

Potential Impacts of Hydraulic Fracturing on Water Resources

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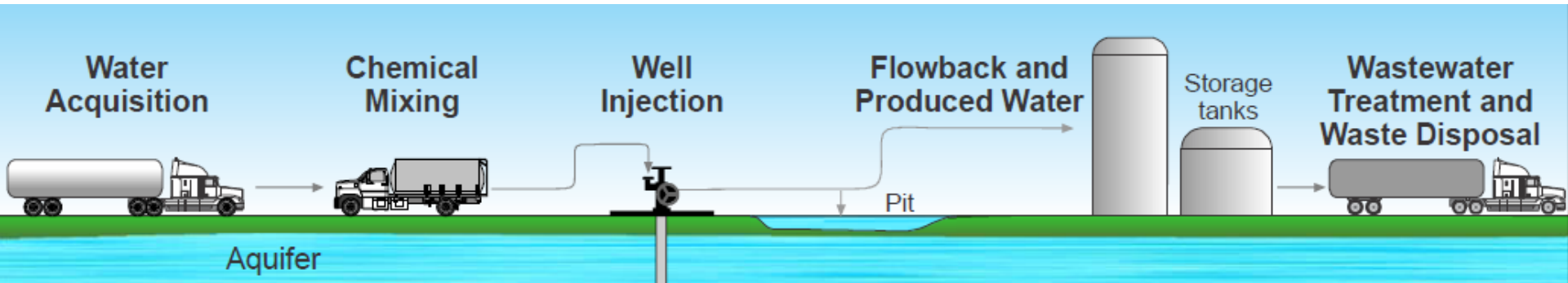
The Water Cycle of Fracking

Re-fracking the same well

Drilling the well

Sand mining

Capping the well



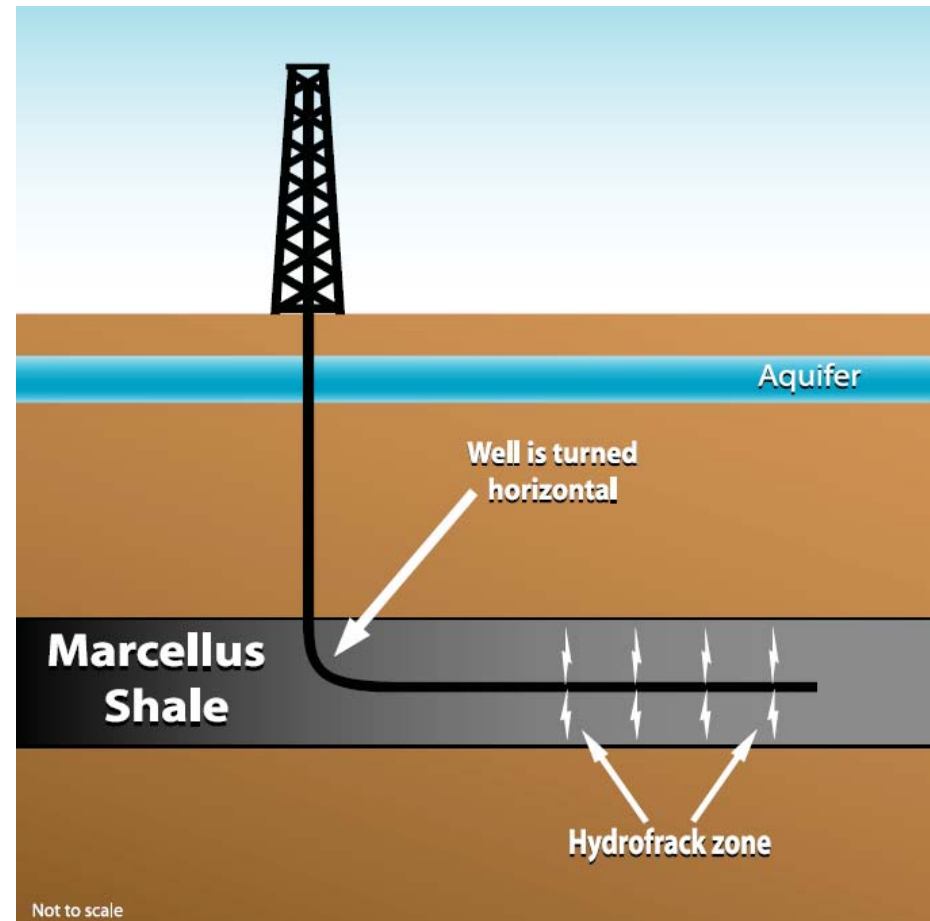
Initial Well Drilling

➤ Drilling liquids/muds

- Spills
- Disposal

➤ Drill cuttings

- disposal



Sand Mining

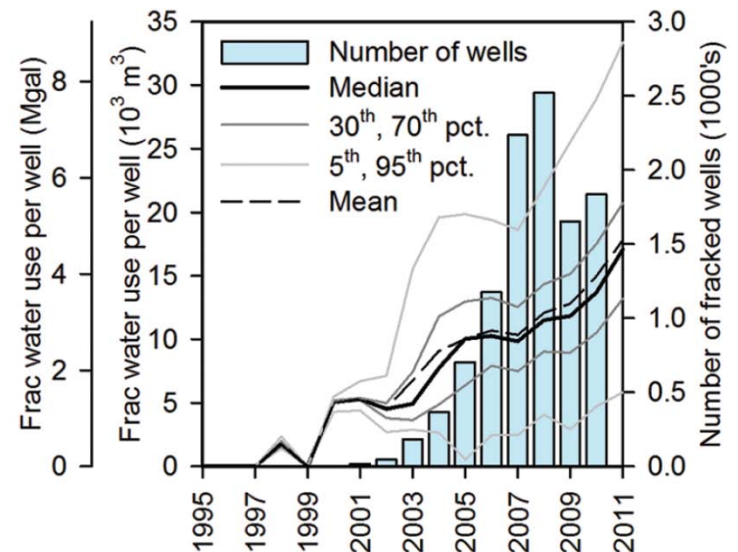
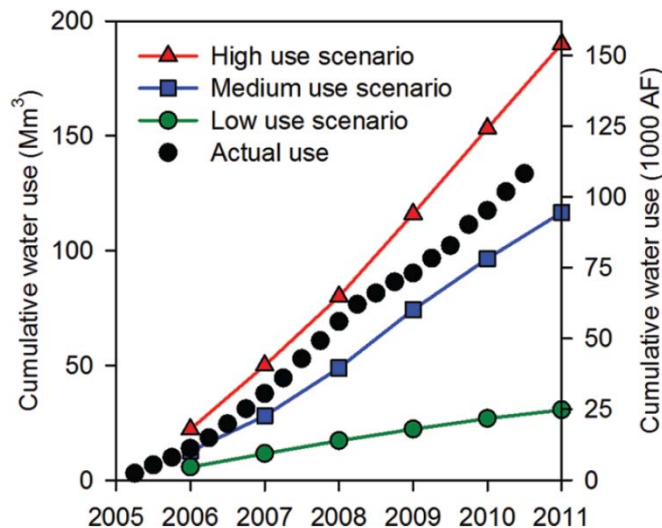
- Large scale sand extraction potential impacts on water resources



Photo credit: © 2012 Brian Peterson, Star Tribune

Water Acquisition

- Large volume water withdrawals
 - Groundwater – surface water interactions
 - Short and long-term impacts on availability
 - Impacts on water quality



Chemical Mixing

- Transport to site
- Worker exposures
- Spills



Well Injection

- Quality of construction
- Subsurface migration of fracking fluids
- Subsurface migration of fracking gases
- Impact of fracking fluids on mobilizing or reacting with existing geochemical substances

Flowback and Produced Water

- Spills
- Subsurface mobility
- Storage

Wastewater Treatment and Disposal

- Surface pits – leaching, flooding
- Spills during transport
- Contaminant fate within WWTPs
- Contaminants in effluent and impact on receiving waters
- Effects on downstream DW plants
- Impacts on groundwater quality and geochemical dissolution from underground injection disposal
- Land application of WWTP solids or fracking wastewater

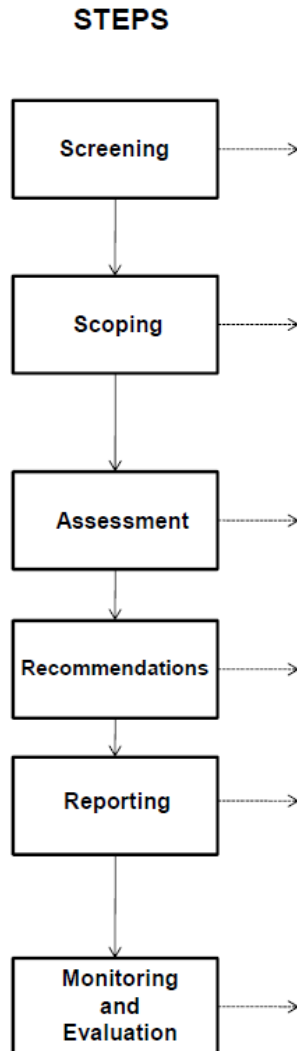
Re-Fracking the Same Well

- All of the above, but with cumulative impacts
- Integrity of well casings and construction components over time

Well-Plugging

- If not done properly, concerns include:
 - Fracking water flowing upward or down wellbore

Applying HIA



An excellent framework for assessing holistic and system effects of HF on human health

- Screening and Scoping: partly being addressed here by IOM
- Other steps: huge data gaps in vulnerable populations and demographics, baseline data, assessment of alternatives

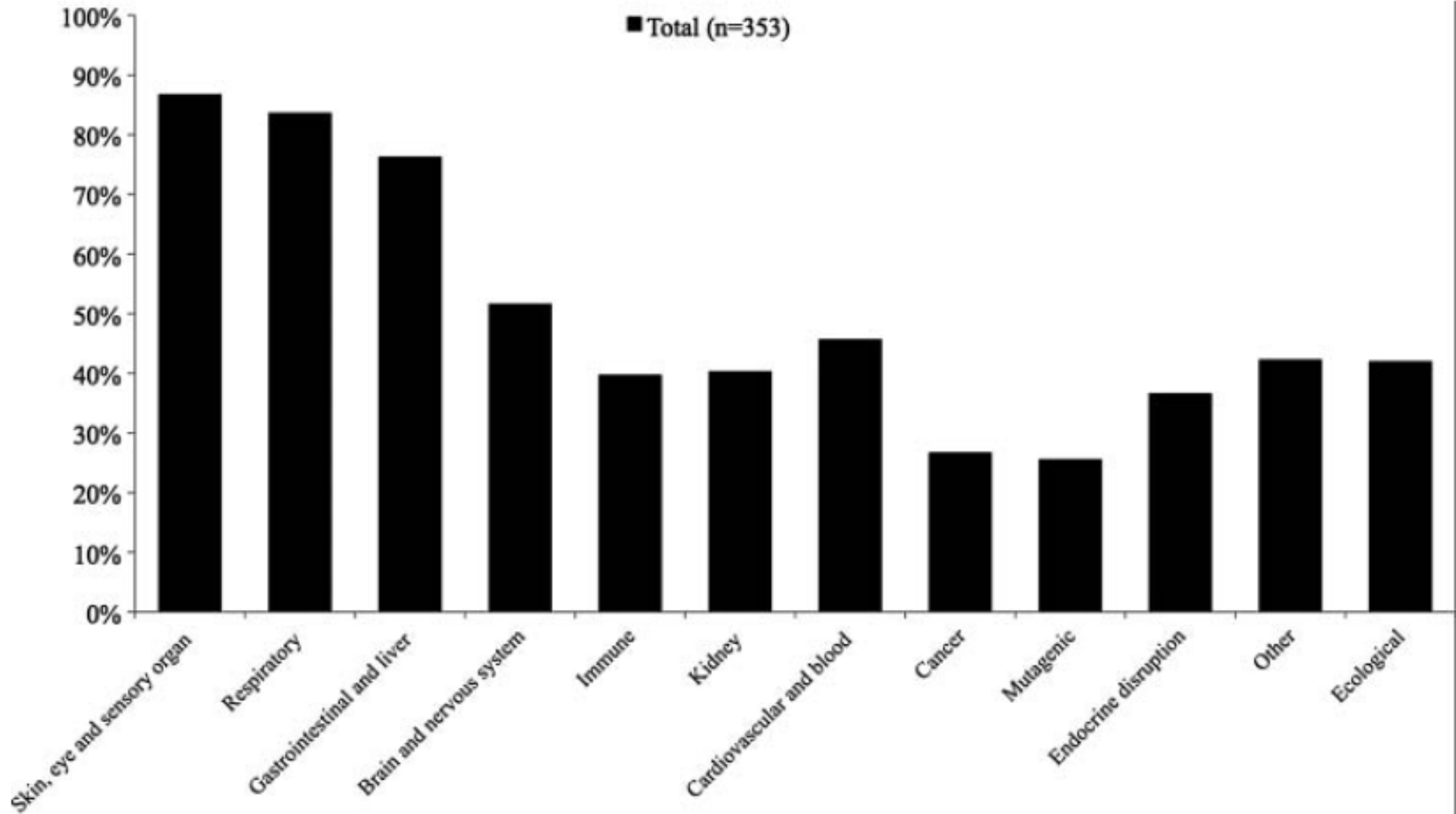
Research Needs: Fate & Exposure

- Annual and cumulative water withdrawals relative to other uses
- Composition of fracking fluids, drilling muds, for exposure modeling
- Fate of fracking fluids – hydrologic properties; mass balance of constituents, of toxic burden
- Flowback water impacts on subsurface, hydrologically and chemically
- Produced water – chemical makeup and toxic burden
- Removal technologies (for both WWTP and DW plants)
- Studies on cumulative impacts from re-fracking
- HIA alternatives to current practices
- Exposure modeling of populations
- Monitoring strategies and “frack fingerprints” for source water, drinking water

Research Needs: Toxicity & Risk Concerns

- Toxicity studies of fracking fluids, flowback, produced water
 - Colborn et al., (2011)

Potential Health Effects of Fracking Constituents



Research Needs: Toxicity & Health Concerns

- Toxicity studies of fracking fluids, flowback, produced water
 - Colborn et al., (2011)
- Health research on vulnerable populations
- Research on social impacts and outcomes
- Monitoring designs

Much Left to Do

