HYDROGEOLOGIC STUDY

FOR

DAVID LEE

May, 1987

by

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INTRODUCTION

The purpose of this study is to determine the aquifer characteristics of the Sandstone/Tamiami aquifer at David Lee's project site and estimate the available water for irrigation from this aquifer.

Aquifer characteristics are determined by analyzing data from an Aquifer Performance Test (APT). The study presented here discusses the on-site geology, APT results, and estimated available water for irrigation withdrawals.

SITE DESCRIPTION

The project site, approximately 300 acres, is located in Glades County, Section 29, Township 42S, Range 28E (Figure 1). The property, which is basically open range, is currently being used for cattle grazing. The west side of the site borders Jacks Branch and includes the adjacent flood plain. A map of the project showing the location of the test site is presented in Figure 2.

A geological cross-section (Figure 3) was constructed using the cuttings collected during the drilling of the test wells. The cross-section shows that the geology varies across the test site area including the production zone limestone unit which ranges from 20 feet to 45 feet in thickness. Data collected from other locations suggests that this limestone unit continues to thicken to the south. A written description for each well is provided in the Appendix.

The geology at the project site consists of about ten (10) feet of the Pamlico formation, underlain by 20-30 feet of the Caloosahatchee marl, 60-70 feet of the Tamiami formation, and over 100 feet of the Hawthorn formation. The Pamlico formation consists of light gray to brown quartz sands and lies unconformably on the Caloosahatchee marl.

The Caloosahatchee marl consists of light colored sandy and silty marl with abundant pelecypod and gastropod megafossils, and hard solution riddled marine limestone. Some of the sediments are stained yellow-brown from the presence of limonite and iron. The Caloosahatchee marl lies uncomformably on the Tamiami formation.

The Tamiami formation was subjected to considerable erosion before being inundated by the Caloosahatchee sea. The erosional surface is irregular with hills and valleys, which were filled with Caloosahatchee deposits. The Tamiami formation consists of two beds:

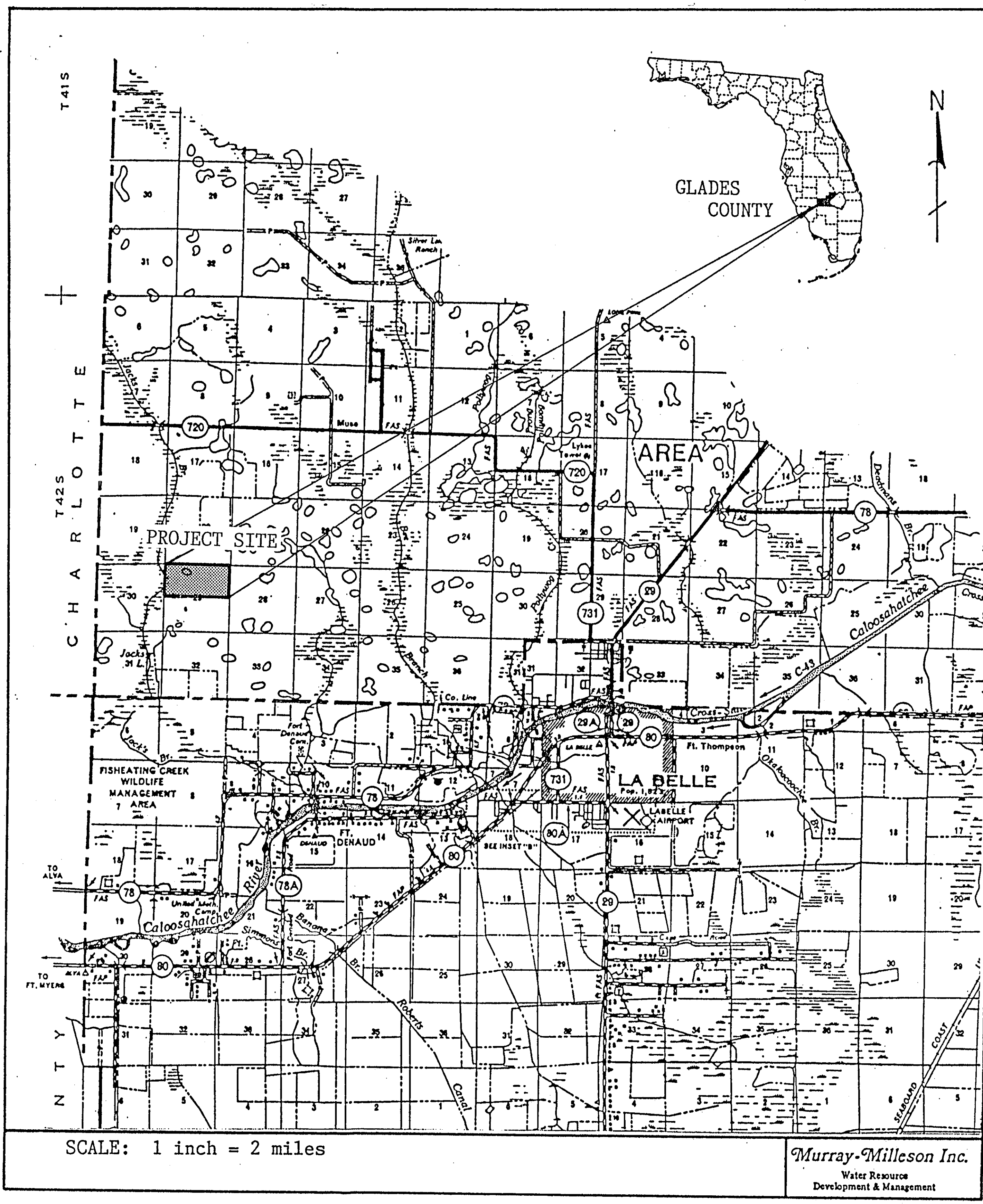

Figure 1: Location Map of David Lee S29/T42S/R28E

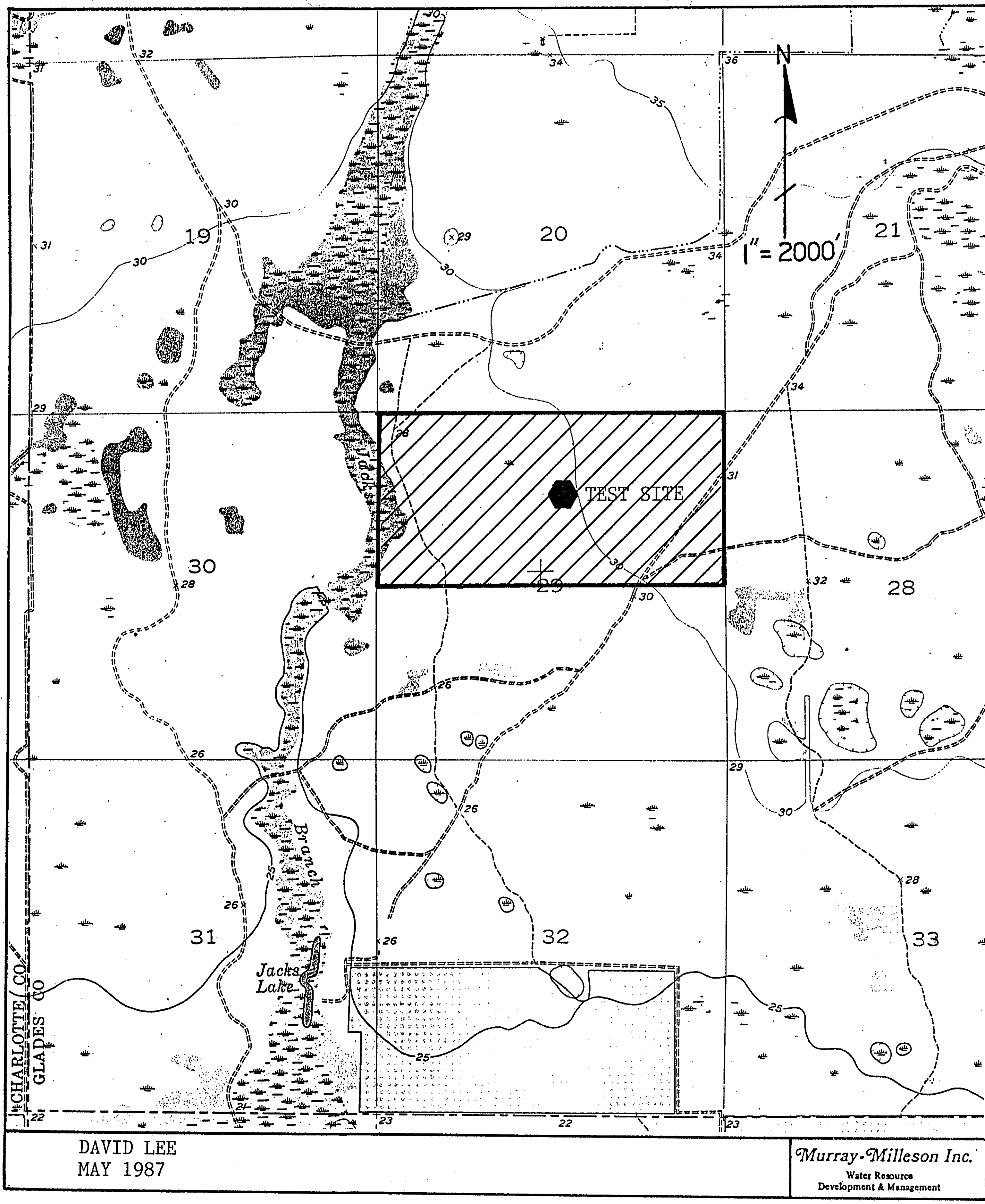

Figure 2: Site Map

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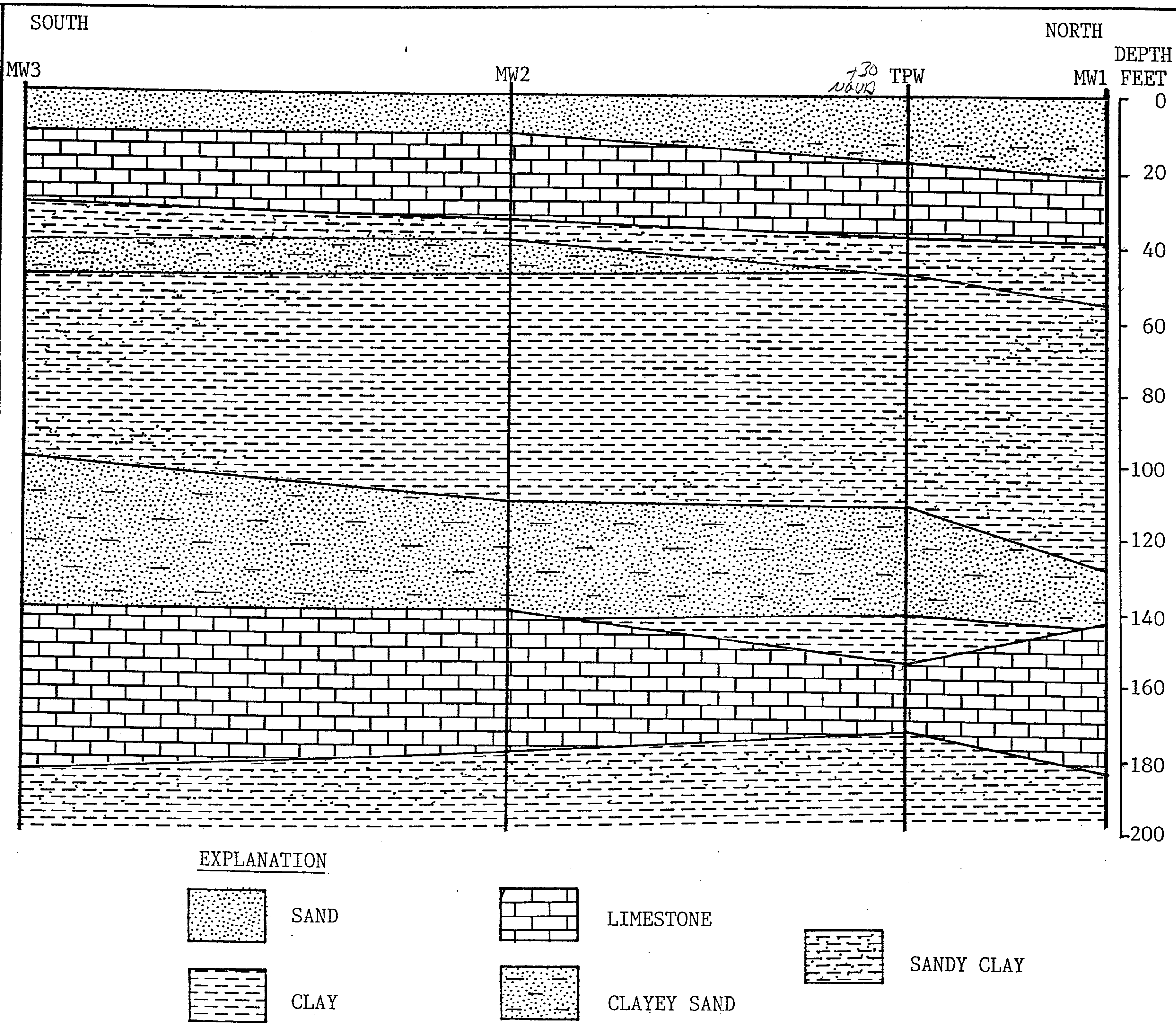

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Figure 3: Geologic Cross-section

an upper, with light colored clay, argillaceous marl, and sand; and a lower, with dark greenish gray to olive green clay and arenaceous clay. The beds are slightly to moderately phosphatic.

The Hawthorn formation, which underlies the Tamiami formation unconformably, is composed of light-green to greenish-gray sandy marl, green and white plastic clay, finely crystalline permeable limestone, silty sands, quartz gravel and pebbles.

METHOD OF STUDY

Well Descriptions

The test production well and monitoring wells were installed by Paul Lawrence Drilling. One 10-inch test production well and three 4-inch monitoring wells were constructed with PVC pipe by mud-rotary drilling to the dimensions described in Table 1. All wells were developed by airlifting.

Aquifer Performance Test

An APT was started on April 30, 1987 and continued for 68.5 hours. The test production well was pumped at a continuous discharge of 200 gallons per minute (gpm) for the duration of the test. A 6-inch turbine pump with 100 feet of intake pipe was used to pump the well. The discharge rate was monitored with a propeller flow meter; discharge was routed away from the site through a plastic lined ditch. The test set-up is depicted in Figure 4. Water levels were measured in monitoring wells #1, #2, and #3 throughout the test with electric tapes. A step-drawdown test was not performed. Recovery data was taken for four hours after the drawdown test was terminated. All of the test results are tabulated and included in the Appendix.

DISCUSSION OF STUDY RESULTS

To properly assess the effects of pumping a confined aquifer, it is necessary to determine three hydraulic coefficients: transmissivity, storage, and leakance. Transmissivity (T) is defined as the amount of water that can be transmitted through an aquifer, usually expressed as gallons per day per foot (gpd/ft). Storage (S) is the volume of water that an aquifer releases from or takes into storage per unit surface area of aquifer per unit change in head, a dimensionless number. Leakance (L) is the rate that water leaks through a confining bed as a result of head declines, usually expressed as gallons per day per cubic foot (gpd/cu ft).

These three coefficients are determined by analyzing the data collected from the aquifer performance tests. The test data were analyzed using the equations described below.

	TPW	MW#1	MW#2	MW#3
Diameter	10"	4"	4"	4"
Total Depth	180'	190'	190'	185'
Cased Depth	100'	100'	100'	100'

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Table 1: Well Descriptions

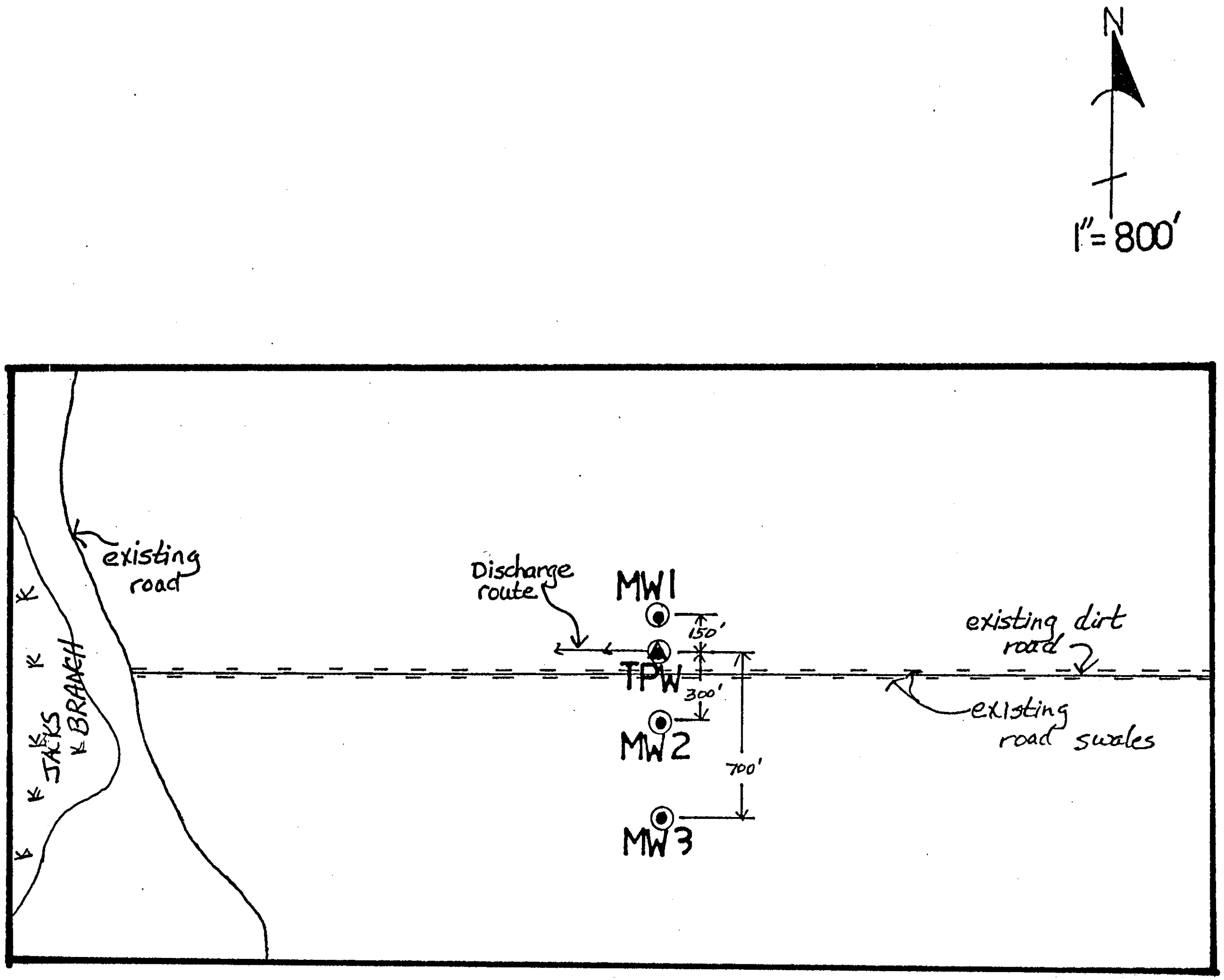

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Figure 4: Test Set-up

Non-equilibrium or Theis equations (Neuman, 1975)

$$T = \frac{114.6Q}{s} W(u) \qquad S = \frac{Ttu}{1.87r^2}$$

where,

T = transmissivity, gpd/ft
Q = pumping rate, gpm
s = drawdown, ft
r = distance of observation well from pumped well, ft
t = time, days
S = storage coefficient, dimensionless
W(u) = well function

Jacob-Hantush time-drawdown approximation (Driscoll, 1986)

$$T = \frac{264Q}{s} \qquad S = \frac{0.3Tt_o}{r^2}$$

where,

s = the change in drawdown over one log cycle, ft
t_o = intercept of the straight line at zero drawdown, days

Jacob-Hantush distance-drawdown approximation (Driscoll, 1986)

$$T = \frac{528Q}{s} \qquad S = \frac{0.3Tt}{(r_o)^2} \qquad L = \frac{0.168T}{(r_o)^2}$$

where,

t = time since pumping started, days
r_o = intercept of extended straight line at zero drawdown, ft
L = leakance, day^{-1}

Jacob-Hantush recovery (Ahrens, et. al., 1985)

$$T = \frac{264Q}{s'}$$

where,

s' = the change in residual drawdown over one log cycle, ft

The above equations assume the aquifer to be homogeneous, anisotropic, infinite in areal extent, of constant thickness, the production and observation wells having no storage capacity, and the wells fully penetrating the aquifer.

The test data for each well were plotted on the appropriate graph paper for each analysis and then matched with the corresponding family of type curves.

The results of the test indicates a range of transmissivity values from 15,366 gallons per day per foot (gpd/ft) to 20,304 gpd/ft, with an average value of 17,670 gpd/ft. The average storage coefficient was 0.000023 and the leakance was 0.00013/day (9.5×10^{-4} gpd/ft^3). Transmissivity values increase in the southerly direction as does the thickness of the aquifer limestone. Also, from the lithology, it appears that the southern area may be less confined.

The distance-drawdown analysis results in the following estimated aquifer characteristics: transmissivity of 12,723 gpd/ft, storage coefficient of 0.00015, and leakance of 0.00013/day (9.5×10^{-4} gpd/ft^3).

The plotted data for the test is presented in the Appendix, with the calculations for the aquifer characteristics shown on each graph. A summary of the calculated values is presented in Table 2.

Background water level data collected by continuous recorder for several days prior to the APT, did not indicate any irregularities. Apparently the background data collection was started during a weekly pumpage cycle, and the cycle ended after the start of the APT. When the levels started to increase at an unexpected rate during the test, I visited the surrounding agricultural developments. Six L's Farm had been pumping several wells, one of which is about 1.3 miles northeast of the test site. Upon my request, they agreed not to pump again until the test was over. Also, the project manager of a 40-acre grove just southeast of the site, was asked to discontinue pumpage. Even though interference was experienced during the test, it occurred at a time after the curve had been determined. Consequently, the analysis represents relatively accurate aquifer characteristics.

Based on the lithology (Figure 3) the pumped well was withdrawing from an area where the production zone appears to be the thinnest. It is probable that the aquifer will be more productive in other areas.

Water quality data taken at the beginning and end of the test showed little change with pumpage. The parameters and results are listed below:

	Beginning of test	End of test
Chloride	70 mg/l	90 mg/l
Conductance	700 micromhos/cm	700 micromhos/cm
Total iron	0.1 mg/l	
pH	7	

METHOD	MW #1		MW #2		MW #3	
	T gpd/ft	S	T gpd/ft	S	T gpd/ft	S
Theis	14,325	0.000031	16,371	0.000021	19,100	0.000026
Jacob-Hantush Time-Drawdown	15,529	0.000021	16,762	0.000020	18,857	0.000020
Jacob-Hantush Recovery	16,246		18,857		22,956	
AVERAGE	15,366	0.000026	17,330	0.000021	20,304	0.000023

Distance-Drawdown T = 12,723 gpd/ft S = 0.00015 L = 0.00013 /day
= 0.00095 gpd/ft³

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Table 2: Summary of Aquifer Characteristics

WATER AVAILABILITY ANALYSIS

Water availability can be determined by using drawdown projection computer models when aquifer parameters are known for an area. Because this aquifer normally responds as a leaky aquifer and agricultural withdrawals are intermittent rather than continuous, a steady-state leaky artesian model would be the most appropriate to project drawdowns. A withdrawal rate of 1.1 million gallons per day (mgd) is sufficient to irrigate 200 acres of citrus. However, because the aquifer characteristics are low, a withdrawal rate of 0.4 MGD was used to project drawdowns in this aquifer.

Four production wells were simulated to pump at a rate of 100,000 gpd each using the following aquifer parameters: T = 17,670 gpd/ft and L = 0.00013/day (9.5×10^{-4} gpd/ft^3). The resultant projected cone-of-depression is depicted in Figure 5. Off-site drawdowns are projected to be generally less than six(6) feet at this pumping rate and scheme. Because of the assumptions that there is no recharge to the aquifer and that the aquifer characteristics do not vary, this represents a worst case situation. As indicated above, the aquifer is variable and potentially more productive across the project site.

To meet the balance of the irrigation needs, water will be needed from the Water Table Aquifer. From data collected within one mile of the project site, the aquifer is characterized by the following values: transmissivity of about 16,000 gpd/ft and specific yield of 0.1. Because of the suspected high iron content in the shallow water, the water will need to be treated. This can be achieved by either digging a large (about 2-3 acres) 15-20 foot lake and withdrawing from the lake or by installing shallow wells that would be pumped into a smaller lake, which would then be withdrawn into the irrigation system. Treatment occurs when the water is exposed to air, causing the iron to convert from the solution state to a solid state, which then settles to the bottom.

A combination of the two (2) sources, Water Table and Sandstone/Tamiami Aquifers, will provide sufficient water for irrigation of citrus at the site. Adverse impacts to surrounding legal exiting users or environmental features will not result as a consequence of these withdrawals.

CONCLUSIONS

The project site was investigated to determine the availability of water from the Sandstone/Tamiami aquifer for irrigation purposes. From the analysis of the tests performed, the following are concluded:

1. Adequate water is available from the Sandstone/Tamiami aquifer and the Water Table aquifer for the irrigation needs of this project.

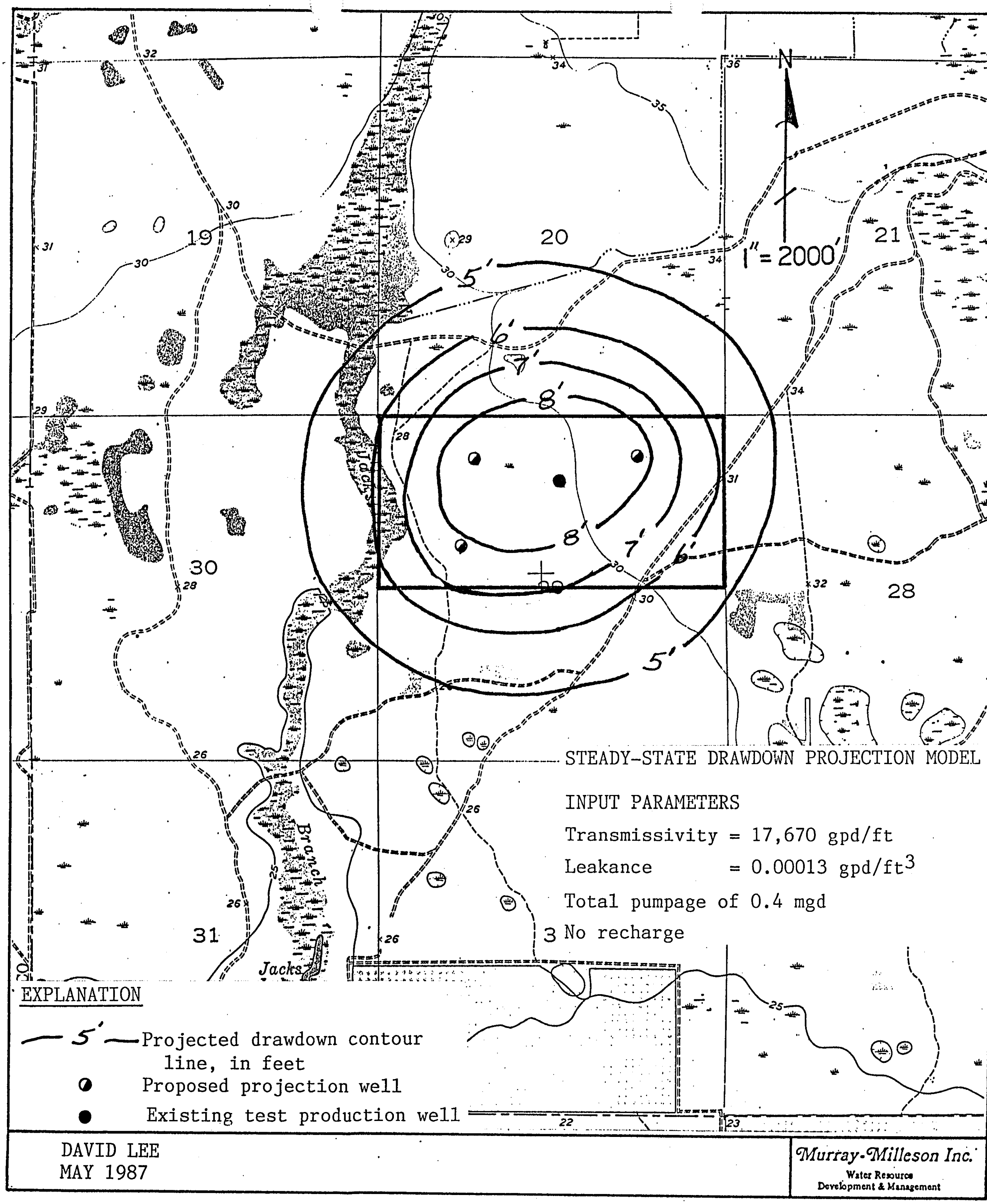

Figure 5: Projected Cone-of-depression in the Sandstone/Tamiami Aquifer withdrawing 0.4 MGD

2. The aquifer characteristics determined for the Sandstone/Tamiami aquifer at this site average as follows: a transmissivity of 17,670 gpd/ft, a storage coefficient of 0.000023, and a leakance value of 0.00013/day (9.5×10^{-4} gpd/ft³).

3. Water quality of the aquifer remained relatively constant with pumpage and within potable chloride concentration standards.

4. The proposed irrigation of the site will not adversely impact the surrounding legal existing users or impact any environmental features.

RECOMMENDATIONS

To achieve maximum use of available water with minimal drawdowns and impact, the following is recommended.

1. The Sandstone/Tamiami Aquifer wells should be 8 inches in diameter and constructed to a total depth of about 190 feet with casing to the top to the limestone, about 145 feet below land surface. A submersible pump with a capacity of 400-600 GPM should be placed about 80-100 feet below the top of casing. The wells should be located in the general areas indicated in Figure 5.

2. Water Table withdrawals should be made from on-site lake(s), 300-400 feet in diameter and 15-20 feet in depth, to allow the iron to precipitate and settle to the bottom. Withdrawals from the Sandstone/Tamiami Aquifer could also be pumped into the lake(s), with all irrigation withdrawals coming out of the lake into the irrigation system.

3. An alternative to #2 is to construct shallow wells, cased to the top of the first limestone unit (approximately 10-15 feet below land surface) and then open-hole through the limestone to approximately 40-45 feet. This shallow well water would then be pumped into a smaller lake (6-10 feet deep) at a rate of about 200-300 gpm per well before being pumped into the irrigation system. Water from the Sandstone/Tamiami wells would be pumped directly into the irrigation system.

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APPENDIX

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TEST PRODUCTION WELL

S29/T42/R28

LITHOLOGICAL DESCRIPTION

DEPTH	DESCRIPTION
0'-10'	Sand, moderate brown, very fine to medium grained, subangular to subrounded
10'-18'	Clayey sand, pale green, fine grained, subangular
18'-40'	Limestone, white to light orange
40'-50'	Sandy clay, white; minor limestone
50'-80'	Clay, dark grayish olive to dark greenish gray
80'-115'	Sandy clay, greenish gray to light olive gray
115'-145'	Clayey sand, pale olive to dark greenish gray, fine grained, subangular
145'-160'	Sandy clay, white
160'-178'	Limestone, white
178'-180'	Sandy clay, white

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MONITORING WELL #1

S29/T42/R28

LITHOLOGICAL DESCRIPTION

DEPTH	DESCRIPTION
0'-15'	Sand, light brown, very fine to medium grained, subangular
15'-18'	Same as above with 20% clay
18'-39'	Fossiliferous limestone, white to light orange
39'-55'	Sandy clay, yellowish gray
55'-60'	Clay, dark greenish gray
60'-73'	Sandy clay, greenish gray
73'-78'	Clay, dark greenish gray
78'-130'	Sandy clay, greenish gray,
130'-145'	Clayey sand, olive green, medium to coarse grained, subrounded
145'-155'	Limestone, white to light gray
155'-158'	Sandy clay, white
155'-160'	Limestone, white to light gray
160'-163'	Sandy clay, white
163'-185'	Limestone, white to very light orange
185'-190'	Sandy clay, white

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MONITORING WELL #2

S29/T42/R28

LITHOLOGICAL DESCRIPTION

DEPTH	DESCRIPTION
0'-10'	Sand, light brown, very fine to medium grained, subangular
10'-35'	Fossiliferous limestone, very pale orange
33'-40'	Sandy clay, white; minor limestone
40'-50'	Clayey sand, pale greenish yellow, medium grained, subangular
50'-115'	Clay, greenish gray to greenish olive; minor sand
115'-120'	Clayey sand, white, coarse grained, subrounded
120'-145'	Clayey sand, pale olive, very fine to fine grained, subangular
145'-158'	Limestone, white to light gray
158'-162'	Sandy clay, white
162'-185'	Limestone, white
185'-190'	Sandy clay, white

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MONITORING WELL #3

S29/T42/R28

LITHOLOGICAL DESCRIPTION

	DEPTH	DESCRIPTION
	0'-10'	Sand, light brown, very fine to medium grained, subangular
	10'-30'	Fossiliferous limestone, very pale orange
	30'-40'	Sandy clay, white; minor limestone
	40'-48'	Clayey sand, pale greenish yellow, medium grained, subangular
	48'-70'	Sandy clay, grayish olive
	70'-80'	Clay, dark greenish gray
	80'-100'	Sandy clay, greenish gray
70-115	100'-145'	Clayey sand, greenish gray to dark greenish gray, fine to medium grained, subangular
115-118	145'-148'	Limestone, light gray
118-120	148'-150'	Sandy clay, white; minor gravel
120-125	150'-155'	Limestone, light gray
125-128	155'-158'	Sandy clay, pale olive; minor limestone
128-155	158'-185'	Limestone, white to very pale orange
155	185'	Sandy clay, white

AQUIFER PERFORMANCE TEST FORM

NAME: David Lee
PROJECT NAME:

DATE OF TEST: 4/30/87
LOCATION: S29 T42 R28

DISTANCE FROM PUMPED WELL: 150 FEET
WEATHER CONDITIONS: Clear
PUMPING RATE:200 GPM
WELL #: MW1 STATIC W L (FT BELOW TOC) 9.73

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
0.25	10.58	0.85
0.50	11.48	1.75
0.75	12.03	2.30
1.00	12.39	2.66
1.25	12.75	3.02
1.50	13.03	3.30
1.75	13.29	3.56
2.00	13.46	3.73
2.50	13.87	4.14
3.00	14.03	4.30
3.50	14.26	4.53
4.00	14.44	4.71
4.50	14.65	4.92
5.00	14.78	5.05
6.00	15.03	5.30
7.00	15.26	5.53
8.00	15.47	5.74
9.00	15.64	5.91
10.00	15.77	6.04
11.00	15.91	6.18
12.00	16.06	6.33
13.00	16.17	6.44
14.00	16.28	6.55
15.00	16.38	6.65

PROJECT: David Lee   DATE: 4/30/87   WELL#: MW1

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
20.00	16.79	7.06
25.00	17.12	7.39
30.00	17.38	7.65
35.00	17.60	7.87
40.00	17.80	8.07
45.00	17.97	8.24
50.00	18.13	8.40
55.00	18.26	8.53
60.00	18.39	8.66
70.00	18.64	8.91
80.00	18.88	9.15
90.00	19.09	9.36
100.00	19.27	9.54
110.00	19.38	9.65
120.00	19.49	9.76
150.00	19.95	10.22
180.00	20.30	10.57
210.00		
240.00	20.72	10.99
270.00		
330.00	21.22	11.49
420.00	21.58	11.85
540.00	21.88	12.15
750.00	22.30	12.57
960.00	21.60	11.87
1080.00	21.30	11.57
1380.00	21.28	11.55

PROJECT: David Lee DATE: 4/30/87 WELL#: MW1

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
1620.00	23.65	13.92
2010.00	24.28	14.55
2400.00	23.00	13.27
2760.00	21.85	12.12
2940.00	21.93	12.20
3180.00	22.37	12.64
3660.00	22.62	12.89
4110.00	22.29	12.56

AQUIFER PERFORMANCE TEST FORM

NAME: David Lee
PROJECT NAME:

DATE OF TEST: 4/30/87
LOCATION: S29 T42 R28

DISTANCE FROM PUMPED WELL: 300 FEET
WEATHER CONDITIONS: Clear
PUMPING RATE: 200 GPM
WELL #: MW2 STATIC W L (FT BELOW TOC) 11.26

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
0.25	11.44	0.18
0.50	11.90	0.64
0.75	12.31	1.05
1.00	12.44	1.18
1.25	12.85	1.59
1.50	13.28	2.02
1.75	13.42	2.16
2.00	13.79	2.53
2.50	13.90	2.64
3.00	14.00	2.74
3.50	14.20	2.94
4.00	14.26	3.00
4.50	14.40	3.14
5.00	14.50	3.24
6.00	14.79	3.53
7.00	14.96	3.70
8.00	15.13	3.87
9.00	15.29	4.03
10.00	15.41	4.15
11.00	15.54	4.28
12.00	15.65	4.39
13.00	15.79	4.53
14.00	15.84	4.58
15.00	15.93	4.67

PROJECT: David Lee　DATE: 4/30/87　WELL#: MW2

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
20.00	16.28	5.02
25.00	16.56	5.30
30.00	16.79	5.53
35.00	16.98	5.72
40.00	17.15	5.89
45.00	17.31	6.05
50.00	17.40	6.14
55.00	17.57	6.31
60.00	17.67	6.41
70.00	17.90	6.64
80.00	18.10	6.84
90.00	18.28	7.02
100.00	18.45	7.19
110.00	18.57	7.31
120.00	18.68	7.42
150.00		
180.00	19.32	8.06
210.00		
240.00	19.75	8.49
270.00		
330.00	20.21	8.95
420.00	20.53	9.27
540.00	20.80	9.54
750.00	21.16	9.90
960.00	20.70	9.44
1080.00	20.48	9.22
1380.00	20.43	9.17

PROJECT: David Lee DATE: 4/30/87 WELL#: MW2

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
1620.00	22.85	11.59
2010.00	23.38	12.12
2400.00	22.24	10.98
2760.00	21.15	9.89
2940.00	21.16	9.90
3180.00	21.48	10.22
3660.00	21.71	10.45
4110.00	21.42	10.16

AQUIFER PERFORMANCE TEST FORM

NAME: David Lee
PROJECT NAME:

DATE OF TEST: 4/30/87
LOCATION: S29 T42 R28

DISTANCE FROM PUMPED WELL: 700 FEET
WEATHER CONDITIONS: Clear
PUMPING RATE: 200 GPM
WELL #: MW3
STATIC W L (FT BELOW TOC) 86.12

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
0.25	86.12	0.00
0.50	86.14	0.02
0.75	86.16	0.04
1.00	86.24	0.12
1.25	86.26	0.14
1.50	86.30	0.18
1.75	86.34	0.22
2.00	86.40	0.28
2.50	86.56	0.44
3.00	86.66	0.54
3.50	86.68	0.56
4.00	86.90	0.78
4.50	87.02	0.90
5.00	87.10	0.98
6.00	87.28	1.16
7.00	87.44	1.32
8.00	87.58	1.46
9.00	87.70	1.58
10.00	87.80	1.68
11.00	87.92	1.80
12.00	87.98	1.86
13.00	88.08	1.96
14.00	88.14	2.02
15.00	88.20	2.08

PROJECT: David Lee DATE: 4/30/87 WELL#: MW3

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
20.00	88.46	2.34
25.00	88.66	2.54
30.00	88.88	2.76
35.00	89.06	2.94
40.00	89.18	3.06
45.00	89.30	3.18
50.00	89.42	3.30
55.00	89.52	3.40
60.00	89.62	3.50
70.00	89.80	3.68
80.00	89.96	3.84
90.00	90.12	4.00
100.00	90.24	4.12
110.00	90.36	4.24
120.00	90.48	4.36
150.00	90.67	4.55
180.00	91.00	4.88
210.00		
240.00	91.42	5.30
270.00		
330.00	91.80	5.68
420.00	92.08	5.96
540.00	92.33	6.21
750.00	92.65	6.53
960.00	92.44	6.32
1080.00	92.34	6.22
1380.00	92.33	6.21

PROJECT: David Lee DATE: 4/30/87 WELL#: MW3

TIME (IN MINUTES)	WATER LEVEL FROM TOC	DRAWDOWN IN FEET
1620.00	94.56	8.44
2010.00	94.97	8.85
2400.00	94.09	7.97
2760.00	93.16	7.04
2940.00	93.10	6.98
3180.00	93.30	7.18
3660.00	93.42	7.30
4110.00	93.21	7.09

AQUIFER PERFORMANCE TEST FORM

NAME: David Lee   DATE OF TEST: 4/30/87
PROJECT NAME: LOCATION: S29 T42 R28
DISTANCE FROM PUMPED WELL: 150 FEET   WEATHER CONDITIONS: Clear
PUMPING RATE: 200 GPM
WELL #: MW1   STATIC W L (FT BELOW TOC)   9.73
TIME PUMP TURNED OFF (IN MINUTES):   4110

TIME SINCE PUMP START t (MIN)	TIME SINCE PUMP STOPPED t' (MIN)	t/t'	WATER LEVEL FROM TOC (FT)	RESIDUAL DRAWDOWN s' (FT)
4110.50	0.50	8221.00	20.60	10.87
4111.00	1.00	4111.00	19.80	10.07
4111.50	1.50	2741.00	19.36	9.63
4112.00	2.00	2056.00	19.04	9.31
4113.00	3.00	1371.00	18.55	8.82
4114.00	4.00	1028.50	18.21	8.48
4115.00	5.00	823.00	17.94	8.21
4116.00	6.00	686.00	17.72	7.99
4117.00	7.00	588.14	17.55	7.82
4118.00	8.00	514.75	17.38	7.65
4119.00	9.00	457.67	17.23	7.50
4120.00	10.00	412.00	17.10	7.37
4125.00	15.00	275.00	16.59	6.86
4130.00	20.00	206.50	16.21	6.48
4135.00	25.00	165.40	15.90	6.17
4140.00	30.00	138.00	15.68	5.95
4145.00	35.00	118.43	15.45	5.72
4150.00	40.00	103.75	15.26	5.53
4160.00	50.00	83.20	14.93	5.20
4170.00	60.00	69.50	14.67	4.94
4200.00	90.00	46.67	14.05	4.32
4230.00	120.00	35.25	13.60	3.87

4300.00	190.00	22.63	12.93	3.20
4330.00	220.00	19.68	12.70	2.97
4355.00	245.00	17.78	12.58	2.85

AQUIFER PERFORMANCE TEST FORM

NAME: David Lee DATE OF TEST: 4/30/87
PROJECT NAME: LOCATION: S29 T42 R28
DISTANCE FROM PUMPED WELL: 300 FEET WEATHER CONDITIONS: Clear
PUMPING RATE: 200 GPM
WELL #: MW2 STATIC W L (FT BELOW TOC) 11.26
TIME PUMP TURNED OFF (IN MINUTES): 4110.00

TIME SINCE PUMP START t (MIN)	TIME SINCE PUMP STOPPED t' (MIN)	t/t'	WATER LEVEL FROM TOC (FT)	RESIDUAL DRAWDOWN s' (FT)
4110.50	0.50	8221.00	20.87	9.61
4111.00	1.00	4111.00	20.34	9.08
4111.50	1.50	2741.00	19.97	8.71
4112.00	2.00	2056.00	19.68	8.42
4113.00	3.00	1371.00	19.25	7.99
4114.00	4.00	1028.50	18.98	7.72
4115.00	5.00	823.00	18.68	7.42
4116.00	6.00	686.00	18.50	7.24
4117.00	7.00	588.14	18.34	7.08
4118.00	8.00	514.75	18.19	6.93
4119.00	9.00	457.67	18.08	6.82
4120.00	10.00	412.00	17.96	6.70
4125.00	15.00	275.00	17.54	6.28
4130.00	20.00	206.50	17.23	5.97
4135.00	25.00	165.40	16.98	5.72
4140.00	30.00	138.00	16.76	5.50
4145.00	35.00	118.43	16.58	5.32
4150.00	40.00	103.75	16.42	5.16
4160.00	50.00	83.20	16.16	4.90
4170.00	60.00	69.50	15.88	4.62
4200.00	90.00	46.67	15.30	4.04
4230.00	120.00	35.25	14.90	3.64

4300.00	190.00	22.63	14.26	3.00
4370.00	260.00	16.81	13.90	2.64

AQUIFER PERFORMANCE TEST FORM

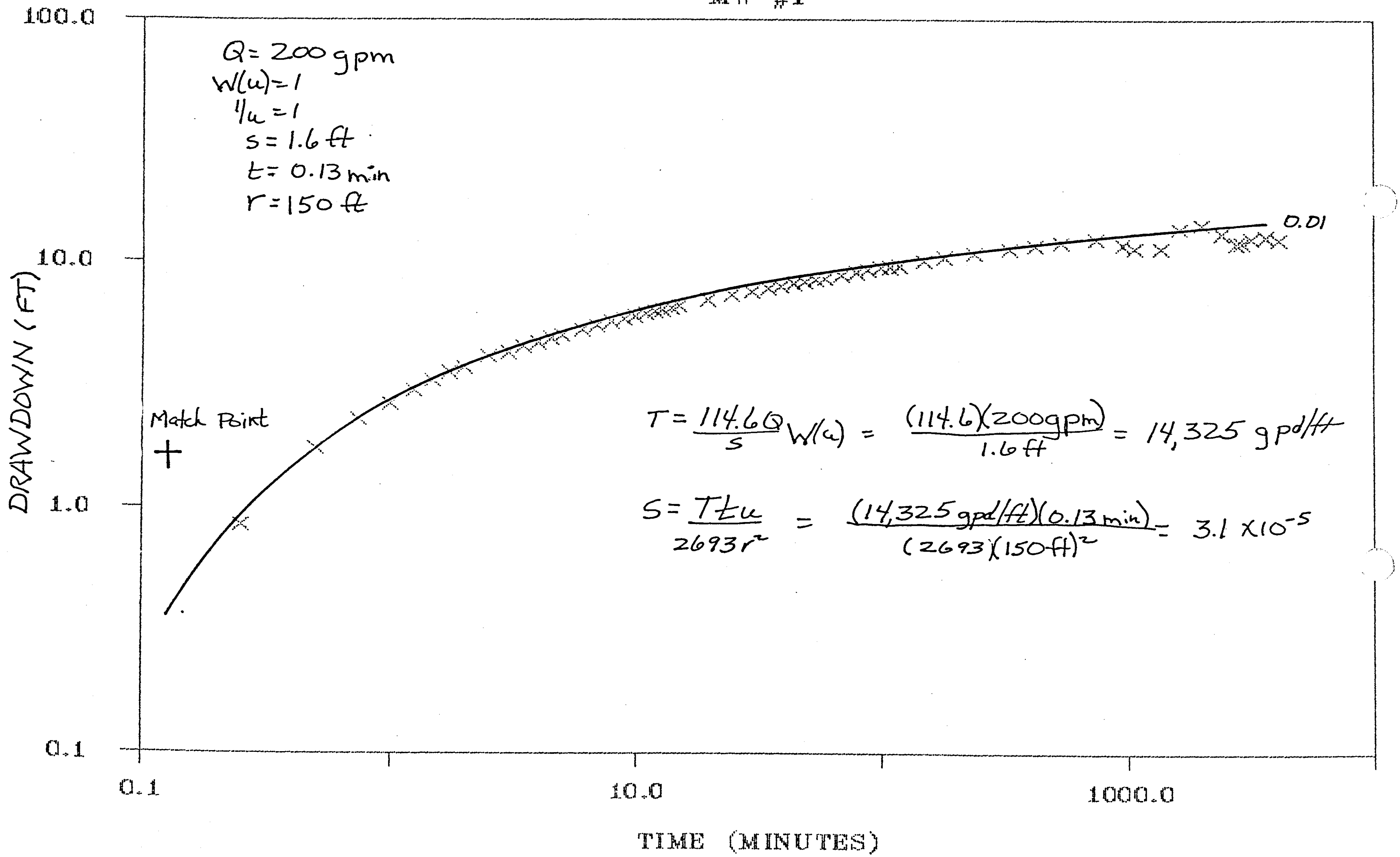
NAME: David Lee　　　　　　　　　　　　　　DATE OF TEST:
PROJECT NAME:　　　　　　　　　　　　　　LOCATION: S29　T42　R28
DISTANCE FROM PUMPED WELL: 700 FEET　WEATHER CONDITIONS: Clear
PUMPING RATE: 200　GPM
WELL #: MW3　　STATIC W L (FT BELOW TOC)　　86.12
TIME PUMP TURNED OFF (IN MINUTES): 4110.00

TIME SINCE PUMP START t (MIN)	TIME SINCE PUMP STOPPED t' (MIN)	t/t'	WATER LEVEL FROM TOC (FT)	RESIDUAL DRAWDOWN s' (FT)
4110.50	0.50	8221.00	93.21	7.09
4111.00	1.00	4111.00	93.13	7.01
4111.50	1.50	2741.00	93.04	6.92
4112.00	2.00	2056.00	92.92	6.80
4113.00	3.00	1371.00	92.72	6.60
4114.00	4.00	1028.50	92.54	6.42
4115.00	5.00	823.00	92.38	6.26
4116.00	6.00	686.00	92.24	6.12
4117.00	7.00	588.14	92.12	6.00
4118.00	8.00	514.75	92.02	5.90
4119.00	9.00	457.67	91.93	5.81
4120.00	10.00	412.00	91.84	5.72
4125.00	15.00	275.00	91.55	5.43
4130.00	20.00	206.50	91.33	5.21
4135.00	25.00	165.40	91.16	5.04
4140.00	30.00	138.00	91.01	4.89
4145.00	35.00	118.43	90.87	4.75
4150.00	40.00	103.75	90.75	4.63
4160.00	50.00	83.20	90.53	4.41
4170.00	60.00	69.50	90.32	4.20
4200.00	90.00	46.67	89.91	3.79
4230.00	120.00	35.25	89.58	3.46

4300.00	190.00	22.63	89.00	2.88
4370.00	260.00	16.81	88.68	2.56

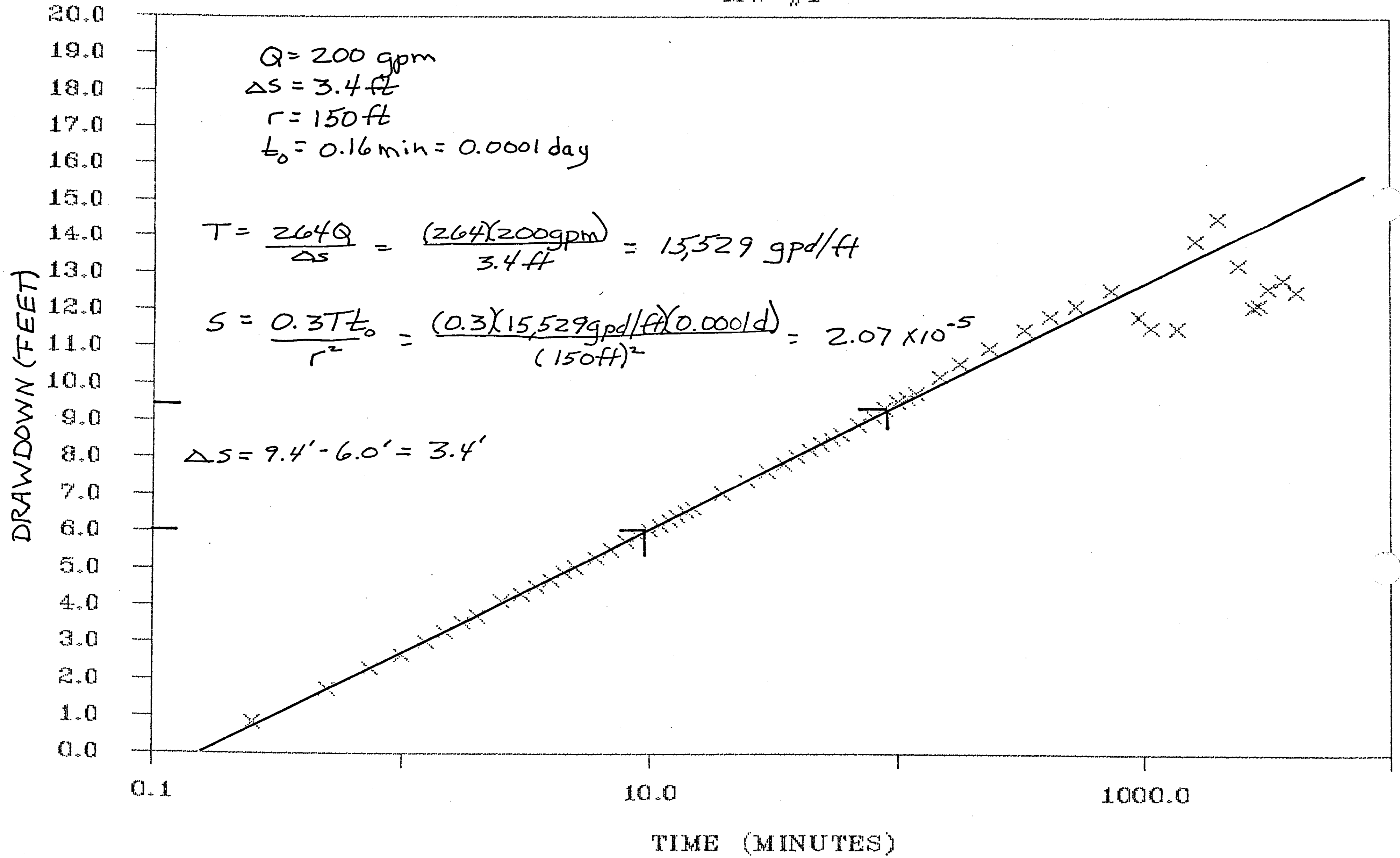
LOG-LOG GRAPH OF DRAWDOWN VS TIME

MW #1



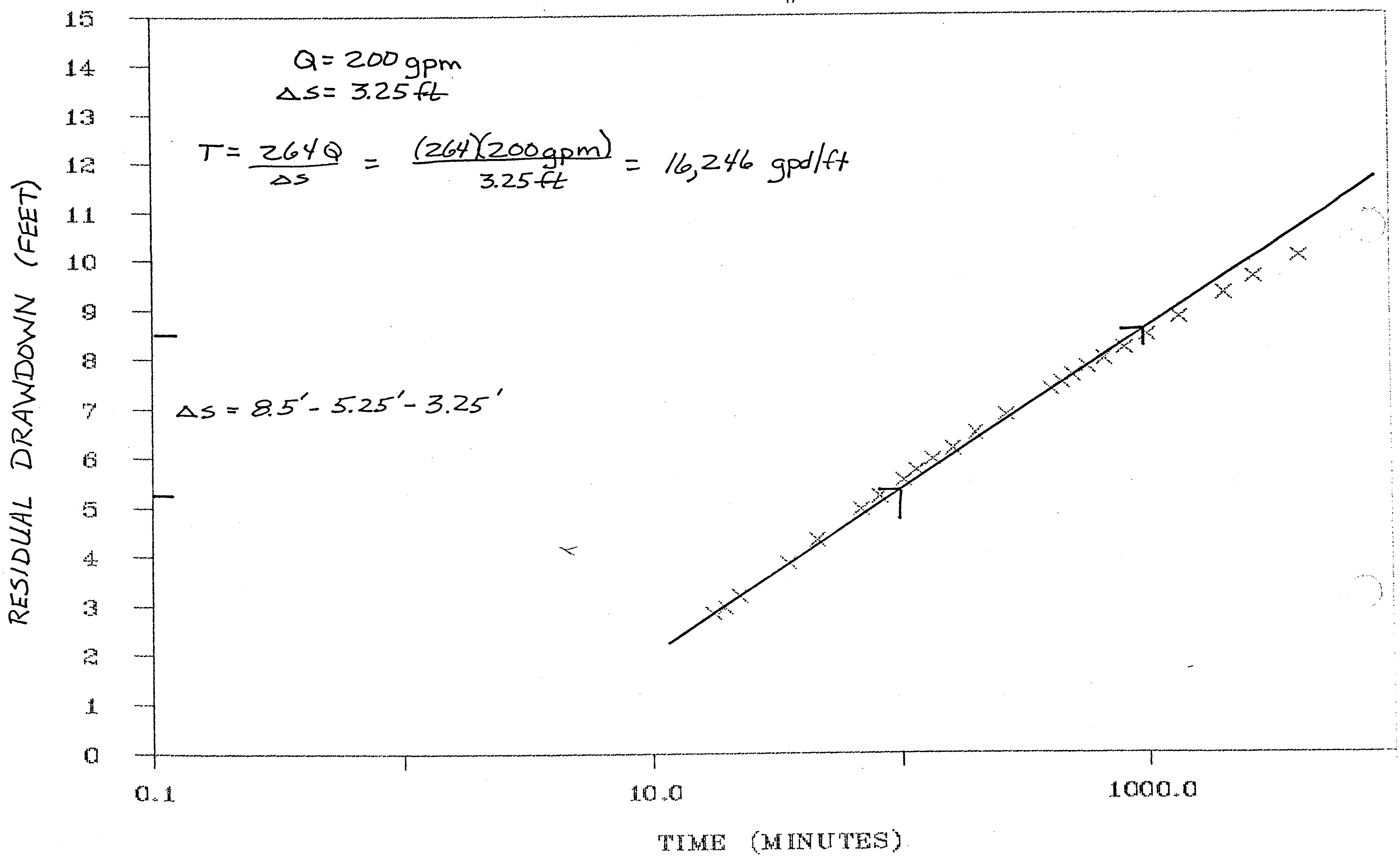
SEMI-LOG GRAPH OF DRAWDOWN VS TIME

MW #1



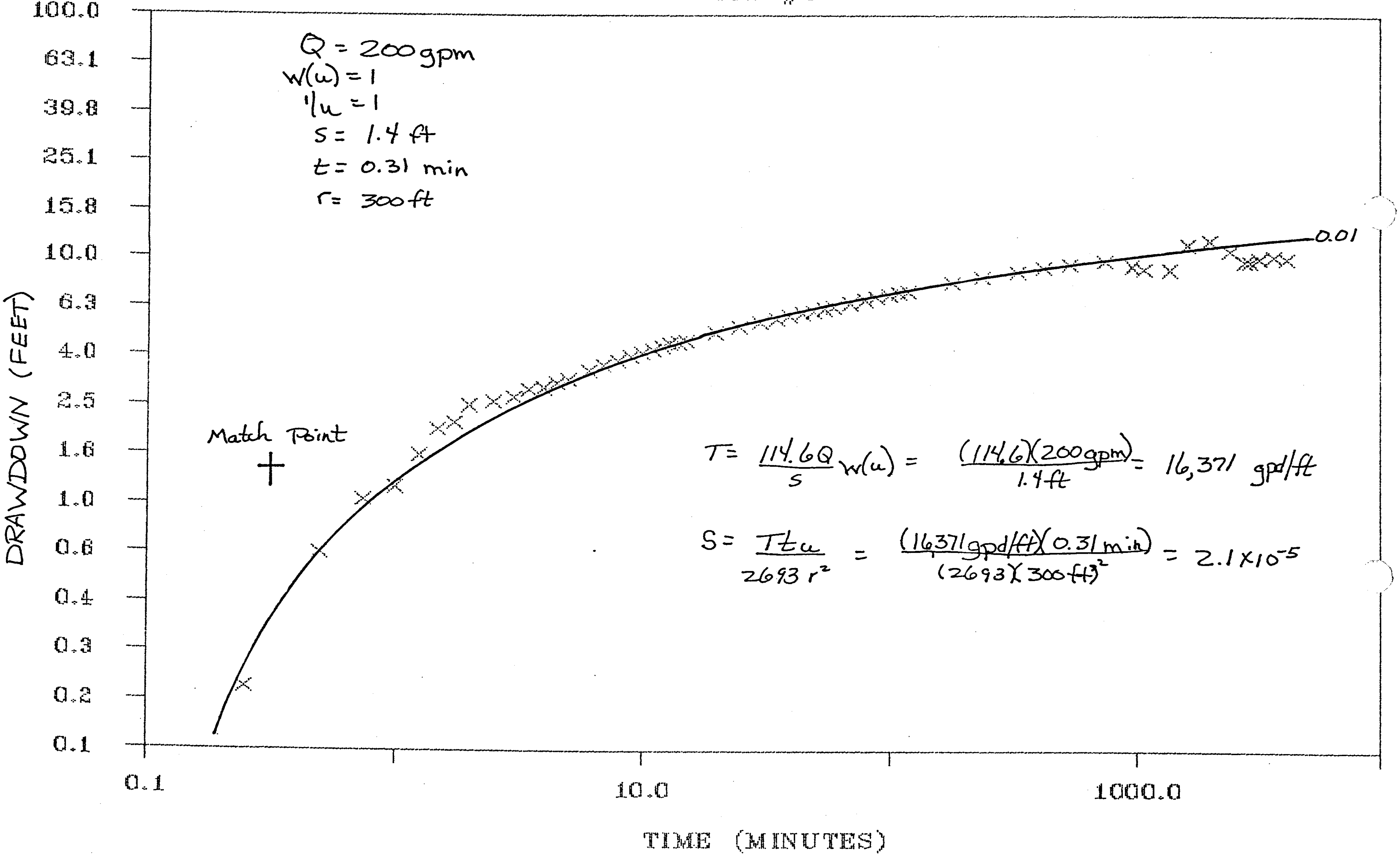
SEMI-LOG GRAPH OF RECOVERY DATA

MW #1



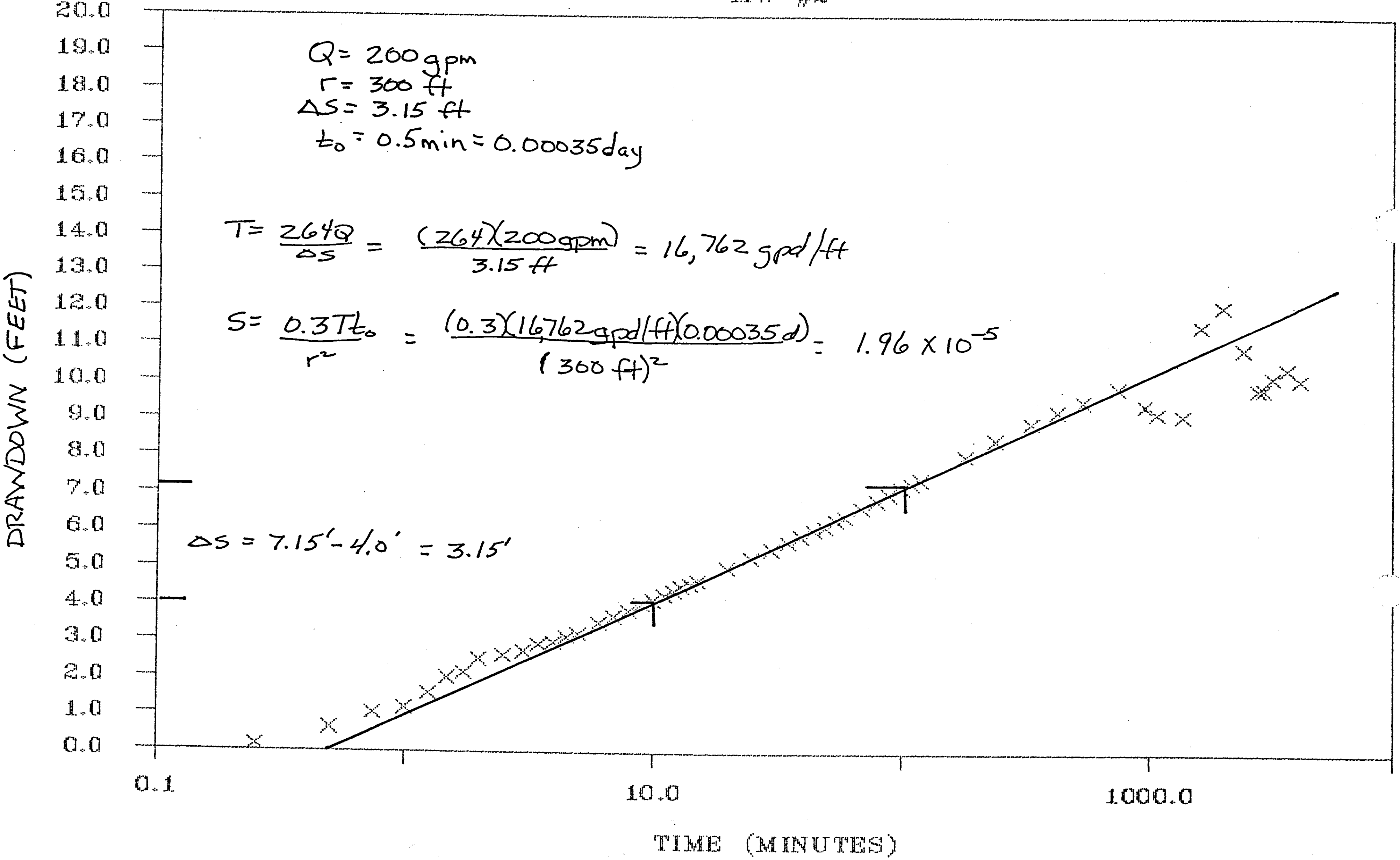
LOG—LOG GRAPH OF DRAWDOWN VS TIME

MW #2



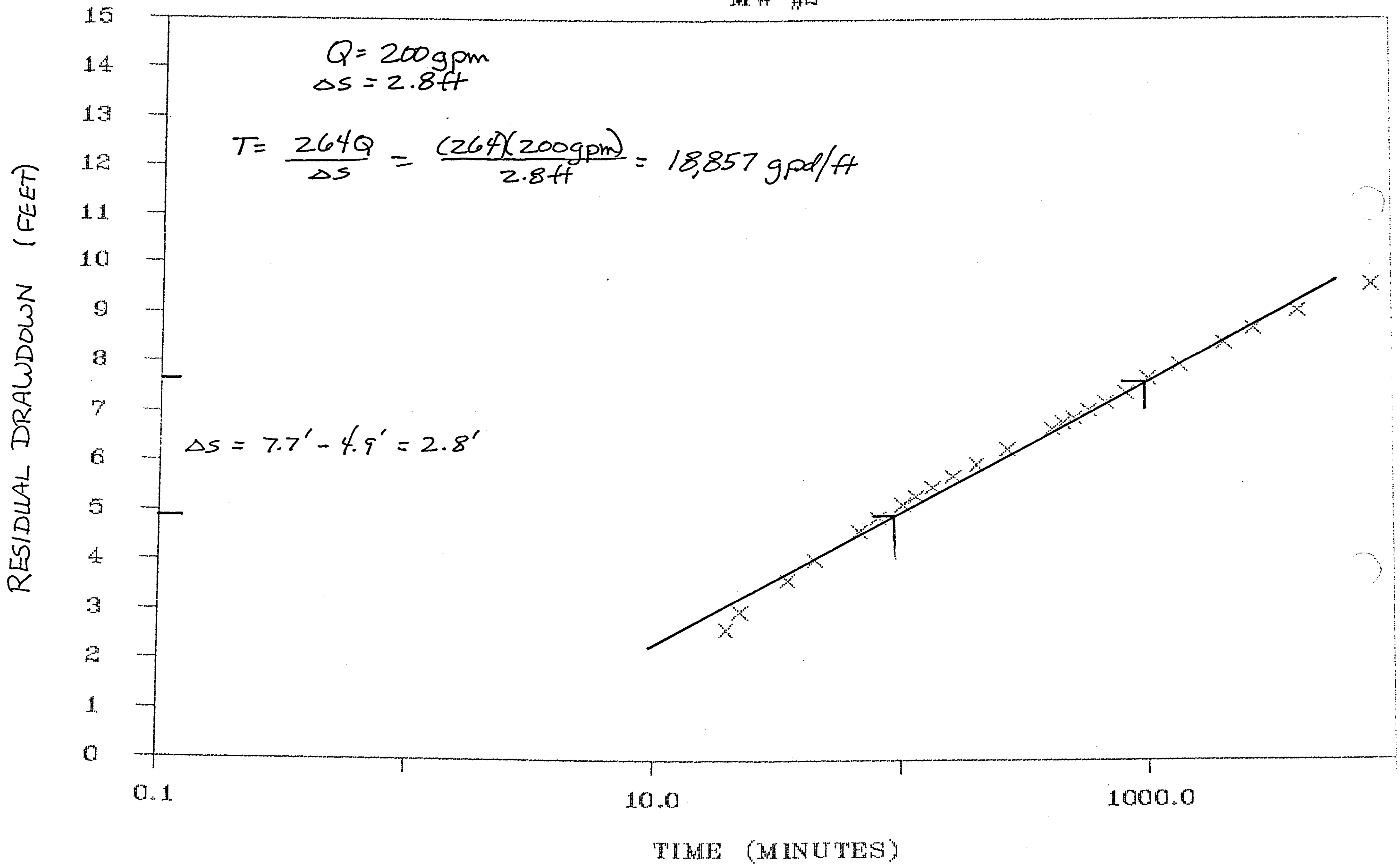
SEMI-LOG GRAPH OF DRAWDOWN VS TIME

MW #2

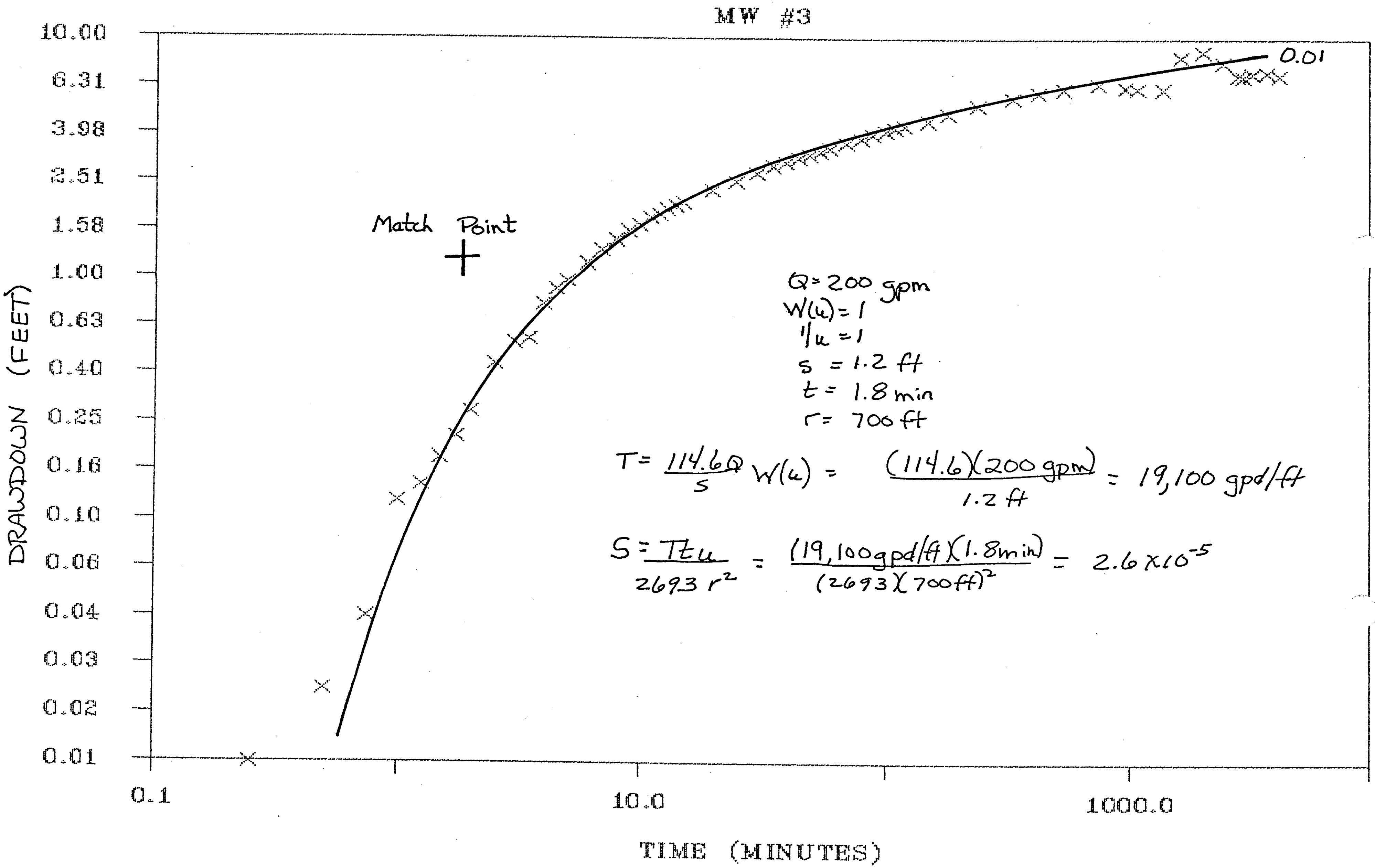


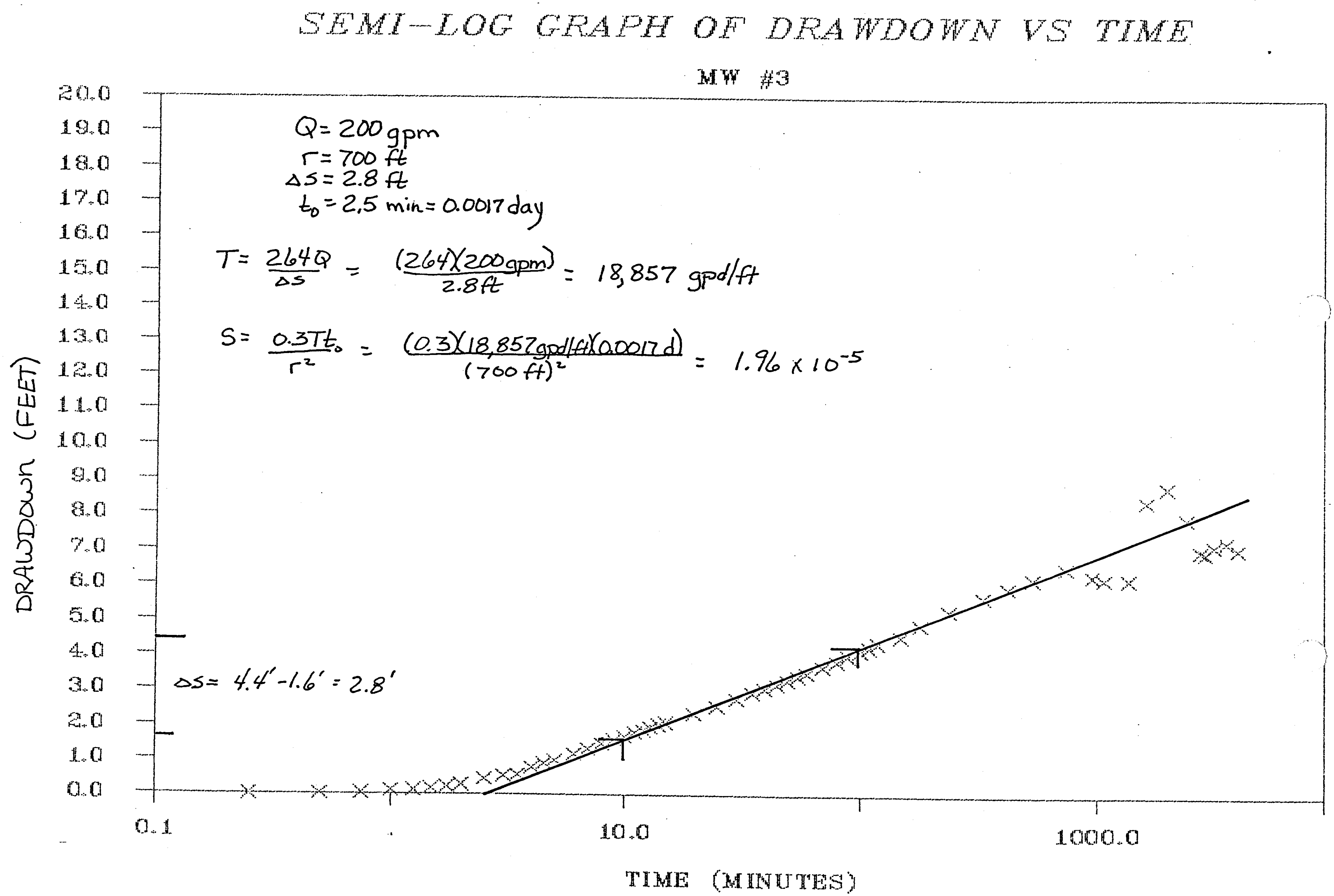
SEMI-LOG GRAPH OF RECOVERY DATA

MW #2

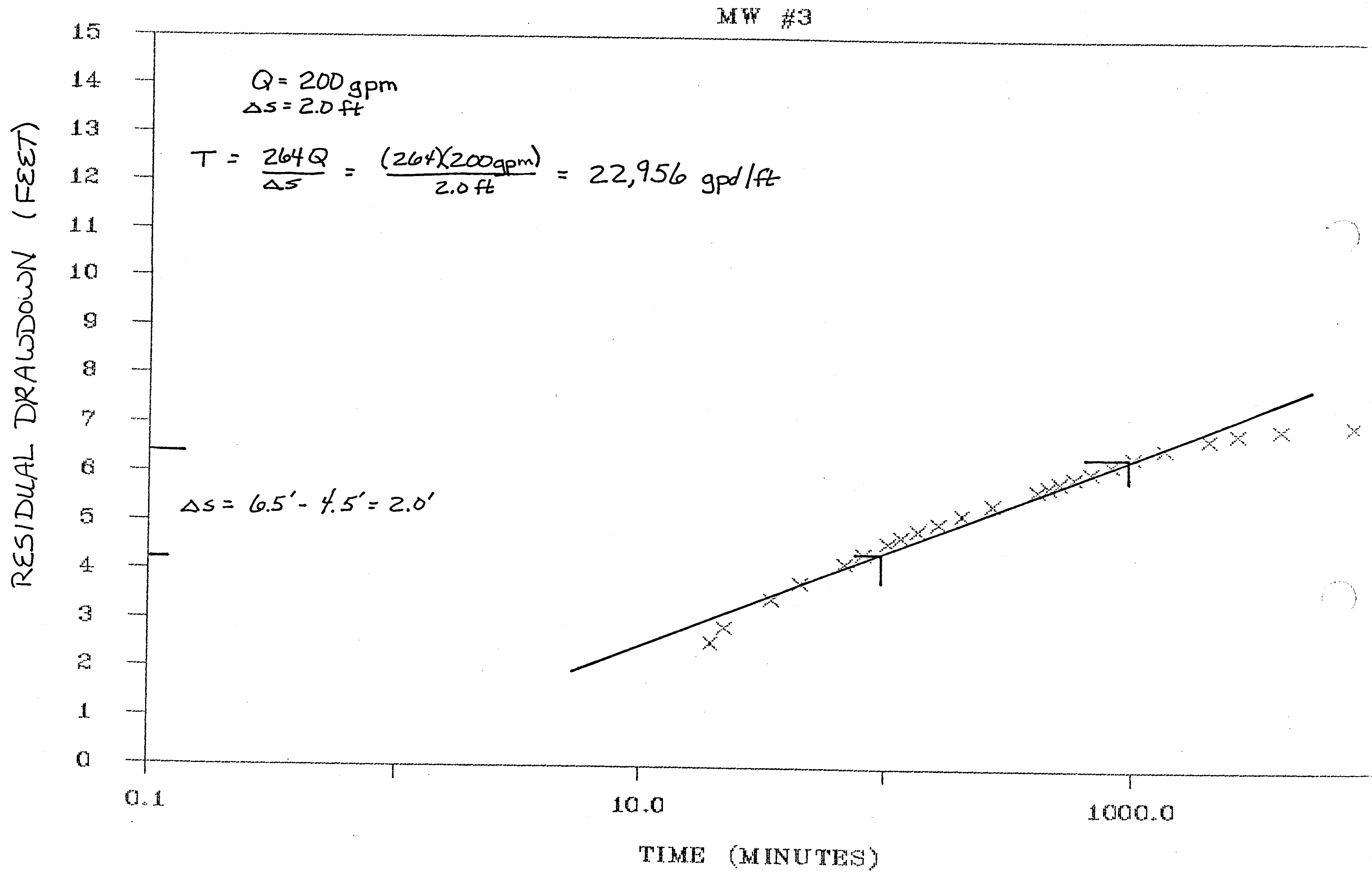


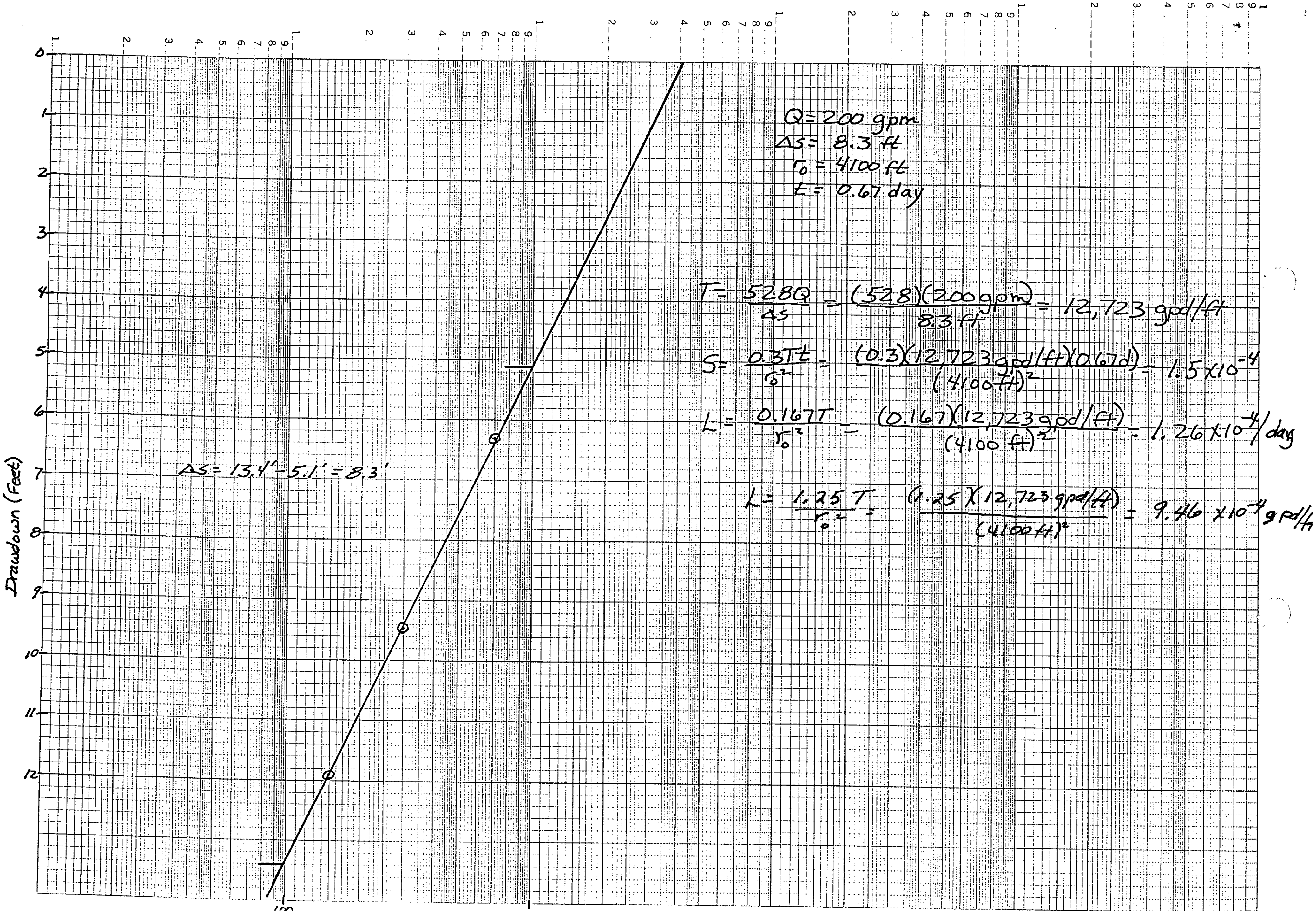
LOG–LOG GRAPH OF DRAWDOWN VS TIME




SEMI-LOG GRAPH OF DRAWDOWN VS TIME
MW #3
Q = 200 gpm
r = 700 ft
Δs = 2.8 ft
t₀ = 2.5 min = 0.0017 day
T = 264Q/Δs = (264)(200 gpm)/2.8 ft = 18,857 gpd/ft
S = 0.3Tt₀/r² = (0.3)(18,857 gpd/ft)(0.0017 d)/(700 ft)² = 1.96 x 10⁻⁵
Δs = 4.4' - 1.6' = 2.8'
DRAWDOWN (FEET)
20.0
19.0
18.0
17.0
16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.1
10.0
1000.0
TIME (MINUTES)

SEMI-LOG GRAPH OF RECOVERY DATA





DISTANCE - DRAWDOWN GRAPH

Q = 200 gpm
Δs = 8.3 ft
r_0 = 4100 ft
t = 0.67 day

$$T = \frac{528Q}{\Delta s} = \frac{(528)(200\,gpm)}{8.3\,ft} = 12{,}723\ gpd/ft$$

$$S = \frac{0.3Tt}{r_0^2} = \frac{(0.3)(12{,}723\,gpd/ft)(0.67d)}{(4100\,ft)^2} = 1.5 \times 10^{-4}$$

$$L = \frac{0.167T}{r_0^2} = \frac{(0.167)(12{,}723\,gpd/ft)}{(4100\,ft)^2} = 1.26 \times 10^{-4}/day$$

$$L = \frac{1.25\,T}{r_0^2} = \frac{(1.25)(12{,}723\,gpd/ft)}{(4100\,ft)^2} = 9.46 \times 10^{-4}\ gpd/ft$$