

**EWART UNIT NO. 6**

**WATERFLOOD EOR PROJECT**

**ANNUAL REPORT FOR 2015**

**June 14, 2015**

**Tundra Oil and Gas Partnership**

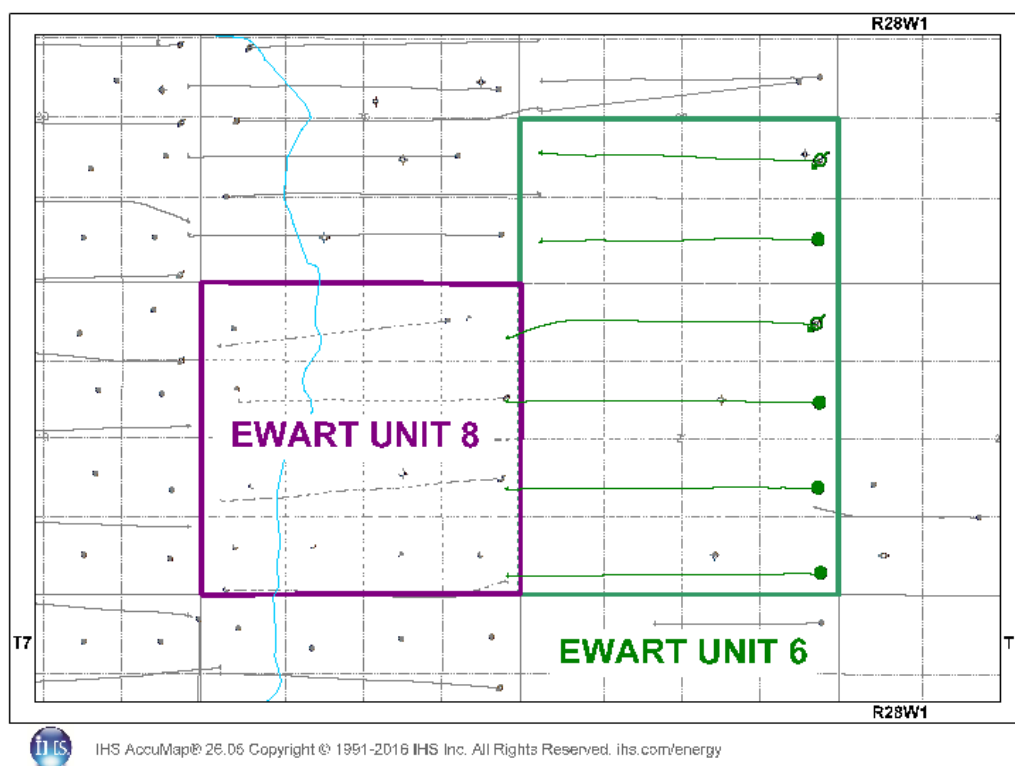
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## **INTRODUCTION**

Ewart Unit No. 6 Enhanced Oil Recovery (EOR) Waterflood Project was approved under Waterflood Order No. 42, effective January 1, 2015 with Tundra Oil and Gas (Tundra) as Operator. The EOR Unit area, outlined in green, contains 4 producing horizontal wells and 2 water injection wells in 16 LSDs in Township 7 Range 28 W1 as shown in the figure below. Well list and well status is available in Appendix A.

**Figure 1: Ewart Unit No. 6 Area Outline**



In accordance with Section 73 of the Manitoba Drilling and Production Regulation, Tundra hereby submits the following 2015 Annual Progress Report for Ewart Unit No. 6.

## **DISCUSSION**

### **Production History**

For the wells included in Ewart Unit No. 6, production started in August 2009 with the 02/08-28-007-28W1 well. Average oil production peaked at 10.39 m<sup>3</sup>/d per well in March

2012. This production was coming from 6 wells and totaled 62.36 m<sup>3</sup>/d for the Unit. In December 2015, the Unit was producing 12.33 m<sup>3</sup>/d of oil and 14.95 m<sup>3</sup>/d of water. Water injection commenced in Ewart Unit No. 6 in April 2015. The rates and WOR are presented in Figure 2.

**Figure 2: Ewart Unit No. 6 Production/Injection Rates and WOR vs Time**

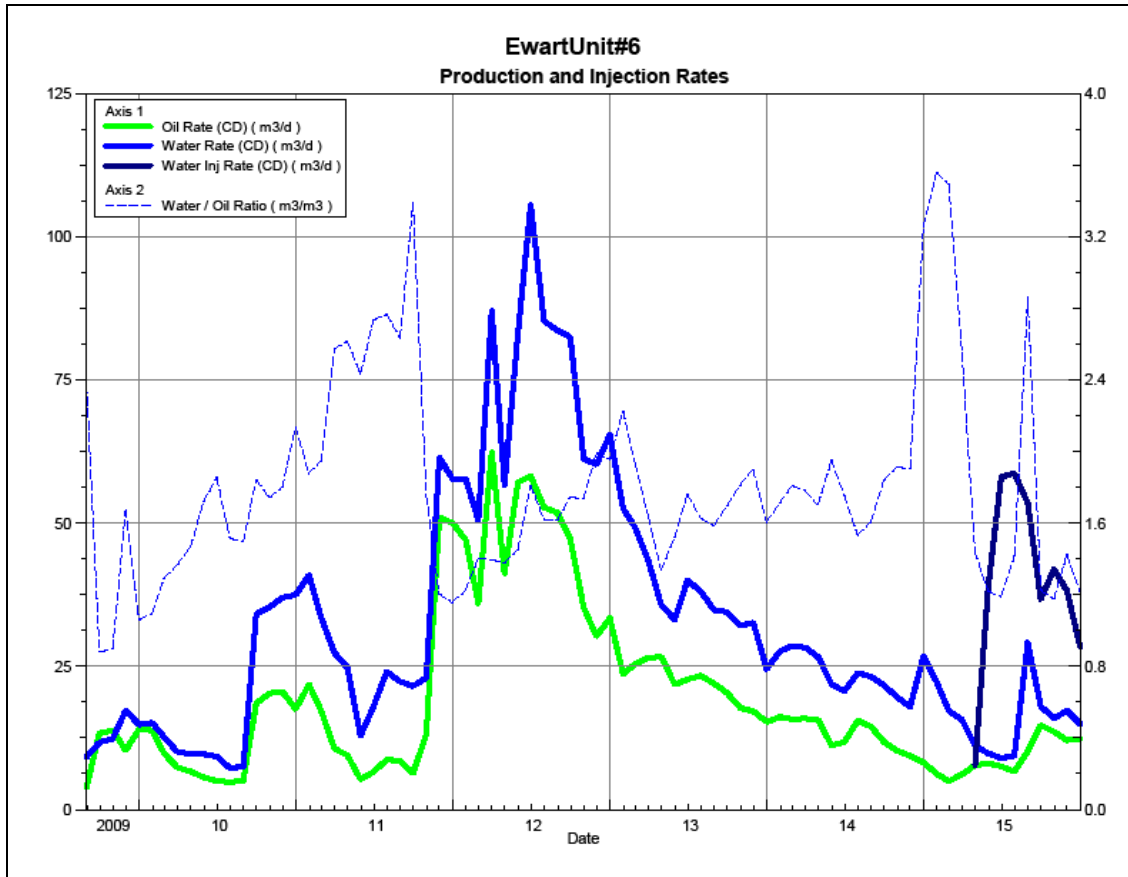
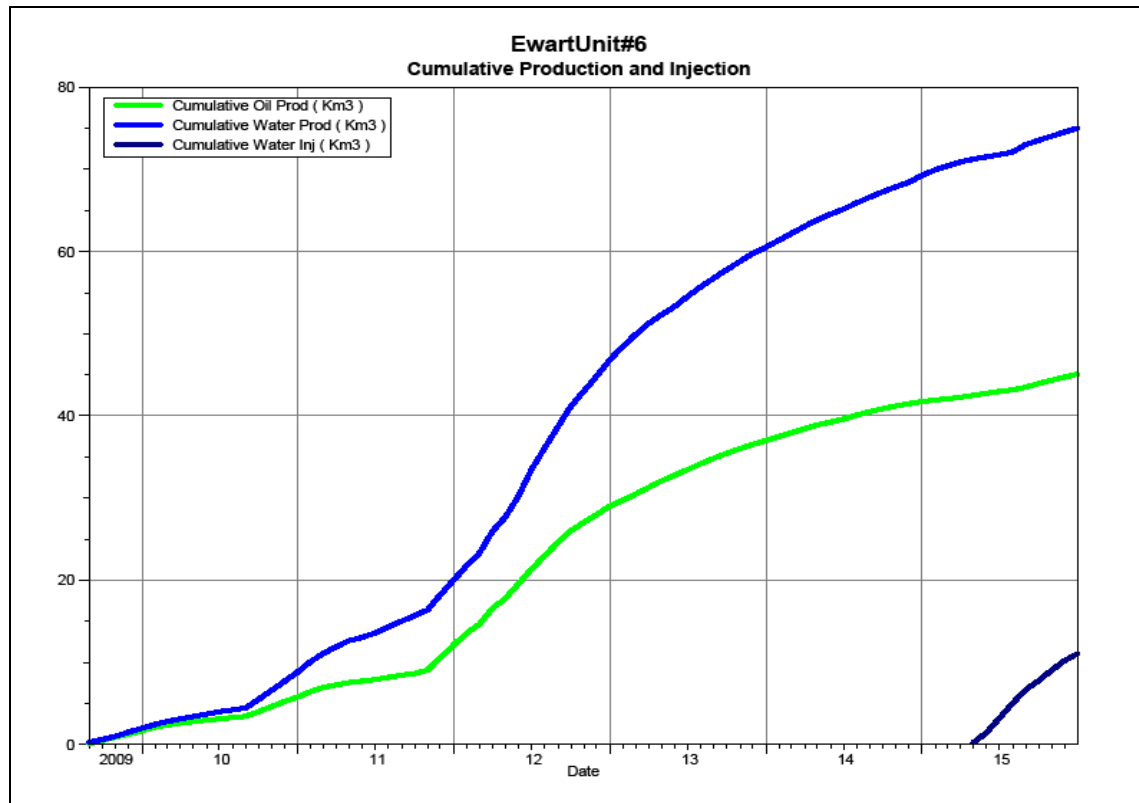


Figure 3 shows the cumulative production for Ewart Unit No. 6 to the end of December 2015 as 45.1 e<sup>3</sup>m<sup>3</sup> of oil, and 75.0 e<sup>3</sup>m<sup>3</sup> of water, representing a 6.9% recovery factor of the OOIP.

**Figure 3: Ewart Unit No. 6 Cumulative Oil, Water and Water Injected vs Time**



## **Waterflood Development Plan**

### **Ewart Unit No. 6 Waterflood (WF) Development Plan**

Ewart Unit No. 6 is still in the development phase at the end of 2015. Three (3) of the existing horizontal producing will be converted to injection wells within the proposed Ewart Unit No. 6 to complete waterflood patterns with effective 40 acre spacing. Ewart Unit No. 6 will be the first horizontal line drive at 40 acre spacing in the Daly Sinclair Field. All of the horizontal wells are fracture stimulated to improve the injection rates. In 2015, Tundra converted the 00/16-21 and 02/08-28-007-28W1 producers to injectors. Tundra anticipates converting the 00/08-21 producer to an injector in Q4 2016.

Production performance by injector pattern are summarized in Appendix B.

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 Ewart Unit No. 6 will be sourced from the 16-32-007-29W1 well (Lodgepole formation). The water is treated at the 03-04-007-29W1 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**

Injection started in this Unit in April 2015. The average monthly wellhead injection pressure for each injector is summarized in Appendix C. Since injection in this Unit is still in the early stages, the injectors are still building up to a target injection pressure of 6300 kPaa.

### **Reservoir Pressure**

Where practical, Tundra is committed to collecting pressure data from newly drilled openhole injection wells. For Ewart Unit No. 6, no reservoir pressure measurements were taken in 2015.

### **Well Servicing**

Table 1 lists the maintenance that was required in Ewart Unit No. 6 in 2015.

**Table 1: Service and Maintenance in Ewart Unit No. 6**

102.08-28-007-28W1.00	Packers Plus Drillout & WIW Conversion	2/10/2015
100.16-21-007-28W1.00	Cemented Liner Cleanout & WIW Conversion	2/13/2015
100.01-21-007-28W1.00	Cemented Liner Cleanout	7/24/2015

## **Waterflood Performance Discussion**

At the end of 2015, Ewart Unit No. 6 waterflood area had 2 injection patterns in place. The waterflood area had three (3) proposed horizontal injection wells drilled and put on production. Water injection began in April 2015, after the conversion of the 00/16-21 and 02/08-28 producers to injectors. Tundra currently plans to produce the 00/08-21 producer until the latter part of 2016 and then convert it to an injector.

Plots of the production and injection data along with the VRR information is presented in Appendix D for each of the injection patterns.

## **List of Appendices**

Appendix A: Well Name and Well Status

Appendix B: Injection Pattern Summary

Appendix C: Average Monthly Injection Pressure Summary

Appendix D: Injector Pattern Production/Injection Rates, Cumulative and VRR Plots for  
the following injectors:

00/08-21-007-28W1

00/16-21-007-28W1

02/08-28-007-28W1

## APPENDIX A

<i><b>UWI</b></i>	<i><b>Surface Hole Location</b></i>	<i><b>License Number</b></i>	<i><b>Type</b></i>	<i><b>Status</b></i>
100/01-21-007-28W1/0	100/01-20-007-28W1/0	008152	Horizontal	Capable of OIL Prod
100/08-21-007-28W1/0	100/08-20-007-28W1/0	008513	Horizontal	Capable of OIL Prod
100/09-21-007-28W1/0	100/09-20-007-28W1/0	008154	Horizontal	Capable of OIL Prod
100/16-21-007-28W1/0	100/16-20-007-28W1/0	008500	Horizontal	WTR Injection
100/01-28-007-28W1/0	100/04-28-007-28W1/0	007389	Horizontal	Capable of OIL Prod
102/08-28-007-28W1/0	102/05-28-007-28W1/0	006971	Horizontal	WTR Injection



## Appendix B

### Ewart Unit No. 6 Injection Pattern Summary as of December 2015

Pattern Name	Injector BH Location (007-28W1)	Injector Surf. Location (007-28W1)	Status	No. of Supported Wells	Supported Wells (007-28W1)	Allocation Factor	Pattern Prod Start Month	Inj Start Month	Oil Rate (m <sup>3</sup> /d)	Water Rate (m <sup>3</sup> /d)	WOR (m <sup>3</sup> /m <sup>3</sup> )	Water Injection (m <sup>3</sup> /d)	Cum Oil (E <sup>3</sup> m <sup>3</sup> )	Cum Water (E <sup>3</sup> m <sup>3</sup> )	Cum Inj Water (E <sup>3</sup> m <sup>3</sup> )	Monthly VRR	Cum VRR
00/08-21-007-28Inj	00/08-21	00/08-20	Capable of OIL Prod	2	01-21, 09-21	0.5	Oct 2011	-	7.1	6.3	0.89	-	18.6	21.2	0.0	0.000	0.000
00/16-21-007-28Inj	00/16-21	00/16-20	WTR Injection	2	09-21, 01-28	0.5	Aug 2010	Apr 2015	1.3	3.3	2.67	12.19	10.5	26.1	6.2	2.615	0.166
02/08-28-007-28Inj	02/08-28	02/05-28	WTR Injection	2	01-28, 09-28	0.5	Aug 2009	Apr 2015	0.9	4.7	4.99	16.16	11.5	31.9	4.9	2.861	0.110

## Appendix C

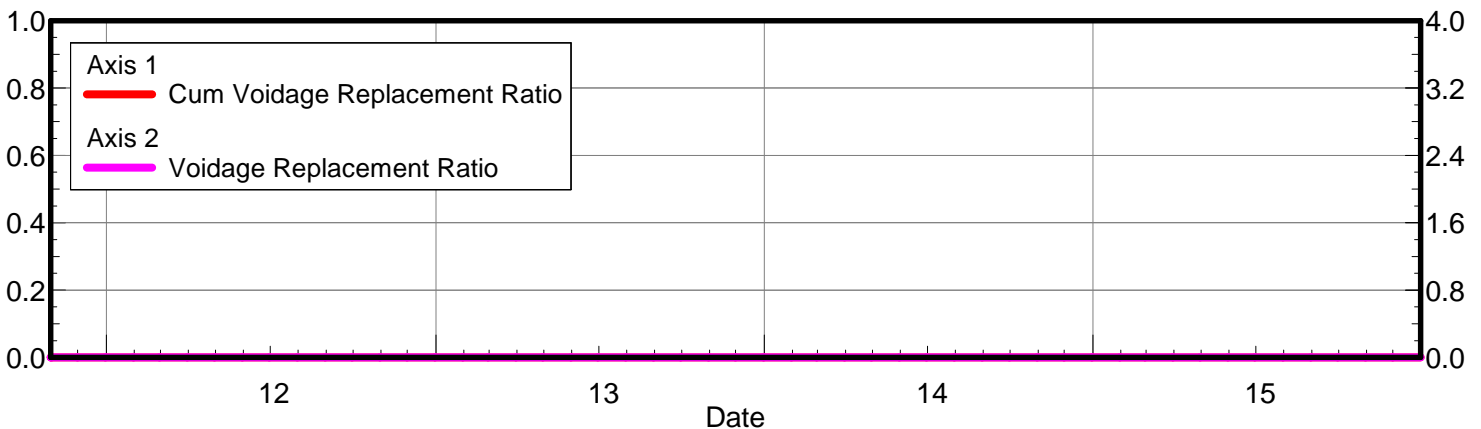
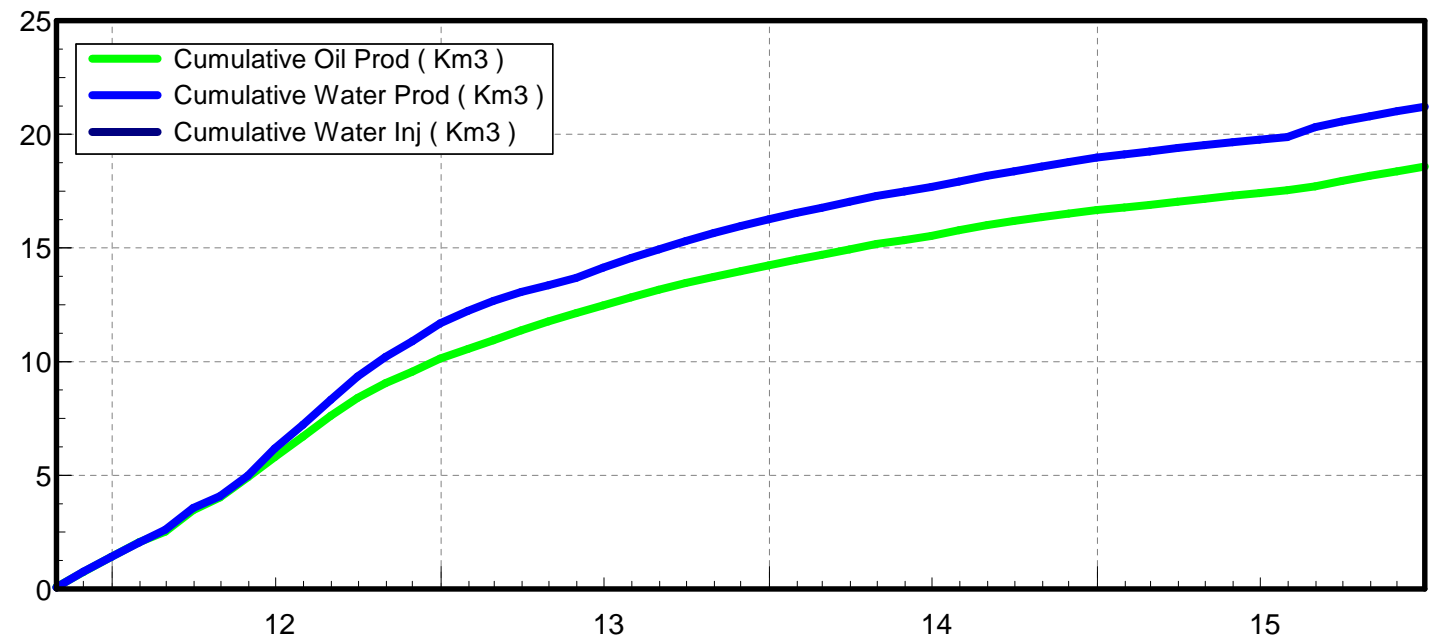
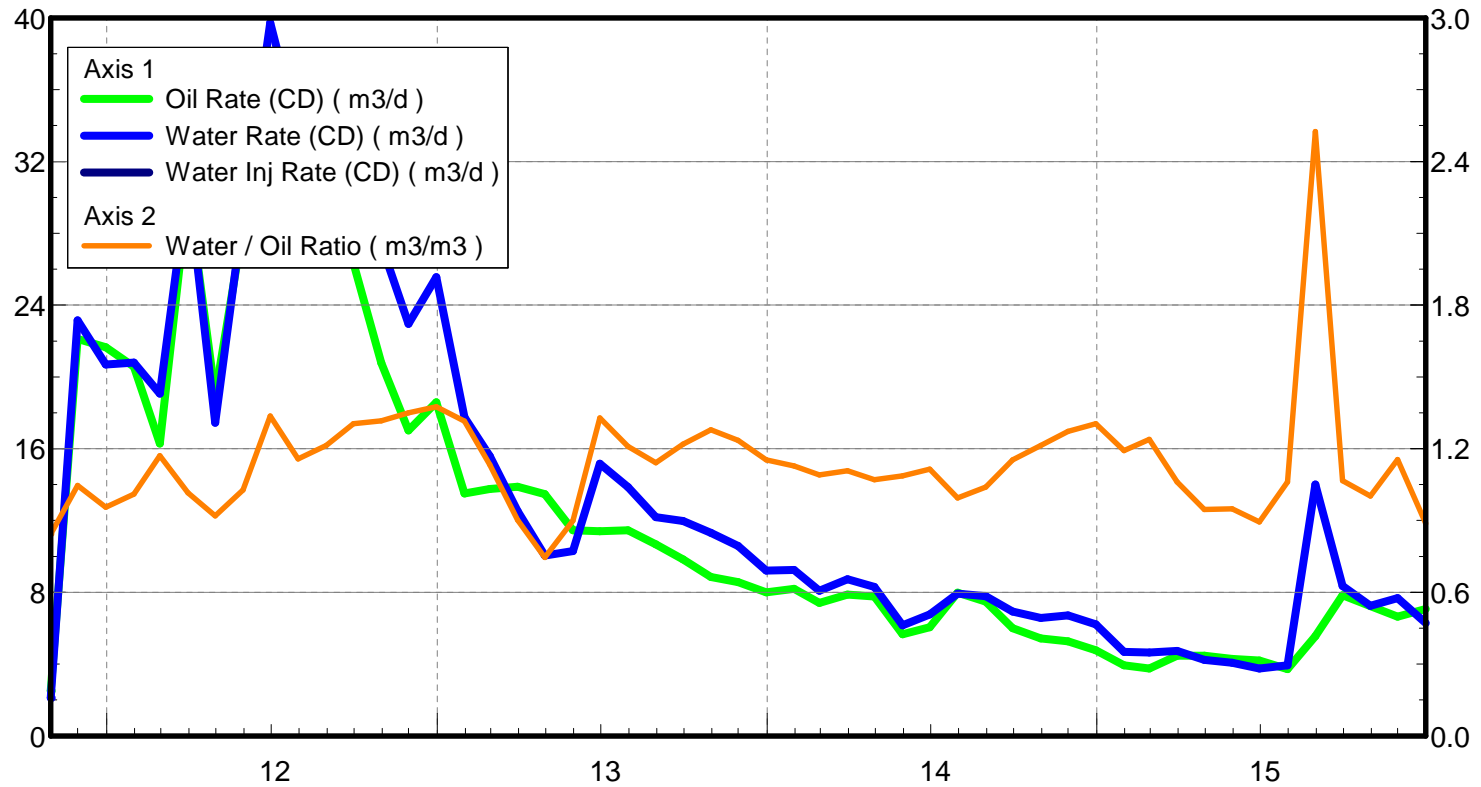
### Average Monthly Injection Pressure (kPag)

Month	100/16-21	102/08-28
Jan-15	-	-
Feb-15	-	-
Mar-15	-	-
Apr-15	105	-28
May-15	195	-79
Jun-15	-85	1019
Jul-15	1020	1694
Aug-15	2687	2260
Sep-15	4361	2449
Oct-15	3486	2881
Nov-15	3459	3256
Dec-15	3465	3453

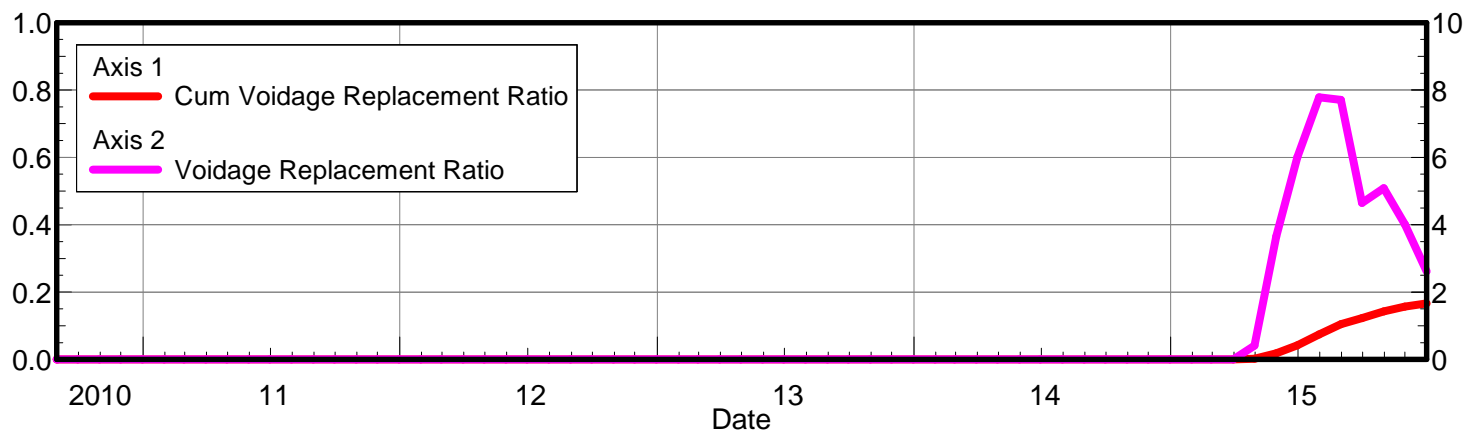
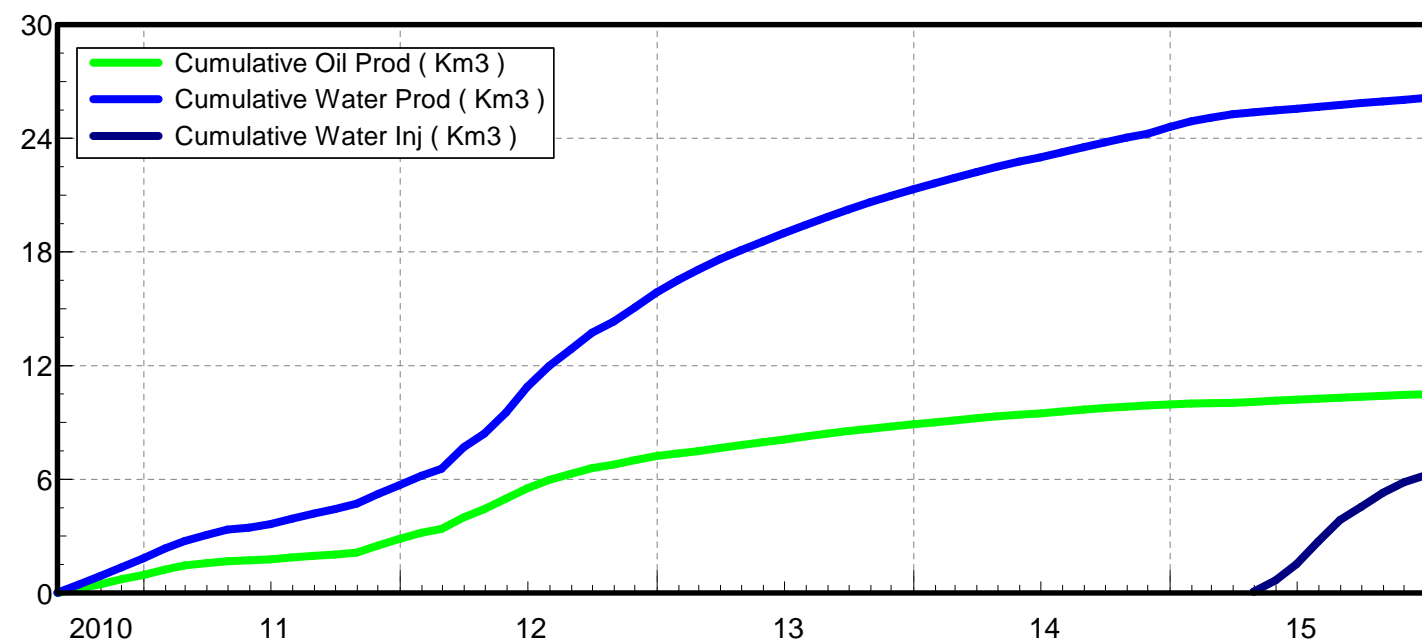
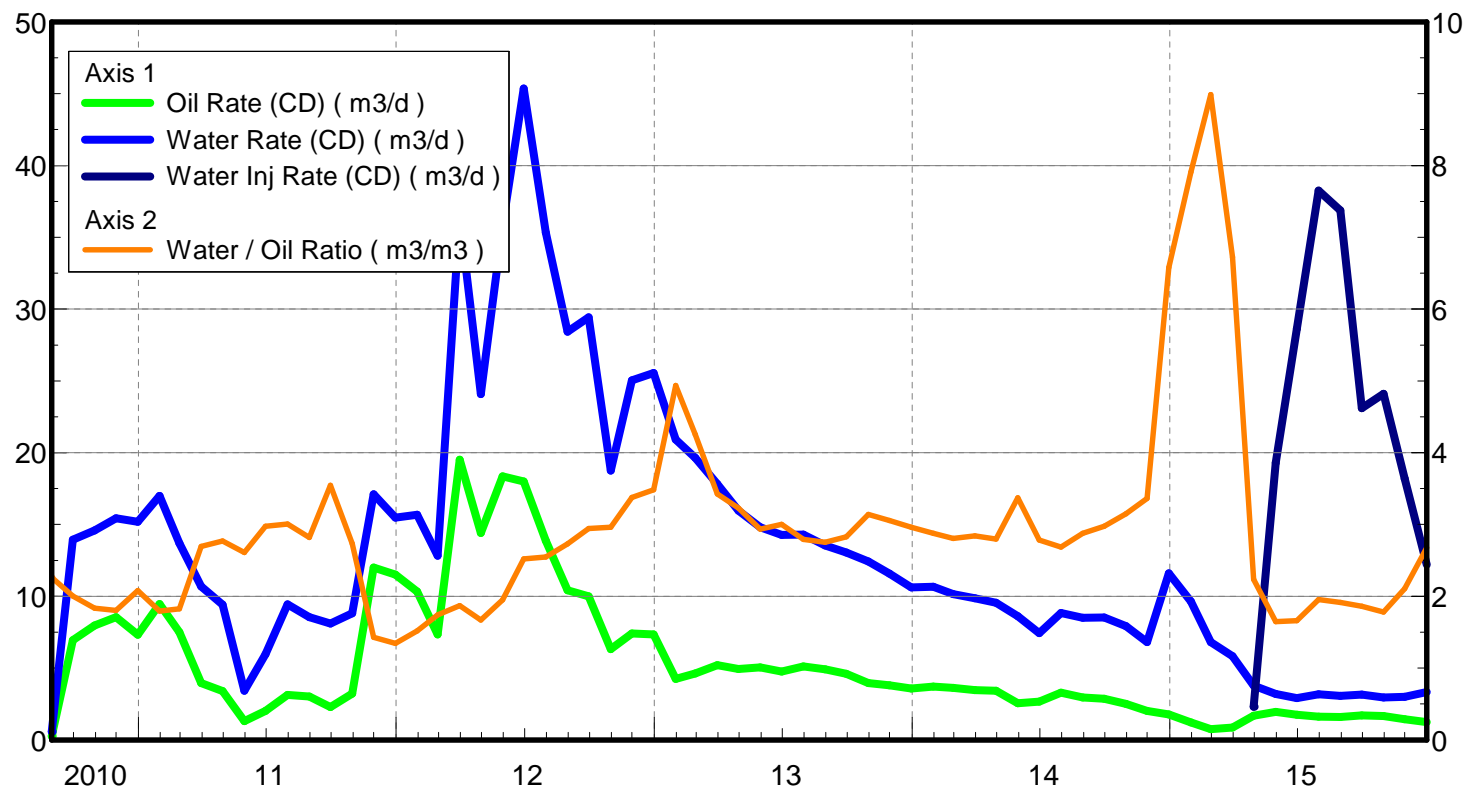
## **Appendix D**

### **Rates and VRR Plots**

Oil Formation Vol Factor : 1.00150 m3/m3  
Water Formation Vol Factor : 1.00150 m3/m3  
Water / Oil Ratio : 1.12 m3/m3  
Pattern : 00/08-21-007-28Inj Set: EwartUnit#6  
June 13, 2016  
Operator: Tundra\_O&G\_Prtshp  
Oil Rate (CD) : 5.57 m3/d  
Water Rate (CD) : 6.27 m3/d  
Water Inj Rate (CD) : \* m3/d



Oil Formation Vol Factor : 1.00150 m<sup>3</sup>/m<sup>3</sup> Pattern: 00/16-21-007-28Inj Set: EwartUnit#6 Oil Rate (CD) : 0.96 m<sup>3</sup>/d  
 Water Formation Vol Factor : 1.00150 m<sup>3</sup>/m<sup>3</sup> June 13, 2016 Water Rate (CD) : 3.14 m<sup>3</sup>/d  
 Water / Oil Ratio : 3.26 m<sup>3</sup>/m<sup>3</sup> Operator: Tundra\_O&G\_Prtshp Water Inj Rate (CD) : 13.39 m<sup>3</sup>/d



Oil Formation Vol Factor : 1.00150 m3/m3  
Water Formation Vol Factor : 1.00150 m3/m3  
Water / Oil Ratio : 5.65 m3/m3  
Pattern : 02/08-28-007-28Inj Set: EwartUnit#6  
June 13, 2016  
Operator: Tundra\_O&G\_Prtshp  
Oil Rate (CD) : 0.75 m3/d  
Water Rate (CD) : 4.21 m3/d  
Water Inj Rate (CD) : 14.90 m3/d

