



Introduction to GWPC's Produced Water Initiative

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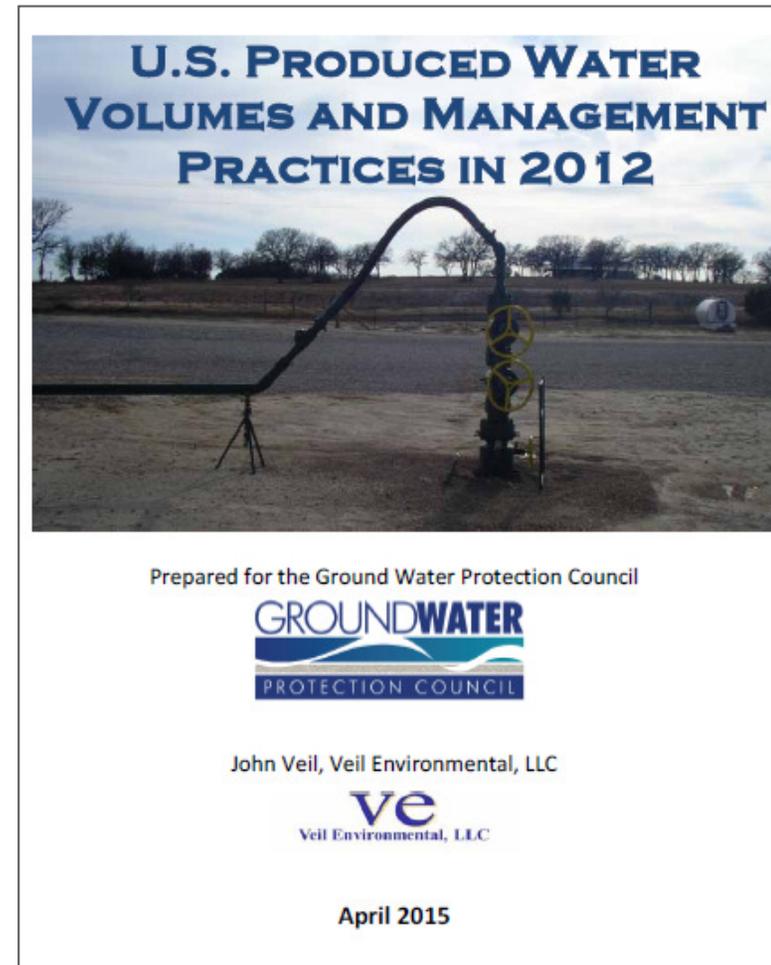
Topics for Discussion

- Produced water
 - How much?
 - How is it managed?
 - Why is GWPC interested?
- How does GWPC plan to proceed?
- Scoping efforts to date



Most Current Detailed Produced Water Inventory for the U.S.

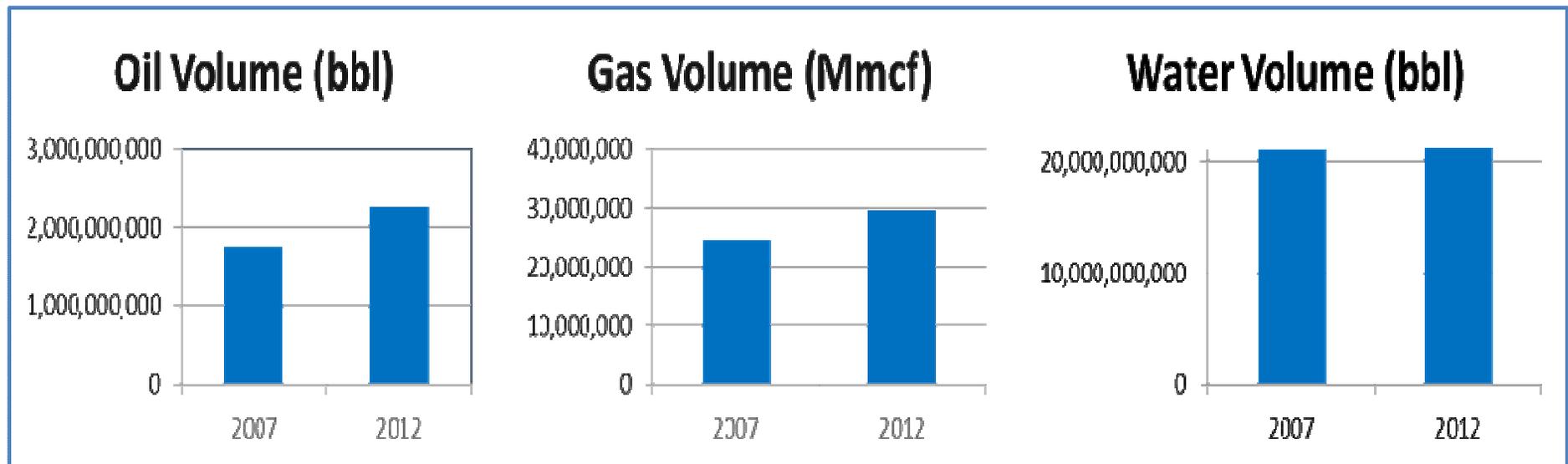
- Previous study done in 2009 looked at 2007 year
- The Ground Water Protection Council (GWPC) contracted with Veil Environmental to update a 2009 report using 2012 as the baseline year.
- Data were collected during the second half of 2014
- Report was published in April 2015



http://www.veilenvironmental.com/publications/pw/prod_water_volume_2012.pdf

Five Year Changes in Fluid Production

- Between 2007 and 2012
 - U.S. oil production increased by 29%
 - U.S. gas production increased by 22%
 - U.S. water production increased by <1%
 - 21.2 billion bbl vs. 21 billion bbl



Putting Produced Water Volume into Perspective

21.2 billion bbl/yr = 2.44 billion gal/day

1. U.S. population = 323 million people
 - 7.5 gals produced water/person/day
2. Niagara Falls average flow = 150,000 gal/sec
 - More than twice the amount of water that typically flows over the Niagara Falls each day is generated as produced water
3. Number of cans of beer or Coke at 12 oz/can
 - If all produced water were placed into cans, it would yield 26 billion cans/day
4. Cubic volume
 - The Empire State Building has a volume of 37 million ft³
 - The U.S. produced water would fill that volume nearly 9 times each day



Top Ten States in 2012 Water Production

Ranking	State	2012 Water (bbl/yr)	% of Total Water
1	Texas	7,435,659,000	35
2	California	3,074,585,000	15
3	Oklahoma	2,325,153,000	11
4	Wyoming	2,178,065,000	10
5	Kansas	1,061,019,000	5
6	Louisiana	927,635,000	4
7	New Mexico	769,153,000	4
8	Alaska	624,762,000	3
9	Federal Offshore	358,389,000	2
10	Colorado	320,191,000	2

2012 Produced Water Management Practices

<i>Management Option</i>	<i>Volume (bbl/yr)</i>	<i>%</i>
Injection for Enhanced Recovery	9,287,855,000	45.1
Injection for disposal	8,010,364,000	38.9
Surface discharge	1,121,045,000	5.4
Evaporation	691,142,000	3.4
Offsite Commercial Disposal	1,373,131,000	6.7
Beneficial Reuse	125,737,000	0.6
Total Produced Water Managed	20,609,274,000	100

- Injection for disposal should also include nearly all offsite commercial disposal
- $38.9\% + 6.7\% = 45.6\%$ (almost equal to injection for recovery)

GWPC's Interest and Involvement with Produced Water

- Much of GWPC's focus is on ground water issues.
 - The majority of produced water originates as natural ground water.
- GWPC places a strong emphasis on energy and water interactions.
 - Produced water is a direct byproduct of oil and gas production, and a large percentage of produced water is reinjected to help produce more oil.
- Regulation of underground injection of fluids (the Safe Drinking Water Act's Underground Injection Control or UIC program) is one of GWPC's major programmatic concerns.
 - Over 90% of the produced water brought to the surface is reinjected back into the ground to aid in future oil and gas production or for disposal.

GWPC Activities Relating to Produced Water or Other Oil and Gas Water Issues

- Created the highly-acclaimed Risk Based Data Management (RBDMS) that is used by more than 24 state agencies to track oil and gas data
- Developed and implemented the FracFocus system with its unique chemical disclosure registry
- Conducted several national conferences on energy/water interactions
- Published a groundbreaking Shale Gas Primer in 2009, including water issues
- Organized the first-of-its-kind national conference on stray gas issues in 2012
- Initiated discussions on induced seismicity related to hydraulic fracturing and disposal wells at several events in 2013. This effort led to formation of an induced seismicity work group and a 2015 primer on Technical and Regulatory Considerations Informing Risk Management and Mitigation
- Sponsored a 2015 report that estimates the total volume of produced water for the year 2012 and describes how that water is managed

New Produced Water Initiative

- GWPC wants to undertake a new comprehensive Produced Water Initiative
- Initially planned to have a Produced Water Primer that would cover a wide range of produced water topics
- In December 2016, EPA published its final hydraulic fracturing study
 - Many sections of the HF study covered produced water material
- Rather than duplicate what EPA and others had already published, GWPC decided to refine its scope of interest through a two-phased scoping effort

Scoping Effort

- Phase 1 - Review EPA HF study and identify produced water topics that were covered there
- Phase 2 - Develop a “universe” of produced water topics and evaluate each of the topics with two criteria
 - Are the topics within GWPC’s scope of interest and expertise? For example, Chapter 9 of the HF study goes into great detail on toxicological properties of chemicals used in hydraulic fracturing and found in produced water. While that is an important subject it is not one on which GWPC staff and member states are like to focus. That would be considered outside of GWPC’s interest and expertise. On the other hand, regulatory issues are definitely within GWPC’s scope.
 - Are the topics adequately covered by the HF study and other available literature? Using Chapter 9 of the HF study as an example again, the HF study covers toxicological subjects adequately given the current state of the literature. Conversely, the HF study does not go into sufficient detail on produced water beneficial uses.

Universe of Produced Water Topics

- The Phase 2 report identifies 150 produced water topics covering many different aspects of produced water. These are divided into 7 major themes and 21 secondary areas as shown below.

Disposal

- Injection
- Discharge
- Evaporation

Produced Water Characterization

- What Is Produced Water?
- What Is in Produced Water?
- How Much Produced Water Is Generated?

Processing, Storage, and Transportation

- Initial Processing of Produced Water
- Produced Water Storage
- Produced Water Transportation

Beneficial Use

- Uses within the Oil and Gas Industry
- Uses Outside of Oil and Gas Industry
- Barriers to Beneficial Use

Treatment

- Types of Produced Water Technologies
- Choosing Technologies
- Byproducts

Regulating Produced Water

- State and Federal Relationship
- Compilations of Regulations and Best Practices
- Other Issues

Impacts and Risks

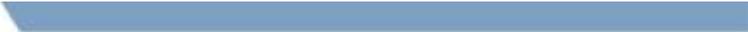
- Types of Impacts and Risks
- Knowledge of Chemicals in Produced Water
- Risk Assessment and Analysis

Examples of Topics and Scoping Evaluation

Topic	In GWPC's Interest Scope	Covered in Literature	Discussion and Questions
Initial Processing of Produced Water			
Separation methods used for different types of oil and gas production.	Yes	Yes, but need more	Does the type of oil and gas production (e.g., conventional, shale, coalbed methane) affect how the fluids are separated
Separation methods for flowback water vs. produced water	Yes	Yes, but need more	Are frac flowback water and produced water treated in similar or different ways?
Management of byproducts	Yes	No	Sludge or sediment may accumulate during the separation process. How are these byproducts captured and removed? How are they managed? How frequently must they be removed?

Caveats

- The list of topics and the evaluations of each topic were made by John Veil for the GWPC
 - If someone else with a different background and experience had developed the list of topics and evaluated each topic, the final lists would most likely have some similarities but not be identical
- 27 of the topics were deemed to be outside of GWPC's scope of interest and expertise. Only 1 topic was believed to be adequately covered in the literature. That leaves 122 active topics on the list.
- These do not all have the same weighting – some may be broad issues while others have a much more narrow focus.
- What is important is creation of a list that can form the starting point for GWPC's new produced water initiative. Topics can be added or removed at any time based on different opinions, new information, availability of funding, and other reasons.



Next Steps

- GWPC will complete its internal review of the two scoping reports
- GWPC will most likely seek some external review to:
 - Refine the list of topics and evaluations
 - Prioritize those topics that will be studied first
 - Seek funding to undertake projects
- The Produced Water Initiative is an open-ended program that will evolve over time to study some issues intensively and identify new issues