Fracking-Based Energy Developments and Transportation Impacts and Needs

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Presentation Outline

- What is hydraulic fracturing ("fracking")?
- Transportation impacts
- Current initiatives and needs

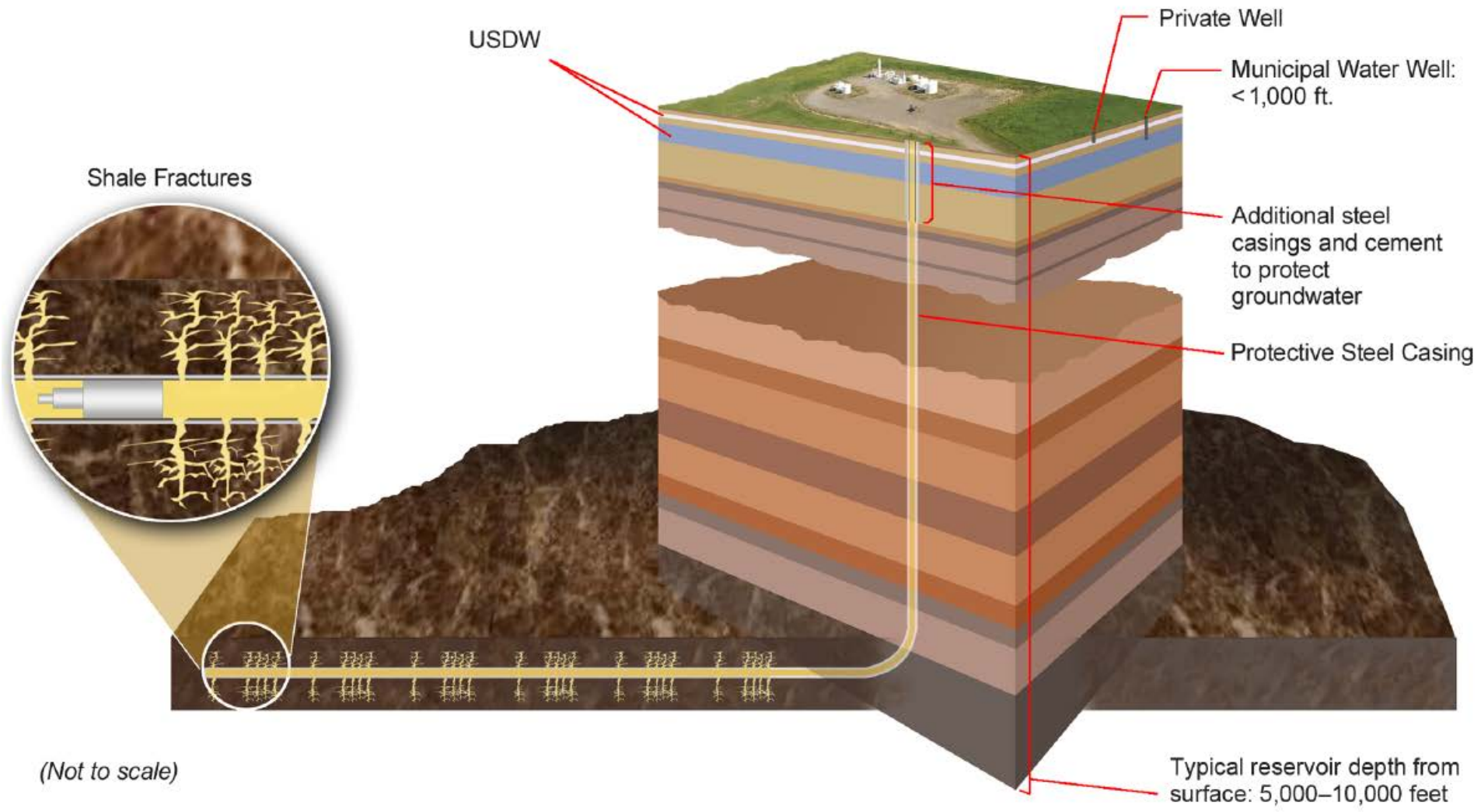
Hydraulic Fracturing ("Fracking")

- Rock fracturing using fluid at high pressure
- Water mixed with sand and chemicals
- Small fractures in rock enable gas, petroleum, and water to migrate to the well
- Has been around since the 1940s
- DOE's Eastern Gas Shales Project (EGSP)
  - Research and demonstration project
  - Cost-sharing with industry (1976-1992)

Hydraulic Fracturing ("Fracking")

- Horizontal drilling
  - Late 1980s, Austin Chalk Formation in Texas
  - 1991, Barnett Shale
- Slickwater fracturing
  - 1996/1997
  - Chemicals added to water to increase fluid flow
- Horizontal drilling + slickwater fracturing
  - Shale gas extraction became efficient and feasible

Horizontal Drilling + Fracking



Horizontal Drilling + Fracking

- 2012: 1 million fracking jobs in the U.S.
- 2011-2040 (according to EIA estimates):
  - Crude oil: 6 – 10 million barrels/day
  - Natural gas: 23 – 32 trillion cubic feet/year
- Eagle Ford Shale in South Texas:
  - 230 oil rigs, 30 gas rigs as of August 2013
  - 2008: 350 barrels/day
  - 2012: 387,000 barrels/day
  - 05/2013: 564,000 barrels/day

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- **Transportation impacts**
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Surface Transportation Needs

- Barnett Shale (North Texas) example:
  - 187 truckloads for pad site preparation, rig mobilization, drilling operations, and rig removal
  - 997 truckloads for fracking (3.7 million gallons or 88,100 barrels of water needed for fracking and saltwater disposal)
  - 353 truckloads per year for maintenance, most of which involves saltwater loads for gas well injections
  - 997 truckloads every few years for refracking

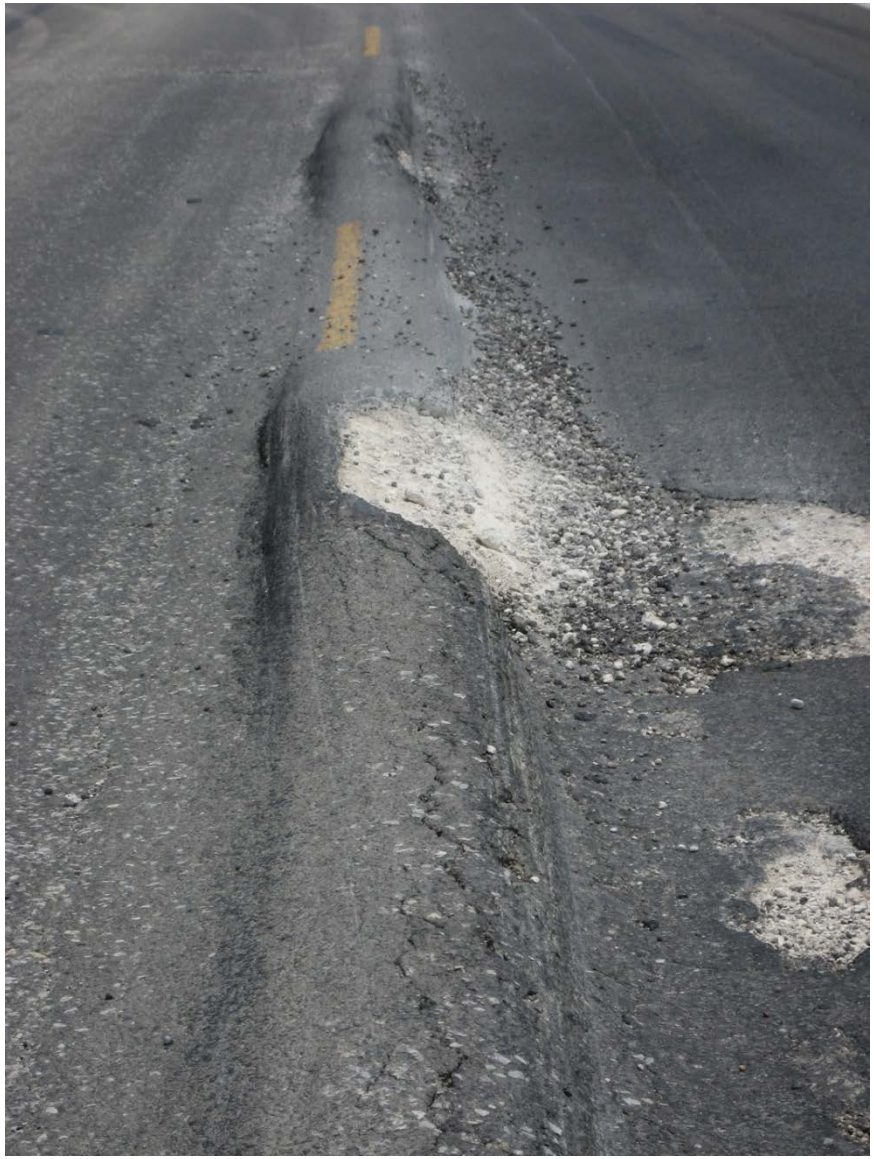
Surface Transportation Needs

- Number of truckloads is a function of:
  - Well type and depth
  - Geology
  - Drilling technology
- Water needs for fracking: 2 – 6 million gallons
- Vertical vs. horizontal wells (Marcellus Shale)
  - Vertical well fracking: 20,000 – 80,000 gallons
  - Horizontal well fracking: 2 – 9 million gallons

Transportation Impacts

- Pavement impacts
- Roadside impacts
- Operational and safety impacts

IH 35W – East Frontage Road



Pavement shoving, loss of surface

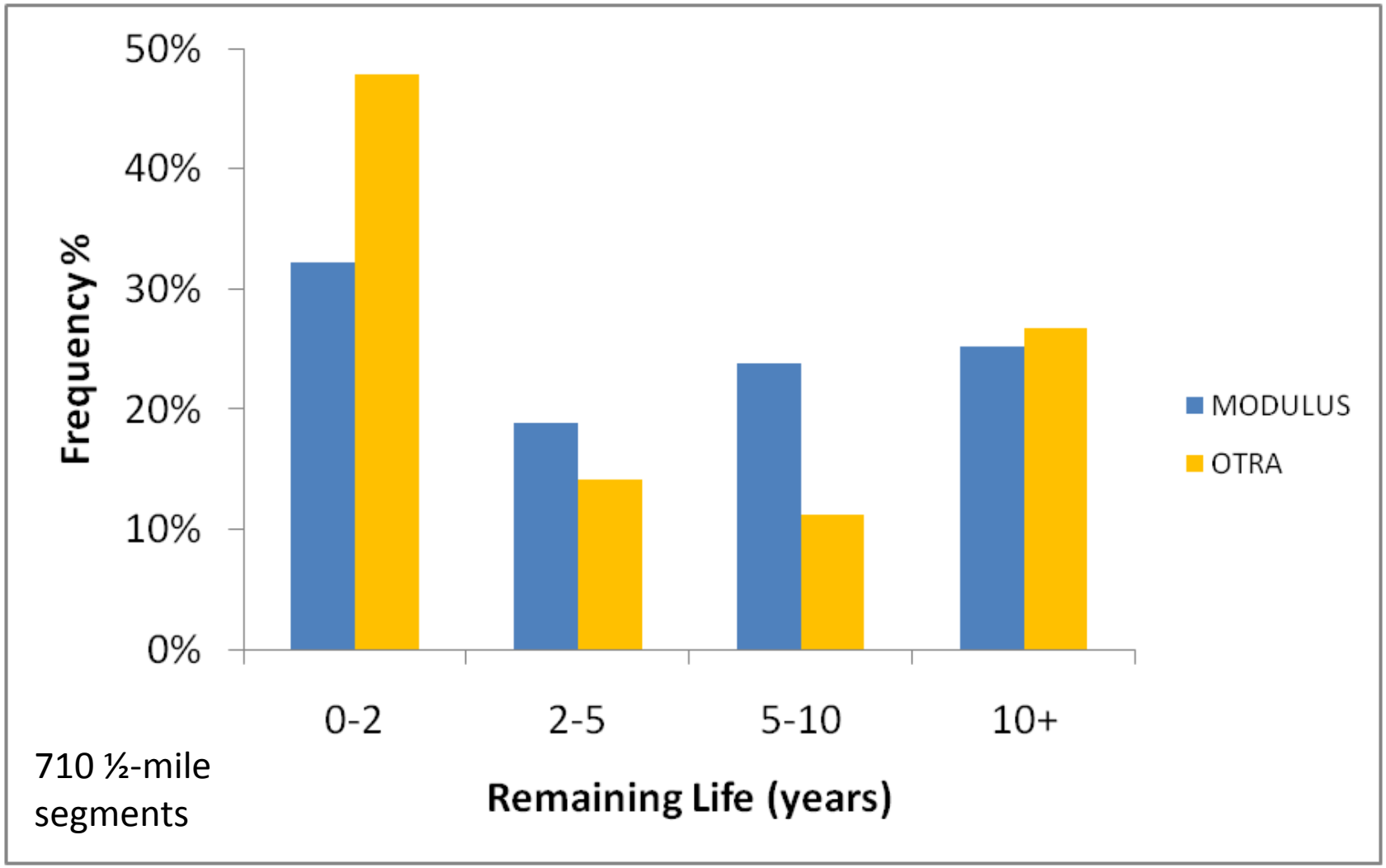
Pavement shoving, loss of surface

FM 2257

County road T-intersection

Shoulder patches, cracked seals

Remaining Life Analysis



710 ½-mile segments

Saltwater Disposal Facility Impact

Saltwater Disposal Facility				Pavement Life (Years) for No. of Design ESALs		
Capacity barrels/day	No. truck loads per day	No. truck loads per year	No. ESALs used per year	750,000	2,500,000	7,000,000
1,000	10	3,494	8,581	87.4	291.3	815.8
3,000	29	10,483	25,743	29.1	97.1	271.9
10,000	97	34,944	85,810	8.7	29.1	81.6
20,000	194	69,888	171,621	4.4	14.6	40.8
25,000	243	87,360	214,526	3.5	11.7	32.6
30,000	291	104,832	257,431	2.9	9.7	27.2
37,000	359	129,293	317,499	2.4	7.9	22.0

Impact on roads near the saltwater disposal facility is lower if energy developers recycle saltwater at the gas well location or use a pipeline to carry saltwater.

2CST 6-in flex 6-in LSS	2CST 8-11 in flex 8-in LSS	3-in HMA 10-in CSB 8-in LSS
(FM 2095)	(SH 11)	(US 79)

2CST: Two-course surface treatment
HMA: Hot-mix asphalt
CSB: Cement-stabilized base
LSS: Lime-stabilized subgrade

Statewide Impact Estimate

- $1 billion per year
- $2 billion per year including local roads
- Assumptions:
  - 5-mile impact radius analysis
  - Impact to main hwys (e.g., US or IH) not included
  - Impact to bridges not included
  - Impact of overweight vehicles not included
  - Truck hauling of petroleum products in areas not served by pipelines not included

Relative Pavement Impact

Total Weight (lb)	EALF	Weight Ratio	EALF Ratio	Weight Ratio	EALF Ratio
		With respect to 35,000 lb		With respect to 80,000 lb	
35,000	0.077	1	1		
80,000	2.4	2.3	31	1	1
90,000	3.8	2.6	49	1.1	1.6
100,000	5.6	2.9	73	1.2	2.4

EALF: Equivalent axle load factor

Other Impacts

- Roadside impacts
  - Driveway access and permitting
  - Utility accommodation and permitting
    - Crossings
    - Longitudinal installations
    - Gathering lines
    - Temporary lines
    - Easement issues

IH 35W – West Frontage Road

Tire tracks on unpaved shoulder

Tire tracks on safety end treatment

FM 1611

Drainage problem at driveway

Mud tracking

Other Impacts

- Operational and safety impacts
  - Increase in the number of crashes and fatalities
  - Commercial vehicle safety violations
    - Over 34,000-lb tandem axle
      - 2007: No. 4 (energy-related), No. 6 (non energy-related)
      - 2008: No. 4 (energy-related), No. 10 (non energy-related)
      - 2009: No. 3 (energy-related), No. 9 (non energy-related)

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- **Current initiatives and needs**

Current Initiatives

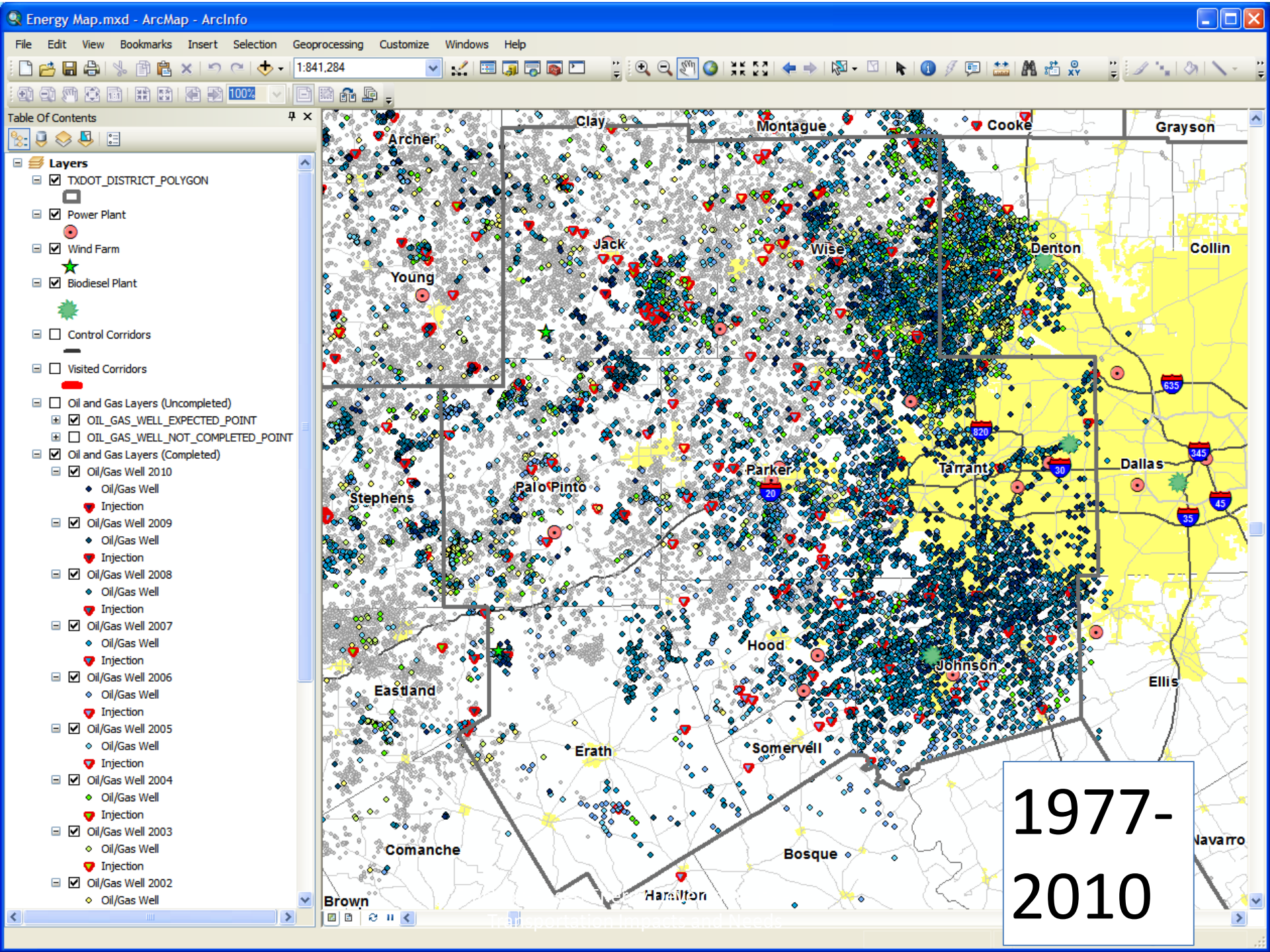
- Increasing awareness
  - Focus is still only on environmental and water issues
- State and local jurisdiction efforts:
  - Arkansas, Ohio, Pennsylvania, Texas, …
  - Regional conferences
  - National conferences
    - 2013 TRB Annual Meeting
    - 2014 ASCE Shale Energy Engineering Conference (SEEC)
      - Pittsburg, Pennsylvania

Needs

- National research agenda
  - Currently, some state-level research
  - Upcoming NCHRP synthesis project
- Case studies and best practices
  - Communication and coordination with industry
  - Pavement repair, rehabilitation, reconstruction
  - Operations and safety
  - Roadside management
  - Laws and regulatory framework

Needs

- Transportation planning
  - Supply chains at different geographic levels
  - Regional and metropolitan planning
  - Multimodal considerations
    - Rail
    - Ports and waterways
    - International commerce
- Environmental issues
  - Emissions and air quality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Navarro
1977-2010

Thank You!

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