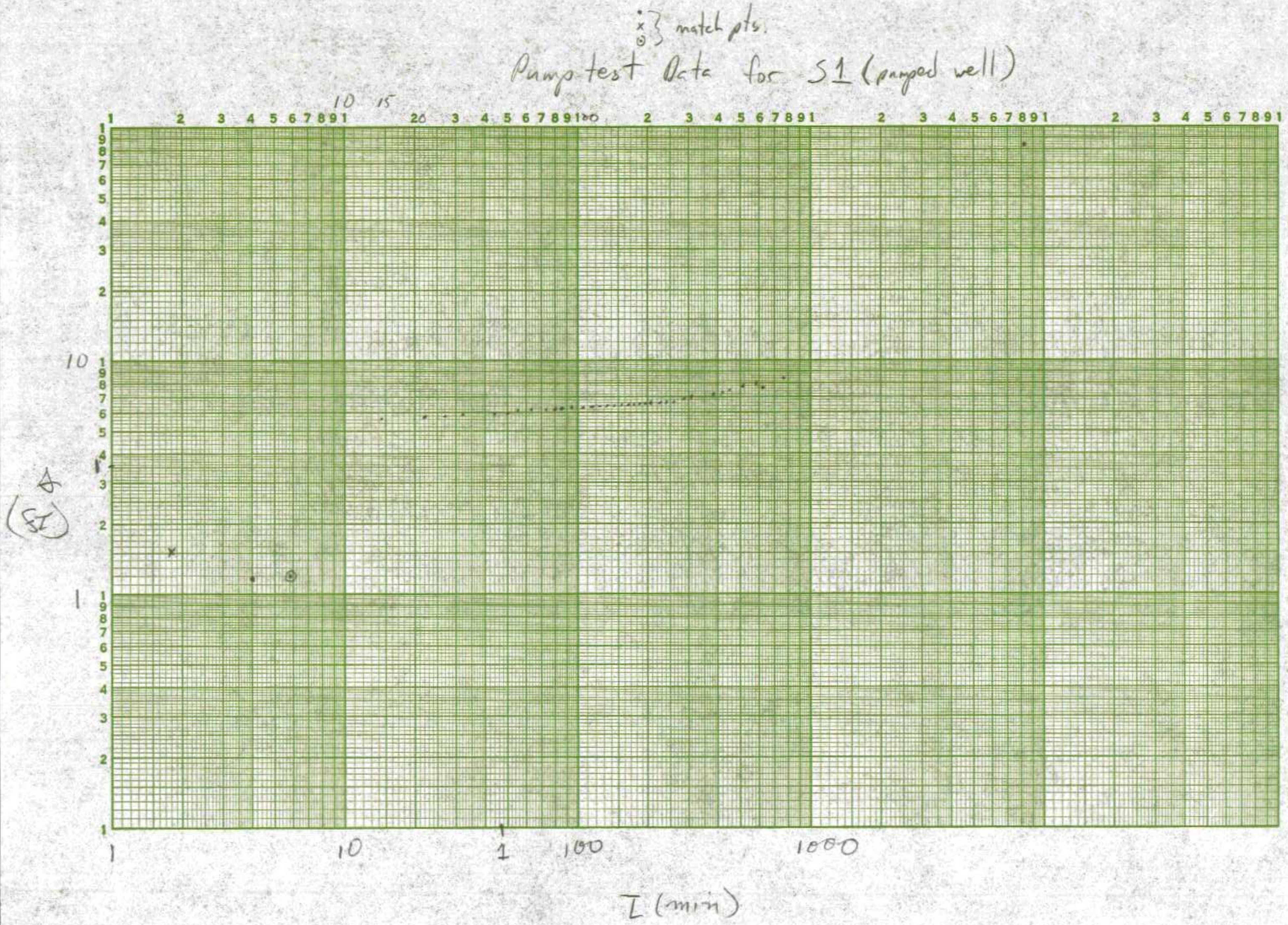
$s = 1.2$ ft

$t_B = 5.8$ min $= 4.03 \times 10^{-3}$ day

$r/B = 0.1$

$$T = \frac{(108.4 \text{ gal/min})}{4\pi(1.2 \text{ ft})}(1.0)\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right) = 10351 \text{ gpd/ft}$$

$$r = \sqrt{\frac{(0.1)(4)(10351 \text{ gpd/ft})(4.03\times10^{-3} \text{ day})\left(0.134 \text{ ft}^3/\text{gal}\right)}{0.2}} = 3.34 \text{ ft}$$



• x ⊙ } match pts.
Pump test Data for S1 (pumped well)
10
15
20
100
10
1
s (ft)
1
10
1
100
1000
T (min)

AQUIFER TEST WELL Pumped Well

Owner FLORA Vista Well No. 5-1

__ __1/4 SW 1/4 SW 1/4 Section 23, T. 30 (N) S, R. 12 E (W) NMPM B&M

SWL 5.443 feet Date 4/22/86, 1156

Measuring point "V" Notch which is 0.46 feet above ~~ground surface~~ Red survey mark on concrete pad

Discharge Diameter — inches Orifice Survey PT 6 inches

Other Measuring Device City of Farmington Totalizer (Qcorrected = 1.05Q

Perforated Interval ______ Data collected by: ______

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86	–									
0917	–	5.406								
0918	–	5,408								
4/22 1156	–	5,445								
1157	–	5,440								
13:00:30	0 Start Test – Avg Pumping Rate (corrected)									$\bar{Q}_c$ = 108.4 gpm
1315	14.5	12.360	6.917	5.696	0.0526					
1323	22.5	12,431	6.988	5,742	0,0530					
1328	27.5	12,510	7.067	5.793	0.0534					
1333	32.5	12,769	7.326	5.957	0.0550					
1345	44.5	12,751	7.308	5.946	0.0548					
1351	50.50	12,792	7.349	5.971	0.0551					
1356	55.50	12,945	7.50	6.07	.0560					
1404	63.5	12,965	7.52	6.08	.056					
1414	73.5	13.061	7.62	6.14	.057					
1421	80.5	13.091	7.65	6.16	.057					
1427	86.5	13.135	7.69	6.18	.057					

AQUIFER TEST PAGE 2 WELL Pumped Well

Owner Flora Vista WELL NO. 5-4

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22/86										
1434	93.5	13.191	7.75	6.22	.057					
1446	105.5	13.253	7.81	6.25	.058					
1455	114.5	13.300	7.86	6.28	.058					
1506	125.5	13.448	8.00	6.37	.059					
1516	135.5	13.518	8.08	6.41	.059					
1525	144.5	13.498	8.06	6.40	.059					
1536	155.5	13.519	8.08	6.41	.059					
1545	164.5	13.542	8.10	6.43	.059					
1555	174.5	13.598	8.16	6.46	.060					
1605	184.5	13.628	8.19	6.48	.060					
1615	194.5	13.691	8.25	6.51	.060					
1630	209.5	13.732	8.29	6.54	.060					
1645	224.5	13.815	8.37	6.58	.061					
1702	241.5	13.893	8.45	6.63	.061					
1716	255.5	13.956	8.51	6.66	.061					
1745	284.5	14.246	8.80	6.83	.063					
1817	316.5	14.490	9.05	~~6.60~~ 6.96	.064					
1920	379.5	14.760	9.32	7.10	.066					
1958	417.5	15.105	9.66	7.28	.067					
2032	451.5	15.400	9.96	7.43	.068					
2136	515.5	16.120	10.68	7.77	.076	671.7				Change $\bar{Q}_{c2}$ = 102.8 at 21:32
2245	584.5	16.38_	10.94	7.86	.077	654.6				Cascading?
2310	609.5	15.50_	10.06	7.48	.073	673.3				〃 ?

AQUIFER TEST PAGE 3 WELL Pumped Well

Owner Sloro Vista WELL NO. S-1

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/23/86										
0157	776.5	17.42	11.98	8.32	.081	823.3				Decreased Q to 88.6 (Qc3) at 02:47
0344	883.5	14.215	8.77	6.81	.077	1447.9				
0446	945.5	14.282	8.84	6.85	.077	1384.5				
0659	1078.5	14.341	8.90	6.88	.078	1418.0				
0830	1169.5	14.382	8.94	6.90	.078	1476.3				
0857	1196.5	14.398	8.96	6.91	.078	1495.9				
1056	1315.5	14.495	9.05	6.96	.079	1590.3				
1254	1433.5	14.563	9.12	~~6.~~ 7.00	.079	1691.7				
1446	1545.5	15.179	9.74	7.32	.083	1792.1				
1704	1683.5	14.736	9.29	7.09	.080	1919.3				
1905	1804.5	14.918	9.48	7.18	.081	2033.0				
2009	1868.5	15.000	9.56	7.23	.082	2093.7				
2101	1920.5	15.080	9.64	7.27	.082	2143.3				
4/24 0126	2185.5	15.605	10.16	7.53	.088	2647.9				Change, Q_4 = 85.9 gpm @ 23:49
0128	2187.5	15.605	10.16	7.53	.088	2648.6				
0228	2247.5	15.775	10.33	7.61	.089	2676.6				
0243	2262.5	15.860	10.42	7.65	.089	2685.6				
0345	2324.5	15.102	9.66	7.28	.085	2727.7				
0502	2401.5	15.552	10.11	7.50	.087	2786.8				
0900	2639.5	15.530	10.09	7.49	.087	2991.0				
1245	2864.5	15.269	9.83	7.36	.086	3197.3				
1329	2908.5	15.198	9.76	7.33	.085	3238.4				End Test 13:34

AQUIFER TEST PAGE 4 WELL Pumped well

Owner Flora Vista WELL NO. S-1

Recovery

Date & Time 4/24	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
1335	2914.5	13.71	8.27	6.52	.076	3244.0	1	2914.5	3244	Recovery
1336	2915.5	10.861	5.42	4.67	.054	3245.0	2	1457.8	1622.5	
1337	2916.5	10.03	4.59	4.05	.047	3245.9	3	972.2	1082.0	
1338.5	2918.0	9.63	4.19	3.74	.044	3247.3	4.5	648.4	721.6	
1340.5	2920.0	9.451	4.01	3.60	.042	3249.2	6.5	449.2	499.9	
1342.5	2922.0	9.329	3.89	3.50	.041	3251.0	8.5	343.8	382.5	
1343.5	2923.0	9.235	3.79	3.43	.040	3252.0	9.5	307.7	342.3	
1344.5	2924.0	9.172	3.73	3.37	.039	3252.9	10.5	278.5	309.8	
1345.25	2924.8	9.138	3.69	3.35	.039	3253.6	11.3	260.0	289.2	
1346	2925.5	9.076	3.63	3.30	.038	3254.3	12.0	243.8	271.2	
1347	2926.5	9.016	3.57	3.25	.038	3255.3	13.0	225.1	250.4	
1348	2927.5	8.956	3.51	3.20	.037	3256.2	14.0	209.1	232.6	
1349	2928.5	8.918	3.48	3.17	.037	3257.1	15.0	195.2	217.1	
1350.3	2929.8	8.849	3.41	3.11	.036	3258.4	16.3	179.4	199.5	
1351.5	2931.0	8.803	3.36	3.07	.036	3259.5	17.5	167.5	186.3	
1352.5	2932.0	8.760	3.32	3.04	.035	3260.4	18.5	158.5	176.2	
1353.5	2933.0	8.726	3.28	3.01	.035	3261.4	19.5	150.4	167.2	
1355	2934.5	8.671	3.23	2.96	.035	3262.8	21.0	139.7	155.4	
1356	2935.5	8.641	3.20	2.94	.034	3263.7	22.0	133.4	148.4	
1357	2936.5	8.615	3.17	2.92	.034	3264.7	23.0	127.7	141.9	
1358.5	2938.0	8.583	3.14	2.89	.034	3266.1	24.5	119.9	133.3	
1359	2938.5	8.552	3.11	2.86	.033	3266.5	25.0	117.5	130.7	
1401.5	2941.0	8.476	3.03	2.80	.033	3268.9	27.5	106.9	118.9	

AQUIFER TEST PAGE 5 WELL Pumped Well

Owner Flora Vista Recovery WELL NO. 5-1

Date & Time 4/24	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
1404	2943.5	8.405	2.96	2.74	.032	3271.2	30.0	98.1	109.0	
1406.5	2946.0	8.359	2.92	2.70	.031	3273.6	32.5	90.6	100.7	
14:08.5	2948.0	8.290	2.85	2.64	.031	3275.5	34.5	85.4	94.9	
14:11	2950.5	8.221	2.78	2.58	.030	3277.8	37.0	79.7	88.6	
14:13.5	2953.0	8.171	2.73	2.54	.030	3280.2	39.5	74.8	83.0	
1415.5	2955.0	8.110	2.67	2.49	.029	3282.0	41.5	71.2	79.1	
1418.5	2958.0	8.061	2.62	2.44	.028	3284.9	44.5	66.5	73.8	
1422	2961.5	8.018	2.58	2.41	.028	3288.2	48.0	61.7	68.5	
1424.5	2964.0	7.981	2.54	2.37	.028	3290.5	50.5	58.7	65.2	
1427.5	2967.0	7.950	2.51	2.35	.027	3293.3	53.5	55.5	61.6	
1430.5	2970.0	7.911	2.47	2.31	.027	3296.2	56.5	52.6	58.3	
14:40.5	2980.0	7.836	2.39	2.25	.026	3305.6	66.5	44.8	49.7	
14:50.5	2990.0	7.749	2.31	2.17	.025	3315.0	76.5	39.1	43.3	
15:10.5	3010.0	7.626	2.18	2.06	.024	3333.9	96.5	31.2	34.5	
15:30.5	3030.0	7.548	2.10	1.99	.023	3352.8	116.5	26.0	28.8	
15:55	3054.5	7.458	2.03	1.91	.022	3376.1	141.0	21.7	23.9	
16:10	3069.5	7.409	1.97	1.87	.022	3390.3	156.0	19.7	21.7	
16:31	3090.5	7.359	1.90	1.80	.021	3410.3	177.0	17.5	19.3	
16:52	3111.5	7.285	1.84	1.76	.020	3430.2	198.0	15.7	17.3	
17:13	3132.5	7.228	1.78	1.70	.020	3450.3	219.0	14.3	15.8	
17:30	3149.5	7.173	1.73	1.65	.019	3466.5	236.0	13.3	14.7	
17:50	3169.5	7.130	1.69	1.61	.019	3485.6	256.0	12.4	13.6	
20:47	3346.5	6.788	1.35	1.30	.015	3655.5	433.0	7.73	8.44	

AQUIFER TEST PAGE 6 WELL Pumped Well

Owner Flora Vista WELL NO. R 5-1

Recovery

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/24										
2138	3397.5	6.714	1.27	1.23	.014	3704.7	484.0	7.02	7.65	
2213	3432.5	6.655	1.21	1.17	.014	3738.5	519.0	6.61	7.20	
2237	3456.5	6.620	1.18	1.14	.013	3761.6	543.0	6.37	6.93	
2315	3494.5	6.562	1.12	1.09	.013	3798.5	581.0	6.01	6.54	
4/25 0824	4043.5	6.017	.574	.561	.0065	4333.9	1130.0	3.58	3.84	
0918	4097.5	5.970	.53	.52	.0061	4386.89	1184.0	3.46	3.71	
0920	4099.5	5.970	.53	.52	.0061	4388.8	1186.0	3.46	3.70	
0949	4128.5	5.952	.51	.50	.0058	4417.3	1215.0	3.40	3.64	
1034	4173.5	5.916	.47	.47	.0055	4461.5	1260.0	3.31	3.54	

4/21/86 Well S1 - Elevation:

Time	Hold	Cut	DTW	TD	Sat. Aquif. Thick b
0917	6.0	0.594	5.406		
0918	6.0	0.592	5.408	20.86	15.45
4/22 1156	6.0	.555	5.445		
1157	6.0	.560	5.440		
1315	13.00	0.64	~~5.360~~	12.360	
1323	13.00	0.569	~~5.431~~	12.431	
1328	13.00	.490	~~5.510~~	12.510	
1333	13.0	.231	~~5.769~~	12.769	
1343	14.0	1.279	12.751		
1351	14.0	1.208	12.792		
1356	14.0	1.055	12.945		
1400	14.0	1.035	12.965		
1414	14.0	.939	13.061		
1421	14.0	.909	13.091		
1427	14.0	.865	13.135		
1434	14.0	.809	13.191		
1446	14.0	.747	13.253		
1455	14.0	.700	13.300		
1506	14.0	.552	13.448		
1516	14.0	.482	13.518		
1525	14.0	.502	13.498		
1536	14.0	.481	13.519		
1545	14.0	.458	13.542		
1555	14.0	.402	13.598		
1605	14.0	.372	13.628		

Comments

04/21/86

Well S1 has plate removed
Measuring point for test
"V" notch 0.46 feet above
and opposite red paint mark
on ~~the~~ concrete pad.
8604210945 organics only
Sampled after bailing ~20
bails w/ 1" PVC bailer cleaned
w/ liquinox. TD 19.45+1.41

From City of Farmington -
As well 105.0 gpm / 100 gpm
(As adjusted for lates use 100.4 gpm/...

Leave Santa Fe ~ 6PM 4/20/86
Mileage leaving 68132
Arrive Santa Fe ~6:30 PM 4/25/86
Mileage 68772
Total Miles 640

TIME	WELL HOLD	S1 CUT	DTW	TD	b
1615	14.0	.309	13.691		
1630	14.0	.268	13.732		
1645	14.0	.185	13.815		
1702	14.5	.607	13.893		
1716	14.5	.544	13.956		
1745	14.5	.254	14.246		
1817	15.0	~~.0510~~	0.510	14.490	
1920	15.0	.240	14.760		
1958	15.5	.395	15.105		
2032	16.0	.600	15.400		
~~2136~~	~~16.0~~				
2136	16.5	.380	16.120	OK?	
~~2230~~	~~17.0~~	~~.855~~	~~16.145~~	Cascading	
~~2237~~	~~17.0~~	~~1.30~~	~~15.70~~	? "	"
2245	17.0	.62	16.38	"	"
2310	18.0	2.50	15.50	? Testing	

Wednesday April 23

0157 Approx 2.25 feet of water above Foot Valve

Depth to top of Valve: 19.1' + .57' (WT. Length)

19.67
2.25

17.42 feet DTW @ 0157

TIME	WELL HOLD	S1 CUT	DTW	TD	b
0341	~~14~~ 16	1.785	14.215		
0446	16.0	1.718	14.282		

10.8 Top of Screen
+1.4

Moved engine closer - more hose in

1817 Oil!—

1950 - Discharge at hose end

2025 - 790 cond (temp correct)

Samples at 2010 *, 2015 (1ST)

* bailer submerged

		51		
TIME	HOLD	CUT	DTW	b
0659	16.0	1.659	14.341	
0830	16.0	1.618	14.382	
0857	16.0	1.602 ~~1.602~~	14.398	
1056	16.0	~~1.510~~ 1.505	14.495	
1254	16.0	1.437	14.563	
1446	~~17.0~~ 16.0	1.821 1.821	15.179	
1704	16.0	1.264	14.736	
1905	16.0	1.082	14.918	
2009	16.0	1.000	15.000	
2101	16.0	0.920	15.280	
~~#~~	Thursday April 24			
~~0121~~	~~16.0~~	~~0.432~~ DTB		
0136	16.0	0.395	15.605	
0128	16.0	0.395	15.605	
0228	17.0	1.225	15.775	
0243	17.0	1.140	15.860	
0345	17.0	1.898 1.899	15.102	
0502	17.0	1.449 1.448	15.552	
0900	17.0	1.468 1.472	15.530	
1245	17.0	1.731	15.269	
1329	17.0	1.802	15.198	
1334	END TEST			

Engine sputtered several times. Checked rate = 845

Slimy visible grease on tape. Sampled 8604230832

EPNG sampled @ 0917

Orifice changed - see other book

Pump stopped ~2349 / 2355 See other book
055 0143 - 0144
0250 - 0251

Stopped pump 0310 For gas / oil. Started ~0314

Stopped @ 0727 - 0734
@ 0930 - 0932

Cascading

Orifice 4.65 - 4.7

4/24 S1 RECOVERY

TIME	HOLD	CUT	OTW		6
133~~4~~5.5	10.0	2.290			
1336	12.0	1.139			
1337	11.0	.970			
1338.5	10.0	.370			
1340.5	10.0	.549			
1342.5	10.0	.671			
1343.5	10.0	.765			
1344.5	10.0	.828			
1345.25	10.0	.862			
1346	10.0	.924			
1347	10.0	.984			
1348	10.0	1.044			
1349	10.0	1.082			
1350.3	10.0	1.151			
1351.5	10.0	1.197			
1352.5	10.0	1.240			
1353.5	10.0	1.274			
1355	9.0	.329			
1356	9.0	.359			
1357	9.0	.385			
1358.5	9.0	.417			
1359	9.0	.448			
1401.5	9.0	.524			
1404	9.0	.595			

1402 organic sample - odor + sheen
sampled w/ new Mason jar

4/24	RECOV		S 1
Time			
1406.5	9.0	.641	
1408.5	9.0	.710	
1411	9.0	.779	
1413.5	9.0	.829	
1415.5	9.0	.890	
1418.5	9.0	.939	
1422	9.0	.982	
1424.5	9.0	1.019	
1427.5	9.0	1.050	
1430.5	9.0	1.089	
1440.5	8.0	.164	
1450.5	8.0	.251	
		.374←	
1510.5	8.0	.352x	
1530.5	8.0	.452	
1555	8.0	.542	
1610	8.0	.591	
1631	8.0	.661	
1652	8.0	.715	
1713	8.0	.772	
1730	8.0	.827	
1758	8.0	.870	
2047	7.0	.212	
2138	7.0	.282	
2213	7.0	.345	
~~7[illegible]~~ 12.5			
~~0830~~	~~7.0~~	~~.953~~	

Recovery S1

2237	7.0	.0380	
2315	7.0	.438	
Fri 4/25			
0824	7.0	.983	6.017
0918	7.0	1.030	
0920	7.0	1.030	
0949	7.0	1.048	
1034	7.0	1.084	

Recovery - Monitor Wells

m1

0826	7.5	.891

m2

0828	7.0	.387

m3

0831	9.0	1.939

m4

0833	6.5 6.5	1.406

m5

0835	4.5	.335

CAMP 43250

Well	Transmissivity (gpd/ft) Theis	Jacob	Adjusted Time Drawdown	Recovery	Dimensionless Time Recovery	From Theis Method S_y	S
S1	8014	7311	(1) 9429 (2) 5500 (3+4) 9962	15529			
XS1	14614		13200	10308	(A) 12279 (B) 11186 (C) 7765		0.027 0.041 } from adjusted time drawdown
M1 (early)	14966						0.008
M1 (late)	15925					0.10	
M3 (early)	12422	13012				(0.071 (Jacob)	0.094
M3 (late)	15148					0.08	
M4	15527					0.094	
M5 (early)	11292						0.012
M5 (late)	14966					0.10	

Hydraulic Gradient through S1 : $i = \frac{0.8\ ft}{102\ ft} = 0.0079$ (4/21) T using 108.4 gpm

$i = \frac{0.8\ ft}{112\ ft} = 0.0071$ (5/21) (not 106.3)

OBS. Well - SX 1

Flora Vista Pump Test Analysis

Data

$Q = 108.4$ gpm

$S_y = 0.2$ (assumed)

$r = 30$ ft.

$$T = \frac{Q}{4\pi \rho} W(u_A, u_B, r/B)$$

$$S = \frac{4 T t_a u_a}{r^2}$$

1.) ⊙ match pt.

NO

$W(u_A, u_B, r/B) = 1.0$ $\qquad r/B = 0.4$

$1/u_a = 1.0$

$\rho = 1.5$ ft.

$t_a = 9.7$ min $= 6.74 \times 10^{-3}$ days

$$T = \frac{108.4 \text{ gal/min}}{4\pi (1.5 \text{ ft})}(1.0)\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right) = 8281 \text{ gpd/ft}$$

$$S = \frac{4(8281 \text{ gpd/ft})(6.74 \times 10^{-3} \text{ days})(1.0)\left(\frac{0.134 \text{ ft}^3}{\text{gal}}\right)}{(30 \text{ ft})^2} = 0.033$$

2.) ⊡ match pt

Best Fit

$W(u_A, u_B, r/B) = 1.0$

$1/u_a = 1.0$

$\rho = 0.85$ ft.

$t_A = 4.4$ min $= 3.05 \times 10^{-3}$ days

$r/B = 0.1$

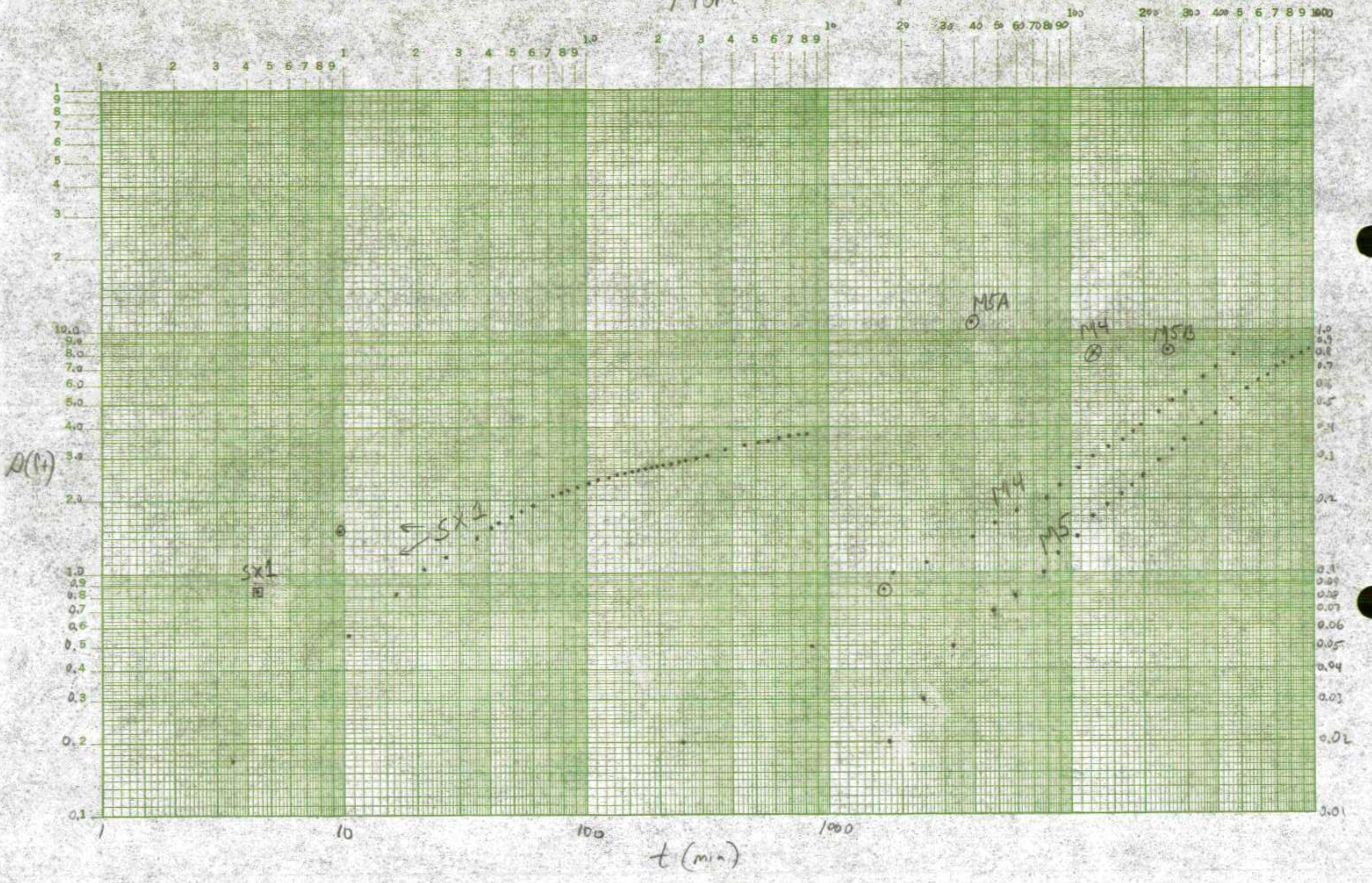
$$T = \frac{108.4 \text{ gal/min}}{4\pi (0.85 \text{ ft})}(1.0)\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right) = 14614 \text{ gpd/ft}$$

$$S = \frac{4(14614 \text{ gpd/ft})(3.05 \times 10^{-3} \text{ days})(1.0)\left(\frac{0.134 \text{ ft}^3}{\text{gal}}\right)}{(30 \text{ ft})^2} = 0.027$$

K+E LOGARITHMIC 3 x 5 CYCLES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 7522

Flora Vista Pump Test Data for Monitor Well M4.



Flora Vista Pump test data for SX1

Flora Vista Pump Test Analysis

Monitor Well - M4

Data

$Q = 108.4$ gpm
$r = 87.5$ ft

$$T = \frac{Q}{4\pi \rho} W(u_A, u_B, r/B)$$

$$S_y = \frac{4 T t_B u_B}{r^2}$$

⊗ match point

$W(u_A, u_B, r/B) = 1.0$
$1/u_B = 1.0$
$\rho = 0.80$ ft.
$t_B = 125$ min $= 0.87$ days
$r/B = 3.0$

$$T = \frac{(108.4 \text{ gpm})}{4\pi(0.80 \text{ ft})}(1.0)(60)(24) = \boxed{15527 \text{ gpd/ft}}$$

$$S_y = \frac{4(15527 \text{ gpd/ft})(0.87 \text{ days})(1.0)(0.134 \text{ ft}^3/\text{gal})}{(87.5 \text{ ft})^2} = \boxed{0.094}$$

Flora Vista Pump Test Analysis

Monitor Well - M5

Data

$Q = 108.4$ gpm

$r = 118.5$

$T = \frac{Q}{4\pi s} W(u_A, u_B\ r/B)$

$S = \frac{4Ttu}{r^2}$

⊙ M5A match point (early time data)

$W(u_A, r/B) = 1.0$

$r/B = 3.0$

$1/u_A = 1.0$

$s_A = 1.1$ ft

$t_A = 39.0$ min $= 0.027$ days

$$T = \frac{(108.4\ gal/min)}{4\pi(1.1\ ft)}(1.0)(60\ min/hr)(24\ hr/day) = \boxed{11\,292\ gpd/ft}$$

$$S = \frac{4(11292\ gpd/ft)(0.027\ days)(1.0)(0.134\ ft^3/gal)}{(118.5\ ft)^2} = \boxed{0.012}$$

⊙ M5B match point (late time data)

$W(u_B, r/B) = 1.0$

$r/B =$

$1/u_B = 1.0$

$s_B = 0.83$ ft

$t_B = 250$ min $= 0.174$ days

$$T = \frac{(108.4\ gal/min)}{4\pi(0.82\ ft)}(1.0)(60\ min/hr)(24\ hr/day) = \boxed{14\,966\ gpd/ft}$$

$$S_y = \frac{4(14966\ gpd/ft)(0.174\ days)(1.0)(0.134\ ft^3/gal)}{(118.5\ ft)^2} = \boxed{0.10}$$

AQUIFER TEST

WELL Observation

Owner Sloma Vista

Well No. XS-1

1/4 SW 1/4 SW 1/4 Section 23, T. 30 (N) S, R. 12 E (W) B&M

SWL 4.810 feet

Date 4/22/86, 1204

Measuring point "V" Notch at Red Paint Survey which is Survey Point 7 feet above ground surface

Discharge Diameter inches Orifice inches

Other Measuring Device

Perforated Interval

Data collected by: Boyer/Bailey/Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0924	—	4.813								
0925	—	4.811								
4/22 1201	—	4.81								
1204	—	4.81								
1300	?	4.600								Start at 13:00:30 Qn = 108.4 gpm
1304	3.5	4.980	.17	.17	.0016					
1311	10.5	5.380	.57	.56	.0052					
1317	16.5	5.658	.85	.83	.0077					
1322	21.5	5.876	1.07	1.04	.0096					
1327	26.5	6.018	1.21	1.17	.0108					
1336	35.5	6.260	1.45	1.40	.0129					
1341	40.5	6.402	1.59	1.53	.0141					
1344	43.5	6.496	1.69	1.61	.0149					
1350	49.5	6.615	1.80	1.72	.0159					
1354	53.5	6.715	1.90	1.81	.0167					
1401	60.5	6.812	2.00	1.90	.0175					
1413	72.5	7.022	~~2.12~~ 2.212	~~2.09~~ 2.09	.0193					

AQUIFER TEST PAGE 2 WELL Observation

Owner Flora Vista WELL NO. X51

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22										
1420	79.5	7.090	2.28	2.15	.0198					
1425	84.5	7.147	2.34	2.20	.0203					
1433	92.5	7.230	2.42	2.27	.0209					
1443	102.5	7.319	2.51	2.35	.0217					
1453	112.5	7.390	2.58	2.41	.0222					
1505	124.5	7.480	2.67	2.49	.0230					
1514	133.5	7.531	2.72	2.53	.0234					
1524	143.5	7.584	2.77	2.58	.0235					
1536	155.5	7.636	2.83	2.62	.0242					
1544	163.5	~~7.726~~ 7.665	2.86	2.65	.0244					
1554	173.5	7.726	2.92	2.70	.0240					
1604	183.5	7.746	2.94	2.72	.0251					
1614	193.5	7.794	2.98	2.76	.0254					
1629	208.5	7.840	3.03	2.80	.0258					
1644	223.5	7.878	3.07	2.83	.0261					
1701	240.5	7.940	3.13	2.88	.0266					
1715	254.5	7.984	3.17	2.92	.0269					
1744	283.5	8.057	3.25	2.98	.0275					
1815	314.5	8.172	3.36	3.07	.0284					
1918	377.5	8.358	3.55	3.23	.0298					
2031	450.5	8.530	3.72	3.37	.0311					
2134	513.5	8.643	3.83	3.46	.0336	694.7				Change to Q_{c3} = 102.8 @ 21:32

AQUIFER TEST PAGE 3 WELL Observation

Owner Flora Vista WELL NO. XS-1

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22										
2227	566.5	8.732	3.92	3.53	.0343	643.24				
2328	627.5	8.815	4.00	3.60	.0350	687.9				
4/23 0031	690.5	8.894	4.08	3.66	.0356	743.2				
0129	748.5	8.951	4.15	3.71	.0361	796.9				
0225	804.5	~~9.02~~ 9.019	4.21	3.76	.0365	850.0				
0343	882.5	8.892	4.08	3.66	.0413	1450.2				Change rate to (Q_{c3}) 88.6 @ 02:47
0444	943.5	8.865	4.06	3.64	.0410	1385.1				
0458	957.5	8.879	4.07	3.65	.0412	1382.2				
0655	1074.5	8.928	4.12	3.69	.0416	1415.8				
0854	1193.5	8.990	4.18	3.73	.0421	1493.7				
1054	1313.5	9.059	4.25	3.79	.0428	1588.7				
1253	1432.5	9.109	4.30	3.83	.0432	1690.8				
1445	1544.5	9.102	4.29	3.82	.0431	1791.2				
1701	1680.5	9.139	4.33	3.85	.0435	1916.5				
20:56	1915.5	9.304	4.49	3.98	.0449	2138.5				
4/24 0105	2164.5	9.270	4.46	3.95	~~.0446~~ .0460	2643.7				Change Q_{c4} to 85.9 gpm @ 23:49
0308	2287.5	9.408	4.60	4.06	~~.0458~~ .0472	2701.7				
0341	2320.5	9.352	4.54	4.02	~~.0463~~ .0467	2724.8				
0500	2399.5	9.427	4.61	4.07	~~.0459~~ .0473	2785.2				
0856	2635.5	9.472	4.66	4.11	.0478	2987.5				
1239	2858.5	9.480	4.67	4.11	.0479	3191.7				End Test 13.34

AQUIFER TEST PAGE 4 WELL Observation

Owner Flora Vista WELL NO. X 5-2

Recovery

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks: Extended Drawdown Sa	Recovery Sa-S' with S'=Sc
4/24											
13:34	2913.5	9.488	4.68	4.12	.0480	3243.1	0	—	—	—	—
13:35:30	2915.0	9.488	4.68	4.12	.0480	3244.5	1.5	1943.3	2163.0	4.14	0.02
13:37	2916.5	9.~~578~~ 438	4.63	4.08	.0475	3245.9	3.0	972.2	1082.0	4.14	0.06
13:37:30	2917.0	9.378	4.57	4.04	.0470	3246.4	3.5	833.4	927.5	4.14	0.10
13:39	2918.5	9.321	4.51	3.99	.0465	3247.8	5.0	583.7	649.6	4.14	0.15
13:41	2920.5	9.272	4.46	3.95	.0460	3249.6	7.0	417.2	464.2	4.14	0.19
13:43	2922.5	9.218	4.41	3.91	.0455	3251.5	9.0	325	361	4.14	0.23
13:44	2923.5	9.170	4.36	3.88	.0451	3252.5	10.0	292	325	4.14	0.26
13:45	2924.5	9.140	4.33	3.85	.0448	3253.4	11.0	266	296.	4.14	0.29
13:45:20	2924.8	9.099	4.29	3.82	.0445	3253.7	11.3	258	287	4.14	0.32
13:46:30	2926.0	9.058	4.25	3.79	.0441	3254.8	12.5	234	260	4.14	0.35
13:47:30	2927.0	9.020	4.21	3.76	.0437	3255.7	13.5	217	241	4.14	0.38
13:48:30	2928.0	8.991	4.18	3.74	.0435	3256.7	14.5	202	225	4.14	0.40
13:49:30	2929.0	8.960	4.15	3.71	.0432	3257.6	15.5	189	210	4.14	0.43
13:51	2930.5	8.882	4.07	3.65	.0425	3259.0	17.0	172	192	4.14	0.49
13:52:30	2932.0	8.849	4.04	3.62	.0422	3260.4	18.5	158	176	4.14	0.52
13:53	2932.5	8.802	3.99	3.59	.0417	3260.9	19.0	154	172	4.14	0.55
13:54	2933.5	8.762	3.95	3.55	.0414	3261.8	20.0	147	163	4.14	0.59
13:55:30	2935.0	8.730	3.92	3.53	.0411	3263.2	21.5	136	152	4.14	0.61
13:56:30	2936.0	8.711	3.90	3.51	.0409	3264.2	22.5	130.	145	4.14	0.63
13:58	2937.5	8.659	3.85	3.47	.0404	3265.6	24.0	122	136	4.14	0.67
13:59	2938.5	8.618	3.81	3.44	.0400	3266.5	25.0	118	131	4.14	0.70
14:01	2940.5	8.546	3.74	3.38	.0393	3268.4	27.0	109	121	4.14	0.76

AQUIFER TEST PAGE 5 WELL Observation

Owner Flora Vista WELL NO. X 5-4

Recovery

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks: Extended drawdown	Calculated Recovery $s_e - s'$
4/24											
14:02	2941.5	8.502	3.69	3.34	.0389	3269.4	28.0	105	117	4.14	0.80
14:06	2945.5	8.382	3.57	3.25	.0378	3273.1	32.0	92.0	102	4.15	0.90
14:08	2947.5	8.323	3.51	3.20	.0372	3275.0	34.0	86.7	96.3	4.15	0.95
14:10	2949.5	8.262	3.45	3.15	.0366	3276.9	36.0	81.9	91.0	4.15	1.00
14:13	2952.5	8.174	3.36	3.07	.0358	3279.7	39.0	75.7	84.1	4.15	1.08
14:15	2954.5	8.130	3.32	3.04	.0354	3281.6	41.0	72.1	80.0	4.15	1.11
14:18	2957.5	8.040	3.23	2.96	.0345	3284.4	44.0	67.2	74.6	4.15	1.19
14:21	2960.5	7.981	3.17	2.91	.0339	3287.2	47.0	63.0	69.9	4.15	1.24
14:24	2963.5	7.911	3.10	2.86	.0332	3290.0	50.0	59.3	65.8	4.15	1.29
14:27	2966.5	7.847	3.04	2.80	.0326	3292.9	53.0	56.0	62.1	4.15	1.35
14:30	2969.5	7.7830	2.98	2.75	.0320	3295.7	56.0	53.0	58.9	4.15	1.40
14:40	2979.5	7.610	2.80	2.60	.0303	3305.1	66.0	45.1	50.1	4.15	1.55
14:50	2989.5	7.468	2.66	2.48	.0288	3314.6	76.0	39.3	43.6	4.15	1.67
15:10	3009.5	7.232	2.42	2.27	.0265	3333.5	96.0	31.3	34.7	4.16	1.89
15:30	3029.5	7.080	2.27	2.14	.0249	3352.4	116.0	26.1	28.9	4.16	2.02
15:57	3056.5	6.918	2.11	1.99	.0232	3378.0	143.0	21.4	23.6	4.17	2.18
16:12	3071.5	6.858	2.05	1.94	.0226	3392.2	158.0	19.4	21.5	4.17	2.23
16:30	3089.5	6.790	1.98	1.88	.0219	3409.3	176.0	17.6	19.4	4.18	2.30
16:53	3112.5	6.710	1.90	1.81	.0210	3431.2	199.0	15.6	17.2	4.18	2.37
17:10	3129.5	6.658	1.85	1.76	.0205	3447.4	216.0	14.5	16.0	4.18	2.42
17:33	3152.5	6.602	1.79	1.71	.0199	3469.3	239.0	13.2	14.5	4.19	2.48
17:53	3172.5	6.562	1.75	1.67	.0195	3488.4	259.0	12.2	13.5	4.19	2.52

AQUIFER TEST PAGE 6 WELL Observation

Owner Flora Vista Recovery WELL NO. X 5 1

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks: Extended Drawdown	Calculated Recovery
4/24											
20:50	3349.5	6.225	1.42	1.36	.0159	3658.4	436.0	7.68	8.39	4.23	2.87
21:40	3399.5	6.156	1.35	1.30	.0151	3706.6	486	6.99	7.63	4.24	2.94
22:15	3434.5	6.099	1.29	1.25	.0145	3740.4	521	6.59	7.18	4.24	2.99
22:40	3459.5	6.060	1.25	1.21	.0141	3764.6	546	6.34	6.89	4.25	3.04
23:17	3496.5	6.010	1.20	1.16	.0135	3800.4	583	6.02	6.52	4.26	3.10
4/25 08:25	4044.5	5.436	.63	.62	.0072	4334.9	1131	3.58	3.83	4.35	3.23
09:23	4102.5	5.395	.58	.58	.0067	4391.8	1189	3.45	3.69	4.36	3.78
09:51	4130.5	5.369	.56	.55	.0064	4419.3	1217	3.39	3.63	4.37	3.82
10:32	4171.5	5.338	.53	.52	.0061	4459.5	1258	3.32	3.54	4.38	3.86

	well SX1		Elevation			
4/21	Hold	Cut	DTW	TD	b	Comments - Measurement From "V" Notch at red paint mark.
0924	6.5	0.687	5.8135	should be 4.813, 4.811		
0925	6.5	0.689	5.811	24.02	~~18.20~~ 19.21	
4/22 1201	6.0	1.190	4.81			
1204	6.0	1.190	4.81			
1300	6.0	1.400	4.600			
1304	6.0	1.020	4.980			
1311	6.5	1.120	5.380			
1317	6.5	0.0842	5.658			
1322	6.5	0.624	5.876			
1327	6.5	0.482	6.018			
1336	6.5	0.240	6.260			Rain stop
1341	7.0	0.598	6.402			
1344	7.0	0.504	6.496			
1350	7.0	0.385	6.615			
1354	7.5	0.785	6.715			
1401	7.5	0.688	6.812			
1413	7.5	0.478	7.022			
1420	7.5	0.410	7.090			
1425	7.5	0.353	7.147			
1433	8.0	0.770	7.230			
1443	8.0	0.681	7.319			
1453	8.0	0.610	7.390			
1505	8.0	0.520	7.480			
1514	8.0	0.469	7.531			
1524	8.0	0.416	7.584			

TIME	HOLD	SX1 CUT	DTW	TO	b
1536	8.0	.364	7.636		
1544	8.0	.335	7.665		
1554	8.0	.274	7.726		
1604	8.0	.254	7.746		
1614	8.0	.206	7.794		
1629	8.5	.660	7.840		
1644	8.5	.622	7.878		
1701	8.5	.560	7.940		
1715	8.5	.516	7.984		
1744	8.5	.443	8.057		
1815	8.5	.328	8.172		
1916	9.0	.642	8.358		
2031	9.0	.470	8.530		
2134	9.0	.357	8.643		
2227	9.0	.268	8.732		
2328	9.0	.185	8.815		
~~0030~~	Wednesday		April	23	
0031	9.0	.106	8.894		
0129	~~9.0~~ 10.0	1.043	8.957		
0225	10.0	.981	9.019		
0343	10.0	1.108	8.892		
0444	10.0	1.135	8.865		
0458	10.0	1.121	8.879		
0555	10.0	1.072	8.928		
0654	10.0	1.009 / 1.010	8.990		

		SX1		
TIME	HOLD	CUT	DTW	6
1054	10.0	.941	9.059	
1253	10.0	.891	9.109	
1445	10.0	.897 .898		
1701	10.0	.861		
20.58	10.0	.696		
	Thursday April 24			
0105	10.0	.730		
0308	10.0	.592		
0341	10.0	.648		
0500	10.0	.583		
0856	10.00	.528		
1239	10.0	.520		

RECOVERY SX1

TIME 4/24	HOLD	CUT	DTW		6
1334	10.0	.512			
1335.5	10.0	.512			
1337	10.0	.562			
1337.5	10.0	.622			
1339	10.0	.679			
1341	10.0	.728			
1343	10.0	.782			
1344	10.0	.830			
1345	10.0	.860			
1345.3	10.0	.901			
1346.5	10.0	.942			
1347.5	10.0	.980			
1348.5	10.0	1.009			
1349.5	10.0	1.040			
1351	10.0	1.118			
1352.5	10.0	1.151			
1353	10.0	1.198			
1354	10.0	1.238			
1355.5	9.0	.270			
1356.5	9.0	.289			
1358	9.0	.341			
1359	9.0	.382			
1401	9.0	.454			
1402	9.0	.498			

OR

4/24	RECOV		XSI
1406	9.0	.618	
1408	9.0	.677	
1410	9.0	.738	
1413	9.0	.826	
1415	9.0	.870	
1418	9.0	.960	
1421	9.0	1.019 1.019	
1424	9.0	1.089	
1427	9.0	1.153	
1430	9.0	1.217	
1440	8.0	.390	
1450	8.0	.532	
1510	8.0	.768	
1530	8.0	.920	
1557	7.0	.082	
1612	7.0	.142	
1630	7.0	.210	
1653	7.0	.290	
1710	7.0	.342	
1733	7.0	.397	
1753	7.0	.438	
2050	7.0	.775	
~~2138~~	~~7.0~~		
2140	7.0	.844	6.156
2215	7.0	.901	6.099

Recovery XS1

2240	7.0	0.940	6.060
2317	7.0	0.990	6.010
Fri 4/25			
0825	7.0	1.564	5.436
0923	6.0	0.605	5.395
0951	6.0	0.631	5.369
1032	6.0	.662	5.338

4/24	RECOV		XSI
1406	9.0	.618	
1408	9.0	.677	
1410	9.0	.738	
1413	9.0	.826	
1415	9.0	.870	
1418	9.0	.960	
1421	9.0	1.019	
1424	9.0	1.089	
1427	9.0	1.153	
1430	9.0	1.217	
1440	8.0	.390	
1450	8.0	.532	
1510	8.0	.768	
1530	8.0	.920	
1557	7.0	.082	
1612	7.0	.142	
1630	7.0	.210	
1653	7.0	.290	
1710	7.0	.342	
1733	7.0	.397	
1753	7.0	.438	
2050	7.0	.775	
~~2130~~	~~7.0~~		
2140	7.7	.844	6.156
2215	7.0	.901	6.099

51-M3	43.8	ft.
51-XS1	29.6	ft.
51-M1	131.1'	
51-M5	118.5'	
51-M4	87.5'	

Wells M3 & M4 still dry at 1750.
Personal note - Lots of wildlife seen and heard with pump off. 3 whitetail deer seen about 3PM, 4 more mule deer seen at 5:30 PM where discharge hose was. Evidence of fresh beaver cutting of saplings. Honking geese flying overhead all the time. Skunks not seen but they made their presence known anyway. A fox (or large house cat with bushy tail) seen Thursday Midnight. Nice location to do field work!

Flora Vista Pump Test Analysis

Monitor Well - M1

Data

$Q = 108.4$ gpm

$r = 131.1$ ft.

$$T = \frac{Q}{4\pi s} W(u_A, u_B, r/B)$$

⊙ M1A - match point

$W(u_A, r/B) = 1.0$

$1/u_A = 1.0$

$s_A = .83$ ft

$t_A = 24.5$ min $= 0.017$ days

$r/B = 3.0$

$$T = \frac{(108.4 \text{ gal/min})}{4\pi\ (0.83 \text{ ft})}(1.0)\left(60 \tfrac{\text{min}}{\text{hr}}\right)\left(24 \tfrac{\text{hr}}{\text{day}}\right) = 14966 \text{ gpd/ft}$$

$$S = \frac{4(14966 \text{ gpd/ft})(0.017 \text{ days})(0.134 \text{ ft}^3/\text{gal})}{(131.1 \text{ ft})^2} = 0.008$$

⊙ M1B - match point

$W(u_B, r/B) = 1.0$

$1/u_B = 1.0$

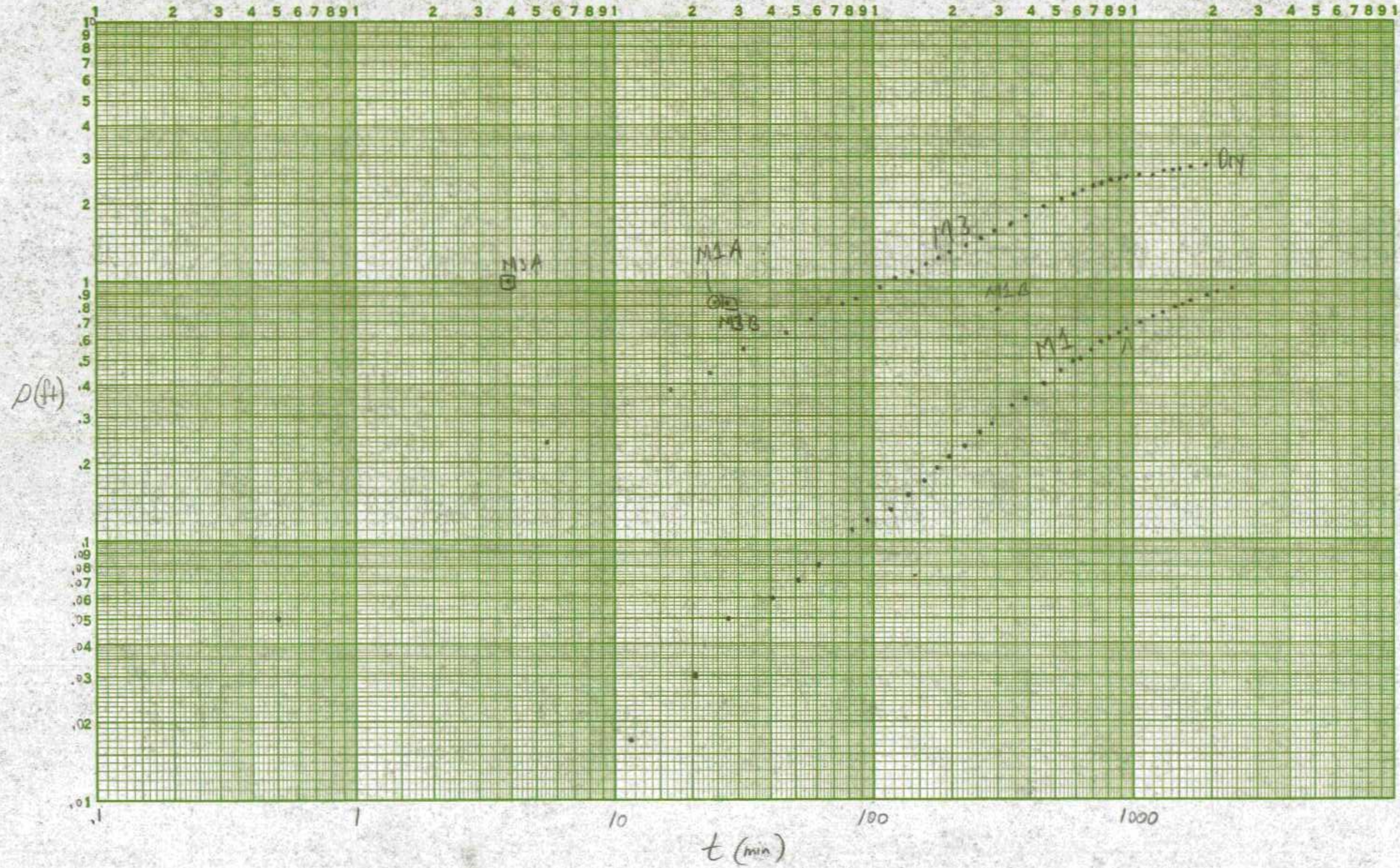
$s_B = 0.78$ ft

$t_B = 300$ min $= 0.208$ days

$$T = \frac{(108.4 \text{ gal/min})}{4\pi\ (0.78 \text{ ft})}(1.0)\left(60 \tfrac{\text{min}}{\text{hr}}\right)\left(24 \tfrac{\text{hr}}{\text{day}}\right) = 15925 \text{ gpd/ft}$$

$$S_y = \frac{4(15925 \text{ gpd/ft})(0.208 \text{ days})(0.134 \text{ ft}^3/\text{gal})}{(131.1 \text{ ft})^2} = 0.103$$

K+E LOGARITHMIC 3 X 5 CYCLES 46 7522 MADE IN U.S.A. KEUFFEL & ESSER CO.



Flora Vista Pump Test for M1 and M3

Flora Vista Pump Test Analysis

$\boxed{\text{Monitor Well - M3}}$

Data

$Q = 108.4$

$r = 43.8$ ft

$$T = \frac{Q}{4\pi A} W(u_A, u_B, 1/B)$$

$$S = \frac{4Ttu}{r^2}$$

☐ M3A - match point (early time)

$W(u_A, 1/B) = 1.0$

$1/u_A = 1.0$

$s_A = 1.0$

$t_A = 39$ min $= 0.027$ days

$$T = \frac{(108.4 \text{ gal/min})}{4\pi (1.0 \text{ ft})}(1.0)(60)(24) = \boxed{12422 \text{ gpd/ft}}$$

$$S = \frac{4(12422 \text{ gpd/ft})(0.027 \text{ days})(1.0)(0.134 \text{ ft}^3/\text{gal})}{(43.8 \text{ ft})^2} = \boxed{0.094}$$

☐ M3B - match point (late time)

$W(u_B, 1/B) = 1.0$

$1/u_B = 1.0$

$s_B = 0.82$

$t_B = 27$ min $= 0.0187$ days

$$T = \frac{108.4}{4\pi(0.82)}(1.0)(60)24 = \boxed{15148 \text{ gpd/ft}}$$

$$S_y = \frac{4(15148)(0.0187)(.134)}{(43.8)^2} = \boxed{0.08}$$

AQUIFER TEST

WELL Observation - Monitor

Owner Flora Vista

Well No. M1

____ 1/4 SW 1/4 SW 1/4 Section 30, T. 30 N S, R. 12 E W NMPM B&M

SWL 6.253 (Avg) feet

Date 4/22/86 1149

Measuring point "V" Notch which is Surveyed Point #11 feet above ground surface

Discharge Diameter ________ inches Orifice ________ inches

Other Measuring Device ________

Perforated Interval ________ Data collected by: Boyn, Bailey, Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0854	–	6.215								
0856	–	6.213								
4/22 1147	–	6.250								
1149	–	6.255								
1312	11.5	6.270	.017	.017	.0002					Start Test at 13:00:30 Q = 108.4 gpm
1321	20.5	6.283	.03	.03	.0003					
1328	27.5	6.300	.05	.05	.0004					
1342	41.5	6.311	.06	.06	.0005					
1352	51.5	6.327	.07	.07	.0007					
1402	61.5	6.336	.08	.08	.0008					
1423	82.5	6.360	.11	.11	.0010					
1436	95.5	6.373	.12	.12	.0011					
1458	117.5	6.386	.13	.13	.0012					
1518	137.5	6.408	.16	.15	.0014					
1538	157.5	6.428	.18	.17	.0016					
1556	175.5	6.444	.19	.19	.0018					
1616	195.5	6.460	.21	.21	.0019					

AQUIFER TEST PAGE 2 WELL Observation Monitor

Owner Flora Vista WELL NO. MW 1

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22/86										
1646	225.5	6.489	.24	.23	.0022					
1717	256.5	6.510	.26	.26	.0024					
1748	287.5	6.530	.28	.28	.0025					
1842	341.5	6.583	.33	.33	.0030					
1923	382.5	6.608	.36	.35	.0032					
2035	454.5	6.660	.41	.40	.0037					
2146	525.5	6.710	.46	.45	.0044	640.2				Change Q to 102.8gpm @ 21:32
2249	588.5	6.747	.49	.49	.0049	657.4				
2331	630.5	6.764	.51	.50	.0049	690.5				
4/23 0035	694.5	6.800	.55	.54	.0053	746.8				
0133	752.5	6.837	.58	.58	.0056	800.7				
0226	805.5	6.866	.61	.60	.0059	851.0				
0347	886.5	6.898	.65	.63	.0072	1441.2				Change Q to 88.6gpm at 0247
0449	948.5	6.919	.67	.65	.0074	1383.8				
0659	1078.5	6.958	.71	.69	.0078	1418.0				
0859	1199	6.993	.74	.73	.0082	1497				
1059	1319	7.029	.78	.76	.0086	1593				
1255	1435	7.060	.81	.79	.0089	1693				
1450	1550	7.077	.82	.81	.0091	1796				
1709	1689	7.107	.85	.84	.0094	1924				
2106	1926	7.149	.90	.88	.0099	2148				
4/24 0111	2171	7.184	.93	.91	.0106	2644				Change Q to 85.9gpm @ 23:49
0506	2406	7.219	.97	.94	.010	2790				

AQUIFER TEST PAGE 3 WELL Observation - Monitor

Owner Flora Vista WELL NO. MW 1

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/24										
0901	2641	7.241	.99	.96	.0112	2992				
1240	2860	7.259	1.01	.98	.0114	3193				End Test 13:34
4/25 0826	4046	6.609	.36	.35	.0041					

	Well: M1		Elevation:		
Time	Hold	Cut	DTW	TD	b
0854	7.0	0.785	6.215		
0856	7.0	0.787	6.213	8.4'	2.19
4/22 1147	7.0	.750	6.250		
1149	7.0	.745	6.255		
1312	7.5	1.230	6.270		
1321	7.5	1.217	6.283		
1328	7.5	1.207	6.300		
1342	7.5	1.189	6.311		
1352	7.5	1.173	6.327		
1402	7.5	1.164	6.336		
1423	7.5	1.140	6.360		
1436	7.5	1.127	6.373		
1458	7.5	1.114	6.386		
1518	7.5	1.092	6.408		
1538	7.5	1.072	6.428		
1556	7.5	1.056	6.454		
1616	7.5	1.040	6.460		
1646	7.5	1.011	6.489		
1717	7.5	.990	6.510		
1748	7.5	.970	6.530		
1842	7.5	.917	3		
1923	3.5	.892			
2035	7.5	.840			
2146	7.5	.790			
2349	7.5	.753			

Well M1 bailed approximately
10 volumes
Sample 8604211035

MW 1

TIME	HOLD	CUT	DTW	TD	b
2331	7.5	0.736	6.764		
Wednesday April 23					
0035	7.5	0.696	6.804		
0133	7.5	0.663	6.837		
0226	7.5	.634	6.866		
0347	7.5	.602	6.898		
0449	7.5	.581	6.919		
0659	7.5	.542	6.958		
0859	7.5	.507	6.993		
1059	7.5	.471	7.029		
1255	7.5	.440	7.060		
1450	7.5	.423			
1709	7.5	.393			
2106	7.5	.351			
Thursday April 24					
0111	7.5	.316			
0506	7.5	.281			
0901	7.5	.259			
1240	7.5	.241			
4/25 0826	7.5	.891			

AQUIFER TEST WELL Oberservation-Monitor

Owner Flora Vista Well No. M2

1/4 SW 1/4 SW 1/4 Section 23, T. 30 N S, R. 12 E W B&M

SWL ~~6.560~~ 6.643 feet Date

Measuring point "V" Notch on well pipe which is Survey point 12 feet above ground surface

Discharge Diameter inches Orifice inches

Other Measuring Device

Perforated Interval Data collected by: Boyd / Bailey / Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0859	—	6.560								
0901	—	6.560								
4/22 1153	—	6.640								
1154	—	6.645								
1313	12.5	6.584	.06	.06	.00055 .00055					Start at 13:00:30 Q = 108.4 gpm
1321	20.5	6.594	.05	.05	.000453 ~~.0005~~					
1329	28.5	6.606	.04	.04	.00034 ~~.0003~~					
1343	42.5	6.600	.04	.04	~~.000419~~ ~~.0004~~ .000397					
1353	52.5	6.580	.06	.06	.000582 ~~.0006~~					
1403	62.5	6.580	.06	.06	.000582 ~~.0006~~					
1423	82.5	6.592	.05	.05	.000471 ~~.0005~~					
1437	96.5	6.590	.05	.05	.000440 ~~.0005~~					
1459	118.5	6.580	.06	.06	.000582 ~~.0006~~					
1520	139.5	6.577	.07 ~~.06~~	.07	.000610 ~~.0006~~					
1539	158.5	6.578	.06	.07	.000601 ~~.0006~~					
1557	176.5	6.572	.07	.07	.000656 ~~.0007~~					
1616	195.5	6.577	.07	.07	.000610 ~~.0006~~					

AQUIFER TEST PAGE 2 WELL Oberivation-Monitor

Owner Flora Vista WELL NO. M2

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22										
1646	226	6.572	.07	.07	.000656 ~~.0007~~					
1718	258	6.571	.07	.07	.000665 ~~.0007~~					
1749	289	6.574	.07	.07	.000638 ~~.0006~~					
1845	345	6.584	.06	.06	.000545 ~~.0005~~					
1925	385	6.582	.06	.06	.000564 ~~.0006~~					
2037	457	6.595	.05	.05	.000443 ~~.0004~~					
2149	529	6.598	.04	.05	.000438 ~~.0004~~	637				Change Q to 102.8gpm @ 21:32
2252	592	6.598	.04	.05	.000438 ~~.0004~~	660				
2334	634	6.599	.04	.04	.000428 ~~.0004~~	693				
4/23 0038	698	6.610	.03	.03	.000321 ~~.0003~~	750				
0136	756	6.614	.03	.03	.000282 ~~.0003~~	803				
0227	807	6.615	.03	.03	.000273	852				
0352	892	6.621	.02	.02	.000248	1431				Change Q to 88.6gpm @ 02:47
0452	952	6.630	.01	.01	.000147	1383				
0702	1082	6.645	.002	.002	.000023	1420				
0902	1202	6.659	.02	.02	.000181	1500				
1100	1320	6.668	.03	.02	.000272	1594				
1257	1437	6.676	.03	.03	.000372	1694				
1451	1551	6.681	.04	.04	.000428	1797				
1711	1691	6.689	.05	.05	.000519	1926				
2110	1930	6.699	.06	.06	.000631	2152				
4/24 0115	2175	6.712	.07	.07	.000802	2645				Change Q to 85.9 gpm @ 23:49

AQUIFER TEST PAGE 3 WELL Observation Monitor

Owner Flora Vista WELL NO. M 2

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/24										
0510	2410	6.713	.07	.07	.000813	2793				
0903	2643	6.715	.07	.07	.000837	2994				
1341	2861	6.725	.08	.08	.000953	3194				END TEST 13.34
4/25 0828	4048					—				

Time	Well Hold	M2 Elevation: Cut	DTW	TD	
0859	7.0	0.440	6.560		
0901	7.0	0.440	6.560	9.05	2.49
4/22 1153	7.0	.360	6.640		
1154	7.0	.355	6.645		
1313	8.0	1.416	6.584		
1321	8.0	1.406	6.594		
1329	8.0	1.394	6.606		
1343	8.0	1.400	6.600		
1353	8.0	1.420	6.580		
1403	8.0	1.420	6.580		
1423	8.0	1.408	6.592		
1437	8.0	1.410	6.590		
1459	8.0	1.420	6.580		
1520	8.0	1.423	6.577		
1539	8.0	1.422	6.578		
1557	8.0	1.428	6.572		
1616	8.0	1.423	6.577		
1646	8.0	1.428	6.572		
1718	8.0	1.429	6.571		
1749	8.0	1.426	6.574		
1845	8.0	1.416	6.584		
1925	8.0	1.418	6.582		
2037	8.0	1.405	6.595		
2149	8.0	1.402	6.598		
2252	8.0	1.402	6.598		

comment

Well M-2 bailed approx 10 volumes
organic sample ~~86~~ 8604211055

		MW2			
TIME	HOLD	CUT	DTW	TD	b
2334	7.0	.401	6.600		
~~00~~	~~7.0~~	Wedenesday April 23			
0036	7.0	.390	6.610		
0136	7.0	.386	6.614		
0227	7.0	.385 (385) .380	6.615		
0352	7.0	.379	6.621		
0452	7.0	.370 .370	6.630		
0702	7.0	.355 .355	6.645		
0902	7.0	.341 .341	6.659		
1100	7.0	332 .333	6.667		
1257	7.0	.324	6.676		
1451	7.0	.319			
1711	7.0	.311			
2110	7.0	.301	6.699		
	Thursday April 24				
0115	7.0	.289			
0510	7.0	.287			
0903	7.0	.285			
1241	7.0	.275			

Jacob Analysis of Monitor Well 3

(Only good for $t \geq 390$ min where $u < 0.01$)

Data

$Q = 108.4$ gpm

$s_{c_1} = 0.60$ ft $\quad \Delta s_c = 2.05$ ft $\quad h_e = 19$ ft

$s_{c_2} = 2.65$ ft $\quad r = 43.8$ ft $\quad t_0 = 50$ min $= 0.0347$ days

T_c = corrected Transmissivity

$$= \frac{2.3Q}{4\pi \Delta s_c}$$

$$= \frac{2.3(108.4 \text{ gpm})\left(\frac{60 \text{ min}}{\text{hr}}\right)\left(\frac{24 \text{ hr}}{\text{day}}\right)}{4\pi(2.05 \text{ ft})} = 13937 \text{ gpd/ft}$$

$$T = T_c \frac{(h_e - \bar{s})}{h_e}$$

$$\bar{s} = \sqrt{s_{c_1} s_{c_2}} = \sqrt{(0.6 \text{ ft})(2.65 \text{ ft})} = 1.26 \text{ ft}$$

$$T = (13937 \text{ gpd/ft}) \frac{(19 - 1.26 \text{ ft})}{19 \text{ ft}} = \boxed{13012 \text{ gpd/ft}}$$

$$S_y = \frac{2.25 T t_0}{r^2}$$

$$= \frac{2.25(13012 \text{ gpd/ft})(0.0347 \text{ days})\left(\frac{0.134 \text{ ft}^3}{\text{gal}}\right)}{(43.8 \text{ ft})^2}$$

$$\boxed{S_y = 0.071}$$

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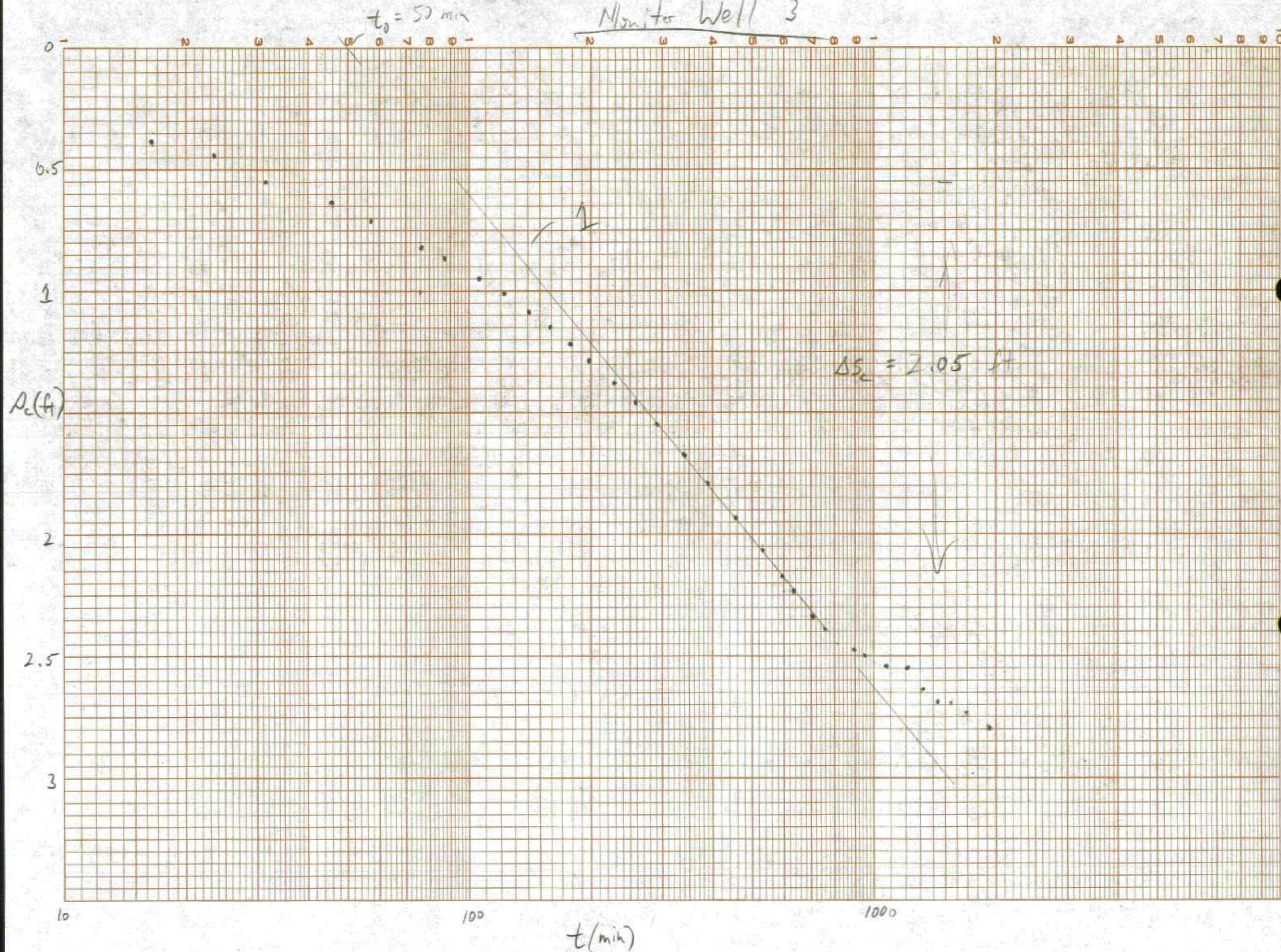


AQUIFER TEST

WELL Observation Monitor

Owner Flora Vista

Well No. MJ

___1/4 SW 1/4 SW 1/4 Section 23, T. 30 (N) S, R. 12 E (W) ___ B&M

SWL 6.469 feet

Date 4/22/86, 1133

Measuring point "V" notch on well pipe which is Survey point #8 feet above ground surface

Discharge Diameter ___ inches Orifice ___ inches

Other Measuring Device ___

Perforated Interval ___ Data collected by: Boyd / Bailey / Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0831	–	6.458								
0833	–	6.456								
4/22 1131	–	6.47								
1133	–	6.469								
1301	0.5	6.515	.05	.05	.0004					Start at 13:00:30 Q = 108.4 gpm
1306	5.5	6.715	~~.24~~ .25	.24	.0023					
1317	16.5	6.850	.38	.38	.0035					
1324	23.5	6.916	.45	.44	.0041					
1332	31.5	7.030	.56	.55	.0051					
1347	46.5	7.113	.64	.63	.0058					
1358	57.5	7.188	.72	.71	.0065					
1417	76.5	7.305	.84	.82	.0075					
1428	87.5	7.350	.88	.86	.0079					
1447	106.5	7.440	.97	.95	.0087					
1502	121.5	7.508	1.04	1.01	.0093					
1521	140.5	7.590	1.12	1.09	.0100					
1540	159.5	7.656	1.19	1.15	.0106					

AQUIFER TEST PAGE 2 WELL Observation Monitor

Owner Flora Vista WELL No. M3

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22 1558	178	7.729	1.26	1.22	.0113					
1617	197	7.791	1.32	1.28	.0118					
1649	229	7.893	1.42	1.37	.0127					
1719	259	7.990	1.52	1.46	.0135					
1751	291	8.082	1.61	1.55	.0143					
1838	338	8.214	1.74	1.67	.0154					
1930	390	8.350	1.88	1.79	.0165					
2039	459	8.504	2.04	1.93	.0178					
2154	534	8.658	2.19	2.07	.0201	635				Change Q to 102.8 gpm @ 21:32
2256	596	8.776	2.31	2.17	.0211	663				
2338	638	8.846	2.38	2.23	.0217	696				
4/23 0042	702	8.952	2.48	2.33	.0226	753				
0140	760	9.023	2.55	2.39	.0232	807				
0233	813	9.097	2.63	2.45	.0239	858				Change rate to 88.6 gpm @ 02:47
0356	896	9.121	2.65	2.47	.0279	1425				
0454	954	9.148	2.68	2.50	.0282	1383				
0705	1085	9.205	2.74	2.54	.0287	1421				
0905	1205	9.211	2.74	2.55	.0288	1502				
1103	1323	9.311	2.84	2.64	.0298	1596				
1300	1440	9.360	2.89	2.68	.0302	1697				
1453	1553	9.379	2.91	2.69	.0304	1798				
1713	1693	9.420	2.95	2.73	.0308	1928				
2115	1935	9.505	3.04	2.80	.0316	2157				

4/2 0130 - Dry 04/25 0831, 4051 minutes, DTW = 7.061

Well M3, Elevation:

Time	Hold	Cut	DTW	TD	b
06:31	7.0	0.542	6.458	9.5'	3.04
0833	7.0	0.544	6.456		
4/22 1131	7.0	0.530	6.47		
1133	7.0	0.531	6.469		
1301	7.0	0.485	6.515		
1306	7.0	0.285	6.715		
1317	7.0	0.150	6.850		
1324	7.5	0.584	6.916		
1332	7.5	0.470	7.030		
1347	7.5	0.387	7.113		
1358	7.5	0.312	7.188		
1417	7.5	0.195	7.305		
1428	8.0	0.650	7.350		
1447	8.0	0.560	7.440		
1502	8.0	0.492	7.508		
1521	8.0	.410	7.590		
1540	8.0	0.344	7.656		
1558	8.0	.271	7.729		
1617	8.0	.209	7.791		
1649	8.0	.107	7.893		
1719	8.5	.510	7.990		
1751	8.5	.418	8.082		
1828	8.5	.286	8.214		
1930	8.5	.150	8.350		
2035	9.0	.496	8.504		

Well M3 bailed approx 10 volumes
8604211010 - Organic sample only.

MW3

TIME	HOLD	CUT	DTW	TO	b
2154	9.0	~~.49~~ .342	8.658		
2256	9.0	0.224	8.776		
2336	9.0	0.154	8.846		
Wednesday April 23					
0042	9.5	0.548	8.952		
0140	9.5	0.477	9.023		
0232	9.5	.403	9.097		
0356	9.5	.379	9.121		
0454	9.5	.352	9.148		
0705	9.5	.295 .295	9.205		
0905	9.5	.289	9.211	9.555	
1103	9.5	.189 .190	9.311		
1300	9.5	.140	9.360		
1453	9.5	.121	9.379		
1713	9.55	.130	9.420		
2115	9.55	.045	9.505	TD	9.57
Thursday April 24					
0130	Dry				

AQUIFER TEST

WELL Monitor Observation

Owner Flora Vista

Well No. M. 4

____ 1/4 SW 1/4 SW 1/4 Section 23, T. 30 N (S), R. 12 E (W) ____ B&M

SWL 3.820 feet

Date 4/22/86, 1254

Measuring point "V" Notch on Well Pipe which is Survey Point 10 feet above ground surface

Discharge Diameter ____ inches Orifice ____ inches

Other Measuring Device ____

Perforated Interval ____ Data collected by: Boyd/Bailey/Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0845	–	3.852								
0846	–	3.852								
4/22 1207	–	3.825								
1211	–	3.820								
1250	–	3.83								
1251	–	3.828								
1253	–	3.822								
1254	–	3.820								
1303	2.5	3.835	.02	.02	.0001					Start Test 13:00:30 Q=108.4gpm
1309	8.5	3.875	.06	.05	.0005					
1319	18.5	3.916	.10	.10	.0009					
1326	25.5	3.930	.11	.11	.0010					
1340	39.5	3.957	.14	.14	.0013					
1349	48.5	3.982	.16	.16	.0015					
1400	59.5	4.000	.18	.18	.0017					
1420	79.5	4.022	.20	.20	.0019					
1430	89.5	4.054	.23	.23	.0021					

AQUIFER TEST PAGE 2 WELL Monitor-Observation

Owner Flora Vista WELL NO. M. 4

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22/86										
1449	108.5	4.089	.27	.27	.0025					
1504	124	4.124	.30	.30	.0028					
1523	143	4.152	.33	.33	.0030					
1543	163	4.170	.35	.35	.0032					
1600	180	4.208	.39	.38	.0035					
1619	199	4.238	.42	.41	.0038					
1651	231	4.288	.47	.46	.0043					
1721	261	4.334	.51	.51	.0047					
1753	293	4.374	.55	.55	.0050					
1851	351	4.472	.65	.64	.0059					
1935	395	4.531	.71	.70	.0064					
2044	464	4.629	.81	.79	.0073					
2200	–	DRY								
2301	–	DRY								
4/25 ~~0835~~	~~4053~~	~~5.094~~								
0835	4053	4.165								

Time	Well Hold	MA-Elevation CuT	DTW	TD	b
4/21 0845	4.5'	0.648	3.852		
0846	4.5	0.648	3.852	5.81'	1.55
4/22 1139				4.7	
1207	4.0	0.175	3.825		
1211	4.0	0.180	3.820		
1249				4.75	
1250	4.0	0.170	3.83		
1251	4.0	0.172	3.828		
	4.0	0.184	3.916		
1253	4.0	0.178	3.822		
1254	4.0	0.180	3.820		
1303	4.0	0.165	3.835		
1309	4.0	0.125	3.875		
1319	4	0.084	3.916		
1326	4.5	.570	3.930		
1340	4.5	.543	3.957		
1349	4.5	.518	3.982		
1400	4.5	.500	4.000		
1420	4.5	.478	4.022		
1430	4.5	.446	4.054		
1449	4.5	.411	4.089		
1504	4.5	.376	4.124		
1523	4.5	.348	4.152		
1543	4.5	.330	4.170		
1600	4.5	.292	4.208		
1619	4.5	.262	4.238		
1631	4.5	.212	4.288		

Comments—
Well bailed approx 100 demes

Sample for organics only
860421 1130

Tried reaming out sand

		MW 4			
TIME	HOLD	CUT	DTW	TD	6
1721	4.5	.166	4.334		
1753	4.5	.126	4.374		
1851	4.6	.128	4.472		
1935	4.6	.069	4.531		
~~2044~~	~~4.65~~	~~.071~~			
2044	4.7	.071	4.629	4.705	
~~2200~~	~~Dry~~				
2301	Dry.				
	Wednesday April 23				
0050	Dry.				
4/23					
0711		DRY		4.69	

AQUIFER TEST

WELL Observation-Monitor

Owner Flora Vista

Well No. M5

1/4 SW 1/4 SW 1/4 Section 23, T. 30 (N) S, R. 12 E (W) NMPM B&M

SWL 4.920 feet

Date 4/22/86, 1125

Measuring point "V" Notch in well pipe which is Survey Point #4 feet above ground surface

Discharge Diameter ______ inches Orifice ______ inches

Other Measuring Device ______

Perforated Interval ______ Data collected by: Boyd/Bailey/Anderson

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/21/86										
0837	—	4.924								
0838	—	4.922								
4/22 1125	—	4.920								
1302	1.5	4.885	.04	.04	.003					Start test 13:00:30 Q = 108.4 gpm
1307	6.5	4.920	00	00	00					
1318	17.5	4.940	.02	.02	.0002					
1325	24.5	4.951	.03	.03	.0003					
1333	32.5	4.971	.05	.05	.0005					
1348	47.5	4.988	.07	.07	.0006					
1359	58.5	4.998	.08	.08	.0007					
1418	77.5	5.025	.10	.10	.0010					
1429	88.5	5.039	.12	.12	.0011					
1447	106.5	5.062	.14	.14	.0013					
1503	122.5	5.087	.17	.17	.0015					
1522	141.5	5.106	.19	.19	.0017					
1542	161.5	5.129	.21	.21	.0019					
1559	178.5	5.150	.23	.23	.0021					

AQUIFER TEST PAGE 2 WELL Observation Monitor

Owner Flora Vista WELL NO. M5

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/22/86										
1618	198	5.172	.25	.25	.0023					
1650	230	5.208	.29	.29	.0026					
1720	260	5.242	.32	.32	.0029					
1752	292	5.278	.36	.35	.0033					
1848	348	5.333	.41	.41	.0038					
1932	392	5.379	.46	.45	.0042					
2041	461	5.446	.53	.52	.0048					
2156	536	5.496	.58	.57	.0055	634				Change Q to 102.8 gpm @ 21:32
2259	599	5.553	.63	.62	.0061	665				
2350	650	5.581	.66	.65	.0063	707				
4/23 0046	706	5.630	.71	.70	.0068	757				
0144	764	5.669	.75	.73	.0071	811				
0236	816	5.702	.78	.77	.0075	861				
0358	898	5.735	.82	.80	.0090	1422				Change Q to 88.6 @ 02:47
0456	956	5.769	.85	.83	.0094	1382				
0708	1088	5.818	.90	.88	.0099	1423				
0907	1207	5.850	.93	.91	.0102	1503				
1106	1326	5.880	.96	.94	.0106	1599				
1302	1442	5.905	.98	.96	.0108	1699				
1453	1553	5.918	1.00	.97	.0110	1798				
1719	1699	5.944	1.02	1.00	.0113	1933				
2124	1944	5.970	1.05	1.02	.0116	2165				
4/24 0134	2194	5.997	1.08	1.05	.0122 ~~.0118~~	2651				Change rate to 85.9 gpm @ 23:49

AQUIFER TEST PAGE 3 WELL Observation Monitor

Owner Flora Vista WELL NO. M5

Date & Time	Time since start pump Minutes	Depth to water Feet	Observed Drawdown s_o Feet	Corrected Drawdown s_c Feet	$\frac{s}{Q_n}$ Ft/gpm	Adjusted time since start t_a (Min)	Time since pump stopped t' (Min)	t/t'	t_a/t'	Remarks
4/24/86										
0516	2416	6.019	1.10	1.07	.0124	2798				
0905	2645	6.039	1.12	1.09	.0127	2996				
1244	2864	6.056	1.14	1.10	.0128	3196				End Test 13:34
4/25 0833	4053	5.094								

Well M 5, Elevation

Time	Hold	Cut	DTW	TD	b
0837	5.5'	0.576	4.924		
0838	5.5	0.578	4.922	7.6'	2.68
4/22 1125	5.5	.580	4.920	6.1+1.4 7.5	
1302	5.5	.615	4.885		
~~1306~~	~~6.5~~	~~.275~~			
1307	6.5	1.580	4.920		
1318	6.5	1.560	4.940		
1325	6.5	1.549	4.951		
1333	6.5	1.529	4.971		
1348	6.5	1.512	4.988		
1359	6.5	1.502	4.998		
1418	6.5	1.475	5.025		
1429	6.5	1.461	5.039		
1447	6.5	1.438	5.062		
1503	6.5	1.413	5.087		
1522	6.5	1.394	5.106		
1542	6.5	1.371	5.129		
1559	6.5	1.350	5.150		
1618	6.5	1.328	5.172		
1650	6.5	1.292	5.208		
1720	6.5	1.258	5.242		
1752	6.5	1.222	5.278		
1846	6.5	1.167	5.333		
1932	6.5	1.121	5.379		
2041	6.5	1.054	5.446		

Well M-5 bailed approx 10 Volumes

Sample 8604211115 For organics only

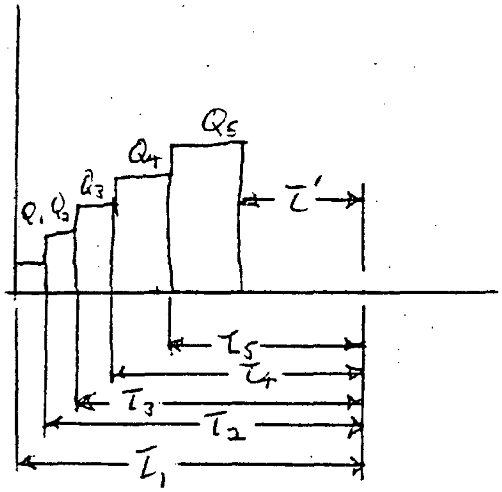
TIME	HOLD	MWS CUT	DTW	TD	6
~~2156~~	~~9.0~~				
2156	6.5	1.004	5.496		
2259	6.5	0.947	5.553		
2350	6.5	0.919	5.581		
~~00~~	Wednesday April 23				
0046	6.5	0.870	5.630		
0144	6.5	0.831	5.669		
0236	6.5	.798	5.702		
0358	6.5	.765	5.735		
0456	6.5	.731 .682	5.769		
0708	6.5	.685 .649	5.818		
0907	6.5	.650	5.850		
1106	6.5	.620	5.880		
1302	6.5	.595	5.905		
1453	6.5	.582			
1719	6.5	.556			
2124	6.5	.527			
	Thursday April 24				
0134	6.5	.503			
0516	6.5	.482 .481			
0905	6.5	.461			
1244	6.5	.444			

Aquifer Studies

David G. Boyer

Application of Harrill's Equation to a Limestone Aquifer

by W. K. Summers[a]



Terminology: $\Delta Q_1 = Q_1 - Q_0$
$\Delta Q_2 = Q_2 - Q_1$
$\Delta Q_n = Q_n - Q_{n-1}$

ABSTRACT

A relatively simple program generates the computationally complicated argument of Harrill's equation. The transmissivity of the San Andres limestone determined by Harrill's equation compares favorably with that computed using other techniques.

This brief report serves two purposes. First, it provides a computer program useful in applying Harrill's (1971) equation for the determination of the coefficient of transmissivity from the water level recovery made following a step-drawdown test. Second, it demonstrates the validity and applicability of the equation using step-test data from New Mexico.

Harrill's equation may be written

$$s = \frac{264\, Q_n}{T} \log \left[\frac{t_1^{\Delta Q_1/Q_n}\; t_2^{\Delta Q_2/Q_n} \;.\;.\;.\;.\;.\; t_n^{\Delta Q_n/Q_n}}{t'} \right] ,$$

where
s = residual drawdown (feet),
n = number of step,
t_n = time since the Q_n step began,
Q_n = discharge of the n^{th} step (gpm),
$\Delta Q_1, \Delta Q_2$ .... = incremental increase in discharge over preceding step (gpm),
t' = time since pump went off, and
T = coefficient of transmissivity (gpd/ft).

This equation is similar to the Theis recovery formula and is subject to the same restrictions.

Table 1 gives the program to calculate the argument of the logarithmic term. Table 2 is a sample printout. To use the data in Table 2, plot the residual drawdown versus log (function). This is similar to the usual plot of s versus t/t' on semi-log paper for water level observations during recovery following constant discharge tests. Transmissivity is computed by

$$T = \frac{264\, Q_n}{\Delta s} ,$$

where Δs is the change of residual drawdown over one log cycle of function.

To learn more about the efficiencies of wells tapping the San Andres limestone in the Roswell-Artesia reach of the Pecos River Basin, in 1969 eight step tests were run on seven wells. Six of the wells flowed naturally at the surface and tests consisted simply of installing a recording pressure meter and opening gate valves. Each well was equipped with a totalizing flow meter. The number of steps ranged from 4 to 10. The primary constraint on the test was imposed by the New Mexico State engineer who gave approval for the pumped

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Discussion open until December 1, 1972.

Determination of Aquifer Parameters from Step Tests and Intermittent Pumping Data

by Yüksel K. Birsoy and W. K. Summers[1]

ABSTRACT

The expression

$$s/Q_n = \frac{264}{T} \log_{10} \left[\frac{0.3\,T}{r^2 S} \beta_n(t)\,(t - \tau_n) \right]$$

is a handy tool for predicting aquifer parameters using all the drawdown and recovery data obtained during step-drawdown tests or periods of cyclic or intermittent pumping.

For inefficient wells the expression

$$s/Q_n = \frac{264}{T} \log_{10} \left[\frac{0.3\,T}{r^2 S} \beta_n(t)\,(t - \tau_n) \right] + CQ_n^v$$

fits pumping wells better. The data from conventional step-drawdown tests of pumping wells can be used to obtain T, C, and v. If the data fail to fit the ideal, they may be used to interpret local hydrologic conditions.

BACKGROUND

Two problems that hydrologists face frequently are (1) existing wells cannot be taken from service long enough to conduct controlled long-term pumping tests or cost prohibits long-term constant rate tests, and (2) tests of new wells are rarely conducted at ideal constant rates. To cope with these problems we have developed a relatively simple analytic technique that lets us use step-drawdown data and drawdown data obtained from wells that pump intermittently at different discharge rates.

This brief note presents the technique we use to evaluate drawdown and recovery data obtained during step-pumping tests or during several episodes of intermittent pumping. First, we present the simple general equation that relates the usual variables (drawdown, transmissivity, storativity, etc.) to step-wise changes in discharge. (Intermittent pumping equates to a step with zero discharge.) Then we show how the equation provides a basis for determining transmissivity and storativity of the water-yielding rocks using nearly all the data simultaneously. Next we discuss how departures of the data during conventional step-drawdown tests from the ideal provide other useful hydrogeologic information. Finally we give some examples from our field experience.

THEORY

For an ideally confined system with radial flow to a well with constant discharge, Q, the drawdown, s, is given by Theis' nonequilibrium formula as

$$s = \frac{Q}{4\pi T} W(u) .$$

Since the differential form of the equation and its boundary conditions are linear, for a step change in pumping rate, ΔQ, at time τ, the drawdown at any time, $t > \tau$, is given by the principle of superposition as

$$s = \frac{1}{4\pi T} \left[Q\,W(u) + \Delta Q\,W(u') \right] \quad t > \tau \qquad (1)$$

[1]Geologists, W. K. Summers and Associates, Box 684, Socorro, New Mexico 87801.

Discussion open until September 1, 1980.

where $W(u) = \int_u^\infty \frac{e^{-u}}{u}\,du$ is the well function;

$u = \frac{r^2 S}{4Tt}$ and $u' = \frac{r^2 S}{4T(t-\tau)}$ are dimensionless variables; r is the radial distance from the center of the pumping well to a point of observation in the flow-system; and S and T are the storage coefficient and transmissivity.

If the change in pumping rate at time τ is from Q to zero (i.e., $\Delta Q = -Q$), the well is then said to be recovering, and Equation (1) takes the form

$$s = \frac{Q}{4\pi T}\,[W(u) - W(u')] \quad t > \tau \qquad (2)$$

Jacob (1950) noted that for small values of u' (i.e., large values of elapsed time), Equation (2) can be approximated by

$$s = \frac{Q}{4\pi T}\ln\left(\frac{t}{t-\tau}\right) \qquad (3)$$

If t is in days, Q is in gallons per minute, T is gallons per day per foot, and r is in feet, Equation (3) can be generalized for a series of pumping and recovery periods (Figure 1) as

$$s = \begin{cases} \dfrac{264Q_n}{T}\log_{10}\left[\left(\dfrac{t_1}{t_1'}\right)^{Q_1/Q_n} \cdots \left(\dfrac{t_{n-1}}{t_{n-1}'}\right)^{Q_{n-1}/Q_n}\dfrac{t_n}{t_n'}\right] & (4a) \\ \qquad t_n' > 0 \text{ during recovery} & \\ \dfrac{264Q_n}{T}\log_{10}\left[\dfrac{0.3T}{r^2S}\cdot\left(\dfrac{t_1}{t_1'}\right)^{Q_1/Q_n} \cdots \left(\dfrac{t_{n-1}}{t_{n-1}'}\right)^{Q_{n-1}/Q_n}\cdot t_n\right] & \\ \qquad t_n > 0 \text{ during pumpage} & \ldots\ldots (4b) \end{cases}$$

where $t_i = t - \tau_i$ is the elapsed time since the ith pumping rate started; $t_i' = t - \tau_i'$ is the elapsed time since the ith pumping rate stopped; and τ_i and τ_i' are the times ith pumping rate started and ended respectively.

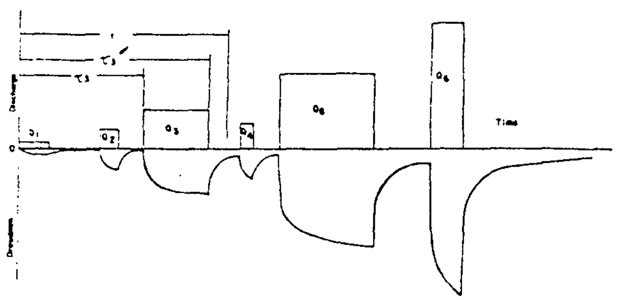


Fig. 1. Drawdown pattern associated with intermittent discharge of varying duration and at different pumping rates.

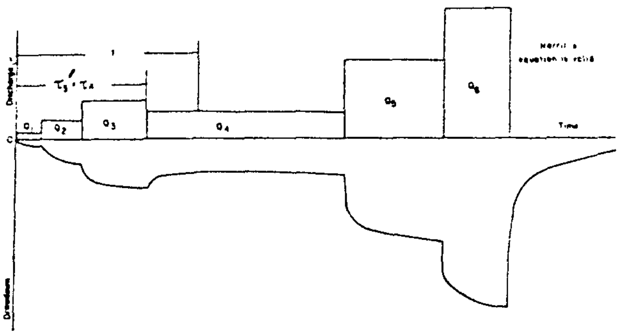


Fig. 2. Drawdown pattern caused by step pumping.

For the case where the pumping rate for several steps (Figure 2) changes but does not go to zero, the elapsed time since the end of the (i − 1)th pumpage is the same as that since the beginning of the ith pumpage (i.e., $t_{i-1}' = t_i$), then Equation (4a) reduces to

$$s = \frac{264Q_n}{T}\log_{10}\frac{t_1^{\Delta Q_1/Q_n}\ldots t_n^{\Delta Q_n/Q_n}}{t'} \quad \text{(Harrill, 1971)},$$

where t' is the time since pumping stopped.

For the case where the intermittent pumping rate is constant (i.e., $Q = Q_1 = \ldots Q_n$, Equation (4a) reduces to

$$s = \frac{264Q}{T}\log_{10}\left(\frac{t_1}{t_1'}\cdots\cdots\frac{t_n}{t_n'}\right) \quad \text{(Brown, 1963).}$$

APPLICATION

Equations (4a) and (4b) are cumbersome to work with. However, if we let

$$\beta_n(t) = \begin{cases} \prod_{i=1}^{n-1}\left(\dfrac{t-\tau_i}{t-\tau_i'}\right)^{Q_i/Q_n} = \left(\dfrac{t-\tau_1}{t-\tau_1'}\right)^{Q_1/Q_n}\cdots\left(\dfrac{t-\tau_{n-1}}{t-\tau_{n-1}'}\right)^{Q_{n-1}/Q_n} & n = 2, m \\ 1 & n = 1, \end{cases}$$

(where m is the total number of steps in a pumping test, and n is the number of the step we are interested in analyzing) and divide both sides of Equations (4a) and (4b) by Q_n, we get

$$\frac{s}{Q_n} = \begin{cases} \dfrac{264}{T}\log_{10}\left[\beta_n(t)\dfrac{t-\tau_n}{t-\tau_n'}\right] \quad t > \tau_n' \text{ during recovery} & (5a) \\ \dfrac{264}{T}\log_{10}\left[\dfrac{0.3T}{r^2S}\beta_n(t)(t-\tau_n)\right] \quad t > \tau_n \text{ during pumpage.} & (5b) \end{cases}$$

In these equations $\beta_n(t)$ can be thought of as an adjustment factor that takes previous pumpage into account. We define the expression

$$\beta_n(t)\,(t-\tau_n),$$

as the *adjusted time* and the expression

$$\beta_n(t)\;(t-\tau_n)/(t-\tau_n'),$$

as *dimensionless time.* Appendix A is the program written for an HP-25 pocket calculator that we use to calculate $\beta_n(t)$ up to n = 4 for the cases where τ_{i-1}' equals τ_i.

Assuming that a pumping well is one hundred percent efficient, Equations (5a) and (5b) indicate that data plots on semilogarithmic graph paper of s/Q (n = 1, m) versus adjusted time for pumpage (or adjusted dimensionless time if recovery) should fall on the same straight line, which has a slope 264/T (Figure 3). This characteristic of Equations (5a) and (5b) allows hydrologists to make use of all data collected during step-pumping tests to calculate T and S.

$$T = \frac{264}{\Delta(s/Q)}\ \text{one log cycle}$$

For an observation well (r feet from the pumping well) the intercept of the straight line drawn through the plotted points with s/Q = 0 gives t_0 for the conventional determination of storativity

$$S = 2.08 \times 10^{-4}\ Tt_0/r^2$$

DISCUSSION

For evaluating well performance, transmissivity, and local hydrologic conductivity we have found that short step-drawdown tests are in many ways as useful as much longer constant-rate tests. Our typical step test consists of five thirty-minute steps and five hours of recovery. These tests rarely include observation wells.

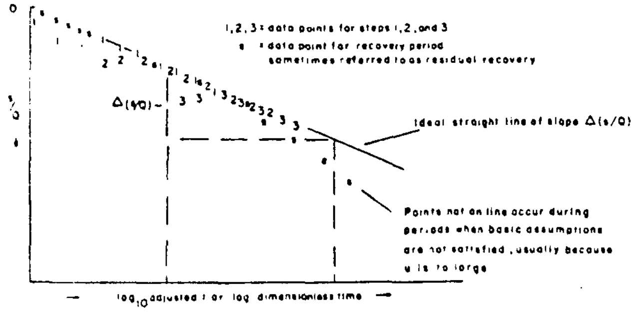


Fig. 3. Plot of drawdown versus log adjusted time and residual drawdown versus log dimensionless time in an ideal efficient pumping well.

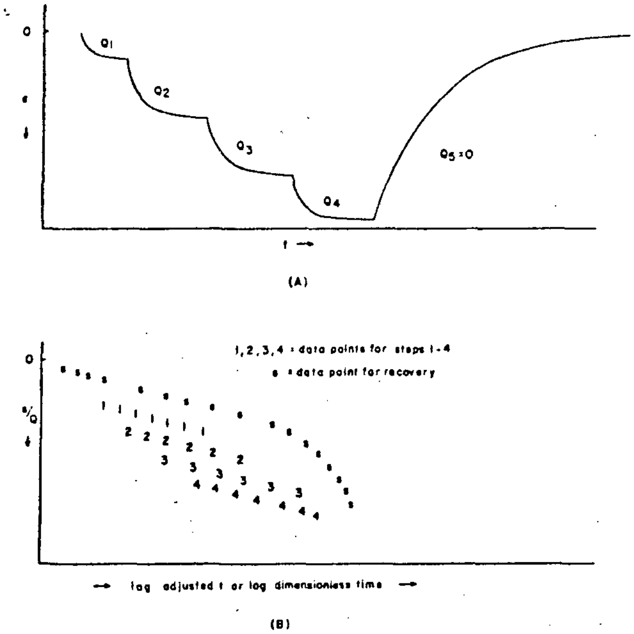


Fig. 4. (A) Drawdown pattern during conventional step test. (B) Pattern of drawdown versus adjusted or dimensionless time in inefficient pumping well.

Moreover, the data for the pumped well rarely conform to the ideal described above. In the following paragraphs we address the principal reasons for the lack of conformity. These reasons include:

(1) well losses,

(2) well is developing,

(3) hydrologic boundaries and local hydrologic conditions that violate the Theisian assumptions, and

(4) other factors.

Well Losses

Figure 4 illustrates a typical plot of data obtained at a pumped well during a step test. Instead of the data falling on one ideally straight line they lie on parallel lines and the early recovery data fell on a curve. These departures come about because the well itself imposes head losses that are not taken into account in Equations (5a) and (5b). These well losses may be calculated by determining the coefficients of the equation

$$s = BQ + CQ^z \quad \text{or} \quad s/Q = B + CQ^y \qquad (6a)$$

from the data of a step-drawdown test (Rorabaugh, 1953; Lennox, 1966; Sheahan, 1971).

Jacob (1950) argued that for most uses z = 2

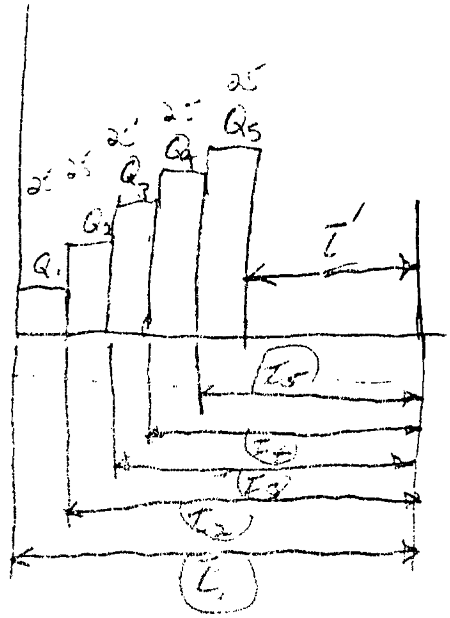
$\Delta Q_1 = Q_1 - Q_0 \quad Q_1 = 1705, \; T_1 = 125 + 15 = 140$

$\Delta Q_2 = Q_2 - Q_1 \quad Q_2 = 1855, \; T_2 = 100 + 15 = 115$

$\Delta Q_3 = Q_3 - Q_2 \quad Q_3 = 1940, \; T_3 = 75 + 15 = 90$

$\Delta Q_4 = Q_4 - Q_3 \quad Q_4 = 1990, \; T_4 = 50 + 15 = 65$

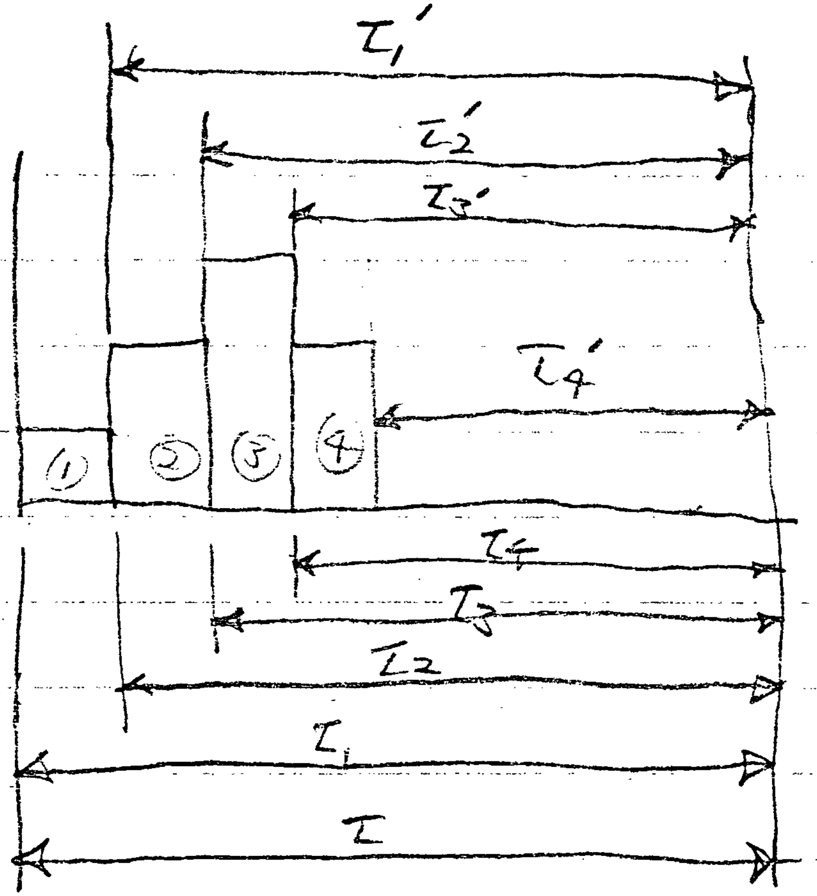
$\Delta Q_5 = Q_5 - Q_4 \quad Q_5 = 2080, \; T_5 = 25 + 15 = 40$



$$\frac{140^{1705/2080} \cdot 115^{(150/2080)} \cdot 90^{(85/2080)} \cdot 65^{(50/2080)} \cdot 40^{90/2080}}{15}$$

$$\frac{(57.44)(1.41)(1.20)(1.11)(1.17)}{15} = 8.404 \;!!$$

Q 4



$\tau = \tau_1$ or $\tau_i = \tau_{i-1}'$

$\tau_2 = \tau_1'$

$\tau_3 = \tau_2'$

$\tau_4 = \tau_3'$

$\tau_4' = \tau'$

Estimated 180,000 gpd from two wells

50,000 gpd = 35 gpm average

~~A~~ = $K = 750\ gpd/ft^2$ $b = 17\ ft$
$T = Kb = 12750\ gpd/ft$
$S = \cancel{0.05}\ 0.1$

Eq 4.15 $Q = \pi K \dfrac{h_o^2 - h_w^2}{\ln(r_o/r_w)}$

$r_w = (5/12)\ ft$
$Q = 35\ gpm\ (60\ gpm)$
$K = 750\ gpd/ft^2$
$h_o = 17$
$r_o = ?$
$h_w = h_o - s_w = \cancel{5.5}\ 17.0 - 5.5 = 11.5\ ft$

~~$\ln(r_o/r_w) =$~~

$\ln r_o - \ln r_w = (\pi K)(h_o^2 - h_w^2)/Q$

$\ln r_o = \pi K(h_o^2 - h_w^2)/Q + \ln r_w$

Eq 4.15 Todd

$= \pi\ 750 \dfrac{g}{day\ ft^2} \cdot \dfrac{min}{60 g} \times \dfrac{day}{1440\ min} \times (17^2 - 11.5^2)$

$+ \ln(5/12)$

$\ln r_o = 4.275 + (-0.875) = 3.399$
$= 30\ ft$

Can't really use - don't know actual s, r_w.

(2)

$Q = 60\,gpm \quad t = days,\ r\ ft$

$T = Kb = \frac{750\,gpd}{ft^2} \times 17 = 12750\,gpd/ft$

$S = \frac{0.3Tt}{r_0^2}$

For $S = 0.05, 0.10, 0.15$ + $t = .5, 1$ and 2 days

$r_0^2 = \frac{0.3Tt}{S}$

can't use Jacob here for short t, high S, high r

S	t	r_0				
0.05	.5	195.6	3	479.1	7	731.8
0.05	1	276.6	4	553.2	10	874.6
0.05	2	391.1	5	618.5		
0.10	.5	138.3	3	338.7	7	517.4
0.10	1	195.6	4	391.2	10	618.5
0.10	2	276.6	5	437.3		
0.15	.5	112.9	3	276.6	7	422.5
0.15	1	159.7	4	319.4	10	505.0
0.15	2	225.8	5	357.1		

$r_0 = 110$
$S = 0.15$
$t = \frac{r_0^2 S}{0.3T} = 0.47$ days

For $r_0 = 250\,ft,\ S = 0.15$
$t = 2.45$ days

$S = \frac{Tut}{1.87r^2}$ For $u = 0.05,\ r = 250,\ S = 0.15$

$t = \frac{1.87r^2 S}{(T)(.05)} = \left[\frac{1.87}{(12750)(.05)}\right] r^2 S \geq 27.5$ days

For $u \leq 0.01,\ t = \underline{137.5}$ days

For a drawdown of 0.1 foot (1.2 inches) at tank location at a distance of 250 feet from a well pumping 60 gpm constantly:

Theis:

$T = 12750$ gpd/ft

$S = 0.20 = S_y$

$r = 230$ ft

$Q = 60$ gpm

$s_c = 0.1$ ft

$Tu = 1.87 r^2 S / t$

$t = \frac{1.87 r^2 S}{Tu} = \frac{1.552}{u}$

$s = \frac{114.6 Q}{T} W(u)$, $W(u) = \frac{sT}{114.6 Q}$

For

s	$W(u)$	(u)	t
0	0	10	0.155 days (?)
.01	0.018543	2.73	0.568 days
.1	0.18543	1.1	1.41 days
.5	0.9271	2.92×10^{-1}	5.32
1.0	1.8543	9.65×10^{-2}	16.1 days
0.29′ ←	.5362 ←	5.2×10^{-1} ←	3.0 days

For $s = 0.1$, for $\bar{Q} = 35$ gpm, $W(u) = 0.318$ $u = .79$

$t = 1.964 \simeq 2$ days

~~, for $\bar{Q} = 65$ gpm $W(u) = 0.171$, $u \cong 1.15$~~ $t \cong 1.35$ days

Images 4.43 Todd

$h_0 - h = s$ $x_1 = 250$, y_1

$x = -250$ $y = 230$

$s = \frac{Q}{4\pi T} \ln \left[\frac{(x - x_1)^2 + y^2}{(x + x_1)^2 + y^2} \right]$

$s = \frac{35 \text{ gpm ft}}{4\pi \, 12750 \text{ gpd}} \times \frac{1440 \text{ min}}{\text{day}} \ln \frac{(-250 - 250)^2 + 230^2}{(-250 + 250)^2 + 230^2}$

$= 0.315 \times \ln(5.726) = 0.549$ ft

(4)

$T = Kb =$

Todd

Fig 4.16 $\dfrac{250\,ft}{\sqrt{\dfrac{4}{0.2}\left(12750\,\dfrac{gal}{day\,ft} \times \dfrac{ft^3}{7.48\,g} \times 10\,days\right)}} = \dfrac{250\,ft}{583.8} = 0.428$

For 100 days: $\dfrac{250}{1846} = 0.135$

For 10 days $\dfrac{Q_r}{Q} = 0.52 \cong 52\%$

For 100 days $\dfrac{Q_r}{Q} \cong 82\%$

Well use: $100{,}000\,gpd \times \dfrac{1\,day}{1440\,min} \times \dfrac{}{2\,wells} = 34.7\,gpm$
$\cong 35\,gpm$

For 60 gpm for 3 days: $s \approx 0.3$ feet

If well s is 6 ft − 1 ft for well loss, $s_w = 5'$

$\Delta s = s_w - s = 5 - .55 = 4.45\,ft / 230\,ft$ distance $= 0.0193$
$\cong 0.019$ average (straight line) gradient

$v = 100\,\dfrac{ft}{day} \cdot \dfrac{0.02}{.25} \cong 7.7\,/day$, $\dfrac{230\,ft}{7.7\,ft/day} = 29.9\,days$

$\therefore$ 30 days required to reach ... position of straight line used!

$d = vt$

$100\,\dfrac{ft}{day}$

$t = 230$

$t = \dfrac{d}{v}$

$v = 100\,\dfrac{ft}{day} \cdot \left(\dfrac{\Delta s - \Delta/d}{.25}\right) = 400\,(\Delta s - \Delta/d)$

$t = \dfrac{d}{400(\Delta s/d)} = \dfrac{230}{400 \cdot 4.45} = 29.7$

$x = -250;\ x_1 = 250$ (5)

$$s = \frac{(\pi)\,35\,gpm \times 1440\,min/day}{4\pi\ 12750\,gpd} \times \ln\left[\frac{(x-x_1)^2 + y^2}{(x+x_1)^2 + y^2}\right]$$

$$= 0.315 \times \ln\left[\frac{250{,}000 + y^2}{(0) + y^2}\right] \qquad \tau = \frac{d^2}{400(\Delta s)}$$

y	[ ]	ln[ ]	s	Δs	d	τ
230	5.7259	1.745	0.550	–	–	–
200	7.250	1.981	0.623	0.0730	30	30.8
150	12.111	2.494	0.785	0.1620	50	38.6
100	26.000	3.258	1.025	0.2400	50	26.0
50	101.0	4.615	1.452	0.4270	50	14.6
25	401.0	5.994	1.885	0.4330	25	3.61
10	2501	7.824	2.461	0.5760	15	0.98
5	10001	9.210	2.897	0.4360	5	0.14
2.5	40001	10.597	3.333	0.4360	2.5	0.04
2	62501	11.043	3.474			
1	250001	12.429	3.910			114. days
0.5	1000001	13.816	4.346			3.8 months
0.4167	1439771	14.18	4.47 ~ 4.5'			

For well near stream – NOT useful if cone does not intercept.

Determination of Travel Time for radial flow

$$\bar{v} = \frac{Q}{An} = \frac{Ki}{n}$$ ← variable, can't use if did W/C, 7.75 ft/day

Drawdown,

$$\bar{v} = \frac{Q}{(2\pi r_w h_w)n}, \quad Q = \frac{\pi K (h_o^2 - h_w^2)}{\ln(r_o/r_w)}$$

Solving for h_w:

$$\frac{Q \ln(r_o/r_w)}{\pi K} = h_o^2 - h_w^2$$

$$h_w^2 = h_o^2 - \frac{Q \ln(r_o/r_w)}{\pi K}$$

$n = 0.25$, $Q = 35\,\text{gpm}$, $h_o = 17$, $r_o = 500$ ft, $K = 750 \frac{\text{gpd}}{\text{ft}^2}$

$$h_w = \sqrt{289 - \frac{35\,\text{gpm} \ln(500/r_w)\,\text{ft}^2}{\pi\, 750\,\text{gpd}} \frac{1440\,\text{min}}{\text{day}}}$$

$$h_w = \sqrt{289 - 21.39 \ln(500/r_w)}$$

$$\bar{v} = \frac{35\,\text{gpm}}{2\pi r_w h_w (.25)} \times \frac{1\,\text{ft}^3}{7.48\,\text{g}} \times \frac{1440\,\text{min}}{\text{Day}} = \frac{429.0}{r_w h_w}$$

$$= \frac{429.0}{r_w \sqrt{289 - 21.39 \ln(500/r_w)}}\ \text{ft/day}$$

$$\text{or} = \frac{Q \times 122.56}{r_w \sqrt{289 - (Q)(0.61) \ln(500/r_w)}}\ \text{ft/day}$$

(Q in r_o)

($h_0 = 17$)

$\bar{t} = \frac{d}{v}$

D	Δt	h_w	v	$\bar{v}$	d	$\bar{t}$
230 ST	0.50	16.50	1.13 ft/day		—	
200 ST	0.59	16.41	1.31	1.22	30 ST	24.6
150 ST	0.78	16.22	1.76	1.54	50	32.6
100 ST	1.04	15.96	2.69	2.23	50	22.5
50	1.52	15.48	5.54	4.12	50	12.2
25	2.00	15.00	11.44	8.49	25	2.9
10	2.67	14.33	29.94	20.69	15	0.72
5	3.20	13.80	62.16	46.05	5	0.11
2.5	3.75	13.25	129.47	95.82	2.5	0.03

95.7 days

3.2 months

(8)

For Well in Uniform Flow:

$Q = 35\,gpm$, $K = 750\,gpd/ft^2$ $b = 17\,ft$
$i = 0.01$

$$x_L = -\frac{Q}{2\pi K b i} = -\frac{35 \times 1440}{2\pi \times 750 \times 17 \times 0.01} = -62.9\,ft$$

$$y_L = \pm \frac{Q}{2 K b i} = \pm \frac{35 \times 1440}{2 \times 750 \times 17 \times 0.01} = 197.6\,ft$$

boundary width $= 2\pi X_L = 395.2$

Equation of boundary line:

$$-\frac{y}{x} = \tan\left(\frac{2\pi K b i y}{Q}\right) = \tan\left(\frac{2\pi\, 750 \cdot 17 \cdot .01 \cdot y}{35 \cdot 1440}\right)$$

Use Radians

$$-y/x = \tan(0.0159\,y)$$

$$x = -y/\tan(0.0159\,y)$$

$x = 0$ @ ~98.82

$Q =$ 35 gpm

y	x	y	x	y	x	y	x
1	-62.9	50	-49.1	100	1.9	150	158.7
5	-62.8	55	-46.0	105	10.3	155	192.5
10	-62.4	60	-42.6	110	19.7	160	234.7
15	-61.7	65	-38.9	115	30.2	165	288.9
20	-60.8	70	-31.6	120	42.0	170	361.6
25	-59.6	75	-29.8	125	55.2	175	465.6
30	-58.1	80	-24.7	130	70.3	180	624.8
35	-56.3	85	-19.0	135	87.5	185	907.9
40	-54.2	90	-12.7	140	107.4	190	1555.4
45	-51.8	95	-5.8	145	130.8	195	4631.9
						200	

For $Q = 65\,gpm$:

$$-\frac{y}{x} = \tan\left(\frac{2\pi\,750.17 \cdot 0.01}{65 \cdot 1440}\right) y$$

$$-\frac{y}{x} = \tan(0.0086)\, y$$

$x_L = -116.8 \quad y_L = 367.1$, width 734.1

Q = 65 gpm

y	x	y	x	y	x
1	-116.8	175	-12.8	205	38.1
10	-116.5	183.5	0	210	48.4
20	-115.7	200	28.4	215	59.4
30	-114.3	225	83.4	220	71.0
50	-109.6	250	159.9	230	96.6
75	-100.3	275	273.6	235	110.8
100	-86.8	300	464.0	240	126.0
125	-68.4			245	142.3
150	-44.3				

Theis non-equil[illegible] formula

$u = 1.87 r^2 S / Tt$ $r = 2[illegible]$ ft, $S = 0.2$

t (days) $T = 12750$ gpd/ft

$$s = \frac{114.6 Q}{T} W(u)$$

t	u	W(u)	Q=35 s	Q=65 s
5	3.1×10^{-1}	0.882	0.28	0.52
10	1.6×10^{-1}	1.41	0.44	0.82
50	3.1×10^{-2}	2.93	0.92	1.71
100	1.6×10^{-2}	3.57	1.12	2.09
500	3.1×10^{-3}	5.20	1.64	3.04
1000	1.6×10^{-3}	5.86	1.84	3.42

For $r = 500$ ft

t	u	W(u)	Q=35 s	Q=65 s
5	7.8×10^{-1}	.322	0.10	0.19
10	3.9×10^{-1}	.719	0.23	0.42
30	1.3×10^{-1}	1.59	0.50	0.93
50	7.8×10^{-2}	2.05	0.64	1.20
100	3.9×10^{-2}	2.71	0.[illegible]5	1.58
500	7.8×10^{-3}	4.34	1.35	2.50
1000	3.9×10^{-3}	4.97	1.56	2.90

For $r = 1000'$

t	u	W(u)	Q=35 s	Q=65 s
5	5.9×10^{0}	.00040[illegible]	1.3×10^{-4}	2.4×10^{-4}
10	2.9×10^{0}	0.0148	4.7×10^{-3}	0.01
30	9.8×10^{-1}	[illegible]	0.07	[illegible]
50	5.9×10^{-1}	0.464	0.15	0.[illegible]7
100	2.9×10^{-1}	0.9[illegible]1	0.29	0.[illegible]4
500	5.9×10^{-2}	2.[illegible]1	0.73	1.35
1000	2.9×10^{-2}	2.99	0.94	1.75

1.

Time of Transport to well:

Darcy: $\bar{v} = \frac{Ki}{n} = \frac{K}{n}\frac{\Delta s}{\Delta r}$, $T = \frac{d}{\bar{v}} = \frac{\Delta r\, n}{Ki} = \frac{\Delta r\,\Delta r\, n}{K\Delta s} = \frac{\Delta r^2 n}{K\Delta s}$

$T = \frac{0.25\,\Delta r^2}{750\ g/d/ft^2} = \frac{0.25\ d\ ft^2}{750\ g} \times \frac{7.48\ g}{ft^3} \times \frac{\Delta r^2}{\Delta s} = \frac{1}{401}\frac{\Delta r^2}{\Delta s}$

For $Q = 35$ gpm, $s_1 = s_2 + \Delta s_{35} \log\frac{r_2}{r_1}$, $|s_1 - s_2| = \Delta s$

$\Delta s_{35} = 1.45$

Jacob: $s_1 = 1.12 + 1.45 \log\left(\frac{230}{r_1}\right)$

r	Δs	Δr	i	T	s_1
230	–	–	–	–	1.12
200	0.09	30	0.003	24.9	1.208
150	0.181	50	0.004	34.4	1.389
100	0.256	50	0.005	24.4	1.645
50	0.436	50	0.009	14.3	2.081
35	0.225	15	0.015	2.5	2.306
25	0.212	10	0.021	1.2	2.518
15	0.322	10	0.032	0.8	2.840
10	0.255	5	0.051	0.2	3.095
5	0.436	5	0.087	0.1	3.531
				102.8 days	

$Q = 65$, $s_1 - s_2 = 2.70 \log\left(\frac{230}{r_1}\right)$, $\Delta s_{65} = 2.70$

r	Δs	Δr	T
230	–	–	–
200	0.164	30	13.7
150	0.337	50	18.5
100	0.475	50	13.1
50	0.813	50	7.7
35	0.418	15	1.3
25	0.393	10	0.6
15	0.599	10	0.4
10	0.475	5	0.1
5	0.813	5	0.1
			55.6 days

(12)

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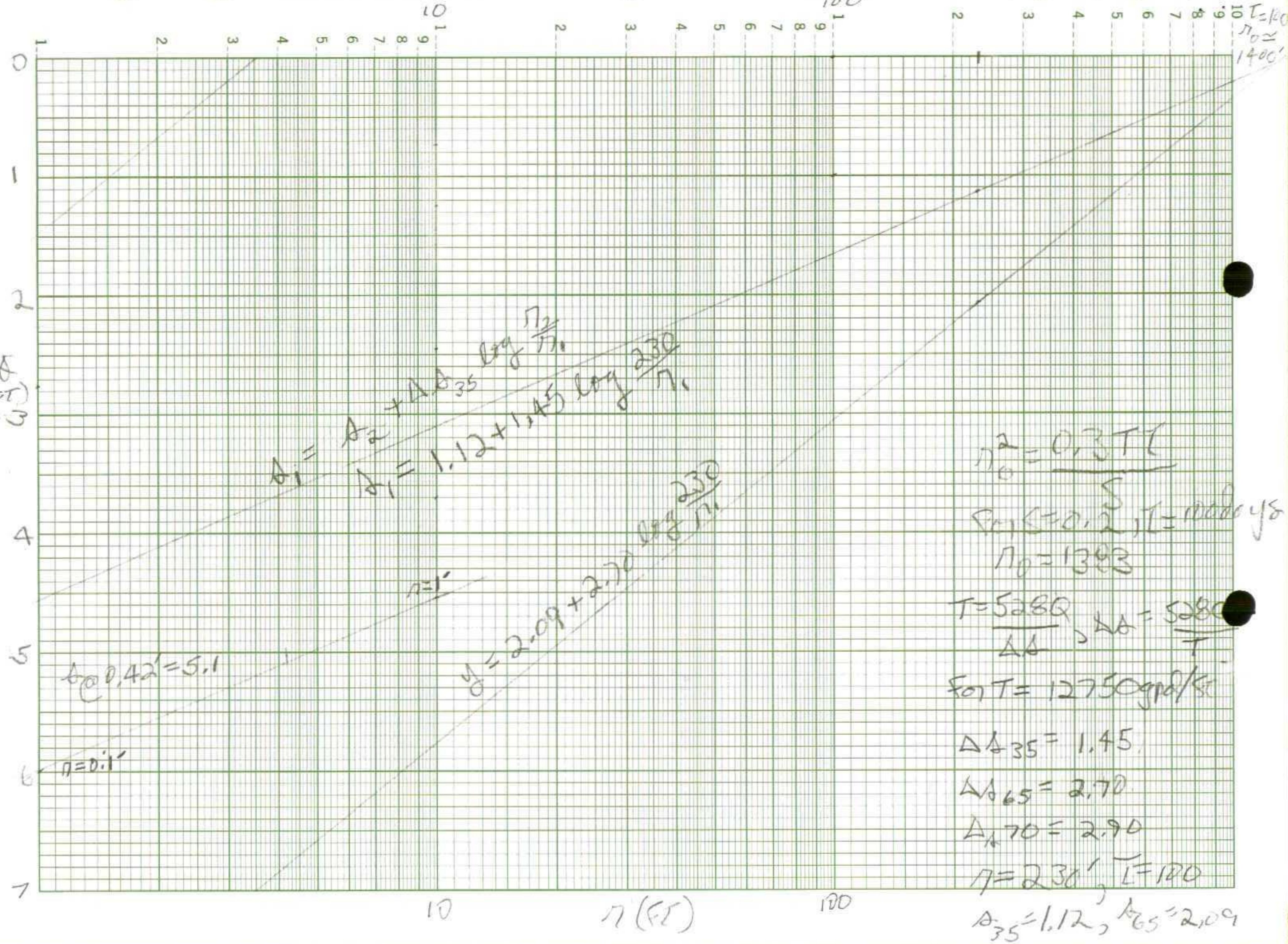
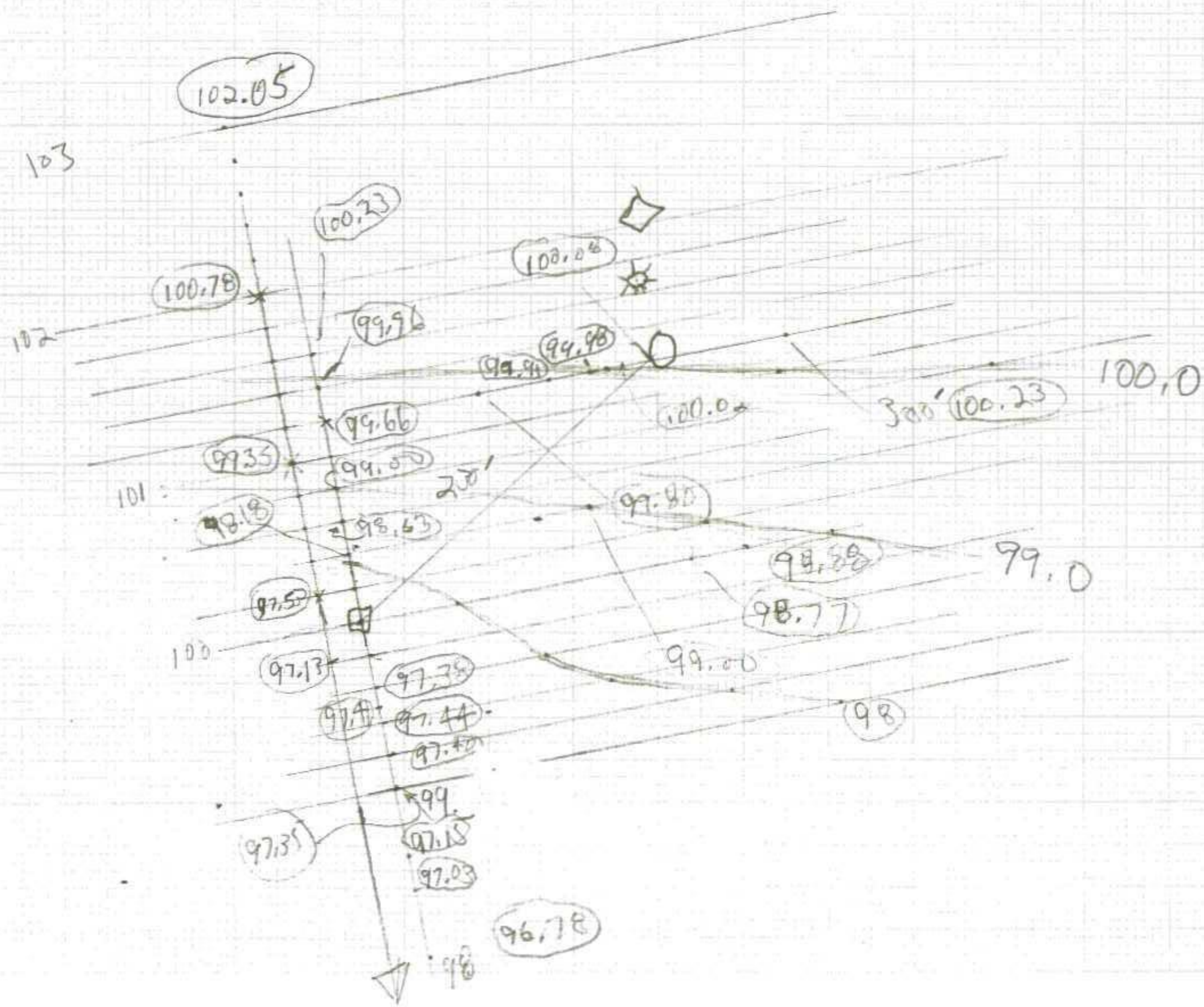
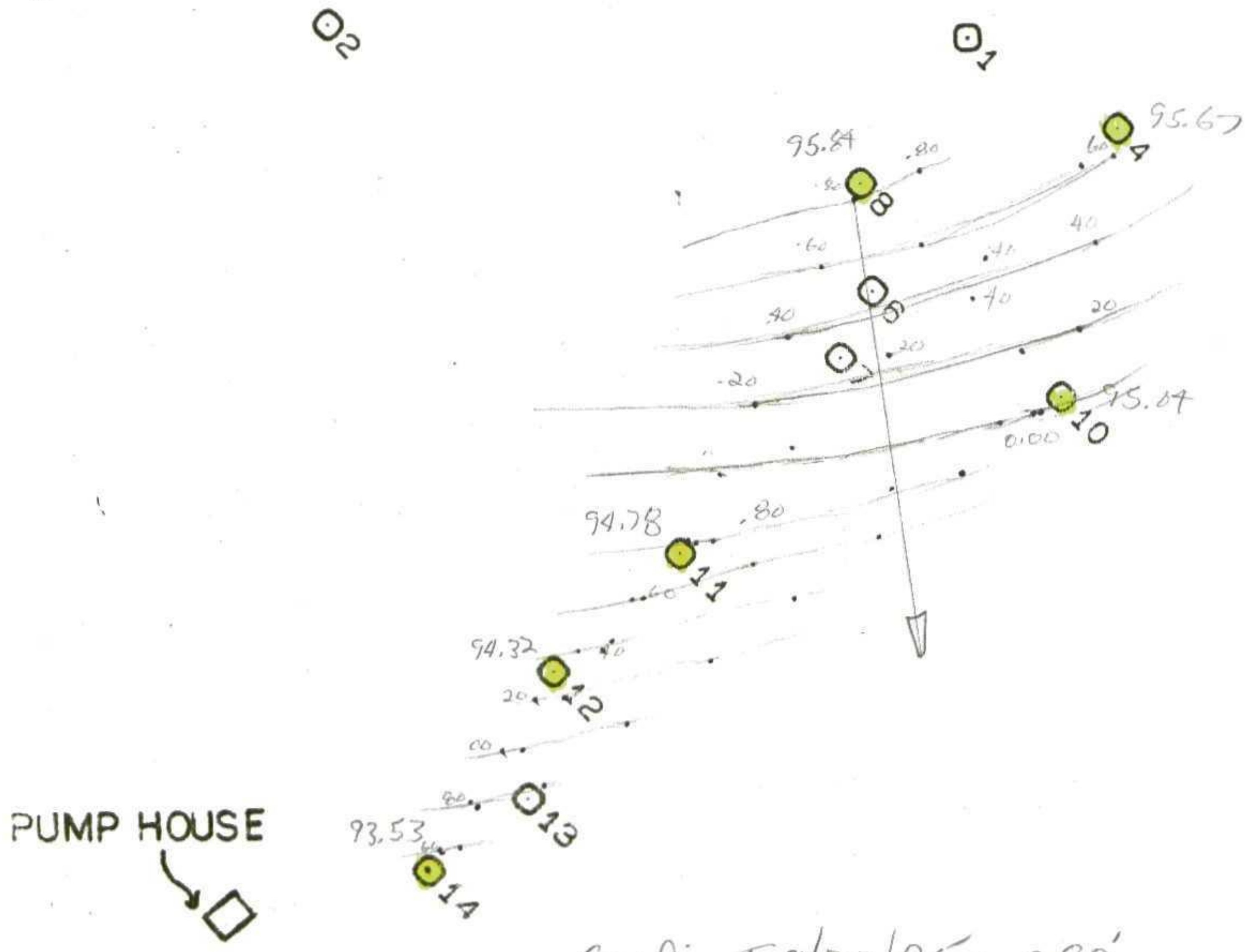




102.05
103
100.23
100.78
102
99.96
100.08
99.98
100,0
300'
100.23
100.0
99.66
99.35
101
20'
99.80
98.18
98.63
99.0
98.77
97.50
100
99.00
97.13
97.38
98
97.44
99
97.35
97.15
97.03
96.78
98

(13)

		DTW 9/20/85	
PT. 4 = mw 5	Elev = 100.18	4.510	95.67
PT. 8 = mw 3	101.90	6.065	95.84
PT. 10 = mw 4	98.51	3.468	95.04
PT. 11 = mw 1	100.61	5.830	94.78
PT 12 = mw 2	100.46	6.140	94.32
PT 14 = SW	99.45	5.925	93.53



Gradient 9/20/85 = $\frac{0.80'}{3.93\text{cm}}$

$\frac{0.80'}{3.95\text{cm}} \times \frac{6.50\text{cm}}{165\text{ ft}} = 0.0080 = \frac{42\text{ ft}}{\text{mile}}$

(Double River Gradient of 0.0004,
Less than Topographic Gradient
of 0.014)

$\frac{10\text{ ft}}{700\text{ ft}} = .0143$

$\frac{20}{1100} = .0182$

$\bar{v} = \frac{K}{n}(i) = \frac{100\text{ ft}\ (0.008)}{\text{Day}\ (.25)} = 3.2\text{ ft/day} = 1168\text{ ft/yr.}$

Wells	Distance
4 To 8	4.15 cm
4 To 10	4.30
4 to 11	9.60
8 to 11	6.50
8 to 10	4.60
10 to 11	6.45
12 To 8	9.10
12 To 11	2.70
12 to 4	12.4
12 to 10	9.1
13 to 14	3.7
14 to 10	12.5

11 To 8 Distance 6.50 9/20/85

95.84	94.80	0.02/1.06 × 6.50	= 0.12
94.78	95.00	.22/	= 1.35
1.06	.20	.42/	= 2.58
	.40	.62/	= 3.80
	.60	.82/	= 5.03
	.80	1.02/	= 6.25

11 to 10 Distance 6.45

95.04	94.80	0.02/.26 × 6.45 = 0.50
94.78	95.00	0.22/.26 × 6.45 = 5.46
.26		

4 To 8 Distance 4.15

95.84	95.80	0.13/.17 × 4.15 = 3.17
95.67		
.17		

10 To 4 Distance 4.30

95.67	95.00	.04/.63 x 4.30	= 0.27
95.04	.20	.16/.63 x 4.30	= 1.09
.63	.40	.36/.63	= 2.46
	.60	.56/	= 3.82

10 to 8 Distance 4.60

95.84	95.20	.16/.80 x 4.60	= 0.92
95.04	40	.36/	= 2.07
0.80	60	.56/	= 3.22
	80	.76/	= 4.37

11 To 4 Distance 9.60

95.67	94.80	.02/.89 x 9.60	= 0.22
94.78	95.00	.22	= 2.37
.89	.20	.42	= 4.53
	.40	.62	= 6.69
	.60	.82	= 8.84

12 to 11 d = 2.70

94.78	94.40	.08/.46 x 2.70	= 0.47
94.32	94.60	.28/.46 x	= 1.64
.46			

12 to 10 d = 9.1

95.04	94.40	.08/.72 x 9.1 =	1.01
94.32	94.60	.28/.72	3.54
.72	94.80	.48/	6.07
	95.00	.68/	8.59

14 to 12 d = 3.7

94.32 93.60 .07/.79 × 3.7 = 0.33

93.53 93.80 .27/ 1.26

0.79 94.00 .47/ 2.20

94.20 .67/.79 3.14

14 To 10 d = 12.5

95.04 93.60 .07/1.51 × 12.5 = 0.58

93.53 .80 .27/ = 2.24

1.51 94.00 .47/ = 3.89

.20 .67/ = 5.55

.40 .87/ = 7.20

.60 1.07/ = 8.86

.80 1.27/ = 10.51

95.00 1.47/ = 12.17

14 To 11 d = 6.4

94.78 93.60 .07/1.25 × 6.4 = 0.36

93.53 .80 .27/ 1.38

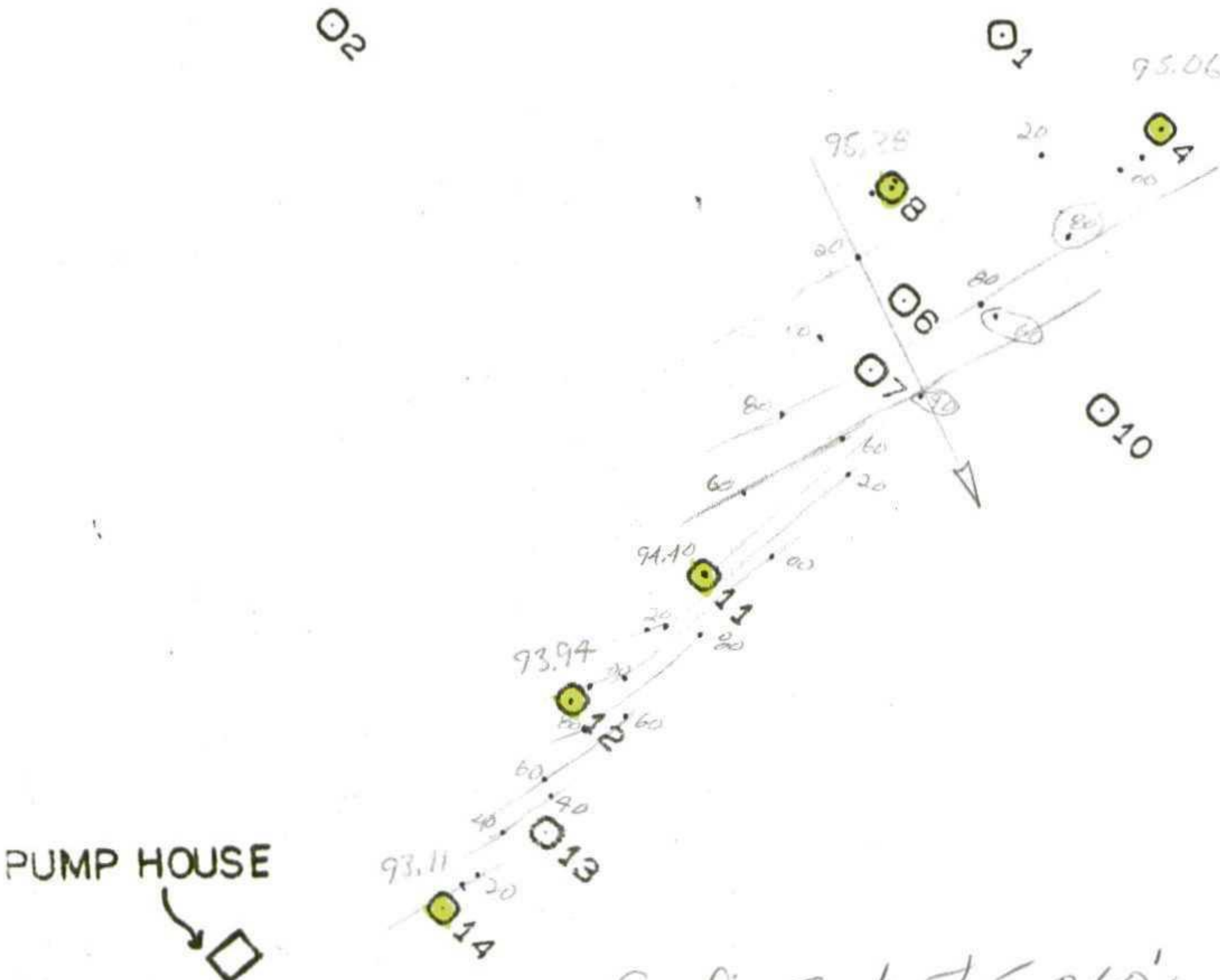
1.25 94.00 .47/ 2.41

20 .67/ 3.43

40 .87/ 4.45

.60 1.07/ 5.48

10/25/85



Gradient 10/25/85 = $\frac{0.60'}{2.25cm}$

$\frac{0.60'}{2.25cm} \times \frac{650cm}{165ft} = 0.0105 = 55ft/mile$

$v = \frac{K}{n}(i) = \frac{100ft}{(.25)day}(0.0105) = 4.2ft/day$

$= 1533 ft/yr.$

10/25/81

	LS Elev	DTW	WL Elev,	From 9/20 Δ
PT 4 = MW #5	100.18	5.12	95.06	-0.63
PT 8 = MW #3	101.90	6.52	95.38	-0.46
PT 10 = MW #4	98.51	Dry	—	—
PT 11 = MW #1	100.61	6.21	94.40	-0.38
PT 12 = MW #2	100.46	6.52	93.94	-0.38
PT 14 = SW	99.45	6.34	93.11	-0.42

95.38
95.06
.32

4 to 8 Distance 4.15

95.20 .14/.32 × 4.15 = 1.82

95.40 .34/.32 × = 4.41

95.06
94.40
.66

11 to 4 d = 9.60

94.60 .20/.66 × 9.60 = 2.91

94.80 .40/ = 5.82

95.00 .60/ = 8.73

95.20 .80/ = 11.64

95.38
94.40
.98

11 to 8 d = 6.50

94.60 .20/.98 × 6.50 = 1.33

.80 .40/ = 2.65

95.00 .60/ = 3.98

.20 .80/ = 5.31

.40 1.00/ = 6.63

14 To 11 $d = 6.45$

94.40	93.20	.09/1.29 × 6.45 =	0.45
93.11	93.40	.29/	1.45
1.29	.60	.49	2.45
	.80	.69	3.45
	94.00	.89	4.45
	.20	1.09	5.45

12 to 11 $d = 2.70$

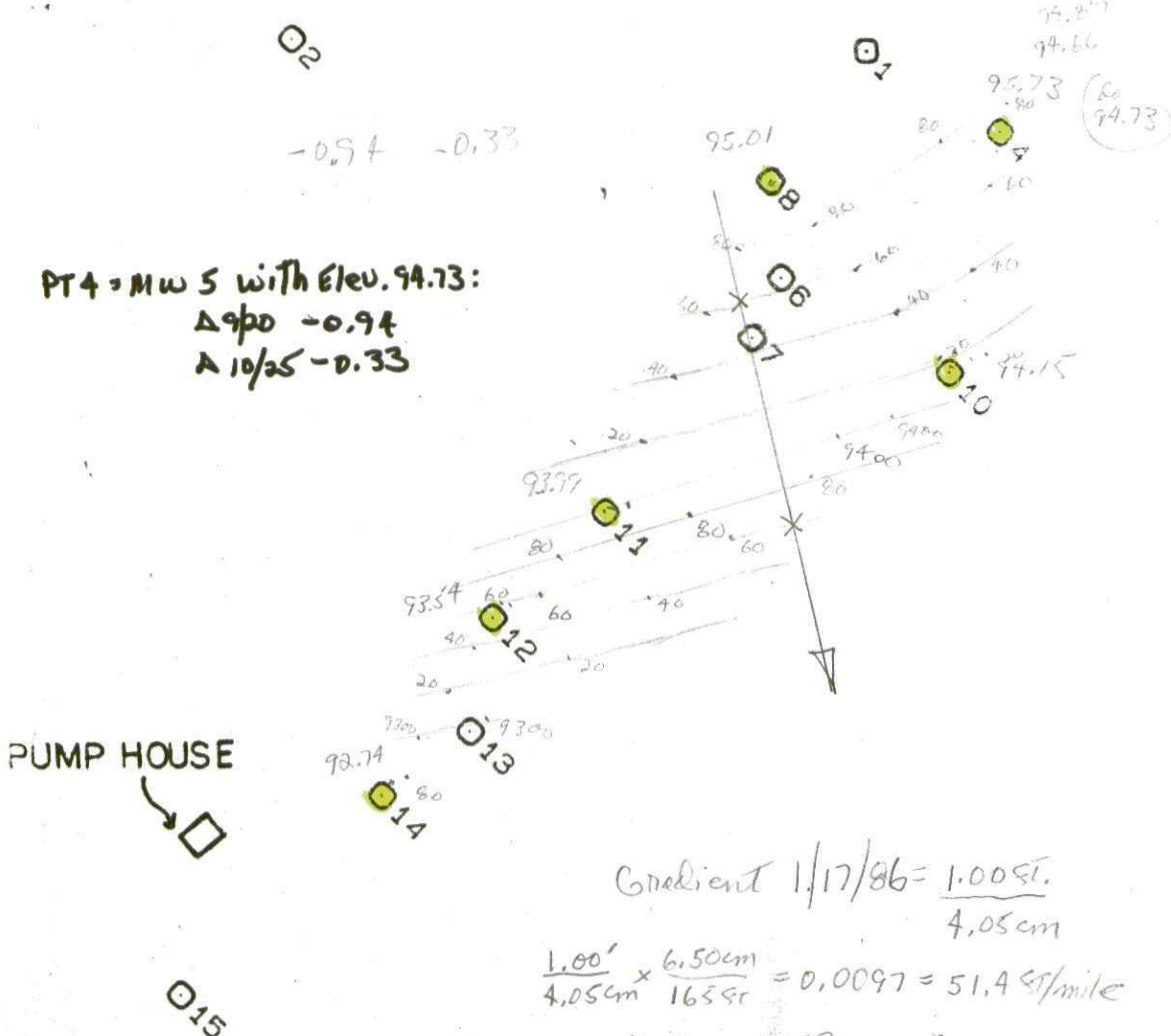
94.40	94.00	.06/.46 × 2.70 =	0.35
93.94	.20	.26/	1.53
0.46	.40	.46/	2.70

14 to 4 $d = 19.0$ (30 scale)

95.06	93.20	.09/1.95 × 19.0 =	0.88
93.11	.40	.29/	2.83
1,95	.60	.49	4.77
	.80	.69	6.72
	94.00	.89	8.67
	.20	1.09	10.62
	.40	1.29	12.57
	.60	1.49	14.52
	.80	1.69	16.47
	95.00	1.89	18.42

	1/17/86	DTW	Elev	Δ9/20	Δ10/25
? PT 4 = MW 5	Elev = 100.18	4.45	95.73	+0.06	+0.67
PT 8 = MW 3	101.90	6.89	95.01	-0.83	-0.37
PT 10 = MW 4	98.51	4.36	94.15	-0.89	—
PT 11 = MW 1	100.61	6.62	93.99	-0.79	-0.41
PT 12 = MW 2	100.46	6.92	93.54	-0.78	-0.40
PT 14 = S5	99.45	6.71	92.74	-0.79	-0.37

PT 4 = MW 5 with Elev. 94.73:
Δ9/20 -0.94
Δ10/25 -0.33



Gradient 1/17/86 = $\frac{1.00 ft.}{4.05 cm}$

$\frac{1.00'}{4.05 cm} \times \frac{6.50 cm}{165 ft} = 0.0097 = 51.4$ ft/mile

$v = \frac{K}{n}(i) = \frac{100 ft}{day}\frac{(0.0097)}{(.25)} = 3.9$ ft/day

$= 1416$ ft/yr.

1/17/86

95.01	11 To 8	$d = 6.50$	
93.99	94.00	.01 / 1.02 × 6.50 =	0.06
1.02	94.20	.21	1.34
	94.40	.41	2.61
	94.60	.61	3.89
	94.80	.81	5.16
	95.00	1.01	6.44

94.15	11 To 10	$d = 6.55$	
93.99	94.00	.01/0.16 × 6.55 =	0.41
0.16	94.20	.21/	8.60

95.01	10 To 8	$d = 4.60$	
94.15	94.20	.05/0.86 × 4.60 =	0.27
.86	94.40	.25/	1.34
	94.60	.45/	2.41
	94.80	.65/	3.48
	95.00	.85/	4.55

94.15	12 To 10	$d = 9.1$	
93.54	93.60	0.06/0.61 × 9.1 =	0.90
0.61	93.80	0.26/	3.88
	94.00	0.46/	6.86
	94.20	0.66/	9.85

12 To 11 d = 2.70

93.99	93.60	.06/.45 × 2.70 = 0.36	
93.54	93.80	.26/	1.56
.45	94.00	.46/	2.76

10 to 4 d = 4.35

95.73	94.20	0.05/1.58 × 4.35 = 0.14		94.73	94.20	.05/0.58	0.38
94.15	.40	.25	6.69	94.15	94.40	.25	1.88
1.58	.60	.45	1.24	0.58	94.60	.45	3.38
	.80	.65	1.79		94.80	.65	4.9[illegible]
	95.00	.85	2.34				
	.20	1.05	2.89				
	.40	1.25	3.44				
	.60	1.45/1.58	3.99				

14 To 12 d = 3.7

93.54	92.80	0.06/0.80 × 3.7 = 0.28	
92.7[illegible]	[illegible]	.26/	1.20
0.[illegible]	93.[illegible]	.46/	2.13
	93.[illegible]	.66/	3.05

14 to 10 d = 12.55

94.15	92.80	0.06/1.41 × 12.55 = 0.53		94.00	1.26/	11.21
92.74	93.00	.26/	2.31	.20	1.40/1.41 × 12.55 = 13.00	
1.41	93.20	.46/	4.09			
	93.40	.66/	5.87			
	93.60	.86/	7.65			
	93.80	1.06/	9.43			

95.01
94.73
0.28

4 To 8 $d = 4.15$

94.80 .07/.28 × 4.15 = 1.04

95.00 .27/.28 4.00

$T = 14,966 = 15,000$

$\frac{1 ft}{inch} \times \frac{1.8 cm}{100 ft} \times \frac{1 in}{2.54 cm} = \frac{1 ft}{141 ft} = 0.007$ in May

$\frac{1 ft}{2.3 cm} \times \frac{1.85 cm}{100 ft} = 0.008$ in April

---

$T = 15,000$ gpd/ft $S_y = 0.10$
$Q = 108.4$ gpm

at 316 minutes have oil (1) what is radius of cone, (2) what is radius of draw?

$r^2 = Tut/1.87S = (15000)(u)(0.22)/1.87(0.10)$

$r^2 = 17647\,u$

$0.1 = \frac{114.6\,Q}{T} W(u) = \frac{(114.6)(108.4)}{15,000} W(u)$

$0.01 = 0.828\,w(u)$ | $0.1 = 0.828\,w(u)$ | $0.5 = .828\,w(u)$

$W(u) = 0.012,\ u = 3.0$ | $W(u) = 0.121\ \therefore\ u = 1.4$ | $W(u) = 0.604$

$r^2 = (3.0)(17647)$ | $r^2 = (17647)(1.4)$, $r = 157$ | $u = 4.6 \times 10^{-1}$

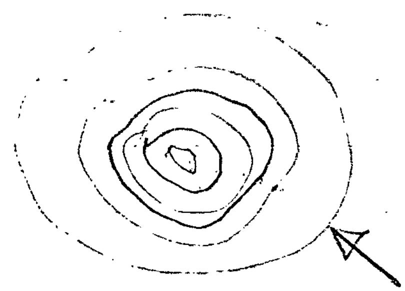
$r = 230$ | $r = 90$ ft

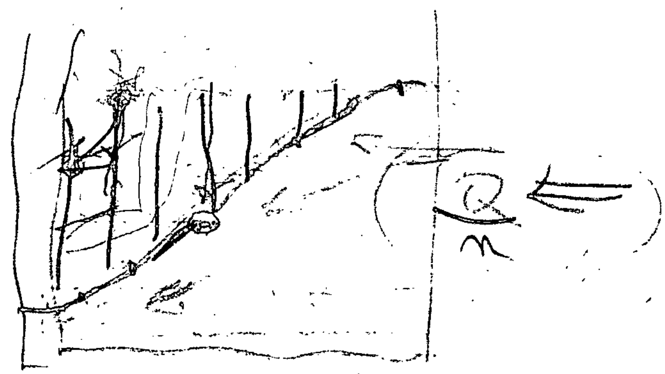
surge

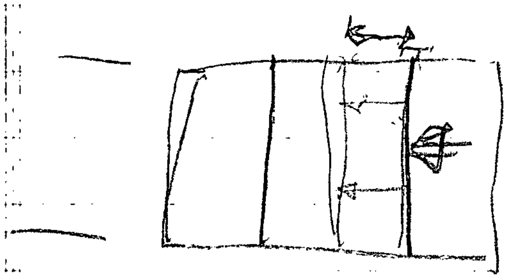
$$316 \text{ mins} \times 108.4 \text{ gpm} \times \frac{ft^3}{7.48 g} = 4579.47 ft^3$$

$$V = \pi r^2 h, \quad r^2 = \frac{V}{.2\pi h} = \frac{4579.5}{(.2)(\pi)(19.6)} = 371.8$$

$$r = 19.3 ft^3$$







$\frac{dh}{dr}$ $\frac{dh}{dr}$

Conclusions

* No verifiable contamination detected except after use of air compressor
* Small amounts of toluene in #1 & M4 for one sampling only. Possible sampling error
* Nothing detected in Oct 85
* GW movement 3-4 ft/day (in fall) towards the river ~~or~~ away from wells
* Produced water tanks w/in ~~radius~~ radius of capture of well #1. Particle movement takes 95-115 days
* Zone of ~~red~~ residual oil saturation may be present if large oily phase discharged

Recommendations

* OCD will continue sampling WL elevations & WQ thru 86
* Well #5 capped; Wells #1 & #5 caps have access for sampling & pumping.
* Aquifer test at #1 for 72 hrs for aquifer parameters and check of close contam.

Further evidence in court suit → * Digging close to tank location to see if residual oil present. Sampled & witnessed

* If oil found capture a possibility again
* Use Well #1 as a reserve well
* After checking #5 probably OK to use also
* More known after spring measurements.

Points to cover.

* Only evidence of found to date was trace levels in monitoring wells and oil/grease found in one sample taken by former employee.

* Would have better case using work done directly by WUA in March 83 (see Cheney letter of 3/2/83) - Testimony and deposition by association officers.

* Might even have problem with that if backhoe could have leaked hydraulic oil as it did in March 85

* Pump Test 72hrs @ ~60gpm
(or what you plant pump [illegible] back in service)

* Discharge water to swamp area near bank of river

* Cap wells but allow access.