

EARLOUGHER ENGINEERING
PETROLEUM CONSULTANTS - CORE ANALYSES
3316 EAST 21ST STREET
TULSA, OKLAHOMA

June 18, 1953

Lowry et al Operating Account
616 East Central Avenue
Albuquerque, New Mexico

Re - Core Analysis
Federal Well No. 11-52-85
Sec. 4, T. 26-N., R. 6-W.
Rio Arriba County, New Mexico

Gentlemen:

Attached are results of analysis, together with profile and summary,
covering core received from your above well.

Yours very truly

EARLOUGHER ENGINEERING



R. C. Earlougher, Engineer

JMR s

Encl - 2

cc - T. G. Lowry
A. C. McLee
G. F. Moulton
G. L. Yates

EARLOUGHER ENGINEERING
CORE SUMMARY

Company Lowry et al Operating Account Lease Federal Well No. 11-52-85
 Location Approximately 610 feet South of North line, 670 feet East of West line SW4
 Section 4 Twp. 26-N. Rge. 6-W. County Rio Arriba State New Mexico
 Formation Cored Tocito sand Type Core 4-inch Diamond
 Date Cored 6-5-53 Date Shot _____ Coring Fluid Oil emulsion

Depths:	Top of core, black shale	6643.0 feet
	Top of oil sand	6658.3 "
	Bottom of oil sand	6670.5 "
	Net feet of oil sand	11.2
	Bottom of core, black shale	6690.5 "
	Total feet cored	47.5
	Feet analyzed	20.0

Shot Record:

Set Packer _____ Feet

<u>Depth, Feet</u>	<u>Shell</u>	<u>Quarts</u>	<u>Quarts</u>
<u>From</u> <u>To</u>	<u>Diameter</u>	<u>Per Foot</u>	<u>Total</u>

Completion Data.

Hrs. well stood after coring _____; Feet Fluid in Hole _____ (Oil _____ Water _____)

Clean-out time, hrs. _____; Initial production, bbls. day _____ (Oil _____ Water _____)

Remarks: The interval from 6643.0 to 6690.5 feet was diamond cored and core sampled by Lowry Oil Company. Coring was commenced and completed in black shale. The entire upper part of the cored section from 6643.0 to 6672.7 feet was sealed in cans at the well and shipped to our laboratory in Tulsa for analysis. Two additional samples were received from the shale cored from 6674.4 to 6687.2 feet. Analysis was limited to the section between depths 6653.8 and 6674.7 feet.

Results of analyses indicate 11.2 net feet of oil sand between depths 6658.3 and 6670.5 feet. The data are summarized in two sections on the basis of variation in permeability. Section one contains 8.6 net feet of sand with permeability in the range 0.1 to 5 millidarcys. Section two contains 2.6 net feet of sand having permeability values above 6 millidarcys. The entire oil sand section is grey, calcareous shaly sand and was 91 per cent insoluble in cold HCl.

PERMEABILITY The permeability is low throughout the oil sand with the weighted average being 5.1 millidarcys. The 8.6 net feet of sand in section one has an average permeability of 0.9 millidarcys compared with the average of 19 millidarcys for the 2.6 net feet of more permeable sand in section two. Permeability capacity is 57 foot-millidarcys.

POROSITY Weighted average porosity of the oil sand is 11.2 per cent with section one showing an average of 10.4 and section two an average of 13.7 per cent.

PER CENT SATURATION This well was cored with oil emulsion mud and shows a relatively high average oil saturation of 31 per cent. The average core water saturation is 23 per cent which represents average connate water.

OIL CONTENT Average oil content of the oil sand is 273 barrels per acre-foot with section one showing an average of 234 and section two an average of 404 barrels per acre-foot.

LABORATORY FLOODING TESTS Laboratory water flooding tests on twelve samples from the oil sand section yielded no oil recovery from any of the samples analyzed. The over-all average residual oil saturation after flooding was 35 per cent which is approximately 4 per cent higher than the

average of adjacent samples. The high residual oil saturation together with the lack of any measurable oil recovery in these laboratory flooding tests may result from the use of oil emulsion mud for coring.

All samples were flooded with fresh water and the average radial permeability to water for the low permeability sand in section one was 0.068 millidarcys and for the more permeable sand in section two, 0.46 millidarcys. These data indicate that the more permeable sand in section two has a permeability to water approximately 7 times greater than the sand in section one whereas the permeability to air for section two is approximately 21 times higher than that of section one.

Eight of the above mentioned twelve samples from the oil sand section were flooded at a very high pressure of approximately 920 psi. All other samples were flooded with a maximum pressure of 70 psi. No oil recovery was effected at 920 psi and the rate of water through-put increased in the order of magnitude that might be expected for such increase in pressure.

Eight additional core samples were flooded in the laboratory. These samples had been exposed to the air for approximately 48 hours before flooding. The samples were milled to $2\frac{1}{2}$ " O.D. prior to flooding whereas the previous flood tests were on full diameter fresh cores.

The eight dry core samples were flooded with fresh water for 11 hours and then with synthetic brine for an additional 8 hours. Some plugging due to use of fresh water was evident especially in the samples with the highest permeability. Average permeability to the fresh water was 0.84 millidarcy at 30 psi, and 0.50 millidarcy at 70 psi. The average permeability to brine was 0.42 millidarcy at 70 psi. The full diameter fresh core samples indicated an average permeability to fresh water of 0.13 millidarcy at 70 psi.

The eight dry cores indicated an average residual oil saturation of 36 per cent compared with the average residual of 35 per cent for the twelve fresh flood samples. None of the fresh core samples yielded any measurable oil recovery while three of the dry core samples showed recoveries varying from 5 to 9 barrels per acre-foot.

CONCLUSIONS

1. Net feet of oil sand is 11.2 located between depths 6658.3 and 6670.5 feet.
2. The oil sand has a low average permeability of 5.1 millidarcys and low average porosity of 11.2 per cent. Permeability capacity is 57 foot-millidarcys with the majority of this being contained in 2.6 net feet of the oil sand section.
3. The core shows a relatively high average oil saturation of 31 per cent and no oil recovery was effected in the laboratory water flooding tests. This may be due to the oil emulsion mud used for coring.
4. The estimated primary oil recovery by gas expansion is 113 barrels per acre-foot or 1270 barrels per acre from the area of which this core is representative.
5. If reservoir pressure is maintained by an efficient water drive it is possible that an additional oil recovery of 65 barrels per acre-foot or approximately 730 barrels per acre may be obtained.

Respectfully submitted

EARLOUGHER ENGINEERING


J. M. Robinson, Engineer

JMR s

LOWRY, ET AL OPERATING ACCOUNT

FEDERAL WELL NO. 11-52-85

ACID SOLUBILITY TESTS

<u>Sample No.</u>	<u>Depth. Ft.</u>	<u>% Acid Insoluble **</u>
42	6657.3	66. *
46	6658.4	83.
49	6659.3	94.
53	6660.5	97.
56	6661.6	87.
59	6662.6	64. *
62	6663.6	94.
65	6664.5	93.
68	6665.5	81.
72	6666.6	95.
75	6667.7	92.
78	6668.6	91.
81	6669.6	96.
83	6670.3	91.
87	6671.6	80. *
Average		<u>91.</u>

* Not included in averages.

** Percent insoluble in, cold 15% HCl.

EARLOUGHER ENGINEERING
SUMMARY OF CORE ANALYSES DATA

COMPANY Lowry, et al Operating Account LEASE Federal WELL NO. 11-52-85

Sec.	Formation	Depth, Ft.		Net Ft. of Sand	Avg. Por.	Avg. Core Saturation		Core Oil Content		Permeability		Flood Pot Residuals			Oil Recovery Bbl./Acre		
		From	To			Oil	Water	Avg. B/A. Ft.	Total B/Ac.	Avg. Md.	Capacity Ft. x Md.	Saturation	Oil Content	Oil	Water	B/A. Ft.	B/Ac.
1	0.1 to 5. md	6658.3	6670.5	8.6	10.4	29.	23.	234.	2010.	0.9	7.7	37.	50.	291.	2500.	-0-	+
2	Above 6. md	6658.3	6670.5	2.6	13.7	38.	22.	404.	1050.	19.	49.	33.	59.	352.	920.	110.	+
1&2		6658.3	6670.5	11.2	11.2	31.	23.	273.	3060.	5.1	57.	35.	52.	306.	3420.	-0-	+

EARLOUGHER ENGINEERING

RESULTS OF CORE ANALYSES

COMPANY Lowry, et al Operating Account

WELL Federal No. 11-52-85

Sample No.	Depth Feet	Perm. Md.	Porosity Per Cent	Per Cent Saturation			Avg. Oil Content Bbl./A. Ft.	Remarks
				Oil	Water	Total		
32	6653.9	--	4.3	24.	76.	100.	81.*	
34	6654.5	--	--	--	--	--	--	
35	6654.9	--	7.9	11.	54.	65.	69.*	
38	6655.9	--	--	--	--	--	--	
39	6656.3	0.4	6.9	12.	54.	66.	62.*	
42	6657.3	IMP	3.5	38.	44.	82.	100.*	
43	6657.6	0.1	--	--	--	--	-- *	
45	6658.2	0.3	--	--	--	--	-- *	
46	6658.4	0.5	8.7	33.	31.	64.	220.	
48	6659.0	0.5	--	--	--	--	--	
49	6659.3	0.9	10.4	36.	16.	52.	290.	
53	6660.5	0.3	13.8	17.	22.	39.	190.	
54	6660.9	48.	--	--	--	--	--	
55	6661.3	18.	--	--	--	--	--	
56	6661.6	9.2	15.4	35.	20.	55.	420.	
57	6661.9	47.	--	--	--	--	--	
58	6662.3	IMP	--	--	--	--	-- *	
59	6662.6	0.3	6.3	23.	11.	34.	100.*	
60	6662.9	5.6	--	--	--	--	--	
61	6663.2	4.9	--	--	--	--	--	
62	6663.6	8.6	12.0	41.	24.	65.	380.	
63	6663.9	11.	--	--	--	--	--	
64	6664.2	0.8	--	--	--	--	--	
65	6664.5	2.6	13.1	30.	15.	45.	300.	
67	6665.2	1.1	--	--	--	--	--	
68	6665.5	0.1	9.1	35.	10.	45.	250.	
71	6666.3	0.8	--	--	--	--	--	
72	6666.6	1.5	10.6	34.	14.	48.	280.	
75	6667.7	1.0	10.5	19.	34.	53.	150.	
76	6668.0	0.5	--	--	--	--	--	
78	6668.6	0.9	9.0	19.	44.	63.	130.	
79	6669.1	IMP	--	--	--	--	-- *	
80	6669.4	cracked	--	--	--	--	--	
81	6669.6	0.6	9.2	29.	23.	52.	200.	
83	6670.3	1.8	9.2	33.	17.	50.	240.	
84	6670.7	0.1	--	--	--	--	-- *	
87	6671.6	0.1	4.7	36.	23.	59.	130.*	

SUMMARY

Depth, Feet		Feet of Sand	Average Permeability	Average Porosity	Avg. Oil Sat.	Avg. Water Sat.	Avg. Oil Content Bbl./A. Ft.
From	To						

EARLOUGHER ENGINEERING
RESULTS OF CORE ANALYSES

COMPANY Lowry, et al Operating Account

WELL Federal No. 11-52-85

Sample No.	Depth Feet	Perm. Md.	Porosity Per Cent	Per Cent Saturation			Avg. Oil Content Bbl./A. Ft.	Remarks
				Oil	Water	Total		
88	6671.9	IMP	--	--	--	--	-- *	
90	6672.7	IMP	5.2	25.	75.	100.	100.*	
91	6674.6	--	5.1	28.	72.	100.	110.*	
* Exclude from average								

SUMMARY

Depth, Feet		Feet of Sand	Average Permeability	Average Porosity	Avg. Oil Sat.	Avg. Water Sat.	Avg. Oil Content Bbl./A. Ft.
From	To						

Case 55

Lowry et al Operating Account

South Blanco Tocito Pool

PROPOSED EXPERIMENTAL PRESSURE MAINTENANCE PROGRAM

PURPOSE:

The purpose of the proposed experimental pressure maintenance program is to evaluate the possibilities of increasing ultimate oil recovery from the South Blanco Tocito Pool by the injection of water. Providing formation characteristics are adaptable to water injection, ultimate oil recovery will be increased by water displacing oil in the pore space, providing an extraneous energy source to move oil to the well bores, and provide for the more efficient use of gas presently in solution with the oil.

SOURCE OF WATER:

There are a number of water sands present in the area of the South Blanco Tocito Pool. Present plans contemplate the converting of an uneconomic Pictured Cliffs Gas well to a water supply well. This well (PC - 89) is located in the NW/4 SW/4 Section 3, T26N, R6W, Rio Arriba County, New Mexico. Water sands from 1700 feet to 2400 feet are considered good potential sources for injection water.

PROGRAM PROPOSED FOR EXPERIMENTATION:

It is proposed to inject initially 1500 barrels of water per day into the Tocito formation. One well, Federal T-134, will be used as an injection well providing the stipulated volume of water can be injected. If it is necessary to use two wells to provide sufficient injection capacity, Federal T-109 will also be converted. It is contemplated that maximum injection pressures will be 3000 p.s.i.

PROPOSED INJECTION WELLS:

Federal T-134

Location:	660FNL, 1980FWL, Sec.10, T26N, R6W
Elevation:	6,550' DF
Drilling commenced:	April 29, 1950
Drilling completed:	July 19, 1950
Commenced producing:	August 21, 1952
Surface Pipe:	13 3/8" OD casing @ 312', with 350 sks cement
Intermediate Pipe:	9 5/8" OD casing @ 2,990', w/500 sks cement
Production Pipe:	7" OD casing @ 7210', w/300 sks cement.
	Milled out 7" casing 6728' - 6770' to produce from Tocito formation.
Total depth:	7,562 feet
Plugged back total depth:	6,770 feet

Federal T-134 (continued)

Acid Treatment: 1st treatment: 500 gallons mud acid
2nd treatment: 2,000 gal. acid after shot
Shot records: 120 quarts SMG
Initial Potential: 37.9 barrels of oil per day.
Present Production: Approximately 10 barrels of oil per day.

Federal T-109

Locations: 660' FSL, 660' FWL, Sec. 3, T26N, R6W.
Elevations: GL 6,484'
Drilling commenced: February 23, 1952
Drilling completed: March 30, 1952
Commenced Producing: May 5, 1952
Surface Pipe: 10 3/4" OD casing set @ 480' w/250 sks cement
Production Pipe: 7 5/8" OD casing set @ 6,674' w/175 sks cement
Tubing: 2" EUE set @ 6,700'
Total depth: 6,735'
Acid treatment: None
Shot Record: Not shot
Initial Potential: 135 barrels of oil per day.
Present Production: Approximately 75 barrels of oil per day.

EXPANSION OF WATER INJECTION PROGRAM:

The expansion of the pressure maintenance program will depend on the success achieved for the experimental program. To maintain reservoir pressure on a fieldwide basis will require additional volumes of water to be injected and the use of additional water injection wells. It will be necessary to observe the experimental program for a period of time in order to determine the feasibility and proper planning of a fieldwide program.

June 29, 1953

United States Department of the Interior
Geological Survey
Post Office Box 965
Farmington, New Mexico

Attention: Mr. P. T. McGrath,
District Engineer

Re: South Blanco Tociito Pool,
Rio Arriba County, New Mexico

Gentlemen:

Lowry et al Operating Account proposes conducting an experimental pressure maintenance program for our properties of the South Blanco Tociito Pool, Rio Arriba County, New Mexico. This program contemplates the use of water as a repressuring medium and the source of water is to be from fresh water sands in the area, occurring from the surface to a depth of approximately 2400'. Initially it is proposed that approximately 1500 barrels of water per day be injected into the Tociito formation in order to help maintain reservoir pressure, thereby greatly increasing ultimate oil recovery from the pool. In order to accomplish this experimental program, it is proposed that either one or both of the following wells be converted to water injection wells:

SF 079035-A - Federal 1-134: This well is located 660' from the North line and 1980' from the West line of Section 10, Township 2 6N, Range 6W, Rio Arriba County, New Mexico. The well was completed at a plugged back total depth of 6770', and is productive from the Tociito formation for the interval 6728' - 6770'.

NM 03551 - Federal 7-35-109: This well is located 660' from the South line and 660' from the West line of Section 3, Township 26N, Range 6W, Rio Arriba County New Mexico. This well was completed at a total depth of 6735', and is productive from the Tociito formation for the interval 6684' - 6735'.

U. S. Department of the Interior
Geological Survey

Attention: Mr. McGrath

- 2 -

June 29, 1953

Our plans are to attempt to inject the desired volumes of water into Federal T-134, and if sufficient quantities can be injected into this well then 7-35-109 will not be used as an injection well. As it is highly doubtful that this one well will provide sufficient injection capacity, approval is being requested to use either one or both of the above detailed wells for injection purposes.

We would like to emphasize that this program will be on an experimental basis to determine the feasibility of the injection of greater volumes of water in order to maintain reservoir pressure and increase ultimate oil recovery from the reservoir. As this pool produces from a solution gas drive, pressure maintenance, with water, if successful, will greatly increase ultimate oil recovery by providing additional energy to the reservoir.

Attached is a plat showing the wells of the South Blanco Tocito Pool and the proposed water injection wells. This program will be placed in effect within the next two or three months and we respectfully request your approval.

Yours very truly,



A. F. Holland

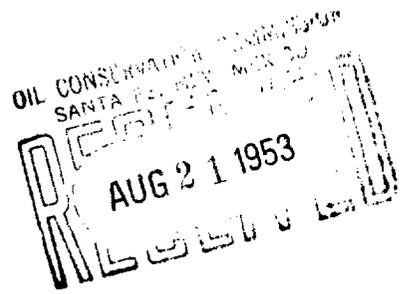
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RECEIVED

JUL 1 1953

U. S. GEOLOGICAL SURVEY
FARMINGTON, N. M.

August 20, 1953



Mr. R. R. Spurrier
Post Office Box 871
Santa Fe, New Mexico

Re: South Blanco Tocito Pool
Rio Arriba County, N. M.

Dear Mr. Spurrier:

We acknowledge receipt of New Mexico Oil Conservation Commission Order #R-349, dated July 27, 1953, granting approval for Lowry et al Operating Account to conduct a pilot pressure maintenance program for the above captioned Pool. I wish to express my appreciation to the Commission for approving Lowry's plans for a pressure maintenance program for the Pool, and for the past cooperation you have given to our mutual problems.

Shipment of some of the equipment needed for our program has been delayed and it is believed that it will be the latter part of September, 1953, before we will be able to commence water injection.

Again I wish to express my appreciation for the Commission's approval.

Yours very truly,

(Signed) A. F. HOLLAND

A. F. Holland

AFH:eg

cc: Mr. W. B. Macey, Chief Engineer, Oil Conservation Commission
Mr. Jason W. Kellahin, Attorney at Law, Santa Fe, New Mexico

BROOKHAVEN OIL COMPANY

FIRST NATIONAL BANK BUILDING

(MAIL) P. O. BOX 644

Albuquerque, New Mexico

PHONE 7-8853

TELETYPE AQ-96

September 22, 1953.

New Mexico Oil Conservation Commission
State Capitol
Santa Fe, New Mexico

Att: Mr. R. R. Spurrier, Secretary

Dear Mr. Spurrier:

I notice in the Docket: Regular Hearing July 16, 1953, before your Commission, there was a Case No. 555 - Application of Lowry et al Operating Account for approval of a pilot pressure maintenance program for water injection in the South Blanco-Tocito Pool, Rio Arriba County.

I note the order of the Commission, Case No. 555, Order No. R-349, approving the application of Lowry for permission to institute a pressure maintenance program in the above area; that permission is granted to inject water in injection wells, etc. The Commission takes note that no objection was made to the granting of this application.

Please be advised that the Lowry Company contacted neither the Brookhaven Oil Company or the Dacresa Corporation either previous or after the hearing. These corporations own acreage adjoining and within the Lowry block in Township 26 North, Ranges 6 and 7 west, and also have overriding royalties on Lowry leases. Please be advised that the above corporations object very strongly to a water flooding program at this time and I believe that all interested parties should be notified of such a program by the Lowry people and a rehearing had before your Commission.

Very truly yours,

BROOKHAVEN OIL COMPANY

Thos. B. Scott, Jr.
Thos. B. Scott, Jr.
President

DACRESA CORPORATION

Thomas B. Scott, Jr.
Thomas B. Scott, Jr.
President

TBS:ms

BROOKHAVEN OIL COMPANY

FIRST NATIONAL BANK BUILDING

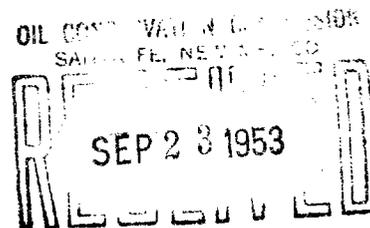
(MAIL) P. O. BOX 644

Albuquerque, New Mexico

PHONE 7-8853

TELETYPE AQ-96

September 22, 1953.



Mr. R. E. Spurrier
New Mexico Oil Conservation Commission
State Capitol
Santa Fe, New Mexico

Dear Dick:

Would you please put the attached letter before the proper people and in the proper hands.

I believe it is very dangerous for the Commission to approve such projects just because there is no objection. I believe before such projects as spacing, repressuring, water flooding are determined ~~on~~ by your Commission, that all interested parties should be required to be notified by petition and that the Commission should not consider such projects without certification of such notices.

Very kindest regards,

BROOKHAVEN OIL COMPANY

Tom Scott

Thos. E. Scott, Jr.
President

TPS:ms

Enc. - Letter to Commission

OIL CONSERVATION COMMISSION

P. O. BOX 871

SANTA FE, NEW MEXICO

September 24, 1953

**Mr. Thomas B. Scott, Jr., President
Brookhaven Oil Company
P. O. Box 644
Albuquerque, New Mexico**

Dear Mr. Scott:

**This will acknowledge your letter of September 22nd
with enclosed letter addressed to the Commission.**

**With reference to Case No. 555, which is Lowry's
Pilot Water Injection in the South Blanco-Tocito Pool case, you
are hereby advised that the case was properly advertised and due
hearing was held. The proper time for the filing of your objection
was at the time of the hearing.**

**You may, however, apply for re-hearing, as our rules
and regulations provide and the Commission will be glad to consider
your petition.**

Very truly yours,

**R. R. Spurrier
Secretary and Director**

RRS:vc

C

O

P

Y

RS

Lowry Oil Company

616 Central Avenue S.E.

Albuquerque, New Mexico

October 13, 1953



Mr. R. R. Spurrier
 New Mexico Oil Conservation Commission
 Post Office Box 871
 Santa Fe, New Mexico

Re: Pressure Maintenance Program
 South Blanco Tocito Pool

Dear Mr. Spurrier:

Case 555

This is to advise that water injection for the South Blanco Tocito Pool was commenced on October 7, 1953, in conformance with New Mexico Oil Conservation Commission Order R-349, dated July 27, 1953. At the present time, well T-134 is being used as a water injection well.

Monthly reports, as requested by the above mentioned Order, will be furnished, commencing with the month of October, 1953.

The cooperation of the Oil Conservation Commission on matters relating to the South Blanco Tocito Pool have been greatly appreciated.

Yours very truly,

A. F. Holland

A. F. Holland

AFH:eg

cc: Mr. W. B. Macy

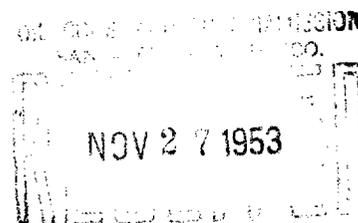
Lowry Oil Company

616 Central Avenue S.E.

Albuquerque, New Mexico

November 25, 1953

Case 555



Mr. R. R. Spurrier
N. M. Oil Conservation Commission
Post Office Box 871
Santa Fe, New Mexico

Re: Pressure Maintenance Program
South Blanco Tocito Pool

Dear Mr. Spurrier:

As previously reported, water injection was commenced on October 7, 1953 for the South Blanco Tocito Pool, Rio Arriba County, New Mexico. During subject month, the Lowry et al Operating Account T-134 well was used for injection purposes, and a total of 14,511 barrels of water was injected. Production data for the Lowry operated properties, during the month of October, 1953, was as follows:

Well No.	Monthly Oil Production, Barrels	Monthly Water Production, Barrels	Monthly Gas Production, M.C.F.
T-179	4,405	0	6,235
T-132	2,410	0	2,060
T-157)	5,296	176	8,621
T-109)	1,753	0	
T-182)	0	0	0
T-207)	5,332	0	12,745
T-129)	5,349	0	
T-177)	2,406	0	16,710
T-127)	5,690	0	
T-85	429	0	671
T-125	2,184	0	2,350
	<hr/> 35,254	<hr/> 176	<hr/> 49,392

Mr. R. R. Spurrier
N. M. Oil Conservation Commission

November 25, 1953

- 2 -

As could be expected, mechanical failures of equipment were numerous during the initial stages of this pressure maintenance program, and there was considerable down-time during the month. The water injected, therefore, during the month, was not as much as we had hoped to achieve.

Yours very truly,

A. F. Holland
A. F. Holland *J*

AFH:eg