

APR: LS-032-20370

# OILFIELD RESEARCH LABORATORIES

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

October 5, 1978

Missouri Lead & Zinc Company  
1705 North Walnut  
Pittsburg, Kansas 66762

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Hiller Lease, Well No. 4, Neosho County, Kansas, and submitted to our laboratory on September 22, 1978.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

*Benjamin R. Pearman*  
Benjamin R. Pearman

SAM:km  
4 c to Pittsburg, Kansas  
1 c to Chanute, Kansas

- REGISTERED ENGINEERS -

CORE ANALYSIS - WATER ANALYSIS - REPRESSURING ENGINEERING - SURVEYING & MAPPING - PROPERTY EVALUATION & OPERATION



The core was reported to be from virgin territory. The drilling fluid was fresh water mud. The core was sampled, and the samples were sealed in plastic bags by an agent of the client.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
160.5 - 169.0	Light brown shaly sandstone.
169.0 - 170.4	Gray sandy shale.
170.4 - 171.0	Brown broken shaly sandstone.
171.0 - 185.3	Brown slightly laminated carbonaceous sandstone.
185.3 - 185.7	Brown shaly sandstone.
185.7 - 188.0	Brown sandstone.
188.0 - 189.0	Brown laminated shaly sandstone.
189.0 - 194.4	Brown sandstone.
194.4 - 195.0	Brown carbonaceous sandstone.
195.0 - 197.0	Brown sandstone.
197.0 - 199.7	Brown carbonaceous sandstone.
199.7 - 201.2	Gray sandy shale.
201.2 - 201.4	Brown sandstone.
201.4 - 202.4	Light brown very shaly sandstone.
202.4 - 204.0	Light brown shaly sandstone.
204.0 - 221.6	Brown slightly carbonaceous slightly shaly sandstone.

SUMMARY

It would appear from a study of the data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 11,700 barrels of oil per acre. This is an average of 475 barrels per acre foot from 24.7 feet of floodable pay sand analyzed in this core.

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

Original formation volume factor	✓ 1.03
Reservoir water saturation, percent	10.0 / 18.9
Average porosity, percent	✓ 23.7
Oil saturation after flooding, percent	37.5 / 38.9
Performance factor, percent	✓ 50.0
Net floodable pay sand, feet	24.7 / 14.0

110,000  
 1,700,000  
 1

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

Planned for  
ports for  
prod. test.

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 md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	160.6	18.5	37	39	76	531	8.5	0.5	0.5	266	4.25
2	161.5	16.1	37	41	78	462	19.	1.0	1.5	462	19.00
3	162.5	14.9	30	52	82	347	1.5	1.0	2.5	347	1.50
4	163.5	16.1	33	44	77	412	6.1	1.0	3.5	412	6.10
5	164.5	15.6	28	57	85	339	3.4	1.0	4.5	339	3.40
6	165.5	17.6	38	34	72	519	12.	1.0	5.5	519	12.00
7	166.5	17.7	43	36	79	591	13.	1.0	6.5	591	13.00
8	167.5	15.2	40	54	94	472	3.9	1.0	7.5	472	3.90
9	168.5	14.7	35	57	92	399	4.4	1.0	8.5	399	4.40
10	170.5	14.4	6	73	79	67	2.0	0.6	9.1	40	1.20
11	171.5	22.2	43	19	62	741	200.	1.0	10.1	741	200.00
12	172.5	21.1	42	23	65	688	88.	1.0	11.1	688	88.00
13	173.5	24.0	46	17	63	857	203.	1.0	12.1	857	203.00
14	174.5	20.5	51	23	74	811	113.	1.0	13.1	811	113.00
15	175.5	21.9	49	19	68	833	135.	1.0	14.1	833	135.00
16	176.5	22.5	58	18	76	1,012	118.	1.0	15.1	1,012	118.00
17	177.5	23.7	55	18	73	1,011	119.	1.0	16.1	1,011	119.00
18	178.5	21.1	64	16	80	1,048	65.	1.0	17.1	1,048	65.00
19	179.5	24.3	63	11	74	1,188	364.	1.0	18.1	1,188	364.00
20	180.5	24.9	64	14	78	1,236	288.	1.0	19.1	1,236	288.00
21	181.5	27.2	59	21	80	1,245	189.	1.0	20.1	1,245	189.00
22	182.5	25.9	60	21	81	1,206	220.	1.0	21.1	1,206	220.00
23	183.5	25.9	56	20	76	1,125	377.	1.0	22.1	1,125	377.00
24	184.5	24.3	70	25	95	1,320	250.	1.3	23.4	1,320	325.00
25	185.5	18.9	39	(42)	81	572	208.	0.4	23.8	229	83.20
26	186.5	23.3	46	(29)	75	832	156.	1.3	25.1	1,082	202.80
27	187.5	24.7	41	(28)	69	786	259.	1.0	26.1	786	259.00
28	188.5	22.4	41	(29)	70	713	121.	1.0	27.1	713	121.00

158  
1 per ft

165  
Butter zone

171

1 per ft

184

Butter zone

# Oilfield Research Laboratories

## RESULTS OF SATURATION & PERMEABILITY TESTS

### TABLE 1-B

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

	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 md.
				Oil	Water	Total			Ft.	Cum. Ft.		
189	29	189.5	25.7	36	33	69	718	160.	1.0	28.1	718	160.00
1 per ft	30	190.5	22.5	39	32	71	681	239.	1.0	29.1	681	239.00
per foot	31	191.5	23.6	36	39	75	659	184.	1.0	30.1	659	184.00
	32	192.5	24.9	40	32	72	773	218.	1.0	31.1	773	218.00
	33	193.5	24.3	42	29	71	792	129.	1.4	32.5	1,109	180.60
↑	34	194.5	26.3	37	47	84	755	364.	0.6	33.1	453	218.40
	35	195.5	21.9	36	46	82	612	148.	1.0	34.1	612	148.00
196	36	196.5	24.5	37	46	83	703	101.	1.0	35.1	703	101.00
	37	197.5	23.8	40	33	73	739	111.	1.0	36.1	739	111.00
Substr	38	198.5	23.4	40	32	72	726	158.	1.0	37.1	726	158.00
Zone	39	199.5	21.0	45	26	71	733	97.	0.7	37.8	513	67.90
	40	202.5	14.5	13	76	89	147	6.4	0.6	38.4	88	3.84
	41	203.5	8.8	30	62	92	205	0.23	1.0	39.4	205	0.23
	42	204.5	17.1	33	46	79	438	12.	1.0	40.4	438	12.00
205	43	205.5	18.1	32	48	80	449	29.	1.0	41.4	449	29.00
	44	206.5	20.6	35	45	80	559	35.	1.0	42.4	559	35.00
	45	207.5	19.8	47	45	92	722	57.	1.0	43.4	722	57.00
	46	208.5	22.4	42	40	82	730	94.	1.0	44.4	730	94.00
	47	209.5	19.3	31	52	83	464	24.	1.0	45.4	464	24.00
	48	210.5	20.2	33	47	80	517	35.	1.0	46.4	517	35.00
	49	211.5	19.7	31	50	81	474	23.	1.0	47.4	474	23.00
	50	212.5	21.3	31	50	81	512	11.	1.0	48.4	512	11.00
	51	213.5	22.9	26	51	77	462	97.	1.0	49.4	462	97.00
	52	214.5	20.5	23	58	81	366	15.	1.0	50.4	366	15.00
	53	215.5	20.2	28	52	80	439	14.	1.0	51.4	439	14.00
	54	216.5	19.6	26	55	81	395	7.5	1.0	52.4	395	7.50
1 per ft	55	217.5	19.6	25	59	84	380	27.	1.0	53.4	380	27.00

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

222 ← 1 per cent / ft.

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 md.
			Oil	Water	Total			Ft.	Cum. Ft.		
56	218.5	19.8	21	64	85	323	28.	1.0	54.4	323	28.00
57	219.5	20.1	20	62	82	312	28.	1.0	55.4	312	28.00
58	220.5	22.4	21	60	81	365	49.	1.0	56.4	365	49.00
59	221.5	21.6	21	58	79	352	60.	0.6	57.0	211	36.00
	11270.6	1230.0		2356			6107.93				

# Oilfield Research Laboratories

## SUMMARY OF PERMEABILITY & SATURATION TESTS

### TABLE III

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
160.5 - 171.0	9.1	7.0	63.75
171.0 - 185.3	14.3	196.1	2804.00
185.3 - 199.7	14.4	165.6	2384.00
202.4 - 221.6	19.2	32.6	625.57
160.5 - 221.6	57.0	103.1	5877.32

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
160.5 - 171.0	9.1	16.7	33.6	43.4	423	3,847
171.0 - 185.3	14.3	23.6	56.0	19.1	1,001	14,321
185.3 - 199.7	14.4	23.6	39.9	34.1	729	10,496
202.4 - 221.6	19.2	19.5	28.9	53.5	438	8,411
160.5 - 221.6	57.0	21.1	39.2	38.3	650	37,075

**Oilfield Research Laboratories**

**RESULTS OF LABORATORY FLOODING TESTS**

**TABLE IV**

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

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	Bbbs./A. Ft.			
11	171.5	22.7	43	758	11 <sup>25.6</sup>	194	32	64	564	339	21.05	15
12	172.5	21.5	42	701	8 <sup>18.9</sup>	133	34	32	568	249	14.50	15
13	173.5	23.6	46	843	14 <sup>30</sup>	257	32	64	586	341	19.00	15
14	174.5	20.8	51	823	17 <sup>33.4</sup>	275	34	63	549	180	12.00	10
15	175.5	20.6	49	784	16 <sup>32.6</sup>	256	33	63	528	180	5.97	15
16	176.5	22.4	58	1,009	21 <sup>36.2</sup>	365	37	62	644	308	12.00	10
17	177.5	23.4	55	998	19 <sup>34.5</sup>	345	36	58	653	40	1.26	20
18	178.5	21.5	64	1,068	22 <sup>34.3</sup>	367	42	53	701	188	21.00	5
19	179.5	24.5	63	1,198	25 <sup>39.7</sup>	476	38	54	722	233	65.60	5
20	180.5	24.9	64	1,237	24 <sup>37.5</sup>	464	40	57	723	296	40.00	5
21	181.5	26.9	59	1,232	10 <sup>6.9</sup>	209	49	48	1,023	207	27.60	5
22	182.5	25.6	60	1,192	18 <sup>30</sup>	358	42	53	834	292	8.00	25
23	183.5	25.9	56	1,126	11 <sup>9.6</sup>	221	45	48	905	216	21.91	15
24	184.5	24.3	66	1,244	16 <sup>24.3</sup>	302	50	46	942	327	28.31	15
25	185.5	19.1	39	578	0	0	39	56	578	197	23.49	10
26	186.5	23.1	46	825	9	161	37	62	664	153	4.65	25
27	187.5	24.5	41	780	3	57	38	59	723	325	30.36	15
28	188.5	22.2	41	707	7	121	34	59	586	55	1.12	30
29	189.5	25.5	36	712	2	40	34	58	672	174	21.46	10
30	190.5	22.7	39	687	2	36	37	62	652	283	14.66	15
31	191.5	23.4	36	654	2	36	34	62	618	254	20.65	10
32	192.5	24.5	40	760	4	76	36	59	684	257	20.54	15
33	193.5	24.1	42	786	3	57	39	60	729	247	20.86	15
34	194.5	25.9	37	744	0	0	37	61	744	305	26.82	5
35	195.5	21.7	36	607	0	0	36	63	607	58	1.38	25

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.

# Oilfield Research Laboratories

## RESULTS OF LABORATORY FLOODING TESTS

### TABLE IV

Company Missouri Lead & Zinc Company Lease Hiller Well No. 4

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
36	196.5	24.2	37	695	0	0	37	57	695	336	13.14	5
37	197.5	23.6	40	678	0	0	40	55	678	322	7.33	15
38	198.5	23.3	40	723	2	36	38	59	687	232	17.60	15
39	199.5	20.8	45	726	2	33	43	53	693	31	0.88	30
							1103			523.14'		

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.

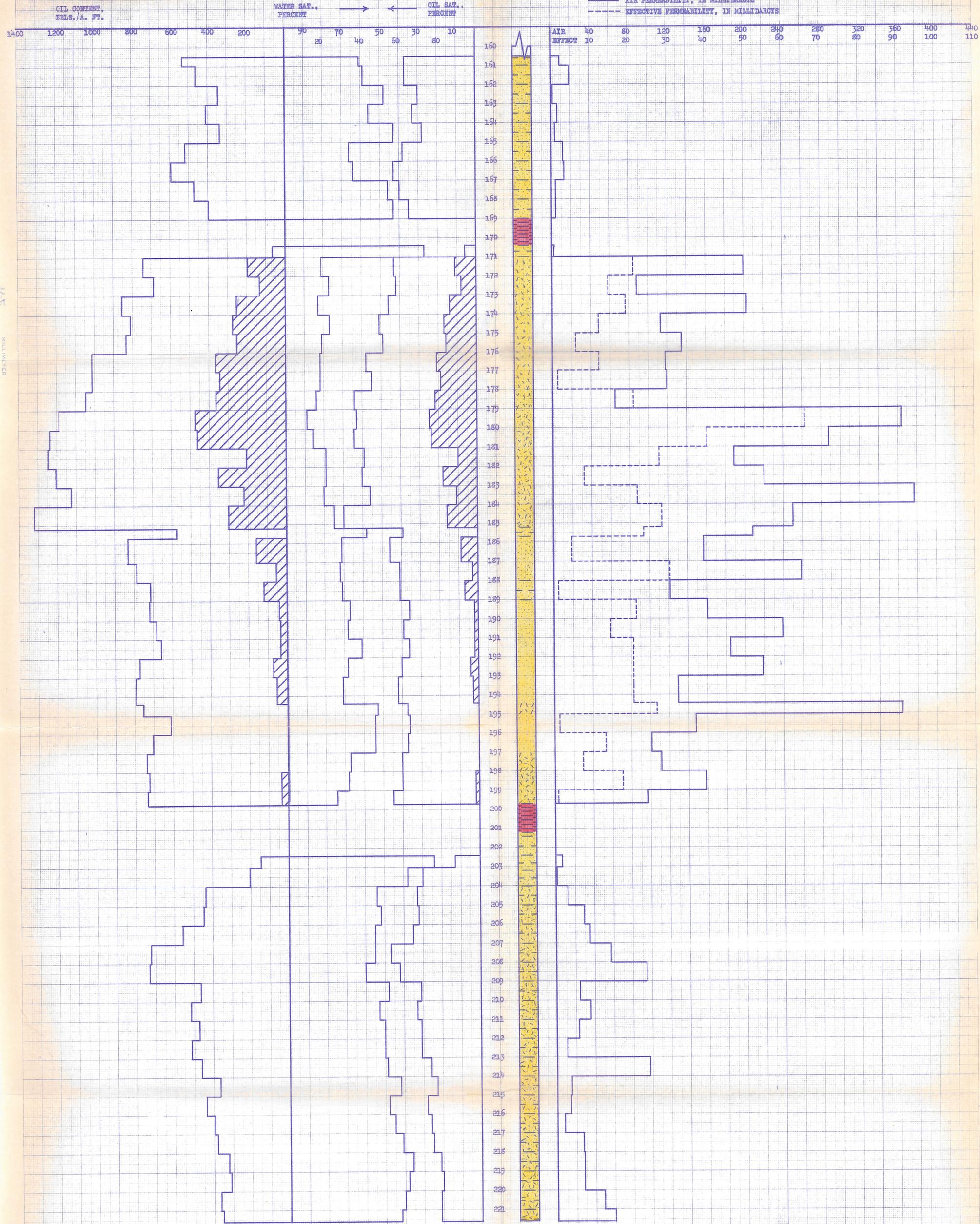
# Oilfield Research Laboratories

## SUMMARY OF LABORATORY FLOODING TESTS

### TABLE V

Company	Lease		Well No.
Missouri Lead & Zinc Company	Hiller		4
Depth Interval, Feet	171.0 - 185.3	185.3 - 199.7	171.0 - 199.7
Feet of Core Analyzed	14.3	10.4	24.7
Average Percent Porosity	23.5	24.1	23.7
Average Percent Original Oil Saturation	55.7	39.2	48.7
Average Percent Oil Recovery	16.6	3.8	11.2
Average Percent Residual Oil Saturation	39.1	35.4	37.5
Average Percent Residual Water Saturation	54.5	57.3	55.6
Average Percent Total Residual Fluid Saturation	93.6	92.7	93.1
Average Original Oil Content, Bbls./A. Ft.	341.	102.	241.
Average Oil Recovery, Bbls./A. Ft.	302.	67.	203.
Average Residual Oil Content, Bbls./A. Ft.	39.	35.	38.
Total Original Oil Content, Bbls./Acre	4872.	1059.	5931.
Total Oil Recovery, Bbls./Acre	4313.	691.	5004.
Total Residual Oil Content, Bbls./Acre	559.	368.	927.
Average Effective Permeability, Millidarcys	21.52	15.60	19.03
Average Initial Fluid Production Pressure, p.s.i.	12.5	18.0	14.8

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



KEY:  
 FLOOD POT RECOVERY  
 CARBONACEOUS SANDSTONE  
 SHALY SANDSTONE  
 SANDSTONE  
 SANDY SHALE  
 CARBONACEOUS SANDY SANDSTONE

**MISSOURI LEAD & ZINC COMPANY**  
 HILLER LEASE  
 MOSHO COUNTY, KANSAS  
 WELL NO. 4

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE PERCENT POROSITY	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT	AVG. OIL CONTENT BBLs./A. FT.	TOTAL OIL CONTENT BBLs./ACRE	AVG. AIR PERMEABILITY, MILLIDARCYs	CALCULATED OIL RECOVERY BBLs./ACRE
160.5 - 171.0	9.1	16.7	33.6	43.4	423	3,047	7.0	
171.0 - 185.3	14.3	23.6	56.0	19.1	1,001	14,321	196.1	
185.3 - 199.7	14.4	23.6	39.9	34.1	729	10,496	165.6	
202.1 - 221.6	19.5	19.5	28.9	53.5	438	8,411	32.6	
160.5 - 221.6	57.0	21.1	39.2	38.3	650	37,075	103.1	11,700 (PRIMARY & WATERFLOODING)

OILFIELD RESEARCH LABORATORIES  
 CHANUTE, KANSAS  
 OCTOBER, 1976.