Background & Motivation

- Significant increase in horizontal drilling and hydraulic fracturing in Colorado in 2010
- Denver-Julesburg (DJ) Basin has become one of the highest-producing basins in the last decade
- Crestone Peak plans to drill 216 wells in eastern Boulder County to access the DJ Basin
- Increased risk for contamination of surface and groundwater by chemical additives in fracturing fluids
- Surface spills are the most likely groundwater contamination pathway for oil- and gas-related compounds (Vida, et al.) In DJ, only these water wells contaminated by spills; but 51 wells contaminated by oil and gas wells (Schroeder et al., in prep).
- In the DJ Basin of Colorado, from 2010-2014 operators reported about 90 surface spills per year which contaminated groundwater (Armstrong et al., in prep). But only 6.3% reach water wells.

Objective:
Develop a thorough baseline groundwater quality assessment for eastern Boulder County and make data publicly available for assessing any changes in water quality as a result of oil and gas development

Groundwater Sampling

Current Procedure:
- Plan to sample groundwater for 400 volunteers in eastern Boulder County
- Purge 50-100 gallons of groundwater until initial water quality measurements stabilize using In-Situ Aqua TROLL 600 multi-parameter sonde – pH, temperature, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity
- Collect samples to be analyzed for:
  - Volatile Organic Compounds: Methane and 5°C
  - Trace Elements: Total organic carbon
  - Major cations and anions: Alkalinity

Application and Future Directions
- Continue sampling more volunteers
- Make data available to the public
- Investigate methane concentrations, proximity to coal beds and coal faults.
- Identify spatial trends for VOCs & discuss potential sources with volunteers

Trace Elements & Major Ions:

Samples containing trace elements that exceeded current drinking water quality standards were identified. ArcGIS Inverse distance weighting method (IDW) was used to identify spatial trends for the varying concentrations of the metals. IDW uses a linear combination of sample data points and determines the influence of a point based on its distance and value compared to the other points.

Chromium:

- Primary Drinking Water Quality Standard: 100 mg/L
- Potential Sources: geologic

Selenium:

- Primary Drinking Water Quality Standard: 50 μg/L
- Potential Sources: coal and organic-rich fine sediments

Nitrate [NO₃⁻]:

- Primary Drinking Water Quality Standard: 44.3 mg/L
- Potential Sources: fertilizers, food, ponds, permeable soils

Uranium:

- Primary Drinking Water Quality Standard: 30 μg/L
- Potential Sources: geologic, historically mined in Colorado

Manganese:

- Primary Drinking Water Quality Standard: 10 μg/L
- Secondary Drinking Water Quality Standard: 50 μg/L
- Potential Source: geologic, manganese- rich fine bedded coal faults

Sulfate [SO₄²⁻]:

- Primary Drinking Water Quality Standard: 250 mg/L
- Secondary Drinking Water Quality Standard: 200 mg/L

Volatile Organic Compounds:

- Samples containing volatile organic compounds were identified

Chloroform (CHCl₃)

- Bromodichloromethane
- Dibromochloromethane
- Chloroform

- Disinfection
- Butane
- 2-butanone
- Pentanes
- Smells like butterscotch

Methane:

- Samples containing dissolved methane were identified. ArcGIS was used to investigate spatial correlations and proximity to coal beds and coal faults.

Applicability & Future Directions:
- Develop thorough baseline groundwater quality assessment for eastern Boulder County
- Make data publicly available for assessing changes in water quality as a result of oil and gas development

References: