Ground-Water Investigation at Pavillion, WY

Briefing for Northern Arapaho Tribal Council

February 7, 2013

Overview

- Background
  - Site history
  - Prior sampling phases and summary of results
- Summary of 2012 sampling and results
- Peer review and next steps

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Background – Pavillion, WY

- Investigation area is east of the town of Pavillion within Wind River Indian Reservation
- There are ~ 80 domestic wells, and numerous agricultural wells (stock watering). The town of Pavillion west of the investigation area has five active municipal drinking water wells
- Ground water is principal source of municipal, domestic, and livestock water in Pavillion area
  - Upper Wind River Formation (intermingled sandstone, siltstone & mudstone)
  - Domestic wells screened as deep as 800 ft in area of investigation
- Wind River Formation meets EPA's definition of an Underground Source of Drinking Water (USDW); 40 CFR 144.3
- In response to citizen complaints regarding adverse changes in quality of well water, Region 8 initiated a groundwater investigation (Sept 2008)

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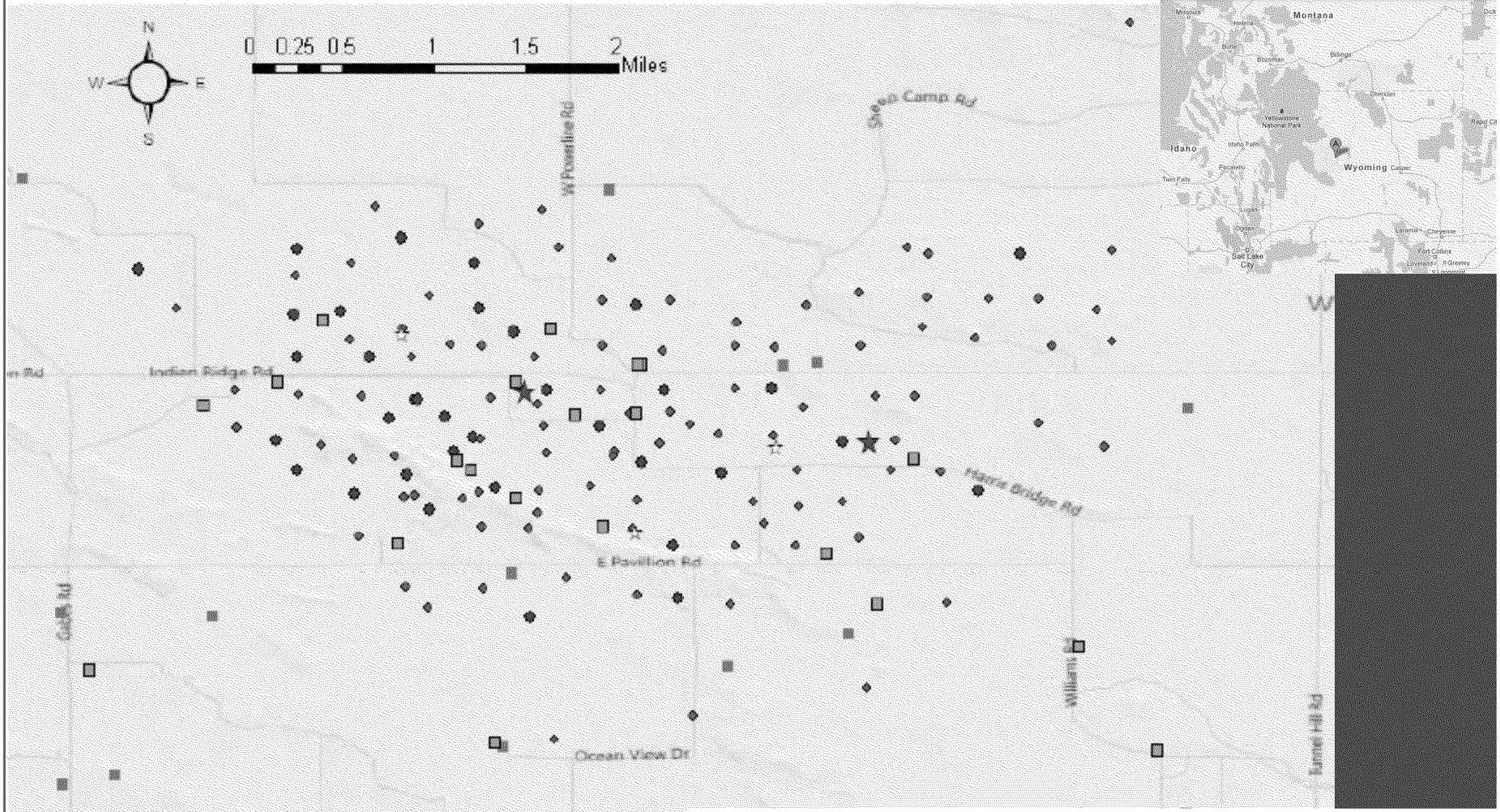

Map of Study Area

Legend

- Domestic Water Wells with Admantane, Methane, and/or DRO Detection
- Hydraulically Fractured Production Wells
- Pit Monitoring Well
- EPA Monitoring Well
- Production Wells
- Domestic Water Wells

History of Pavillion Investigation

- **Phase I** (March 2009)
  - Determine presence/absence of potential ground-water contamination
  - 35 domestic and 2 town wells sampled
- **Phase II** (January 2010)
  - Intended to confirm contaminants and quantify Tentatively Identified Compounds
  - Also collected potential source samples (e.g. pits, production fluids, gas)
  - 17 domestic wells, 4 stock wells and 2 town wells sampled
- **Phase III** (June-October 2010)
  - Differentiate potential sources of ground-water contamination
  - Installation and sampling of deep monitoring wells and 4 domestic wells
- **Phase IV** (April 2011)
  - Resampling of deep monitoring wells and 11 domestic/stock wells
  - Expanded analyte list– glycols and alcohols
- **Phase V** (April 2012)
  - Sampling of deep monitoring wells in conjunction with USGS
  - Also resampled 5 nearby domestic wells and 1 town of Pavillion municipal well

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Phase III & IV
Summary of Results

- MW01 and MW02
  - pH 11.2-12.0; Elevated K^+ and Cl^-, BTEX & DRO (benzene at 50x MCL)
  - Synthetic compounds (glycols, alcohols, 2-BE) and thermogenic methane
- Domestic and agricultural wells
  - Thermogenic methane (~10 to 800 ppb)
  - DRO/GRO (23 /28 samples); specific hydrocarbons at ppb levels
  - 2-BE phosphate (9 wells), phenols, naphthalene
  - No significant nitrate (1 well) or pesticides (4 wells at ppt levels)
- Phase III-IV domestic well results support Phase I-II data
- Contaminants at high concentrations in deep and shallow monitoring wells
  - Deep well contamination in proximity to production wells
- Widespread, but low concentration, contamination in drinking water wells

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EPA Draft Report

- Draft Report "Investigation of Ground Water Contamination near Pavillion, Wyoming" released December 7, 2011

- Finding: "…approach utilized at this site best supports an explanation that inorganic and organic constituents associated with hydraulic fracturing have contaminated ground water at and below the depth used for domestic water supply."

- Finding: "…gas production activities have likely enhanced gas migration…"

- Report documented concerns with gas well construction that may provide a pathway for contaminants to migrate upward from production zone

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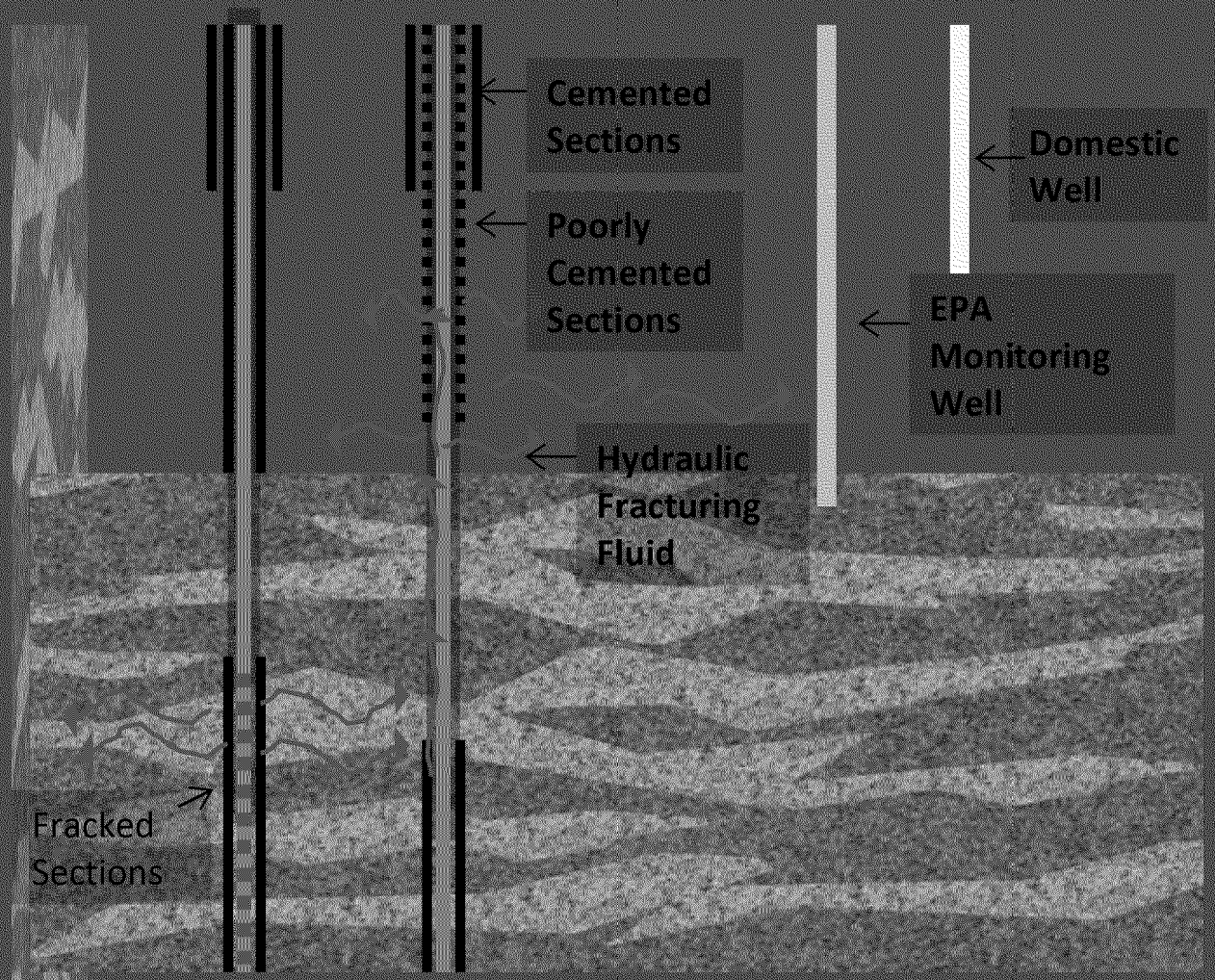
Potential Contaminant Migration – Enhanced Migration via Un-Cemented or Poorly Cemented Gas Well Bore Intervals



- Hydraulically fractured sections as shallow **<1100 feet deep**
- Monitoring wells **775 and 970 feet deep**
- Domestic wells range up to 800 feet deep, most around 300 feet deep

Phase V (2012) Sampling

- Initiated by State of Wyoming through cooperative agreement with USGS Wyoming office
- USGS, State, Tribes agreed to work collaboratively to develop sampling approach
- EPA, to ensure consistency with prior phases, elected to collect samples in conjunction with USGS sampling
- Cross-agency technical team developed approach for MW01; did not have time to do so for MW02
- MW01: EPA collected series of 10 samples as well was purged; USGS collected 2 samples during purging
- MW02: EPA collected one sample before purging and a second sample after purging one well volume (a replicate of the second sample was sent to USGS lab for analysis)
- Low flow characteristics meant USGS could not use standard approaches; opted not to sample MW02

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EPA Phase V (2012) Results

- MW01 and MW02
  - Results consistent with Phase III and IV results
  - Saturation levels of thermogenic methane
  - Presence of synthetic organic compounds, petroleum hydrocarbons, phenol, and degradation products
- Domestic wells
  - Little change in major ion chemistry in domestic wells (Mar 2009 to Apr 2012)
  - Detections of GRO, DRO and organic chemicals are consistent with previous sampling events
  - Results for dissolved methane are consistent with oxidation of thermogenic gas
- Comparison with USGS data
  - EPA results are generally consistent with USGS data
  - Most areas of difference due to differences in analytes or detection limits
    - Glycols not detected by USGS (USGS used less sensitive lab method)
    - USGS did not analyze for some organic compounds that EPA analyzed for (e.g. ethoxylated alcohols)

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Example MW02 Data from Phase V

Compound	Concentration in EPA post-purge MW02 sample	Concentration in USGS MW02 sample
Methane	22,000 ug/L	32,000 ug/L
Benzene	232 ug/L	250 ug/L
Gasoline Range Organics	5,290 ug/L	6,800 ug/L
Tert-butyl Alcohol	6,120 ug/L	6,300 ug/L
Phenol	102.3 ug/L (J)	156 ug/L
Diethylene Glycol	378 ug/L	*<7,730 ug

*Less than laboratory method detection limit
J: value is estimated

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Peer Review Process

- EPA continuing to accept public comment through Sept 2013
- Phase V data from EPA and USGS have been added to the record
- EPA responded to 2 major FOI requests from Encana and is posting all technical documentation on website
- EPA is working to develop responses to major comment areas
- Major issues raised by commenters to date:
  - Monitoring well construction and purging/sampling methods
  - Laboratory methods and Quality Assurance
  - Interpretation of Geology and Hydrology

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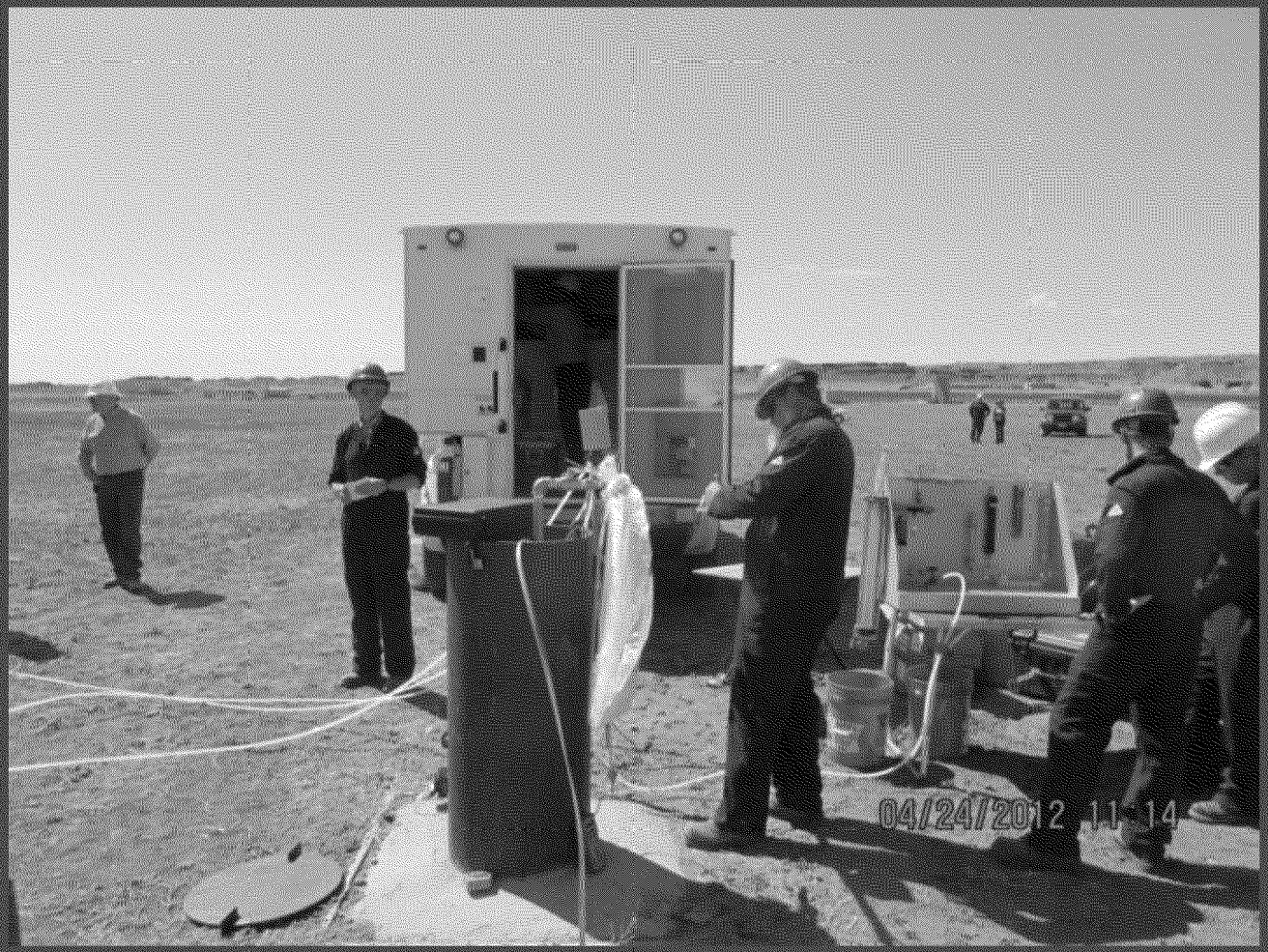
Questions?