The Importance of Pipelines in Water Management for Onshore Unconventional Development*

Michael Dunkel[1]

Search and Discovery Article #42406 (2019)**
Posted July 29, 2019

*Adapted from oral presentation given at 2019 AAPG Annual Convention and Exhibition, San Antonio, Texas, May 19-22, 2019
 DOI:10.1306/42406Dunkel2019

[1]Advisian, A Worley Group Company, Calgary, Alberta, Canada (dunkelmrd@gmail.com)

Abstract

This presentation will build on the study by the Ground Water Protection Council on water reuse and experience with midstream and upstream companies. Water infrastructure, once installed, greatly reduces the cost to move water from its source to the hydraulic fracturing site. This allows water from more distant sources, including brackish sources, municipalities and produced water, to be used in hydraulic fracturing. This presentation will contrast the water challenges of various onshore basins and analyze how the problems are being solved by upstream and midstream companies.

The Importance of Pipelines in Water Management for Onshore Unconventional Development

AAPG

Michael Dunkel - May 20, 2019

Advisian

Disclaimer Details

DISCLAIMER

This presentation has been prepared by a representative of Advisian.

The presentation contains the professional and personal opinions of the presenter, which are given in good faith. As such, opinions presented herein may not always necessarily reflect the position of Advisian as a whole, its officers or executive.

Any forward-looking statements included in this presentation will involve subjective judgment and analysis and are subject to uncertainties, risks and contingencies—many of which are outside the control of, and may be unknown to, Advisian.

Advisian and all associated entities and representatives make no representation or warranty as to the accuracy, reliability or completeness of information in this document and do not take responsibility for updating any information or correcting any error or omission that may become apparent after this document has been issued.

To the extent permitted by law, Advisian and its officers, employees, related bodies and agents disclaim all liability—direct, indirect or consequential (and whether or not arising out of the negligence, default or lack of care of Advisian and/or any of its agents)—for any loss or damage suffered by a recipient or other persons arising out of, or in connection with, any use or reliance on this presentation or information.

PRIVACY NOTICE

Advisian is subject to various privacy laws. Advisian's Privacy Notice is included in this document. Additionally, information on how personal data provided by your organisation to Advisian is processed can be found at https://www.advisian.com/en-us/who-we-are/privacy-policy.

The information you provide as part of Advisian's business relationship with you will be used by or on behalf of Advisian and its affiliated companies and subsidiaries as part of the WorleyParsons Group (Group):

- To carry out due diligence on you and/or your company as a prospective counterparty to Advisian. This includes assessing financial standing, HSSE profile, technical and quality standards, and corruption/money laundering risk.
- If necessary to enter into or perform our contract with you.
- To manage our services.

Advisian consults private risk intelligence databases and publicly available sources of information, such as sanction lists, on an ongoing basis in order to comply with its internal anti-money laundering, and bribery and corruption prevention processes, and to prevent, detect or investigate dishonesty, malpractice or seriously improper conduct.

If you choose to provide Advisian with personal information on directors, officers, employees and/or owners of your company or any third party's personal information (such as name, email or phone number), you represent that you have the relevant person's permission to do so.

We may share your information:

- With our third-party service providers who perform business operations on our behalf.
- As part of a sale of a Group subsidiary or brand to another company.
- To protect and defend Advisian.
- When required by law and/or government authorities.

Given the global nature of Advisian and the Group's business, personal information may be transferred internationally for these purposes (but remains protected by the Group's Privacy Policy).

We retain your information:

- Only as long as is necessary for the purpose for which we obtained it and any other permitted linked purposes (for example, where relevant to the defense of a claim against us). So, if information is used for two purposes, we will retain it until the purpose with the latest period expires; but we will stop using it for the purpose with a shorter period once that period expires.
- In relation to your information used to perform any contractual obligation with you we may retain that data whilst the contract remains in force plus seven (7) years to deal with any queries or claims thereafter.
- In relation to any information where we reasonably believe it will be necessary to defend or prosecute or make a claim against you, us or a third party, we may retain that data for as long as that claim could be pursued.

Our retention periods are based on business needs and your information that is no longer needed is either irreversibly anonymised (and the anonymised information may be retained) or securely destroyed.

If you do not wish to provide your personal information to us, we may not be able to proceed with a business relationship with you.

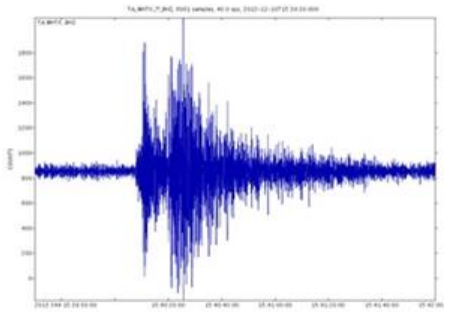
For further information on how your personal information is processed, please visit our website at www.advisian.com for further details on the Group's Privacy Policy.

Advisian

Agenda

- **Water Management**
- **Pipelines**
- **Costs**
- **GWPC report**

Connecting Water Pipelines to Seismicity



Induced Seismicity

Produced Water Disposal

Reuse instead of disposal

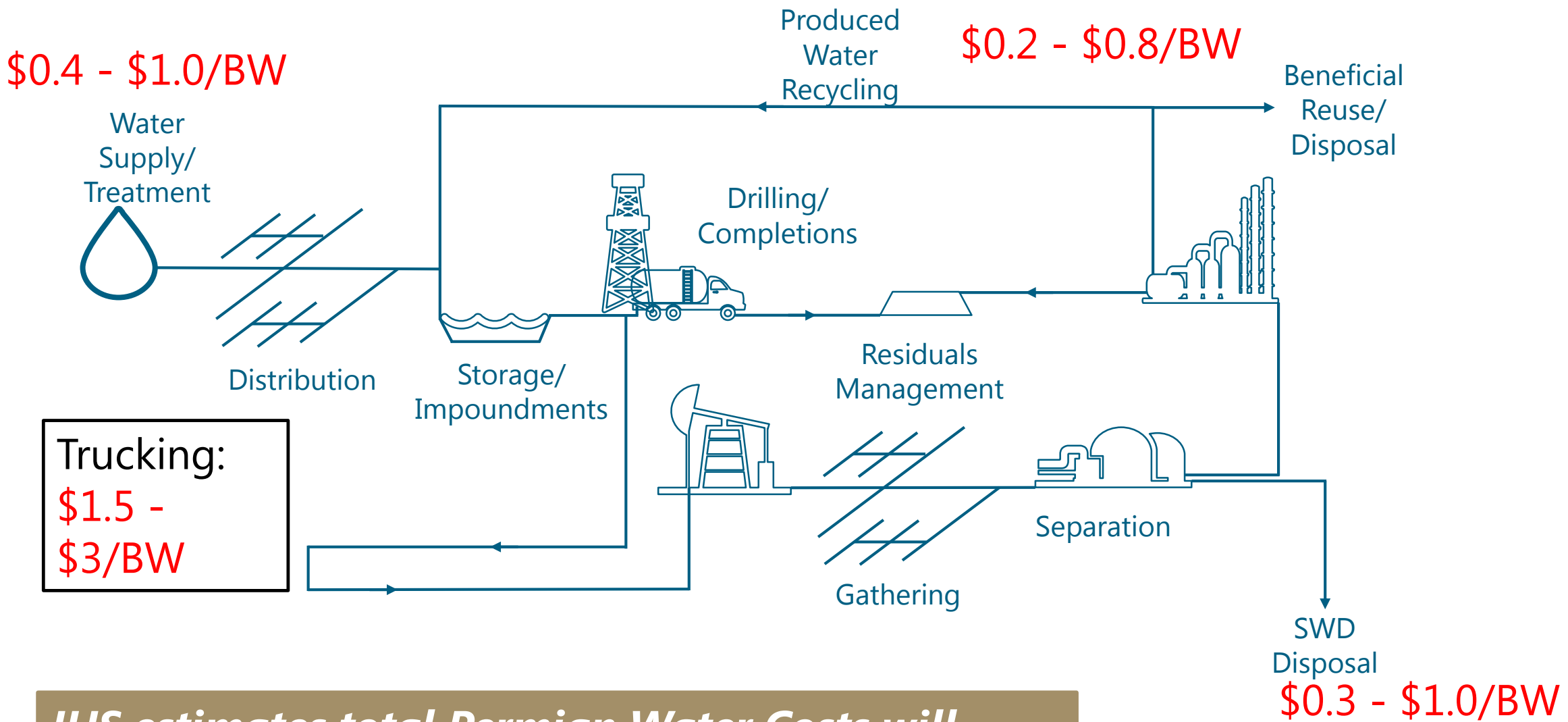
Pipelines needed for reuse

Evan Dunkel

Water Cost Drivers

- Limited source water & high demand
- Potential limits on disposal & increasing water costs
- Concentration of drilling activity
- Water system integration via pipelines

Water Management Component Costs



IHS estimates total Permian Water Costs will increase from $12 B in 2018 to $22 B in 2022.

Combined Water Costs

Traditional Nearby Sourcing & Disposing	*Reuse without Pipelines (with trucking)*	*Reuse with Pipelines (no trucking)*
0.4 – 1.0 Sourcing 0.3 – 1.0 Disposal	0.2 – 0.8 Treatment 0.05 – 0.1 Storage 1.5 – 3.0 Trucking	0.2 – 0.8 Treatment 0.05 – 0.1 Storage 0.2 – 0.5 Pipeline
$0.7 – 2.0/BW Total	**$1.75 – 3.9/BW Total**	**$0.45 – 1.4/BW Total**

Notes: Pipeline & storage per barrel costs assume substantial volumes of water over a period of years. Costs do not include temporary (layflat) lines that may be necessary in most cases.

Salt Water Disposal Well

- More deep SWDs ($10+ million) being permitted in the Permian…will this increase seismicity?
- Texas RRC reducing injection pressures on new SWD permits
- Expect more delays and challenges from regulations

Evan Dunkel

Impoundments

- Two side-by-side 500k barrel PW impoundments now common
- Cost: ~$2 million
- Producers and Midstream companies are increasingly developing PW impoundments for reuse.

Courtesy of Solaris

Cimarex water riser

The Rise of Produced Water Reuse in 2019 in Permian

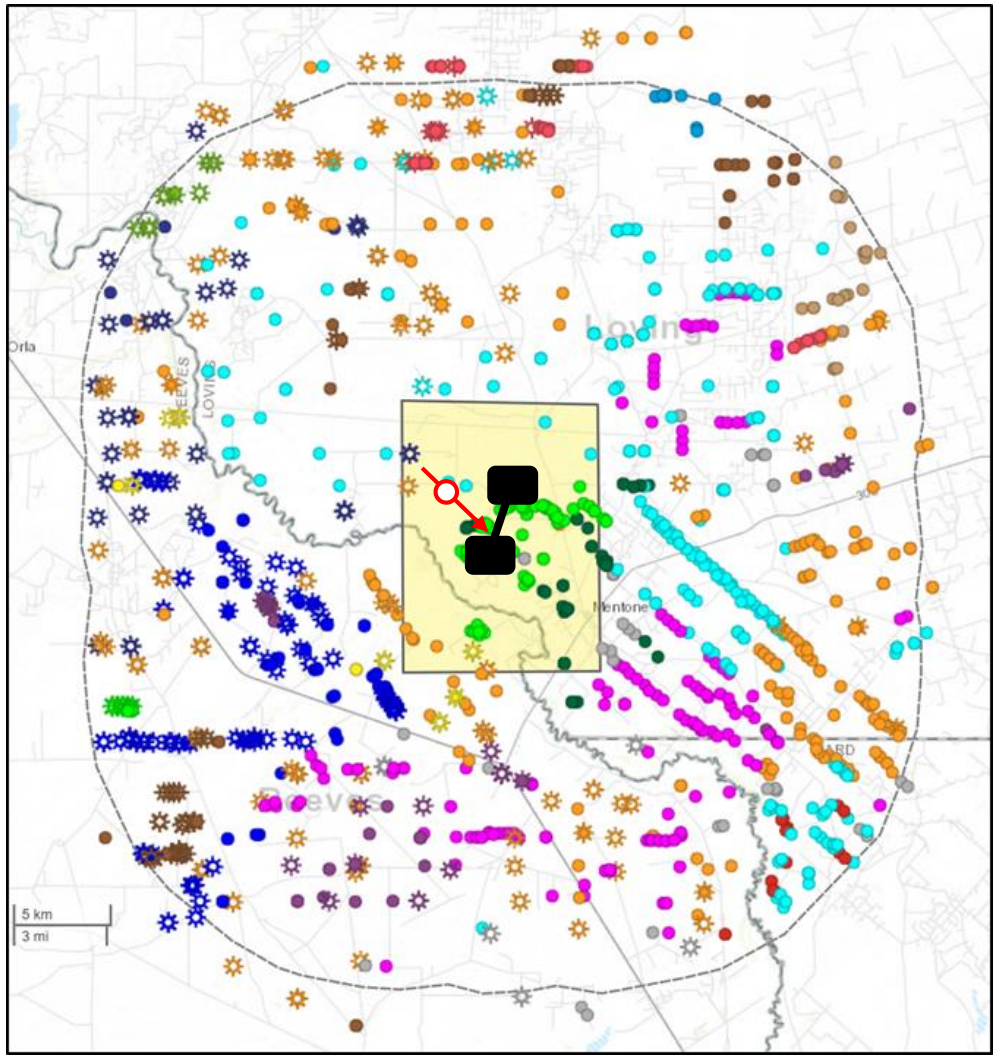
- Cimarex: water reuse 53% in 2018; saving ~$1.20/BW
- Devon, Oxy and Cimarex - water reuse 80+% in 2019
- Pioneer – 30% reuse by end of 2019
- Concho – Reusing water in all development areas

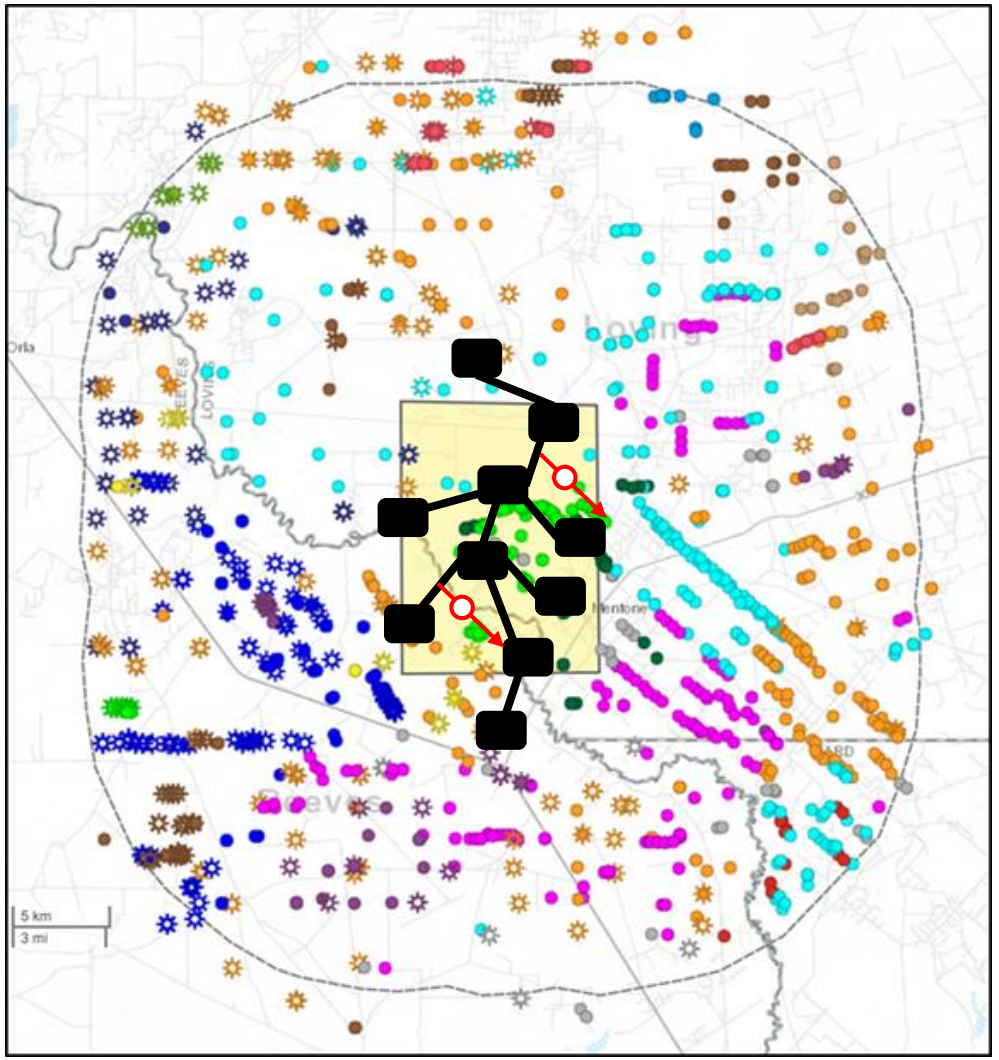
Courtesy of Fountain Quail

Water Reuse & Treatment Costs

- Treatment levels vary:
  - Bacteria kill
  - TSS/O&G
  - Iron / hardness
- Treatment costs range from $0.2 to $0.8/BW
- Few producers operate their own treatment plants

Multiple Small Systems vs. One Large System

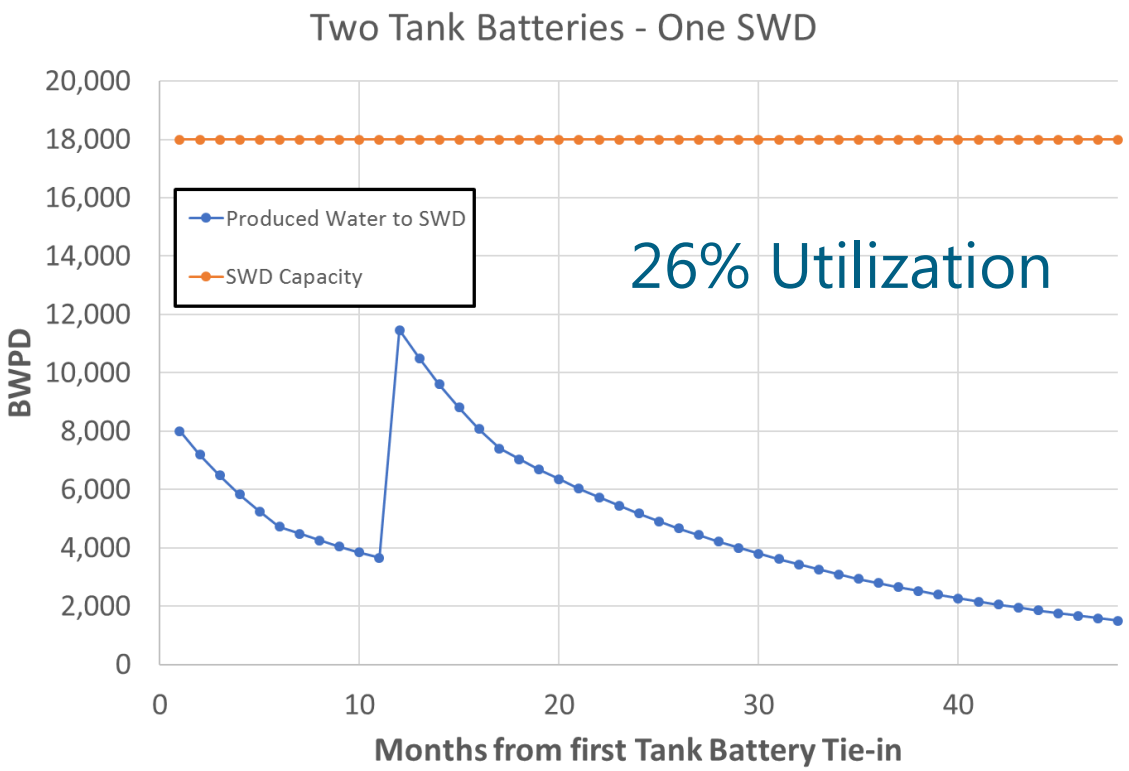


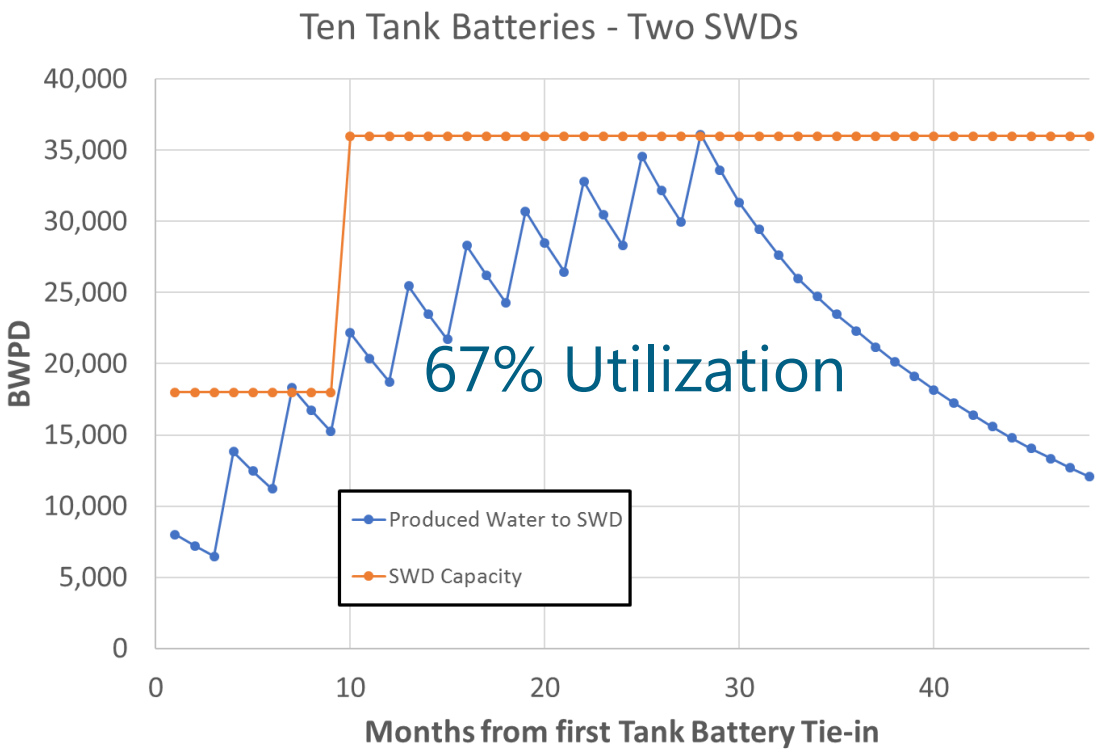


Legend: Tank battery ■ Water Pipeline / Salt water disposal well

Larger SWD Systems Gain Cost Efficiency

- Peak water demands can be spread across a linked network of SWDs
- Example: save the cost of 3 SWDs, or potentially ~$25 to $30 million
- Multi-producer systems can have even higher average capacity utilization





Advent of Water Midstream

***Water Midstream*: Own & operate water pipelines to deliver source water or take-away & dispose of produced water. May involve treatment & reuse.**

Operator Positives

- Reduce costs
- Minimize Capex for producers
- Allow producers to complete more wells
- Balance water supply and demand better

Operator Concerns

- Potential concern over control
- Commitment needed from producers
- Water mixing/Source water criteria
- Complexity of system

GROUNDWATER
PROTECTION COUNCIL

PRODUCED WATER REPORT

Regulations, Current Practices & Research Needs

Developing Solutions: Modular Approach

MODULE 01

Regulatory & Legal Frameworks

This module describes the current legal and regulatory frameworks that address produced water. It also addresses changes that may need to occur to facilitate the use of produced water.

Leadership:
John Baza, Utah Division of Oil, Gas & Mining
Shellie Chard: Oklahoma DEQ, Water Quality

MODULE 02

Produced Water Use in the Oilfield

This module describes the current uses and potential future uses of produced water inside the oilfield. It defines the existing constraints of use and identifies the opportunities and challenges of expanded use.

Leadership:
Tom Kropatsch: Wyoming Oil & Gas Commission
Scott Kell: Ohio Department of Natural Resources

MODULE 03

Produced Water Use & Research Needs Outside the Oilfield

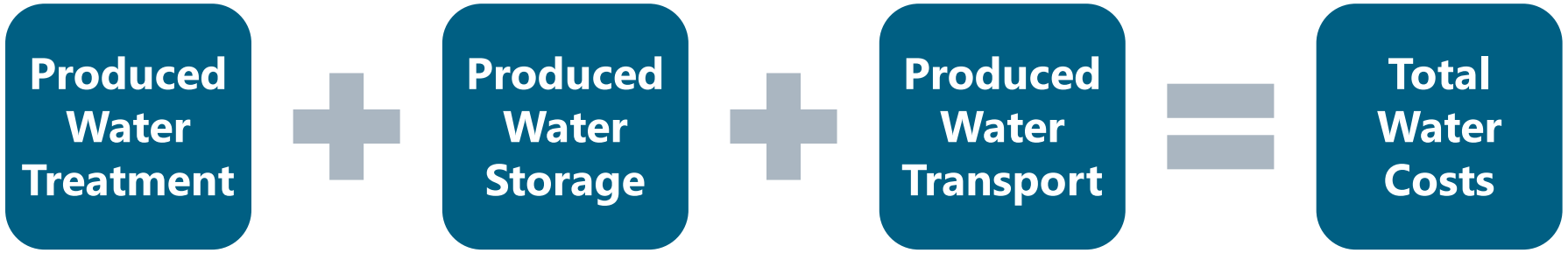
This module describes current and potential use of produced water outside the oilfield and identifies the research needs that will need to be addressed to facilitate expanded use.

Leadership:
Ken Harris: California Department of Conservation
Nichole Saunders, Environmental Defense Fund

Economics of Reuse

Water Costs without Reuse

Water Costs with Reuse



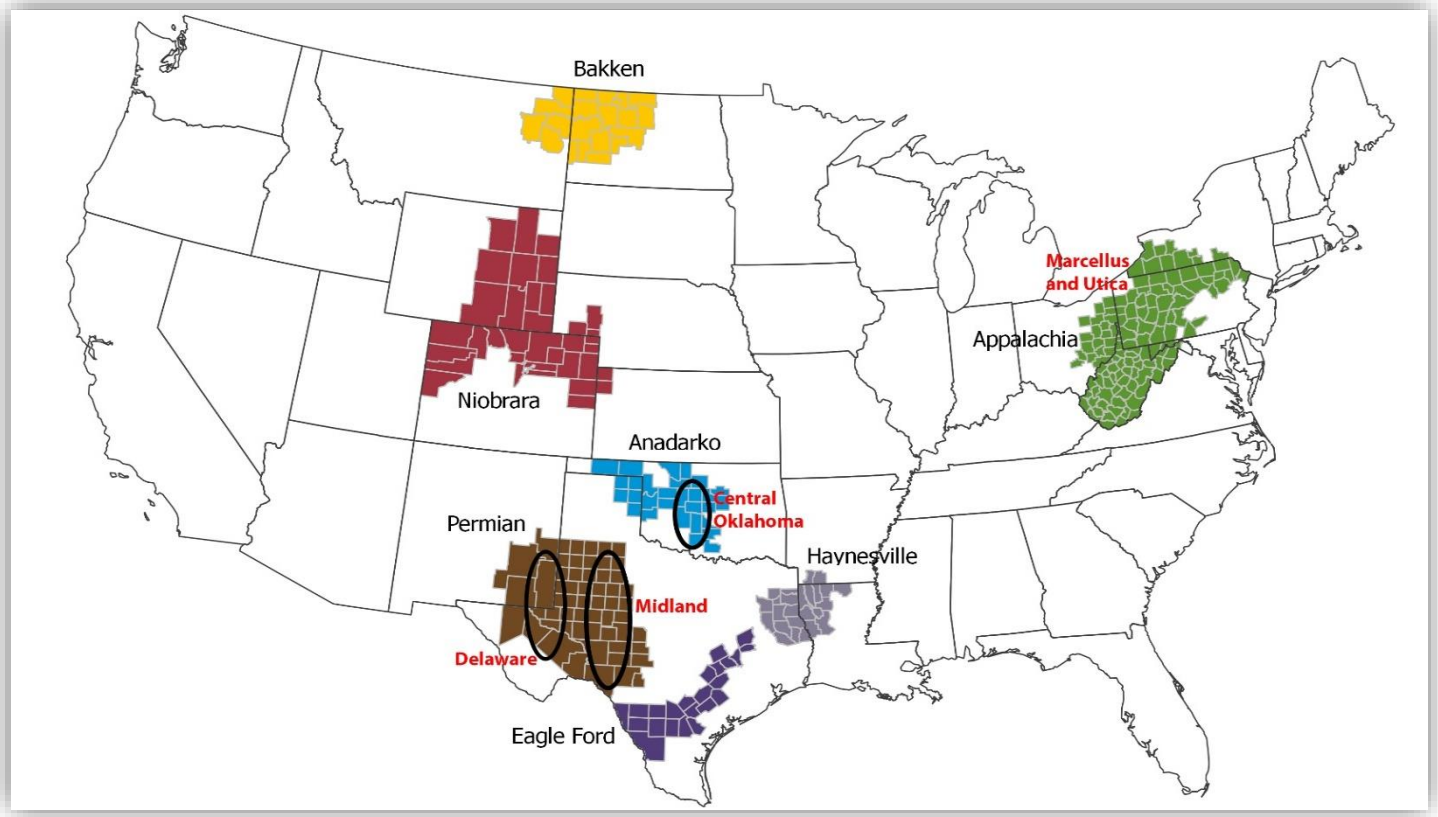
Trends in Water Management

Sourcing	Treatment	Storage	Transport	Disposal
Fresh ↓	Mobile Unit —	Frac Tanks ↓	Trucking ↓	Saltwater Disposal Wells ↑
Brackish ↑	Fixed Plant —	Impoundments ↑	Permanent Pipelines ↑	Reuse in new Frac Wells ↑
Reuse ↑	Wellsite bacteria —	Above-ground Storage Tanks ↑	Temp. Lines ↑	Reuse outside O&G —

Produced Water Reuse In Unconventional Oil and Gas Operations: Regional Studies

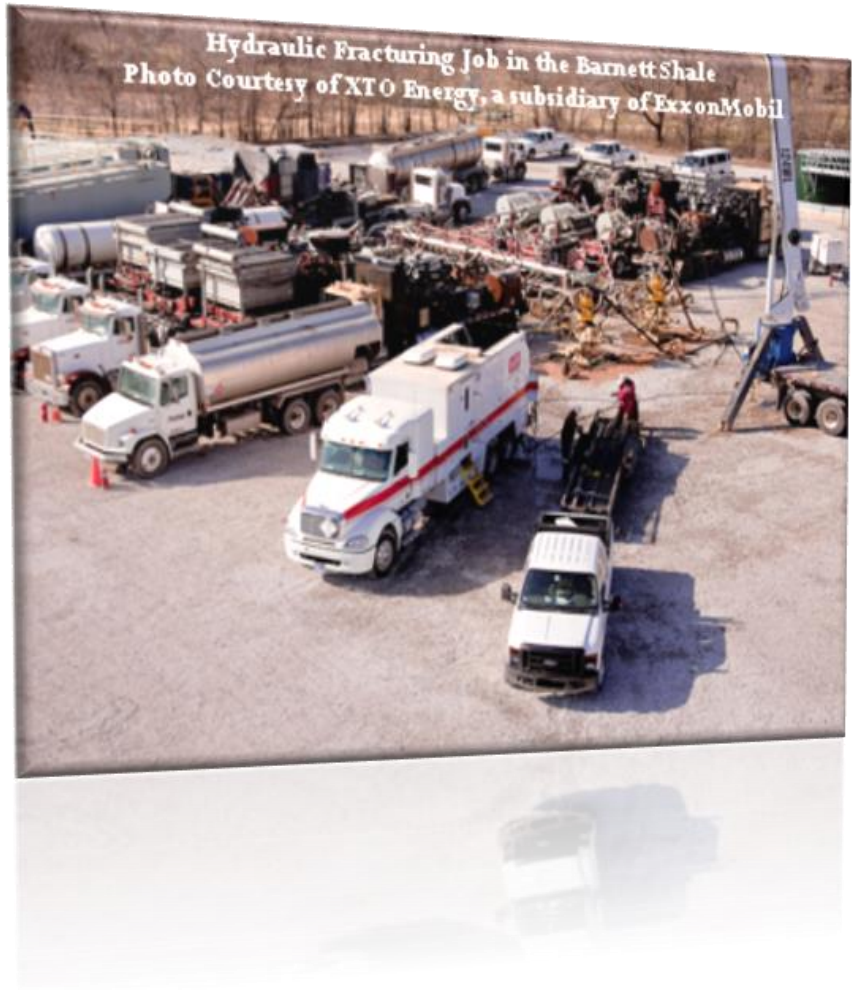
Seven basins profiled

- Appalachia
- Bakken
- Eagle Ford
- Haynesville
- Niobrara/ DJ
- Oklahoma
- Permian



Challenges & Opportunities of Water Management

- Adapting state regulatory frameworks
- Transport
- Storage
- Underground Injection
- Treatment
- Spill Management and Mitigation
- Treatment Residuals Management
- Air Emissions
- Wildlife Protection



Future for Water Infrastructure

- More water pipelines for sourcing & produced water
- Key drivers: cost, reduce trucking, increase reuse, disposal limits
- Each basin/county has different water factors for infrastructure
- Large & small producers installing water infrastructure
- Water midstream companies: growing role