Anticipating Water Production, Reuse, and Disposal Volumes

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- Derive relatively accurate estimates of "statewide" volumes for freshwater and salt water associated with O&G
- Provide independent source of information that can be referenced by industry and state planning
- Disseminate realistic view of water use in O&G to the public

Related Presentations:

- Oct 25 "State-Scale Perspective on Water Use in Oil and Gas Operations" at OWS workshop, Norman, OK
- Nov 13 "Estimating Freshwater and Saline Water Volumes Associated with Oil and Gas Production in Oklahoma, 2000 to present" at Gov Water Conference, Tulsa, OK
- Nov 14 "Total dissolved solids in produced water for the Mississippian Lime and other active plays in Oklahoma" at Gov Water Conference, Tulsa, OK
- Nov 28-29 "Quantities of Water for Mississippian Lime Oil & Gas Operations" at Mississippian Lime Congress, OKC, OK

How much freshwater is used, where is most/least freshwater used?



http://ok.water.usgs.gov/infodata/wateruse.html

Which formations for horiz. wells (2000 - present)?



How much freshwater is used for fracing horizontal wells each year?



Estimated statewide horiz. well frac fluid volumes (2000 to 08-18-12)



Fluid Volumes from: IHS Database

How much water is co-produced when oil and gas are produced?



Estimated Statewide Produced Water Volumes (1985 to 2011)



Produced Water Volumes from OGS: Murray (2012)

Reported TDS of Produced Water by Formation



How much wastewater is injected into the subsurface?



How much wastewater is injected by County (2010)?



All Water on a Relative Scale

Freshwater

Saline water



Considerations for Produced Water vs Injected Water

- Accuracy of reported injection volumes?
- Evaporative loss of produced water before injection?
- Produced water from/to other states?
- How many and where are the commercial injection sites?
- What proportion is wastewater from other industries?

How much have UIC water volumes increased in Mississippian area?



Data:

- 2005 to 2010 increase of 124,525,332 BBLs (5,230 MGal) injected in Alfalfa, Grant, Kay, and Woods Counties
- 129 wells completed (81 in Miss) from 2006 to 2010

Estimates:

- Assuming Injected volume = produced volume
- Equates to ~ 965,313 BBLs (~40.5 MGal) produced water per well

Water Use in Oil and Gas Operations

- Oil and gas drilling and well completion accounts for a very small fraction (less than 1%) of freshwater use in Oklahoma
- Produced water volumes are substantial and brine in terms of TDS

Formation	*H ₂ O Frac Volume per Well (Gal)	H ₂ O Prod Vol per Well per Year (Gal)	*H ₂ O:Oil Produced (Vol:Vol)	*H ₂ O:Gas Produced (BBL:MCF)	*TDS (mg/L)
Mississippian Lime	1,854,216	40,543,131	18.5	3.9	194,650
Arbuckle	27,300	NA	42.4	7.7	193,766
*Indicates median value					

- Produced water must be handled carefully
- Production and injection wells must be adequately sealed to avoid contamination of freshwater resources



Figure 5. Oklahoma Annual Well Completions Comparing Vertical and Horizontal Drilling. Data from IHS Energy (2011) through January 1, 2011.

Figure from Shale Shaker article: Boyd (2011)

Horizontal Wells as Percentage of Total (2002 – 2010)



Figure 6. Oklahoma Annual Horizontal Drilling as a Percentage of Total Completions. Note: in terms of footage drilled 2010 horizontal wells accounted for 50% of State drilling. Data from IHS Energy (2011) through January 1, 2011.

Figure from Shale Shaker article: Boyd (2011)

Enhancements:

- 1. How much freshwater is used <u>per lateral length</u> in horizontal wells?
- 2. How much freshwater, volume as a function of depth, is used for <u>drilling</u> horizontal wells in each formation?
- 3. Can we estimate oil & gas produced by play/unit? Hence, allowing produced water calculation by play/unit.
- 4. How much freshwater is used for <u>drilling & fracing</u> of <u>vertical</u> <u>wells</u>?
- 5. Can we estimate wastewater disposal volumes per receiving unit/formation?
- 6. What injection pressures are required in each unit/formation and is there any relationship to seismic activity (i.e., induced earthquakes)?

Contributions and Input:

- Scientists and Staff at OGS
- Mallory Irwinsky, OU Geology B.S. student
- Jordan Carrell, OU Geology M.S. student



Sources of Data:

- Oklahoma Corporation Commission
- Producers and Service Companies
- U.S. Geological Survey

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Comparison of Completion Report Data in IHS database vs. FracFocus

