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A Primer on the Concerns associated with Oil & Gas Development

Loveland

June 12, 2012

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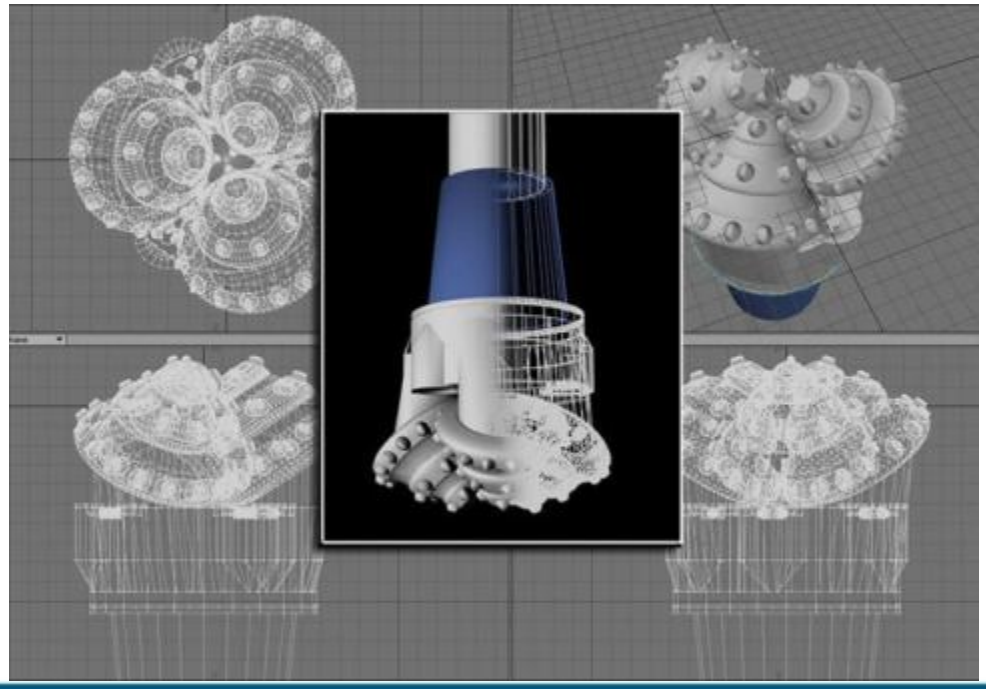
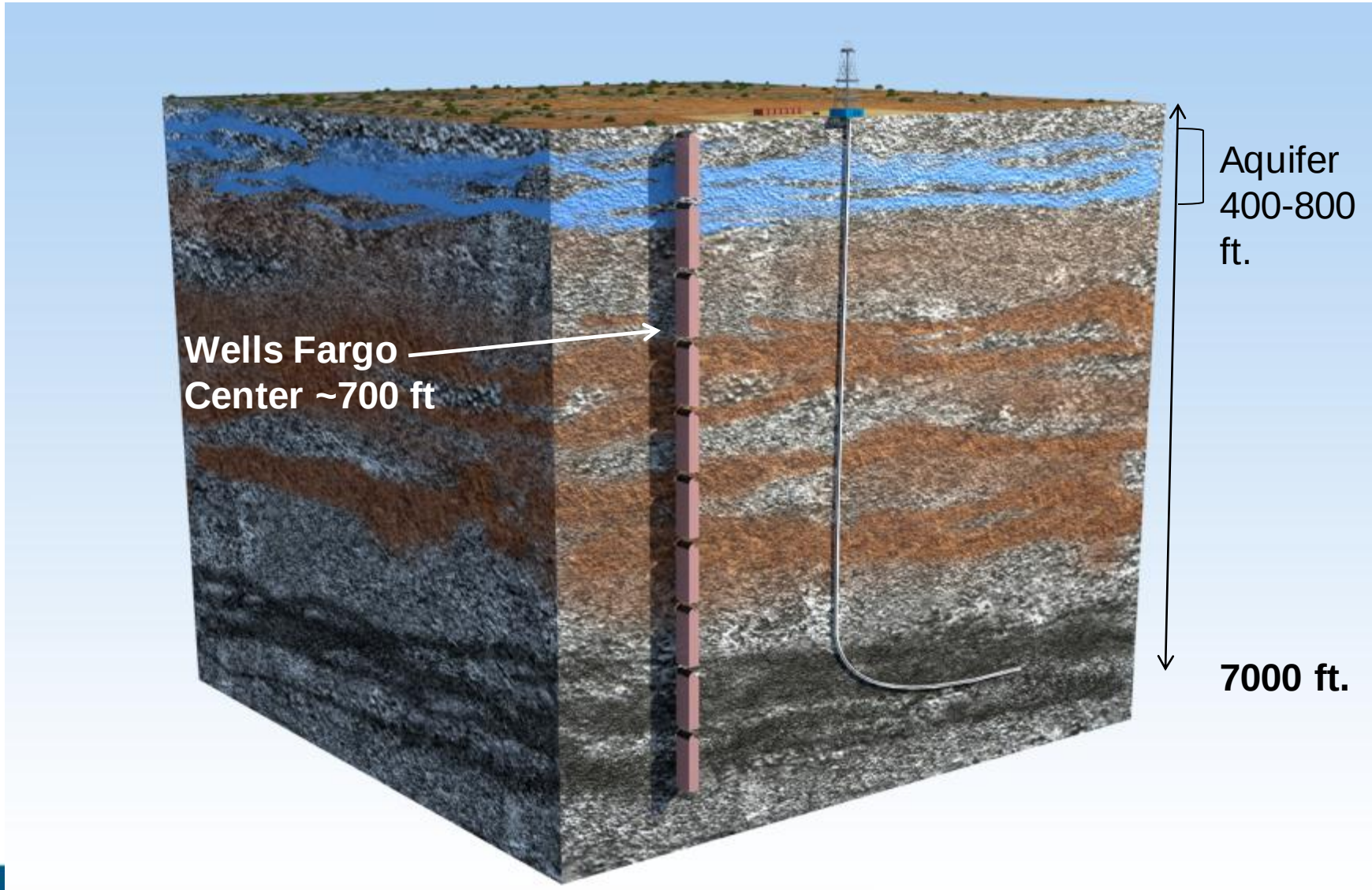
Drilling

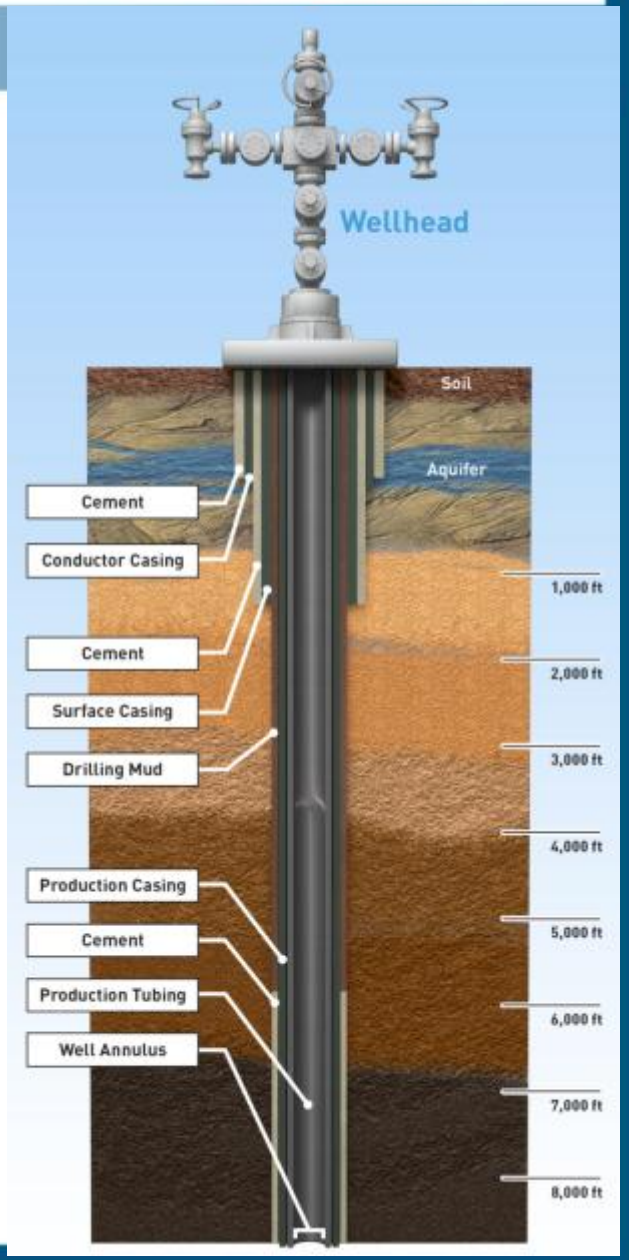


Drilling Distance



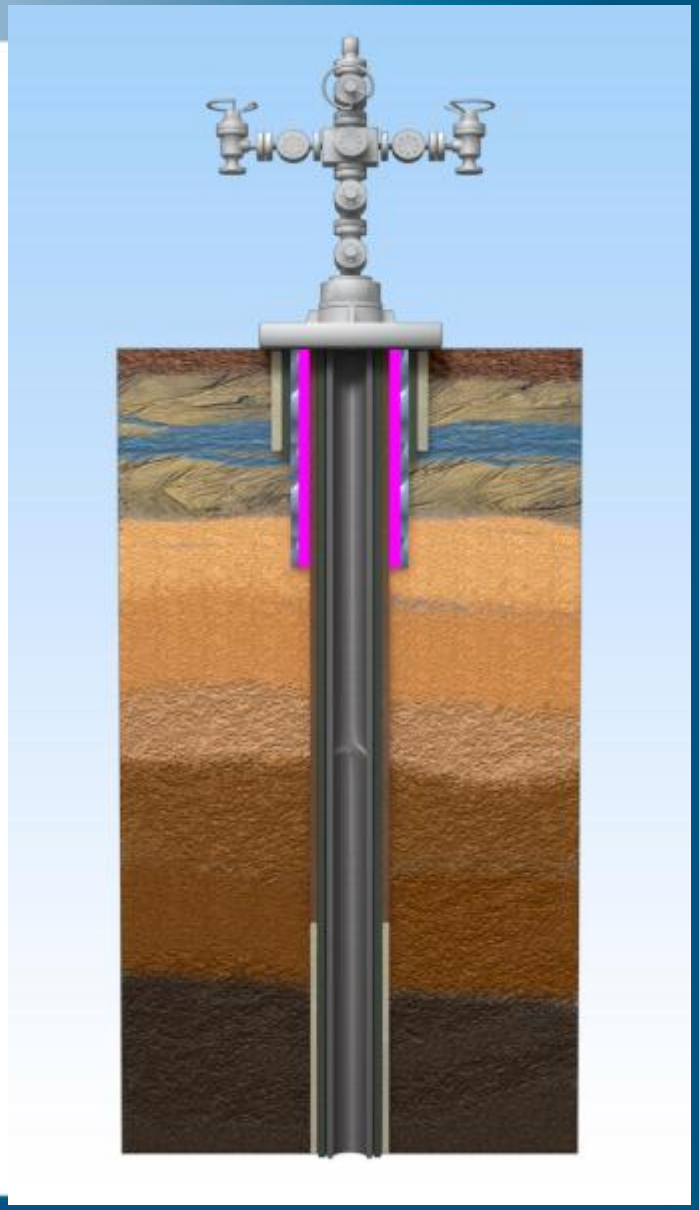
Casing

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



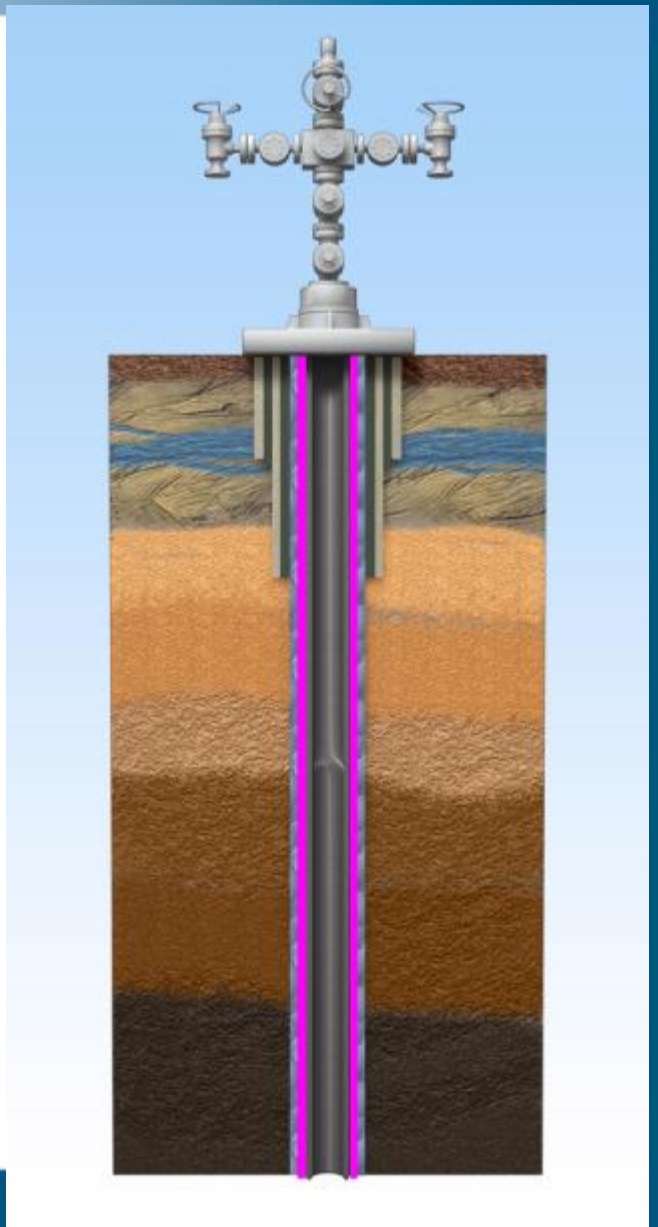
Surface Casing

- Purpose
  - Protect ground water
  - Provide stable wellbore during drilling operation
  - Provide well control during drilling
- Depth Requirements
  - Set by State and BLM regulations
  - Extends below the aquifer
- Cement Helps
  - Protect casing from corrosion
  - Provide zonal isolation
  - Support casing in wellbore

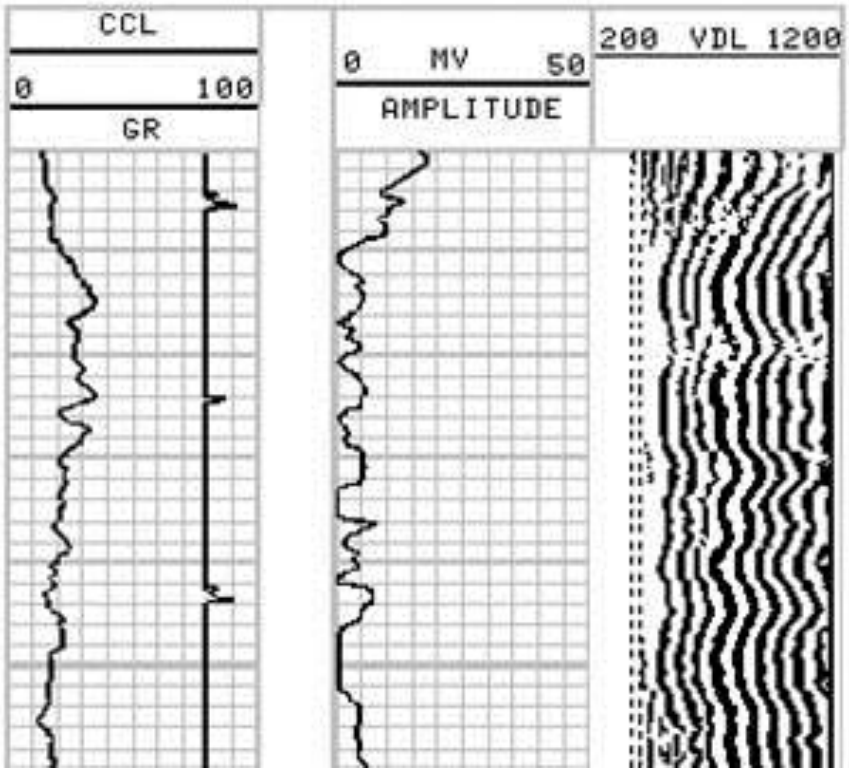


Production Casing

- Purpose
  - Provide zonal isolation
  - Provide well control
  - Well path to productive intervals
- Cement Requirements
  - Set by State regulations
  - Set by BLM regulations
  - Operator requirements
- Cement Helps
  - Protect casing from corrosion
  - Support casing in wellbore



Cement Logging & Bradenhead



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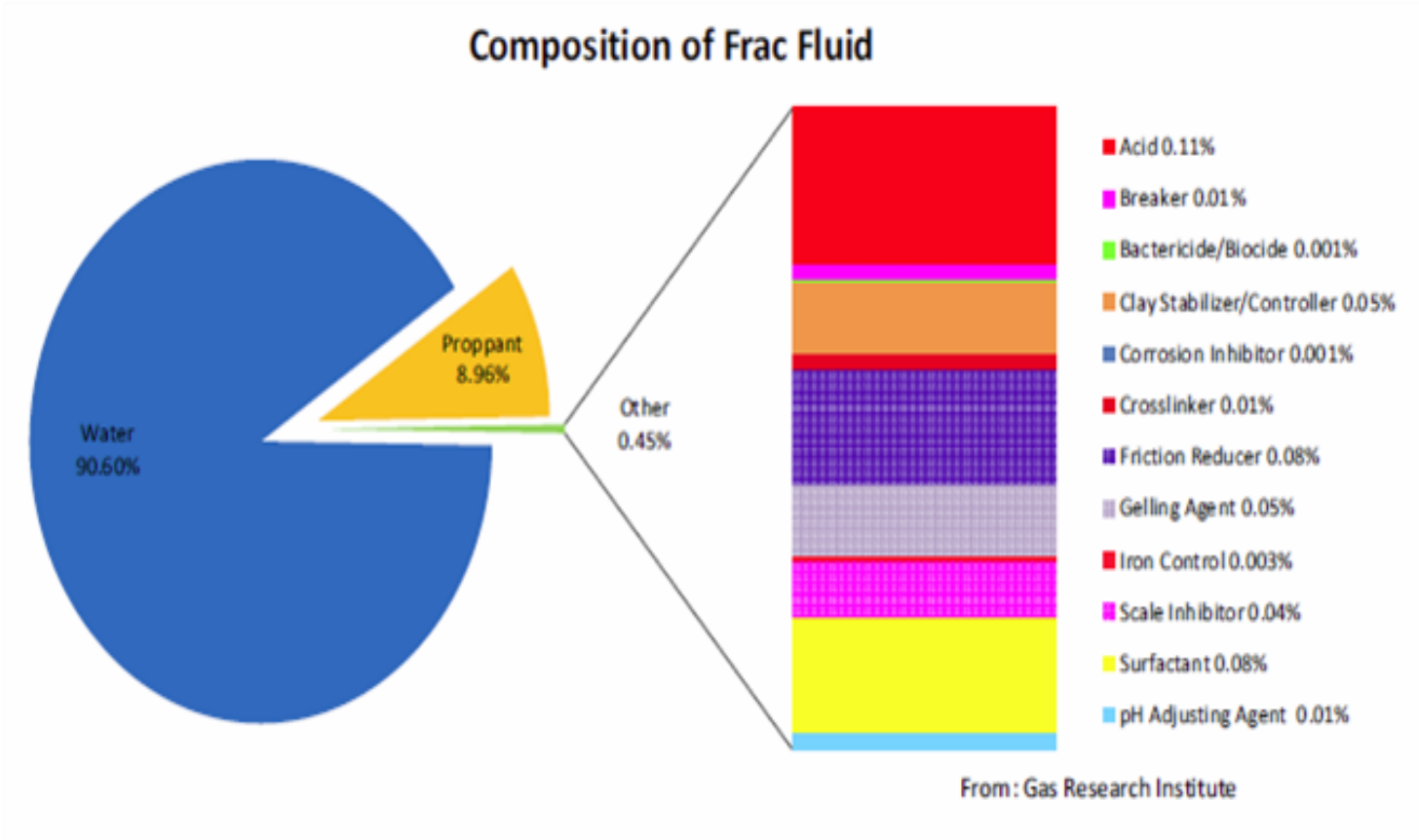
HF Disclosure

HF Fluids



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New HF Rule

- Requires public disclosure of HF chemicals using FracFocus.org
  - Well-by-well Basis
- Include MSDS Information
- Trade Secret Protection
  - File with COGCC
  - Justify Trade Secret Status

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New HF Rule

- 48 hour advance notice from Operator to the Commission is required of intention to hydraulically fracture a well.
- Stakeholder Rulemaking Process Late 2011
- Most Stringent in Nation

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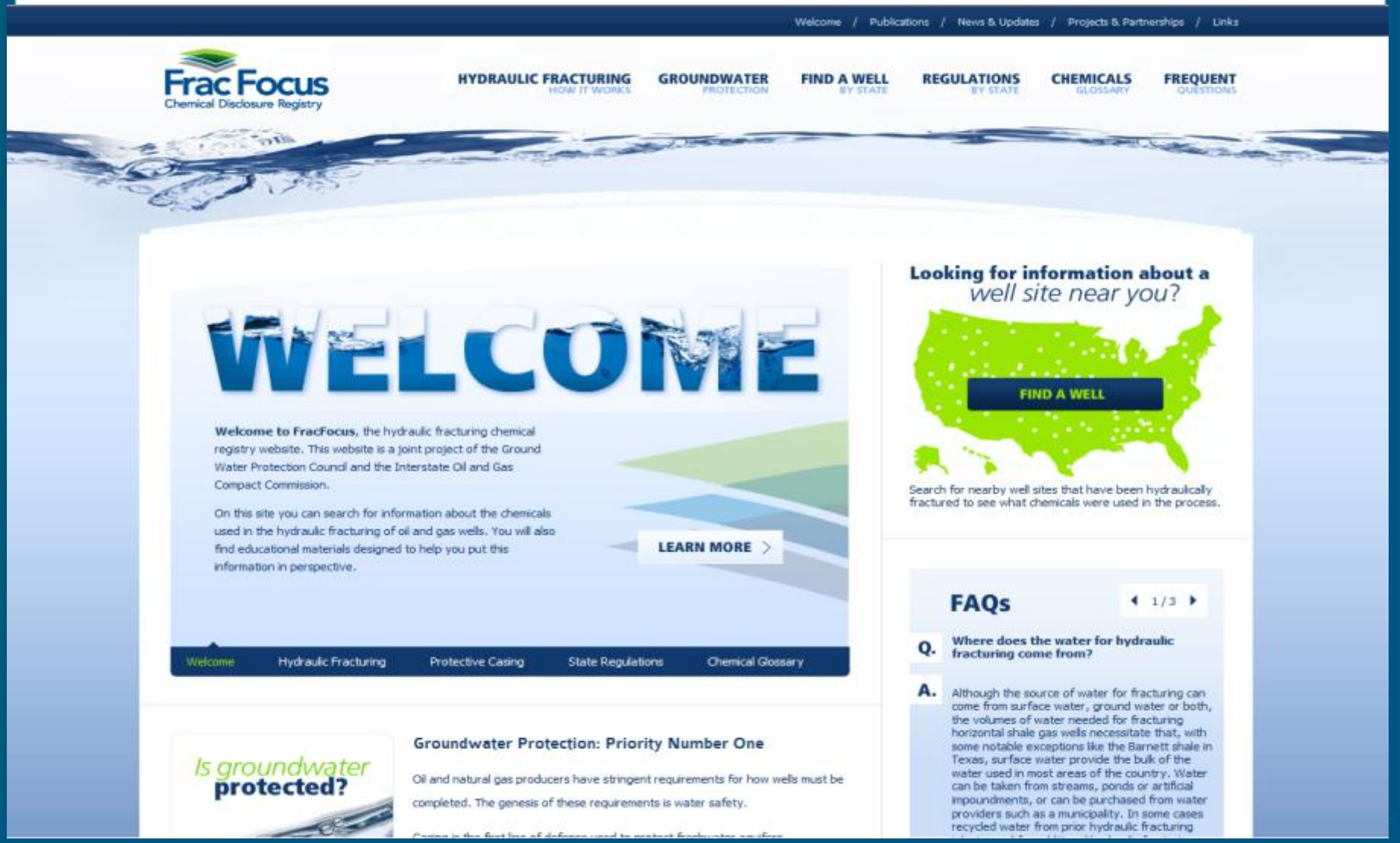
FracFocus Website



HF Disclosure Example

Hydraulic Fracturing Fluid Product Component Information Disclosure

Fracture Date:	2/17/2011
State:	OKLAHOMA
County:	ROGER MILLS
API Number:	3512923458
Operator Name:	CHESAPEAKE
Well Name and Number:	THOMAS 1-16H
Longitude:	-99.948713
Latitude:	35.510162
Long/Lat Projection:	NAD27
Production Type:	Gas
True Vertical Depth (TVD):	10,607
Total Water Volume (gal)*:	3,977,442

Hydraulic Fracturing Fluid Composition:

Trade Name	Supplier	Purpose	Ingredients	Chemical Abstract Service Number (CAS #)	Maximum Ingredient Concentration in Additive (% by Mass)**	Maximum Ingredient Concentration in HF Fluid (% by Mass)**	Comments
Fresh Water		Carrier/Base Fluid				88.72029%	
Sand (Proppant)		Proppant				10.26952%	
15 hcl	TRICAN WELL SERVICE LP	Acid	Hydrochloric Acid	007647-01-0	15.00%	0.01336%	
MC B 8650 WS	MULTI-CHEM GROUP LLC	Bactericide	Glutaraldehyde (Pentanediol)	000111-30-8	50.00%	0.01787%	
			Water	007732-18-5	50.00%	0.01787%	
			Methanol (Methyl Alcohol)	000067-56-1	0.50%	0.00018%	
CC-1 (Clay Control)	TRICAN WELL SERVICE LP	Clay Stabilizer	Choline Chloride	000067-48-1	70.00%	0.11937%	
LFR-30	TRICAN WELL SERVICE LP	Friction Reducer	Anionic Polyacrylamide Copolymer	N/A	100.00%	0.08923%	
			Petroleum Distillate	N/A	100.00%	0.08923%	
			Ammonium Chloride	N/A	2.00%	0.00178%	
WG-111L	TRICAN WELL SERVICE LP	Gelling Agent	Petroleum Distillate Blend	N/A	60.00%	0.08827%	
			Polysaccharide blend	N/A	60.00%	0.08827%	
LBK-30 EP	TRICAN WELL SERVICE LP	Breaker	Ammonium Persulfate	007727-54-0	100.00%	0.00315%	
LNE-20	TRICAN WELL SERVICE LP	Surfactant	Alcohol Alkoxylate	N/A	20.00%	0.00783%	
			Methanol (Methyl Alcohol)	000067-56-1	20.00%	0.00783%	

* Total Water Volume sources may include fresh water, produced water, and/or recycled water

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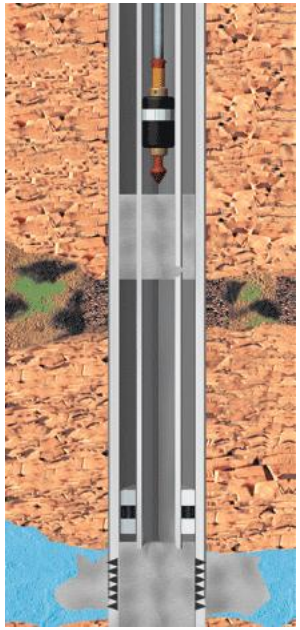
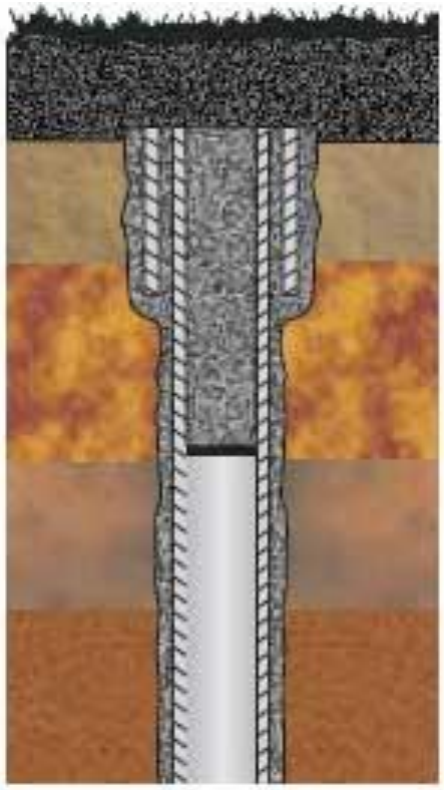
Plugging Wells



Plugging

Rule 319

- Plugging materials used must be placed in a manner to permanently prevent migration of oil, gas, water and other materials
- Multiple cement plugs are required to extend 50 feet above each producing zone



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Longevity

- High grade cement
  - Compressive strength of 800 psi
- Steel casing is protected from corrosion from outside cement layer
- Well is no longer under pressure when plugged, no risk of upward migration

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Water Use

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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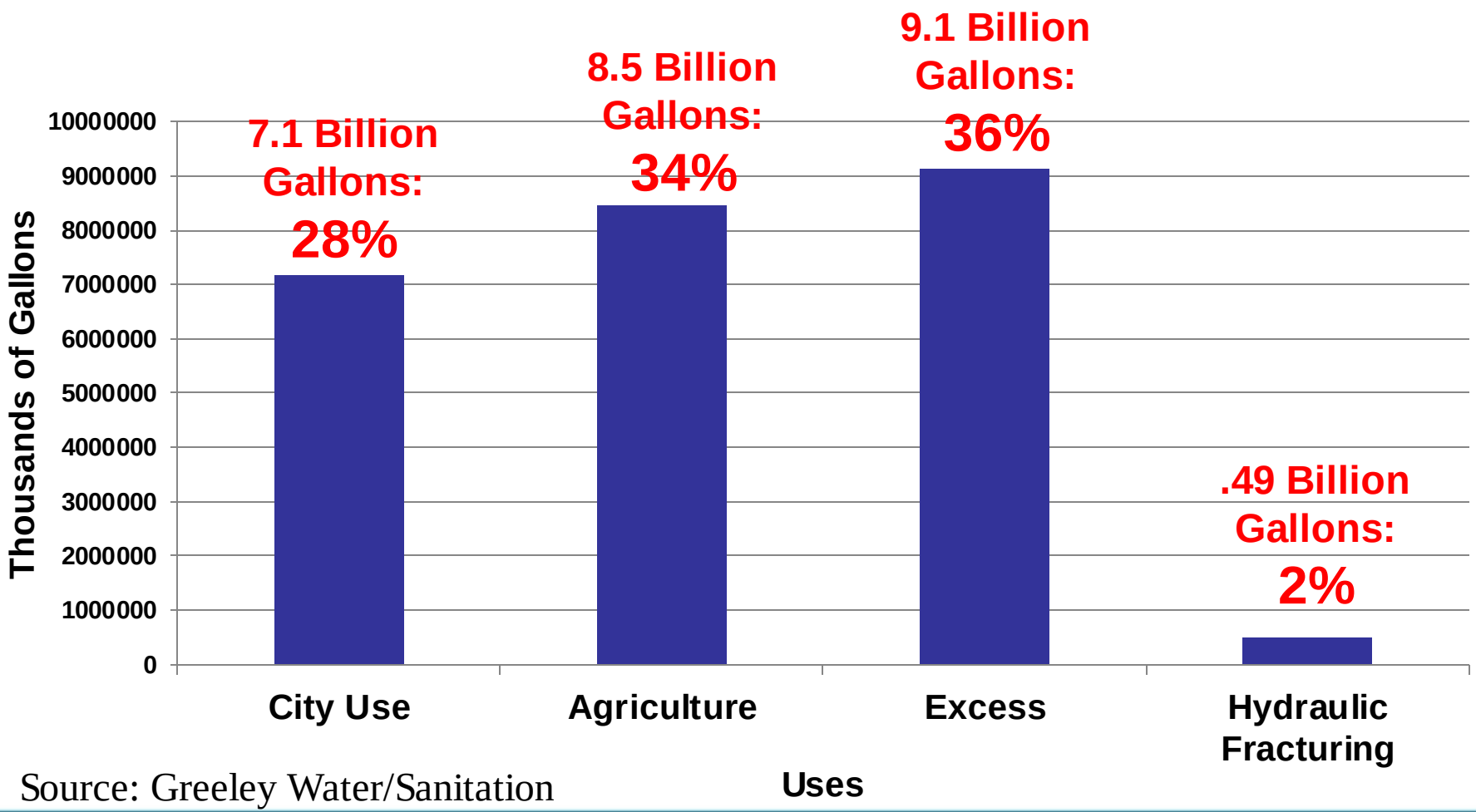
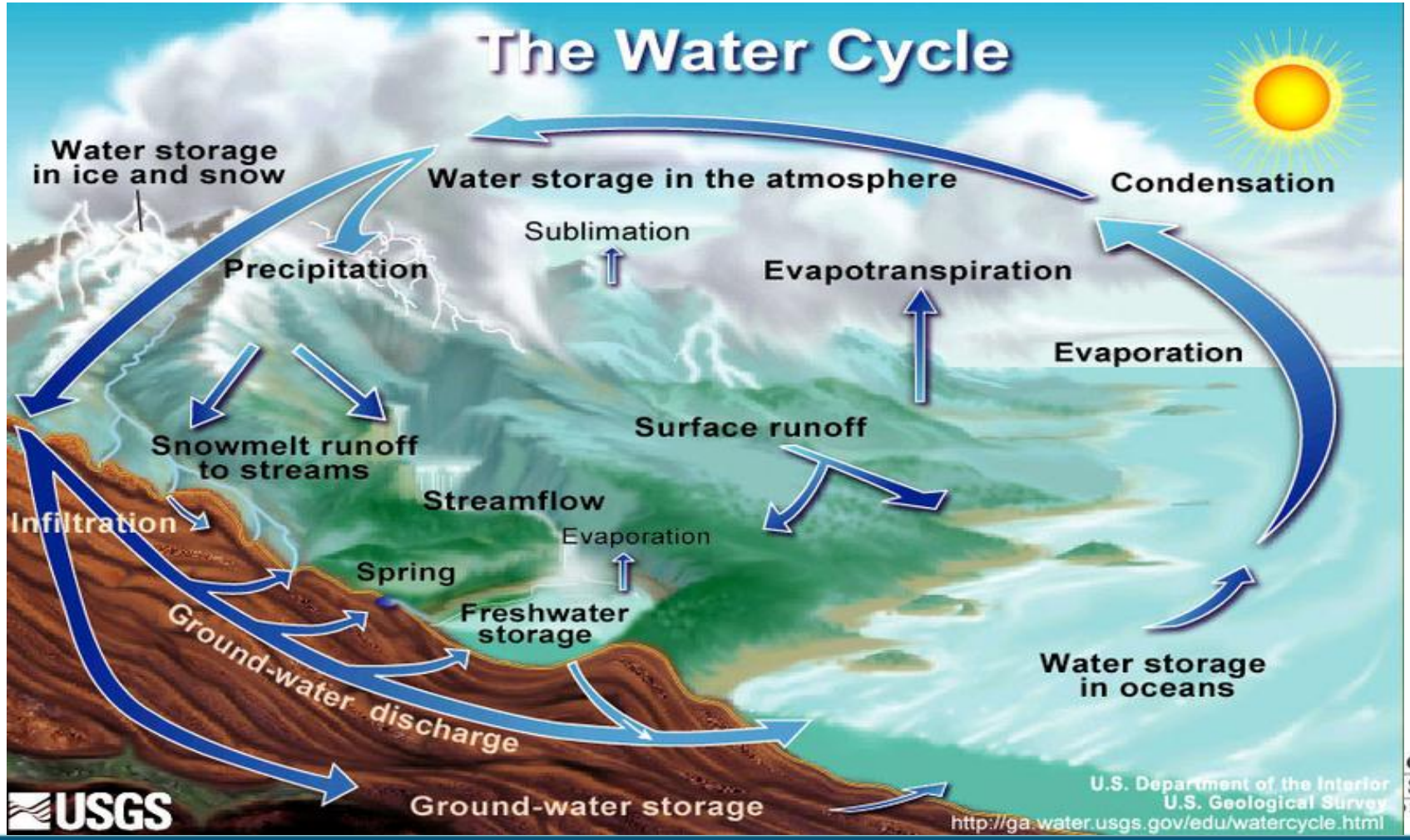
Greeley Water 2011

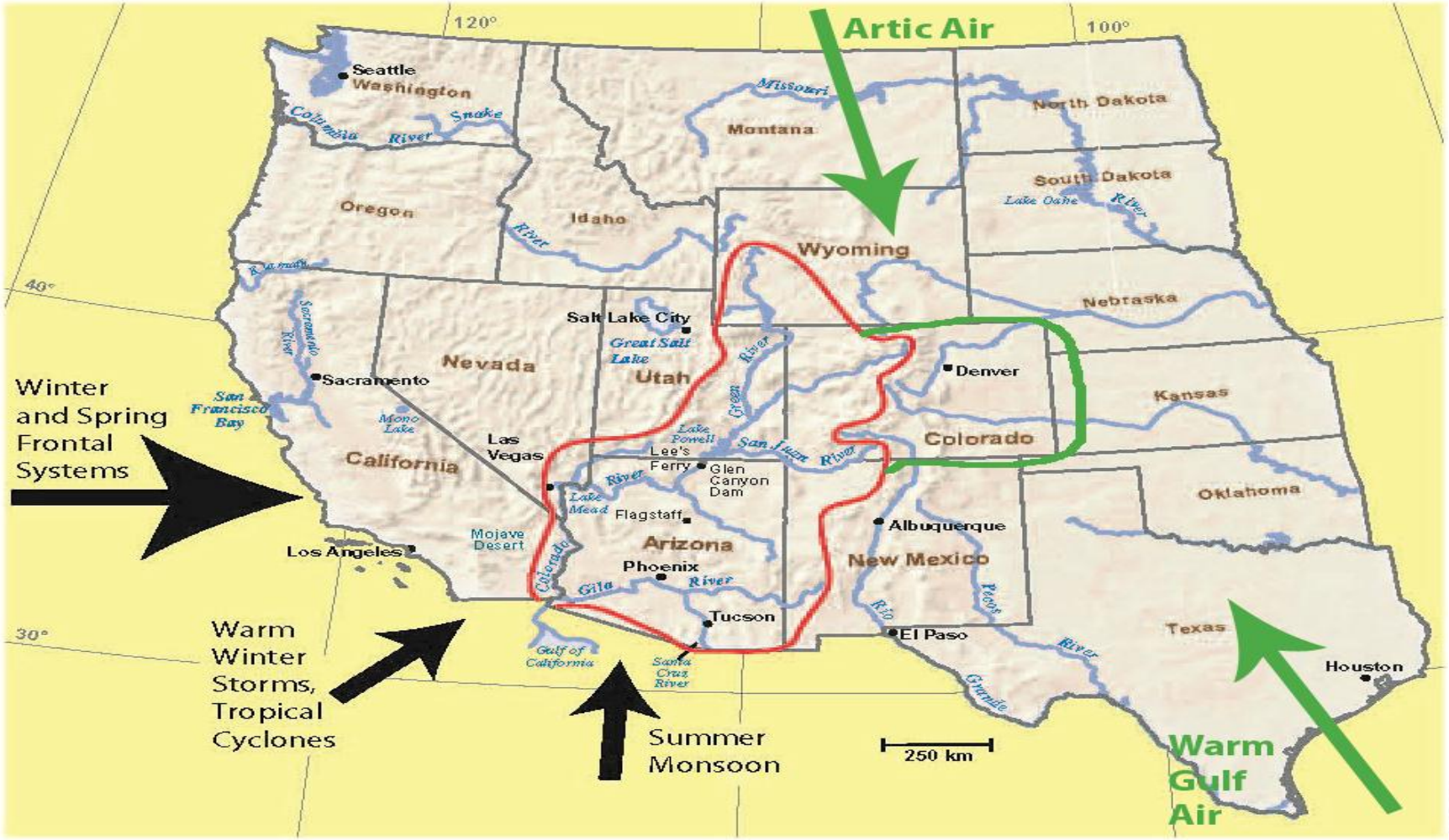


Source: Greeley Water/Sanitation

A Trip Down Memory Lane



"Permanent Removal"



Burning NG Creates Water

- In addressing the lifecycle disposal of water, burning NG creates it

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_20 + \text{Energy}$$

- A gas well that produces 1 Billion Cubic Feet actually contributes back ~11 million gallons of water back to the hydrologic cycle

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The Mischaracterization of Spills

When it happens

- Immediate response to COGCC within 24 hours when discovered or occurs
- Mitigation and Remediation via rules 909 & 910 of the COGCC
- Notification of proper authorities and local agencies
- 5+ barrels require reporting
- Cleanup/Containment required of ALL spills, no matter the size

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Spill Prevention & Regulation

- Rule 906
  - Control & Containment
  - Investigation & Cleanup
  - Mitigation & Groundwater Standards
  - Emergency Notification
  - State Waters Reclamation, and Notification

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Spill Prevention & Regulation

Additional Rules

- Rule 604 – Containment construction requirements, maintenance, inspection for all valves
- Rule 902 – Containment Operating Standards
- Rule 904 – Lining specifications
- Rule 905 – Closure obligations on waste pits
- Rule 907 – Waste fluid management to protect state waters
- Rule 909 – Investigation and reporting and remediation

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The Numbers

- 495 spills in 2010
  - Primarily reported from replacing old equipment, witnessed contaminated soil, reported

Sounds like a lot?

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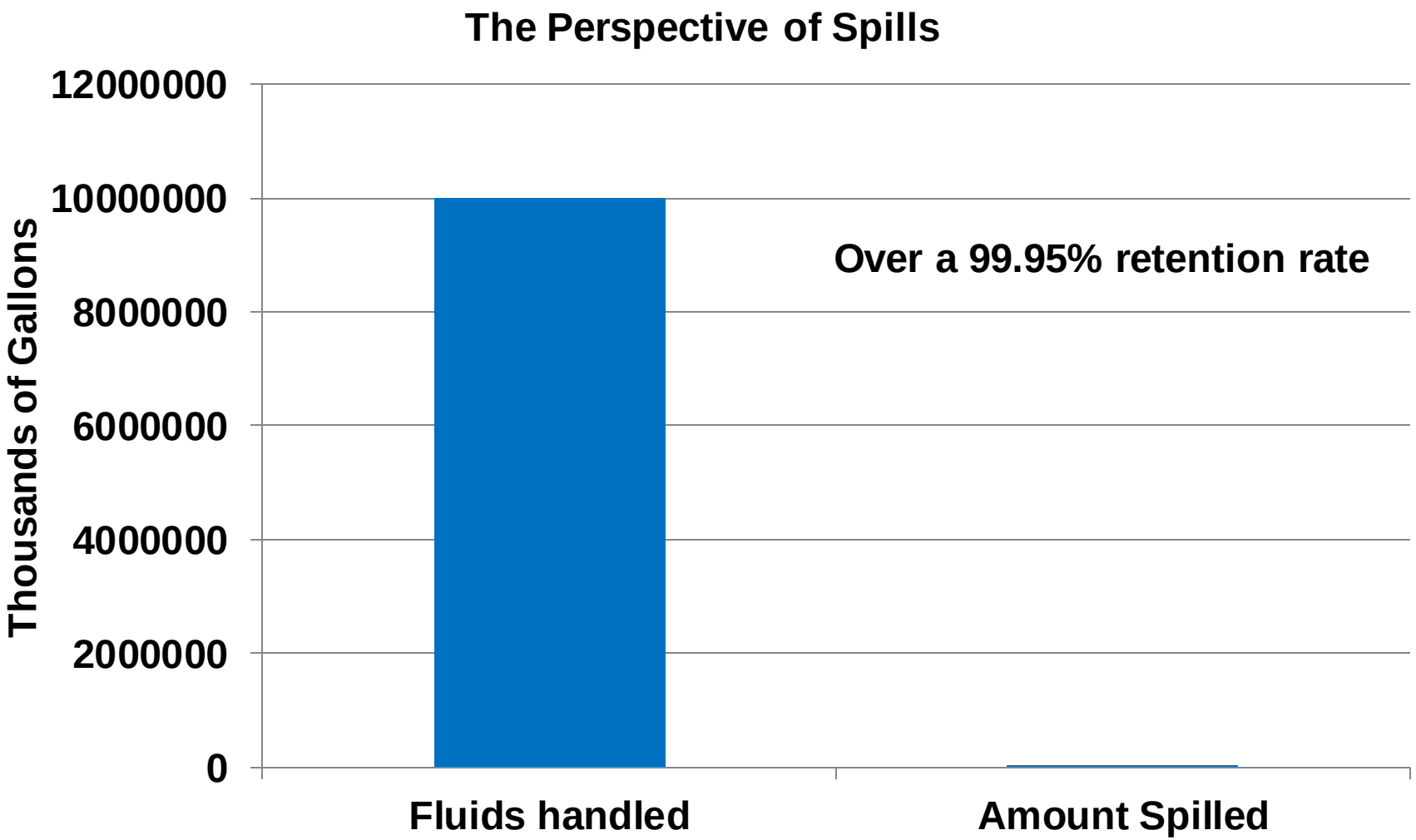
How much?


The Perspective of Spills
Thousands of Gallons
12000000
10000000
8000000
6000000
4000000
2000000
0
Over a 99.95% retention rate
Fluids handled
Amount Spilled

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Surface Waste? Or Lack of Understanding?

“Allegations”

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Reality

- Drilling Mud – Bentonite Clay Spreading
  - Non-toxic
  - Good nutrients for agriculture
  - Legal
- Requires a surface use agreement

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Produced Water Disposal

- Underground Injection Control Wells
  - Regulated by the EPA
  - Isolated formations, 10,000+ feet deep
- Pits
  - Lining according to 900 Series Rules
- Surface Discharge
  - Only in Southern Raton Basin watersheds, never rivers in DJ Basin
  - Water requires treatment & must meet State Water Quality Control Commission Standards
  - Constant live monitoring throughout watersheds

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Air Emissions

Studies & Assessments

- *Community Health Risk Analysis of Oil and Gas Industry Impacts in Garfield County*. Saccomanno Research Institute & Mesa State College. 2008
- *Pathway Analysis and Risk Assessment For Solids and Fluids Used in Oil and Gas Exploration and Production in Colorado*. QEPA, June 2008
- National Oceanic and Atmospheric Administration Data Analysis-Dollis M. Wright, QEPA, Erie, CO, 2012
- Town of Erie Air Quality Toxicology Assessment Pinyon Project # 1/12- 695-02.8000, 2012

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Additional Studies

- *Northeastern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report.* January 12, 2011. Commonwealth of Pennsylvania. Department of Environmental Protection
- *Southwestern Pennsylvania Marcellus Shale Short-Term Ambient Air Sampling Report.* November 1, 2010. Commonwealth of Pennsylvania. Department of Environmental Protection
- *DISH, Texas Exposure Investigation*. May 12, 2010. Texas Department of State Health Services

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CU Public Health Study

- Exaggerated inputs of over 900% of drill times
- Based off outdated practices
- Despite that, the study determined higher risk of cancer
- The “increased risk” of cancer was below the National-Scale Air Toxics Assessment put out by the EPA

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AQCC Regulation 7

- Air Quality Control Commission
  - Emissions of Volatile Organic Compounds and Nitrogen Oxides
- What it means
  - Tight regulation statewide, and even tighter in Non-attainment zones

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Setbacks and Property Values

Setbacks

- COGCC 600-Series rules
  - 150 feet minimum setback for buildings
  - 350 feet for high density areas
- Most setbacks exceed minimum requirements 2009-2011
  - 92% of locations are setback 500+ feet
  - 74% setback 1000+ feet
- Most buildings are non-residences
  - Agricultural structures

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The Reality

Well to Building Setback Review

Colorado Oil and Gas Conservation Commission

February 22, 2012

Listing of Locations less than 200 feet to Building

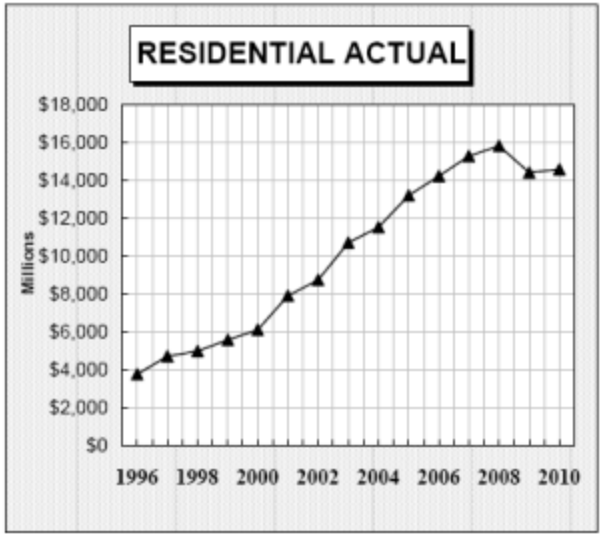
Year	Document Number	County	High Density	New Location	Distance	Proximity	Building Description
2011	2587822	CHEYENNE	No	No	58	less 150	Water well house
2009	1691798	WELD	No	No	58	less 150	Vehicle garage
2010	400072164	WELD	No	Yes	69	less 150	Abandoned hog shed
2012	400240957	GUNNISON	No	Yes	90	less 150	Equipment Shed
2009	1758843	WELD	No	Yes	103	less 150	Building to be razed
2011	1636646	WELD	No	No	122	less 150	Storage shed
2009	400011284	LAS ANIMAS	No	Yes	127	less 150	Operator is owner
2009	1786896	PHILLIPS	No	No	132	less 150	Grain Storage
2011	400117702	WELD	No	Yes	143	less 150	Irrigation pump house
2011	400227765	WELD	No	Yes	145	less 150	Storage Barn
2009	1904205	WELD	No	No	154	150 to 350	Livestock Enclosure
2011	400179419	WELD	No	Yes	157	150 to 350	Existing well / storage building
2010	400054716	WELD	No	No	159	150 to 350	Equipment Barn
2011	400188968	WELD	No	Yes	159	150 to 350	Abandoned
2010	400021477	WELD	No	Yes	162	150 to 350	Goat Barn
2009	1758386	WELD	No	Yes	168	150 to 350	Storage Shed
2011	1635946	WELD	No	No	169	150 to 350	Storage shed
2011	400165164	WELD	No	Yes	178	150 to 350	Residence
2011	400188780	WELD	No	Yes	180	150 to 350	Residence
2010	1697620	WELD	No	No	187	150 to 350	Livestock Shed
2009	1758746	WELD	No	No	193	150 to 350	Storage Shed
2011	400154431	WELD	No	Yes	198	150 to 350	Turkey barn
2009	1774783	WELD	No	No	199	150 to 350	cement service building
2011	400118102	YUMA	No	Yes	199	150 to 350	Steel Barn

Weld County

- 17,592 Active wells **38%**
- 2000-2010 Population Grew **+39%**
- 2000-2010 Assessed Residential Property Values **+138%**

RESIDENTIAL ACTUAL

Years	Value	Change
1996	$3,763,735,907	
1997	$4,714,884,189	25.3%
1998	$4,999,863,860	6.0%
1999	$5,590,332,033	11.8%
2000	$6,109,023,306	9.3%
2001	$7,907,716,066	29.4%
2002	$8,748,249,180	10.6%
2003	$10,718,089,196	22.5%
2004	$11,535,093,216	7.6%
2005	$13,211,814,322	14.5%
2006	$14,233,673,241	7.7%
2007	$15,277,114,070	7.3%
2008	$15,821,919,724	3.6%
2009	$14,415,237,688	-8.9%
2010	$14,594,785,930	1.2%



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Questions?

Thank you for your interest in Colorado's oil and gas industry!

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