STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

OIL CONSERVATION DIVISION
P. O. Box 2088
SANTA FE, NEW MEXICO
87501

ADMINISTRATIVE ORDER
NFL 116

INFILL DRILLING FINDINGS AND WELL-SPACING WAIVER
MADE PURSUANT TO SECTION 271.305(b) OF THE
FEDERAL ENERGY REGULATORY COMMISSION REGULATIONS,
NATURAL GAS POLICY ACT OF 1978 AND OIL CONSERVATION DIVISION
ORDER NO. R-6013

I.

Operator ARCO OIL & GAS COMPANY Well Name and No. Seven Rivers Queen Unit Well #63

Location: Unit L Sec. 34 Twp. 22S Rng. 36E Cty. Lea

II.

THE DIVISION FINDS:

(1) That Section 271.305(b) of the Federal Energy Regulatory Commission Interim Regulations promulgated pursuant to the Natural Gas Policy Act of 1978 provides that, in order for an infill well to qualify as a new onshore production well under Section 103 of said Act, the Division must find, prior to the commencement of drilling, that the well is necessary to effectively and efficiently drain a portion of the reservoir covered by the proration unit which cannot be so drained by any existing well within that unit, and must grant a waiver of existing well-spacing requirements.

(2) That by Order No. R-6013, dated June 7, 1979, the Division established an administrative procedure whereby the Division Director and the Division Examiners are empowered to act for the Division and find that an infill well is necessary.

(3) That the well for which a finding is sought is to be completed in the South Eunice Seven Rivers Queen Pool, and the standard spacing unit in said pool is 40 acres.

(4) That a 40 -acre proration unit comprising the NW/4 SW/4 of Sec. 34, Twp. 22S, Rng. 36E, is currently dedicated to the applicant's Seven Rivers Queen Unit Well #34 located in Unit L of said section.

(5) That this proration unit is (X) standard ( ) nonstandard; if nonstandard, said unit was previously approved by Order No. NA.

(6) That said proration unit is not being effectively and efficiently drained by the existing well(s) on the unit.

(7) That the drilling and completion of the well for which a finding is sought should result in the production of an additional 32,500 MCF of gas from the proration unit which would not otherwise be recovered.

(8) That all the requirements of Order No. R-6013 have been complied with, and that the well for which a finding is sought is necessary to effectively and efficiently drain a portion of the reservoir covered by said proration unit which cannot be so drained by any existing well within the unit.

(9) That in order to permit effective and efficient drainage of said proration unit, the subject application should be approved as an exception to the standard well spacing requirements for the pool.

IT IS THEREFORE ORDERED:

(1) That the applicant is hereby authorized to drill the well described in Section I above as an infill well on the existing proration unit described in Section II(4) above. The authorization for infill drilling granted by this order is an exception to applicable well spacing requirements and is necessary to permit the drainage of a portion of the reservoir covered by said proration unit which cannot be effectively and efficiently drained by any existing well thereon.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on this 28th day of January, 19 86.

DIVISION DIRECTOR ___ EXAMINER ✓

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0149

Joe R. Hastings
District Engineer — West

December 20, 1984

New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Sirs:

ARCO Oil and Gas Company (AOGC) respectfully requests the New Mexico Oil Conservation Division grant an infill finding for infill Wells 62 and 63 in the Seven Rivers-Queen Unit (SRQU).

Infill drilling is necessary to promote efficient and effective drainage of the South Eunice and Langlie Mattix Pools. The development drilling will result in increased recovery and prevention of waste caused by oil trapped in discontinuities between wells on the present 40-acre spacing. In addition, infill drilling will reduce effects of a steep structural dip which causes a decrease in correlative pay between wells.

Documentation to support these claims is found in the attached engineering discussion. Additional information necessary to the infill finding application is also included. Copies of this application and a request for a waiver of protest have been furnished the offset operators by registered mail. A copy of the letter sent to the offset operators is included in this package. Should any questions arise, please do not hesitate to call me at (915) 684-0149. We will be happy to assist you with any concerns you may have. Your early consideration in this matter would certainly be appreciated.

Yours very truly,

Joe R. Hastings

JRH:RBM:sc
Atts.

Engineering Discussion On The Improvement In Recovery From The Seven Rivers-Queen Unit Utilizing Infill Drilling

Seven Rivers-Queen Unit Wells No. 62 and 63 were recently drilled as development wells on 20-acre spacing. The wells were approved by the New Mexico Oil Conservation Division under order numbers NSL-1816 and NSL-1815. The two wells were drilled to produce from locations within the present 40-acre spacing that are not efficiently drained throughout the unitized interval. The Seven Rivers-Queen Unit consists of the entire Queen formation and the bottom 100' of the Seven Rivers. The following discussion provides evidence supporting the need for SRQU Wells No. 62 and 63.

The recovery efficiency of the SRQU will increase as the effects of reservoir heterogeneity and structural dip are reduced. These factors combine to reduce the correlative pay between wells which results in a low injection efficiency. The unit's waterflood material balance analysis and pattern performance plot (Figures 3 thru 5) support the fact that injection efficiency within the unit is less than desired.

The primary benefit derived from drilling the two infill wells No. 62 and 63 was the reduction in the negative effect the structural dip plays in the SRQU (Figure 6). As can be seen from the two cross-sections, (Figures 7 and 8), a significant amount of net pay is open to production in the two infill wells that occur at a depth below the WOC in two of the three offset producers. Primary as well as secondary oil and solution gas production should be recovered from these two infill wells. Primary reserves should be realized in wells such as No. 63 in which pay is open which had not been previously produced by either offset producer. Secondary reserves should be enhanced by providing a drawdown for the oil and its solution gas to flow rather than becoming trapped between the water bank created by injection, and the WOC. In addition to this, small stringers are picked up that are not continuous between producers. These two factors help to improve the overall injection efficiency of the Seven Rivers-Queen Unit.

The cross-sections through the two infill wells were prepared from gamma ray-neutron porosity logs. Net pay was determined using an 8% minimum porosity cutoff which is typical for the Seven Rivers and Queen in the area. No pay was included above the GOC at -150' SS or below the WOC at -285' SS. Production from the gas zone would decrease reservoir energy and therefore is usually not opened to production. Pay below the WOC is generally not open in producers in the SRQU, however, injection wells have been perforated below the WOC to sweep oil and solution gas updip to producers.

Two previous infill wells, SRQU No. 60 and 61, were also drilled to reduce the effect of structural dip. Both wells picked up pay that was lost below the WOC in one of its offsets. These two infill wells were completed in April, 1983 and have since produced an average of 17.7 MBO and 2.2 MMCFG each. The expected ultimate recoveries are 57 and 61 MBO, respectively. Production data shows no increase in decline rate after the completion of SRQU No. 60 and 61 (Figure 9), thus indicating that the reserves for the infill wells are new reserves and are not simply the result of rate acceleration.

Seven Rivers-Queen Unit Wells No. 62 and 63 initially potentialed at 8 BOPD and 47 BOPD, respectively. Production from Seven Rivers-Queen Unit No. 62 has increased significantly since its initial potential test. Six 24 hour tests were reported for SRQU No. 62 in October, 1984 and the well averaged 33 BOPD production. The increase in production for the well is due to the fact the well has been pumped off after having a high fluid level at the time of the initial test. Production from SRQU No. 62 and 63 is expected to decline at a rate similar to SRQU No. 60 and 61. The two new infill wells should produce approximately 50 MBO and 32.5 MMCFG each. This value compares favorably to the 47.5 MBO obtained through material balance calculations (Figures 10 thru 13).

Infill drilling in the SRQU helps alleviate the problems associated with structural dip and to a lesser degree the reservoir heterogeneity that is present. SRQU No. 62 and 63 should result in an increase in recoverable reserves of approximately 100 MBO and 65 MMCFG. This, coupled with the 118 MBO and 53.1 MMCFG increase expected from SRQU No. 60 and 61, prove the necessity of infill drilling to improve recovery in the Seven Rivers-Queen Unit.

Richard Morton
Engineer

RBM:sc
Atts.

PERMIAN DISTRICT – WEST AREA

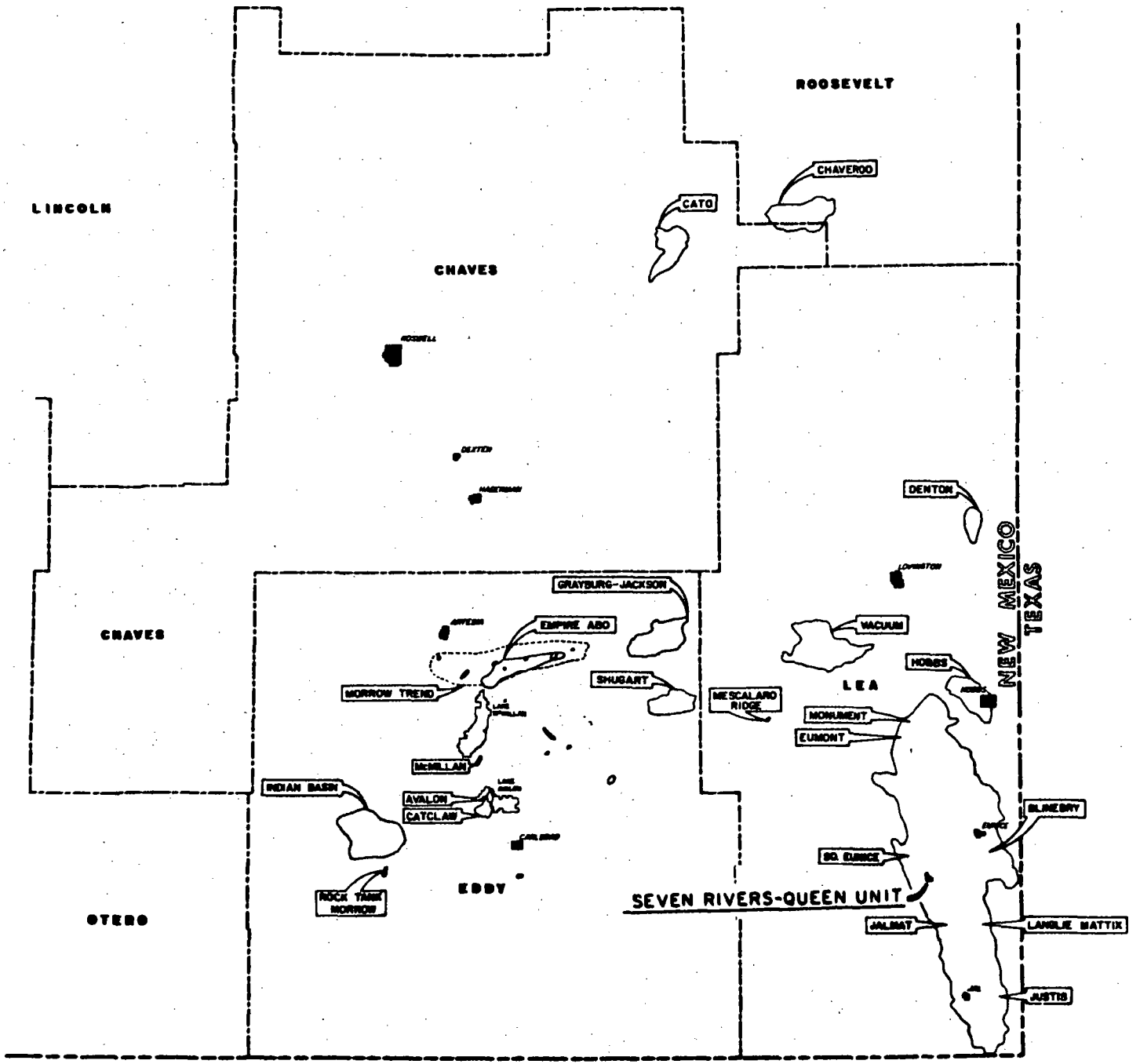
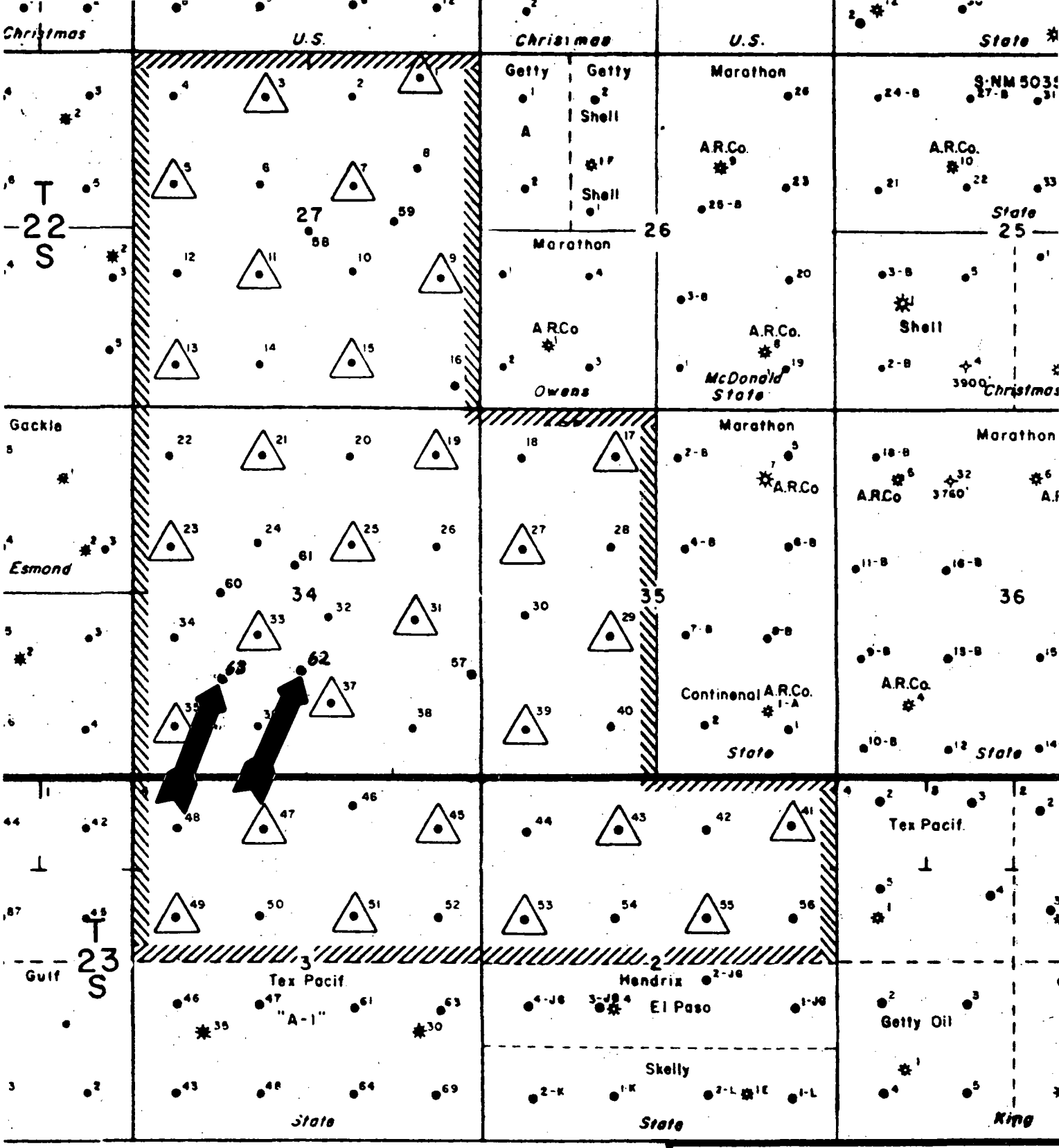


Figure 1



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UNIT BOUNDARY

ARCO Oil and Gas Company
Division of Atlantic Richfield Company
Permian District Midland, Texas

SEVEN RIVERS-QUEEN UNIT

LEA COUNTY, NEW MEXICO

UNIT MAP

SCALE: 1" = 2000'

By: R. CRAIG	Drawn By:	Date: 4-81
Data:	Revised By: RdL	Date: 6-83
Dept.: WEST AREA ENGR.	Dwg No.:	

Figure 2

AtlanticRichfieldCompany ◆ **Waterflood Material Balance Analysis**

Field: South Eunice-Langlie Mattix

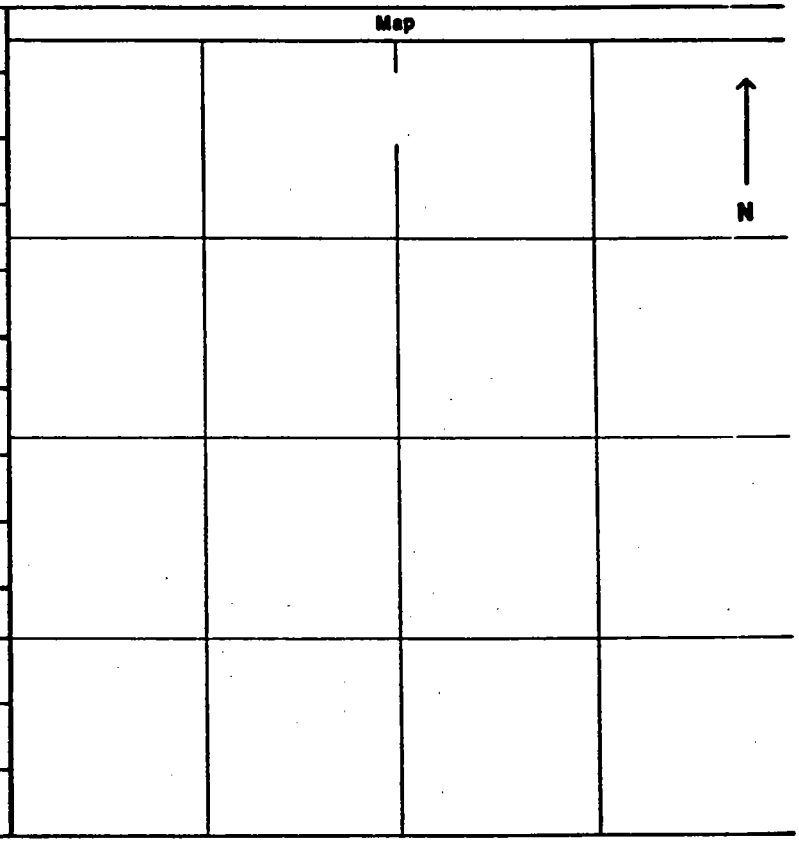
Reservoir: Seven Rivers-Queen

Element area: 2240 Acres

Average thickness: 31 Feet

Date start of injection: 3/74

Map



Cumulative production at start of injection

Oil (N_p) = 2,932 MSTB

Gas (G_p) = Avg. GOR = 1500 4,398 MMCF

Water (W_p) = Avg. WOR = .7 2,052 MBbls

Rock and fluid data

ϕ = .11 S_{cw} = .32

B_{ox} = 1.04 S_{or} = .32

B_{oi} = 1.21

Pattern volumetric data

V_p = 7758 x ϕ x h x Area = 7758 x .11 x 31 x 2240 = 59,259 M RVB

$V_D = V_p \times (1.0 - S_{cw} - S_{or})$ = 59,259 x (1.0 − .32 − .32) = 21,333 M RVB

$$\text{O.O.I.P.} = \frac{V_p \times (1.0 - S_{cw})}{B_{oi}} = \frac{59,259 \times (1.0 - .32)}{1.21} = 33,302\ \text{M STB}$$

$$S_{gx} = S_{oi}\left[1.0 - \frac{B_{ox}}{B_{oi}}(1 - f)\right] = .68\left[1.0 - \frac{1.04}{1.21}(1 - .0880)\right] = .1470$$

$V_{fillup} = V_p \times S_{gx}$ = 59,259 x .1470 = 8709 RVB

$$\text{Disp. eff.}\ (E_D) = \frac{S_{oi} - S_{or}}{S_{oi}} = \frac{.68 - .32}{.68} = .5294$$

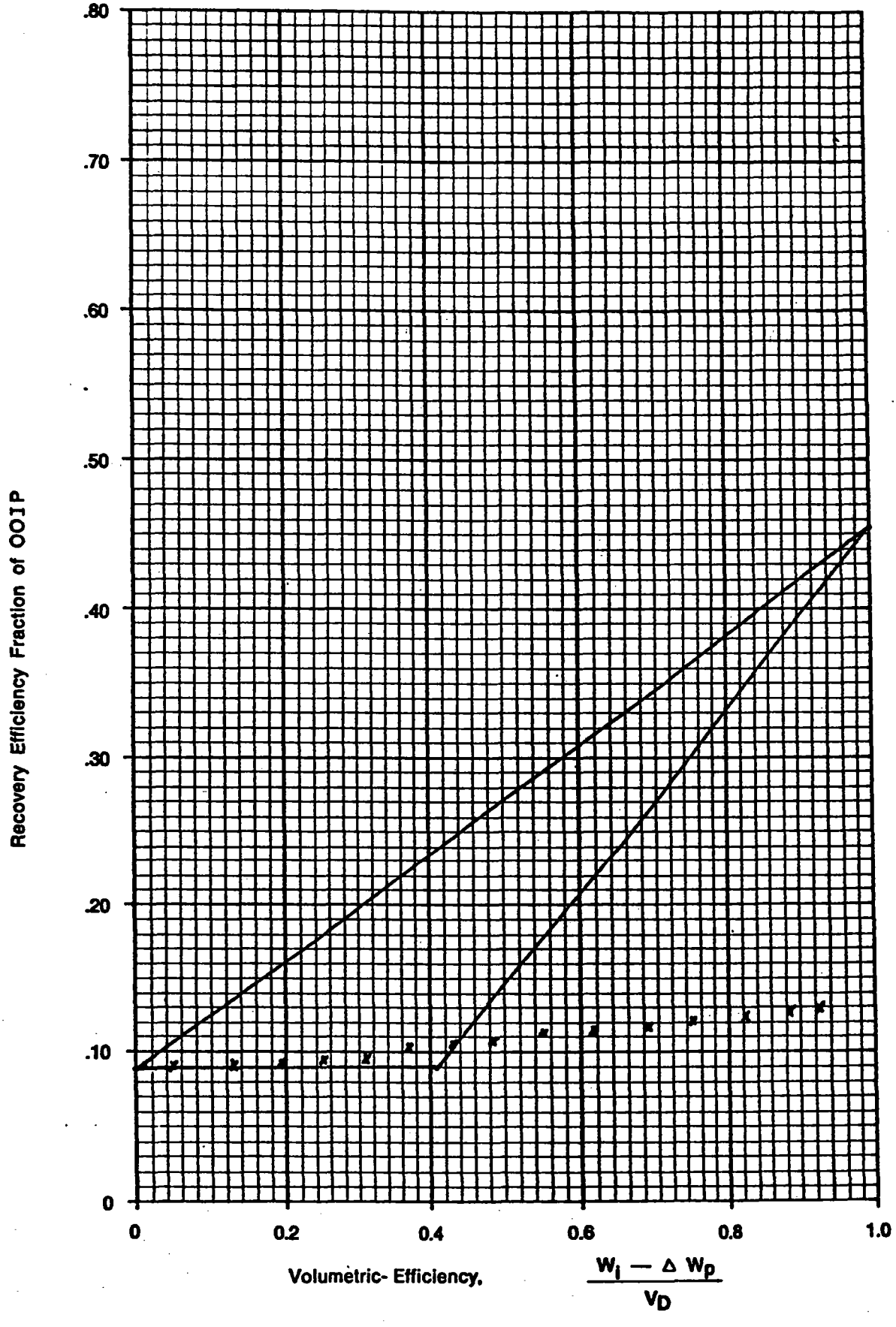
$$\text{ABAR} = \frac{S_{gx}}{1.0 - S_{cw} - S_{or}} = \frac{.1470}{.36} = .4083$$

AR3B-2668-A

FIGURE 3

AtlanticRichfieldCompany ◆ **Pattern Performance**

F at start of flood	ABAR	F at $E_v = 1.0$	Pattern No.
.088	.4083	$F = 1.0 - \frac{B_{oi}}{B_{or}}(1.0 - E_D) = 1 - \frac{1.21}{1.04}(1 - .5294) = .4525$	Unit



AR3B-2665-A

FIGURE 4

INJECTION EFFICIENCY CALCULATION

FROM PATTERN PERFORMANCE PLOT

TO REACH OUTSIDE LINE OF TRIANGLE

$E_V = .48$

$$\frac{Wi - Wp}{V_D} = .48$$

$$Wi = .48\ V_D + Wp$$

$$Wi = 12{,}435.1 \text{ MBW}$$

$$\text{INJECTION EFFICIENCY} = \frac{12{,}435.1}{22{,}114.1} = \underline{\underline{58\%}}$$

TO REACH CENTER OF TRIANGLE

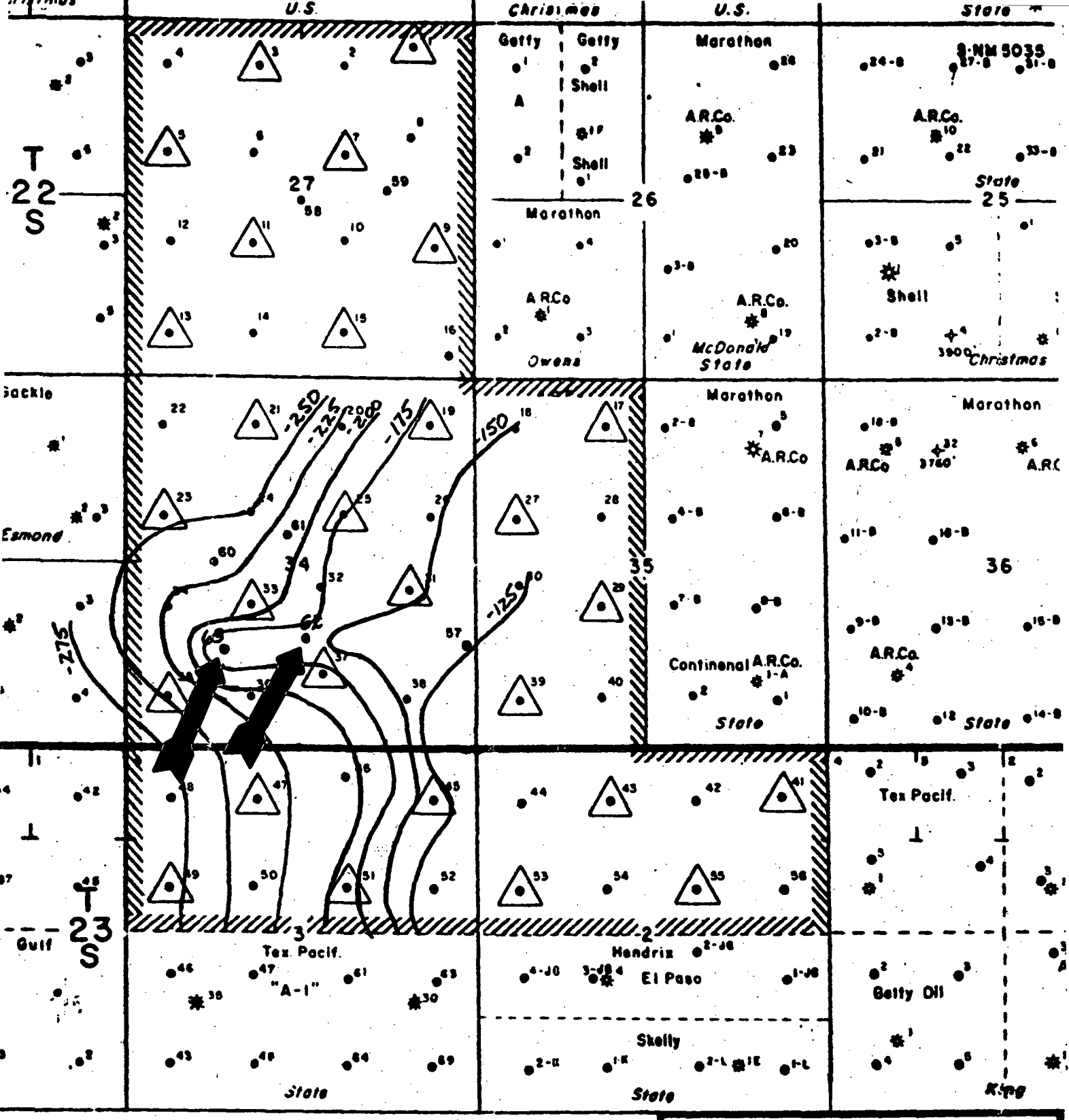
$E_V = .30$

$$Wi = .30\ V_D + Wp$$

$$Wi = 8{,}595.1 \text{ MBW}$$

$$\text{INJECTION EFFICIENCY} = \frac{8{,}595.1}{22{,}114.1} = \underline{\underline{40\%}}$$

Figure 5



UNIT BOUNDARY

ARCO Oil and Gas Company
Division of Atlantic Richfield Company
Permian District Midland, Texas

SEVEN RIVERS-QUEEN UNIT

LEA COUNTY, NEW MEXICO

STRUCTURE MAP ON TOP OF QUEEN

Countour Interval = 25'

SCALE: 1" = 2000'

By: R. CRAIG	Drawn By:	Date: 4-81
Date:	Reviewed By: RdL	Date: 9-83
Dept.: WEST AREA ENGR.	Dwg No.:	

Figure 6

INTENTIONAL OMISSIONS

The following document(s) have been intentionally omitted from this file due to the indicated reasons.

FILE # NFL-116

DESCRIPTION OF OMITTED DOCUMENTS

OMITTED DOCUMENT	REASON OMITTED
Cross Section "AA" Graph	Too Large
" "BB" "	"

SRQU TOTAL PRODUCTION

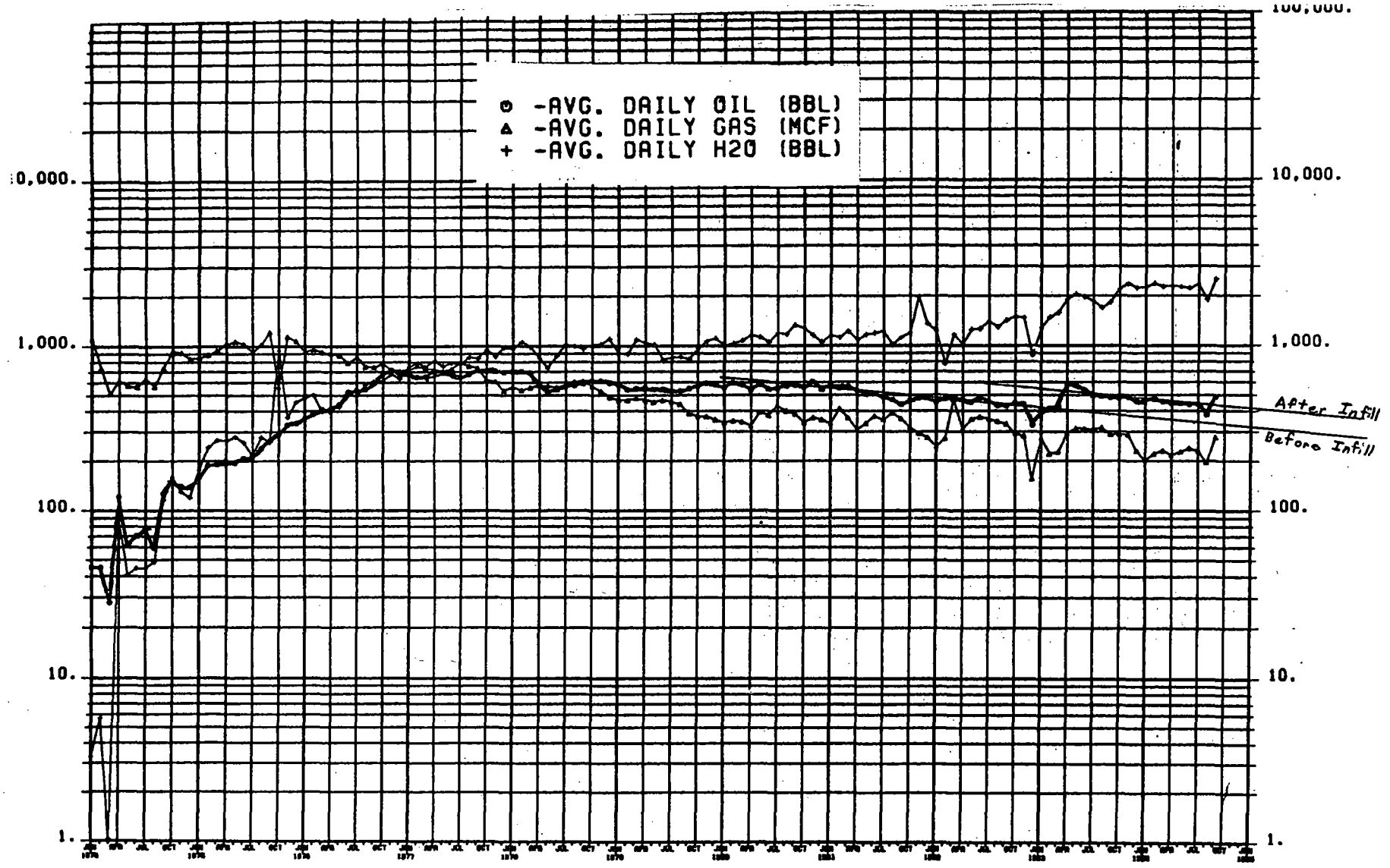


Figure 9

AtlanticRichfieldCompany ◆ **Waterflood Material Balance Analysis**

Field: South Eunice

Reservoir: Seven Rivers - Queen

Element area: 35.5 Acres

Average thickness: 52.5 Feet

Date start of injection: 3/74

Cumulative production at start of injection

Oil (N_p) = 74.95 MSTB

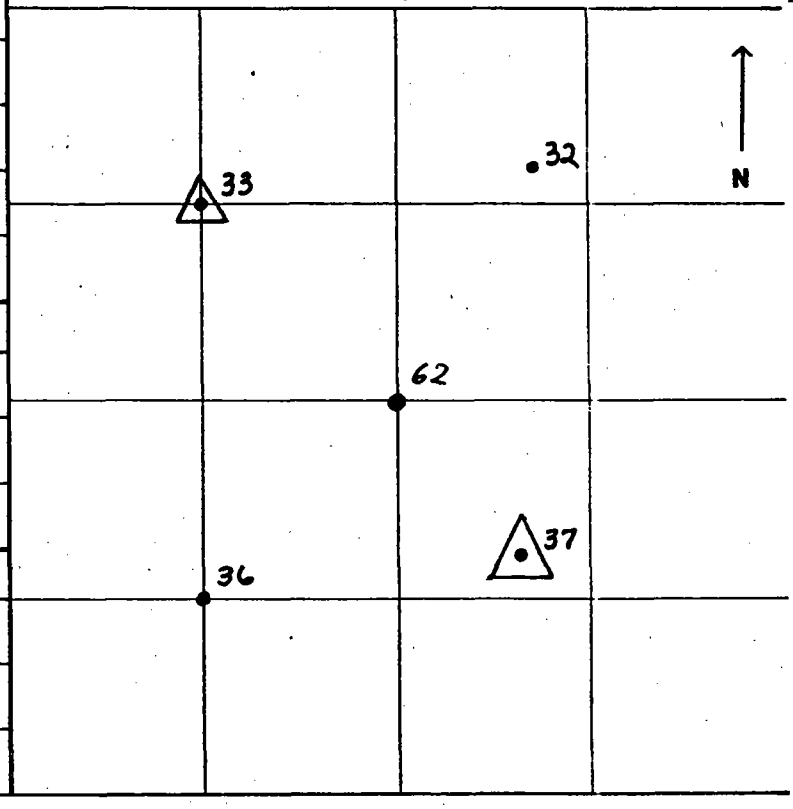
Gas (G_p) = 112.4 MMCF

Water (W_p) = 52.5 MBbls

Rock and fluid data

ϕ = .11	S_{cw} = .32
B_{ox} = 1.04	S_{or} = .32
B_{oi} = 1.21	

Map



Pattern volumetric data

$= 7758 \times \phi \times h \times \text{Area} = 7758 \times .11 \times 52.5 \times 35.5 = 1590.5$ MRVB

$V_D = V_p \times (1.0 - S_{cw} - S_{or}) = 1590.5 \times (1.0 - .32 - .32) = 572.6$ MRVB

$$\text{O.O.I.P.} = \frac{V_p \times (1.0 - S_{cw})}{B_{oi}} = \frac{1590.5 \times (1.0 - .32)}{1.21} = 893.8 \text{ MSTB}$$

$$S_{gx} = S_{oi}\left[1.0 - \frac{B_{ox}}{B_{oi}}(1 - f)\right] = .68\left[1.0 - \frac{1.04}{1.21}(1 - .0839)\right] = .1445$$

$V_{fillup} = V_p \times S_{gx} = 1590.5 \times .1445 = 229.9$ RVB

$$\text{Disp. eff.}(E_D) = \frac{S_{oi} - S_{or}}{S_{oi}} = \frac{.68 - .32}{.68} = .5294$$

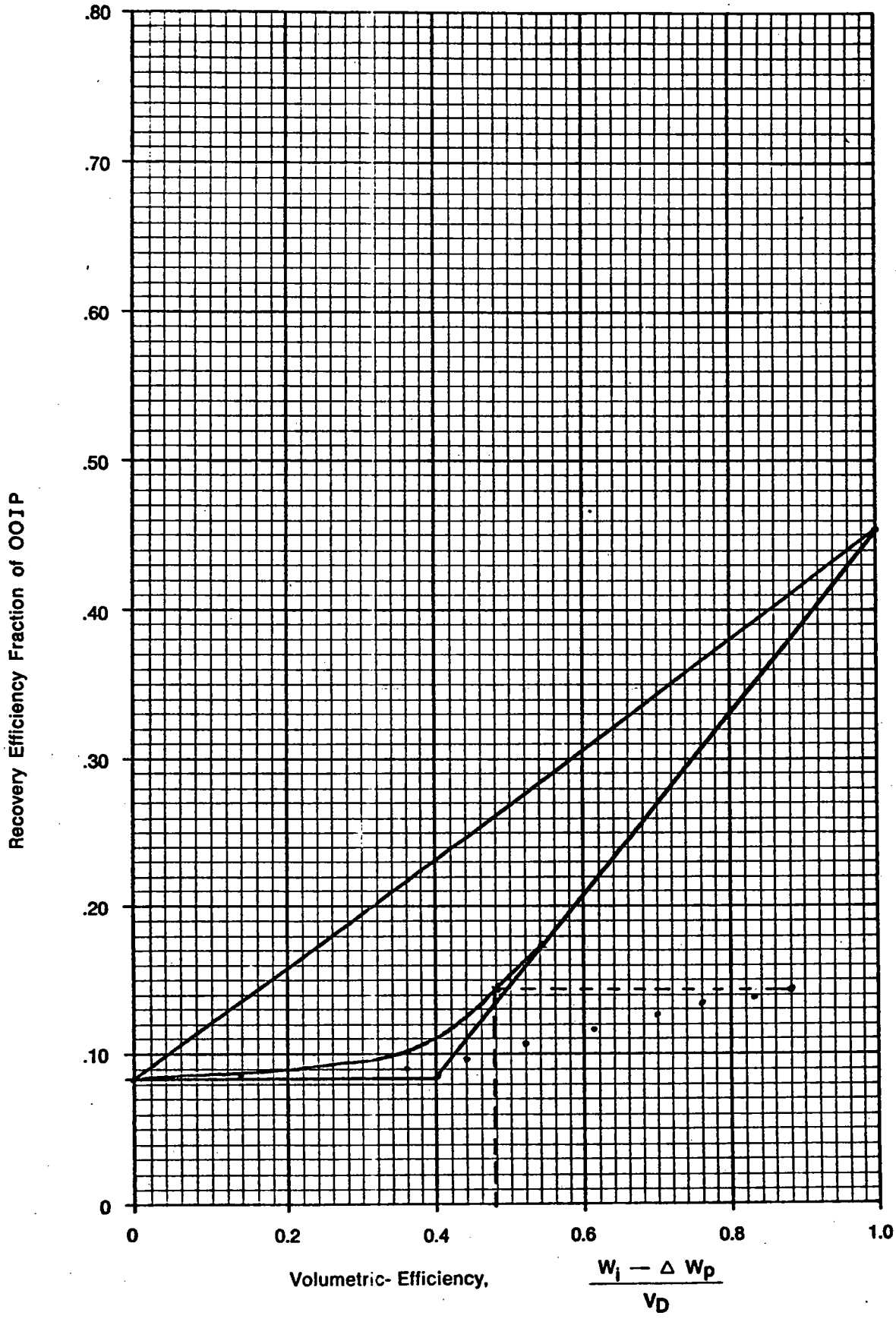
$$\text{ABAR} = \frac{S_{gx}}{1.0 - S_{cw} - S_{or}} = \frac{.1445}{.36} = .4014$$

AR3B-2668-A

Figure 10

AtlanticRichfieldCompany ◆ **Pattern Performance**

F at start of flood	ABAR	F at $E_v = 1.0$	Pattern No.
.084	.401	$F = 1.0 - \frac{B_{oi}}{B_{ox}} (1.0 - E_D) = .452$	



AR3B-2669-A

Figure 11

Seven Rivers Queen Unit #62

Increased recovery due to infill drilling

Average pay of surrounding wells

Well #	Net Pay Logged	Estimated Add'l Pay Open	Total Net Pay
32	37+	11	48
33	28+	26	54
36	25+	28	53
37	37+	18	55
	127+		210'
Avg.	31.8	Avg.	52.5'

From cross-section of Well Nos. 33, 61, and 25:

% Continuous pay - 40 acre spacing: 69%

% Continuous pay - 20 acre spacing: 77%

From relative permeability data:

Soi = 68%
Sor = 32%

$$E_D = \frac{Soi - Sor}{Soi} = \frac{.68 - .32}{.68} = .5294$$

From cores on SRQU Nos. 41, 53, and 57:

Avg. $\emptyset$ = 11%

From "Proposed Seven-Rivers Queen Unit Waterflood Study"

Boi = 1.21 RVB/STB Box = 1.04 RVB/STB

$$OOIP_{35.5 \text{ acres}} = \frac{7758\ (.11)(35.5)(52.5)(.68)}{1.21} = 893.8 \text{ MBO}$$

Figure 12

Well #	Primary Recovery, MBO
32	80.6
33	64.4
36	74.0
37	80.8
	299.8 x .25 = 74.95 MBO

Pattern currently has an injection efficiency of 71%. Assuming an 8% increase in injection efficiency, new reserves should be:

$$\Delta E_R = \frac{Boi}{Box} E_D [(E_{V2} - E_{V1})f_1 + (E_{V2} - \bar{A})(f_2 - f_1)]$$

$$= \frac{1.21}{1.04}(.5294)[(.79 - .71)(.69)+(.79 - .401)(.77 - .69)]$$

$$= .0532$$

New reserves = (.0532)(893.8) = 47.5 MBO

Where:
- Soi = initial oil saturation
- Sor = residual oil saturation to waterflood
- Sgx = gas saturation at start of flood
- E_D = displacement efficiency
- E_V = volumetric efficiency
- $\bar{A}$ = displaceable pore volume occupied by gas
- f = floodable pay
- 1 = before infill drilling
- 2 = after infill drilling

Figure 13

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0149

Joe R. Hastings
District Engineer — West

December 20, 1984

Offset Operators
Infill Wells Nos. 62 and 63
ARCO's Seven Rivers-Queen Unit
Section 34, T22S, R36E
Lea County, New Mexico

Gentlemen:

Waiver of Objection
Infill Finding

ARCO Oil and Gas Company hereby notifies you as offset operator to our Seven Rivers-Queen Unit that we have requested the New Mexico Oil Conservation Division grant an infill finding for infill Wells 62 and 63. If you have no objection to the request, please sign this waiver of protest. Send one copy to the NMOCD, one copy to ARCO, and retain one for your files. Stamped, self-addressed envelopes are enclosed for your convenience. Should any questions arise, please contact me at (915)684-0149.

Yours very truly

Joe R. Hastings

Joe R. Hastings

JRH:RBM:sc
Atts.

I waive protest to ARCO's application for an infill finding for their Seven Rivers-Queen Unit Wells Nos. 62 and 63.

Name: _____

Title: _____

Company: _____

Date: _____

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0149

Joe R. Hastings
District Engineer — West

December 20, 1984

New Mexico Oil Conservation Division
P. O. Box 2088
Santa Fe, New Mexico 87501

Dear Sirs:

ARCO Oil and Gas Company (AOGC) respectfully requests the New Mexico Oil Conservation Division grant an infill finding for infill Wells 62 and 63 in the Seven Rivers-Queen Unit (SRQU).

Infill drilling is necessary to promote efficient and effective drainage of the South Eunice and Langlie Mattix Pools. The development drilling will result in increased recovery and prevention of waste caused by oil trapped in discontinuities between wells on the present 40-acre spacing. In addition, infill drilling will reduce effects of a steep structural dip which causes a decrease in correlative pay between wells.

Documentation to support these claims is found in the attached engineering discussion. Additional information necessary to the infill finding application is also included. Copies of this application and a request for a waiver of protest have been furnished the offset operators by registered mail. A copy of the letter sent to the offset operators is included in this package. Should any questions arise, please do not hesitate to call me at (915) 684-0149. We will be happy to assist you with any concerns you may have. Your early consideration in this matter would certainly be appreciated.

Yours very truly,

Joe R. Hastings

JRH:RBM:sc
Atts.

OFFSET OPERATORS
ARCO's Seven Rivers-Queen Unit
Infill Wells No. 62 & 63

Conoco, Inc.
P. O. Box 460
Hobbs, New Mexico 88240

ARCO Oil and Gas Company
Permian District
Post Office Box 1610
Midland, Texas 79702
Telephone 915 684 0149

Joe R. Hastings
District Engineer — West

December 20, 1984

CERTIFIED
RETURN RECEIPT
REQUESTED

Offset Operators
Infill Wells Nos. 62 and 63
ARCO's Seven Rivers-Queen Unit
Section 34, T22S, R36E
Lea County, New Mexico

Gentlemen:

Waiver of Objection
Infill Finding

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Yours very truly,

Joe R. Hastings

Joe R. Hastings

JRH:RBM:sc
Atts.

I waive protest to ARCO's application for an infill finding for their Seven Rivers-Queen Unit Wells Nos. 62 and 63.

Name: Donald W Johnson

Title: Division Manager

Company: CONOCO INC.

Date: January 15, 1985

Donald W. Johnson
Division Manager
Production Department
Hobbs Division
North American Production

Conoco Inc.
P.O. Box 460
726 East Michigan
Hobbs, NM 88240
(505) 393-4141

January 14, 1985

ARCO Oil and Gas Company
Permian District
P.O. Box 1610
Midland, TX 79702

Attention Mr. Joe. R. Hastings

Gentlemen:

ARCO's Seven Rivers - Queen Unit Infill Wells No. 62 and 63, Section 34, T-22-S, R-36-E, Lea County, New Mexico

Conoco Inc., as offset operator, has approved your waiver letter for the subject wells. One copy is being forwarded to the NMOCD in Santa Fe.

Yours very truly,

HAI:mjs
Enclosure
cc: NMOCD - Santa Fe

Received 11/11/85 M.S.
Action Immediately

OIL CONSERVATION DIVISION
P. O. Box 2088
SANTA FE, NEW MEXICO
87501

STATE OF NEW MEXICO
ENERGY AND MINERALS DEPARTMENT

ADMINISTRATIVE ORDER
NFL 116

INFILL DRILLING FINDINGS AND WELL-SPACING WAIVER
MADE PURSUANT TO SECTION 271.305(b) OF THE
FEDERAL ENERGY REGULATORY COMMISSION REGULATIONS,
NATURAL GAS POLICY ACT OF 1978 AND OIL CONSERVATION DIVISION
ORDER NO. R-6013

I.

Operator ARCO Oil & Gas Company Well Name and No. Seven Rivers Queen Unit Well No. 63

Location: Unit L Sec. 34 Twp. 22 South Rng. 36 East Cty. Lea

II.

THE DIVISION FINDS:

(1) That Section 271.305(b) of the Federal Energy Regulatory Commission Interim Regulations promulgated pursuant to the Natural Gas Policy Act of 1978 provides that, in order for an infill well to qualify as a new onshore production well under Section 103 of said Act, the Division must find, prior to the commencement of drilling, that the well is necessary to effectively and efficiently drain a portion of the reservoir covered by the proration unit which cannot be so drained by any existing well within that unit, and must grant a waiver of existing well-spacing requirements.

(2) That by Order No. R-6013, dated June 7, 1979, the Division established an administrative procedure whereby the Division Director and the Division Examiners are empowered to act for the Division and find that an infill well is necessary.

(3) That the well for which a finding is sought is to be completed in the South Eunice Seven Rivers Queen Pool, and the standard spacing unit in said pool is 40 acres.

(4) That a 40 -acre proration unit comprising the NW/4 SW/4 of Sec. 34, Twp. 22 South, Rng. 36 East, is currently dedicated to the applicant's Seven Rivers Queen Unit Well No. 34 located in Unit L of said section.

(5) That this proration unit is (✓) standard ( ) nonstandard; if nonstandard, said unit was previously approved by Order No. NA.

(6) That said proration unit is not being effectively and efficiently drained by the existing well(s) on the unit.

(7) That the drilling and completion of the well for which a finding is sought should result in the production of an additional 32,500 MCF of gas from the proration unit which would not otherwise be recovered.

(8) That all the requirements of Order No. R-6013 have been complied with, and that the well for which a finding is sought is necessary to effectively and efficiently drain a portion of the reservoir covered by said proration unit which cannot be so drained by any existing well within the unit.

(9) That in order to permit effective and efficient drainage of said proration unit, the subject application should be approved as an exception to the standard well spacing requirements for the pool.

IT IS THEREFORE ORDERED:

(1) That the applicant is hereby authorized to drill the well described in Section I above as an infill well on the existing proration unit described in Section II(4) above. The authorization for infill drilling granted by this order is an exception to applicable well spacing requirements and is necessary to permit the drainage of a portion of the reservoir covered by said proration unit which cannot be effectively and efficiently drained by any existing well thereon.

(2) That jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary.

DONE at Santa Fe, New Mexico, on this _____ day of _____, 19_____.

DIVISION DIRECTOR ___ EXAMINER ___

cc - OCD Hobbs
NMOTGEC Hobbs