Potential Impacts of Hydraulic Fracturing on Water Resources

Deborah L. Swackhamer, Ph.D.
University of Minnesota
The Water Cycle of Fracking

Drilling the well

Capping the well

Sand mining

Re-fracking the same 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

![Graph showing cumulative water use and frac water use per well from 2005 to 2011](image)

![Bar chart showing number of wells, median, 30th, 70th, 5th, 95th percentile, and mean from 1995 to 2011](image)
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

- Skin, eye and sensory organ
- Respiratory
- Gastrointestinal and liver
- Brain and nervous system
- Immune
- Kidney
- Cardiovascular and blood
- Cancer
- Mutagenic
- Endocrine disruption
- Other
- Ecological
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