

DHC RELEASE 9.26.93

**MERIDIAN OIL**

OIL CONSERVATION DIVISION  
RECEIVED

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August 31, 1993

New Mexico Oil Conservation Division  
Attn: Mr. Bill LeMay  
P.O. Box 2088  
310 Old Santa Fe Trail  
Santa Fe, New Mexico 87501

*Winds*  
RE: San Juan 28-5 Unit #228  
Unit B, Section 24, T28N, R05W  
Rio Arriba County, New Mexico  
Downhole Commingling Request

Dear Mr. LeMay:

Meridian Oil Inc. is applying for an administrative downhole commingling order for the referenced well in the Pictured Cliffs and the Basin Fruitland Coal fields. The ownership of the zones to be commingled is common. All offsetting acreage in this case belongs to Meridian Oil Inc. A letter has been sent to the Bureau of Land Management notifying them.

The Fruitland Coal and Pictured Cliffs wells producing in this area operated by Meridian are marginally productive. Based on offset production in this area, drilling of separate wells and dual completions to produce the Fruitland Coal and Pictured Cliffs are not economically justified. The only economical way to recover the Fruitland Coal and Pictured Cliffs reserves in this drill block is to downhole commingle production from both zones in this well.

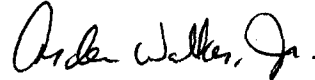
It is proposed to complete the Pictured Cliffs formation and test its production. It is then proposed to set a bridge plug above the Pictured Cliffs, perforate and stimulate the Fruitland Coal, and test its production. The bridge plug will then be removed, and both zones produced through a single string of tubing. The reservoir characteristics of each of the subject zones are such that underground waste will not be caused by the proposed commingling. Neither producing interval makes oil, and only minimal amounts of similar water are produced in the offset wells. The average shut-in pressures in the area for the Pictured Cliffs and Fruitland Coal are 1090 and 1070 psi, respectively.

The allocation of the commingled production will be calculated using the attached allocation formula. This formula is based on offset Pictured Cliffs production performance (material balance) and volumetrics, and uses accepted Reservoir Engineering methods to allocate the Pictured Cliffs reserves. This addresses the Fruitland Coal producing characteristics of early life inclining production rates.

New Mexico Oil Conservation Division  
Mr. Bill LeMay  
San Juan 28-5 Unit #228  
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Approval of this commingling application will allow for the prevention of wasted resources and protection of correlative rights. Included with this letter are plats showing ownership of offsetting leases for both the Pictured Cliffs and Fruitland Coal, a copy of the letter to the BLM and an allocation formula.

Sincerely,



Arden L. Walker, Jr.  
Regional Production Engineer

KS:tg  
Attachments

cc: Frank T. Chavez - NMOCD/Aztec

# MERIDIAN OIL

August 31, 1993

Bureau of Land Management  
1235 La Plata Highway  
Farmington, New Mexico 87401

RE: San Juan 28-5 Unit #228  
Unit B, Section 24, T28N, R05W  
Rio Arriba County, New Mexico  
Downhole Commingling Request

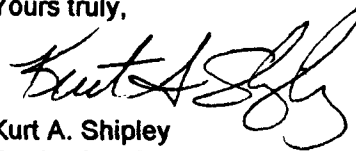
Gentlemen:

Meridian Oil, Inc. is in the process of applying for a downhole commingling order for the San Juan 28-5 Unit #228 well located in Unit B, Section 24, T28N, R05W, N.M.P.M., Rio Arriba County, New Mexico, in the Pictured Cliffs and the Basin Fruitland Coal fields.

The purpose of this letter is to notify you of such action. If you have no objections to the proposed commingling order, we would appreciate your signing this letter and returning it to this office.

Your prompt attention to this matter would be appreciated.

Yours truly,



Kurt A. Shipley  
Production Engineering

KS/tg

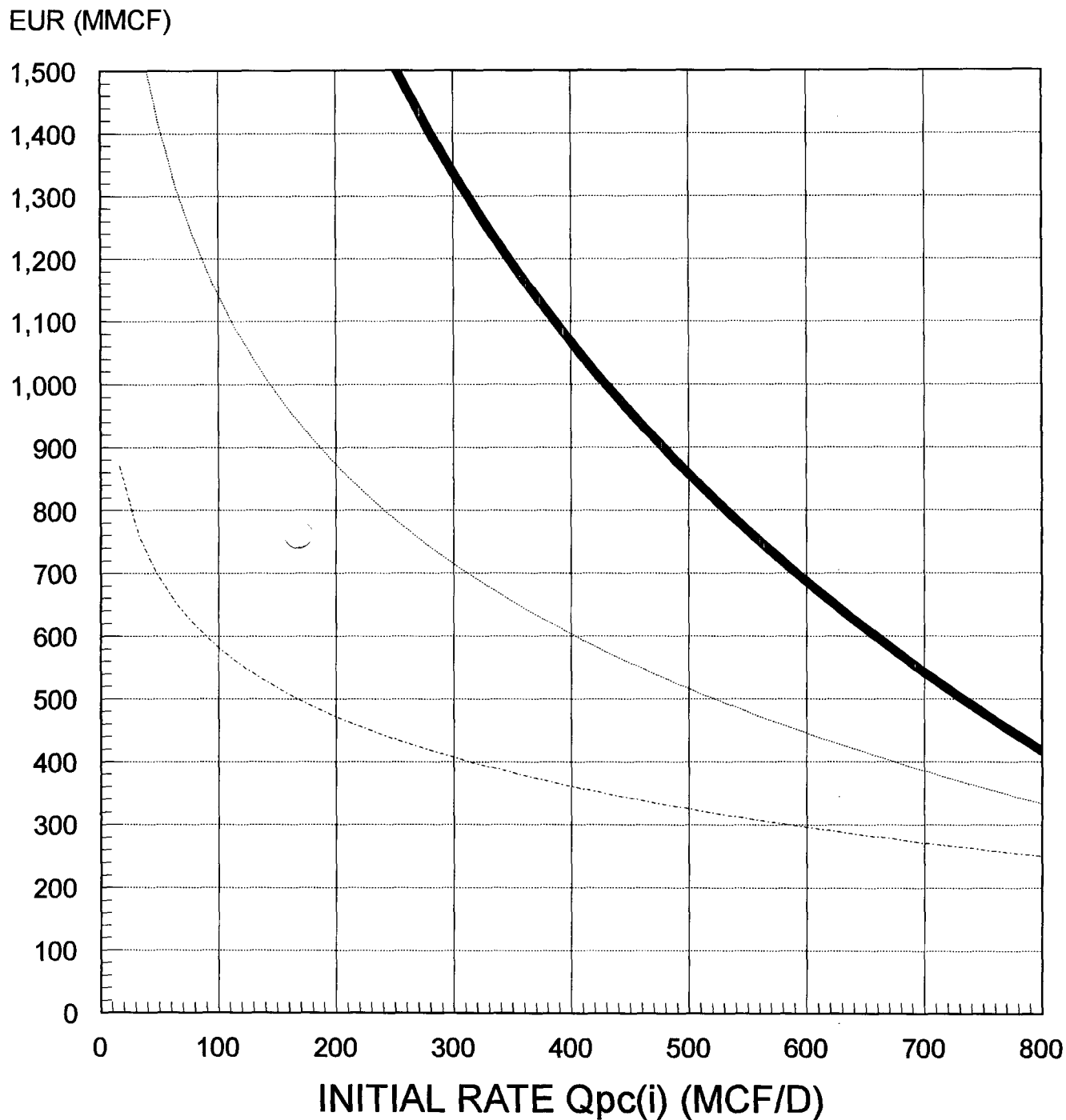
The above downhole commingling request is hereby approved:

\_\_\_\_\_  
Date: \_\_\_\_\_

# SAN JUAN 28-5 UNIT #228

## FRUITLAND COAL/ PICTURED CLIFFS

### ECONOMIC EVALUATION: $Q_i$ vs EUR



SINGLE	DUAL	COMMINGLED
15% ROR	15% ROR	15% ROR

EST. FTC EUR: 757 MMCF    EST. FTC  $Q_i$ : 165 MCFD  
 EST. PC EUR: 834 MMCF    EST. PC  $Q_i$ : 310 MCFD

# SAN JUAN 28-5 UNIT #228

## MONTHLY GAS PRODUCTION ALLOCATION FORMULA

### GENERAL EQUATION

$$Q_t = Q_{ftc} + Q_{pc}$$

WHERE:  $Q_t$  = TOTAL MONTHLY PRODUCTION (MCF/MONTH)  
 $Q_{ftc}$  = FRUITLAND COAL (ftc) MONTHLY PRODUCTION  
 $Q_{pc}$  = PICTURED CLIFFS (pc) MONTHLY PRODUCTION (MCF/MONTH)

REARRANGING THE EQUATION TO SOLVE FOR  $Q_{ftc}$ :

$$Q_{ftc} = Q_t - Q_{pc}$$

ANY PRODUCTION RATE OVER WHAT IS CALCULATED FOR THE PICTURED CLIFFS (PC) USING THE APPLIED FORMULA IS FRUITLAND COAL (FTC) PRODUCTION.

PICTURED CLIFFS (PC) FORMATION PRODUCTION FORMULA IS:

$$Q_{pc} = Q_{pci} \times e^{\{-(D_{pc}) \times (t)\}}$$

WHERE:  $Q_{pci}$  = INITIAL PC MONTHLY FLOW RATE (CALCULATED FROM FLOW TEST)  
 $D_{pc}$  = PICTURED CLIFFS MONTHLY DECLINE RATE CALCULATED FROM:  
 $D_{pc} = (Q_{pci} - Q_{pcabd}) / N_{p(pc)}$   
See Determination of  $Q_{pci}$  and PC Estimated Ultimate Recovery ( $N_{p(pc)}$ )  
 $Q_{pcabd} = 300 \text{ MCF/M}$

WHERE:  $N_{p(pc)}$  = PICTURED CLIFFS ESTIMATED ULTIMATE RECOVERY (EUR)  
 $N_{p(pc)} = P \times 0.81 \text{ MMCF/PSI}^{**} \times R_f$   
 $P^*$  = INITIAL RESERVOIR PRESSURE (SIBHP)  
 $R_f$  = RECOVERY (FIELD ANALOGY): = 0.95  
 $**$  DETERMINED FROM MATERIAL BALANCE (FIELD ANALOGY) AND VOLUMETRIC RESERVES (LOG ANALYSIS)

By calculating  $N_{p(pc)}$  from SIBHP and determining  $Q_{pci}$ ,  $D_{pc}$  can then be calculated utilizing the previously described parameters. See derivation of  $D_{pc}$ , item (c) on page 4.

THUS:  $Q_{ftc} = Q_t - Q_{pci} \times e^{\{-(D_{pc}) \times (t)\}}$   
WHERE: (t) IS IN MONTHS

REFERENCE: Thompson, R. S., and Wright, J. D., "Oil Property Evaluation", pages 5-2, 5-3, 5-4.

# **SAN JUAN 28-5 UNIT #228**

In order to facilitate an economic Pictured Cliffs completion three requirements must be met. It is the combination of these three requirements that determines the economic status and completion method (PC single completion, PC-FTC Dual, PC-FTC commingle) utilized. In some cases the Pictured Cliffs formation may be economic as a stand alone or dual completion. The Fruitland Coal, however, fails to meet economic criteria in all cases except commingling. These three requirements are as follows:

**RESERVES  $N_p(pc)$**

**FLOW RATE ( $Q_{pci}$ )**

**COSTS (Investment and Operating)**

Shown in the following example are the parameters and calculations used to determine Pictured Cliffs initial rate ( $Q_{pci}$ ), Pictured Cliffs Estimated Ultimate Recovery ( $N_p(pc)$ ), and Pictured Cliffs decline rate ( $D_{pc}$ ). Additionally, estimated costs associated with each completion method and economic sensitivities (figures 1-3) are attached to show the effects of PC reserves ( $N_p(pc)$ ), initial PC rates ( $Q_{pci}$ ), and completion method (costs).

The monthly gas production allocation formula presented is similar to the allocation formula presented by Meridian Oil in previous commingle hearings.

# **SAN JUAN 28-5 UNIT #228**

## **DETERMINATION OF $Q_{pci}$ : (INITIAL PICTURED CLIFFS MONTHLY PRODUCTION)**

$$Q_{pci} = Q_{t(1)} \times Q_{pc(p)} / \{Q_{pc(p)} + Q_{ftc(p)}\}$$

### **WHERE:**

**$Q_{t(1)}$  = FIRST MONTH TOTAL PRODUCTION (MCF)**

**$Q_{pc(p)}$  = FINAL PICTURED CLIFFS FLOW TEST (MCFPD)**

**$Q_{ftc(p)}$  = FINAL FRUITLAND COAL FLOW TEST (MCFPD)**

# SAN JUAN 28-5 UNIT #228

## EXAMPLE DETERMINATION OF:

(a)  $N_p(pc)$

(b)  $Q_{pci}$

(c)  $D_{pc}$

PC EUR

INITIAL PC MONTHLY FLOW RATE

PC MONTHLY DECLINE RATE

### (a) DETERMINATION OF $N_p(pc)$

(see page 5 for  $N_p(pc)$  derivation)

$$N_p(pc) = 0.81 \text{ (MMCF/PSI)} \times P^* \text{ (PSI)} \times R_f$$

$$P^* = 1090 \text{ PSI (FROM SIBHP)}$$

$$N_p(pc) = 0.81 \text{ MMCF/PSI} \times 1090 \text{ PSI} \times 0.95$$

$$\underline{N_p(pc) = 834 \text{ MMCF}}$$

### (b) DETERMINATION OF $Q_{pci}$

$$Q_{pci} = Q_t(1) \times \{Q_{pc}(p) / (Q_{pc}(p) + Q_{ftc}(p))\}$$

$$Q_t(1) = 15,000 \text{ MCF}$$

$$Q_{pc}(p) = 500 \text{ MCF/D}$$

$$Q_{ftc}(p) = 400 \text{ MCF/D}$$

1ST MONTH TOTAL PRODUCTION

PC FLOW TEST

FTC FLOW TEST

$$Q_{pci} = 15,000 \text{ MCF/M} \times \{500 \text{ MCF/D} / (500 \text{ MCF/D} + 400 \text{ MCF/D})\}$$

$$\underline{Q_{pci} = 8,333 \text{ MCF/M}}$$

### (c) DETERMINATION OF $D_{pc}$

$$D_{pc} = (Q_{pci} - Q_{pcabd}) / N_p(pc)$$

$$Q_{pcabd} = 300 \text{ MCF/M}$$

$$D_{pc} = (8,333 \text{ MCF/M} - 300 \text{ MCF/M}) / (834,000 \text{ MCF})$$

$$\underline{D_{pc} = 0.0096/M}$$

$$\underline{\text{THUS: } Q_{ftc} = Q_t(\text{MCF/M}) - 8,333(\text{MCF/M}) \times e^{\{-(0.0096(1/M))\}} \times t(M)\}$$



# SAN JUAN 28-5 UNIT #228

<b>A.</b>	<b>DETERMINATION OF PC RESERVES <math>N_p(pc) = (HCPV \times B_g \times R_f)</math></b>			
	<b>Volumetric Evaluation (averages are for subject 160 acre drill block)</b>			
a.	(t)	thickness	=	23.0 ft
b.	(phi)	porosity	=	14.0 %
c.	(Sw)	H2O saturation	=	44.0 %
d.	(Rf)	Recovery Factor	=	95.0 %
e.	(rcf)	Reservoir Cubic Feet	@ reservoir conditions	
f.	(scf)	Standard Cubic Feet	@ standard conditions	

1. **HCPV = HYDROCARBON PORE VOLUME (rcf)**

$$= t \text{ (ft)} \times a \text{ (ft}^2\text{)} \times \phi \times (1-S_w)$$

$$= 23 \text{ (ft)} \times 160 \text{ (acres)} \times 43,560 \text{ (ft}^2\text{/acre)} \times 0.14 \times (1-0.44)$$

$$= 12,328,800 \text{ ft}^3 \quad 1 \text{ mmrcf} = 1,000,000 \text{ ft}^3$$

**HCPV = 12.329 mmrcf**

2.  **$B_g$  = FORMATION VOLUME FACTOR (scf/rcf)**

UTILIZING THE REAL GAS LAW TO DETERMINE THE FORMATION VOLUME FACTOR ( $B_g$ ):

REAL GAS LAW states:

$$P V = Z n R T$$

Rearranging to solve for n:

$$n = P V / Z R T$$

assuming:

$$n_r = n_s$$

WHERE:  **$n_r$  = NUMBER OF MOLES OF GAS AT RESERVOIR CONDITION**

**$n_s$  = NUMBER OF MOLES OF GAS AT SURFACE CONDITIONS**

THUS:  $\frac{P_r V_r}{Z_r T_r R} = \frac{P_s V_s}{Z_s T_s R}$

Rearranging:  $\frac{V_s}{V_r} = \frac{B_g}{Z_s T_s P_r / Z_r T_r P_s}$

assuming:

$$\begin{aligned} Z_s &= 1.00 \\ Z_r &= 0.94 \\ T_s &= 60 \text{ } ^\circ\text{F} \quad \text{or } 520 \text{ } ^\circ\text{R} \\ T_r &= 100 \text{ } ^\circ\text{F} \quad \text{or } 560 \text{ } ^\circ\text{R} \\ P_s &= 15.025 \text{ psia} \\ P_r &= \text{Determined from build-up test} \end{aligned}$$

$$\begin{aligned} B_g &= \text{FORMATION VOLUME FACTOR (scf/rcf)} = \frac{Z_s T_s P_r}{Z_r T_r P_s} \\ &= (\text{scf/rcf}) \{1.00 \times 520 \text{ (} ^\circ\text{R)} \times P_r \text{ (psia)}\} / \{0.94 \times 560 \text{ (} ^\circ\text{R)} \times 15.025 \text{ (psia)}\} \\ \underline{B_g} &= \underline{0.0657 \text{ \{scf/ (rcf psia)\} } \times P_r \text{ (psia)}} \end{aligned}$$

3. **EUR = HCPV  $\times B_g \times R_f$**

$$= 12.329 \text{ (mmrcf)} \times 0.0657 \text{ \{scf/(rcf psia)\} } \times P_r \text{ (psia)} \times 0.95$$

**$N_p(pc) = 0.81 \text{ (mmscf/psia)} \times P_r \text{ (psia)} \times 0.95$**

# **SAN JUAN 28-5 UNIT #228**

## **B. PICTURED CLIFFS DRILLING /COMPLETION COST SUMMARY**

### **1. STAND ALONE SINGLE PC COMPLETION**

<b>ESTIMATED COSTS:</b>	<b>TANGIBLE (M\$)</b>	<b>INTANGIBLE (M\$)</b>	<b>TOTAL (M\$)</b>
	<b>115.00</b>	<b>209.75</b>	<b>324.75</b>

### **2. FTC/PC DUAL COMPLETION\***

<b>ESTIMATED COSTS:</b>	<b>TANGIBLE (M\$)</b>	<b>INTANGIBLE (M\$)</b>	<b>TOTAL (M\$)</b>
	<b>127.20</b>	<b>144.34</b>	<b>271.54</b>

### **3. FTC/PC COMMINGLE COMPLETION\***

<b>ESTIMATED COSTS:</b>	<b>TANGIBLE (M\$)</b>	<b>INTANGIBLE (M\$)</b>	<b>TOTAL (M\$)</b>
	<b>58.90</b>	<b>141.45</b>	<b>200.35</b>

**\*PICTURED CLIFFS COSTS ONLY**

## **C. ECONOMIC SUMMARY**

**THE FIGURE INCLUDED DEPICTS RESERVES (EUR) VS INITIAL RATE (MC**

**THREE CASES PER FIGURE (FTC/PC COMMINGLE, FTC/PC DUAL, PC SINGLE) @ 15 % ROR**

# **SAN JUAN 28-5 UNIT #228**

## **Expected Reservoir Pressures**

Pictured Cliffs - Average of the closest PC completions is 1090 psi SICP (pressures range from 1017 psi to 1065 psi). All of the completions are within 4 miles of the subject location. The initial pressure at the subject location is expected to be the offsetting PC average of 1090 psi.

Fruitland Coal - Average of the closest FTC completions is 1070 psi SICP (pressures range from 635 to 1459 psi). All of the completions are within 4-5 miles of the subject location. The pressure at the subject location is expected to be the offset FTC average of 1070 psi.

**PC - 1090 psi, FTC - 1070 psi. Within limits of pressure requirements for commingling.**

## **Fluid Compatibility**

Neither producing formation makes oil or water in existing wells in the area. Both formations are very dry gas producers and no fluid production is anticipated in this well.

**PC - dry gas production , FTC - dry gas production. Only natural gas will be produced so fluids are compatible.**

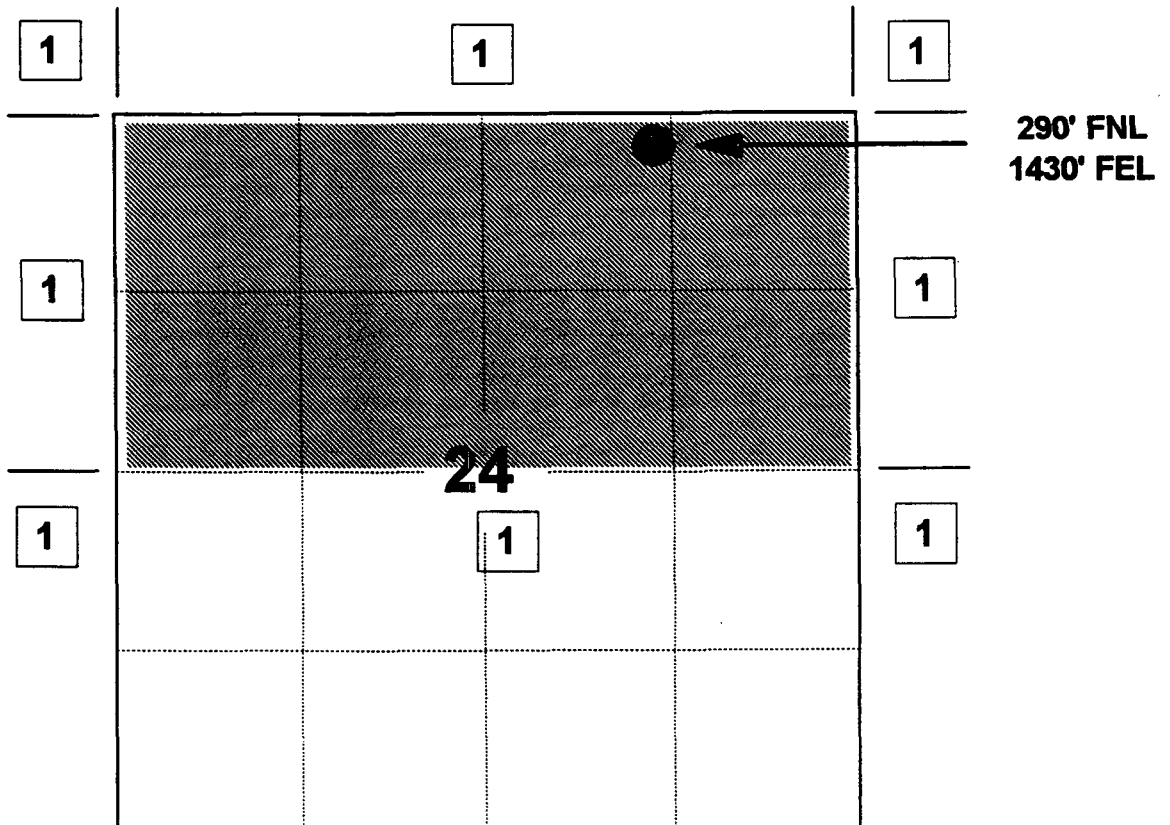
# MERIDIAN OIL INC

## SAN JUAN 28-5 UNIT #228

OFFSET OPERATOR \ OWNER PLAT

Fruitland Coal / Pictured Cliffs Formations Commingle

Township 28 North, Range 05 West



1) Meridian Oil Inc

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