PILOT WATERFLOOD EXPANSION AND UNITIZATION STUDY

WEST TRES PAPALOTES PENN UNIT
WEST TRES PAPALOTES FIELD
LEA COUNTY, NEW MEXICO

By
Sage Energy Company
Midland, Texas

Pilot Waterflood Expansion and Unitization Study

West Tres Papalotes Penn Unit
West Tres Papalotes Field
Lea County, New Mexico

Sage Energy Company
Midland, Texas

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I. Introduction

The State of New Mexico Oil Conservation Division on September 4, 1987, and by Order No. R-8505 granted to Sage Energy the authority to conduct a pilot waterflood on its New Mexico "30 State Lease, West Tres Papalotes - Pennsylvanian Pool, Lea County, New Mexico. Water was to be injected into the Bough "C" member of the Pennsylvanian formation from perforations at 10392 feet to 10,407 feet in the New Mexico "30" State Well No. 1 located 1980 feet from the North line and 800 feet from the East line of Section 30, Township 14 South, Range 34 East. The subject pilot was designated the Sage Energy Company State "30" Lease Waterflood Project and was governed by the provision of Rules 701 through 708 of the Division Rules and Regulations. Since there has been waterflood response in the pilot area, Sage is requesting that it be expanded and unitized as shown on Exhibit No. 1.

II. Parameter Study

A. Base Map

The base map shown in Exhibit No. 1 with appropriate Tract and Well numbers is the area to be unitized. It contains 1120 surface acres.

B. Vertical Interval to be Unitized

Sage recommends unitization of the subsurface interval of the Permo Penn Limestone and identified as follows:

> The Permo Penn Limestone shall be defined and construed as being that oil bearing limestone, the top of which was encountered at a depth of 10,392 feet and the base of which was encountered at a depth of 10,510 feet (log measurements) in the Sage Energy Company New Mexico State No. 3 Well, located 1160 feet from the north line and 560 feet from the east line of Section 31, Township 14 South, Range 34 East N.M.P.M., Lea County, New Mexico, as recorded on the BHC Acoustilog of said well dated April 26, 1983 (Exhibit No. 2).

C. Participation Parameters

Participation parameters for the Unit Area are tabulated by tract and by working interest owner in

Tables 1 and 2, respectively. A summary of the unitization parameters is listed in Exhibit No. 3. Pertinent comments about each parameter follows.

1. Usable Wellbores - The term "usable wellbore" includes all wells within the Unit Area that have potential value either as injection or producing wells. Wells that are excluded are those that have been permanently abandoned or have severe downhole mechanical obstructions.

2. Surface Acres - Since detailed tract by tract survey data was not available for this report, nominal acreage based on commercial land maps was used in this tabulation. (Exhibit No. 4)

3. Cumulative Production - Cumulative oil production to January 1, 1989, was tabulated. Cumulative gas production was not used as a participation parameter.

4. Current Six Month Production - Current production from January 1 through July 1, 1989, of oil was tabulated for this six month period. The production was obtained from NMOCD Form C-115.

5. Remaining Primary Reserves - Remaining Primary Reserves as of January 1, 1989, were estimated through the use of semi-log rate-time curves (decline curves). Individual lease decline curves were well established making reliable estimates of remaining reserves possible. The decline curves were extrapolated to an economic limit of 90 BOPM per producing well.

6. Main Pay Zone Net Pay - Due to the lack of cores and other petrophysical data, the net pay was picked from Gamma Ray - Acoustic logs using a 5% porosity cutoff. The Main Pay was picked as the zone that was continuous across the field; this being the interval 10,397' - 10,406' on the Sage New Mexico State No. 3 type log. An isopach map using these net pay figures was constructed (Exhibit No. 5). The Main Pay net acre-feet was then calculated from planimetered data of the isopach map.

7. Primary Ultimate Oil Recovery - The primary ultimate was calculated by adding the remaining primary oil reserves to the cumulative oil production as of January 1, 1989.

III. Waterflood Study

A. Recommendation

Since there has been waterflood response in the pilot area as indicated by increased oil production in Well No.'s 29-1 and 31-3 (Exhibit No. 6), Sage is requesting expansion of the pilot area and unitization of the field, based on 100% Primary Ultimate Oil Recovery.

B. Introduction and Summary

In the proposed unit area there are three producing wells, one temporarily abandoned, and one water injection well. Three producing wells have been plugged and abandoned. There are two plugged and abandoned dry holes. The three producing wells make 57 BOPD, 46 BWPD, and 70 MCFD. Injection into the water injection well is 475 BWPD @ 2700 psi.

As of January 1, 1989, cumulative oil production was 1,164,885 BO with a remaining primary of 141,887 BO based on the current 10%/yr decline. Cumulative injection in the pilot waterflood November 1, 1989, was 431,302 BW. Injection began January 15, 1988.

A full scale waterflood will require a capital investment of $1,498,900. Incremental secondary recovery of 1,067,000 BO will result in a 3.83 year payout, 37.22% rate of return and $14,656,600 net profit, before Federal Income Taxes.

C. Field Location and Discovery

The West Tres Papalotes Field is located seventeen miles northwest of Lovington, New Mexico, on the western platform margin of the Tatum Basin. Its location in relation to other fields is shown on Exhibit No. 7.

The field was discovered in 1972 with production from the Permo Penn Limestone at an average depth of 10,400 feet.

D. Field Development History

Early development occurred during 1972. The typical well was perforated through casing and acidized with 500 to 2500 gals. of 15% hydrochloric acid.

E. Geology

The West Tres Papalotes Field produces from several members of the Bough "C" formation. The Bough "C" is widely productive along the western platform margin of the Tatum Basin. Dated as Permo-Penn in age, the productive members consist of clean, porous, white limestone, very fossiliferous, with chert nodules interspersed within the limestone. The depositional model of this reservoir is most likely algal mats that grew and thrived within the photic zone, basinward from the basin edge in a relatively high energy environment, creating in the process the porous, high permeability productive limestone.

Exhibit No. 8 is a structure map on the top of the main pay which indicates a plunging anticline to the south. Exhibit No. 5 is a net pay isopach of the main pay using a 5% porosity cut off. The field is self contained in that the field boundary is defined by a porosity pinchout (see cross section on Exhibit No. 9). There is no defined oil-water contact.

F. Reservoir and Fluid Properties

Due to the lack of cores and the quality of logs that were run, certain reservoir properties could not be determined. Likewise, no fluid samples have been taken for running PVT analysis. Lack of any bottom hole pressures made material balance calculations impossible. The following is a list of properties that are known:

Estimated Productive Area	920 AC
Type Drive	Solution Gas
Oil/Water Contact	None
Current GOR	2718 SCF/STB
Oil Gravity, API	41
Reservoir Temperature	153
Gas Gravity	.85
Average Porosity	5-7%
Average Net Pay	10-12'
Main Pay Zone Net Pay	8,209 ac-ft

G. Unit Waterflood Reserves

Because of an insufficient quantity of basic reservoir data, secondary reserves were calculated by analogy with Mobil's Vacuum (Middle) Penn Waterflood, seventeen miles to the south. Depth (10,400') and quality of

pay are similar. It is the only recorded Penn waterflood in New Mexico. There is one water injection well and one producing well on 80 acre spacing (Exhibit No. 10). Water injection began into well No. 147 in September, 1974. Response was seen in the Bridges State #165 one year and four months later (Exhibit No. 11). The well peaked at 132 BOPD and averaged 86 BOPD for six years. Incremental secondary oil has been 199 MBO for a primary to secondary ratio of one to one. Water breakthrough did not occur until nine years after the start of water injection. In contrast, the proposed expanded waterflood peaks at 45 BOPD/well and maintains its peak for four years. The recovery ratio is 0.92/1, which corresponds to 1,067,000 bbls of secondary oil, depending on oil price.

H. Plan for Waterflood Operation

Sage plans to expand the pilot waterflood by sidetracking well 29-2 600 feet to the North and putting it on water injection. Depending upon results, Sage will then drill producing well 29-3 and 31-4 and convert 31-2 to water injection (Exhibit No. 5). Estimated cost is $1,498,900. The expanded injection system will require 300-500 BWPD per well at a maximum injection pressure of 3000 psi. The current system is closed with a gas blanket on the water supply tank. Injection is down internally plastic coated tubing set on a nickel coated packer. All plugged and abandoned wells were plugged adequately to protect all known producing and fresh water zones.

I. Waterflood Economics

The escalated incremental economics of continued operations versus the expanded pilot waterflood are summarized on the following page. Detailed cash flow is shown on Exhibit No. 13.

Waterflood Profitability
(BFIT)

Capital Investment	$1,498,900
Cash Flow	14,656,600
Present Worth @ 10%	5,141,500
Payout, years	3.83
Rate of Return	37.22%
Gross Oil Reserves	1,067,000 bbls

Assumptions:

Working Interest:	100.00
Net Revenue Interest:	84.96
Oil Price:	18.50/bbl
Gas Price:	0
Effective Date:	January 1, 1990

Waterflood Capital Investment

Cement lined injection lines, wrapped and buried	$87,900
Connections, valves and meters	15,000
Labor	10,000
Damages	2,000
Drill 1 water injection well	396,000
Drill 2 producing wells	900,000
Convert 1 producing well to injection	75,000
Misc.	13,000
	$1,498,900

Operating Costs

Operating cost per well (Including Inj. Well)	$2500/month
Average injection per well	500 BWPD
Initial Operating Cost	$15000/month

EXHIBITS

1 Through 13

EXHIBIT NO. 1

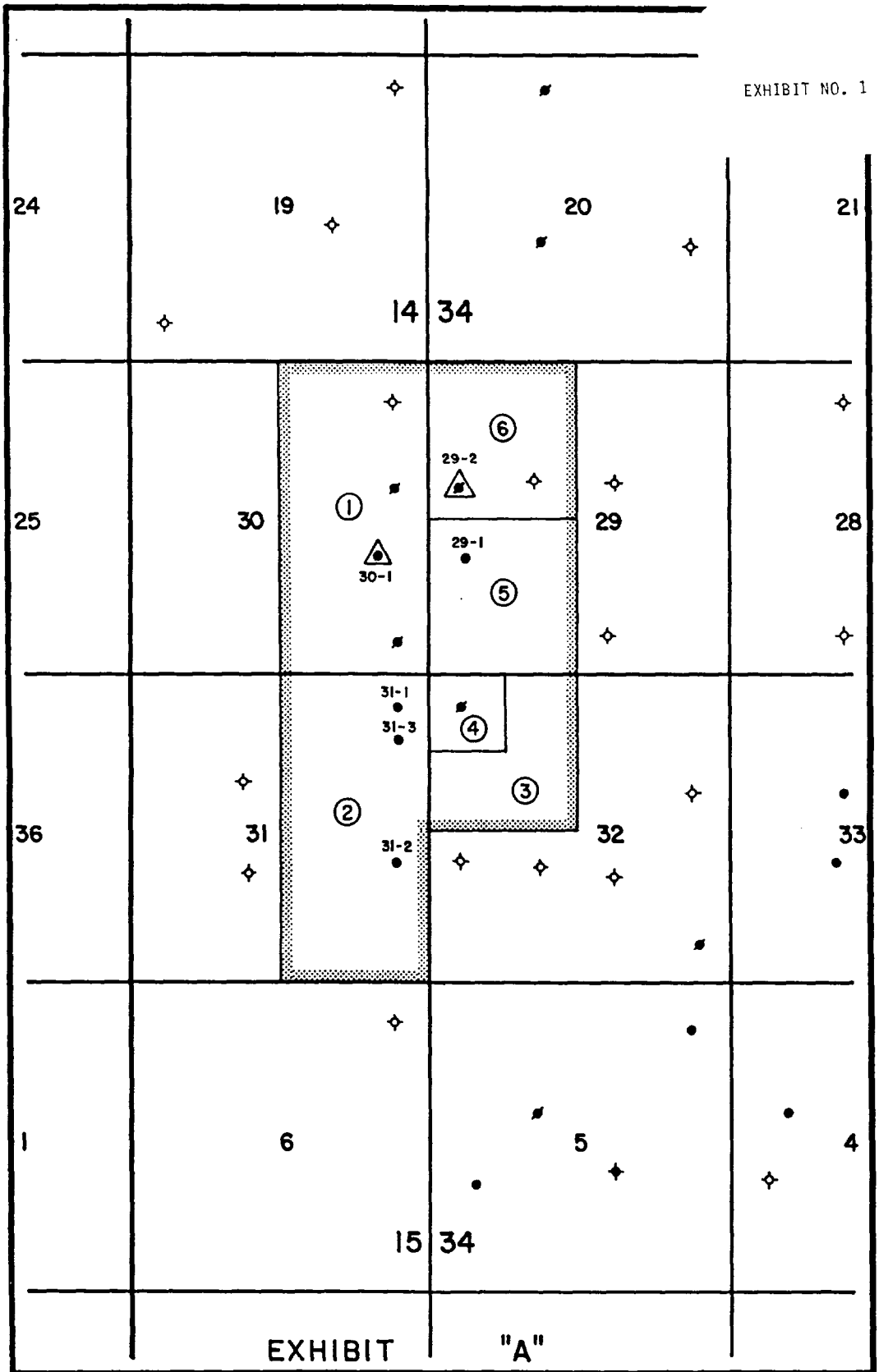


EXHIBIT "A"

SAGE ENERGY COMPANY
WEST TRES PAPALOTES PENN UNIT
WEST TRES PAPALOTES FIELD
LEA COUNTY, NEW MEXICO
SCALE: 1" = 2000' 4-28-89

FORM 975321 REV (9-80)

Dresser Atlas

DRESSER

BHC Acoustilog® Gamma Ray

EXHIBIT NO. 2

FILE NO

API NO

FIELD PRINT!

10398½ - 10406

Company: SAGE ENERGY

Well: N M STATE #3

Field: SAUNDERS

County: LEA State: N.M.

LOCATION: NOT AVAILIBLE ON LOCATION 1160 FWL 2560 FEL

SEC 31 TWP 14S RGE 34E

Other Services: DLL/GR

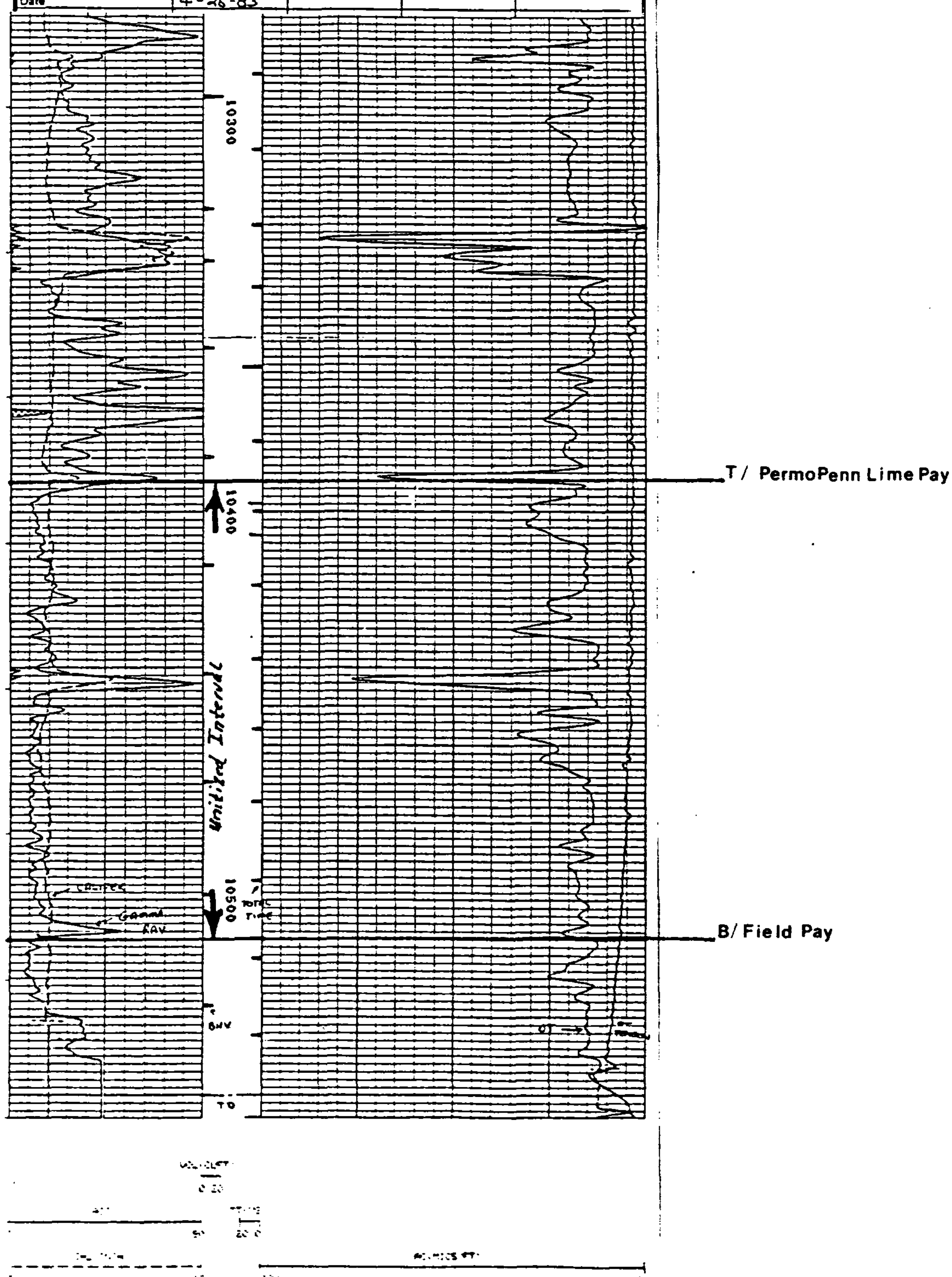
Permanent Datum: GL 4144.3 Elev.

Log Measured from: KB 17 Ft. Above Permanent Datum

Drilling Measured from: KB

Elev. KB 4161 DF GL 4144

Date: 4-26-83



UNITIZATION PARAMETERS
WEST TRES PAPALOTES UNIT
SAGE ENERGY COMPANY

EXHIBIT NO. 3

COMPANY	TRACT NO.	USABLE WELLS NO.	USABLE WELLS PER CENT	SURFACE ACRES NO.	SURFACE ACRES PER CENT	CUMULATIVE OIL BBLS TO 1/1/89	CUMULATIVE OIL PER CENT	6 Mo. Rate 1-6/89 Rate BO	6 Mo. Rate 1-6/89	PRIMARY REMAINING OIL BBLS	PRIMARY REMAINING OIL PER CENT	NET ACRE FEET FEET	NET ACRE FEET PER CENT	PRIMARY ULTIMATE OIL BBLS	PRIMARY ULTIMATE OIL PERCENT
SAGE ENERGY COMPANY															
NEW MEXICO STATE 30 NO. 1	1	1	0.2000000	320	0.2857143	199562	0.1713148	-0-	-0-	0	0.0000000	[illegible]	[illegible]	199562	0.1527267
NEW MEXICO STATE NO. 1,2,3	2	3	0.6000000	320	0.2857143	599825	0.5149821	18126	.9137470	137234	0.9672063	2740	0.3337800	737059	0.5640217
STATE OF NEW MEXICO V-2160	3	0	0.0000000	120	0.1071429	0	0.0000000	-0-	-0-	0	0.0000000	273	0.0332562	0	0.0000000
STATE OF NEW MEXICO V-1791	4	0	0.0000000	40	0.0357143	73327	0.0629478	-0-	-0-	0	0.0000000	446	0.0543306	73327	0.0561182
JOHN ETCHEVERRY NO. 1	5	1	0.2000000	160	0.1428571	230309	0.1977096	1711	.0862530	4653	0.0327937	1680	0.2046534	230962	0.1768006
JOHN ETCHEVERRY "A" NO. 2	6	0	0.0000000	160	0.1428571	61862	0.0531057	-0-	-0-	0	0.0000000	748	0.0911195	61862	0.0473388
BRAND TOTAL		5	1.0000000	1120	1.0000000	1164885	1.0000000	19837	1.0000000	141887	1.0000000	8209	1.0000000	1306792	1.0000000

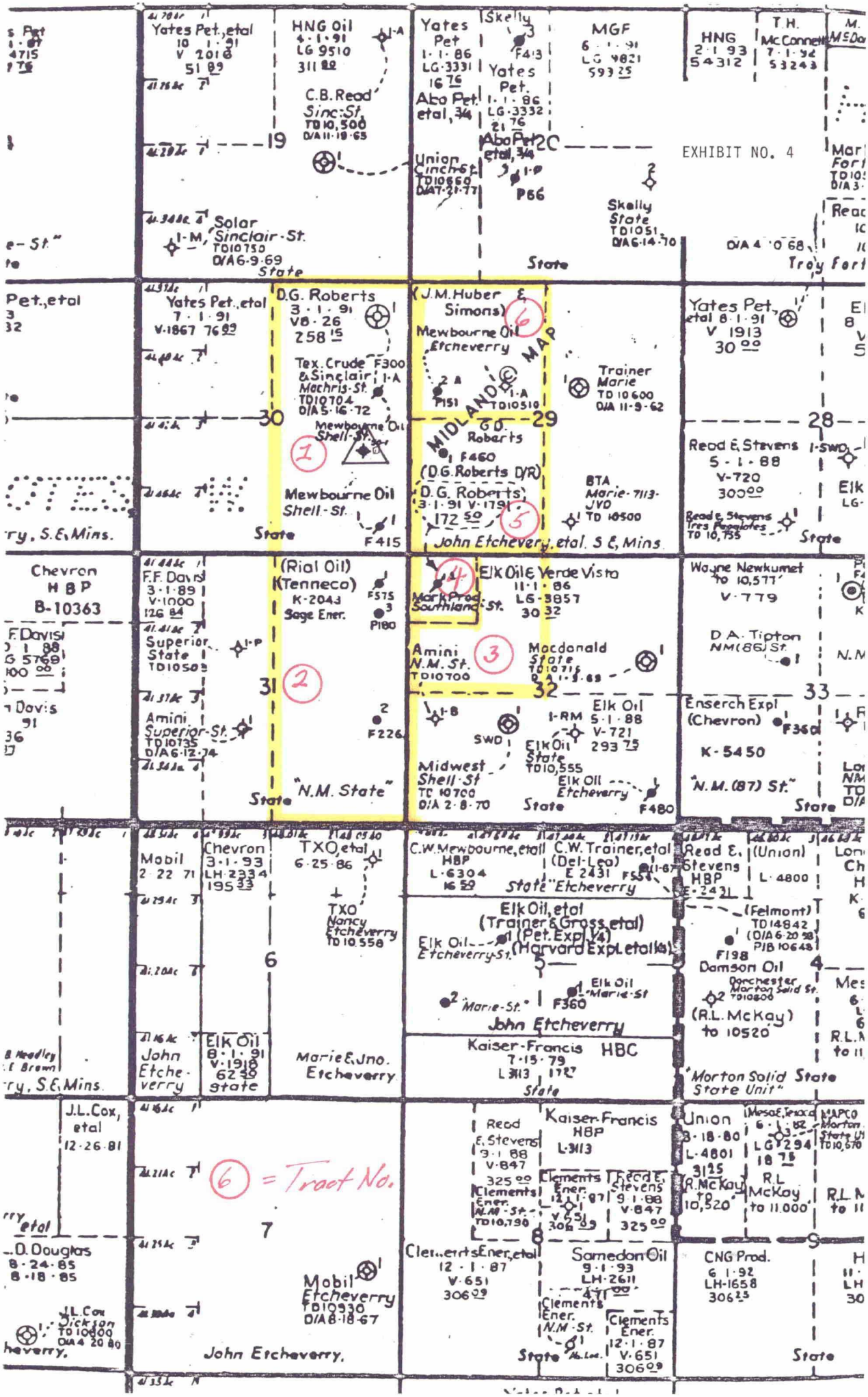


EXHIBIT NO. 4
MIDLAND MAP
Yates Pet.,etal
HNG Oil
C.B. Read
Sinc-St.
Solar
Sinclair-St.
Yates Pet.
Skelly
MGF
Union
Abo Pet.,etal
Skelly State
T.H. McConnell
HNG
Troy Fort
D.G. Roberts
Tex. Crude & Sinclair
Mechris-St.
Mewbourne Oil
Shell-St.
(J.M. Huber & Simons)
Mewbourne Oil
Etcheverry
Trainer
Marie
Roberts
(D.G. Roberts D/R)
D.G. Roberts
BTA
Marie-7113-JVD
John Etcheverry, etal. S & Mins.
Read & Stevens
Elk
Chevron
H B P
B-10363
F.F. Davis
Superior
State
Amini
Superior-St.
(Rial Oil)
(Tenneco)
Sage Ener.
"N.M. State"
Elk Oil & Verde Vista
Mark Prod.
Southland-St.
Amini
N.M. St.
Macdonald
State
Wayne Newkumet
to 10,577
D.A. Tipton
NM(86) St.
Elk Oil
Midwest
Shell-St
Elk Oil
Etcheverry
Enserch Expl
(Chevron)
K-5450
"N.M. (87) St."
Mobil
Chevron
TXO, etal
TXO
Nancy
Etcheverry
C.W. Mewbourne, etal
HBP
C.W. Trainer, etal
(Del-Leo)
Read & Stevens
HBP
(Union)
Elk Oil, etal
(Trainer & Gross, etal)
(Pet. Exp. V4)
(Harvard Expl. etal 1/6)
Elk Oil
Etcheverry-St.
Marie-St.
John Etcheverry
(Felmont)
Damson Oil
Dorchester
Morton Solid St.
(R.L. McKay)
to 10520
Kaiser-Francis HBC
"Morton Solid State Unit"
John Etcheverry
Elk Oil
John Etche-verry
Marie & Jno. Etcheverry
J.L. Cox, etal
Read & Stevens
Kaiser-Francis
HBP
Union
R.L. McKay
to 10,520
R.L. McKay
to 11.000
Clements Ener.
Clements Ener., etal
Samedon Oil
CNG Prod.
D. Douglas
Mobil
Etcheverry
John Etcheverry,
State
6 = Tract No.

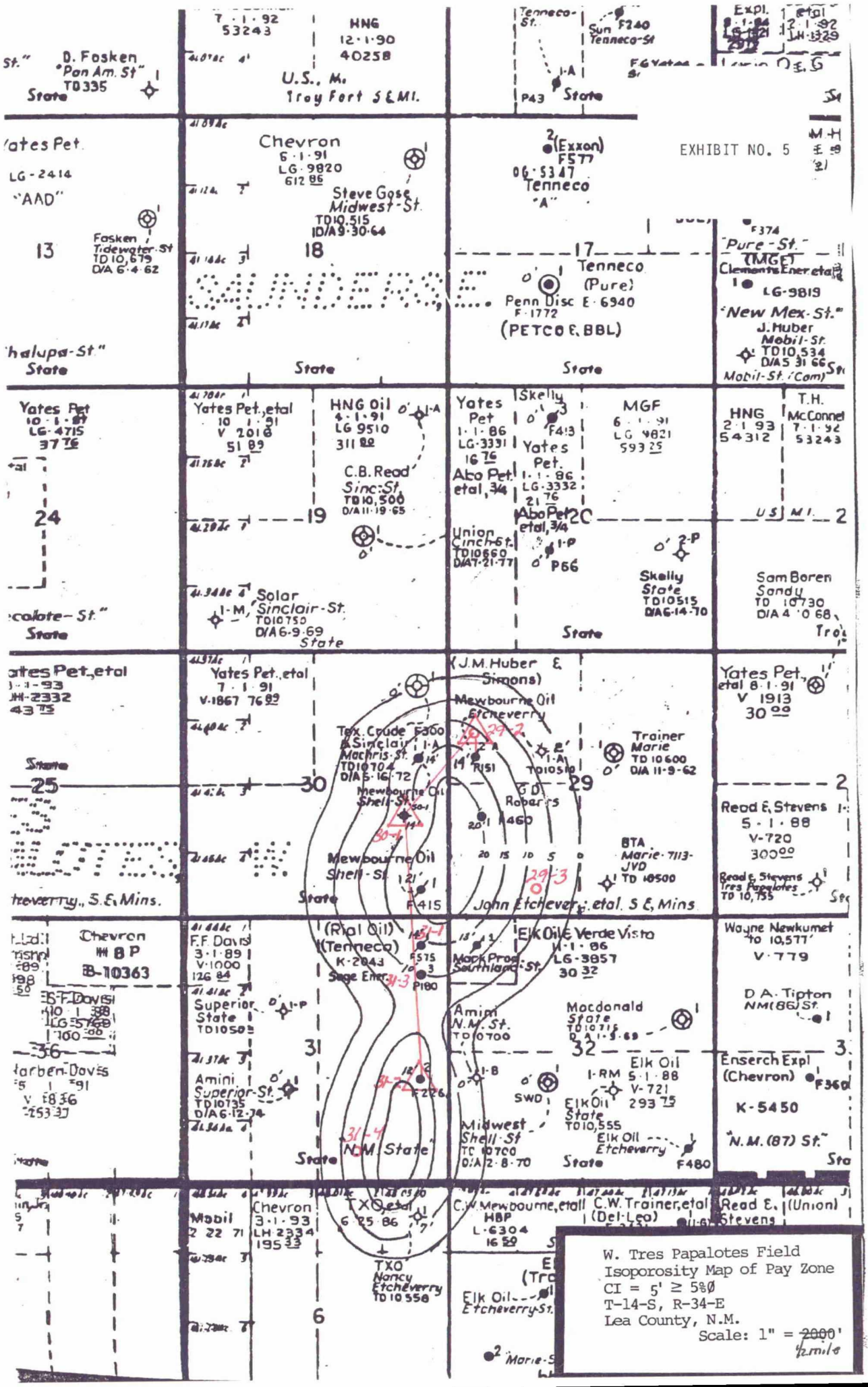


EXHIBIT NO. 5
W. Tres Papalotes Field
Isoporosity Map of Pay Zone
CI = 5' ≥ 5%Ø
T-14-S, R-34-E
Lea County, N.M.
Scale: 1" = 2000'
½ mile
Chevron
Steve Gose
Midwest-St.
TD 10,515
ID/A 9-30-64
Tenneco
(Pure)
Penn Disc E-6940
F-1772
(PETCO & BBL)
Yates Pet.
LG-2414
"AAD"
Fasken
Tidewater-St
TD 10,679
D/A 6-4-62
Yates Pet., etal
HNG Oil
4-1-91
LG 9510
311 80
C.B. Read
Sinc-St
TD 10,500
D/A 11-19-65
Solar
Sinclair-St.
TD 10750
D/A 6-9-69
Yates Pet
1-1-86
LG-3331
16 76
Abo Pet. etal, 3/4
Yates Pet.
1-1-86
LG-3332
21 76
Abo Pet etal, 3/4
Union
Cinch-St
TD 10660
D/A 7-21-77
Skelly
State
TD 10515
D/A 6-14-70
MGF
6-1-91
LG 9821
593 25
HNG
2-1-93
54312
T.H. McConnel
7-1-92
53243
Sam Boren
Sandy
TD 10730
D/A 4-0-68
Yates Pet., etal
7-1-91
V-1867 76 80
Tex. Crude & Sinclair
Machris-St.
TD 10704
D/A 5-16-72
Mewbourne Oil
Shell-St.
F-415
(J.M. Huber & Simons)
Mewbourne Oil
Etcheverry
Trainer
Marie
TD 10600
D/A 11-9-62
G.D. Roberts
BTA
Marie-7113-JVD
TD 10500
John Etcheverry, etal
Yates Pet., etal
8-1-91
V 1913
30 00
Read & Stevens
5-1-88
V-720
300 00
Read & Stevens
Tres Papalotes
TD 10,755
(Rial Oil)
(Tenneco)
K-2943
Sage Enrg
F.F. Davis
3-1-89
V-1000
126 84
Superior
State
TD 10505
Amini
Superior-St.
TD 10735
D/A 6-12-74
NM State
Elk Oil & Verde Vista
11-1-86
LG-3857
30 32
Mock Prod.
Southland-St.
Amini
N.M. St.
TD 10700
Macdonald
State
TD 10715
D/A 1-5-69
Elk Oil
5-1-88
V-721
293 75
Elk Oil
State
TD 10,555
Midwest
Shell-St
TD 10700
D/A 2-8-70
Elk Oil
Etcheverry
F480
Wayne Newkumet
to 10,577'
V-779
D.A. Tipton
NM(86) St.
Enserch Expl
(Chevron)
F360
K-5450
"N.M. (87) St."
Chevron
8 P
B-10363
Barben-Davis
Mobil
Chevron
3-1-93
LH-2334
195 33
TXO, etal
6-25-86
TXO
Nancy Etcheverry
TD 10558
C.W. Mewbourne, etall
HBP
L-6304
16 29
C.W. Trainer, etal
(Del-Lea)
Read & Stevens
(Union)
Elk Oil
Etcheverry-St.
Marie-St
Tenneco
"A"
Pure-St.
(TMGE)
Clements Ener. etal
LG-9819
"New Mex-St."
J. Huber
Mobil-St.
TD 10,534
D/A 5-31-66
Mobil-St. (Com)
Expl. etal
Sun
Tenneco-St
F240
F.G. Yates
Jr.
D. Fosken
"Pan Am. St"
TD 335
U.S., M.
Troy Fort S & M.I.
HNG
12-1-90
40258
7-1-92
53243
Skelly
F413
Tenneco-St.
P43
P66
P180
F226
F575
F374
F360
F415
F460
F480
P100
P1S1
SWD
Etcheverry
Mock Prod.
Southland-St.
Elk Oil
Etcheverry
Mewbourne Oil
Shell-St
Mewbourne Oil
Shell-St
Mewbourne Oil
Etcheverry
Elk Oil
Etcheverry-St.
Marie-St
Tenneco-St.
Pure-St.
New Mex-St.
Mobil-St. (Com)
Yates Pet.
Fasken
Tidewater-St
Chevron
Steve Gose
Midwest-St.
Tenneco
(Pure)
Penn Disc
(PETCO & BBL)
Yates Pet., etal
HNG Oil
C.B. Read
Sinc-St
Solar
Sinclair-St.
Yates Pet
Yates Pet.
Abo Pet. etal, 3/4
Abo Pet etal, 3/4
Union
Cinch-St
Skelly
State
MGF
HNG
T.H. McConnel
Sam Boren
Sandy
Yates Pet., etal
Tex. Crude & Sinclair
Machris-St.
Mewbourne Oil
Shell-St.
(J.M. Huber & Simons)
Mewbourne Oil
Etcheverry
Trainer
Marie
G.D. Roberts
BTA
Marie-7113-JVD
John Etcheverry, etal
Yates Pet., etal
Read & Stevens
Read & Stevens
Tres Papalotes
(Rial Oil)
(Tenneco)
Sage Enrg
F.F. Davis
Superior
State
Amini
Superior-St.
NM State
Elk Oil & Verde Vista
Mock Prod.
Southland-St.
Amini
N.M. St.
Macdonald
State
Elk Oil
Elk Oil
State
Midwest
Shell-St
Elk Oil
Etcheverry
Wayne Newkumet
to 10,577'
D.A. Tipton
NM(86) St.
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K-5450
"N.M. (87) St."
Chevron
8 P
B-10363
Barben-Davis
Mobil
Chevron
TXO, etal
TXO
Nancy Etcheverry
C.W. Mewbourne, etall
HBP
C.W. Trainer, etal
(Del-Lea)
Read & Stevens
(Union)
Elk Oil
Etcheverry-St.
Marie-St
Tenneco
"A"
Pure-St.
(TMGE)
New Mex-St.
Mobil-St. (Com)
Expl. etal
Sun
Tenneco-St
F.G. Yates
Jr.
D. Fosken
"Pan Am. St"
TD 335
U.S., M.
Troy Fort S & M.I.
HNG
40258
Skelly
F413
Tenneco-St.
P43
P66
P180
F226
F575
F374
F360
F415
F460
F480
SWD
Etcheverry
Mock Prod.
Southland-St.
Mewbourne Oil
Shell-St
Mewbourne Oil
Shell-St
Mewbourne Oil
Etcheverry
Elk Oil
Etcheverry-St.
Marie-St
Tenneco-St.
Pure-St.
New Mex-St.
Mobil-St. (Com)
Yates Pet.
Fasken
Tidewater-St
Chevron
Steve Gose
Midwest-St.
Tenneco
(Pure)
Penn Disc
(PETCO & BBL)
Yates Pet., etal
HNG Oil
C.B. Read
Sinc-St
Solar
Sinclair-St.
Yates Pet
Yates Pet.
Abo Pet. etal, 3/4
Abo Pet etal, 3/4
Union
Cinch-St
Skelly
State
MGF
HNG
T.H. McConnel
Sam Boren
Sandy
Yates Pet., etal
Tex. Crude & Sinclair
Machris-St.
Mewbourne Oil
Shell-St.
(J.M. Huber & Simons)
Mewbourne Oil
Etcheverry
Trainer
Marie
G.D. Roberts
BTA
Marie-7113-JVD
John Etcheverry, etal
Yates Pet., etal
Read & Stevens
Read & Stevens
Tres Papalotes
(Rial Oil)
(Tenneco)
Sage Enrg
F.F. Davis
Superior
State
Amini
Superior-St.
NM State
Elk Oil & Verde Vista
Mock Prod.
Southland-St.
Amini
N.M. St.
Macdonald
State
Elk Oil
Elk Oil
State
Midwest
Shell-St
Elk Oil
Etcheverry
Wayne Newkumet
to 10,577'
D.A. Tipton
NM(86) St.
Enserch Expl
(Chevron)
K-5450
"N.M. (87) St."
Chevron
8 P
B-10363
Barben-Davis
Mobil
Chevron
TXO, etal
TXO
Nancy Etcheverry
C.W. Mewbourne, etall
HBP
C.W. Trainer, etal
(Del-Lea)
Read & Stevens
(Union)
Elk Oil
Etcheverry-St.
Marie-St