

**EBOR UNIT NO. 2  
WATERFLOOD EOR PROJECT**

**ANNUAL REPORT FOR 2010**

**July 22, 2011**

**Tundra Oil and Gas Partnership**



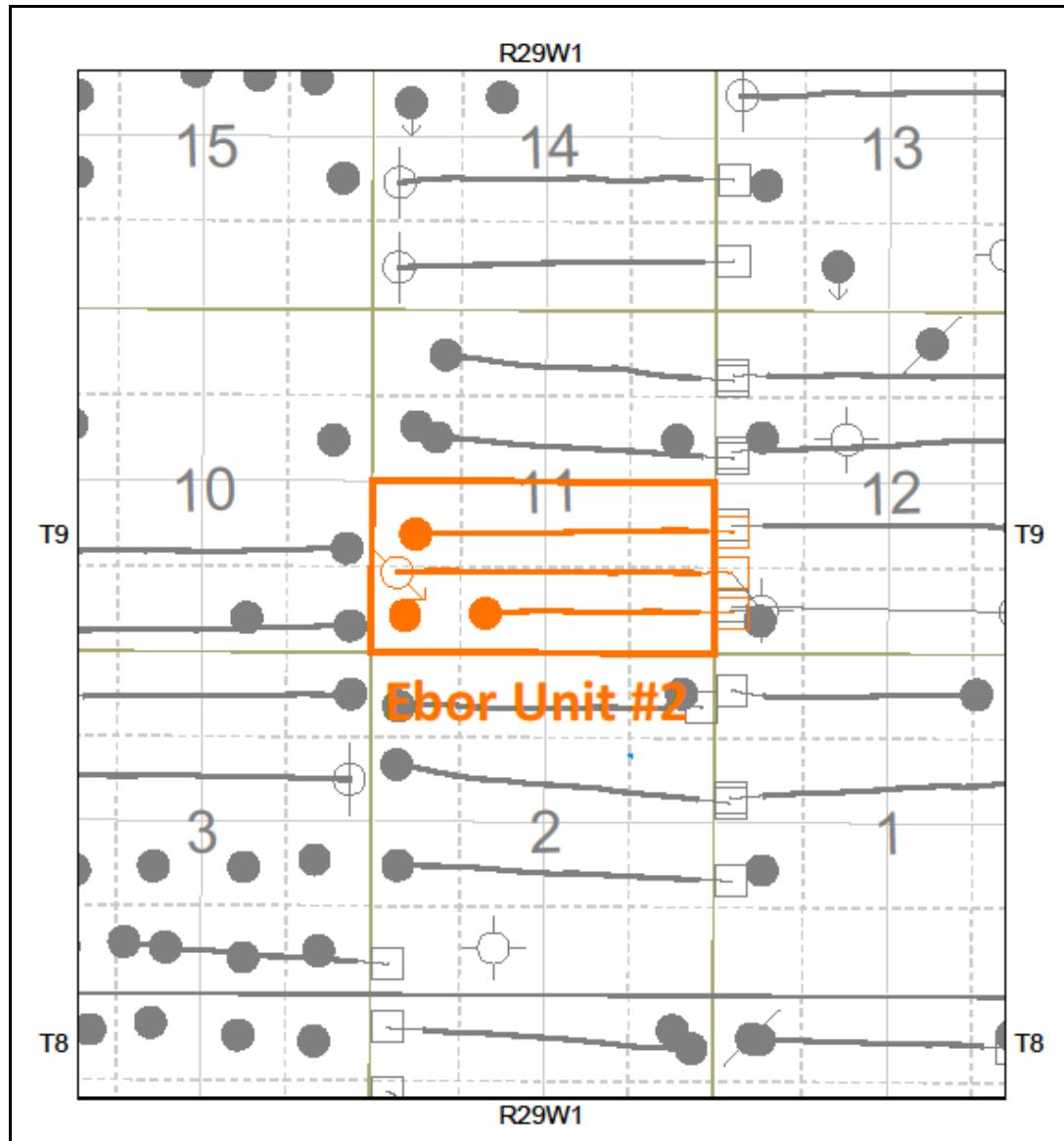
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## INTRODUCTION

Ebor Unit No. 2 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Board Order No. 20 effective March 2010 with Tundra Oil and Gas (Tundra) as Operator. The EOR project area, outlined in Orange the attached Figure 1, contains 4 wells in the South half of Section 11 in Township 9, Range 29 W1. A well list and status is included as Appendix A.

**Figure 1: Ebor Unit No. 2 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra submits the following 2010 Annual Progress Report for Ebor Unit No. 2 as required by Waterflood Order No 20.

## **DISCUSSION**

### **Production History**

For the wells included in Ebor Unit No. 2, production started in August 2007 with 00/04-11-009-29W1/0. Oil production peaked at 17.65 m<sup>3</sup>/d in January of 2009, when 00/05-11-009-29W1/0 came on production. In December 2010, the Unit was producing 4.28 m<sup>3</sup>/d of oil and 19.20 m<sup>3</sup>/d of water. The water oil ratio (WOR) averaged 2.62 m<sup>3</sup>/m<sup>3</sup> in 2010. The rates and WOR are presented in Figure 2.

**Figure 2: Ebor Unit No. 2 Production/Injection Rates and WOR vs Time**

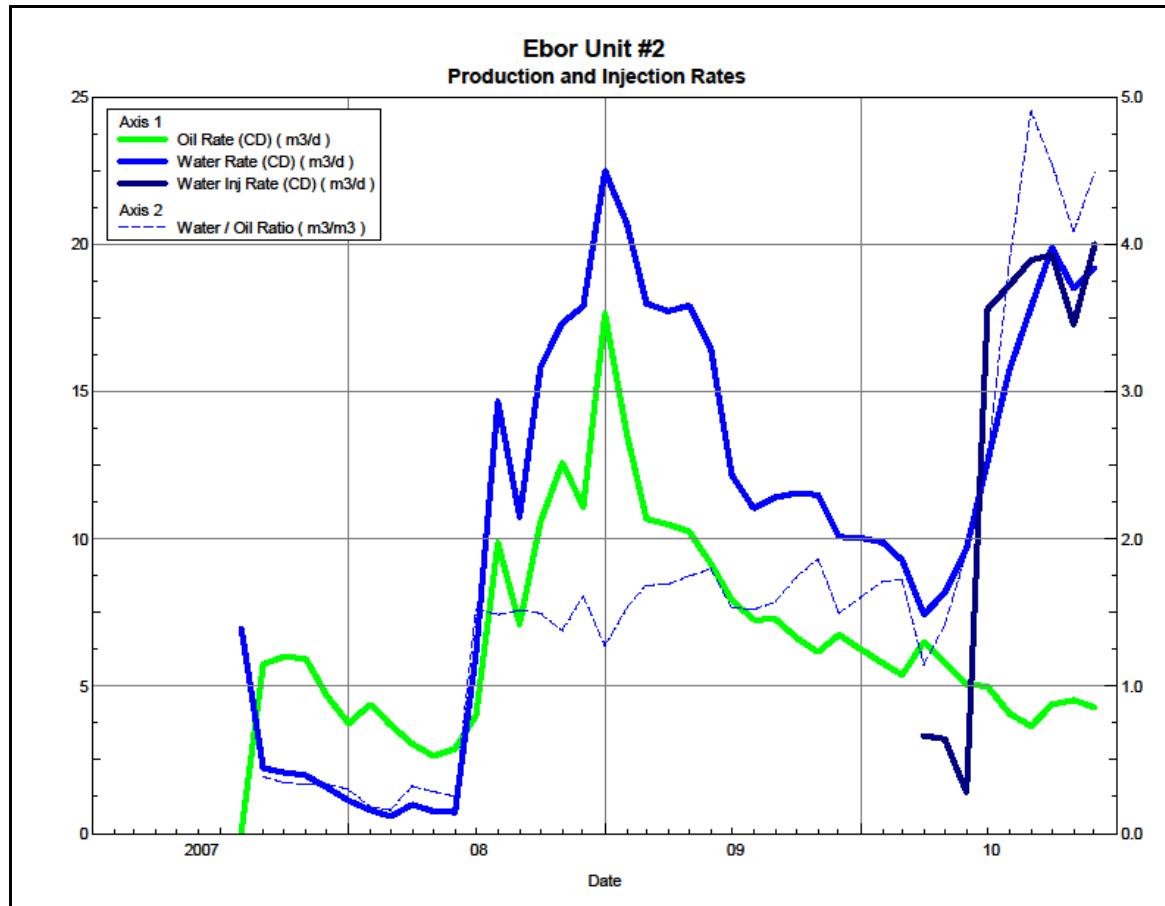
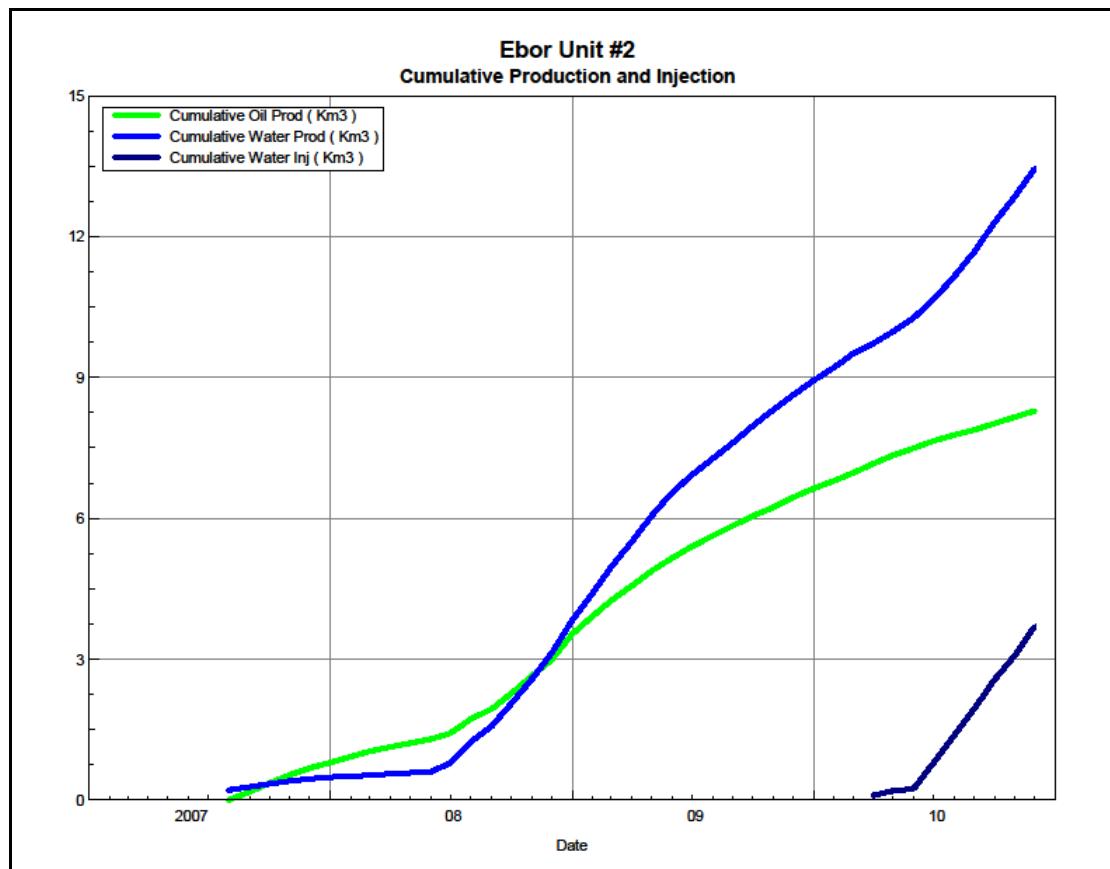


Figure 3 shows the cumulative production for Ebor Unit No. 2 to the end of December 2010 as 8.29 E<sup>3</sup>m<sup>3</sup> of oil, and 13.45 E<sup>3</sup>m<sup>3</sup> of water, representing a 4 % recovery factor of the OOIP. Cumulative water injected at the end of 2010 is 3.70 E<sup>3</sup>m<sup>3</sup>.

**Figure 3: Ebor Unit No. 2 Cumulative Oil, Water and Water Injected vs. Time**



### **Waterflood Development Plan**

As of December 2010 the Unit has 1 active horizontal water injector, 02/04-11-009-29W1/2, which started injecting in April 2010. Cumulative water injection for this well is  $3.70 \text{ E}^3 \text{ m}^3$ .

There is some evidence that the water production has increased faster than expected in the offset producers since the start of water injection in the pattern. Any future revisions to the waterflood development or surveillance plan would be based on new production or performance response data, technical studies, or observed reservoir behavior and reserves recovery interpretations.

### **Waterflood EOR Operating Strategy and Performance**

#### **Water Source and Quality**

The injection water for Ebor Unit No. 2 is sourced from the 16-32-007-29W1 well (Lodgepole formation). The water is treated at the 03-04-008-29W1 battery where it is

filtered to 0.5 microns and has scale inhibitor added. The injection water is then distributed to the injectors through the dedicated infrastructure system.

### **Injection Wellhead Pressures**

The monthly wellhead injection pressures 02/04-11 are summarized in Appendix B. The injection pressures in April and May are pre-hydraulic fracture. The injection rates during these months were low and hence the well was fractured after which the injection rates improved. Since injection in this Unit is still in the early stages the injector shows, post fracture, little to no wellhead pressure if any at all. This is due to voidage that has been created by production of oil and water in the area. In some instances, the water is basically being injected under vacuum. As fill-up occurs the wellhead pressures will begin to register.

### **Reservoir Pressure**

Tundra is committed to collecting pressures from every new injection well drilled. Bottom hole recorders were set in the injection well 02/04-11 in February 2010. The MPP Pressure of 6559 kPaa was recorded which is one of the highest pressures Tundra has observed in any of the past injector wells in the Sinclair area.

### **Well Servicing**

No maintenance was required on the 4 wells in Ebor Unit No. 2, in 2010.

### **Voidage Replacement**

Tundra injects water for a minimum of 1 year period to re-pressurize the reservoir due to cumulative primary production voidage and corresponding pressure depletion. During the initial fill-up period, the instantaneous voidage replacement ratio (VRR) averages approximately 1.6 to 1.8. The VRRs will be discussed in the waterflood performance section of the report.

### **Waterflood Performance Discussion**

At year end 2010, Ebor Unit No.2 waterflood area had 1 injector pattern in place. Water injection started in the April 2010. Monthly VRR averaged 0.87 over the last half of 2010 and the Cumulative VRR for the Unit was 0.168 at the end of the year. Plots and tables of the production and injection data along with the VRR information are presented in Appendix C.



## **List of Appendices**

Appendix A: Ebor Unit No. 2 Well List and Status

Appendix B: Monthly Injection Wellhead Pressures Table

Appendix C: Production/Injection Rates, Cumulatives and VRRs

## **Appendix A**

<b>UWI</b>	<b>Surface Location</b>	<b>Well Status</b>
00/03-11-009-29W1/0	04-12-009-29W1	Capable of Oil Production
00/04-11-009-29W1/0		Capable of Oil Production
02/04-11-009-29W1/2	04-12-009-29W1	WTR Injection
00/05-11-009-29W1/0	05-12-009-29W1	Capable of Oil Production

## Appendix B

### Average Monthly Injection Pressure (kPag)

Ebor Unit No. 2	
Month	102/04-11
Jan-10	
Feb-10	
Mar-10	
Apr-10	4663
May-10	5158
Jun-10	-
Jul-10	-
Aug-10	-
Sep-10	-
Oct-10	-
Nov-10	-
Dec-10	-

# Pattern: 02/04-11-009-29 Inj Set: Ebor Unit #2

Oil Formation Vol Factor : 1.03000 m3/m3

Water Formation Vol Factor : 1.00150 m3/m3

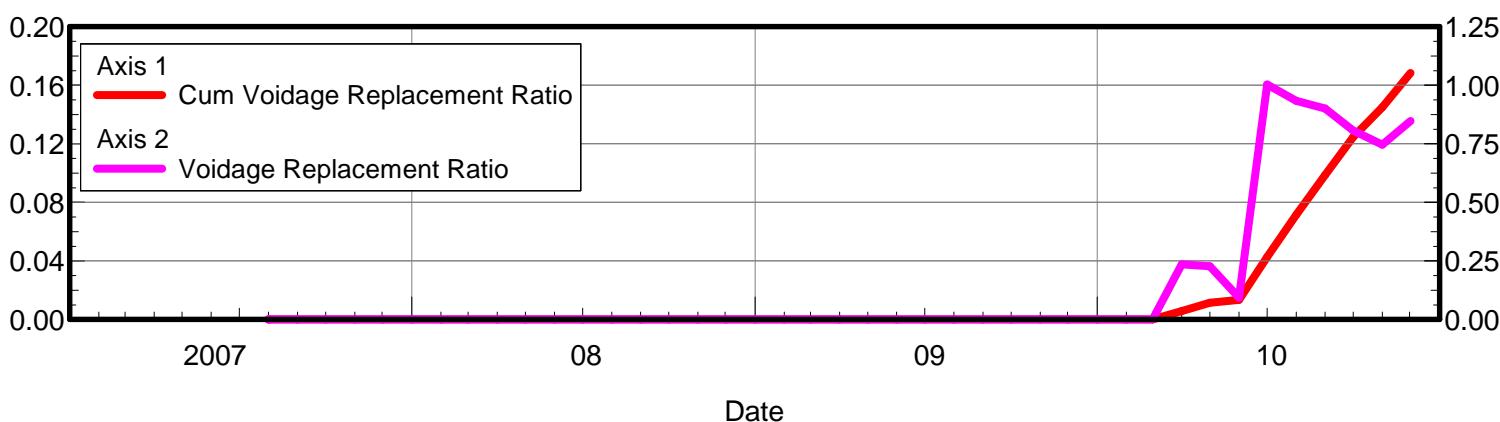
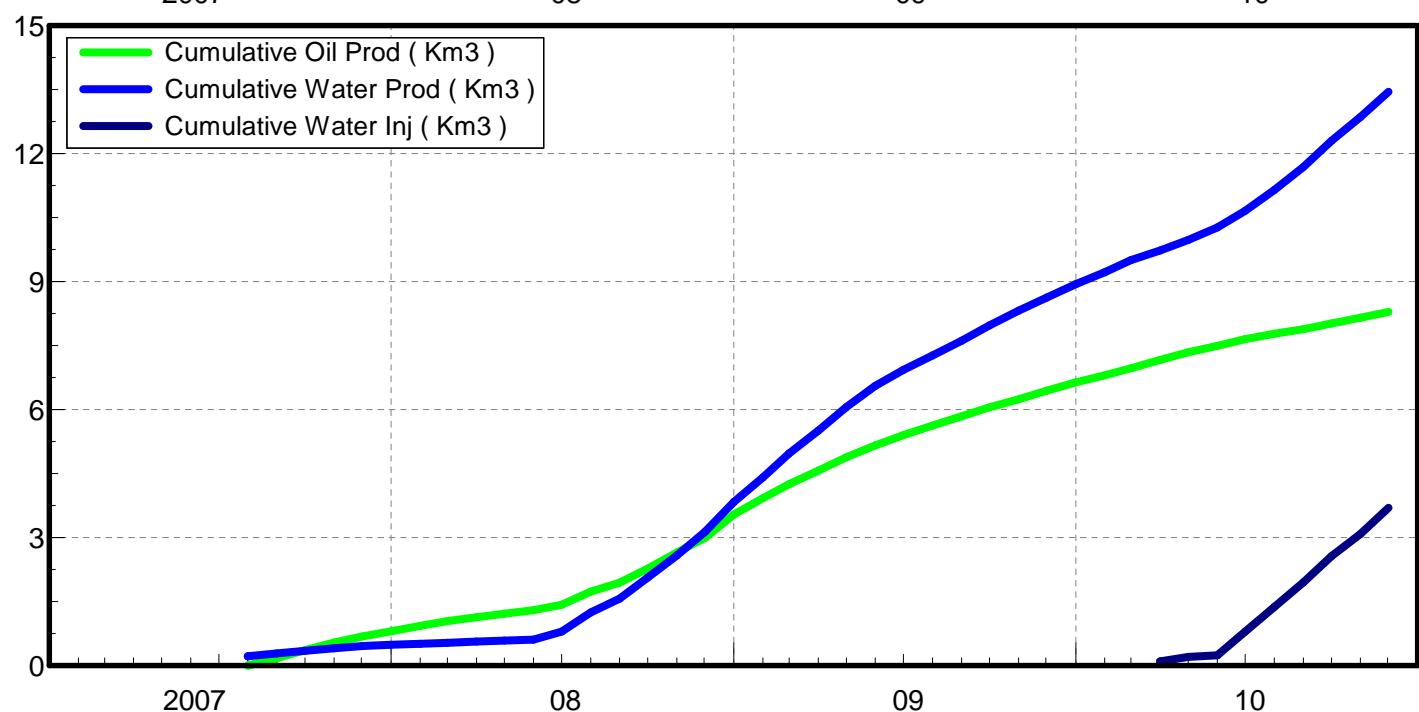
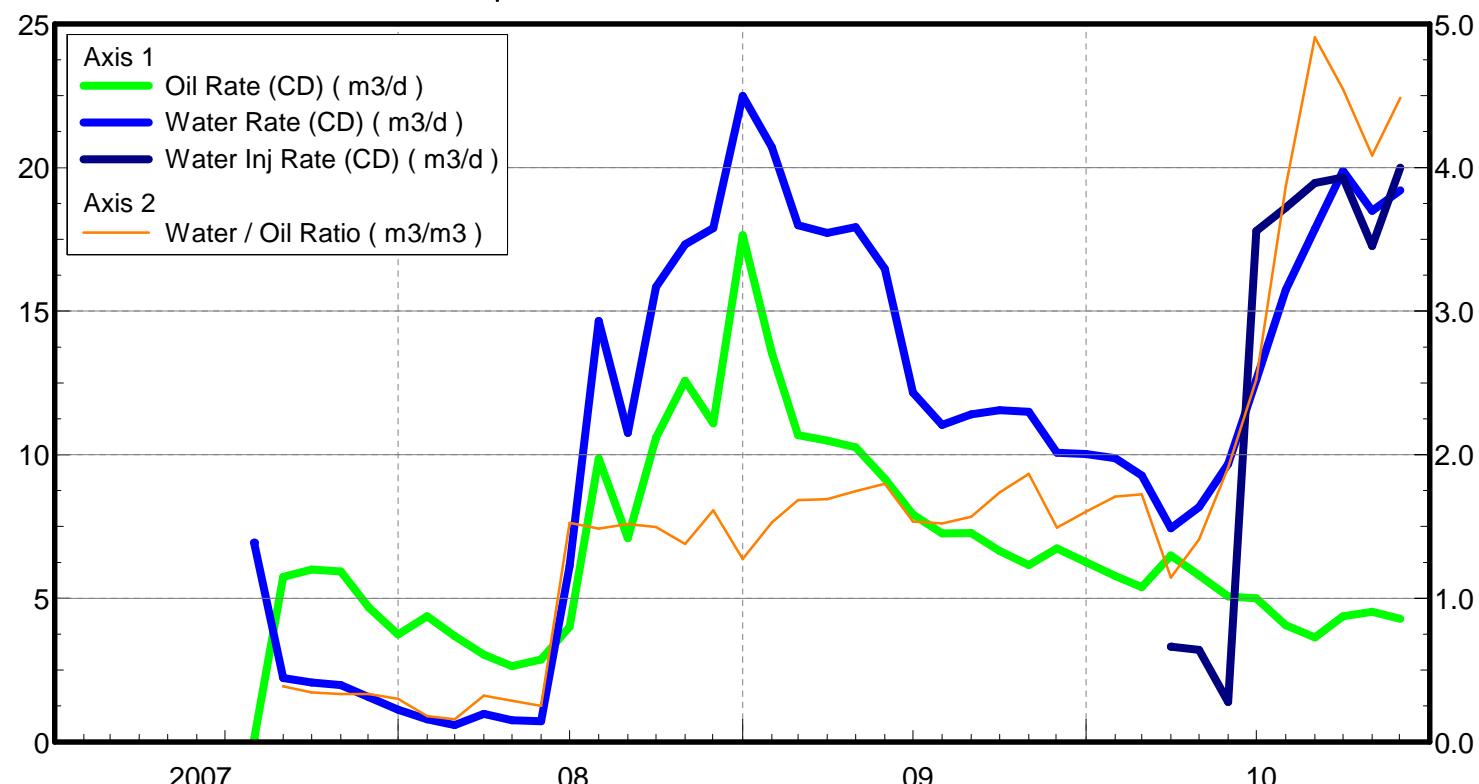
Water / Oil Ratio : 4.49 m3/m3

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Oil Rate (CD) : 4.28 m3/d

Water Rate (CD) : 19.20 m3/d

Water Inj Rate (CD) : 20.00 m3/d



Date	Oil Rate (CD) m3/d	Water Rate (CD) m3/d	Water Oil Ratio m3/m3	Water Inj Rate (CD) m3/d	Cum Oil Prod Km3	Cum Water Prod Km3	Cum Water Inj Km3	Voidage Replacemnt Ratio	Cum Voidage Replacemnt Ratio
8/1/2007	0.08	6.94	86.04		0.00	0.22	0.00	0.000	0.000
9/1/2007	5.74	2.22	0.39		0.17	0.28	0.00	0.000	0.000
10/1/2007	6.01	2.07	0.34		0.36	0.35	0.00	0.000	0.000
11/1/2007	5.93	1.98	0.33		0.54	0.41	0.00	0.000	0.000
12/1/2007	4.67	1.56	0.33		0.68	0.45	0.00	0.000	0.000
1/1/2008	3.74	1.12	0.30		0.80	0.49	0.00	0.000	0.000
2/1/2008	4.38	0.79	0.18		0.93	0.51	0.00	0.000	0.000
3/1/2008	3.68	0.58	0.16		1.04	0.53	0.00	0.000	0.000
4/1/2008	3.04	0.98	0.32		1.13	0.56	0.00	0.000	0.000
5/1/2008	2.63	0.75	0.29		1.21	0.58	0.00	0.000	0.000
6/1/2008	2.87	0.72	0.25		1.30	0.60	0.00	0.000	0.000
7/1/2008	4.01	6.12	1.53		1.42	0.79	0.00	0.000	0.000
8/1/2008	9.87	14.66	1.48		1.73	1.25	0.00	0.000	0.000
9/1/2008	7.10	10.76	1.52		1.94	1.57	0.00	0.000	0.000
10/1/2008	10.59	15.84	1.50		2.27	2.06	0.00	0.000	0.000
11/1/2008	12.58	17.32	1.38		2.65	2.58	0.00	0.000	0.000
12/1/2008	11.09	17.89	1.61		2.99	3.14	0.00	0.000	0.000
1/1/2009	17.65	22.49	1.27		3.54	3.83	0.00	0.000	0.000
2/1/2009	13.55	20.71	1.53		3.92	4.41	0.00	0.000	0.000
3/1/2009	10.68	17.99	1.68		4.25	4.97	0.00	0.000	0.000
4/1/2009	10.49	17.73	1.69		4.56	5.50	0.00	0.000	0.000
5/1/2009	10.26	17.92	1.75		4.88	6.06	0.00	0.000	0.000
6/1/2009	9.16	16.48	1.80		5.16	6.55	0.00	0.000	0.000
7/1/2009	7.92	12.16	1.54		5.40	6.93	0.00	0.000	0.000
8/1/2009	7.26	11.04	1.52		5.63	7.27	0.00	0.000	0.000
9/1/2009	7.27	11.41	1.57		5.85	7.61	0.00	0.000	0.000
10/1/2009	6.65	11.55	1.74		6.05	7.97	0.00	0.000	0.000
11/1/2009	6.16	11.49	1.87		6.24	8.32	0.00	0.000	0.000
12/1/2009	6.74	10.06	1.49		6.45	8.63	0.00	0.000	0.000
1/1/2010	6.26	10.03	1.60		6.64	8.94	0.00	0.000	0.000
2/1/2010	5.78	9.88	1.71		6.80	9.22	0.00	0.000	0.000
3/1/2010	5.38	9.28	1.72		6.97	9.50	0.00	0.000	0.000
4/1/2010	6.49	7.43	1.15	3.32	7.16	9.73	0.10	0.235	0.006
5/1/2010	5.80	8.18	1.41	3.21	7.34	9.98	0.20	0.227	0.011
6/1/2010	5.06	9.67	1.91	1.39	7.50	10.27	0.24	0.093	0.013
7/1/2010	4.99	12.60	2.52	17.79	7.65	10.66	0.79	1.003	0.043
8/1/2010	4.07	15.74	3.87	18.61	7.78	11.15	1.37	0.934	0.072
9/1/2010	3.64	17.86	4.91	19.47	7.89	11.68	1.95	0.901	0.099
10/1/2010	4.37	19.88	4.54	19.65	8.02	12.30	2.56	0.806	0.125
11/1/2010	4.53	18.49	4.08	17.27	8.16	12.86	3.08	0.746	0.145
12/1/2010	4.28	19.20	4.49	20.00	8.29	13.45	3.70	0.847	0.168