

# OILFIELD RESEARCH LABORATORIES

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

February 4, 1980

Jackson Brothers  
514 North Main  
Eureka, Kansas 67045

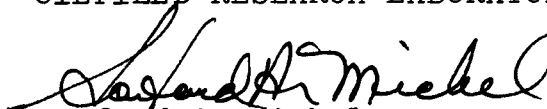
Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Hawthorne Lease, Well No. 13, Greenwood County, Kansas, and submitted to our laboratory on January 7, 1980.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

  
Sanford A. Michel

SAM/tem  
6 c to Eureka, Kansas

# Oilfield Research Laboratories

## GENERAL INFORMATION & SUMMARY

|                                                                 |                  |       |           |                                    |               |
|-----------------------------------------------------------------|------------------|-------|-----------|------------------------------------|---------------|
| Company                                                         | Jackson Brothers | Lease | Hawthorne | Well No.                           | 13            |
| Location                                                        | NE SE SE         |       |           |                                    |               |
| Section                                                         | 22               | Twp.  | 25S       | Rge.                               | 8E            |
|                                                                 | County           |       |           | Greenwood                          |               |
|                                                                 | State            |       |           | Kansas                             |               |
| Elevation, Feet                                                 |                  |       |           | Ground Level                       | Kelly Bushing |
|                                                                 |                  |       |           | 1485.0                             | 1490.0        |
| Name of Sand                                                    |                  |       |           | Bartlesville                       |               |
| Top of Core                                                     |                  |       |           | 2505.0                             |               |
| Bottom of Core                                                  |                  |       |           | 2528.5                             |               |
| Top of Sand                                                     |                  |       |           | 2505.0                             |               |
| Bottom of Sand                                                  |                  |       |           | 2528.5                             |               |
| Total Feet of Permeable Sand                                    |                  |       |           | 17.3                               |               |
| Total Feet of Floodable Sand                                    |                  |       |           | 8.0                                |               |
| Distribution of Permeable Sand:                                 |                  |       |           |                                    |               |
| Permeability Range<br>Millidarcys                               | Feet             |       |           | Cum. Ft.                           |               |
| 0 - 10                                                          | 8.0              |       |           | 8.0                                |               |
| 10 - 20                                                         | 5.3              |       |           | 13.3                               |               |
| 20 - 30                                                         | 4.0              |       |           | 17.3                               |               |
| Average Permeability Millidarcys                                |                  |       |           | 12.5                               |               |
| Average Percent Porosity                                        |                  |       |           | 15.7                               |               |
| Average Percent Oil Saturation                                  |                  |       |           | 21.5                               |               |
| Average Percent Water Saturation                                |                  |       |           | 60.8                               |               |
| Average Oil Content, Bbls./A. Ft.                               |                  |       |           | 258.                               |               |
| Total Oil Content, Bbls./Acre                                   |                  |       |           | 4,745.                             |               |
| Average Percent Oil Recovery by Laboratory Flooding Tests       |                  |       |           | 3.6                                |               |
| Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. |                  |       |           | 50.                                |               |
| Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre     |                  |       |           | 399.                               |               |
| Total Calculated Oil Recovery, Bbls./Acre                       |                  |       |           | See "Calculated Recovery" Section. |               |

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The core was sampled by a representative of Oilfield Research Laboratories. Fresh water mud was used as a drilling fluid. The core was reported to be from a virgin area.

FORMATION CORED

The detailed log of the formation cored is as follows:

| <u>Depth Interval,<br/>Feet</u> | <u>Description</u>                            |
|---------------------------------|-----------------------------------------------|
| 2502.0 - 2506.2                 | Brown and gray laminated sandstone and shale. |
| 2506.2 - 2507.0                 | Gray sandy shale.                             |
| 2507.0 - 2508.1                 | Brown and gray laminated sandstone and shale. |
| 2508.1 - 2508.9                 | Gray sandy shale.                             |
| 2508.9 - 2509.7                 | Brown and gray laminated sandstone and shale. |
| 2509.7 - 2511.3                 | Gray sandy shale.                             |
| 2511.3 - 2511.9                 | Brown and gray laminated sandstone and shale. |
| 2511.9 - 2513.8                 | Gray sandy shale.                             |
| 2513.8 - 2515.1                 | Brown shaly sandstone.                        |
| 2515.1 - 2517.3                 | Brown sandstone.                              |
| 2517.3 - 2518.8                 | Light brown shaly sandstone.                  |
| 2518.8 - 2522.0                 | Brown sandstone.                              |
| 2522.0 - 2523.2                 | Light brown shaly sandstone.                  |
| 2523.2 - 2524.1                 | Light brown slightly shaly sandstone.         |
| 2524.1 - 2525.6                 | Light brown sandstone.                        |
| 2525.6 - 2526.7                 | Light brown slightly shaly sandstone.         |
| 2526.7 - 2528.5                 | Light brown sandstone.                        |

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LABORATORY FLOODING TESTS

The lower portion of the sand in this core responded to laboratory flooding tests, as a total recovery of 399 barrels of oil per acre was obtained from 8.0 feet of sand. The weighted average percent oil saturation was reduced from 24.6 to 21.0, or represents an average recovery of 3.6 percent. The weighted average effective permeability of the samples is 1.58 millidarcys, while the average initial fluid production pressure is 33.1 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 19 samples tested, 8 produced water and oil, and 4 samples produced water only. This indicates that approximately 42 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 1,350 barrels of oil per acre. This is an average recovery of 169 barrels per acre foot from 8.0 feet of floodable sand analyzed in this core.

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

|                                                |      |
|------------------------------------------------|------|
| Original formation volume factor, estimated    | 1.20 |
| Reservoir water saturation, percent, estimated | 45.0 |
| Average porosity, percent                      | 17.8 |
| Oil saturation after flooding, percent         | 21.0 |

## OILFIELD RESEARCH LABORATORIES

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|                                        |      |
|----------------------------------------|------|
| Performance factor, percent, estimated | 50.0 |
| Net floodable sand, feet               | 8.0  |

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Jackson Brothers Lease Hawthorne Well No. 13

| 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          | 2505.5      | 11.3                       | 14                 | 73    | 87    | 123                       | 3.1          | 1.2          | 1.2      | 148               | 3.72                     |
| 2          | 2507.3      | 8.1                        | 50                 | 47    | 97    | 314                       | Imp.         | 1.1          | 2.3      | 345               | 0.00                     |
| 3          | 2509.5      | 13.1                       | 18                 | 65    | 83    | 183                       | 3.9          | 0.8          | 3.1      | 146               | 3.12                     |
| 4          | 2511.5      | 9.0                        | 6                  | 90    | 96    | 42                        | 11.          | 0.6          | 3.7      | 25                | 6.60                     |
| 5          | 2514.5      | 15.1                       | 27                 | 50    | 77    | 316                       | 3.8          | 1.3          | 5.0      | 411               | 4.94                     |
| 6          | 2515.5      | 16.9                       | 19                 | 55    | 74    | 249                       | 24.          | 1.0          | 6.0      | 249               | 24.00                    |
| 7          | 2516.5      | 19.5                       | 24                 | 48    | 72    | 363                       | 25.          | 1.2          | 7.2      | 436               | 30.00                    |
| 8          | 2517.5      | 15.6                       | 17                 | 68    | 83    | 206                       | 2.2          | 1.0          | 8.2      | 206               | 2.20                     |
| 9          | 2518.5      | 16.3                       | 21                 | 63    | 84    | 266                       | 5.8          | 0.5          | 8.7      | 133               | 2.90                     |
| 10         | 2519.5      | 19.4                       | 28                 | 53    | 81    | 421                       | 14.          | 1.2          | 9.9      | 505               | 16.80                    |
| 11         | 2520.5      | 17.0                       | 28                 | 53    | 81    | 369                       | 15.          | 1.0          | 10.9     | 369               | 15.00                    |
| 12         | 2521.5      | 16.0                       | 25                 | 66    | 91    | 310                       | 16.          | 1.0          | 11.9     | 310               | 16.00                    |
| 13         | 2522.5      | 12.4                       | 13                 | 70    | 83    | 125                       | 4.4          | 1.2          | 13.1     | 150               | 5.28                     |
| 14         | 2523.5      | 19.6                       | 17                 | 63    | 80    | 259                       | 8.0          | 0.9          | 14.0     | 233               | 7.20                     |
| 15         | 2524.5      | 16.8                       | 18                 | 74    | 92    | 235                       | 15.          | 0.9          | 14.9     | 212               | 13.50                    |
| 16         | 2525.5      | 19.0                       | 18                 | 62    | 80    | 265                       | 14.          | 0.6          | 15.5     | 159               | 8.40                     |
| 17         | 2526.5      | 18.3                       | 14                 | 56    | 70    | 199                       | 9.9          | 1.1          | 16.6     | 219               | 10.89                    |
| 18         | 2527.5      | 17.6                       | 19                 | 58    | 77    | 259                       | 29.          | 1.0          | 17.6     | 259               | 29.00                    |
| 19         | 2528.2      | 17.6                       | 21                 | 63    | 84    | 287                       | 21.          | 0.8          | 18.4     | 230               | 16.80                    |

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## SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

| Company | Jackson Brothers | Lease | Hawthorne | Well No. | 13 |
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## RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Well No. 13

Lease Hawthorne

Company Jackson Brothers

| 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 |                               |                                      |                                                |
| 1          | 2505.5      | 11.1                       | 14                      | 121          | 0            | 0            | 14                  | 70      | 0                             | Imp.                                 | -                                              |
| 2          | 2507.3      | 8.1                        | 50                      | 314          | 0            | 0            | 50                  | 42      | 0                             | Imp.                                 | -                                              |
| 3          | 2509.5      | 13.0                       | 18                      | 182          | 0            | 0            | 18                  | 65      | 0                             | Imp.                                 | -                                              |
| 4          | 2511.5      | 9.0                        | 6                       | 42           | 0            | 0            | 6                   | 90      | 0                             | Imp.                                 | -                                              |
| 5          | 2514.5      | 15.4                       | 27                      | 323          | 3            | 36           | 24                  | 58      | 10                            | 0.20                                 | 45                                             |
| 6          | 2515.5      | 17.0                       | 19                      | 251          | 2            | 26           | 17                  | 52      | 46                            | 0.80                                 | 30                                             |
| 7          | 2516.5      | 19.3                       | 24                      | 359          | 3            | 45           | 21                  | 66      | 46                            | 0.70                                 | 30                                             |
| 8          | 2517.5      | 15.9                       | 17                      | 210          | 0            | 0            | 17                  | 71      | 0                             | Imp.                                 | -                                              |
| 9          | 2518.5      | 16.5                       | 21                      | 269          | 3            | 38           | 18                  | 70      | 10                            | 0.20                                 | 50                                             |
| 10         | 2519.5      | 19.6                       | 28                      | 426          | 7            | 106          | 21                  | 74      | 162                           | 4.00                                 | 20                                             |
| 11         | 2520.5      | 17.2                       | 28                      | 374          | 5            | 67           | 23                  | 68      | 62                            | 1.40                                 | 30                                             |
| 12         | 2521.5      | 16.2                       | 25                      | 314          | 2            | 25           | 23                  | 74      | 32                            | 0.70                                 | 40                                             |
| 13         | 2522.5      | 12.4                       | 13                      | 125          | 0            | 0            | 13                  | 70      | 0                             | Imp.                                 | -                                              |
| 14         | 2523.5      | 19.2                       | 17                      | 253          | 0            | 0            | 17                  | 75      | 50                            | 0.90                                 | 25                                             |
| 15         | 2524.5      | 17.0                       | 18                      | 237          | 0            | 0            | 18                  | 74      | 0                             | Imp.                                 | -                                              |
| 16         | 2525.5      | 19.1                       | 18                      | 267          | 0            | 0            | 18                  | 78      | 376                           | 7.20                                 | 20                                             |
| 17         | 2526.5      | 18.0                       | 14                      | 196          | 0            | 0            | 14                  | 83      | 26                            | 0.40                                 | 30                                             |
| 18         | 2527.5      | 17.7                       | 19                      | 261          | 0            | 0            | 19                  | 78      | 302                           | 5.80                                 | 20                                             |
| 19         | 2528.2      | 17.9                       | 21                      | 292          | 3            | 42           | 18                  | 80      | 220                           | 4.70                                 | 20                                             |

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                                           | Jackson Brothers | Lease | Hawthorne | Well No. | 13 |
| Depth Interval, Feet                              | 2513.8 - 2528.5  |       |           |          |    |
| Feet of Core Analyzed                             | 8.0              |       |           |          |    |
| Average Percent Porosity                          | 17.5             |       |           |          |    |
| Average Percent Original Oil Saturation           | 24.6             |       |           |          |    |
| Average Percent Oil Recovery                      | 3.6              |       |           |          |    |
| Average Percent Residual Oil Saturation           | 21.0             |       |           |          |    |
| Average Percent Residual Water Saturation         | 67.1             |       |           |          |    |
| Average Percent Total Residual Fluid Saturation   | 88.1             |       |           |          |    |
| Average Original Oil Content, Bbls./A. Ft.        | 334.             |       |           |          |    |
| Average Oil Recovery, Bbls./A. Ft.                | 50.              |       |           |          |    |
| Average Residual Oil Content, Bbls./A. Ft.        | 284.             |       |           |          |    |
| Total Original Oil Content, Bbls./Acre            | 2,669.           |       |           |          |    |
| Total Oil Recovery, Bbls./Acre                    | 399.             |       |           |          |    |
| Total Residual Oil Content, Bbls./Acre            | 2,270.           |       |           |          |    |
| Average Effective Permeability, Millidarcys       | 1.58             |       |           |          |    |
| Average Initial Fluid Production Pressure, p.s.i. | 33.1             |       |           |          |    |

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 Jackson Brothers Lease Hawthorne Well No. 13

| Sample No. | Depth, Feet | Chloride Content of Brine in Sand ppm | Percent Water Saturation |                    |       |
|------------|-------------|---------------------------------------|--------------------------|--------------------|-------|
|            |             |                                       | Connate                  | Drilling & Foreign | Total |
| 1          | 2505.5      | 74,763                                |                          |                    |       |
| 2          | 2507.3      | 94,529                                |                          |                    |       |
| 3          | 2509.5      | 91,260                                |                          |                    |       |
| 4          | 2511.5      | 78,222                                |                          |                    |       |
| 5          | 2514.5      | 56,553                                |                          |                    |       |
| 6          | 2515.5      | 18,680                                |                          |                    |       |
| 7          | 2516.5      | 14,599                                |                          |                    |       |
| 8          | 2517.5      | 52,194                                |                          |                    |       |
| 9          | 2518.5      | 67,472                                |                          |                    |       |
| 10         | 2519.5      | 30,434                                |                          |                    |       |
| 11         | 2520.5      | 75,855                                |                          |                    |       |
| 12         | 2521.5      | 71,954                                |                          |                    |       |
| 13         | 2522.5      | 86,179                                |                          |                    |       |
| 14         | 2523.5      | 12,898                                |                          |                    |       |
| 15         | 2524.5      | 71,602                                |                          |                    |       |
| 16         | 2525.5      | 10,425                                |                          |                    |       |
| 17         | 2526.5      | 13,662                                |                          |                    |       |
| 18         | 2527.5      | 13,918                                |                          |                    |       |
| 19         | 2528.2      | 12,648                                |                          |                    |       |

Note: ppm — parts per million

0K

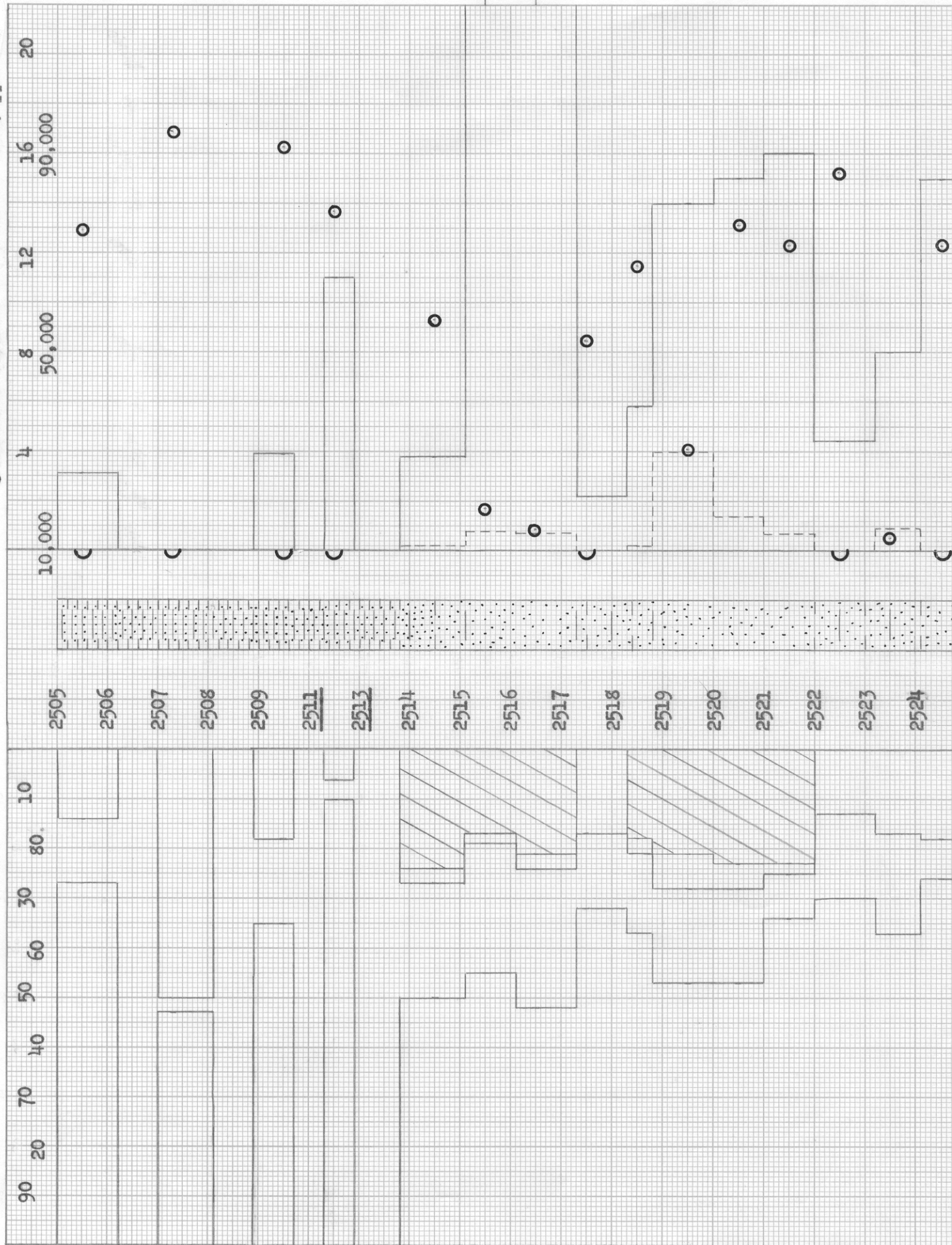
K&E 10 X 10 TO THE CENTIMETER • 25 X 38 CM.  
KEUFFEL & ESSER CO. MADE IN U.S.A.

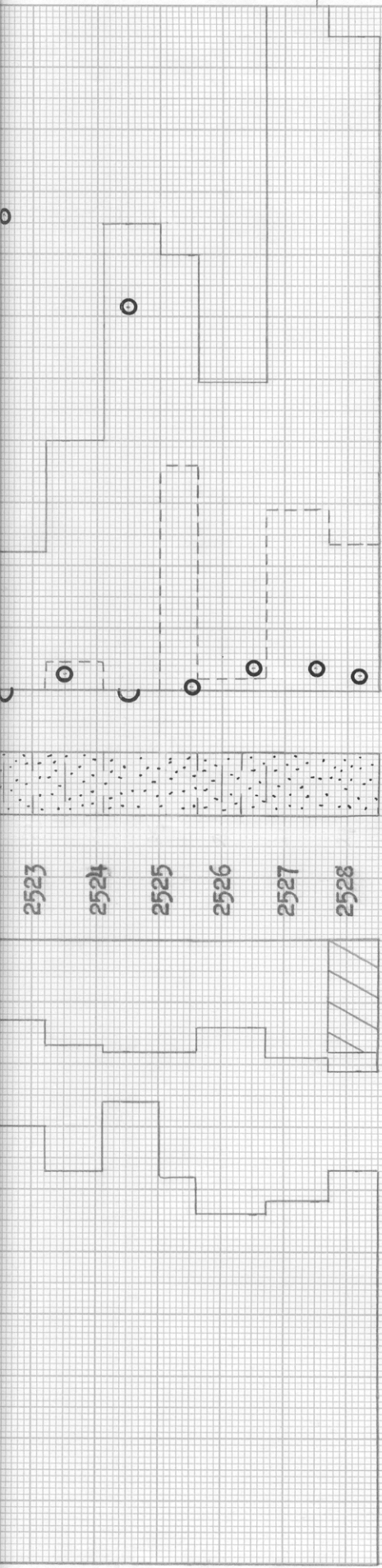
WATER SAT.,  
PERCENT

→ OIL SAT.,  
PERCENT

47 1512  
PERMEABILITY, IN MILLIDARCS

--- EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCS  
○ CHLORIDE CONTENT OF BRINE IN SAND, ppm





KEY:

-  SANDSTONE
-  LAMINATED SANDSTONE AND SHALE
-  FLOODPOT RESIDUAL OIL SATURATION
-  SHALY SANDSTONE
-  SANDY SHALE
-  IMPERMEABLE TO WATER

# JACKSON BROTHERS

HAWTHORNE LEASE  
WELL NO. 13

GREENWOOD COUNTY, KANSAS

| DEPTH INTERVAL,<br>FEET | FEET OF CORE<br>ANALYZED | AVERAGE<br>POROSITY<br>PERCENT | AVG. OIL<br>SATURATION<br>PERCENT | AVG. WATER<br>SATURATION<br>PERCENT | AVERAGE<br>PERMEABILITY,<br>MILLIDARCS | CALCULATED<br>OIL RECOVERY<br>BBL./ACRE |
|-------------------------|--------------------------|--------------------------------|-----------------------------------|-------------------------------------|----------------------------------------|-----------------------------------------|
| 2505.0 - 2511.9         | 3.7                      | 10.4                           | 24.3                              | 66.3                                | 5.2                                    |                                         |
| 2513.8 - 2528.5         | 14.7                     | 17.1                           | 20.8                              | 59.5                                | 13.8                                   |                                         |
| 2505.0 - 2528.5         | 18.4                     | 15.7                           | 21.5                              | 60.8                                | 12.5                                   | 1,350 (PRIMARY AND<br>WATERFLOODING)    |

OILFIELD RESEARCH LABORATORIES  
CHANUTE, KANSAS  
FEBRUARY, 1980  
HR