

PRELIMINARY INVESTIGATION OF
YATES DRILLING COMPANY
PECOS RIVER DEEP UNIT #1

By: Ralph L. Gray

Aug. 23, 1963

PECOS RIVER DEEP
EDDY COUNTY, NEW MEXICO

May 15, 1962

EXHIBIT NO.

CASE NO.

Fee Land



I N D E X

<u>REPORT</u>	<u>Page</u>
Purpose	1
Summary	1
Location	1
General Information	1
Geology	3
Reservoir Data	4
Calculation of Reserves	5
Economics	5

<u>TABLES</u>	
1. Well Data and History	7
2. Multi-point Back Pressure Test	8
3. Gas Analysis	9
4. Formation Tops	10
5. Core Data	11

<u>FIGURES</u>	
1. Map	13
2. Well Log Data	14

PRELIMINARY INVESTIGATION OF
YATES DRILLING COMPANY - PECOS RIVER DEEP UNIT #1

PURPOSE: The purpose of this report is to assemble the known data on the Yates Drilling Company - Pecos River Deep Unit well #1, make a preliminary analysis of the Morrow gas reservoir, calculate the probable reserves of oil and gas, and show the expected economics involved in paying out drilling cost.

SUMMARY: Based on a minimum size track of 320 acres:

Calculated total gas reserves - - 4,428,800 MCF.

Calculated total oil reserves - - 26,572 bbls.

Estimated working interest income,

Gas - - - - -	\$496,025
Oil - - - - -	<u>51,655</u>
Total W. I. Income - - - - -	\$547,680
Estimated total expense - - - - -	<u>310,000</u>
Estimated net profit- - - - -	\$237,680 per well.

The above figures are considered minimum since it is possible that a larger size track can be drained by each well.

LOCATION: The location of well #1 is in the SE/4 of the NW/4 of Section 28, Township 19 South, Range 27 East, Eddy County, New Mexico. The well is the first well drilled on the Pecos River Deep Unit. The outline of this unit is shown on the map, Figure 1.

GENERAL INFORMATION: The Yates Drilling Company has been designated as the Operator for the Pecos River Deep Unit. Well #1 was recently drilled to a depth of 10,741 feet, and reached this depth on March 10, 1963. Two zones were tested - the Morrow gas sands at 10,227 to 10,374 feet, and the Wolfcamp zone which was tested from 8193 to 8216 feet. An attempt was made to dually complete the well but packer leakage tests indicated gas

leaking from the Morrow Zones, and the Wolfcamp Zone was found to be producing predominantly sulfur water. The Wolfcamp Zone is now shut-in, and only the Morrow Zones are being produced. Table 1 shows a complete summary of well data, and a history of operations conducted on the Morrow Zones.

During the process of drilling, Drill Stem Test #5 was made from 10,198 to 10,255'. Gas came to the surface in 4 minutes and flowed at the rate of 1.1 million cubic feet per day. Shut-in pressures were 4020 psi. initially and 3900 psi. at the end of test. Drill Stem Test #6 was conducted from 10,260 to 10,374'. Gas came to the surface in 13 minutes and flowed at the rate of 3.1 million cubic feet per day.

Some difficulty was experienced in completing the well, as shown in well history, Table 1. It appears that efforts to stimulate the well actually caused some well bore plugging. The well appears to be gradually cleaning up, but has not yet reached the maximum volume that was obtained on drill stem test.

On July 23, a multi-point back pressure test was conducted and the results of testing is shown in Table 2. The well was flowed at a minimum volume of 469 MCF per day on 12/64" choke at which setting the well head flow pressure was 2145 psia. The maximum flow rate was 1,129 MCF per day on 30/64" choke with a well head flow pressure of 326 psia. It is expected that continued producing will allow the well to clean up further, and improved performance should be obtained. Based on an analysis of the back pressure tests, and other data, it is my opinion that this well should be considered commercial. An analysis of gas is shown in Table 3. The gas is 92.04 percent methane, and has a BTU of 1059. Gas gravity is .6094 which is typical of other Morrow gas pools.

At present the well is shut-in, waiting for a gas purchaser. Southern Union Gas Company has expressed an interest in purchasing the gas, and it is my understanding that a price of 15¢/MCF has been mentioned.

On tests, this well has produced about 10 barrels of distillate per million cubic feet, and this can be sold at a price of \$2.60 per barrel.

GEOLOGY:

Like other Morrow Gas Sand reservoirs, the Pecos River

Deep Unit is thought to cover a stratigraphic trap in which at least the northwestern edge of production will be determined by sand thinning and porosity-permeability pinch out. Figure 1 shows a structural map with contours drawn on top of the upper Morrow pay sand. Control is admittedly meager, but Figure 1 reflects the best interpretation that can be made at this time. Sufficient data to prepare an iso-pach map is not yet available. One control point is available on the Gulf CI well #1 located in Section 25, Township 18 South, Range 27 East, which is approximately $6\frac{1}{2}$ miles to the northeast. The top of the upper Morrow sand was found at a minus 6577 in the Gulf well, as compared to a minus 6722' in the Pecos River Deep Unit well. Dipmeter survey and seismic information were used also in predicting the structural relationships.

The Pecos River Deep Unit well is thought to be producing from at least three sands. These sands are medium to coarse grained, sub-angular, to conglomeratic interbedded with dark gray to black shale. The Morrow sands usually exhibit very heterogeneous qualities in porosity and permeability, but usually have extensive fracturing present which permits a high degree of communication within the reservoir. Formation tops are shown in Table 4.

Figure 2 shows log data through the Morrow interval. Data shown includes drill stem test information, self potential, gamma ray, sample lithology, sonic, microlog and cored intervals. Perforations are also shown. Two cores were taken. Core #1 was from 10,255 to 10,264 (9.5'), and Core #2 was from 10,357' to 10,374' (17'). Core analyses are shown in Table 5.

After analyzing all of the well data, it is concluded that the gas pay is limited to three sands as follows:

10,241-247 (6')

10,251-261 (10')

10,360-364 (4')

Total - - - 20'

The interval from 10,241-247 was not cored but indications of pay were shown on the microlog and the caliper log showed the characteristic reduction in hole size due to build up of mud cake on the sand. The sonic log shows an average porosity of 8.5 percent through this interval.

In the interval 10,251-261, the lower part was cored but it is estimated that the first foot of core was 4 feet into the zone. Core analysis showed an average porosity of 8.5 percent. The sonic log indicated an average porosity of 13 percent, so we have used a figure of 10 percent for this interval which is a compromise figure. The microlog showed rather uncertain pay qualities through this interval but possible pay is indicated. The core analysis is definite proof of this interval being productive.

In the interval 10,360-364, the core analysis shows a productive zone having an average porosity of 9.2 percent as compared to a sonic porosity of 10 percent. We have used a value of 9.6 percent in calculations. This interval also shows up good on microlog and shows a mud cake build up on caliper.

There is not yet sufficient information to outline the productive area within the pool, but it will be assumed that well #1 will be productive over at least 320 acres, and will effectively drain this area. It is possible that one well can drain more than 320 acres, possibly as much as 640 acres, so a 320 acre track seems like a reasonable minimum area to consider.

RESERVOIR DATA: The initial reservoir pressure for the interval tested in

drill stem test #1 was shown to be 4,020 psi. This will be assumed as the reservoir initial pressure. A higher pressure was found in drill stem test #2, but since this zone was thin, compared to the total reservoir thickness, the lower value will be used. The original reservoir temperature was measured at 162° F. Gas characteristics are shown in Table 3. The total net pay thickness is indicated to be 20 feet, having an average porosity of 9.4 percent. The formation water saturation is estimated at 25 percent. It is estimated that the abandonment pressure will be 515 psia. in the reservoir. Super-compressibility ("Z") factors have been calculated to be .88 at origin and .97 at abandonment.

CALCULATION
OF RESERVES:

Using the various data shown above, the recoverable gas reserves have been calculated as follows, assuming that at least 320 acres are productive and recoverable by well #1:

Q, original gas in place

$$= 43,560 \times .094 \times .75 \times \frac{4035}{15} \times \frac{520}{622} \times \frac{1}{.88}$$

$$= 783,000 \text{ cu.ft./ac.ft.}$$

Qa, gas left in reservoir at abandonment

$$= 43,560 \times .094 \times .75 \times \frac{515}{15} \times \frac{520}{622} \times \frac{1}{.97}$$

$$= 91,000 \text{ cu.ft./ac.ft.}$$

$$\text{Recoverable gas} = 783,000 - 91,000 = 692,000 \text{ cu.ft./ac.ft.}$$

Amount of gas recoverable from well #1

$$= 692 \times 320 \times 20 = 4,428,800 \text{ MCF.}$$

It is estimated that 6 barrels of distillate per million cubic feet of gas will be recovered.

$$\text{Distillate reserves} = 6 \times 4,428 = 26,572 \text{ barrels.}$$

ECONOMICS:

It is estimated that an average well completed in the Morrow sand should cost approximately \$250,000 including

lease equipment. Assuming that the gas will be produced over a period of twenty years, the lifetime operating expense is estimated at \$60,000 (\$250 per month). Total expense is estimated at \$310,000 per well for future development.

It is expected that a price of 15¢/MCF will be received for gas. After deducting 6.69 percent for taxes, the net gas price will be 14¢/MCF. The price for distillate is expected to net \$2.43 per barrel after deducting 17¢ per barrel (6.69%) for taxes.

At this time, the exact participating area for well #1 is not known, so the exact working interest cannot be accurately determined. However it is believed that an average of .80 of 100 percent is a reasonable figure to use for the working interest. Based on this, the working interest reserves amount to:

Gas - 3,543,040 MCF

Oil - 21,257 barrels.

<u>INCOME:</u>	Expected income from gas - - -	\$496,025
	Expected income from oil - - -	<u>51,655</u>
	Total W. I. Income - - - - -	\$547,680
<u>EXPENSE:</u>	Cost of completed well - - - -	\$250,000
	Lifetime operating expense - -	<u>60,000</u>
	Total Expense- - - - -	\$310,000
	Net profit from operation =	\$237,680.

Respectfully submitted,

Ralph L Gray
 REGISTERED PETROLEUM ENGINEER
 No. 1168

RLG:lw

WELL DATA & HISTORY

YATES DRILLING COMPANY - PECOS RIVER DEEP UNIT #1

Location: 1980' f. N & W Lines, Section 28-19S-27E.

Completed Drilling: March 10, 1963.

Elevation: 3518 K.B.

Producing Zone: Morrow (Penn) Gas Pays.

Pay Intervals: 10,241-247, 10,251-261 and 10,360-364.

Perforations: 10,227-237
 10,241-246
 10,251-261
 10,326-339
 10,348-363
 10,365-374

4½" O.D. Casing at 10,511' with 950 sacks.

Total Depth: 10,741'., PBD - 10,424.

Absolute Open Flow: 1,150 MCFPD + 10 bbls. dist./MMCF.

HISTORY

March 25 - Perforated 10,333.75; 10,334.25; 10,360.7; 10,361.2; 10,361.7. Treated upper and lower sets with 500 gals. acid each.

March 26 - Tested 1.6 MMCFPD plus some diatillate.

March 28 - Fraced lower set with 10,000 gallons gelled oil (screened out after 5,000 gallons + 2600# sand). Fraced lower perforations with 672 gallons oil (3,000 gallons with 1/8# sand/gal. - screened out).

April 4 - Flowed 949,260 MCFPD, TP-200, CP-450.

April 10 - Reperforated 10,227-237; 10,241.5-246; 10,251-261; 10,326-339; 10,348-363; 10,365-374 with 72 holes.

April 12 - Acidized with 3000 gallons, packer at 10,310'.

April 16 - Acidized with 1,000 gallons.

April 20 - Flowed 1,258 MCFPD, TP-300, 3/8" choke.

April 22 - Flowed 1,404 MCFPD, TP-350.

April 29 - Treated with 1000 gallons fluid containing 100 gallons emulsion breaker in 900 gallons 3% acid in brine.

May 1 - Treated with 10,000 gallons emulsion breaker in 5% acid brine.

May 2-8 - Flow well to clean up. TP 50 to 75#.

July 23 - Conduct multi-point back pressure test.

Table 1.

MULTI-POINT BACK PRESSURE TEST

YATES DRILLING COMPANY - PECOS RIVER DEEP UNIT #1

Test Date: July 23, 1963

Test made by: Coleman Petroleum Engineering Co.

Section Tested: 12,227-12,374

72 hour Wellhead Shut-in Pressure - 2883

Absolute Open Flow - 1,150 MCFPD.

FLOW DATA

<u>CHOKE SIZE</u>	<u>DURATION OF FLOW</u>	<u>RATE OF FLOW</u>	<u>WELL HEAD FLOW PRESSURE</u>
12/64"	3 hrs.	469 MCFPD	2145 PSIA.
17/64"	21 hrs.	753	1430
25/64"	4 hrs.	979	941
30/64"	3 hrs.	1,129	326

Reservoir Temperature - - - - - 162° F.

Original Reservoir Pressure - - - - 4,020 PSIG.

Table 2.

ANALYSIS OF MORROW GAS

YATES DRILLING COMPANY - PECOS RIVER DEEP UNIT #1

Helium	.00
Carbon Dioxide	.20
Nitrogen	1.03
Methane	92.04
Ethane	4.71
Propane	1.39
Iso Butane	.15
Normal Butane	.20
Pentane	.20
Hexane, plus	<u>.08</u>
	100.00
Calculated Specific Gravity -----	.6094
Calculated BTU -----	1059

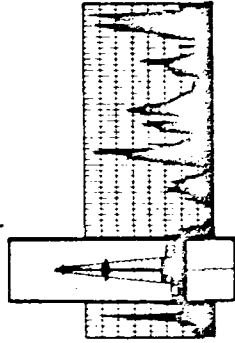
Table 3.

FORMATION TOPS (ELECTRIC LOG)

YATES DRILLING COMPANY - PECOS RIVER DEEP UNIT #1

	<u>DEPTH</u>	<u>SEA-DATUM</u>
Queen	965	+ 2553
San Andres	1,873	+ 1645
Bone Spring Ls.	2,635	+ 883
1st B. S. Sand	5,516	- 1998
2nd B. S. Sand	6,005	- 2487
3rd B. S. Sand	7,463	- 3945
Wolfcamp	7,920	- 4402
WolfCamp-Penn Reef	8,320	- 4802
Morrow Sand	10,098	- 6580
Barnett Shale	10,379	- 6861
Pseudo-Mississippian	10,490	- 6972
Mississippian	10,701	- 7183

Table 4.



Darrell W. Smith Co.

PHONE OX 4-2511—MIDLAND, TEXAS
PHONE EX 3-6173—HOBBS, N. MEX.

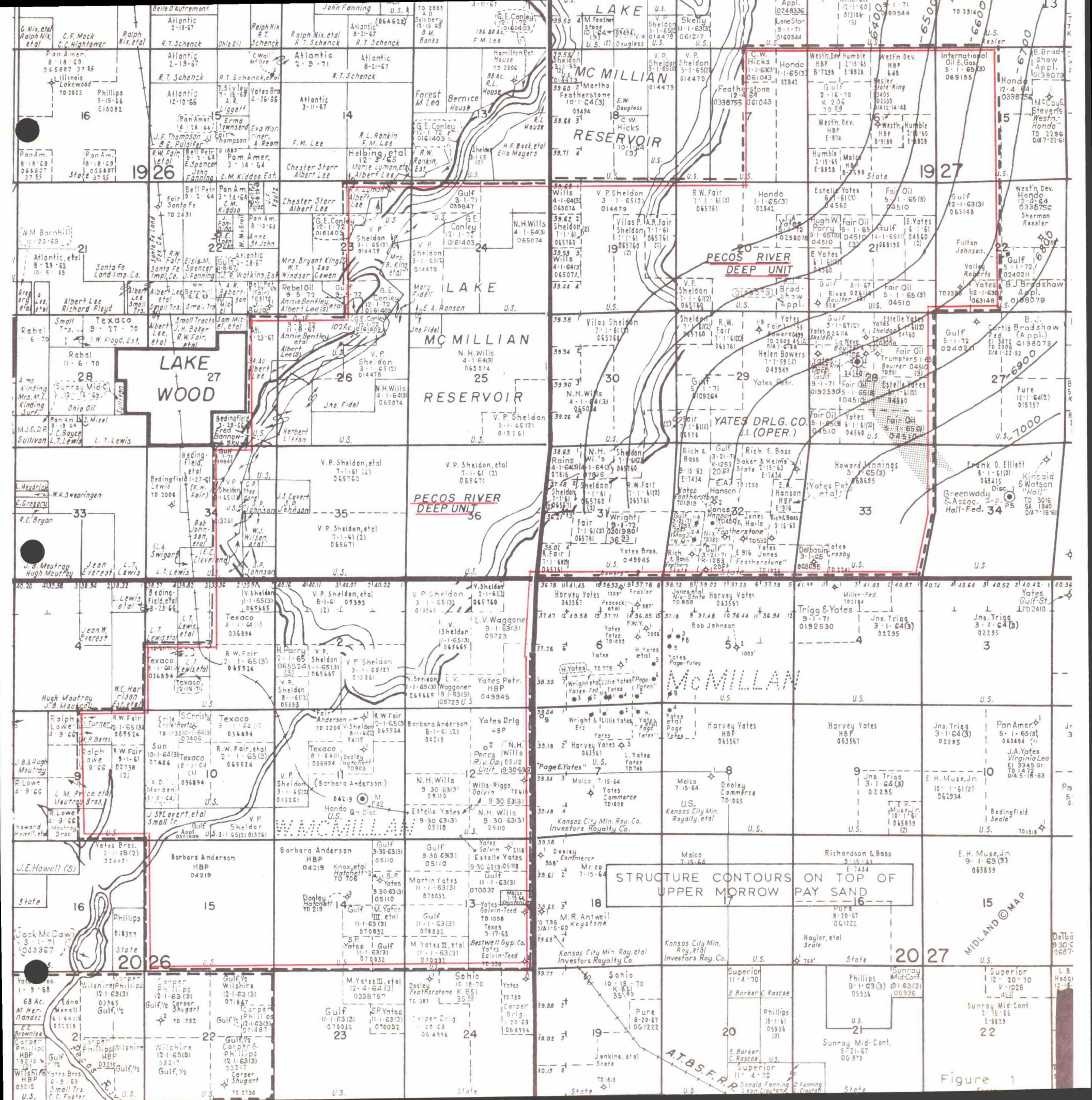
FULL DIAMETER CORE STUDY

Operator Yates Drilling Company Field Undesignated Formation Morrow
Well No. 1 Pecos River Deep Unit Location 1980' FNL & 1980 FWL, Section 28-19S-27E
Depths 10,255-10,374 Date March 31, 1963 Lab No. 676-II

SAMPLE NO.	REPRESENTATIVE OF FEET	FOOTAGE	PERMEABILITY, MD.		EFFECTIVE POROSITY %	SATURATION % OF PORE SPACE		DESCRIPTION
			HORIZONTAL	MATRIX PERM.		RESIDUAL OIL	WATER	
1	10255-56	1.0						Vfg gray Ss slty shy top 4" sh
2	10256-57	1.0	67.7	0.04	11.7	0	36.8	Vfg gray Ss slty shy
3	10257-58	1.0	0.46	-	6.6	0	31.8	Vfg gray Ss slty shy
4	10258-59	1.0	0.49	-	7.7	0	36.4	Vfg gray Ss slty shy
5	10259-60	1.0	Broken	0.10	9.1	0	20.9	Vfg gray Ss slty shy
6	10260-61	1.0	6.7	-	8.6	0	26.7	Vfg gray Ss slty shy
7	10261-62	1.0	20.	0.02	7.0	0	24.3	Vfg gray Ss slty shy
8	10262-63	1.0	1.3	-	5.4	0	35.2	Vfg-fg Ss slty shy Sh ptgs
	10263-64	1.0	0.58	0.36	5.4	0	46.3	Vfg-fg Ss slty shy Sh ptgs
	10264-64.5	1.0	-	0.11	-	-	-	Sh black bottom 4" fg-cg Ss Not Analyzed
	10264.5-10357	0.5	-	-	-	-	-	Sh black sandy Not Analyzed
		92.5	-	-	-	-	-	Drilled
9	10357-58	1.0						Vfg gray Ss slty shy bottom 4" black sh
10	10358-59	1.0	5.1	-	6.0	0	61.7	Vfg gray Ss slty shy VF
11	10359-60	1.0	0.20	-	6.1	0	36.1	Vfg gray Ss slty shy VF
12	10360-61	1.0	<1000.	0.26	2.6	0	25.4	Vfg gray Ss slty PPP M VF
13	10361-62	1.0	17.	3.5	9.4	0	28.5	Vfg gray Ss slty PPP VF
14	10362-63	1.0	14.	8.5	9.9	0	23.1	Vfg gray Ss slty PPP
15	10363-64	1.0	6.6	0.71	10.5	0	25.2	Vf-cg gray Ss slty PPP
16	10364-65	1.0	0.26	-	7.1	0	54.9	Vf-cg gray Ss slty PPP bottom 4" black sh
		1.0	0.67	-	4.7	0	46.8	Vf-cg gray Ss slty shy top 6" black sh

PAGE NO. 2 OPERATOR Yates Drilling Company LAB NO. 676-II

SAMPLE NO.	REPRESENTATIVE OF FEET	FOOTAGE	PERMEABILITY, MD.		EFFECTIVE POROSITY %	SATURATION % OF PORE SPACE		DESCRIPTION
			HORIZONTAL	MATRIX PERM.		RESIDUAL OIL	WATER	
17	10365-66	1.0	0.22	-	4.9	0	48.2	Vf--fg gray Ss slty shy IF
18	10366-67	1.0	3.1	0.12	5.6	0	36.1	Vfg gray Ss slty very shy bottom 6" blk st
19	10367-68	1.0	1.1	-	4.0	0	32.5	Vf-cg gray Ss Sh ptgs slty shy sl lmy
20	10368-69	1.0	0.20	-	5.0	0	34.0	Vf-fg gray Ss Sh ptgs slty shy sl lmy
21	10369-70	1.0	0.06	-	7.3	0	39.6	Vfg gray Ss slty shy sl lmy
22	10370-71	1.0	0.08	-	4.3	0	39.3	Vfg gray Ss slty shy sl lmy VF
23	10371-72	1.0	0.95	-	4.9	0	36.3	Vfg gray Ss slty shy sl lmy VF
24	10372-73	1.0	0.09	-	4.6	0	30.9	Vfg gray Ss slty shy sl lmy
25	10373-74	1.0	0.45	-	3.2	0	25.0	Vfg gray Ss slty shy sl lmy



INDICATED PAY

