WHAT IS FRACKING?
WHAT ISN’T FRACKING?

Todd Greene
Hydraulic fracturing is defined in the proposed ordinance as:

“Any well stimulation treatment that, in whole or in part, includes the pressurized injection of hydraulic fracturing fluid or fluids, which may include a mixture of water, chemicals or sand, into an underground geologic formation in order to fracture, or with the intent to fracture, the formation, thereby causing or enhancing the production of oil, gas, the other hydrocarbon substances from a well.”
Engineering definition:

precise stimulation activity, limited to the fluid action in initiating and extending cracks in the rock

Other definitions:

represents nearly every phase of the well development cycle from drilling to production of a fracked well.
In order for fracturing to occur in rocks at deeper depths, the confining pressure caused by the immense load resting on top of the overlying layers of rock must be overcome.

To overcome this pressure, the process of hydraulic fracturing introduces fluids until the pressure exerted by the added fluids overcomes the tensile strength of the rock causing fractures.

http://setxind.com/upstream/the-hydraulic-fracking-process-and-how-it-works/
Completed Oil/Gas Well

- Often 4 pipe/cement barriers between well and aquifer zone
- Each cement job should be evaluated through pressure testing
- Hydraulic fracturing occurs 1000’s of feet below aquifer zone.

American Petroleum Institute, 1986
Article 3.2. Oil and Gas Drilling Regulations

2128. DRILLING REGULATIONS.

- Conductor casing
- Surface casing
- First casing
- Second Casing
- Intermediate casing
- Production casing

http://www.slc.ca.gov/Regulations/Article_3-2.html
Casing structure of a well

- Conductor Casing
- Surface Casing
- Intermediate Casing
- Production Casing
- Producing Zone
- Cement

Flowing the Well Fluids

- Tubing-Casing Annulus
- Packer
Perforation

- Perforating gun is lowered into the hole at the depth where the oil or gas formation is found (A).
- After the gun is lined up properly, powerful explosive charges are fired (B) from the control panel at the surface. These explosives blast a hole in the steel casing and cement, up to several feet out into the rock.
- Finally, the oil and gas fluids flow into the holes and up the well to the surface (C).
Example of hydraulic fracturing job (numbers are estimates and do not necessarily apply to CA fields)

Hydraulic Fracturing

Hydraulic fracturing, or “fracing,” involves the injection of more than a million gallons of water, sand and chemicals at high pressure down and across into horizontally drilled wells as far as 10,000 feet below the surface. The pressurized mixture causes the rock layer, in this case the Marcellus Shale, to crack. These fissures are held open by the sand particles so that natural gas from the shale can flow up the well.
A typical composition of fracking

- **Water**: 98-99% of total volume—commonly fresh water (<500 TDS)

- **Proppant**: about 1-1.9% of total volume usually sand or ceramic particles carried by the frac fluid into the fracture to keep the fracture open when hydraulic pressure is released

- **Friction reducer**: about 0.025% of total volume—the non-acid form of polyacrylamide, reduces friction pressure of water flowing through the pipe during high rate pumping, thereby reducing required pump horsepower output

- **Disinfectant (biocide)**: about 0.005 to 0.05% of total volume sued to control growth of certain kinds of microbes that would destroy gelled fracture fluids

- **Surfactants**: modify surface or interfacial tension, break or prevent emulsions, 0.5 to 2 gallons per thousand gallons

- **Gelation chemicals (thickeners)** such as guar gum increases the viscosity of the fracking fluids and aid in more efficient delivery of proppants into the fractures.
Proppants

- Keeps fractures from closing after hydraulic pressure is reduced.
- Usually clean quartz sand in typical gas shale & tight oil plays.
- Higher strength materials (e.g. ceramics) needed in deep wells.
- Problem of embedment in soft formations.
- Ultra-Lightweight Proppants (ULWP)
  e.g. porous ceramics, resin-coated walnut shell

<table>
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<th>Settling Velocity (SiO₂ in water, 20°C) (cm/s)</th>
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<td>6 – 13</td>
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<tr>
<td>40/70</td>
<td>0.21-0.42</td>
<td>2 – 6</td>
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flexProp 20/40 Frac Sand
Typical 5,000 foot Horizontal Well

Water: ~5 million gallons (15 acre-feet)  
Sand: ~1 lb/gal

4000 gal/min @ 10,000 psi → 24,000 horsepower = 18 MW

2000 hp/truck, 75% efficient, plus spare trucks → 20 trucks

(1-2 hours/stage) x (10-40 stages) = 1-2 days/well
On the high end, the pressure used for hydraulic fracking may as high as 15,000 psi and the injection rate could be as much as 100 barrels per minutes.

Common equipment used for hydraulic fracking includes the following:

- Slurry blender to mix the fracking fluids.
- High-pressure, high-volume pumps such as triplex or quintuplex pumps.
- Monitoring equipment Fracturing fluid tanks
- Proppant storage tanks
- Chemical additive unit
- High-pressure treating iron
- Low-pressure flexible hoses
- Various meters and gauges

Acidizing

- If the formation is composed of rocks that dissolve upon being contacted by acid, such as limestone or dolomite, then a technique known as acidizing may be required.

- Acidizing operation basically consists of pumping from fifty to thousands of gallons of acid down the well.

- The acid travels down the tubing, enters the perforations, and contacts the formation.
Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources
PROGRESS REPORT
US Environmental Protection Agency
Figure 1. Illustration of the five stages of the hydraulic fracturing water cycle. The cycle includes the acquisition of water needed for the hydraulic fracturing fluid, onsite mixing of chemicals with the water to create the hydraulic fracturing fluid, injection of the fluid under high pressures to fracture the oil- or gas-containing formation, recovery of flowback and produced water (hydraulic fracturing wastewater) after the injection is complete, and treatment and/or disposal of the wastewater.