Development of Water Use Estimates and Projections in the Texas Mining and Oil and Gas Industries (FY2020)

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Task 1. Quantify current and historical water use for hydraulic fracturing and produced water volumes

Hydraulic Fracturing

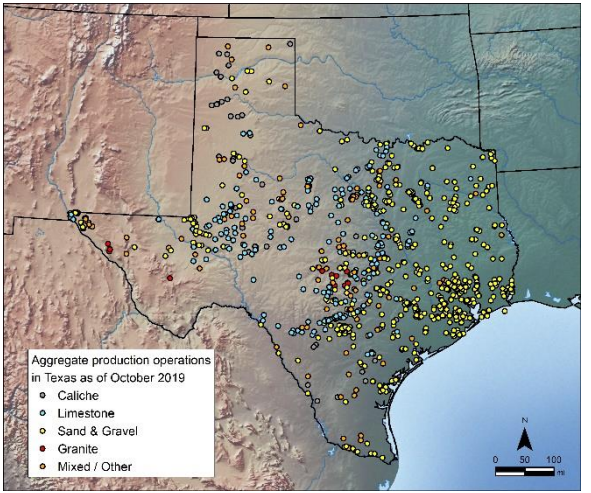
- Data sources for HF water use: FracFocus and IHS
- Time period: 2009 – 2020
- Well completion data: depth, lateral length
- HF water use intensity per length of lateral
- Permian, Eagle Ford, Barnett, and Haynseville
- Surveys to estimate water reuse

- **Produced water volumes**
  - Data sources: IHS database
  - Time period: 2009 – 2019
  - Focus on wells in unconventional reservoirs
  - Check against Salt Water Disposal volumes

Task 3. Develop projections of future water demand for hydraulic fracturing for oil & gas (2030–2080)

- Projected well inventory for unconventional reservoirs
  - Remaining drillable area
  - Well spacing (consider parent child well issues)
  - Well lateral length
  - Time period 2018 – 2020
- Technically Recoverable Resource estimate (assuming all potential wells will be drilled)
- Consider recent well spacing and vertical stacking to develop projections
- Spatial resolution (well inventory/mi^2)
- Expand on previous projections for water demand for hydraulic fracturing for the Permian Basin, Barnett, Eagle Ford, and Haynesville plays

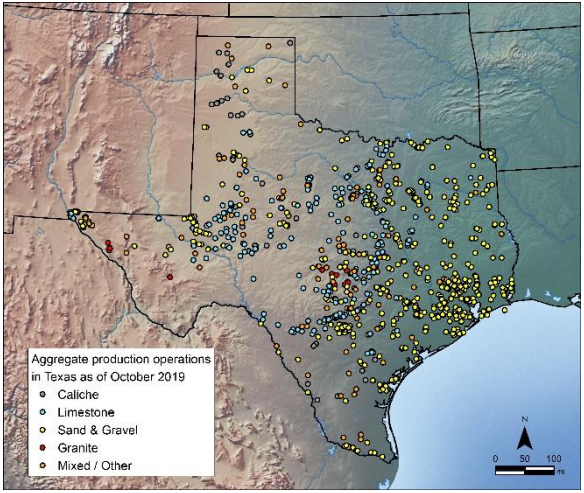
Task 4. Identify locations of operations and quantify current and projected future water use for coal and lignite mining


Aggregate production operations
in Texas as of October 2019
Caliche
Limestone
Sand & Gravel
Granite
Mixed / Other
N
0
50
100
mi

Task 4. cted.

- Current **active mines** in Texas: Calvert, Kosse Strip, Liberty, San Miguel, S Hallsville No. 1, and Tatum Strip, closing Eagle Pass, recently closed Marshall)
- Survey major **coal companies**: e.g. Luminant, North American Coal Company etc.
- Discuss with **Texas Mining and Reclamation Association**
- **Water use estimates**: dewatering, consumptive
- Use electricity projections from **ERCOT** to estimate future water use

Task 5. Identify locations of operations and quantify current and projected future water use for aggregates



Location of aggregate facilities

TCEQ permits: Aggregate Production Operation Permits (2019)

Type of extraction material

Total disturbed acres

Survey operators, reuse/recycling

Task 6. Collaborate with USGS personnel on water use for the mining category

- USGS mining water use reports exceed those from FracFocus and IHS database.
- When comparing data for the Permian Basin, it seems that USGS includes produced water volumes in their mining water use category.
- We will work with the USGS to clarify the different categories and reduce confusion.

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Water Issues Related to Transitioning from Conventional to Unconventional Oil Production in the Permian Basin

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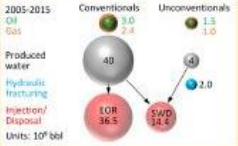
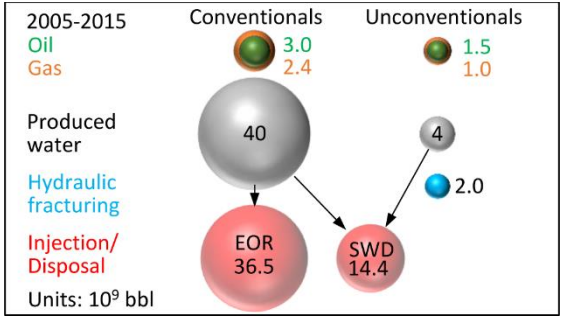
Supporting Information

ABSTRACT: The Permian Basin is being transformed by the "shale revolution" from a major conventional play to the world's largest unconventional play, but water management is critical in this semiarid region. Here we explore evolving issues associated with produced water (PW) management and hydraulic fracturing water demands based on detailed well-by-well analyses. Our results show that although conventional wells produce ~13 times more water than oil (PW to oil ratio, PWOR = 13), this produced water has been mostly injected back into pressure-depleted oil-producing reservoirs for enhanced oil recovery. Unconventional horizontal wells use large volumes of water for hydraulic fracturing that increased by a factor of ~10−16 per well and ~7−10 if normalized by lateral well length (2008−2015). Although unconventional wells have a much lower PWOR of 3 versus 13 from conventional wells, this PW cannot be reinjected into the shale reservoirs but is disposed into nonproducing geologic intervals that could result in overpressuring and induced seismicity. The potential for PW reuse from unconventional wells is high because PW volumes can support hydraulic fracturing water demand based on 2014 data. Reuse of PW with minimal treatment (clean brine) can partially mitigate PW injection concerns while reducing water demand for hydraulic fracturing.





Scanlon, B. R., Reedy, R. C., Male, F. & Walsh, M. Water issues related to transitioning from conventional to unconventional oil production in the Permian Basin. *Environmental Science & Technology* ***51, 10903-10912, doi:10.1021/acs.est.7b02185 (2017).***

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Maximize reuse of PW for HF

Will Water Issues Constrain Oil and Gas Production in the U.S.?

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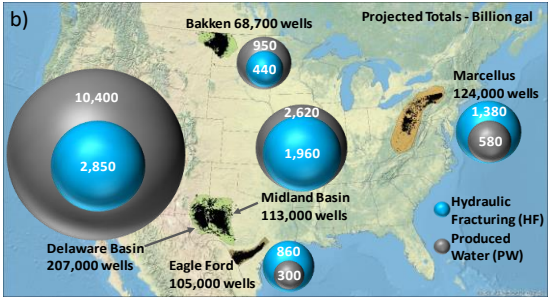
- Oil plays in semiarid W U.S.; gas plays in humid east
- PW from oil reservoirs >> than that from gas reservoirs

  Permian PW = 50× Marcellus PW
- **Partially mitigate water sourcing and disposal issues by reusing PW for HF**
- Projected PW volumes = ~ 4× HF water demand in the Delaware



Scanlon, B. R., Ikonnikova, S., Yang, Q. & Reedy, R. C. , Will water issues constrain oil and gas production in the U.S.? *Env. Sci. & Technol.*
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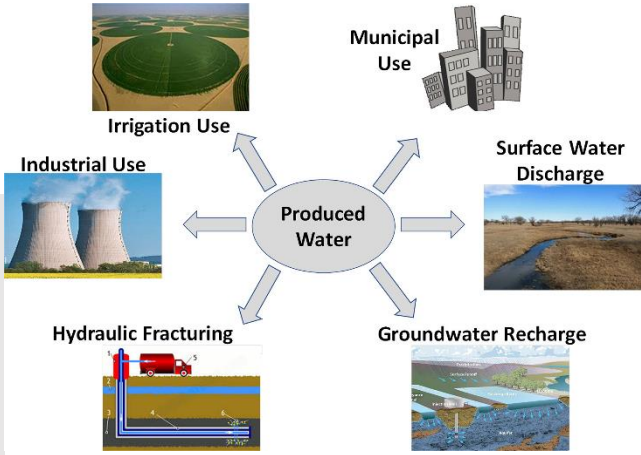
Can we beneficially reuse produced water from oil and gas extraction in the U.S.?

Highlights

- Irrigation demand exceeds produced water (PW) volumes and could accommodate treated PW.
- Treated PW could also be used to recharge depleted aquifers if there was confidence in the treatment process



Scanlon, B. R. *et al.* Can we beneficially reuse produced water from oil and gas extraction in the U.S.? *Science of the Total Environment* https://www.sciencedirect.com/science/article/pii/S0048969720305957

Texas Water Development Board

IHS

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Task 5. Identify locations of operations and quantify current and projected future water use for aggregates

Mace, 2019

Location of aggregate facilities
TCEQ permits: Aggregate Production
Operation Permits
Type of extraction material
Total disturbed acres

Survey operators, reuse/recycling
TDLR data: 230 production wells with 16 Facilities.
130 – 260 gal/ton of sand

Location of aggregate facilities in the Permian Basin in Monahans/Mescalero Sand Ecosystem