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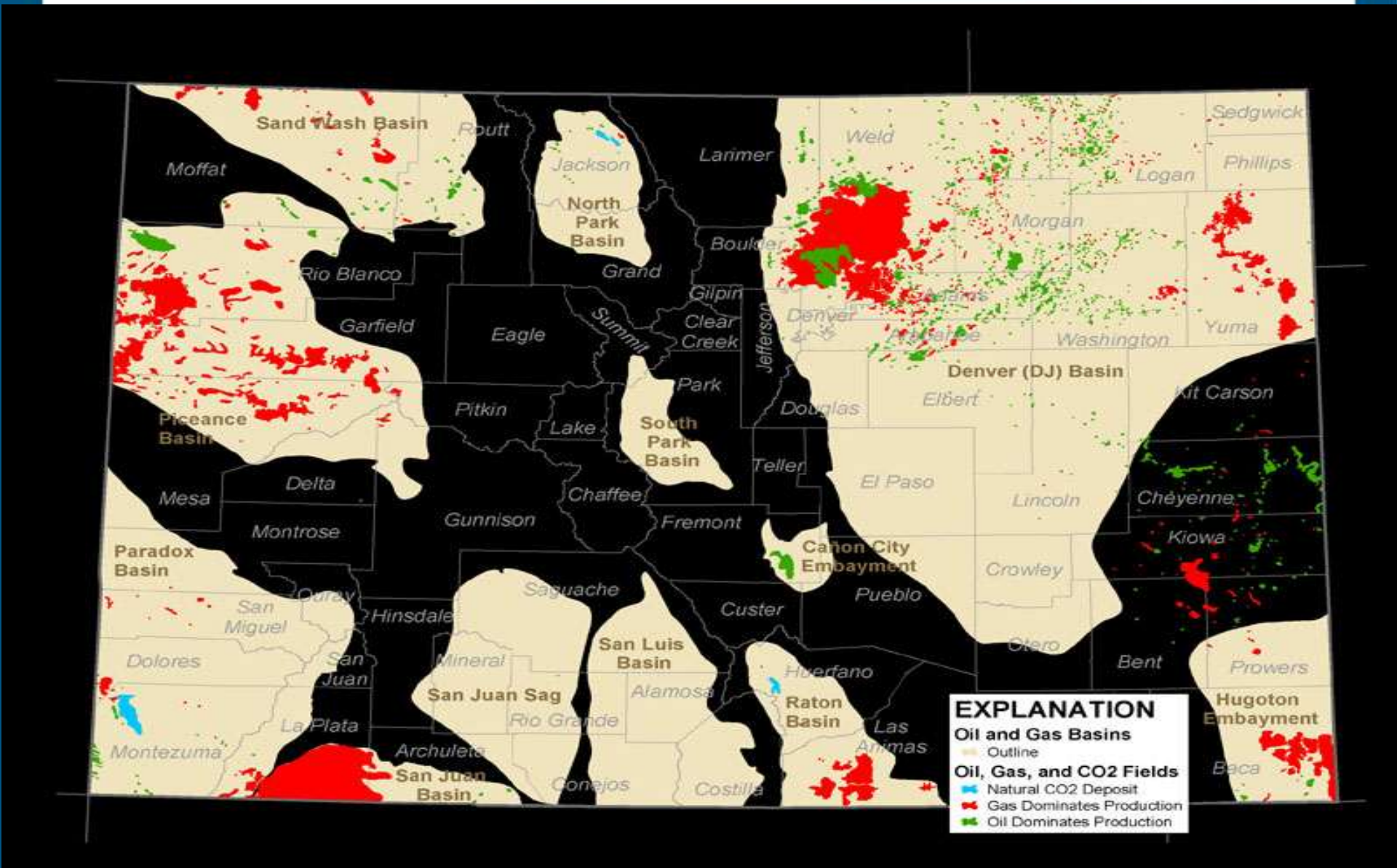
CUSP

April 11, 2014

O&G in Colorado



Colorado's O&G Industry

- 51,814 active wells
- 6th highest state in natural gas produc
- 9th highest state in crude oil productio
- $1.6B in public revenue
- 111,000 jobs
- $500 Million to Education

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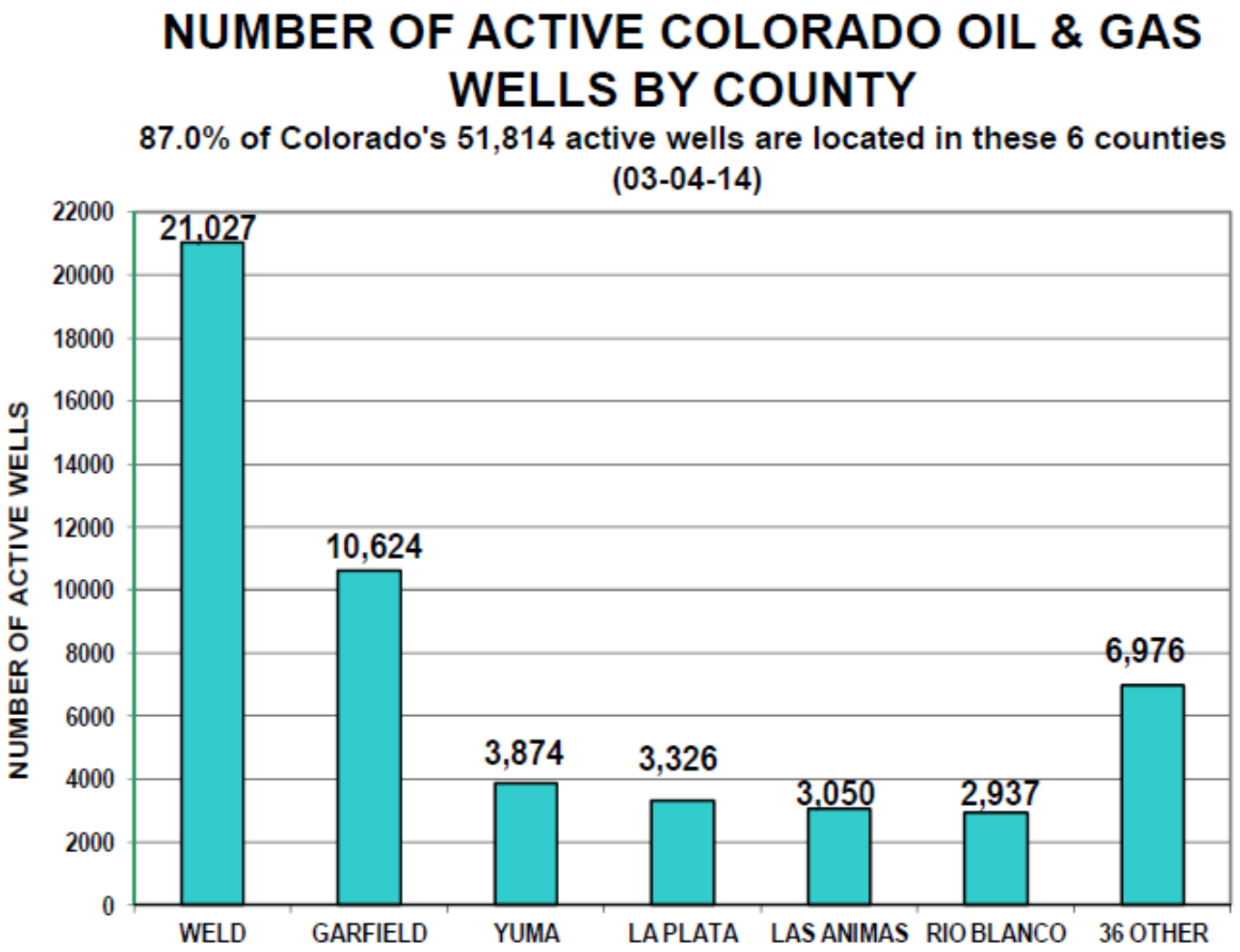
Sources: Colorado Oil and Gas Conservation Commission, Independent Petroleum Association of America.

Active Wells



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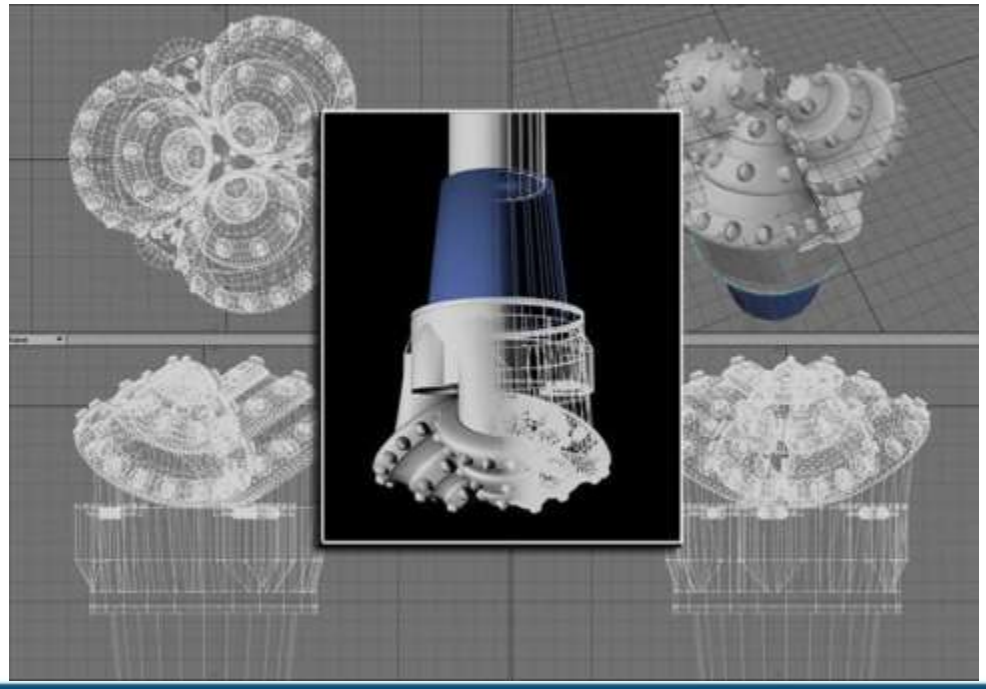
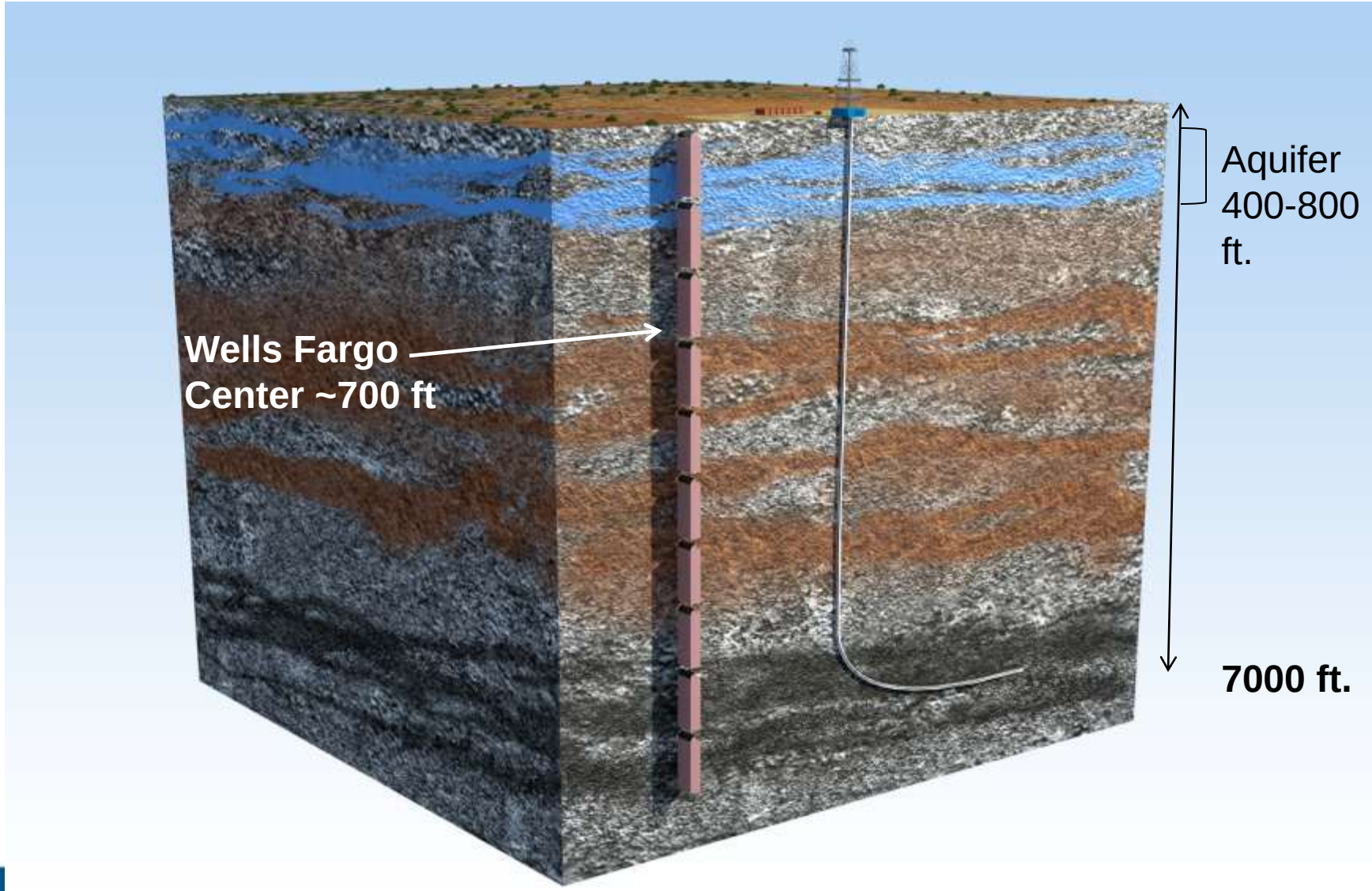
Drilling

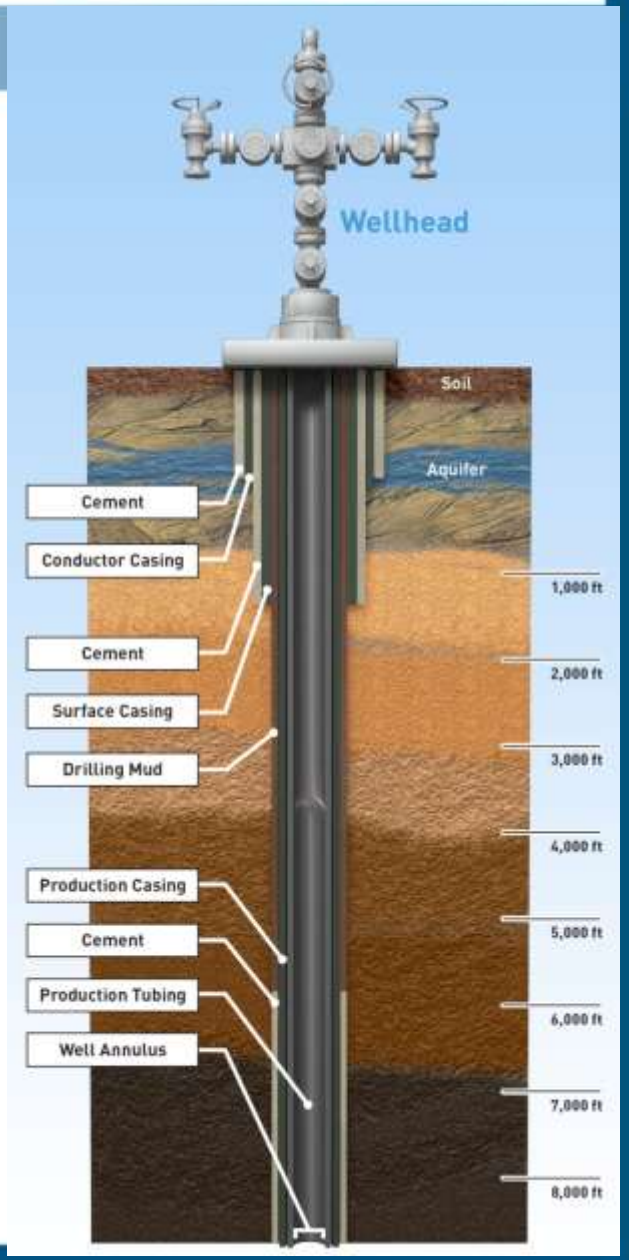


Drilling Distance



Casing

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



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

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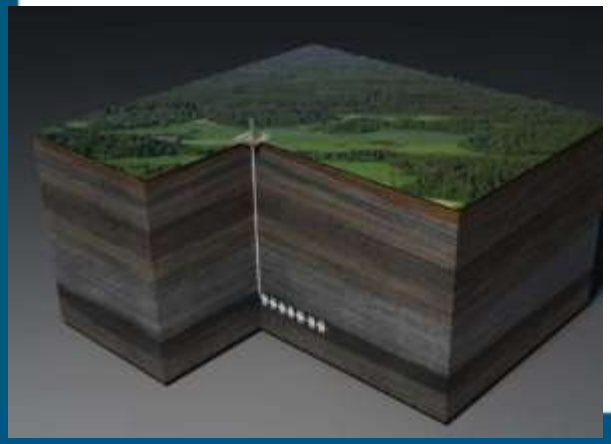
Definition

- 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



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Why HF a Well?

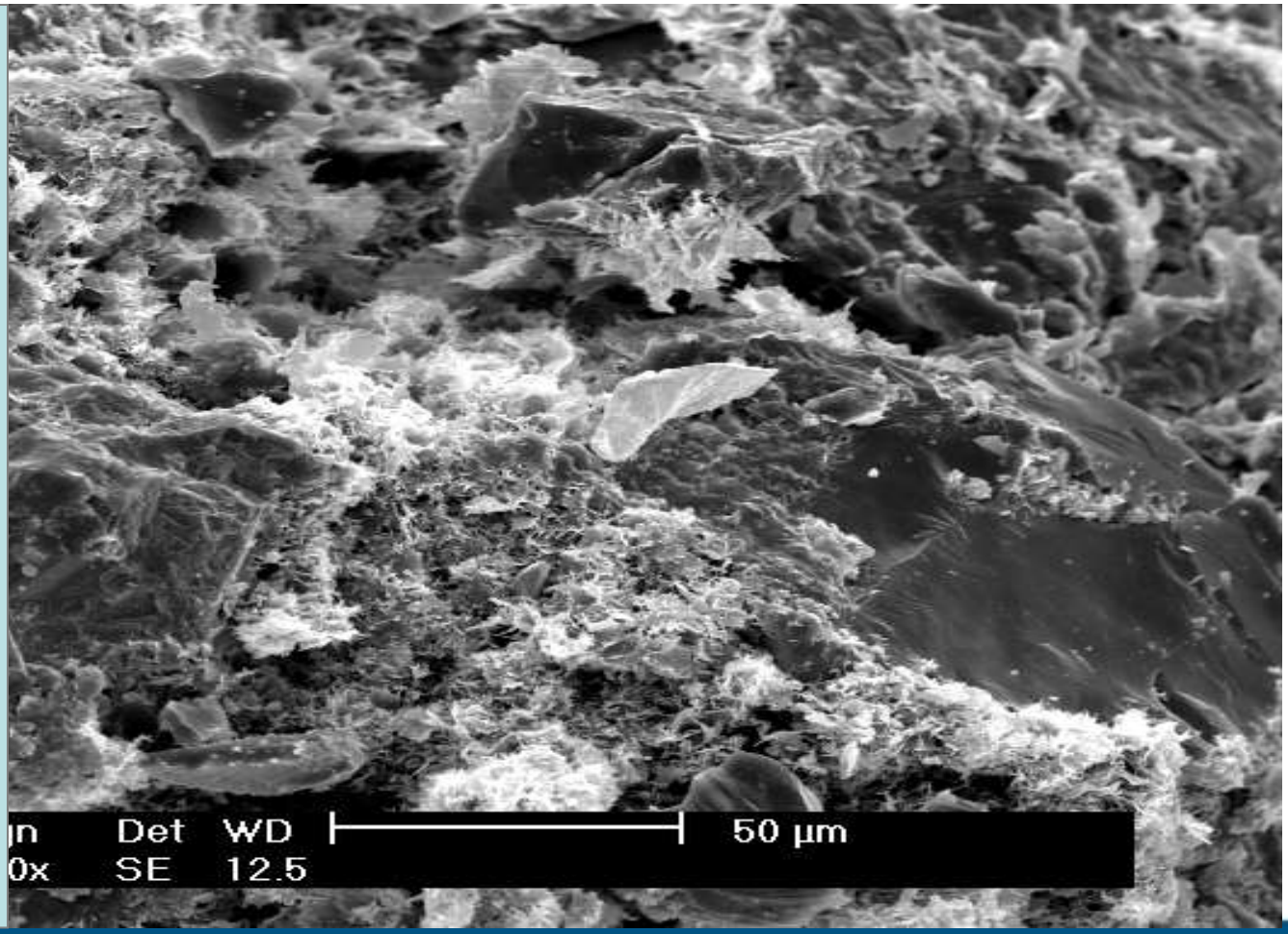
Electronic Microscope Image of Rock

Magnification: 1000X

Filename: S0178.tif

Width of a human hair

100 µm



Perforation Gun

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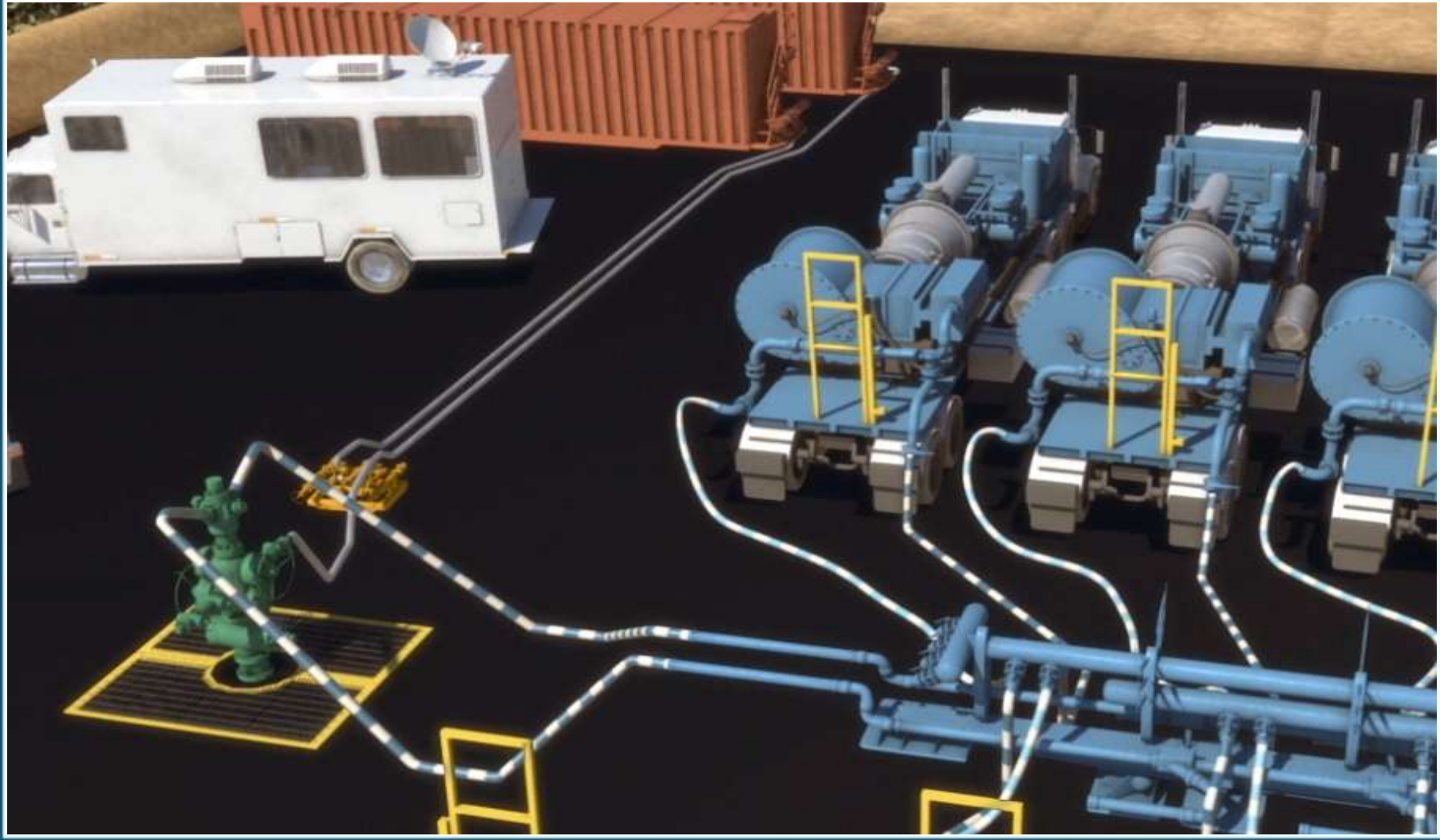
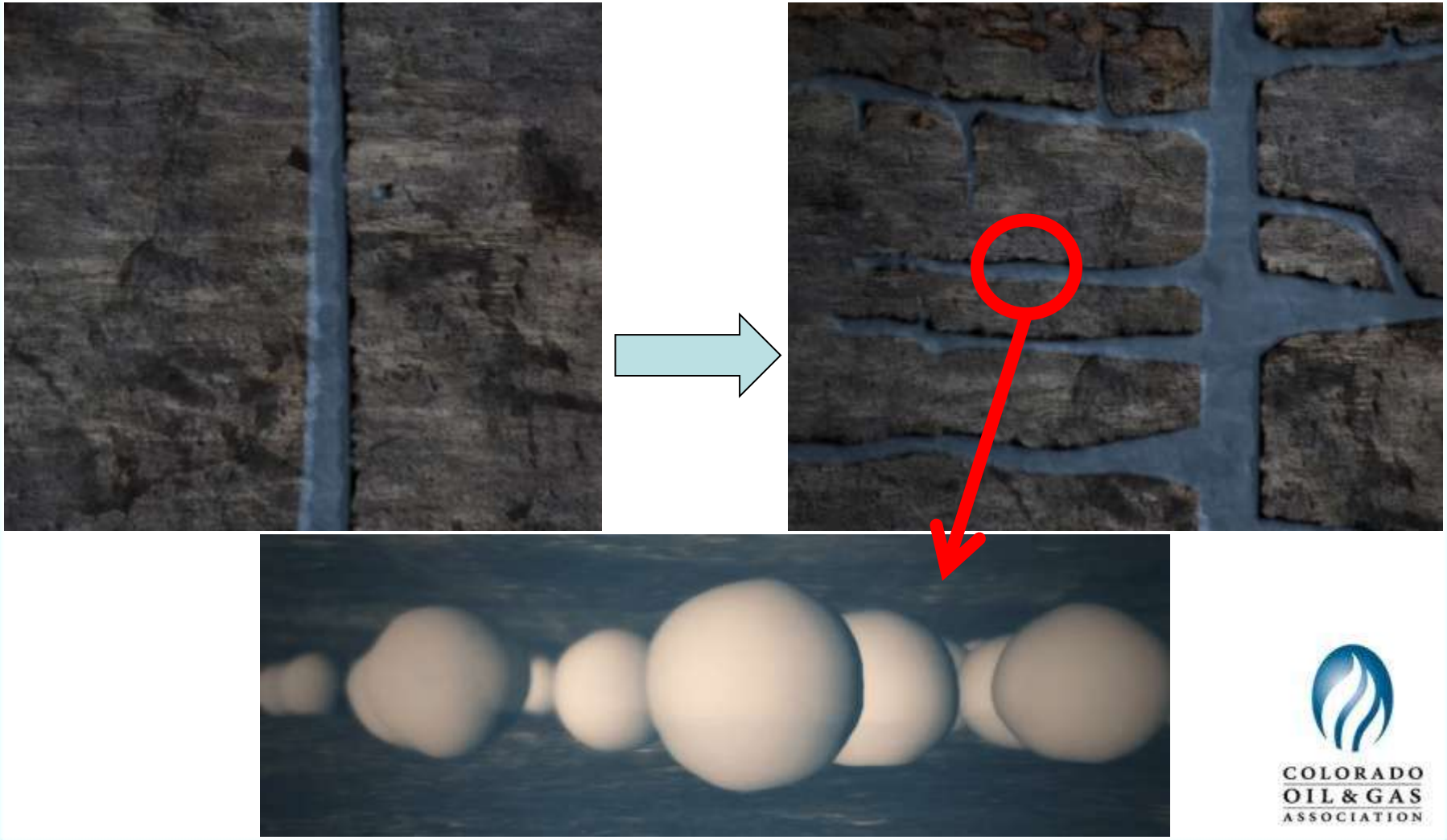
Water is Pumped



Fractures and Proppant



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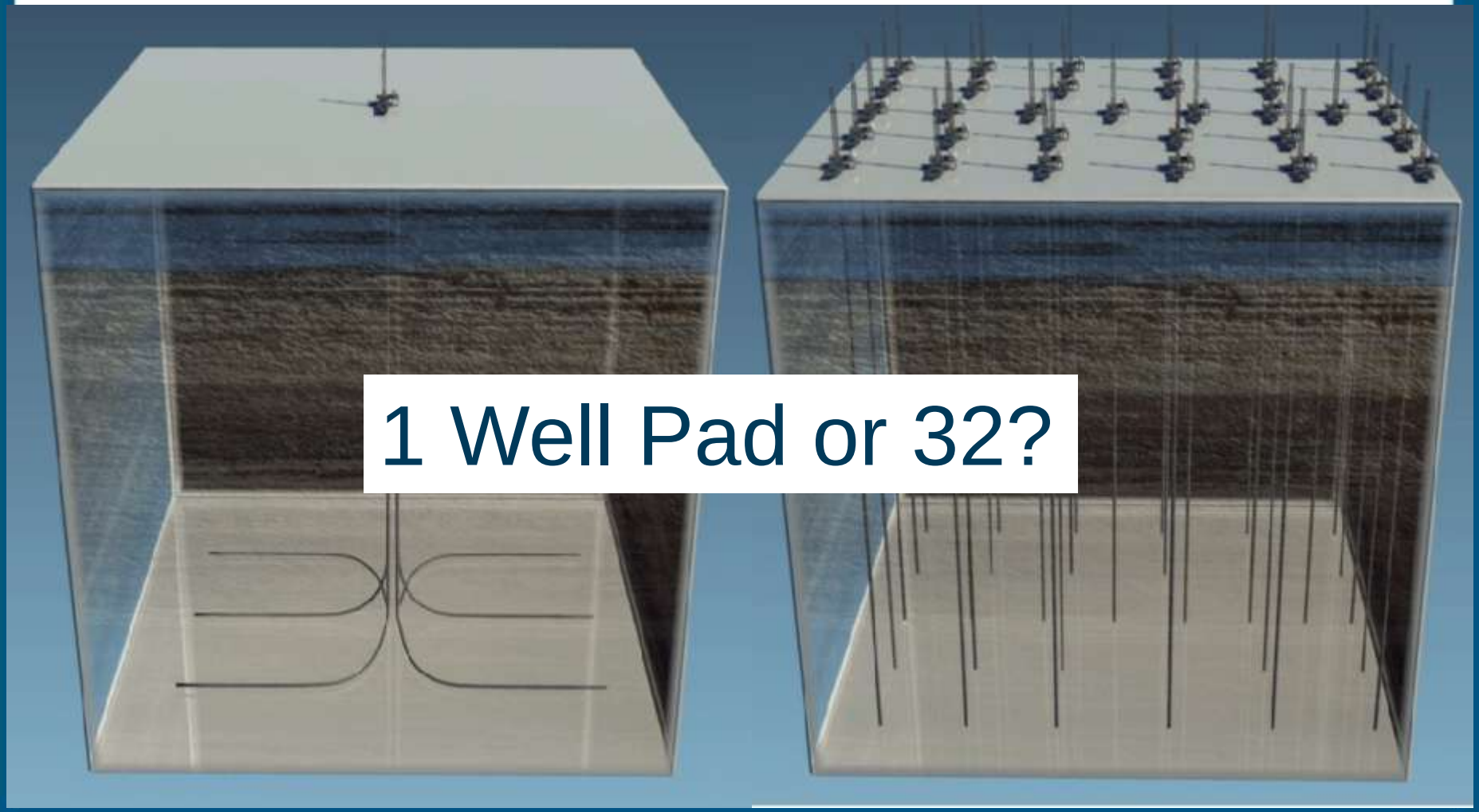
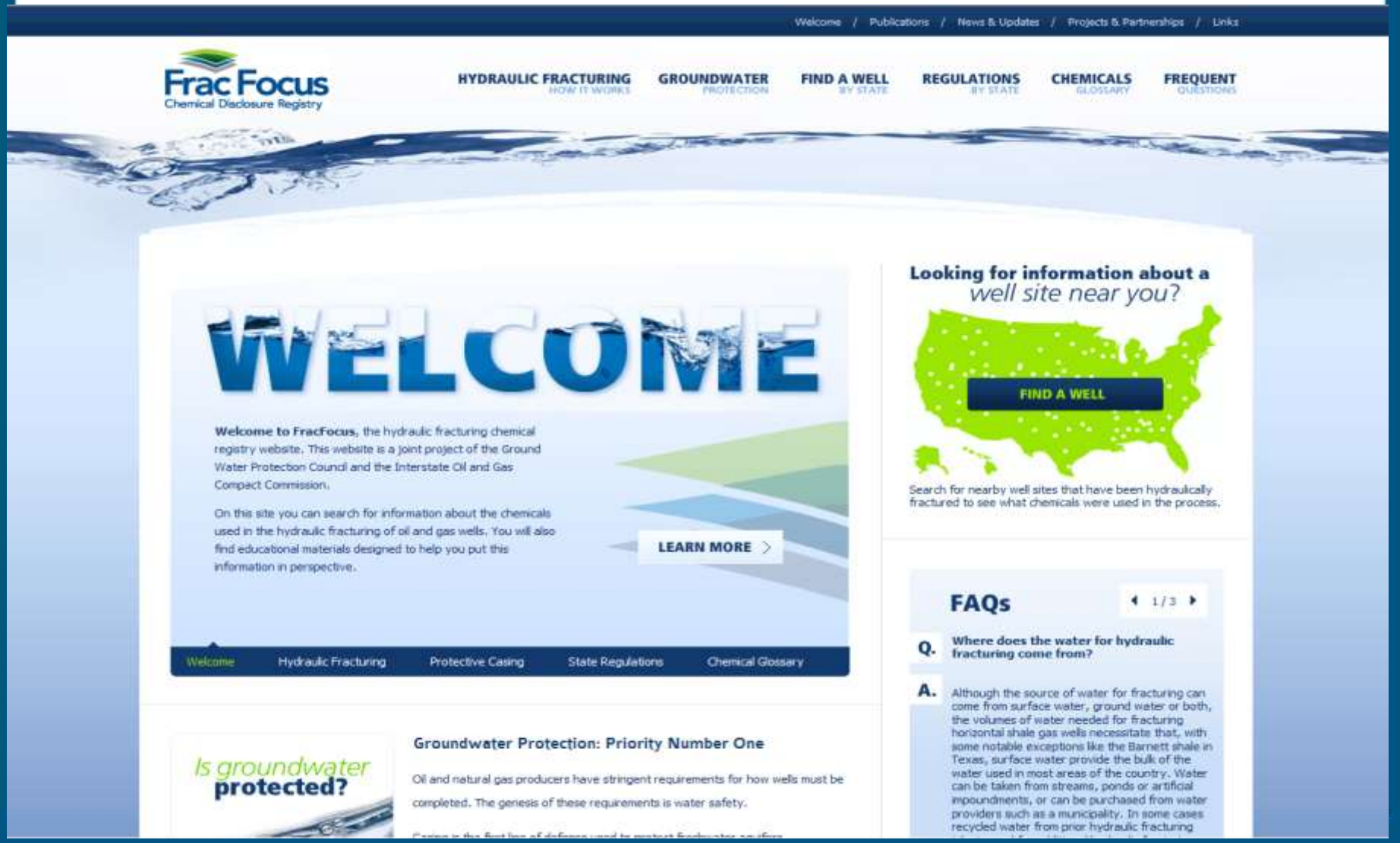
Footprint



FracFocus Website



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)

Source - COGCC

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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

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Colorado Water Use

Sector	2010 Use (Acre-Feet/Yr)[4]	Percent of State Total
Total	**16,359,700**	
Agriculture	13,981,100	85.5%
Municipal and Industrial	1,218,600	7.4%
Total All Others	1,160,000	7.1%
Breakdown of "All Others"		
Total All Others	**1,160,000**	
Recreation	923,100	5.64%
Large Industry	136,000	0.83%
Thermoelectric Power Generation	76,600	0.47%
Hydraulic Fracturing	13,900	0.08%
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[2])[3]					
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

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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

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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

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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.

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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

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