

# **WASKADA UNIT NO. 9**

## **WATERFLOOD PROGRESS REPORT**

**January 1, through December 31, 2010**

### **PennWest Exploration**

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## **INTRODUCTION**

The Waskada Unit No. 9 pressure maintenance project commenced water injection into the Mission Canyon designed and in accordance with Manitoba Energy and Mines Approval No. PM 49. (See Appendix A- Area Map)

**PRESSURE MAINTENANCE:** Governed by Board Order No. PM 49

### Unit Information:

**UNITIZED ZONE:** Mission Canyon

Original Unit, April.1, 1986 - Board Order; Voluntary

**POOL:** Waskada Mission Canyon 3b B (03 42B)

**POOL:** Waskada Mission Canyon 3a C (03 43C) – one well only 11-27-1-26

This report documents the performance of the Waskada Unit No.9 pressure maintenance project for the period of January 1 to December 31, 2010.

Unit # 1 is part of main Waskada. 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 (WPM).

The Waskada Fields produce light density crude (approximately 36° API), predominantly from the Lower Amaranth formation. The interlaminated, shallow marine to subtidal succession of sandstones, silstones, 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 founded 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 meters 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.

## **UNIT HISTORY**

### **Waskada Unit # 9 (Unit History)**

<b>Abbreviated Well ID</b>	<b>Date Well Spudded</b>	<b>On Prod YYYY/MM</b>	<b>Org Operator Name</b>	<b>Ground Elevation (m)</b>	<b>TVD (m)</b>
00/11-27-001-26W1/09/14/1982	1982/10	1982/10	Omega Hydcbns Ltd	464.5	951.0
02/12-27-001-26W1/27/6/1983	1986/02	1986/02	NCE Petrofund Corp	462.0	948.0
00/13-27-001-26W1/012/8/1982	1982/12	1982/12	Omega Hydcbns Ltd	461.6	957.0
02/13-27-001-26W1/26/19/1983	1989/03	1989/03	NCE Petrofund Corp	461.5	948.0
00/14-27-001-26W1/011/19/1982	1982/12	1982/12	Omega Hydcbns Ltd	462.7	950.0
00/15-27-001-26W1/01/31/1983	1983/02	1983/02	Omega Hydcbns Ltd	463.3	948.0
02/15-27-001-26W1/26/2/1983	1989/03	1989/03	Omega Hydcbns Ltd	464.3	952.0
00/16-27-001-26W1/010/21/1982	1982/12	1982/12	Omega Hydcbns Ltd	462.6	955.0
02/16-27-001-26W1/26/6/1983	1990/06	1990/06	NCE Petrofund Corp	464.1	954.0
00/01-34-001-26W1/011/24/1984	1984/12	1984/12	Omega Hydcbns Ltd	463.9	960.0
00/02-34-001-26W1/03/13/1983	1983/06	1983/06	Omega Hydcbns Ltd	465.0	964.0

**Waskada Unit #9 (Production & Injection History)**

<b>Abbreviated Well ID</b>	<b>First Prod YYYY/M M</b>	<b>On Inject. YYYY/M M</b>	<b>Last Prod. YYYY/M M</b>	<b>Cumulative OIL Prod. (m3)</b>	<b>Cumulative WTR Prod. (m3)</b>	<b>Last Inject. YYYY/M M</b>
00/11-27-001-26W1/0	1982/10	1986/05	1989/10	2,585	6,472	1986/12
02/12-27-001-26W1/2	1986/02		1993/02	2,851	20,556	
00/13-27-001-26W1/0	1982/12		1996/02	11,443	63,342	
02/13-27-001-26W1/2	1989/03		1991/04	66	2,846	
00/14-27-001-26W1/0	1982/12		2010/12	12,774	64,654	
00/15-27-001-26W1/0	1983/02		1989/10	5,156	20,053	
02/15-27-001-26W1/2	1989/03		1991/02	50	9,217	
00/16-27-001-26W1/0	1982/12		1991/04	10,802	43,801	
02/16-27-001-26W1/2	1990/06		1996/06	577	15,167	
00/01-34-001-26W1/0	1984/12	1987/01	1986/02	281	4,176	1988/01
00/02-34-001-26W1/0	1983/06		1983/08	21	369	

**DISCUSSION:**

**Production Performance**

The Waskada MC3b B Pool was discovered in September, 1982 with the completion of the well Omega Waskada 11-27-1-26 in the MissionCanyon 3b zone over the interval 927.0 to 930.0 m KB. Board Order No. PM 49 provided for pressure maintenance operations in theWaskada Unit No.9. The Unit includes several producers in the Waskada MC3b BPool and the two injectors. On February 5, 1986, Omega Hydrocarbons Ltd., as operator of the proposed Waskada Unit No.9, has made application for approval to conduct pressure maintenance operations in the Waskada MC3b Pool. Omega started to inject water in two wells (located in Lsd 11 of Section 27-1-26 and in Lsd 1 of Section 34-1-26).

Appendix B is a plot of Unit performance and shows the production and injection profiles. The pressure maintenance scheme will involve the injection of produced water into the Mission Canyon 3bB formation through wells 11-27 and 1-34-1-26 WPM to maintain reservoir pressure and "sweep" oil towards the offsetting production wells, but it did not impact the produced fluid. (Appendix D-see oil, water and injection rates)  
On December 2, 1988, Omega Hydrocarbons Ltd., operator of the Waskada Unit No. 9 has made an application under Pressure Maintenance Rule No. 1(3) of Board Order No. PM 49 and suspended the water injection into the subject wells.

### **Voidage Replacement Ratio Calculation**

Upon review of the voidage replacement ratio (VRR) for the Waskada Unit # 9 area, it was shown that the area has been under injected. This is shown by instantaneous and cumulative VRR for the Waskada Unit # 9 (Please see the Appendix C).

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

We currently inject ScalCor down all the new horizontal wells. Plus, PennWest will be installing cathodic protection on the wells. Also, the new gathering system is Fiberglass and as such is not susceptible to corrosion.

## **SUMMARY AND RECOMMENDATIONS**

### **Producers:**

#### **Current Producing Wells**

1. 00/14-27-001-26W1/0

#### **Current Suspended Producing Wells**

None

#### **Abandoned Producing Wells**

1. 02/12-27-001-26W1/2 (since 1993/03)
2. 00/13-27-001-26W1/0 (since 1996/03)
3. 02/13-27-001-26W1/2 (since 1991/05)

4. 00/15-27-001-26W1/0 (since 1989/11)
5. 02/15-27-001-26W1/2 (since 1991/03)
6. 00/16-27-001-26W1/0 (since 1991/05)
7. 02/16-27-001-26W1/2 (since 1996/07)
8. 00/02-34-001-26W1/0 (since 1983/09)

## **Injectors**

### **Current Injecting Wells**

None

### **Current Suspended Injection Wells**

None

### **Abandoned Injection Wells**

1. 00/01-34-001-26W1/0 (since 1988/02)
2. 00/11-27-001-26W1/0 (since 1987/01)

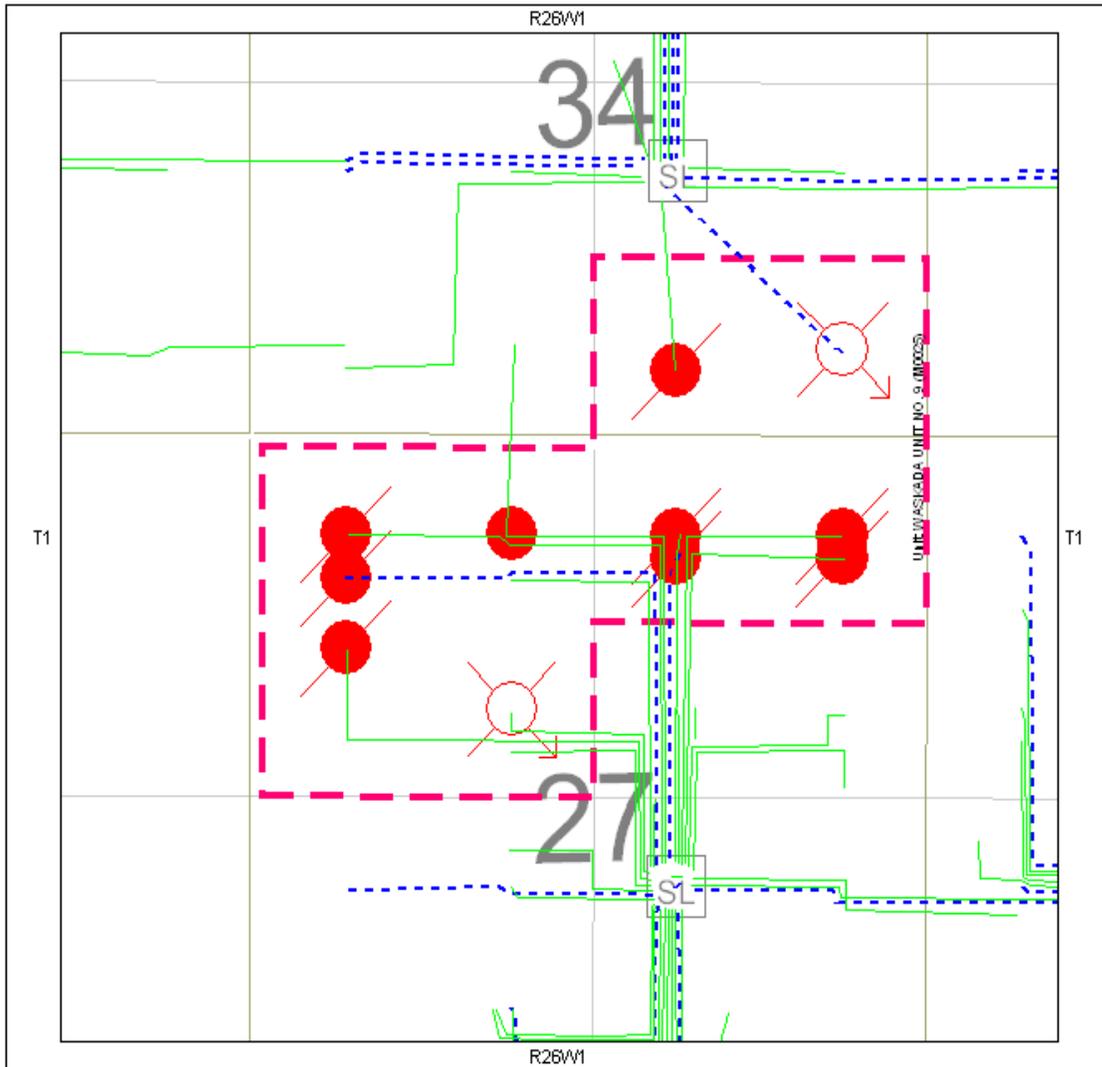
Since there is only one producer and no injection well in this unit, we do not have any plan for this unit other than monitoring the only producer.

**TABLE****Waskada Unit #9**

Date	Oil		Water		Inj Water	
Year	m3/year	m3/day	m3/year	m3/day	m3/year	m3/day
1982	401	1.10	340	0.93	0	0.00
1983	10,722	29.38	3,451	9.45	0	0.00
1984	8,359	22.90	8,731	23.92	0	0.00
1985	6,954	19.05	19,766	54.15	0	0.00
1986	4,623	12.67	27,611	75.65	19,497	53.42
1987	4,475	12.26	30,348	83.14	13,295	36.43
1988	2,481	6.80	20,434	55.98	733	2.01
1989	1,310	3.59	19,773	54.17	0	0.00
1990	1,135	3.11	17,857	48.92	0	0.00
1991	967	2.65	13,640	37.37	0	0.00
1992	983	2.69	13,127	35.96	0	0.00
1993	651	1.78	10,603	29.05	0	0.00
1994	442	1.21	6,492	17.79	0	0.00
1995	237	0.65	8,991	24.63	0	0.00
1996	183	0.50	3,652	10.00	0	0.00
1997	278	0.76	2,918	8.00	0	0.00
1998	118	0.32	3,460	9.48	0	0.00
1999	152	0.42	4,031	11.04	0	0.00
2000	145	0.40	4,067	11.14	0	0.00
2001	148	0.41	3,657	10.02	0	0.00
2002	167	0.46	3,483	9.54	0	0.00
2003	167	0.46	2,716	7.44	0	0.00
2004	214	0.59	3,690	10.11	0	0.00
2005	194	0.53	3,663	10.03	0	0.00
2006	142	0.39	3,588	9.83	0	0.00
2007	248	0.68	2,979	8.16	0	0.00
2008	219	0.60	2,871	7.87	0	0.00
2009	278	0.76	2,774	7.60	0	0.00
2010	211	0.58	1,946	5.33	0	0.00

# **APPENDIX A**

# Appendix A – Area Map



WELL SYMBOLS

• OIL	⚡ AO	⊕ PTN	⊕ D&A	⊕ WI
○ LCT	⊕ AWI	⊕ STN	⊕ CMM	⊕ DRL
⊕ RDR	⊕ WD	⊕ AWS	⊕ AWD	⊕ SWI
⊕ SO	⊕ WSC	⊕ J&A	□ SL	

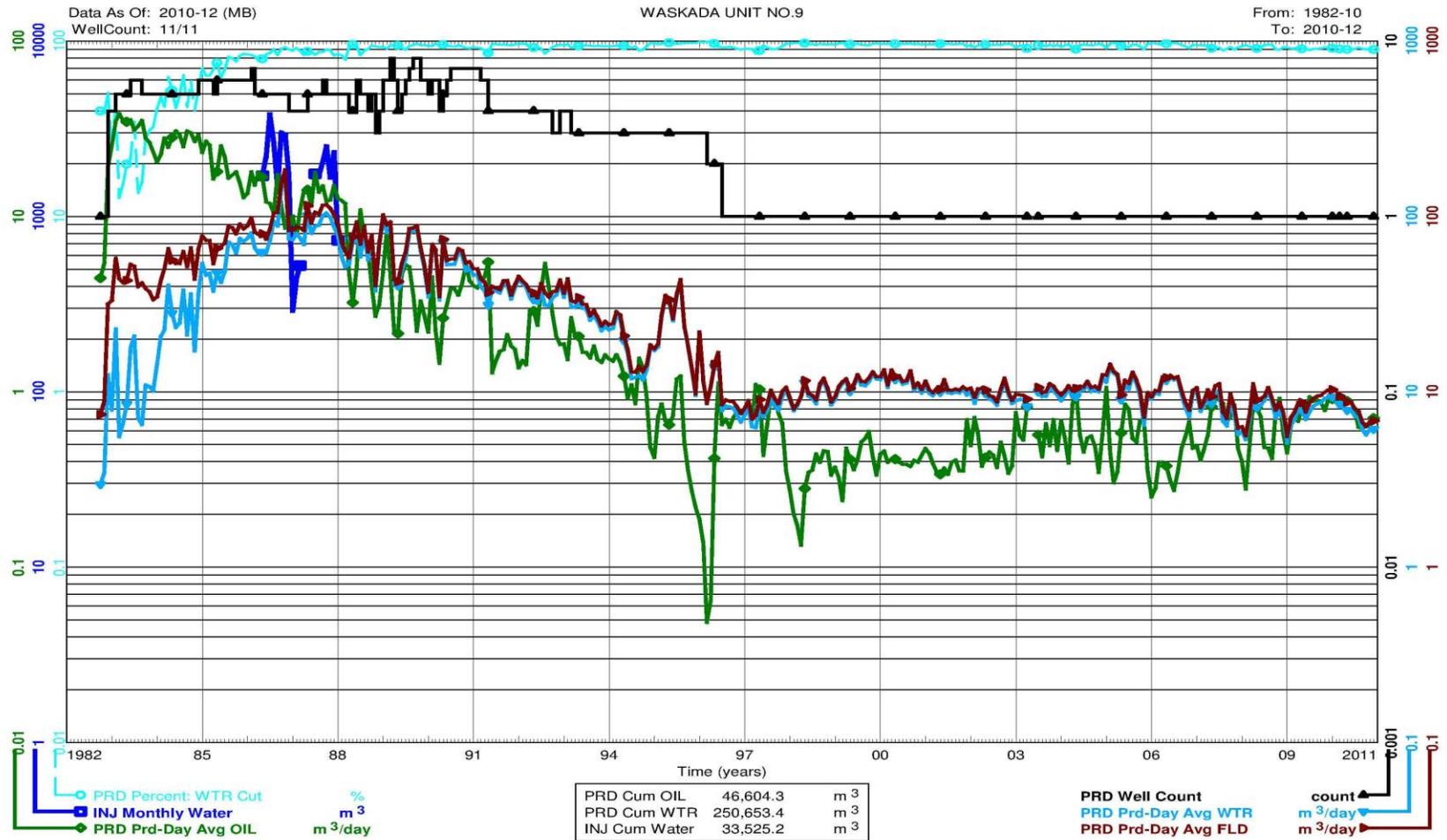
**PennWest**  
Exploration

Waskada Unit #9

	By :	Date : 2011/04/14
	Scale = 1:12844	Project : Waskada

## **APPENDIX B**

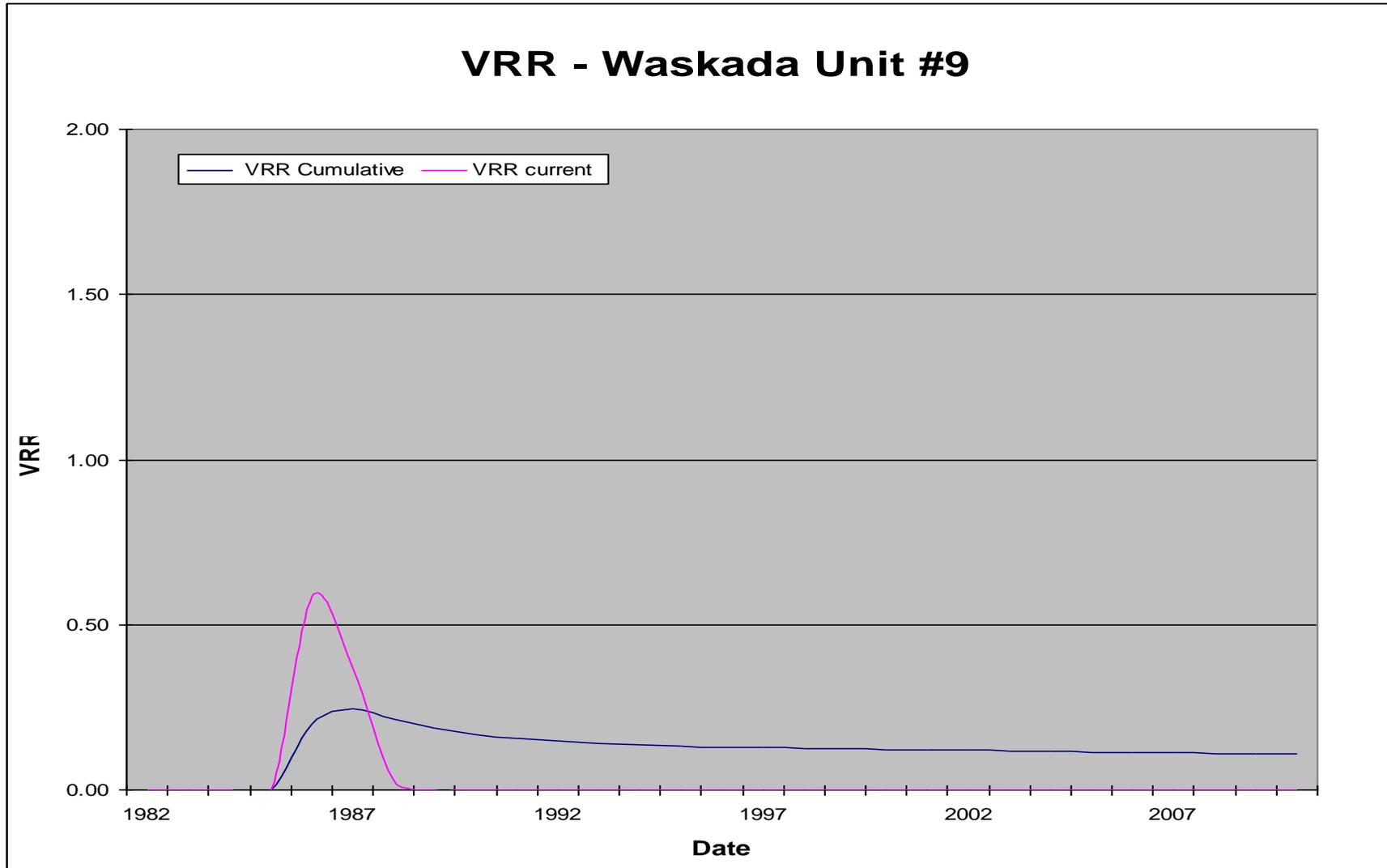
## Appendix B – Production and Injection History plot



Thursday, March 31, 2011, 04:25 PM

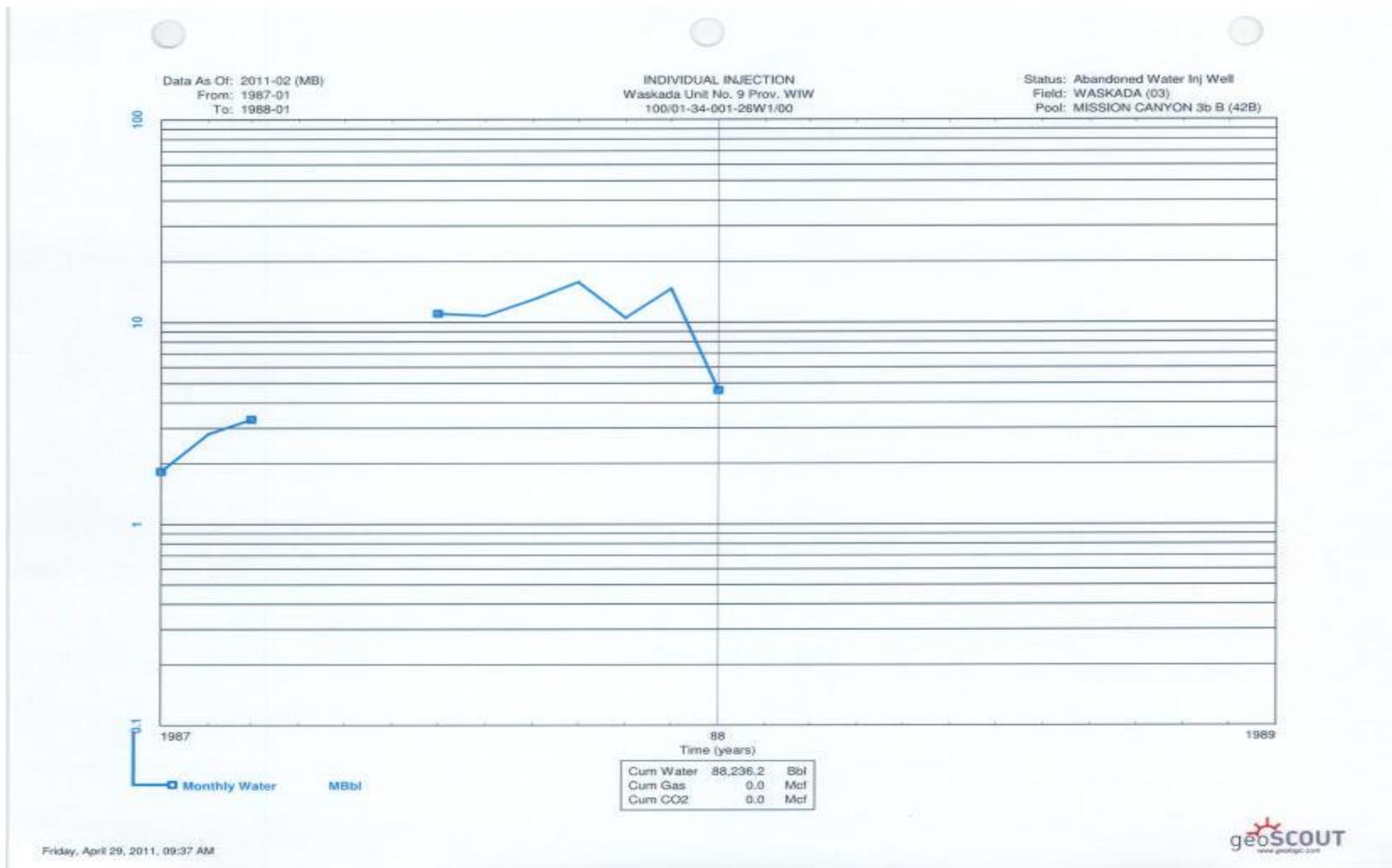
## **APPENDIX C**

Appendix C – Voidage Replacement Ratio VRR



## **APPENDIX D**

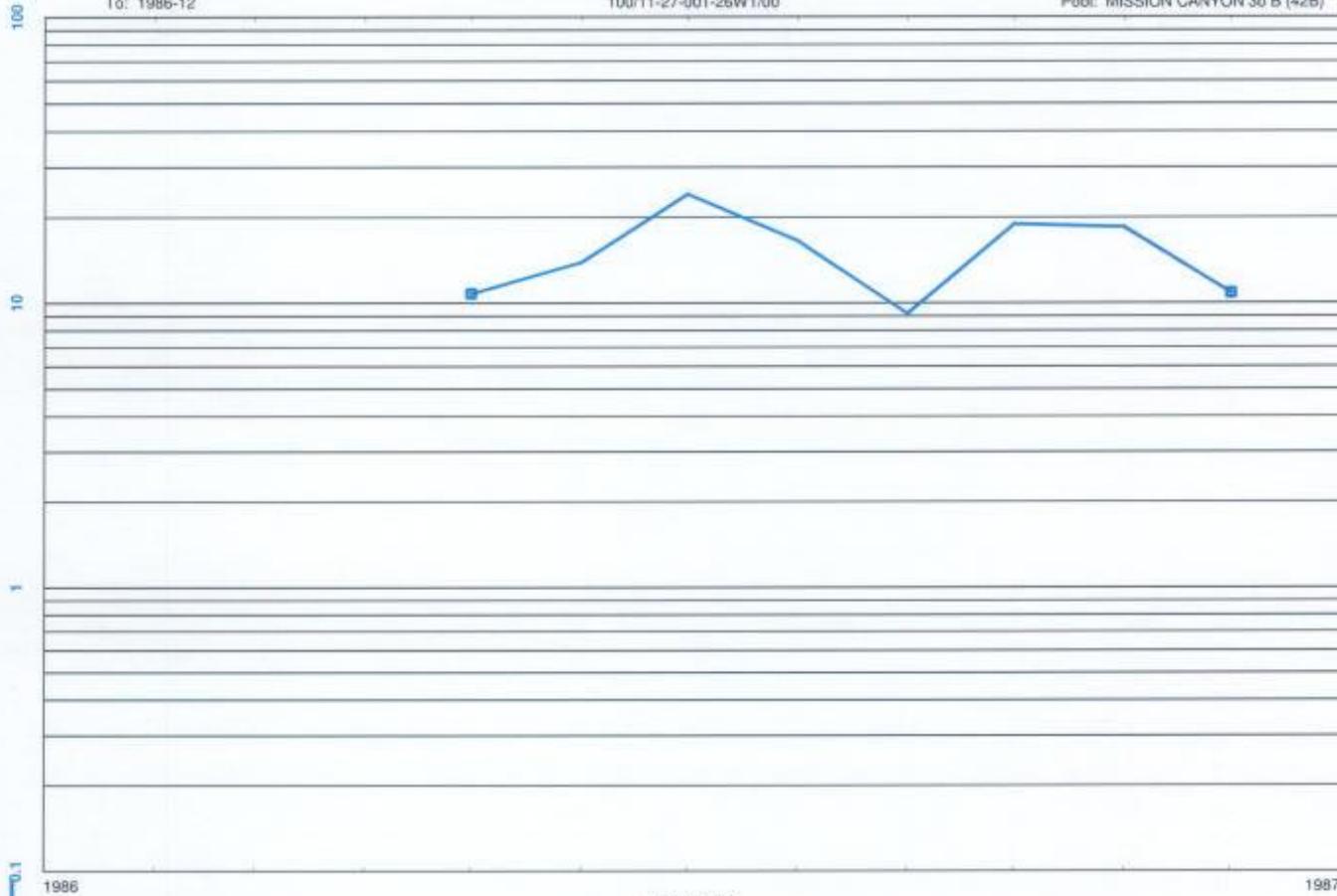
## Appendix D – Production and Injection Profiles



Data As Of: 2011-02 (MB)  
From: 1986-05  
To: 1986-12

INDIVIDUAL INJECTION  
-Omega-Waskada-WIW-  
100/11-27-001-28W1/00

Status: Abandoned Water Inj Well  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



0.1  
1  
10  
100  
□ Monthly Water MBbl

Time (years)		
Cum Water	122,640.5	Bbl
Cum Gas	0.0	Mcf
Cum CO2	0.0	Mcf

Data As Of: 2011-02 (MB)  
From: 1983-06  
To: 1983-08

INDIVIDUAL PRODUCTION  
Omegas Waskada Prov.  
100/02-34-001-26W1/00

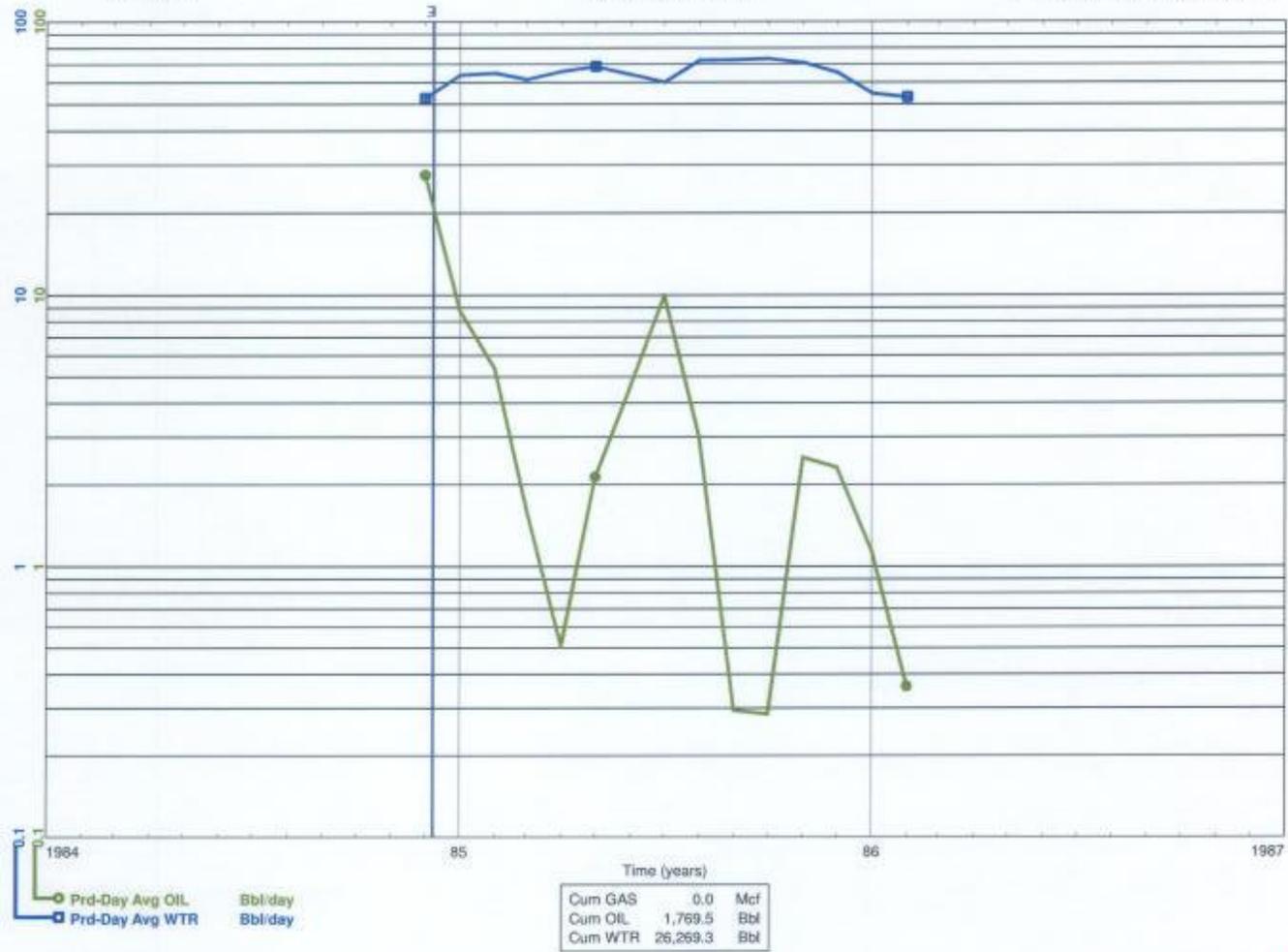
Status: Abandoned Producer  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1984-12  
To: 1986-02

INDIVIDUAL PRODUCTION  
Waskada Unit No. 9 Prov. WIW  
100/01-34-001-26W1/00

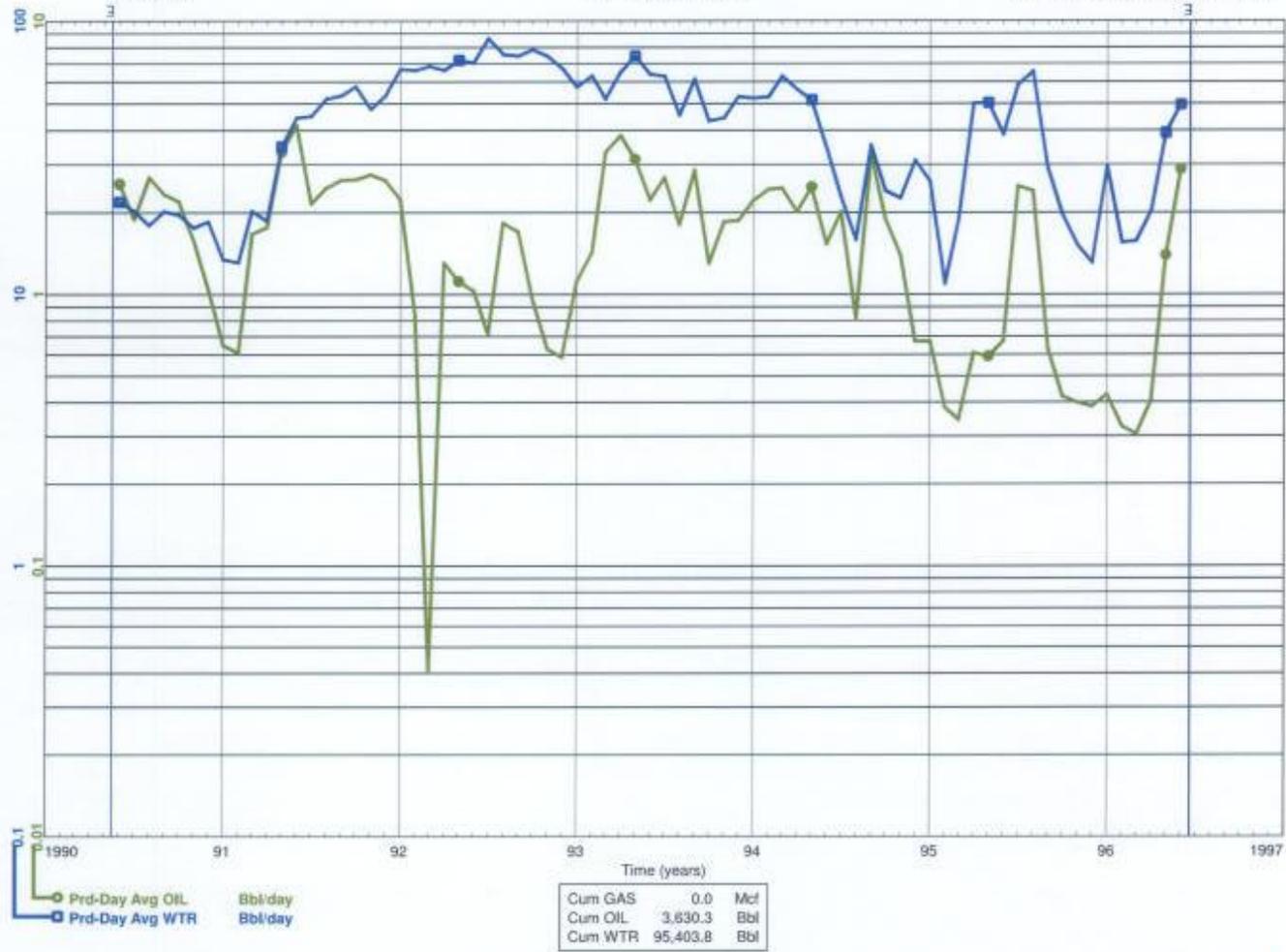
Status: Abandoned Water Inj Well  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1990-06  
To: 1996-06

INDIVIDUAL PRODUCTION  
Waskada Unit No: 2  
102/16-27-001-26W1/02

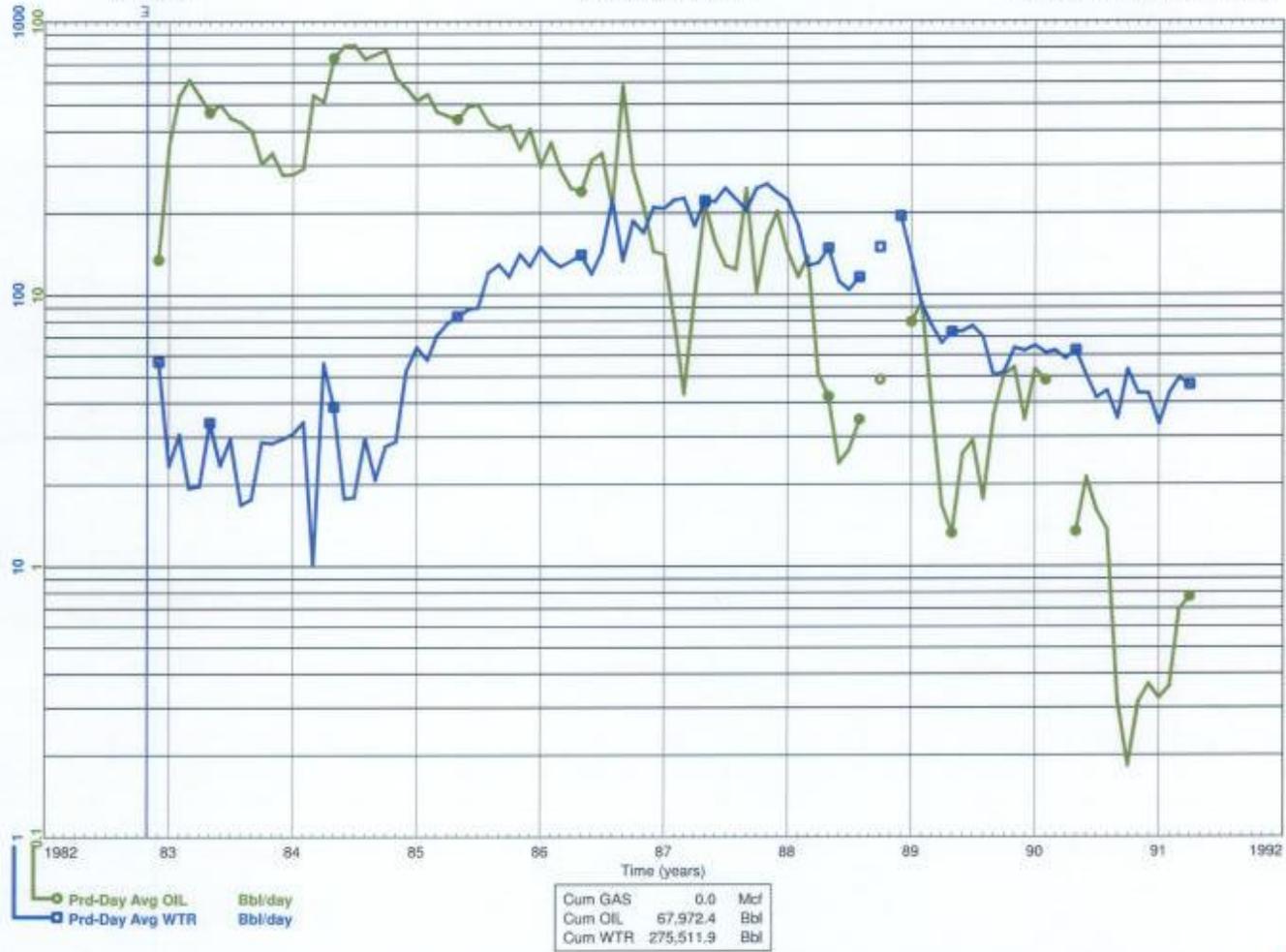
Status: Abandoned Producer  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1982-12  
To: 1991-04

INDIVIDUAL PRODUCTION  
Waskada Unit No. 9  
100/16-27-001-26W1/00

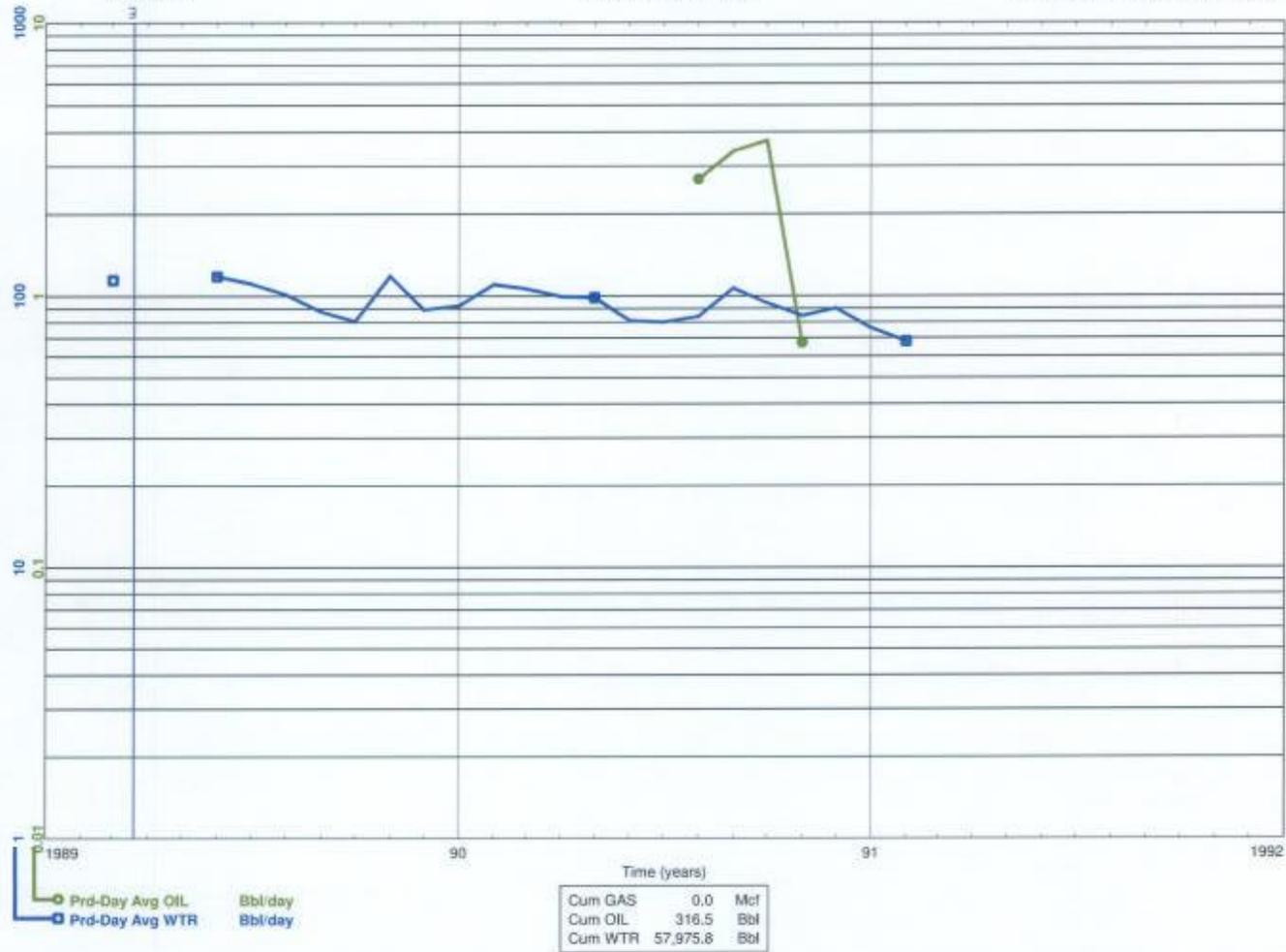
Status: Abandoned Producer  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1989-03  
To: 1991-02

INDIVIDUAL PRODUCTION  
Omega-Waskada...  
102/15-27-001-26W1/02

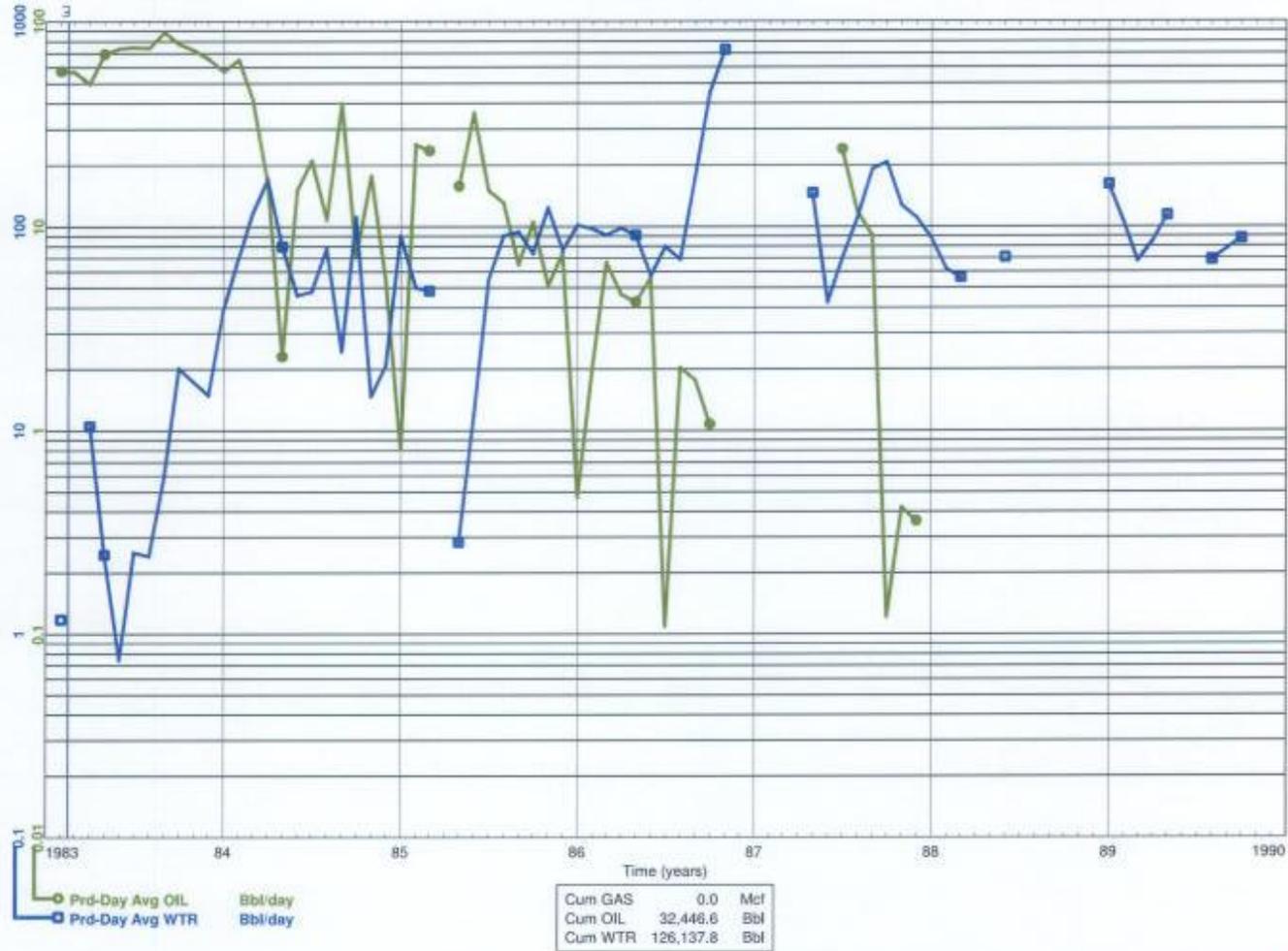
Status: Abandoned Producer  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
 From: 1983-02  
 To: 1989-10

INDIVIDUAL PRODUCTION  
 Omega Waskada-  
 100/15-27-001-26W1/00

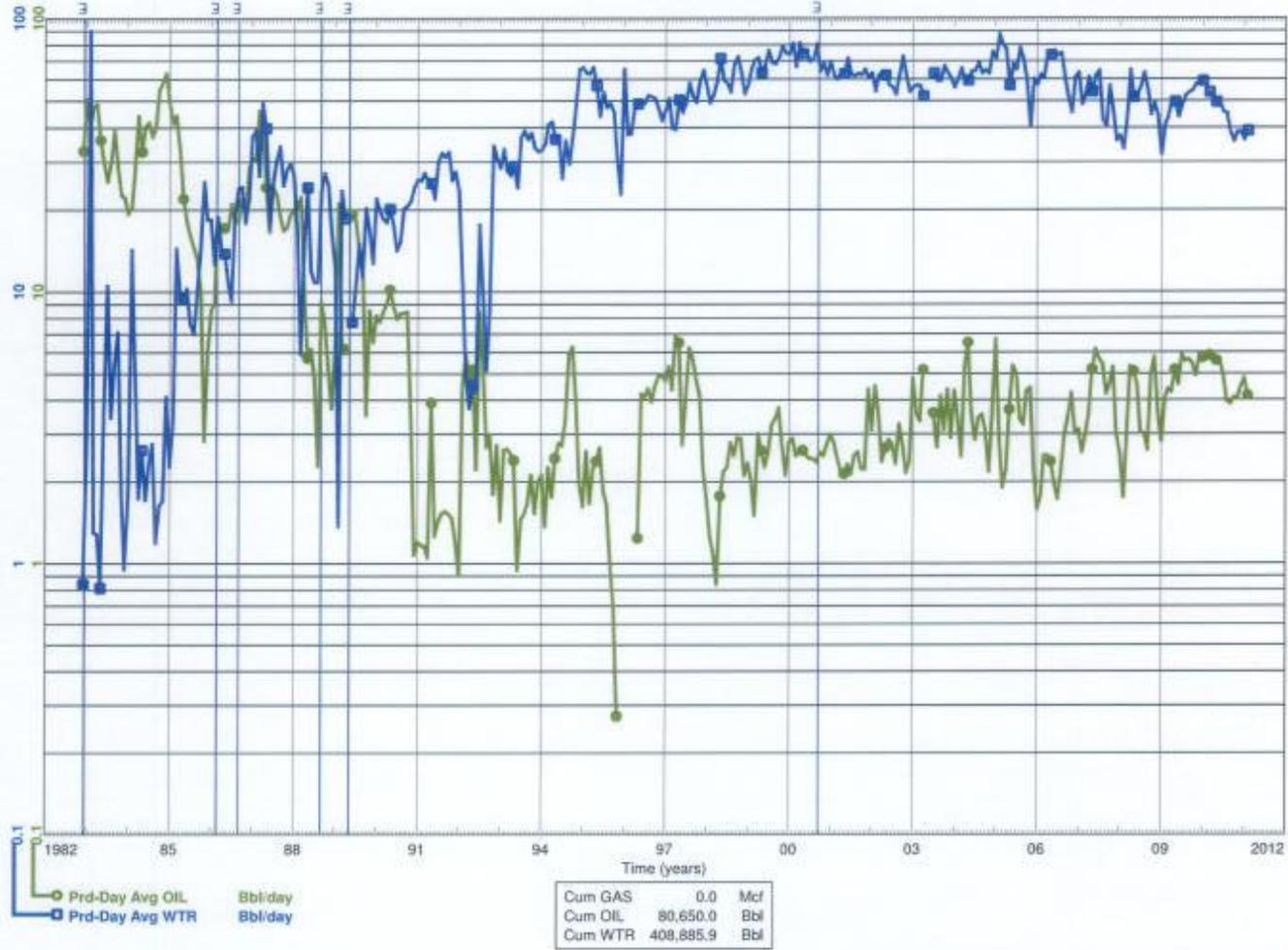
Status: Abandoned Producer  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1982-12  
To: 2011-02

INDIVIDUAL PRODUCTION  
Waskada Unit No. 9  
100/14-27-001-26W1/00

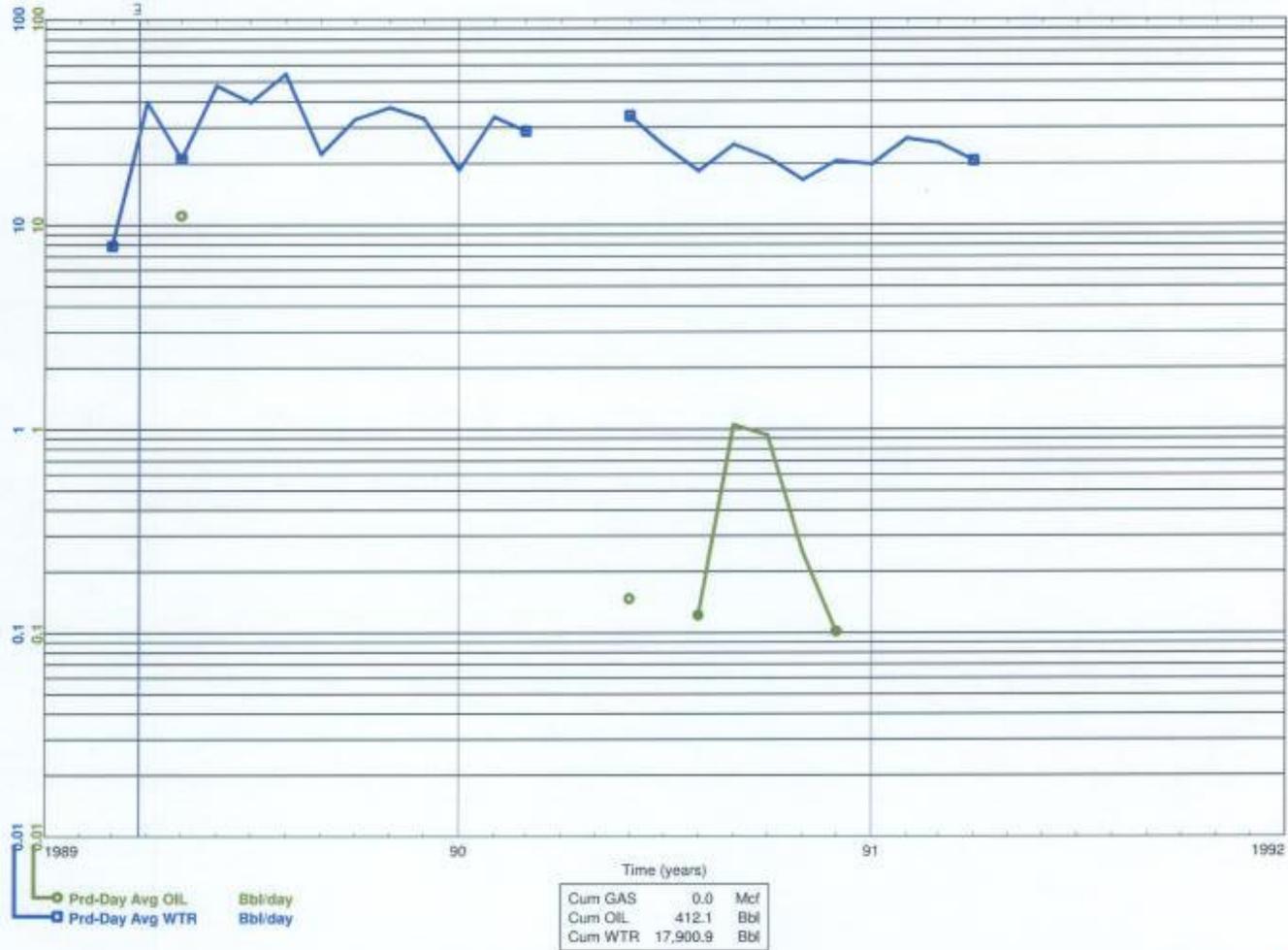
Status: Capable Of Oil Prod.  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
 From: 1989-03  
 To: 1991-04

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 9  
 102/13-27-001-26W1/02

Status: Abandoned Producer  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1982-12  
To: 1996-02

INDIVIDUAL PRODUCTION  
Waskada Unit No. 9  
100/13-27-001-26W1/00

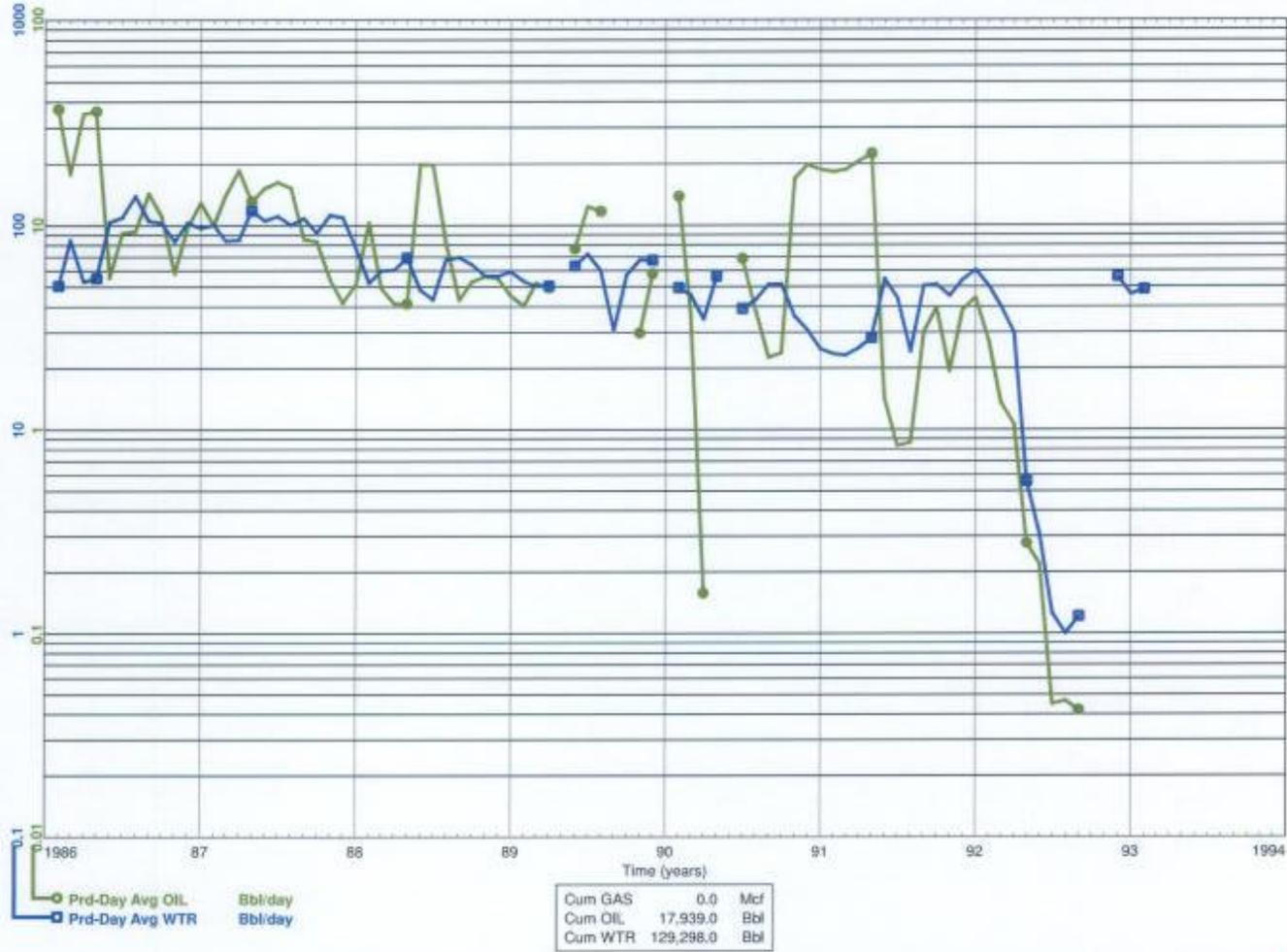
Status: Abandoned Producer  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
 From: 1986-02  
 To: 1993-02

INDIVIDUAL PRODUCTION  
 Waskada Unit No. 9  
 102/12-27-001-26W1/02

Status: Abandoned Producer  
 Field: WASKADA (03)  
 Pool: MISSION CANYON 3b B (42B)



Data As Of: 2011-02 (MB)  
From: 1982-10  
To: 1989-10

INDIVIDUAL PRODUCTION  
-Omega.Waskada.WIW  
100/11-27-001-26W1/00

Status: Abandoned Water Inj Well  
Field: WASKADA (03)  
Pool: MISSION CANYON 3b B (42B)

