The State of Hydraulic Fracturing in CA: Where Are We, and Where Are We Going?

Butte County Board of Supervisors February 10, 2015

Steve Bohlen, State Oil and Gas Supervisor, California Division of Oil, Gas, and Geothermal Resources
Division Mandates

...supervisor shall so supervise the drilling, operation, maintenance, and abandonment of wells and the operation, maintenance, and removal or abandonment of tanks and facilities...

...so as to prevent, as far as possible, damage to life, health, property, and natural resources; damage to underground oil and gas deposits from infiltrating water ... prevent damage...and waste...to underground and surface waters
Division Mandates

...supervisor shall also supervise...to permit the owners...to utilize all methods...and practices known to the industry for the purpose of increasing the ultimate recovery.

To best meet oil and gas needs in this state, the supervisor shall administer this division so as to encourage the wise development of oil and gas resources.
California’s Oil and Gas Fields
Crude Oil Production

Production data from EIA
Colliding Issues: SB4, Drought, Induced Seismicity

Senate Bill 4 – Regulation of Hydraulic Fracturing in California

Drought – Focus on CA Aquifers and Compliance with the Federal Safe Drinking Water Act

Induced Seismicity – State’s Underground Injection Control Program
Gas Field Locations in Butte, Glenn, Colusa and Sutter Counties
Active, Idle or “New” Wells in Butte, Glenn, Colusa and Sutter Counties (black), and Wells Hydraulically Fractured Per Frac Focus (blue)
Wells Reported as Hydraulically Fractured Per Frac Focus
Table Identifying Wells Hydraulically Fractured Per Frac Focus

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Note: Reported as Hydraulically Fractured. [Link](http://www.fracfocusdata.org/DisclosureSearch/)
ACTIVE WELLS IN BUTTE COUNTY

Total Non-Plugged and Abandoned Wells: 32

Fields And Well Count:

Wild Goose Gas: 21 Wells (Gas Storage)
Perkins Lake Gas: 5 Wells
Durham Gas: 5 Wells
County: 1 Well
ACTIVE WELLS BY TYPE

- Dry Gas: 9 Active Wells, 1 Idle Well
- Gas Storage: 17 Active Wells
- Water Disposal: 1 Active Well
- Observation: 4 Active Wells

- Per Frac Focus No Wells Have Been Hydraulically Fractured in Butte County.

Glenn County

- Total Non-Abandoned Wells: 322
- Dry Gas: 291 Active, 25 Idle
- Water Disposal: 2 Active, 1 Idle
- Newly Permitted Wells: 3 (not drilled yet)

**Information From Frac Focus:**
- 1 Well Hydraulically Fractured 6/23/2011
- Venoco Inc. “Carriere” 18-3 021-20936
Total Depth of Wells In Butte County

• Wild Goose: 2960’ – 4332’

• Perkins Lake Gas: 3900’ – 5587’

• Durham Gas: 2250’ - 2326’

• County: 3560’
As of **January 1, 2014**, Oil and Gas Operators Were Required to Obtain Permits To Perform Any Well Stimulation Activity

For Butte County, Since January 1, 2014 No Well Stimulation Permit Applications Have Been Received.

For Colusa, Glenn and Sutter Counties, Since January 1, 2014 No Well Stimulation Permit Applications Have Been Received.

[http://maps.conservation.ca.gov/doggr/iwst_index.html](http://maps.conservation.ca.gov/doggr/iwst_index.html)
Senate Bill 4 (SB 4) (2013)

• Creates: “Article 3. Well Stimulation” in state law

• Purpose:
  – To increase transparency of CA well stimulation techniques
  – Provides framework for a comprehensive study, environmental review and regulation of well stimulation
SB 4 Legislation Summary

REQUIRES:

• A study on well stimulation [Public Resources Code Section (§) 3160]

• A State-wide Environmental Impact Report [§ 3161(b)]

• The Division to adopt well stimulation regulations [§ 3160 (b) (1) (A)]

• Permits for well stimulation [§ 3160 (d) (2) (A)]
SB 4 Legislation Summary

REQUIRES:

• Groundwater monitoring plans [§ 3160 (d) (1) (F)]
• Public disclosure [§ 3160 (g) (2) (A)]

ESTABLISHES:

• Notification requirements [§ 3160 (d) (6) (A)]
• Trade secret procedures [§ 3160 (j) (1)]

PROVIDES:

• Amendments to the oil and gas fee structure [§ 3401 (a)]
Regulatory Path

• SB 4 rulemaking commenced Nov. 2013
  – Draft regulations released
  – 60-day comment period
  – Five public comment hearings throughout state

• Revised draft regulations posted Jun. 2014
  – 60-day comment period
  – Five public comment hearings throughout state

• Public comment on final draft closed Friday, October 23
Regulations Include

- Nearby Geologic Review
- Pre-Fracturing Well Testing
- Advance Notification
- Allow for Water Well Testing
- Seismic Monitoring
Regulations Include

- Seismic and Ground Water Monitoring Before, During & After Fracturing Operations
- Disclosure of Materials Used in Fracturing Fluid
- Trade Secrets
- Storage of Hydraulic Fracturing Fluids
Water Use in Hydraulic Fracturing

**FIGURE 3: AVERAGE WATER USE PER WELL BY TYPE OF PRODUCTION**

- **Horizontal Gas**: 4.8 M gallons
- **Horizontal Oil**: 3.2 M gallons
- **Vertical Gas**: 0.5 M gallons
- **Vertical Oil**: 0.7 M gallons

*Source: Ceres analysis using PacWest FracDB from FracFocus data from wells drilled January 2011-May 2013.*
**Water Injection**

Total Produced Water Injection: 2.7 Billion bbls/yr
(348,000 a-f)

- **Enhanced Oil Recovery (EOR):** 1.9 Billion bbls/yr
  (240,000 a-f) (70%)
  - Water Flood - 50%
  - Steam Flood - 13%
  - Cyclic Steam - 6%

- **Water Disposal (WD):** .8 Billion bbls/yr (105,000 a-f)
  (30%)
Non-Injected Produced Water

Total Produced Water Non-Inject: 866 Million bbls/yr

- Evaporation - Percolation: 624 Million bbls/yr (72%)
- Freshwater Uses: 198 Million bbls/yr (25,400 a-f) (23%)
- Sewer Systems: 44 Million bbls/yr (5%)
Fresh Water Balance

Produced Freshwater: 198 Million bbls/yr (25,400 a-f)

Industry’s Use for:
- Well Drilling Operations: 3 Million bbls (386 a-f)
- Hydraulic Fracturing Operations: 2 Million bbls (270 a-f)
- Cementing: 0.6 Million bbls (80 a-f)

Total: 5.6 Million bbls (736 a-f)

Balance: 192 Million bbls or 24,800 acre-feet
Colliding Issues: SB4, Drought, Induced Seismicity

The collision of these issues has changed the future landscape for DOGGR:

- Public Scrutiny
- Legislative Oversight
- Operational Imperatives
Colliding Issues: SB4, Drought, Induced Seismicity

The Partnership Vision for a Successful DOGGR:

Current Status – A paper exercise

Future Status – Data and Science Driven

Partnerships and Fellowships

Working together on difficult problems
Concerns

- Migration of Gas
- Migration of Fluid
- Water Use
- Management of Produced Water
- Identification of Additives
- Surface Spills
- Anthropogenic Road Traffic, Dust, Noise
- Fauna and Flora
- Well Construction
- Desalinisation plant inefficiency
- Seismicity
Fracturing Fluids

Water and Sand: >98%

Other: <2%
- Acid: Used in swimming pools
- Anti-bacterial Agent: Used in disinfectants
- Breaker: Used in hair color
- Clay Stabilizer: Used in IV fluids
- Corrosion Inhibitor: Used in plastics
- Crosslinker: Used in laundry detergents

Friction Reducer
- Used in cosmetics

Gelling Agent
- Used in toothpastes

Iron Control
- Used in food additives

pH Adjusting Agent
- Used in many bar soaps

Scale Inhibitor
- Used in household cleaners

Surfactant
- Used in deodorant

Percentage of Water Used by Category:
- Irrigation: 37%
- Thermoelectric Power: 41%
- Public Supply: 12%
- Livestock: 1%
- Mining and Oil & Gas: 1%
- Industrial: 5%
- Domestic: 1%
- Aquaculture: 2%
- Total: 100%
Statewide Data

• FracFocus data for Jan 30, 2011 –Dec 31, 2013
  – 1505 Disclosures received voluntarily
  – Average water usage = **88,311 gallons** per job
  – Average Depth of Well = **1817’ TVD**

• 2014 Division Well Stimulation Data (Most HF)
  – 1000 + notices posted to website for 2014
  – Average water usage = **63,000 gallons** per job
  – 98% of Well Stimulation treatments occur in Kern County
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Fracture propagation is rate sensitive: could this be exploited to increase fracture density, control geometry, and reduce water use?

Swift & Kusubov (1982)

Dally et al., (1975)