

## **Water Use and Reuse for Bakken Shale Oil Development**

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### ***1. How much water is used for fracking and for other oil and gas activities?***

- Per well water use (0.5 MG to 3.9 MG) increased 8 times from 2008 to 2014
- Annual water use (0.55 BG to 10.2 BG) increased 19 times from 2008 to 2014
- The ratio of non-fracking water use vs. fracking water use ranged from 0.1 to 0.2
- Brine dilution usage rate was 465-685 gal/well/day (For comparison, average American water use per capita: 80-100 gal/day)
- Temporary oilfield service workers added an equivalent of 15% of annual total industrial water use for fracking

### ***2. How much water is used for industrial purposes in North Dakota?***

- Industrial water use for fracking accounted for 3 to 40% of the total consumptive water uses in the four-county region (Dunn, McKenzie, Mountrail, and Williams), 1.3 to 25% in western North Dakota, and 0.5 to 10% state-wide
- Before 2012, more groundwater was used for fracking than surface water, the trend was reversed after 2012

### ***3. What are the environmental and economic impacts of industrial water use?***

- Although potentiometric heads continue to drop, deep regional aquifers were not affected by Bakken oil development due to restrictive regulations
- Of the 15 glaciofluvial aquifers under study, 12 have seen water levels increasing or unchanged and the water levels for the Charbonneau, Tobacco Garden Creek, and Killdeer aquifers have decreased
- The average annual 7-day low flows for all 9 small-to-medium streams under study have increased
- Limited impact on regional water supply (in terms of water quantity) was attributed to 22% increase in precipitation and adaptive management measures
- Water depot industrial water sales increased from \$2m to \$230m from 2007 to 2014

### ***4. How much of the water used for fracking is recaptured or recycled?***

- Reuse of fracking wastewater (flowback and produced) is mainly happening in Texas, Pennsylvania, and Colorado
- Reuse of fracking wastewater is mainly affected by three factors: lack of freshwater (e.g., Tx), lack of Class II injection wells (e.g., Pa), and good quality of fracking wastewater (e.g., Co)
- Texas also uses brackish water (0.05-3% salts) for fracking

### ***5. Which fracking methods use no or less water?***

- Alternative fracking fluids are developed for production purpose, not for water conservation
- Non-aqueous-based fluids, using propane and petroleum distillates, have been discontinued for safety concerns since 2001
- Energized fluids, foams, and emulsions, developed for high proppant carrying capacity and fluid recovery efficiency, use less water