

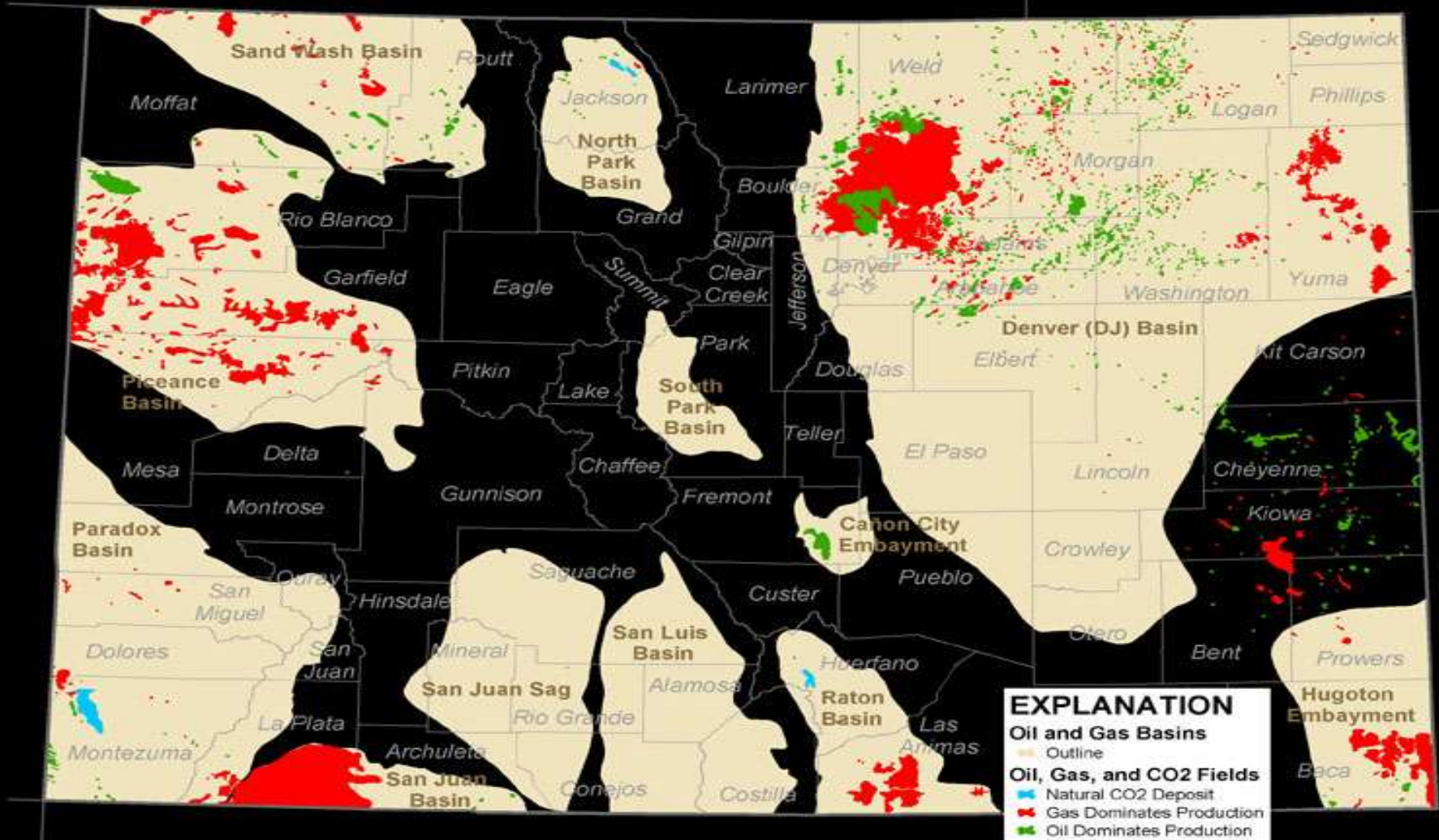


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**OIL & GAS**  
**ASSOCIATION**

**CUSP**

**April 11, 2014**

# ▶▶▶ O&G in Colorado



# ▶▶▶ Colorado's O&G Industry

- 51,814 active wells
- 6<sup>th</sup> highest state in natural gas production
- 9<sup>th</sup> highest state in crude oil production
- \$1.6B in public revenue
- 111,000 jobs
- \$500 Million to Education

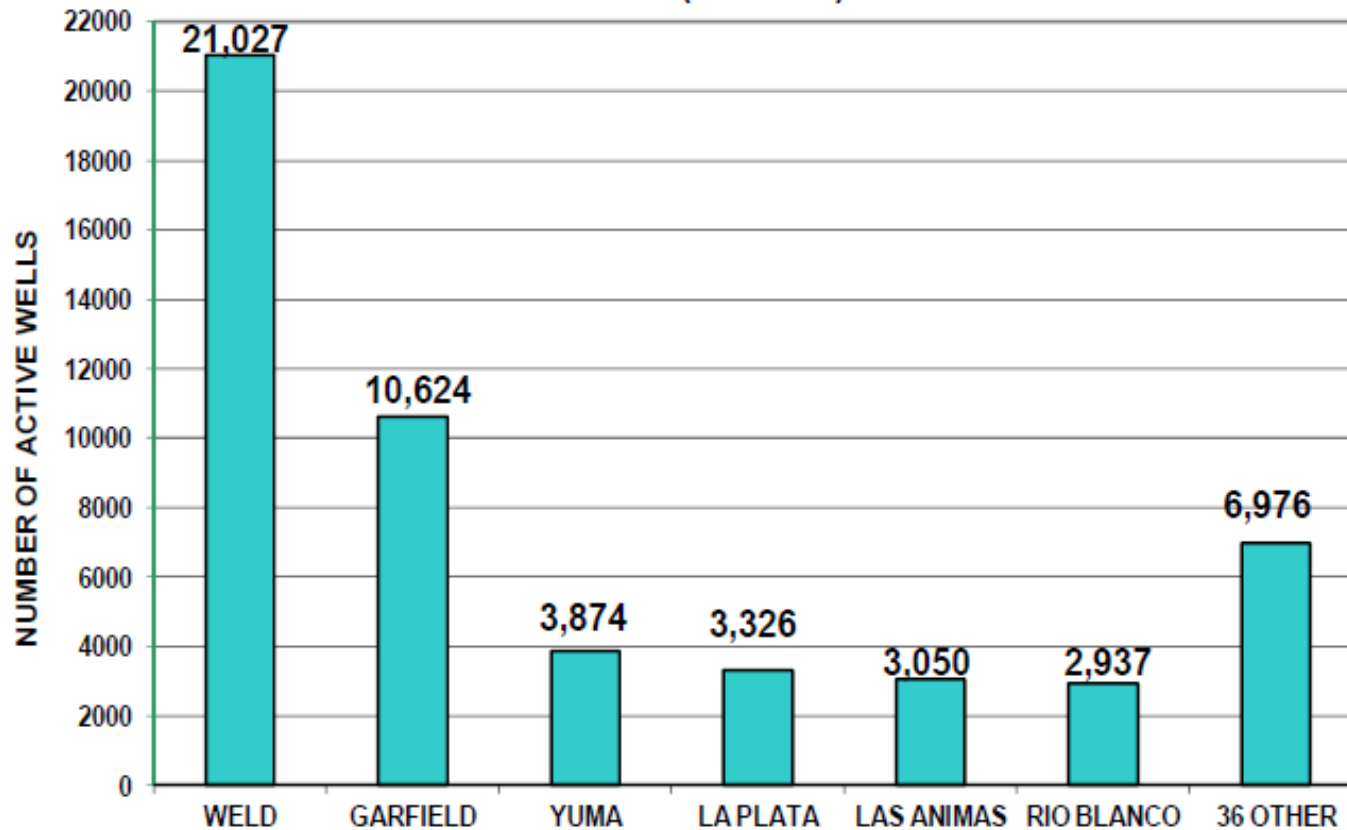


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# ▶▶▶ Active Wells

## NUMBER OF ACTIVE COLORADO OIL & GAS WELLS BY COUNTY

87.0% of Colorado's 51,814 active wells are located in these 6 counties  
(03-04-14)

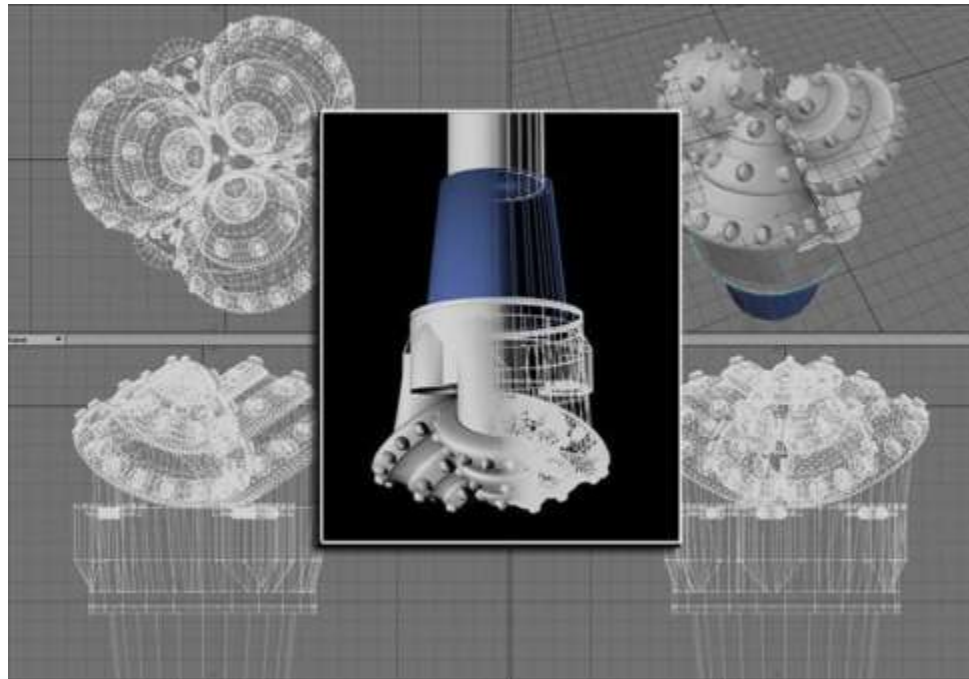


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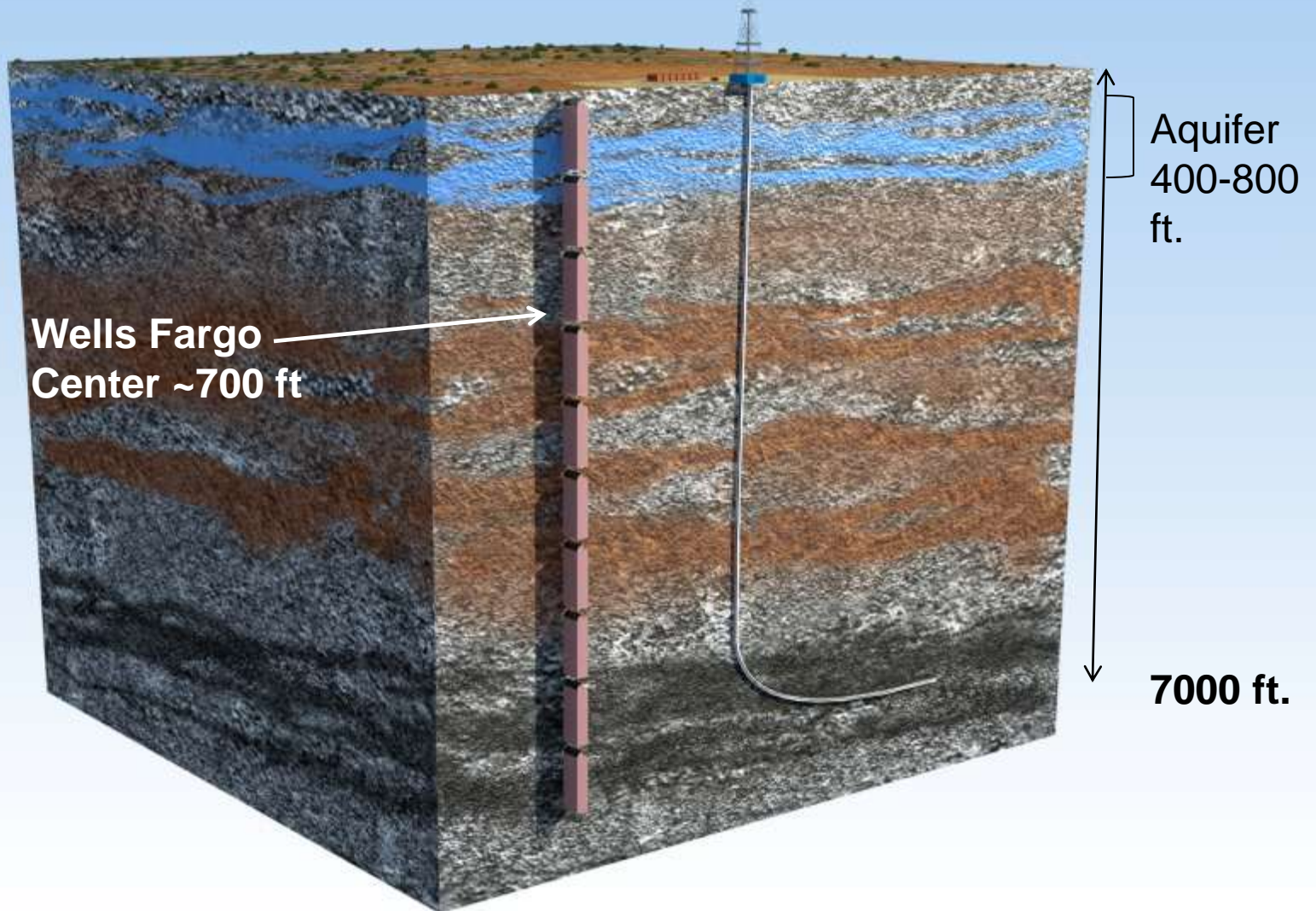


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# Drilling

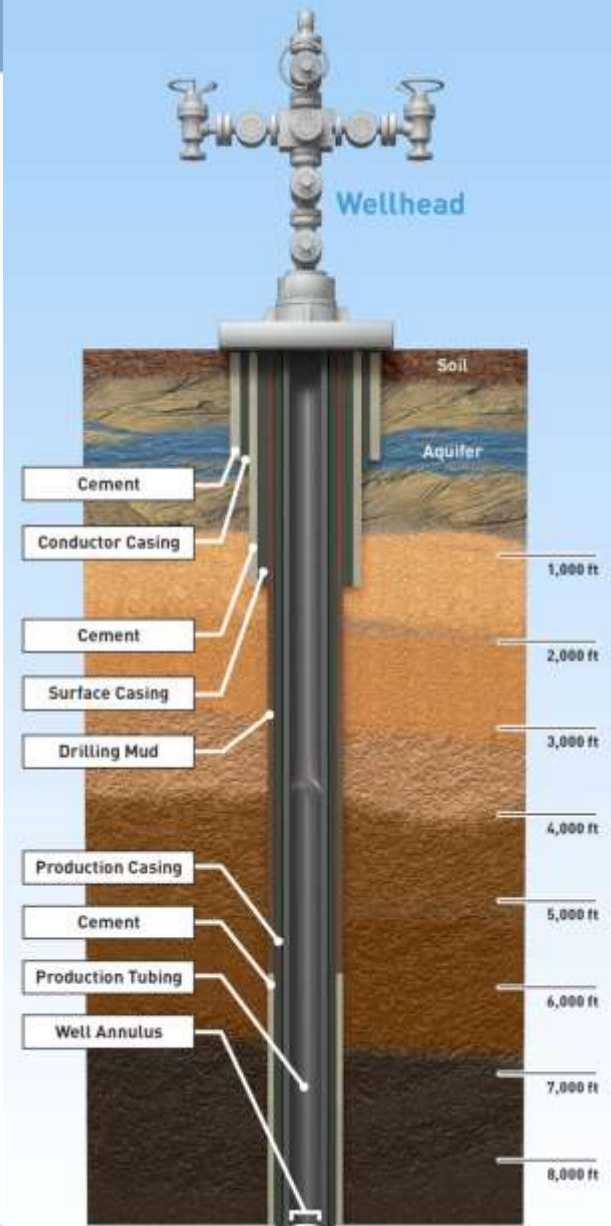


# ▶▶▶ Drilling Distance



# ▶▶▶ Casing

- Multiple layers surrounding the aquifer
  - Cement
  - Conductor Casing
  - Cement
  - Surface Casing
  - Drilling Mud
  - Production Casing
  - Cement
  - Production Tubing
  - Well Annulus



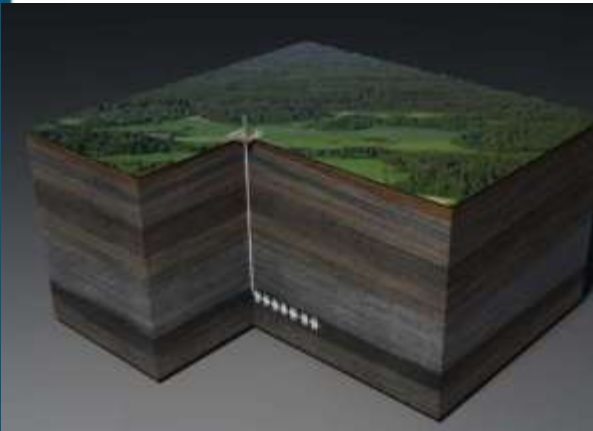
# ▶▶▶ Hydraulic Fracturing

- Very little “conventional” production
- Over 95% of the wells drilled in the U.S. and in Colorado are hydraulically fractured
  - Over 1 million wells in U.S., 2 million worldwide
- No Hydraulic Fracturing = No Oil and Gas



## ▶▶▶ Definition

- The use of fluids to create a crack by hydraulic pressure
- The continued injection of fluids into the created crack fracture to make it grow larger
- The placement of small granular solids into the crack to ensure the crack remains open after the hydraulic pressure is no longer applied



# ▶▶▶ Why HF a Well?

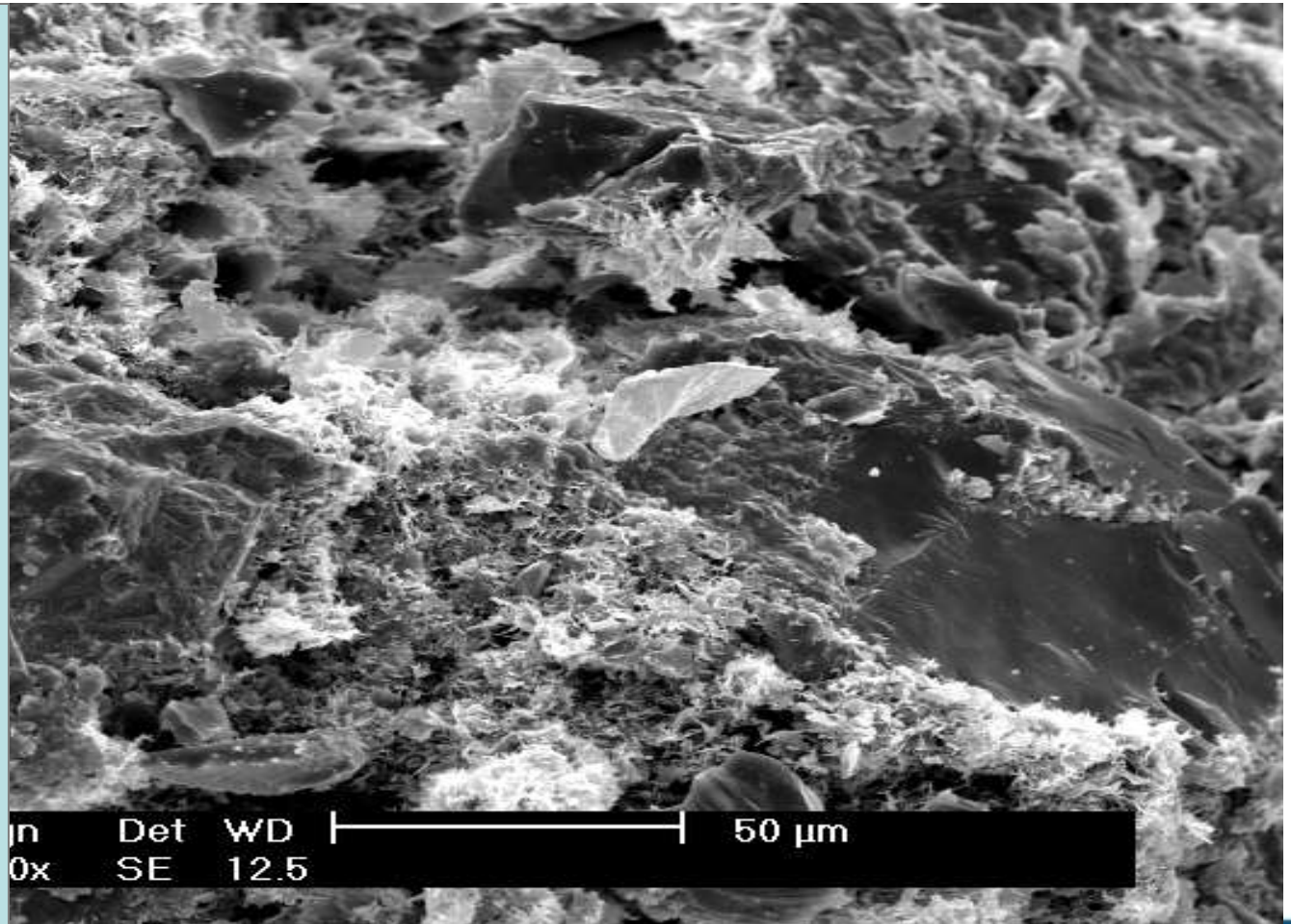
## Electronic Microscope Image of Rock

Magnification: 1000X

Filename: S0178.tif

Width of a human  
hair

100  $\mu\text{m}$

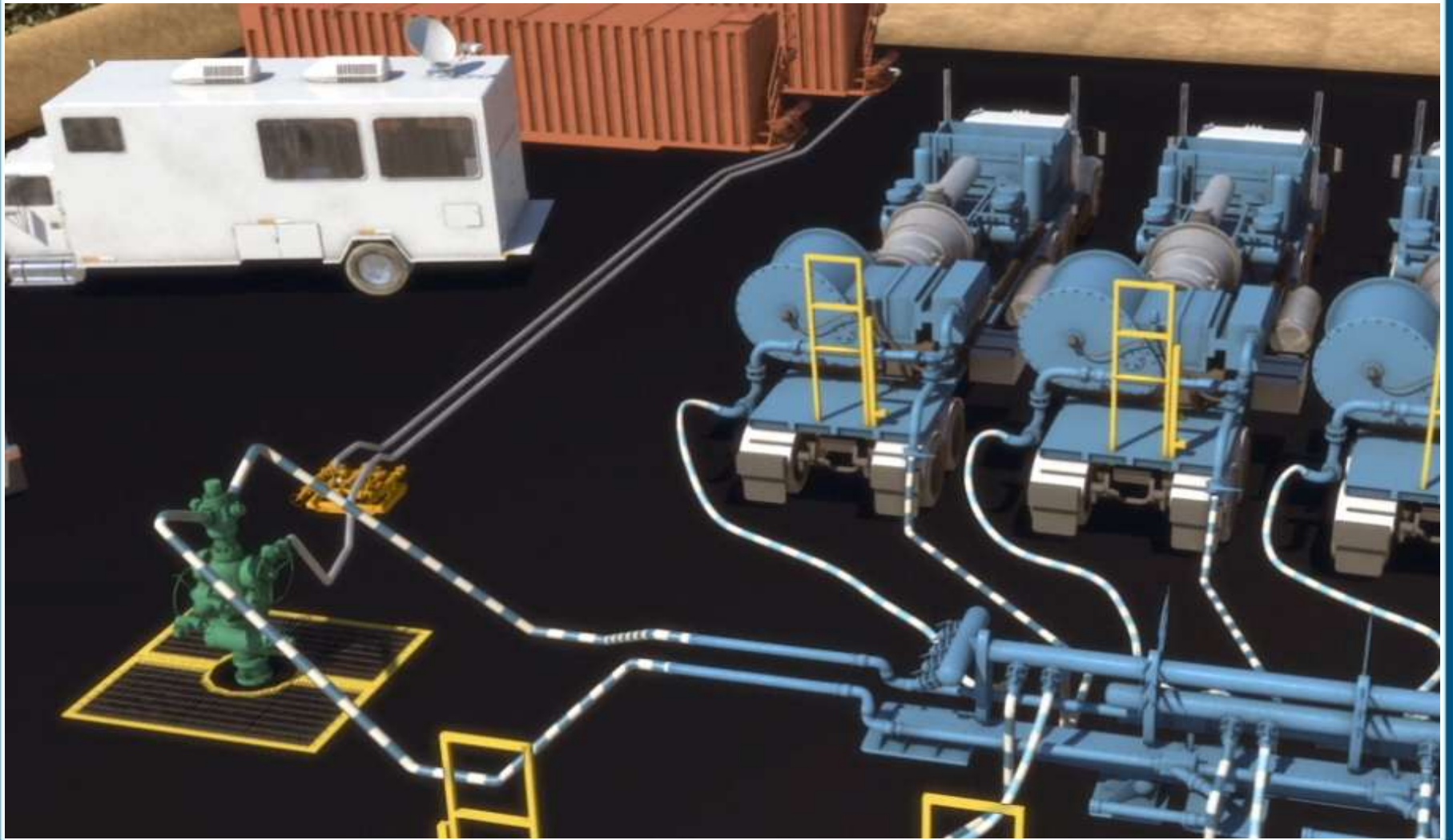


# ▶▶▶ Perforation Gun

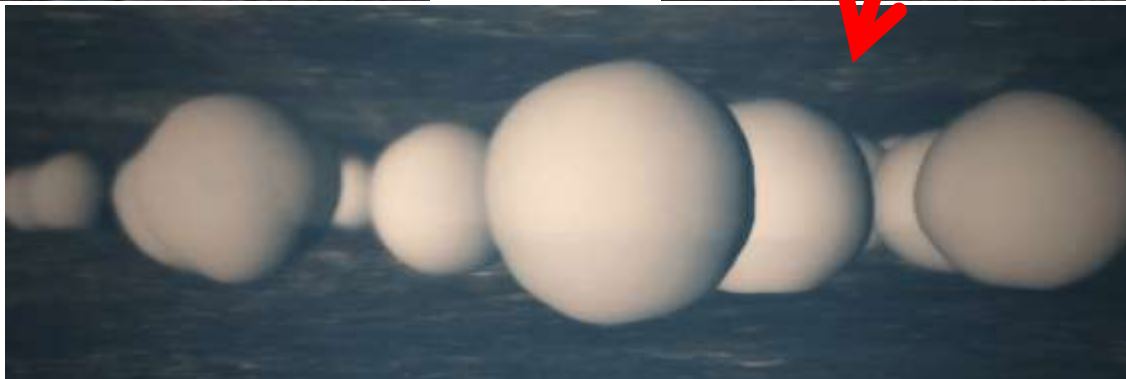


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# ▶▶▶ Water is Pumped



# ▶▶▶ Fractures and Proppant



# ▶▶▶ Footprint



# ▶▶▶ FracFocus Website

The screenshot shows the FracFocus website homepage. At the top, there is a navigation menu with links for Welcome, Publications, News & Updates, Projects & Partnerships, and Links. Below this is the FracFocus logo and a secondary navigation bar with categories: HYDRAULIC FRACTURING (HOW IT WORKS), GROUNDWATER PROTECTION, FIND A WELL (BY STATE), REGULATIONS (BY STATE), CHEMICALS GLOSSARY, and FREQUENT QUESTIONS. The main content area features a large 'WELCOME' banner with a background image of water splashing. Below the banner is a paragraph of introductory text and a 'LEARN MORE' button. To the right, there is a section titled 'Looking for information about a well site near you?' with a map of the United States and a 'FIND A WELL' button. Below the map is a search instruction. At the bottom left, there is a section titled 'Is groundwater protected?' with a small image of a well. At the bottom right, there is a 'FAQs' section with a '1/3' indicator and a question about the source of water for hydraulic fracturing, followed by an answer.

Welcome / Publications / News & Updates / Projects & Partnerships / Links

**Frac Focus**  
Chemical Disclosure Registry

**HYDRAULIC FRACTURING**  
HOW IT WORKS

**GROUNDWATER PROTECTION**

**FIND A WELL**  
BY STATE

**REGULATIONS**  
BY STATE

**CHEMICALS**  
GLOSSARY

**FREQUENT**  
QUESTIONS

# WELCOME

Welcome to FracFocus, the hydraulic fracturing chemical registry website. This website is a joint project of the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission.

On this site you can search for information about the chemicals used in the hydraulic fracturing of oil and gas wells. You will also find educational materials designed to help you put this information in perspective.

[LEARN MORE >](#)

**Looking for information about a well site near you?**

**FIND A WELL**

Search for nearby well sites that have been hydraulically fractured to see what chemicals were used in the process.

**FAQs** 1/3

**Q.** Where does the water for hydraulic fracturing come from?

**A.** Although the source of water for fracturing can come from surface water, ground water or both, the volumes of water needed for fracturing horizontal shale gas wells necessitate that, with some notable exceptions like the Barnett shale in Texas, surface water provide the bulk of the water used in most areas of the country. Water can be taken from streams, ponds or artificial impoundments, or can be purchased from water providers such as a municipality. In some cases recycled water from prior hydraulic fracturing

**Is groundwater protected?**

**Groundwater Protection: Priority Number One**

Oil and natural gas producers have stringent requirements for how wells must be completed. The genesis of these requirements is water safety.

# ▶▶▶ Water Management



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## ▶▶▶ Amount of Water

- The amount of water needed depends on the geologic basin, the formation, and the well.
  - Raton Basin, approximately 50,000 to 300,000 gallons may be for a shallow coalbed methane well
  - Piceance Basin, approximately 800,000 to 2 million gallons for a deeper tight sand gas well.
  - DJ Basin, approximately 250,000 gallons may be used to frac a vertical well, while up to 5 million gallons may be used to frac a horizontal well.
    - (Niobrara wells consistently demonstrate use of ~2.5 million gallons)

## ▶▶▶ Sources of Water

- Use of Water Must be Legally Allowed
  - Municipal lease/purchase (industrial uses)
  - Changed water rights (e.g. temp agricultural to industrial)
  - Fully consumed water (leased/purchase effluent)
  - Produced water (non-trib or decreed trib & augmented)
  - Non-tributary (landowner & operator agreement)

Source - COGCC

# ▶▶▶ Colorado Water Use

Sector	2010 Use (Acre-Feet/Yr) <sup>4</sup>	Percent of State Total
<b>Total</b>	<b>16,359,700</b>	
Agriculture	13,981,100	85.5%
Municipal and Industrial	1,218,600	7.4%
Total All Others	1,160,000	7.1%
<b>Breakdown of "All Others"</b>		
<b>Total All Others</b>	<b>1,160,000</b>	
Recreation	923,100	5.64%
Large Industry	136,000	0.83%
Thermoelectric Power Generation	76,600	0.47%
<b>Hydraulic Fracturing</b>	<b>13,900</b>	<b>0.08%</b>
Snowmaking	5,300	0.03%
Coal, Natural Gas, Uranium, and Solar Development	5,100	0.03%
Oil Shale Development	0	0.00%

## ▶▶▶ Estimated Water Use

Projection of Annual Demand for Hydraulic Fracturing (Acre-Feet <sup>2</sup> ) <sup>3</sup>					
2010	2011	2012	2013	2014	2015
13,900	14,900	16,100	16,900	17,800	18,700

- 2015: 0.10% of total water use

One Acre Foot is Approximately 326,000 Gallons

Source: COGCC

## ▶▶▶ Recycling Rates

- Front Range: ~50% produced water and >90% flowback water
- Piceance Basin: 99% produced and flowback water
- Southern Basins: Wells produce more water than gas, fresher than other basins



# ▶▶▶ Groundwater & Surface Water Protection

The prevention of adverse environmental impacts

- Downhole review of casing & cementing plan
- Review of Location Drawing, Hydrology Map submitted with Form 2A
- Review of surrounding water wells & well data
- Review of surface water features
- Review of operator provided Best Management Practices (BMPs)

# ▶▶▶ Groundwater & Surface Water Protection

## **COGCC Rule 317B - Public Water System Protection**

3 zones measured out from surface water supply, for 5 miles upstream of intake

1. External Buffer: 501 – 2640'. Pitless drilling or lined pits, surface water sampling, notification to PWS, emergency spill response.
2. Intermediate Buffer: 301 – 500'. Pitless drilling, lined and oversized secondary containment, all others as required for external.
3. Internal Buffer: 0 – 300'. Variance request required, plus all requirements for Intermediate.

# ▶▶▶ Conditions of Approval (COA)

Technically feasible, economically practicable COAs may be placed on a Form 2 or Form 2A to respond to public health, safety and welfare concerns identified during staff review.

- Lined drilling pits or closed-loop (pitless) drilling systems;
- Lined tank batteries;
- Water well sampling, including baseline;
- Slope stabilization;
- Additional high density operational requirements.







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## ▶▶▶ Baseline Water Sampling

- Pre and Post-drilling water samples taken around new well starts
- Increased transparency & accountability for industry
- Database Active



## ▶▶▶ Visit US!

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- 303-861-0362
- Facebook: COGA
- Twitter: @ColoradoOilGas
- [www.coga.org](http://www.coga.org)
  - Fact Sheets
  - Press Releases
  - Events
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