# Water for 2060 Produced Water Reuse and Recycling

In support of the Oklahoma Governor's initiative, launched in December, to re-use or recycle water produced in oil and gas operations, the Produced Water Re-use and Recycling report assessed the potential alternatives to current practices of injecting produced water from oil and gas wells into disposal wells in Oklahoma.

To achieve this goal, a 17-member Produced Water Working Group (PWWG), led by the Oklahoma Water Resources Board, was tasked with studying and recommending alternatives to produced water disposal from oil and gas operations in Oklahoma. The PWWG met five times from early 2016 to early 2017 to discuss and develop its recommendations. The recommendations included in the report are part of a long term effort to improve water management in the state.

**Produced Water Working Group Goals**

***Studying and Recommending*** *alternatives to produced water disposal from oil and gas operations in Oklahoma.* ***Discussing*** *opportunities and challenges associated with treating produced water for beneficial uses, such as industrial use or crop irrigation.*

In support of the PWWG efforts, the technical study team investigated the following key information:

- Produced water production in 66 Oklahoma counties and water quality in 29 counties;
- The top 40 major water users in the state based on water permits;
- Typical water treatment costs for various volumes and treatment levels from eight selected companies.

The data and information gathered through these efforts served as the basis to evaluate the cost-effectiveness of alternatives to current produced water disposal methods.

Ten representative cases were developed and further assessed by coupling a potential produced water user or alternative disposal method to an existing adjoining produced water source and evaluating the economics of each case in order for the PWWG to prioritize and make recommendations. The costs for the 10 cases range from $0.57 per barrel of water to more than $7 per barrel of water.

**Cost Estimates for Ten Produced Water Use Scenarios**

| New Case | Case Description | Total Capital ($Millions) | Capacity BWPD | County | Assumed Wtr TDS (mg/L) | Normalized $/BW |
|---|---|---|---|---|---|---|
| 1 | Typical Source and Dispose - STACK & SCOOP | NA | NA | Central OK | NA | 1.09 |
| 2 | Oil and gas re-use (treatment cost only) | NA | NA | State-wide | NA | 0.57 |
| 3 | Clean Brine Transfer & treatment | 208 | 200,000 | Alfalfa | 213,000 | 1.03 |
| 4 | Evaporation - low TDS (SCOOP & STACK) | NA | 20,000+ | Blaine | 17,000 | 1.66 |
| 5 | Evaporation - high TDS (Miss. Lime) | NA | 20,000+ | Alfalfa | 213,000 | 1.79 |
| 6 | Desalination for Surface Discharge | 22 | 15,000 | Beckham | 9,000 | 3.58 |
| 7 | Desalination for Power Use | 88 | 130,000 | Pawnee | 125,000 | 4.37 |
| 8 | Desalination for Power Use | 95 | 230,000 | Seminole | 180,000 | 4.43 |
| 9 | Desalination for Industrial Use | 35 | 30,000 | Grant | 227,000 | 7.41 |
| 10 | Desalination for Surface Discharge | 38 | 30,000 | Grant | 227,000 | 7.49 |

## Key Findings (ordered by viability and timeframe)

1. Produced water re-use by the oil and gas industry is the most cost-effective alternative due to minimal water treatment needs and thus low treatment costs. Increased inter-organizational planning and sharing of resources to improve re-use viability are required. The oil and gas industry has built limited water pipeline networks to date; however, the expansion of the water distribution systems over time would reduce conveyance costs and further facilitate produced water use for hydraulic fracturing.
2. A special case of water re-use was evaluated using surplus produced water from the Mississippi Lime play area around Alfalfa County. This surplus could be gathered and conveyed to sites in Blaine County for oil and gas re-use. Although the project could be technically and commercially complex, the analysis shows it has potential to be financially competitive with current disposal methods. A more detailed evaluation is needed.
3. Evaporation techniques for produced water should be further investigated and developed. Due to low water treatment costs and potentially limited water conveyance requirements, evaporation technology could be a viable alternative to disposal.
4. Water treatment and desalination techniques of produced water should be further investigated and developed. Although current technologies are technically implementable, the cases presented in this report are the most expensive strategies by a factor greater than four times current disposal costs. Water treatment at or near fresh water levels could produce usable water for power and other industry or potentially be discharged to augment local stream flow.

## Recommendations (abridged)

**1.** Reduce the challenges to water re-use through targeted regulations and legislation by:

- Removing legal ambiguity about ownership of produced water when sold or in the event of an environmental impact;
- Establishing bonding requirements for water impoundments that are appropriate without being an impediment;
- Clarifying rules regarding ownership when water is transferred from one company to another;
- Requesting delegation from the U.S. Environmental Protection Agency (EPA) to Oklahoma for permitting the discharge of treated produced water consistent with water quality protections for the receiving stream;
- Considering methods to make obtaining right-of-way for pipelines that allow cost-effective transfer of recycled/re-used water easier.

**2.** Further investigate methods to facilitate the re-use of produced water in oil and gas operations.

**3.** Study further the feasibility of transferring the Mississippi Lime area produced water to the STACK play (Case 3).

**4.** Conduct a more detailed evaluation of evaporation as an alternative to injection (Cases 4 and 5).

**5.** Continue the PWWG or some similar working group to continue to push the cooperative planning and development of new techniques, infrastructure, new legislation and regulatory structure. A regular dialogue between producing companies, regulators, technology providers and stakeholders is warranted.

**6.** Long-term funding of research: identifying toxicological risks to ensure the public health and environmental risks are minimized; the potential for agricultural uses and marginal aquifer recharge with produced water.