TAMEST Shale Task Force

Read the Report: tamest.org/shaletaskforce

The Academy of Medicine, Engineering and Science of Texas (TAMEST):

Environmental and Community Impacts of Shale Development in Texas

- Introduction: The Honorable Gordon England, TAMEST President
- Report Overview: Melinda Taylor, The University of Texas School of Law
- Chapter Presentations:
  - Water – Danny Reible, Texas Tech University
  - Seismicity – Brian Stump, Southern Methodist University
  - Transportation – John Barton, Texas A&M University System

About TAMEST

The Honorable Gordon England

Board President

The Academy of Medicine, Engineering and Science of Texas (TAMEST)

About TAMEST

- TAMEST is Texas' premier scientific organization, bringing together the state's best and brightest scientists and researchers.
- TAMEST membership includes all Texas-based members of the National Academies of Sciences, Engineering and Medicine and the state's Nobel Laureates.
- 18 research universities are affiliates of TAMEST.

About TAMEST

- TAMEST works to promote Texas as a destination for outstanding research, supports rising star researchers in the state and serves Texas as an intellectual resource.
- The TAMEST Board of Directors commissioned this National Academies-style study to help inform state policymakers and the public.
- The task force includes expert representation by academia, industry, an NGO and government.

Shale Task Force

Sponsored and Conducted by

TAMEST

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FOUNDATION

Report Overview

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Report Overview

Melinda Taylor, Ph.D.

Senior Lecturer and Executive Director of the Kay Bailey Hutchison Center for Energy, Law, and Business

The University of Texas School of Law

Statement of Task

- Evaluate the scientific basis of available body of information
- Communicate current state of knowledge

- Key steps:
  - Review methodologies and approaches
  - Identify gaps
  - Suggest improvements
  - Make recommendations

Task Force Membership

Christine Ehlig-Economides – Chair

Air

David Allen – Lead

Ramón Alvarez

Matthew Harrison

Land

Melinda Taylor – Lead

Joseph Fitzsimons

Tracy Hester

Water

Danny Reible – Lead

Denny Bullard

Michael Young

Seismicity

Brian Stump – Lead

Kris J. Nygaard

Craig Pearson

Transportation

John Barton – Lead

Cesar Quiroga

General

Amelie G. Ramirez

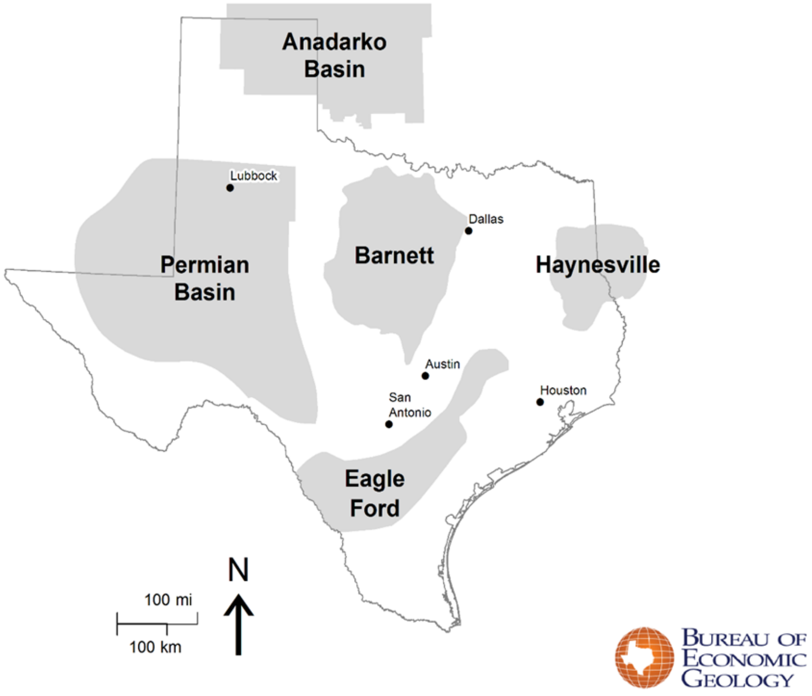
Economic/Social

Gene Theodori – Lead

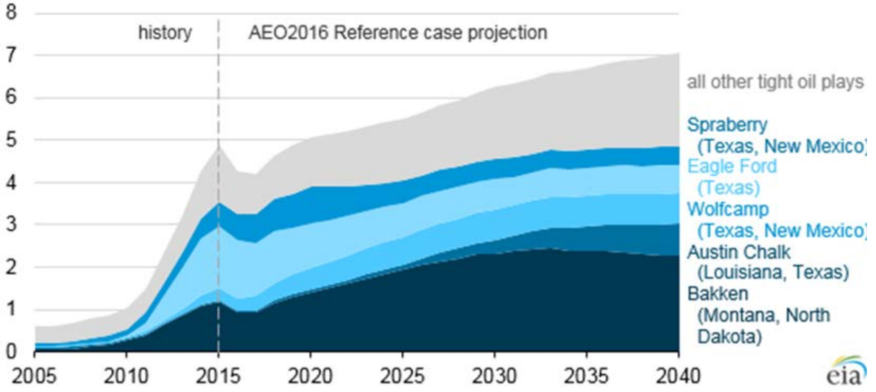
Omar Garcia

Urs Kreuter

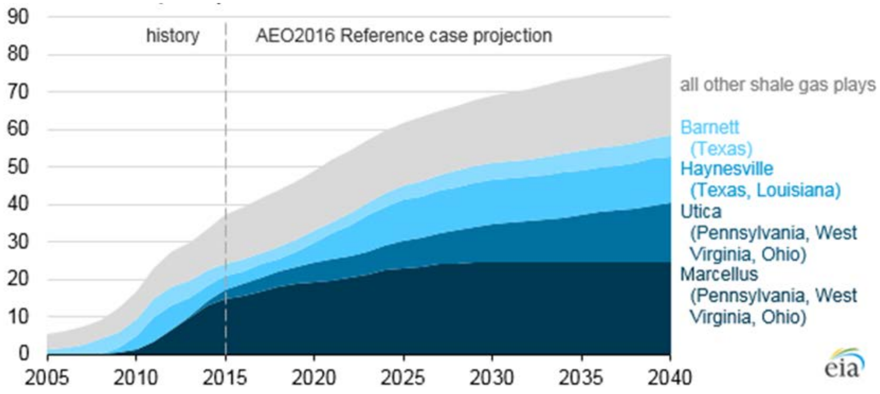
The Texas Shale Experience



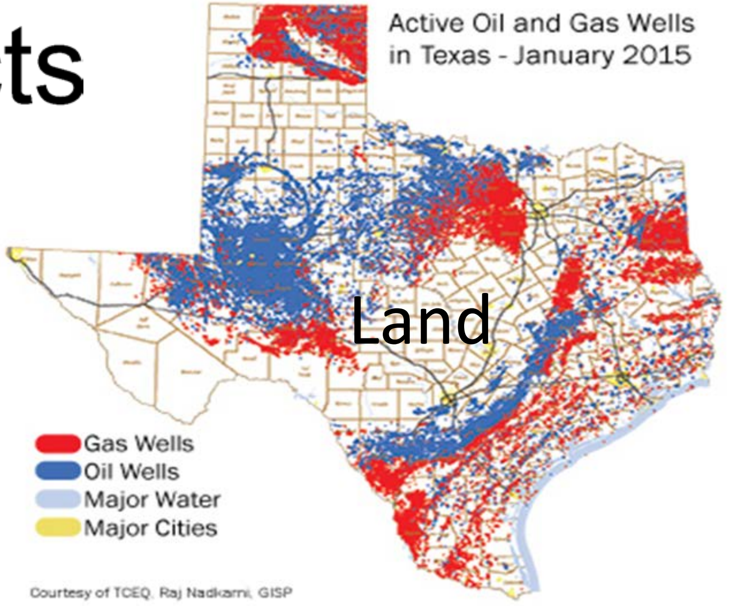
Tight Oil

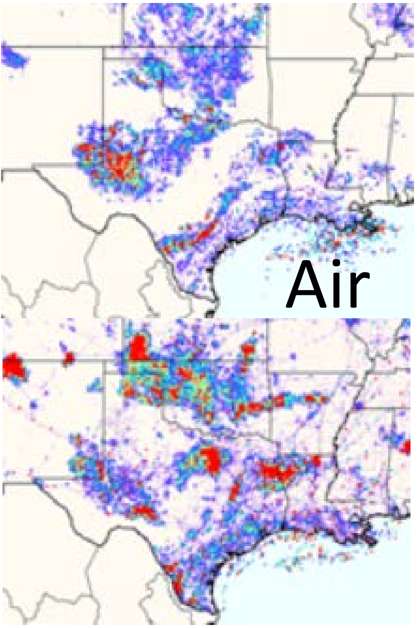


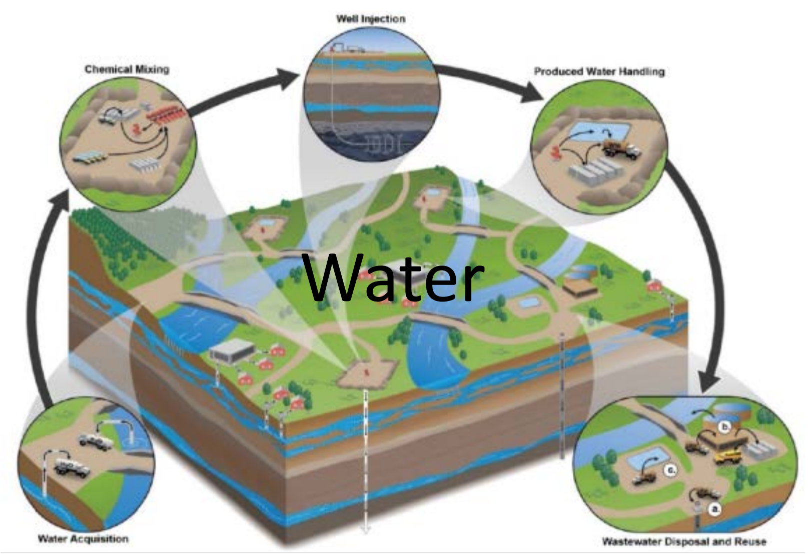
Natural Gas

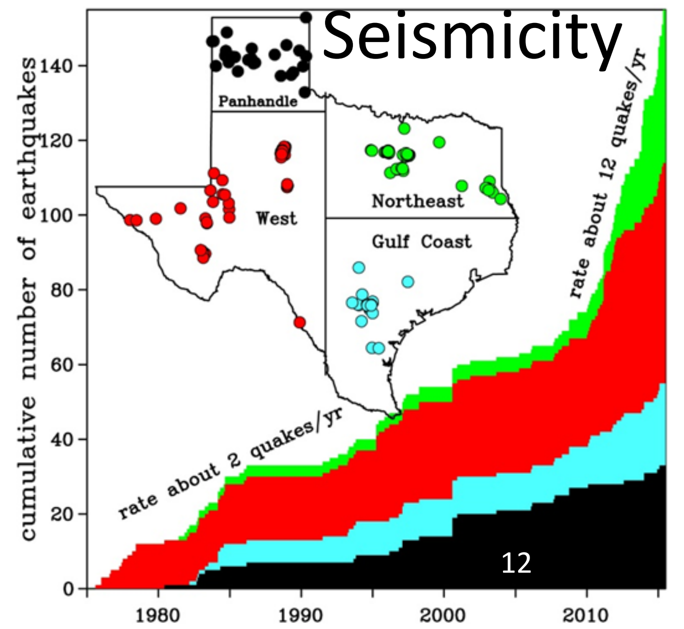


Environmental Impacts

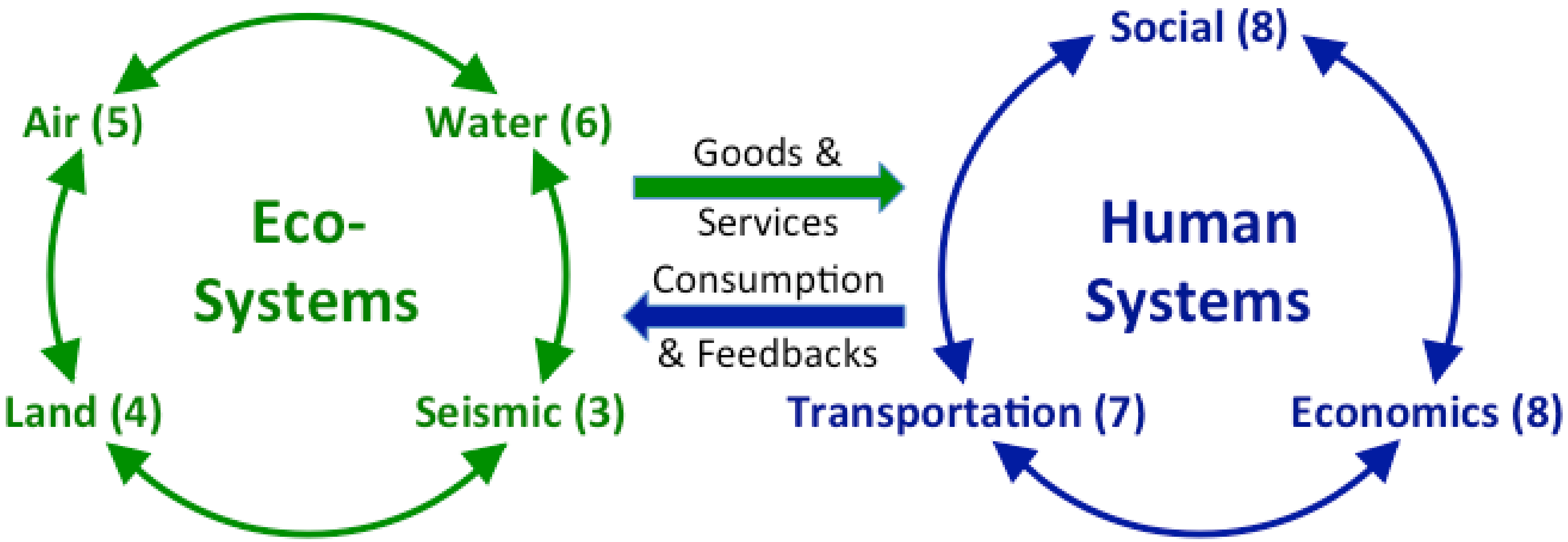








Way Forward



Transdisciplinary Connections, Trade-offs, and Decision Making

Water Quantity and Quality

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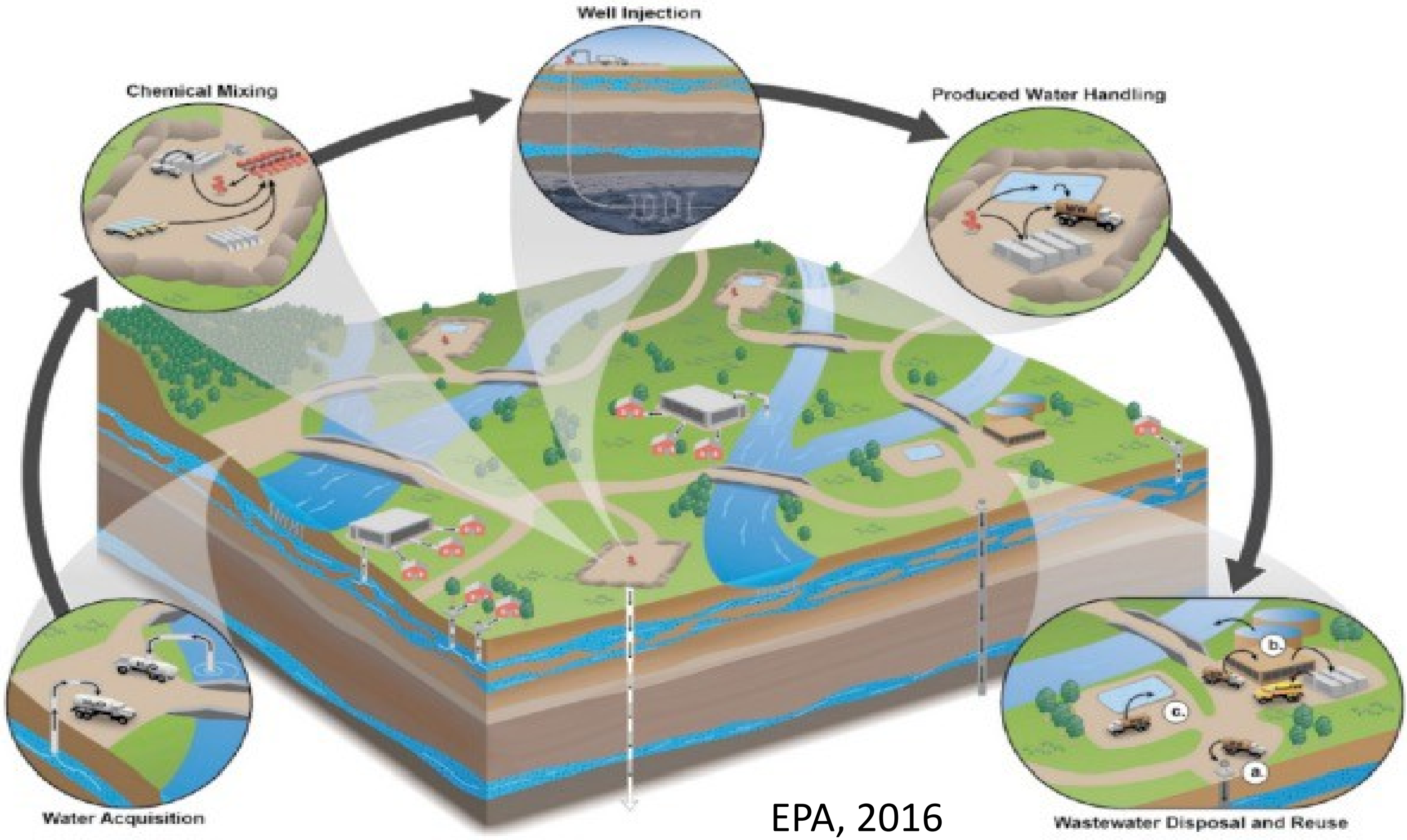
Water Impacts of Shale Development is an Important Public Concern



EPA, 2016

Water Quantity and Quality

Danny Reible, Ph.D., NAE

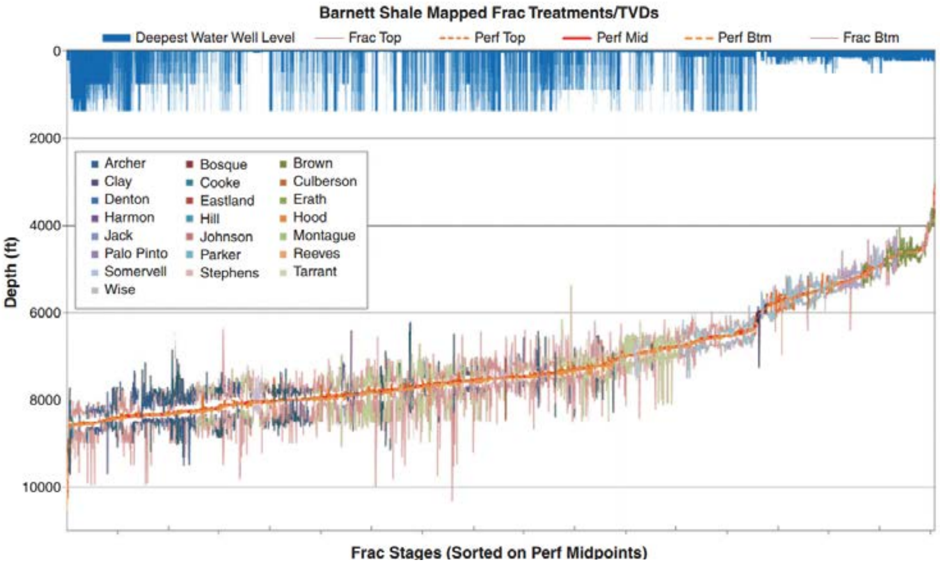
Donovan Maddox Distinguished Engineering Chair
Texas Tech University

Water Use for Hydraulic Fracturing

- Life cycle water use for shale oil and gas is typically substantially less than life cycle water use for other forms of energy (e.g. coal, nuclear and biofuels)
- Statewide, total freshwater use for shale oil and gas is <1% of total statewide freshwater use. Future use likely to decrease as brackish and produced water use increases
- Locally, freshwater use can be significant, particularly in rural counties without large amounts municipal or agricultural freshwater use
- Use of brackish and produced water can substantially reduce the impact of shale development on freshwater resources

Hydraulic Fracturing is Unlikely to Directly Impact Drinking Water Resources

- Fracturing is typically far removed from drinking water aquifers
  - Image of mapped fractures in Barnet Shale

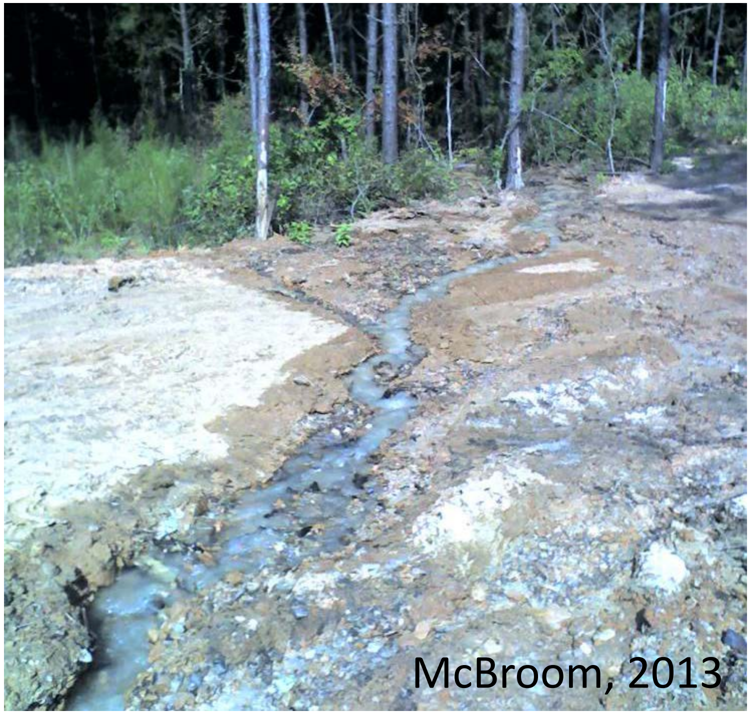


Fisher and Warpinski, 2012, SPE

- Indirect impacts due to spills and leaks of saline water at the surface more likely a cause for concern

Produced Water Quality is Poor

- Often triple the salinity of seawater in Texas
- Treatment for uses other than for hydraulic fracturing is costly and inefficient
- Impact of spills and leaks of this fluid perhaps greatest potential impact on land and water resources
- Greater handling of these fluids (e.g. reuse) may increase potential for spills and leaks


McBroom, 2013

- Spill reporting (particularly of saline waters) is less stringent and less accessible in Texas

Recommendations

- Use of water resources—other than freshwater—should be encouraged through operational changes, research and regulatory enhancements. Effectiveness of these efforts should be monitored.
- Brackish water resources should be better understood and, where appropriate, exploited for municipal, agricultural, and industrial uses.
- Spill and leak reporting and tracking should be improved to aid identification, and to correct recurring causes and improve best management practices.

Geology and Earthquake Activity

Geology and Earthquake Activity

Brian Stump, Ph.D.

Albritton Professor of Earth Sciences
Dedman College of Humanities and Sciences
Southern Methodist University

Geology and Earthquake Activity

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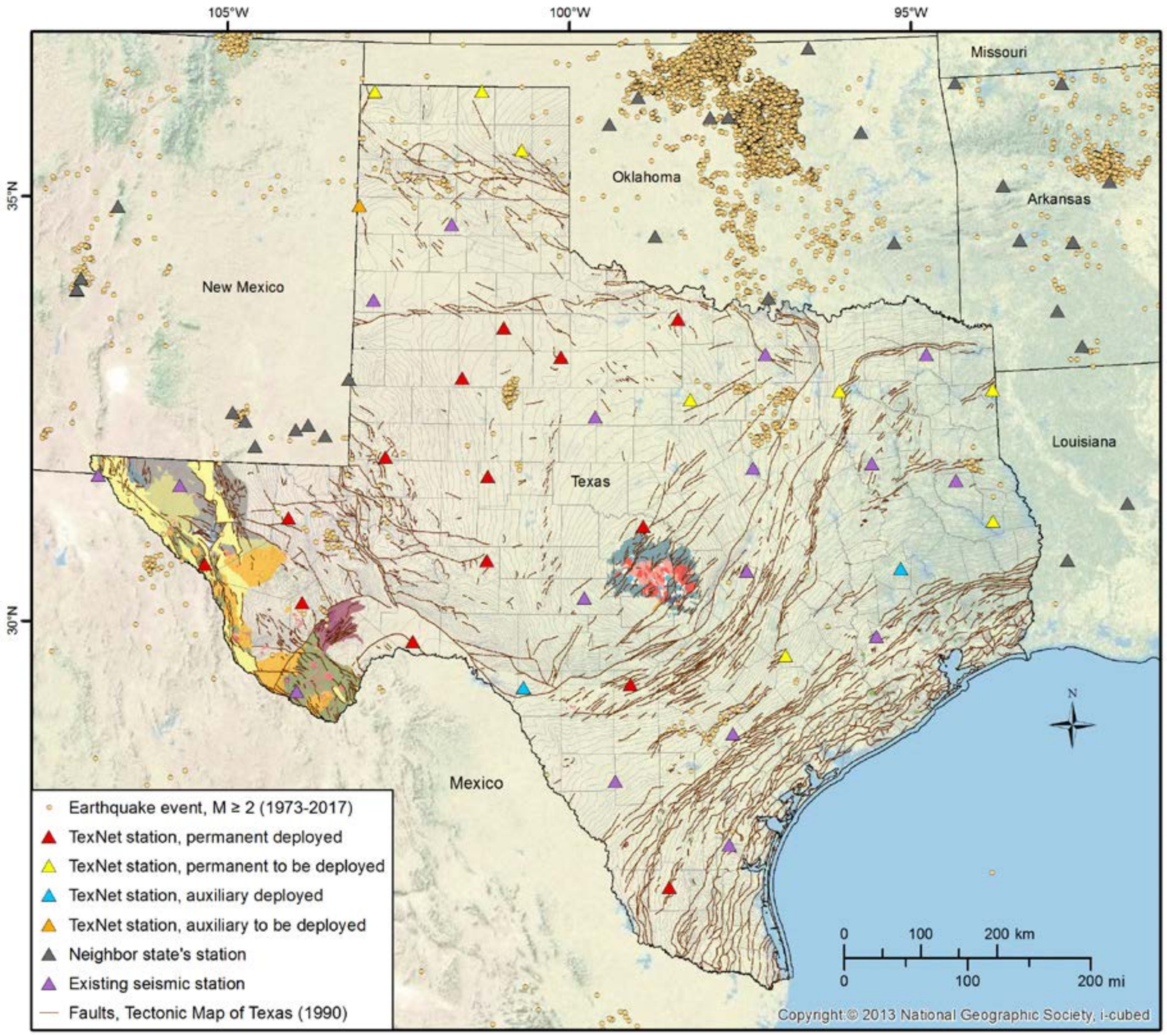
• Geologic faults are ubiquitous across Texas; these faults are poorly and incompletely characterized, with the majority of known faults in the subsurface in Texas stable and not prone to generating earthquakes.

• Earthquakes have increased in Texas. Before 2008, Texas recorded about 2 earthquakes a year. Since then, there have been about 12-15 a year.

• Some of these earthquakes are linked to wastewater disposal from oil and gas development, not with hydraulic fracturing.

• Seismic monitoring stations in Texas are increasing from 18 to 43 with TexNet.

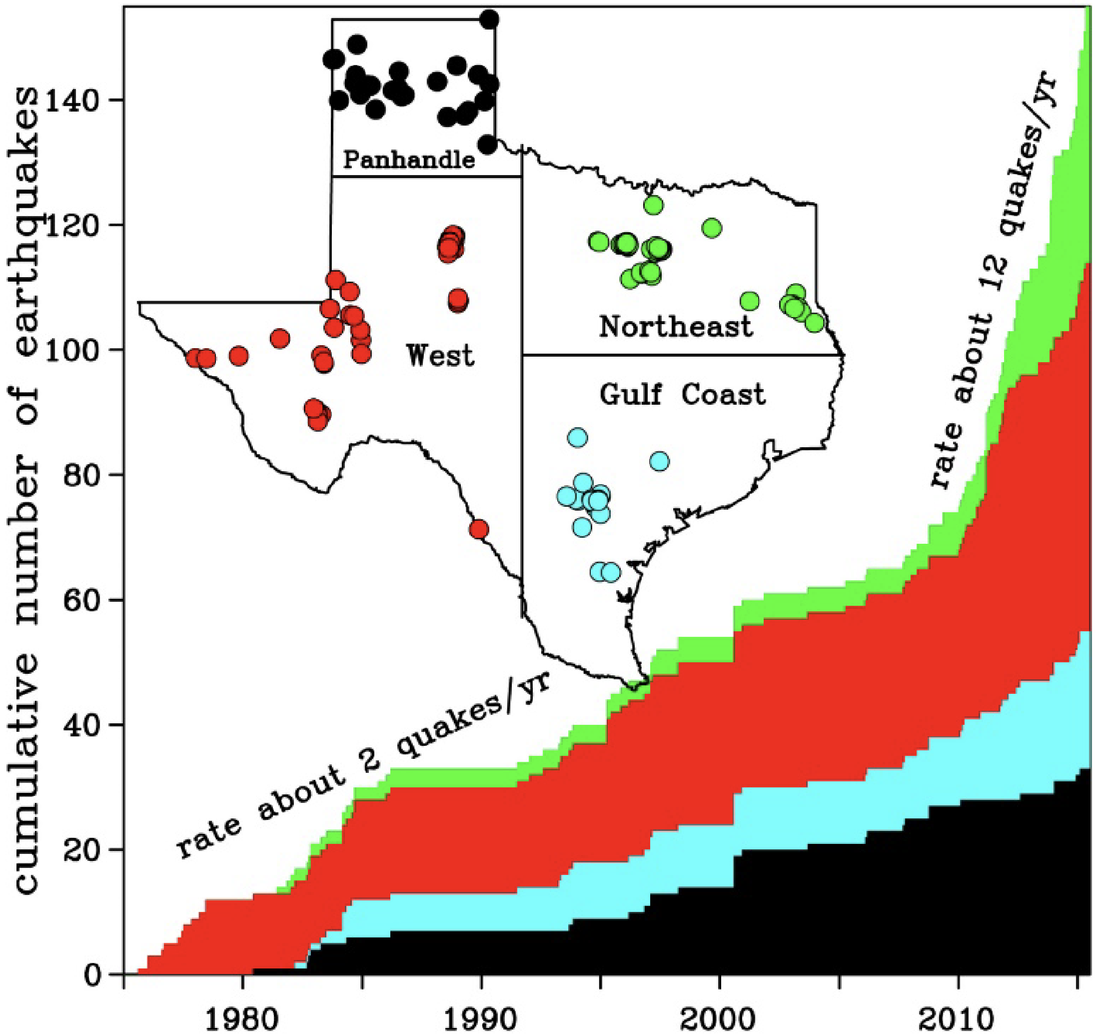
• Wastewater disposal wells near earthquake locations now must receive special approval from state regulators.



Geologic faults are ubiquitous across Texas; these faults are poorly and incompletely characterized with the majority of known faults in the subsurface in Texas stable and not prone to generating earthquakes.

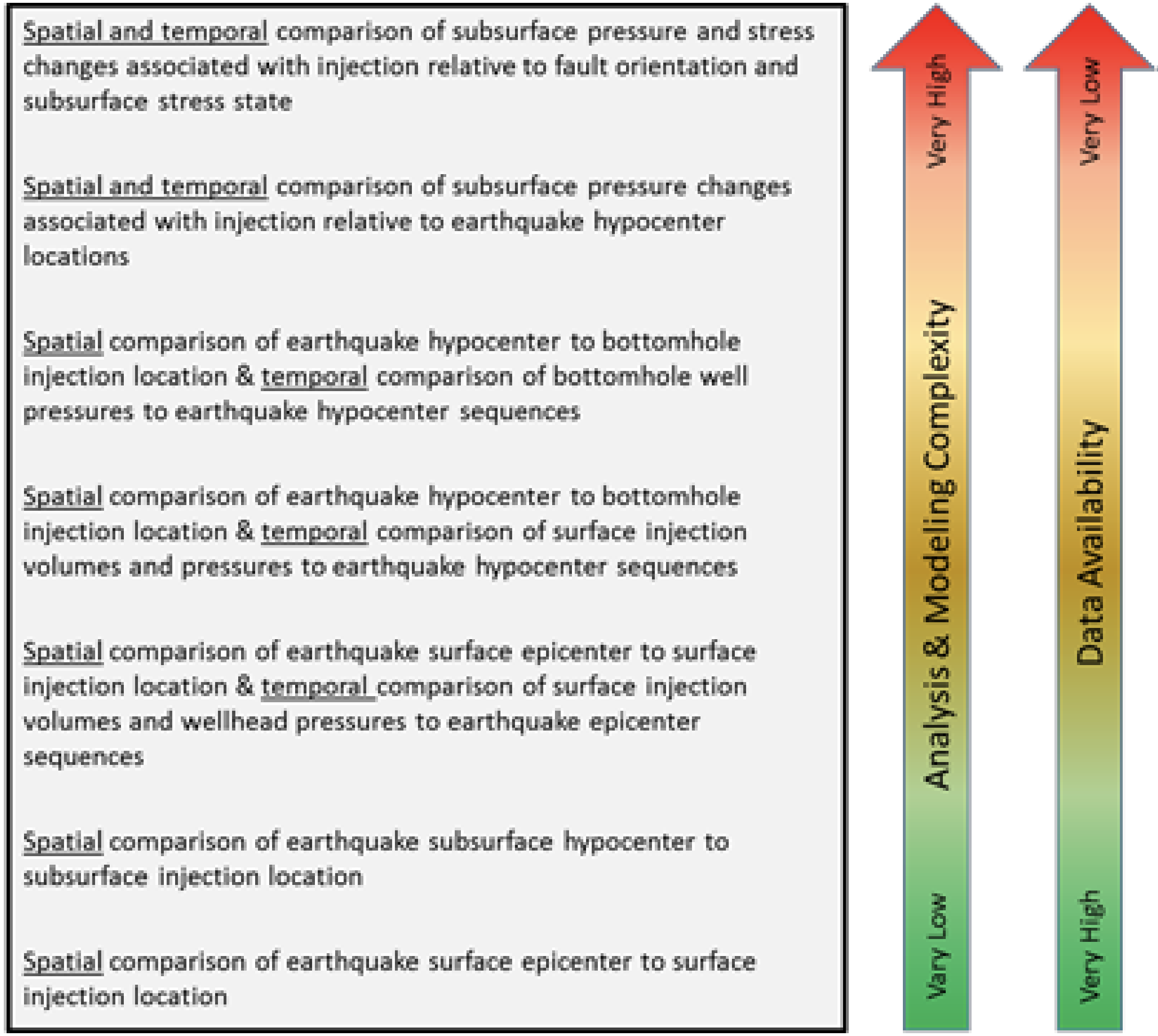
SOURCE: BEG, 2016 (after Ewing, 1991).

Texas Seismic Events since 1975 with Magnitude of 3.0 or Above



Earthquakes have increased in Texas. Before 2008, Texas recorded about 2 earthquakes a year. Since then, there have been about 12-15 a year.

SOURCE: Frohlich et al., 2016.



Some of these earthquakes are linked to wastewater disposal from oil and gas development, not with hydraulic fracturing.

SOURCE: Groundwater Protection Council and Interstate Oil and Gas Compact Commission, 2015.

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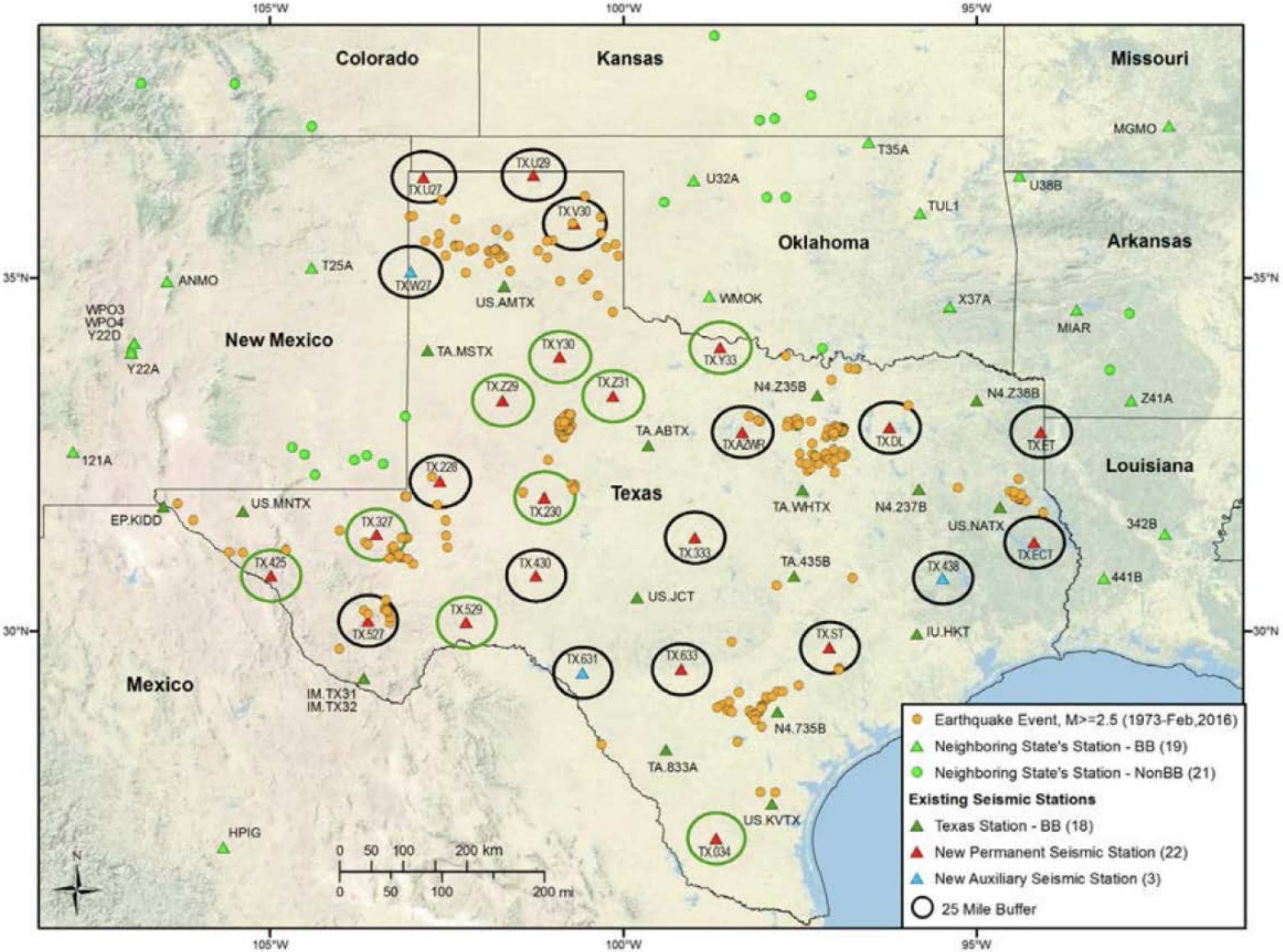

Seismic monitoring stations in Texas are increasing from 18 to 43 with TexNet.

SOURCE: BEG, 2016.

Recommendations

• **Future geologic and seismological research initiatives should develop improved and transparent approaches that seek to balance concerns surrounding data handling and sharing, and that promote sharing of data.**

• **Development of a common data platform and standardized data formats could enable various entities collecting data to contribute to better data integration. It also could facilitate interdisciplinary collaboration directed toward mitigation and avoidance of induced seismicity.**

• **The TexNet goals address an integrated research portfolio that considers seismicity analysis, geologic characterization, fluid-flow modeling, and geomechanical analysis.**

Transportation

Read the Report: tamest.org/shaletaskforce

Transportation

John A. Barton, P.E.

Associate Vice Chancellor

Texas A&M University System

Deputy Director & Chief Engineer, TxDOT (Retired)

Critical Reality

Current technologies for oil and gas development and production create a dramatic increase in heavy truck traffic volumes, especially in rural areas

- Number of truckloads per well: 1,000-1,500
- Number of ESALs per well: 5,000-15,000
  (ESAL: Equivalent single-axle load)

Most highway corridors, particularly secondary roads, were <u>never</u> designed to sustain heavy energy-related traffic, resulting in <u>accelerated</u> pavement, bridge and roadside <u>deterioration</u>

Relative Pavement Impact *per Truck*

Total Weight (lb)	Weight Ratio	EALF Ratio	Weight Ratio	EALF Ratio	Weight Ratio	EALF Ratio
	WRT 4,000 lb		**WRT 35,000 lb**		**WRT 80,000 lb**	
4,000	**1**	**1**				
10,000	2.5	23				
35,000	8.8	583	**1**	**1**		
80,000	20	18,009	2.3	**31**	**1**	**1**
84,000	21	**22,210**	2.4	**38**	1.05	**1.2**
90,000	22	28,511	2.6	**49**	1.1	1.6
100,000	25	42,753	2.9	**73**	1.25	**2.4**

Economic Impact

$1 billion per year on low volume highways

$2 billion per year including county roads & city streets

- No main highways or bridges included

Cost to industry if no pavement repair is done:

- $1.5-3.5 billion per year
  - Equipment damage
  - Lower operating speeds

Traffic Safety Impact

Dramatic increase in crash rates

Comparing crashes in rural areas involving CMVs in the Eagle Ford Shale and Permian Basin regions for the 4 year periods of 2006-2009 to 2010-2013:

- 52-61% increase in the total number of crashes
- 57-77% increase in the number of fatal, incapacitating, and non-incapacitating crashes
- 76-88% increase in the number of fatal crashes

Dramatic increase in crash-related costs

$50-$150 million per year

Major Takeaways

- Current technologies for oil and gas development and production from shale formations **require extremely large volumes of heavy truckloads**
- Most existing roadways and bridges were **not designed** to carry/accommodate energy sector truckloads
- Truck traffic associated with the development and production of oil and gas from shale formations has resulted in **severe traffic crash increases**
- Funding to address the impacts to the transportation infrastructure and traffic safety in energy sector areas is **very low relative to the magnitude of the impact**

Recommendations

The following strategies will improve preparedness of the state's transportation systems for oil and gas development and production in the future:

- Improve availability and quality of data related to ongoing and forecasted drilling activities
- Develop integrated, multimodal transportation infrastructure strategies and solutions
- Identify provisions for reliable, sustainable funding for proactively preparing the state's transportation infrastructure for future drilling activities

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