



# In Situ Oil Sands Schemes Approval 9404 Brintnell Sector

## Enhanced Recovery of Crude Bitumen by Water Injection 2006 Semi Annual Presentation

**Sept 20, 2006**

Presented by: Brad Falez  
Reservoir Engineer, Development Group  
Athabasca Business Unit

# Agenda



Current Approval Status

Geological Overview

Field Performance

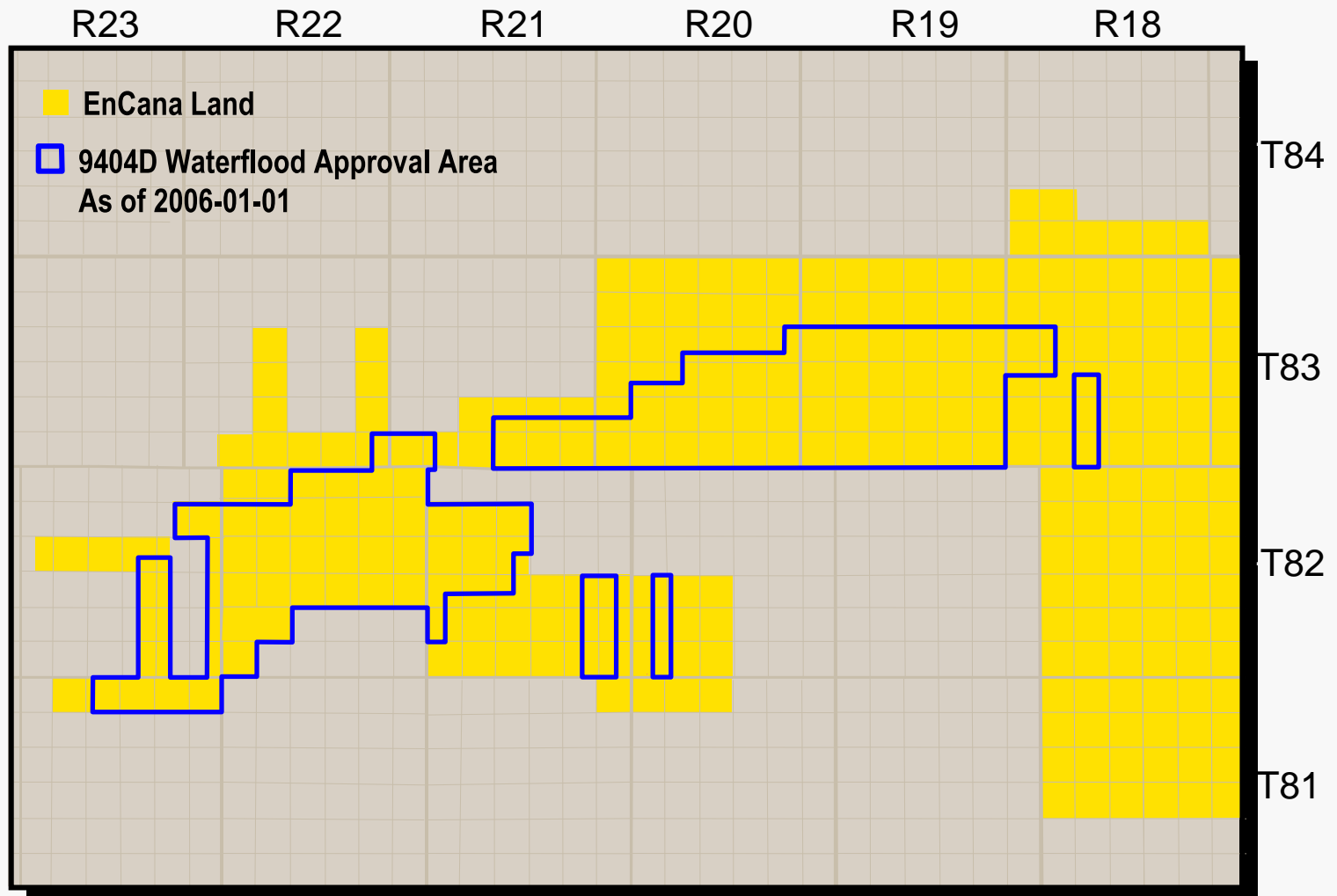
Key Learnings

Future plans

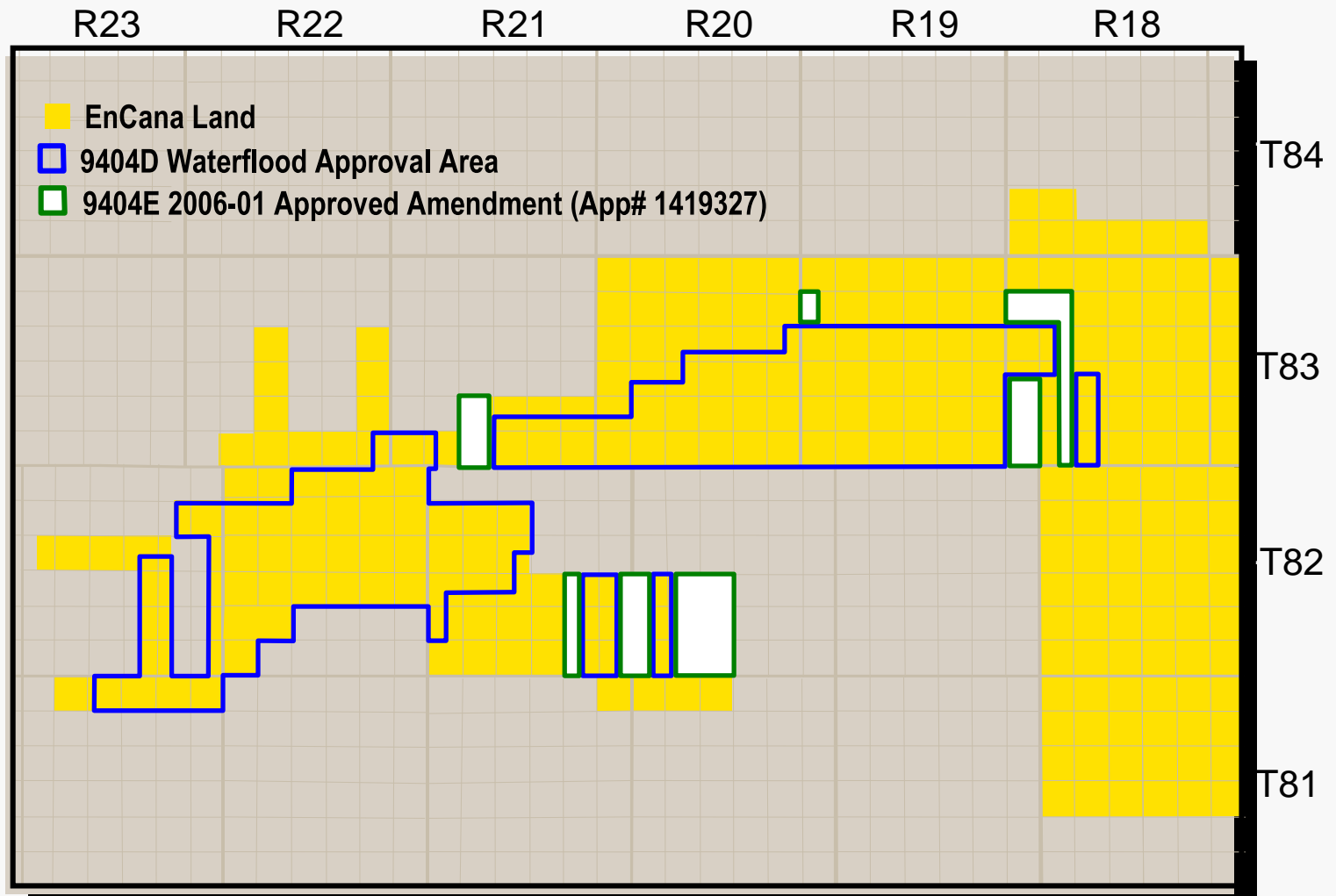
EUB issues

Compliance

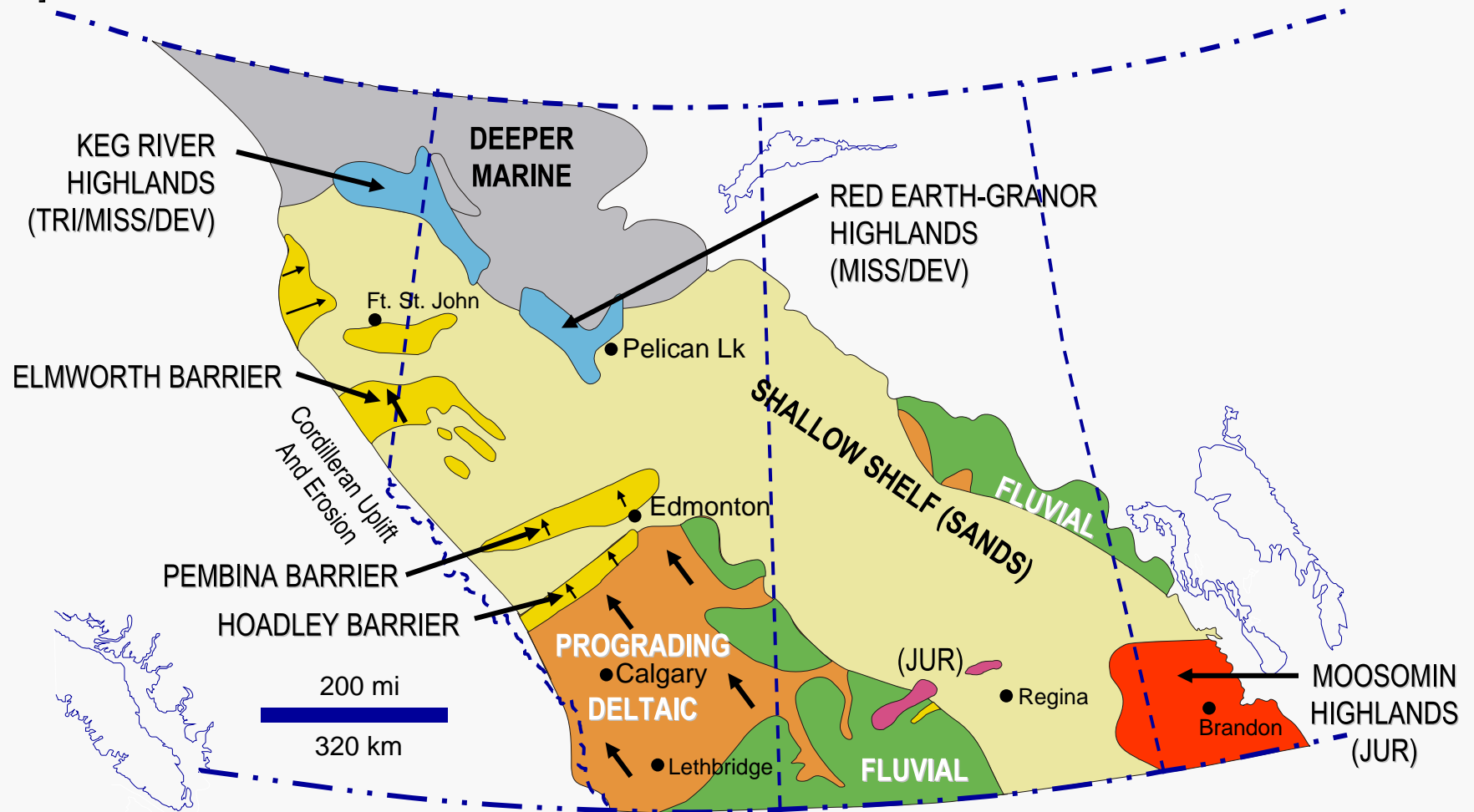
# Approval 9404D Approval Area



# Approval 9404E Current Approval Area

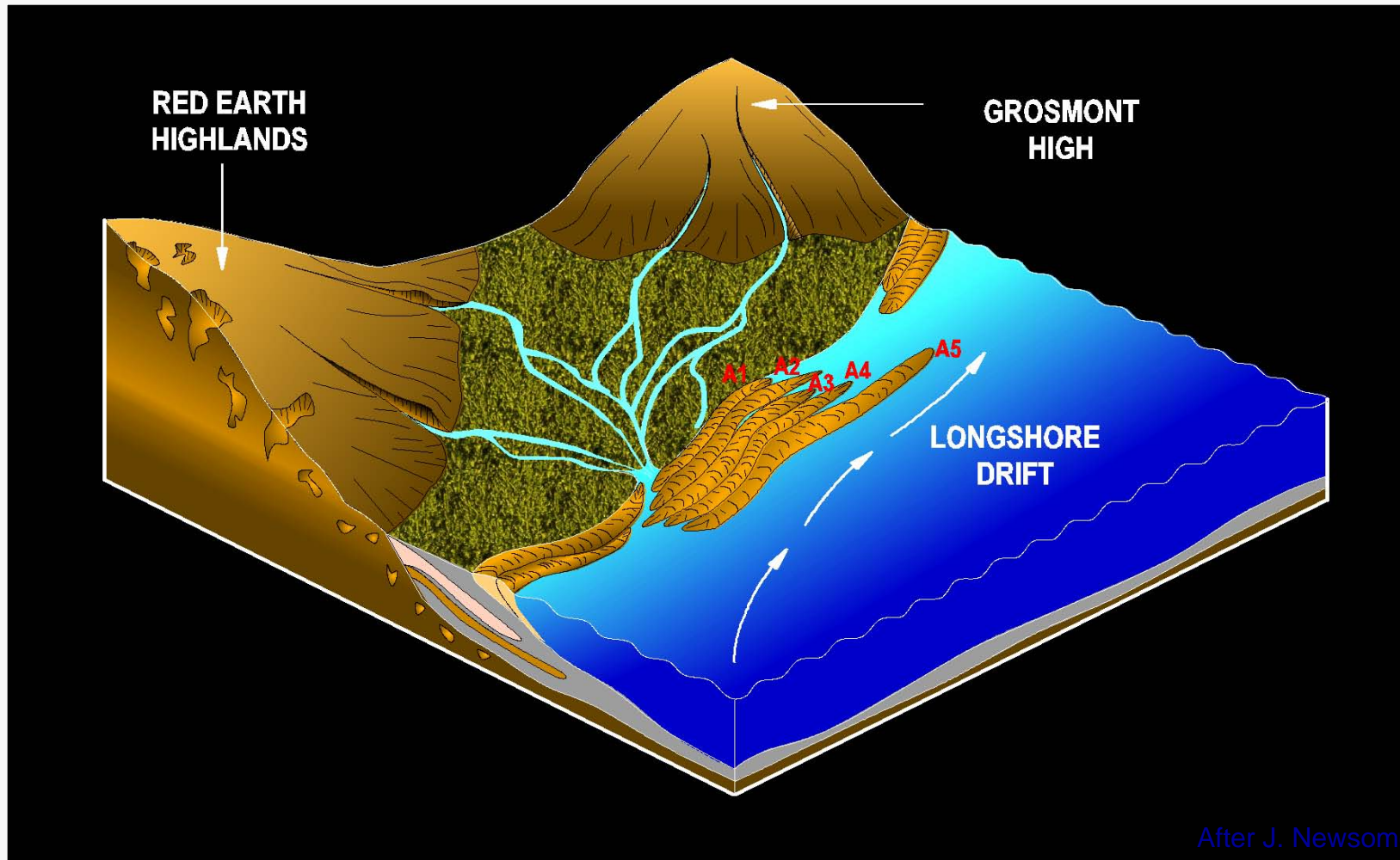


# Paleogeography of the Wabiskaw and Stratigraphic Equivalents



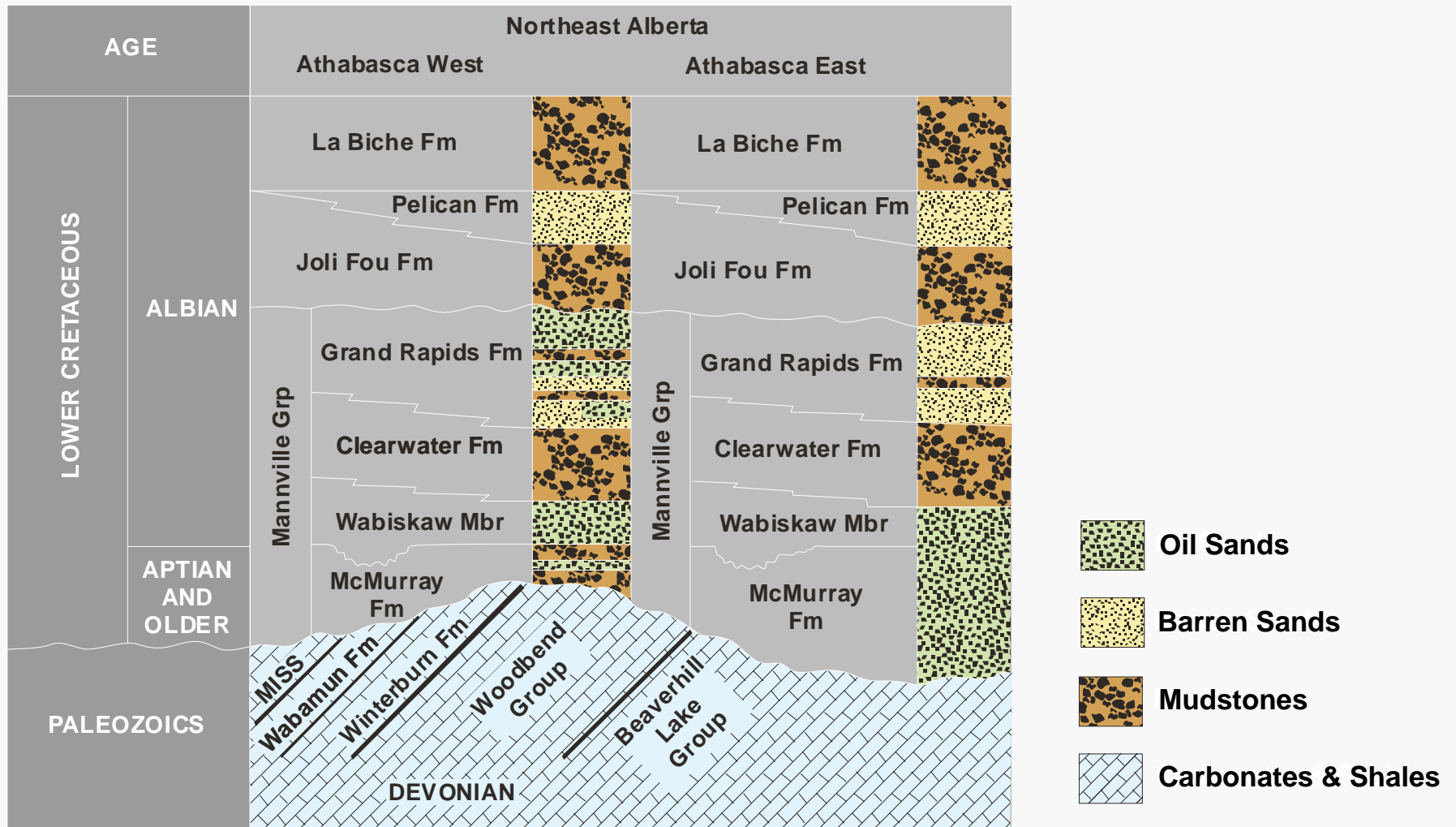
(Modified from Leckie and Smith, 1992)

# Wabiskaw Depositional Model Pelican Lake Area

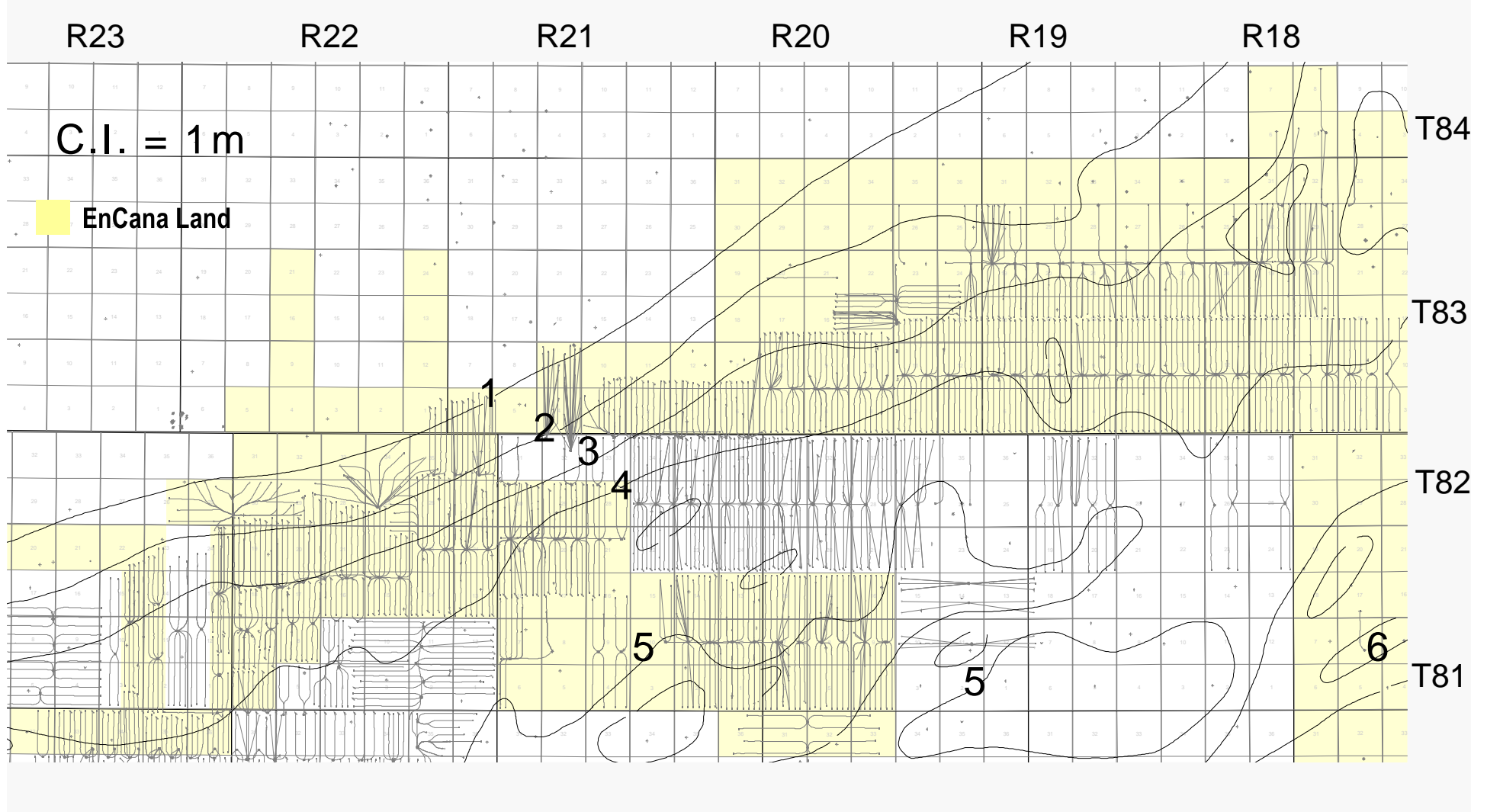


After J. Newsome

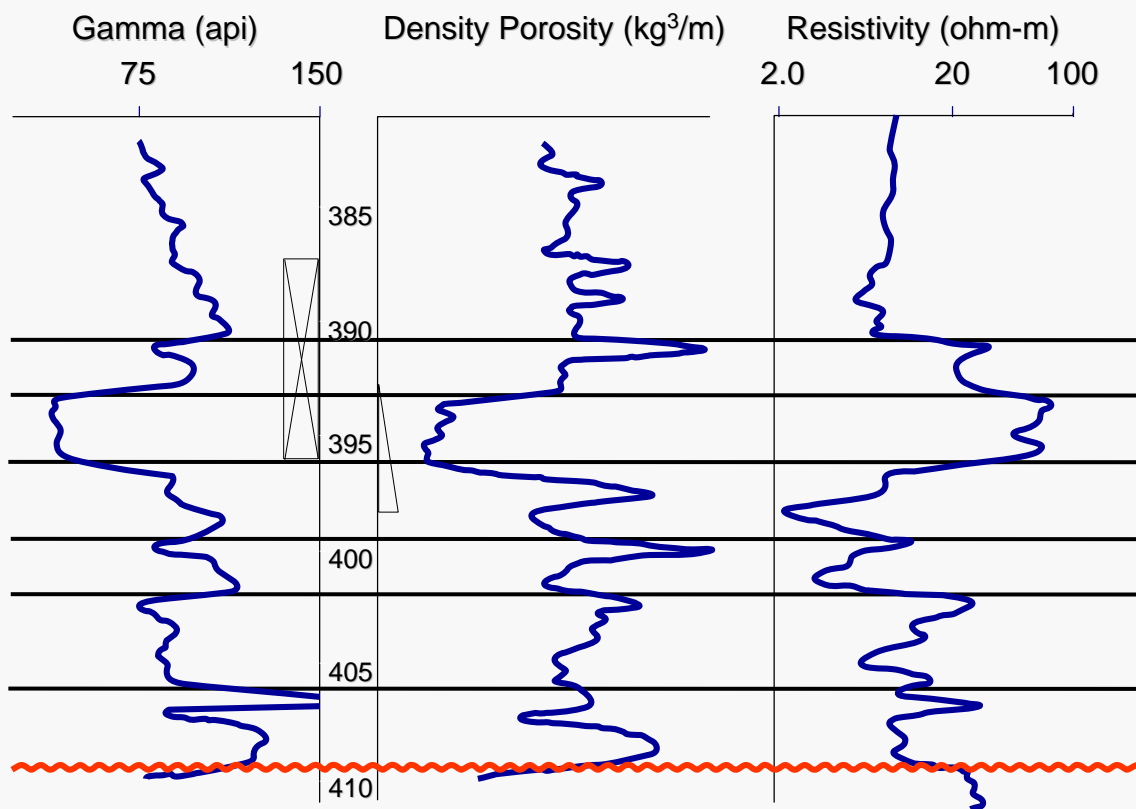
# Cretaceous Stratigraphy of the Athabasca Oil Sands Area



# Pelican Lake Net Pay Map



# Pelican Lake Reference Well AECOOG 14-4-83-20W4M



**K.B. 627.1m**  
**G.L. 623.3m**

Clearwater

Wabiskaw "A" (T31)

Wabiskaw Porosity (T21)

Base Wabiskaw Porosity

Wabiskaw B (T15, E14)

Wabiskaw C (T11)

McMurray (T105, E10)

Sub-Cretaceous Unconformity  
(Paleozoic Carbonates)

# Pelican Lake Wabiskaw "A" Typical Reservoir Parameters



**Depth:**  
350m - 450m

**Thickness:**  
3m

**Porosity:**  
30%

**Permeability:**  
300 - 3000 md

**Temperature:**  
17° C

**Initial Reservoir Reserve:**  
1800 - 2400 kPa

**Water Saturation:**  
30%

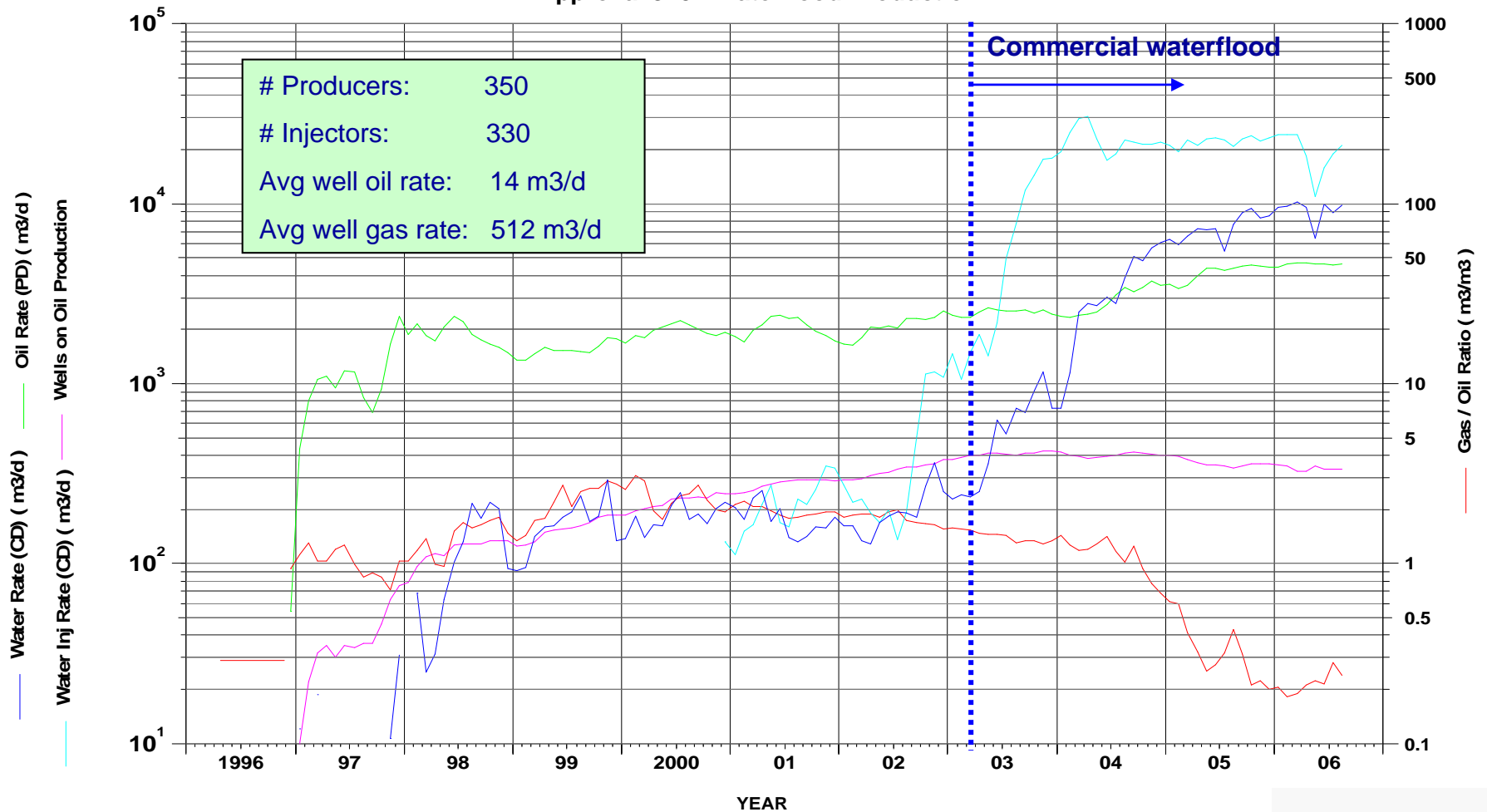
**Oil Viscosity (live oil)**  
300 - 5000+ cp

**Oil Gravity:**  
13.5° - 16.5° API

# Approval 9404 Field Performance



Approval 9404 Waterflood Production



# Producers:	350
# Injectors:	330
Avg well oil rate:	14 m <sup>3</sup> /d
Avg well gas rate:	512 m <sup>3</sup> /d

# Approval 9404 Waterflood Surveillance



Balance between fluid injection and production

- instantaneous VRR  $> 1$  due to fillup period

Target cumulative VRR to approach unity

- Some well VRR's  $> 1$  due to insufficient historical produced gas, but surface pressures below MAWHIP

VRR Report to 2006-07 submitted

# Approval 9404 Waterflood Surveillance Cont'd



Real time pattern performance monitoring

- fluid rate, fluid level, watercut, injection rate/pressure, etc.

Monitor injectivity changes w/ Hall Plots

Daily injection water quality tracking (ppm oil)

Monthly injection Target adjustment

Tracer programs on select WF & workover wells

Monthly sampling for polymer returns

# Approval 9404 Remedial Injector Workovers



Ongoing workovers to mitigate high water-cuts:

Pad 8	100/9-12-82-23W4 ( Dec '03 )
Pad NE5	00/03-06-83-19W4 ( Dec '04 )
Pad NE5	00/04-06-83-19W4 ( Dec' 04 )
Pad NE5	00/06-18-83-19W4 ( May '05 )
Pad NE5	00/05-18-83-19W4 ( Nov '05 )

Positive response on Pad 8 & NE 5 Pad

# Approval 9404 Remedial Injector Workovers



## Recent workovers commenced in 2006:

Pad NE 1	4 Approved Injectors (Jan '06 )
Pad 17	4 Approved Injectors (Jan'06)
Pad E5	4 Approved Injectors (March' 06 )
NW 1-4	16 approved Injectors (est. Oct '06)

Early Pad NE1 data looks encouraging

No definitive response on Pads 17 & E5

# Approval 9404 Current & Projected Recovery Factors



## Category

## Recovery Factor (%)

Current

3

Primary

6

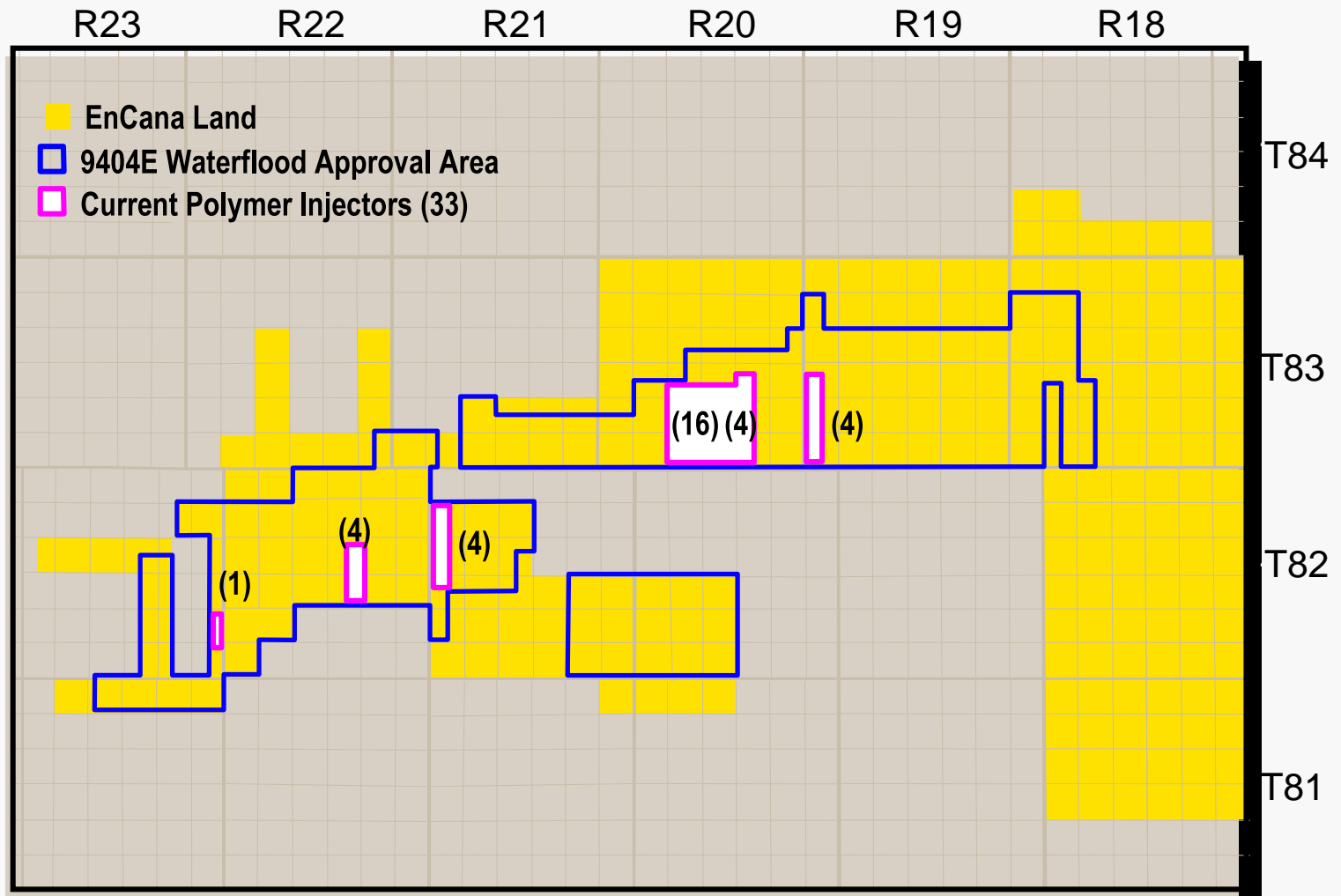
Waterflood

12

Ultimate

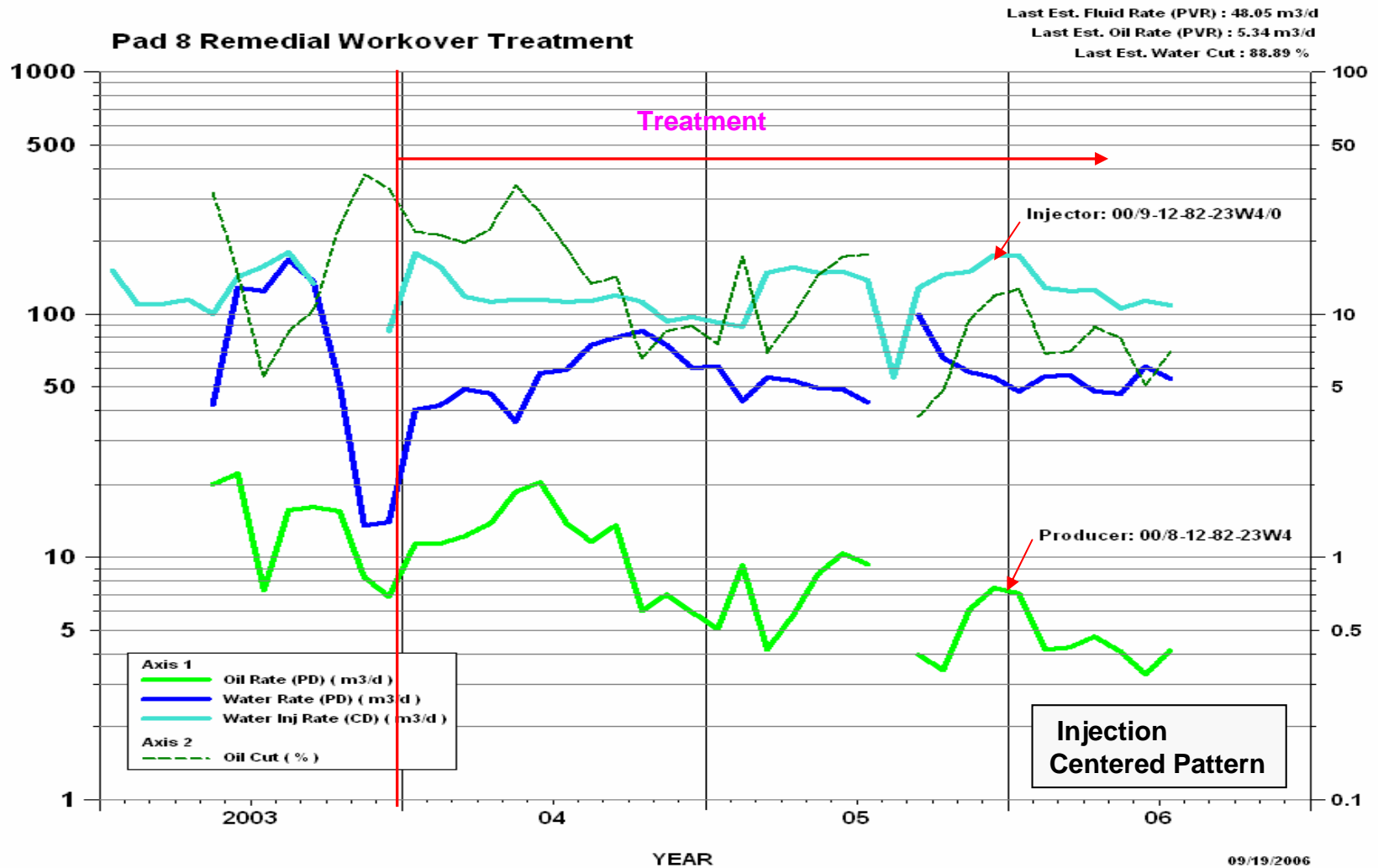
18

# Approval 9404 Current Remedial Workovers



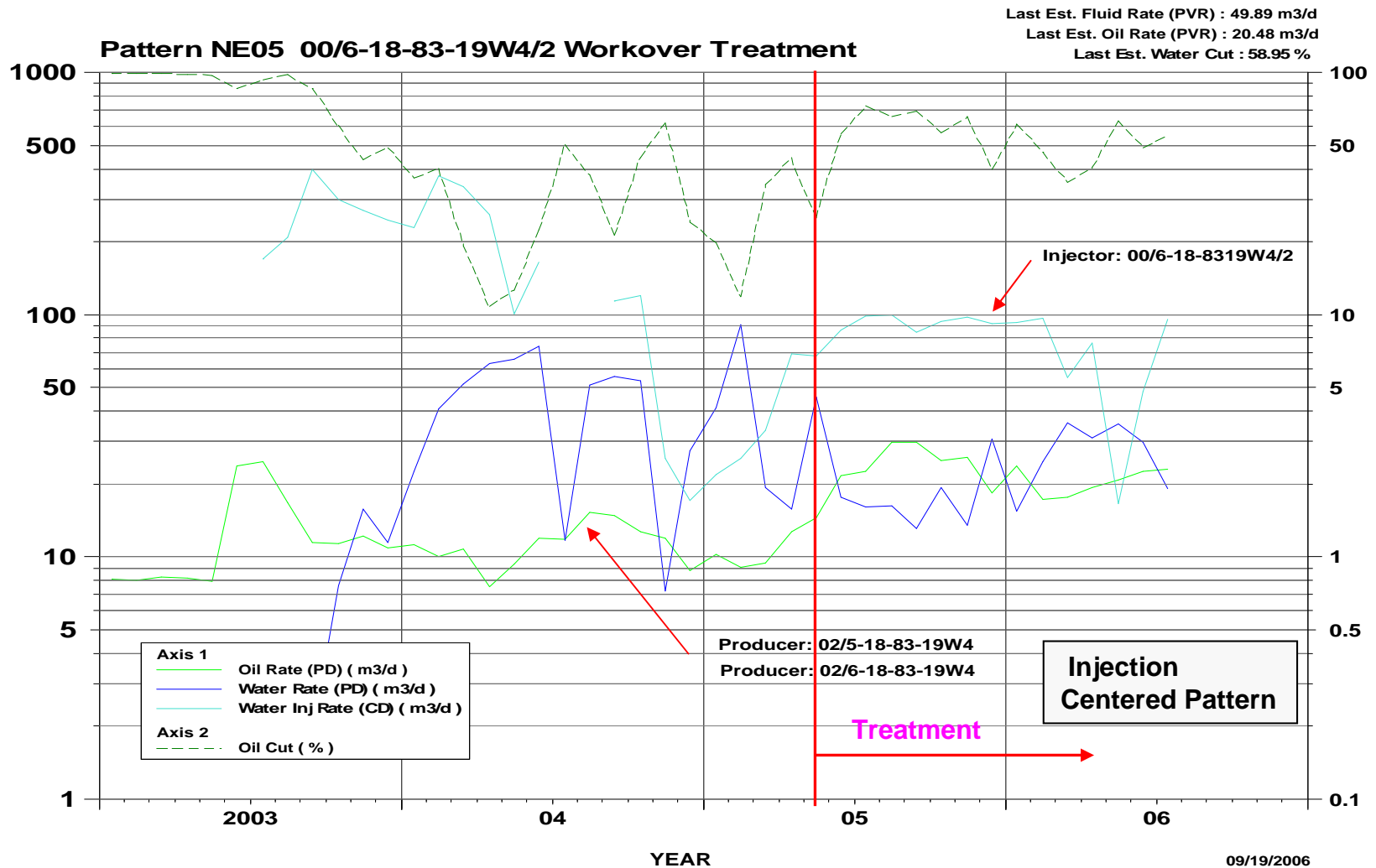
# Approval 9404

## Pad 8 Workover : High watercut



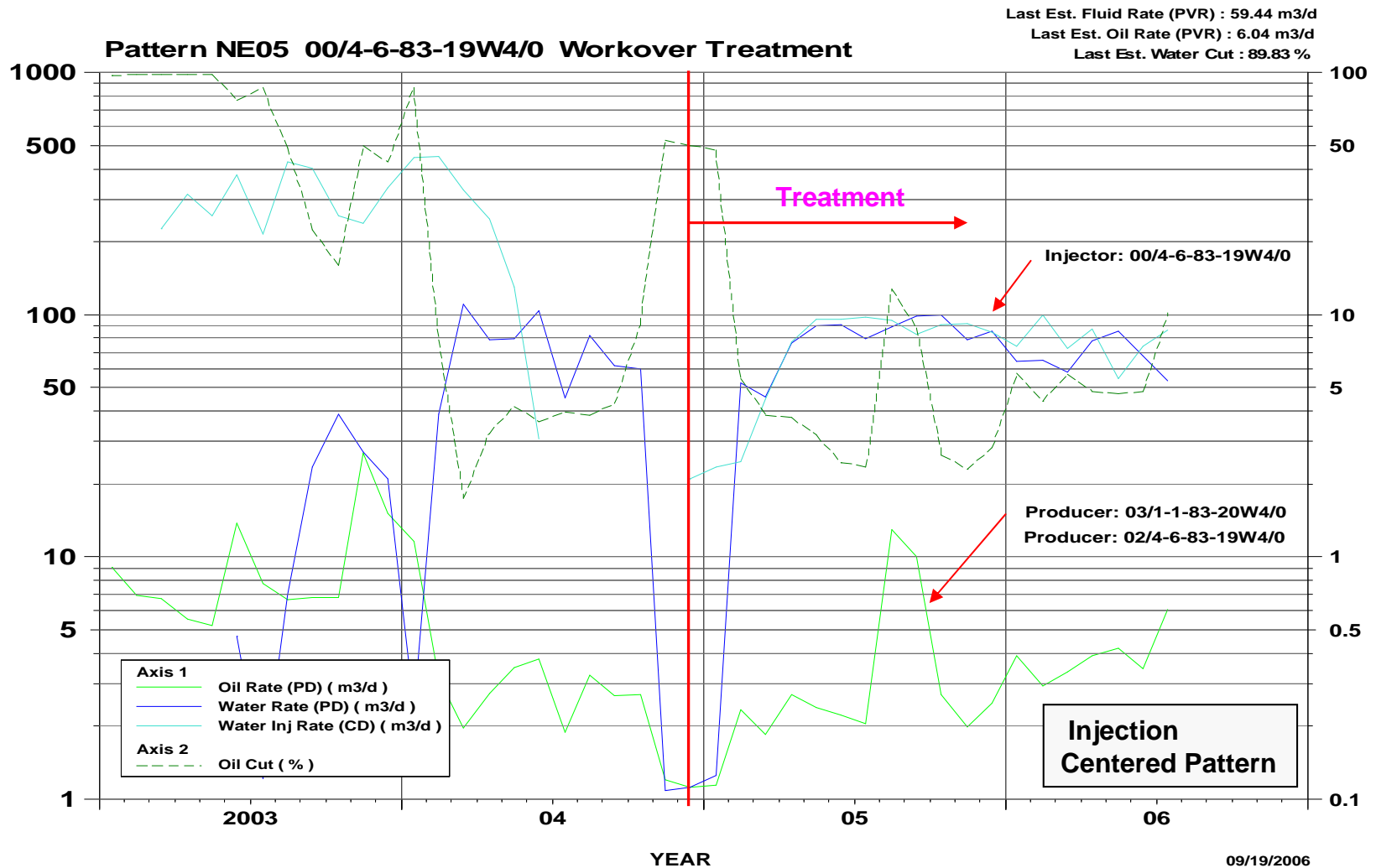
# Approval 9404

## Pattern NE5 00/6-18 Workover



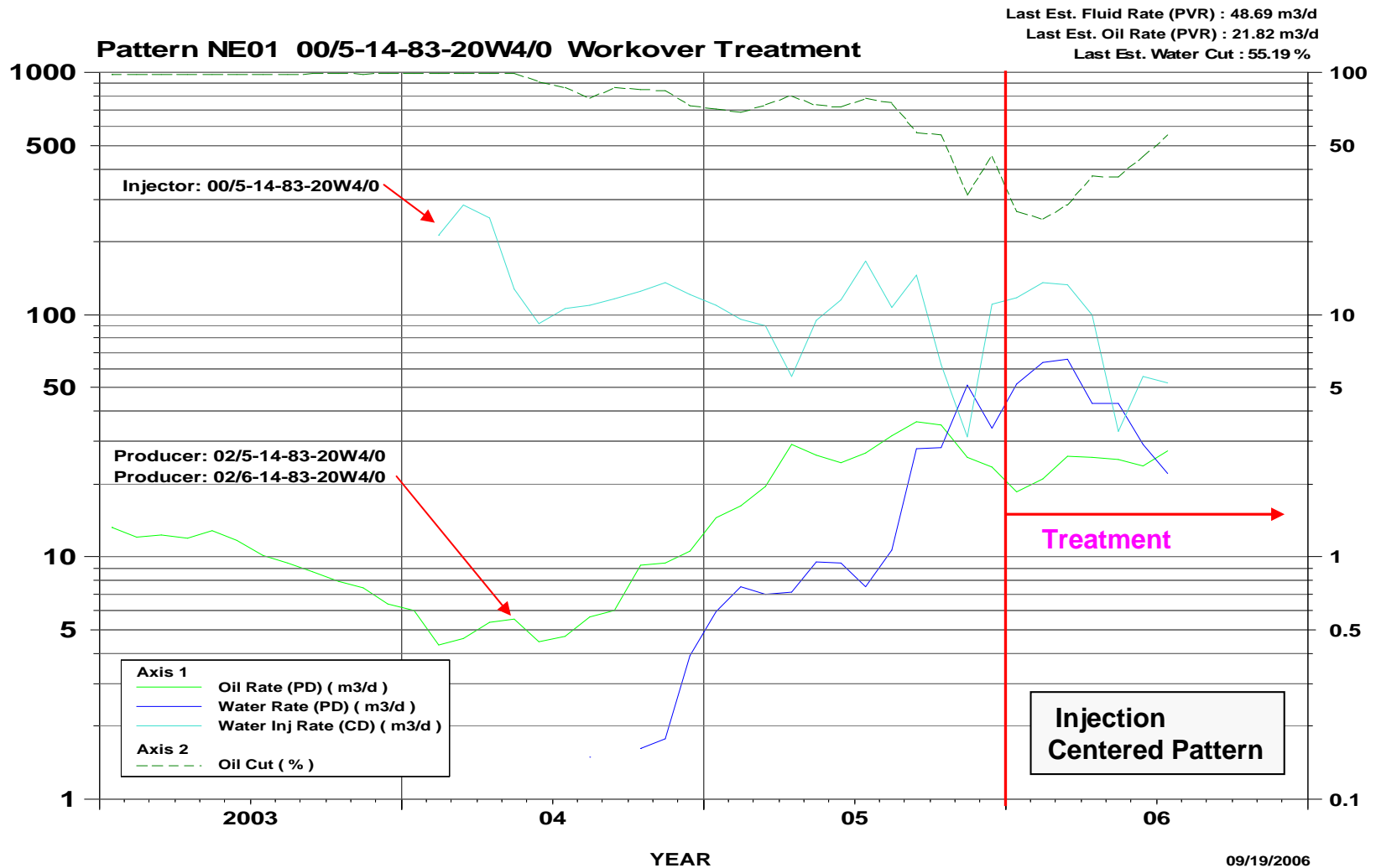
# Approval 9404

## Pattern NE5 00/4-6 Workover



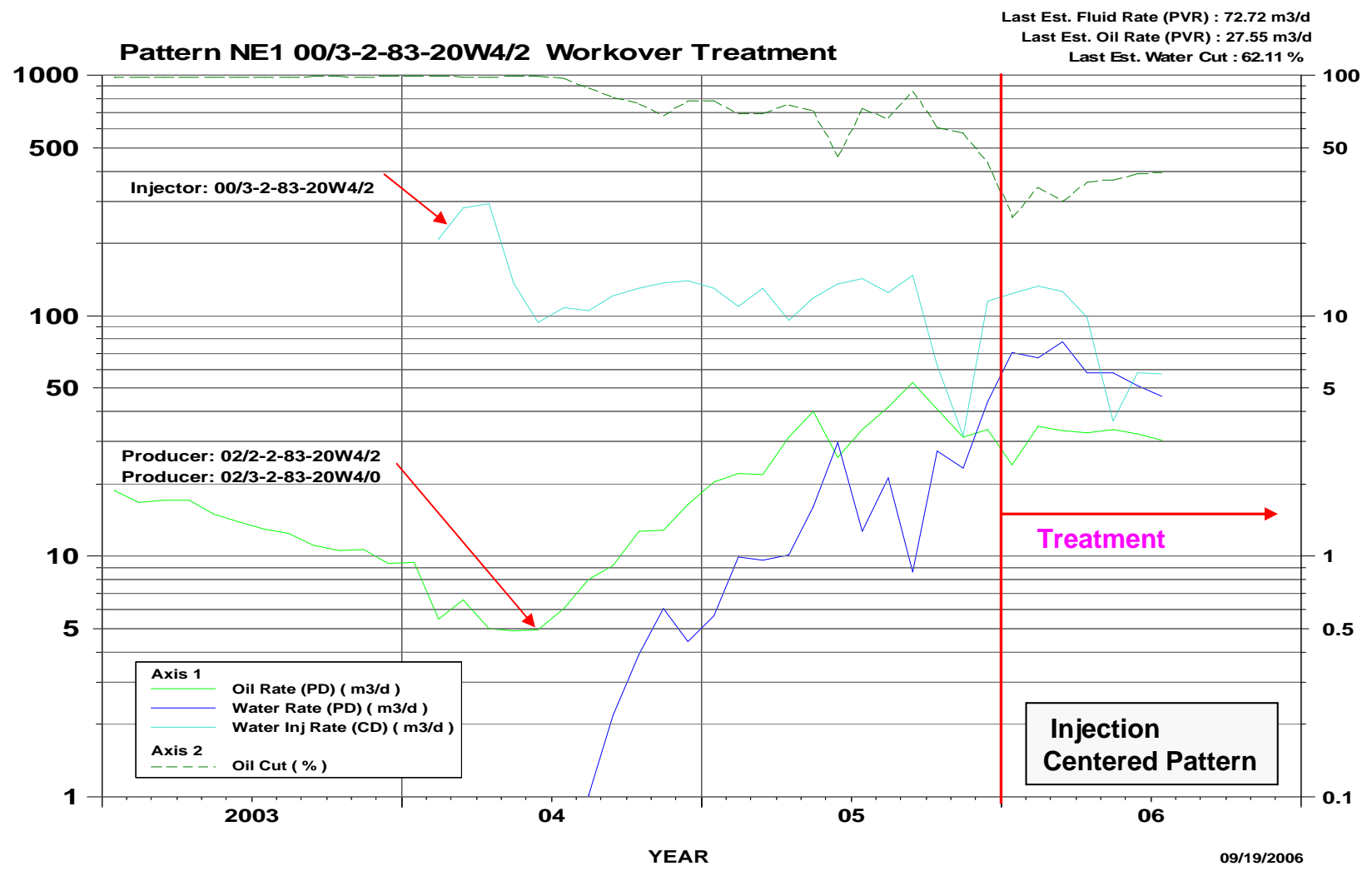
# Approval 9404

## Pattern NE1 00/5-14 Workover

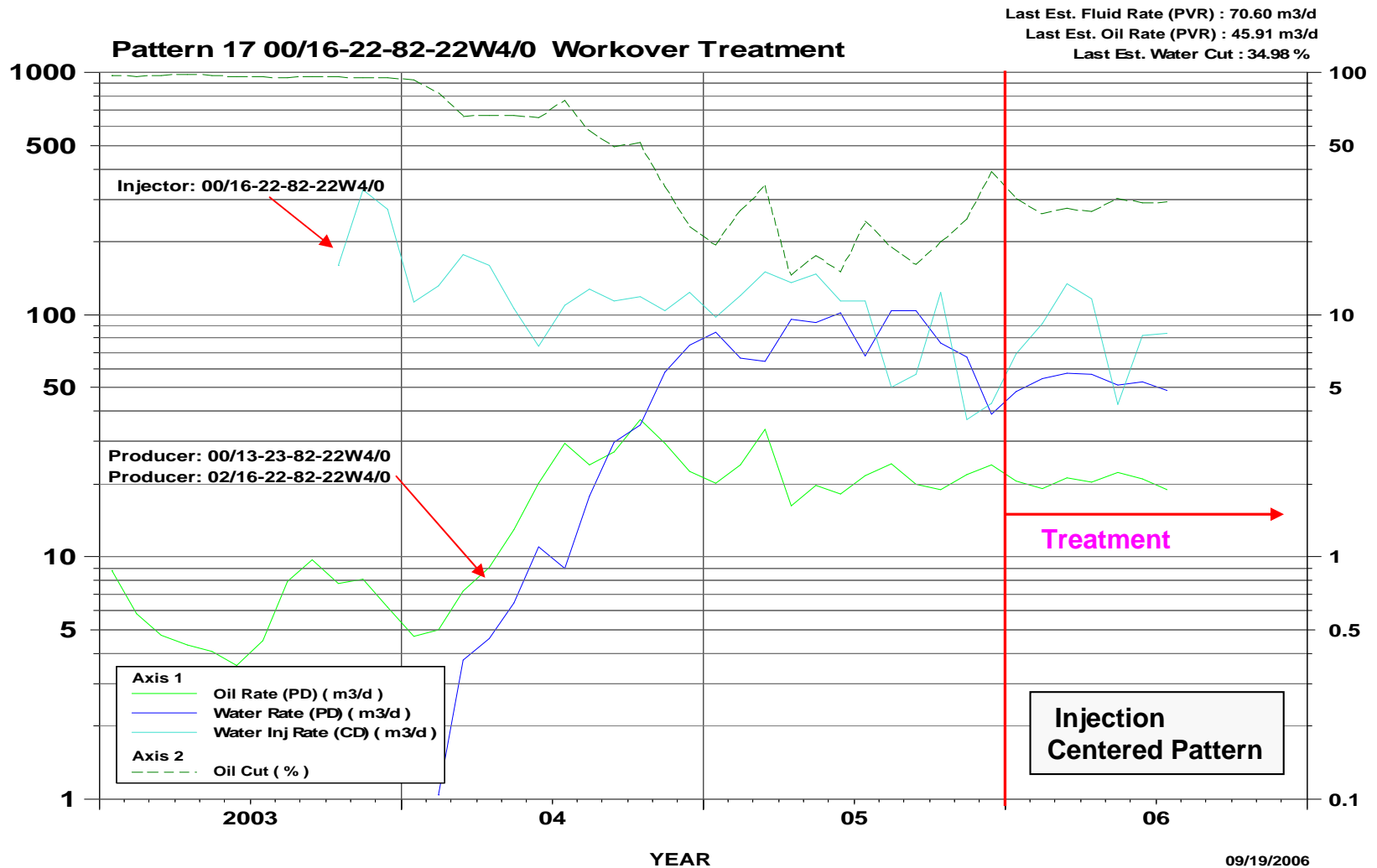


# Approval 9404

## Pattern NE1 00/03-02 Workover

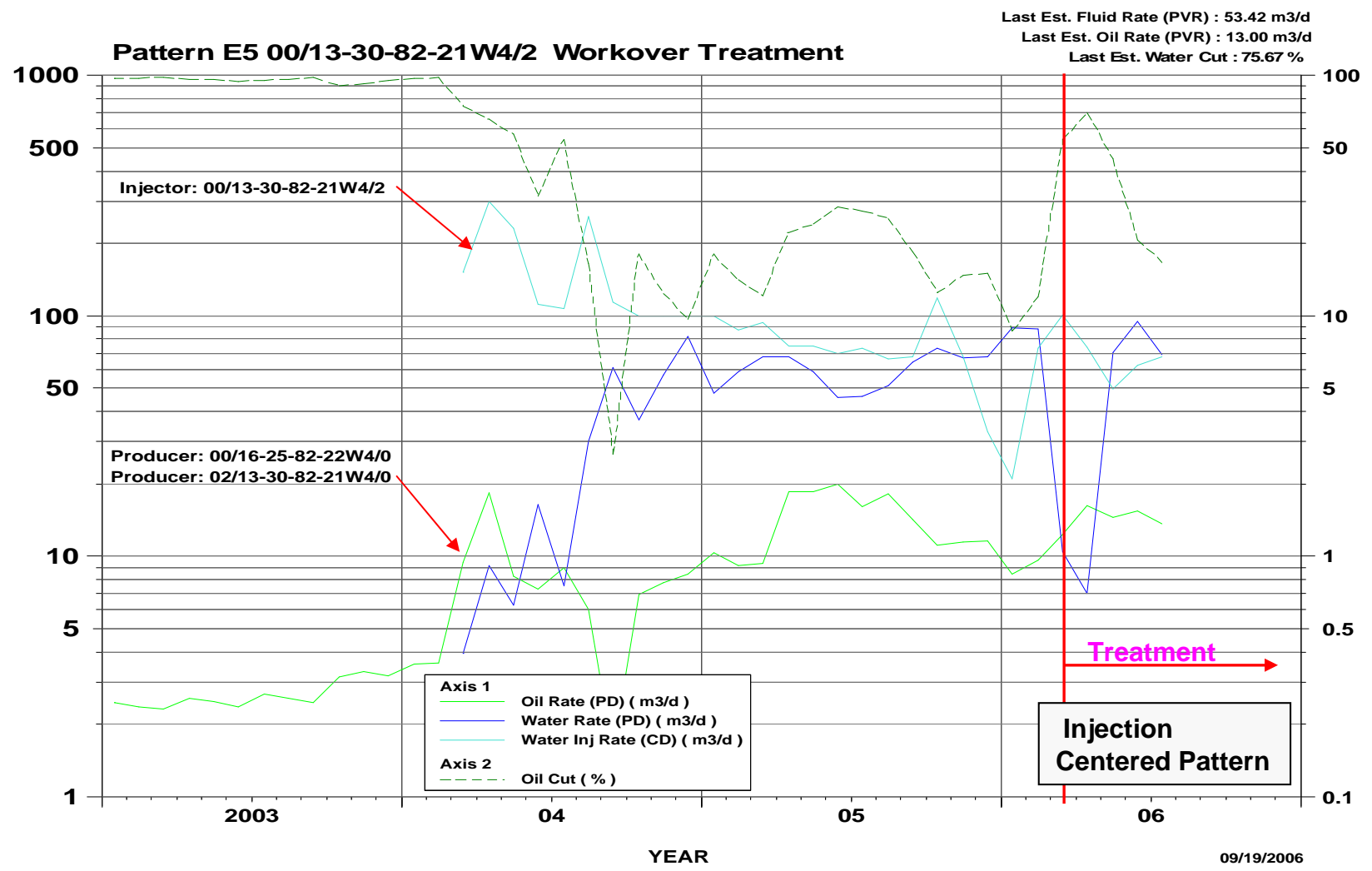


# Approval 9404 Pattern 17 00/16-22 Workover

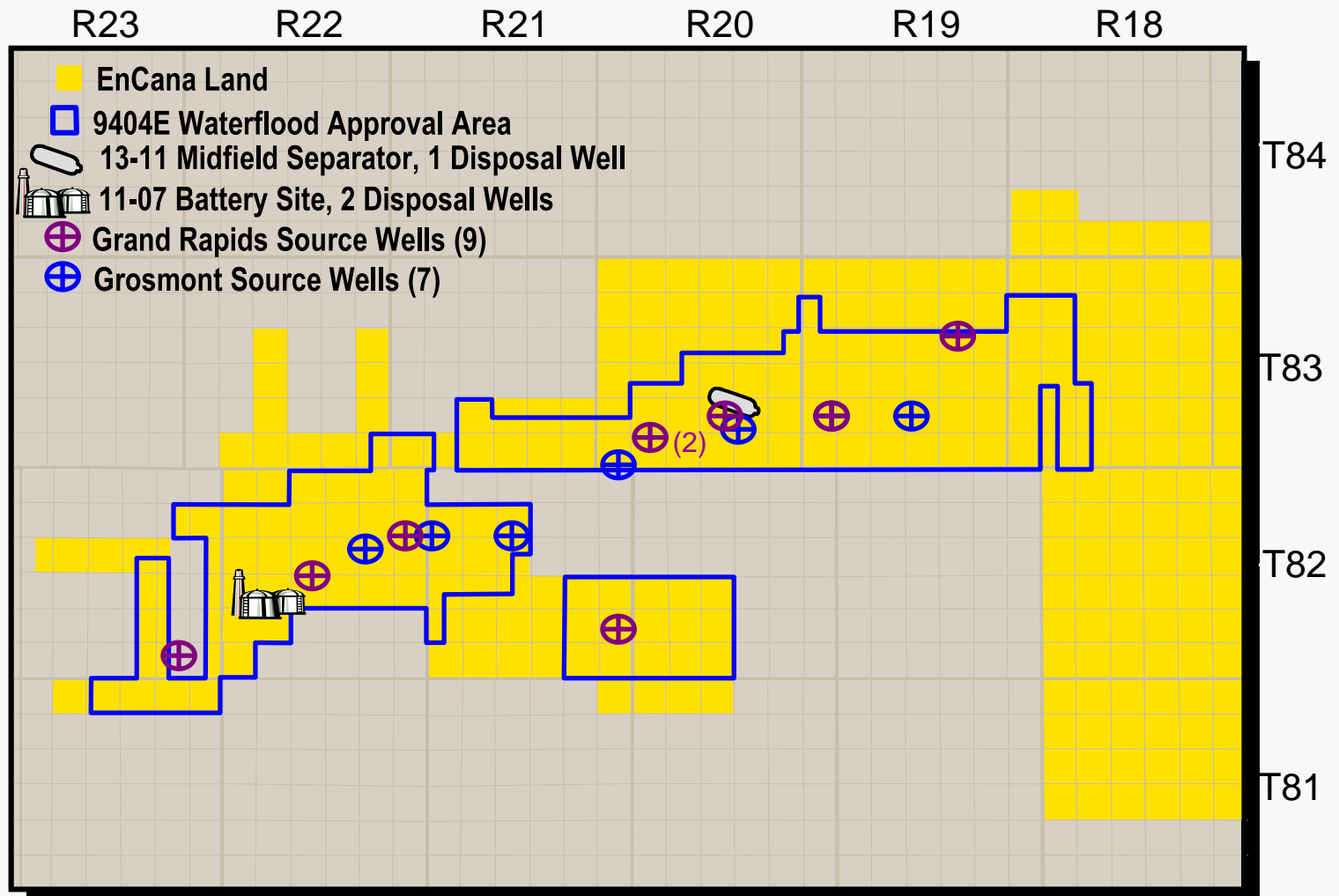


# Approval 9404

## Pattern E5 00/13-30 Workover



# Approval 9403E Approval Current Water Source Wells



# Approval 9404 Brackish Water Source Well Summary



## Annual Produced Volume (e3m3)

<u>Source Well Location</u>	<u>Formation</u>	<u>2005</u>	<u>*YTD 2006</u>	<u>**Est. 2006</u>	<u>**Est 2007</u>
1F1/10-21-082-21W4/3	Grosmont	391	321	625	1,025
1F1/15-36-082-21W4/0	Grosmont	1432	212	426	700
F1/06-23-082-22W4/0	Grosmont	141	0	0	230
100/07-07-083-19W4/0	Grosmont	726	288	683	1,120
1F1/06-10-083-19W4/0	Grosmont	1269	572	983	1,612
1F1/04-11-083-20W4/0	Grosmont	490	738	640	1,050
1F1/12-19-082-21W4/0	Grosmont	877	1	1	1,400
***1F1/12-18-082-22W4/0	Grosmont	0	0	0	0
***1F1/13-11-083-20W4/0	Grosmont	0	0	0	0
(0) Future 2007 Wells	Grosmont	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
<b>Total:</b>		<b>5,326</b>	<b>2,132</b>	<b>3,358</b>	<b>7,137</b>

\*YTD based on public record volumes to end of July 2006

\*\*Estimates based on projection from most current rate and 2007 planned development.

\*\*\* Wells are currently suspended.

# Approval 9404 Fresh Water Source Well Summary



## Annual Produced Volume (e3m3)

<u>Source Well Location</u>	<u>Formation</u>	<u>2005</u>	<u>*YTD 2006</u>	<u>**Est. 2006</u>	<u>**Est 2007</u>
1F1/05-07-083-19W4/0	Grand Rapids B	34	16	39	55
1F1/08-07-082-20W4/0	Grand Rapids B	4	2	2	12
1F1/09-24-083-19W4/0	Grand Rapids A	10	2	2	0
1F1/05-11-083-20W4/0	Grand Rapids B	8	14	29	37
1F1/11-19-082-21W4/0	Grand Rapids B	6	12	28	37
1F1/10-01-082-23W4/0	Grand Rapids B	51	29	48	46
1F1/02-09-083-20W4/0	Grand Rapids A	0	2	11	37
1F1/03-09-083-20W4/0	Grand Rapids B	0	0	12	73
1F1/08-07-082-20W4/0	Grand Rapids B	4	2	2	12
(3) Future 2007 Wells	Grand Rapids B	<u>0</u>	<u>0</u>	<u>0</u>	<u>220</u>
	<b>Total:</b>	<b>117</b>	<b>79</b>	<b>173</b>	<b>529</b>

\*YTD based on public record volumes to end of July 2006

\*\*Estimate based on projection from current rate and planned 2007 development.

# Approval 9404 Water Disposal Summary



## Annual Injected Volume (e3m3)

<u>Disposal Well Location</u>	<u>Formation</u>	<u>2005</u>	<u>*YTD 2006</u>	<u>Est. 2006</u>	<u>Est. 2007</u>
F1/10-07-082-22W4/0	Grosmont	0	92	250	300
102/11-07-082-22W4/0	Nisku	228	170	320	400
**100/13-11-083-20W4/0	Nisku	<u>0.07</u>	<u>0.03</u>	<u>1</u>	<u>2</u>
<b>Total:</b>		<b>228</b>	<b>262</b>	<b>571</b>	<b>702</b>

\*YTD based on public record volumes to end of July 2006

\*\*100/13-11 used primarily for drilling fluid waste disposal

# Approval 9404 Key Learnings



Insufficient fluid processing capacity constrained performance

- Gathering pipelines
- Battery oil treatment
- Water handling and disposal capacity

High water-cuts due to poor mobility ratio

Injector workovers have successfully reduced water production

No injectivity issues to date with waterflood or remedial workover treatments

# Approval 9404 Future Plans



Continue waterflood expansion as main reservoir drive mechanism

- 49 conversions in 2007

Expand waterflood areas

- 2007 application for 14 conversions in 2008

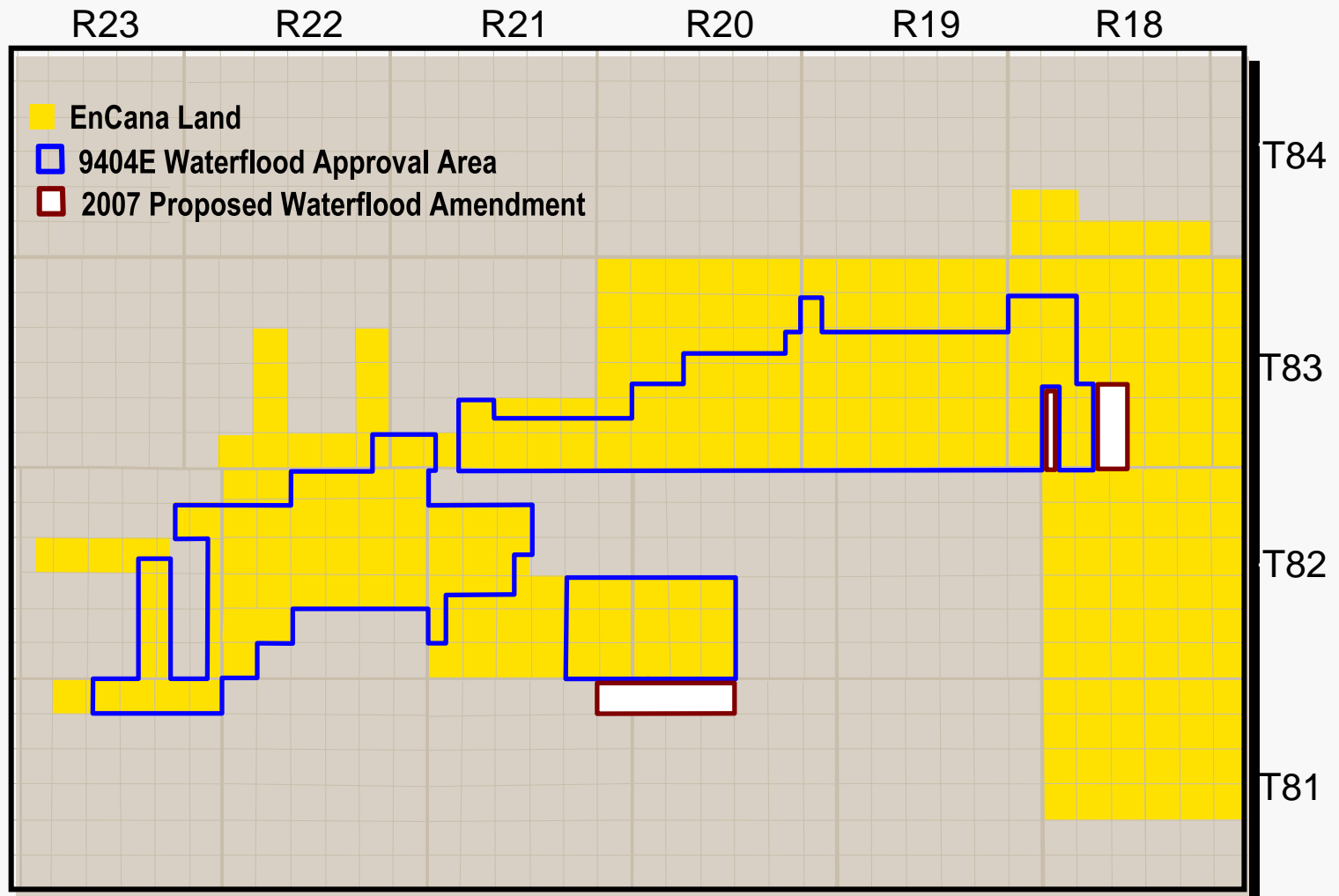
Increase number of injector workovers:

- Optimize existing 33 treatments
- Implement 66 new treatments in 2007
- Reduce water handling costs and extend well life

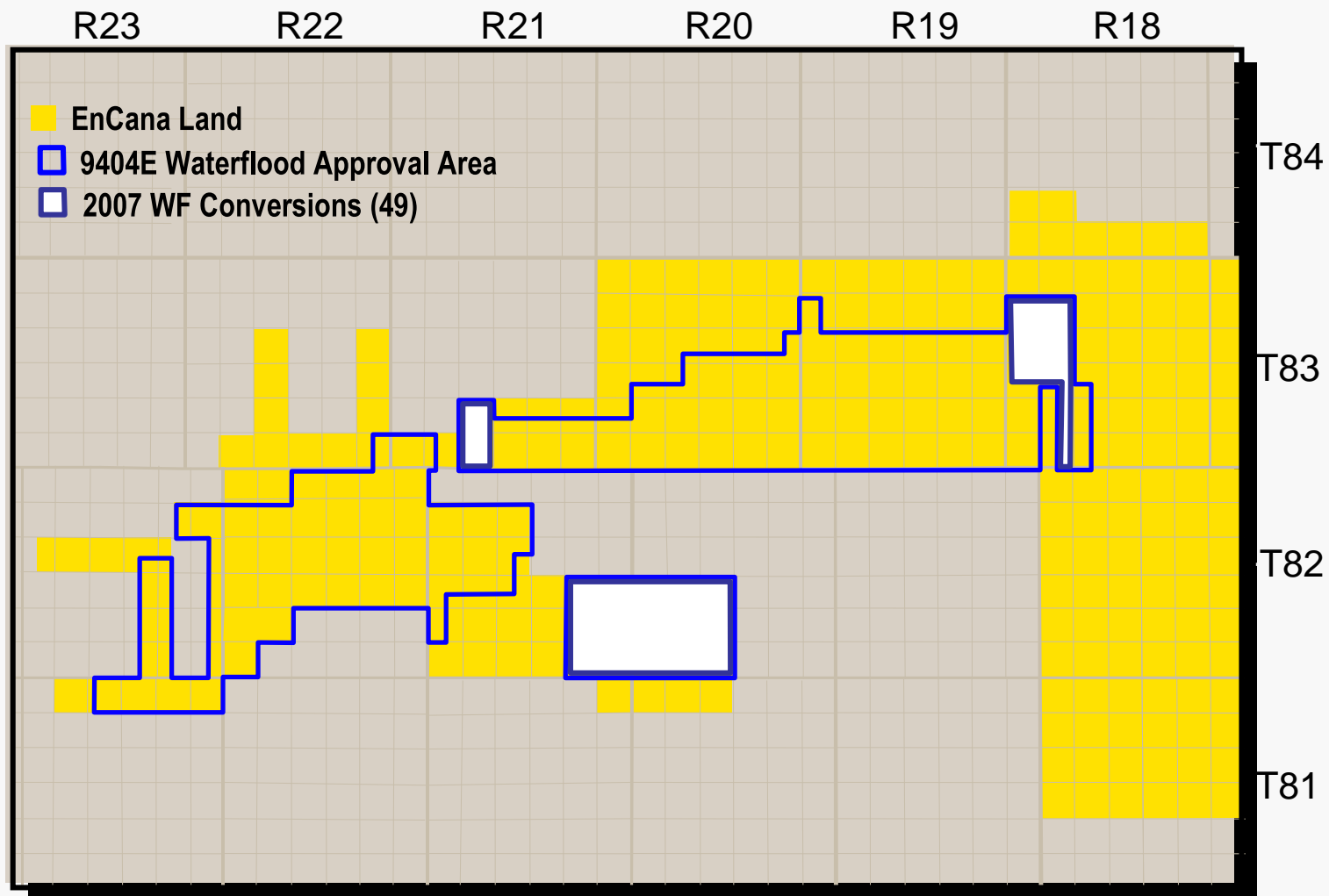
Evaluate Brackish vs Fresh Source Water Feasibility:

- Assess Grand Rapids hz well deliverability
- Pilot Reverse Osmosis process for TDS reduction
- Assess option feasibility by Q2 2007

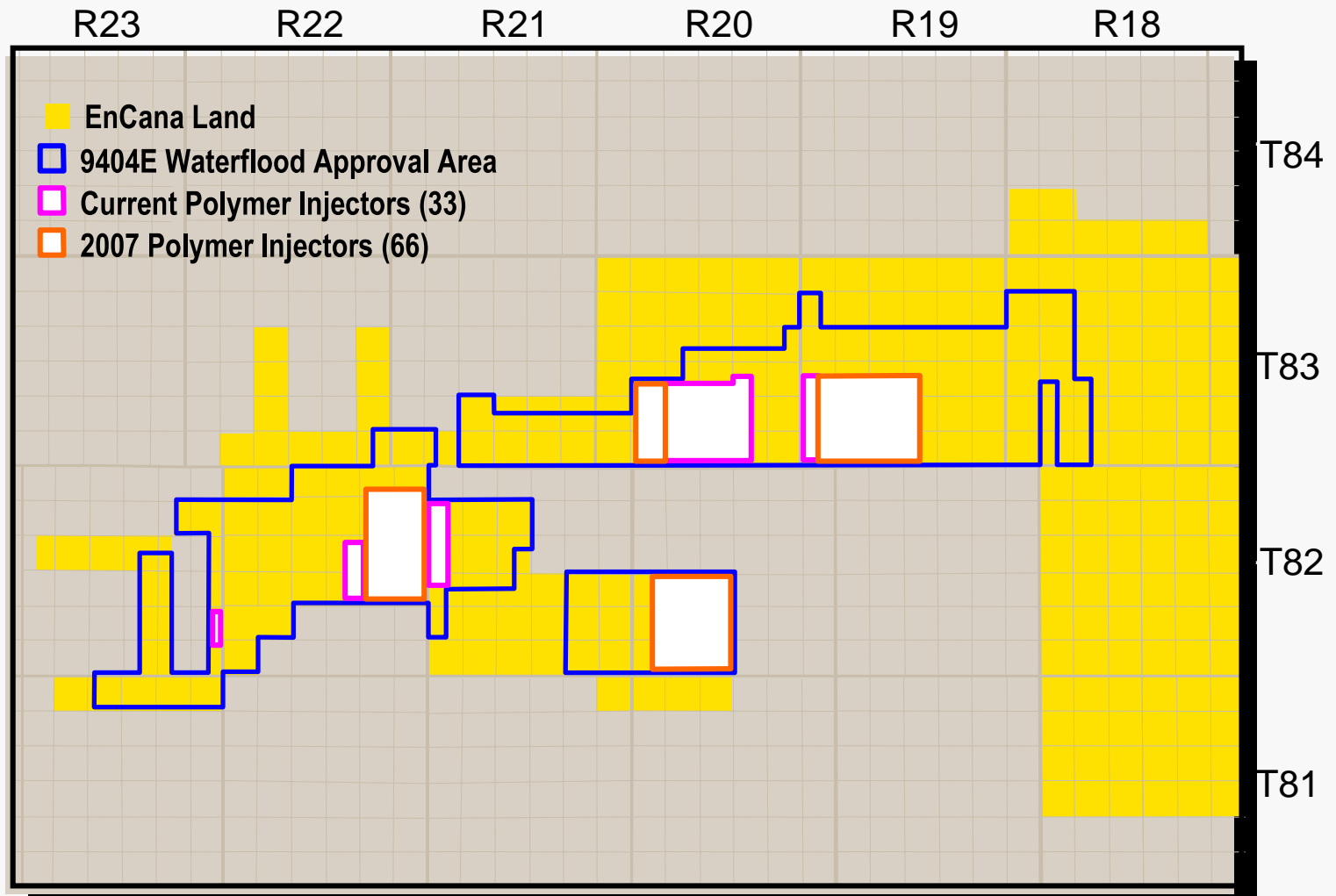
# Future Plans Waterflood Expansion



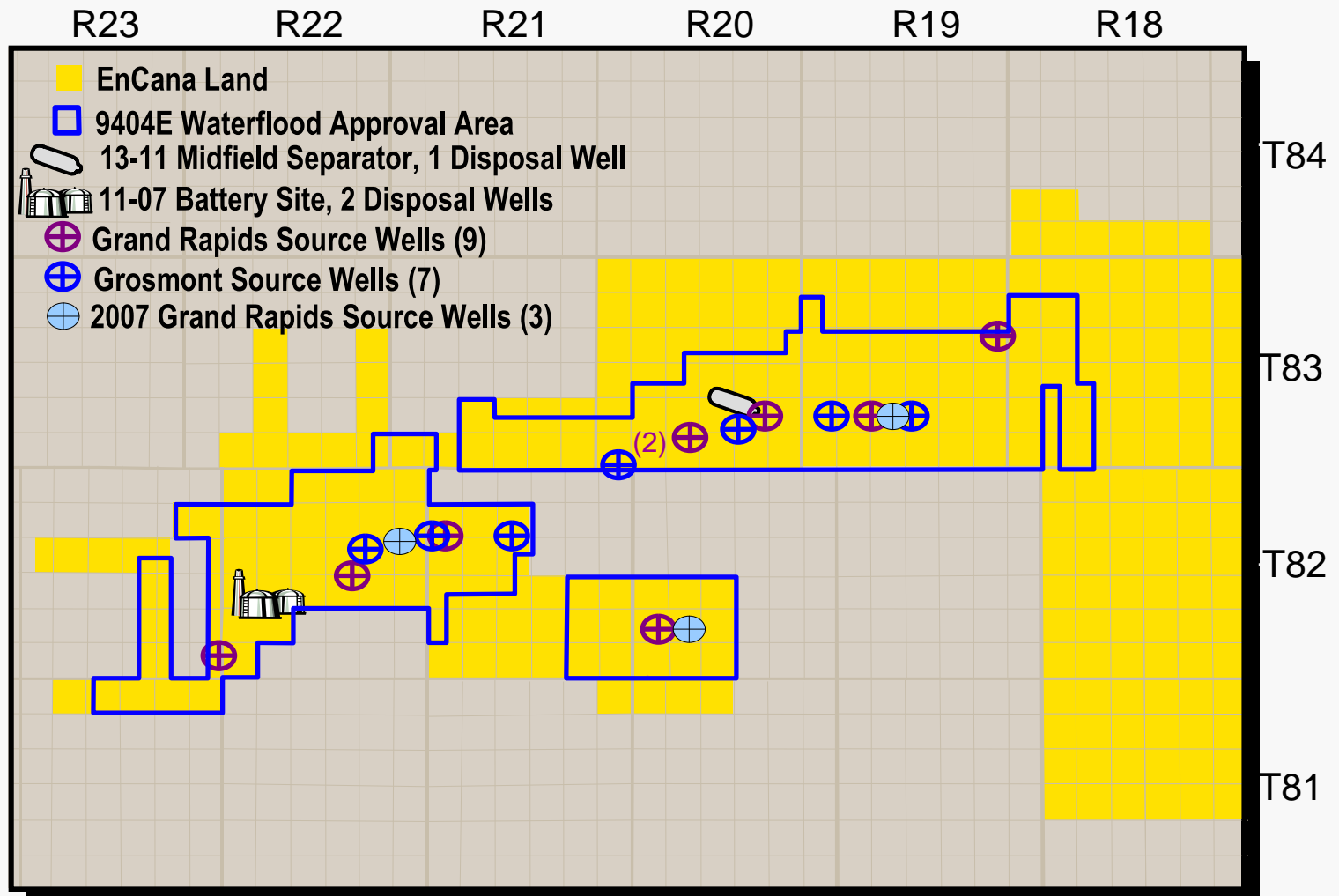
# Future Plans 2007 Injector Conversions



# Future Plans Remedial Injector Workovers



# Approval 9403E Future Water Source Wells



# Approval 9404 Approval Management



## Recommended changes

- Delete list of injectors
  - waterflood area and well spacing defines project
- Replace semi annual with annual review
  - 6 months is a short time frame for production monitoring
- Replace VRR requirements with MAWHIP
  - A practical, measurable yardstick of waterflood performance

# Approval 9404 Issues



Guidance on regulatory approval extension process:

## Pending Injector Workover Approval Expiries

<u>Injector Workover Location</u>	<u>Expiry</u>	<u>Injectors</u>
— Pilot Pad 8	April 30, 2007	1
— Pilot NE5	May 31, 2007	4
— Field Wide 2006 Approvals	Oct 31, 2008	96
— Future Balance of field, 2008+	Not applied For	200+

# Approval 9404 Compliance



EnCana is not aware of any conditions in its Approvals or Regulations in which it is not compliant.

Commitments described in the original application have been met, or are in the process of being met.