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TESTING OF TWO WELLS AT THE
DOUBLE DIAMOND RANCH NEAR
RENO, NEVADA

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RENO, NEVADA

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1.0--CONCLUSION

The Double Diamond wells, under present conditions, are capable of a long-term yield of 330 gpm and 800 gpm for Wells DD-T-1 and DD-T-2, respectively. Higher short-term yields are acceptable if pumping stays within the constraints of available drawdown, casing diameter, and pumping duration.

2.0--AQUIFER CHARACTERISTICS

Aquifer characteristics determined by the pumping test conducted by CH2M HILL in February 1984 are consistent with the aquifer characteristics found by Hydro-Search, Inc., in December 1980 and January 1981. Table 1 summarizes the results of each test pumping.

3.0--LONG-TERM YIELD

The estimated yield of DD-T-1 is 330 gpm, and the estimated yield of DD-T-2 is 800 gpm. Many factors affect estimates of long-term yield of a well. Listed below are some of the main factors associated with predictions of long-term yield and their relationship to the Double Diamond wells. Calculations of estimated long-term yield are shown in Table 2.

1. Pumping Duration--Estimates of long-term yield may be based on continuous pumping or intermittent pumping (such as that caused by seasonal changes in demand). Estimates of long-term yield for the Double Diamond wells are based on a continuous demand for 19 years. Different values for duration of pumping and well yield may be substituted in the yield formula to estimate yield for intermittent demands.
2. Limitations of Pumping Test--Long-term yield is based on data collected during 24 hours of continuous pumping. Estimates of long-term yield are based on the assumption that the aquifer is not limited and will continue to respond under the same conditions shown in the pumping test data. Hydro-Search, Inc., ran a 72-hour pumping test in 1981. Their data indicate the aquifer associated with the Double Diamond wells is more likely to intercept recharge and may at some point during pumping reach steady-state conditions (steady-state meaning flow into the well means discharge without additional drawdown). Our long-term yield estimates are conservatively based on the 24-hour test pumping data.

Table 1
DATA SUMMARY
DOUBLE DIAMOND RANCH WELL TESTS

		<u>Pumping</u>	<u>Recovery</u>
<u>Well No. DD-T-1 (Pumping)^a</u>			
1984	CH2M HILL Transmissivity (gpd/ft)	10,200	9,600
1981	Hydro-Search (gpd/ft)	9,600	10,300
Well Efficiency at 300 gpm = 74 percent			
<u>Well No. DD-O-1 (Observation)^a</u>			
1984	CH2M HILL Transmissivity (gpd/ft)	12,500	11,400
1981	Hydro-Search Transmissivity (gpd/ft)	11,900	11,300
1984	CH2M HILL Storage Coefficient	1.1×10^{-4}	
1981	Hydro-Search Storage Coefficient	4.0×10^{-4}	
<u>Well No. DD-T-2 (Pumping)^b</u>			
1984	CH2M HILL Transmissivity (gpd/ft)	12,000	12,800
1981	Hydro-Search Transmissivity (gpd/ft)	10,900	13,400
Well Efficiency at 300 gpm = 84 percent			
<u>Well No. DD-O-2 (Recovery)^b</u>			
1984	CH2M HILL Transmissivity (gpd/ft)	16,200	14,400
1981	Hydro-Search Transmissivity (gpd/ft)	13,500	11,600
1984	CH2M HILL Storage Coefficient	1.7×10^{-3}	
1981	Hydro-Search Storage Coefficient	1.9×10^{-3}	

^aAverage T value = 10,800 gpd/ft

^bAverage T value = 13,100 gpd/ft

Table 2
ESTIMATES OF LONG-TERM YIELD
DOUBLE DIAMOND WELLS

Well DD-T-1

Assumptions

1. 19-year continuous pumping (7-log cycles)
2. 57 feet of available drawdown ($\Delta s = 8.1$ ft per log cycle)
3. 10,800 gpd/ft transmissivity value (T)

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

$$Q = \frac{10,800 \times 8.1}{264}$$

$$Q = 330 \text{ gallons per minute}$$

Recommended Maximum Q = 330 gallons per minute. Well efficiency for DD-T-1 at 330 gallons per minute is approximately 70 percent.

Well DD-T-2

Assumptions

1. 19-year continuous pumping (7-log cycles)
2. 114 feet of available drawdown ($\Delta s = 16.2$ ft per log cycle)
3. 13,100 gpd/ft transmissivity value (T)

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

$$Q = \frac{13,100 \times 16.2}{264}$$

$$Q = 800 \text{ gallons per minute}$$

Recommended Maximum Q = 800 gallons per minute^a. Well efficiency for DD-T-2 at 700 gpm is approximately 70 percent.

^aAlthough test pumping data indicate the aquifer will yield 800 gpm for 7-log cycles, the small diameter casing may be significant as a controlling factor.

3. Available Drawdown--Long-term yield (19 years) is estimated considering the deepest pumping level desirable. Generally, the desired maximum depth is just above the first perforated zone. For the Double Diamond wells this depth is 57 feet and 114 feet, respectively, for Wells DD-T-1 and DD-T-2. Potentiometric surfaces are just above ground surface for each well, so available drawdown is approximately 57 feet and 114 feet for Wells DD-T-1 and DD-T-2, respectively.
4. Casing Diameter--Casing diameter limits the size of the pump that may be installed in the well. High uphole velocities caused by high pumping yields from small diameter casings may cause deleterious effects on the well and pump. Based on the test pumping data from DD-T-2, long-term yields may be limited by the small diameter well casing.
5. Additional Aquifer Demand--Pumping wells within each other's area of influence compound drawdown rates. Additional well development within the radius of influence of the Double Diamond wells would reduce the long-term yield of the wells.
6. Well Efficiency--The effects of well efficiency on long-term yield are primarily economic. Additional drawdown caused by well inefficiency increases energy costs associated with pumping lift. The shallow pumping levels anticipated with the Double Diamond wells do not make well efficiency a major factor. Calculated efficiencies at various pumping rates for each well are shown in the appendix.

4.0--FIELD WORK

Field work was undertaken in February 1984. Robertson Engineering of Carson City, Nevada, provided the necessary equipment and personnel to install and operate the test pumping equipment. Water level data and field calculations were completed by a CH2M HILL hydrogeologist and Washoe County personnel.

A step-drawdown and 24-hour constant discharge pumping test was run on each well. Water was discharged away from the pumping well down a drainage channel. Water levels were measured in the pumping well and one observation well for each test. Measurements were made during pumping and recovery. Discharge rates were monitored using an orifice plate flow monitoring device. With the exception of a minor engine stall during the constant discharge testing of Well

DD-T-1, the pumping tests ran smoothly. Data and calculations for each aspect of the pumping test are included in the appendix.

5.0--WATER QUALITY

Samples were collected for water quality analysis at the end of each 24-hour constant discharge test. The samples were retained by Washoe County for analysis. Those analyses should be attached to this report when they become available.

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6.0--APPENDIX

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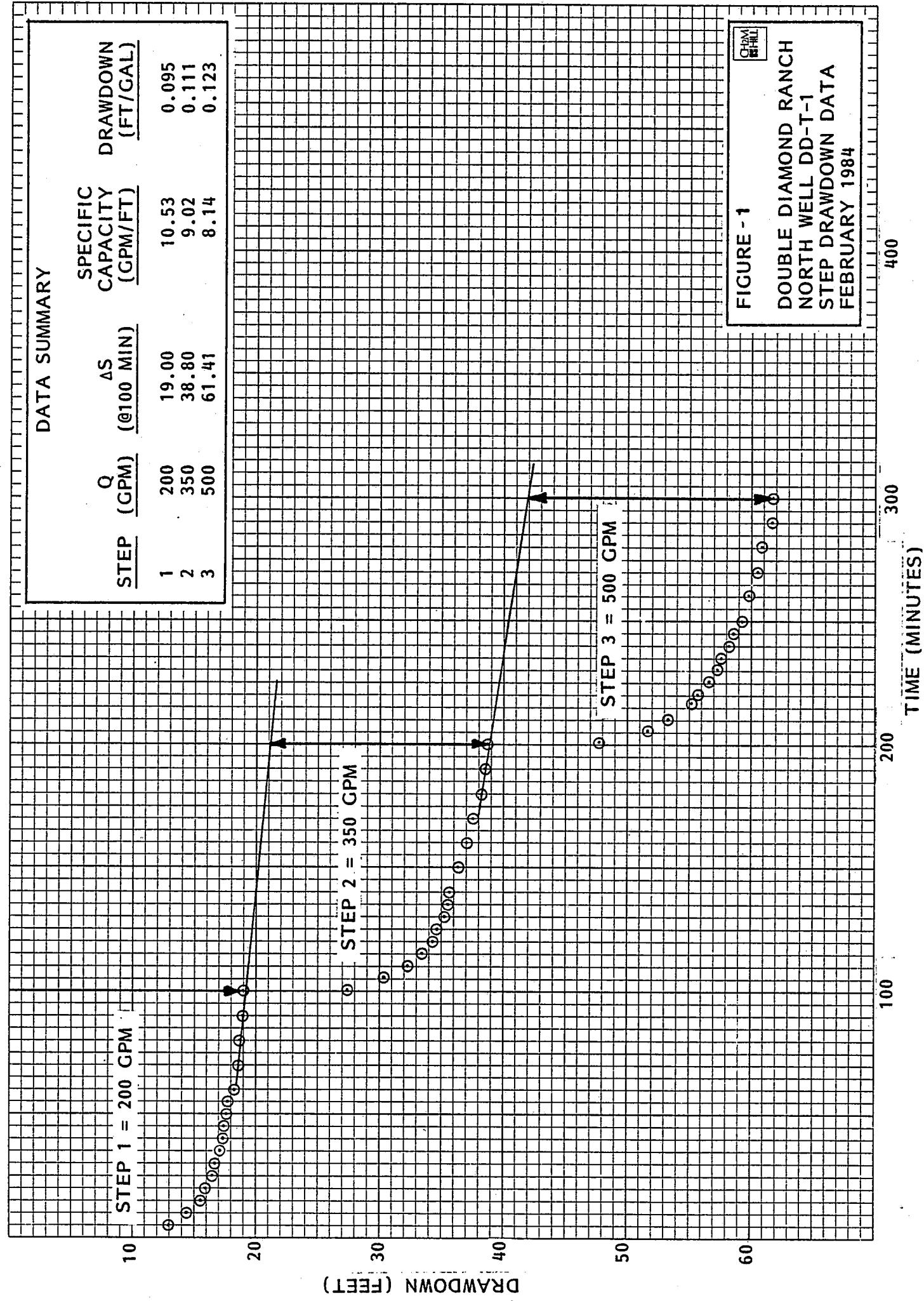
North Well

Figure 1, 2, 3--Well DD-T-1--Step Drawdown Data
Figure 4--Well DD-T-1--Pumping Data
Figure 5--Well DD-T-1--Recovery Data
Figure 6--Well DD-O-1--Pumping Data
Figure 7--Well DD-O-1--Recovery Data

South Well

Figure 8, 9, 10--Well DD-T-2--Step Drawdown Data
Figure 11--Well DD-T-2--Pumping Data
Figure 12--Well DD-T-2--Recovery Data
Figure 13--Well DD-O-1--Pumping Data
Figure 14--Well DD-O-1--Recovery Data

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DRAWDOWN (FT/GPM)

DRAWDOWN
MADE IN U.S.A.

10 X 10 PER INCH

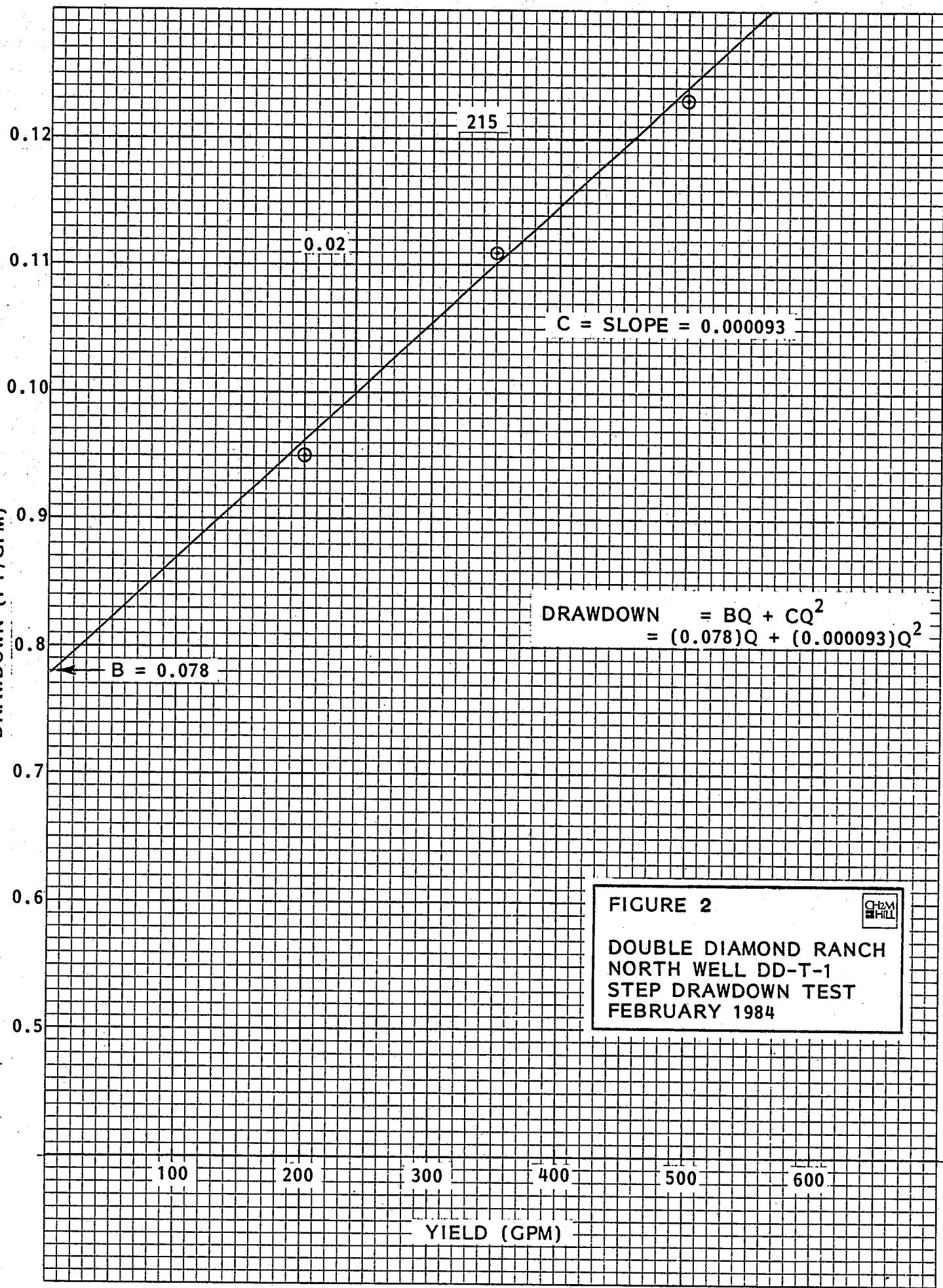


FIGURE 2

CH2M
HILL

DOUBLE DIAMOND RANCH
NORTH WELL DD-T-1
STEP DRAWDOWN TEST
FEBRUARY 1984

DRAZEN CORPORATION

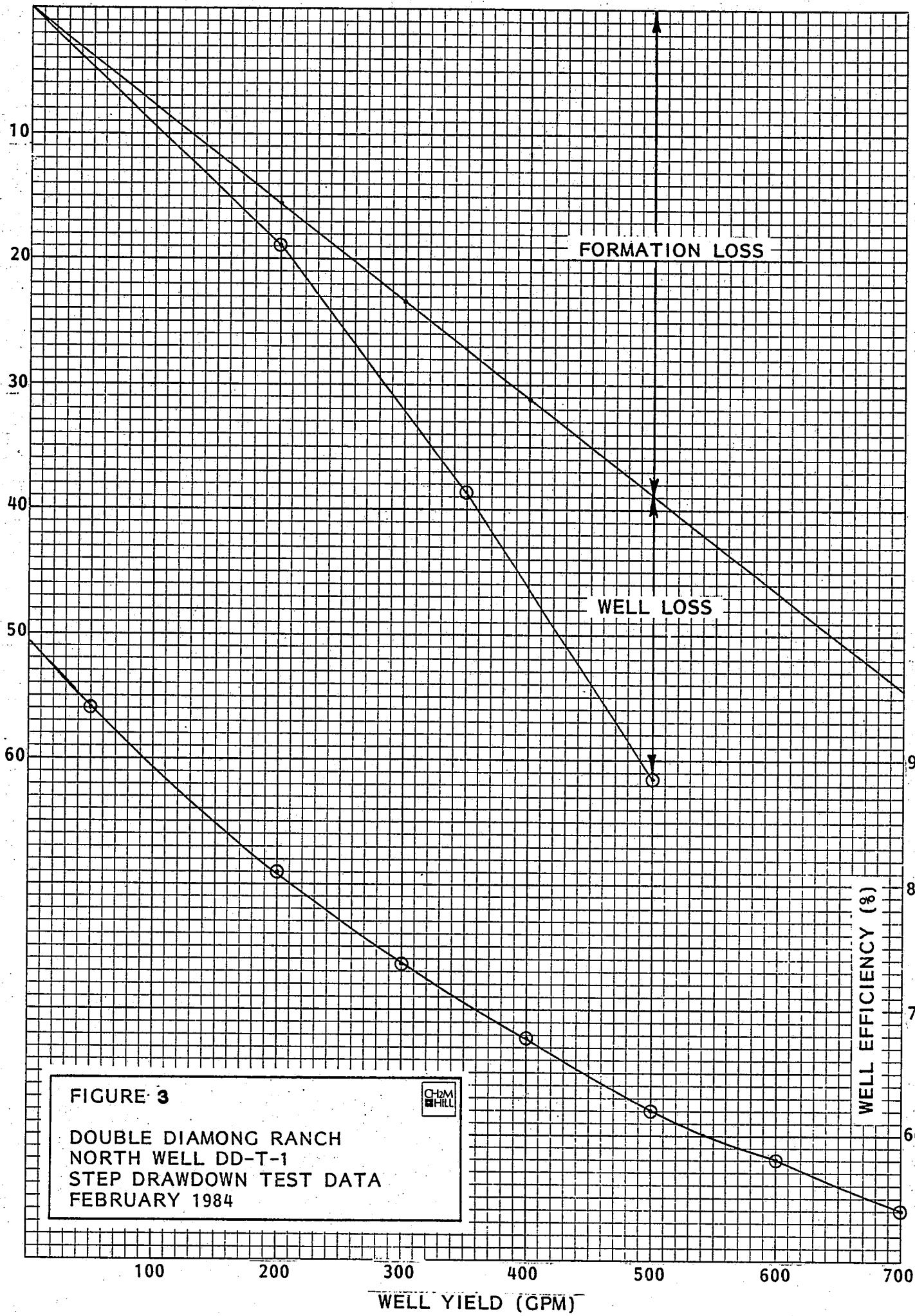


FIGURE 3

DOUBLE DIAMOND RANCH
NORTH WELL DD-T-1
STEP DRAWDOWN TEST DATA
FEBRUARY 1984

CH2M
HILL

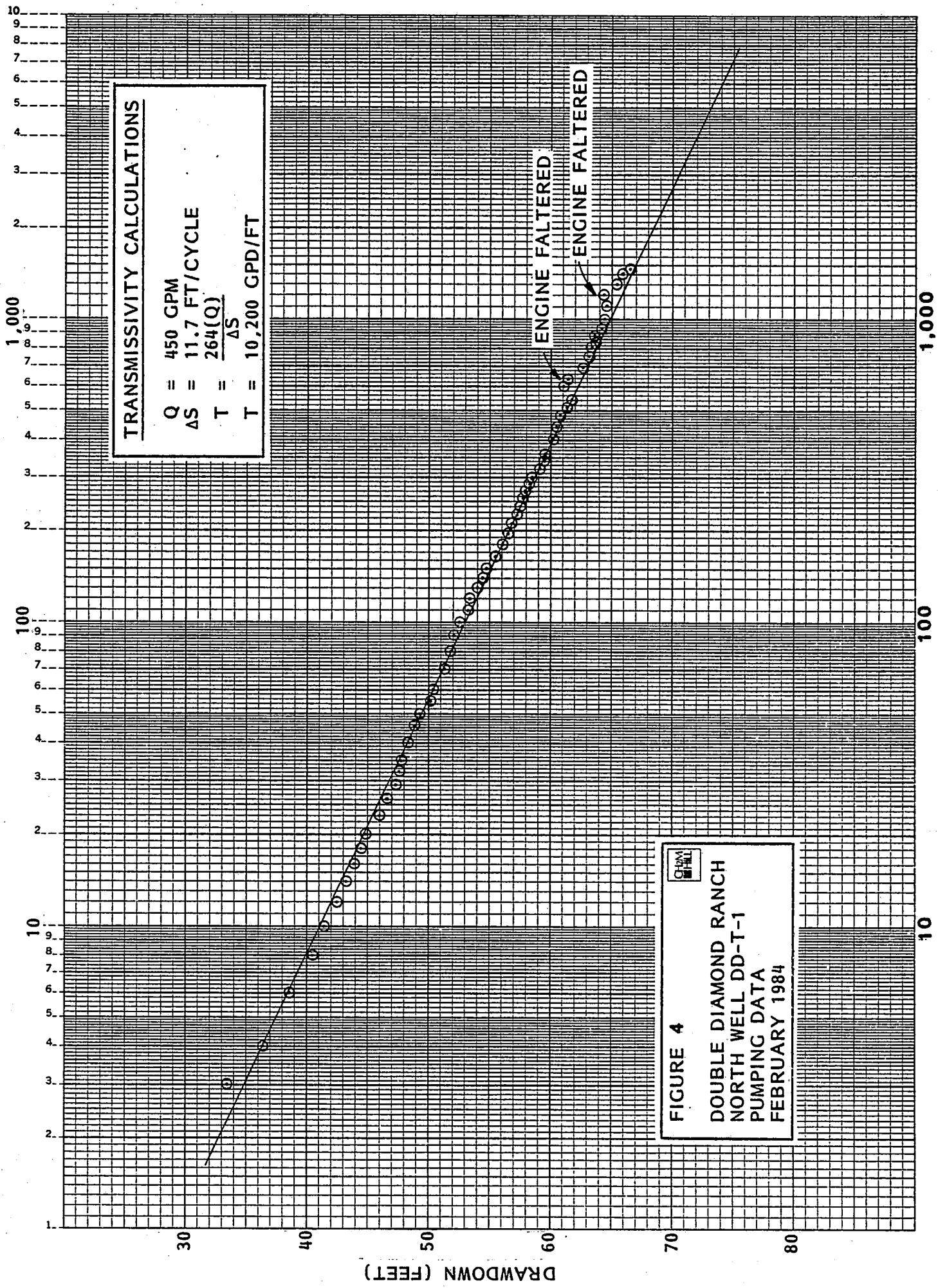
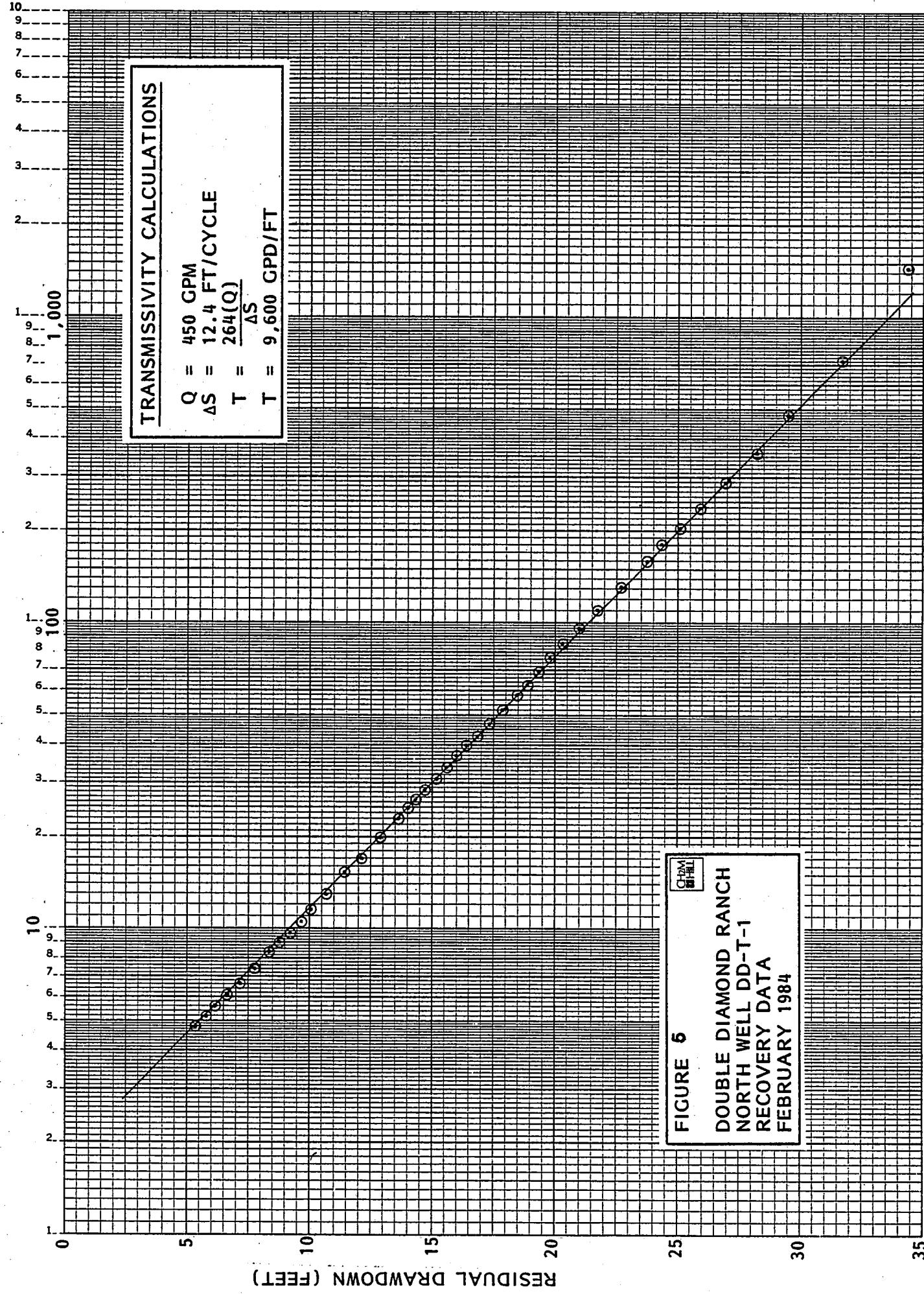


FIGURE 4
DOUBLE DIAMOND RANCH
NORTH WELL DD-T-1
PUMPING DATA
FEBRUARY 1984

CHM
HILL



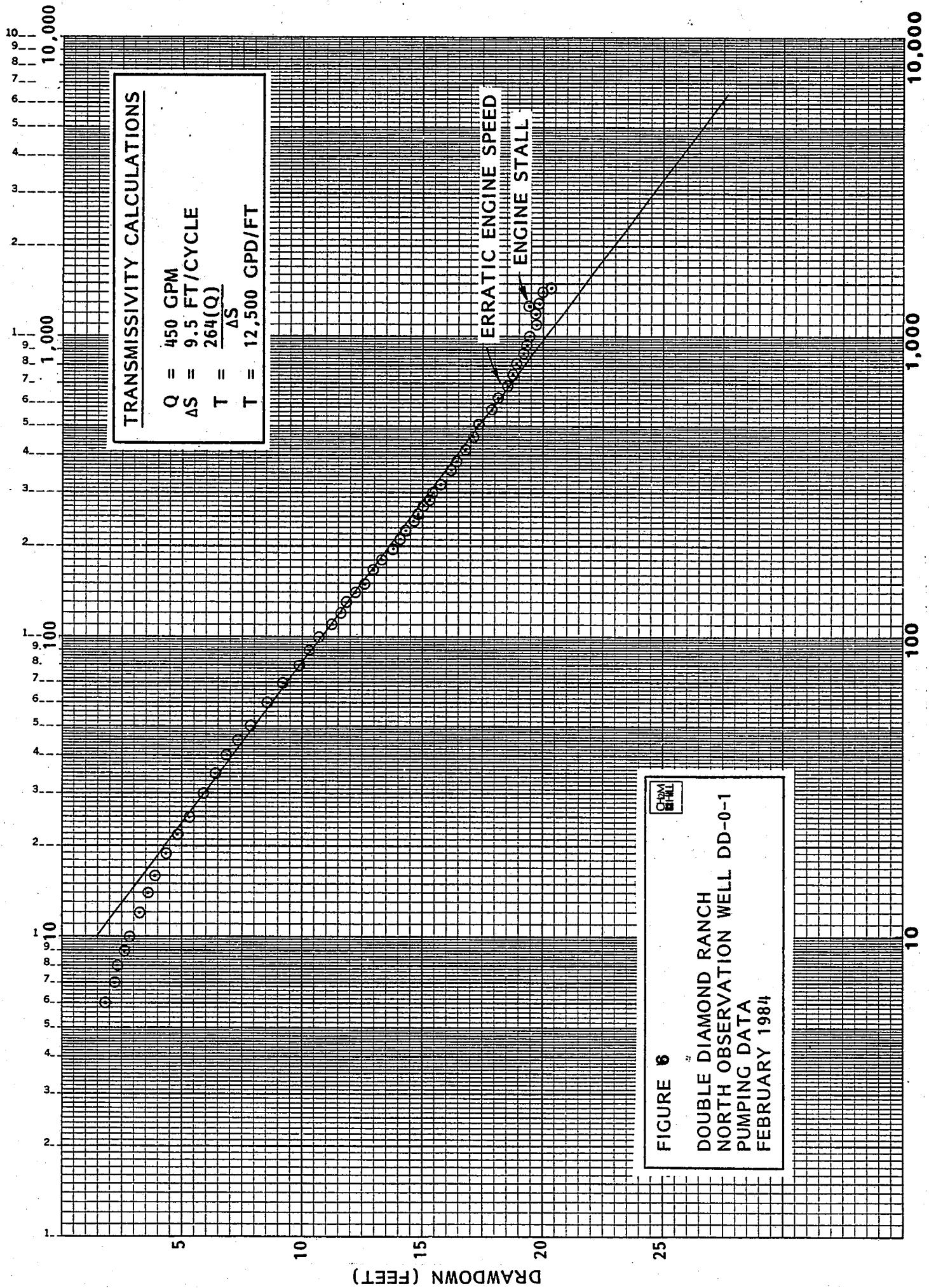


FIGURE 6
DOUBLE DIAMOND RANCH
NORTH OBSERVATION WELL DD-0-1
PUMPING DATA
FEBRUARY 1984

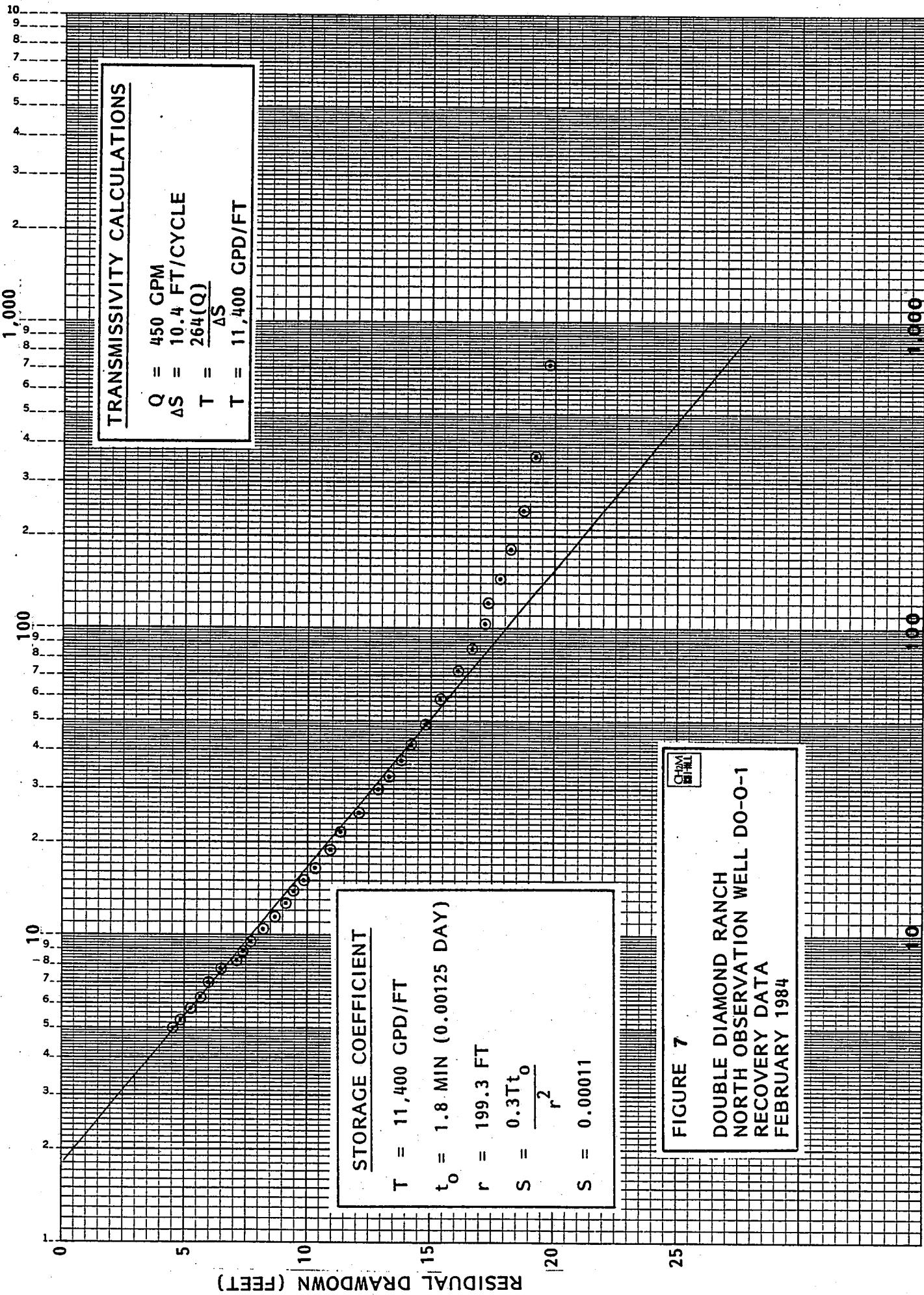
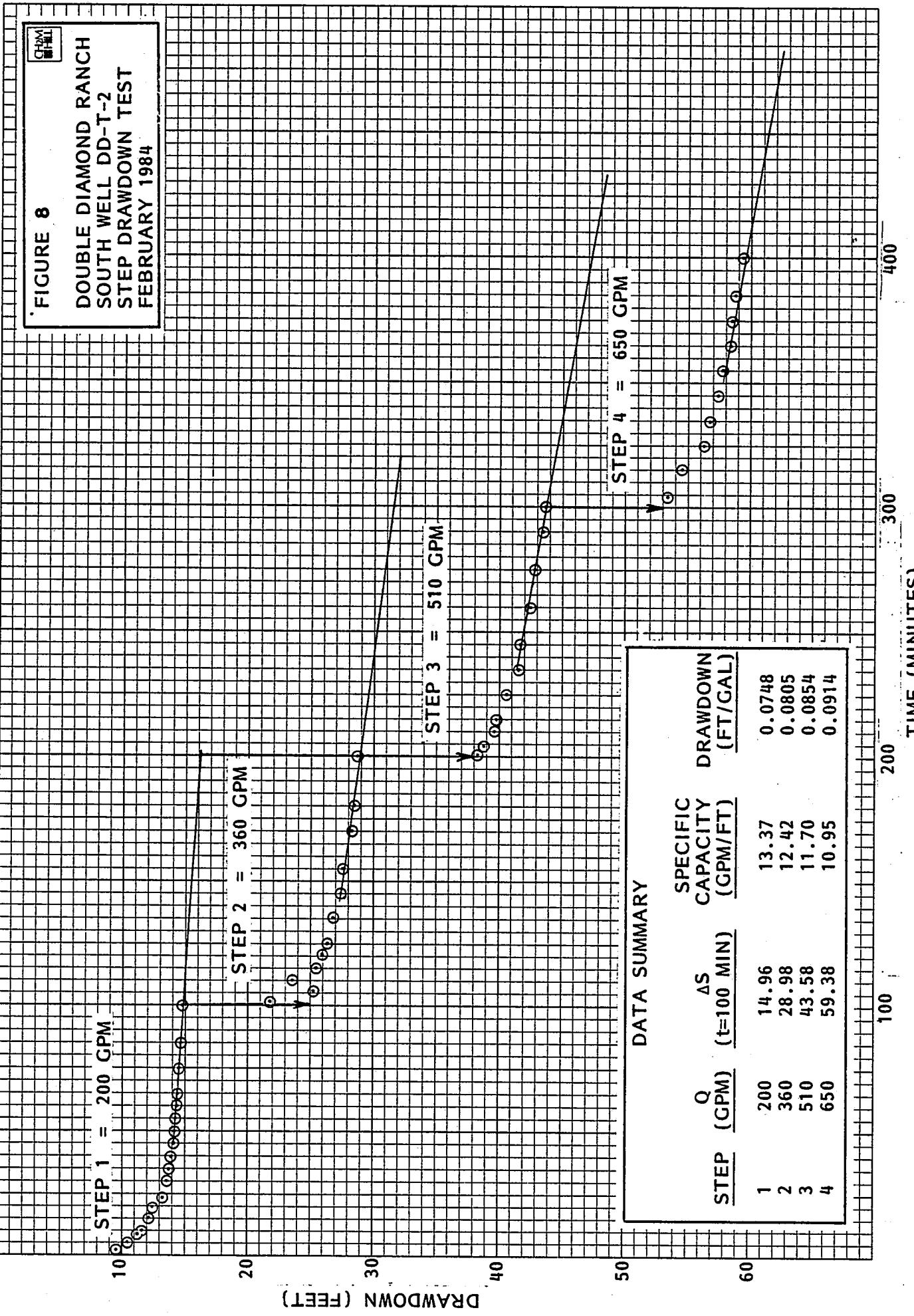


FIGURE 7

DOUBLE DIAMOND RANCH
NORTH OBSERVATION WELL DO-O-1
RECOVERY DATA
FEBRUARY 1984

FIGURE 8
DOUBLE DIAMOND RANCH
SOUTH WELL DD-T-2
STEP DRAWDOWN TEST
FEBRUARY 1984



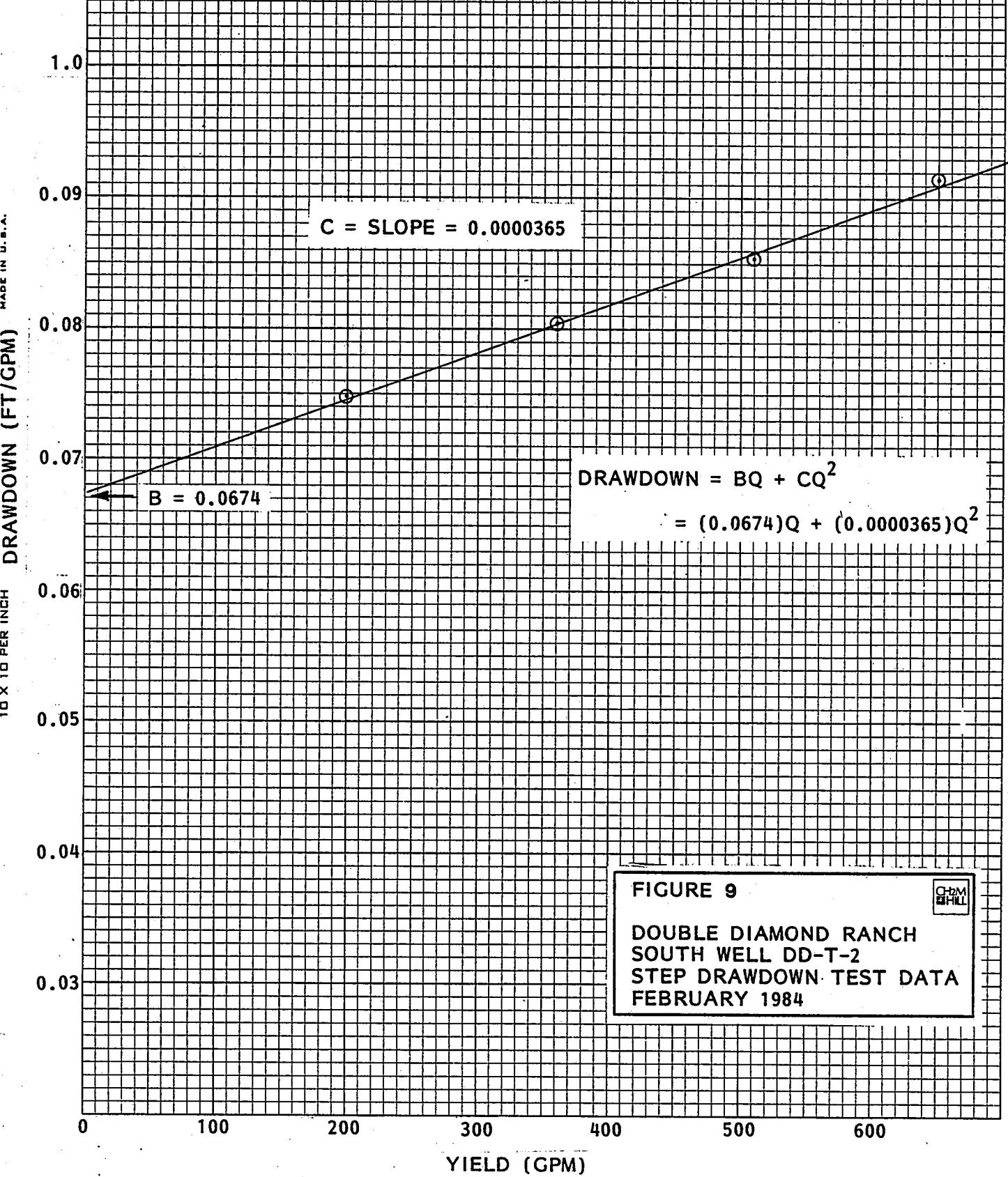
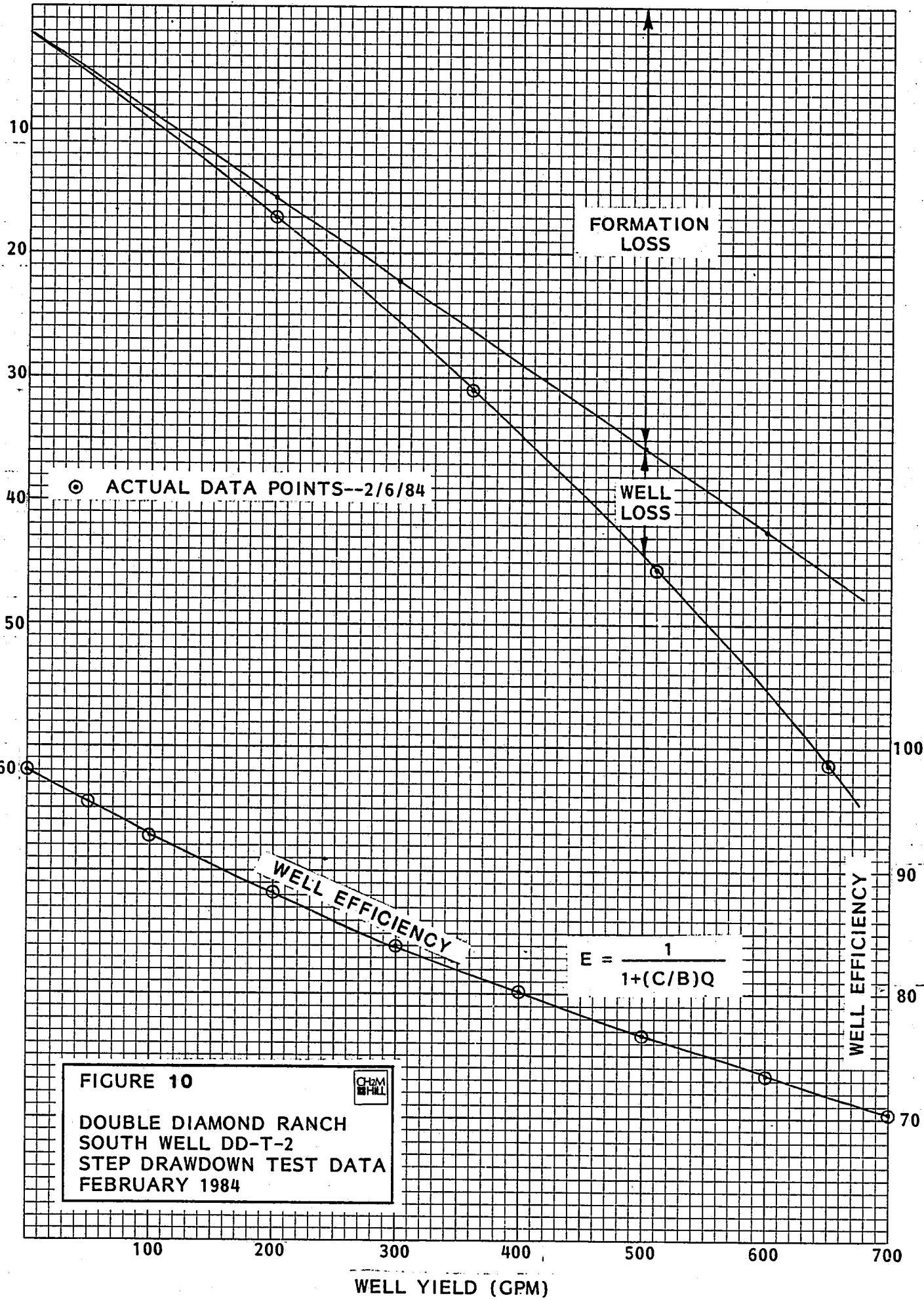


FIGURE 9

DOUBLE DIAMOND RANCH
SOUTH WELL DD-T-2
STEP DRAWDOWN TEST DATA
FEBRUARY 1984





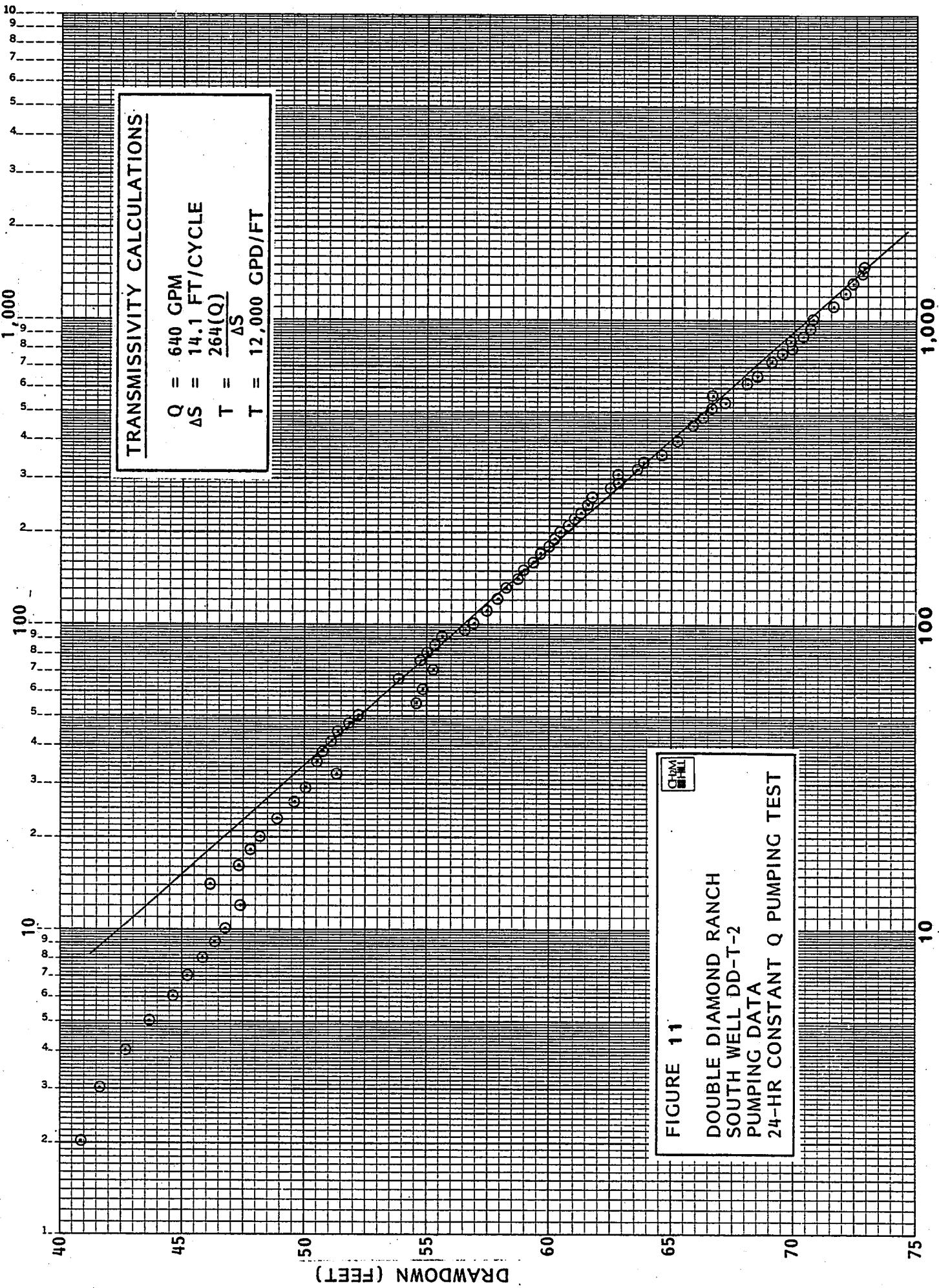


FIGURE 11

DOUBLE DIAMOND RANCH
SOUTH WELL DD-T-2
PUMPING DATA
24-HR CONSTANT Q PUMPING TEST

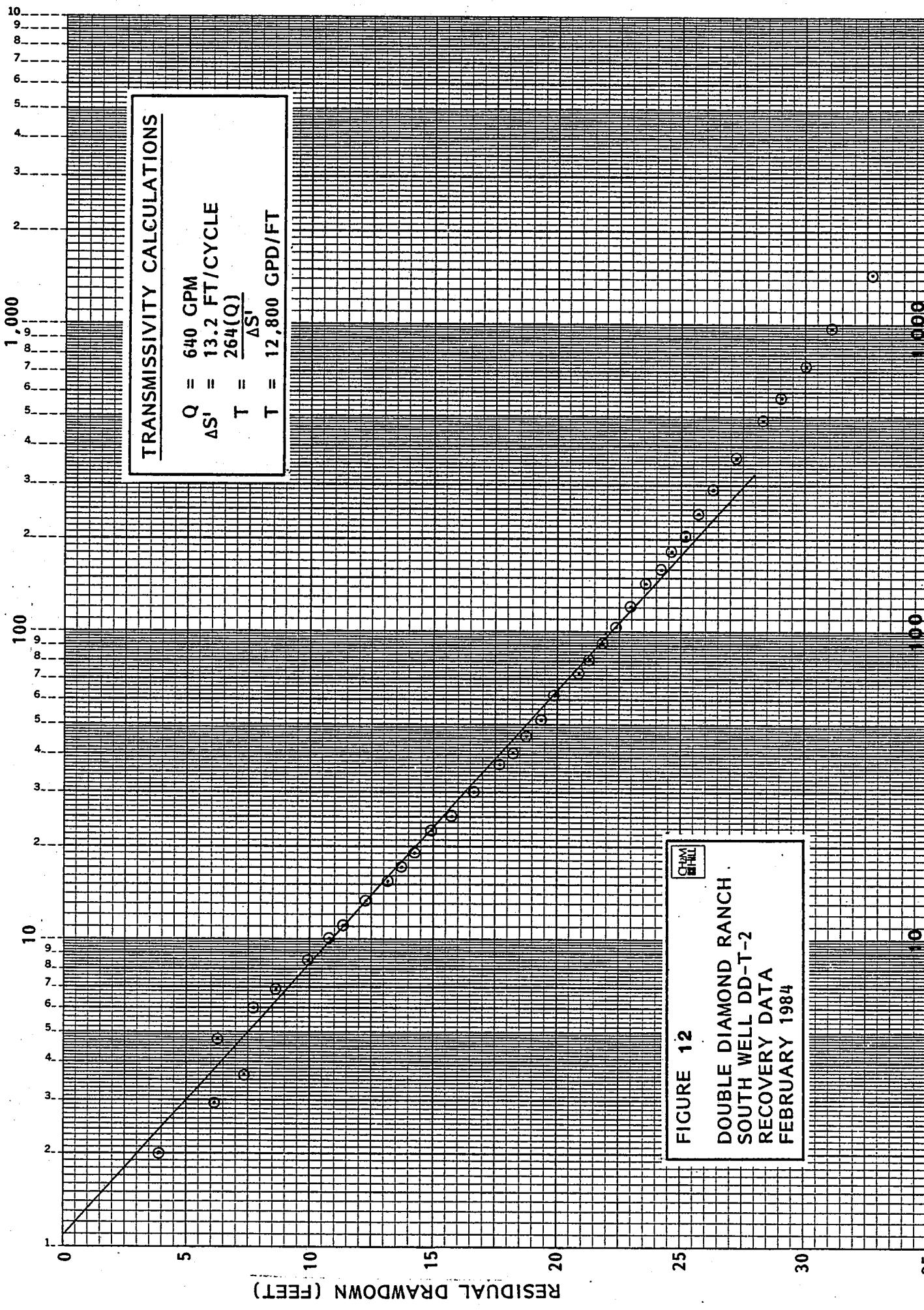


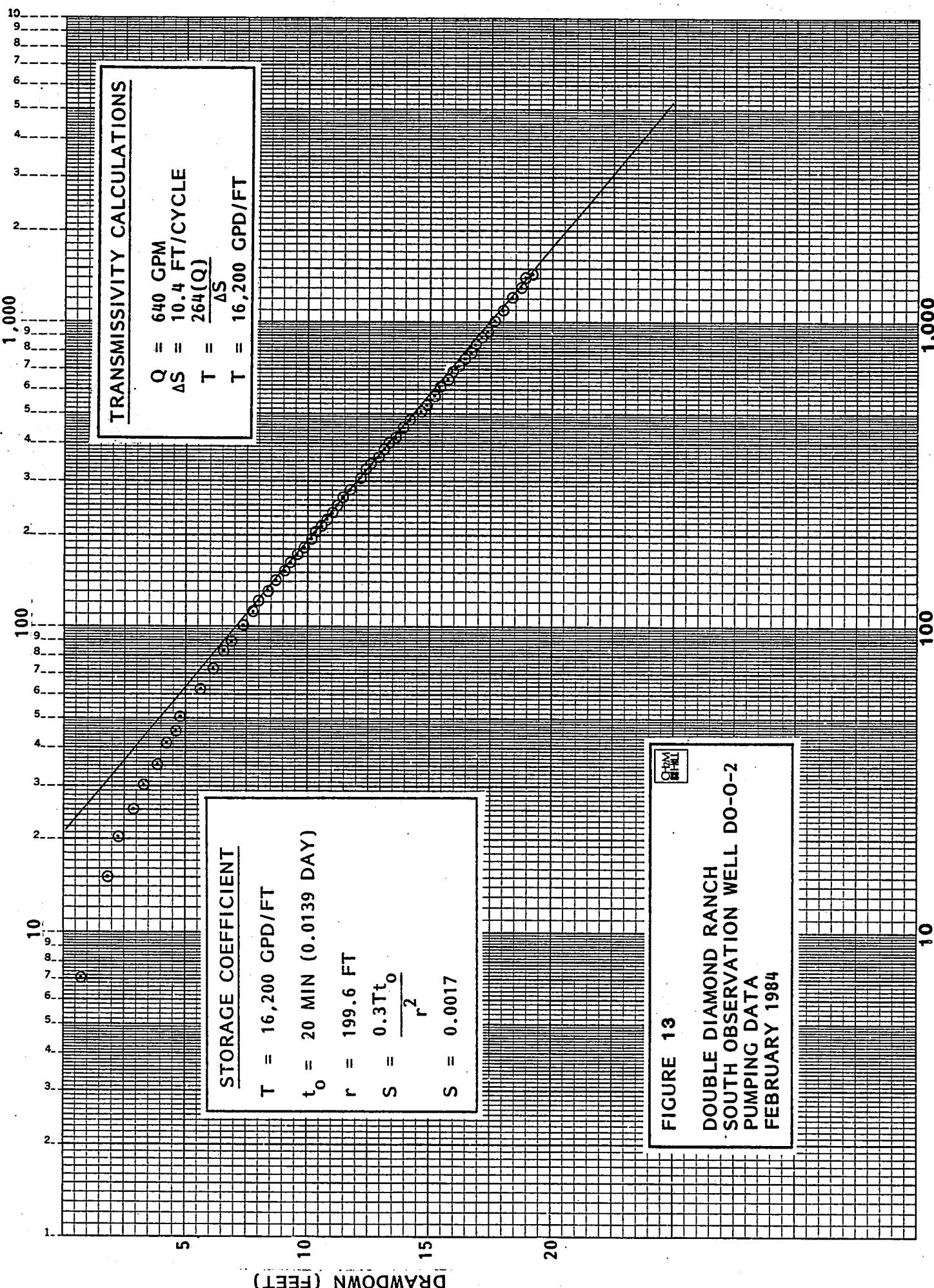
FIGURE 12
DOUBLE DIAMOND RANCH
SOUTH WELL DD-T-2
RECOVERY DATA
FEBRUARY 1984

25 30

100
10
1
0.1
0.01
0.001
 t/t

100
10
1
0.1
0.01
0.001

35



CHM
B&H

FIGURE 13

DOUBLE DIAMOND RANCH
SOUTH OBSERVATION WELL DO-0-2
PUMPING DATA
FEBRUARY 1984

K-E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013

1,000

TRANSMISSIVITY CALCULATIONS

$$Q = 640 \text{ GPM}$$
$$\Delta S = 11.7 \text{ FT/CYCLE}$$
$$T = \frac{264(Q)}{\Delta S'}$$
$$T = 14,400 \text{ GPD/FT}$$

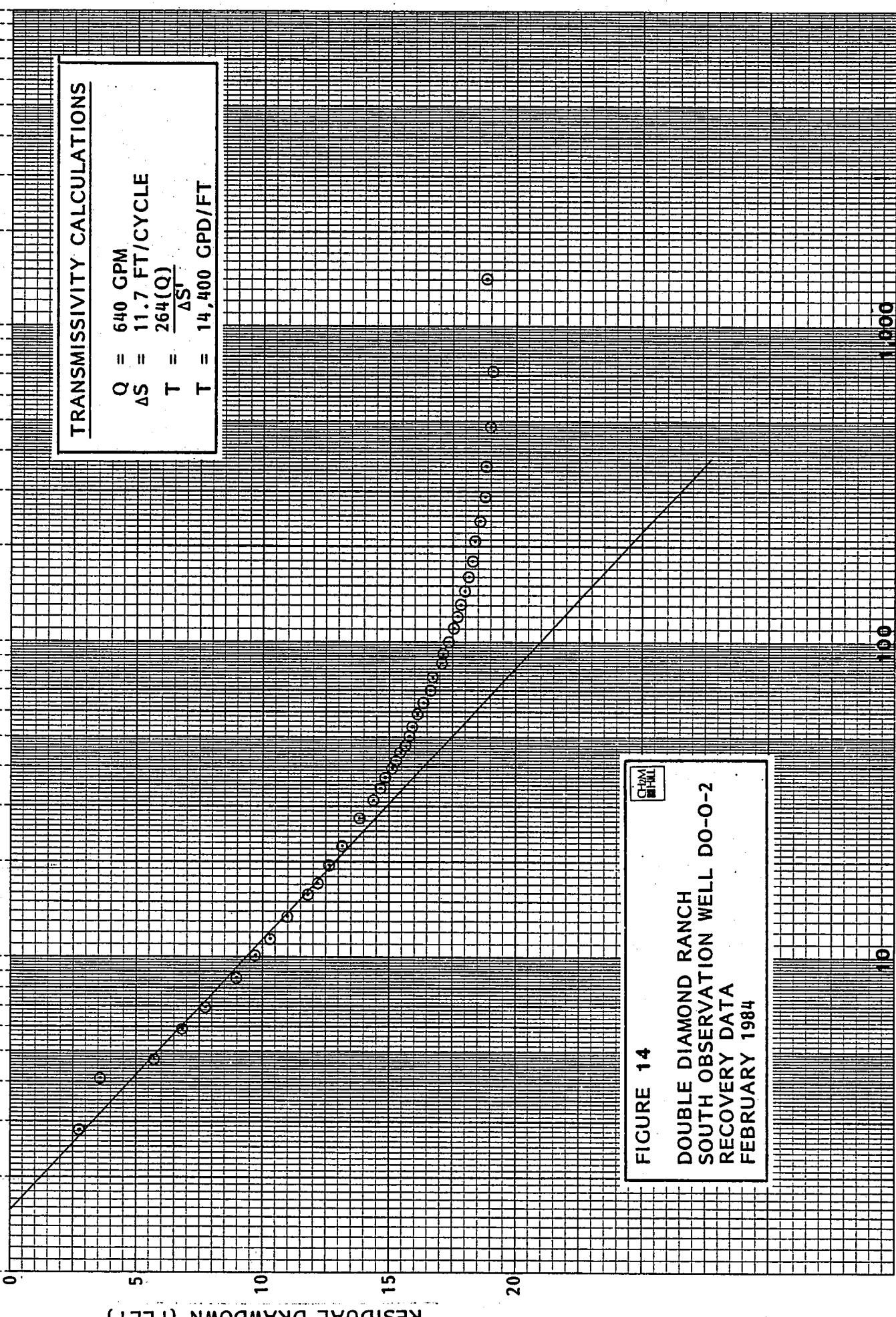


FIGURE 14

DOUBLE DIAMOND RANCH
SOUTH OBSERVATION WELL DO-0-2
RECOVERY DATA
FEBRUARY 1984

CHM
Hill

t = TIME SINCE PUMPING STARTED
 t' = TIME SINCE PUMPING STOPPED
 t/t'