Revised March 23, 2017

| RECEIVED: | REVIEWER: | TYPE: | APP NO: |
|---|---|---|---|
| 7-21-2017 | | DHC | pMAM1720235113 |

ABOVE THIS TABLE FOR OCD DIVISION USE ONLY

**NEW MEXICO OIL CONSERVATION DIVISION**
- Geological & Engineering Bureau –
1220 South St. Francis Drive, Santa Fe, NM 87505

## ADMINISTRATIVE APPLICATION CHECKLIST

THIS CHECKLIST IS MANDATORY FOR ALL ADMINISTRATIVE APPLICATIONS FOR EXCEPTIONS TO DIVISION RULES AND REGULATIONS WHICH REQUIRE PROCESSING AT THE DIVISION LEVEL IN SANTA FE

**Applicant:** Cimarex Energy Co. Of Colorado **OGRID Number:** 162683
**Well Name:** White City 31 Federal #2 **API:** 30-015-33394
**Pool:** White City; Penn (Gas), Purple Sage, Wolfcamp (Gas) **Pool Code:** 87280, 98220

**SUBMIT ACCURATE AND COMPLETE INFORMATION REQUIRED TO PROCESS THE TYPE OF APPLICATION INDICATED BELOW**

DHC-4804-A

1) **TYPE OF APPLICATION:** Check those which apply for [A]
A. Location – Spacing Unit – Simultaneous Dedication
☐NSL ☐NSP(PROJECT AREA) ☐NSP(PRORATION UNIT) ☐SD

B. Check one only for [I] or [II]
[I] Commingling – Storage – Measurement
☒DHC ☐CTB ☐PLC ☐PC ☐OLS ☐OLM
[II] Injection – Disposal – Pressure Increase – Enhanced Oil Recovery
☐WFX ☐PMX ☐SWD ☐IPI ☐EOR ☐PPR

**FOR OCD ONLY**
☐ Notice Complete
☐ Application Content Complete

2) **NOTIFICATION REQUIRED TO:** Check those which apply.
A. ☐ Offset operators or lease holders
B. ☐ Royalty, overriding royalty owners, revenue owners
C. ☐ Application requires published notice
D. ☐ Notification and/or concurrent approval by SLO
E. ☒ Notification and/or concurrent approval by BLM
F. ☐ Surface owner
G. ☐ For all of the above, proof of notification or publication is attached, and/or,
H. ☐ No notice required

3) **CERTIFICATION:** I hereby certify that the information submitted with this application for administrative approval is **accurate** and **complete** to the best of my knowledge. I also understand that **no action** will be taken on this application until the required information and notifications are submitted to the Division.

**Note: Statement must be completed by an individual with managerial and/or supervisory capacity.**

Amithy Crawford
Print or Type Name

Amithy Crawford
Signature

7/21/2017
Date

432-620-1909
Phone Number

acrawford@cimarex.com
e-mail Address

Cimarex Energy Co.

202 S. Cheyenne Ave.

Suite 1000

Tulsa, Oklahoma 74103-4346

PHONE: 918.585.1100

FAX: 918.585.1133

CIMAREX

Michael McMillian
Oil Conservation Division
New Mexico Department of Energy,
Minerals and Natural Resources
1220 South Saint Francis Drive
Santa Fe, New Mexico 87505

Re: White City 31 Federal 2
API 30-015-33394
Section 31, Township 24 South, Range 26 East, N.M.P.M.
Eddy County, New Mexico.

Dear Mr. McMillian:

The White City 31 Federal 2 well is located in the SW/4 of Sec. 31, 24S, 26E, Eddy County NM.

Cimarex is the operator of the SW/4 of Sec. 31, 24S, 26E, Eddy County, NM as to all depths from the surface of the Earth down to 12,036'. Ownership within these depths in the SW/4 are identical.

Sincerely,

Caitlin Pierce
Production Landman
cpierce@cimarex.com
Direct: 432-571-7862

*Cimarex Energy Company*
*White City 31 Fed #2*

# Completion Profiler

# Completion Profile Analysis



| | |
|---|---|
| *Company* | *Cimarex Energy Company* |
| *Well Name* | *White City 31 Fed #2* |
| *Field* | *White City* |
| *Location* | *Eddy County, New Mexico* |
| *Customer Name* | *Mike Karner* |
| *Date of Survey* | *June 7, 2017* |
| *Date of Analysis* | *June 9, 2017* |
| *Logging Engineer* | *Tyler Nixon* |
| *Analyst* | *Derrick George* |

# Table of Contents

## *Survey Objectives*

- Identify gas producing intervals.
- Identify oil producing intervals.
- Identify the source of water production.
- Quantitative production profile.

## *Logging Procedures*

| Date | Time | Comment |
|---|---|---|
| 06/07 | 07:30 | Arrive on location |
| 06/07 | 10:20 | Gauge run start |
| 06/07 | 11:40 | Gauge run stop |
| 06/07 | 12:53 | Program Completion Profile String |
| 06/07 | 13:10 | Start GIH pass |
| 06/07 | 13:53 | Stop GIH pass |
| 06/07 | 14:14 | Start logging passes |
| 06/07 | 17:18 | Stop logging passes |
| 06/07 | 17:19 | Start out of well pass |
| 06/07 | 17:48 | Stop out of well pass |
| 06/07 | 18:04 | Start download |
| 06/07 | 18:23 | Stop download |
| 06/07 | 19:30 | Rig down |

Interval Logged: [From 8,387 to 10,087 ft.]
30 ft/min
60 ft/min
90 ft/min

## *Well Information*

Casing: 5.500" 17.0 lb/ft surface to 12,150 ft PBTD: 10,369 ft

Tubing: 2.875" 6.5 lb/ft surface to 8,332 ft

Perforations:

| Perforation Data | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stage 5 - Wolfcamp** | | | | | | | | | | | | | | | | | | | | | | | |
| 8,458 | to | 8,459 | 8,471 | to | 8,472 | 8,475 | to | 8,476 | 8,482 | to | 8,483 | 8,492 | to | 8,493 |
| 8,504 | to | 8,505 | 8,512 | to | 8,513 | 8,520 | to | 8,521 | 8,528 | to | 8,529 | 8,539 | to | 8,540 |
| 8,550 | to | 8,551 | 8,558 | to | 8,559 | 8,565 | to | 8,566 | 8,570 | to | 8,571 | 8,585 | to | 8,586 |
| 8,597 | to | 8,598 | 8,617 | to | 8,618 | 8,630 | to | 8,632 | 8,636 | to | 8,638 | 8,646 | to | 8,649 |
| **Stage 4 - Wolfcamp** | | | | | | | | | | | | | | | | | | | | | | | |
| 9,058 | to | 9,059 | 9,071 | to | 9,072 | 9,084 | to | 9,085 | 9,095 | to | 9,096 | 9,103 | to | 9,104 |
| 9,113 | to | 9,114 | 9,129 | to | 9,130 | 9,140 | to | 9,141 | 9,150 | to | 9,151 | 9,163 | to | 9,164 |
| 9,170 | to | 9,171 | 9,180 | to | 9,181 | 9,193 | to | 9,194 | 9,204 | to | 9,205 | 9,220 | to | 9,221 |
| 9,230 | to | 9,231 | 9,241 | to | 9,242 | 9,250 | to | 9,252 | 9,258 | to | 9,260 | 9,272 | to | 9,275 |
| **Stage 3 - Wolfcamp** | | | | | | | | | | | | | | | | | | | | | | | |
| 9,301 | to | 9,302 | 9,311 | to | 9,312 | 9,318 | to | 9,319 | 9,329 | to | 9,330 | 9,341 | to | 9,342 |
| 9,351 | to | 9,352 | 9,369 | to | 9,370 | 9,385 | to | 9,386 | 9,395 | to | 9,396 | 9,401 | to | 9,402 |
| 9,412 | to | 9,413 | 9,423 | to | 9,424 | 9,433 | to | 9,434 | 9,446 | to | 9,447 | 9,458 | to | 9,459 |
| 9,472 | to | 9,473 | 9,496 | to | 9,497 | 9,506 | to | 9,508 | 9,514 | to | 9,516 | 9,538 | to | 9,541 |
| **Stage 2 - Wolfcamp** | | | | | | | | | | | | | | | | | | | | | | | |
| 9,691 | to | 9,692 | 9,699 | to | 9,700 | 9,708 | to | 9,709 | 9,717 | to | 9,718 | 9,732 | to | 9,733 |
| 9,739 | to | 9,740 | 9,749 | to | 9,750 | 9,766 | to | 9,767 | 9,778 | to | 9,779 | 9,788 | to | 9,789 |
| 9,799 | to | 9,800 | 9,813 | to | 9,814 | 9,831 | to | 9,832 | 9,849 | to | 9,850 | 9,862 | to | 9,863 |
| 9,877 | to | 9,878 | 9,888 | to | 9,889 | 9,899 | to | 9,901 | 9,913 | to | 9,915 | 9,936 | to | 9,939 |
| **Stage 1 - Cisco Canyon** | | | | | | | | | | | | | | | | | | | | | | | |
| 9,967 | to | 9,968 | 9,984 | to | 9,985 | 10,000 | to | 10,001 | 10,014 | to | 10,015 | 10,026 | to | 10,027 |
| 10,035 | to | 10,036 | 10,043 | to | 10,044 | 10,050 | to | 10,051 | 10,066 | to | 10,067 | 10,076 | to | 10,077 |
| 10,083 | to | 10,084 | 10,095 | to | 10,096 | 10,107 | to | 10,108 | 10,116 | to | 10,117 | 10,126 | to | 10,127 |
| 10,136 | to | 10,137 | 10,150 | to | 10,151 | 10,164 | to | 10,166 | 10,170 | to | 10,172 | 10,181 | to | 10,184 |

## *Tool String*

The 1 11/16" Completion Profiler string comprised the following sensors:

Battery housing; RS-232/CCL; Memory/CPU; Gamma Ray; Pressure/Temperature Combo; Centralizer; Induction Collar Locator; Fluid Density; Fluid Dielectric; Centralizer; Spinner Flowmeter.

## *Results*

The following table summarizes the production from each frac stage.

| MEASURED SURFACE RATES<br>Flow Rates Reported at STP | | | | |
|---|---|---|---|---|
| | Tubing | Gas | Oil | Water |
| | Psi | MCFD | BFPD | BFPD |
| Avg | 640 psi | 220 Mcf/d | 120 bpd | 922 bpd |

| GAS / OIL / WATER PRODUCTION PROFILE<br>Flow Rates Reported at STP | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Zone Intervals | Q-Gas | Qp-Gas | Percent | Q-Oil | Qp-Oil | Percent | Q-Water | Qp-Water | Percent |
| feet | MCFD | MCFD | of Total | BFPD | BFPD | of Total | BFPD | BFPD | of Total |
| Surface to 8458 | 2026.0 Mcf/d | . | 100.00 % | 120.22 bpd | | 100.00 % | 904.18 bpd | . | 100.00 % |
| Stage 5 - Wolfcamp | | | 41.59 % | | | 41.59 % | | | 68.24 % |
| 8458 to 8649 | 2026.0 Mcf/d | 842.7 Mcf/d | | 120.22 bpd | 50.00 bpd | | 904.18 bpd | 617.02 bpd | |
| Stage 4 - Wolfcamp | | | 3.57 % | | | 3.57 % | | | 12.98 % |
| 9058 to 9275 | 1183.3 Mcf/d | 72.3 Mcf/d | | 70.22 bpd | 4.29 bpd | | 287.15 bpd | 117.40 bpd | |
| Stage 3 - Wolfcamp | | | 11.33 % | | | 11.33 % | | | 7.57 % |
| 9301 to 9541 | 1111.0 Mcf/d | 229.6 Mcf/d | | 65.92 bpd | 13.62 bpd | | 169.75 bpd | 68.40 bpd | |
| Stage 2 - Wolfcamp | | | 33.63 % | | | 33.63 % | | | 7.04 % |
| 9691 to 9939 | 881.4 Mcf/d | 681.3 Mcf/d | | 52.30 bpd | 40.43 bpd | | 101.36 bpd | 63.62 bpd | |
| Stage 1 - Cisco Canyon | | | 8.73 % | | | 8.73 % | | | 3.52 % |
| 9967 to 10084 | 200.1 Mcf/d | 176.8 Mcf/d | | 11.87 bpd | 10.49 bpd | | 37.74 bpd | 31.84 bpd | |
| Flow Contribution from Below Log Depth | | | 1.15 % | | | 1.15 % | | | 0.65 % |
| 10087 to Below | 23.3 Mcf/d | | 1.15 % | 1.38 bpd | | 1.15 % | 5.90 bpd | | 0.65 % |

The following table summarizes the production from each producing interval.

| GAS / OIL / WATER PRODUCTION PROFILE<br>Flow Rates Reported at STP | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Zone Intervals feet | Q-Gas MCFD | Qp-Gas MCFD | Percent of Total | Q-Oil BFPD | Qp-Oil BFPD | Percent of Total | Q-Water BFPD | Qp-Water BFPD | Percent of Total |
| | | | | | | | | | |
| **Surface to 8458** | 2026.0 Mcf/d | | 100.00 % | 120.22 bpd | | 100.00 % | 904.18 bpd | | 100.00 % |
| | | | | | | | | | |
| **Stage 5 - Wolfcamp** | | | 41.59 % | | | 41.59 % | | | 68.24 % |
| **8458 to 8459** | 2026.0 Mcf/d | 19.5 Mcf/d | 0.96 % | 120.22 bpd | 1.15 bpd | 0.96 % | 904.18 bpd | 28.55 bpd | 3.16 % |
| **8471 to 8472** | 2006.5 Mcf/d | 13.0 Mcf/d | 0.64 % | 119.06 bpd | 0.77 bpd | 0.64 % | 875.63 bpd | 6.59 bpd | 0.73 % |
| **8475 to 8476** | 1993.5 Mcf/d | 4.3 Mcf/d | 0.21 % | 118.29 bpd | 0.25 bpd | 0.21 % | 869.04 bpd | 4.39 bpd | 0.49 % |
| **8482 to 8483** | 1989.3 Mcf/d | 177.4 Mcf/d | 8.76 % | 118.04 bpd | 10.53 bpd | 8.76 % | 864.65 bpd | 166.88 bpd | 18.46 % |
| **8492 to 8493** | 1811.9 Mcf/d | 140.8 Mcf/d | 6.95 % | 107.51 bpd | 8.36 bpd | 6.95 % | 697.77 bpd | 24.15 bpd | 2.67 % |
| **8504 to 8505** | 1671.0 Mcf/d | 3.4 Mcf/d | 0.17 % | 99.16 bpd | 0.20 bpd | 0.17 % | 673.62 bpd | 10.98 bpd | 1.21 % |
| **8512 to 8513** | 1667.7 Mcf/d | 0.8 Mcf/d | 0.04 % | 98.96 bpd | 0.05 bpd | 0.04 % | 662.64 bpd | 10.98 bpd | 1.21 % |
| **8520 to 8521** | 1666.9 Mcf/d | 2.0 Mcf/d | 0.10 % | 98.91 bpd | 0.12 bpd | 0.10 % | 651.66 bpd | 10.98 bpd | 1.21 % |
| **8528 to 8529** | 1664.9 Mcf/d | 55.2 Mcf/d | 2.72 % | 98.79 bpd | 3.27 bpd | 2.72 % | 640.68 bpd | 57.09 bpd | 6.31 % |
| **8539 to 8540** | 1609.8 Mcf/d | 324.5 Mcf/d | 16.02 % | 95.52 bpd | 19.25 bpd | 16.02 % | 583.59 bpd | 136.14 bpd | 15.06 % |
| **8550 to 8551** | 1285.3 Mcf/d | 85.8 Mcf/d | 4.24 % | 76.26 bpd | 5.09 bpd | 4.24 % | 447.45 bpd | 79.05 bpd | 8.74 % |
| **8558 to 8559** | 1199.4 Mcf/d | 1.8 Mcf/d | 0.09 % | 71.17 bpd | 0.10 bpd | 0.09 % | 368.40 bpd | 15.37 bpd | 1.70 % |
| **8565 to 8566** | 1197.7 Mcf/d | 1.8 Mcf/d | 0.09 % | 71.07 bpd | 0.11 bpd | 0.09 % | 353.03 bpd | 2.20 bpd | 0.24 % |
| **8570 to 8571** | 1195.9 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.96 bpd | 0.11 bpd | 0.09 % | 350.83 bpd | 8.78 bpd | 0.97 % |
| **8585 to 8586** | 1194.1 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.85 bpd | 0.11 bpd | 0.09 % | 342.05 bpd | 4.39 bpd | 0.49 % |
| **8597 to 8598** | 1192.3 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.75 bpd | 0.11 bpd | 0.09 % | 337.65 bpd | 4.39 bpd | 0.49 % |
| **8617 to 8618** | 1190.5 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.64 bpd | 0.11 bpd | 0.09 % | 333.26 bpd | 13.18 bpd | 1.46 % |
| **8630 to 8632** | 1188.7 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.53 bpd | 0.11 bpd | 0.09 % | 320.09 bpd | 4.39 bpd | 0.49 % |
| **8636 to 8638** | 1186.9 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.43 bpd | 0.11 bpd | 0.09 % | 315.70 bpd | 13.18 bpd | 1.46 % |
| **8646 to 8649** | 1185.1 Mcf/d | 1.8 Mcf/d | 0.09 % | 70.32 bpd | 0.11 bpd | 0.09 % | 302.52 bpd | 15.37 bpd | 1.70 % |
| | | | | | | | | | |
| **Stage 4 - Wolfcamp** | | | 3.57 % | | | 3.57 % | | | 12.99 % |
| **9058 to 9059** | 1183.3 Mcf/d | 11.0 Mcf/d | 0.54 % | 70.22 bpd | 0.65 bpd | 0.54 % | 287.15 bpd | 20.78 bpd | 2.30 % |
| **9071 to 9072** | 1172.4 Mcf/d | 1.8 Mcf/d | 0.09 % | 69.57 bpd | 0.11 bpd | 0.09 % | 266.37 bpd | 4.13 bpd | 0.46 % |
| **9084 to 9085** | 1170.6 Mcf/d | 1.8 Mcf/d | 0.09 % | 69.46 bpd | 0.10 bpd | 0.09 % | 262.24 bpd | 1.77 bpd | 0.20 % |
| **9095 to 9096** | 1168.8 Mcf/d | 1.8 Mcf/d | 0.09 % | 69.35 bpd | 0.11 bpd | 0.09 % | 260.48 bpd | 1.77 bpd | 0.20 % |
| **9103 to 9104** | 1167.0 Mcf/d | 20.0 Mcf/d | 0.99 % | 69.25 bpd | 1.19 bpd | 0.99 % | 258.71 bpd | 2.36 bpd | 0.26 % |
| **9113 to 9114** | 1147.0 Mcf/d | 1.8 Mcf/d | 0.09 % | 68.06 bpd | 0.10 bpd | 0.09 % | 256.35 bpd | 16.29 bpd | 1.80 % |
| **9129 to 9130** | 1145.3 Mcf/d | 1.8 Mcf/d | 0.09 % | 67.96 bpd | 0.11 bpd | 0.09 % | 240.06 bpd | 3.54 bpd | 0.39 % |
| **9140 to 9141** | 1143.5 Mcf/d | 1.8 Mcf/d | 0.09 % | 67.85 bpd | 0.11 bpd | 0.09 % | 236.52 bpd | 2.95 bpd | 0.33 % |
| **9150 to 9151** | 1141.7 Mcf/d | 10.9 Mcf/d | 0.54 % | 67.75 bpd | 0.65 bpd | 0.54 % | 233.58 bpd | 21.96 bpd | 2.43 % |
| **9163 to 9164** | 1130.8 Mcf/d | 1.8 Mcf/d | 0.09 % | 67.10 bpd | 0.11 bpd | 0.09 % | 211.62 bpd | 7.08 bpd | 0.78 % |
| **9170 to 9171** | 1129.0 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.99 bpd | 0.10 bpd | 0.09 % | 204.54 bpd | 5.31 bpd | 0.59 % |
| **9180 to 9181** | 1127.3 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.89 bpd | 0.11 bpd | 0.09 % | 199.24 bpd | 6.49 bpd | 0.72 % |
| **9193 to 9194** | 1125.5 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.78 bpd | 0.11 bpd | 0.09 % | 192.75 bpd | 4.72 bpd | 0.52 % |
| **9204 to 9205** | 1123.6 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.67 bpd | 0.11 bpd | 0.09 % | 188.03 bpd | 2.36 bpd | 0.26 % |
| **9220 to 9221** | 1121.8 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.57 bpd | 0.10 bpd | 0.09 % | 185.67 bpd | 2.95 bpd | 0.33 % |
| **9230 to 9231** | 1120.1 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.46 bpd | 0.11 bpd | 0.09 % | 182.73 bpd | 1.77 bpd | 0.20 % |
| **9241 to 9242** | 1118.2 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.35 bpd | 0.11 bpd | 0.09 % | 180.96 bpd | 2.36 bpd | 0.26 % |
| **9250 to 9252** | 1116.4 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.25 bpd | 0.11 bpd | 0.09 % | 178.60 bpd | 1.77 bpd | 0.20 % |
| **9258 to 9260** | 1114.6 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.14 bpd | 0.11 bpd | 0.09 % | 176.83 bpd | 2.36 bpd | 0.26 % |
| **9272 to 9275** | 1112.8 Mcf/d | 1.8 Mcf/d | 0.09 % | 66.03 bpd | 0.11 bpd | 0.09 % | 174.47 bpd | 4.72 bpd | 0.52 % |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage 3 - Wolfcamp | | | | | 11.33 % | | | 11.33 % | | | 7.57 % |
| 9301 | to 9302 | 1111.0 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.92 bpd | 0.11 bpd | 0.09 % | 169.75 bpd | 3.54 bpd | 0.39 % | |
| 9311 | to 9312 | 1109.2 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.82 bpd | 0.11 bpd | 0.09 % | 166.22 bpd | 3.54 bpd | 0.39 % | |
| 9318 | to 9319 | 1107.4 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.71 bpd | 0.10 bpd | 0.09 % | 162.68 bpd | 3.54 bpd | 0.39 % | |
| 9329 | to 9330 | 1105.6 Mcf/d | 1.7 Mcf/d | 0.09 % | 65.61 bpd | 0.10 bpd | 0.09 % | 159.14 bpd | 4.72 bpd | 0.52 % | |
| 9341 | to 9342 | 1103.9 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.50 bpd | 0.11 bpd | 0.09 % | 154.42 bpd | 3.54 bpd | 0.39 % | |
| 9351 | to 9352 | 1102.1 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.40 bpd | 0.10 bpd | 0.09 % | 150.89 bpd | 4.72 bpd | 0.52 % | |
| 9369 | to 9370 | 1100.4 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.29 bpd | 0.11 bpd | 0.09 % | 146.17 bpd | 4.13 bpd | 0.46 % | |
| 9385 | to 9386 | 1098.5 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.18 bpd | 0.11 bpd | 0.09 % | 142.04 bpd | 2.36 bpd | 0.26 % | |
| 9395 | to 9396 | 1096.7 Mcf/d | 1.8 Mcf/d | 0.09 % | 65.08 bpd | 0.11 bpd | 0.09 % | 139.68 bpd | 2.36 bpd | 0.26 % | |
| 9401 | to 9402 | 1094.9 Mcf/d | 1.8 Mcf/d | 0.09 % | 64.97 bpd | 0.10 bpd | 0.09 % | 137.32 bpd | 2.36 bpd | 0.26 % | |
| 9412 | to 9413 | 1093.2 Mcf/d | 1.8 Mcf/d | 0.09 % | 64.87 bpd | 0.11 bpd | 0.09 % | 134.97 bpd | 7.08 bpd | 0.78 % | |
| 9423 | to 9424 | 1091.3 Mcf/d | 1.1 Mcf/d | 0.05 % | 64.76 bpd | 0.07 bpd | 0.05 % | 127.89 bpd | 2.36 bpd | 0.26 % | |
| 9433 | to 9434 | 1090.2 Mcf/d | 0.7 Mcf/d | 0.04 % | 64.69 bpd | 0.04 bpd | 0.04 % | 125.53 bpd | 3.54 bpd | 0.39 % | |
| 9446 | to 9447 | 1089.5 Mcf/d | 116.3 Mcf/d | 5.74 % | 64.65 bpd | 6.90 bpd | 5.74 % | 121.99 bpd | 4.13 bpd | 0.46 % | |
| 9458 | to 9459 | 973.2 Mcf/d | 6.1 Mcf/d | 0.30 % | 57.75 bpd | 0.36 bpd | 0.30 % | 117.87 bpd | 4.72 bpd | 0.52 % | |
| 9472 | to 9473 | 967.1 Mcf/d | 49.0 Mcf/d | 2.42 % | 57.39 bpd | 2.91 bpd | 2.42 % | 113.15 bpd | 4.72 bpd | 0.52 % | |
| 9496 | to 9497 | 918.1 Mcf/d | 6.3 Mcf/d | 0.31 % | 54.48 bpd | 0.37 bpd | 0.31 % | 108.43 bpd | 1.77 bpd | 0.20 % | |
| 9506 | to 9508 | 911.8 Mcf/d | 6.2 Mcf/d | 0.31 % | 54.11 bpd | 0.37 bpd | 0.31 % | 106.66 bpd | 1.18 bpd | 0.13 % | |
| 9514 | to 9516 | 905.7 Mcf/d | 18.7 Mcf/d | 0.92 % | 53.74 bpd | 1.11 bpd | 0.92 % | 105.48 bpd | 2.36 bpd | 0.26 % | |
| 9538 | to 9541 | 886.9 Mcf/d | 5.5 Mcf/d | 0.27 % | 52.63 bpd | 0.33 bpd | 0.27 % | 103.13 bpd | 1.77 bpd | 0.20 % | |
| | | | | | | | | | | | |
| Stage 2 - Wolfcamp | | | | | 33.63 % | | | 33.63 % | | | 7.04 % |
| 9691 | to 9692 | 881.4 Mcf/d | 66.6 Mcf/d | 3.29 % | 52.30 bpd | 3.95 bpd | 3.29 % | 101.36 bpd | 8.25 bpd | 0.91 % | |
| 9699 | to 9700 | 814.8 Mcf/d | 26.6 Mcf/d | 1.32 % | 48.35 bpd | 1.58 bpd | 1.32 % | 93.10 bpd | 7.08 bpd | 0.78 % | |
| 9708 | to 9709 | 788.2 Mcf/d | 17.8 Mcf/d | 0.88 % | 46.77 bpd | 1.05 bpd | 0.88 % | 86.03 bpd | 2.95 bpd | 0.33 % | |
| 9717 | to 9718 | 770.4 Mcf/d | 64.4 Mcf/d | 3.18 % | 45.72 bpd | 3.82 bpd | 3.18 % | 83.08 bpd | 7.61 bpd | 0.84 % | |
| 9732 | to 9733 | 706.1 Mcf/d | 15.9 Mcf/d | 0.79 % | 41.90 bpd | 1.05 bpd | 0.88 % | 75.47 bpd | 2.95 bpd | 0.33 % | |
| 9739 | to 9740 | 690.1 Mcf/d | 6.6 Mcf/d | 0.32 % | 40.84 bpd | 0.26 bpd | 0.22 % | 72.52 bpd | 1.18 bpd | 0.13 % | |
| 9749 | to 9750 | 683.6 Mcf/d | 1.9 Mcf/d | 0.09 % | 40.58 bpd | 0.26 bpd | 0.22 % | 71.35 bpd | 1.77 bpd | 0.20 % | |
| 9766 | to 9767 | 681.7 Mcf/d | 90.8 Mcf/d | 4.48 % | 40.32 bpd | 2.22 bpd | 1.84 % | 69.58 bpd | 4.72 bpd | 0.52 % | |
| 9778 | to 9779 | 590.9 Mcf/d | 23.4 Mcf/d | 1.16 % | 38.10 bpd | 1.64 bpd | 1.36 % | 64.86 bpd | 2.36 bpd | 0.26 % | |
| 9788 | to 9789 | 567.5 Mcf/d | 50.6 Mcf/d | 2.50 % | 36.46 bpd | 1.87 bpd | 1.56 % | 62.50 bpd | 3.54 bpd | 0.39 % | |
| 9799 | to 9800 | 516.9 Mcf/d | 26.2 Mcf/d | 1.29 % | 34.59 bpd | 1.66 bpd | 1.38 % | 58.96 bpd | 1.18 bpd | 0.13 % | |
| 9813 | to 9814 | 490.7 Mcf/d | 153.6 Mcf/d | 7.58 % | 32.93 bpd | 2.76 bpd | 2.29 % | 57.78 bpd | 1.77 bpd | 0.20 % | |
| 9831 | to 9832 | 337.1 Mcf/d | 20.2 Mcf/d | 1.00 % | 30.17 bpd | 11.37 bpd | 9.46 % | 56.01 bpd | 1.77 bpd | 0.20 % | |
| 9849 | to 9850 | 316.9 Mcf/d | 12.0 Mcf/d | 0.59 % | 18.81 bpd | 0.71 bpd | 0.59 % | 54.25 bpd | 4.13 bpd | 0.46 % | |
| 9862 | to 9863 | 304.9 Mcf/d | 19.2 Mcf/d | 0.95 % | 18.09 bpd | 1.14 bpd | 0.95 % | 50.12 bpd | 1.18 bpd | 0.13 % | |
| 9877 | to 9878 | 285.8 Mcf/d | 15.9 Mcf/d | 0.78 % | 16.96 bpd | 0.94 bpd | 0.78 % | 48.94 bpd | 1.77 bpd | 0.20 % | |
| 9888 | to 9889 | 269.9 Mcf/d | 17.7 Mcf/d | 0.88 % | 16.02 bpd | 1.05 bpd | 0.88 % | 47.17 bpd | 2.36 bpd | 0.26 % | |
| 9899 | to 9901 | 252.2 Mcf/d | 14.3 Mcf/d | 0.71 % | 14.96 bpd | 0.85 bpd | 0.71 % | 44.81 bpd | 2.36 bpd | 0.26 % | |
| 9913 | to 9915 | 237.8 Mcf/d | 18.6 Mcf/d | 0.92 % | 14.11 bpd | 1.11 bpd | 0.92 % | 42.45 bpd | 1.77 bpd | 0.20 % | |
| 9936 | to 9939 | 219.2 Mcf/d | 19.1 Mcf/d | 0.94 % | 13.01 bpd | 1.13 bpd | 0.94 % | 40.68 bpd | 2.95 bpd | 0.33 % | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stage 1 - Cisco Canyon** | | | | 8.73 % | | | 8.72 % | | | 3.52 % |
| **9967** to **9968** | 200.1 Mcf/d | 17.4 Mcf/d | | 0.86 % | 11.87 bpd | 1.03 bpd | 0.86 % | 37.74 bpd | 4.72 bpd | 0.52 % |
| **9984** to **9985** | 182.7 Mcf/d | 17.5 Mcf/d | | 0.86 % | 10.84 bpd | 1.04 bpd | 0.86 % | 33.02 bpd | 2.95 bpd | 0.33 % |
| **10000** to **10001** | 165.2 Mcf/d | 17.7 Mcf/d | | 0.87 % | 9.80 bpd | 1.05 bpd | 0.87 % | 30.07 bpd | 4.13 bpd | 0.46 % |
| **10014** to **10015** | 147.6 Mcf/d | 17.0 Mcf/d | | 0.84 % | 8.76 bpd | 1.01 bpd | 0.84 % | 25.94 bpd | 2.36 bpd | 0.26 % |
| **10026** to **10027** | 130.5 Mcf/d | 17.4 Mcf/d | | 0.86 % | 7.75 bpd | 1.03 bpd | 0.86 % | 23.59 bpd | 1.18 bpd | 0.13 % |
| **10035** to **10036** | 113.2 Mcf/d | 20.0 Mcf/d | | 0.99 % | 6.71 bpd | 1.19 bpd | 0.99 % | 22.41 bpd | 1.77 bpd | 0.20 % |
| **10043** to **10044** | 93.1 Mcf/d | 20.4 Mcf/d | | 1.01 % | 5.53 bpd | 1.21 bpd | 1.01 % | 20.64 bpd | 5.31 bpd | 0.59 % |
| **10050** to **10051** | 72.8 Mcf/d | 14.1 Mcf/d | | 0.70 % | 4.32 bpd | 0.84 bpd | 0.70 % | 15.33 bpd | 2.95 bpd | 0.33 % |
| **10066** to **10067** | 58.6 Mcf/d | 22.0 Mcf/d | | 1.09 % | 3.48 bpd | 1.30 bpd | 1.09 % | 12.38 bpd | 2.36 bpd | 0.26 % |
| **10076** to **10077** | 36.7 Mcf/d | 11.0 Mcf/d | | 0.54 % | 2.18 bpd | 0.65 bpd | 0.54 % | 10.02 bpd | 1.77 bpd | 0.20 % |
| **10083** to **10084** | 25.7 Mcf/d | 2.4 Mcf/d | | 0.12 % | 1.52 bpd | 0.14 bpd | 0.12 % | 8.25 bpd | 2.36 bpd | 0.26 % |
| | | | | | | | | | | |
| **Flow Contribution from Below Log Depth** | | | | 1.15 % | | | 1.15 % | | | 0.65 % |
| **10087** to **Below** | 23.3 Mcf/d | | | 1.15 % | 1.38 bpd | | 1.15 % | 5.90 bpd | | 0.65 % |

## *Analysis Summary*

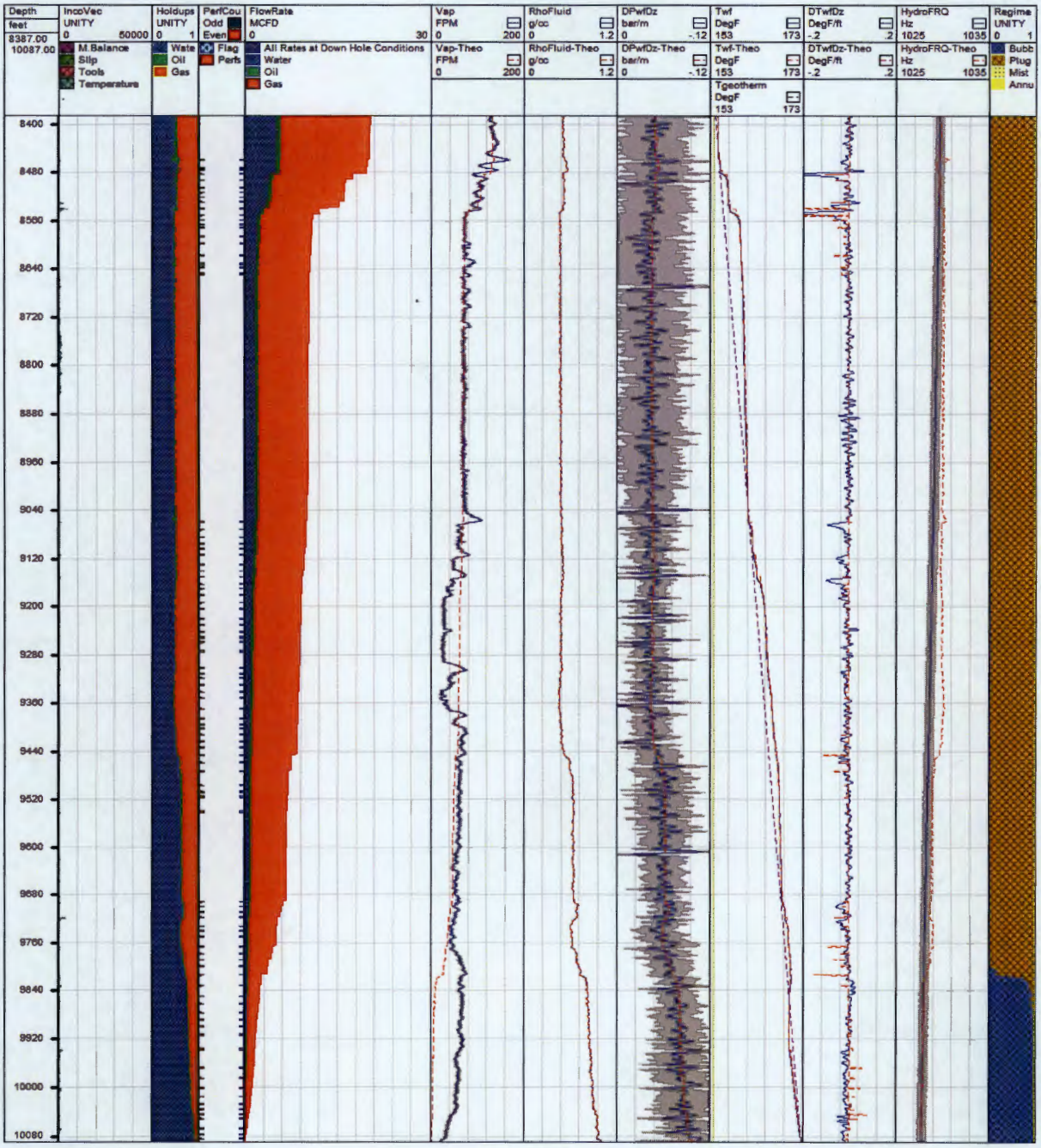
1. The perforations below 10,087 feet were not logged due to wellbore restrictions. Total production from these intervals was calculated based on the data below the 9,967 - 10,084 feet perforations.

2. The analysis was conducted as 3-phase. The oil production of 120 BOPD is too low to accurately quantify. The downhole oil rate, at 100% flow, accounts for approximately 4% of the total mass flow and about 3.5% of the total volumetric rate, assuming free gas entry and solution gas breaking out downhole. The GOR is assumed to be even across all zones.

# Completion Profile Analysis



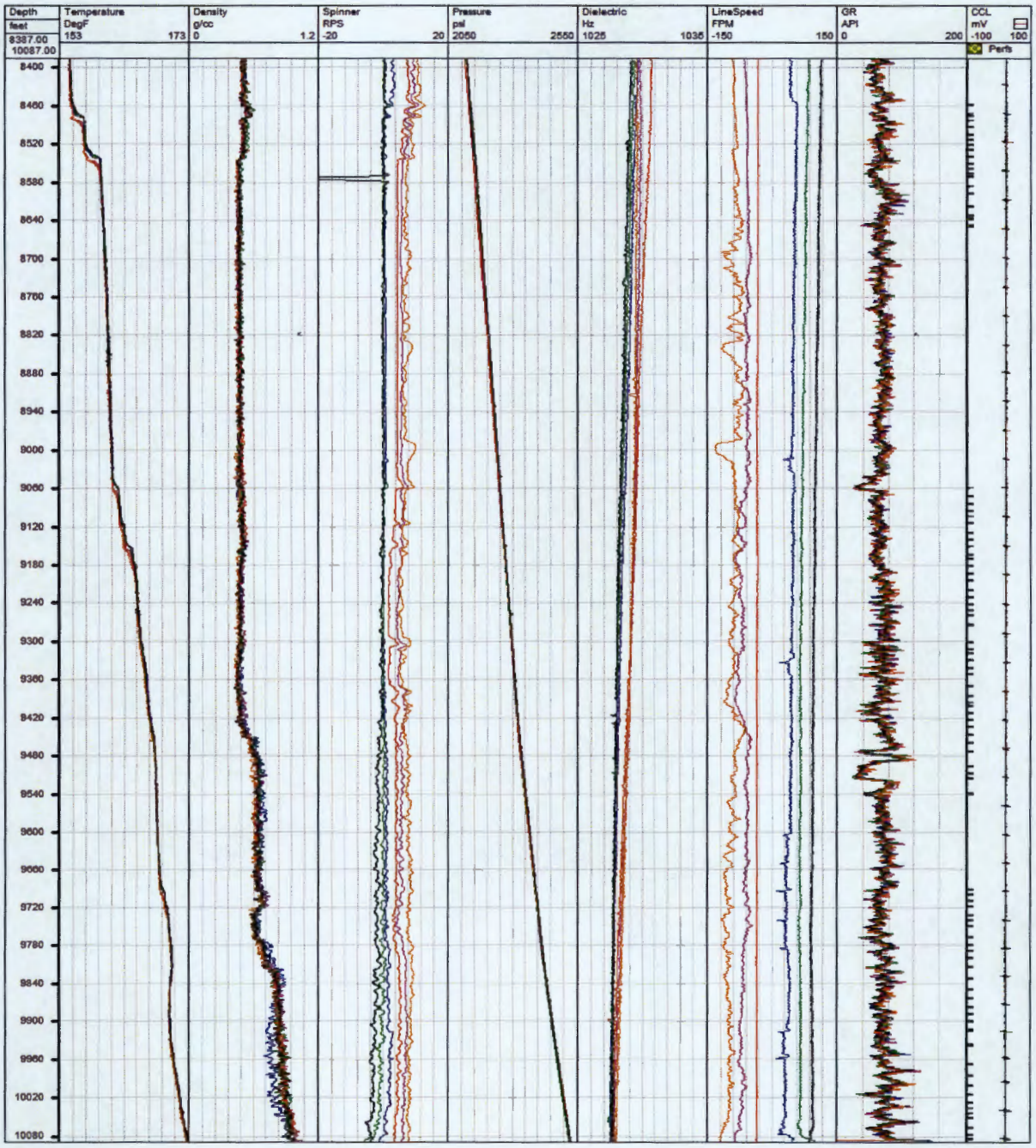
## *Flow Model at Downhole Conditions With Comparison of Theoretical Response to Recorded Data*



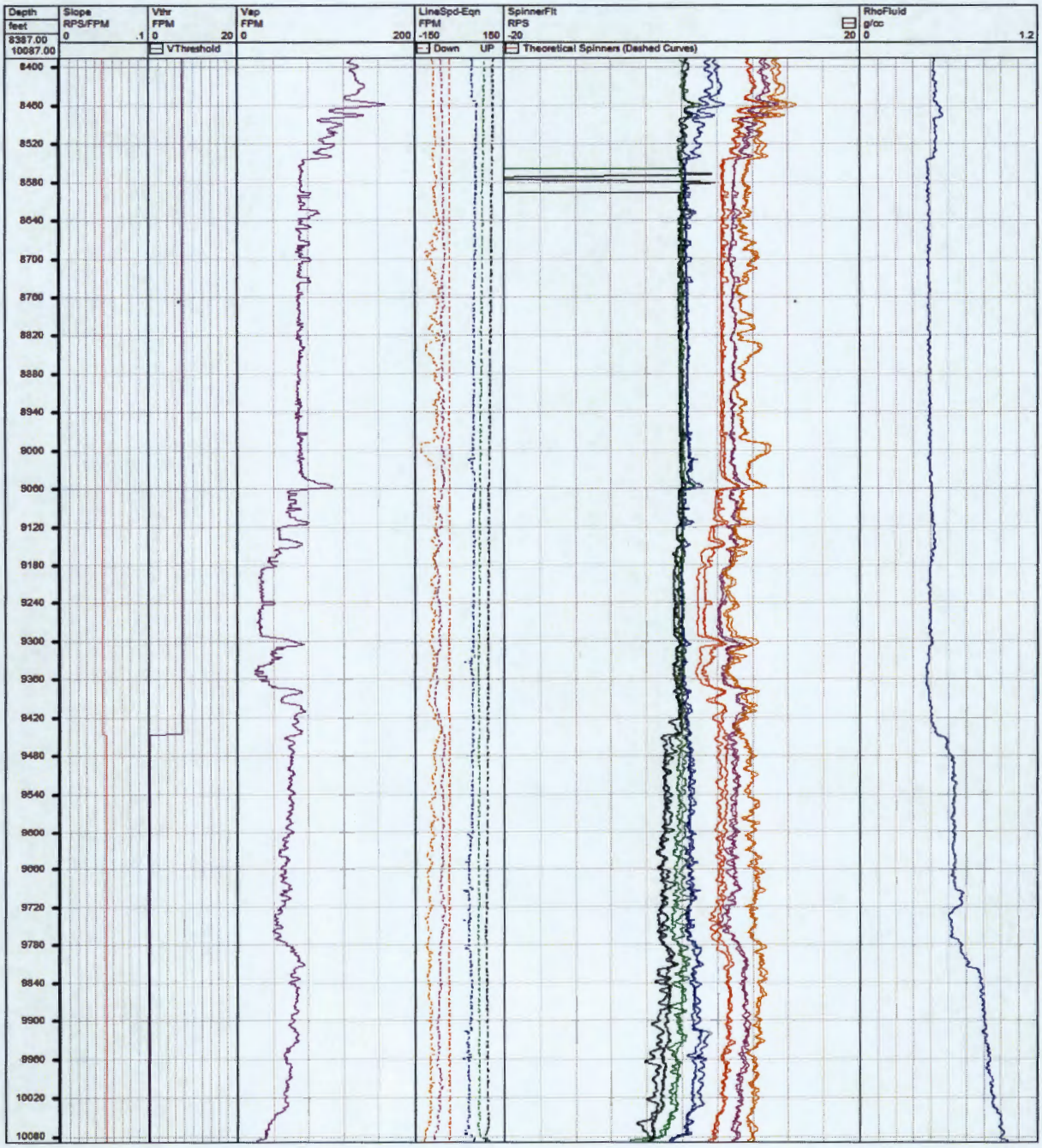
# Completion Profile Analysis



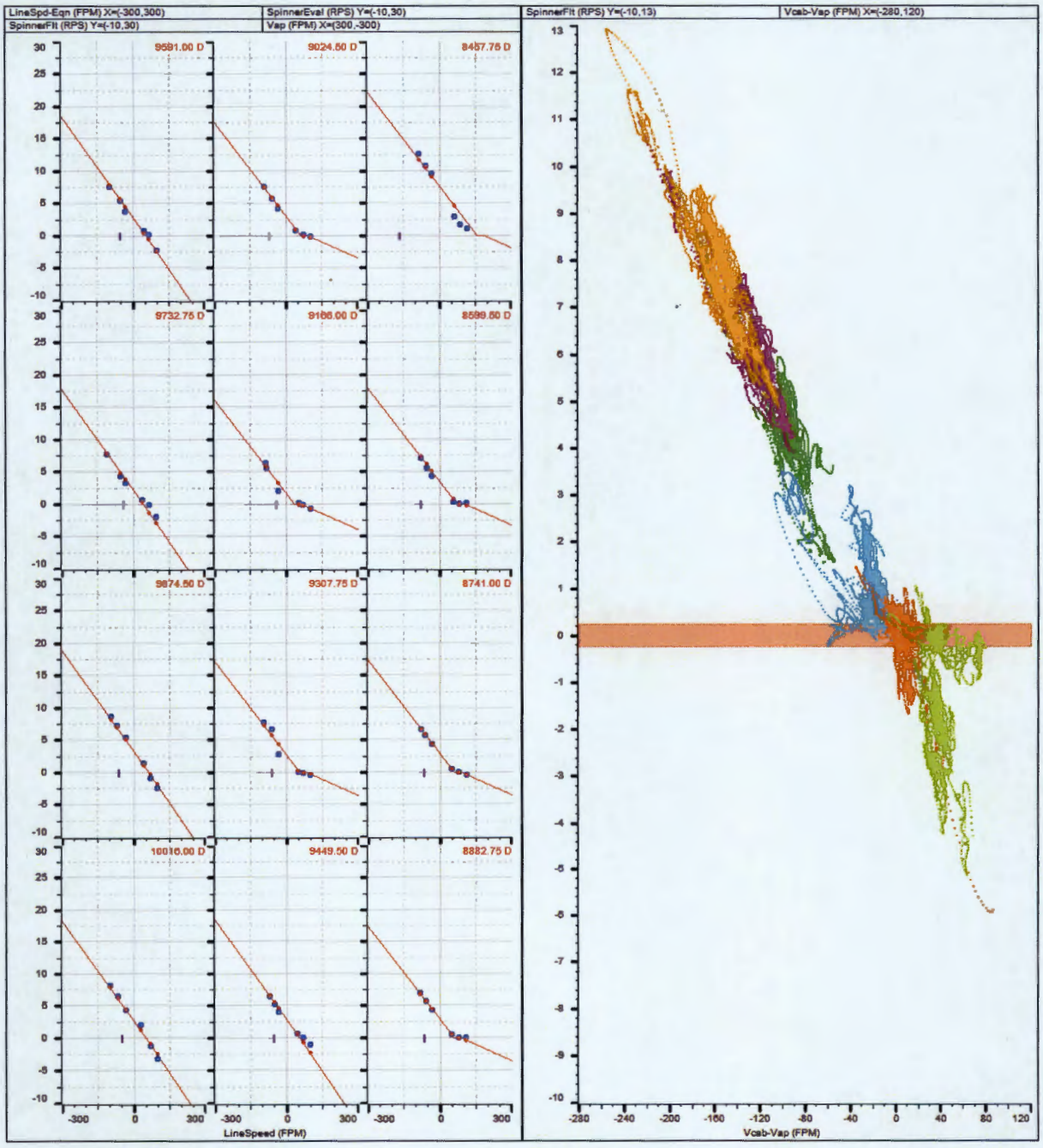
## *Overlay of all Log Data*



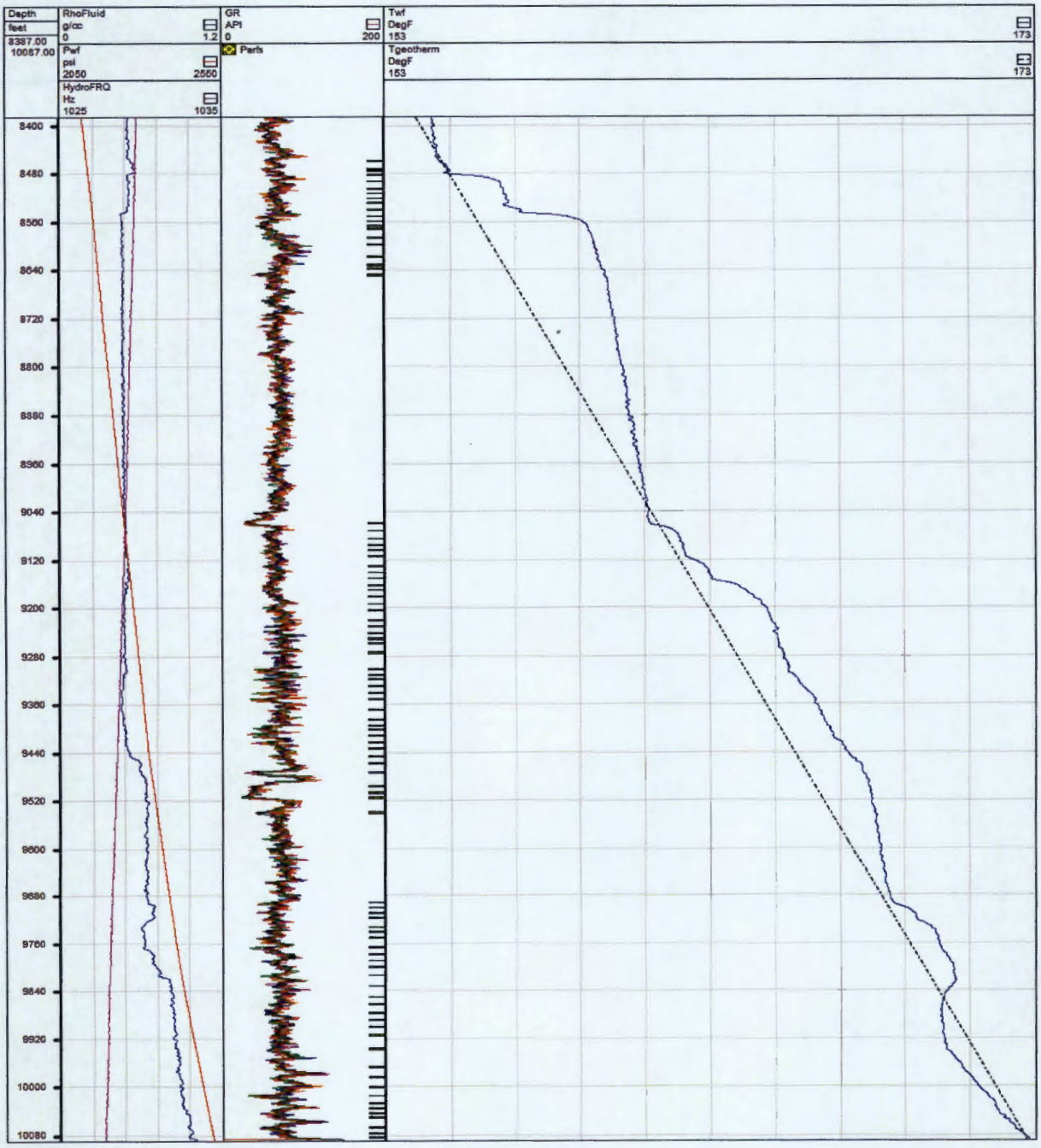
## *Apparent Fluid Velocity Derived from Spinner*



## *Spinner Calibration Plots*
## *Relationship between R.P.S. and Fluid Velocity (fpm)*

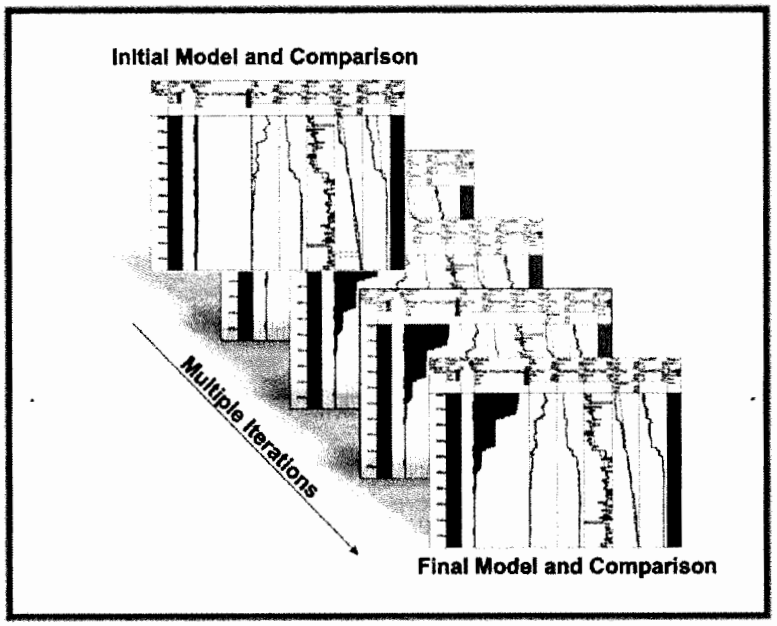


## Geothermal Gradient



## *Brief Description of Process*

The analysis is performed using a global stochastic optimization technique.
In this technique an initial flow model is estimated. Then from this model the theoretical log responses are derived. The theoretical responses are compared to all available data and the model is adjusted until the best possible match of the theoretical and actual data is obtained.




A comparison between the model responses and the recorded data is shown in this report. Good correlation between the theoretical and log data curves indicates that the flow model is in agreement with the log data and the actual well production profile. Discrepancies between the theoretical and raw data curves can be due to tool deficiencies, conflicts between the parameters or conditions that make the underlying empirical models (such as flow regimes) less applicable.

- The flow regimes were determined, directly from the flow rates and holdups, according to the Dukler-Taitel analytic model.
- The profile factors, to calculate the average effective fluid velocity from the apparent velocity, were based on the Reynolds number, calculated from the phase velocities and phase properties.
- Where gas was present the density, heat capacity and Joule-Thompson coefficients were derived from the Lee Kesler Pitzer equation of states.
- Solution gas in oil was derived from the Vasquez and Beggs or Ostein Glas0 correlation.

The analysis was performed in five steps:

- The data preparation to filter the data, compute gradients and error estimates.
- The flow meter analysis to compute the apparent velocity.
- The profile determination to identify the potential producing and/or injecting zones.
- The computation of the flow rates (model) by global optimization.
- The computation of surface production rates and reporting

## Well Information
*Parameters used for Analysis*

| | | |
|---|---|---|
| **SPGG** | UNITY | .658 |
| **APIOil** | UNITY | 52.6 |
| **DPipe** | in | 4.90 |
| **PipeAngle** | DegAng | 6.00 |
| **Geotherm** | °F/ft | .0111 |
| **TgeoRef** | °F | 161 |
| **DgeoRef** | ft | 9021 |

### *Downhole Measured and Computed Parameters*

| Depth | Pwf | Twf | $\rho_{gas}$ | $\rho_{oil}$ | $\rho_{water}$ | RhoFluid | $B_{gas}$ | Vap |
|---|---|---|---|---|---|---|---|---|
| feet | psi | DegF | g/cc | g/cc | g/cc | g/cc | UNITY | FPM |
| 8387.00 | 2117 | 154 | .112 | .736 | 1.03 | .502 | .00719 | 130 |
| 8508.50 | 2143 | 157 | .113 | .736 | 1.03 | .517 | .00715 | 104 |
| 8629.75 | 2166 | 160 | .113 | .735 | 1.03 | .462 | .00713 | 88.1 |
| 8751.25 | 2189 | 160 | .114 | .734 | 1.03 | .474 | .00706 | 68.6 |
| 8872.75 | 2212 | 160 | .115 | .734 | 1.03 | .470 | .00700 | 70.4 |
| 8994.25 | 2235 | 161 | .116 | .734 | 1.03 | .471 | .00693 | 70.4 |
| 9115.50 | 2259 | 162 | .117 | .734 | 1.03 | .500 | .00689 | 77.4 |
| 9237.00 | 2283 | 165 | .117 | .733 | 1.03 | .470 | .00686 | 27.8 |
| 9358.50 | 2307 | 166 | .118 | .732 | 1.03 | .452 | .00682 | 31.2 |
| 9479.75 | 2332 | 168 | .119 | .732 | 1.03 | .620 | .00677 | 59.6 |
| 9601.25 | 2365 | 168 | .120 | .732 | 1.03 | .630 | .00669 | 60.1 |
| 9722.75 | 2398 | 169 | .122 | .731 | 1.03 | .637 | .00661 | 48.5 |
| 9844.25 | 2434 | 170 | .123 | .731 | 1.03 | .830 | .00653 | 64.6 |
| 9965.50 | 2477 | 171 | .125 | .731 | 1.03 | .874 | .00643 | 53.7 |
| 10087.00 | 2525 | 173 | .127 | .730 | 1.03 | 1.00 | .00635 | 19.1 |

## *Definitions*

| Curve Name | Description |
|---|---|
| Holdup | Holdups |
| PerfCount | Perforations |
| QGas | Total Gas Production at surface conditions |
| QpGas | Incremental Gas Production at surface conditions |
| QOil | Total Oil Production (if present downhole) at surface conditions |
| QpOil | Incremental Oil Production (if present downhole) at surface conditions |
| QWater | Total Water Production at surface conditions |
| QpWater | Incremental Water Production at surface conditions |
| GR | Gamma Ray/SpectraScan |
| Twf | Average Temperature |
| Vap | Apparent Velocity |
| Vap-Theo | Theoretical Apparent Velocity |
| Tgeotherm | Geothermal Gradient |
| RhoFluid | Average Fluid Density |
| Pwf | Average Pressure |
| HydroFrq | Average Fluid Dielectric |
| Flowrate | Total Flowrate at downhole conditions |
| Vap | Apparent Velocity |
| Vap-Theo | Theoretical Apparent Velocity |
| RhoFluid | Average Fluid Density |
| RhoFluid-Theo | Theoretical Average Fluid Density |
| DPwfDz | Differential Pressure |
| DPwfDz-Theo | Theoretical Differential Pressure |
| Twf | Average Temperature |
| Twf-Theo | Theoretical Average Temperature |
| Tgeotherm | Geothermal Gradient |
| DTwfDz | Differential Temperature |
| DTwfDz-Theo | Theoretical Differential Temperature |
| Regime | Flow Regimes |
| Temperature | Temperature Passes |
| Density | Fluid Density Passes |
| Spinner | Spinner Passes |
| Pressure | Pressure Passes |
| Linespeed | Linespeed Passes |
| Slope | Spinner Slope |
| Vthr | Spinner Threshold |
| SpinnerFlt | Spinner |
| DPipe | Inside diameter of the casing/tubing across logged interval |
| PipeAngle | Average pipe angle across logged interval |
| APIOil | Degree API of the oil |
| SPGG | Specific Gravity of the gas |
| TgeoRef | Reference Temperature for Geothermal Gradient calculations |
| DgeoRef | Reference Depth for Geothermal Gradient calculations |
| Goetherm | Geothermal Gradient across logged interval |

# Completion Profile Analysis



## Tool Specifications

| | |
|---|---|
| O.D. | 1-11/16 in. (42.86 mm) |
| Length | 11.9 ft.(3.63 m) in combination<br>23.28 ft. (7.1 m) stand alone |
| Pressure Rating | 15,000 psi (103421.4 Kpa) |
| Temperature Rating | 350°F (177°C) |

## Flow Measurement

Measurement of fluid velocity is made using the *Spinner Flowmeter*. This is calibrated by making logging passes at different line speeds to establish the relationship between instrument velocity in feet/minute and the spinner response in revolutions/second (RPS). With this relationship the measured RPS can be converted to fluid velocity in ft/minute. With a known pipe I. D. this can be used to calculate the flow rate in BPD.

$Q_{BPD} = ft/min \times 1.4 \times I.D.^2$

Mass flow rate can be computed using the *Temperature* data. This is based on an enthalpy model, taking into consideration; kinetic energy, frictional and Joule-Thompson heating as well as conduction and convection into the formation.

In gas wells the volumetric fraction of liquids (water) can be very small. Therefore water production may not be quantifiable by velocity measurement alone. Because of water's high mass relative to gas, mass flowrate computed from the *Temperature* data can be better at quantifying the water production.

## Holdup Measurement

Holdup ($\gamma$) - The fraction of each phase in the wellbore (Water, Oil, Gas fraction) This should not be confused with Cut. i.e. 100% water holdup exists in the static rathole but does not flow.

The *Fluid Density* instrument uses a small gamma ray source and a gamma ray detector to measure the density of the wellbore fluid mixture. The mixture density is used to calculate the holdup fraction.

$\gamma water = (\rho mixture - \rho gas) / (\rho water - \rho gas)$

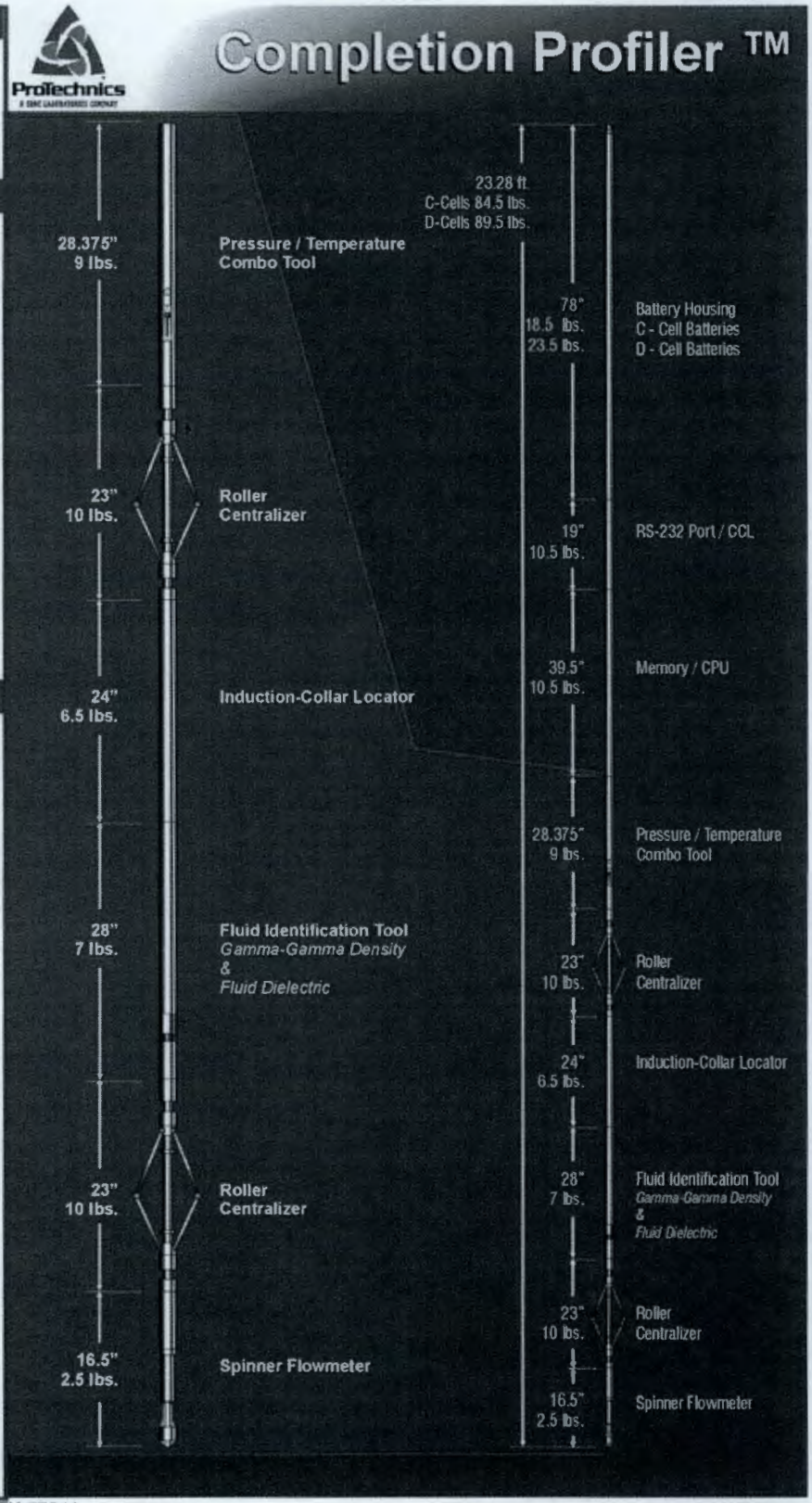
*[For two-phase gas-water production]*

$\rho$: density (gm/cc)

The *Fluid Dielectric* instrument works like an electric capacitor. The capacitor plates are exposed to the wellbore fluids and are a fixed size and distance apart. The value of the capacitance will change as the dielectric of the fluids between the plates change. The instrument response is then used to calculate the hydrocarbon and water fractions. This is possible because of the unique dielectric constant of water, oil and gas.
Water = 78, Oil = 4 and Gas = 1

The *Pressure* data can also be used to corroborate the fluid holdup measurements. This is done by measuring the pressure gradient or the derivative of the pressure curve with respect to depth. The resulting curve in psi/ft can be used to determine the water and gas fractions.

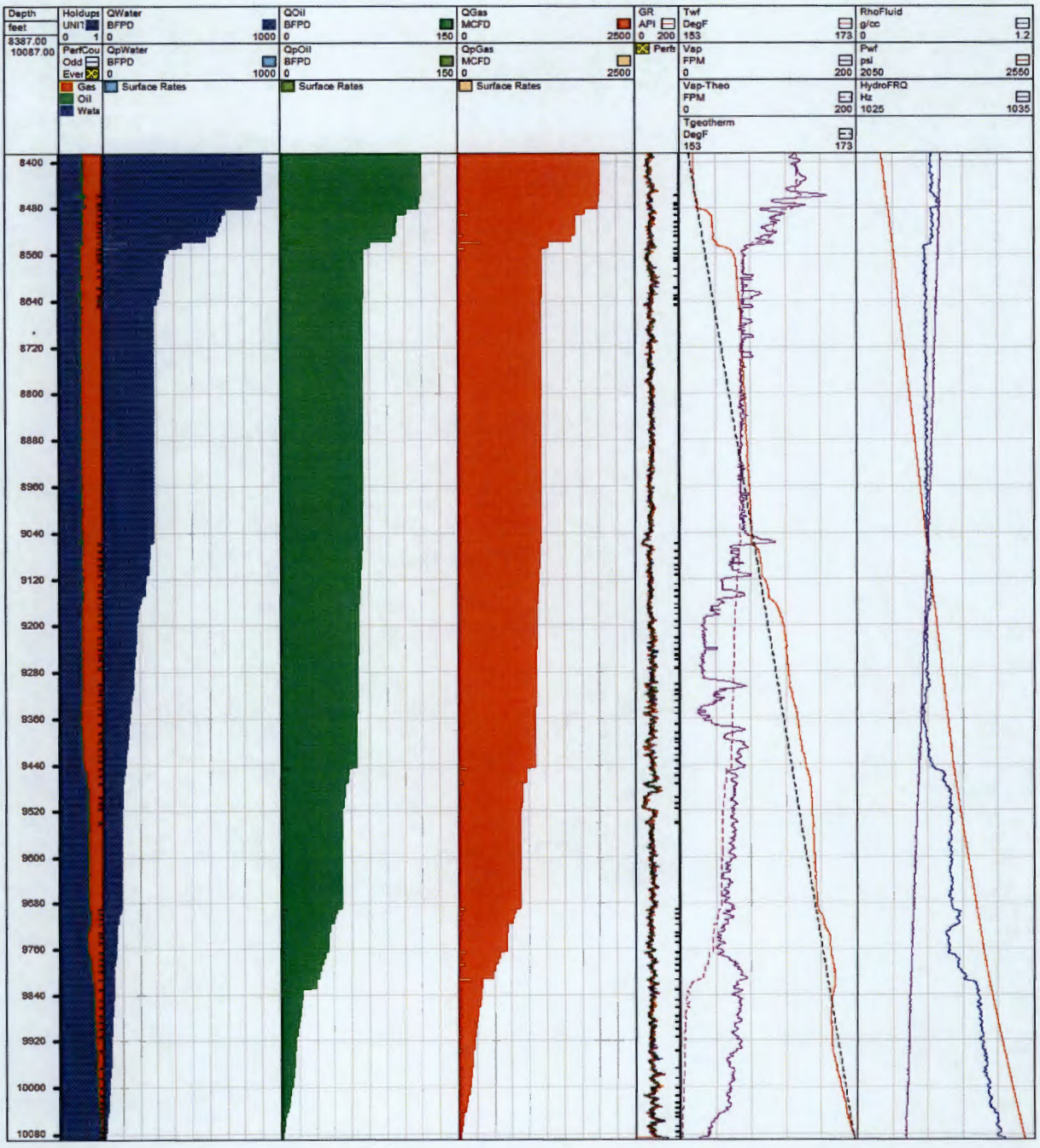
*Note:*
In three phase flow both fluid density and dielectric measurements are necessary. The dielectric is used to determine the water holdup then the density is used to calculate the remaining gas and oil holdups.



# Completion Profile Analysis



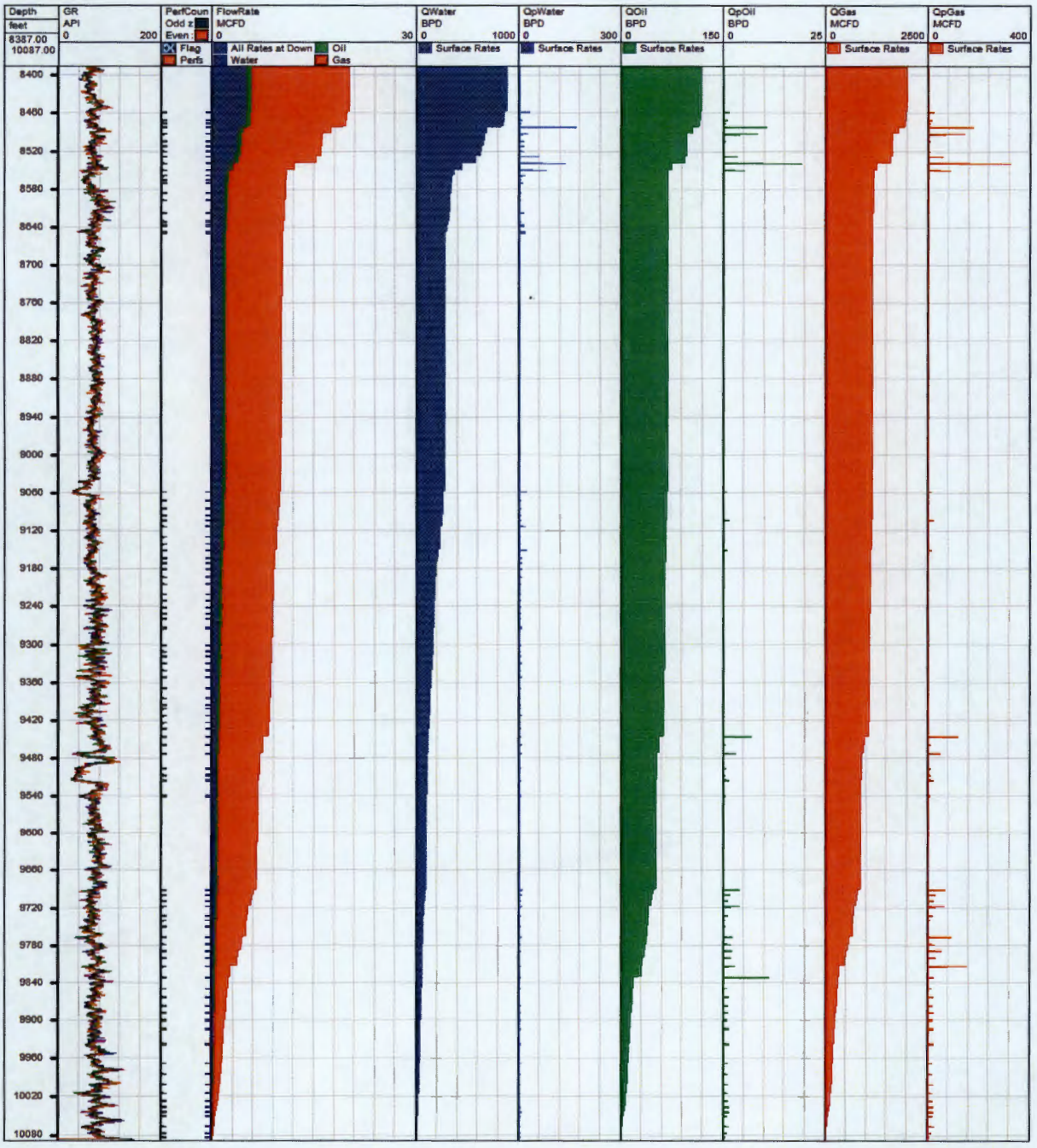
## *Model Results With Recorded Data*



# Completion Profile Analysis



## *Production Rates At Surface Conditions*



State of New Mexico
Energy, Minerals and Natural Resources Department



Administrative Order DHC-4804
Order Date: January 23, 2017
Application Reference Number: pMAM1702341565

Cimarex Energy Co. of Colorado
600 North Marienfeld Street, Suite 600
Midland, Tx. 79701

Attention: Ms. Kimberleigh Rhodes

White City 31 Federal A Well No. 2
API No. 30-015-33394
Unit K, Section 31, Township 24 South, Range 26 East, NMPM
Eddy County, New Mexico

| | | |
|---|---|---|
| Pool | WHITE CITY; PENN (GAS) | Gas (87280) |
| Names: | BLACK RIVER; WOLFCAMP, SW (GAS) | Gas (97693) |

Reference is made to your recent application for an exception to Division Rule 19.15.12.9A. NMAC of the Division Rules and Regulations to permit the above-described well to commingle production from the subject pools in the wellbore.

It appears that the subject well qualifies for approval for such exception pursuant to the provisions of Division Rule 19.15.12.11A. NMAC, and since reservoir damage or waste will not result from such downhole commingling, and correlative rights will not be violated thereby, you are hereby authorized to commingle the production as described above and any Division Order which authorized the dual completion or otherwise required separation of the zones is hereby placed in abeyance.

In accordance with Division Rule 19.15.12.11A (6) NMAC, the production attributed to any commingled pool within the well shall not exceed the allowable applicable to that pool.

As per the application, the assignment of allowable and allocation of oil and gas production from the subject well for the White City; Penn (Gas) Pool and Black River; Wolfcamp, SW (Gas) Pool shall be based on the remaining gas in place (RGIP) calculations, which in turn is based on offset analogy production and well log analysis for each pool.

Assignment of allowable and allocation of production from the well shall be as follows:

| | | |
|---|---|---|
| BLACK RIVER; WOLFCAMP, SW (GAS) | Pct. Oil: 79 | Pct. Gas: 79 |
| WHITE CITY; PENN (GAS) | Pct. Oil: 21 | Pct. Gas: 21 |

It is also understood that notice of this application, pursuant to Division Rule 19.15.4.12 A (6), is not required since the interest ownership between the zones to be commingled is common throughout.

REMARKS: The operator shall notify the Division's District II office upon implementation of commingling operations.

This Order is subject to like approval from the Bureau of Land Management.

Pursuant to Division Rule 19.15.12.11B. NMAC, the commingling authority granted herein may be rescinded by the Division Director if conservation is not being best served by such commingling.

David R. Catanach

**David R. Catanach**
**Director**

DRC/mam

cc: New Mexico Oil Conservation Division – Artesia
Bureau of Land Management - Carlsbad

## McMillan, Michael, EMNRD

**From:** Amithy Crawford <acrawford@cimarex.com>
**Sent:** Friday, July 21, 2017 9:51 AM
**To:** McMillan, Michael, EMNRD
**Subject:** Amend DHC-4808 White City 31 Federal #2
**Attachments:** WhiteCity_31_Fed_2_CP_Report.pdf; DHC Approval White City 31 #2 WC CC.pdf; White City 31 Fed 2 Land Letter.pdf; Admin Checklist White City 31 #2 Amend.pdf

Mr. McMillan,

Based on the fact that ownership is identical and there are no adversely affected parties, please make the allocation percentages 90% Wolfcamp & 10% Cisco Canyon.

Thank you,

**Amithy Crawford**
600 N. Marienfeld St. Suite 600
Midland, TX 79701
Direct Phone: 432-620-1909


**From:** Amithy Crawford
**Sent:** Friday, July 21, 2017 9:02 AM
**To:** 'McMillan, Michael, EMNRD' <Michael.McMillan@state.nm.us>
**Subject:** Amend DHC-4808 White City 31 Federal #2

Mr. McMillan,

Please amend DHC-4808 to reflect 90.12% Wolfcamp and 9.88% Cisco Canyon as shown from the attached production log. The initial application was for a 79% wolfcamp and 21% Cisco Canyon breakout. All interest is identical. Will you also amend the pool on the DHC to the Purple Sage, Wolfcamp (Gas)?
Attached:

- Original DHC approval for reference
- Letter from Land stating ownership
- Production Log
- Administrative Checklist form

Please let me know if you have any questions.

Thank you,