

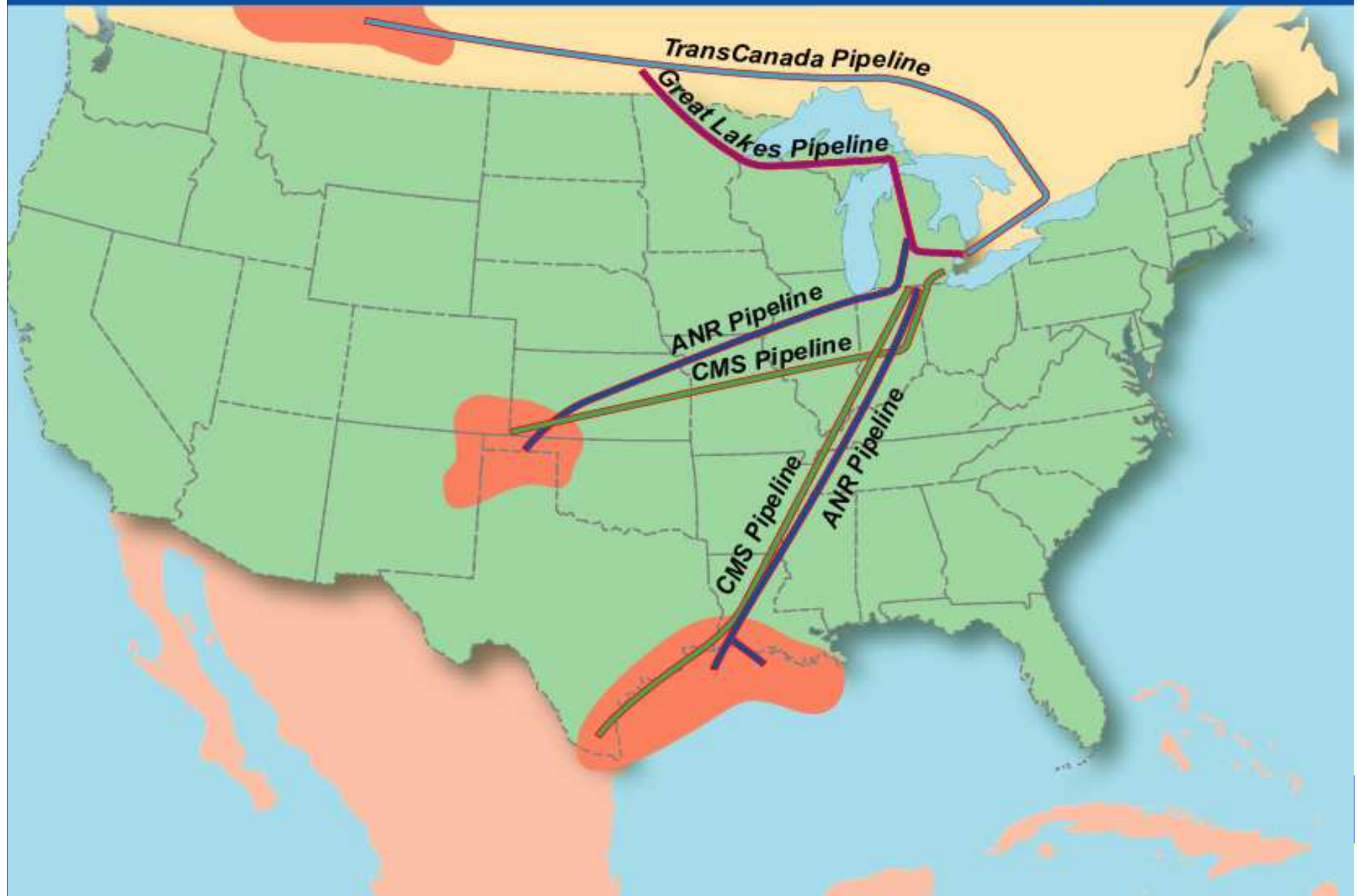
23rd World Gas Conference, Amsterdam 2006

**HORIZONTAL WELL
PERFORMANCE
IN THE MICHIGAN SIX LAKES
STORAGE FIELD**

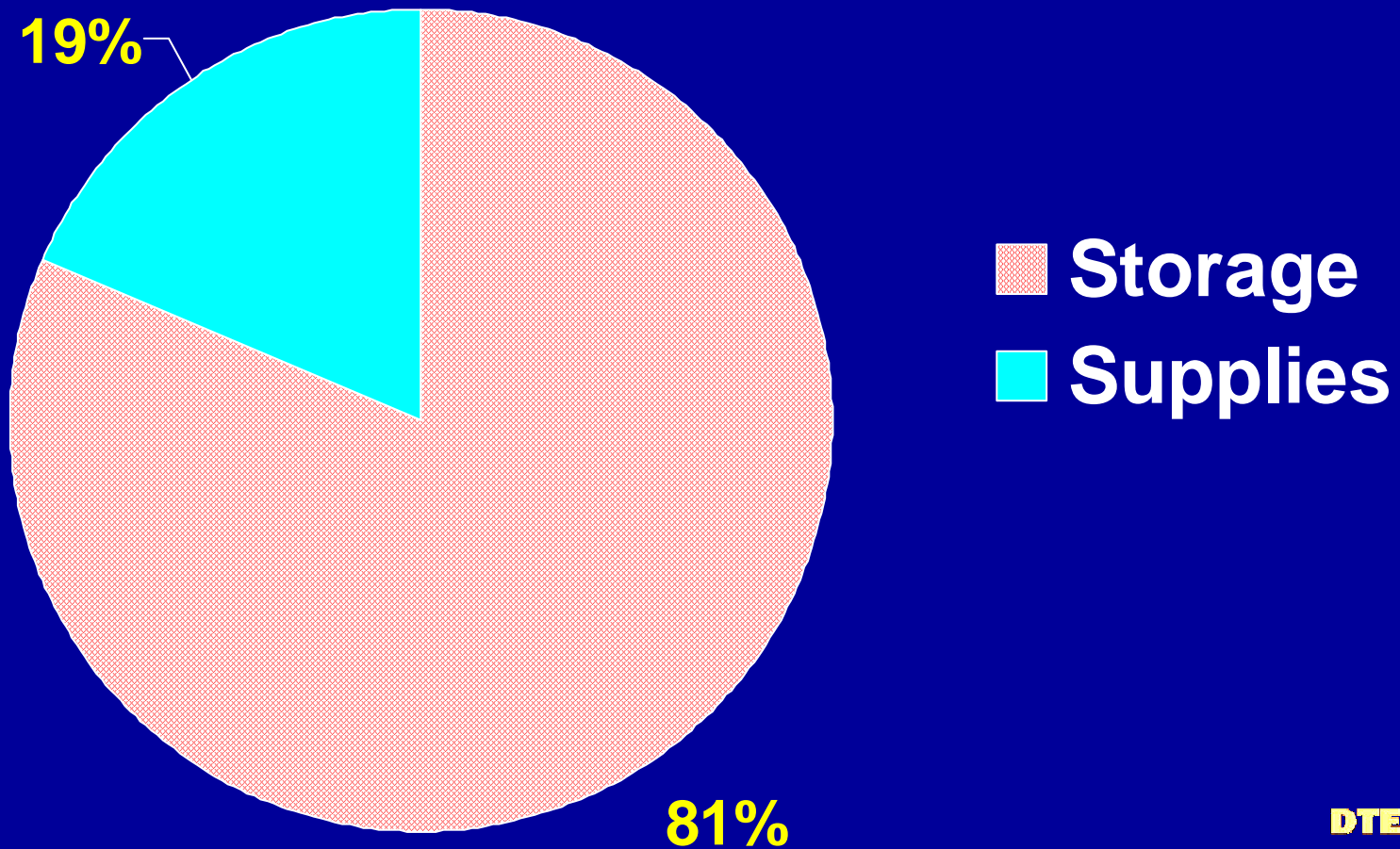
**Edward Dereniewski
Michigan Consolidated Gas
A DTE Energy Company
June 2006**



USA and Canadian Map

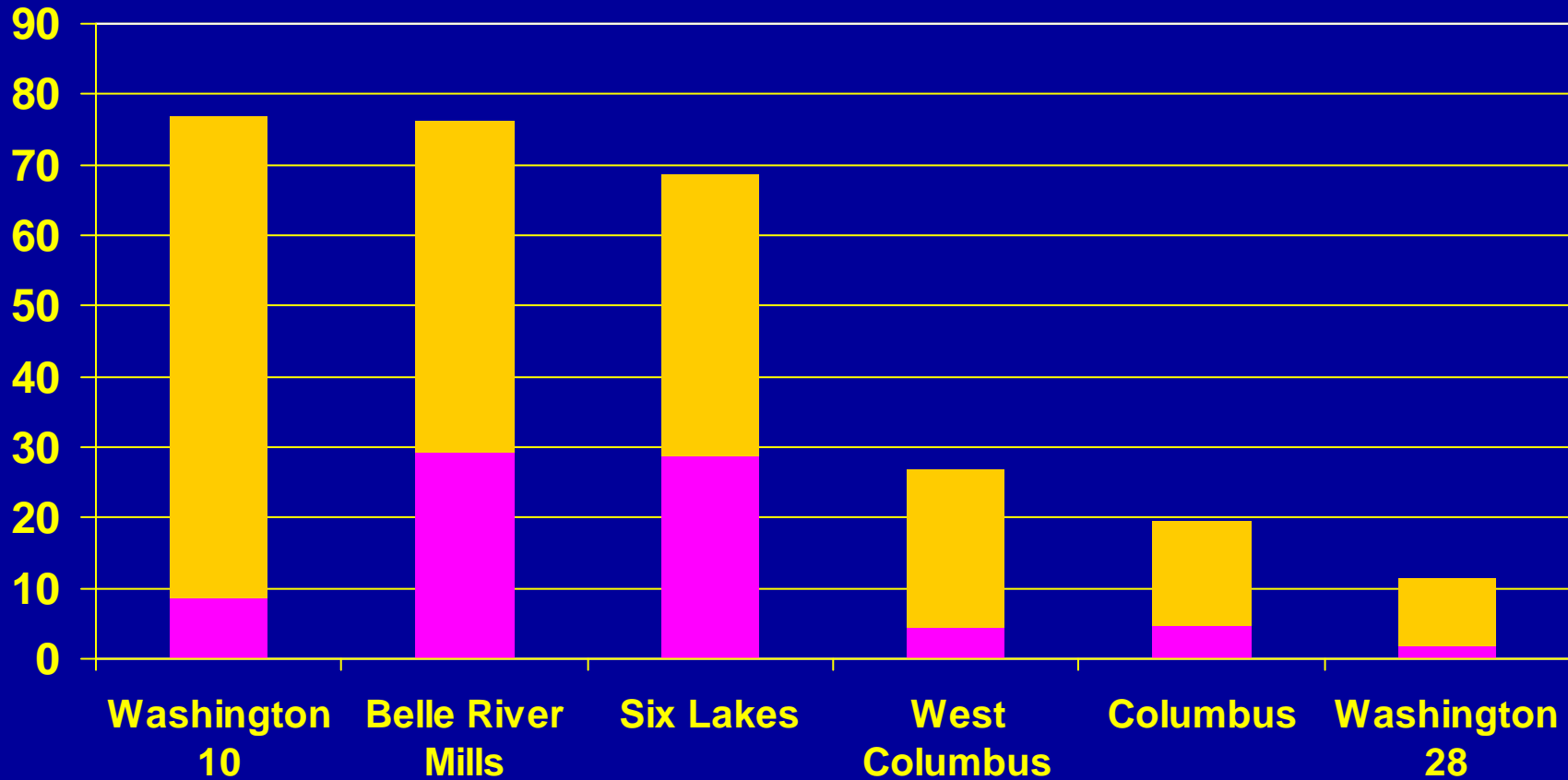


MichCon Peak Day Planned Supply Profile



Field Capacity - Bcf

Volume - BCF



■ Base Gas

■ Working Gas

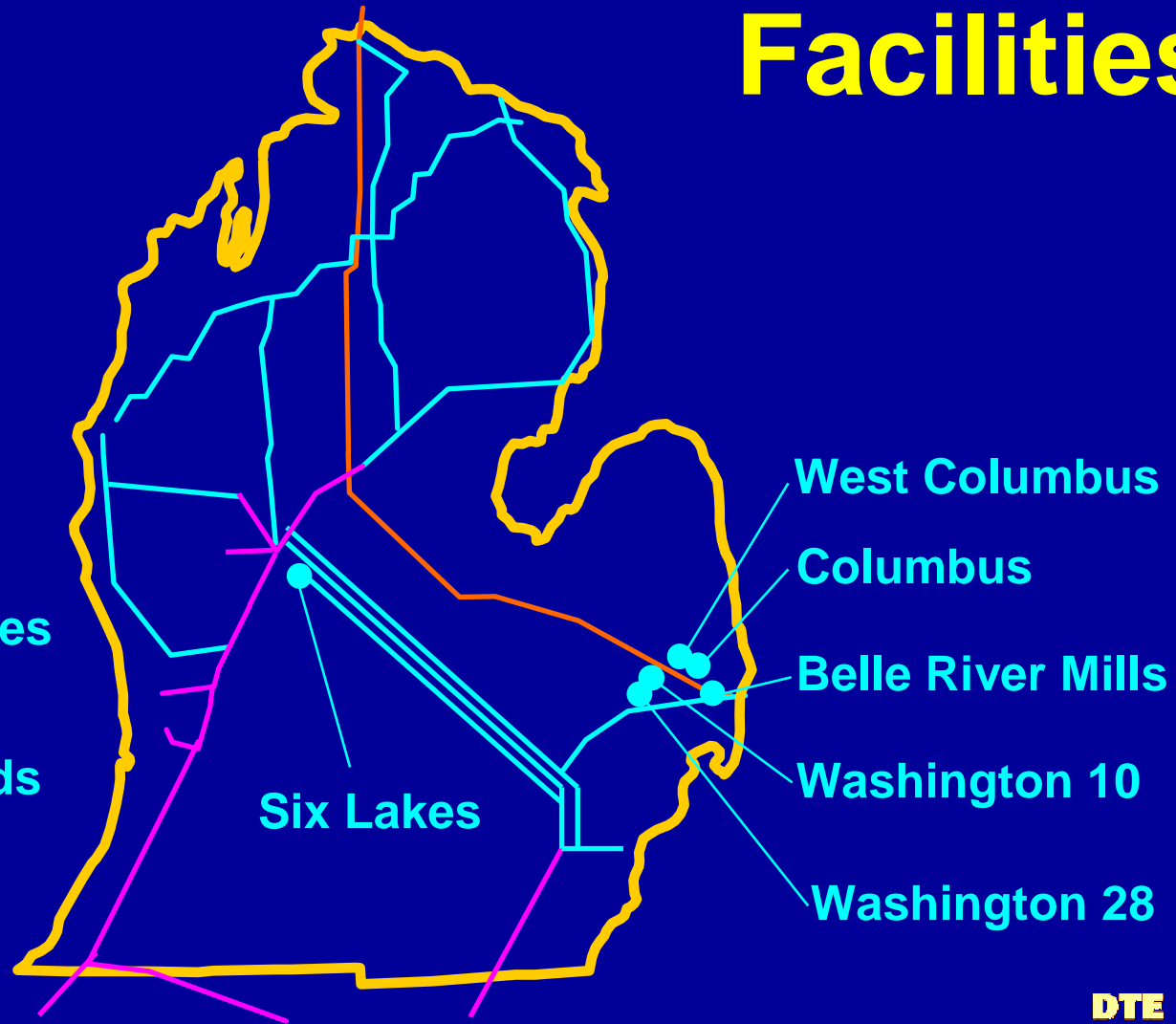
DTE Energy



Michigan Facilities

Legend

- El Paso
- Great Lakes
- MichCon Lines
- MichCon Storage Fields



DTE Energy



Six Lakes Gas Storage Field

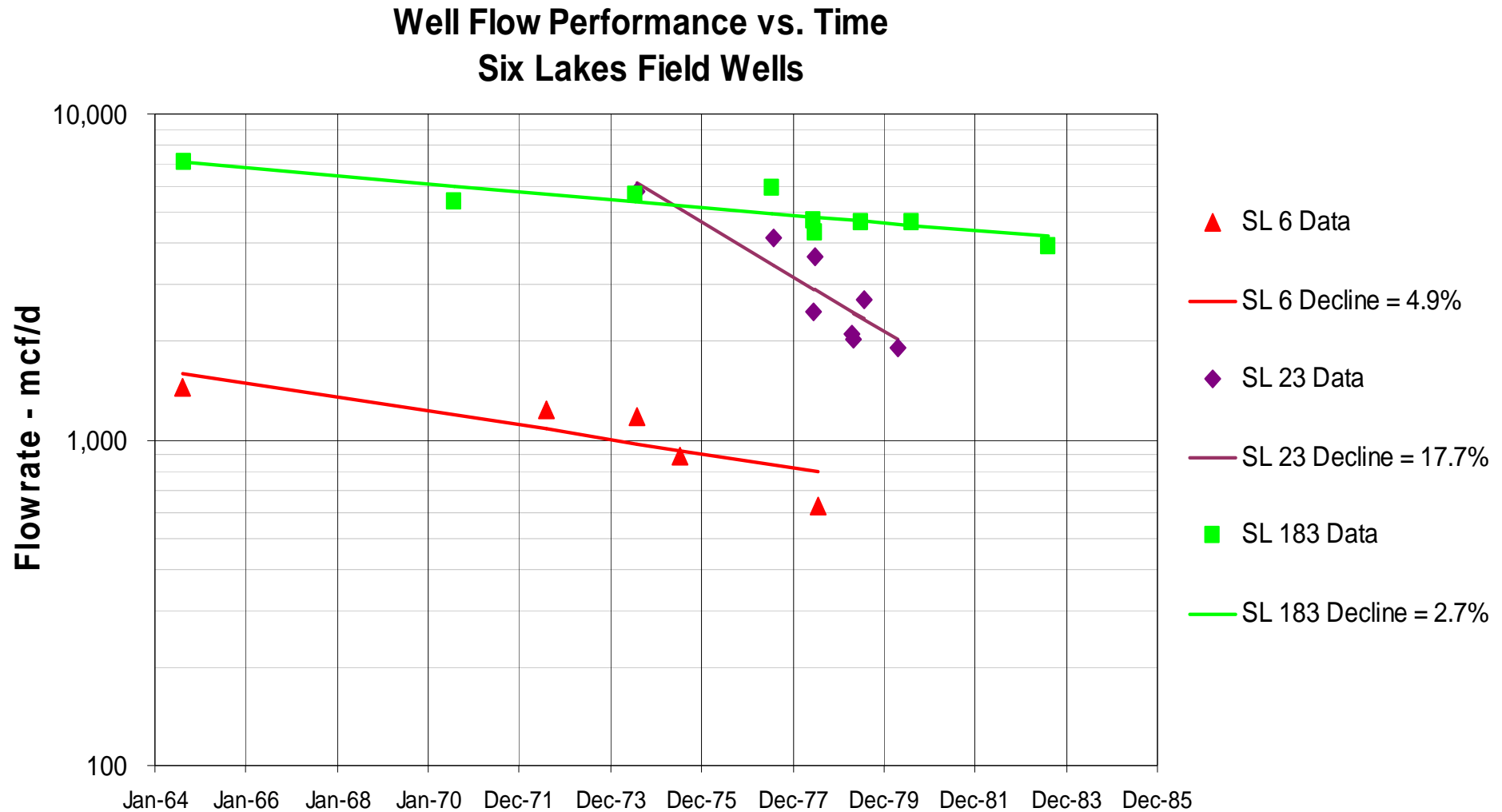
Storage Date	1953
Minimum WHP	200 psig
Maximum WHP	705 psig
Field Capacity	68.6 Bcf
Working Gas	40.0 Bcf
Peak Delivery	700 MMcf/d
Active I/W Wells	134
Horsepower	40,000

DTE Energy

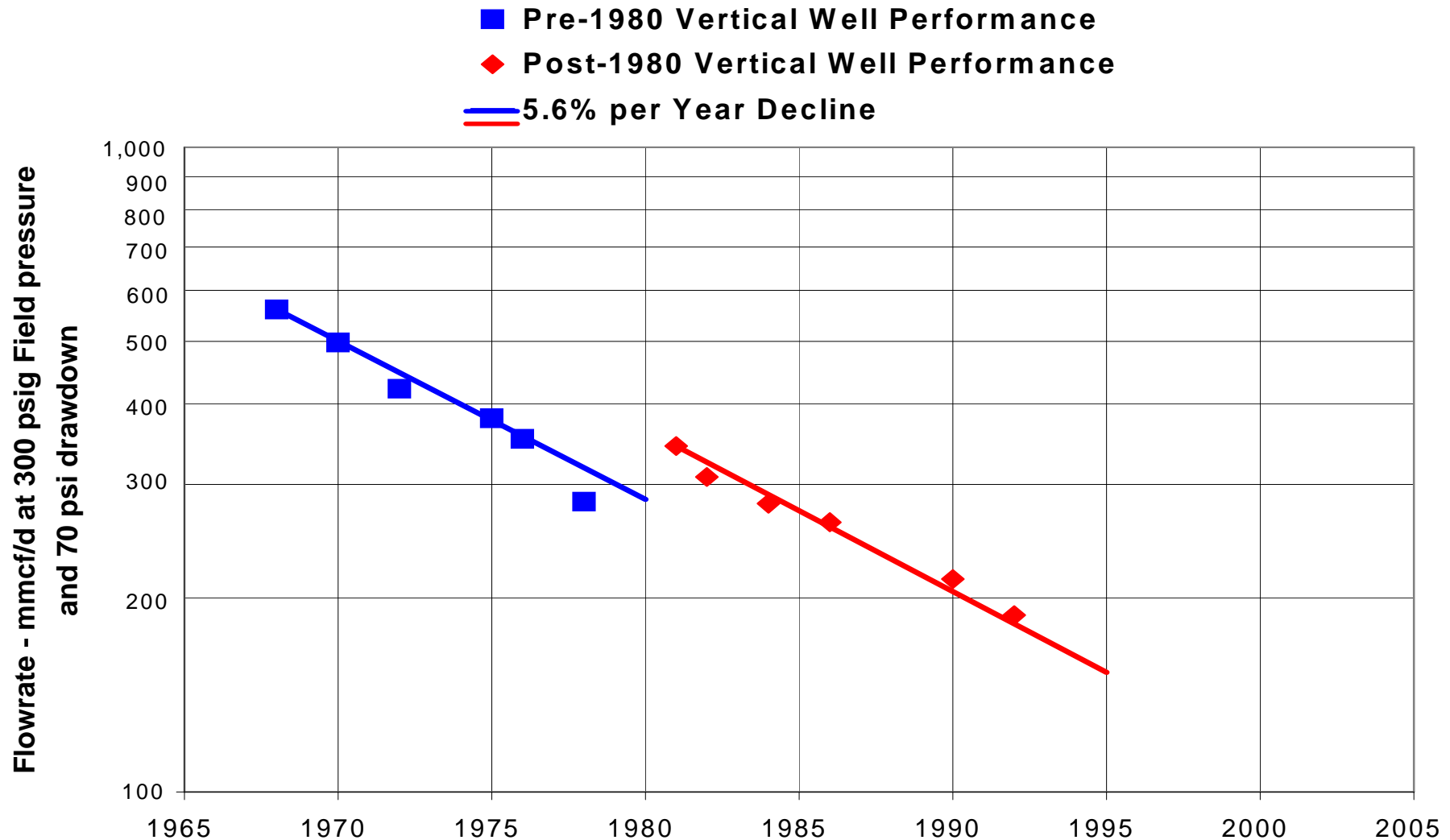


Well Flow Performance vs. Time

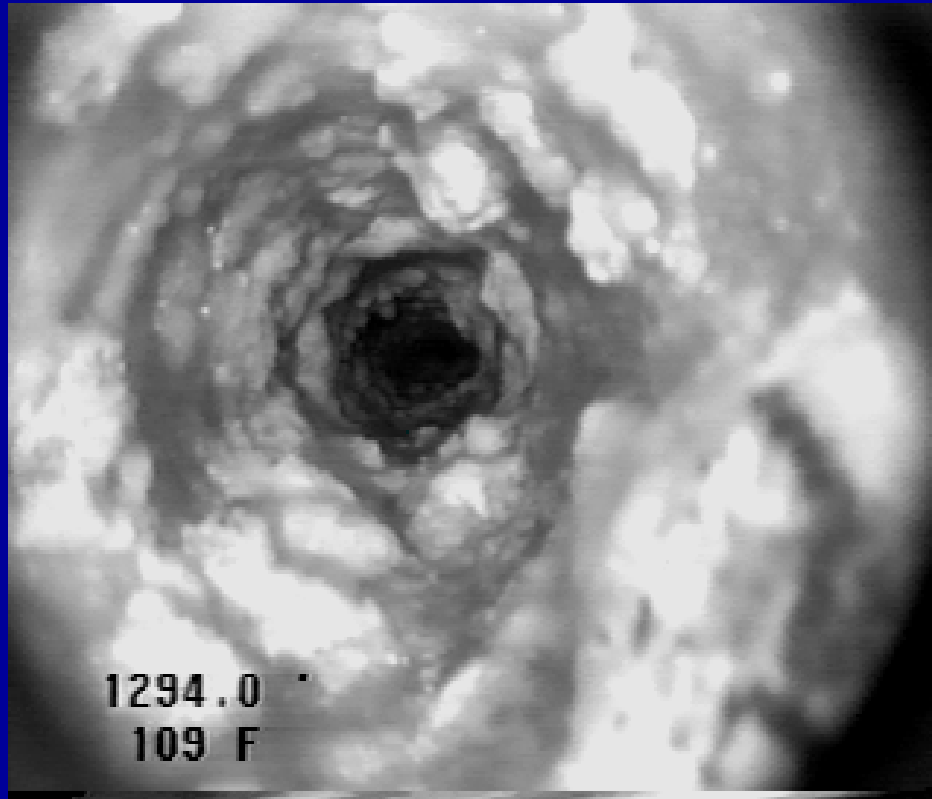
Six Lakes Vertical Wells



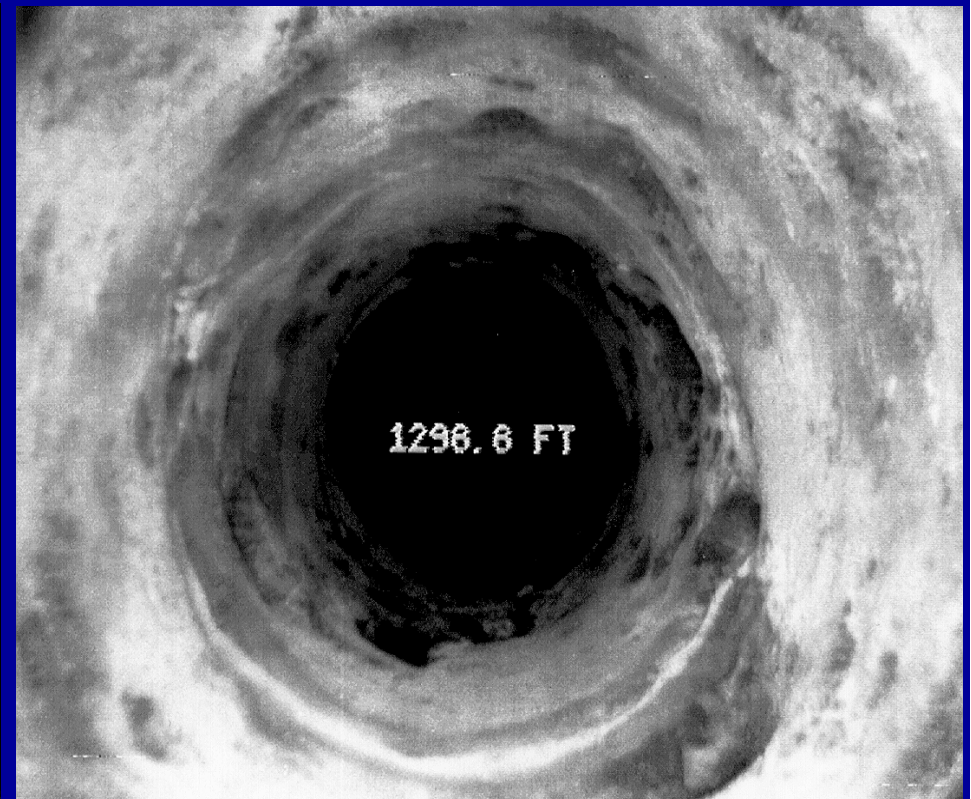
Six Lakes Flowrate History



Results Of Fresh Water Coiled Tubing Wash

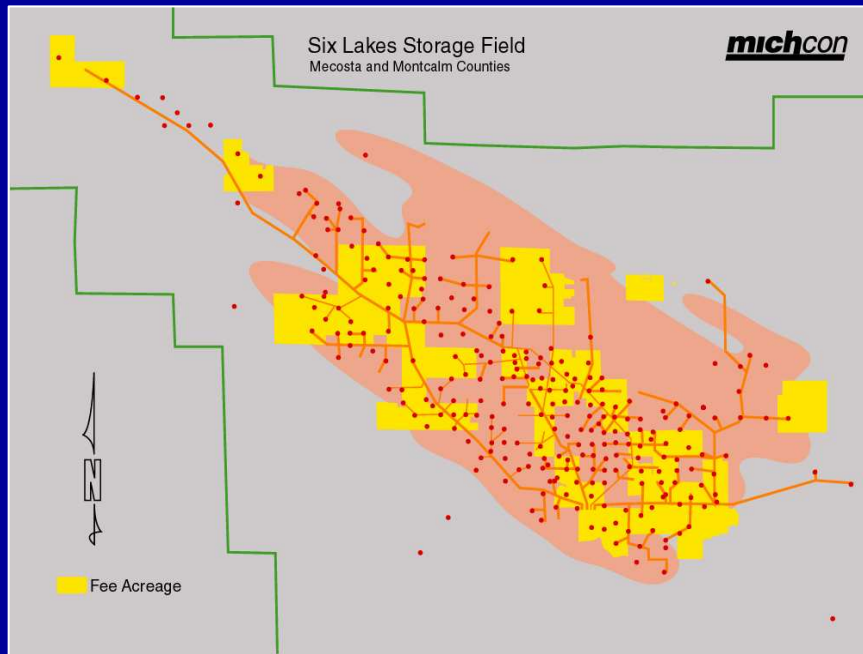


Before Wash



After Wash

New Technology Lowers Costs; Reduces Risks



Former Design

Facility Well Count 281

Miles of Pipelines 41

Miles of Road 53

Free Gas Users 93



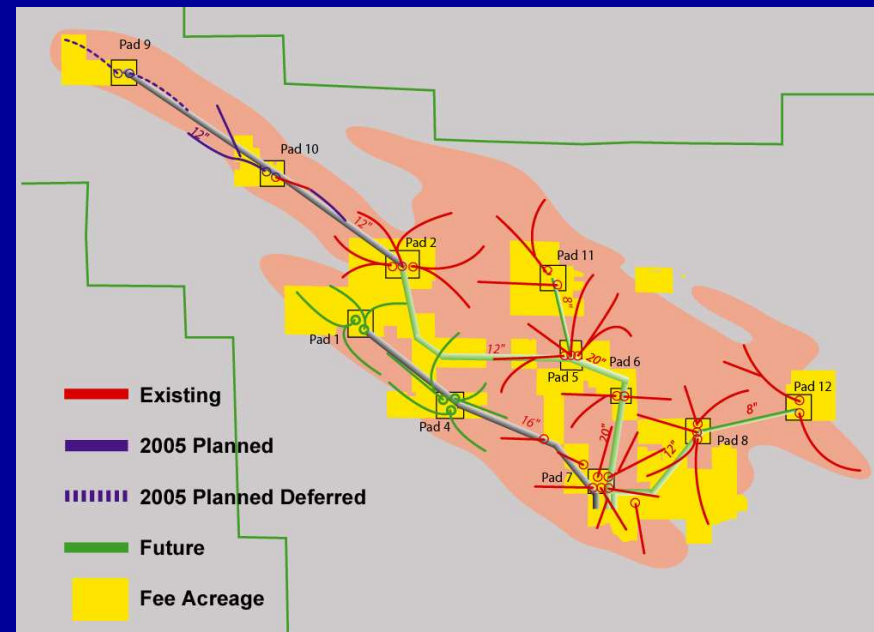
Future Design

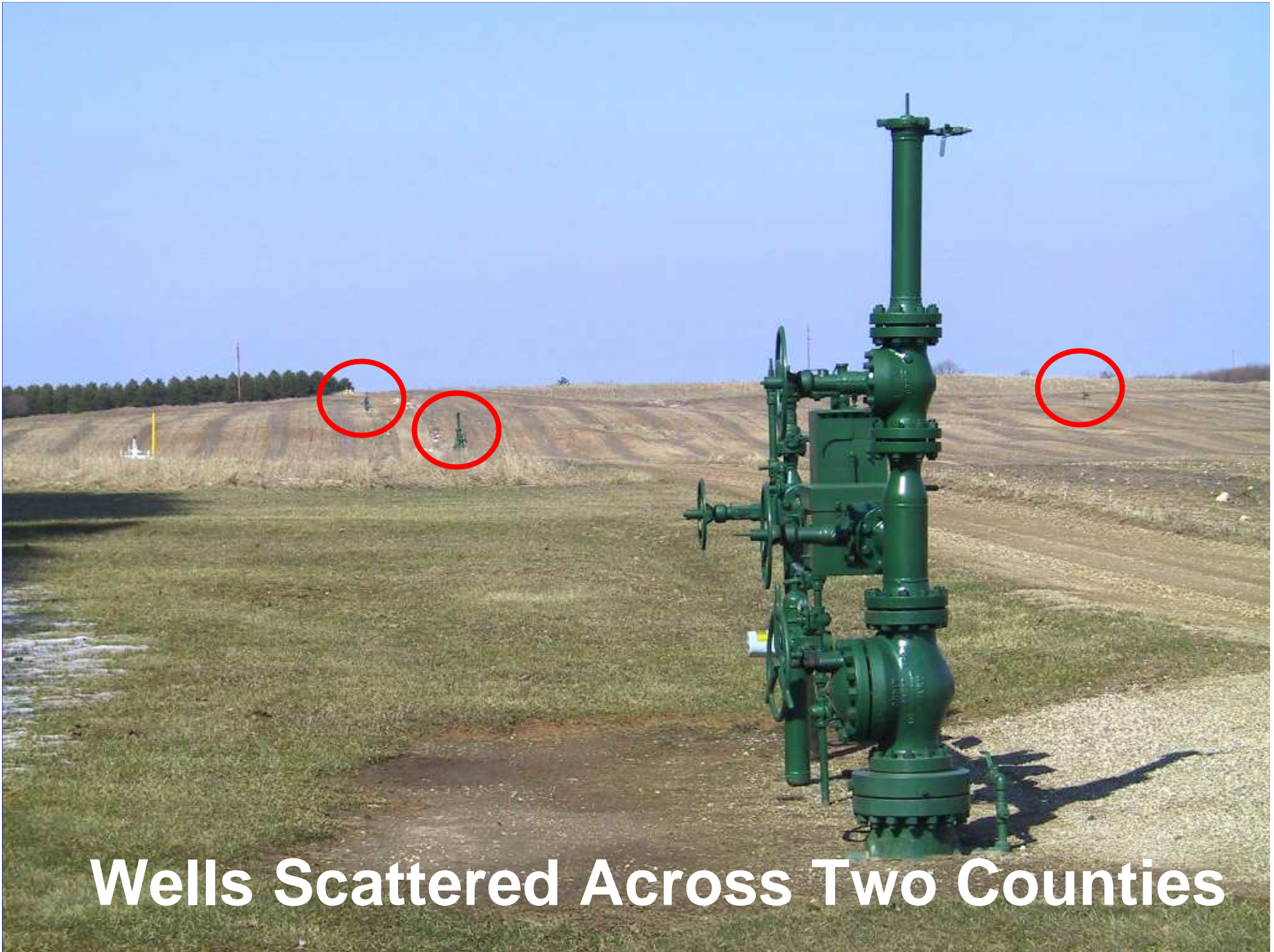
Facility Well Count 50

Miles of Pipelines 15

Miles of Road 6

Free Gas User 5





Wells Scattered Across Two Counties

Typical Pad Location View

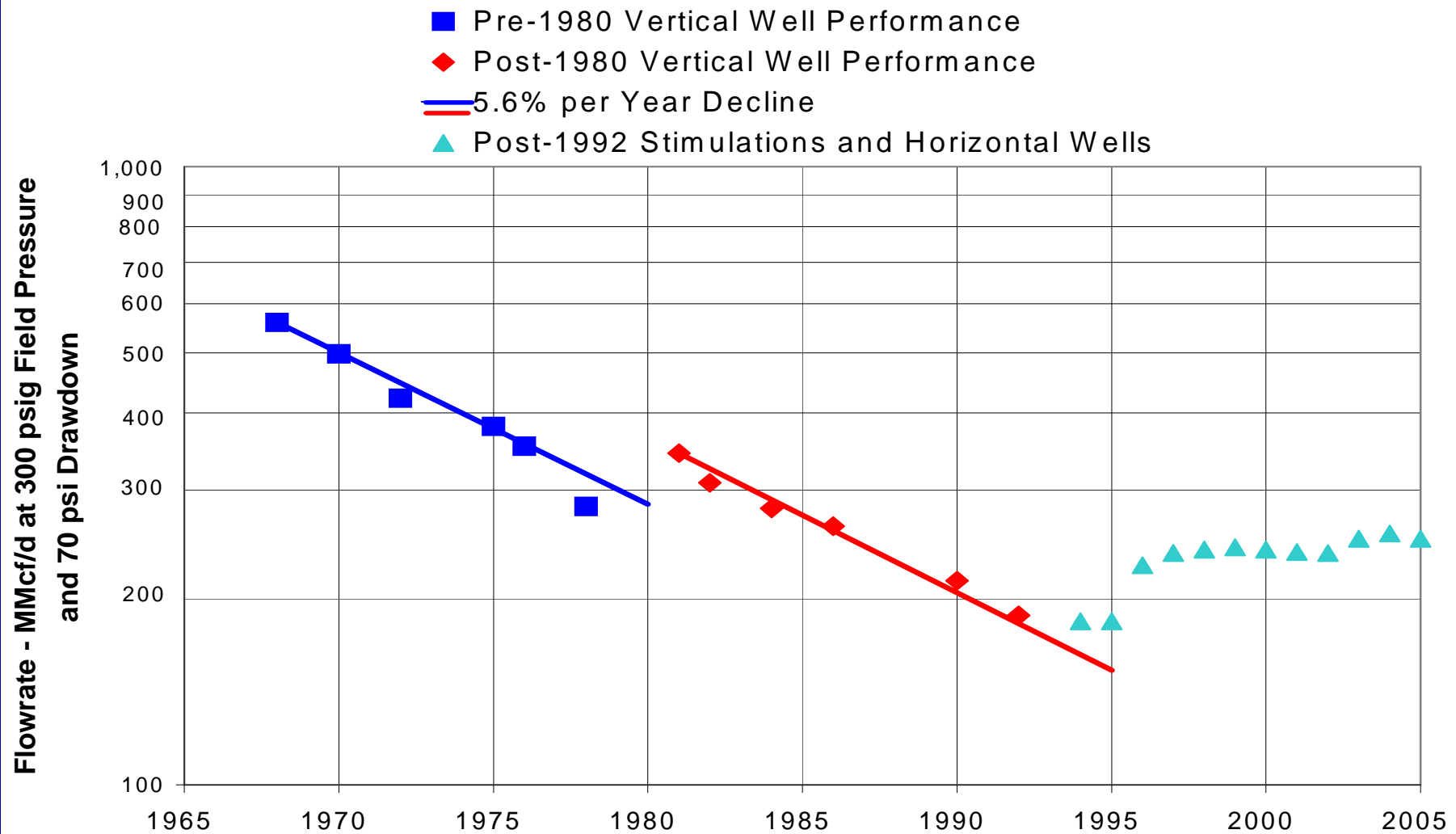


DTE Energy

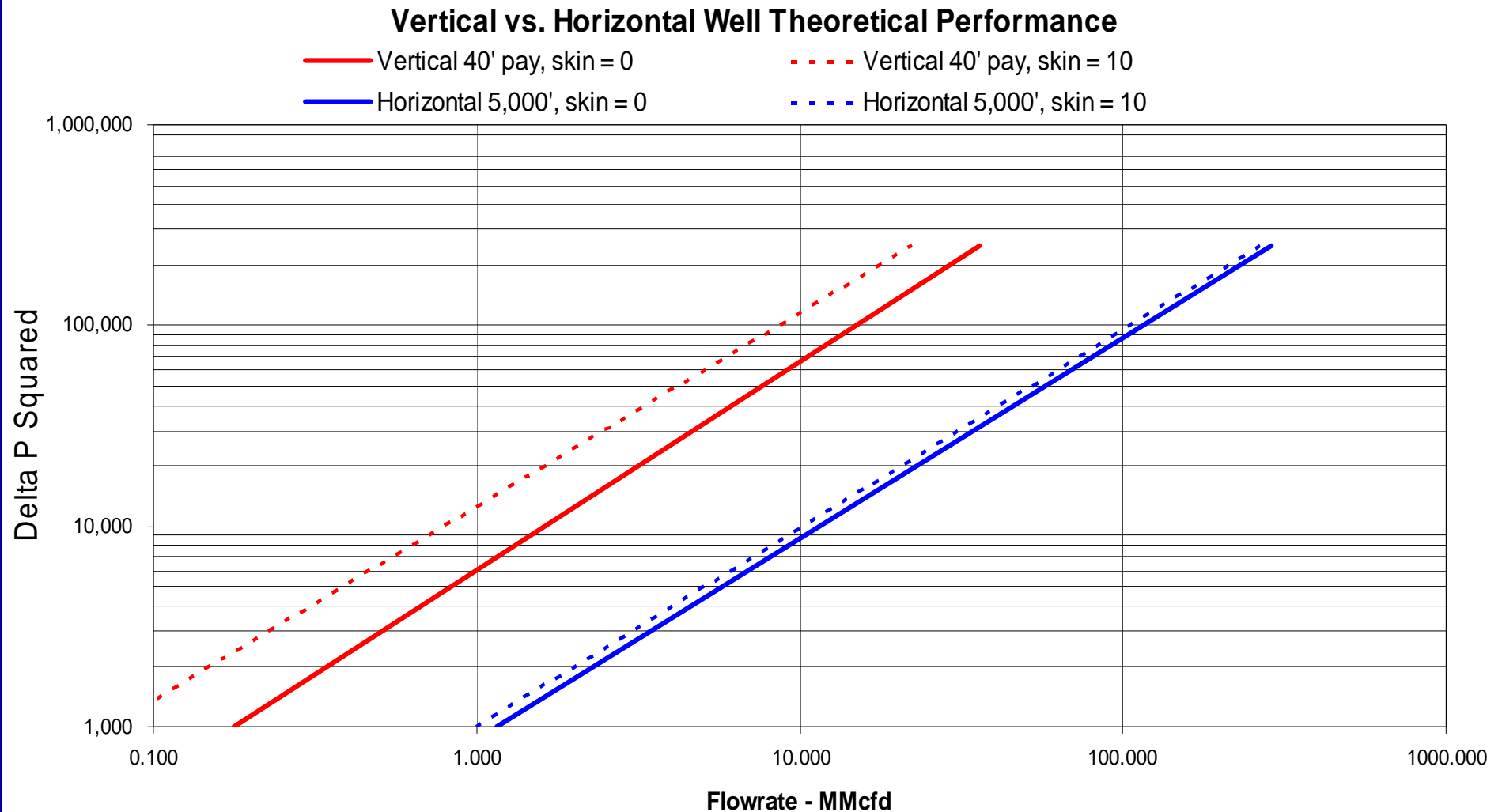


Field Flow Performance vs. Time

Six Lakes Vertical Wells

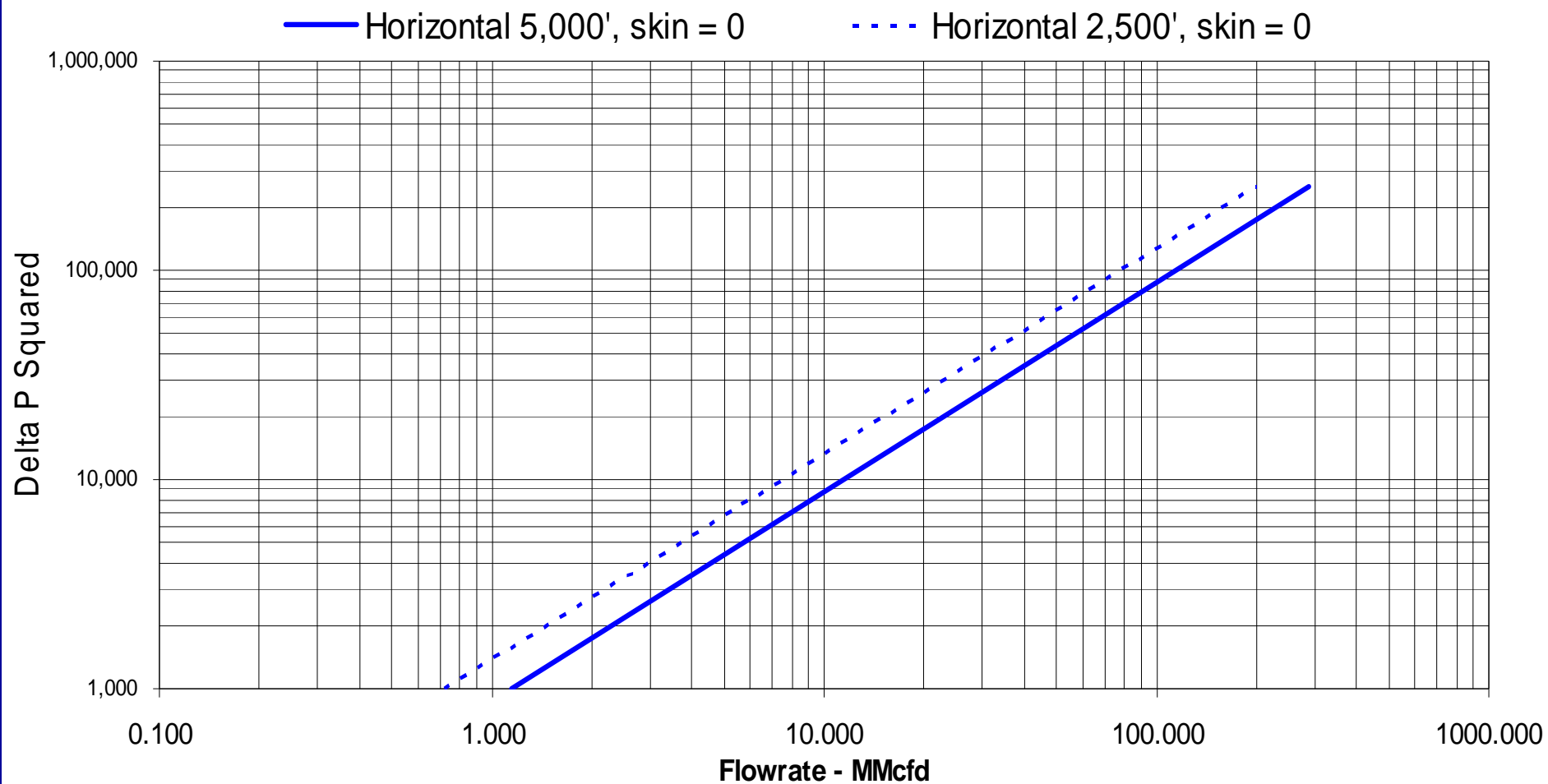


Vertical or Horizontal Wells?

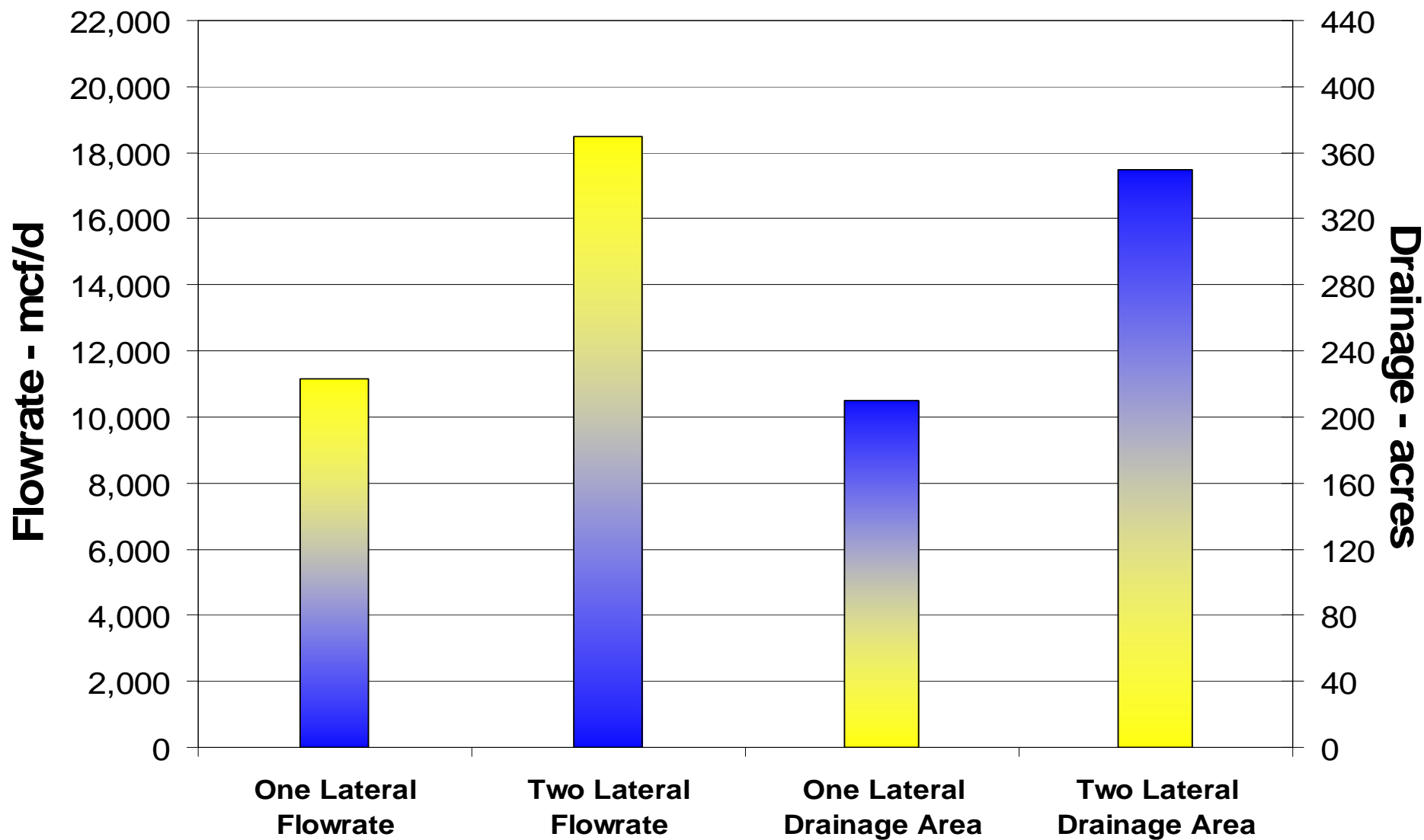


Length of Horizontal Wells

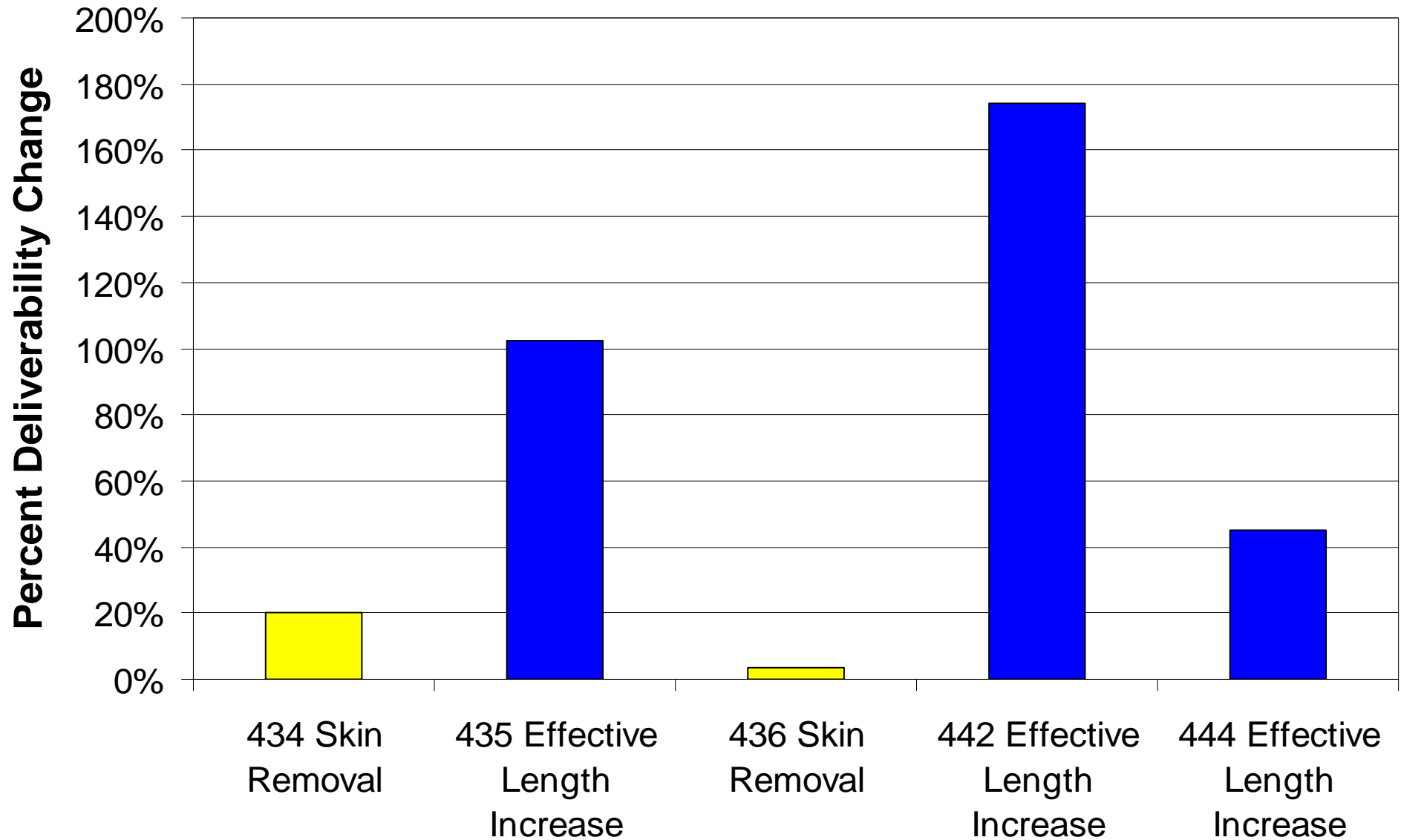
5,000 foot vs. 2,500 foot Horizontal Well Theoretical Performance
44% Deliverability Increase



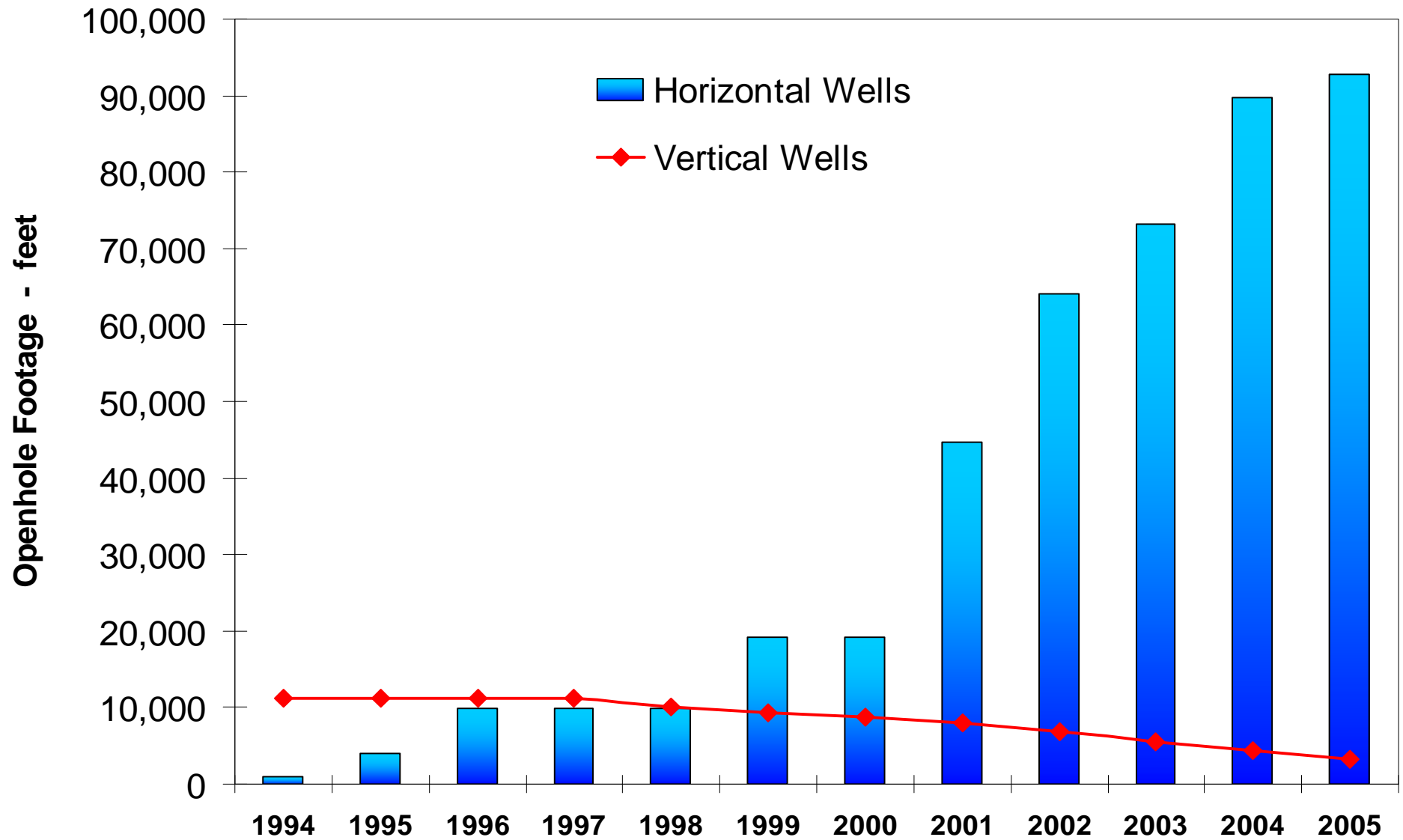
Well #429 Second Leg Results



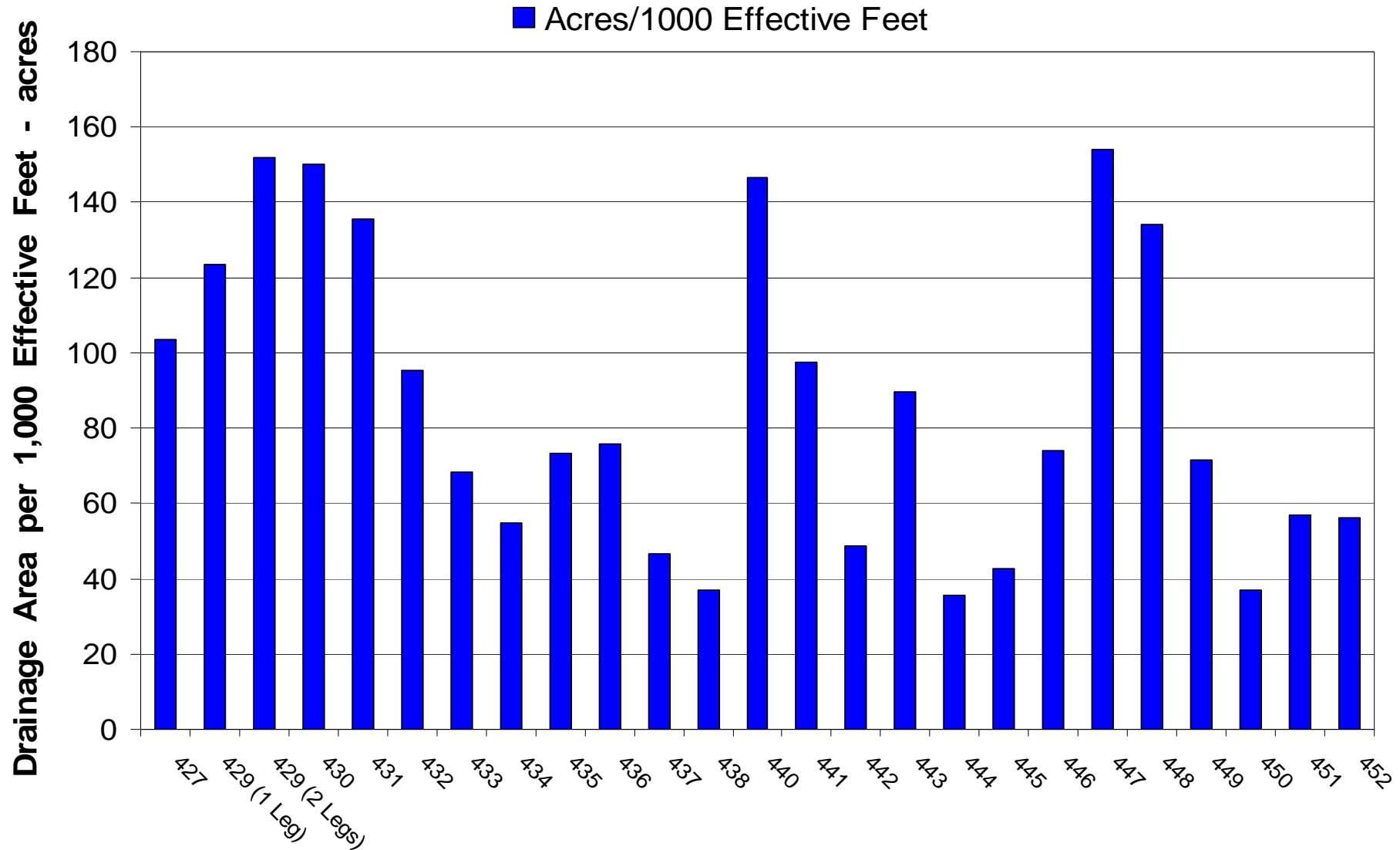
Stimulation Results



Openhole Footage

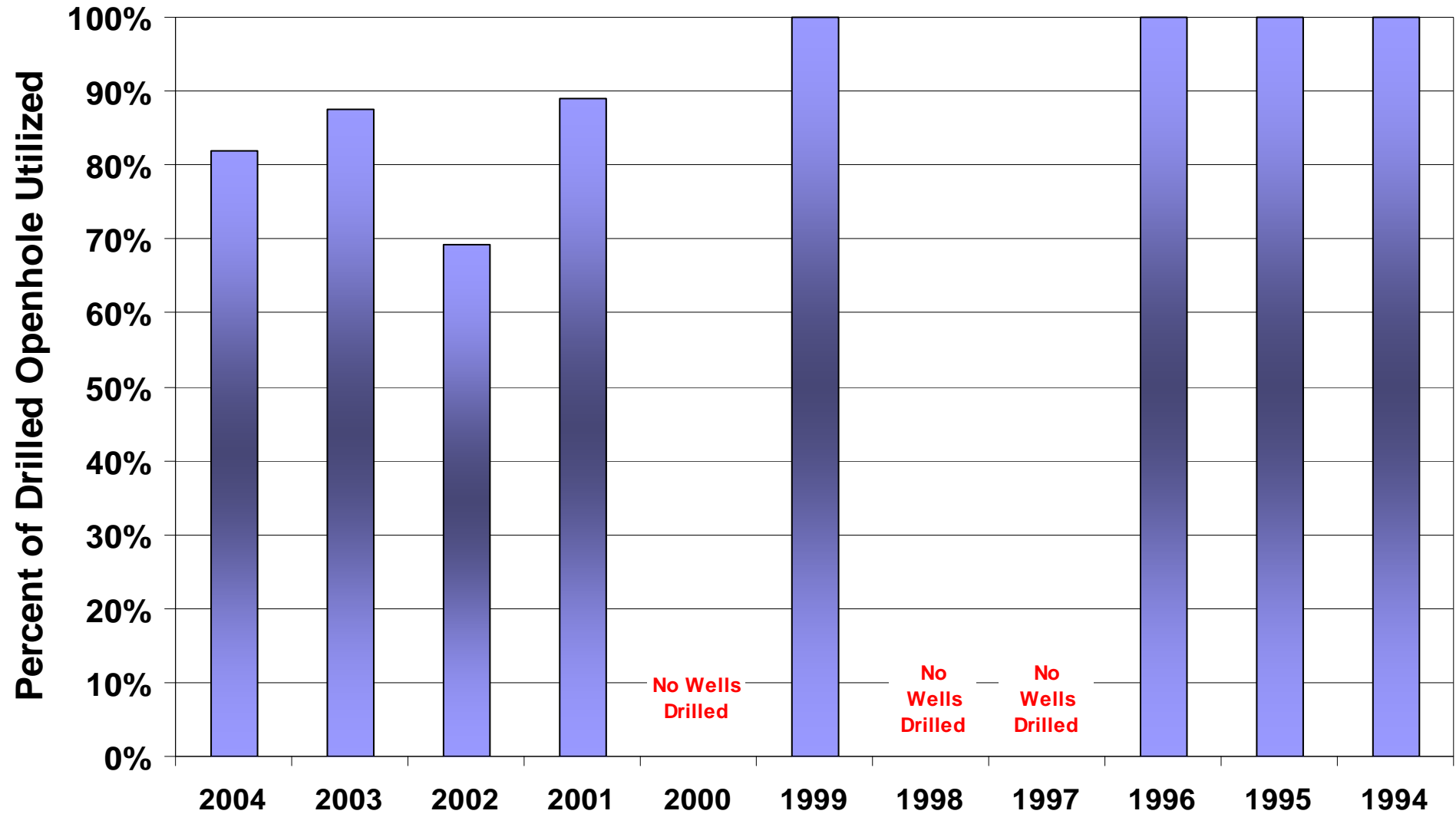


Acres Drained



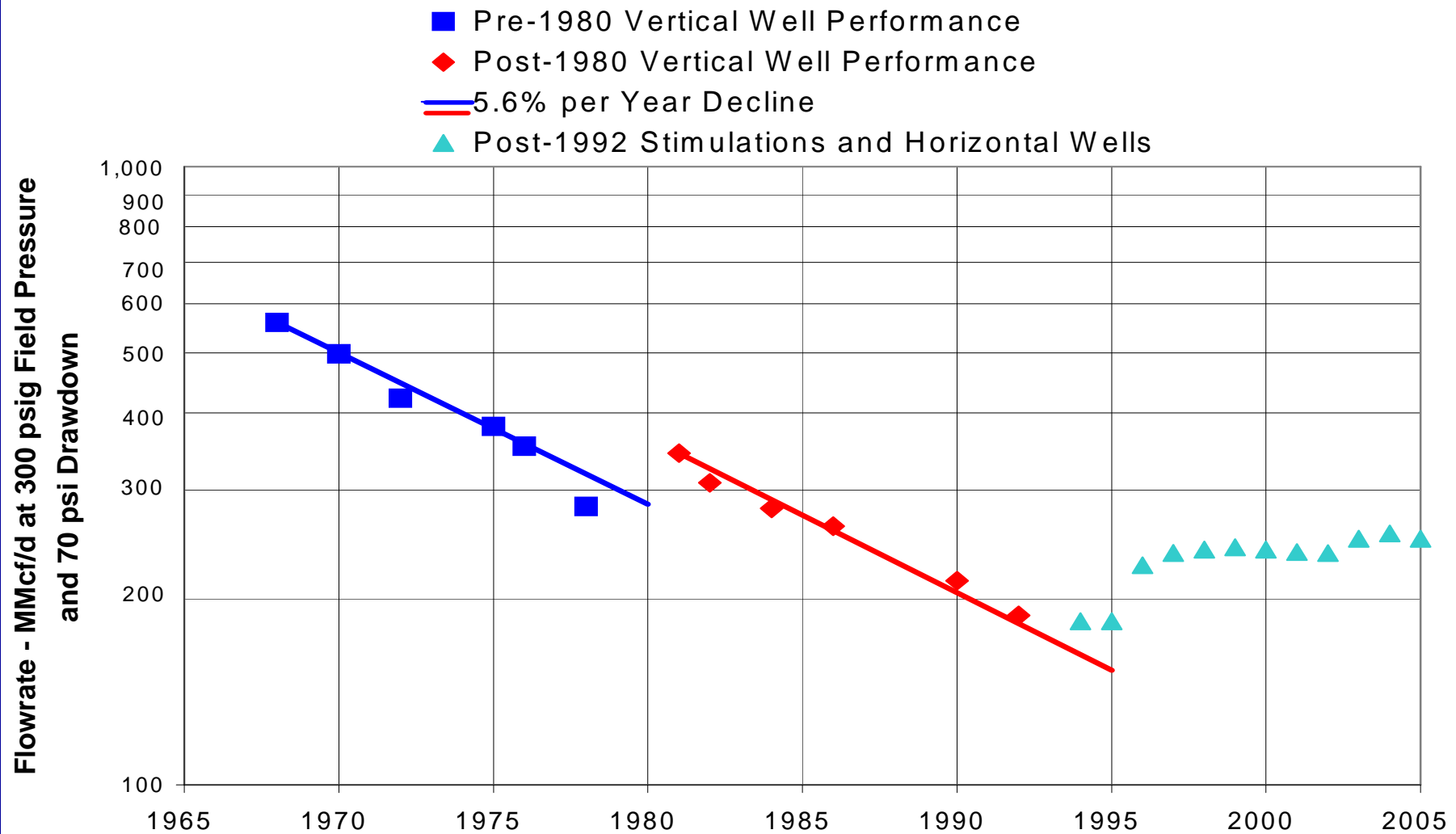
Effective Wellbore Length

Through the 2004-05 Withdrawal Season



Field Flow Performance vs. Time

Six Lakes Vertical Wells





Compressor Building Built in 1953...53 Years Old...

Extra or Unused Slides

Safety and Security

- Fewer Wells
- Fewer Pipelines
- Fewer Roads
- Free Gas User Liability
- Wells Grouped on Pads
- Horizontal Wells on MichCon Land





Well Near Home and Crops



Well Near Home and Highway



Wells on Wellpad on MichCon Land



Meter Runs and Launcher and Receiver

A photograph of an industrial gas metering station. The station consists of a long, horizontal line of yellow pipes supported by metal stands. Several valves and control boxes are visible along the line. The entire setup is located on a large area of grey gravel. In the background, there is a line of bare trees under a clear blue sky. The text "Meter Runs with Ultrasonic Measurement" is overlaid in white at the bottom of the image.

**Meter Runs with Ultrasonic
Measurement**

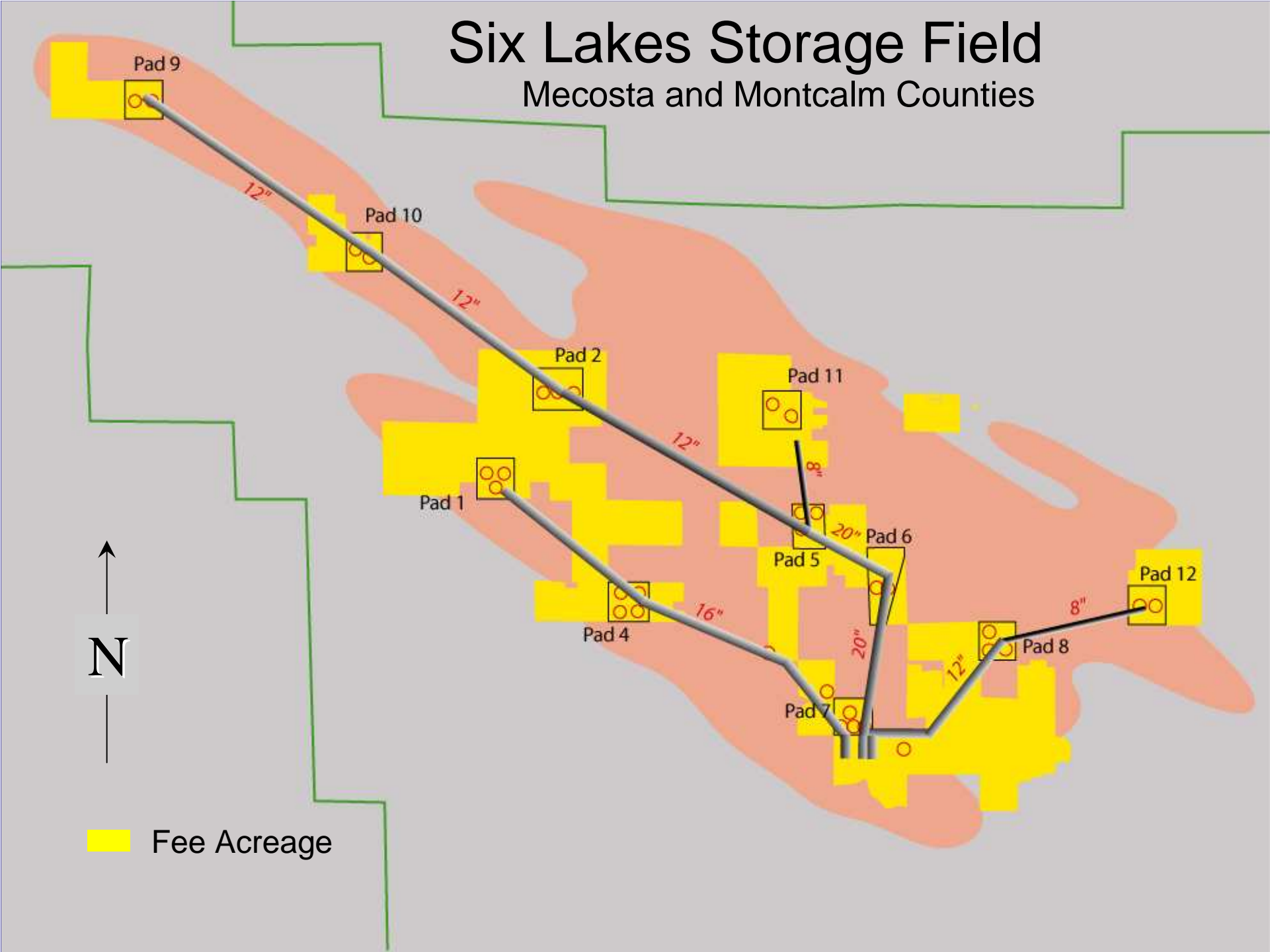
Six Lakes Storage Field

- MichCon – DTE Energy Gas
- Importance of Six Lakes
- Geology
- Deliverability Loss
- Historical Improvement Initiatives
- Horizontal Drilling Program
- Current Performance
- Conclusions







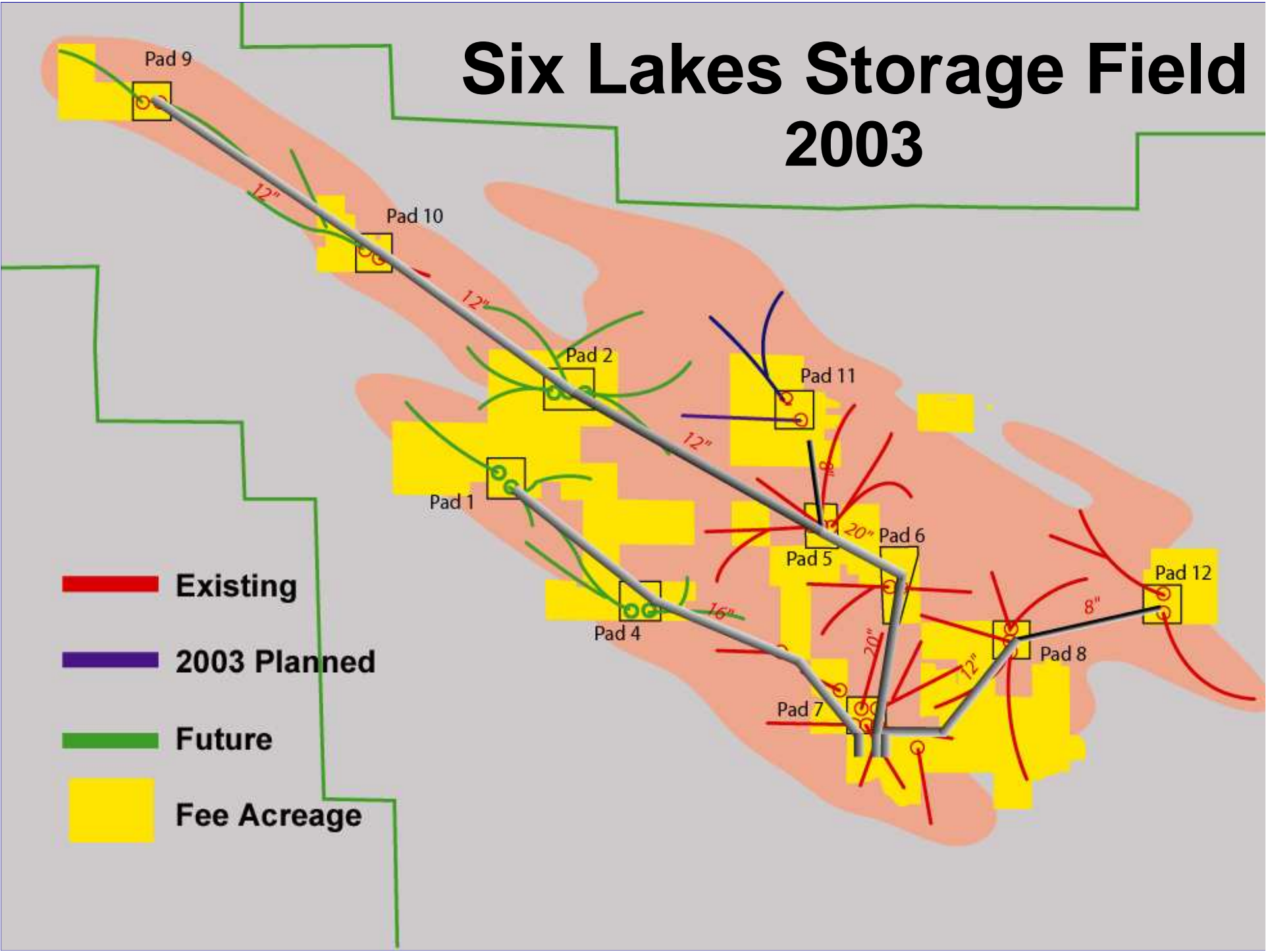
Six Lakes Storage Field

Mecosta and Montcalm Counties



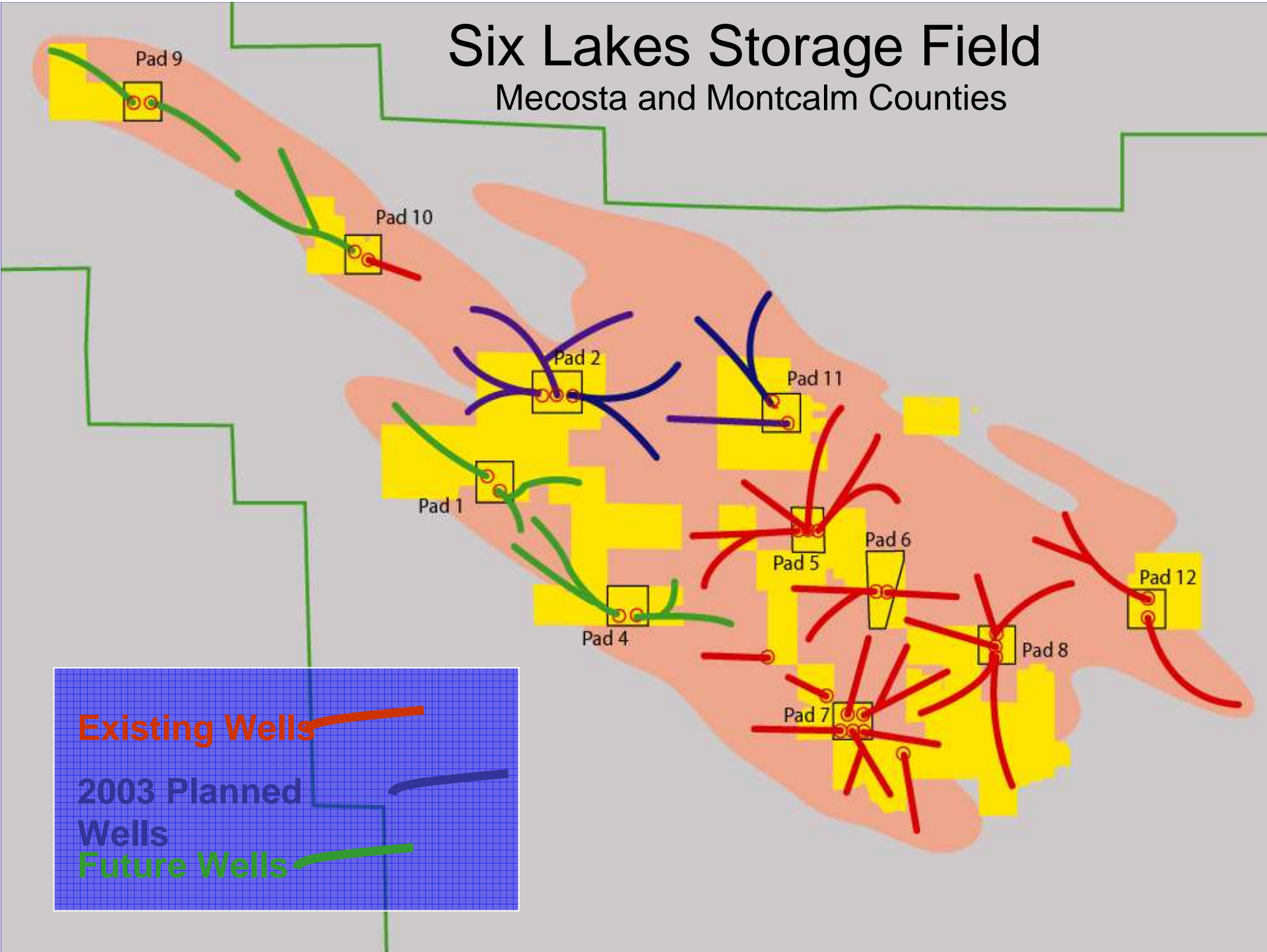
Six Lakes Storage Field 2003

-  Existing
-  2003 Planned
-  Future
-  Fee Acreage



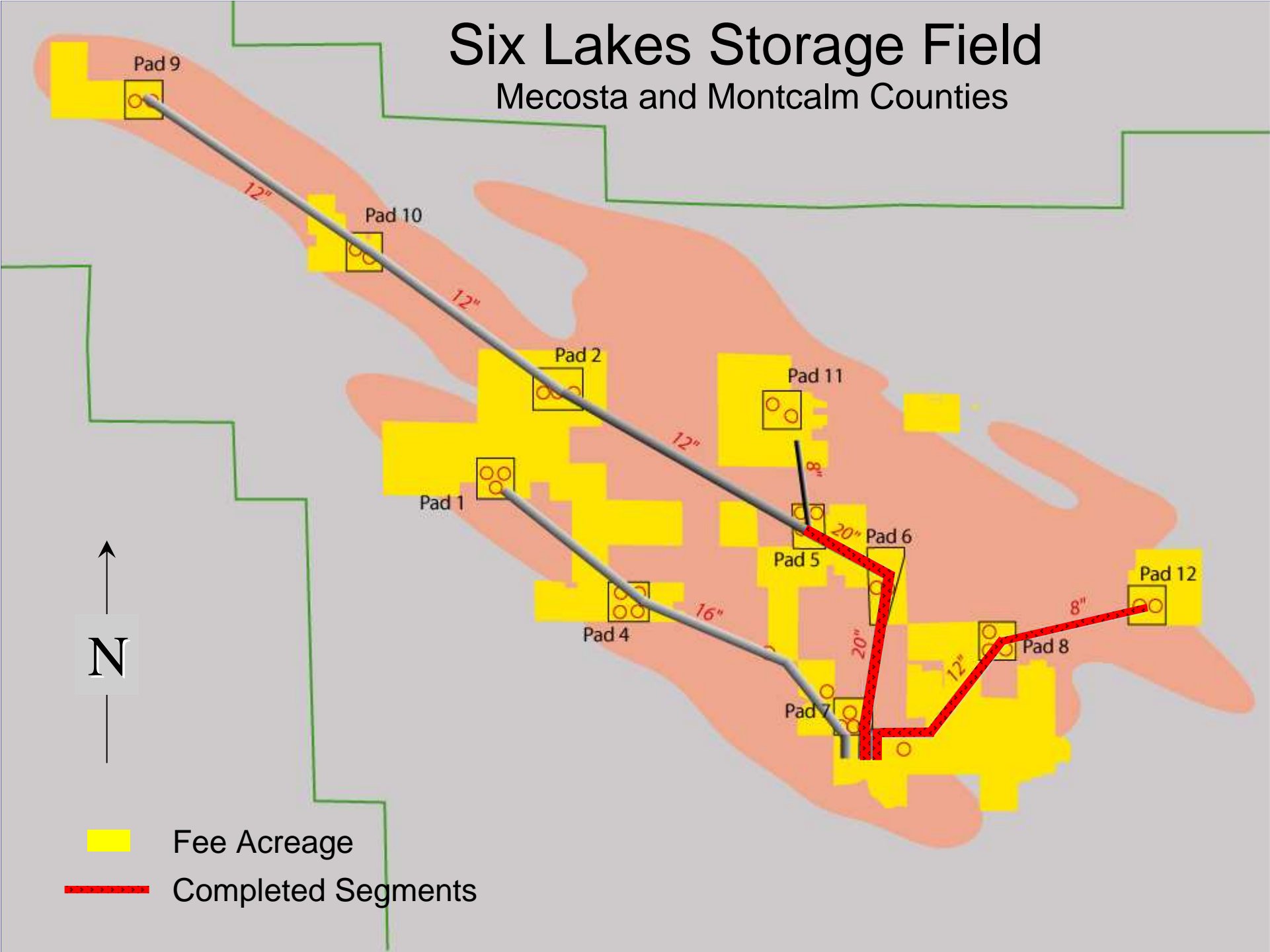
Six Lakes Storage Field

Mecosta and Montcalm Counties

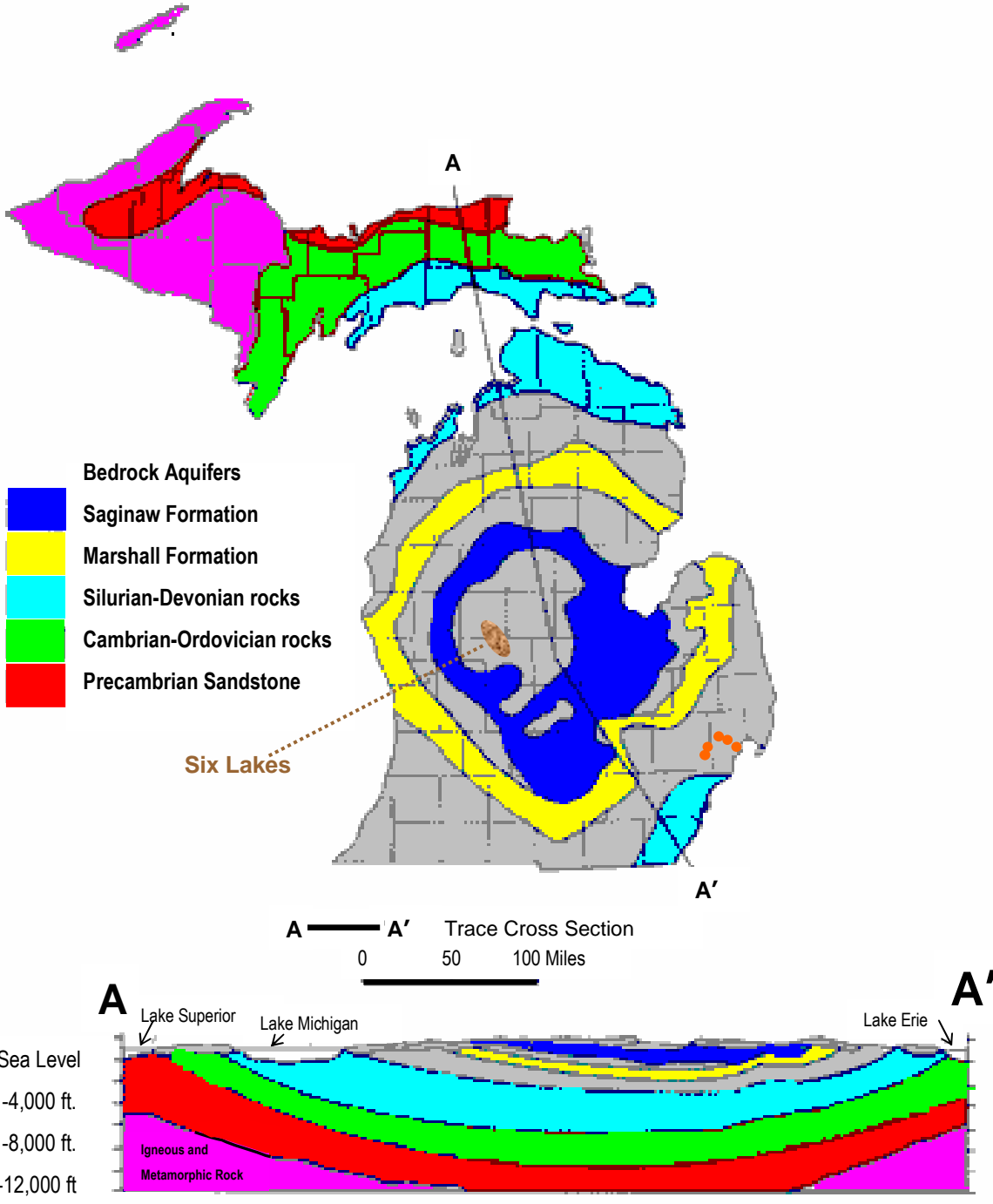


Six Lakes Storage Field

Mecosta and Montcalm Counties



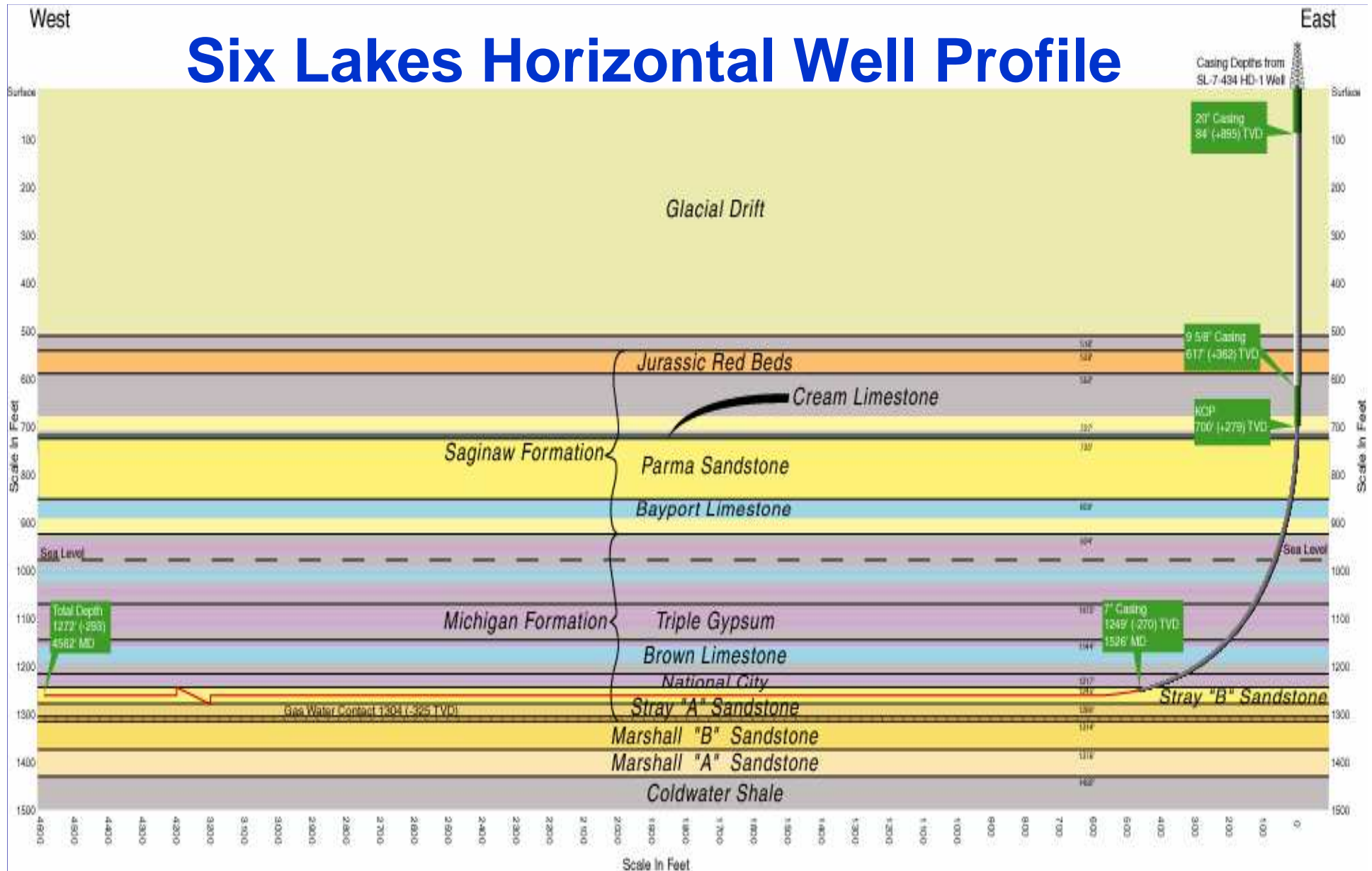
Michigan Basin Geology



DTE Energy



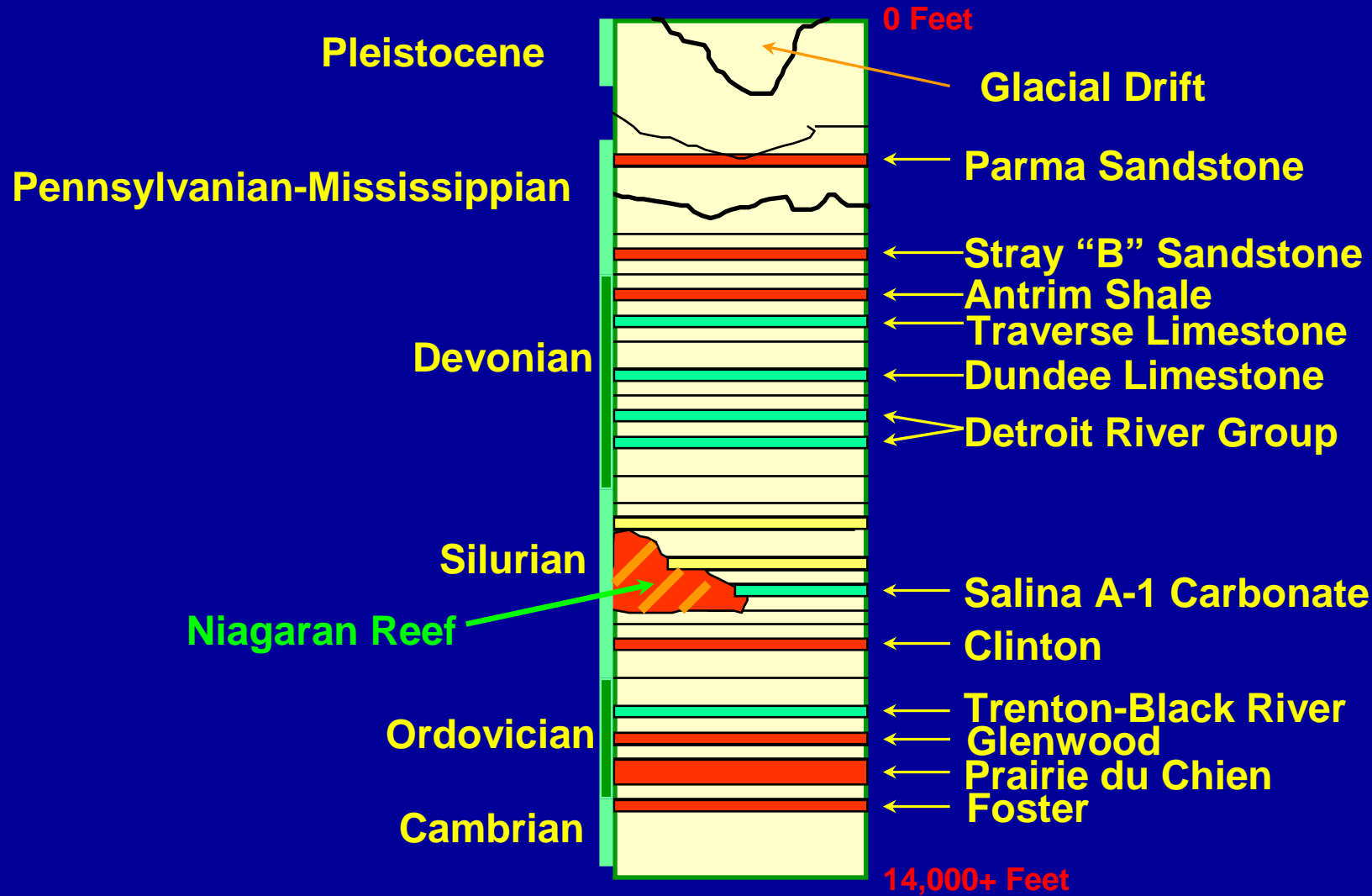
Six Lakes Horizontal Well Profile



Typical Directional Well and Generalized Cross-Section

Six Lakes Storage Field
T12N-R7W, Montcalm County, Michigan

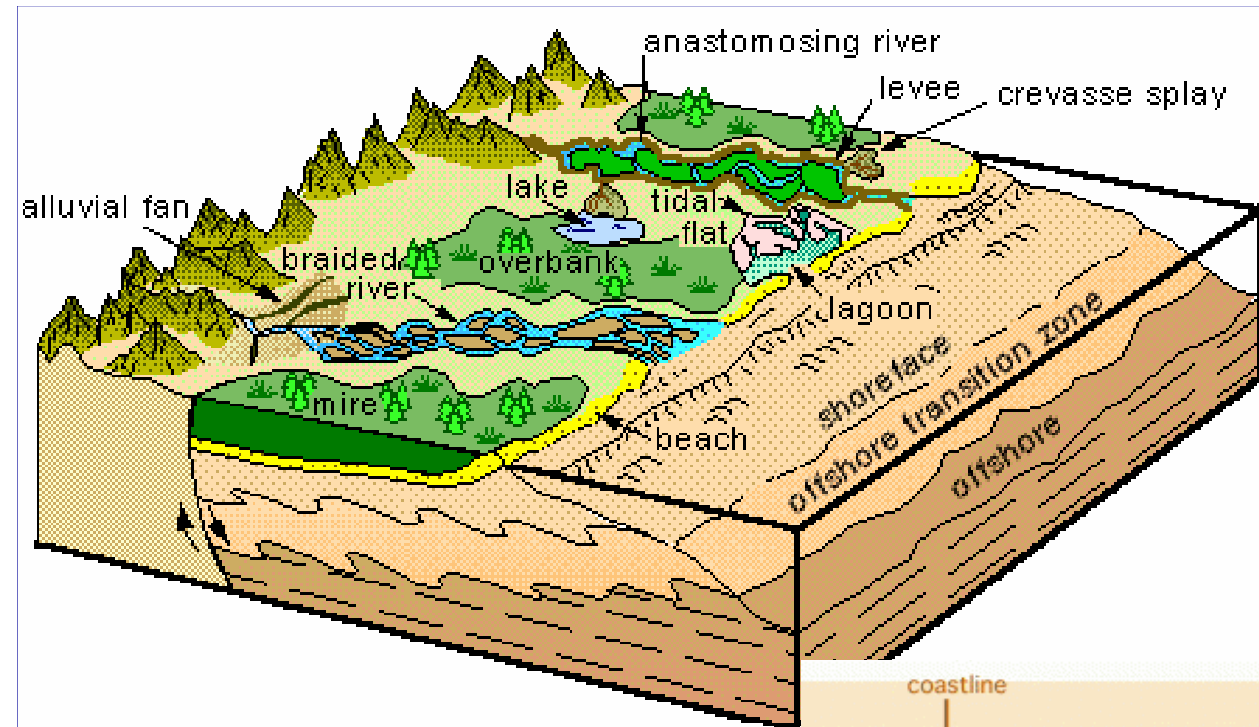
Michigan Geology



■ Salt ■ Gas ■ Oil

DTE Energy

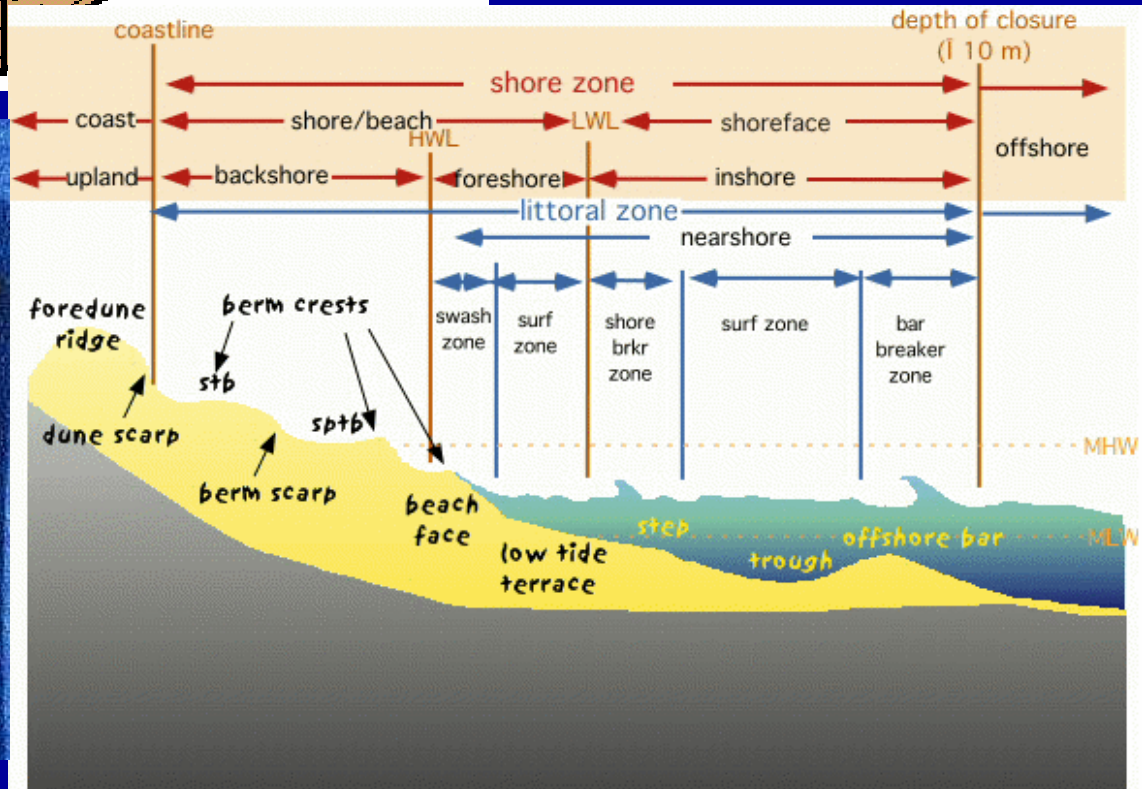




Six Lakes Depositional Environment



Offshore Sand Bars



Field Capacity - Bcf

<u>Field</u>	<u>Base</u>	<u>Working</u>	<u>Total</u>
Belle River Mills	29.2	46.9	76.1
Columbus	4.6	15.0	19.6
West Columbus	3.4	22.5	25.9
Six Lakes	28.6	40.0	68.6
Washington 28	1.9	9.7	11.6
Washington 10	<u>8.5</u>	<u>42.5</u>	<u>51.0</u>
Total	76.2	176.6	252.8



January Peak Day Deliverability -- MMcf/d

<u>Field</u>	<u>Rate</u>
Belle River Mills	1,350
Columbus	170
West Columbus	610
Six Lakes	280
Washington 28	50
Washington 10	<u>240</u>
Total	2,700



MichCon – DTE Energy Gas

- **1.2 Million Customers**

- **4.8 Bcf Peak Day System Demand**

170 Bcf Direct Sales

40 Bcf Customer Choice Transportation

160 Bcf End-User Transportation

470 Bcf System Transportation

840 Bcf Annual Throughput

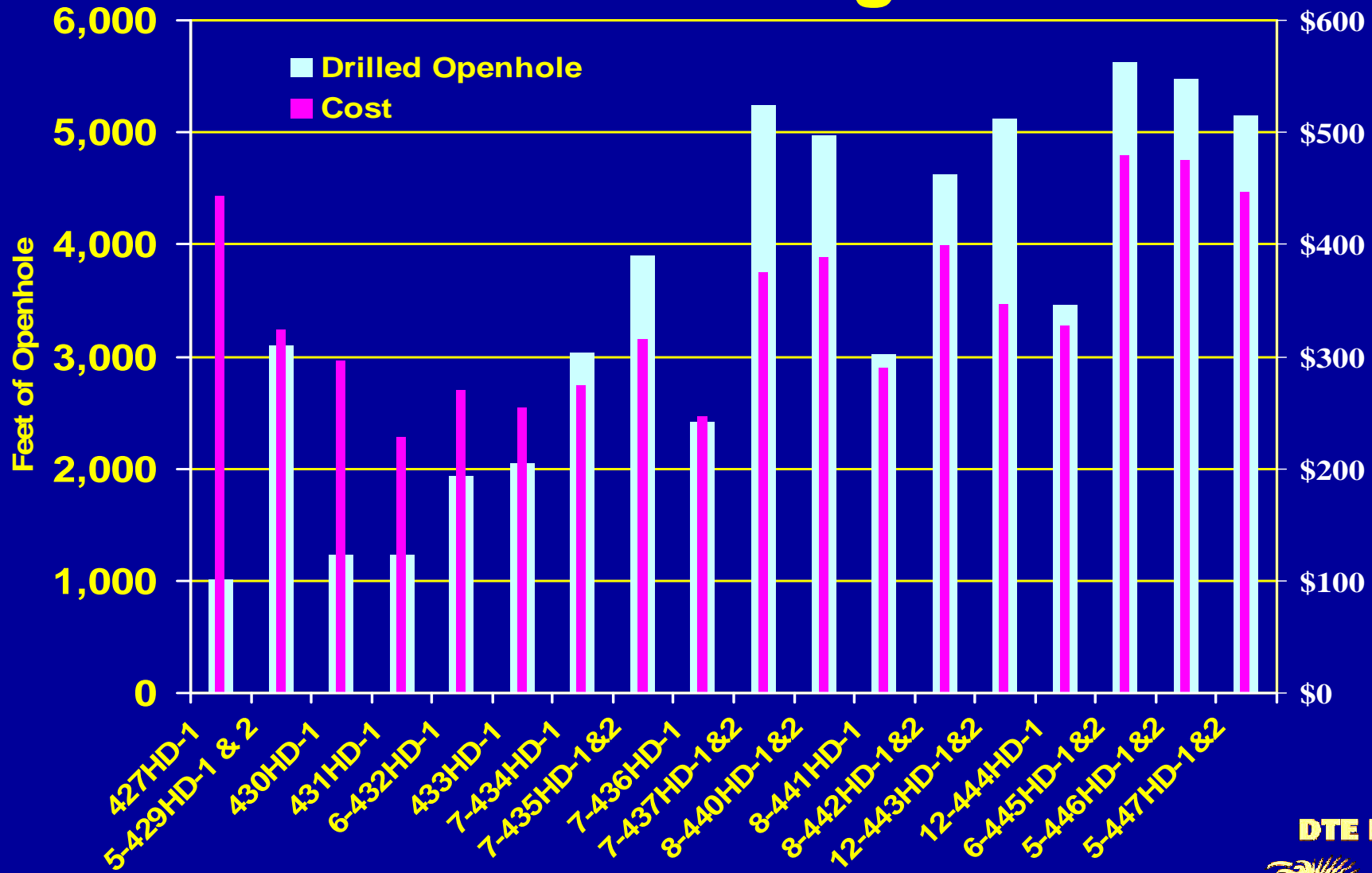
- **Facilities**

- **177 Bcf of Underground Storage**
- **18,900 Miles of Natural Gas Pipelines**

DTE Energy



Six Lakes Gas Storage Field Horizontal Wells Lengths vs. Costs



DTE Energy



Six Lakes Gas Storage Field

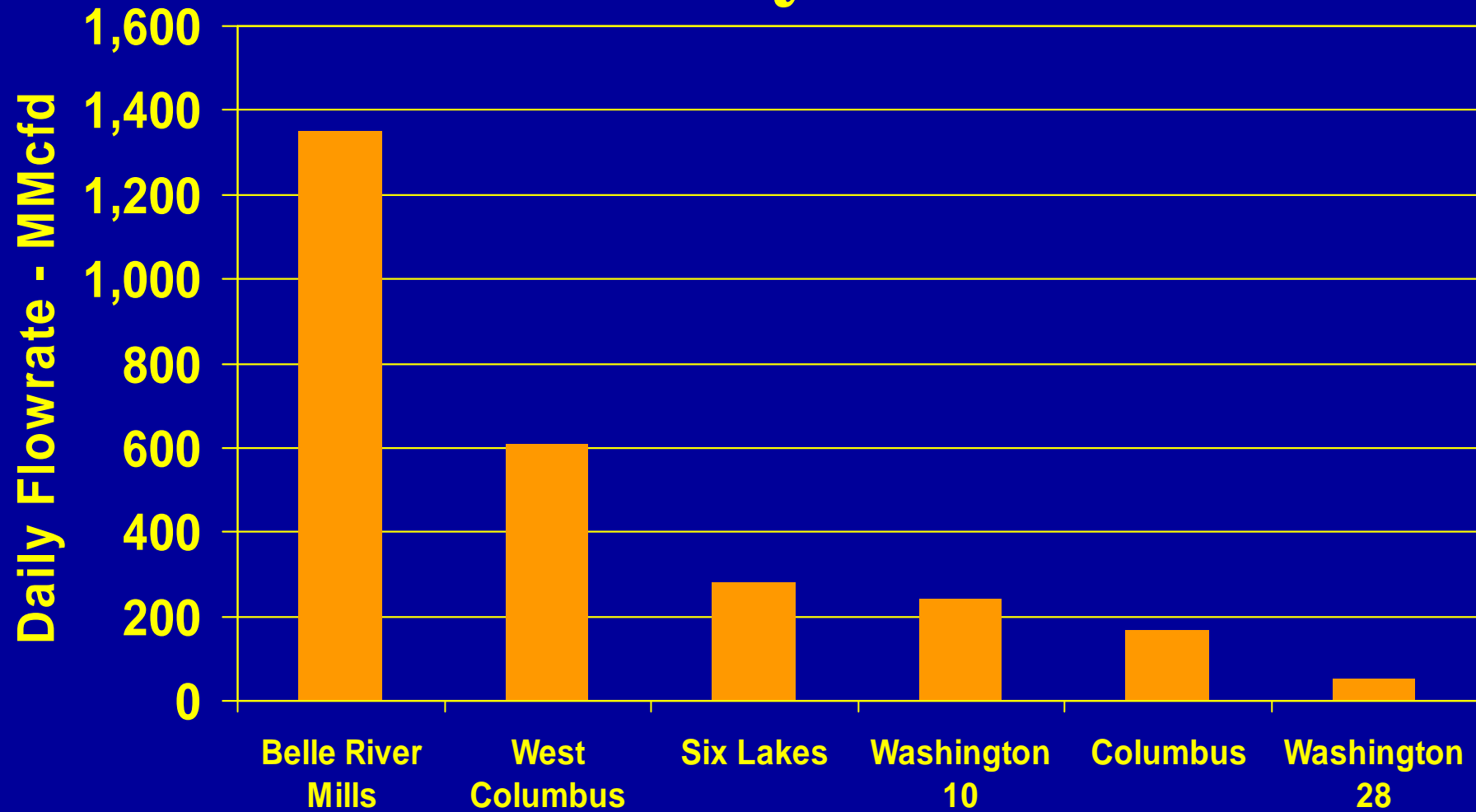
Production

Discovery Date	1934
Rock Type	Sandstone
Areal Extent	12,000 acres
Discovery WHP	513 psig
Original Production	51.6 BCF
Gas Wells	224
Abandonment WHP	25 psig

DTE Energy



January Peak Day Deliverability - MMcfd

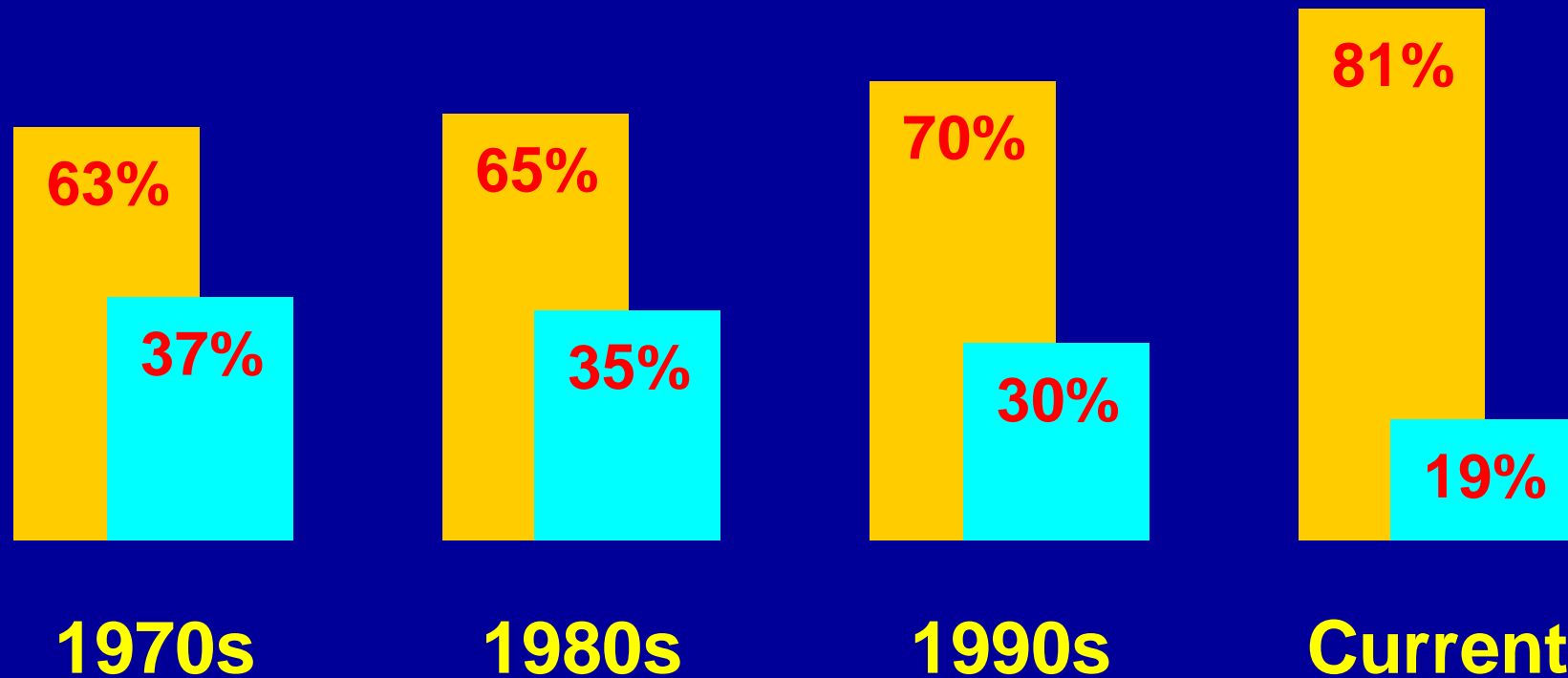


DTE Energy



Historical Peak Day Sendout

■ Storage ■ Supply

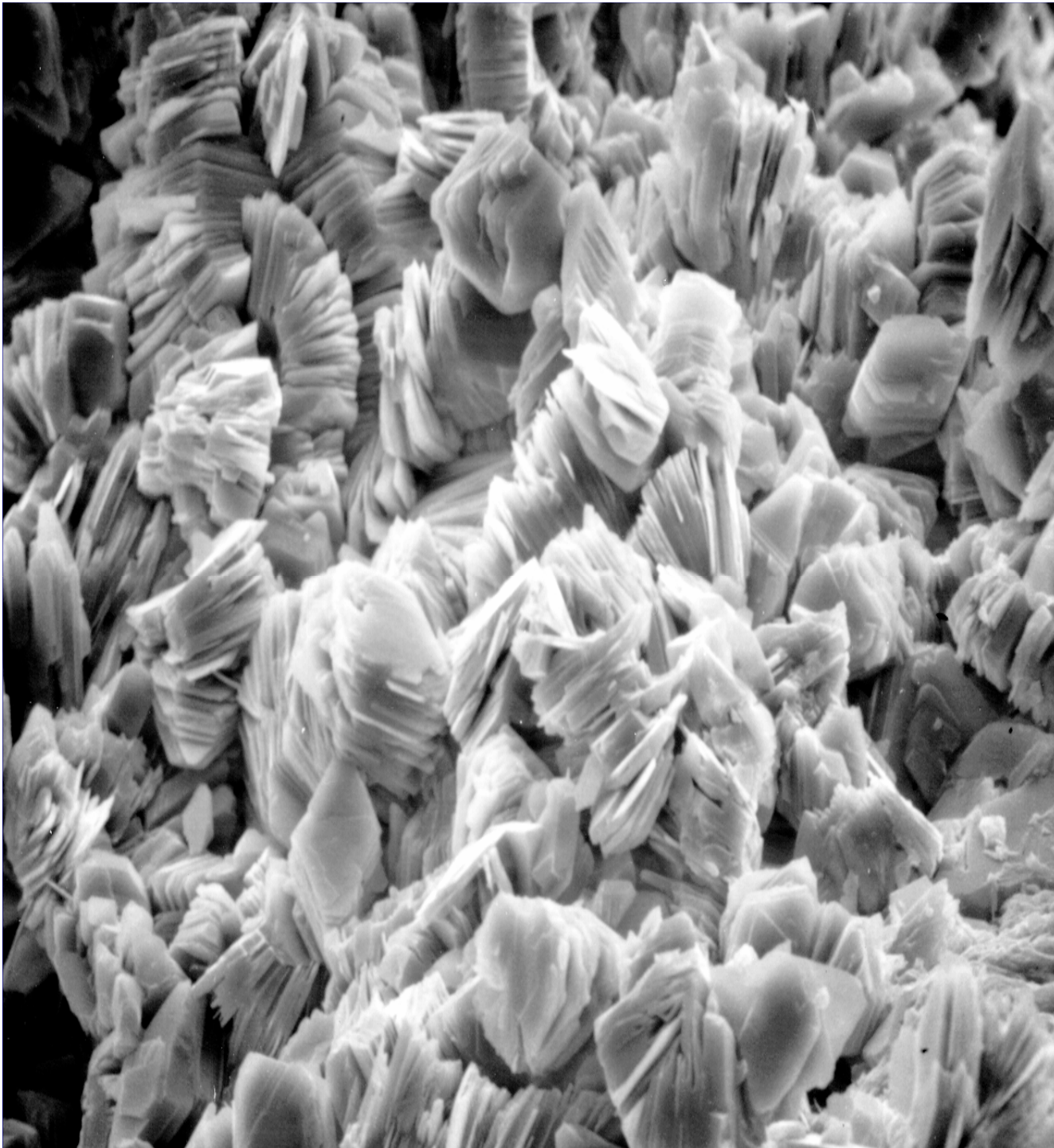


DTE Energy



Coiled Tubing Unit





SL #301

1278 ft

**Undisturbed
kaolinite
platelets**

**No evidence
of fines
migration
after 40+
years of
storage
operations**

DTE Energy



**SL #419
1288 ft.**

**Rotary
sidewall
core.**

**A 1/4" thick
salt
deposit
covers the
sandface.**

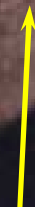
Salt Scale



Sandface



Reservoir Rock



DTE Energy



**SL #419
1294 ft.**

**6 1/4"
openhole
completion**

**Salt
deposits are
totally
covering the
sandface**

**1294.0
109 F**

DTE Energy



SL #328

1246.1 FT

**Openhole
completion
after a fresh
water coiled
tubing wash
and
9 spf
perforations**

1246.1
108 F

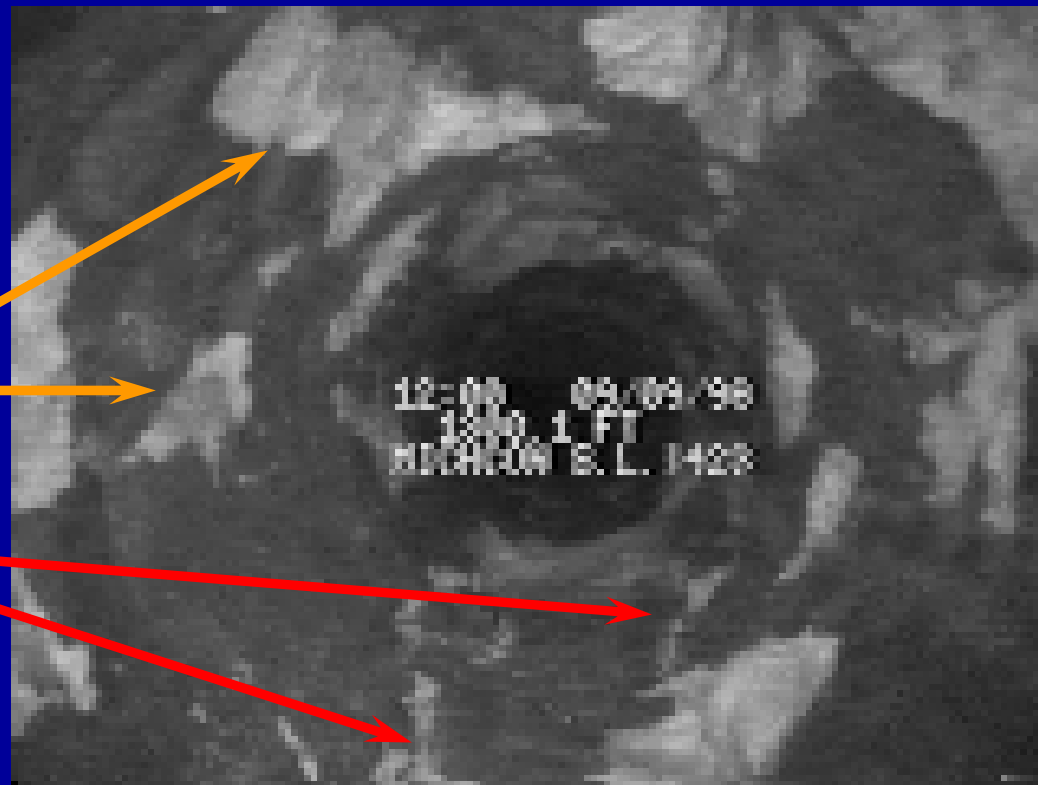
Openhole Perforations

DTE Energy



SL 423 After 1300.1 to 1301.7 feet

Propellant
Exploded
Perforations



Fractures

DTE Energy



Six Lakes #423

