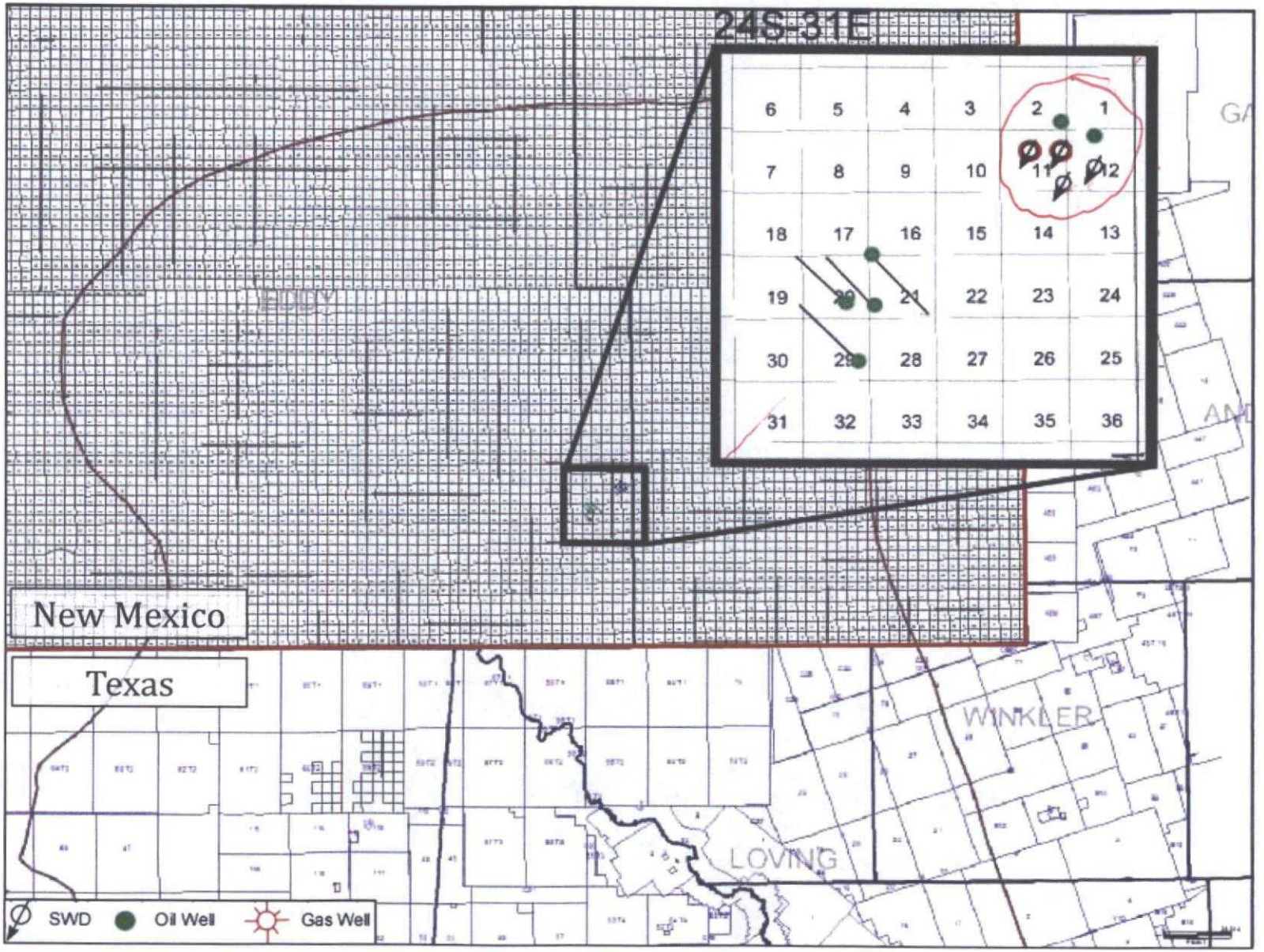
APPLICATION FOR REVOCATION OF INJECTION AUTHORITY CASE NO. 15219 & 15231

NMOCD SPECIAL HEARING DELAWARE DISPOSAL ISSUE OXY USA, INC. & CHEVRON USA, INC.

BEFORE THE OIL CONVERSATION DIVISION
Santa Fe, New Mexico Exhibit No. 2
Submitted by: OXY & Chevron
Hearing Date: December 9, 2014

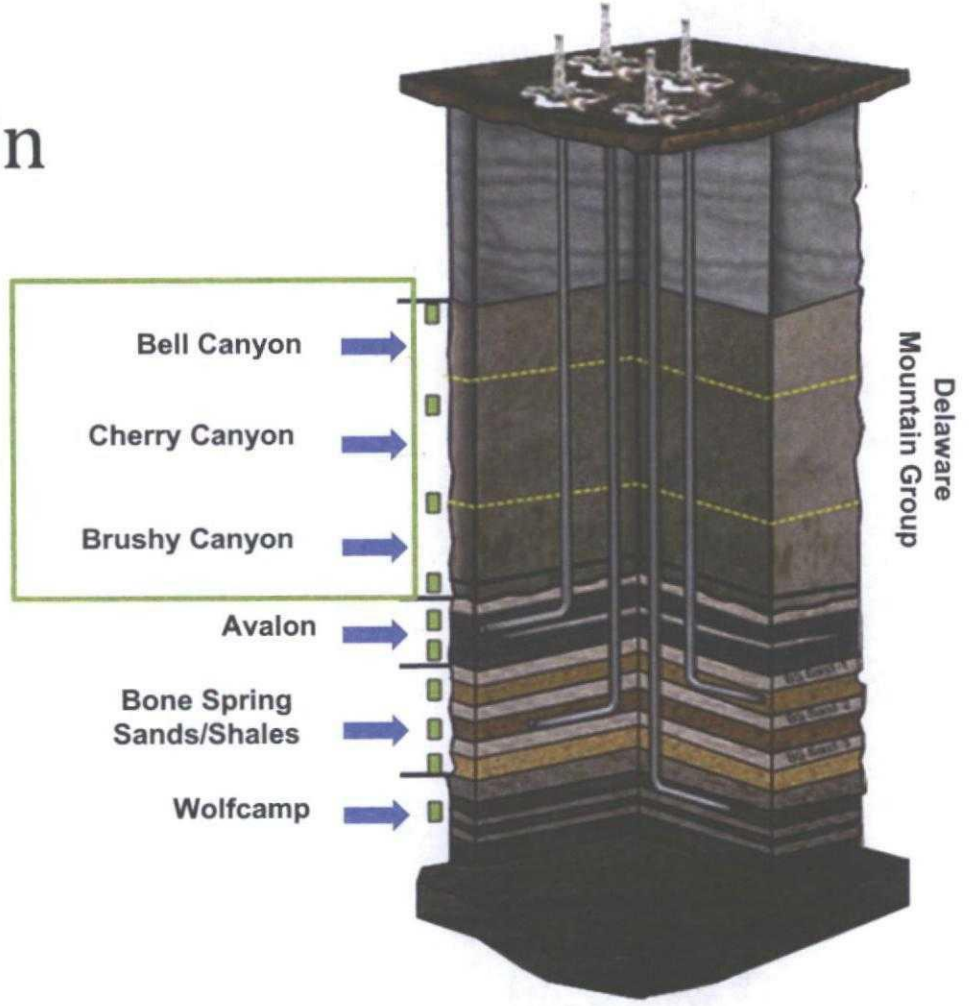
Area of Interest Overview

Area of Interest Map

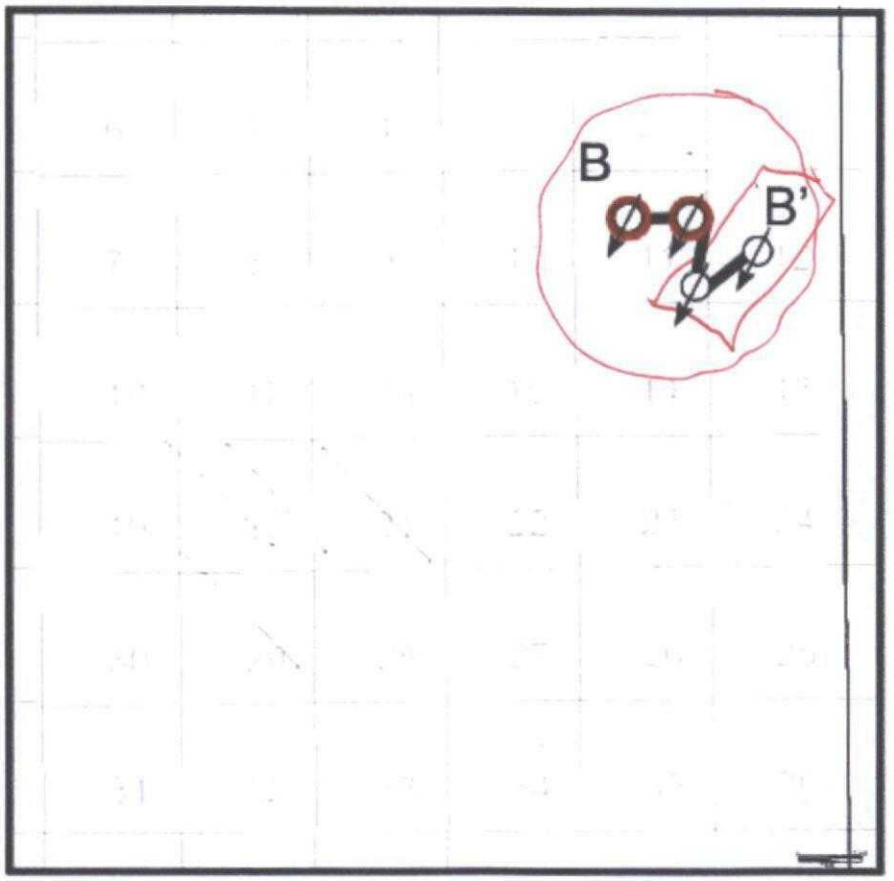


PLU – Investigation of Interference of SWD

- Delaware Mountain Group:
  - Bell & Cherry Canyon are injection zones
  - Brushy Canyon is production zone



SWD Cross-Section



SDS 11 FEDERAL #001
30015276270000

LOTOS 11 FEDERAL #002
30015288210001

BRAN SWD #001
30015256970001

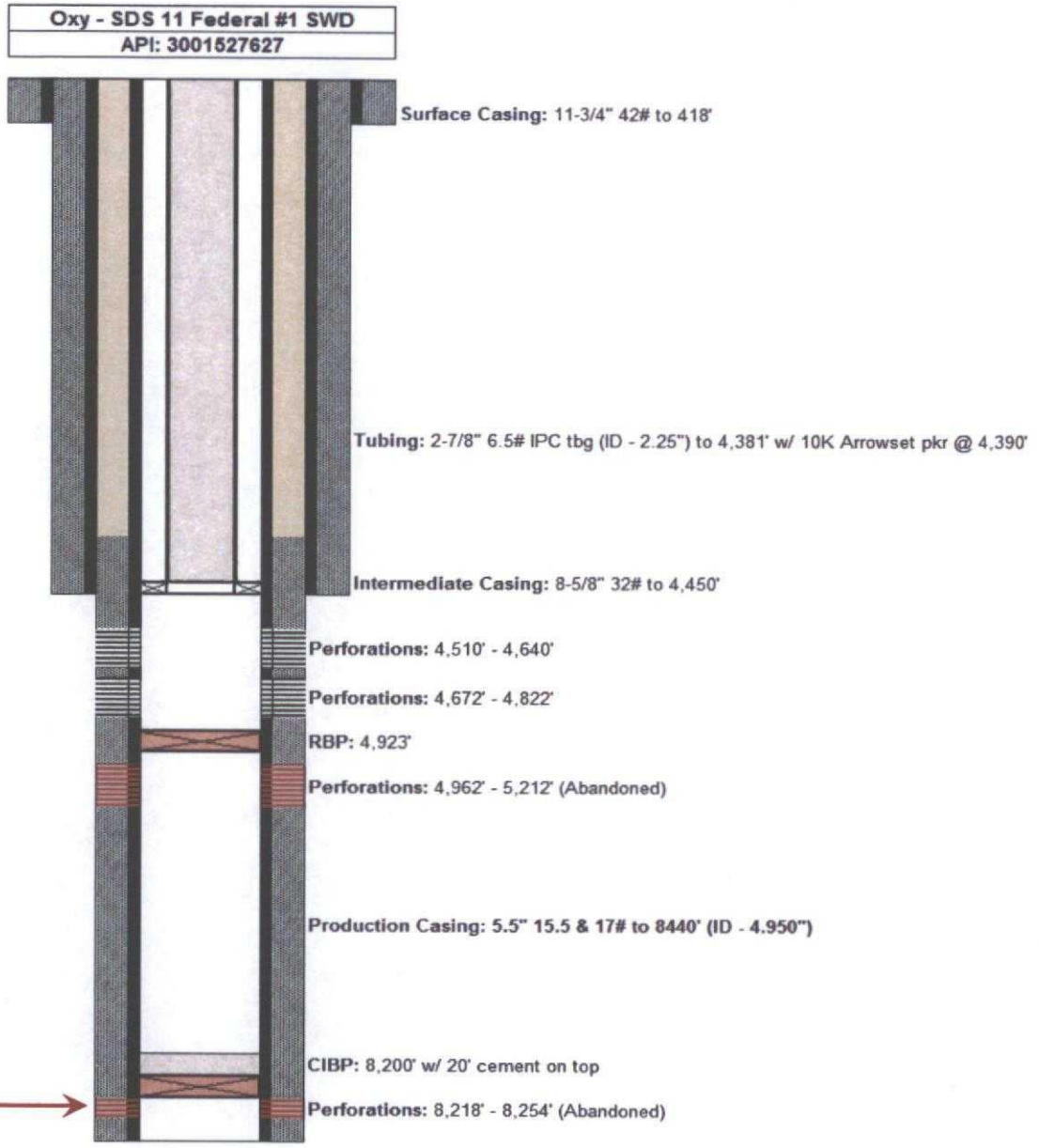
HEAVY METAL 12 FEDERAL #001
3001529602001

Well Name (Disposal date)	Injection Interval	Pressure (PSI)
SDS 11 FEDERAL (1994)	4510' to 4640' 4672' to 4822' RBP @ 4923' 4962' to 5212' (Abandoned)	3170* 1250^
LOTOS 11 FEDERAL (2007)	4570' to 4590' 4848' to 4868' 5020' to 5050' 5110' to 5130' 5240' to 5260' 5420' tp 5440' 5480' to 5510' 5522' to 5542' 5586' to 5600' 5622' to 5632'	1225* 1000^
BRAN SWD (2012)	4850' to 6740'	1450* 325?^
HEAVY METAL 12 FEDERAL (2012)	4586' to 7050' 7050' to 8300' (additional OH)	1400* 300?^

* Permitted Injection Pressure (NMOCD)
^ Avg Injection Pressure (2014)

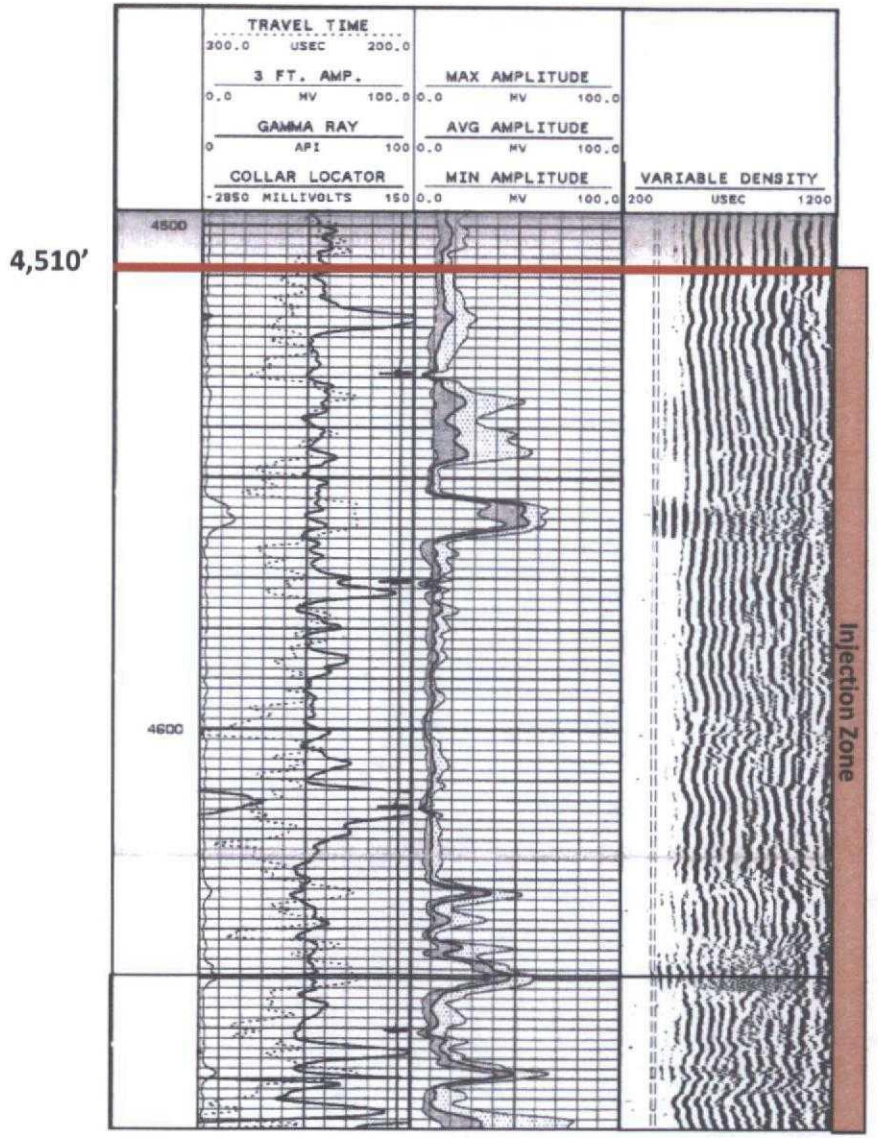
Oxy SDS 11 Federal #1 SWD

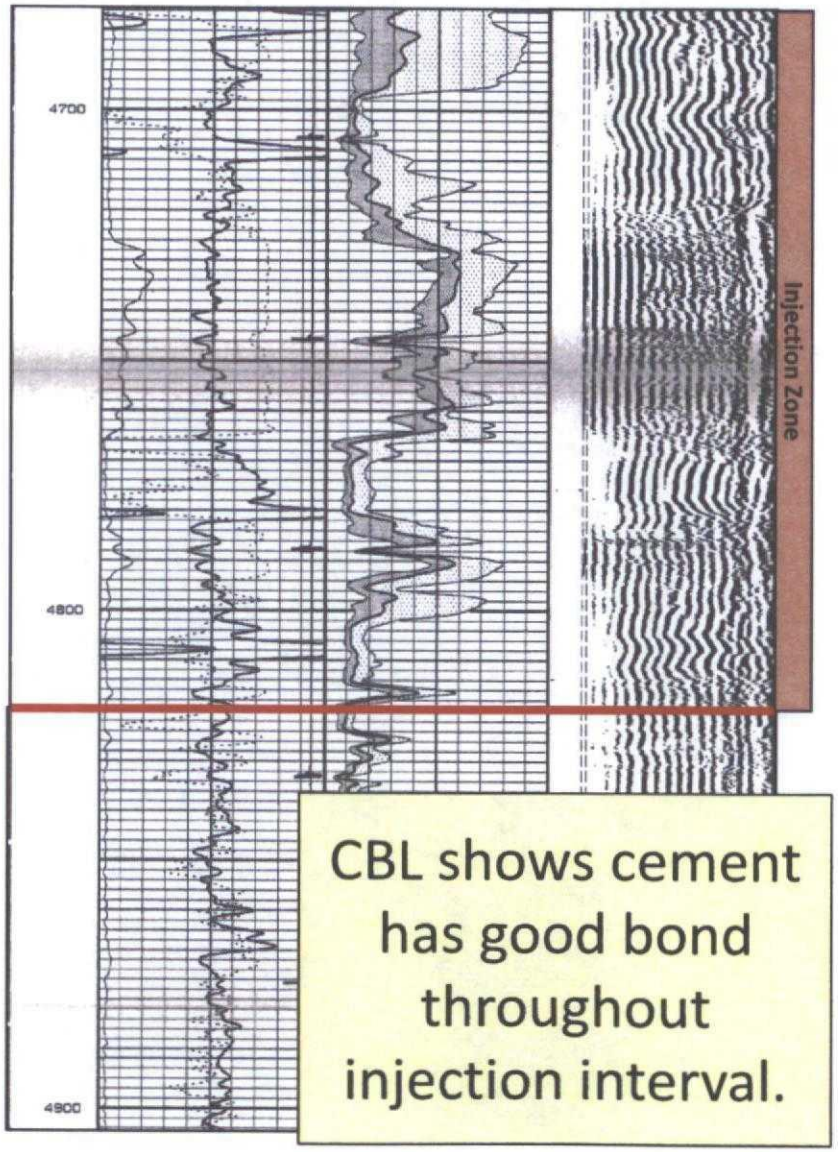
- **01/07/1994:**
  - Well converted to SWD
  - Injection pressure permitted: 902 psi
- **10/24/2006:**
  - Permitted injection pressure increased from 902 psi to 2,200 psi
- **03/01/2008:**
  - Oxy acquires well from Pogo Producing Co.
- **10/11/2013:**
  - Permitted injection pressure increased from 2,200 psi to 3,170 psi
- **02/05/2010:**
  - Oxy found RBP in well @ 4923' with perforations open from 4510 – 4822' (Bell Canyon).



Approximate depth interval of BOPCO's PLU #401H, #392H, #393H, & #394H

Oxy SDS 11 Federal #1 SWD

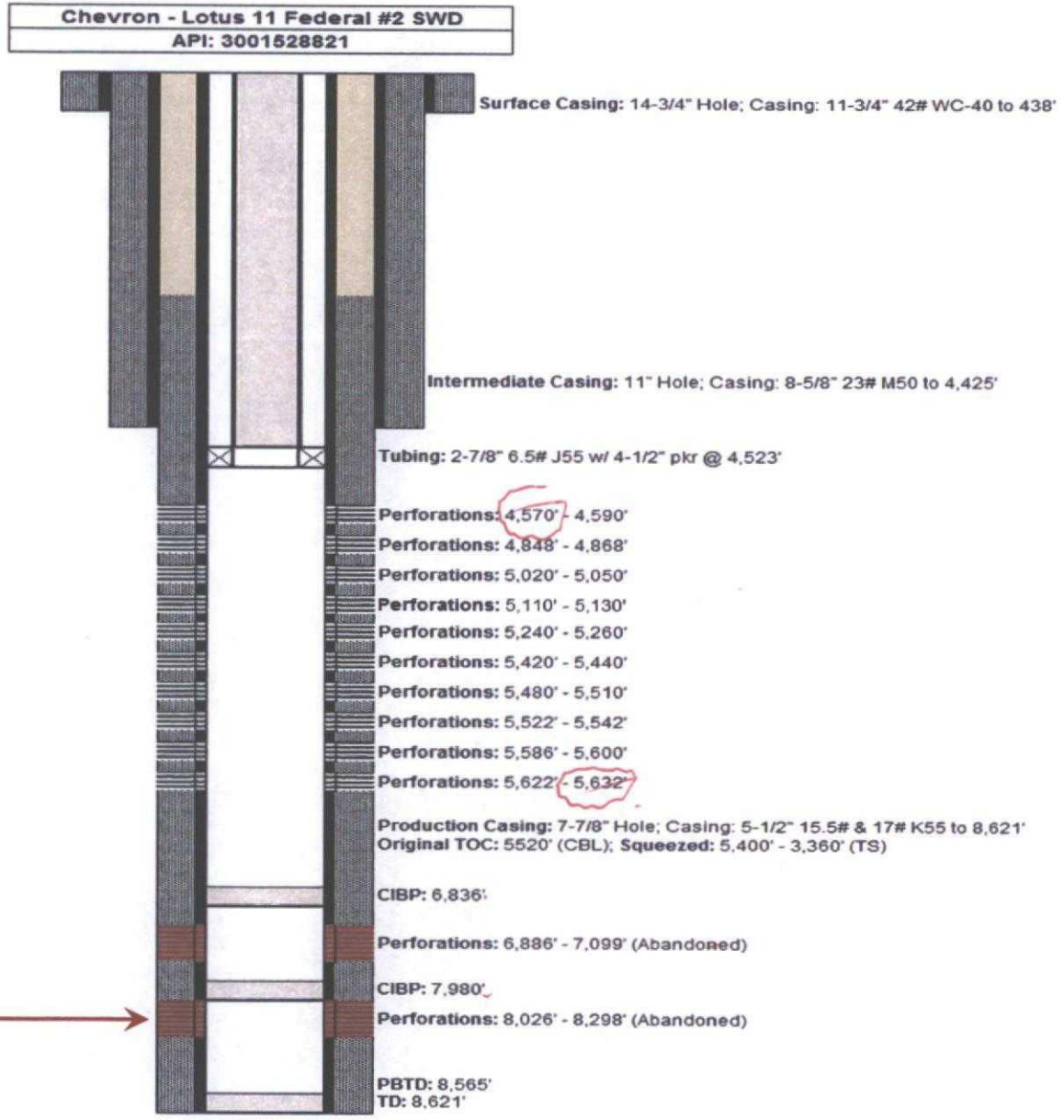




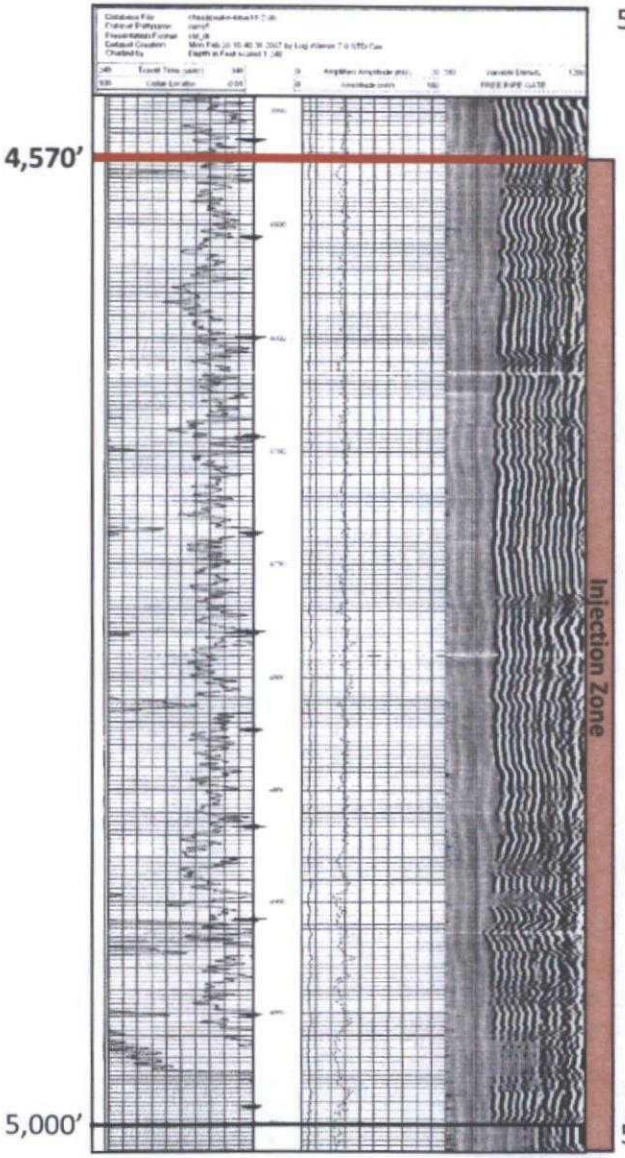
CBL shows cement has good bond throughout injection interval.

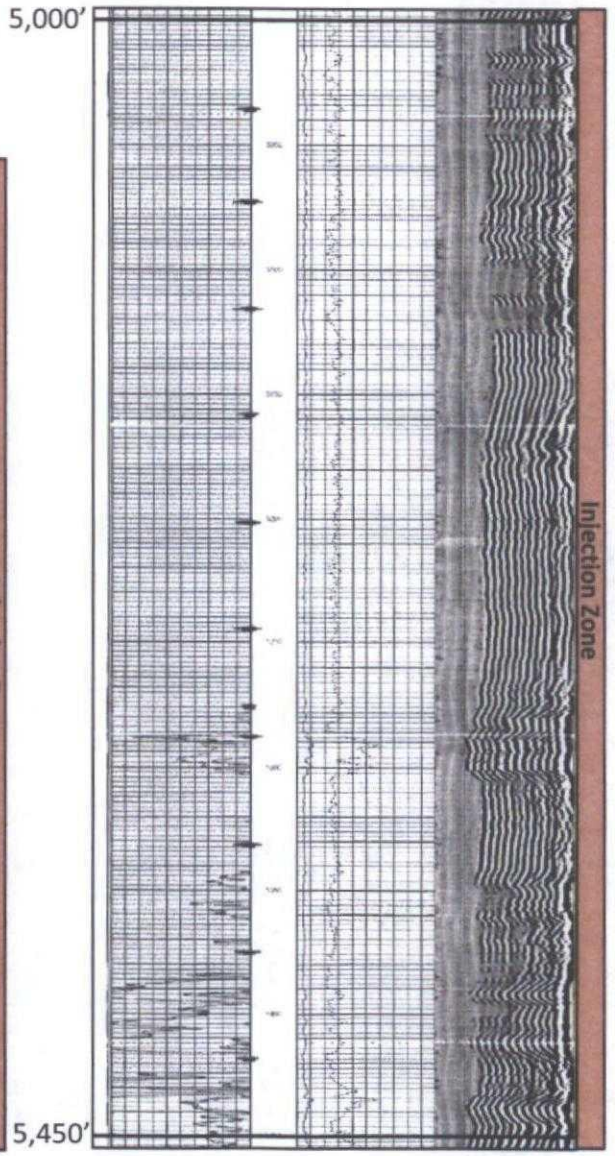
Chevron Lotos 11 Federal #2

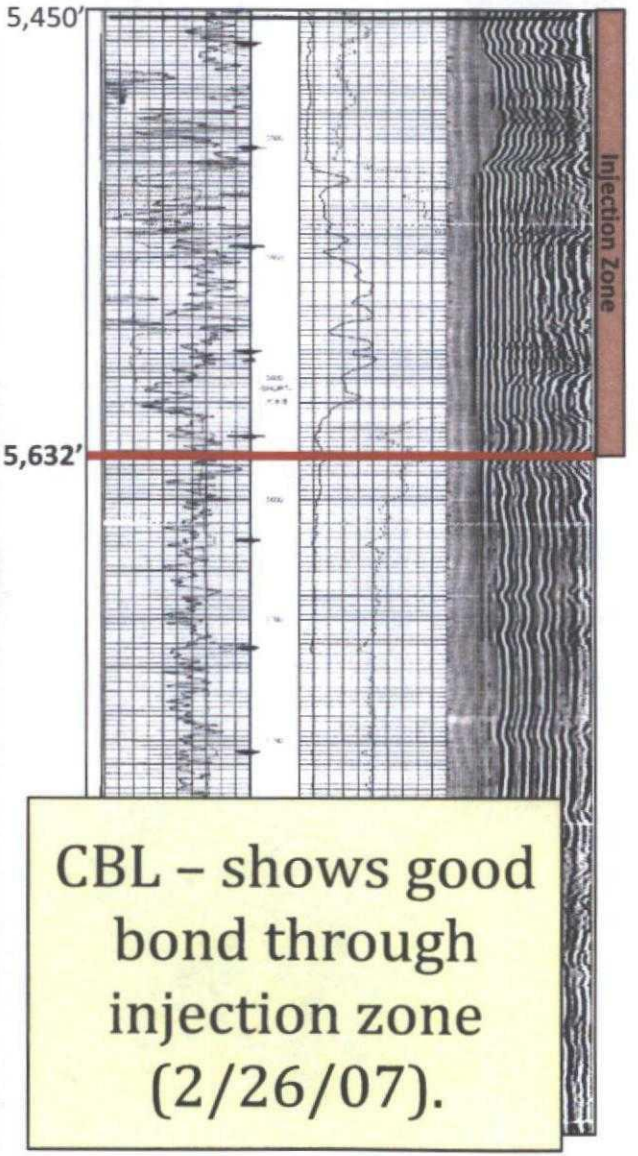
- **12/06/2007:**
  - Well converted to SWD
  - Injection pressure permitted: 914 psi
- **10/09/2012:**
  - Chevron acquires well from Chesapeake Operating, Inc.
- **09/24/2012:**
  - Permitted injection pressure increased from 914 psi to 1,225 psi



Chevron Lotos 11 Federal #2 SWD



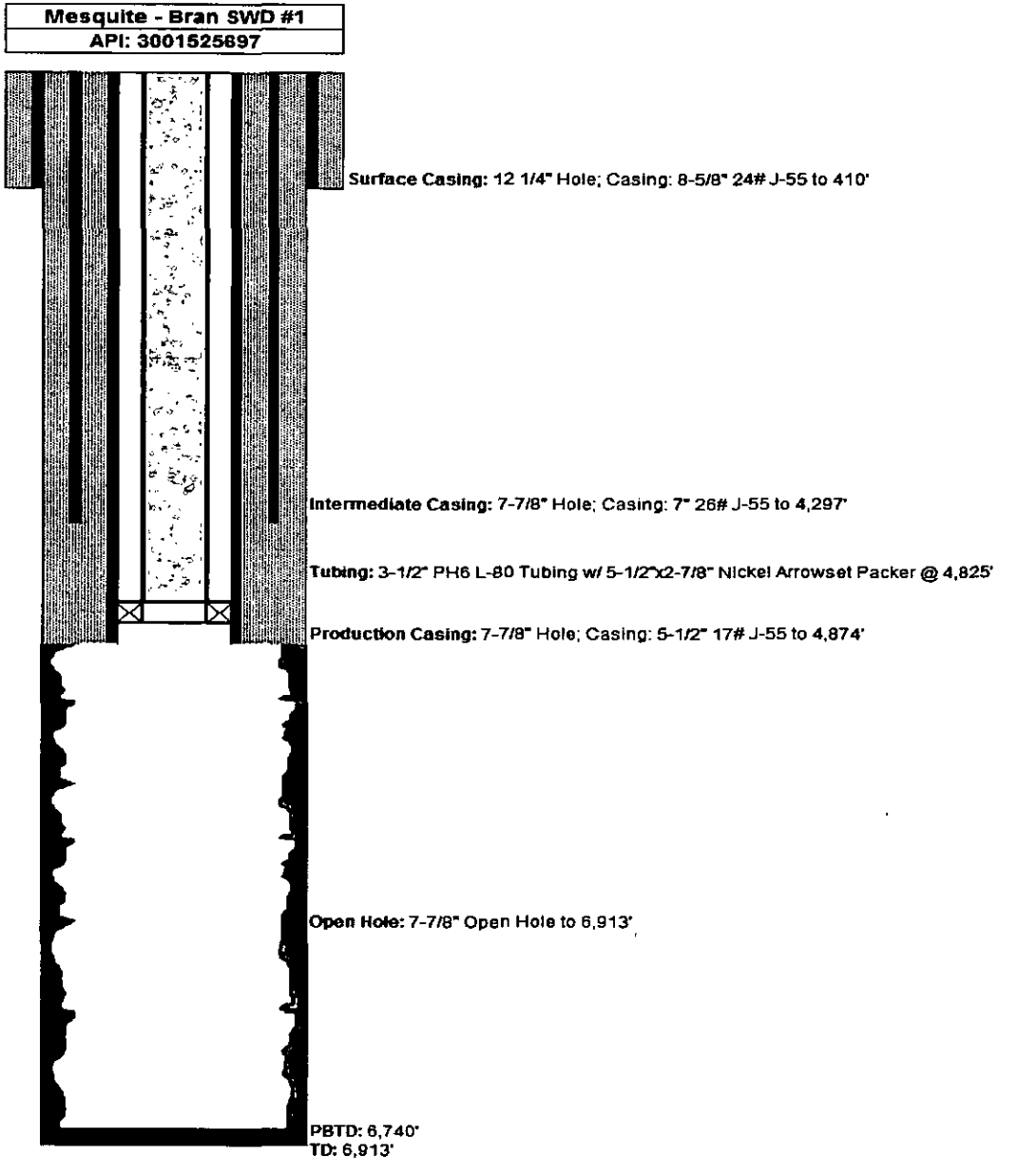




CBL – shows good bond through injection zone (2/26/07).

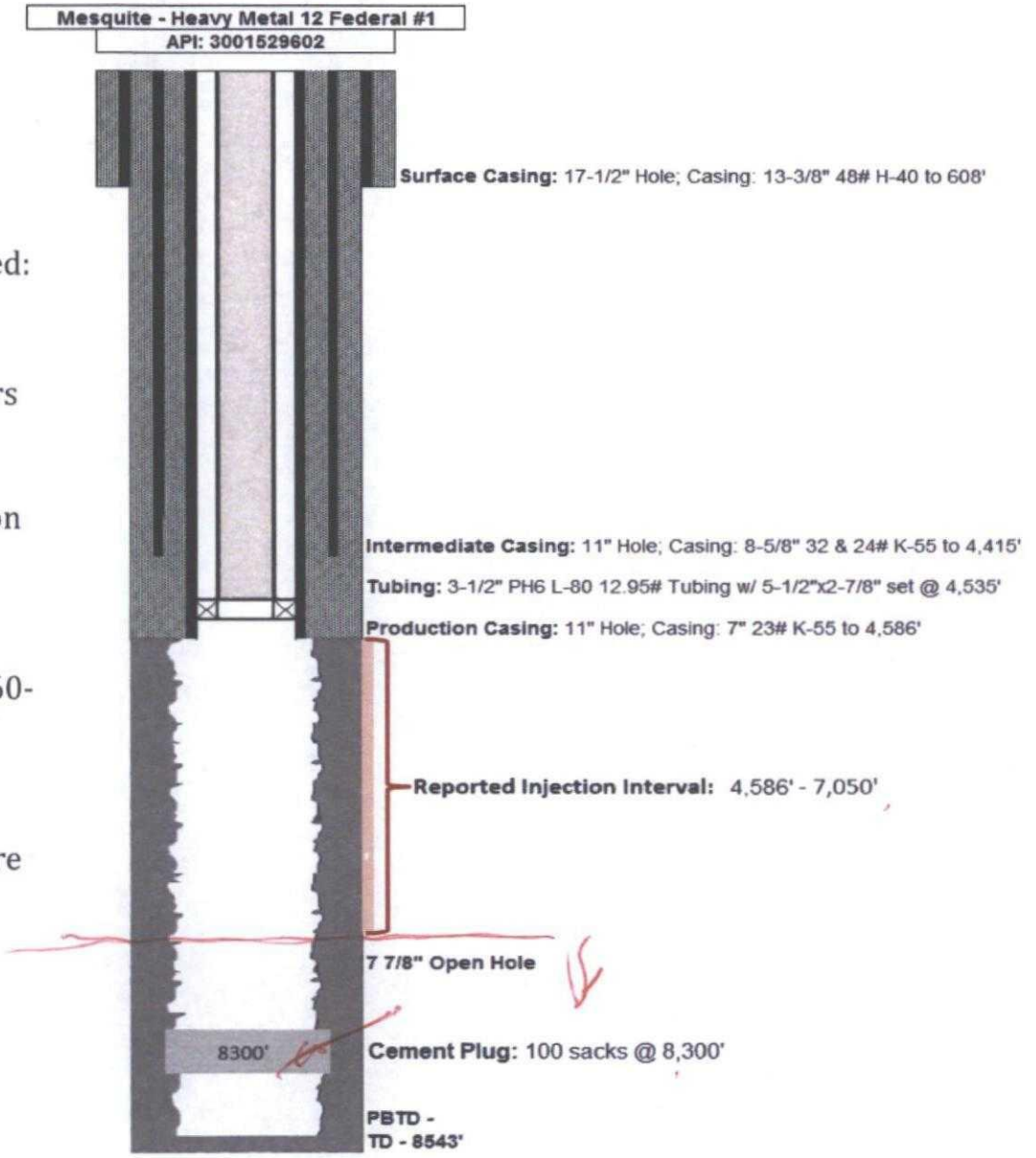
Mesquite Bran SWD

- **11/04/2010:**
  - Mesquite Services, Inc. received SWD permit on Bran SWD #1
  - Injection pressure permitted: 970 psi (4,850' – 6,794')
- **10/18/2011:**
  - Mesquite SWD Inc. re-enters wellbore to drill out, run intermediate & production casing, and complete as SWD.
- **01/01/2012:**
  - First injection volumes reported to State.
- **02/15/2012:**
  - Permitted injection pressure increased from 970 psi to 975 psi (4,874' – 6,740')
- **09/30/2013:**
  - Permitted injection pressure increased from 975 psi to 1,450 psi (4,874' – 6,740')



Mesquite Heavy Metal SWD

- **<u>03/29/2011:</u>**
  - Mesquite Services, Inc. received SWD permit on Heavy Metal 12 Federal #1 SWD
  - Injection pressure permitted: <u>883 psi</u> (4,415' – 7,050')
- **<u>10/10/2011:</u>**
  - Mesquite SWD Inc. re-enters wellbore to drill out and complete as SWD.
  - Mesquite runs 7" production casing to 4,586'
- **<u>12/28/2011:</u>**
  - Mesquite files completion report (Form 3160-4 & 3160-5) reporting OH interval of 4,586' – 6,140'.
- **<u>04/22/2013:</u>**
  - Permitted injection pressure increased from 833 psi to <u>1,400 psi</u> (4,415' – 7,050')



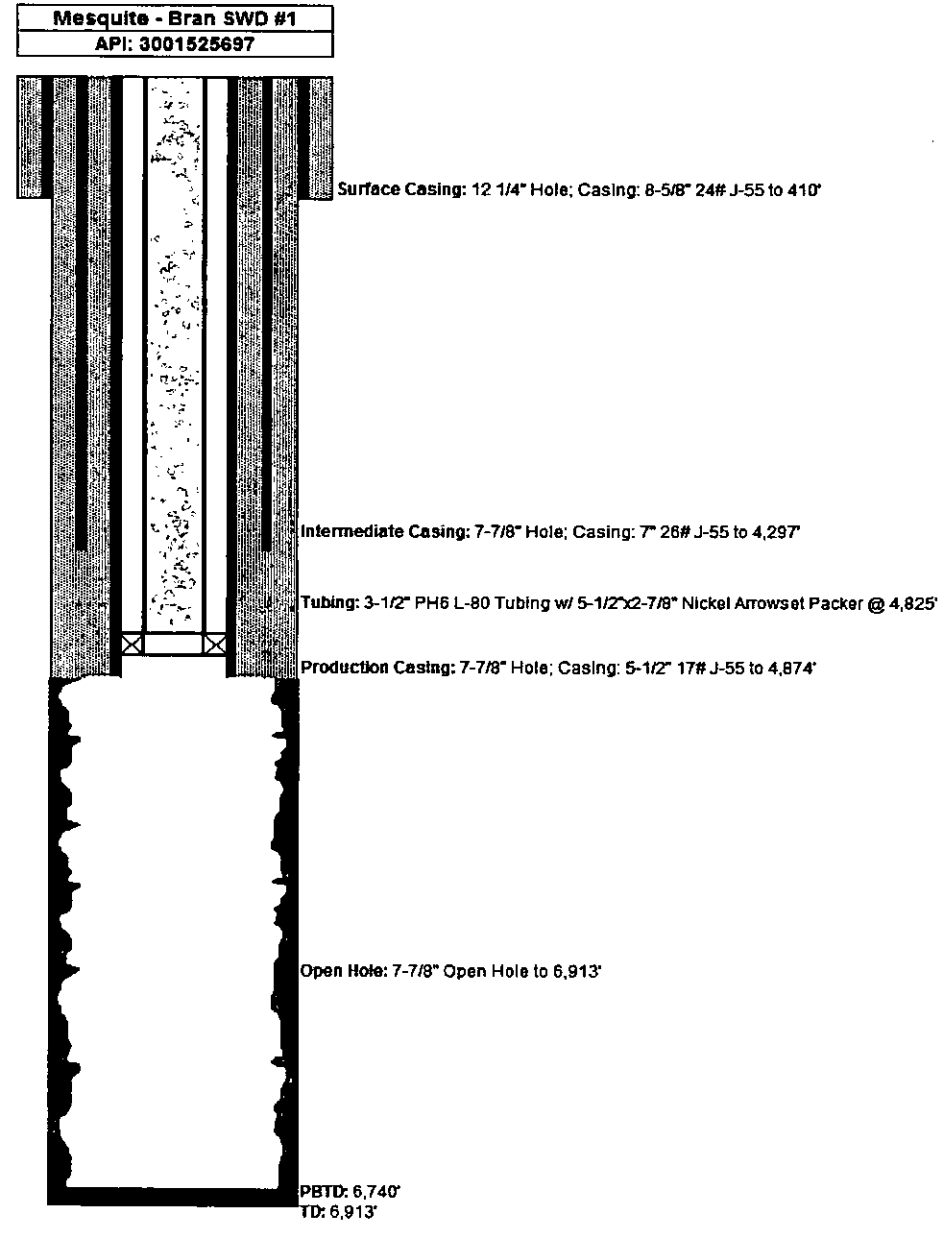
Mesquite Bran SWD

•10/18/2011 - Mesquite SWD Inc re-enters wellbore to drill out and complete as SWD.

Notables:

• Bran Oil Co. were unable to tag a 300' (95 sack) cement plug in the open hole from 4,270' – 4,570'. Bran Oil Co. pumped a secondary plug with an additional 95 sacks and were able to tag (190 sacks total in open hole) @ 3,970'.

• Once Mesquite SWD, Inc. cleaned out the wellbore for SWD conversion in Oct.-2011, they found no cement plugs between 3,970' – 4,530'.



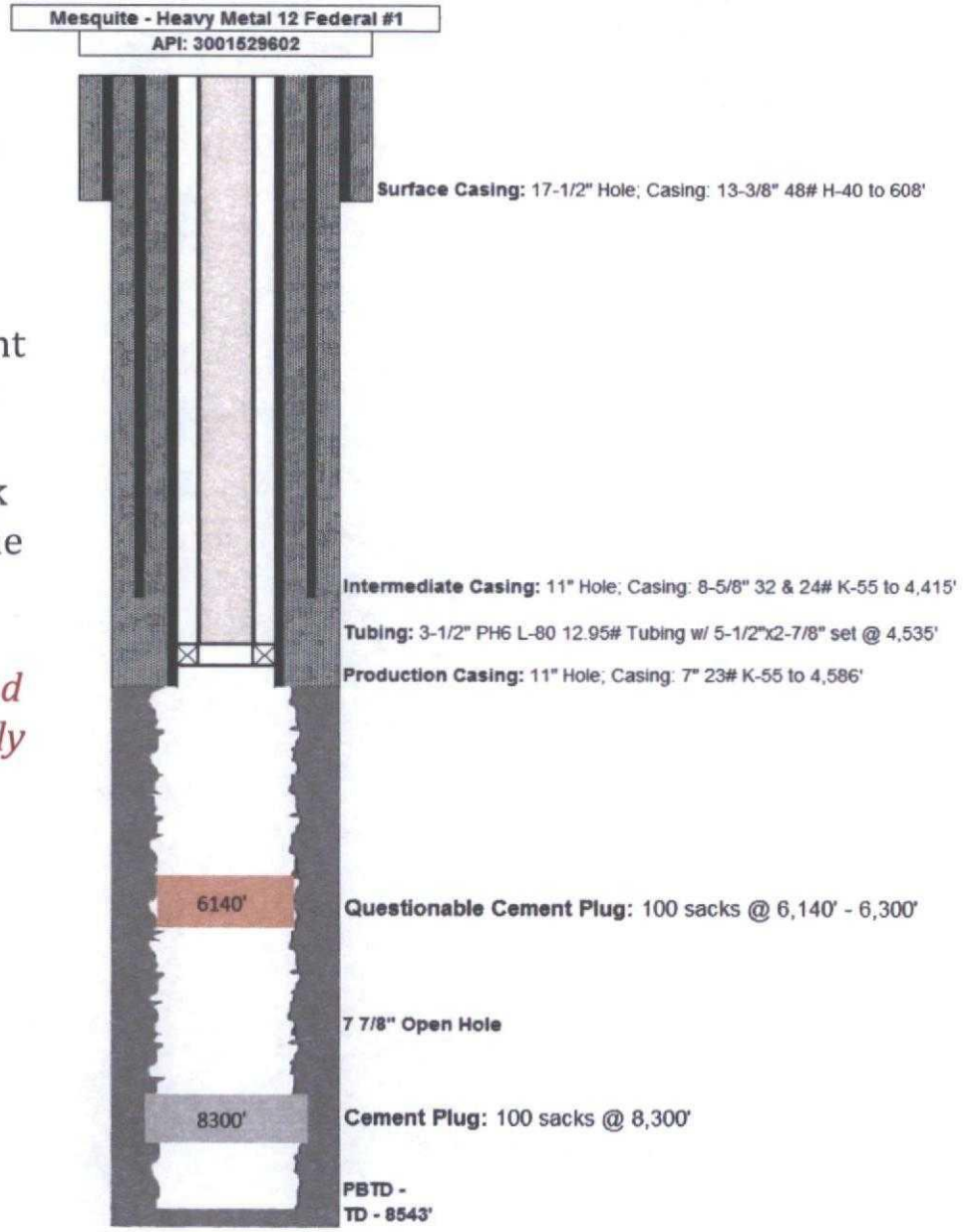
Mesquite Heavy Metal SWD

- 10/10/2011 - Mesquite SWD Inc re-enters wellbore to drill out and complete as SWD.

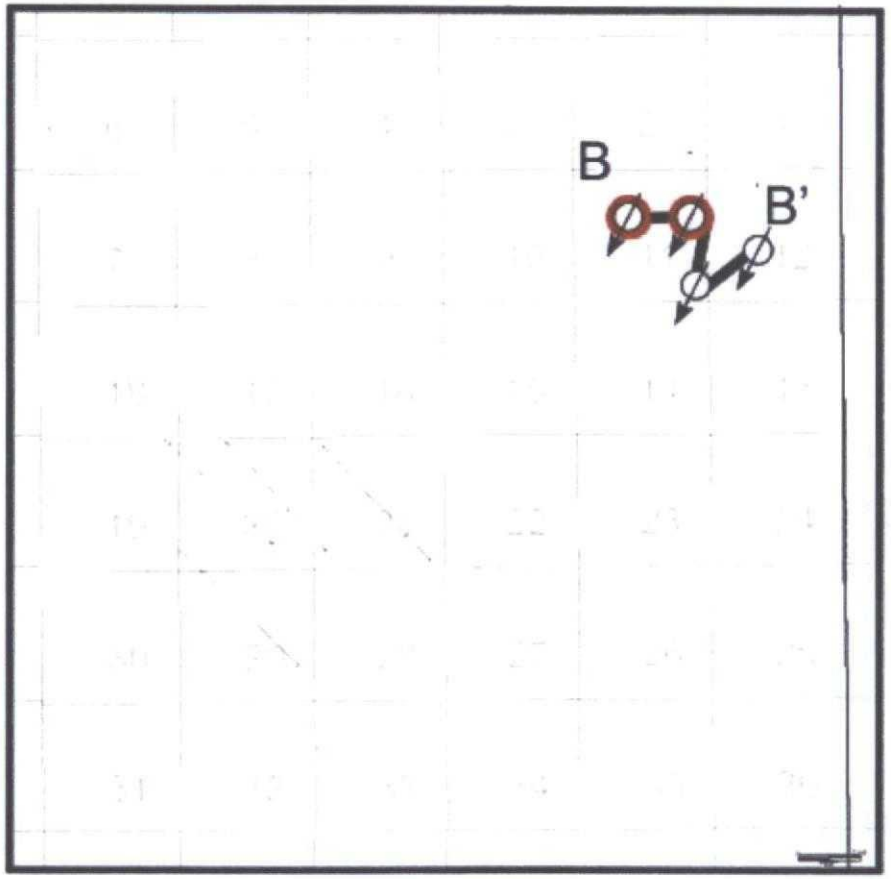
Notables:

- Mesquite SWD, Inc. spotted 50 sacks cement in the open hole at 6,300', waited on cement for 4 hours and could not tag the plug. Mesquite SWD, Inc. spotted a second 50 sack plug in the open hole at 6,300' and tagged the plug 4 hours later at 6,140'.

- *If the first 50 sacks didn't create a bridge and was not tagged, could the second 50 sacks fully isolate the deeper Brushy Canyon from the permitted Bell & Cherry Canyon injection zones? Bran Oil Co. pumped 190 sacks in the open hole on the Bran SWD #1 which, when cleaned out for SWD conversion, was not found.*



SWD Cross-Section



SDS 11 FEDERAL #001
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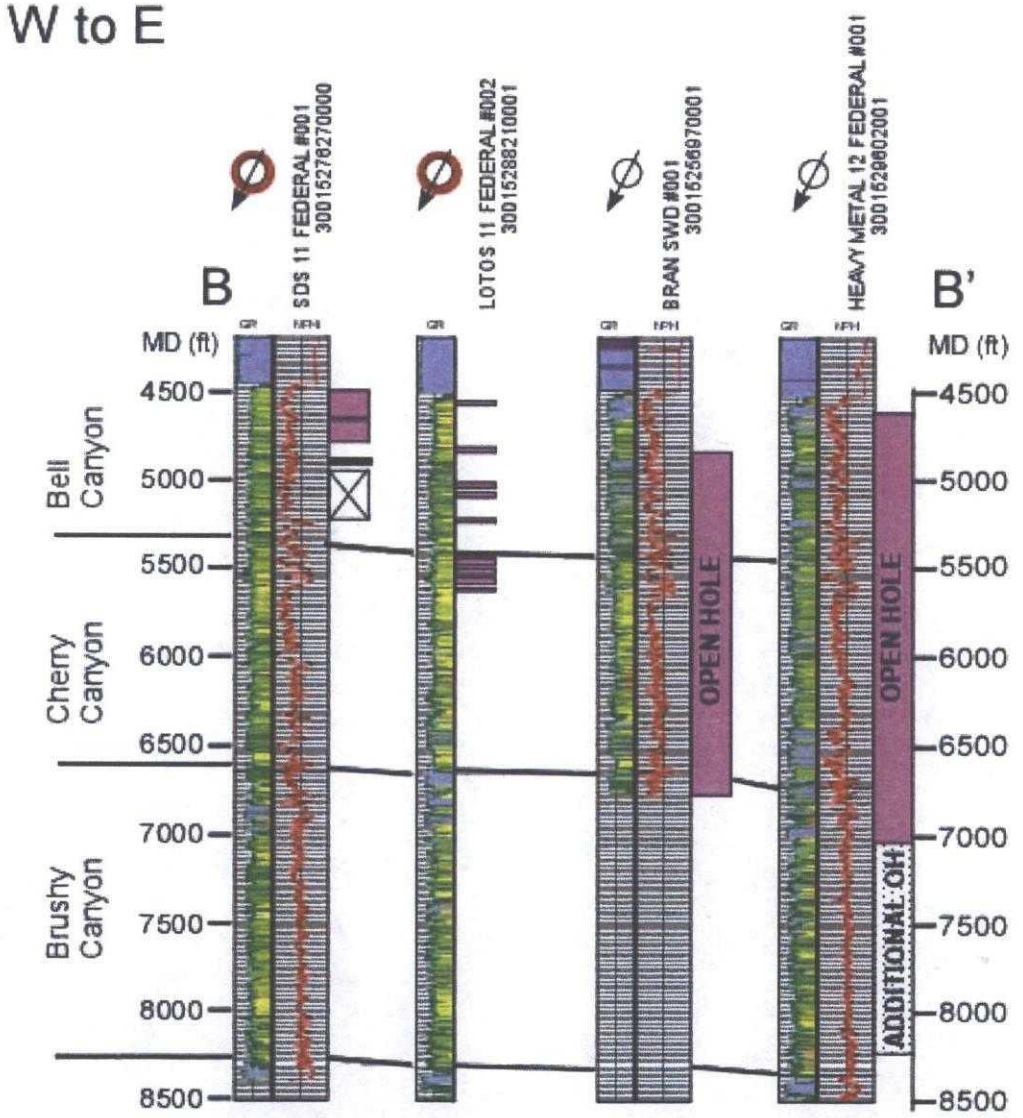
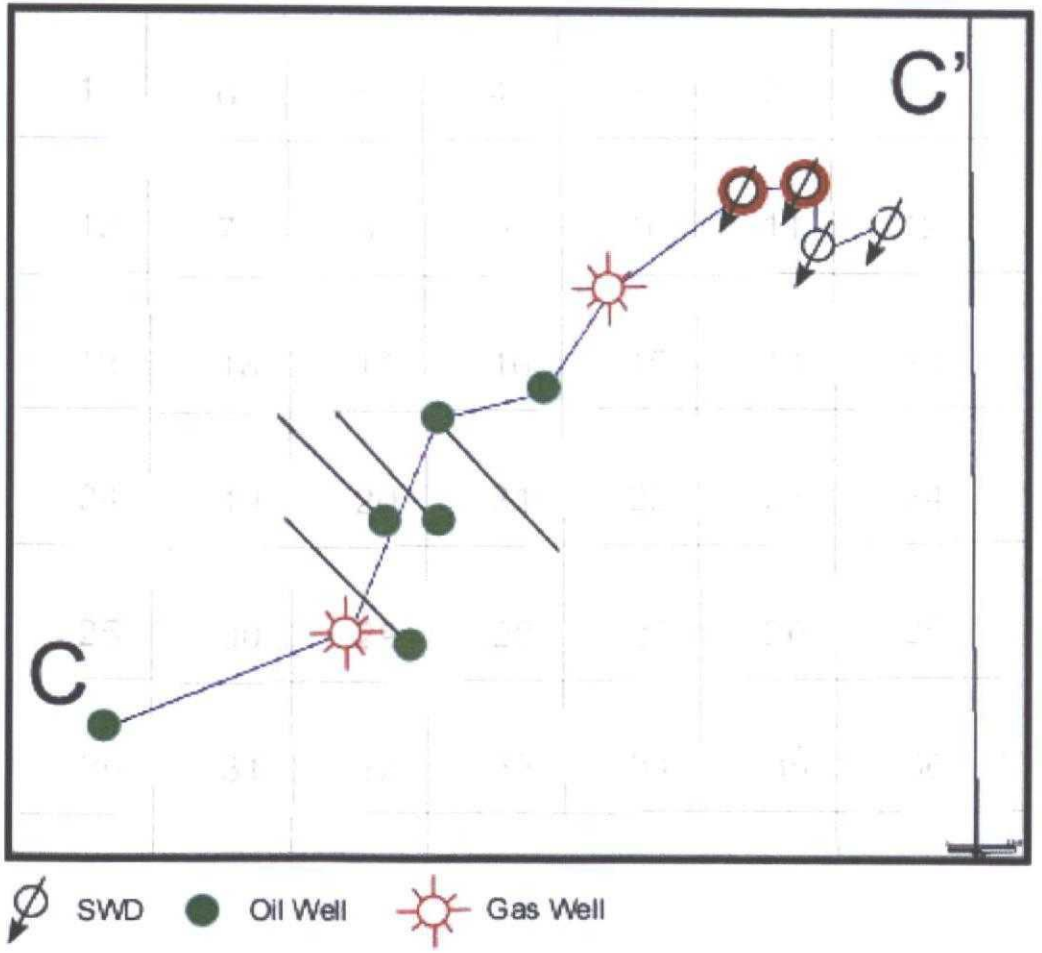


Regional Cross-Section



- POKER LAKE UNIT #084
  30015291030000
- POKER LAKE UNIT #196
  30015331640000
- POKER LAKE UNIT #401H
  30015399180000
- CACTUS 16 STATE #002
  30015300640000
- LOTUS A FEDERAL #001
  30015261740000
- SDS 11 FEDERAL #001
  30015276270000
- LOTOS 11 FEDERAL #002
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- BRAN SWD #001
  30015256970001
- HEAVY METAL 12 FEDERAL #001
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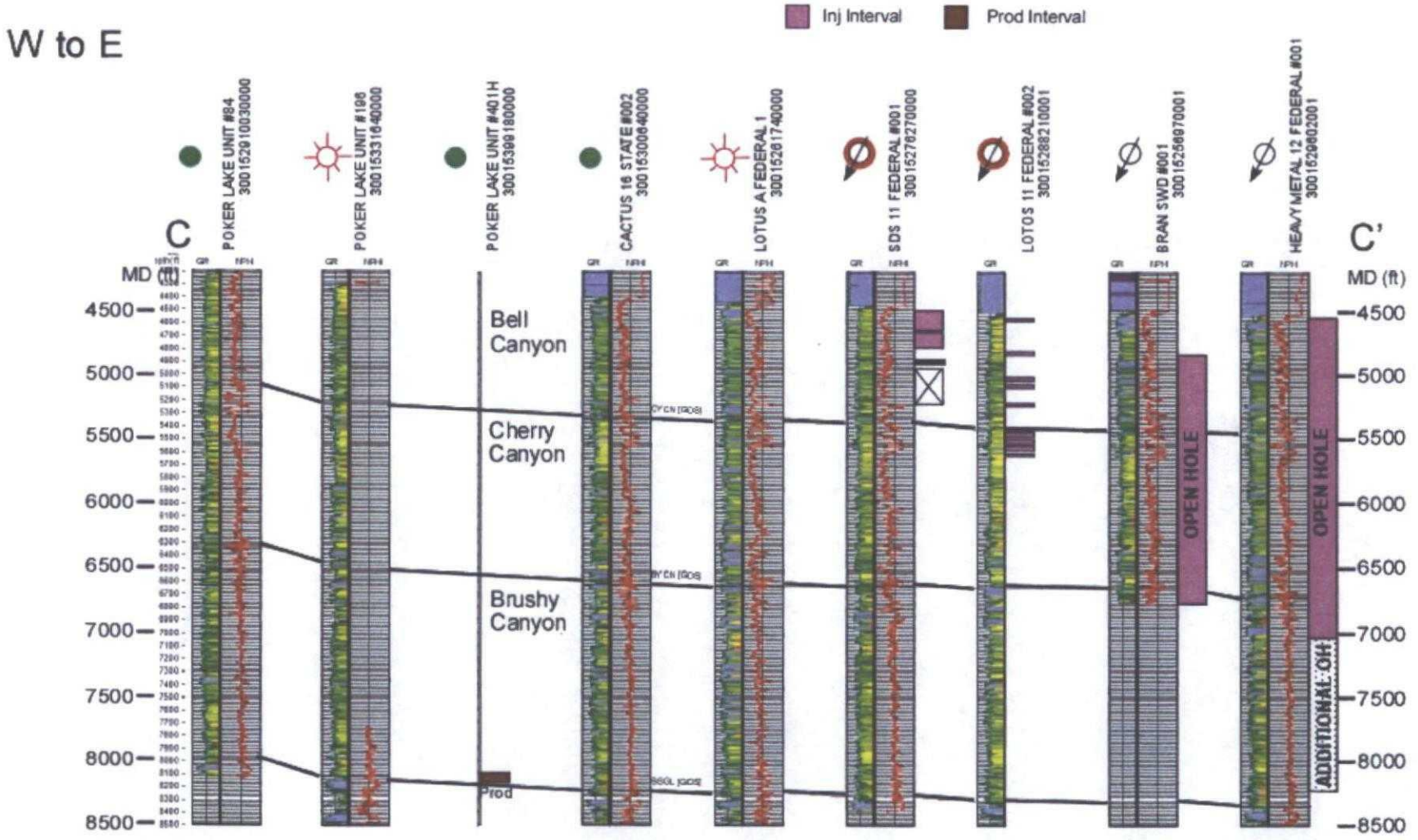
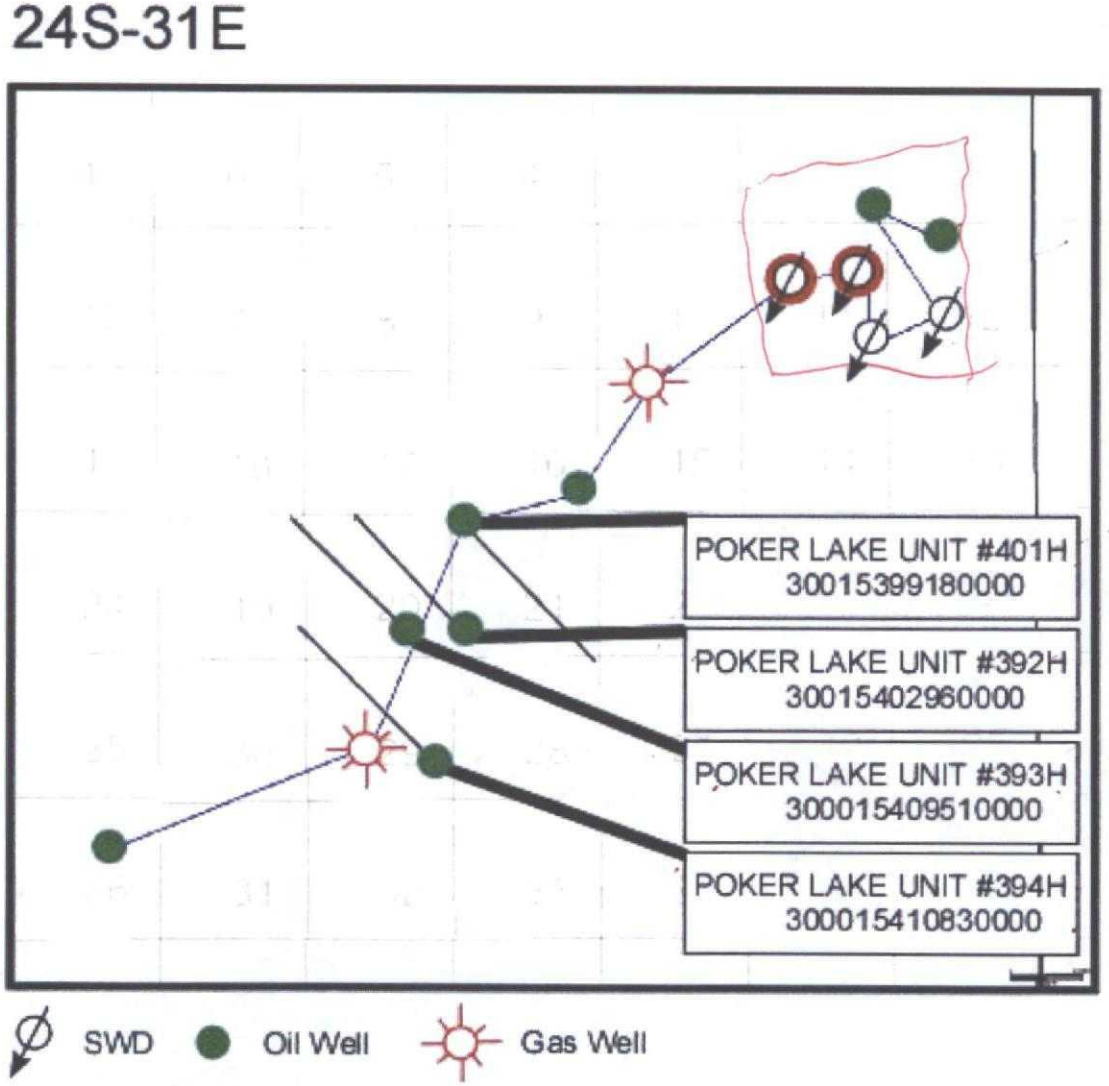
Regional Cross-Section

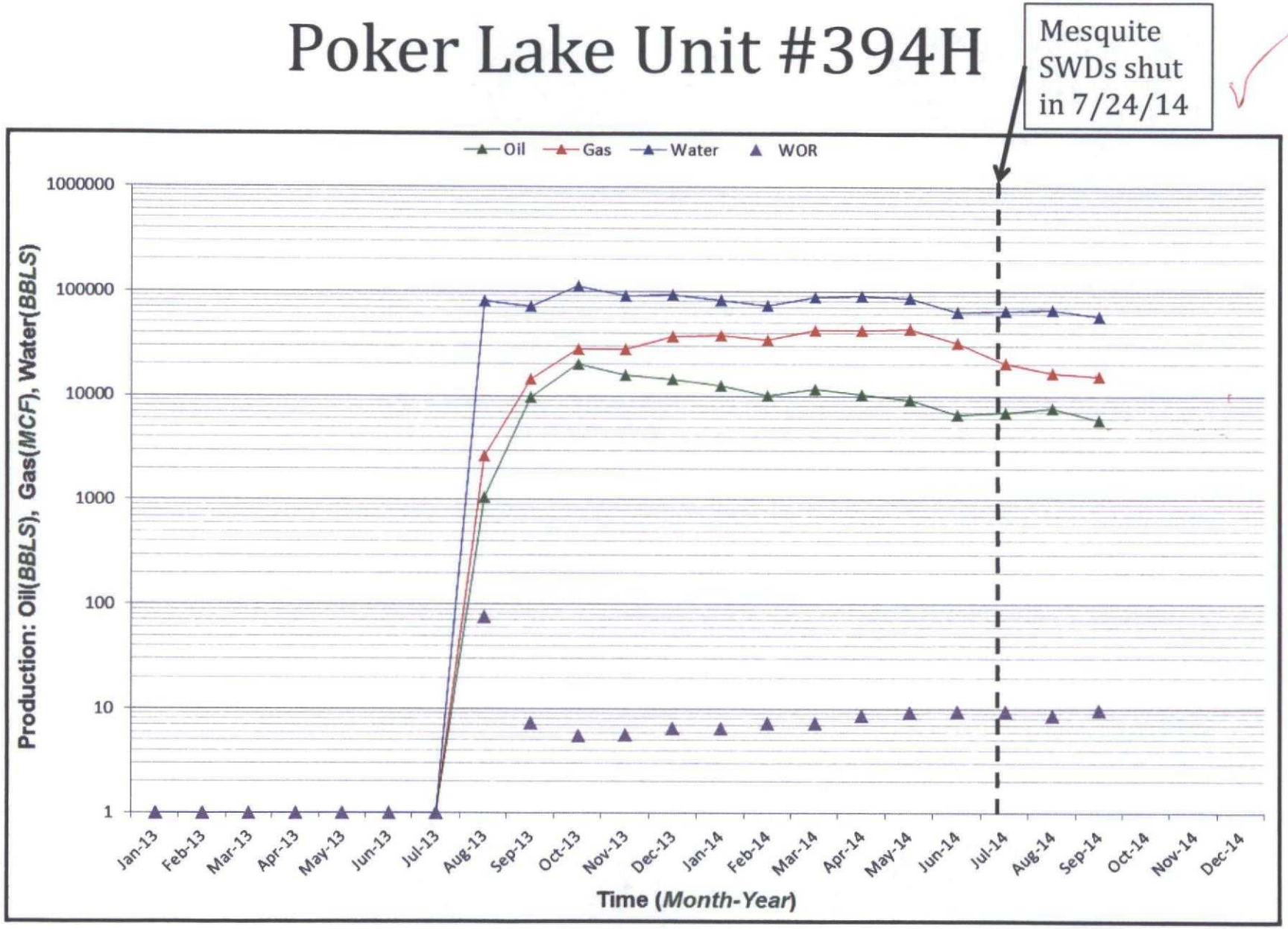


Regional Brushy Canyon Production

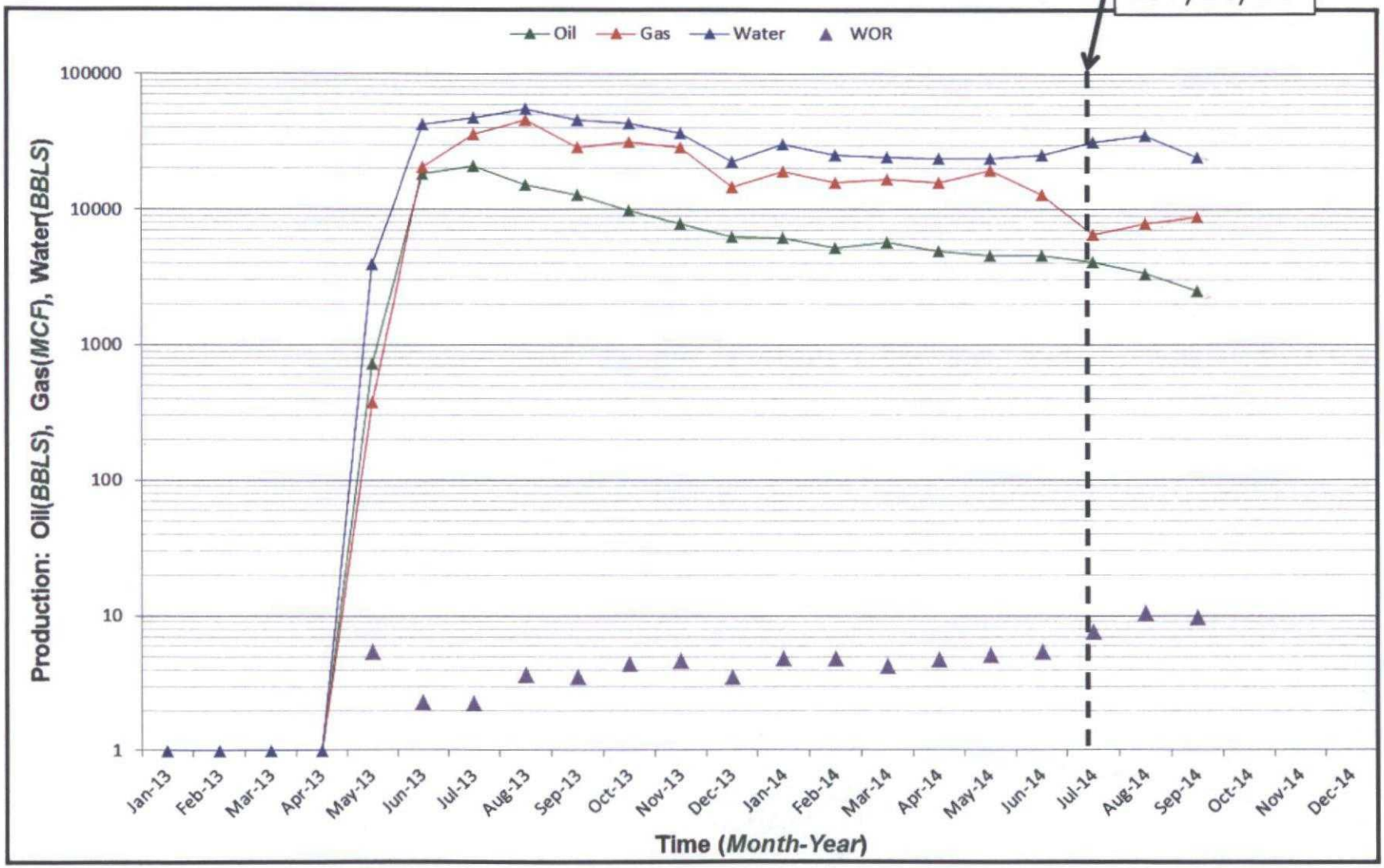
Poker Lake Unit Wells Production



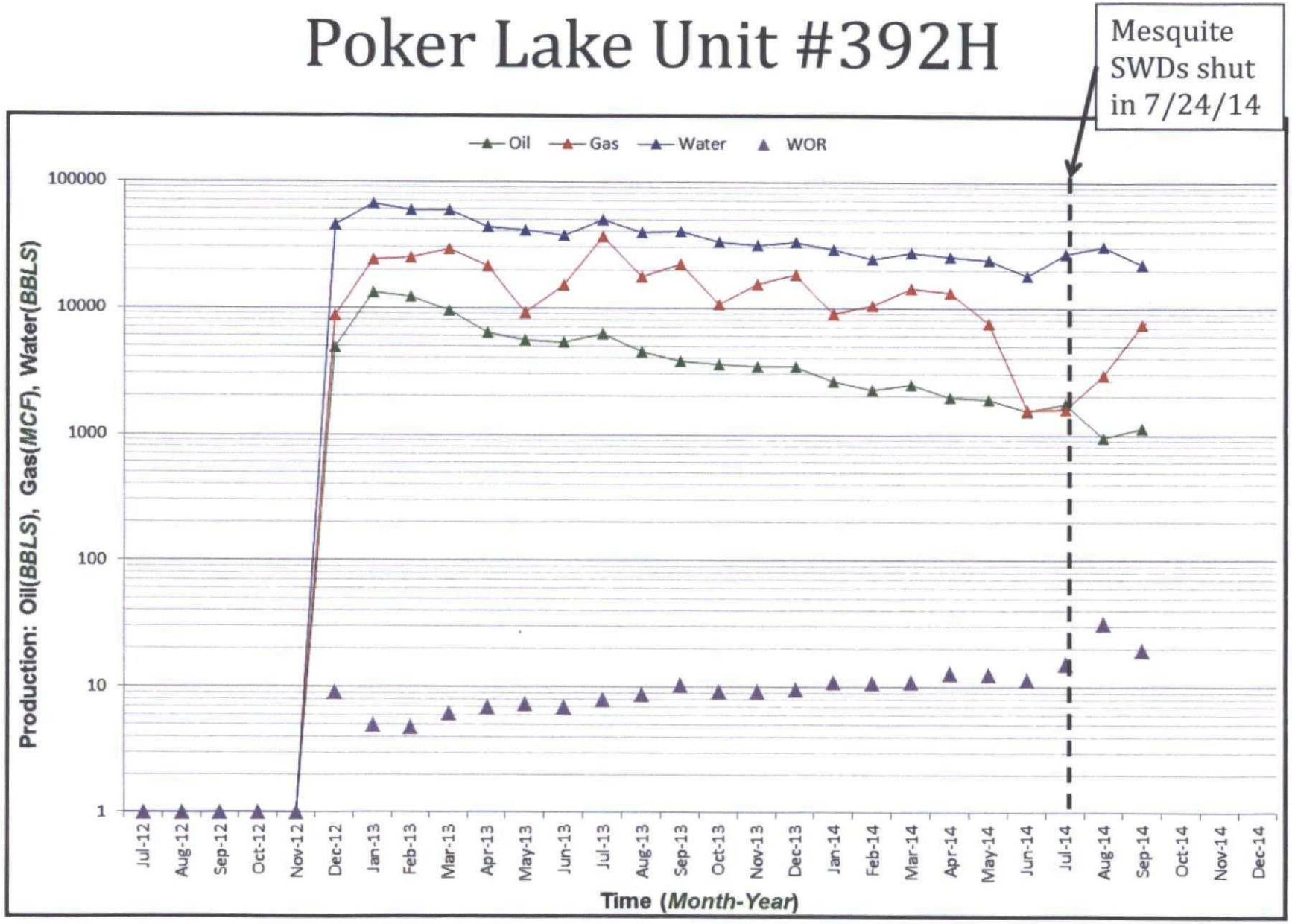
Poker Lake Unit #394H



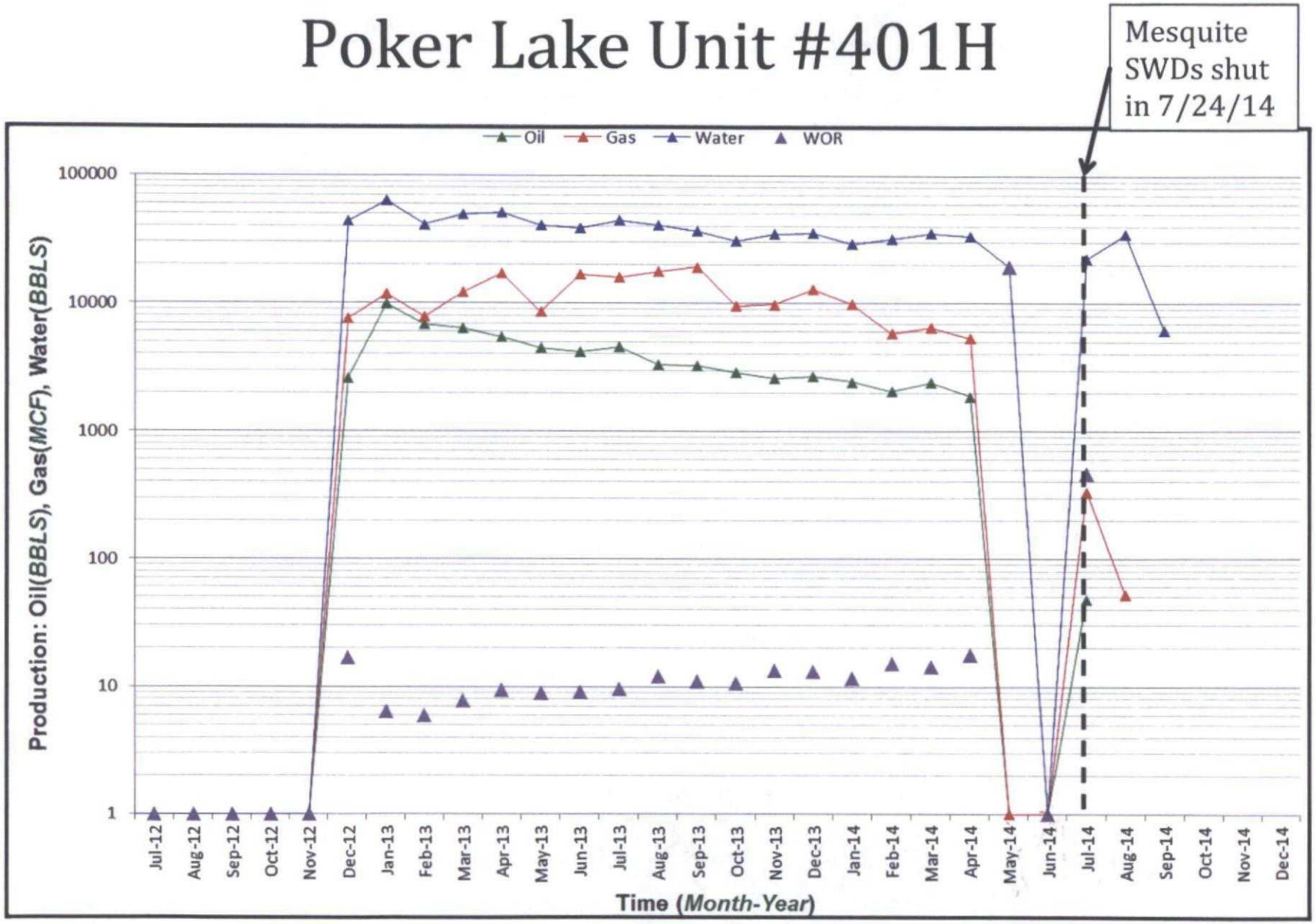
Poker Lake Unit #393H



Poker Lake Unit #392H

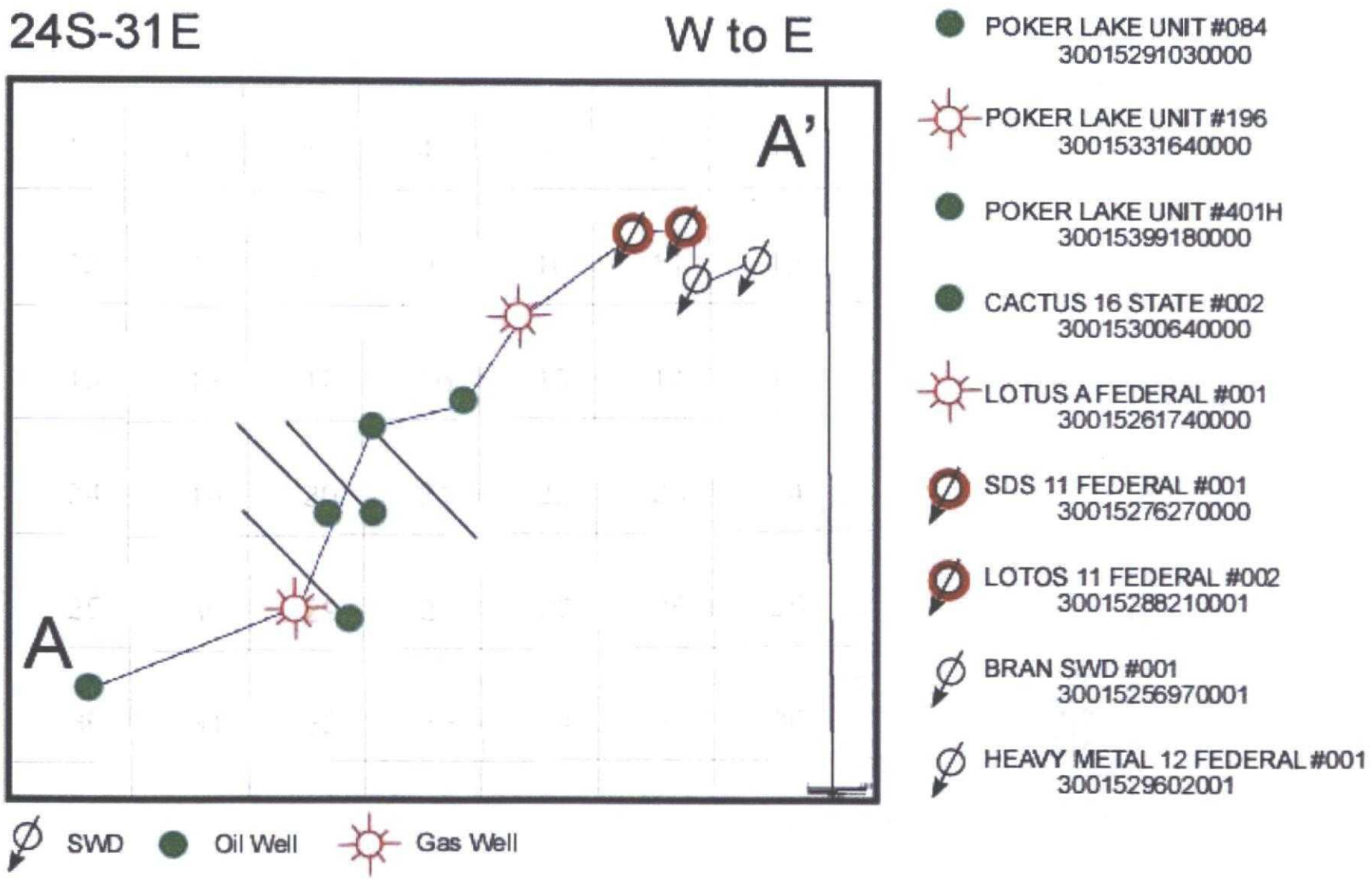


Poker Lake Unit #401H



Jun-14 Oil = 0

24


24S-31E
W to E
A'
A
SWD
Oil Well
Gas Well
POKER LAKE UNIT #084
30015291030000
POKER LAKE UNIT #196
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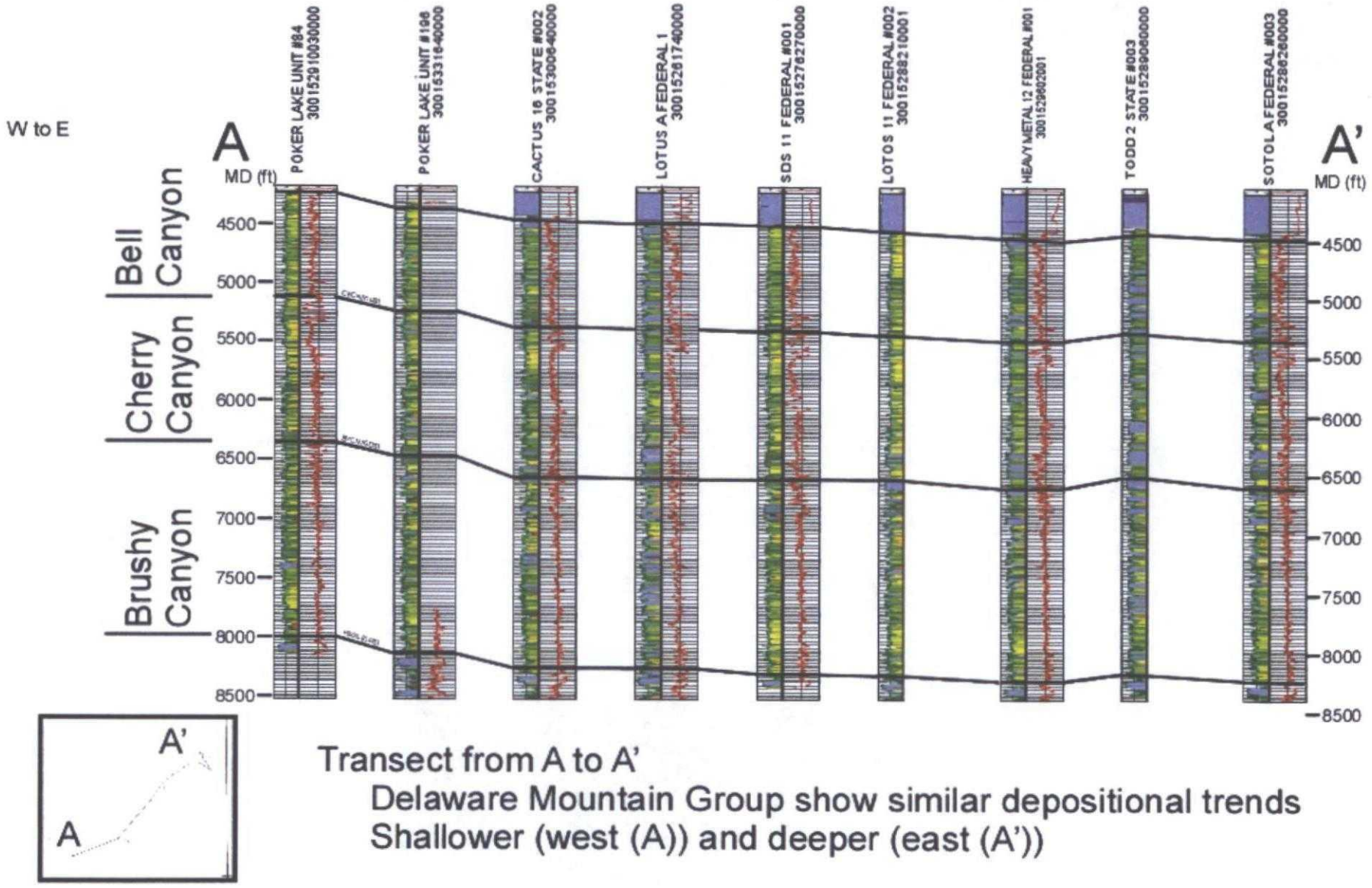
30015276270000
LOTOS 11 FEDERAL #002
30015288210001
BRAN SWD #001
30015256970001
HEAVY METAL 12 FEDERAL #001
3001529602001

Cross-Section Over Area of Interest



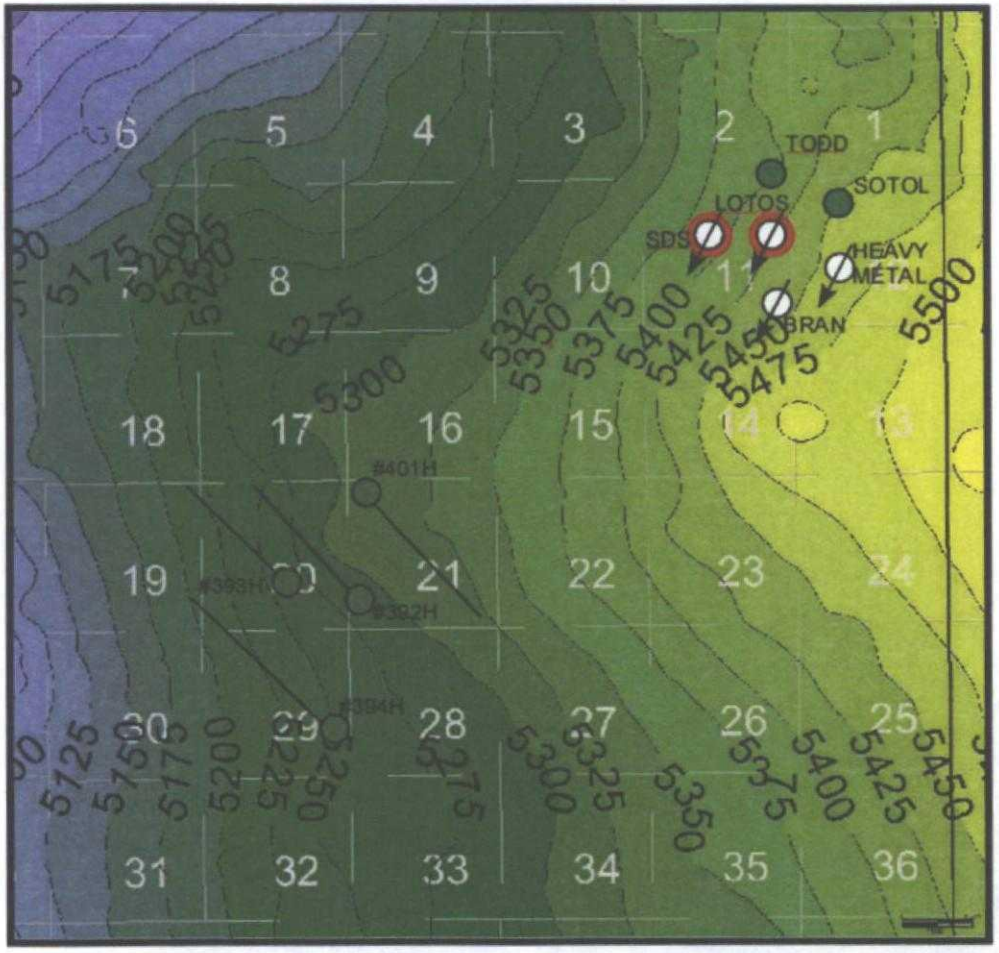
Transect from A to A'

Delaware Mountain Group show similar depositional trends

Shallower (west (A)) and deeper (east (A'))

Structure Map Over Area of Interest

Cherry Canyon



Surface of Cherry Canyon, like Bell and Brushy Canyon, shows deepening to the east.

- SDS 11 FEDERAL #001 30015276270000
- LOTOS 11 FEDERAL #002 30015288210001
- BRAN SWD #001 30015256970001
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- POKER LAKE UNIT #401H 30015399180000
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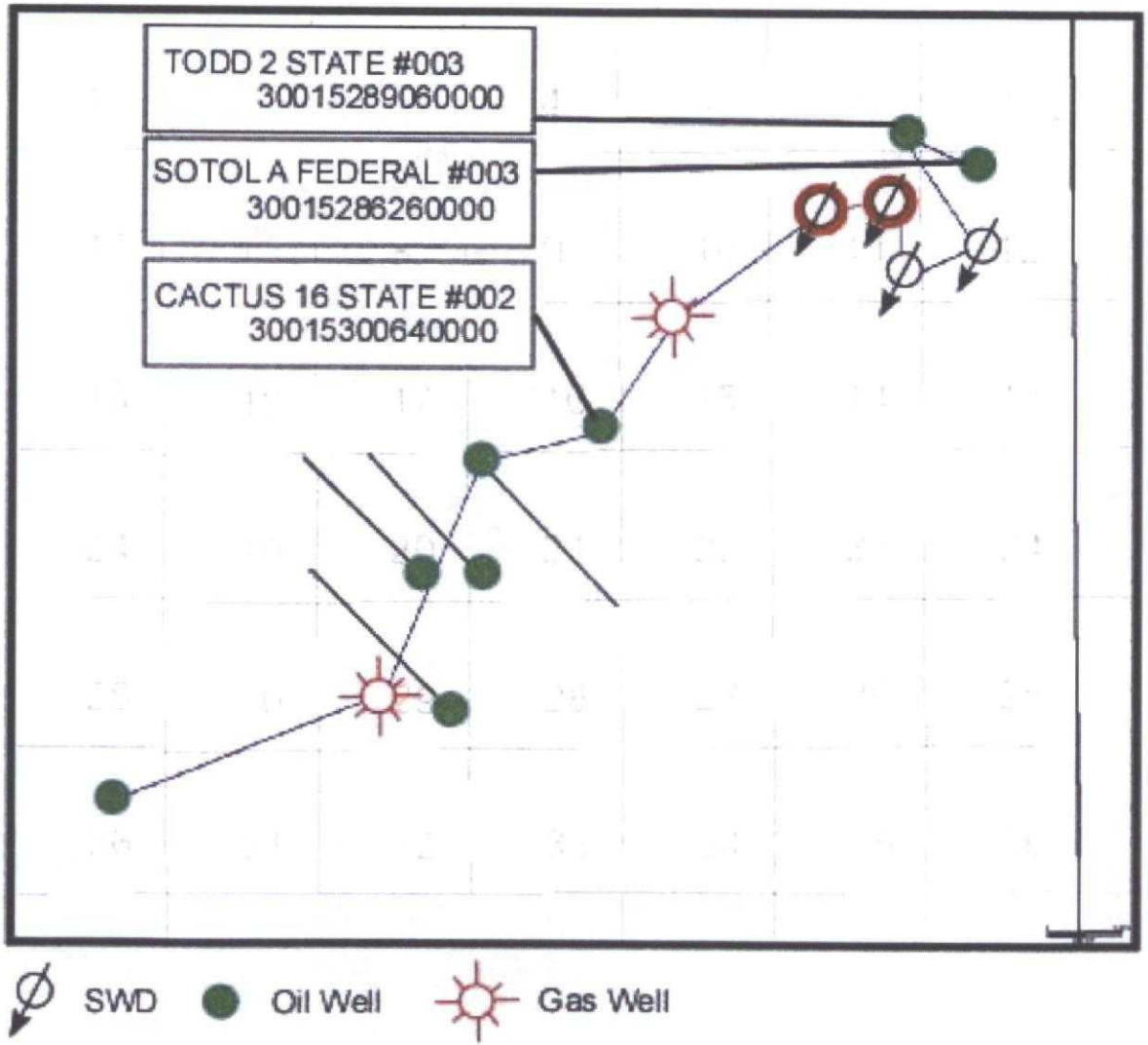
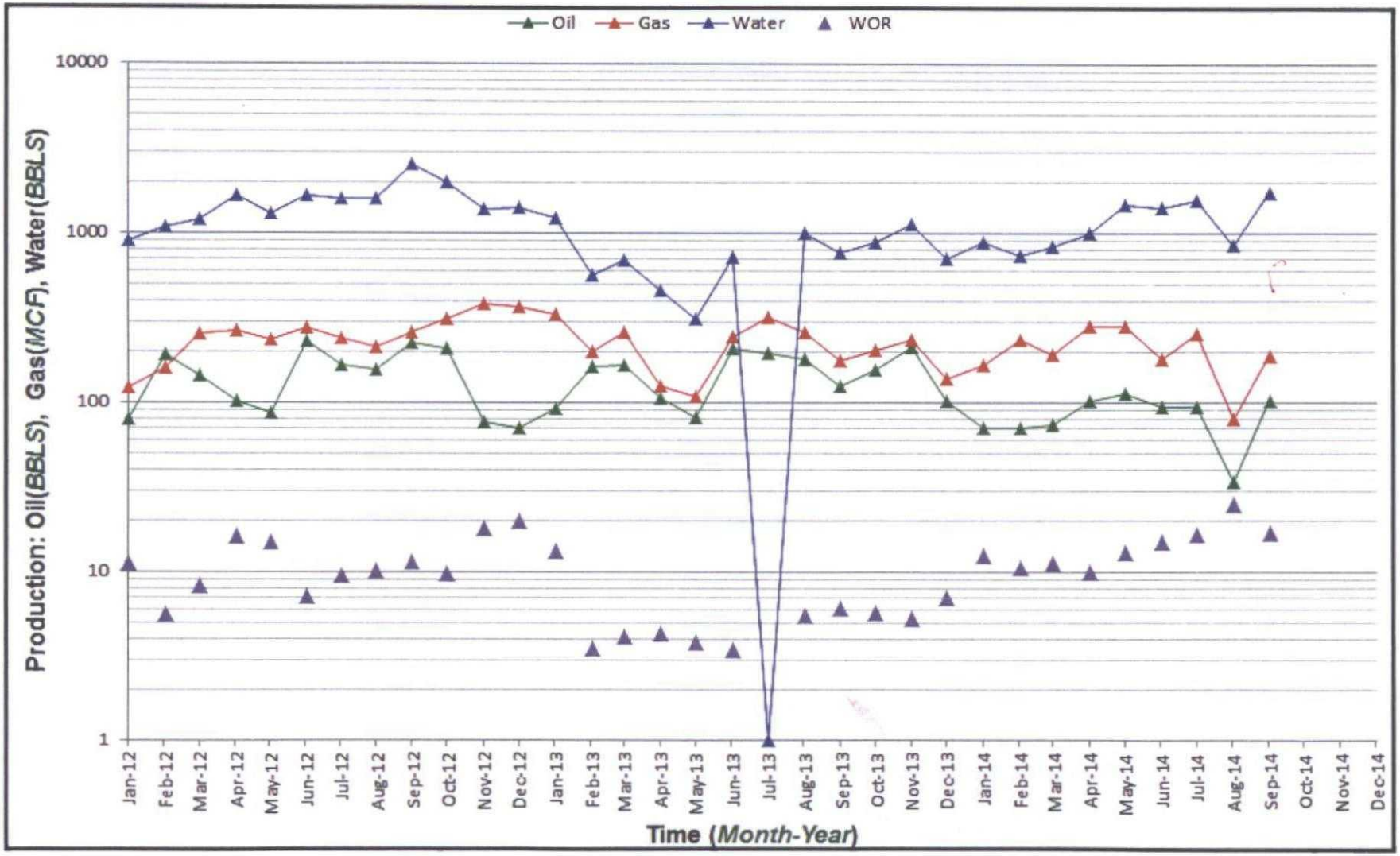
- POKER LAKE UNIT #393H 300015409510000
- POKER LAKE UNIT #394H 300015410830000
- TODD 2 STATE #003 30015289060000
- SOTOL A FEDERAL #003 30015286260000

Chevron Offset Wells Production

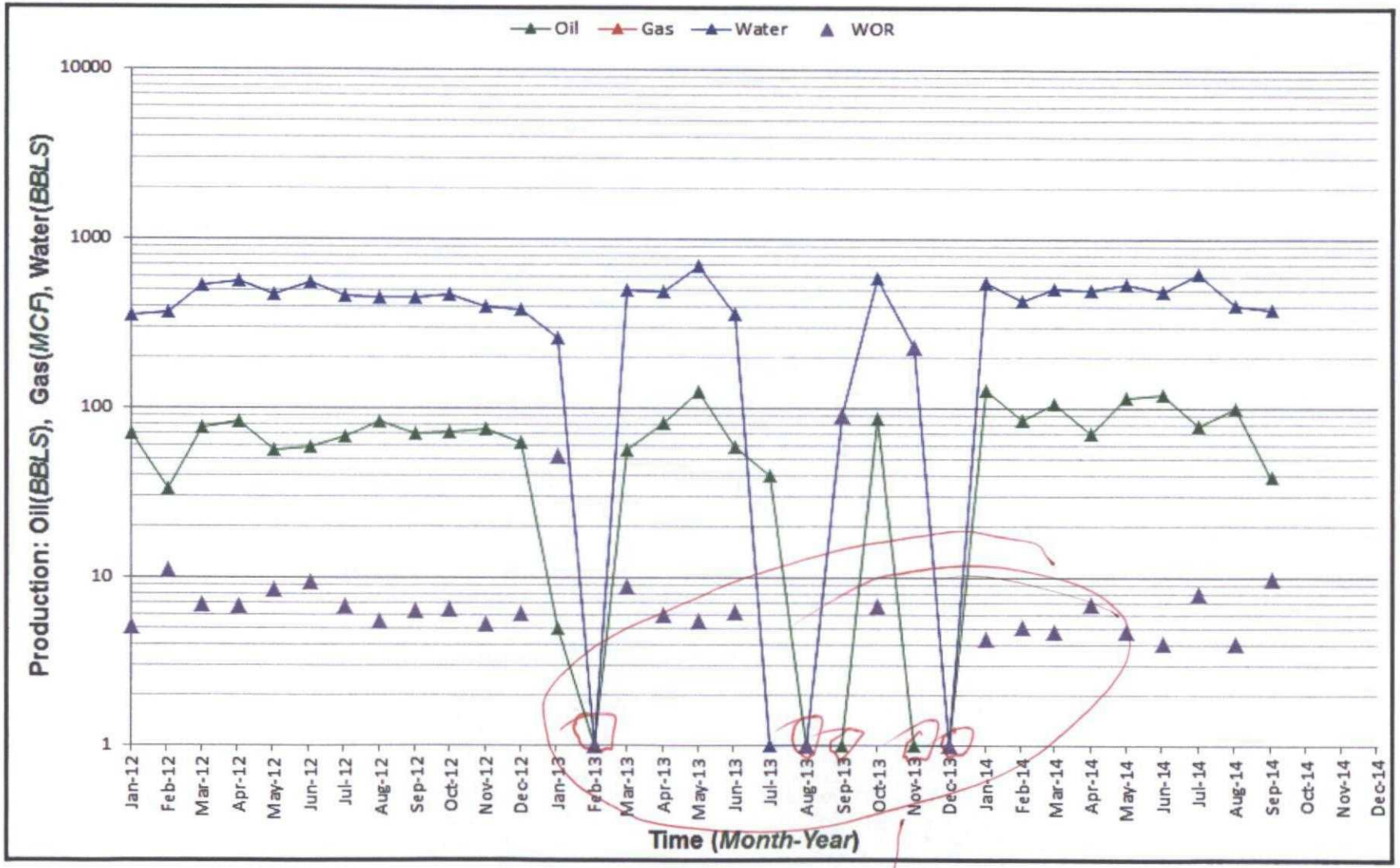
24S-31E



Todd 2 State #3

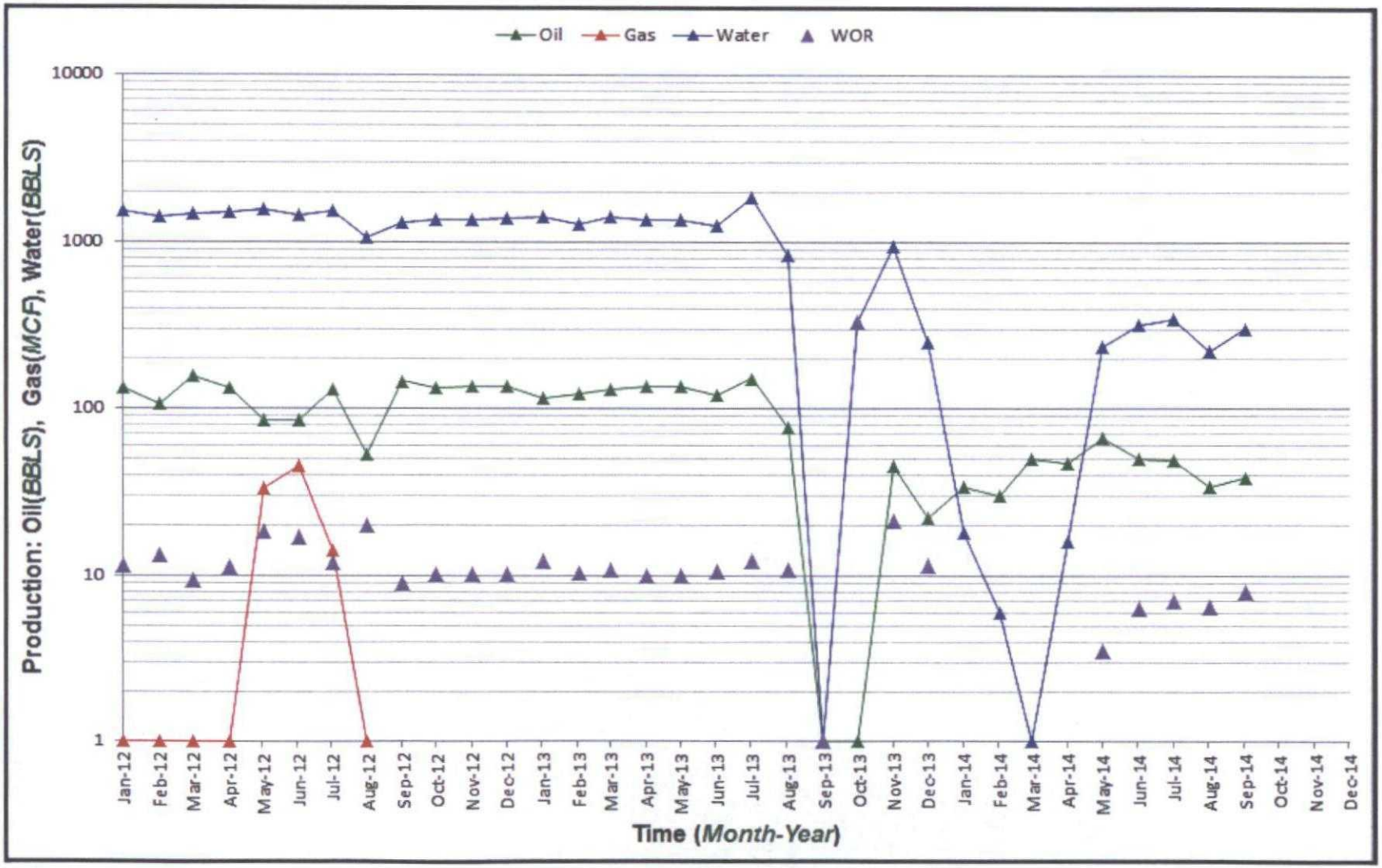


Sotol A Federal #3



Water Surface
Then workover

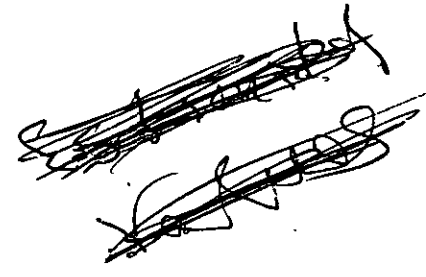
Cactus 16 State #2



Hall Plot Analysis

Hall Plot Meaning & Methodology

- Hall Plots are diagnostic tools used to analyze injection well data.
- These plots reveal historical and current injection characteristics based on the injection pressure and rate.
- The Hall Plot allows for identification of changes in injection conditions, such as:
  - Decreased Injectivity: ✓
    - Wellbore plugging/formation damage
    - A reservoir that is filling up
    - Hydraulic communication with another injector
  - Increased Injectivity: ✓
    - Injection pressure that exceeds fracture pressure
    - Channeling or out-of-zone injection
    - Stimulation

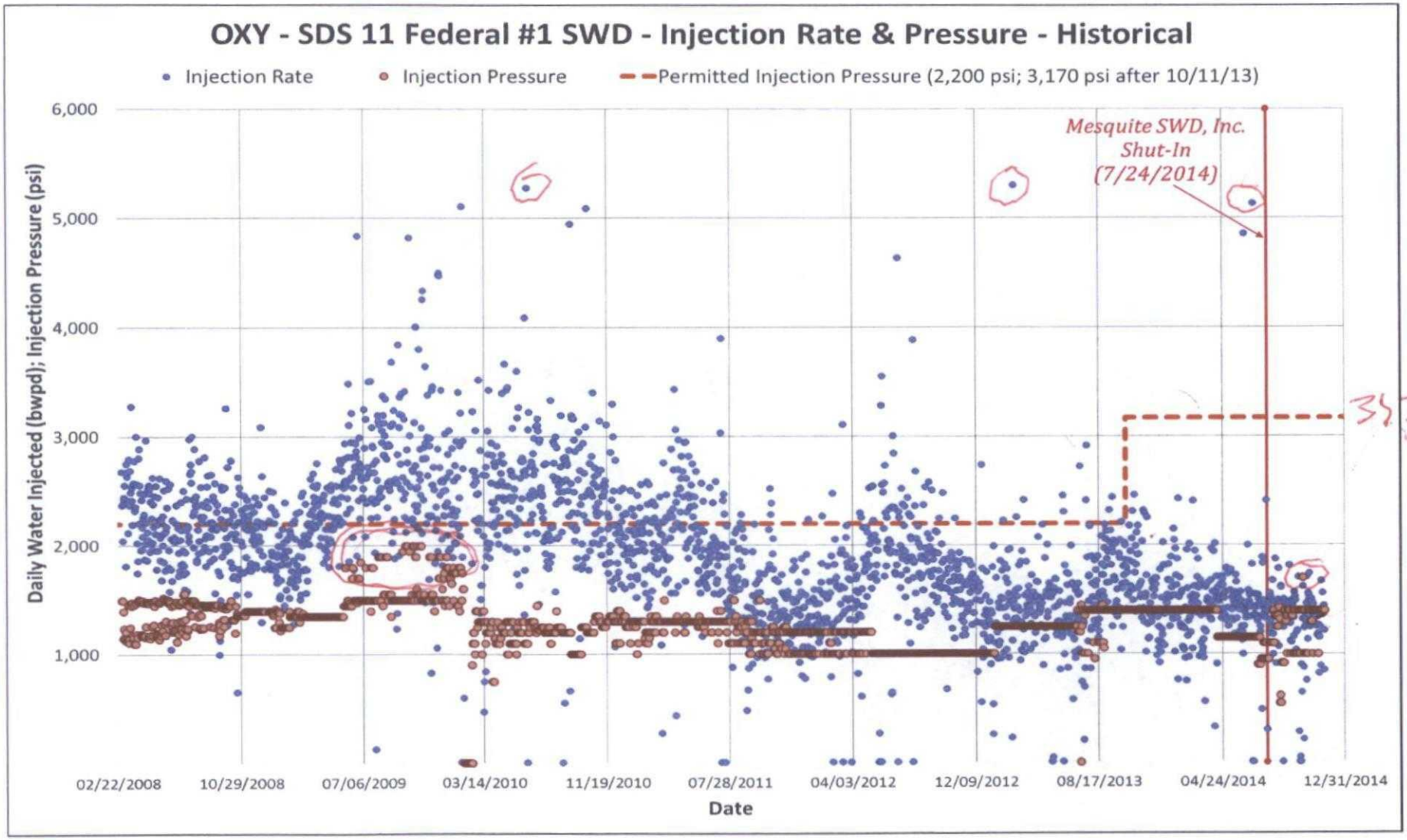


Tracer Surveys

Fall-off Test

Hall Plot Analysis –
Oxy SDS 11 Federal #1 SWD

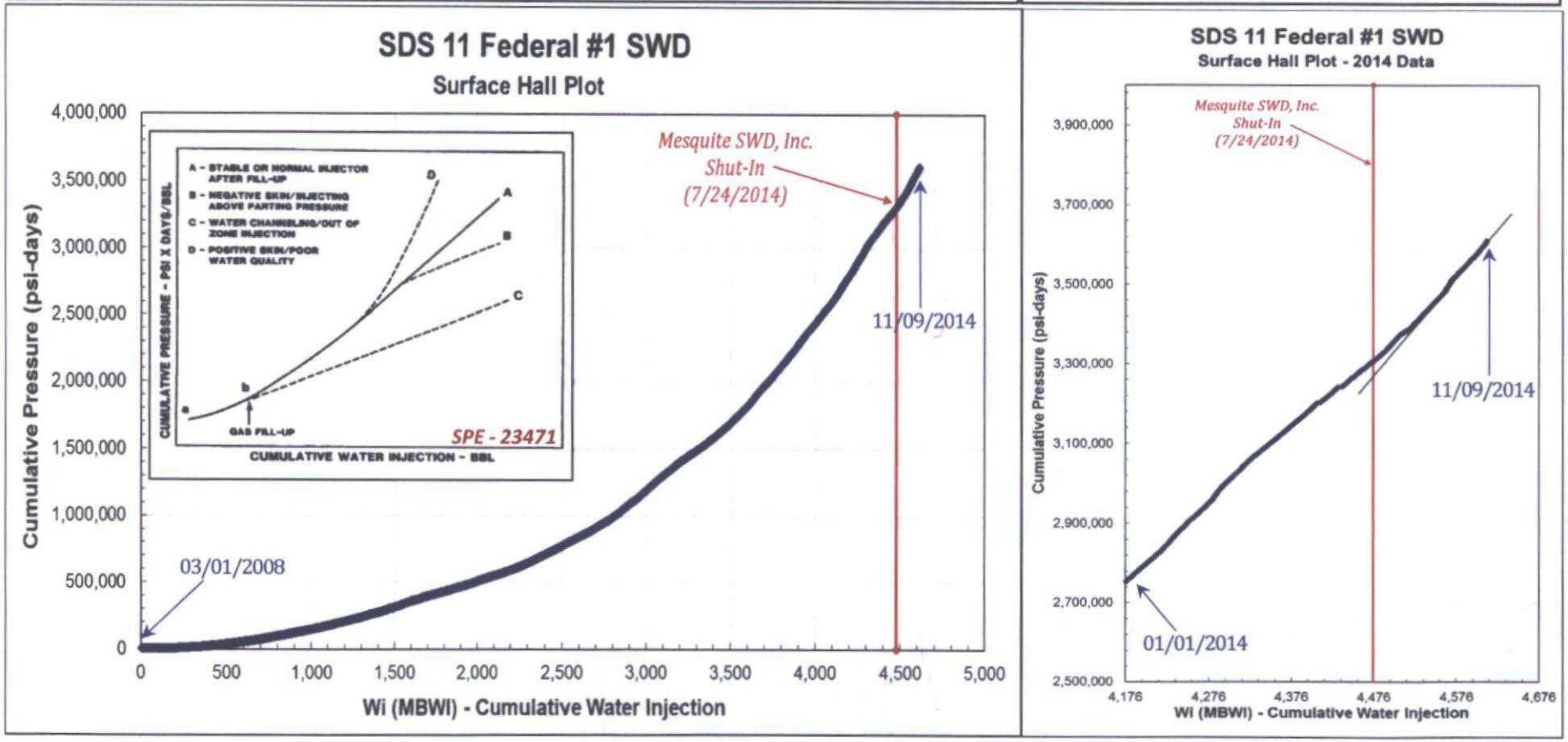
Oxy SDS 11 Federal #1 SWD Historical Daily Injection



Oxy SDS 11 Federal #1 SWD Surface Hall Plot

Surface Hall Plot generated with daily injection data collected since March 2008.

Chart zoomed in to show 2014 data only.

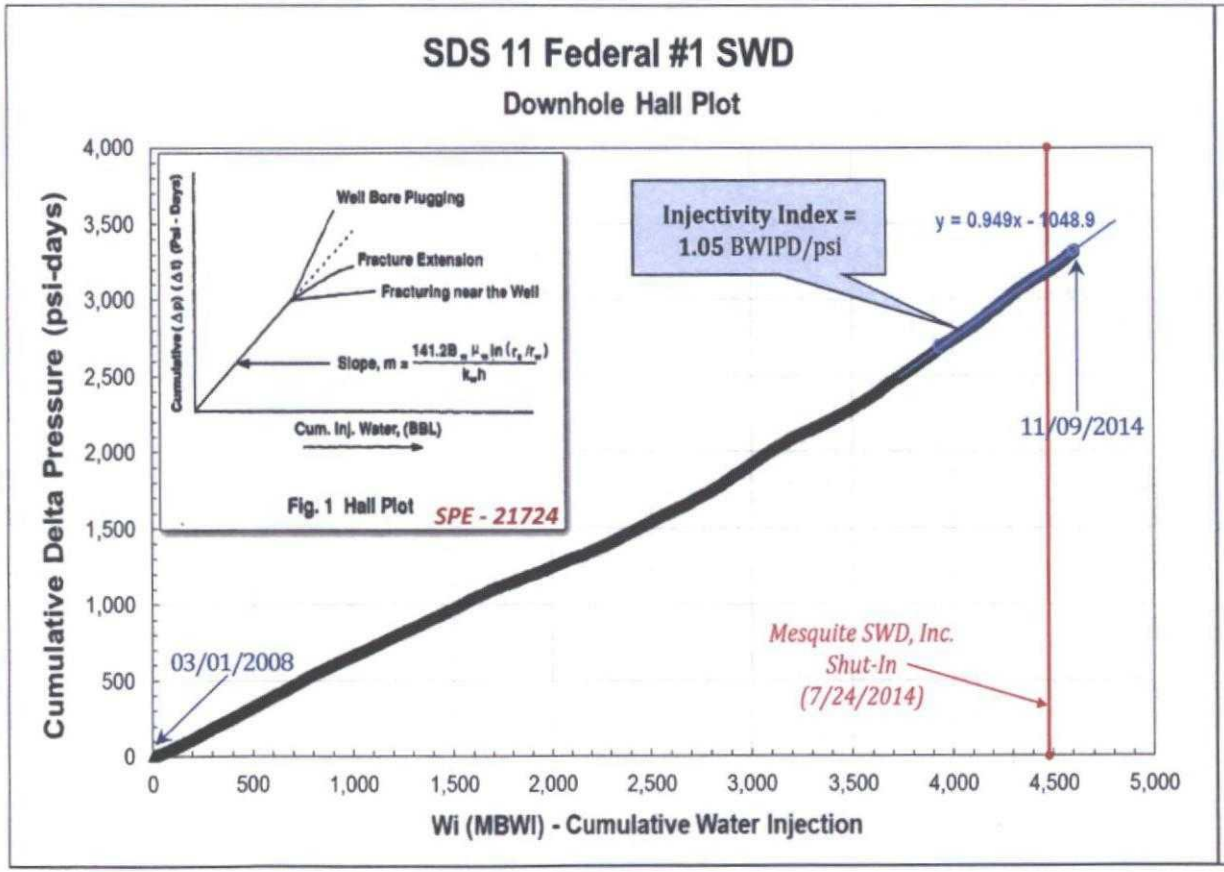


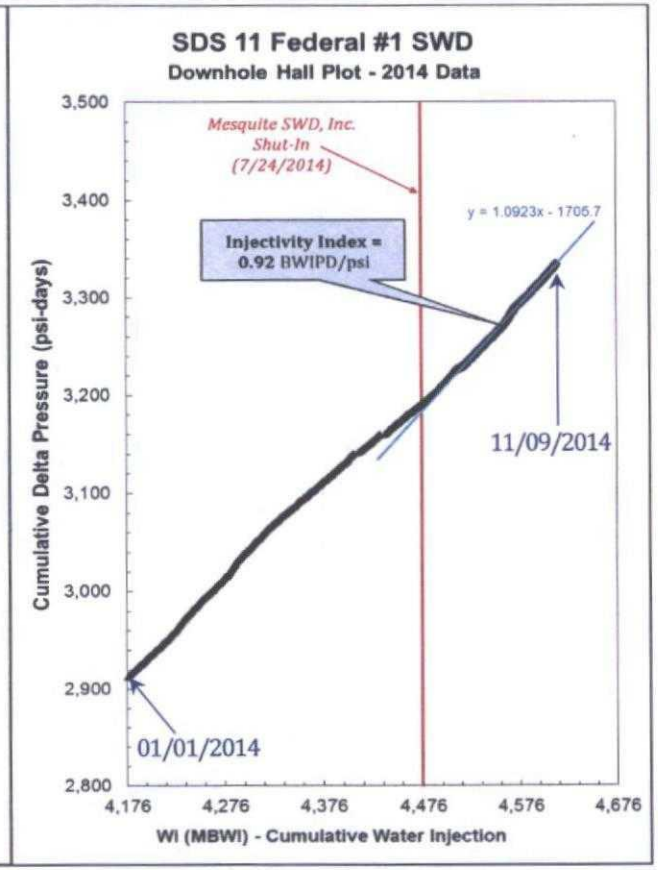
*The Surface Hall Plot exhibits a **concave upward** trend. This trend indicates injection under "normal" conditions, or reduced injectivity over time.*

Oxy SDS 11 Federal #1 SWD Downhole Hall Plot

$P_{reservoir}$ = 2,049 psi *(based on Sandia Report)*

Downhole Hall Plot generated with daily injection data collected since March 2008.	Chart zoomed in to show 2014 data only.



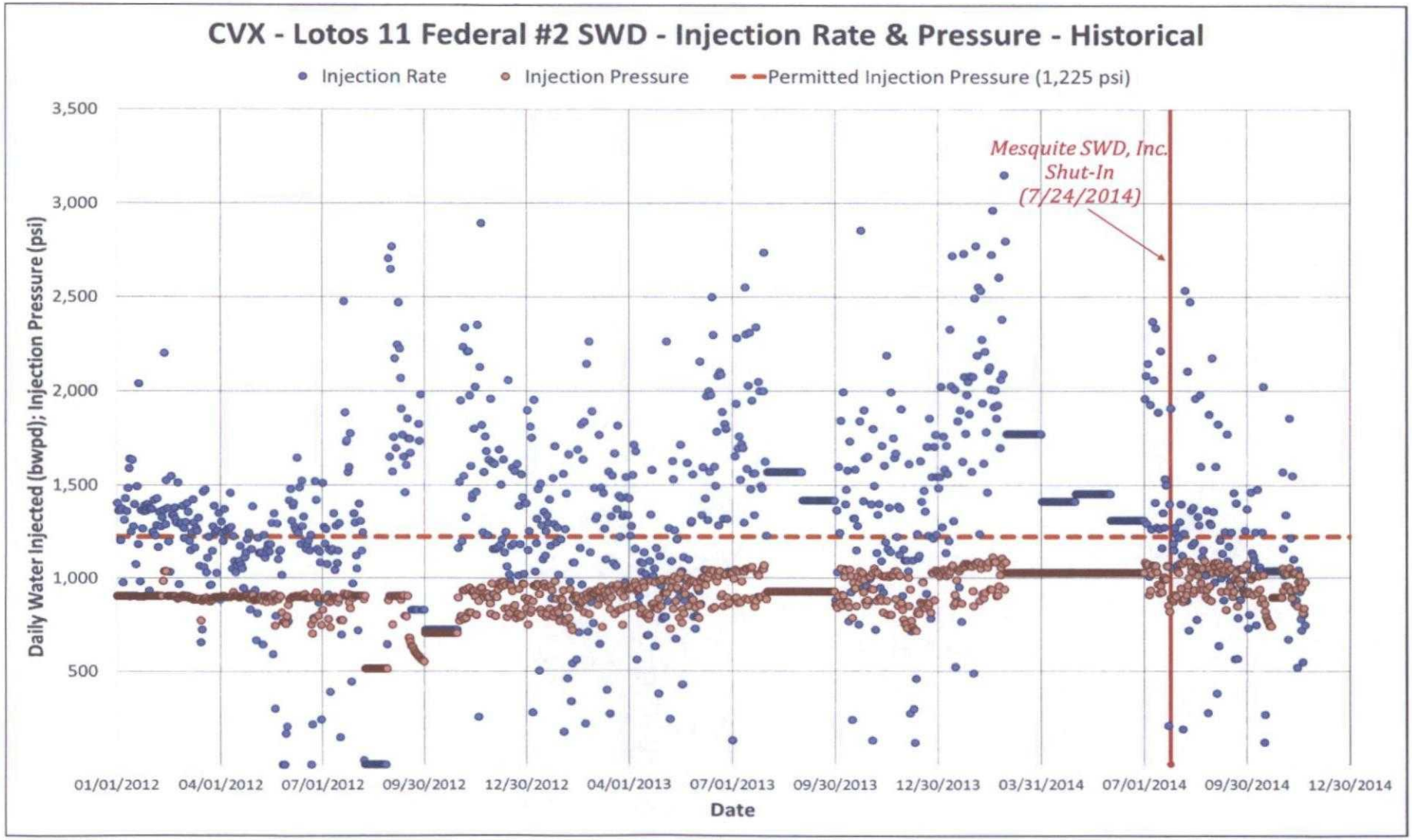


*The Downhole Hall Plot primarily exhibits a **linear** slope, which indicates injection under normal conditions. Injectivity Index is calculated as the inverse of the slope (steeper slope yields smaller I.I.).*

Hall Plot Analysis –

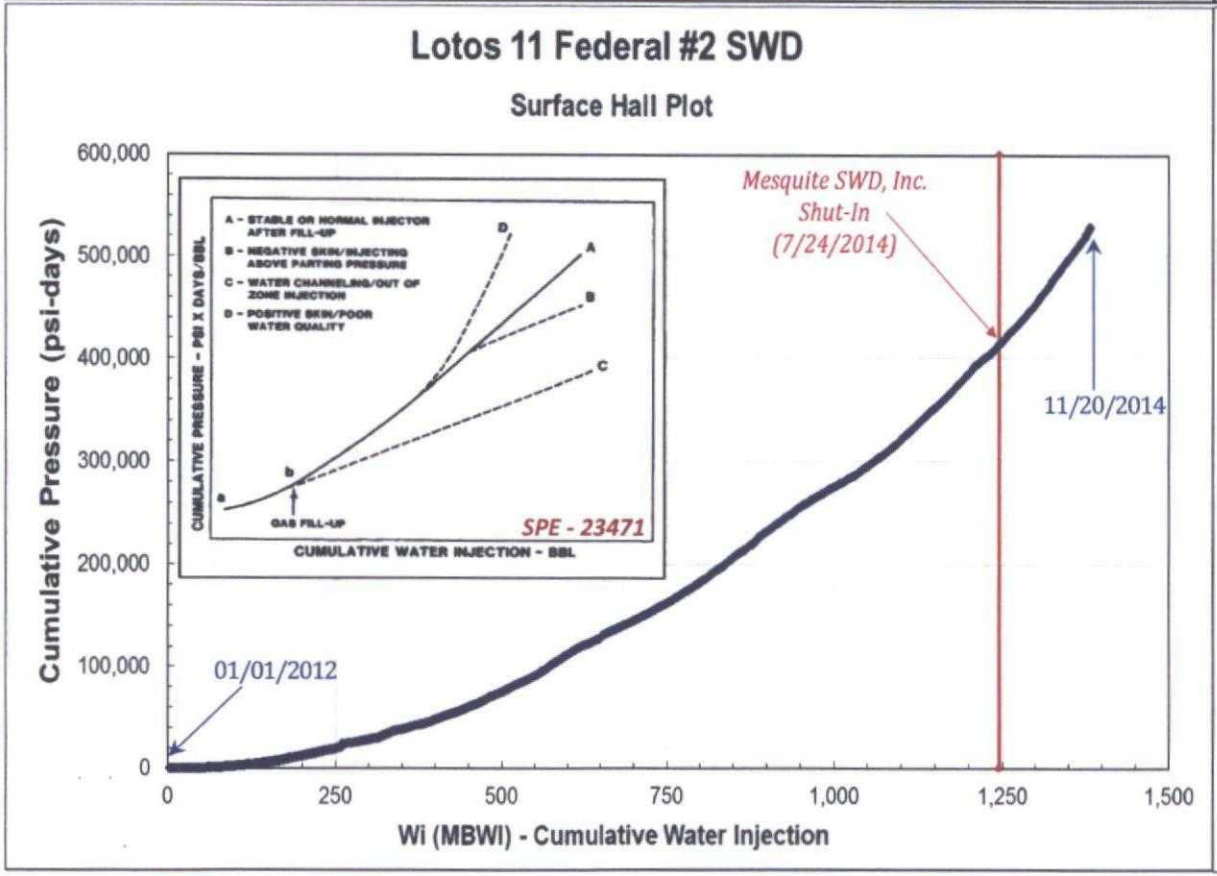
Chevron Lotos 11 Federal #2 SWD

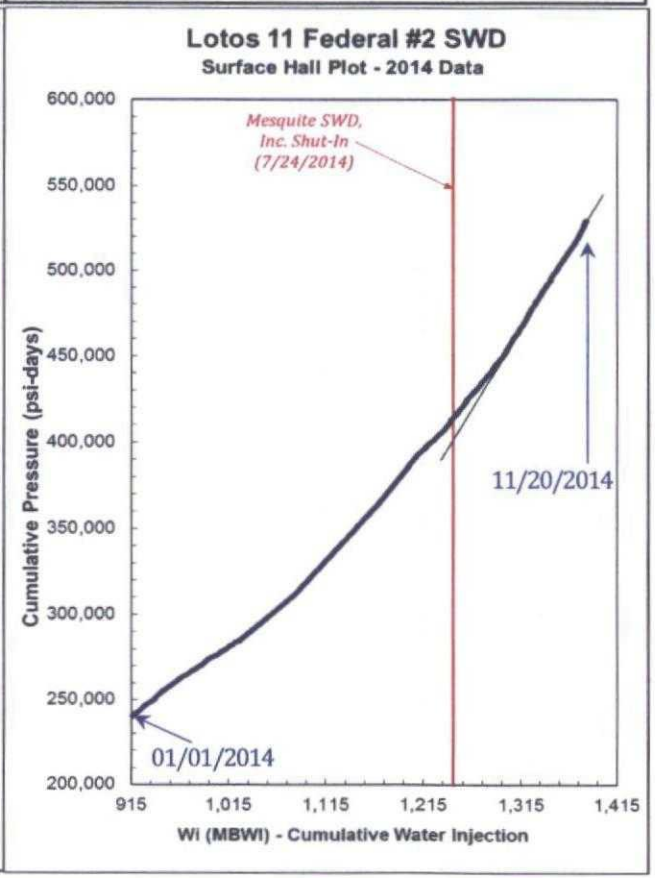
Chevron Lotos 11 Federal #2 SWD Historical Daily Injection



CVX Lotos 11 Federal #2 SWD Surface Hall Plot

Surface Hall Plot generated with daily injection data collected since January 2012.	Chart zoomed in to show 2014 data only.



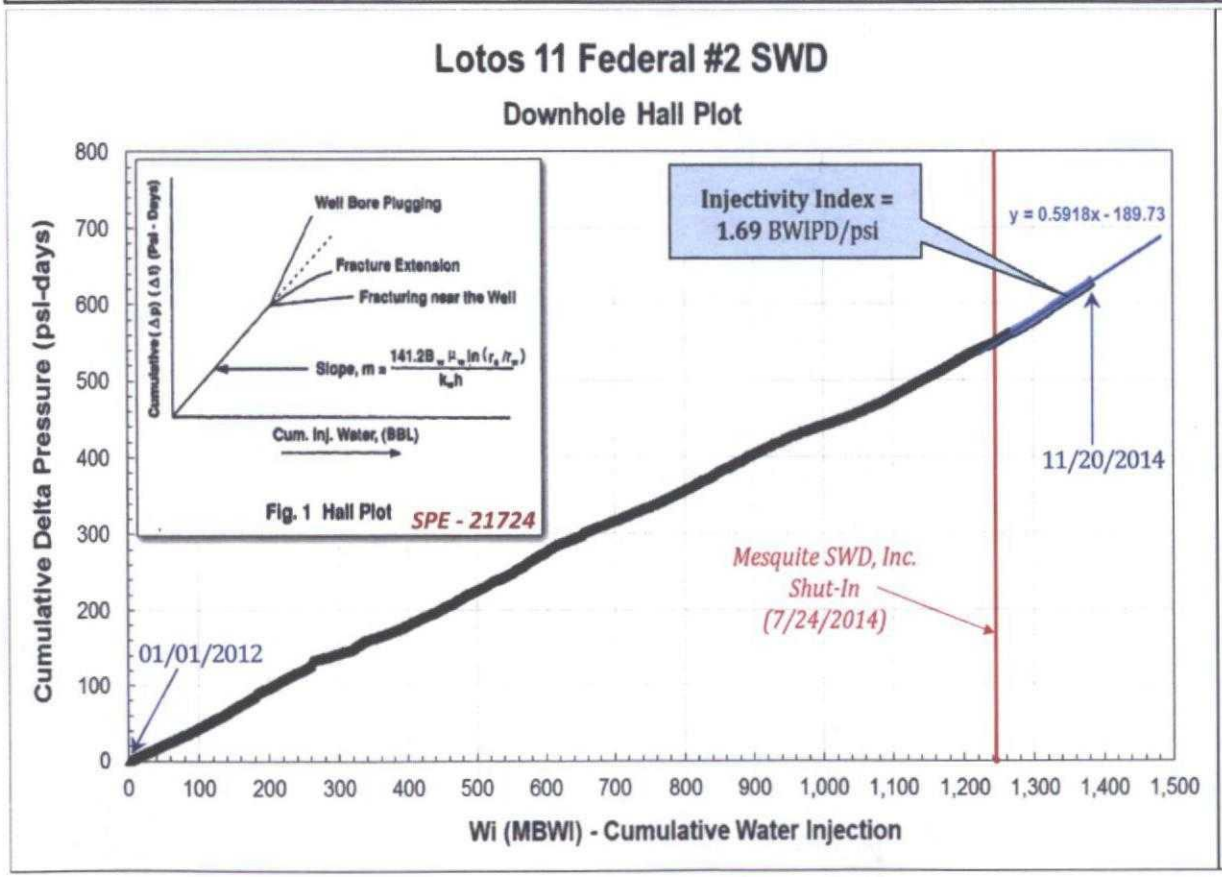


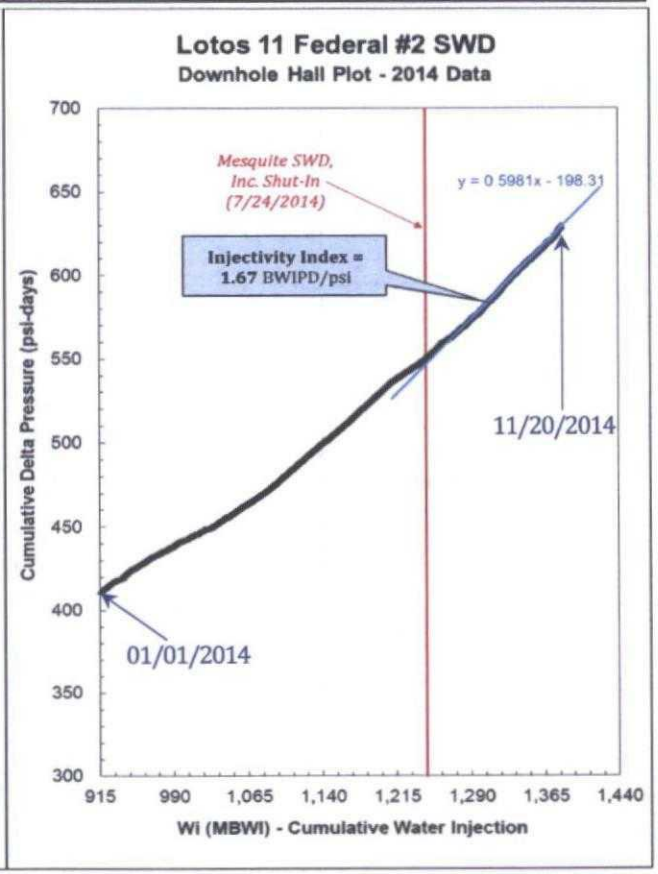
*The Surface Hall Plot exhibits a **concave upward** trend. This trend indicates injection under "normal" conditions, or reduced injectivity over time.*

CVX Lotos 11 Federal #2 SWD Downhole Hall Plot

$P_{reservoir}$ = 2,239 psi *(based on Sandia Report)*

Downhole Hall Plot generated with daily injection data collected since January 2012.	Chart zoomed in to show 2014 data only.





*The Downhole Hall Plot primarily exhibits a **linear** slope, which indicates injection under normal conditions. Injectivity Index is calculated as the inverse of the slope (steeper slope yields smaller I.I.).*

Injectivity Index Analysis

Injectivity Index

- The Injectivity Index of an injection well is a ratio of the injection volume per pressure increment.
- The Injectivity Index is utilized as a relative measure to compare one injection well to another to assess performance.
- The Injectivity Index can be calculated in two different ways:
  - Downhole Hall Plot:
    - The inverse of the slope yields the Injectivity Index at any given time.
    - The formula is represented as:

$$I.I. = Q_i/(P_i-P_r)$$

  - Darcy's Law:
    - Darcy's Law can be rearranged to solve for Injectivity Index using the formula above.
    - The formula is represented as:

$$I.I. = ((7.08*10^{-3})kh)/(\mu\beta_w(\ln(r_e/r_w)+s))$$

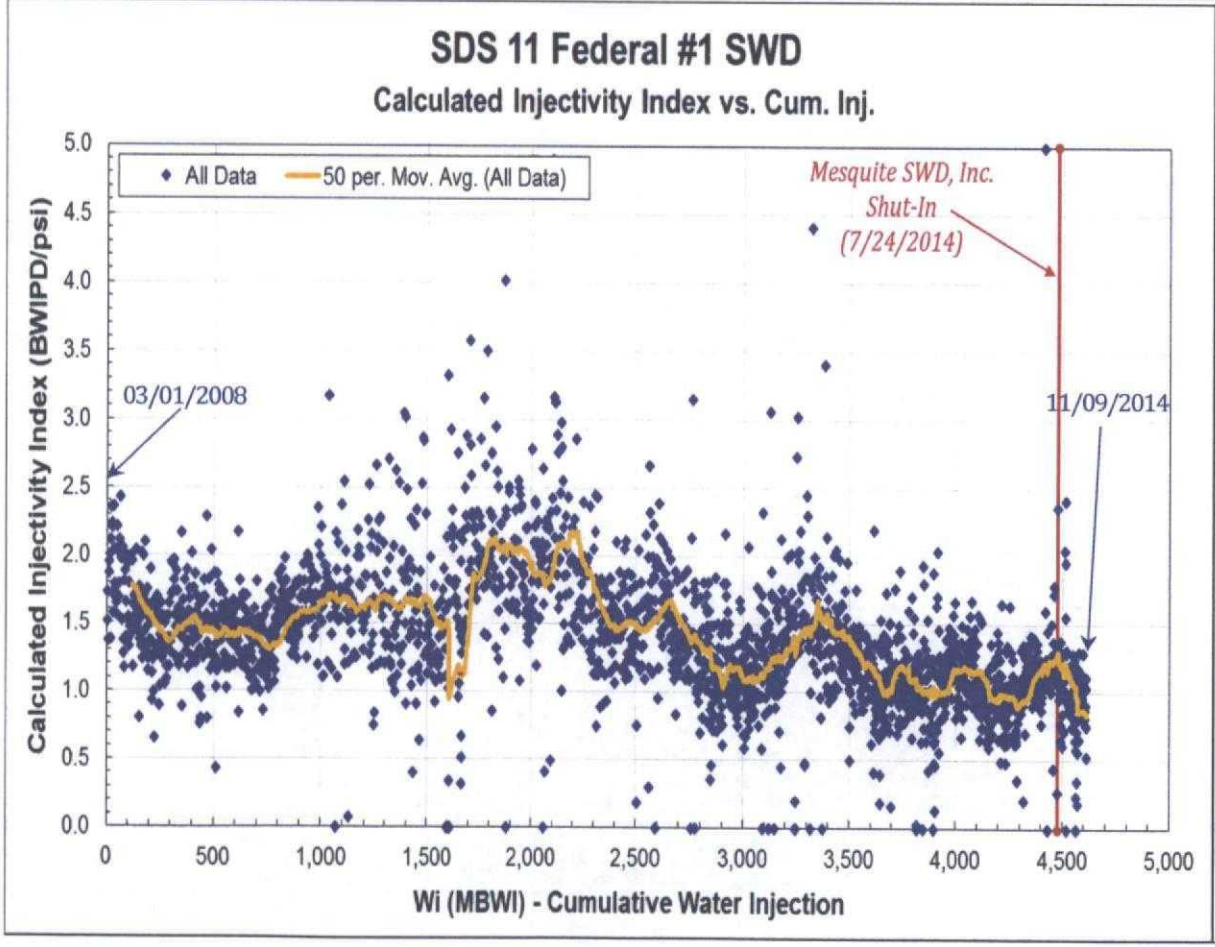
- Darcy's Law can also be reorganized to determine permeability from the calculated Injectivity Index:

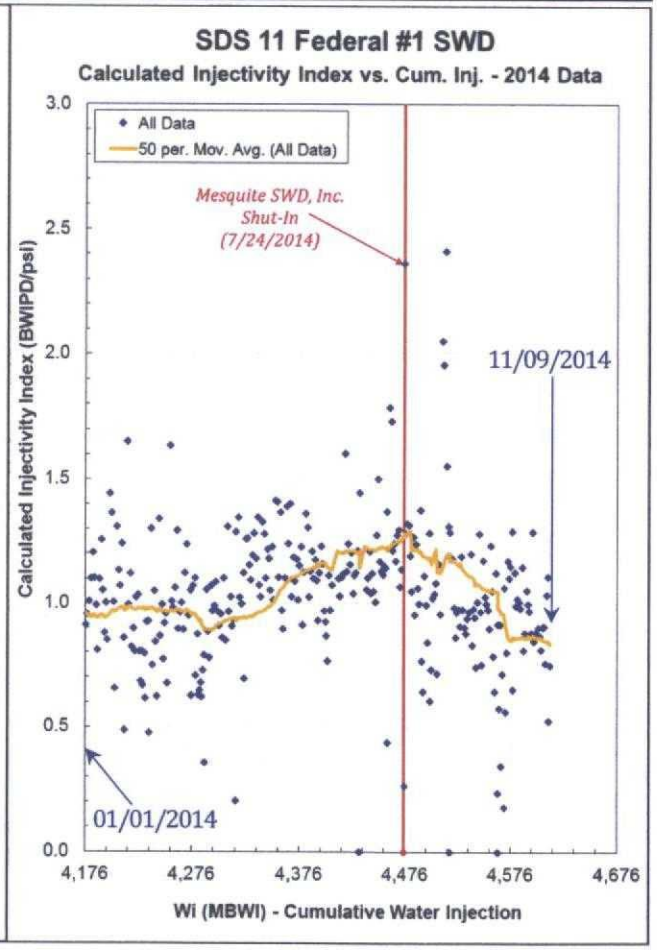
$$k = (I.I.)*(141.2\mu\beta_w(\ln(r_e/r_w)+s))/(h)$$

Reference: "Waterflooding" by William M. Cobb & James T. Smith

Oxy SDS 11 Federal #1 SWD Injectivity Index vs. Cum Injection

Injectivity Index Plot generated with daily injection data collected since March 2008.	Chart zoomed in to show 2014 data only. Injectivity Index from Hall Plot is **0.92 bwpd/psi**.





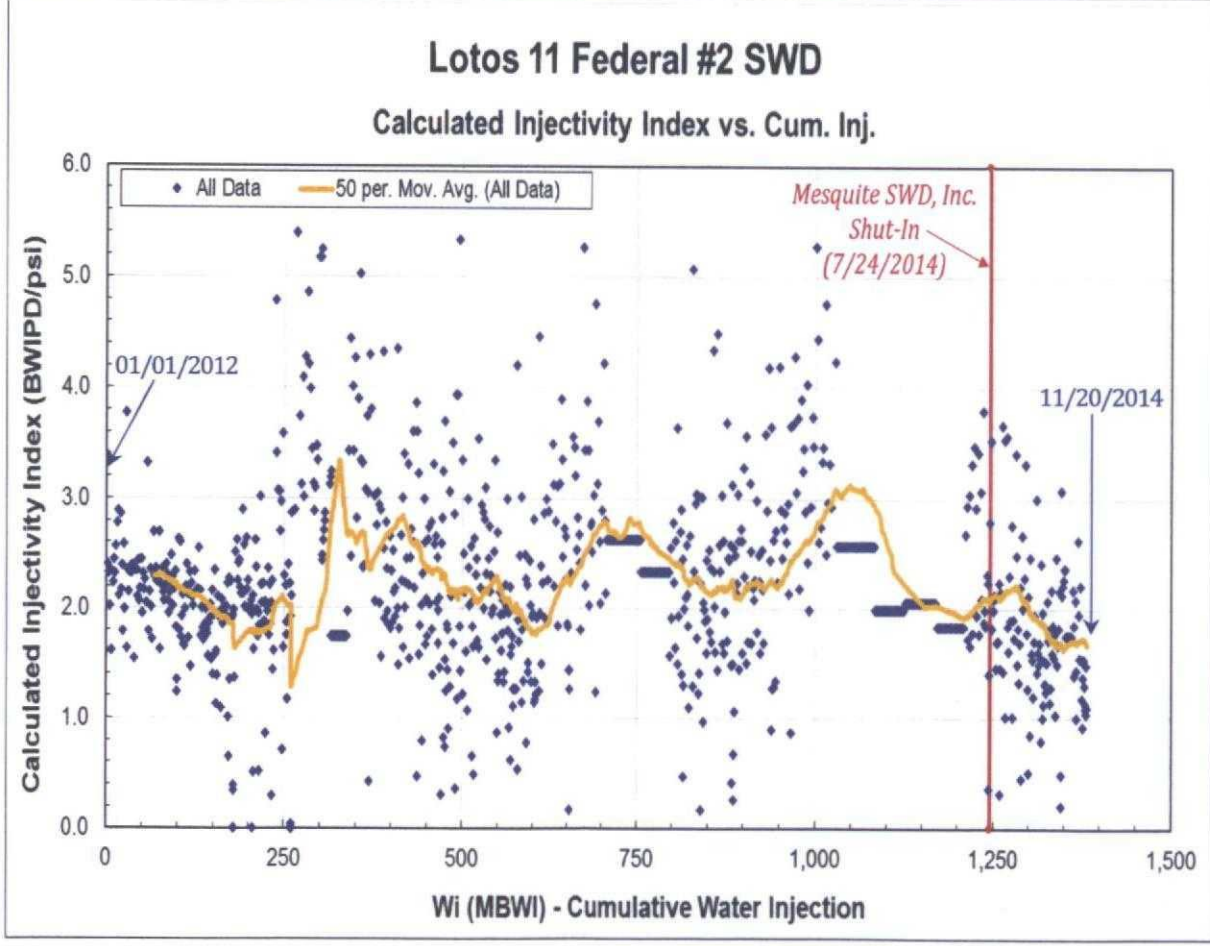
Injectivity Index – SDS 11 Federal #1 SWD

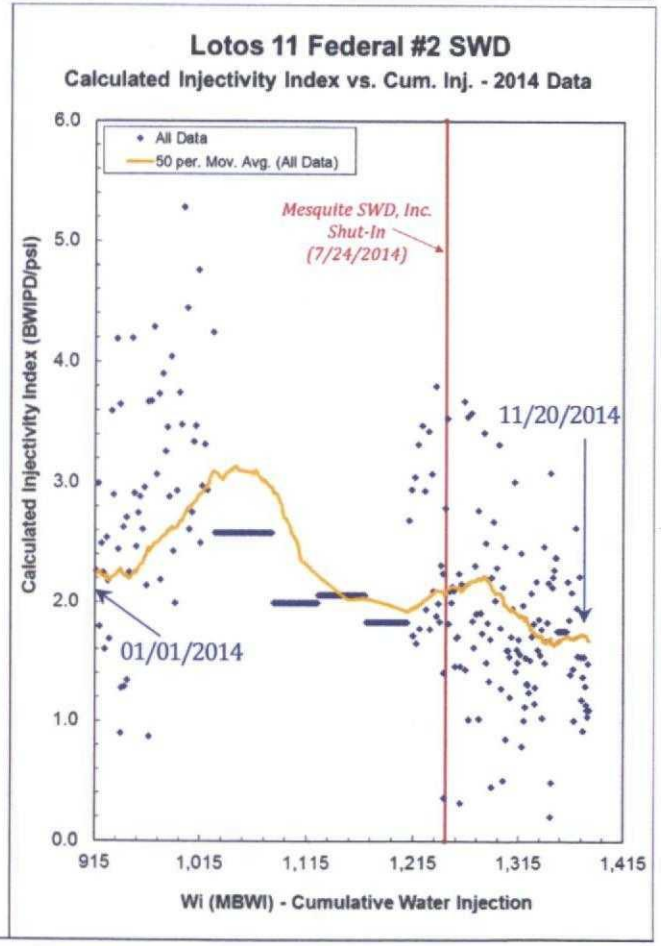
- Based on the calculated Injectivity Index from the Downhole Hall Plot and other required inputs, the estimated injection interval permeability is calculated:
  - Inputs:
    - Injectivity Index: 0.92 bwipd/psi
    - Pay: 280 ft
    - Viscosity: 0.67 cP *(calculated)*
    - Water Formation Volume Factor: 1.00 RB/STB
    - Injection Radius: 484 ft *(calculated)*
    - Wellbore Radius: 0.3 ft
    - Skin: 0
- The estimated injection interval permeability for the SDS 11 Federal #1 SWD is **2.29 mD**, which is representative of matrix permeability.

$$k = (I.I.)*(141.2\mu\beta_w(\ln(r_e/r_w)+s))/(h)$$

CVX Lotos 11 Federal #2 SWD Injectivity Index vs. Cum Injection

Injectivity Index Plot generated with daily injection data collected since January 2012.	Chart zoomed in to show 2014 data only. Injectivity Index from Hall Plot is **1.67 bwpd/psi.**





Injectivity Index – Lotos 11 Federal #2 SWD

- Based on the calculated Injectivity Index from the Downhole Hall Plot and other required inputs, the estimated injection interval permeability is calculated:
  - Inputs:
    - Injectivity Index: 1.67 bwipd/psi
    - Pay: 389 ft
    - Viscosity: 0.60 cP *(calculated)*
    - Water Formation Volume Factor: 1.00 RB/STB
    - Injection Radius: 229 ft *(calculated)*
    - Wellbore Radius: 0.3 ft
    - Skin: 0
- The estimated injection interval permeability for the Lotos 11 Federal #2 SWD is **2.40 mD**, which is representative of matrix permeability.

$$k = (I.I.)*(141.2\mu\beta_w(\ln(r_e/r_w)+s))/(h)$$

Permeability Reference

- Permeability data gathered from DOE study in WIPP site:
  - SANDIA REPORT – SAND86 – 1364: *Hydraulic-Test Interpretations for Well DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site*
    - Prepared by Sandia National Laboratories for the United States Dept. of Energy
- Bell Canyon reservoir permeability tests were performed in the well DOE-2, located in Sec. 8, T22S R31E (~12.5 miles north of AOI).
- Reservoir permeability & pressures were calculated for the Bell Canyon formation (Hays Sandstone Member) via FBU, SBU, & Slug test* data as:
  - Depth Interval: 4220' – 4325'
  - Permeability: **2.3 – 2.4 mD**
  - Reservoir Pressure: 1899 psig @ 4325'

**FBU – first pressure buildup period during a drill stem test (DST)*

**SBU – second pressure buildup period during a DST*

**Slug test – performed after FBU & SBU, a tertiary measurement of inflow during DST*

- *Measured matrix permeability within the Bell Canyon is consistent with the calculated permeabilities of Oxy's SDS 11 Federal #1 SWD (**2.29 mD**) and Chevron's Lotos 11 Federal #2 SWD (**2.40 mD**).*
- *A typical fractured reservoir within the Delaware Mountain Group would have a permeability of **155** mD**.*
- *BOPCO claims to have seen a pressure response within 24 hours of the Mesquite SWD, Inc. shut-in. In order to see a response within 24 hours, the permeability would have to be approximately **900** mD.*

***Source: "MIDDLE PERMIAN BASINAL SILICICLASTIC DEPOSITION IN THE DELAWARE BASIN: THE DELAWARE MOUNTAIN GROUP (GUADALUPIAN)"*