

OILFIELD RESEARCH LABORATORIES

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

November 15, 1982

Petro Valley Services Corporation
P. O. Box 449
Moran, Kansas 66755

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary cores taken from the Woirhaye Lease, Well No. 121, located in Linn County, Kansas and submitted to our laboratory on November 8, 1982.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Sanford A. Michel

SAM/rmc

5 c to Moran, Kansas

- REGISTERED ENGINEERS -

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

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GENERAL INFORMATION & SUMMARY

Company Petro Valley Services Corporation Lease Woirhaye Well No. 121
 Location _____
 Section 2 Twp. 20S Rge. 22E County Linn State Kansas

Elevation, Feet

Name of Sand.....	Squirrel	Cattleman
Top of Core	594.0	660.0
Bottom of Core	613.8	676.8
Top of Sand (Tested)	595.5	660.0
Bottom of Sand (Tested)	612.9	675.7
Total Feet of Permeable Sand	15.3	12.2
Total Feet of Floodable Sand	10.6	4.0

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.
	<u>Squirrel Sandstone</u>	
0 - 12	2.2	2.2
12 - 24	4.6	6.8
24 - 36	6.0	12.8
43 - 170	2.5	15.3
	<u>Cattleman Sandstone</u>	
15 - 50	3.4	3.4
50 - 100	2.7	6.1
100 - 190	4.0	10.1
259 - 325	2.1	12.2

Average Permeability Millidarcys	33.0	122.8
Average Percent Porosity	20.7	23.5
Average Percent Oil Saturation	34.0	70.8
Average Percent Water Saturation.....	44.2	14.0
Average Oil Content, Bbls./A. Ft.....	545.	1,294.
Total Oil Content, Bbls./Acre.....	8,343.	15,788.
Average Percent Oil Recovery by Laboratory Flooding Tests.....	10.6	18.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	168.	363.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,786.	1,453.

See "Calculated Recovery"
Section

OILFIELD RESEARCH LABORATORIES

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The cores were sampled and the samples sealed in plastic bags by a representative of the client. Fresh water mud was used as a drilling fluid.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
<u>SQUIRREL SANDSTONE</u>	
594.0 - 594.5	Grayish brown very shaly sandstone.
594.5 - 595.5	Light brown sandstone with fine gray shale partings.
595.5 - 596.5	Light brown sandstone.
596.5 - 597.0	Light brown sandstone with fine gray shale partings.
597.0 - 601.0	Light brown sandstone with widely scattered fine gray shale partings.
601.0 - 601.6	Light brown sandstone with fine gray shale partings.
601.6 - 603.6	Light brown sandstone with scattered gray shale partings.
603.6 - 604.3	Gray and light brown laminated shale and sandstone.
604.3 - 608.0	Light brown sandstone with scattered fine gray shale partings.
608.0 - 608.6	Light brown shaly sandstone.
608.6 - 610.0	Light brown sandstone.
610.0 - 613.8	Brown sandstone.
613.8 - 660.0	No core.
<u>CATTLEMAN SANDSTONE</u>	
660.0 - 668.7	Very dark brown sandstone.
668.7 - 669.8	Alternate layers gray shale and very dark brown sandstone.

<u>Depth Interval, Feet</u>	<u>Description</u>
669.8 - 673.3	Gray limestone.
673.3 - 675.7	Very dark brown sandstone.
675.7 - 676.8	Dark brown sandstone with scattered fine gray shale partings.

LABORATORY FLOODING TESTS

SQUIRREL SANDSTONE

The Squirrel Sand in this core responded to laboratory flooding tests, as a total recovery of 1,786 barrels of oil per acre was obtained from 10.6 feet of sand. The weighted average percent oil saturation was reduced from 39.1 to 28.5, or represents an average recovery of 10.6 percent. The weighted average effective permeability of the samples is 2.91 millidarcys, while the average initial fluid production pressure is 15.9 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 15 samples tested, 11 produced water and oil, and 3 samples water only. This indicates that approximately 73 percent of the sand represented by these samples is floodable pay sand.

CATTLEMAN SANDSTONE

The Cattleman Sand in this core responded to laboratory flooding tests, as a total recovery of 1,453 barrels of oil per acre was obtained from 4.0 feet of sand. The weighted average percent oil saturation was reduced from 69.3 to 50.5, or represents an average recovery of 18.8 percent. The weighted average effective permeability of the samples

is 8.88 millidarcys, while the average initial fluid production pressure is 17.5 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 13 samples tested, 4 produced water and oil, and 4 samples water only. This indicates that approximately 31 percent of the sand represented by these samples is floodable pay sand.

CALCULATED RECOVERY

It would appear from a study of the core data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 3,640 barrels of oil per acre from the Squirrel Sand, and approximately 1,360 barrels of oil per acre from the Cattleman Sand. This is an average recovery of 343 barrels per acre foot from 10.6 feet of floodable sand from the Squirrel Sand, and an average recovery of 339 barrels per acre foot from 4.0 feet of floodable sand from the Cattleman Sand.

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

	<u>Squirrel Sandstone</u>	<u>Cattleman Sandstone</u>
Original formation volume factor (estimated)	1.04	1.05
Reservoir water saturation, percent, (estimated)	30.0	10.0
Average porosity, percent	20.7	24.8
Oil saturation after flooding, percent	28.5	50.5
Performance factor, percent (estimated)	55.0	50.0
Net floodable sand, feet	10.6	4.0

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE I-B

Company Petro Valley Services Corporation Lease Woirhaye Well No. 121

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			Ft.	Cum. Ft.		
					SQUIRREL SANDSTONE					
1	596.3	19.9	32	44	494	28.	1.0	1.0	494	28.00
2	597.7	19.5	24	40	363	19.	1.5	2.5	545	28.50
3	599.5	20.8	20	69	323	43.	1.5	4.0	485	64.50
4	600.5	22.7	26	53	458	32.	1.0	5.0	458	32.00
5	601.5	20.6	33	55	527	8.9	0.6	5.6	316	5.34
6	602.5	25.6	40	42	794	27.	1.0	6.6	794	27.00
7	603.5	19.5	31	56	469	11.	1.0	7.6	469	11.00
8	604.4	19.8	20	50	307	13.	0.7	8.3	215	9.10
9	605.5	21.8	41	36	693	24.	1.0	9.3	693	24.00
10	606.6	20.0	44	33	683	25.	1.0	10.3	683	25.00
11	607.7	19.1	41	29	608	22.	1.0	11.3	608	22.00
12	608.4	16.4	45	38	573	3.0	0.6	11.9	344	1.80
13	609.5	20.3	49	34	772	19.	1.4	13.3	1081	26.60
14	611.4	22.5	34	33	594	169.	1.0	14.3	594	169.00
15	612.5	20.2	36	49	564	31.	1.0	15.3	564	31.00
					CATTLEMAN SANDSTONE					
16	660.4	27.1	72	6	1514	324.	1.0	1.0	1514	324.00
17	661.4	25.4	70	10	1379	188.	1.0	2.0	1379	188.00
18	662.4	23.6	72	10	1318	153.	1.0	3.0	1318	153.00
19	663.5	22.7	63	18	1110	101.	1.0	4.0	1110	101.00
20	664.7	22.3	66	18	1142	70.	1.0	5.0	1142	70.00
21	665.4	24.3	74	4	1395	127.	1.0	6.0	1395	127.00
22	666.7	21.1	60	22	982	44.	1.0	7.0	982	44.00
23	667.6	22.4	64	18	1112	76.	1.0	8.0	1112	76.00
24	668.5	24.7	76	13	1456	84.	0.7	8.7	1019	58.80
25	669.6	26.5	77	15	1583	259.	1.1	9.8	1741	284.90
26	673.6	20.0	81	15	1257	47.	0.7	10.5	880	32.90
27	674.5	21.5	77	14	1284	15.	0.7	11.2	899	10.50
28	675.6	22.6	74	19	1297	28.	1.0	12.2	1297	28.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Petro Valley Services Corporation Lease Woirhaye Well No. 121

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
<u>SQUIRREL SANDSTONE</u>			
595.5 - 601.6	5.6	28.3	158.34
601.6 - 612.9	9.7	35.7	346.50
595.5 - 612.9	15.3	33.0	504.84
<u>CATTLEMAN SANDSTONE</u>			
660.0 - 675.7	12.2	122.8	1498.10

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
<u>SQUIRREL SANDSTONE</u>						
595.5 - 601.6	5.6	20.6	25.7	52.4	410	2,298
601.6 - 612.9	9.7	20.7	38.8	39.5	623	6,045
595.5 - 612.9	15.3	20.7	34.0	44.2	545	8,343
<u>CATTLEMAN SANDSTONE</u>						
660.0 - 675.7	12.2	23.5	70.8	14.0	1,294	15,788

Oilfield Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

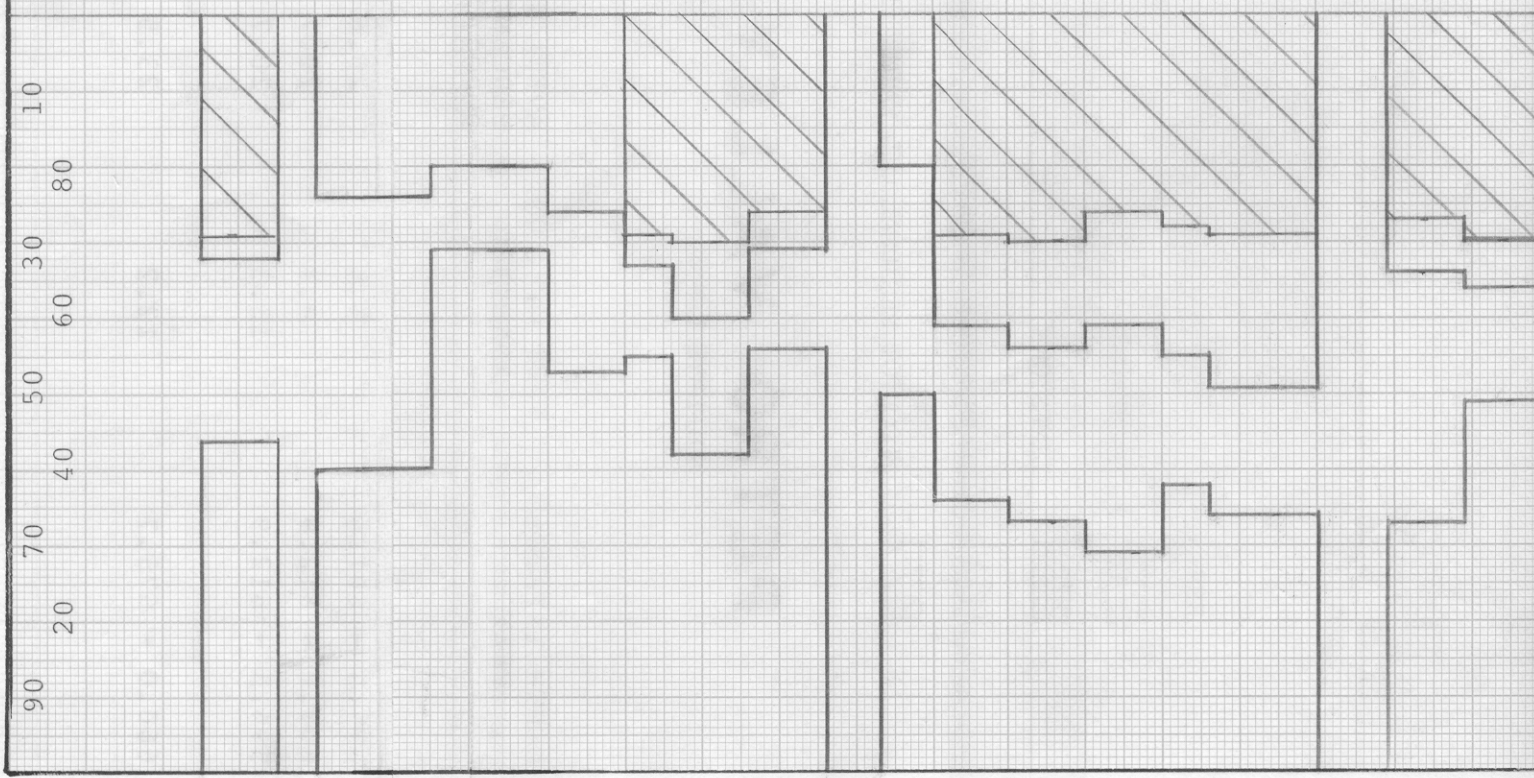
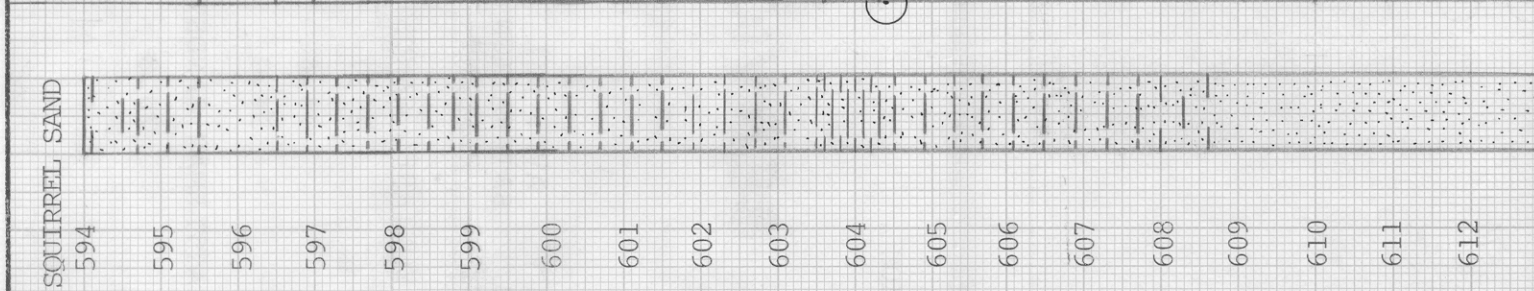
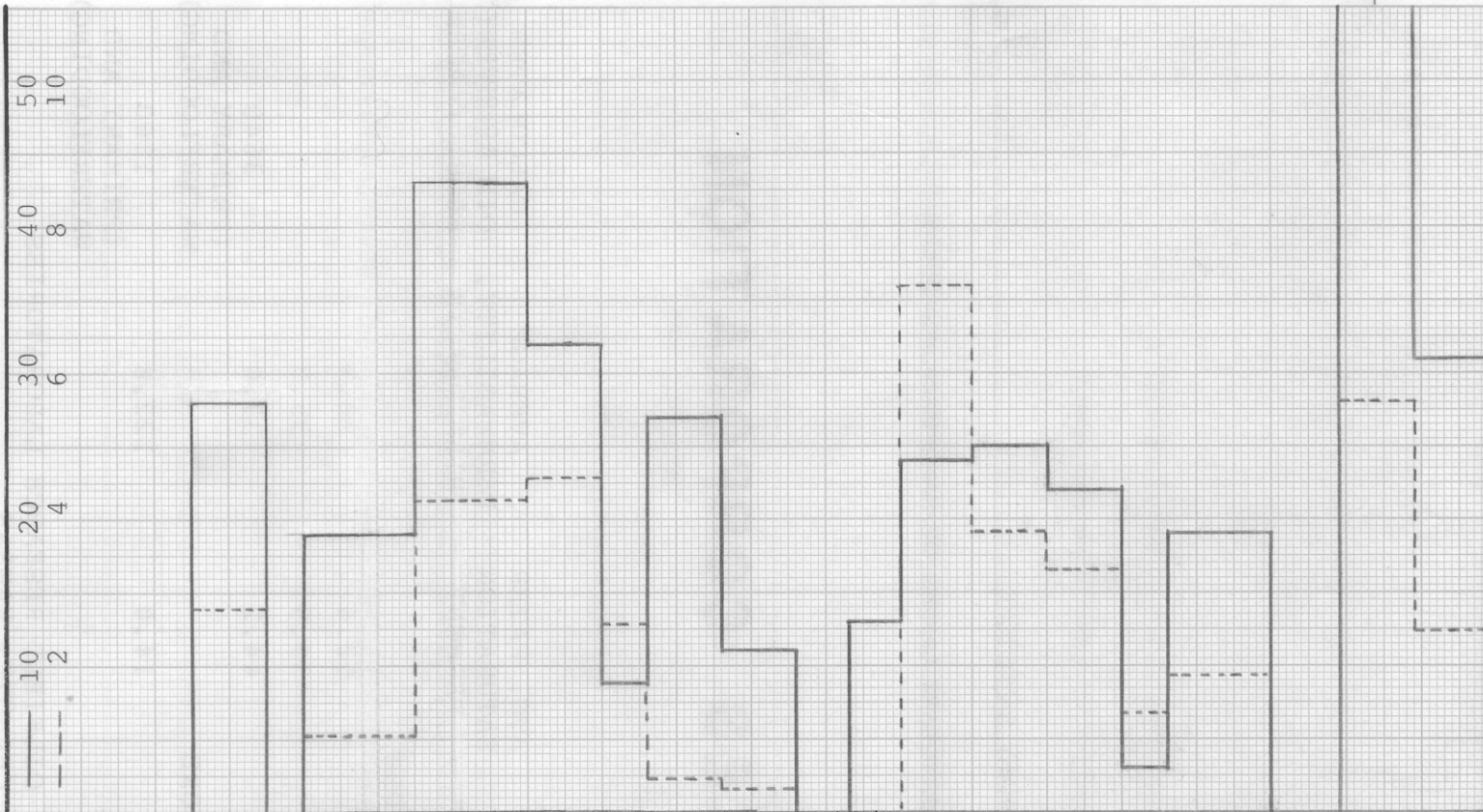
Company	Petro Valley Services Corporation	Lease	Woirhaye	Well No.
Depth Interval, Feet	595.5 - 601.6	SQUIRREL SANDSTONE 601.6 - 612.9	595.5 - 612.9	CATTLEMAN SANDSTONE 660.0 - 675.7
Feet of Core Analyzed	1.6	9.0	10.6	4.0
Average Percent Porosity	20.3	20.7	20.7	24.8
Average Percent Original Oil Saturation	32.4	40.3	39.1	69.3
Average Percent Oil Recovery	3.4	11.9	10.6	18.8
Average Percent Residual Oil Saturation	29.0	28.4	28.5	50.5
Average Percent Residual Water Saturation	63.5	66.3	65.9	46.3
Average Percent Total Residual Fluid Saturation	92.5	94.7	94.4	96.8
Average Original Oil Content, Bbls./A. Ft.	509.	647.	625.	1,334.
Average Oil Recovery, Bbls./A. Ft.	53.	189.	168.	363.
Average Residual Oil Content, Bbls./A. Ft.	456.	458.	457.	971.
Total Original Oil Content, Bbls./Acre	814.	5,820.	6,634.	5,336.
Total Oil Recovery, Bbls./Acre	85.	1,701.	1,786.	1,453.
Total Residual Oil Content, Bbls./Acre	729.	4,119.	4,848.	3,883.
Average Effective Permeability, Millidarcys	2.69	2.95	2.91	8.88
Average Initial Fluid Production Pressure, p.s.i.	12.5	16.7	15.9	17.5

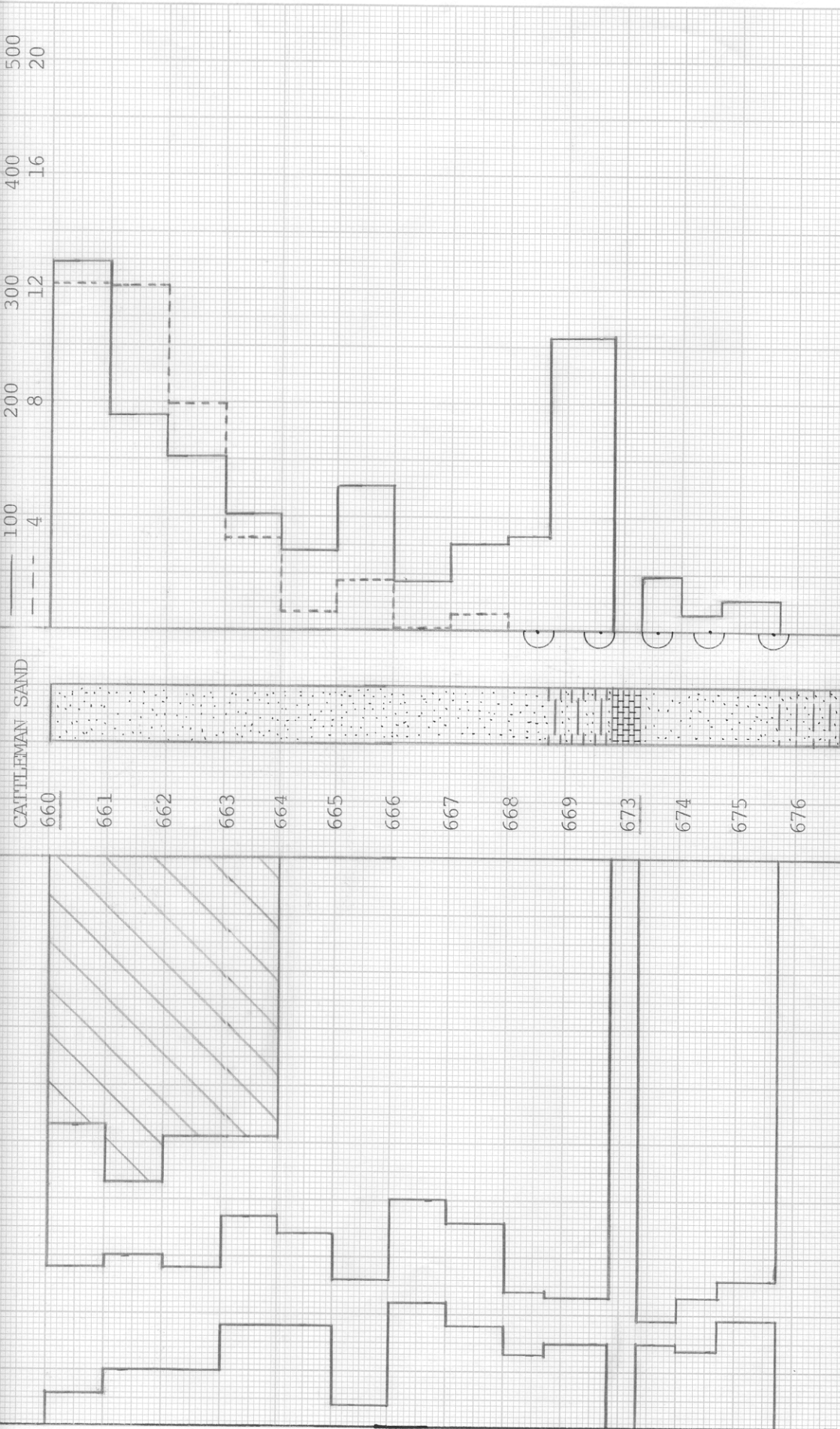
NOTE: Only those samples which recovered oil were used in calculating the above averages.

PERMEABILITY, IN MILLIDARCYS
 EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCYS





PERMEABILITY, IN MILLIDARCYS
 EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCYS

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KEY:

-  SANDSTONE
-  LIMESTONE
-  IMPERMEABLE TO WATER
-  FLOODPOT RESIDUAL OIL SATURATION

SANDSTONE WITH SHALE PARTINGS

LAMINATED SANDSTONE AND SHALE

SHALY SANDSTONE

ALTERNATE LAYERS OF SANDSTONE AND SHALE

PETRO VALLEY SERVICES CORPORATION

WOIRHAYE LEASE

LINN COUNTY, KANSAS

WELL NO. 121

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE PERCENT POROSITY	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT	AVERAGE PERMEABILITY, MILLIDARCS	CALCULATED OIL RECOVERY BBLs. / ACRE
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SQUIRREL SANDSTONE

595.5 - 601.6	5.6	20.6	25.7	52.4	28.3	
601.6 - 612.9	9.7	20.7	38.8	39.5	35.7	
595.5 - 612.9	15.3	20.7	34.0	44.2	33.0	3640 (PRIMARY AND WATERFLOODING)

CATTLEMAN SANDSTONE

660.0 - 675.7	12.2	23.5	70.8	14.0	122.8	1360 (PRIMARY AND WATERFLOODING)
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CHANUTE, KANSAS
NOVEMBER, 1982 PDC