



# IMPACTS OF ENERGY DEVELOPMENT ON TEXAS ROADS

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# Table of Contents

1	Introduction	3-14
2	Statewide Pavement Condition	15-16
3	Truck Traffic From One Single Well Development Activities	17-24
4	Case Study of Proactive vs. Reactive Maintenance/Repair Approach	25-28
5	Mitigation Strategies	29-30
6	Conclusions	31-32

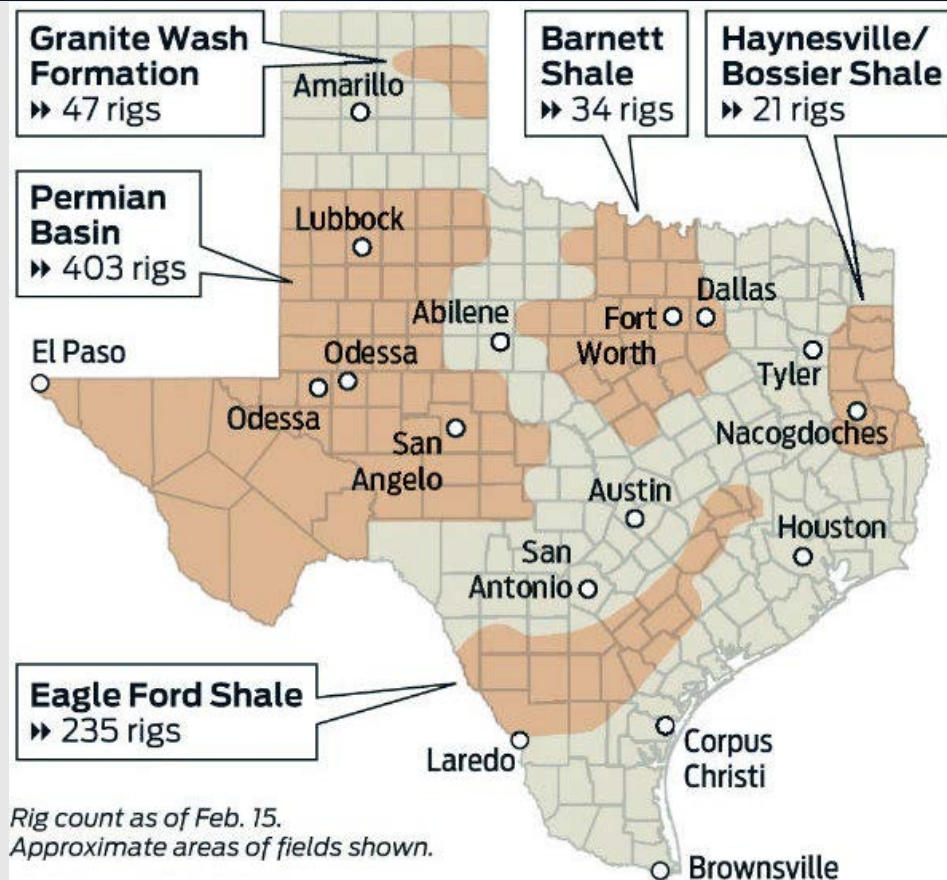
# Oil and Gas Drilling Activities

- The oil and gas drilling activities reached a record high in 2013 and impacted 50% of Texas counties.
- Texas recently has 839 drilling rigs operating – nearly half of all rigs in the U.S. and 22.7 percent of rigs worldwide.
- The U.S. Geological Survey estimates the Eagle Ford holds up to 7 billion to 10 billion in recoverable reserves.

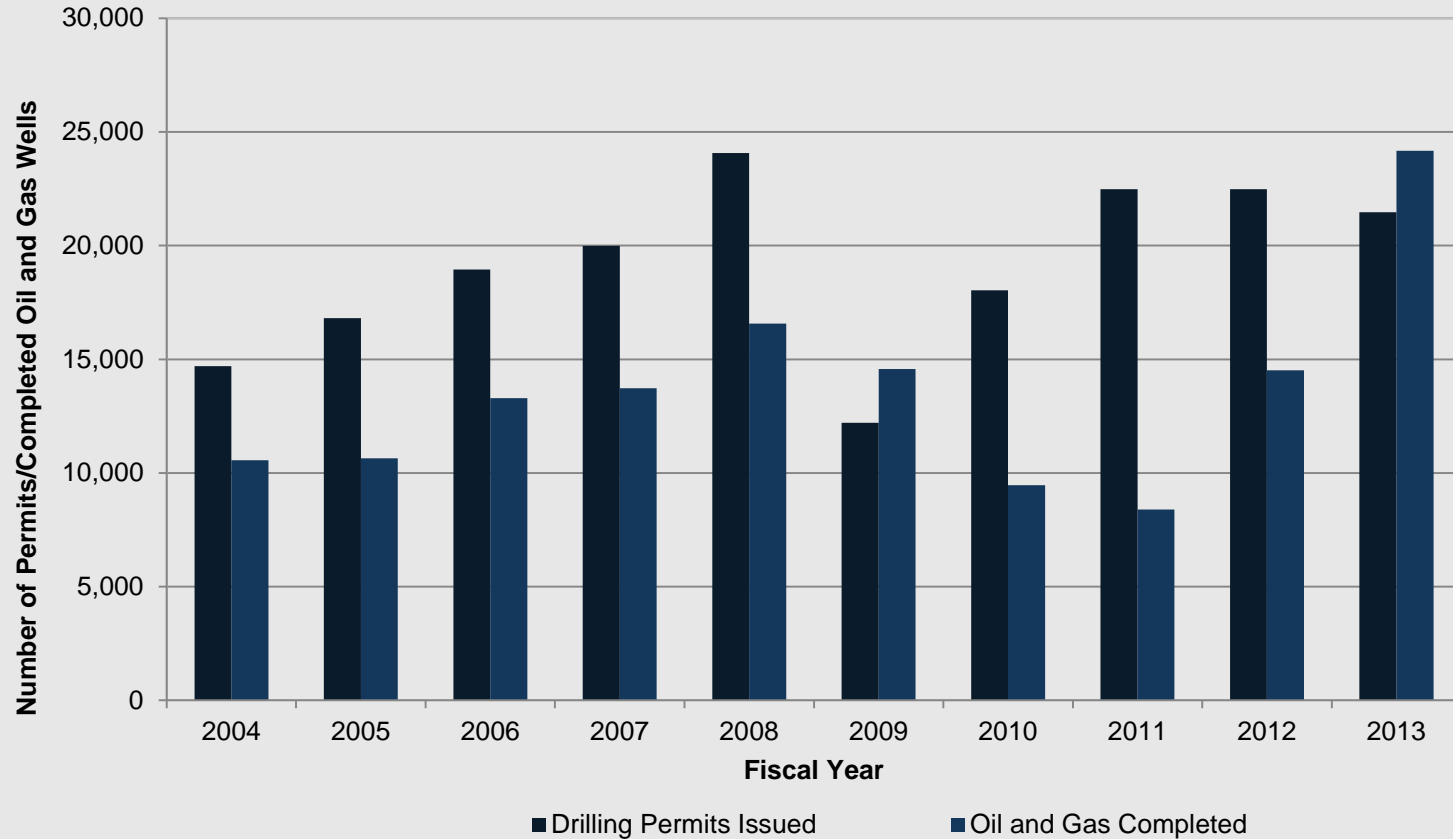


# Texas Oil and Gas Fields

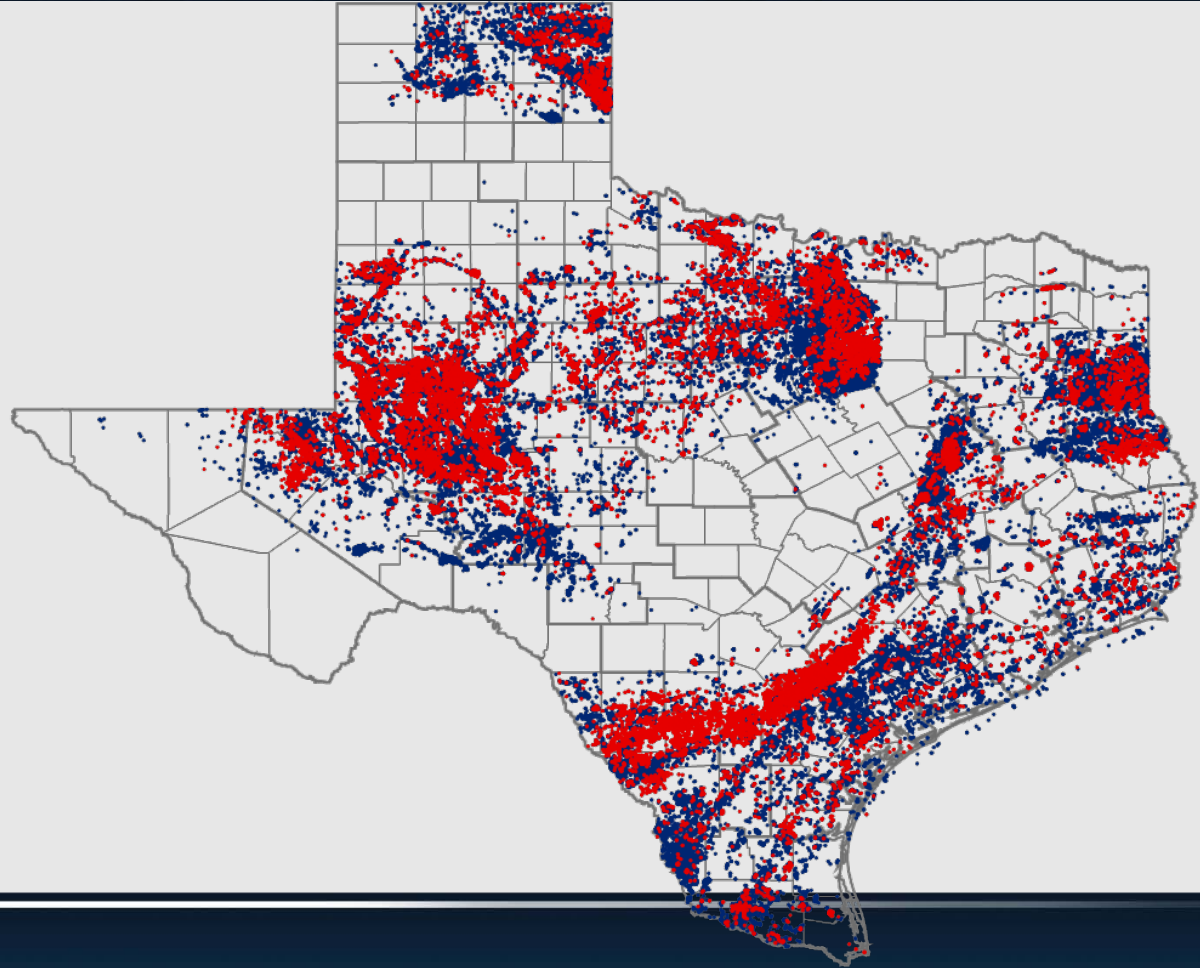
- Barnett Shale
- Haynesville/Bossier Shale
- Eagle Ford Shale
- Granite Wash Formation
- Permian Basin



# Drilling Permits vs. Completed Oil and Gas Wells



# Completed Oil and Gas Locations in 2004-2013



## 1940-1950 era Tractor Trailer



FM roads were designed for this vehicle .....

## 2010 era Tractor Trailer



FM roads now must carry these vehicles .....

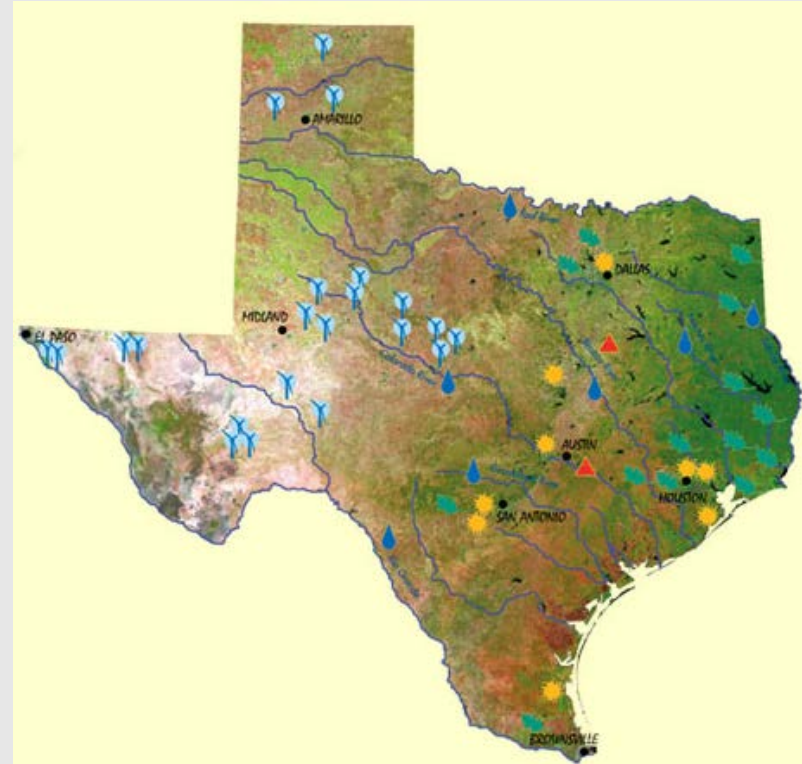


# It's Not Just Oil & Gas



# Wind Farm Development

- Texas has 12,000 MW of wind generation, more than double any other state.
- Texas is home to 6 of the 10 largest wind farms in the U.S.
- According to data from the National Renewable Energy Laboratory, Texas has the best wind resource in the U.S.
- Most wind farms are located in areas overlapping oil and gas development.



# Oversize/Overweight Trucks



# Everyone is Wondering What is Happening



# Road Damages

## Base Failures



## Distress



## Edges



## Rutting

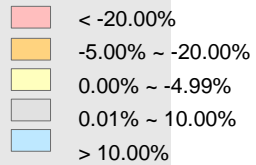


# Traffic/Safety Concerns



# Texas County Performance Measure Change FY2010-2013

## Change in Percent "Good" or Better



# County Pavement Performance Examples

County	FY2010	FY2011	FY2012	FY2013	FY2013-FY2012
Hansford	95.76%	95.87%	89.16%	74.24%	-14.92%
Karnes	86.64%	82.96%	64.48%	58.44%	-6.04%
La Salle	86.08%	71.47%	70.36%	58.60%	-11.76%
Dimmit	84.27%	75.77%	83.32%	72.40%	-10.92%
Lipscomb	88.53%	88.08%	91.18%	77.01%	-14.17%
Roberts	91.66%	96.72%	96.20%	83.00%	-13.20%



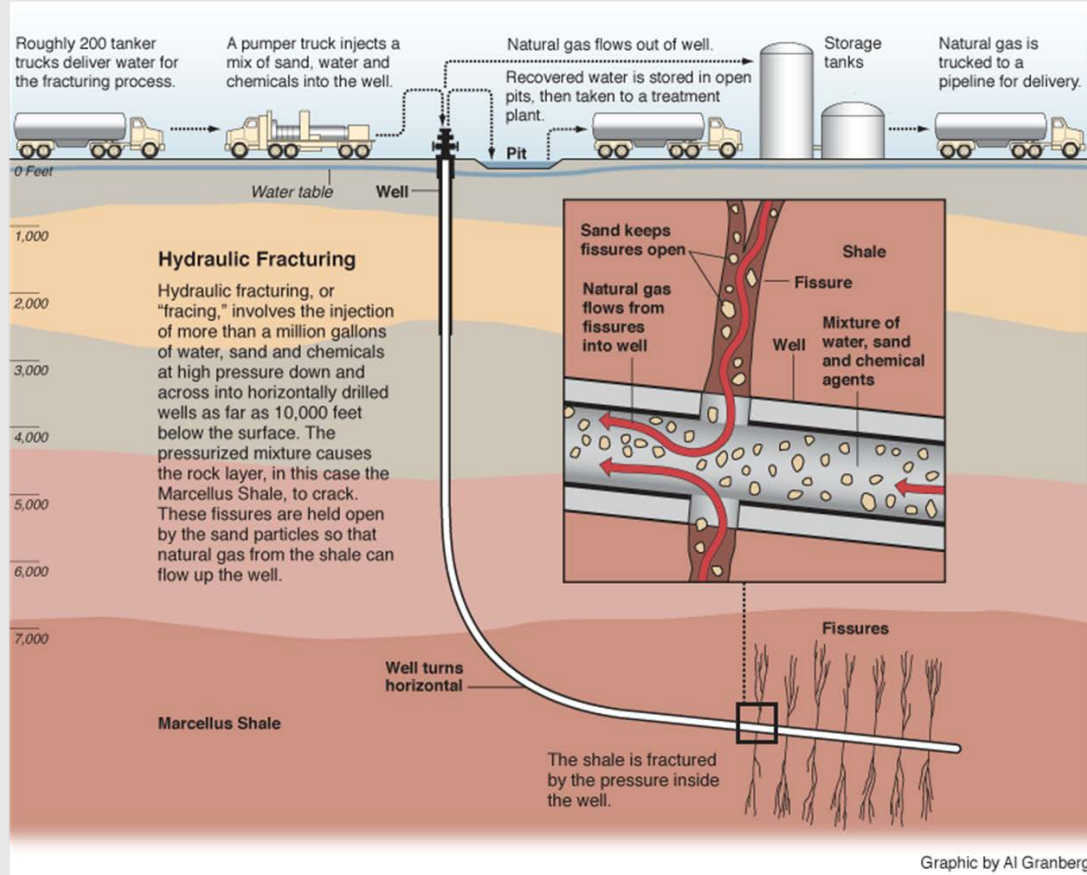
# Traffic Data Challenges in Impacted Areas

- Traffic data plays a critical role on estimating the impact of energy sectors.
- TxDOT 32 Weight-in-Motion data sites on interstates or major routes.
- Traffic counts are one and a half or two years behind.

# Well Drilling Stages

- Stage 1: Drilling well site includes pad site preparation, rig mobilization, drilling operations, and rig removal.
- Stage 2: Fracturing includes mobile rig set-up, fracturing activity, rig removal, and pad restoration.
- Stage 3: Production includes trips for routine maintenance activities.

# Hydraulic Fracturing



# Hydraulic Fracturing Process



# Halliburton Fracking Fleet



# Total Truck ESALs for One Single Well in Barnett Shale

Type of Vehicle	Number of Axles	Loaded Weight (in pounds)	Empty Weight (in pounds)	One-Way Trips (per Wellsite)	Type of Work	18-k ESAL (per Truck)	18-k ESAL (per Wellsite)
<b>Drilling Wellsite</b>							
Rock Hauler	5	84,000	35,000	70	Pad Construction	2.99	209.30
Rig (install)	5	100,000	n/a	2	Rig Set-up	6.21	12.42
Rig (removal)	5	100,000	n/a	2	Rig Removal	6.21	12.42
Bob-Tail	5	80,000	20,000	20	Equipment	2.45	49.00
Bob-Tail	5	80,000	20,000	20	Equipment	2.45	49.00
Bob-Tail	5	80,000	20,000	8	Drilling Pipe	2.45	19.60
Bob-Tail	5	80,000	20,000	6	Cement	2.45	14.70
Bob-Tail	5	80,000	20,000	9	Drilling Mud	2.45	22.05
<b>Subtotals</b>				<b>137</b>			<b>388.49</b>
<b>Fracturing</b>							
Work-over Rig	5	80,000	n/a	2	Rig Set-up	2.45	4.90
Work-over Rig	5	80,000	n/a	2	Rig Removal	2.45	4.90
Tank Truck	5	80,000	35,000	70	Frac Tanks	2.45	171.50
Water Tanker	5	80,000	35,000	685	Water for Fracing	2.45	1,678.25
Water Tanker	5	80,000	35,000	214	Frac Water Removal (50%)	2.45	524.30
Bob-Tail	5	80,000	35,000	24	Equipment	2.45	58.80
<b>Subtotals</b>				<b>997</b>			<b>2,442.65</b>
<b>Production</b>							
Tank Truck	5	80,000	35,000	353	Empty Dehydration Tanks	2.45	864.85
<b>Subtotals</b>				<b>353</b>			<b>864.85</b>

Total ESALs: 388.49+2,442.65=2,781.14

# Total Truck ESALs for One Single Well in Eagle Ford

Type of Vehicle	Number of Axles	Loaded Weight (in pounds)	One-Way Trips (per Wellsite)	18-k ESAL (per Truck)	18-k ESAL (per Wellsite)
<b>Construction Wellsite</b>					
Ingress Overweight Loads	6	108,000	1	4.083	4.083
Ingress Overweight Loads	6	118,000	1	5.719	5.719
Egress Overweight Loads	6	108,000	1	4.083	4.083
Egress Overweight Loads	6	118,000	1	5.719	5.719
7-Axle Truck Trailer Combo Lowboy Trailer	7	141,000	14	3.562	49.868
1/2-3/4-1 ton Truck	2	10,000	94	0.016	1.504
5-axle Semi Tractor Trailer	5	80,000	206	2.451	504.906
<b>Subtotal</b>			<b>318</b>		<b>575.882</b>
<b>Drilling Wellsite</b>					
Ingress Overweight Loads	6	110,000	4	4.395	17.58
Ingress Overweight Loads	6	95,000	2	2.469	4.938
Ingress Overweight Loads	6	90,000	1	3.959	3.959
Ingress Overweight Loads	6	80,000	1	2.451	2.451
Egress Overweight Loads	6	110,000	4	4.395	17.58
Egress Overweight Loads	6	95,000	2	2.469	4.938
Egress Overweight Loads	6	90000	1	3.959	3.959
Egress Overweight Loads	6	80,000	1	2.451	2.451
5-axle Semi Tractor Trailer low boy	5	80,000	144	2.451	352.944
9-axle Semi Tractor Trailer	9	148000	80	4.673	373.84
<b>Subtotal</b>			<b>240</b>		<b>784.64</b>
<b>Fracturing</b>					
5-axle Semi Tractor Trailer	5	80000	560	2.451	1372.56
<b>Subtotals</b>			<b>560</b>		<b>1372.56</b>
<b>Production</b>					
5-axle Semi Tractor Trailer	5	80000	2190	2.451	5367.69
<b>Subtotals</b>			<b>2190</b>		<b>5367.69</b>

Total ESAL: 575.88+784.64+1372.56=2,733.08

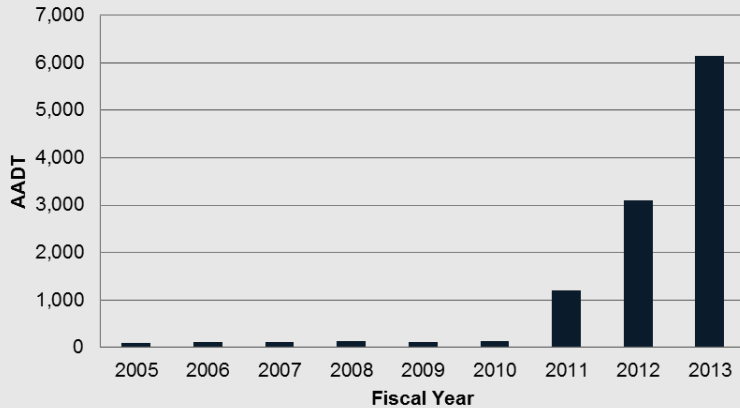
# Comparison of Barnett Shale and Eagle Ford

- The total number of ESALs for the site construction, drilling, and fracturing is very close in these two shale formations.
- The biggest difference is in the production phase.
  - Eagle Ford
  - Barnett Shale
  - Permian Basin
- The number of truck loads depends on a variety of factors such as well type and depth, geology, drilling technology, water needs, and product transportation.



# Case Study

- Dimmit County
  - FM 2688 (12.61 Miles)
  - Surface treatment over flexible base
  - 47 drilling permits issued along FM2688 in 2012



# Analysis Approach

- Reactive vs. Proactive
  - Reactive: roads are fixed or maintained after damage has occurred.
  - Proactive: major rehabilitation to handle new expected traffic loads.
- Analysis Approach
  - The reduction in pavement life was calculated based on the accumulated truck traffic generated by the nearby permitted wells.
  - Average reconstruction cost is \$156,905 per lane mile.
  - Additional annual replacement cost was calculated.

# Estimated 20-Year ESAL

Year	Design Annual ESAL	Number of New Well Sites	Accumulated Number of Well Sites	Development 18-k ESAL	Production 18-k ESAL	Fracture 18-k ESAL	Total Well Site 18-k ESAL	Accumulated Well Site 18-k ESAL	Accumulated Total 18-k ESAL
1	17,100	47	47	173,712	0.00		173,711.53	173,711.53	190,811.53
2	17,100	0	47	-	40,608.00		40,608.00	214,319.53	248,519.53
3	17,100	0	47	-	40,608.00		40,608.00	254,927.53	306,227.53
4	17,100	0	47	-	40,608.00		40,608.00	295,535.53	363,935.53
5	17,100	0	47	-	40,608.00		40,608.00	336,143.53	421,643.53
6	17,100	0	47	-	40,608.00	114,804.55	155,412.55	491,556.08	594,156.08
7	17,100	0	47	-	40,608.00	-	40,608.00	532,164.08	651,864.08
8	17,100	0	47	-	40,608.00	-	40,608.00	572,772.08	709,572.08
9	17,100	0	47	-	40,608.00	-	40,608.00	613,380.08	767,280.08
10	17,100	0	47	-	40,608.00	-	40,608.00	653,988.08	824,988.08
11	17,100	0	47	-	40,608.00	114,804.55	155,412.55	809,400.63	997,500.63
12	17,100	0	47	-	40,608.00	-	40,608.00	850,008.63	1,055,208.63
13	17,100	0	47	-	40,608.00	-	40,608.00	890,616.63	1,112,916.63
14	17,100	0	47	-	40,608.00	-	40,608.00	931,224.63	1,170,624.63
15	17,100	0	47	-	40,608.00	-	40,608.00	971,832.63	1,228,332.63
16	17,100	0	47	-	40,608.00	114,804.55	155,412.55	1,127,245.18	1,400,845.18
17	17,100	0	47	-	40,608.00	-	40,608.00	1,167,853.18	1,458,553.18
18	17,100	0	47	-	40,608.00	-	40,608.00	1,208,461.18	1,516,261.18
19	17,100	0	47	-	40,608.00	-	40,608.00	1,249,069.18	1,573,969.18
20	17,100	0	47	-	40,608.00	-	40,608.00	1,289,677.18	1,631,677.18

# Proactive vs. Reactive Approach Over 20 Years

Number of Additional Well Permits	20-Year ESAL	Proposed Plans	Total Proactive Cost	Total Reactive Cost
0 more	1.63 million	2" Thin Overlay	\$ 2,004,536	\$ 13,756,000
5 more	3.05 million	5" Thick Overlay	\$ 4,654,149	\$ 23,303,952
10 more	4.47 million	Thick ACP Reconstruction	\$ 5,723,533	\$ 27,452,880

- Proactive is more cost effective than reactive.
- Budget constrain, boom and bust cycles, etc.

# Mitigation Strategies

- Preventing damage before it happens by posting load limits
  - Standard operation for oversize and overweight vehicles
  - Emergency load posting
- Pavement preservation treatments
  - Both proactive and reactive approach
  - 4-year pavement management plan
- Updating design standards
  - Triaxial design check
  - Nondestructive testing
  - Cross-sectional width on the rural two-lane highways

- Legislation
  - HB1025 allocated \$450 million (\$225 million to counties and \$225 million to state).
  - Voters approved a constitutional amendment that dedicated a portion of Texas revenue from the oil and gas industry to the State Highway Fund in October, 2014.
  - The Proposition 1 Fund, FY2015, additional \$1.74 billion and another \$2.4 billion for the 2016-2017 biennium.

# Conclusions

- Pavement performance deteriorated significantly in heavily impacted counties.
- Oil and gas development activities generate large amount of heavy truck traffic. The method of how the oil and nature gas product was transported had a significant impact on the pavements.
- Proactive approach is more cost effective than reactive approach.
- Posting load limits, updating maintenance strategies, and modifying design standards could help mitigate the energy development related impact.

# Thank You!

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