

WASKADA UNIT NO. 7

WATERFLOOD PROGRESS REPORT

January 1, through December 31, 2011

PennWest Exploration

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INTRODUCTION

The WASKADA LOWER AMARANTH UNIT NO.7 pressure maintenance project commenced water injection into the Lower Amaranth designed and in accordance with Manitoba Energy and Mines Approval No. PM 58.

PRESSURE MAINTENANCE: Governed by Board Order No. PM 58

Unit Information:

UNITIZED ZONE: Lower Amaranth

Original Unit, Nov.1, 1986 Board Order; Voluntary

POOL: Waskada Lower Amaranth A (03 29A)

This report documents the performance of the Waskada Unit # 7 pressure maintenance project for the period of January 1 to December 31, 2011.

Unit # 7 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 (W1PM).

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, 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 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 No.7 (Unit History)

Abbreviated Well ID	Date Well Spudded	On Prod YYYY/MM	Org Operator Name	Ground Elevation (m)	TVD (m)
00/11-17-001-25W1/0	8/14/1983	1983/09	Omega Hydcbns Ltd	469	950
00/12-17-001-25W1/0	8/11/1983	1983/09	Omega Hydcbns Ltd	469.6	944
00/13-17-001-25W1/0	8/3/1983	1983/08	Omega Hydcbns Ltd	469.2	942
00/14-17-001-25W1/0	11/5/1982	1982/12	Omega Hydcbns Ltd	467.1	950
00/01-18-001-25W1/0	6/25/1984	1984/07	Omega Hydcbns Ltd	466.3	951
00/02-18-001-25W1/0	6/4/1984	1984/07	Omega Hydcbns Ltd	466.7	955
00/07-18-001-25W1/2	6/9/1984	1984/07	NCE Petrofund Corp	466.9	950
00/08-18-001-25W1/0	11/9/1983	1984/01	Omega Hydcbns Ltd	468.1	970
00/09-18-001-25W1/0	11/1/1983	1983/12	Omega Hydcbns Ltd	470	940
02/09-18-001-25W1/0	7/23/2010	2010/10		468.2	912.2
00/16-18-001-25W1/0	7/24/1983	1983/08	Omega Hydcbns Ltd	467.9	934
00/08-19-001-25W1/2	7/23/1985	1985/09	NCE Petrofund Corp	468.5	957
00/03-20-001-25W1/0	3/7/1983	1984/03	Omega Hydcbns Ltd	467.2	957
00/05-20-001-25W1/0	8/2/1985	1985/09	Omega Hydcbns Ltd	468.4	959
00/06-20-001-25W1/0	7/29/1985	1985/12	Omega Hydcbns Ltd	469.3	957
00/11-20-001-25W1/0	2/24/1983	1983/03	Omega Hydcbns Ltd	469.1	950
00/13-20-001-25W1/2	9/28/1983	1983/12	NCE Petrofund Corp	469.5	944
02/13-20-001-25W1/0				470.7	
03/13-20-001-25W1/0				470.8	
00/14-20-001-25W1/0	6/27/1984	1984/11	Omega Hydcbns Ltd	469.4	950

Abbreviated Well ID	Date Well Spudded	On Prod YYYY/MM	Org Operator Name	Ground Elevation (m)	TVD (m)
00/15-20-001-25W1/0	10/26/1982	1982/12	Omega Hydcbns Ltd	470.2	950
00/16-20-001-25W1/0	7/10/1984	1984/08	Omega Hydcbns Ltd	470.7	941
02/16-20-001-25W1/0	3/4/2011			470.4	902.9
03/16-20-001-25W1/0	2/26/2011			470.5	901.7

Waskada Unit No.7 (Production & Injection History)

Abbreviated Well ID	First Prod YYYY/MM	On Inject. YYYY/M M	Last Prod. YYYY/MM	Cumulative OIL Prod. (m3)	Cumulative WTR Prod. (m3)	First 12 mo. Ave WC%	Last Inject. YYYY/MM
00/11-17-001-25W1/0	1983/09		1991/03	3114	2823	39.9	
00/12-17-001-25W1/0	1983/09		1991/01	2445	3725	45.7	
00/13-17-001-25W1/0	1983/08	1987/01	1986/11	575	546	43.2	1991/03
00/14-17-001-25W1/0	1982/12		1991/02	3330	3407	49.5	
00/01-18-001-25W1/0	1984/07		1989/09	1219	4170	64.1	
00/02-18-001-25W1/0	1984/07		1989/01	470	2010	65.6	
00/07-18-001-25W1/2	1984/07	1987/01	1986/11	552	1360	65.1	1989/06
00/08-18-001-25W1/0	1984/01		1989/06	995	1771	51.7	
00/09-18-001-25W1/0	1983/12		1989/05	472	801	48.6	
02/09-18-001-25W1/0	2010/10		2011/11	4199	6936	61	
00/16-18-001-25W1/0	1983/08		1987/09	392	1633	80.4	
00/08-19-001-25W1/2	1985/09		1993/02	1430	681	29	
00/03-20-001-25W1/0	1984/03		1988/07	619	1305	62.9	
00/05-20-001-25W1/0	1985/09	1987/01	1986/11	301	34	8.1	1998/01
00/06-20-001-25W1/0	1985/12		1989/11	1739	15353	72.1	
00/11-20-001-25W1/0	1983/03		2011/11	16420	2186	26.5	
00/13-20-001-25W1/2	1983/12	1987/01	1986/11	1796	3158	14.6	1998/02
02/13-20-001-25W1/0							
03/13-20-001-25W1/0							
00/14-20-001-25W1/0	1984/11		1996/02	14475	31845	56	
00/15-20-001-25W1/0	1982/12	1987/01	1986/11	2111	1140	33.8	1998/02
00/16-20-001-25W1/0	1984/08		1989/08	471	2593	70.8	
02/16-20-001-25W1/0							
03/16-20-001-25W1/0							

DISCUSSION:

Production Performance

Production Response versus Injection: Since injection began, early 1987, injection rates fluctuated to some degree amongst the injectors; it is difficult to link any production responses to any specific injector. Water breakthrough of certain producers could not be directly correlated with over injection in associated injectors. Some wells showed no change in oil rate when injection was ceased in 1998.

Voidage Replacement Ratio Calculation

What could be described as very limited success, the waterflood was not maintained properly and injection rate dropped year after year in most cases. The cumulative VRR in the pool is about 0.85 (under injected) and the current monthly VRR is zero.

(See Appendix C). All of the injectors are shut in currently. PennWest has no plan to re-activate the old injectors.

To understand the past performance of the Lower Amaranth waterflood, we are doing some reservoir engineering work to come up with potential solutions. One of our plans is to do a pilot program in section 2: The objective of the pilot is to:

1. See if we inject water continuously into the Lower Amaranth Formation
 - i. Particle size less than 1 micron
 - ii. Total Suspended Solid (TSS) less than 10 ppm
 - iii. Oil less than 10 ppm
2. Inject below the frac pressure
3. Test the simulation model that we have built.

2011 Waskada Lower Amaranth Waterflood Pilot Location

The pilot producer will be 102/12-01-02-26W1/00 (The horizontal well) and the injectors will be two vertical wells; 100/12-01-02-26W1 and 100/11-01-02-26 (need to be converted to injectors)

Corrosion and Scale Prevention Program

We currently inject ScalCor down all the new horizontal wells. In addition to that, 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. 00/11-20-001-25W1/0
2. 02/09-18-001-25W1/0

Current Suspended Wells

1. None

Abandoned Wells

1. 00/11-17-001-25W1/0 (since 1991/04)
2. 00/12-17-001-25W1/0 (since 1991/02)
3. 00/14-17-001-25W1/0 (since 1991/03)
4. 00/01-18-001-25W1/0 (since 1989/10)
5. 00/02-18-001-25W1/0 (since 1989/02)
6. 00/08-18-001-25W1/0 (since 1989/07)
7. 00/09-18-001-25W1/0 (since 1989/06)
8. 00/16-18-001-25W1/0 (since 1987/10)
9. 00/08-19-001-25W1/2 (since 1993/03)
10. 00/03-20-001-25W1/0 (since 1988/08)
11. 00/06-20-001-25W1/0 (since 1989/12)

12.00/14-20-001-25W1/0 (since 1996/03)

13.00/16-20-001-25W1/0 (since 1989/09)

[Injectors]

Current Injecting Wells

None

Current Suspended Wells

1. None

Abandoned Wells

1. 00/05-20-001-25W1/0 (since 1998/02)

2. 00/07-18-001-25W1/2 (since 1989/07)

3. 00/13-17-001-25W1/0 (since 1991/04)

4. 00/13-20-001-25W1/2 (since 1998/03)

5. 00/15-20-001-25W1/0 (since 1998/03)

The behavior of a Waskada Unit 7 producers are indicated by examining the oil rate versus time plots (see Appendix B). Waskada Unit 7 exhibited relatively high initial oil productivity (most of the vertical wells that drilled in the past), rapidly declining to flat/low decline rates, with almost no discernible water flood response. We are planning to do more pressure survey, in few more wells, to understand the reservoir better, this year.

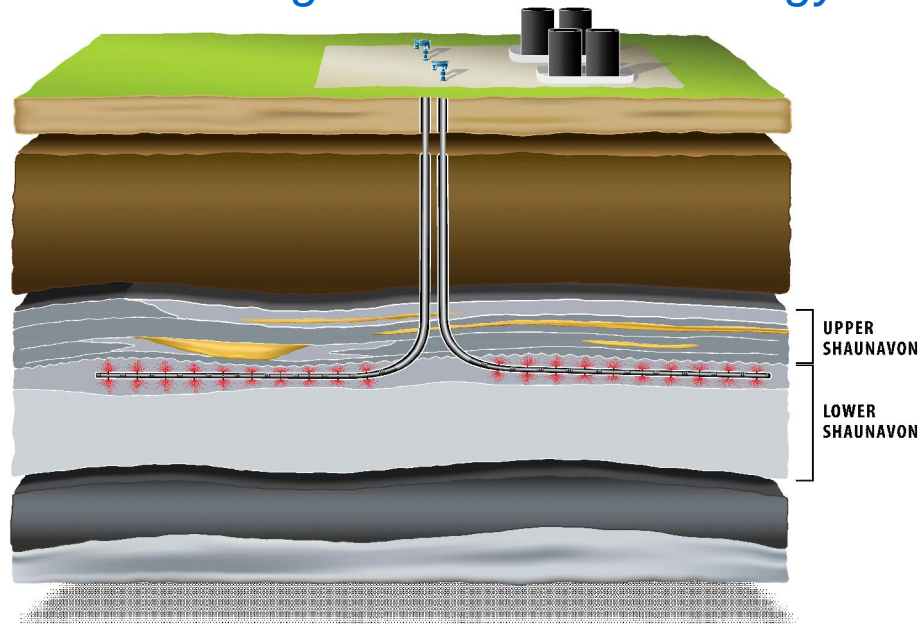
It is believed that fracture stimulation treatments, performed on these wells prior to initiation of water injection, “broke” through into the higher productivity Mississippian and that majority of injected water to date has entered this zone. This is one of the major explanations for lack of waterflood response to date and the continued decline in oil productivities.

The Waskada Lower Amaranth is becoming a non-conventional tight oil resources play that utilizes horizontal multi-stage frac drilling technology (small multi-stage frac

stimulations on newly drilled wells will remain “in zone” within the Lower Amaranth) to re-develop the thick low perm oil zones adjacent to the conventional Amaranth zone that was discovered in the 1980’s. Penn West’s follow up plan is to convert some of the recent horizontal producing wells to injection wells to increase the sweep efficiency and ultimately increase the recoverable oil in place.

The following is the HZ Multi Stage Fracture Technology development plan that we are using:

HZ Multi Stage Fracture Technology



TABLES

Waskada Unit #7

Table 1: Rates History

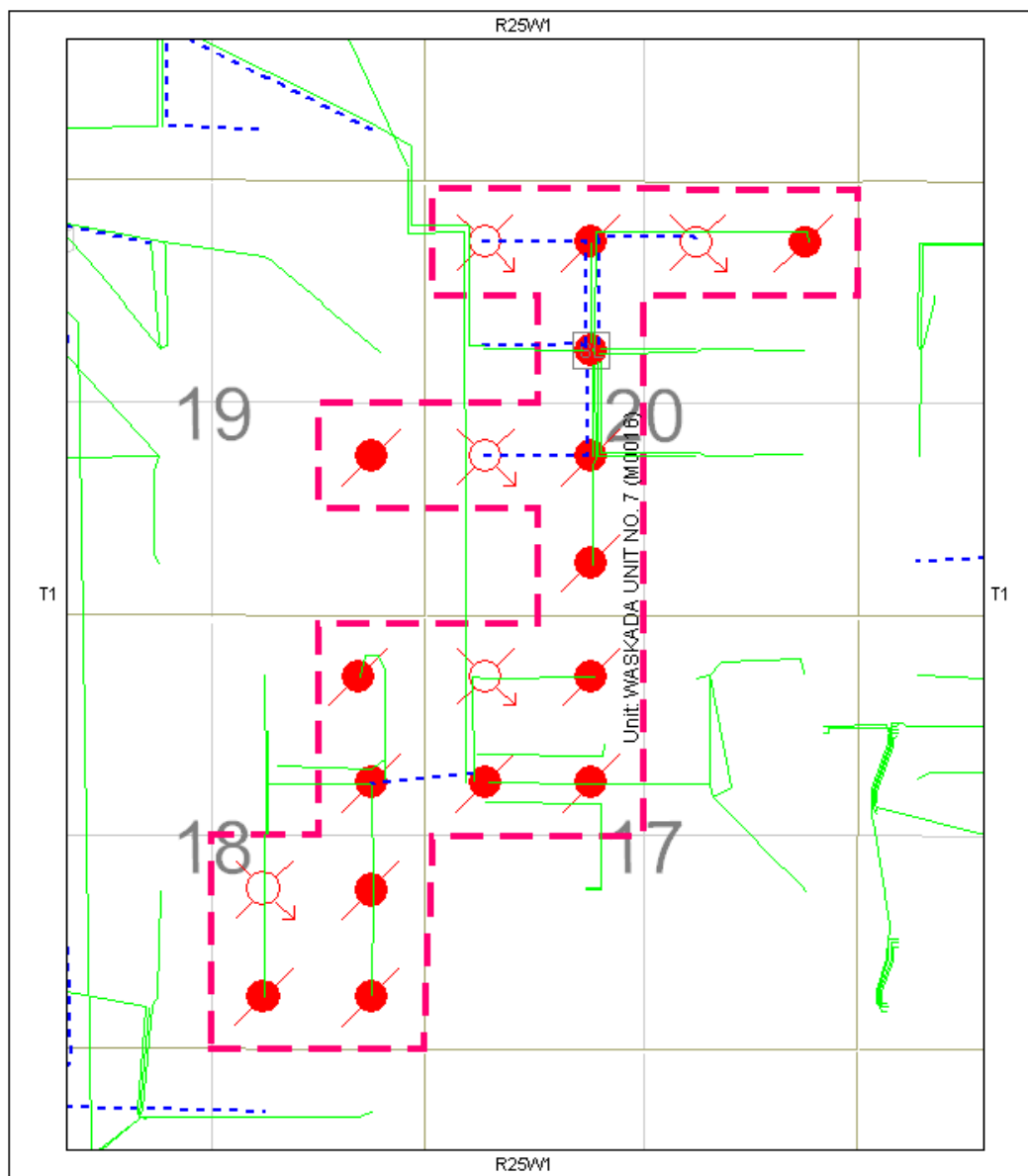
Date	Oil		Water		Inj Water	
Year	m3/year	m3/day	m3/year	m3/day	m3/year	m3/day
1982	409	1.12	175	0.48	0	0.00
1983	4,630	12.69	3,544	9.71	0	0.00
1984	7,337	20.10	6,433	17.62	0	0.00
1985	6,906	18.92	12,628	34.60	0	0.00
1986	7,259	19.89	15,666	42.92	0	0.00
1987	4,083	11.19	17,409	47.70	56,975	156.10
1988	3,990	10.93	9,108	24.95	24,688	67.64
1989	2,167	5.94	5,783	15.84	4,055	11.11
1990	1,090	2.99	2,399	6.57	8,295	22.73
1991	781	2.14	1,533	4.20	2,560	7.01
1992	1,420	3.89	871	2.39	3,335	9.14
1993	1,698	4.65	1,271	3.48	5,099	13.97
1994	962	2.64	1,065	2.92	4,636	12.70
1995	806	2.21	1,750	4.80	4,386	12.02
1996	700	1.92	270	0.74	5,135	14.07
1997	855	2.34	54	0.15	3,863	10.58
1998	762	2.09	89	0.24	409	1.12
1999	492	1.35	49	0.14	0	0.00
2000	525	1.44	40	0.11	0	0.00
2001	505	1.38	28	0.08	0	0.00
2002	796	2.18	39	0.11	0	0.00
2003	774	2.12	34	0.09	0	0.00
2004	661	1.81	42	0.12	0	0.00
2005	562	1.54	47	0.13	0	0.00
2006	602	1.65	43	0.12	0	0.00
2007	497	1.36	37	0.10	0	0.00
2008	481	1.32	34	0.09	0	0.00
2009	431	1.18	29	0.08	0	0.00
2010	2,053	6.42	2,896	7.93	0	0.00
2011	2,889	12.56	4,112	11.26	0	0.00

Table 2: Pressure Survey

Location	Shut In Date	Date of Survey	Type of Survey	Pressure @ Datum Depth (kPa)
00/15-20-001-25W1/0	Jan-91	(18 days)	Static Gradient	10186


APPENDIX A

Appendix A – Area Map



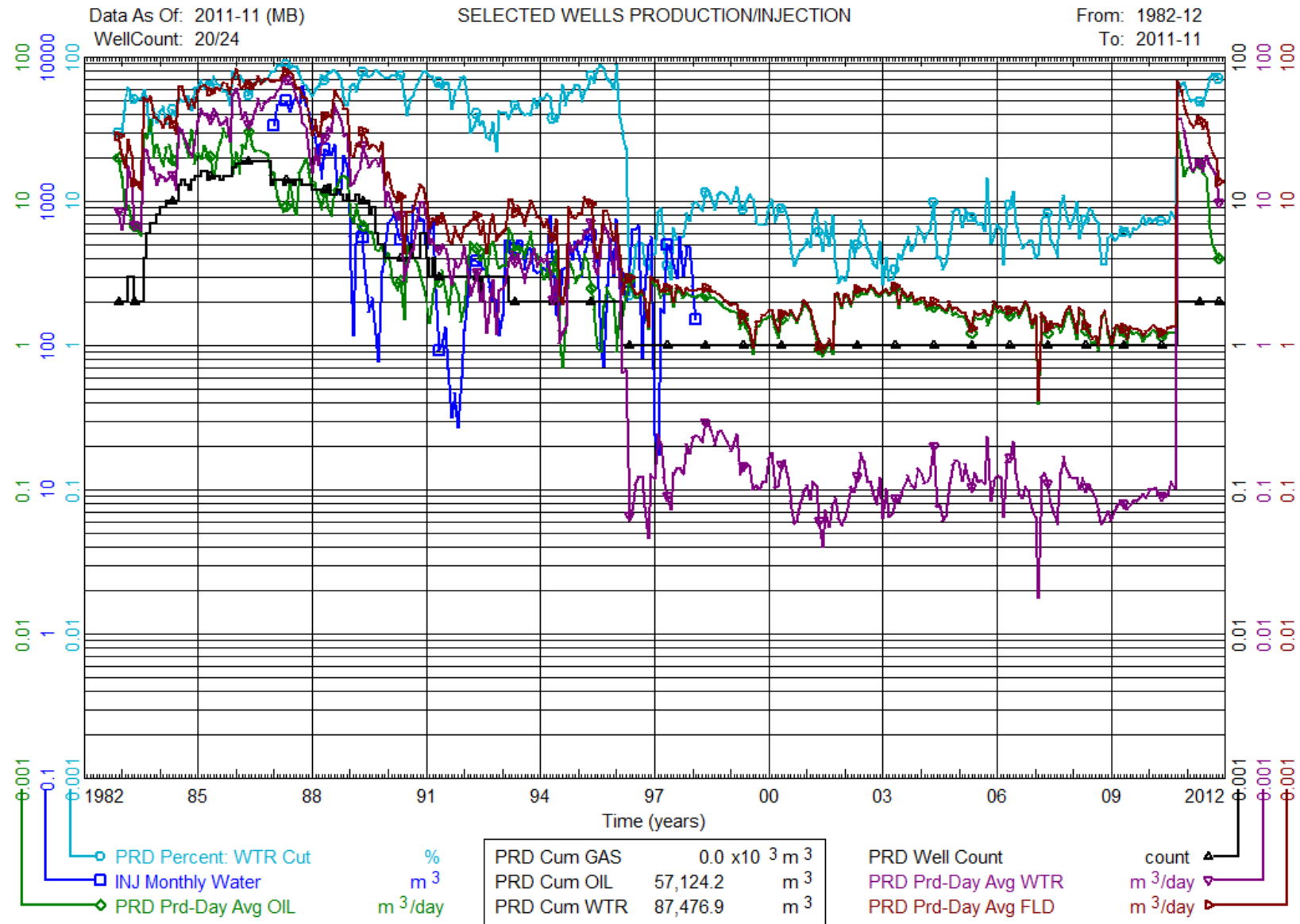
WELL SYMBOLS

• OIL	✂ AD	⊕ PTH	⊕ DSA	⊕ WI
○ LCT	✂ AWI	⊕ STN	⊕ CMM	⊕ DRL
⊕ RDR	⊕ WD	⊕ AWS	⊕ A/V D	⊕ SWI
⊕ SO	⊕ WSC	⊕ JSA	□ SL	

PennWest Exploration	
Waskada Unit #7	
	By :
	Date : 2011/04/14
Scale = 1:20000	Project : Waskada

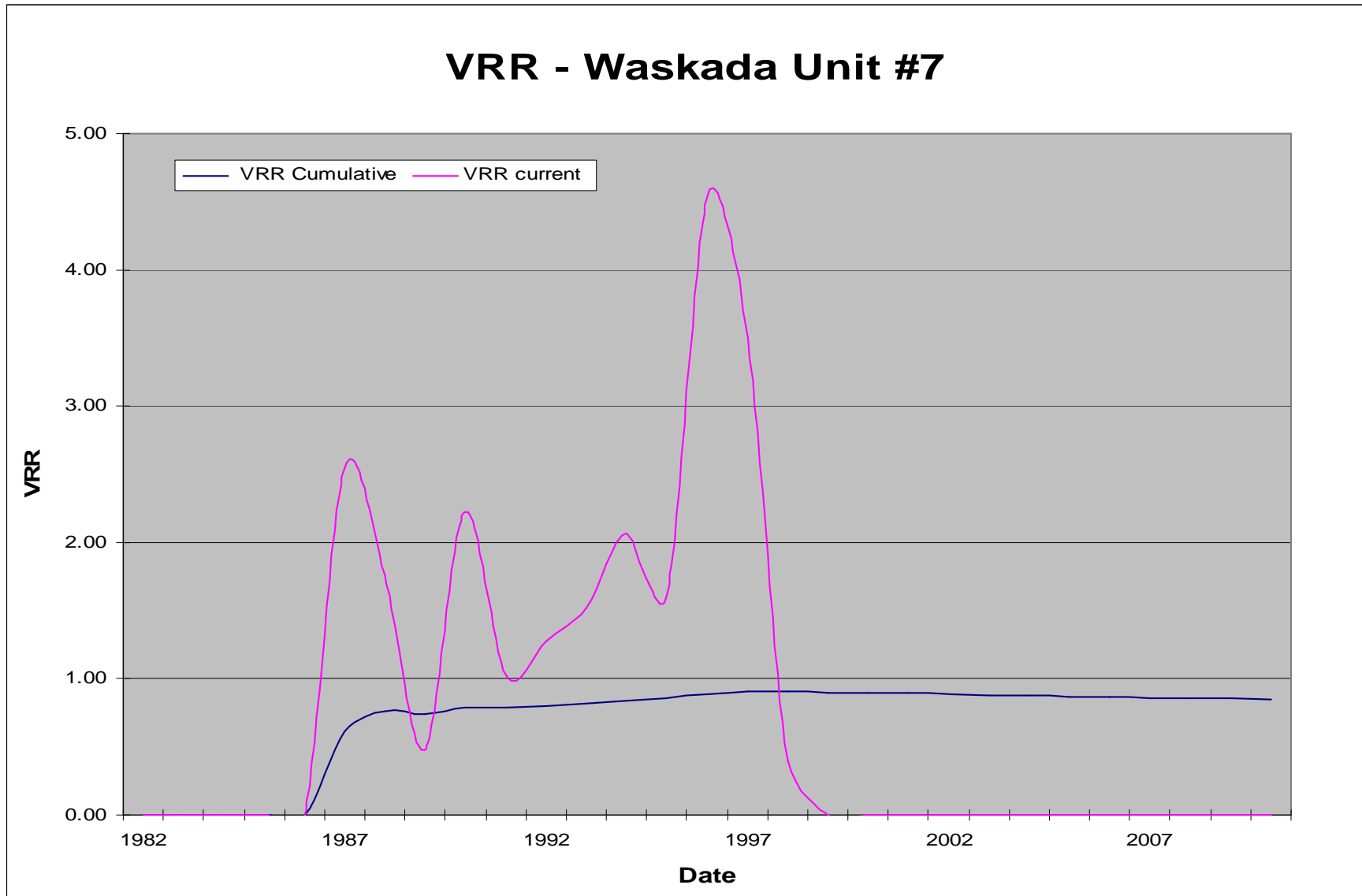
APPENDIX B

Appendix B – Production and Injection History plot



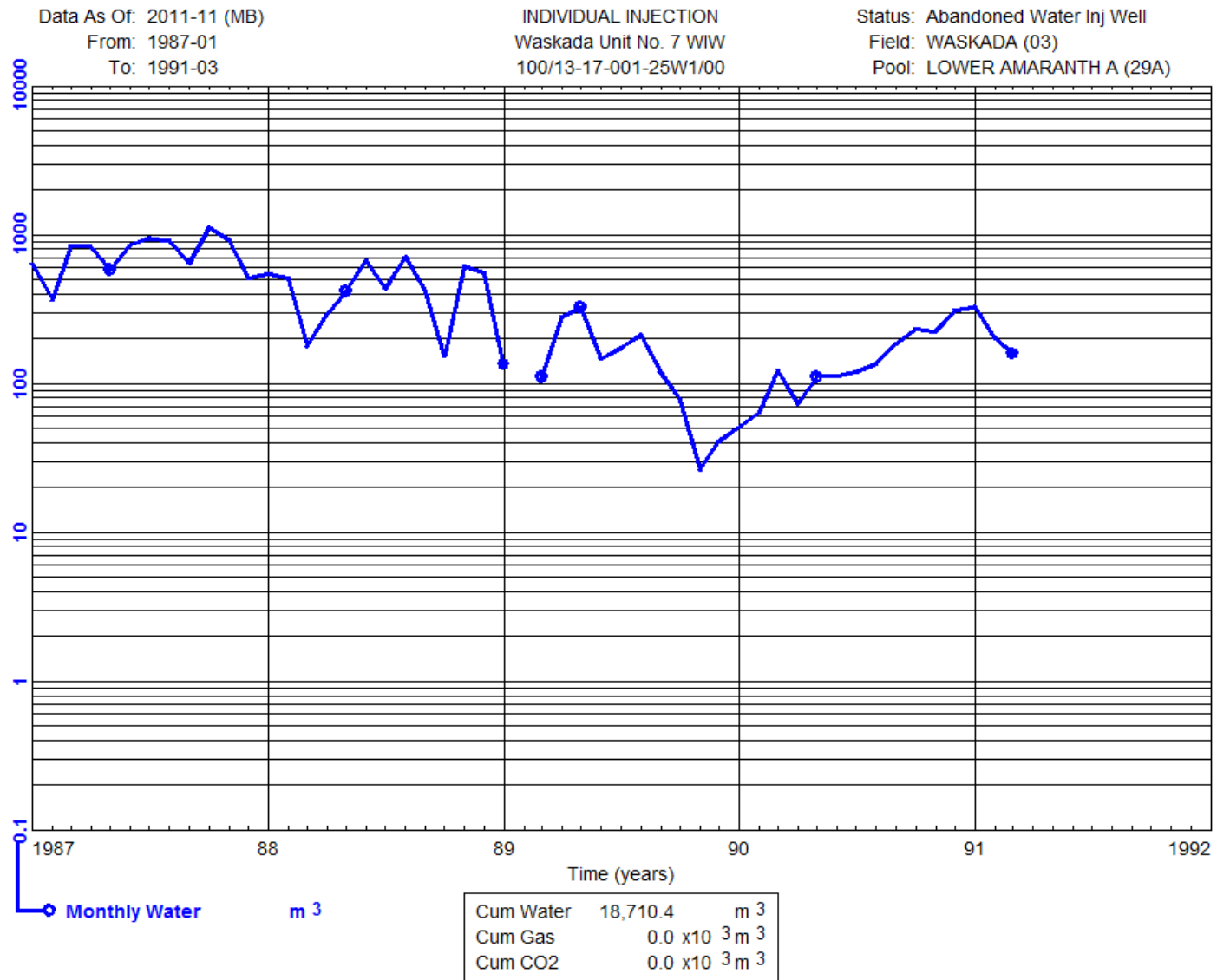
APPENDIX C

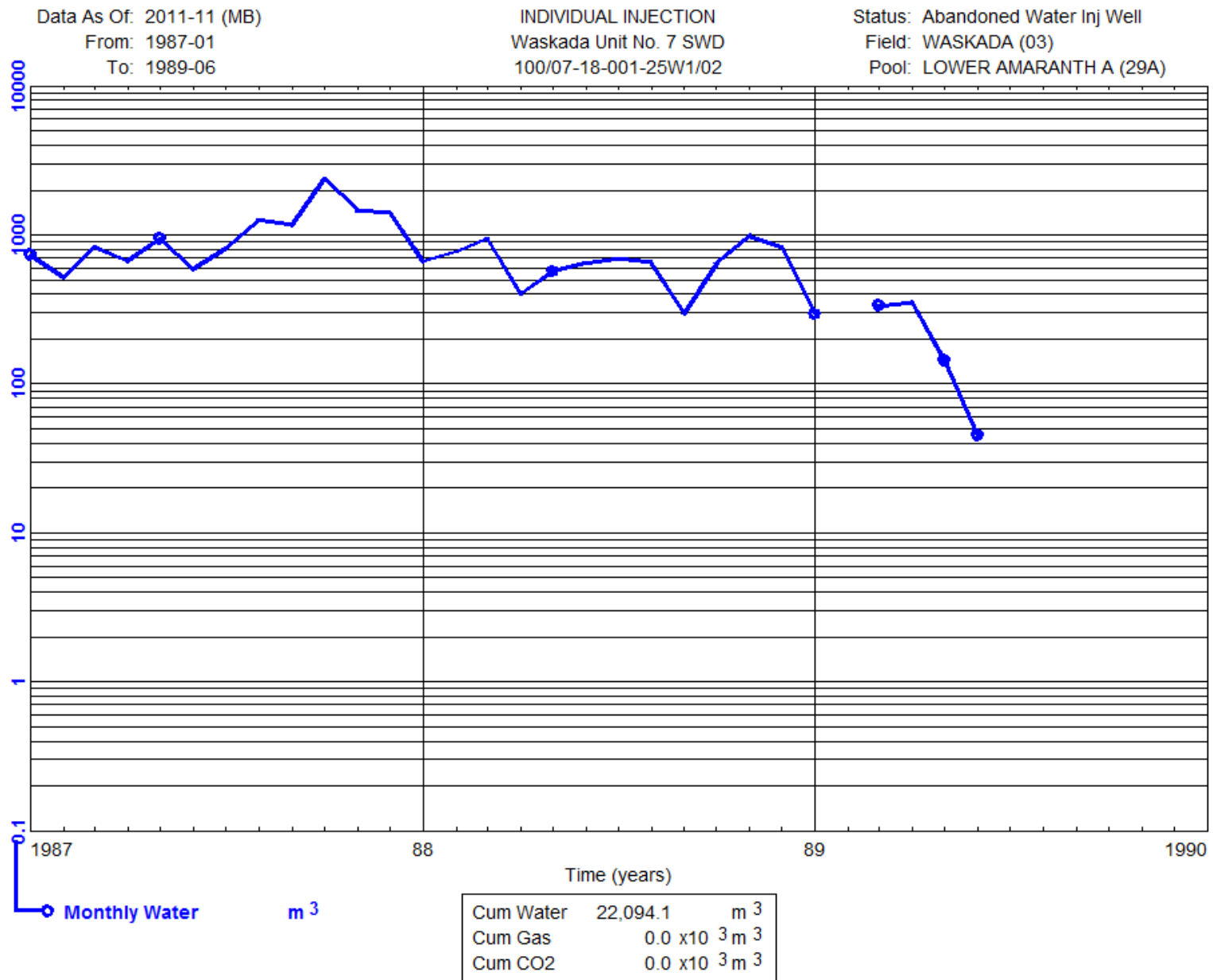
Appendix C – Voidage Replacement Ratio VRR

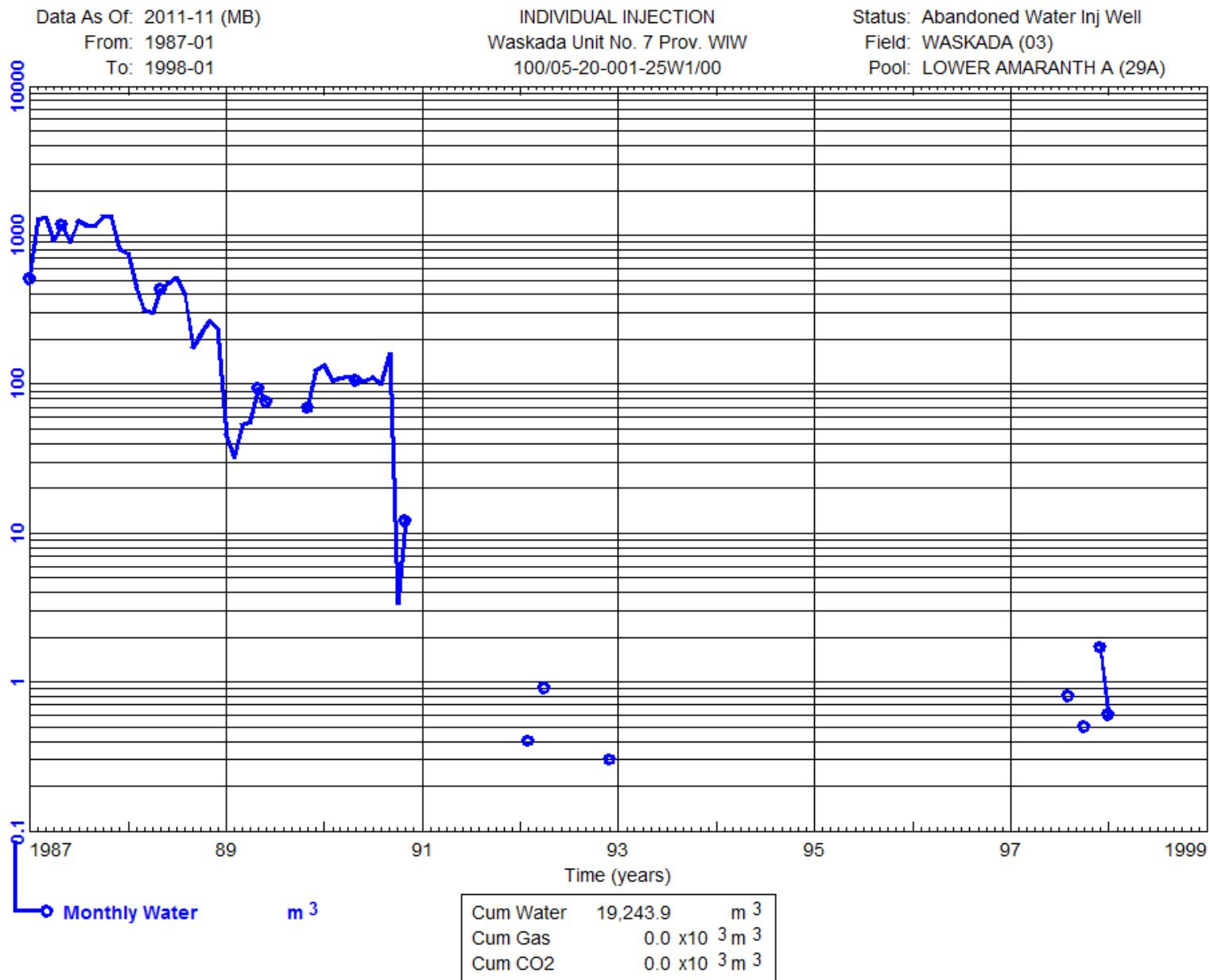


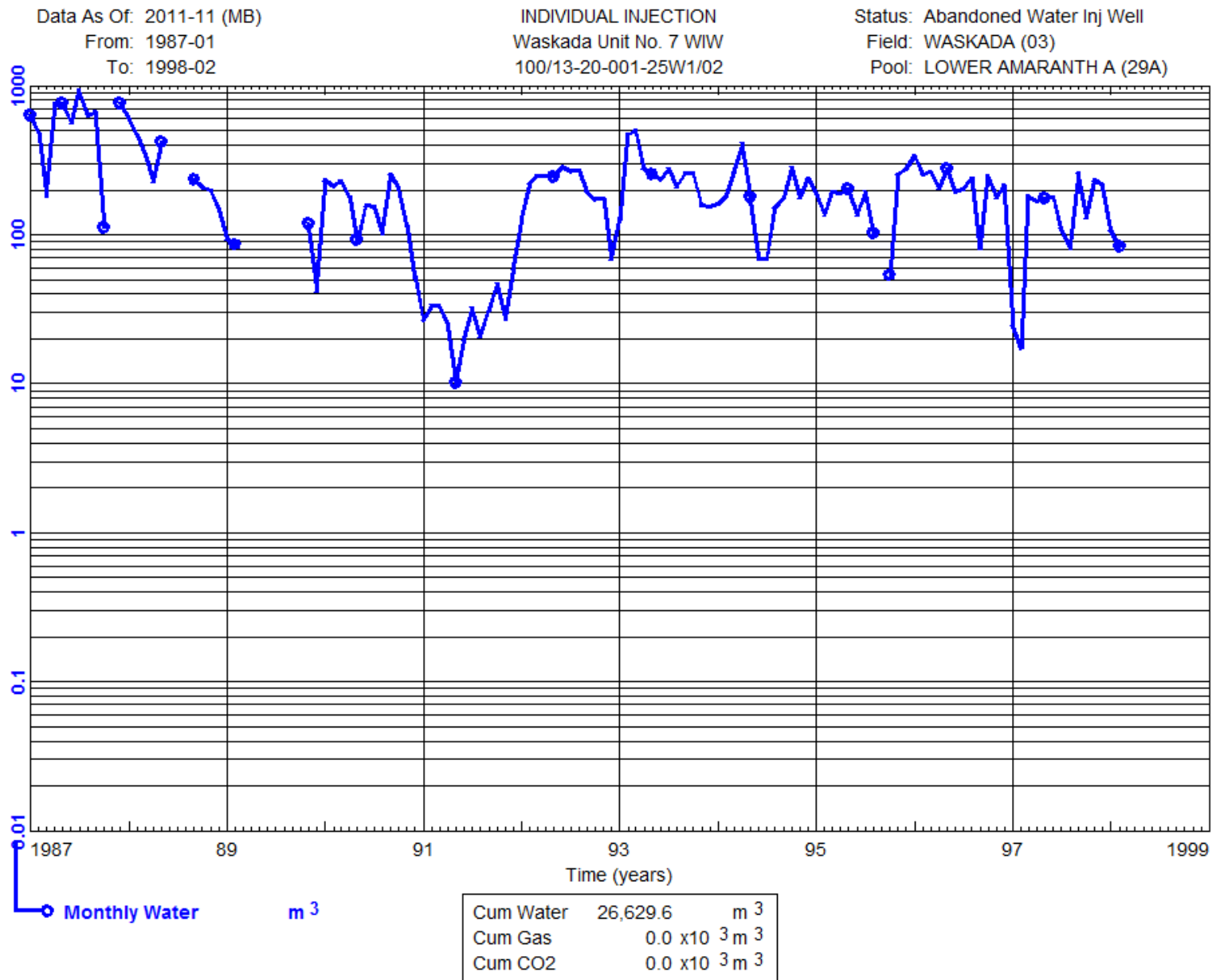
APPENDIX D

Appendix D – Production and Injection Profiles





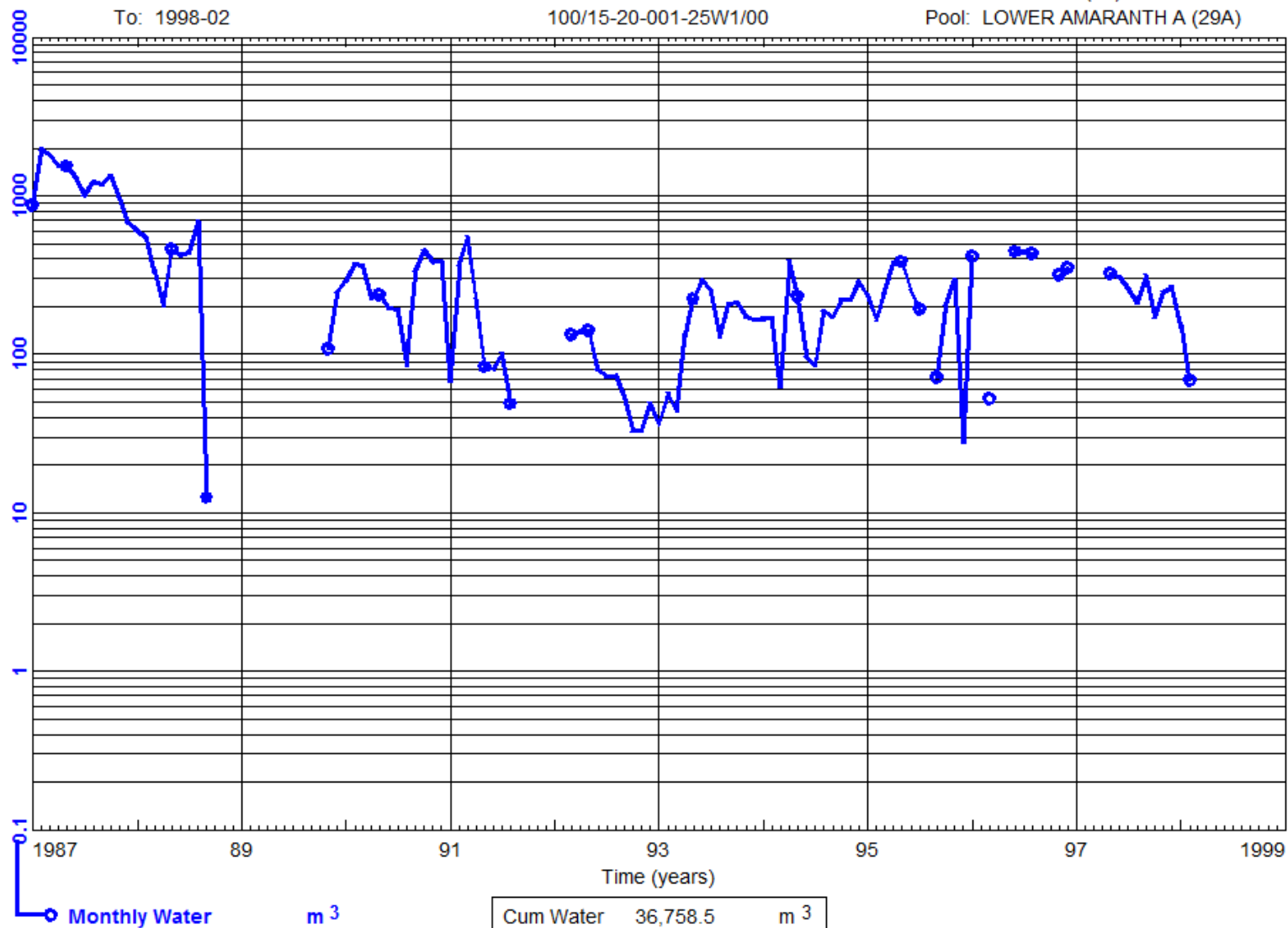




Data As Of: 2011-11 (MB)
From: 1987-01
To: 1998-02

INDIVIDUAL INJECTION
Waskada Unit No. 7 WIW
100/15-20-001-25W1/00

Status: Abandoned Water Inj Well
Field: WASKADA (03)
Pool: LOWER AMARANTH A (29A)

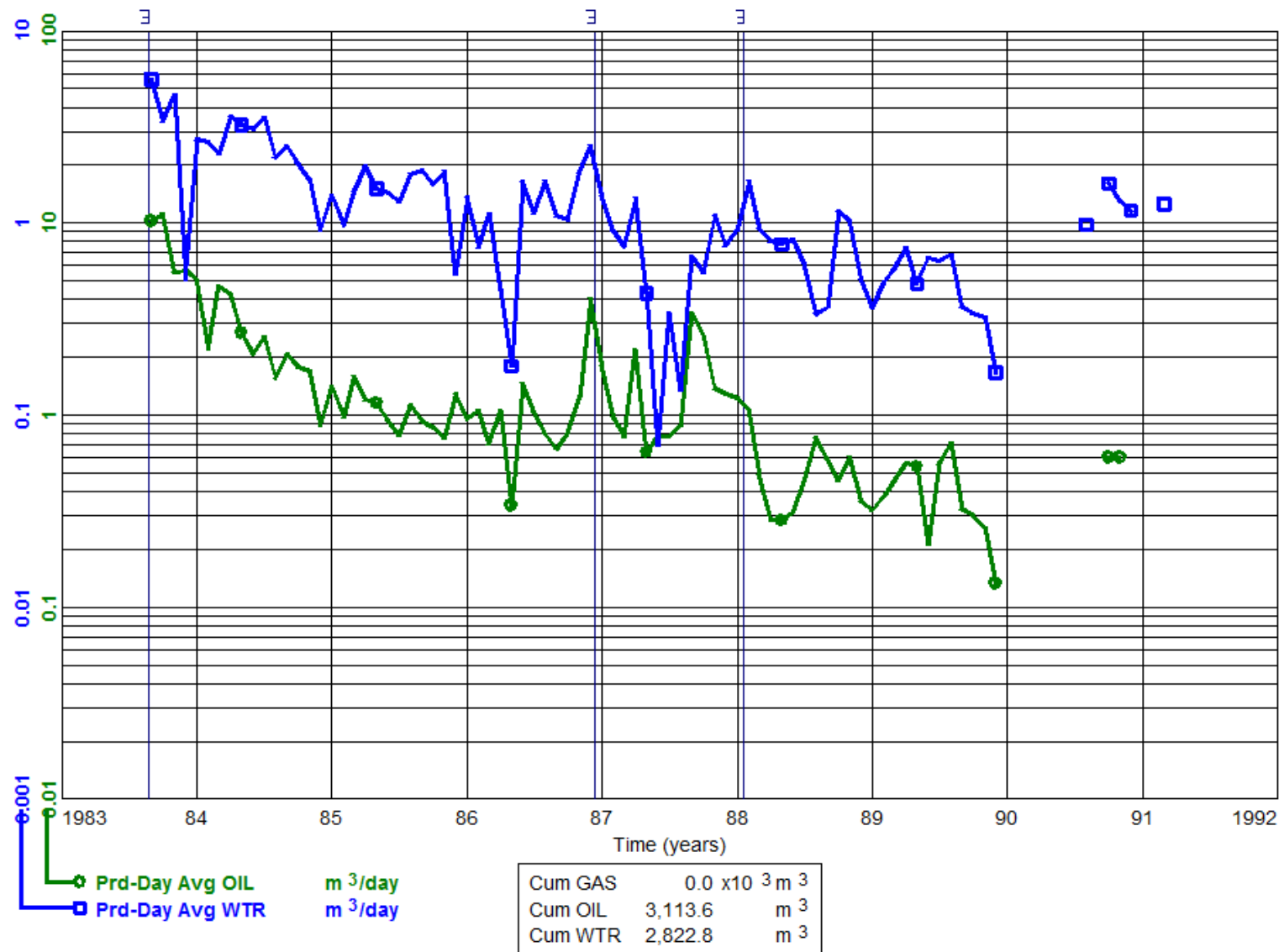


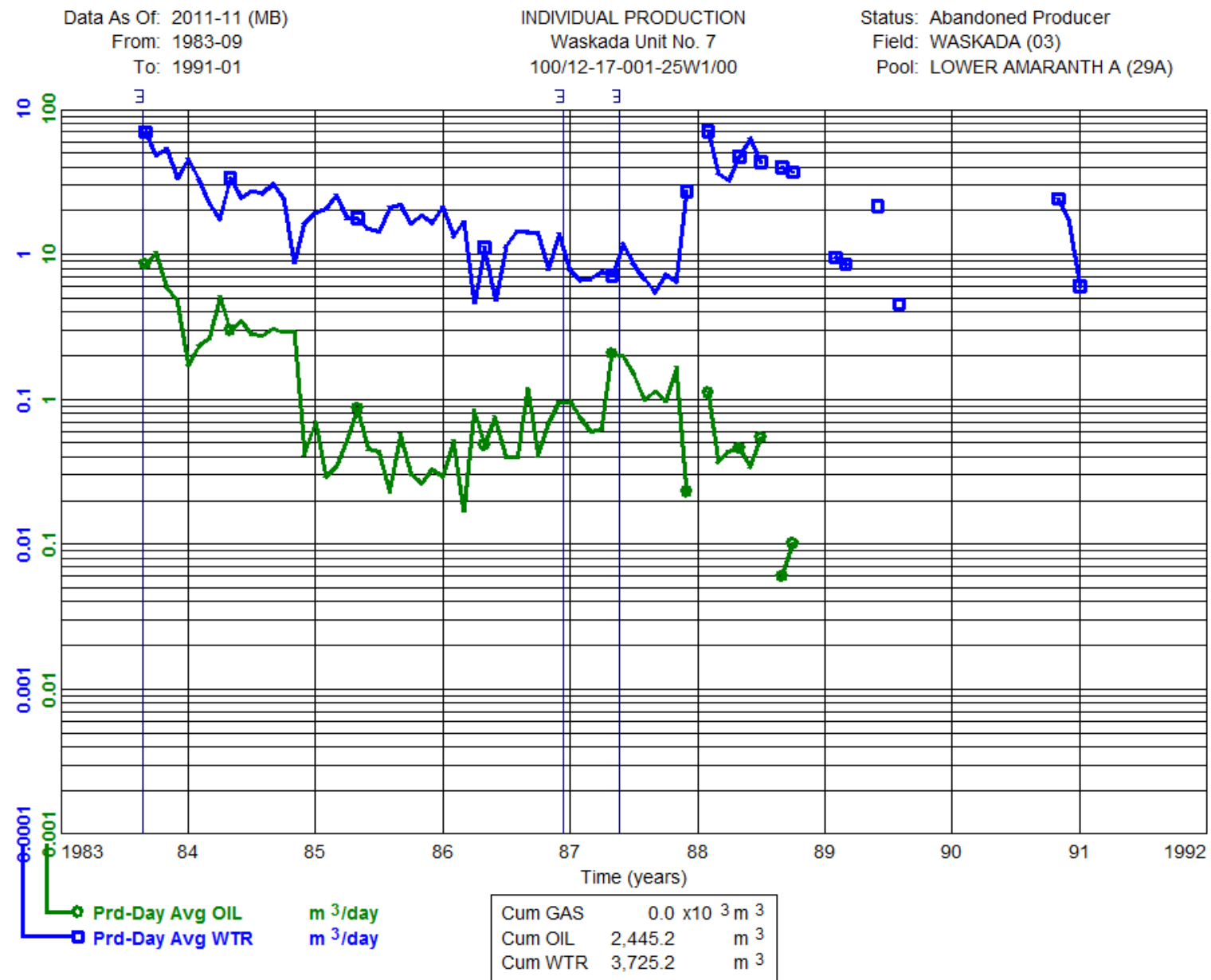
Cum Water	36,758.5	m^3
Cum Gas	0.0	$\times 10^3 \text{m}^3$
Cum CO2	0.0	$\times 10^3 \text{m}^3$

Data As Of: 2011-11 (MB)
 From: 1983-09
 To: 1991-03

INDIVIDUAL PRODUCTION
 Omega Chevron Waskada
 100/11-17-001-25W1/00

Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)

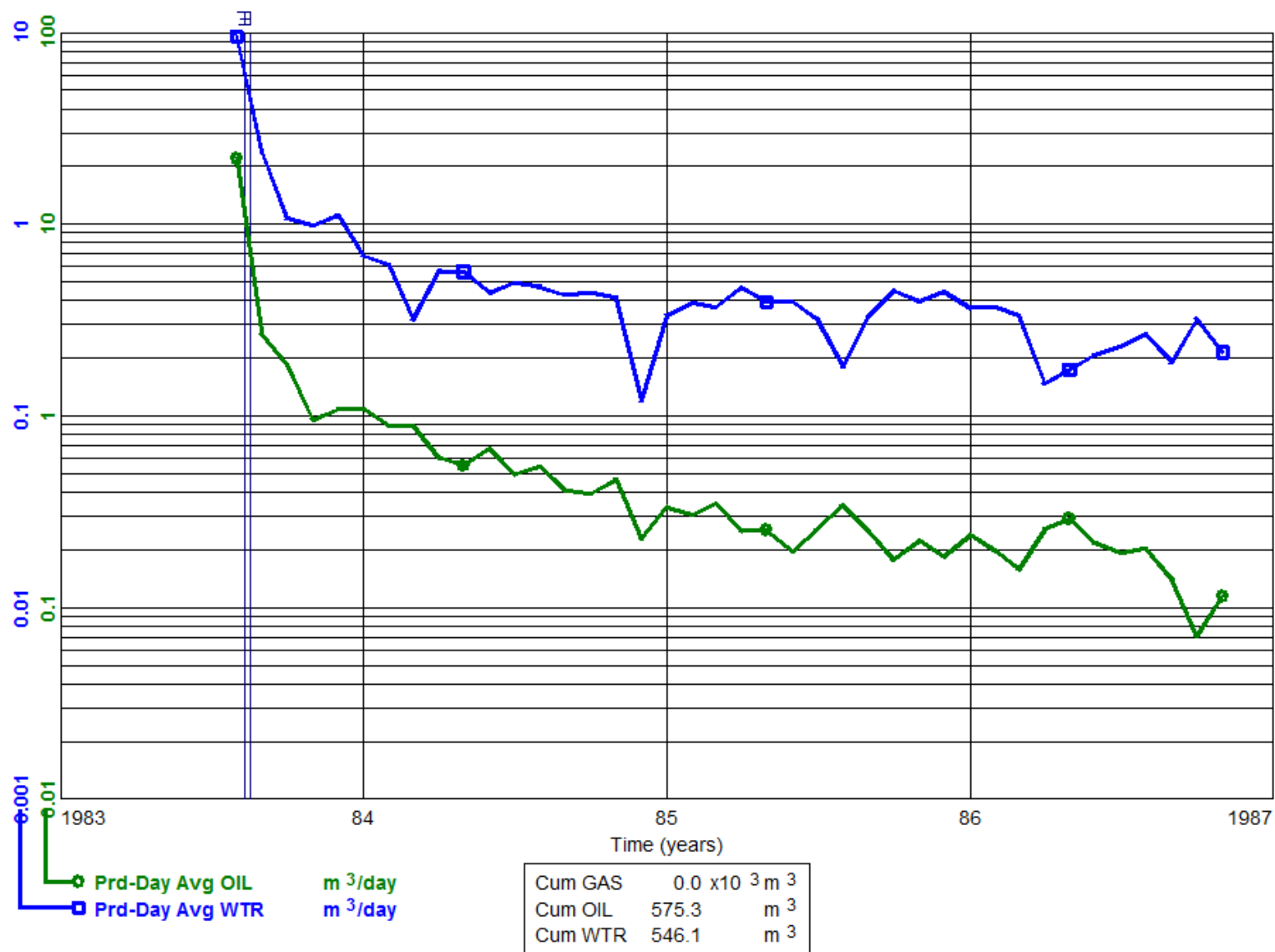




Data As Of: 2011-11 (MB)
 From: 1983-08
 To: 1986-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 WIW
 100/13-17-001-25W1/00

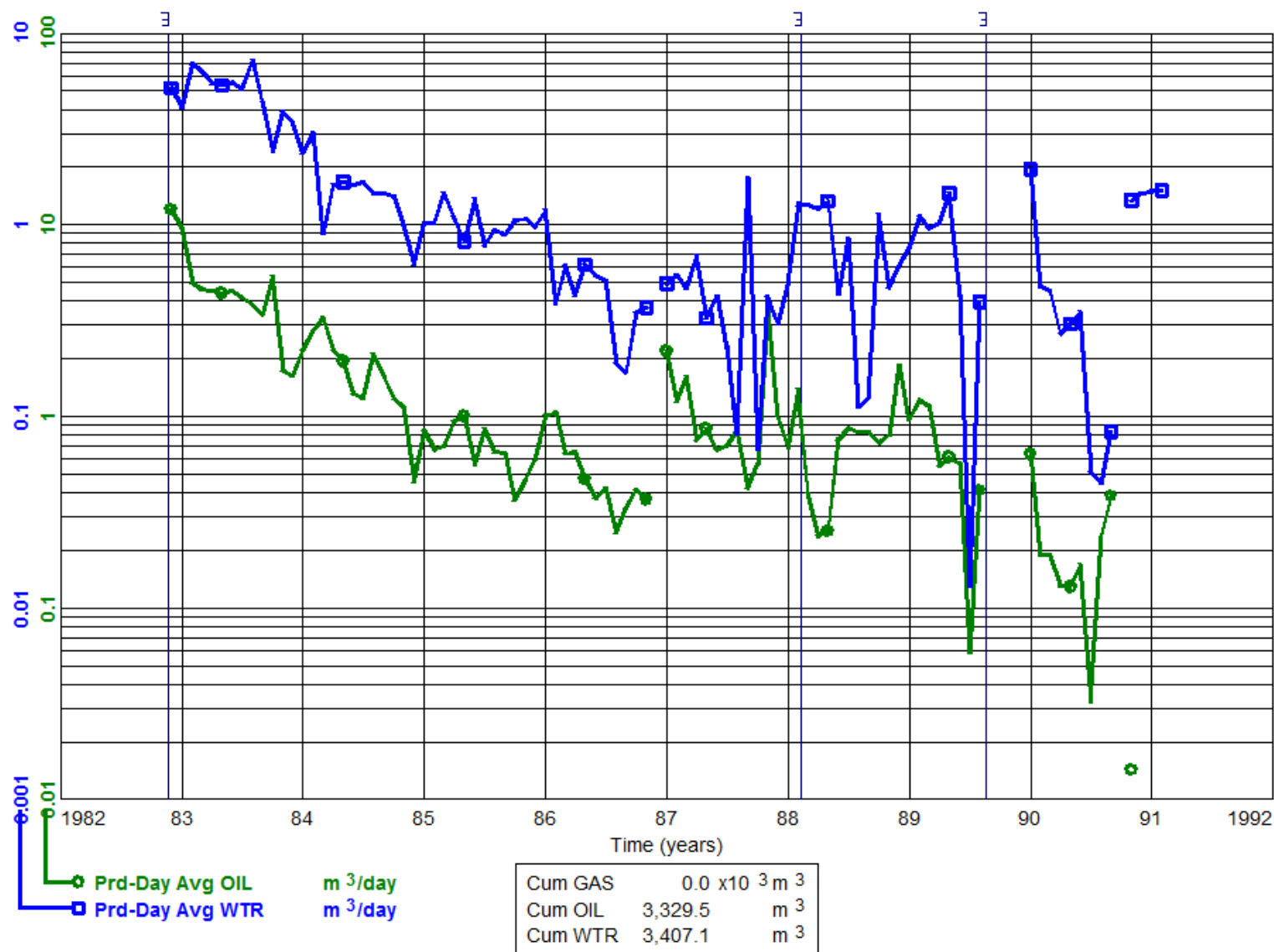
Status: Abandoned Water Inj Well
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)

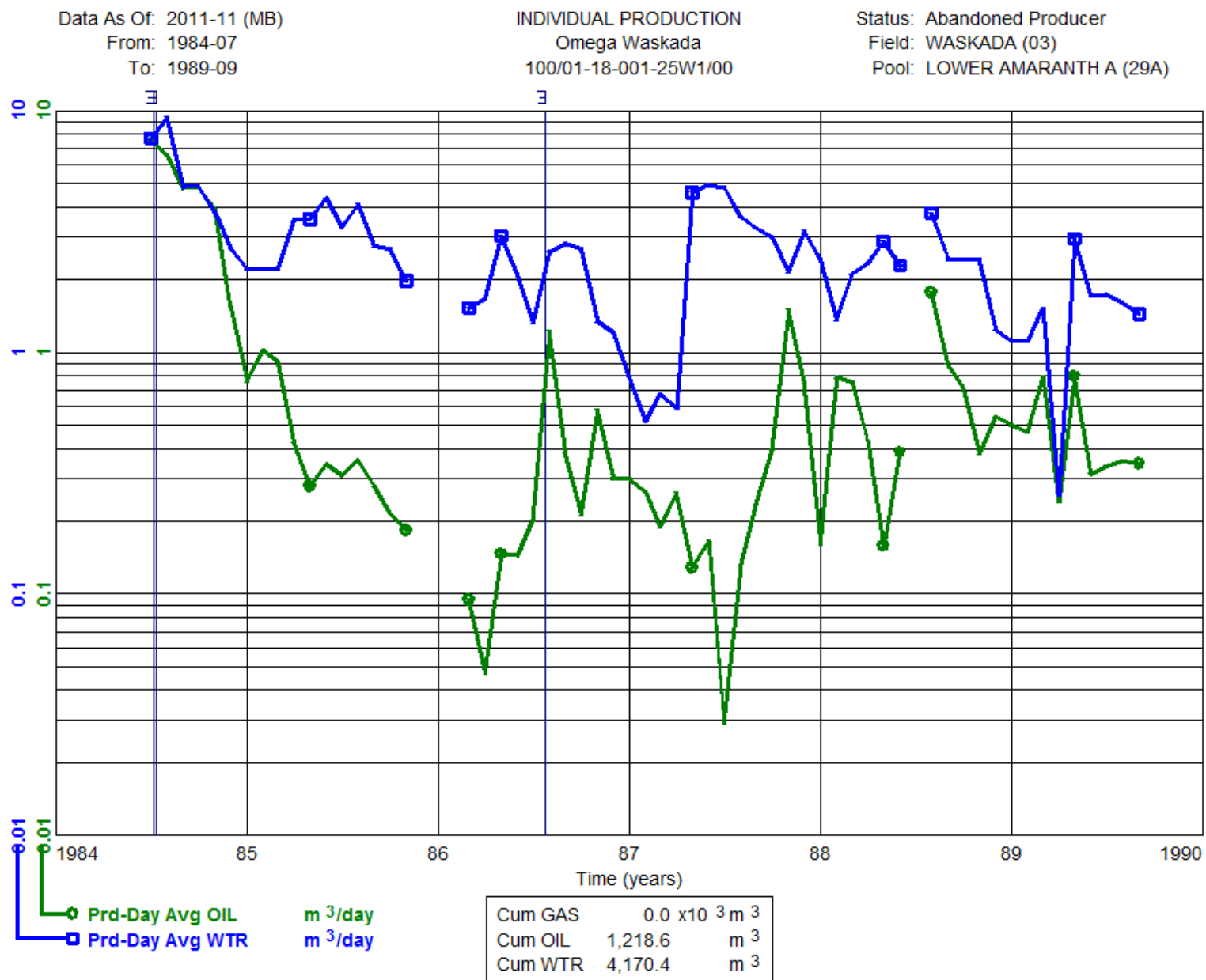


Data As Of: 2011-11 (MB)
 From: 1982-12
 To: 1991-02

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7
 100/14-17-001-25W1/00

Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)

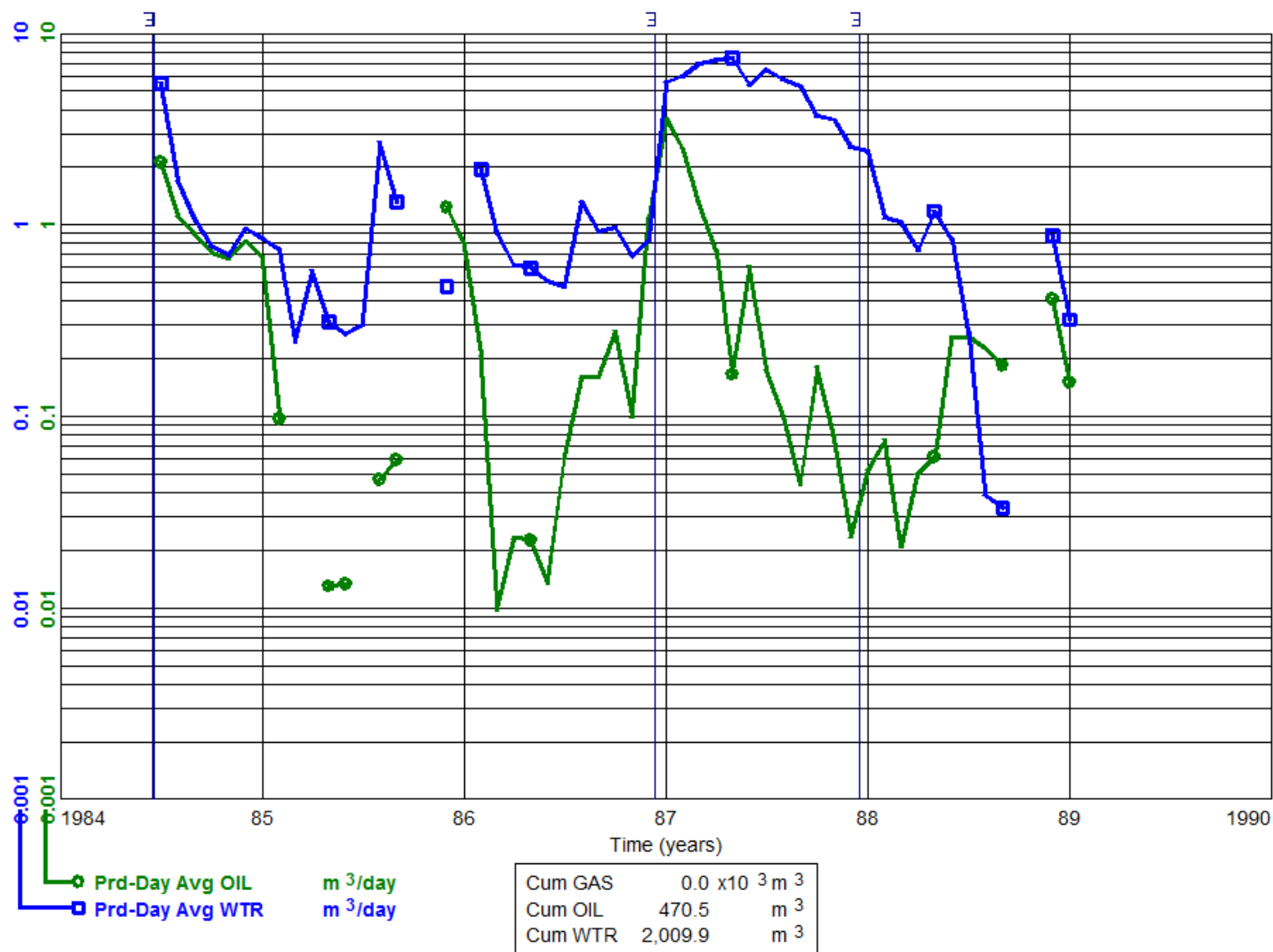




Data As Of: 2011-11 (MB)
 From: 1984-07
 To: 1989-01

INDIVIDUAL PRODUCTION
 Omega Waskada
 100/02-18-001-25W1/00

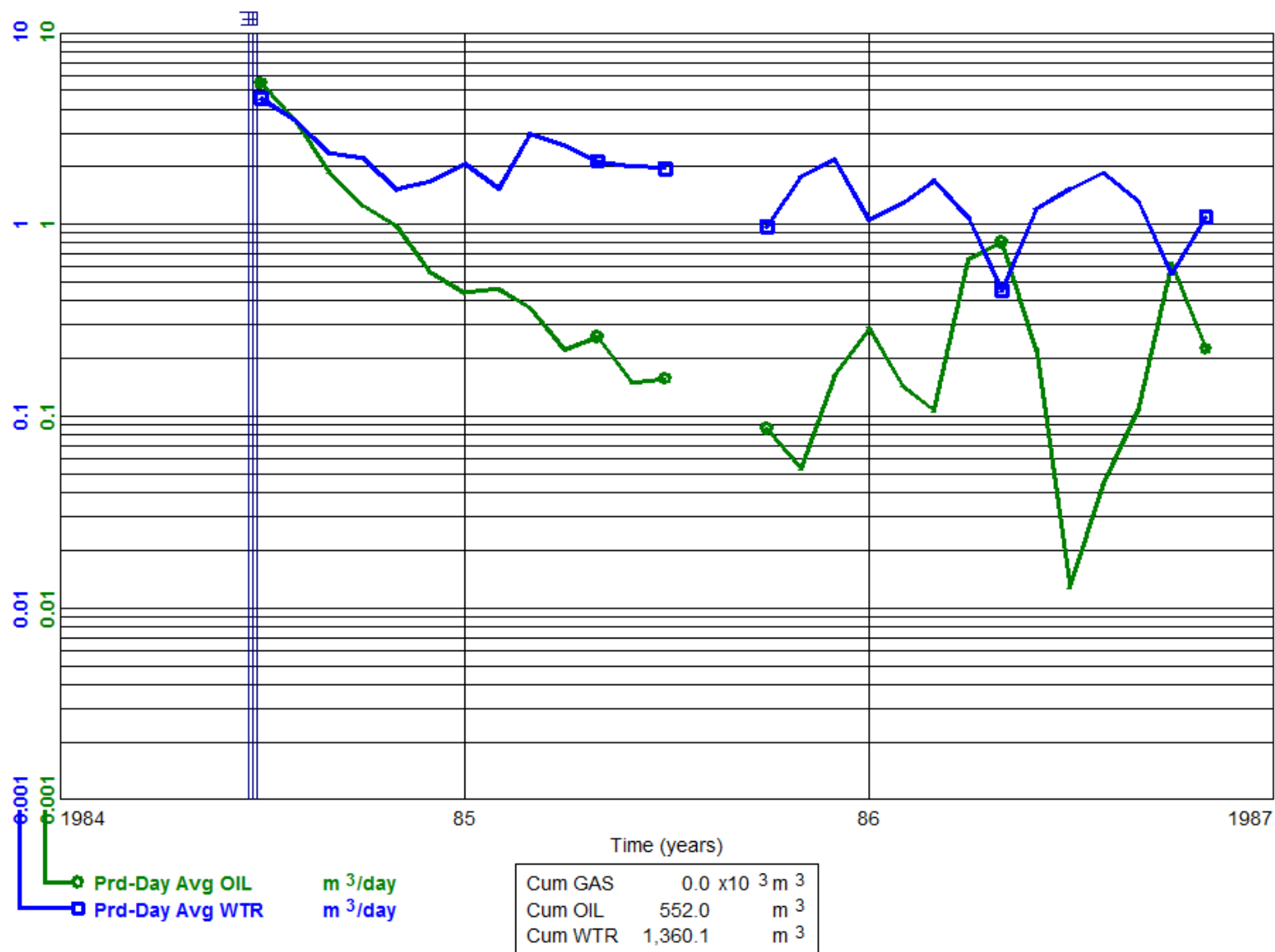
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1984-07
 To: 1986-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 SWD
 100/07-18-001-25W1/02

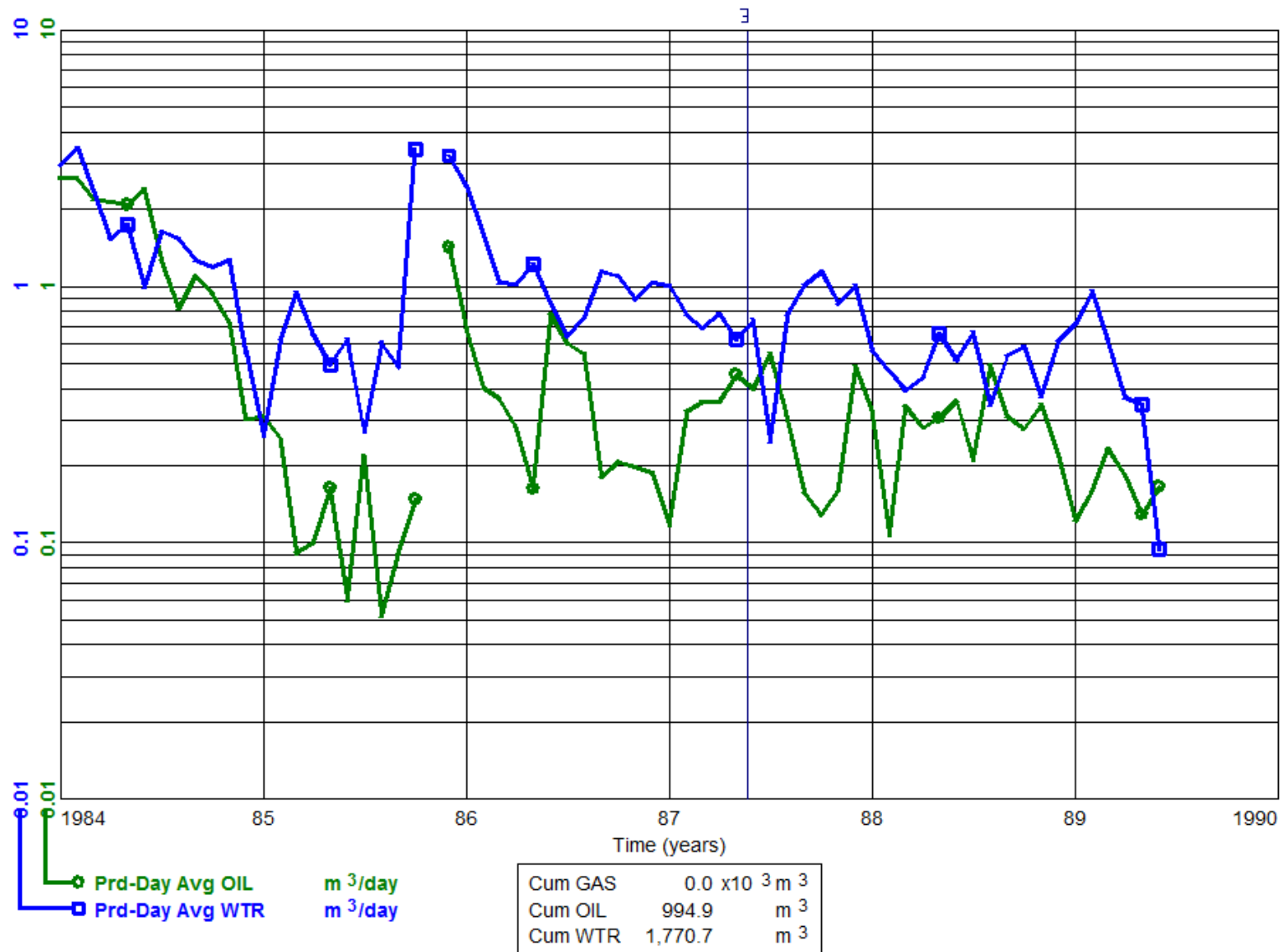
Status: Abandoned Water Inj Well
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1984-01
 To: 1989-06

INDIVIDUAL PRODUCTION
 Omega Waskada
 100/08-18-001-25W1/00

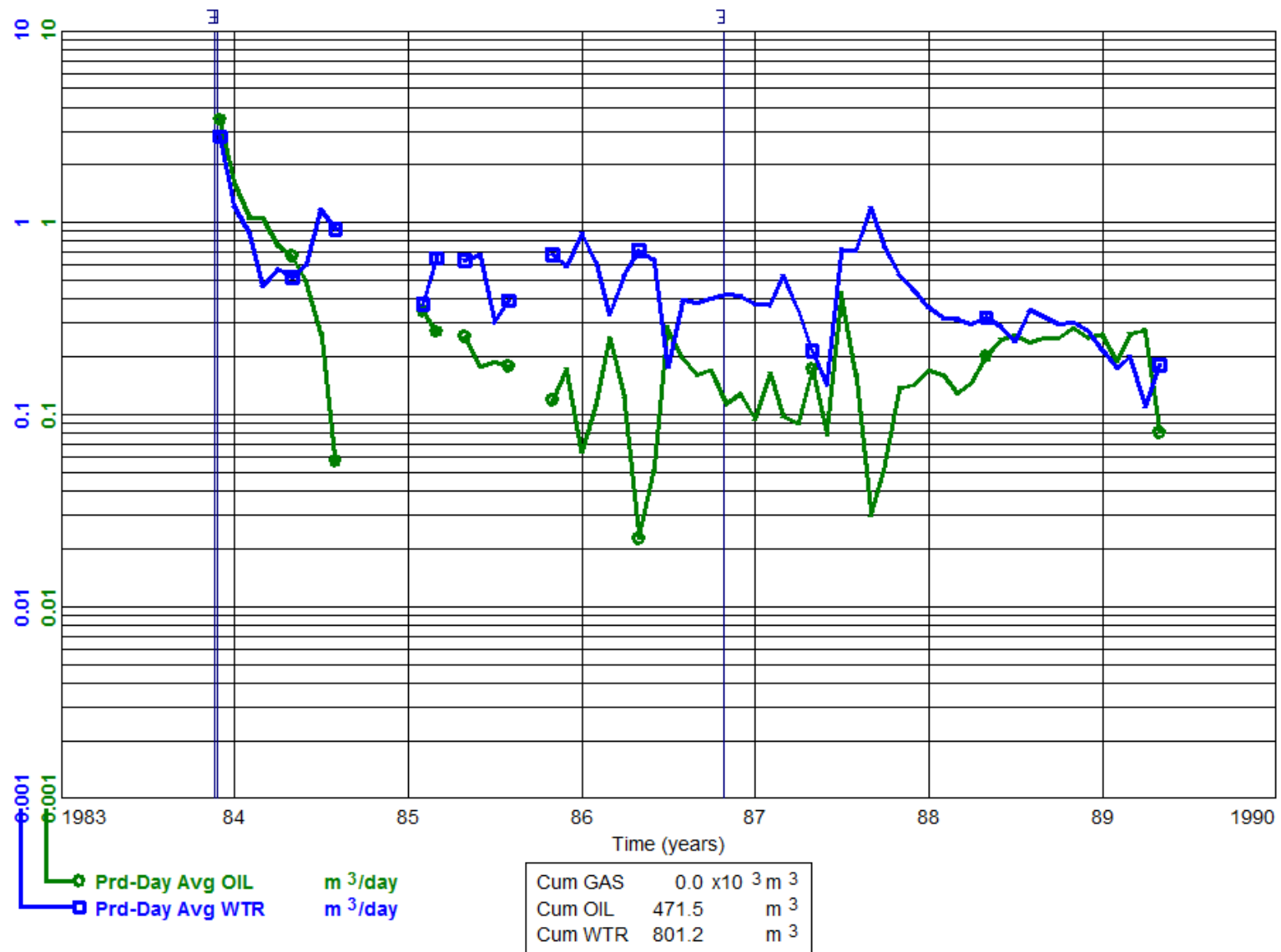
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1983-12
 To: 1989-05

INDIVIDUAL PRODUCTION
 Omega Waskada
 100/09-18-001-25W1/00

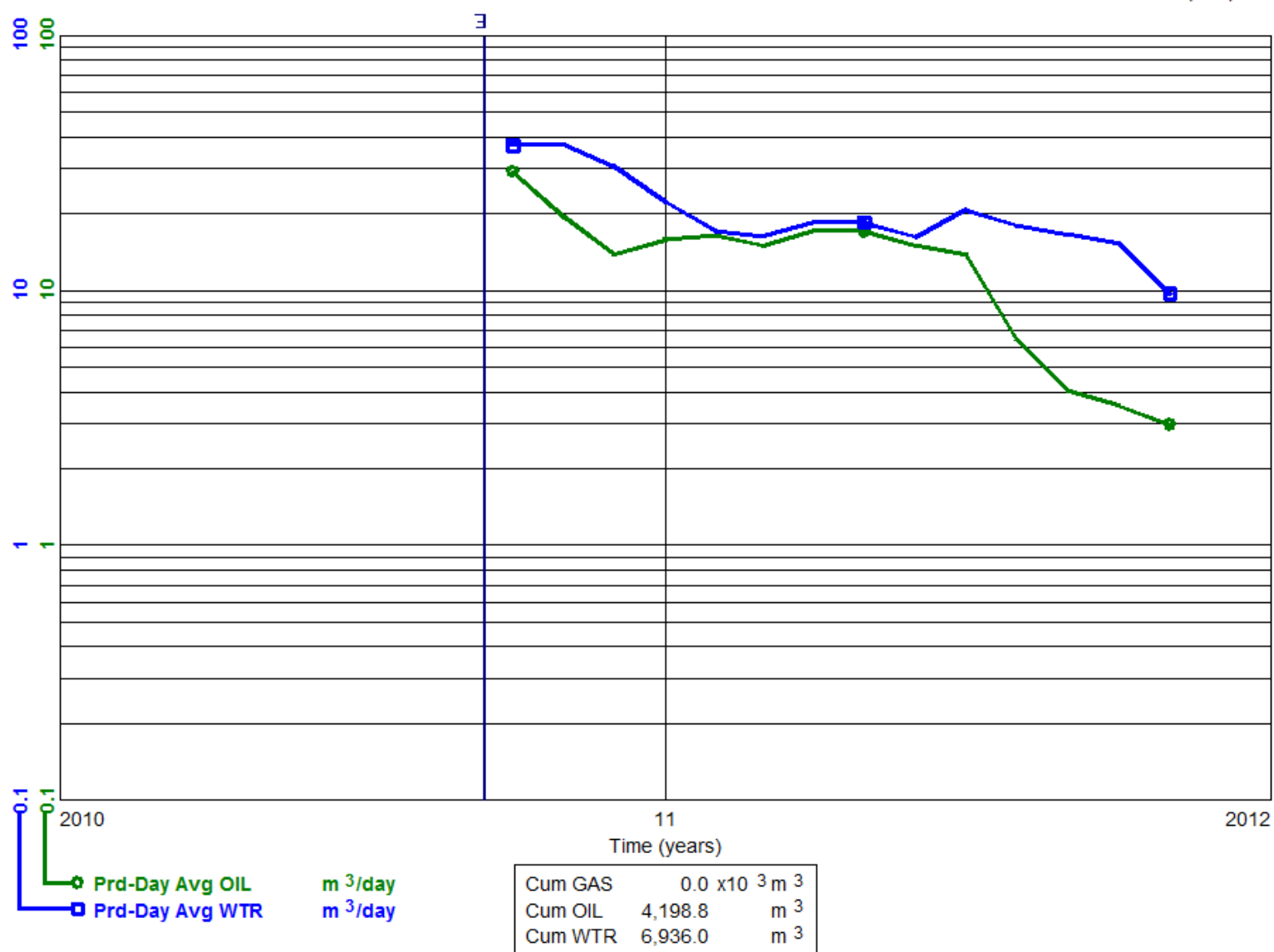
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 2010-10
 To: 2011-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 HZNTL
 102/09-18-001-25W1/00

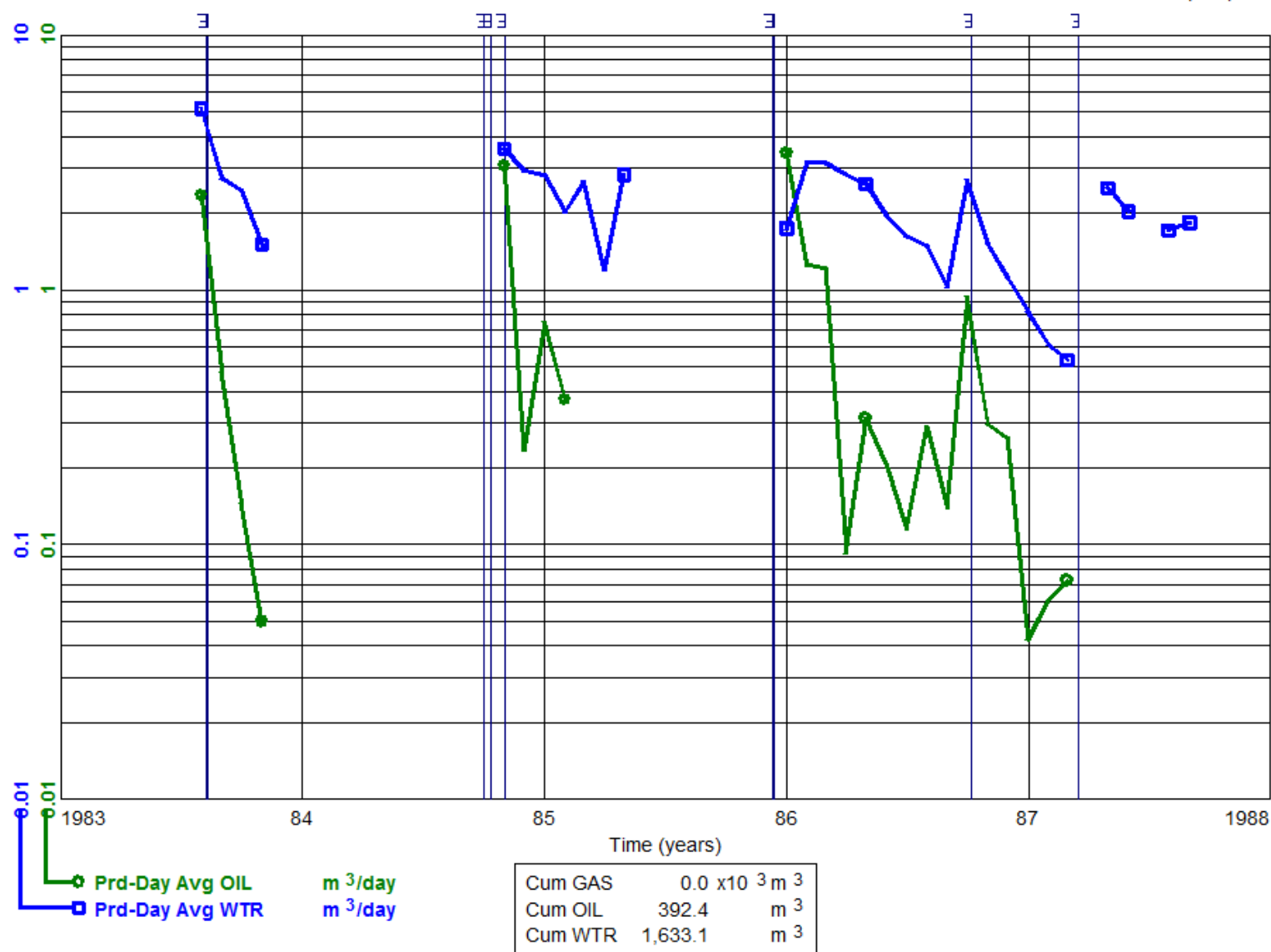
Status: Capable Of Oil Prod
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1983-08
 To: 1987-09

INDIVIDUAL PRODUCTION
 Omega Waskada
 100/16-18-001-25W1/00

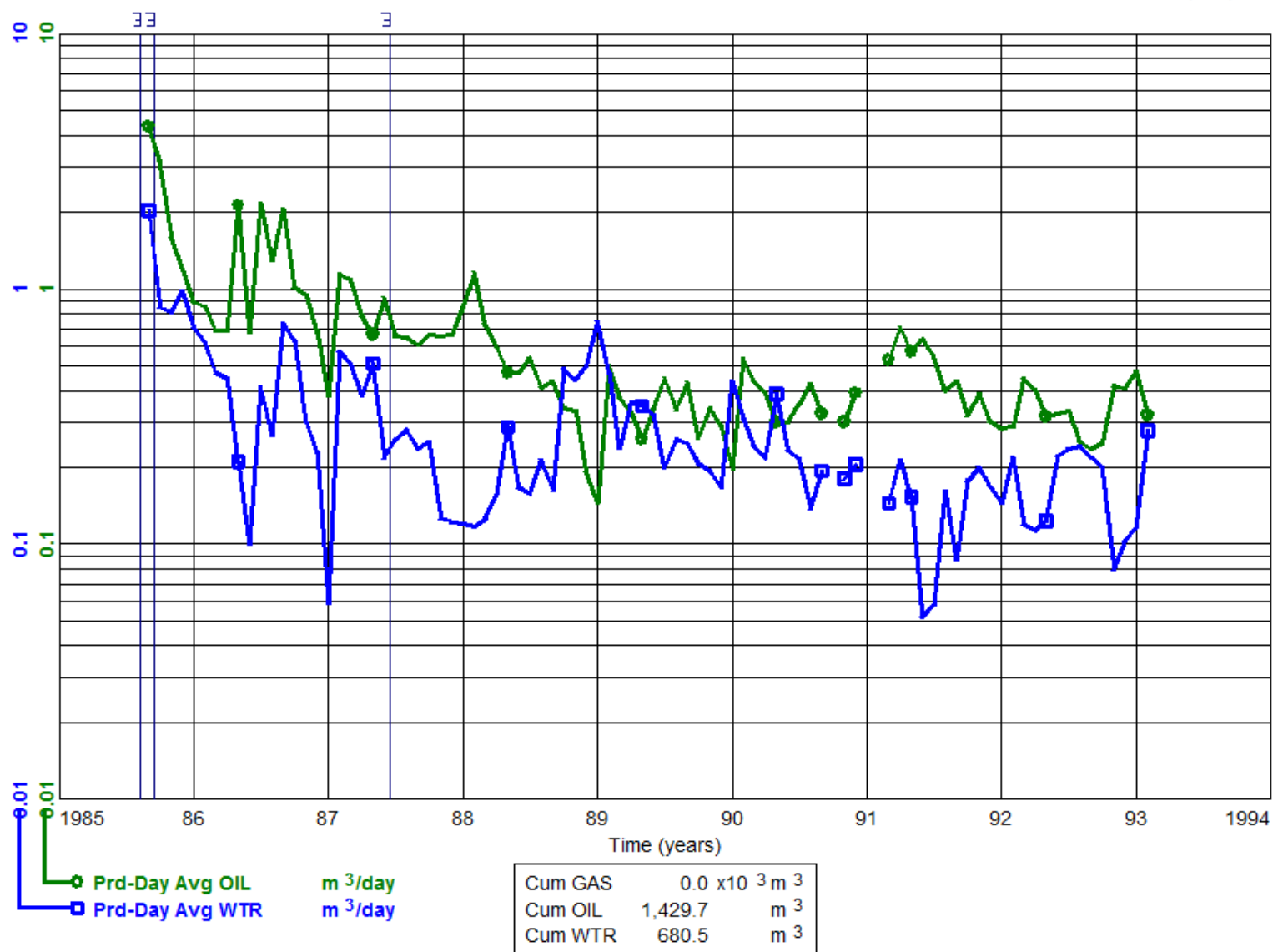
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1985-09
 To: 1993-02

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7
 100/08-19-001-25W1/02

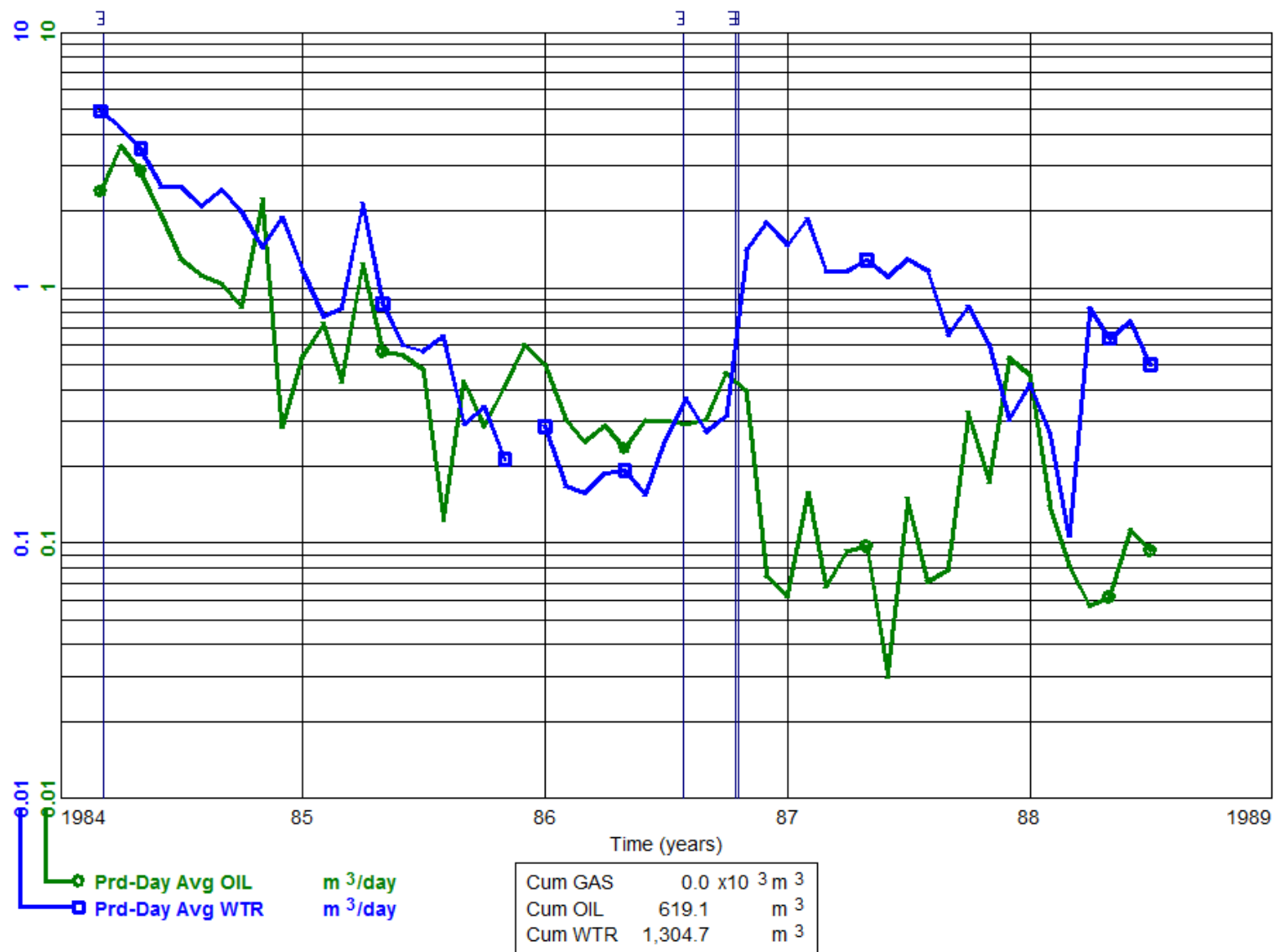
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1984-03
 To: 1988-07

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 Prov.
 100/03-20-001-25W1/00

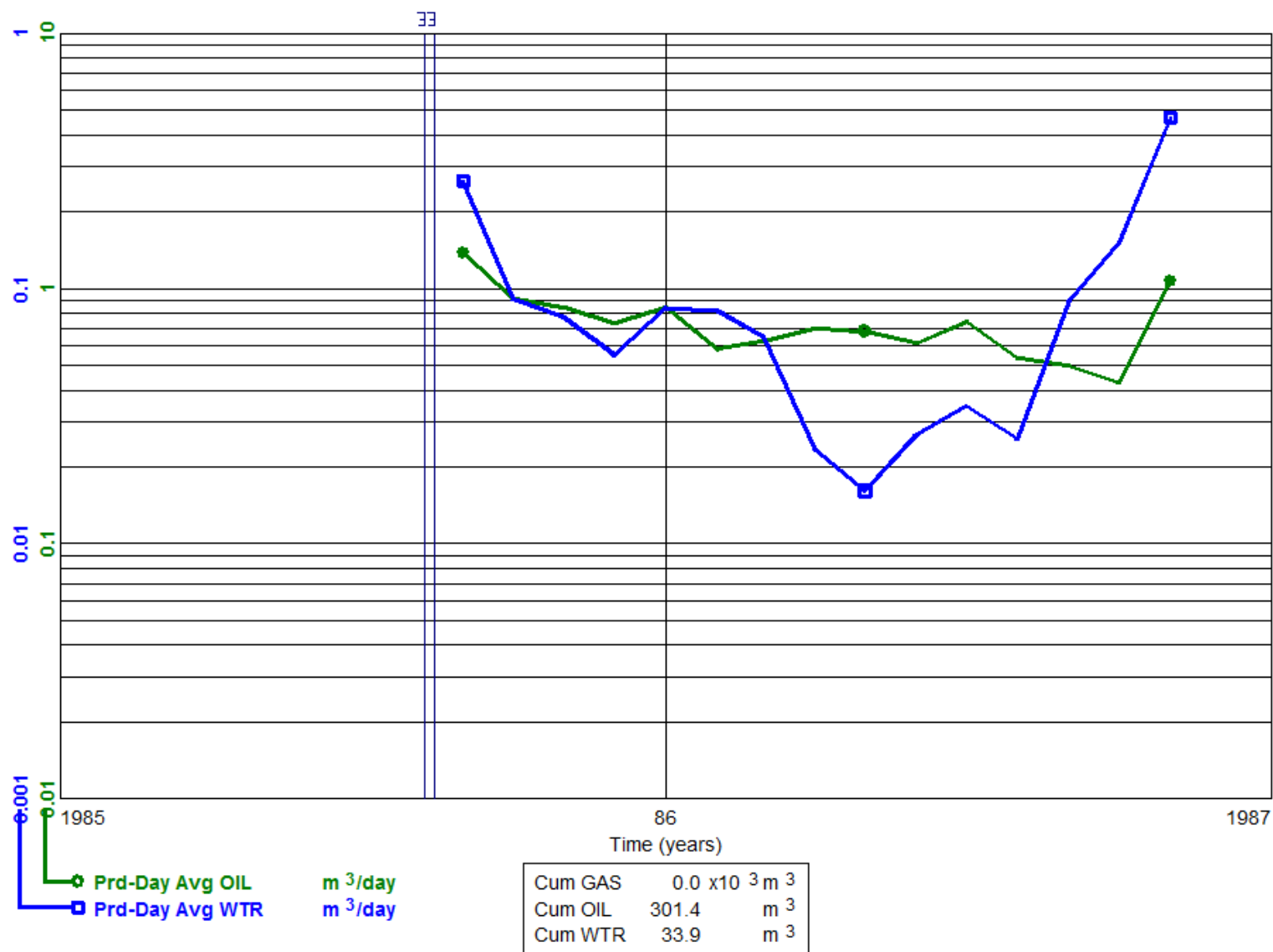
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1985-09
 To: 1986-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 Prov. WIW
 100/05-20-001-25W1/00

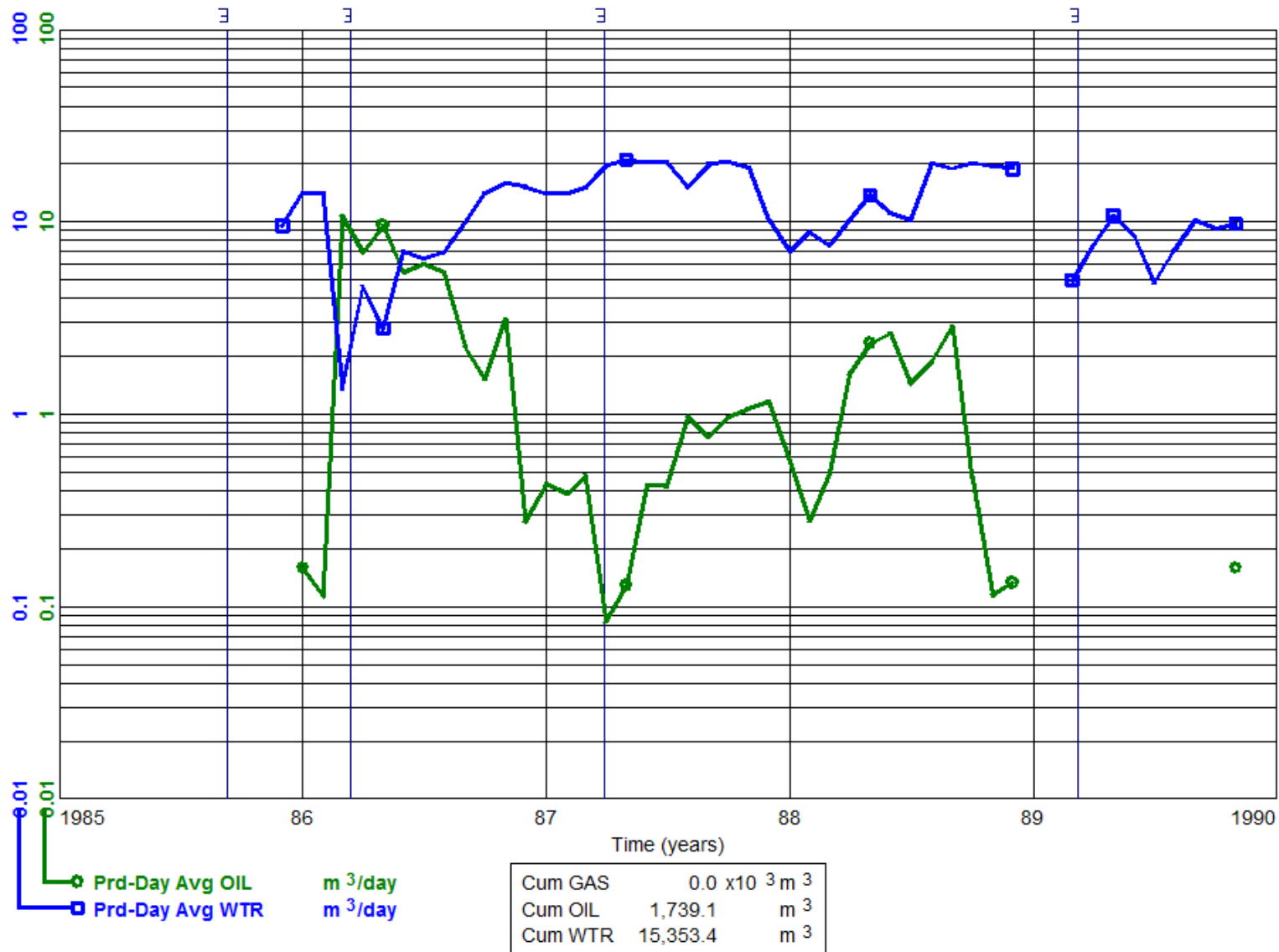
Status: Abandoned Water Inj Well
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1985-12
 To: 1989-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 Prov.
 100/06-20-001-25W1/00

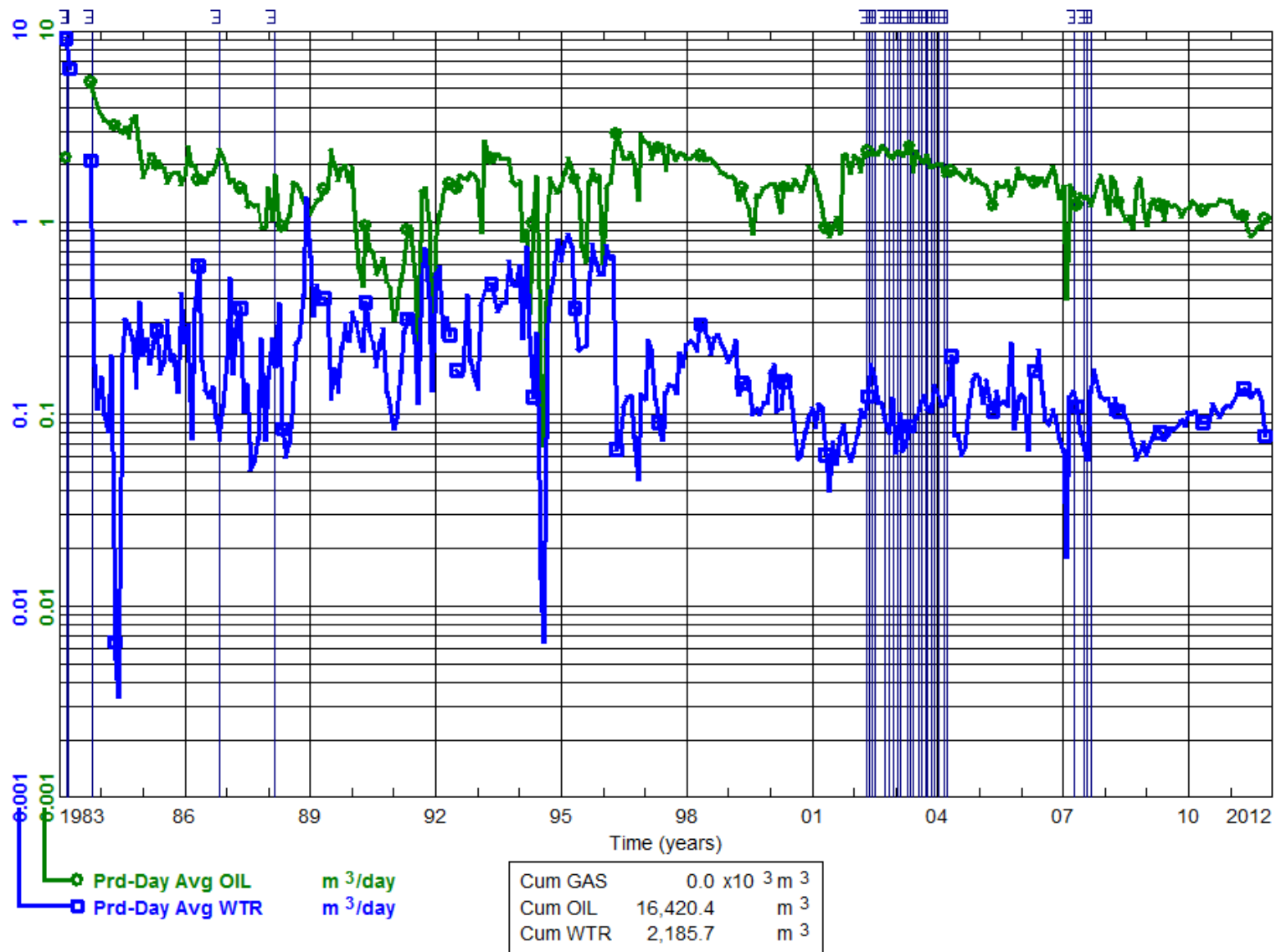
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1983-03
 To: 2011-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7
 100/11-20-001-25W1/00

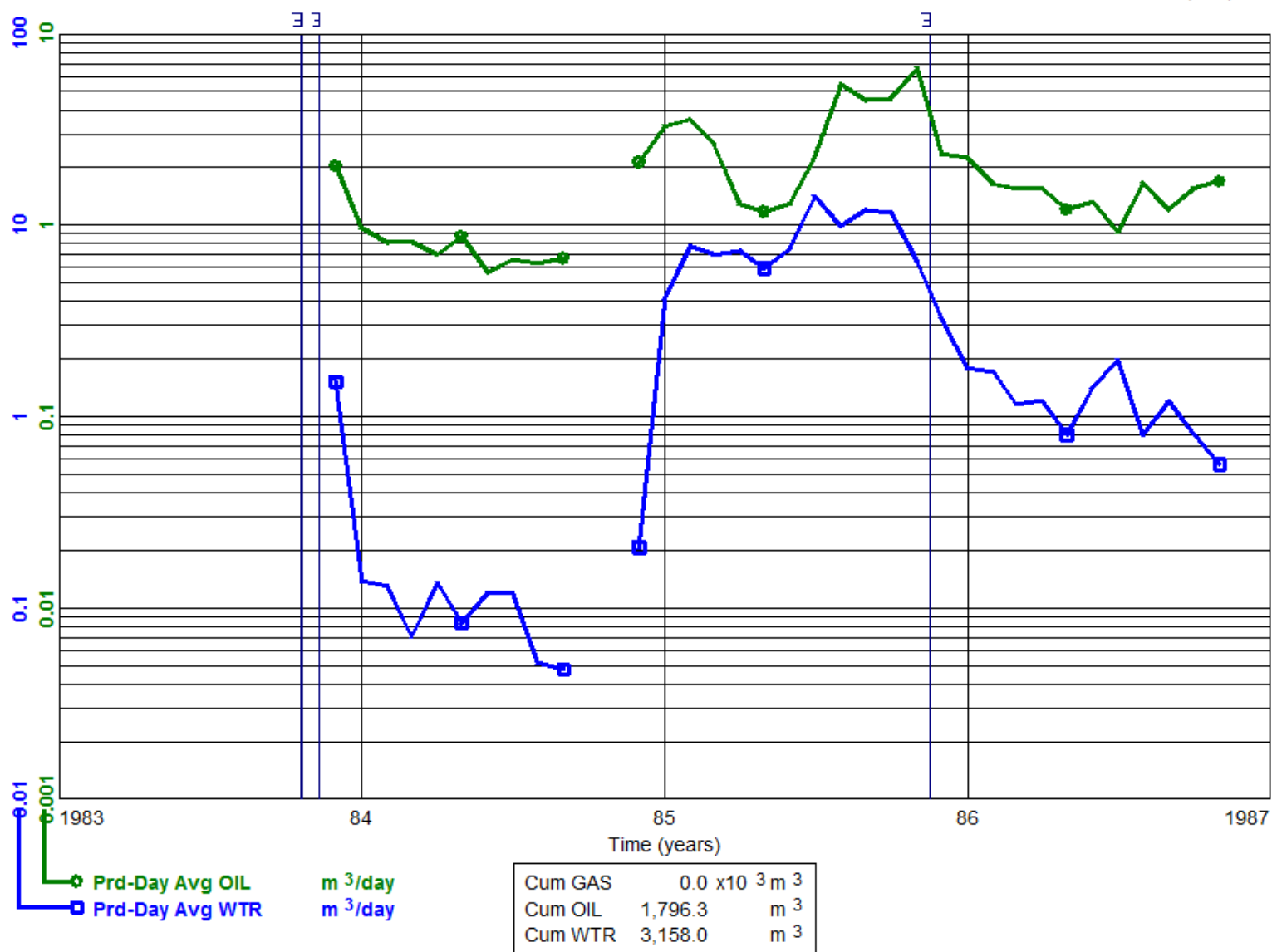
Status: Capable Of Oil Prod
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1983-12
 To: 1986-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 WIW
 100/13-20-001-25W1/02

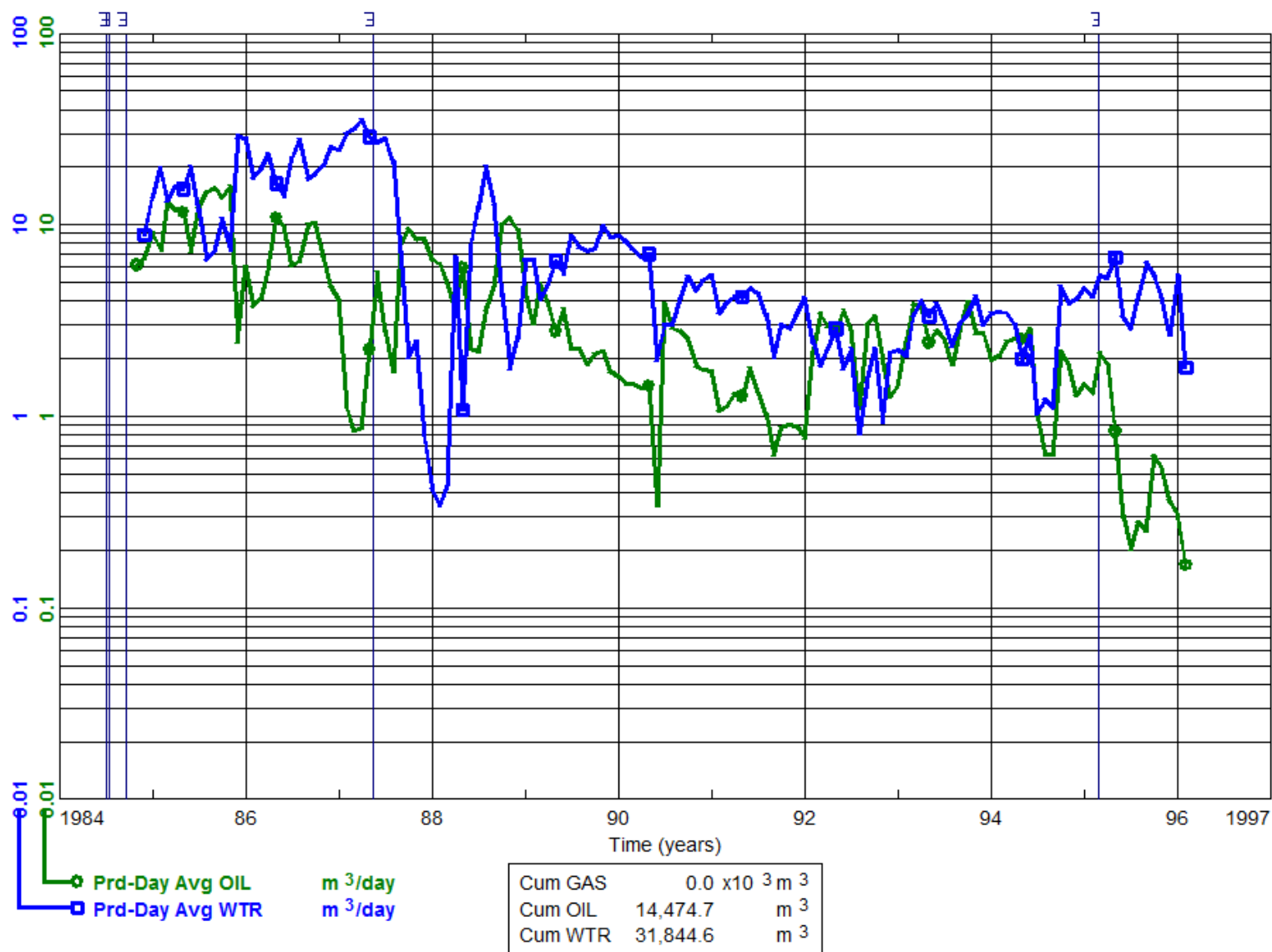
Status: Abandoned Water Inj Well
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1984-11
 To: 1996-02

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7
 100/14-20-001-25W1/00

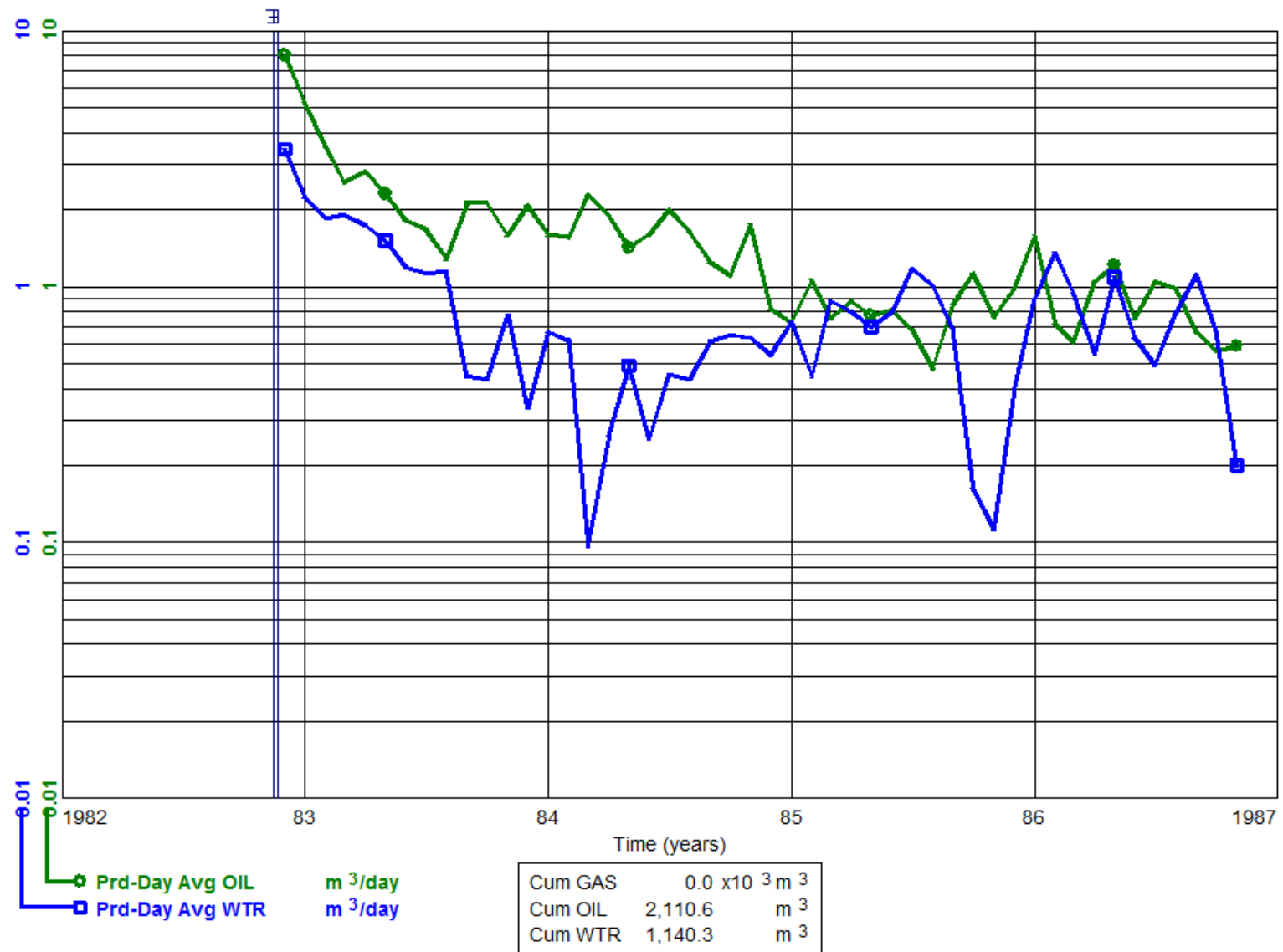
Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1982-12
 To: 1986-11

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7 WIW
 100/15-20-001-25W1/00

Status: Abandoned Water Inj Well
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)



Data As Of: 2011-11 (MB)
 From: 1984-08
 To: 1989-08

INDIVIDUAL PRODUCTION
 Waskada Unit No. 7
 100/16-20-001-25W1/00

Status: Abandoned Producer
 Field: WASKADA (03)
 Pool: LOWER AMARANTH A (29A)

