

OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

October 9, 1979

Hickory Creek Oil Company
1128 Main
Parsons, Kansas 67357

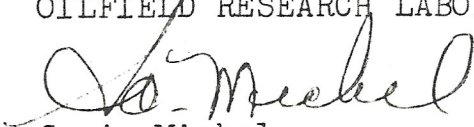
Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from Well No. HCO-45, and submitted to our laboratory on September 27, 1979.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES


S. A. Michel
Chemist

SAM:bl

4 c to Parsons, Kansas
1 c to Chanute, Kansas

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Hickory Creek Oil Company Lease - Well No. HCO-45

Location -

Section - Twp. - Rge. - County - State -

Name of Sand	-	
Top of Core	-	178.0
Bottom of Core	-	209.3
Top of Sand	-	178.0
Bottom of Sand	(Tested)	208.7
Total Feet of Permeable Sand	-	25.5
Total Feet of Floodable Sand	-	14.7

Distribution of Permeable Sand:
Permeability Range
Millidarcys

	Feet	Cum. Ft.
0 - 50	12.8	12.8
50 - 100	7.9	20.7
100 - 200	1.0	21.7
300 - 400	1.8	23.5
400 - 600	2.0	25.5

Average Permeability Millidarcys	-	104.8
Average Percent Porosity	-	20.3
Average Percent Oil Saturation	-	41.7
Average Percent Water Saturation	-	34.5
Average Oil Content, Bbls./A. Ft.	-	673.
Total Oil Content, Bbls./Acre	-	17,170.
Average Percent Oil Recovery by Laboratory Flooding Tests	-	11.2
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	-	208.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	-	3,053.

Total Calculated Oil Recovery, Bbls./Acre	-	See "Calculated Recovery" Section
Packer Setting, Feet	-	
Viscosity, Centipoises @	-	
A. P. I. Gravity, degrees @ 60 °F	-	
Elevation, Feet	-	

-2-

The core was sampled and the samples sealed in plastic bags by a representative of the client.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
178.0 - 180.0	Gray and brown laminated shale and sandstone.
180.0 - 183.8	Dark brown sandstone.
189.0 - 190.3	Gray shale containing thin widely scattered streaks of sandstone.
190.3 - 203.0	Brown sandstone.
203.0 - 205.8	Light brown shaly sandstone.
205.8 - 208.7	Brown sandstone.
208.7 - 209.1	Gray laminated sandy shale.
209.1 - 209.3	Light brown sandstone.

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 3,053 barrels of oil per acre was obtained from 14.7 feet of sand. The weighted average percent oil saturation was reduced from 46.5 to 35.3, or represents an average recovery of 11.2 percent. The weighted average effective permeability of the samples is 27.42 millidarcys, while the average initial fluid production pressure is 18.0 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 26 samples tested, 15 produced water and oil and 9 produced water only. This indicates that approximately 58 percent of the sand represented by these samples is floodable pay sand. The tests also show

that the sand has a wide variation in permeability profile.

CALCULATED RECOVERY

It would appear from a study of the data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 5,880 barrels of oil per acre. This is an average recovery of 400 barrels per acre foot from 14.7 feet of floodable sand analyzed in this core.

These recovery values were calculated using the following data and assumptions:

Original formation volume factor	✓ 1.03
Reservoir water saturation, percent	10.0 / 18.4 ✓
Average porosity, percent	22.0 / 24.9 ✓
Oil saturation after flooding, percent	35.3 / 32.8 ✓
Performance factor, percent	✓ 45.0
Net floodable pay sand, feet	14.7 / 5.0 ✓

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Hickory Creek Oil Company Lease GRAY-17 Well No. HCO-45

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation		Oil Content Bbls. / A Ft.	Perm. Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X m.d.
			Oil	Water			Ft.	Cum. Ft.		
1	178.6	21.4	64	20	84	84.	1.0	1.0	1,063	84.00
2	179.6	22.4	53	20	73	101.	1.0	2.0	921	101.00
3	180.6	26.3	59	18	76	415.	1.0	3.0	1,183	415.00
4	181.5	25.8	54	19	73	358.	1.0	4.0	1,081	358.00
5	182.6	26.2	52	24	76	551.	1.0	5.0	1,057	551.00
6	183.5	23.1	59	11	70	392.	0.8	5.8	846	313.60
7	189.5	14.0	17	76	93	28.	1.3	7.1	241	36.40
8	190.5	19.4	35	37	72	28.	0.7	7.8	369	19.60
9	191.6	21.1	45	29	74	86.	1.0	8.8	737	86.00
10	192.5	22.0	42	31	73	24.	1.0	9.8	717	24.00
11	193.4	21.8	50	33	83	44.	1.0	10.8	846	44.00
12	194.5	18.9	47	35	82	92.	1.0	11.8	689	92.00
13	195.6	13.0	26	44	70	18.	1.0	12.8	262	18.00
14	196.6	14.7	45	38	83	22.	1.0	13.8	513	22.00
15	197.6	17.0	47	34	81	31.	1.0	14.8	620	31.00
16	198.5	21.5	37	31	68	90.	1.0	15.8	617	90.00
17	199.5	20.3	36	43	79	60.	1.0	16.8	567	60.00
18	200.5	22.4	43	32	75	62.	1.0	17.8	747	62.00
19	201.5	20.8	42	31	73	21.	1.0	18.8	678	21.00
20	202.5	18.7	30	35	65	36.	1.0	19.8	435	36.00
21	203.5	20.4	36	40	76	9.6	1.0	20.8	570	9.60
22	204.3	17.5	34	46	80	11.	1.0	21.8	462	11.00
23	205.3	19.9	35	37	72	4.9	0.8	22.6	432	3.92
24	206.6	21.3	35	39	74	79.	1.2	23.8	694	94.80
25	207.4	21.0	38	37	75	49.	1.0	24.8	619	49.00
26	208.5	16.3	23	42	65	58.	0.7	25.5	204	40.60

Top 179'
PERF
PERF 5 Feet
6' SHALE
BREAK

2754.7

482

584

5277.2

5066.3

Oilfield Research Laboratories
SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Hickory Creek Oil Company	Lease	Well No.	HCO-45			
	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.			
	178.0 - 183.8	5.8	314.2	1,822.60			
	189.0 - 195.0	6.0	50.3	302.00			
	195.0 - 208.7	13.7	40.1	548.92			
	178.0 - 208.7	25.5	104.8	2,673.52			
	Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
	178.0 - 183.8	5.8	24.2	56.8	18.9	1,061	6,151
	189.0 - 195.0	6.0	19.3	38.4	42.1	600	3,599
	195.0 - 208.7	13.7	19.0	36.8	37.7	542	7,420
	178.0 - 208.7	25.5	20.3	41.7	34.5	673	17,170

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Hickory Creek Oil Company Lease GRAY - 17 Well No. HCO-45

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation		Volume of Water Recovered cc*	Effective Permeability Millidarcys**	Initial Fluid Production Pressure Lbs./Sq./In.
			%	Bbbs./A. Ft.	%	Bbbs./A. Ft.	% Oil	% Water			
1	178.6	21.3	64	1,058	0	0	64	26	0	Imp.	-
2	179.6	22.2	53	913	19	327	34	58	298	28.11	10
3	180.6	26.5	59	1,213	29	596	30	55	442	134.95	5
4	181.5	25.9	54	1,085	22	442	32	58	260	76.48	5
5	182.6	26.4	52	1,065	18	369	34	50	304	89.96	5
6	183.5	23.5	59	1,076	25	456	34	56	284	51.28	10
7	189.5	14.5	18	202	0	0	18	76	80	1.65	30
8	190.5	19.6	35	532	5	76	30	60	26	0.60	30
9	191.6	21.1	45	737	5	82	40	55	133	3.15	20
10	192.5	22.1	42	728	7	128	35	58	366	6.30	20
11	193.4	22.0	50	853	16	273	34	56	258	8.75	20
12	194.5	19.3	47	704	8	120	39	47	140	2.32	20
13	195.6	13.1	26	264	0	0	26	68	19	0.25	30
14	196.6	15.0	45	524	0	0	45	46	18	0.30	35
15	197.6	16.8	47	613	2	26	45	46	18	0.37	35
16	198.5	21.3	37	611	0	0	37	56	261	4.35	20
17	199.5	20.0	36	559	0	0	36	57	84	1.57	25
18	200.5	22.0	43	734	6	102	37	58	131	2.70	20
19	201.5	21.2	42	691	5	99	37	53	62	1.27	25
20	202.5	18.5	32	459	0	0	32	54	10	0.22	25
21	203.5	20.1	36	561	2	31	34	56	14	0.22	30
22	204.3	17.7	34	467	0	0	34	62	12	0.22	35
23	205.3	20.1	35	546	0	0	35	60	0	Imp.	-
24	206.6	21.2	35	576	2	33	33	63	416	5.92	15
25	207.4	21.0	37	603	0	0	37	45	111	2.10	25
26	208.5	16.4	21	267	0	0	21	70	82	1.50	25

424.54

913

Notes: cc—cubic centimeter.

*—Volume of water recovered at the time of maximum oil recovery.

**—Determined by passing water through sample which still contains residual oil.

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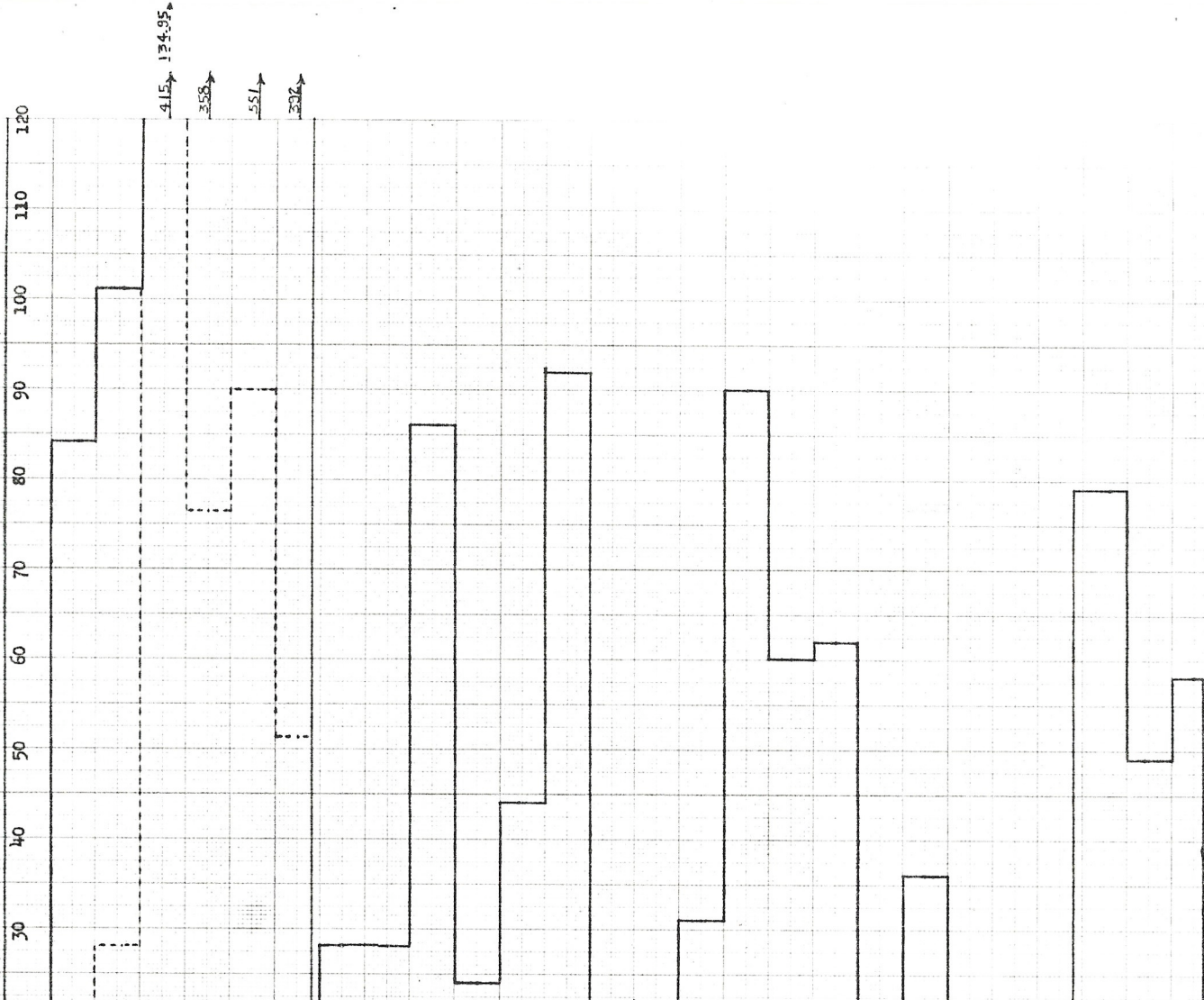
SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Hickory Creek Oil Company	Lease	Well No.	HCO-45
Depth Interval, Feet	178.0 - 183.8	189.0 - 195.0	195.0 - 208.7	178.0 - 208.7
Feet of Core Analyzed	4.8	4.7	5.2	14.7
Average Percent Porosity	25.0	20.9	20.3	22.0
Average Percent Original Oil Saturation	55.3	44.4	40.3	46.5
Average Percent Oil Recovery	22.5	8.4	3.3	11.2
Average Percent Residual Oil Saturation	32.8	36.0	37.0	35.3
Average Percent Residual Water Saturation	55.4	54.9	55.5	55.3
Average Percent Total Residual Fluid Saturation	88.2	90.9	92.5	90.6
Average Original Oil Content, Bbls./A. Ft.	1,070.	723.	633.	805.
Average Oil Recovery, Bbls./A. Ft.	437.	140.	57.	208.
Average Residual Oil Content, Bbls./A. Ft.	633.	583.	576.	597.
Total Original Oil Content, Bbls./Acre	5,137.	3,394.	3,291.	11,822.
Total Oil Recovery, Bbls./Acre	2,099.	656.	298.	3,053.
Total Residual Oil Content, Bbls./Acre	3,038.	2,738.	2,993.	8,769.
Average Effective Permeability, Millidarcys	77.19	4.46	2.24	27.42
Average Initial Fluid Production Pressure, p.s.i.	7.0	22.0	25.0	18.0

NOTE: Only those samples which recovered oil were used in calculating the above averages.

— AIR PERMEABILITY, IN MILLIDARCS
 --- EFFECTIVE PERMEABILITY, IN MILLIDARCS



— SANDY SHALE

— SHALE CONTAINING THIN STREAKS OF SANDSTONE

○ IMPERMEABLE TO WATER

IPANY

WELL NO. HGO-45

TOTAL OIL CONTENT BBL./ACRE	AVG. AIR PERMEABILITY, MILLIDARCS	CALCULATED OIL RECOVERY, BBL./ACRE
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6.151	314.2	
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3,599	50.3	
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7,420	40.1	
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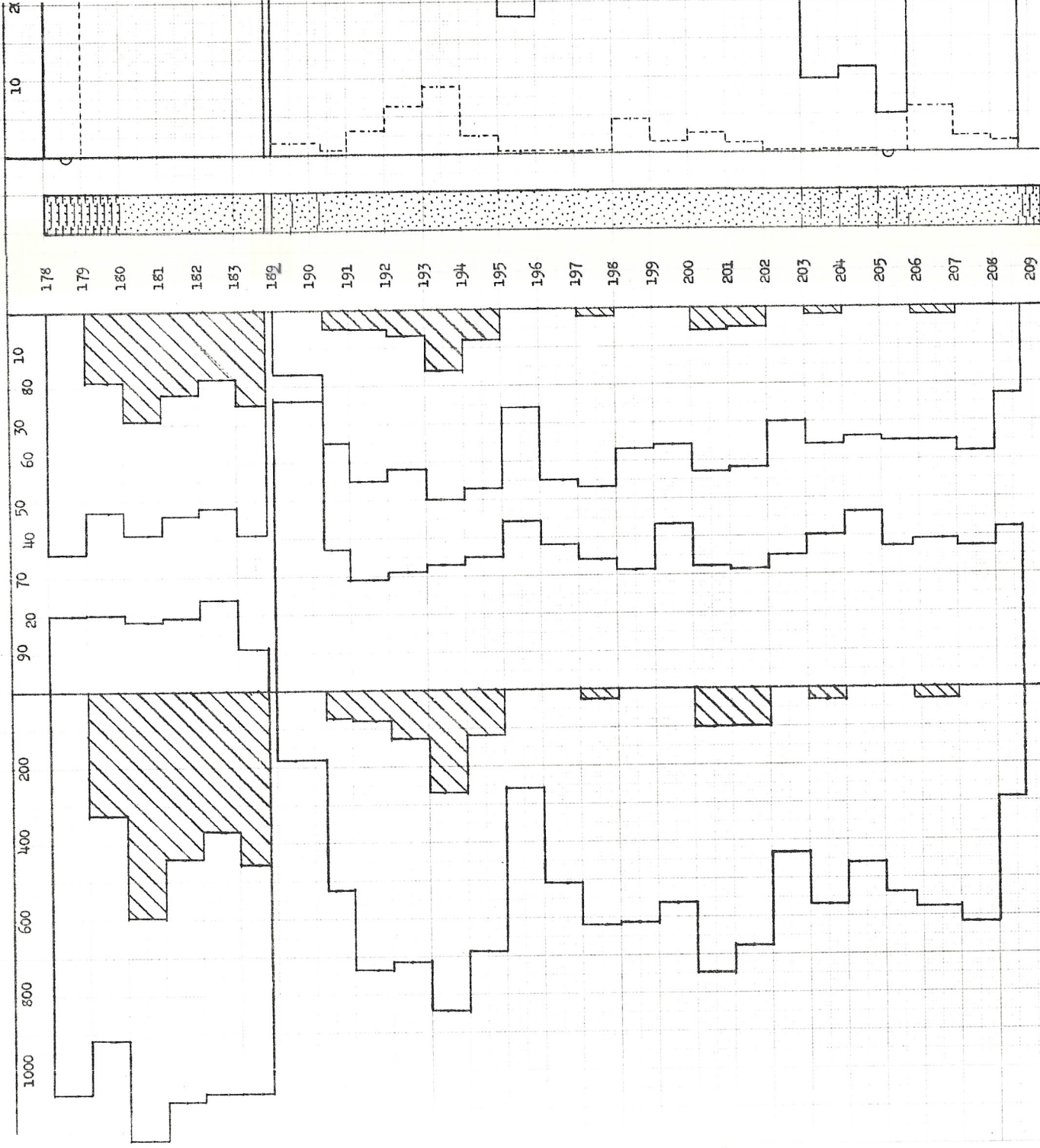
17,170	104.8	
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5,880 (PRIMARY & WATERFLOODING)

OILFIELD RESEARCH LABORATORIES
 CHANUTE, KANSAS
 OCTOBER 9, 1979 EL

WATER SAT., PERCENT

OIL CONTENT, BBL./A. FT.



KEY:
FLOOD POT RECOVERY
SANDSTONE

SHALY SANDSTONE

LAMINATED SANDSTONE AND SHALE

COUNTY, ---

HICKORY CREEK OIL COI

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE PERCENT POROSITY	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT	AVG. OIL CONTENT BBL./A. FT.
178.0 - 183.8	5.8	24.2	56.8	18.9	1,061
189.0 - 195.0	6.0	19.3	38.4	42.1	600
195.0 - 206.7	13.7	19.0	36.8	37.7	542
178.0 - 208.7	25.5	20.3	41.7	34.5	673