OILFIELD RESEARCH LABORATORIES
536 NORTH HIGHLAND - CHANUTE, KANSAS - PHONE HE1-2650

February 28, 1967

CRA, Incorporated
P.O. Box 98
Wellington, Kansas

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the Humphrey Lease, Well No. 5, Bourbon County, Kansas, and submitted to our laboratory on February 24, 1967.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Benjamin R. Pearman

Benjamin R. Pearman

BRP:rf

3 c. - Wellington, Kansas
1 c. - Muskogee, Oklahoma
1 c. - Roy Wood

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company CRA, Incorporated Lease Humphrey Well No. 5

Location 2290' NSL & 440' EWL, SE¼

Section 36 Twp. 24S Rge. 21E County Bourbon State Kansas

Name of Sand	Bartlesville
Top of Core	627.0
Bottom of Core	650.5
Top of Sand (Analyzed)	628.2
Bottom of Sand (Analyzed)	648.8
Total Feet of Permeable Sand	15.3
Total Feet of Floodable Sand	12.1

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	3.2	3.2
5 - 10	2.7	5.9
10 - 20	3.7	9.6
20 - 50	4.9	14.5
50 & above	0.8	15.3

Average Permeability Millidarcys	21.6
Average Percent Porosity	18.5
Average Percent Oil Saturation	42.6
Average Percent Water Saturation	39.4
Average Oil Content, Bbls./A. Ft.	515.
Total Oil Content, Bbls./Acre	9,410.
Average Percent Oil Recovery by Laboratory Flooding Tests	12.9
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	191.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	2,304.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	3,780.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water mud was used as the circulating fluid while taking this core. The core was sampled and the samples sealed in cans by a representative of Oilfield Research Laboratories. The well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

627.0 - 628.2 - Gray sandy shale.

628.2 - 629.0 - Brown, slightly shaly sandstone.

629.0 - 630.2 - Grayish light brown, laminated, shaly sandstone.

630.2 - 630.7 - Gray sandy shale.

630.7 - 631.2 - Grayish light brown, laminated, shaly sandstone.

631.2 - 632.0 - Gray, laminated, sandy shale.

632.0 - 633.0 - Brown, slightly shaly sandstone.

633.0 - 633.6 - Gray sandy shale.

633.6 - 636.4 - Brown, slightly shaly sandstone.

636.4 - 636.7 - Gray sandy shale.

636.7 - 638.4 - Brown, slightly shaly sandstone.

638.4 - 642.0 - Grayish light brown, laminated, shaly sandstone.

642.0 - 642.9 - Gray and brown, laminated, shaly sandstone.

642.9 - 644.4 - Brown, slightly carbonaceous, shaly sandstone.

644.4 - 646.6 - Brown, slightly carbonaceous sandstone.

646.6 - 648.3 - Grayish light brown, shaly sandstone.

648.3 - 648.8 - Brown, carbonaceous sandstone.

648.8 - 649.4 - Grayish light brown, shaly sandstone.

649.4 - 650.5 - Black shale.

Coring was started at a depth of 267.0 feet in sandy shale and completed at 650.5 feet in shale. For the most part, the pay is made up of brown sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 26.0 and 16.9 millidarcys respectively; the overall average being 21.6 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a rather irregular permeability profile. The permeability of the sand varies from 0.26 to a maximum of 75. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 42.6. The weighted average percent oil saturation of the upper and lower sections is 42.5 and 42.9 respectively. The weighted average percent water saturation of the upper and lower sections is 37.4 and 41.5 respectively; the overall average being 39.4 (See Table III). This gives an overall weighted average total fluid saturation of 82.0 percent.

The weighted average oil content of the upper and lower sections is 609 and 622 barrels per acre foot respectively; the overall average being 615. The total oil content, as shown by this core, is 9,410 barrels per acre (See Table III).

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 2,304 barrels of oil per acre was obtained from

12.1 feet of sand. The weighted average percent oil saturation was reduced from 43.3 to 30.4, or represents an average recovery of 12.9 percent. The weighted average effective permeability of the samples is 0.711 millidarcys, while the average initial fluid production pressure is 28.4 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 17 samples tested, 13 produced water and oil. This indicates that approximately 76 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a fairly uniform effective permeability to water.

CONCLUSION

The results of the laboratory tests indicate that efficient primary and secondary operations in the vicinity of this well should recover approximately 3,780 barrels of oil per acre or an average of 312 barrels per acre foot from the 12.1 feet of floodable pay sand analyzed in this core. These recovery values were calculated using the following data and assumptions:

Original formation volume factor	1.06
Reservoir water saturation, percent	25.0
Average porosity, percent	19.1
Oil saturation after flooding, percent	30.4
Performance factor, percent	50.0
Net floodable pay sand, feet	12.1

This core shows a rather broken pay sand section having a good oil saturation, a moderate water saturation and a fairly uniform effective permeability to water.

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company CRA, Incorporated Lease Humphrey Well No. 5

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	628.4	18.6	48	23	71	691	11.	0.8	0.8	554	8.80
2	629.1	16.4	43	50	93	546	6.4	1.2	2.0	655	7.68
3	630.9	17.6	39	52	91	532	0.26	0.5	2.5	266	0.13
4	632.1	19.4	40	36	76	601	14.	1.0	3.5	601	14.00
5	634.1	16.2	37	43	80	464	11.	1.0	4.5	464	11.00
6	635.1	18.0	45	38	83	628	30.	1.0	5.5	628	30.00
7	636.1	19.6	44	27	71	668	46.	0.8	6.3	534	36.80
8	637.1	20.7	41	37	78	658	44.	0.9	7.2	591	39.60
9	638.1	20.4	45	29	74	711	75.	0.8	8.0	569	60.00
10	639.1	16.8	34	59	93	441	2.1	1.2	9.2	529	2.52
11	640.1	17.4	38	57	95	512	1.5	1.0	10.2	512	1.50
12	642.1	19.6	45	36	81	683	14.	0.9	11.1	615	12.60
13	643.1	19.7	46	35	81	702	5.9	0.5	11.6	351	2.95
14	644.1	18.6	40	42	82	576	5.8	1.0	12.6	576	5.80
15	645.1	20.1	52	29	81	810	47.	1.2	13.8	972	56.40
16	646.1	19.9	41	32	73	632	40.	1.0	14.8	632	40.00
17	648.5	17.2	54	32	86	721	2.7	0.5	15.3	361	1.35
								Total		9,410	

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company CRA, Incorporated Lease Humphrey Well No. 5

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
628.2 - 638.4	8.0	26.0	208.01
638.4 - 648.8	7.3	16.9	123.12
628.2 - 648.8	15.3	21.6	331.13

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
628.2 - 638.4	8.0	18.4	42.5	37.4	609	4,862
638.4 - 648.8	7.3	18.7	42.9	41.5	622	4,548
628.2 - 648.8	15.3	18.5	42.6	39.4	615	9,410

Oilfield Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company CRA, Incorporated Lease Humphrey Well No. 5

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.			
1	628.4	18.3	48	681	20	284	28	59	397	31	0.700	20
2	629.1	16.7	43	556	16	207	27	64	349	13	0.300	40
3	630.9	17.9	40	554	0	0	40	50	554	0	Imp.	-
4	632.1	19.8	40	614	6	92	34	64	522	18	0.400	40
5	634.1	16.7	37	479	9	117	28	71	362	21	0.500	30
6	635.1	18.5	45	646	12	172	33	66	474	41	0.900	20
7	636.1	19.2	44	655	12	179	32	66	476	31	0.570	30
8	637.1	20.4	41	648	14	221	27	63	427	43	0.900	20
9	638.1	20.8	45	725	16	258	29	62	467	101	2.10	10
10	639.1	16.6	35	451	0	0	35	60	451	0	Imp.	-
11	640.1	17.5	38	516	0	0	38	60	516	0	Imp.	-
12	642.1	19.3	45	673	20	299	25	72	374	12	0.300	40
13	643.1	19.7	46	702	10	153	36	62	549	12	0.400	35
14	644.1	19.1	40	592	12	178	28	70	414	24	0.600	20
15	645.1	20.2	52	814	15	235	35	63	549	37	0.900	30
16	646.1	20.3	41	646	6	94	35	62	552	29	0.800	35
17	648.5	17.1	55	729	0	0	55	34	729	0	Imp.	-

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 CRA, Incorporated Lease Humphrey Well No. 5

Depth Interval, Feet	628.2 - 646.6
Feet of Core Analyzed	12.1
Average Percent Porosity	19.1
Average Percent Original Oil Saturation	43.3
Average Percent Oil Recovery	12.9
Average Percent Residual Oil Saturation	30.4
Average Percent Residual Water Saturation	65.0
Average Percent Total Residual Fluid Saturation	95.4
Average Original Oil Content, Bbls./A. Ft.	643.
Average Oil Recovery, Bbls./A. Ft.	191.
Average Residual Oil Content, Bbls./A. Ft.	452.
Total Original Oil Content, Bbls./Acre	7,775.
Total Oil Recovery, Bbls./Acre	2,304.
Total Residual Oil Content, Bbls./Acre	5,471.
Average Effective Permeability, Millidarcys	0.711
Average Initial Fluid Production Pressure, p.s.i.	28.4

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