“Hydraulic Fracturing” and Water Resources

Photo: R. Jackson, USA Today

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UT Austin, Feb 17th, 2016

Public Concerns for Water Resources

- Water volumes for hydraulic fracturing
- Disposal of waste waters
- Contamination of drinking water

View of Water Use (12-20 MM L/well) Depends on Scale

In Texas, water use for shale gas is ~1% of state withdrawals, but the groundwater fraction is 11% in Barnett, 38% in Tx-Haynesville, and 18% in Eagle Ford (Nicot and Scanlon 2012).

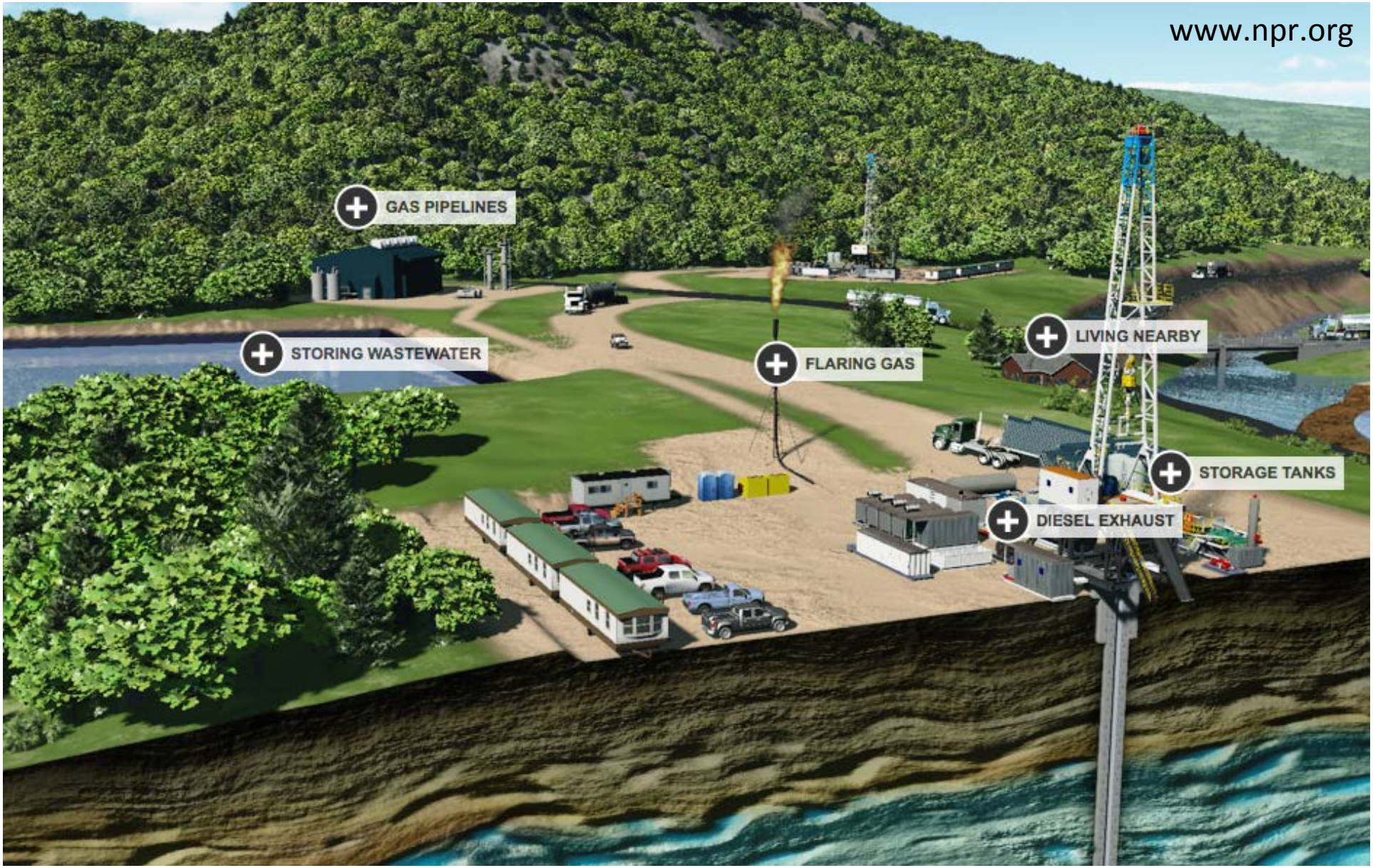
Shale gas is less water intensive than coal, nuclear, & oil sands *per unit energy*, but worse than wind or solar PV (Jackson et al. 2014 Ann Rev Environ Resources).

What's in wastewater and how to dispose of it?

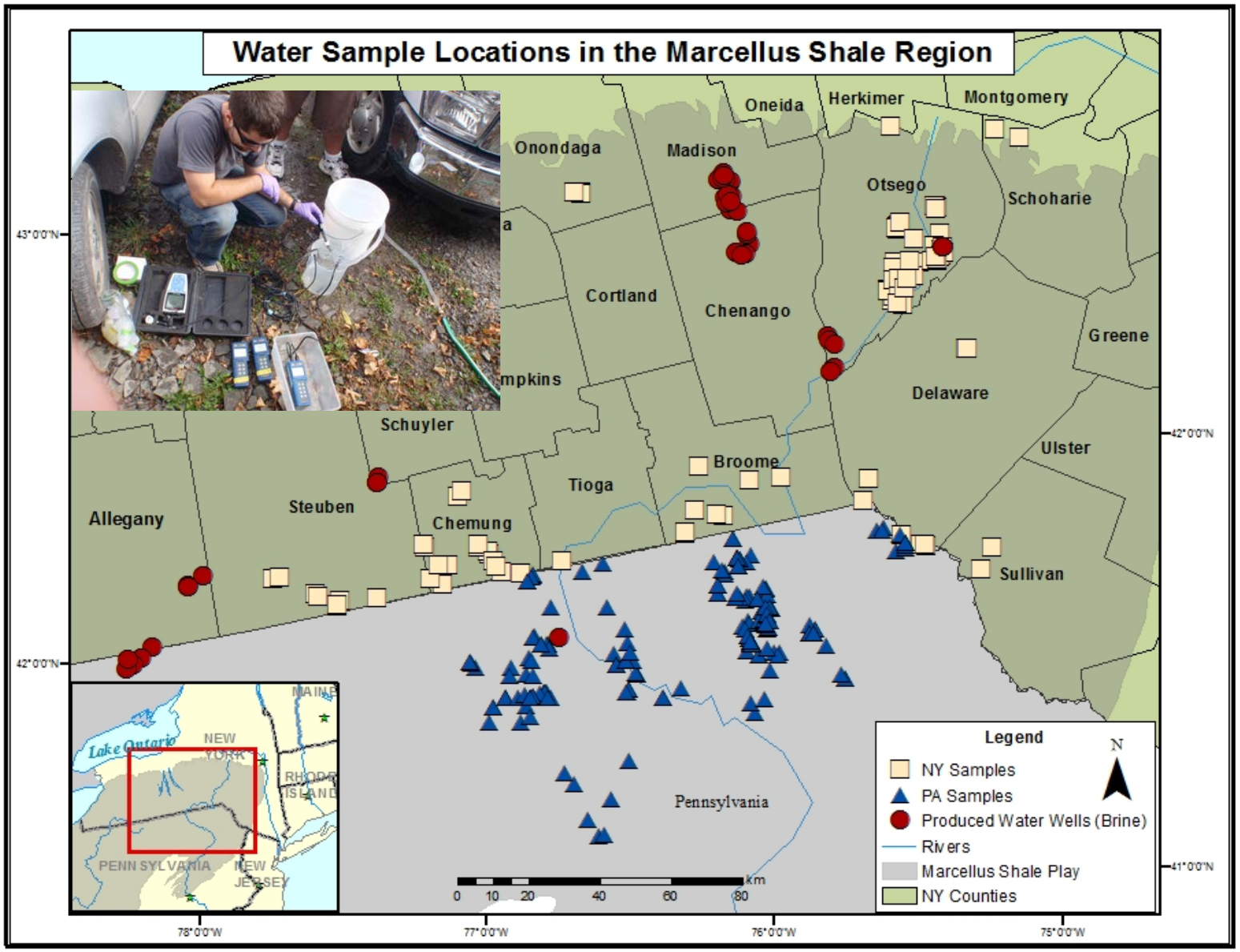
• **Salts** – up to 10-X seawater; **organics**; **bromine**, which can form carcinogenic by-products when chlorinated; toxic elements such as **arsenic** and **barium**; naturally occurring **radioactivity**.

•**Deep inject** underground (>90%); **spray on lands** (legal in half a dozen states); haul to a **municipal treatment** plant (no); **commercial treatment;** and/or **reuse** for hydraulic fracturing.

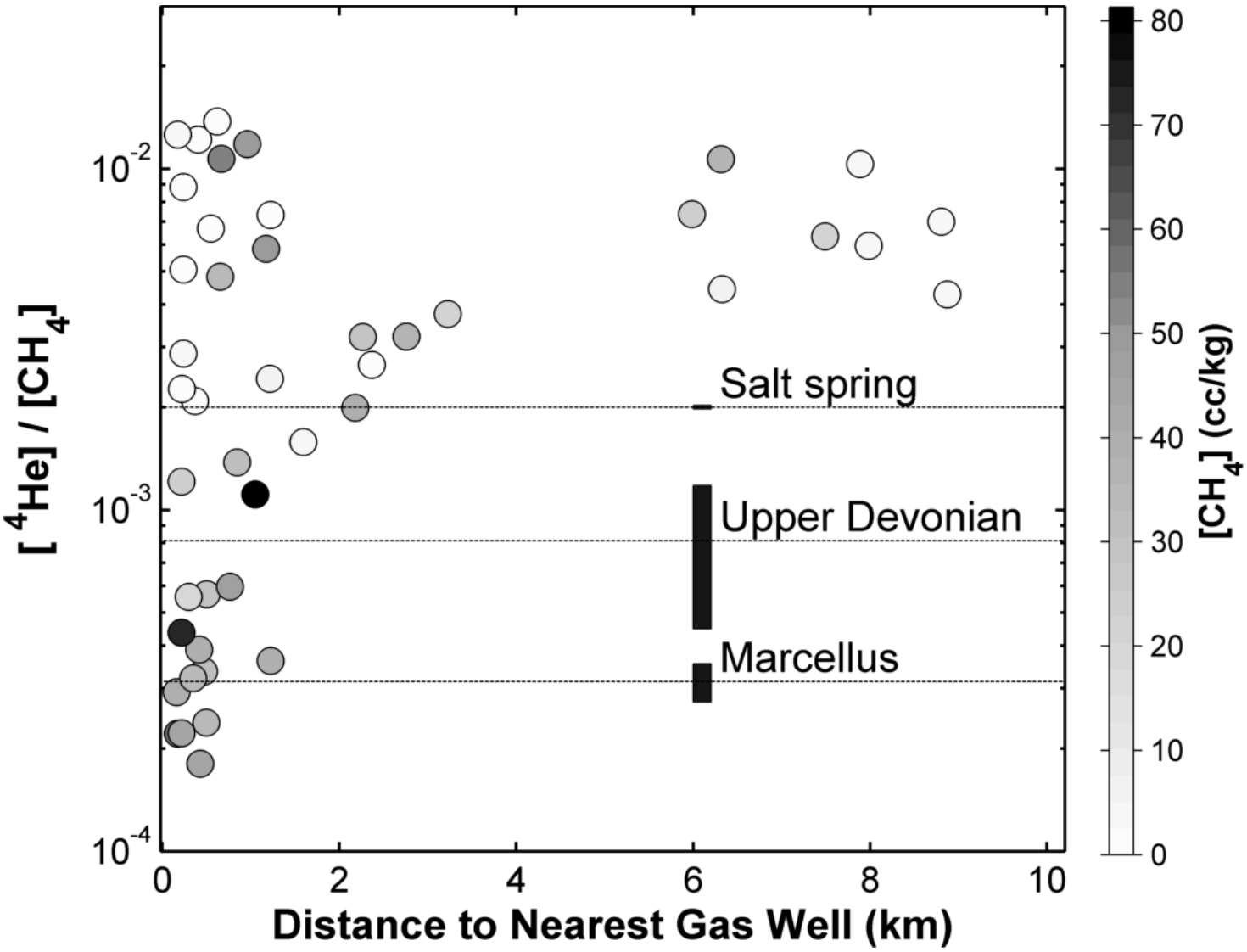
Possible Water Quality Interactions



Sampling in the Marcellus Shale region for the last six years.

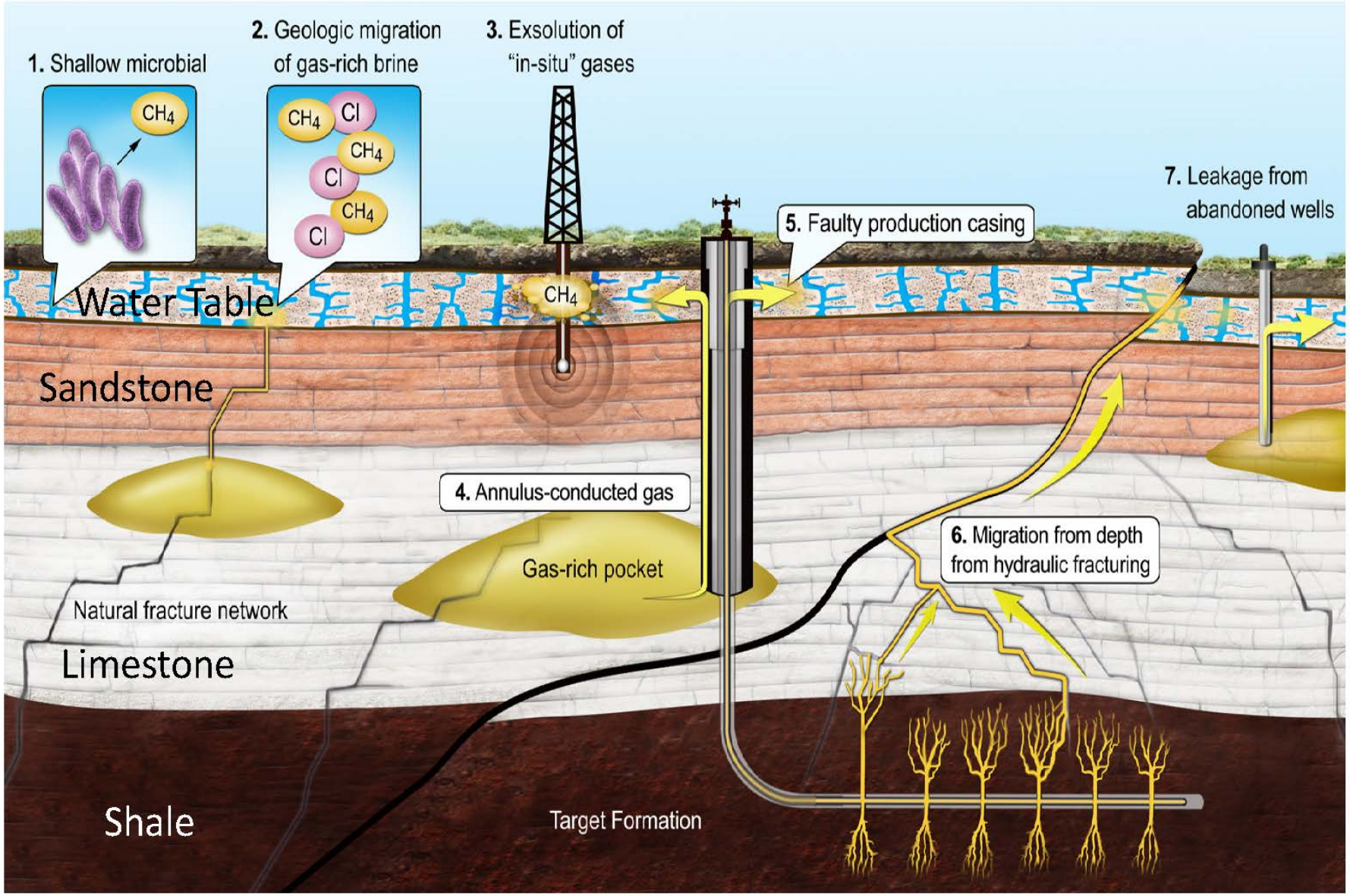


Hydrocarbon ratios and isotopes plus noble gases all suggest deep sourcing for gases only within 1 km.



Jackson et al. 2013 PNAS

Well integrity is the key.

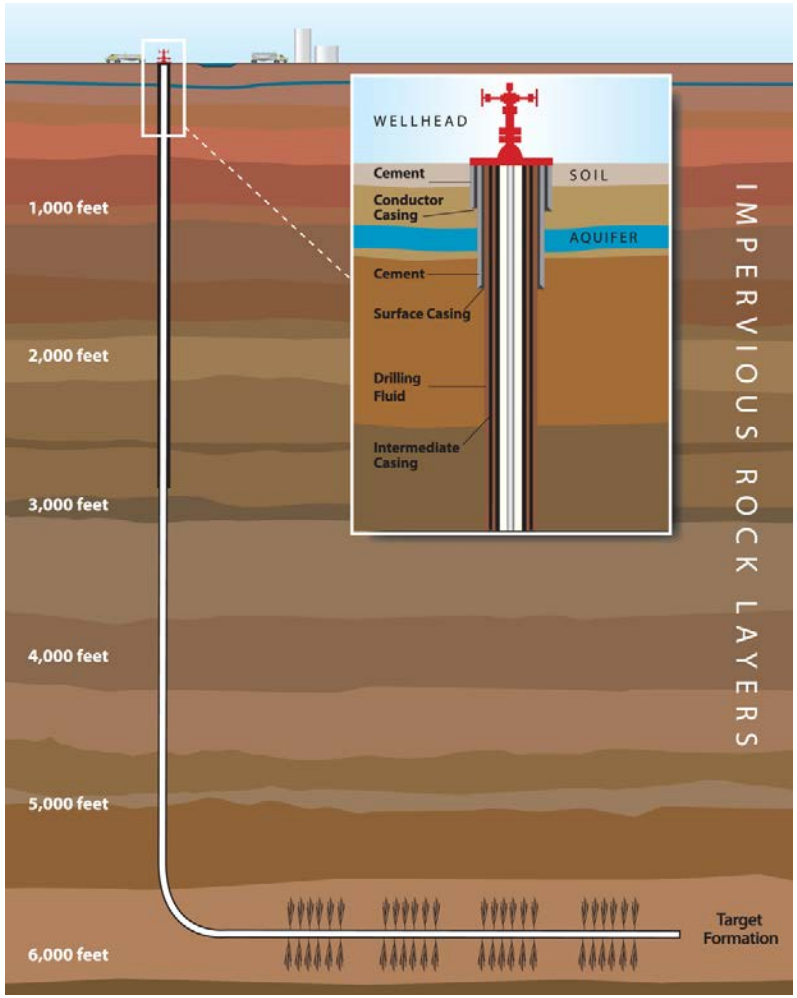


Darrah et al. 2014

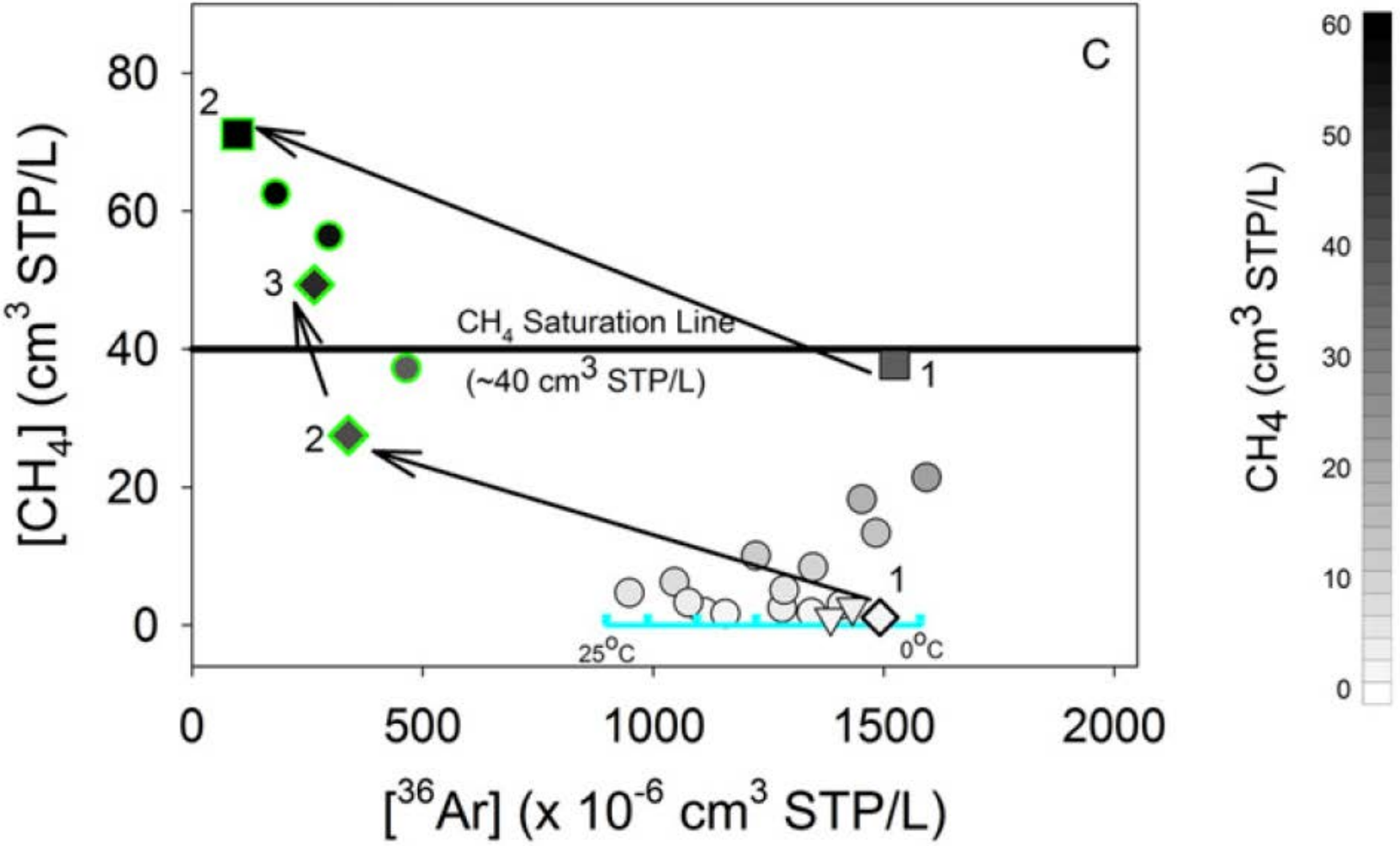
What about the “exceptions”? What if the well stimulation isn’t a mile deep but <1000 feet down? What if there is no cement for 1000s of feet? *Best practices differ*.

In Parker County, TX, Butler & Teal 1H Wells had surface casing and cement to 400 feet; top of cement at 4,700 feet (RRC 2014).

At Pavillion, WY, stimulation as shallow as 699’; domestic water wells as deep as 750’. 30% of wells reviewed had surface casing set shallower than nearby domestic water wells (WOGCC 2014).



Homes changed from clean water to bubbling water during a year's sampling in Parker County.



Darrah et al. 2014 PNAS

1) “Based on the evidence of increasing methane concentrations in some water wells in the Silverado neighborhood, RRC staff recommends that residents properly ventilate and aerate their water systems.”

2) Follow-up work by UT Arlington (Hildenbrand and Schug) also suggests anomalies in Parker County.

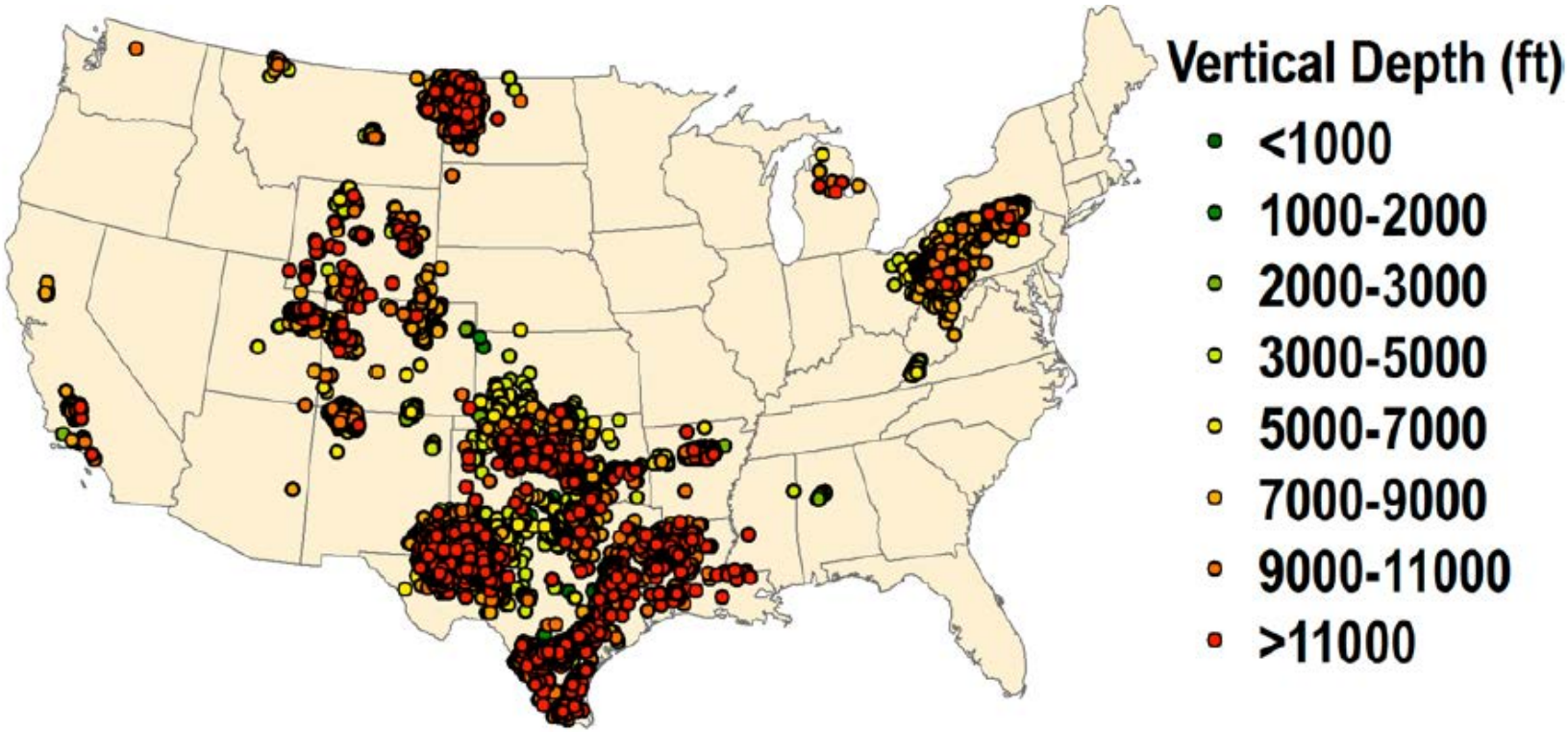
Reopen Barnett Shale water probe

By Rob Jackson, Dec. 1, 2014

http://tribtalk.org/2014/12/01/reopen-barnett-shale-water-probe/

HF is sometimes shallow and water/chemical intensive

HF occurs from ~500 ft to >10,000 ft belowground. Average water use is 2.4 million gallons per well. In ~1% of cases, it occurs <3,000 ft with >5 million gallons.



Jackson et al. 2015 ES&T

In CA, HF is usually shallow (<2,000 ft in half the cases) and has occurred directly into fresh water and USDWs in hundreds, perhaps thousands, of cases.

No other industry is permitted to inject chemicals into fresh water or USDWs without oversight.

(Kang an Jackson, unpublished)

Legacy Wells : What Happens in 25 or 50 Years?

Three Recommendations:

1) Gather as much pre- and post-drilling data as possible for water, air, and natural gas, and make all or most of those data publicly available.

2) Keep track of *everything* – what's used in fracking fluids, where the water used for drilling comes from, how wells are cased and cemented, how wastewater is disposed (a registry), the locations of old and abandoned wells, how wells are plugged, etc.

3) Protect landowners and consumers through best management practices, rules and regulations, and education.

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