

**PennWest**

# Waskada Unit No. 1

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## Waterflood Progress Report

**January 1<sup>st</sup> – December 31<sup>st</sup>, 2014**

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## **INTRODUCTION**

The Waskada Unit No.1 pressure maintenance project commenced water injection into the Mission Canyon designed and in accordance with Manitoba Energy and Mines Approval No. PM 47.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 47

## **UNIT INFORMATION**

UNITIZED ZONE: Mission Canyon  
Original Unit, June 1, 1976 Board Order; Unitization Order No. 22

POOL: Waskada Mission Canyon 3b A (03 42A)

This report documents the performance of the Waskada Unit No.1 pressure maintenance project for the period of January 1 to December 31, 2014. The Unit had no production or injection in 2014.

Unit 1 is part of the main Waskada field. The Waskada field is situated on the northeast rim of the Williston Basin in southern Manitoba. It comprises a large portion of Township 1 and 2, Ranges 25 and 26 W1.

## **GEOLOGY**

The Mission Canyon in the Waskada area produces light density crude (approximately 36° API). Stratigraphically the Mission Canyon can be divided up into various members and marker beds (ie. MC3b, MC3a, MC2, MC1). It is overlain by the Charles Formation or the angular Paleozoic/Mississippian Unconformity, with beds dipping to the southwest. The lithology consists of complex interbedded grainstones, packstones, wackestones, and mudstones with some members consisting of predominantly primary anhydrite (ie. MC2). Porous members typically have porosity of 13-15% and permeabilities of 20-40 mD, although localized alteration due to the truncating Mississippian Unconformity can significantly reduce or eliminate those values in certain areas. Oil accumulation is generally found on isolated structural highs or areas with associated updip permeability degradation.

## **DISCUSSION**

### **Production and Injection Performance**

Board Order No. PM 47 provided for pressure maintenance operations in Waskada Unit No.1. The Unit includes one injection well, 00/06-30-001-25W1/0, abandoned since September 2001, and five producers. None are currently active. Pressure maintenance by water injection began in 1976 until 1983 and ceased in until May 1991 when injection was restarted for 2 months. Injection reoccurred from Jan 1995 to March 1996. Gas injection was conducted from March 1986 to December 1994.

Please refer to Attachment 2 – A summary of the Unit Well List and History.

Please refer to Attachment 3 – A Production and Injection plot of the Unit.

Please refer to Attachment 4 – A summary of Unit Annual Volumes and Rates.

Please refer to Attachment 5 – A Cumulative Production and Injection plot of the Unit.

### **Voidage Replacement Ratio Calculation:**

The Cumulative VRR from production start and Injection start has remained stable around 4.5 and 6 since 1994. By lowering injection rates, until suspending and abandoning the injector, the cum VRR stabilized to a value of 4.3. Currently there is no active injector in this Unit and PennWest has no plans to reactivate injection.

Please refer to Attachment 6 – A Unit Voidage Replacement Ratio Plot.

Please refer to Attachment 7 – Individual Injection Well Performance Plots

### **Pressure Surveys:**

No pressure surveys were conducted in 2014.

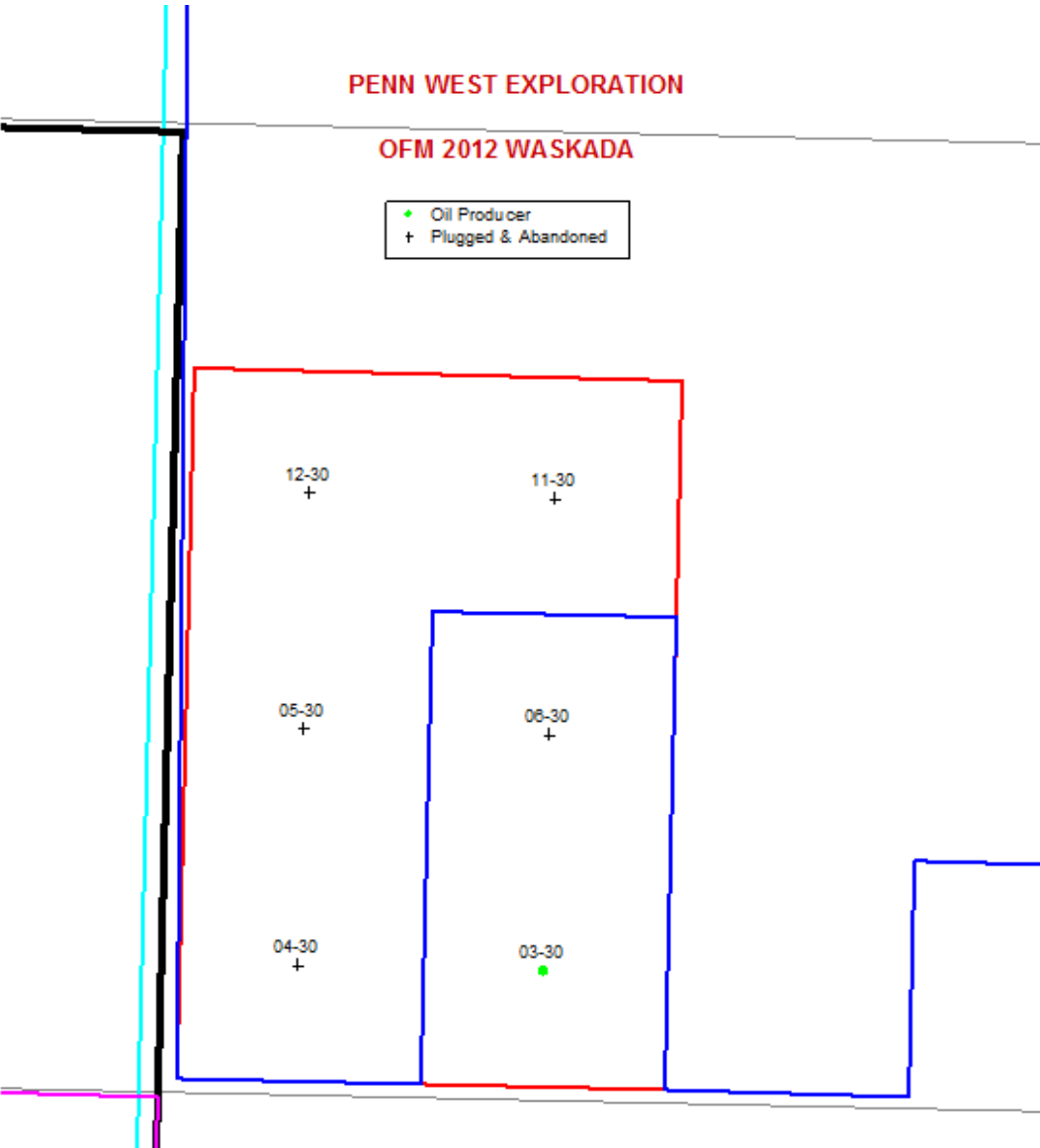
### **Corrosion and Scale Prevention Program:**

Scale corrosion programs are implemented throughout the field. Wells and pipelines have mitigation measures in place.

## **SUMMARY AND RECOMMENDATIONS**

There are currently no active producers or injectors in Waskada Unit 1. Production ended in March 2011 and no plans are in place to reactivate injection or production. Penn West's plan is to concentrate on the Lower Amaranth formation for now.

ATTACHMENT 1 – UNIT AREA MAP

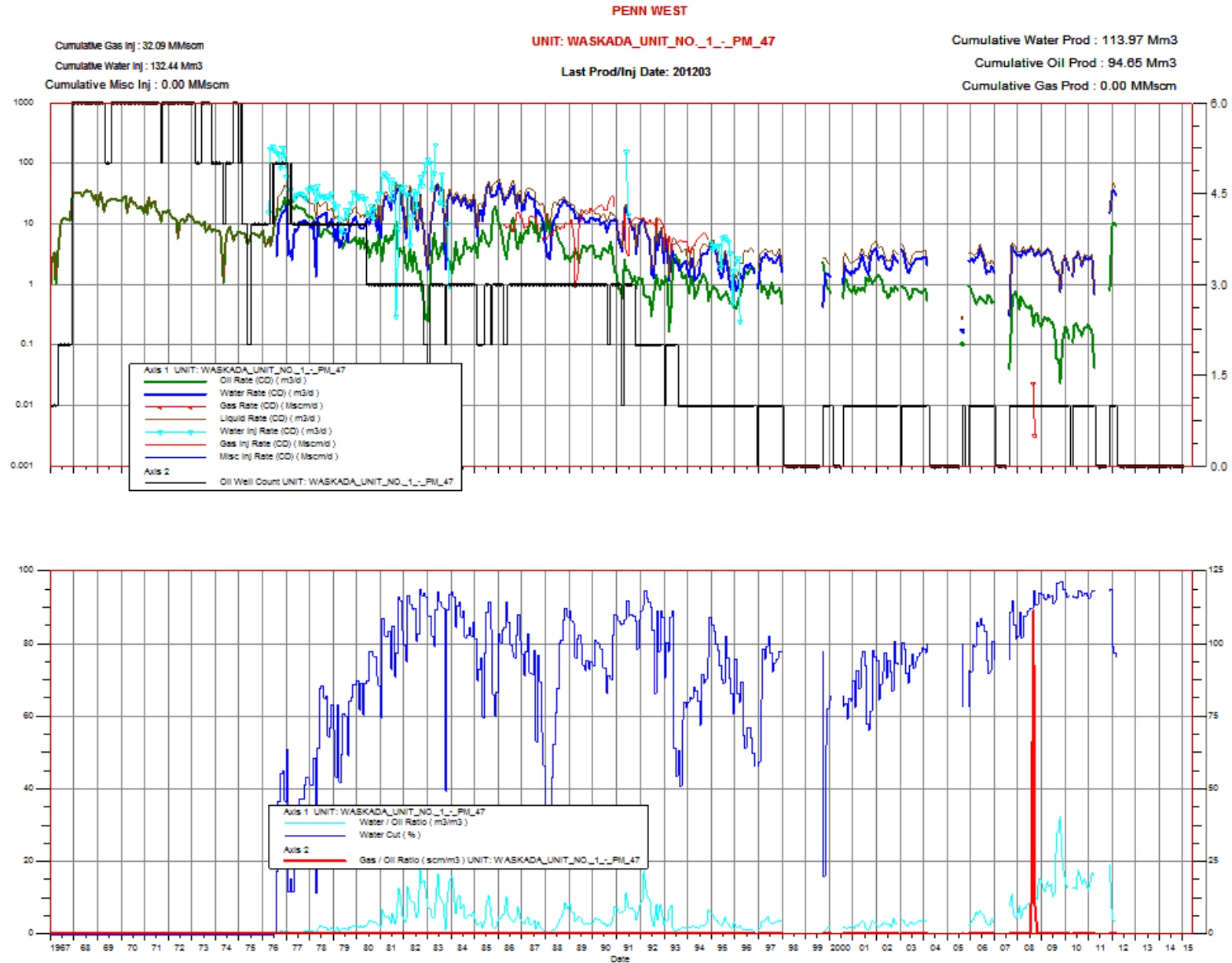


## ATTACHMENT 2 –UNIT HISTORY

*Unit History : Waskada - Unit # 1*

<i>UWI</i>	<i>Completion Date</i>	<i>Operator</i>	<i>Status</i>	<i>New Drills</i>	<i>Kb Elevation</i>	<i>Total Depth</i>	<i>First prd Date</i>	<i>Cum Oil Prd</i>	<i>Cum Water Prd</i>	<i>Last Prd Date</i>	<i>First Inj Date</i>	<i>Cum Water Inj</i>	<i>Cum Gas Inj</i>	<i>Last Inj Date</i>
					<i>m</i>	<i>m</i>		<i>m3</i>	<i>m3</i>			<i>m3</i>	<i>scm</i>	
00/03-30-001-25W1/0	11/25/1967	PENN_WEST	OIL	<N/A>	471.20	953.40	12/1/1967	23483.90	40482.30	3/1/2012		0.00	0.00	
00/04-30-001-25W1/0	12/2/1967	OMEGA_HYDROC	ABD-OIL	<N/A>	473.00	958.30	12/1/1967	23250.40	56278.50	9/1/1991		0.00	0.00	
00/05-30-001-25W1/0	3/21/1967	PENN_WEST	ABD-OIL	<N/A>	472.40	973.80	5/1/1967	15932.60	2775.80	6/1/1977		0.00	0.00	
00/06-30-001-25W1/0	11/11/1967	PENN_WEST	ABD-OIL	<N/A>	471.20	952.20	12/1/1967	10286.40	0.00	2/1/1975	4/1/1976	132443.20	32087500.00	4/1/1996
00/11-30-001-25W1/0	1/3/1967	PENN_WEST	ABD-OIL	<N/A>	472.40	960.10	1/1/1967	6145.90	839.80	5/1/1980		0.00	0.00	
00/12-30-001-25W1/0	11/19/1967	PENN_WEST	ABD-OIL	<N/A>	471.20	964.10	12/1/1967	15552.00	13590.40	7/1/1993		0.00	0.00	

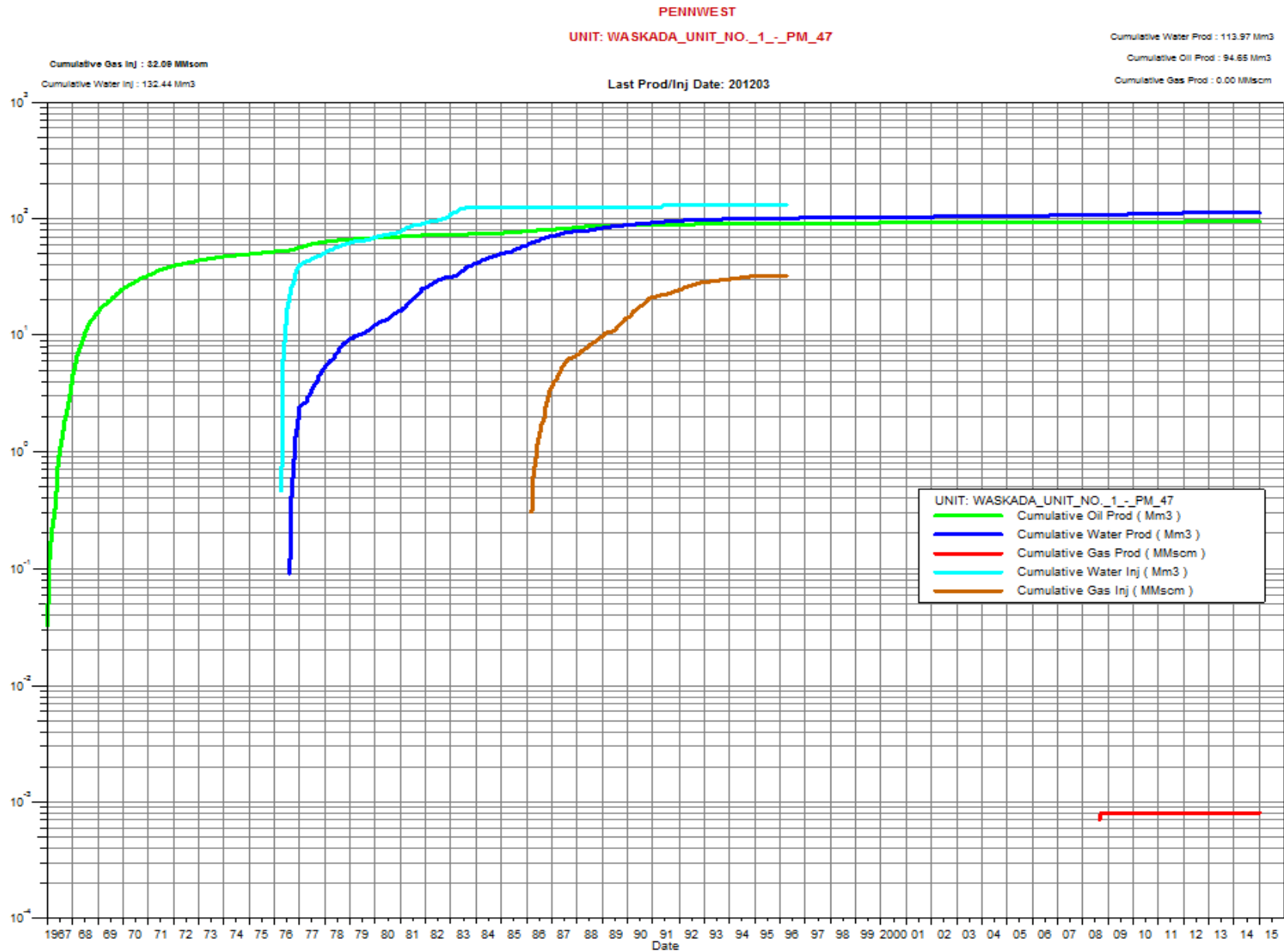
## ATTACHMENT 3 – UNIT PRODUCTION AND INJECTION PLOT



**ATTACHEMENT # 4 – UNIT ANNUAL VOLUMES AND RATES**

<i>Unit : Waskada Unit # 1-- PM47</i>								
<i>Rates and Volume History</i>								
<i>Date</i>	<i>Annual Oil Prd</i>	<i>Annual Oil Rate</i>	<i>Annual Water Prod</i>	<i>Annual Water Prod Rate</i>	<i>Annual Water Inj</i>	<i>Annual Water Inj Rate</i>	<i>Annual Gas Inj</i>	<i>Annual Gas Inj rate</i>
	<i>m3</i>	<i>m3/d</i>	<i>m3</i>	<i>m3/d</i>	<i>m3</i>	<i>m3/d</i>	<i>Mscm</i>	<i>Mscm/d</i>
1/1/1981	2013.70	5.52	9350.90	25.62	15005	41.11	0.00	0.00
1/1/1982	741.80	2.03	6083.30	16.67	14360	39.34	0.00	0.00
1/1/1983	1190.40	3.26	9346.40	25.61	19474	53.35	0.00	0.00
1/1/1984	1308.00	3.57	8836.20	24.14	0	0.00	0.00	0.00
1/1/1985	3055.80	8.37	9208.10	25.23	0	0.00	0.00	0.00
1/1/1986	2549.00	6.98	11575.40	31.71	0	0.00	3299.10	9.04
1/1/1987	3082.80	8.45	7413.30	20.31	0	0.00	3403.90	9.33
1/1/1988	2536.90	6.93	5102.40	13.94	0	0.00	2959.00	8.08
1/1/1989	1284.00	3.52	5025.50	13.77	0	0.00	4123.60	11.30
1/1/1990	1226.00	3.36	3991.00	10.93	0	0.00	7463.30	20.45
1/1/1991	498.80	1.37	3451.30	9.46	5194	14.23	2886.30	7.91
1/1/1992	321.70	0.88	2625.50	7.17	0	0.00	4057.90	11.09
1/1/1993	584.20	1.60	1015.50	2.78	0	0.00	1905.70	5.22
1/1/1994	384.00	1.05	888.40	2.43	0	0.00	1988.70	5.45
1/1/1995	251.80	0.69	872.00	2.39	1530	4.19	0.00	0.00
1/1/1996	420.90	1.15	538.90	1.47	215	0.59	0.00	0.00
1/1/1997	315.50	0.86	935.00	2.56	0	0.00	0.00	0.00
1/1/1998	15.20	0.04	52.90	0.14	0	0.00	0.00	0.00
1/1/1999	142.00	0.39	104.90	0.29	0	0.00	0.00	0.00
1/1/2000	191.30	0.52	329.90	0.90	0	0.00	0.00	0.00
1/1/2001	357.00	0.98	840.50	2.30	0	0.00	0.00	0.00
1/1/2002	347.40	0.95	933.50	2.56	0	0.00	0.00	0.00
1/1/2003	264.20	0.72	835.30	2.29	0	0.00	0.00	0.00
1/1/2004	65.50	0.18	237.70	0.65	0	0.00	0.00	0.00
1/1/2005	31.70	0.09	80.00	0.22	0	0.00	0.00	0.00
1/1/2006	221.90	0.61	919.90	2.52	0	0.00	0.00	0.00
1/1/2007	73.90	0.20	412.90	1.13	0	0.00	0.00	0.00
1/1/2008	154.40	0.42	1228.00	3.36	0	0.00	0.00	0.00
1/1/2009	66.70	0.18	934.00	2.56	0	0.00	0.00	0.00
1/1/2010	60.20	0.16	849.30	2.33	0	0.00	0.00	0.00
1/1/2011	43.90	0.12	753.20	2.06	0	0.00	0.00	0.00
1/1/2012	885.70	2.42	3083.90	8.43	0	0.00	0.00	0.00
1/1/2013	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
1/1/2014	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00
Sum	24686.30		97855.00		55778			

## ATTACHMENT 5 – UNIT CUMULATIVE PRODUCTION AND INJECTION PLOT



## ATTACHMENT 6 – UNIT VOIDAGE REPLACEMENT RATIO PLOT

PENNWEST

UNIT: WASKADA\_UNIT\_NO.\_1\_-\_PM\_47

Cumulative Water Prod : 113.97 Mm3

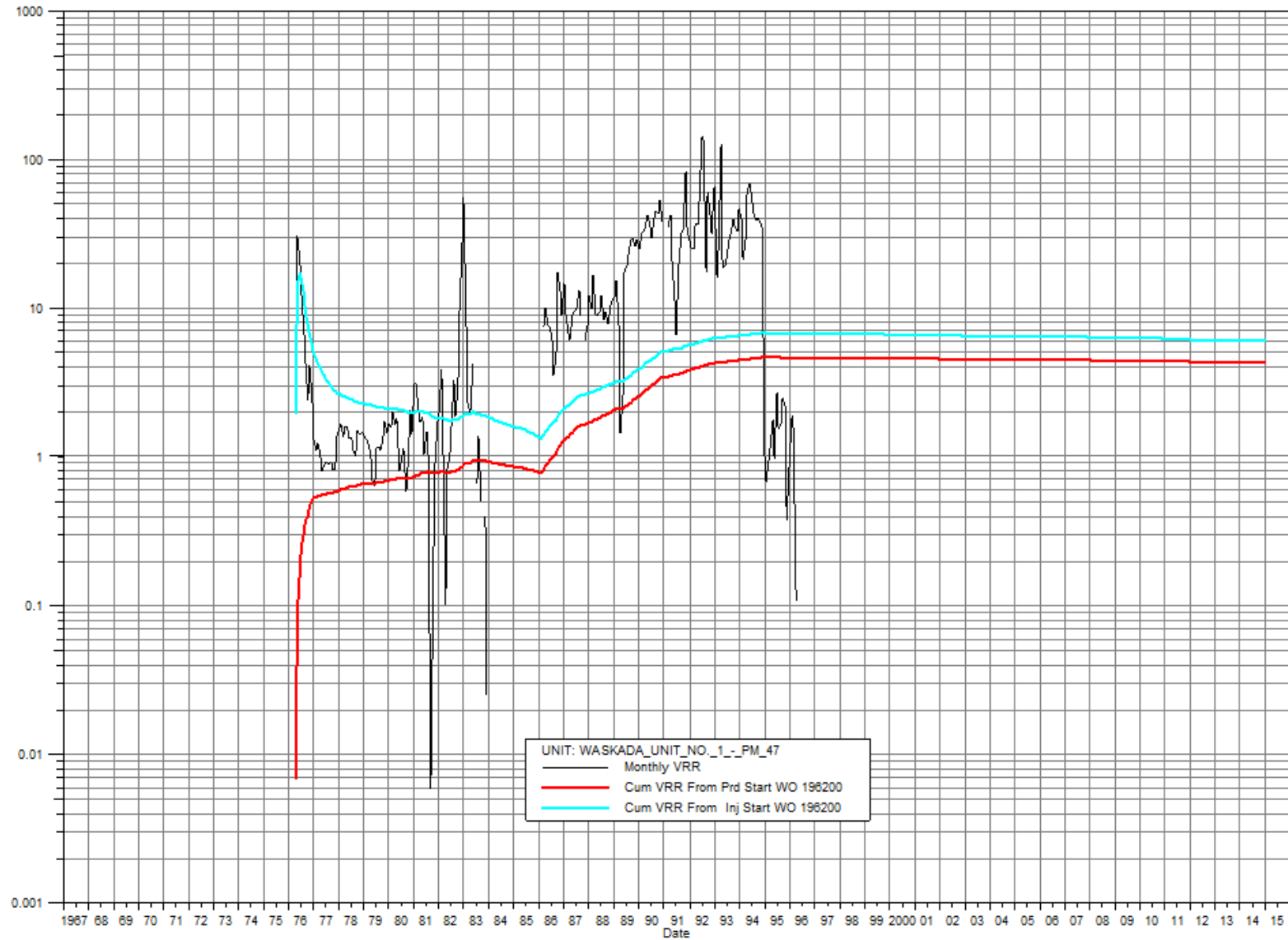
Cumulative Oil Prod : 94.65 Mm3

Cumulative Gas Prod : 0.00 Mm3scf

Cumulative Gas Inj : 32.09 Mm3scf

Cumulative Water Inj : 132.44 Mm3

Last Prod/Inj Date: 201203



## ATTACHMENT 7 – INDIVIDUAL INJECTION WELL PERFORMANCE PLOTS (1 WELL)

