

# OILFIELD RESEARCH LABORATORIES

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

November 3, 1982

Petro Valley Services Corporation  
Box 449  
Moran, Kansas 66755

Gentlemen:

Enclosed herewith is the report of the analysis of the rotary cores taken from the Swarner-Woirhaye Lease, Well No. 111, located in Linn County, Kansas, and submitted to our laboratory on October 27, 1982.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Sanford A. Michel

SAM/tem

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- REGISTERED ENGINEERS -

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

**Oilfield Research Laboratories**  
**GENERAL INFORMATION & SUMMARY**

Company Petro Valley Services Corporation Lease Swamer-Woirhaye Well No. 111

Location \_\_\_\_\_

Section 2 Twp. 20S Rge. 22E County Linn State Kansas

Elevation, Feet .....

Name of Sand.....	Squirrel	Cattleman
Top of Core .....	596.0	660.0
Bottom of Core .....	613.4	676.4
Top of Sand .....	596.0	660.0
Bottom of Sand .....	(Tested) 610.5	669.5
Total Feet of Permeable Sand .....	12.6	8.7
Total Feet of Floodable Sand .....	8.6	3.6

Distribution of Permeable Sand: Permeability Range Millidarcys	Feet	Cum. Ft.		
<u>SQUIRREL SANDSTONE</u>				
0 - 13	8.2	8.2		
28 - 63	2.7	10.9		
127 - 134	1.7	12.6		
<u>CATTLEMAN SANDSTONE</u>				
0 - 4	0.5	0.5		
80 - 85	0.6	1.1		
130 - 190	4.6	5.7		
230 - 385	3.0	8.7		
Average Permeability Millidarcys .....			31.6	188.8
Average Percent Porosity .....			20.3	24.7
Average Percent Oil Saturation .....			32.2	72.8
Average Percent Water Saturation .....			45.6	13.9
Average Oil Content, Bbls./A. Ft. ....		508.		1,388.
Total Oil Content, Bbls./Acre .....		6,401.		12,079.
Average Percent Oil Recovery by Laboratory Flooding Tests .....		7.9		6.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. ....		124.		132.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre .....		1,067.		476.
Total Calculated Oil Recovery, Bbls./Acre .....				

See "Calculated Recovery" Section.

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The core was sampled and the samples sealed in plastic bags by a representative of the client. Air and a salt water mist were used as drilling fluids. The core was reported to be from a non-virgin area.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
	<u>SQUIRREL SANDSTONE</u>
596.0 - 597.0	Light brown sandstone with gray shale and micaceous partings.
597.0 - 599.0	Light brown sandstone with fine gray shale partings.
599.0 - 599.7	Light brown sandstone.
599.7 - 600.0	Grayish brown very shaly sandstone.
600.0 - 603.5	Light brown sandstone with fine gray shale partings.
603.5 - 604.0	Gray and brown laminated micaceous shale and sandstone.
604.0 - 604.6	Light brown sandstone.
604.6 - 605.1	Light brown sandstone with gray shale partings.
605.1 - 606.2	Gray shale.
606.2 - 607.8	Gray and brown finely laminated shale and sandstone.
607.8 - 610.5	Brown sandstone.
610.5 - 611.0	Brown micaceous sandstone.
611.0 - 611.8	Coal.
611.8 - 613.4	Gray shale.
613.4 - 660.0	No core.

<u>Depth Interval, Feet</u>	<u>Description</u>
<u>CATTLEMAN SANDSTONE</u>	
660.0 - 660.6	Dark brown sandstone.
660.6 - 660.8	Gray shale.
660.8 - 661.8	Dark brown sandstone.
661.8 - 662.0	Gray limestone.
662.0 - 667.2	Dark brown sandstone.
667.2 - 667.6	Grayish brown shaly cherty, calcareous sandstone.
667.6 - 669.0	Dark brown sandstone.
669.0 - 669.5	Grayish dark brown shaly sandstone.
669.5 - 670.1	Grayish light brown calcareous shaly sandstone.
670.1 - 675.4	Gray shale.
675.4 - 675.8	Coal.
675.8 - 676.4	Gray shale.

LABORATORY FLOODING TESTSSQUIRREL SANDSTONE

The Squirrel Sandstone in this core responded to laboratory flooding tests, as a total recovery of 1,067 barrels of oil per acre was obtained from 8.6 feet of sand. The weighted average percent oil saturation was reduced from 35.3 to 27.4, or represents an average recovery of 7.9 percent. The weighted average effective permeability of the samples is 5.13 millidarcys, while the average initial fluid production pressure is 16.7 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 14 samples tested, 9 produced water and oil, and 3 produced water only. This indicates that approximately 64 percent of the sand represented by these samples is floodable pay sand.

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LABORATORY FLOODING TESTSCATTLEMAN SANDSTONE

The Cattleman Sandstone in this core responded to laboratory flooding tests, as a total recovery of 476 barrels of oil per acre was obtained from 3.6 feet of sand. The weighted average percent oil saturation was reduced from 70.5 to 63.7, or represents an average recovery of 6.8 percent. The weighted average effective permeability of the samples is 7.45 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 9 samples tested, 4 produced water and oil, and 1 produced water only. This indicates that approximately 44 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 2,630 barrels of oil per acre from the Squirrel Sandstone, and approximately 720 barrels of oil per acre from the Cattleman Sandstone. This is an average recovery of 306 barrels per acre foot from 8.6 feet of floodable sand from the Squirrel Sandstone, and an average recovery of 201 barrels per acre foot from 3.6 feet of floodable sand from the Cattleman Sandstone.

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

	<u>SQUIRREL SANDSTONE</u>	<u>CATTLEMAN SANDSTONE</u>
Original formation volume factor (estimated)	1.05	1.04
Reservoir water saturation, percent (estimated)	35.0	10.0
Average porosity, percent	20.8	25.2
Oil saturation after flooding, percent	27.4	63.7
Performance factor, percent (estimated)	55.0	45.0
Net floodable pay sand, feet	8.6	3.6

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Petro Valley Services Corporation

Lease Swarner-Woirhaye

Well No. 111

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.		
<u>SQUIRREL SANDSTONE</u>											
1	596.5	20.2	30	39	69	470	11.	1.0	1.0	470	11.00
2	597.3	19.9	29	49	78	448	10.	1.0	2.0	448	10.00
3	598.6	20.4	28	47	75	443	7.4	1.0	3.0	443	7.40
4	599.5	21.0	23	51	74	375	30.	0.7	3.7	263	21.00
5	600.6	21.1	36	37	73	589	28.	1.0	4.7	589	28.00
6	601.5	19.5	33	45	78	499	12.	1.0	5.7	499	12.00
7	602.5	18.4	45	50	95	642	6.5	1.5	7.2	963	9.75
8	603.7	18.0	27	52	79	377	1.4	0.5	7.7	189	0.70
9	604.5	19.0	45	38	83	663	10.	0.6	8.3	398	6.00
10	606.5	17.3	17	63	80	228	3.1	0.8	9.1	182	2.48
11	607.5	22.6	34	34	68	596	7.2	0.8	9.9	477	5.76
12	608.4	21.4	32	39	71	531	127.	0.7	10.6	372	88.90
13	609.4	23.6	32	41	73	586	133.	1.0	11.6	586	133.00
14	610.4	21.7	31	52	83	522	62.0	1.0	12.6	522	62.00
<u>CATTLEMAN SANDSTONE</u>											
15	660.4	23.7	73	16	89	1342	80.	0.6	0.6	805	48.00
16	661.4	26.5	59	8	67	1213	384.	1.0	1.6	1213	384.00
17	662.4	26.0	61	13	74	1230	231.	1.0	2.6	1230	231.00
18	663.4	24.3	71	18	89	1339	153.	1.0	3.6	1339	153.00
19	664.3	25.6	80	12	92	1589	241.	1.0	4.6	1589	241.00
20	665.5	24.9	80	15	95	1545	161.	1.0	5.6	1545	161.00
21	666.5	25.5	76	13	89	1504	133.	1.2	6.8	1805	159.60
22	668.5	23.8	78	16	94	1440	188.	1.4	8.2	2016	263.20
23	669.4	18.2	76	14	90	1073	3.7	0.5	8.7	537	1.85

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## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Petro Valley Services Corporation Lease Swarner-Moirhaye Well No. 111

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.		
<u>SQUIRREL SANDSTONE</u>					
596.0 - 610.5	12.6	31.6	397.99		
<u>CATTLEMAN SANDSTONE</u>					
660.0 - 669.5	8.7	188.8	1,642.65		
Depth Interval, Feet	Feet of Core Analyzed	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
<u>SQUIRREL SANDSTONE</u>					
596.0 - 610.5	12.6	20.3	32.2	45.6	6,401
<u>CATTLEMAN SANDSTONE</u>					
660.0 - 669.5	8.7	24.7	72.8	13.9	12,079

# Oilfield Research Laboratories

## RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company: Petro Valley Services Corporation Lease: Swarner-Woirhaye Well No. 111

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			
				<u>SQUIRREL SANDSTONE</u>							
1	596.5	20.3	30	472	0	0	30	49	10	0.15	45
2	597.3	20.1	29	452	0	0	29	54	104	1.12	20
3	598.6	20.5	28	445	3	48	25	60	18	0.37	35
4	599.5	21.1	23	376	0	0	23	65	100	1.50	15
5	600.6	21.0	36	587	11	179	25	73	126	2.02	20
6	601.5	19.4	33	497	7	105	26	71	12	0.30	20
7	602.5	18.5	45	646	14	201	31	66	40	3.27	20
8	603.7	17.5	28	380	0	0	28	51	0	Imp.	-
9	604.5	19.1	45	667	13	193	32	61	62	0.75	15
10	606.5	17.5	17	231	0	0	17	64	0	Imp.	-
11	607.5	22.5	34	593	6	105	28	62	306	4.50	10
12	608.4	21.5	32	534	5	83	27	71	248	17.49	10
13	609.4	23.8	32	591	4	74	28	64	310	8.62	10
14	610.4	21.8	31	524	6	101	25	67	322	11.57	10
				<u>CATTLEMAN SANDSTONE</u>							
15	660.4	23.8	73	1348	11	203	62	29	320	9.33	10
16	661.4	26.6	59	1218	2	41	57	37	236	14.99	10
17	662.4	26.1	61	1235	0	0	61	32	298	19.30	35
18	663.4	24.4	71	1344	4	76	67	30	314	5.55	20
19	664.3	25.5	80	1583	12	237	68	26	40	0.67	30
20	665.5	24.5	81	1540	0	0	81	14	0	Imp.	-
21	666.5	25.1	77	1499	0	0	77	12	0	Imp.	-
22	668.5	23.9	78	1446	0	0	78	15	0	Imp.	-
23	669.4	18.5	75	1076	0	0	75	15	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.

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## SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Petro Valley Services Corporation	Lease	Swarner-Moirhaye	Well No.	111
	SQUIRREL SANDSTONE		CATTLEMAN SANDSTONE		
Depth Interval, Feet	596.0 - 610.5		660.0 - 669.5		
Feet of Core Analyzed	8.6		3.6		
Average Percent Porosity	20.8		25.2		
Average Percent Original Oil Saturation	35.3		70.5		
Average Percent Oil Recovery	7.9		6.8		
Average Percent Residual Oil Saturation	27.4		63.7		
Average Percent Residual Water Saturation	66.3		30.7		
Average Percent Total Residual Fluid Saturation	93.7		94.4		
Average Original Oil Content, Bbls./A. Ft.	565.		1,376.		
Average Oil Recovery, Bbls./A. Ft.	124.		132.		
Average Residual Oil Content, Bbls./A. Ft.	441.		1,244.		
Total Original Oil Content, Bbls./Acre	4,862.		4,954.		
Total Oil Recovery, Bbls./Acre	1,067.		476.		
Total Residual Oil Content, Bbls./Acre	3,795.		4,478.		
Average Effective Permeability, Millidarcys	5.13		7.45		
Average Initial Fluid Production Pressure, p.s.i.	16.7		17.5		

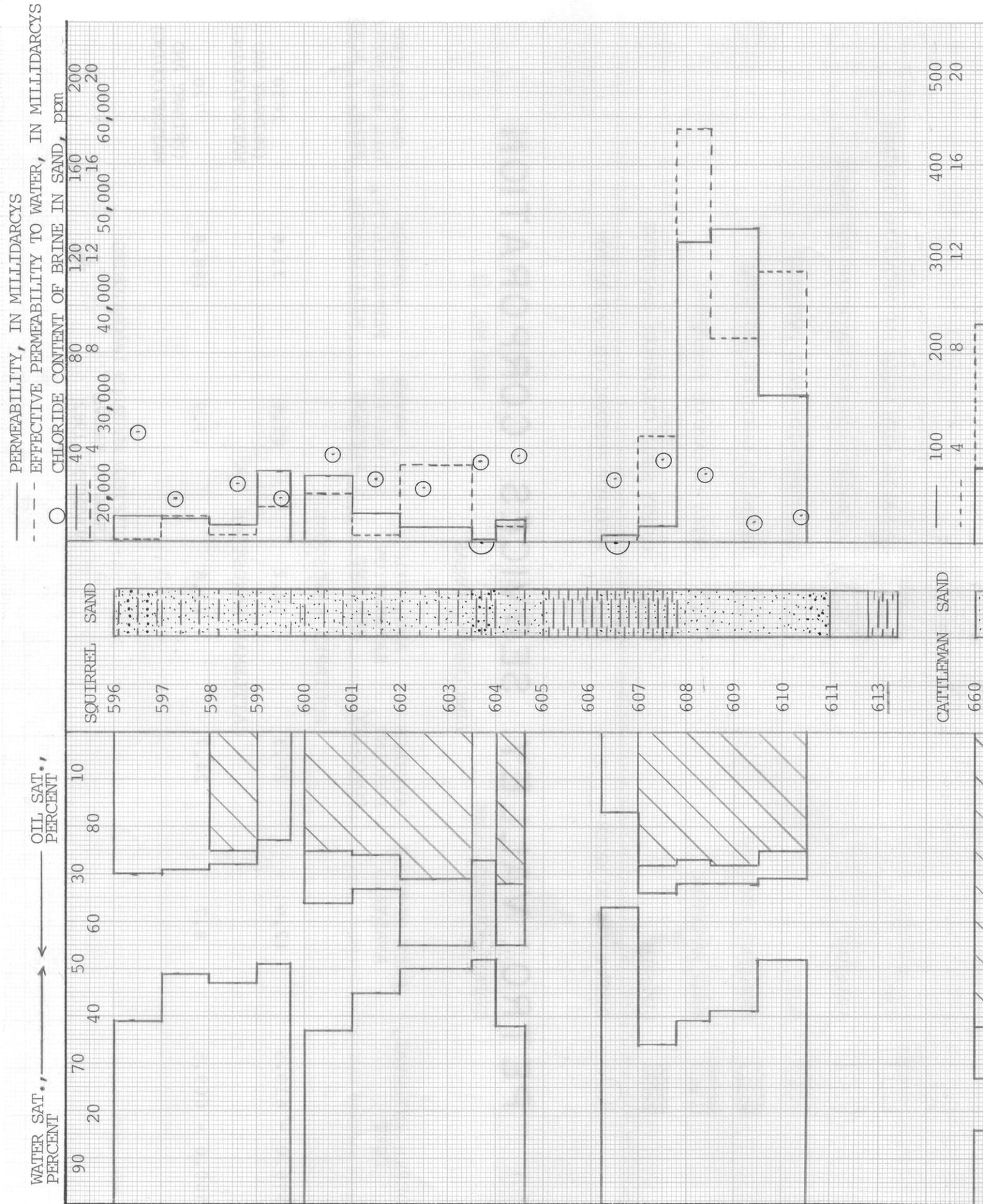
NOTE: Only those samples which recovered oil were used in calculating the above averages.

**Oilfield Research Laboratories**  
**RESULTS OF WATER DIFFERENTIATION TESTS**

**TABLE VI**

Company Petro Valley Services Corporation Lease Swarner-Woirhave Well No. 111

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	596.5	26,747			
2	597.3	19,529			
3	598.6	21,327			
4	599.5	19,577			
5	600.6	24,378			
6	601.5	21,604			
7	602.5	20,754			
8	603.7	23,505			
9	604.5	24,193			
10	606.5	21,707			
11	607.5	23,815			
12	608.4	22,398			
13	609.4	17,194			
14	610.4	17,906			
15	660.4	27,079			
16	661.4	44,277			
17	662.4	29,337			
18	663.4	22,836			
19	664.3	29,634			
20	665.5	23,627			
21	666.5	25,679			
22	668.5	23,245			
23	669.4	31,645			



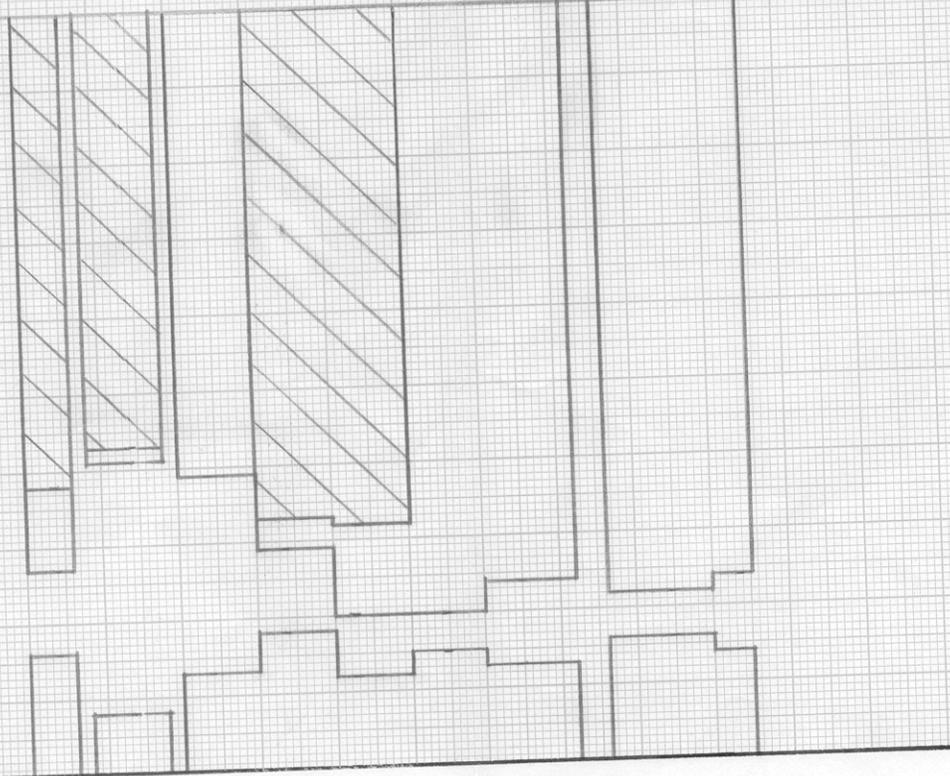
500  
400  
300  
200  
100  
0

16  
12  
8  
4

20

CATTLEMAN SAND

660  
661  
662  
663  
664  
665  
666  
667  
668  
669  
670  
675  
676



KEY:

-  COAL
-  SANDSTONE
-  SHALE
-  MICACEOUS SANDSTONE
-  SHALY SANDSTONE
-  LIMESTONE

SANDSTONE WITH SHALE AND MICACEOUS PARTINGS

-  SANDSTONE WITH SHALE AND MICACEOUS PARTINGS
-  LAMINATED MICACEOUS SANDSTONE AND SHALE
-  SANDSTONE WITH SHALE PARTINGS
-  LAMINATED SANDSTONE AND SHALE
-  SHALY CALcareous SANDSTONE
-  Cherty shaly calcareous SANDSTONE
-  FLOODPOT RESIDUAL OIL SATURATION

IMPERMEABLE TO WATER



# PETRO VALLEY SERVICES CORPORATION

SWARNER-WOIRHAYE LEASE

WELL NO. 111

LINN COUNTY, KANSAS

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

596.0 - 610.5	12.6	20.3	32.2	45.6	31.6	2630 (PRIMARY AND WATERFLOODING)
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CATTLEMAN SANDSTONE

660.0 - 669.5	8.7	24.7	72.8	13.9	188.8	720 (PRIMARY AND WATERFLOODING)
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CHANUTE, KANSAS  
NOVEMBER, 1982 PDC