

PennWest

Waskada Unit No.8

Waterflood Progress Report

January 1st – December 31st, 2014

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INTRODUCTION:

The Waskada Unit No.8 pressure maintenance project commenced water injection into the Lower Amaranth designed and in accordance with Manitoba Energy and Mines Approval No. PM 58.

Please refer to Attachment 1 – Area Map.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 58

UNIT INFORMATION

UNITIZED ZONE: Lower Amaranth
Original Unit, September 1, 1985 Board Order – Voluntary
First Enlargement, June 1, 1986 Board Order - Voluntary

POOL: Waskada Lower Amaranth A (03 29A)

This report documents the performance of the Waskada Unit No. 8 pressure maintenance project for the period of January 1 to December 31, 2014. The Unit had 4 active producers and 1 active injector at the end of 2014. There were no new drills in 2014.

Unit No. 8 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 Waskada Fields produce light density crude (approximately 36° API), predominantly from the Lower Amaranth formation. This is an interlaminated, shallow marine to subtidal succession of sandstones, siltstones, and shale progressively onlaps the Mississippian unconformity surface from basin center, up dip to the north and eastern basin limits in Saskatchewan and Manitoba. The fine grained reservoir rock has a complex reservoir characterization with 13 to 16 % porosity and permeability on the order of 0.5 to 15 md. The Lower Amaranth, the oldest Mesozoic unit, is a clastic red bed sequence lying directly on the Paleozoic erosional surface. It consists of a series of dolomitic siltstones and sandstones interbedded with argillaceous siltstones and shales. The section is usually subdivided into a lower sandy unit and an overlying shale unit. The lower sequence is the oil production zone. The bulk of pay is found in the laminated sandstone/siltstone facies.

The Lower Amaranth has been classified into four general lithological types:

1. Interbedded shale/siltstone/sandstone by grain size, color and texture
2. Siltstone – This lithology occurs in distinct intervals up to two or three metres in thickness. It is generally light green in color and dolomitic.

3. Laminated sandstone – This occurs in distinct sandy intervals with a wide range of grain sizes and primary sedimentary structures.
4. Massive sandstone – This lithology occurs in thin intervals and usually associated with the laminated sandstones facies. Beds are usually light grey to reddish grey in color and coarse to medium – grained.

DISCUSSION

Production and Injection Performance

Board Order No. PM 58 provided for pressure maintenance operations in Waskada Unit No.8. From the startup of injection in October 1985, injection rates fluctuated to the same degree in each injector, making it difficult to link any production responses to any injector. The Unit includes 4 injection wells; at the end of 2014 one was active (100/15-08-002-25W1/0). Injection ceased in the other 3 in 2006. There are currently 4 active producers.

Please refer to Attachment 2 – A Summary of the Unit Well List and History with New Drills

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 is at 1.8; the Cumulative VRR from injection start is at 2.1. This indicates over injection. Both have increased in the last 7 years due to a Monthly VRR consistently above 1.0 as such it has been reduced in the last year. Based on the unusually high cumulative injection, the 100/15-8-25-25W3 Inj well may be in communication with the Mission Canyon. Penn West has no plans to reactivate at this time any of the other injectors.

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

Please refer to Attachment 7 – Individual Injection Well Performance Plots

Pressure Surveys:

There were no pressure surveys conducted in 2013.

Corrosion and Scale Prevention Program:

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

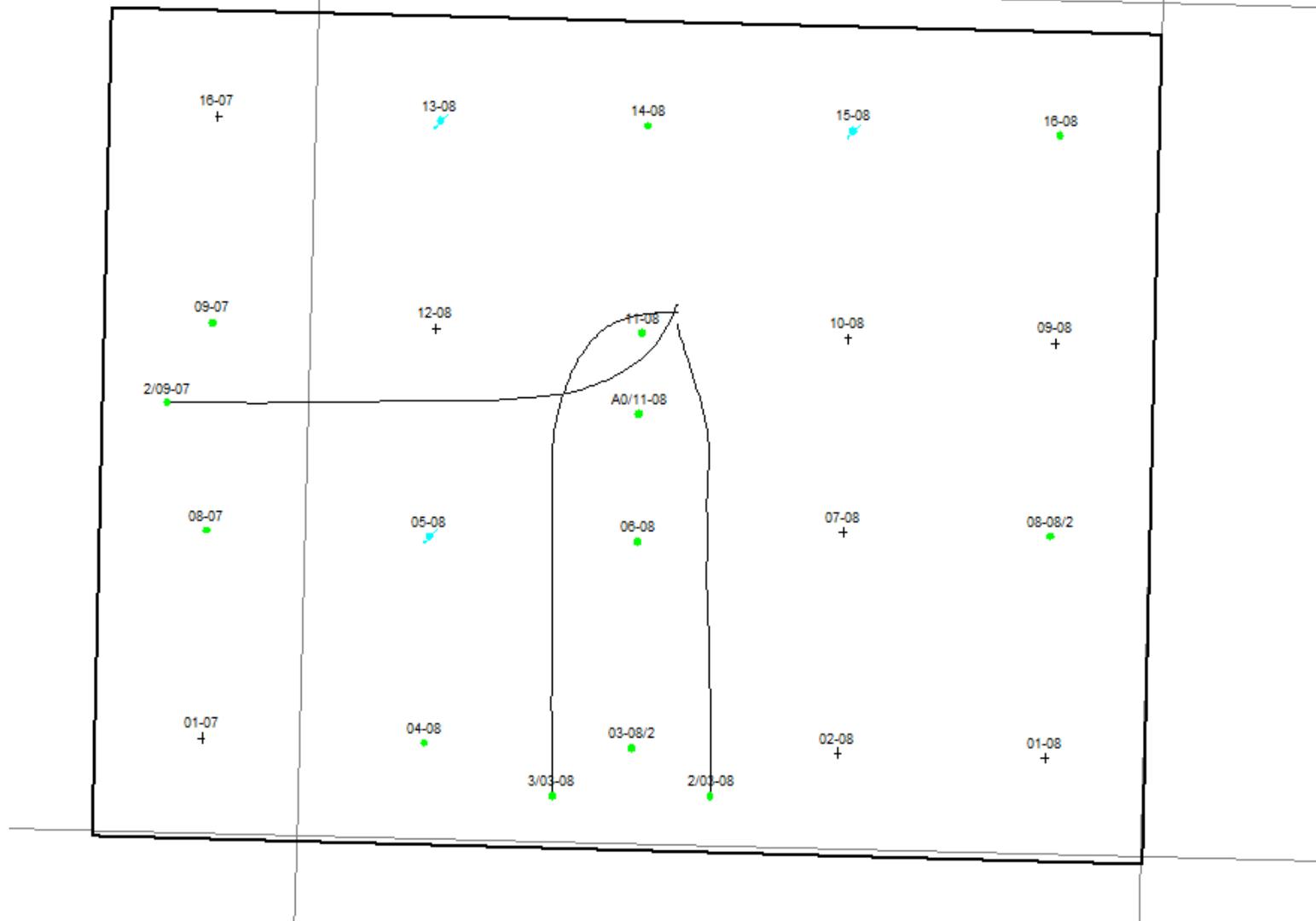
SUMMARY AND RECOMMENDATIONS

The behavior of Waskada Unit 8 producers are indicated by good initial oil productivity, rapidly declining to low rates, with almost no discernible water flood response. It is also believed that fracture stimulation treatments, performed on these wells prior to initiation of water injection, “broke through” into the higher productivity Mississippian and that the majority of injected water to date has entered this zone. This is one of the major explanations for lack of waterflood response to date and the continued decline in oil productivities.

ATTACHMENT 1 – UNIT AREA MAP

PENN WEST EXPLORATION OFM 2012 WASKADA

- Oil Producer
- + Plugged & Abandoned
- ↙ Water Injector



ATTACHMENT 2- UNIT HISTORY

Unit History : Waskada - Unit # 8

UWI	Completion Date	Operator	Status	New Drills	Kb Elevation	Total Depth	First prd Date	Cum Oil Prd	Cum Water Prd	Last Prd Date	First Inj Date	Cum Water Inj	Cum Gas Inj	Last Inj Date
					m	m		m3	m3			m3	scm	
00/01-07-002-25W1/0	8/12/1984	OMEGA_HYD ROC	ABD- OIL	<N/A>	474.40	919.00	10/1/1984	237.20	252.90	4/1/1989		0.00	0.00	
00/01-08-002-25W1/0	7/11/1984	OMEGA_HYD ROC	ABD- OIL	<N/A>	476.60	924.00	10/1/1984	785.30	985.40	8/1/1988		0.00	0.00	
00/02-08-002-25W1/0	6/10/1984	PENN_WEST	ABD- OIL	<N/A>	476.50	904.00	6/1/1984	3319.40	1474.00	2/1/1998		0.00	0.00	
00/03-08-002-25W1/2	7/6/1984	PENN_WEST	OIL	<N/A>	476.40	927.00	11/1/1984	10210.90	8562.80	7/1/2011		0.00	0.00	
00/04-08-002-25W1/0	7/3/1984	PENN_WEST	OIL	<N/A>	475.70	923.00	8/1/1984	23335.10	7753.80	11/1/2010		0.00	0.00	
00/05-08-002-25W1/0	10/28/1983	PENN_WEST	WTR- INJ	<N/A>	475.90	905.00	11/1/1983	1970.10	1927.90	9/1/1985	10/1/1985	90562.90	0.00	6/1/2006
00/06-08-002-25W1/0	9/23/1983	PENN_WEST	OIL	<N/A>	477.90	902.00	10/1/1983	14842.20	3069.50	11/1/2010		0.00	0.00	
00/07-08-002-25W1/0	7/18/1983	PENN_WEST	ABD- WINJ	<N/A>	477.00	940.00	8/1/1983	5593.10	133.00	10/1/1986	11/1/1986	68843.70	0.00	11/1/2006
00/08-07-002-25W1/0	8/15/1984	PENN_WEST	OIL	<N/A>	474.10	923.00	8/1/1984	9602.30	1963.00	11/1/2010		0.00	0.00	
00/08-08-002-25W1/2	7/14/1984	PENN_WEST	CMG- OIL	<N/A>	476.90	920.00	5/1/1985	2225.50	1191.40	10/1/2010		0.00	0.00	
00/09-07-002-25W1/0	8/8/1984	PENN_WEST	OIL	<N/A>	475.80	919.00	8/1/1984	12992.70	2313.40	11/1/2010		0.00	0.00	
00/09-08-002-25W1/0	9/19/1983	PENN_WEST	ABD- OIL	<N/A>	477.90	900.00	10/1/1983	3911.00	2219.00	7/1/1996		0.00	0.00	
00/10-08-002-25W1/0	10/31/1983	PENN_WEST	ABD- OIL	<N/A>	476.90	900.00	11/1/1983	13258.90	11600.00	9/1/2000		0.00	0.00	
00/11-08-002-25W1/0	7/24/1984	PENN_WEST	OIL	<N/A>	476.50	924.00	9/1/1984	20103.90	6611.40	7/1/2011		0.00	0.00	
00/12-08-002-25W1/0	7/28/1984	PENN_WEST	ABD- OIL	<N/A>	477.10	924.00	11/1/1984	2257.20	1900.00	7/1/1996		0.00	0.00	
00/13-08-002-25W1/0	7/31/1984	PENN_WEST	WTR- INJ	<N/A>	475.20	919.00	10/1/1984	122.20	65.40	9/1/1985	10/1/1985	63425.70	0.00	6/1/2006
00/14-08-002-25W1/0	6/13/1984	PENN_WEST	OIL	<N/A>	475.50	908.00	8/1/1984	20326.90	2710.90	1/1/2015		0.00	0.00	
00/15-08-002-25W1/0	7/20/1984	PENN_WEST	WTR- INJ	<N/A>	478.50	915.00	10/1/1984	545.10	372.70	9/1/1985	10/1/1985	392811.7 0	0.00	6/1/2014
00/16-07-002-25W1/0	8/4/1984	PENN_WEST	ABD- OIL	<N/A>	472.70	924.00	10/1/1984	5006.70	4593.50	6/1/1996		0.00	0.00	
00/16-08-002-25W1/0	7/17/1984	PENN_WEST	OIL	<N/A>	477.60	921.00	7/1/1984	19742.30	5747.00	3/1/2011		0.00	0.00	
02/03-08-002-25W1/0	2/24/2011	PENN_WEST	OIL	<N/A>	477.10	1693.00	8/1/2011	6139.30	23672.30	1/1/2015		0.00	0.00	
02/09-07-002-25W1/0	8/15/2012	PENN_WEST	OIL	<N/A>	477.50	1785.00	10/1/2012	5986.10	20884.20	1/1/2015		0.00	0.00	
03/03-08-002-25W1/0	8/10/2012	PENN_WEST	OIL	<N/A>	477.60	1770.00	9/1/2012	3582.60	8046.90	1/1/2015		0.00	0.00	
A0/11-08-002-25W1/0	10/22/1997	PENN_WEST	OIL	<N/A>	477.10	926.00	11/1/1997	4984.50	776.40	11/1/2010		0.00	0.00	

ATTACHMENT 3 – UNIT PRODUCTION AND INJECTION PLOT

PENN WEST

UNIT: WASKADA_UNIT_NO_3_-_PM_58

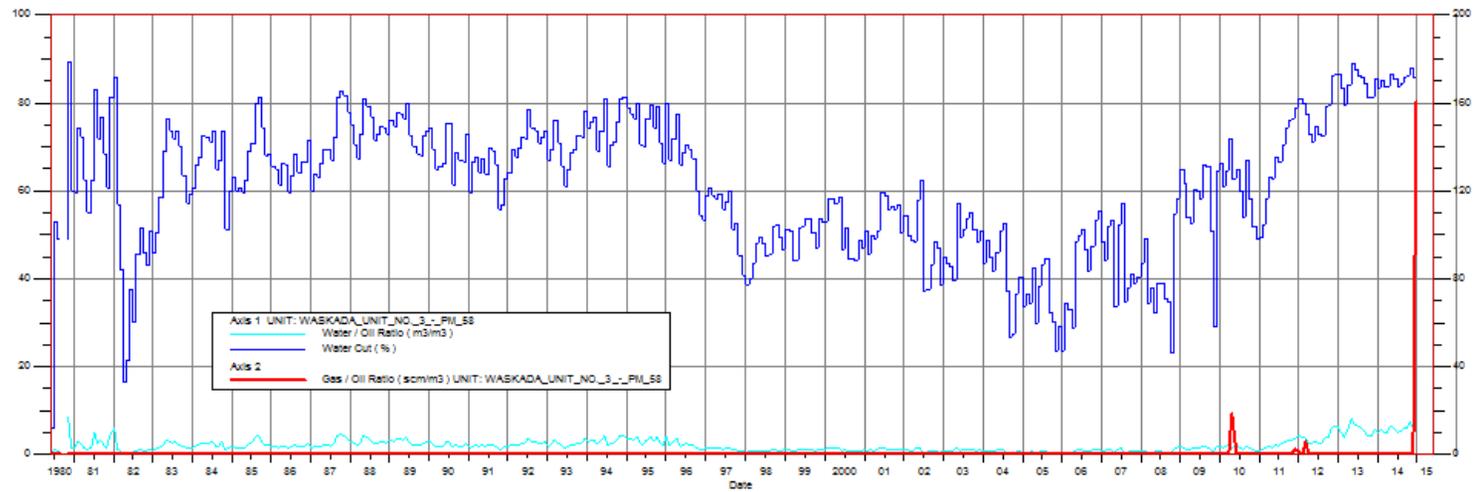
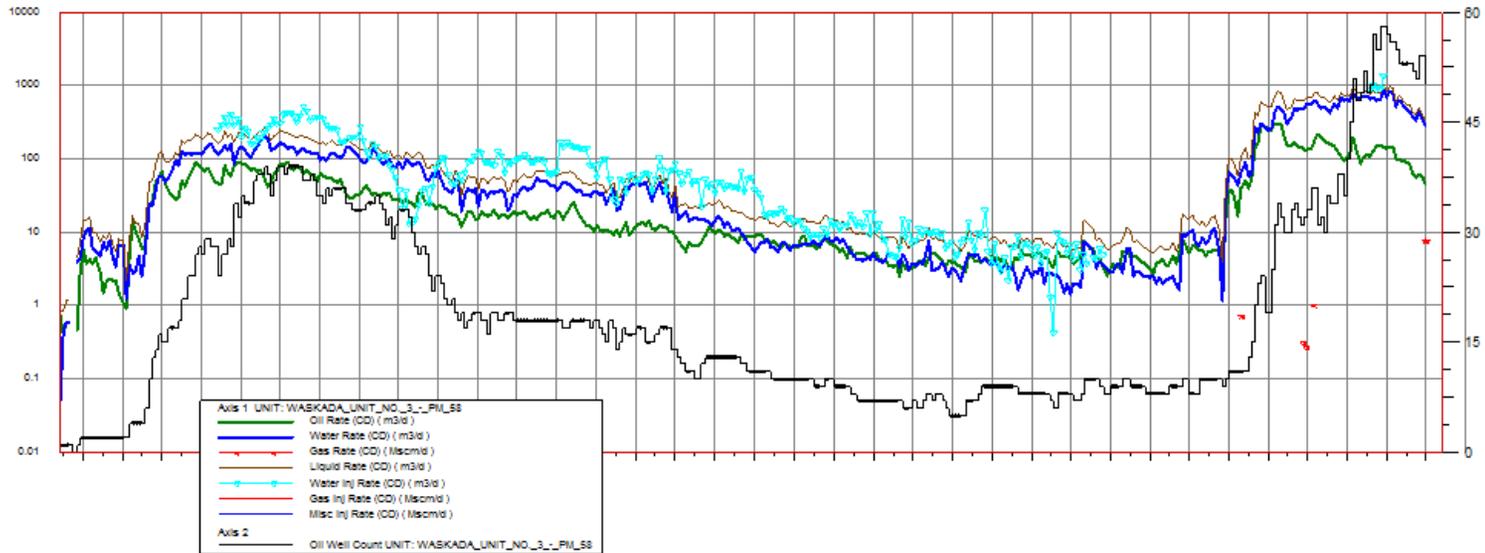
Cumulative Water Prod : 1277.41 Mm3

Cumulative Oil Prod : 456.86 Mm3

Last Prod/Inj Date: 201501

Cumulative Gas Prod : 0.31 MMscm

Cumulative Gas Inj : 0.00 MMscm
 Cumulative Water Inj : 855.72 Mm3
 Cumulative Misc Inj : 0.00 MMscm



ATTACHMENT 4 –UNIT ANNUAL VOLUMES AND RATES

<i>Unit : Waskada Unit # 8 -- PM58</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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/1/1982	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1/1/1983	1072.30	2.94	235.10	0.64	0.00	0.00	0.00	0.00
1/1/1984	9163.20	25.04	1920.70	5.25	0.00	0.00	0.00	0.00
1/1/1985	20802.60	56.99	6067.50	16.62	11348	31.09	0.00	0.00
1/1/1986	16538.60	45.31	3805.80	10.43	57395	157.25	0.00	0.00
1/1/1987	14757.10	40.43	2561.40	7.02	47134	129.14	0.00	0.00
1/1/1988	11953.70	32.66	4153.70	11.35	18592	50.80	0.00	0.00
1/1/1989	11607.20	31.80	4747.80	13.01	9878	27.06	0.00	0.00
1/1/1990	9024.20	24.72	4501.30	12.33	11526	31.58	0.00	0.00
1/1/1991	8144.60	22.31	3456.40	9.47	13196	36.15	0.00	0.00
1/1/1992	7266.50	19.85	3222.90	8.81	14976	40.92	0.00	0.00
1/1/1993	6628.50	18.16	2171.70	5.95	31660	86.74	0.00	0.00
1/1/1994	5331.70	14.61	2716.30	7.44	11248	30.82	0.00	0.00
1/1/1995	5152.00	14.12	4522.40	12.39	12639	34.63	0.00	0.00
1/1/1996	4672.90	12.77	2289.10	6.25	14502	39.62	0.00	0.00
1/1/1997	4846.00	13.28	1641.00	4.50	11958	32.76	0.00	0.00
1/1/1998	5388.00	14.76	1311.60	3.59	8507	23.31	0.00	0.00
1/1/1999	4273.30	11.71	1510.70	4.14	7544	20.67	0.00	0.00
1/1/2000	4499.40	12.29	1829.60	5.00	5226	14.28	0.00	0.00
1/1/2001	3787.30	10.38	1633.10	4.47	5778	15.83	0.00	0.00
1/1/2002	2959.60	8.11	1502.30	4.12	5645	15.47	0.00	0.00
1/1/2003	2635.30	7.22	1267.60	3.47	5693	15.60	0.00	0.00
1/1/2004	2272.70	6.21	1001.60	2.74	5628	15.38	0.00	0.00
1/1/2005	2022.10	5.54	1229.80	3.37	4674	12.81	0.00	0.00
1/1/2006	1959.10	5.37	1500.30	4.11	8710	23.86	0.00	0.00
1/1/2007	1567.80	4.30	1101.00	3.02	1867	5.12	0.00	0.00
1/1/2008	1589.50	4.34	1770.70	4.84	31376	85.73	0.00	0.00
1/1/2009	1646.80	4.51	1181.30	3.24	24265	66.48	0.00	0.00
1/1/2010	1324.90	3.63	842.30	2.31	55871	153.07	0.00	0.00
1/1/2011	2966.20	8.13	4513.10	12.36	33107	90.70	0.00	0.00
1/1/2012	6432.00	17.57	16496.80	45.07	58214	159.05	0.00	0.00
1/1/2013	6078.80	16.65	19527.10	53.50	69391	190.11	0.00	0.00
1/1/2014	2551.00	6.99	11817.70	32.38	18097	49.58	0.00	0.00
Sum	190914.90		118049.70		615644			

ATTACHMENT 5 – UNIT CUMULATIVE PRODUCTION AND INJECTION PLOT

PENNWEST

UNIT: WASKADA_UNIT_NO._8_-_PM_58

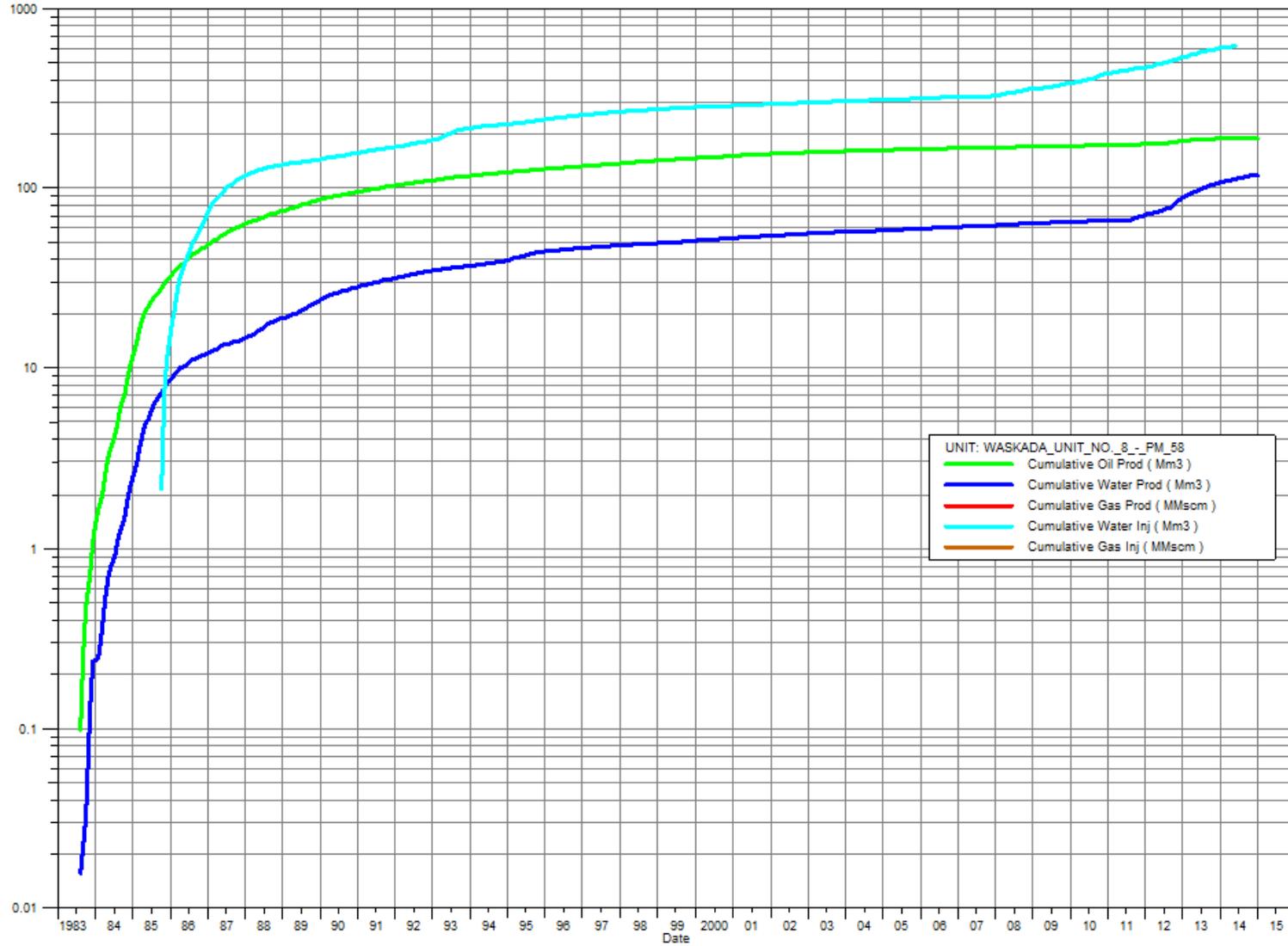
Cumulative Water Prod : 118.83 Mm3

Cumulative Oil Prod : 191.08 Mm3

Cumulative Gas Prod : 0.00 MMscm

Cumulative Gas Inj : 0.00 MMscm
Cumulative Water Inj : 615.64 Mm3

Last Prod/Inj Date: 201501



ATTACHMENT 6 – UNIT VOIDAGE REPLACEMENT RATIO PLOT

PENNWEST

UNIT: WASKADA_UNIT_NO_8_-_PM_58

Cumulative Water Prod : 118.83 Mm3

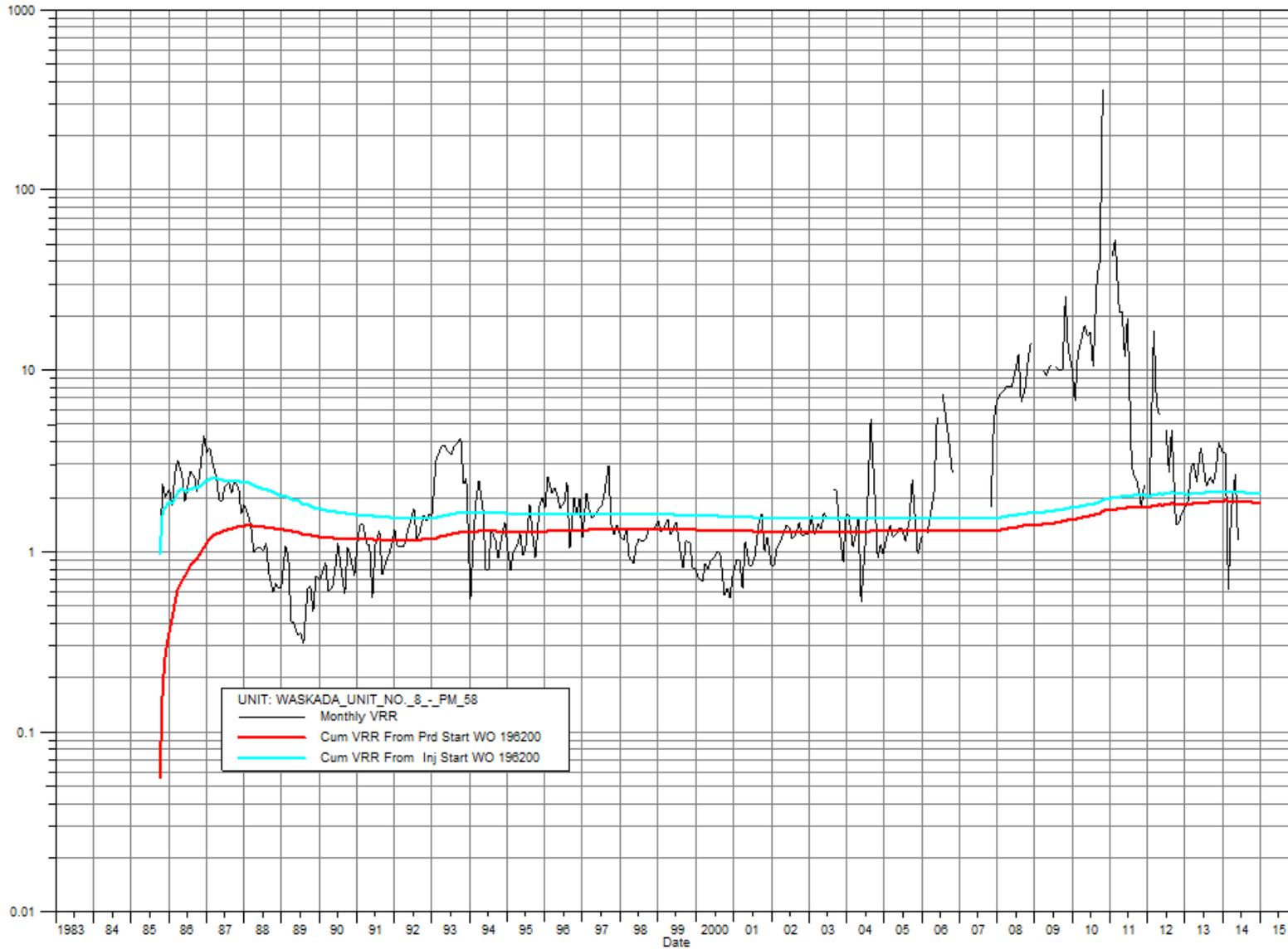
Cumulative Oil Prod : 191.08 Mm3

Cumulative Gas Prod : 0.00 Mm3

Cumulative Gas Inj : 0.00 Mm3

Cumulative Water Inj : 615.64 Mm3

Last Prod/Inj Date: 201501

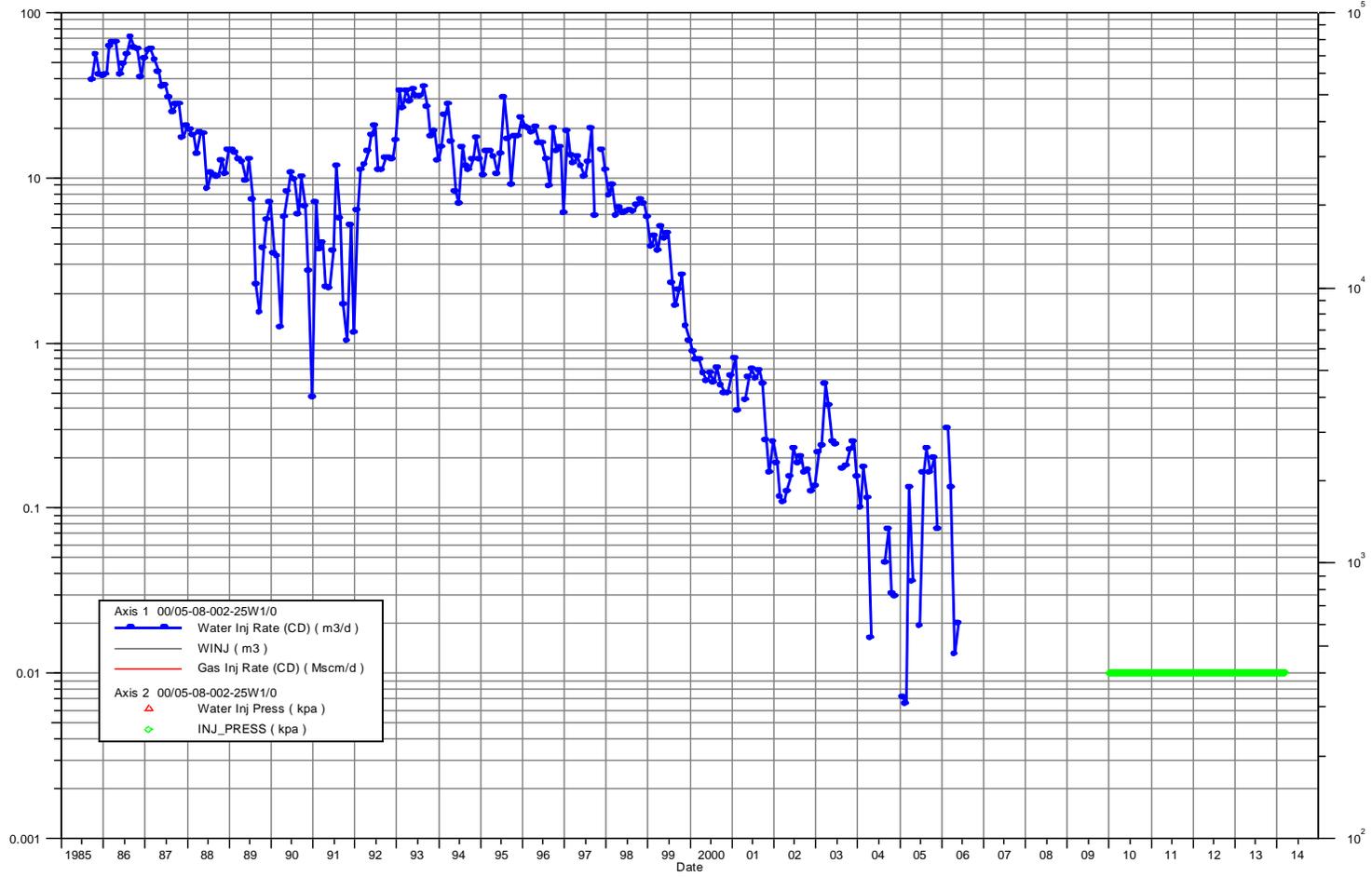


ATTACHMENT 7 – INDIVIDUAL INJECTION WELL PERFORMANCE PLOTS (4 WELLS)

Status: WTR4NJ
 Unit: WASKADA_UNIT_NO._8_-_PM_58
 Zone: LOWER_AMARANTH_A
 Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION
00/05-08-002-25W1/0

Cumulative Gas Inj : 0.00 MMscm
 Cumulative Water Inj : 90.56 Mm3
 Cumulative Water Prod : 1.93 Mm3
 Cumulative Oil Prod : 1.97 Mm3
 Cumulative Gas Prod : 0.00 MMscm



Status: ABD-WINJ

Unit: WASKADA_UNIT_NO._8_-_PM_58

Zone: LOWER_AMARANTH_A

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

00/07-08-002-25W1/0

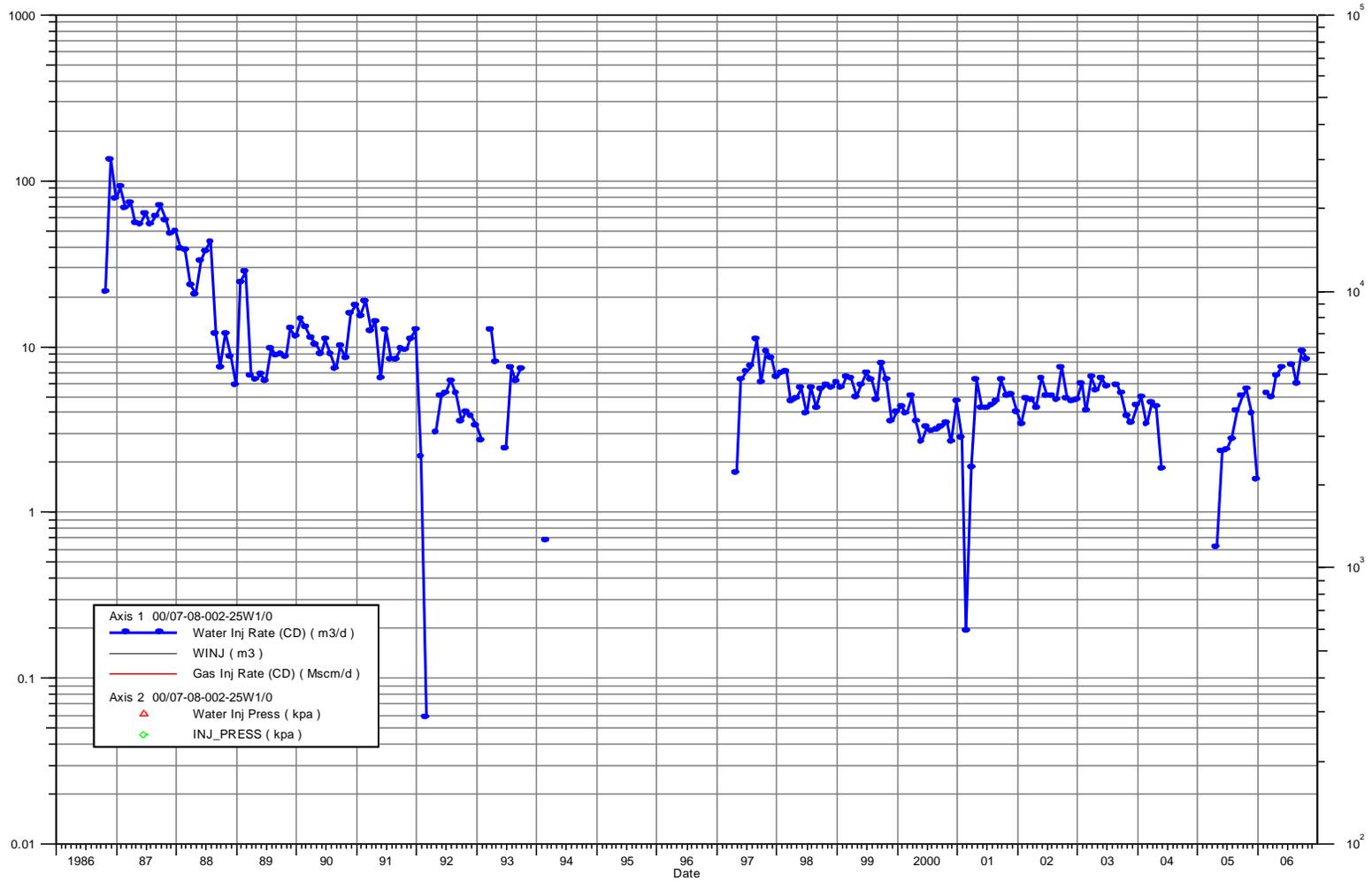
Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 68.84 Mm3

Cumulative Water Prod : 0.13 Mm3

Cumulative Oil Prod : 5.59 Mm3

Cumulative Gas Prod : 0.00 MMscm



Status: WTR-INJ

Unit: WASKADA_UNIT_NO._8_-_PM_58

Zone: LOWER_AMARANTH_A

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

00/13-08-002-25W1/0

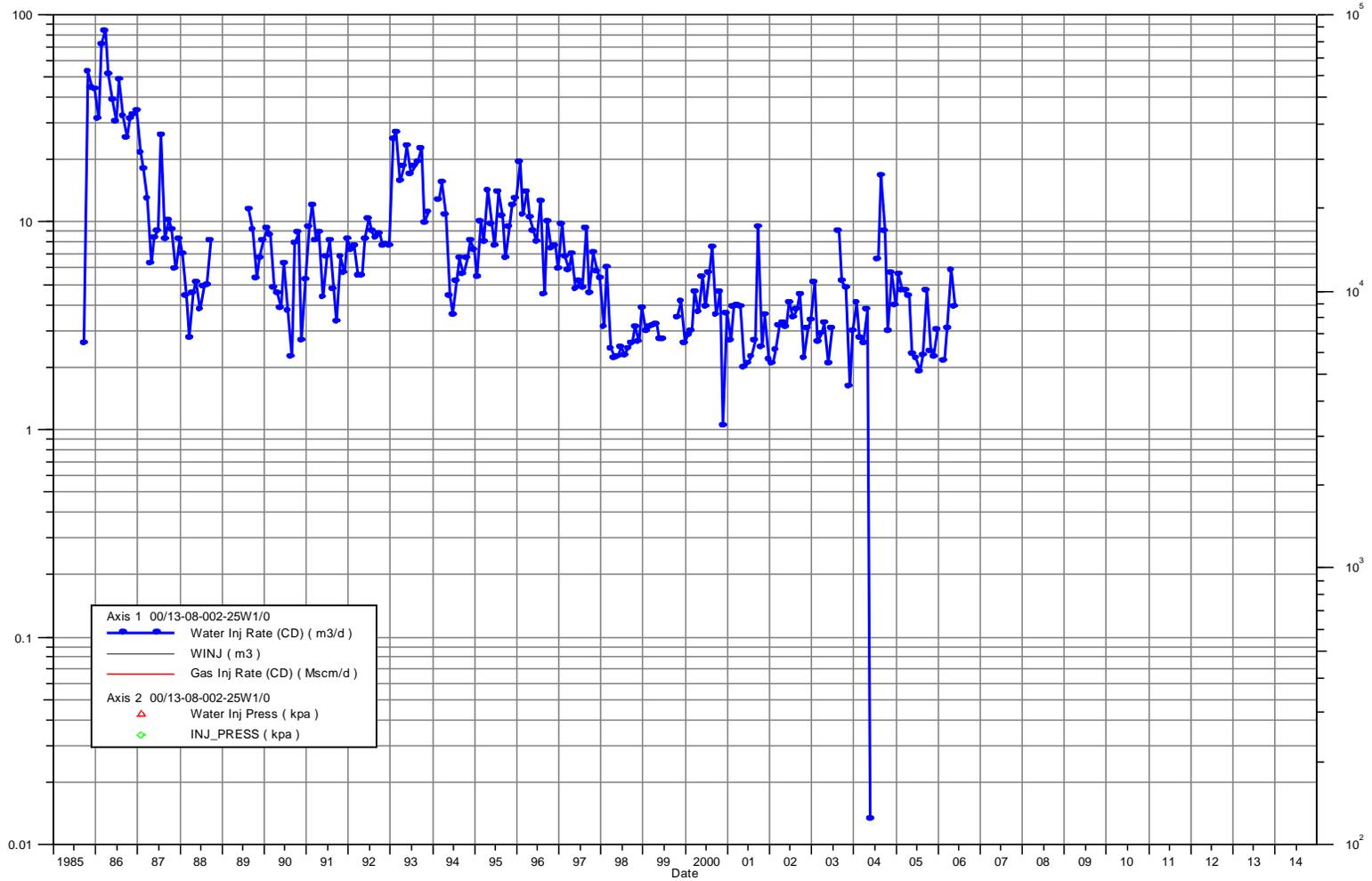
Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 63.43 Mm3

Cumulative Water Prod : 0.07 Mm3

Cumulative Oil Prod : 0.12 Mm3

Cumulative Gas Prod : 0.00 MMscm



Status: WTR-INJ

Unit: WASKADA_UNIT_NO. 8 - PM 58

Zone: LOWER_AMARANTH_A

Operator: PENN_WEST Approval: Amaranth

PENNWEST EXPLORATION

00/15-08-002-25W1/0

Cumulative Gas Inj : 0.00 MMscm

Cumulative Water Inj : 380.33 Mm3

Cumulative Water Prod : 0.37 Mm3

Cumulative Oil Prod : 0.55 Mm3

Cumulative Gas Prod : 0.00 MMscm

