Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/TX-16/9-1530-1		

4. Title and Subtitle	5. Report Date
TRANSPORTATION POOLED FUND PROJECT: STATE RESPONSES TO ENERGY SECTOR DEVELOPMENTS	July 2016
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Katherine F. Turnbull, Jon Epps, Matt Miller, and Cesar Quiroga	Report 9-1530-1

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Texas A&M Transportation Institute The Texas A&M University System College Station, Texas 77843-3135	11. Contract or Grant No. Project 9-1530

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Texas Department of Transportation Research and Technology Implementation Office 125 E. 11th Street Austin, Texas 78701-2483	Technical Report: May 2015–July 2016
	14. Sponsoring Agency Code

15. Supplementary Notes

Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.
Project Title: Transportation Pooled Fund Project: State Responses to Energy Sector Developments
URL: http://tti.tamu.edu/documents/9-1530-1.pdf

16. Abstract

New and expanding energy sector developments—oil, natural gas, coal, wind, biofuels, and solar—are occurring in numerous states throughout the country. While states, counties, and communities are realizing economic benefits from these activities, the impacts from energy development on transportation systems are immediate and extensive. Rural roads and bridges are especially vulnerable to the increased volumes of trucks, but additional demands are also being placed on the rail, port, and aviation networks. State departments of transportation and other agencies are responding in numerous ways to increased truck traffic, infrastructure deterioration, and safety concerns.

This transportation pooled fund (TPF) project allowed participating states to share information and experiences with each other and with experts in the field related to responding to energy sector developments. This report documents the major activities completed under the project, including site visits to the participating states and a meeting of representatives from the TPF states. The report summarizes the state of the practice in the TPF states and presents topics identified for further research.

17. Key Words	18. Distribution Statement
Transportation and Energy Developments, Oil and Gas, Fracking, Transportation Impacts, Crude by Rail	No restrictions. This document is available to the public through NTIS: National Technical Information Service Alexandria, Virginia http://www.ntis.gov

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	74	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

TRANSPORTATION POOLED FUND PROJECT: STATE RESPONSES TO ENERGY SECTOR DEVELOPMENTS

by

Katherine F. Turnbull
Executive Associate Director
Texas A&M Transportation Institute

Jon Epps
Executive Associate Director
Texas A&M Transportation Institute

Matt Miller
Assistant Research Scientist
Texas A&M Transportation Institute

and

Cesar Quiroga
Senior Research Engineer
Texas A&M Transportation Institute

Report 9-1530-1
Project 9-1530
Project Title: Transportation Pooled Fund Project: State Responses to Energy Sector Developments

Performed in cooperation with the
Texas Department of Transportation
and the
Federal Highway Administration

July 2016

TEXAS A&M TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

The United States Government and the State of Texas do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective this report.

ACKNOWLEDGMENTS

This project was conducted in cooperation with TxDOT and FHWA. Joe Adams of TxDOT served as the project manager. Bonnie Duke, Michelle Young, and Sophia Lisovaya of TTI provided word processing on this document. Gary Lobaugh provided editing review on the report. In addition, Racheal Sears, Mary Cearley, and Becca Simons assisted with the transportation pooled fund (TPF) member meeting in College Station, Texas.

The following representatives from the TPF states assisted with the project by organizing the site visits, providing information, and attending the TPF meeting:

- Todd LaCasse and Patrick Tyner of the California Department of Transportation.
- David North, Kirk Zeringue, and Skip Paul of the Louisiana Department of Transportation and Development.
- Dustin Rouse and Victoria Haymond of the Montana Department of Transportation.
- Rebecca Geyer and Tom Bold of the North Dakota Department of Transportation.
- Anna Kuzmich and Lloyd MacAdam of the Ohio Department of Transportation.
- Halley Cole and Benjamin Harlan of the Pennsylvania Department of Transportation.
- Joe Adams, Mark McDaniel, Caroline Mays, and Valente Olivaez, Jr., of the Texas Department of Transportation.
- Matthew Pahs and Barb Ivanov of the Washington State Department of Transportation.

The assistance and contributions of all these individuals are acknowledged and greatly appreciated.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

BACKGROUND AND WORK TASKS

New and expanding energy sector developments—oil, natural gas, coal, wind, biofuels, and solar—are occurring in numerous states throughout the country. While states, counties, and communities are realizing economic benefits from these activities, the impacts from energy development on transportation systems are immediate and extensive. Rural roads and bridges are especially vulnerable to the increased volumes of trucks, but additional demands are also being placed on the rail, port, and aviation networks. State departments of transportation and other agencies are responding in numerous ways to increased truck traffic, infrastructure deterioration, and safety concerns.

To help facilitate the sharing of information and experiences among states, the Texas Department of Transportation (TxDOT) took the lead in developing the Transportation Pooled Fund Project: State Responses to Energy Sector Developments. In addition to TxDOT, the following state departments of transportation from the states illustrated in Figure 1 participated in the transportation pooled fund (TPF) project:

- California Department of Transportation (Caltrans).
- Louisiana Department of Transportation and Development (DOTD).
- Montana Department of Transportation (MDT).
- North Dakota Department of Transportation (NDDOT).
- Ohio Department of Transportation (ODOT).
- Pennsylvania Department of Transportation (PennDOT).
- Washington State Department of Transportation (WSDOT).

Source: Texas A&M Transportation Institute.

Figure 1. States Participating in the TPF Project.

The State Responses to Energy Sector Developments TPF project included three major tasks. In the first task, information was obtained on the practices in each participating state for responding to energy sector impacts, including industry engagement, roadway and infrastructure management, safety, funding and financing, and planning and forecasting. Site visits were conducted to each state by the Texas A&M Transportation Institute (TTI) research supervisor as part of this task. Additional information was obtained and analyzed through a literature review. The second task included conducting a meeting for representatives from the participating states. The meeting was held on March 23–24, 2016, at the TTI State Headquarters and Research Building in College Station, Texas. The third task used the information from the site visits, the literature review, and the workshop to develop a state-of-the-practice synthesis and identify future research.

ORGANIZATION OF THIS REPORT

This report is divided into five chapters following the introduction. Chapter 2 summarizes the literature review conducted at the beginning of the project in 2015. Chapter 3 describes the site visits to the participating states made in late summer and fall 2015. Chapter 4 highlights the March 2016 meeting of representatives from the TPF states held in College Station, Texas. Chapter 5 presents the state-of-the-practice synthesis. Chapter 6 contains the topics identified for further research during the site visits and meeting.

CHAPTER 2: LITERATURE REVIEW

TTI researchers reviewed recent reports, papers, conferences, and workshops as part of the literature search initially conducted on the project in 2015. Information on energy trends available from federal agencies was also examined. Examples of the most relevant documents and activities are summarized in this chapter. Related reports and research from the TPF states are included in the state-of-the-practice synthesis in Chapter 5.

NCHRP SYNTHESIS 469

National Cooperative Highway Research Program (NCHRP) Synthesis 469: Impacts of Energy Developments on U.S. Roads and Bridges (*1*) examined the economic and infrastructure impacts of heavy-truck traffic related to energy developments on roads and bridges. Information was gathered through a literature review, a survey sent to state departments of transportation, and interviews with selected federal and tribal governments. Additional interviews with personnel from multiple agencies were conducted in five states selected for further study—Colorado, Iowa, North Dakota, Pennsylvania, and Texas. Information is presented on impacts to road and bridge infrastructure, safety, operations, and funding. Information on the tools used by states to assess engineering, design, and economic impacts is also summarized, along with examples of collaborative approaches involving energy industries.

PRC ENERGY DEVELOPMENT IMPACTS ON STATE ROADWAYS

A TTI Transportation Policy Research Center (PRC) report, *Energy Development Impacts on State Roadways: A Review of DOT Policies, Programs, and Practices across Eight States* (*2*), reviewed policies, programs, and practices used by state departments of transportation in eight states for dealing with the impacts of intensive energy developments on the roadway system. The eight states included in the study were Colorado, Kansas, North Dakota, Oklahoma, Pennsylvania, Utah, West Virginia, and Wyoming. Information was gathered through telephone interviews with representatives from the eight state departments of transportation. Individuals in different divisions and districts were included in the interviews. In addition, online policy, program, and media articles from the states were reviewed. Information is presented on the impacts to state roadways, policies and programs to address maintenance and operations, industry engagement methods, and other issues.

ASCE SHALE ENERGY ENGINEERING CONFERENCE

The American Society of Civil Engineers (ASCE) Shale Energy Engineering Conference, held in Pittsburgh, Pennsylvania, July 21–23, 2014, included tracks on water, geotechnical, environmental and regulatory, and infrastructure. There were 38 presentations in the infrastructure track covering roadway monitoring and assessments, roadway repair and reconstruction, site development, and stakeholder coordination. The proceedings (*3*) include 73 peer-reviewed papers, including 10 on transportation infrastructure impacts.

TRB CONFERENCES, WORKSHOPS, AND ACTIVITIES

The influence of development in the energy sector on the transportation system was identified as an emerging issue by the Transportation Research Board (TRB) Executive Committee and the Technical Activities Council in 2012 and 2013. At the same time, TRB Technical Activities Committees were also undertaking activities related to energy exploration, extraction, and production. Examples of these activities include a workshop at the 2013 Annual Meeting, sessions at the 2013 and 2014 Annual Meetings, a policy session at the 2013 Executive Committee Summer Meeting, and a May 2014 workshop in Arlington, Texas.

WORKSHOP ON TRANSPORTATION AND ENERGY SECTOR DEVELOPMENTS

The Workshop on Transportation and Energy Sector Developments was held on May 6–7, 2014, in Arlington, Texas. It was co-sponsored by TRB, TxDOT, TTI, and the Upper Great Plans Transportation Institute at North Dakota State University. The workshop featured speakers from Texas, Louisiana, Colorado, Oklahoma, North Dakota, and New Mexico. Participants had the opportunity to discuss research needs and follow-up activities. The potential for a multistate TPF project was identified during these discussions.

In addition, one of the suggested follow-up activities from the Arlington workshop was to establish a joint subcommittee or task force within TRB to help focus and coordinate activities to identify research and technology transfer needs and to promote information sharing. Based on further discussions with TRB staff, a joint subcommittee sponsored by the Freight Group was established. The purpose of the Joint Subcommittee on Transportation and Energy Sector Developments is to bring a focus within TRB and to help coordinate activities related to the influence of energy exploration, extraction, operation, and shipment on the transportation system. The joint subcommittee is helping coordinate activities within TRB and is undertaking efforts in collaboration with standing committees, sections, and groups. The 2015 Summer Meeting session is one example of the joint subcommittee efforts. Examples of other possible activities include organizing Annual Meeting sessions and workshops, hosting webinars, developing research problem statements, sponsoring workshops and conferences, and undertaking other outreach, technology transfer, and information sharing activities.

THE 11TH TRB INTERNATIONAL CONFERENCE ON LOW-VOLUME ROADS

The 11th TRB International Conference on Low-Volume Roads, held in Pittsburgh, Pennsylvania, July 1, 2015, included sessions focusing on the impacts of oil and gas drilling on the transportation system in rural areas.

TRB SUMMER MEETING AND CONFERENCE OF THE FREIGHT SYSTEMS AND MARINE COMMITTEES

The June 24–25, 2015, TRB Summer Meeting and Conference of the Freight Systems and Marine Committees featured sessions on the transport of crude oil by rail, energy sector trends, and assessment of the impacts of energy developments on the transportation system.

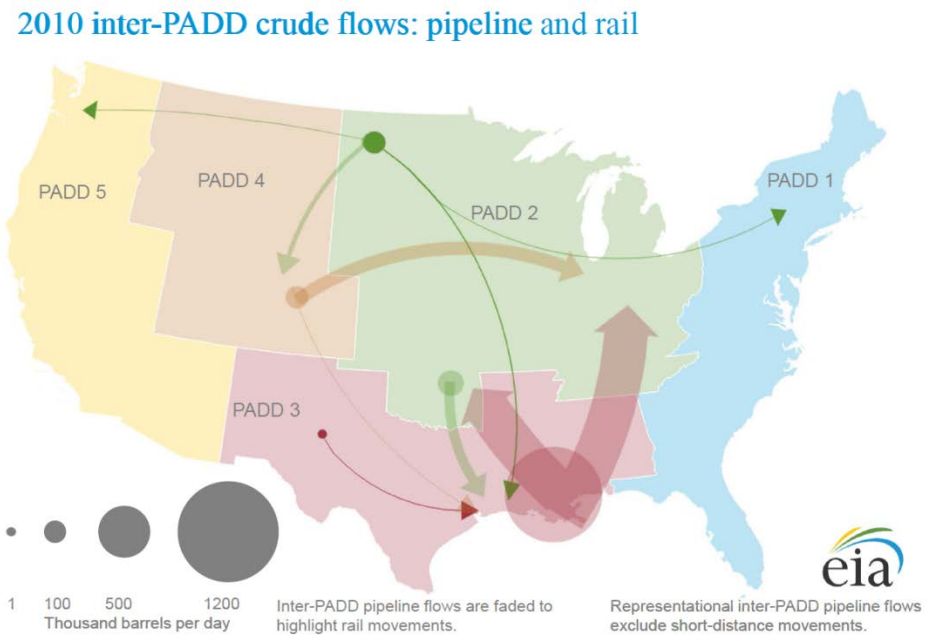
U.S. ENERGY INFORMATION ADMINISTRATION

The U.S. Energy Information Administration (EIA) of the U.S. Department of Energy is responsible for collecting, analyzing, and disseminating "independent and impartial energy information to promote sound policy making, efficient markets, and public understanding of energy and its interaction with the economy and the environment" (*4*). EIA provides a variety of daily, weekly, monthly, quarterly, and annual products on all types of energy. These products are available on the EIA website (www.eia.gov).

EIA began publishing monthly data on rail movements of crude oil (crude by rail [CBR]) with its monthly petroleum supply statistics in March 2015. These statistics previously included movement by pipeline, tanker, and barge. The dataset extends back to 2010. CBR activity is tracked between pairs of Petroleum Administration for Defense District (PADD) regions (inter-PADD), within each region (intra-PADD), and across the U.S.-Canada border.

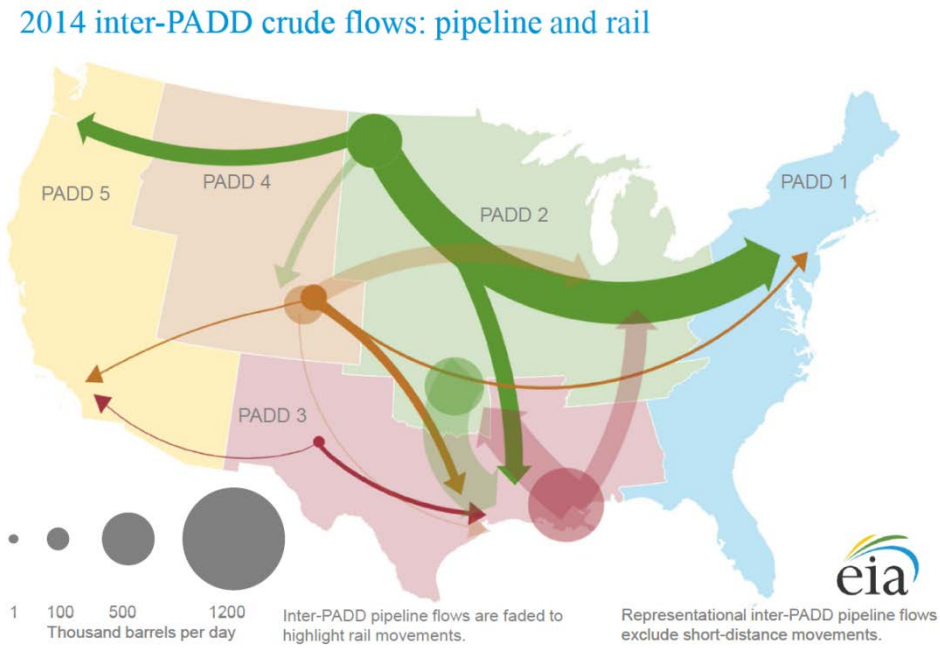
According to EIA, from 2011 to 2012, rail shipments of CBR increased 423 percent, and barge shipments increased 53 percent. Total CBR movements in the United States and between the United States and Canada were more than 1 million barrels per day (bbl/d) in 2014, up from 55,000 bbl/d in 2010. The regional distribution of these movements has also changed over this period.

EIA integrates data from multiple sources to complete this analysis including the Surface Transportation Board (STB) quarterly commodity statistics, the STB carload waybills, the National Energy Board of Canada CBR exports data, and the Oil and Gas Supply Module of the EIA National Energy Modeling System. Figure 2 and Figure 3 illustrate the growth in CBR shipments from 2010 to 2014. The monthly information is available on EIA's U.S. Movement of Crude Oil by Rail webpage (www.eia.gov/petroleum/transportation/).



Source: Energy Information Administration.

Figure 2. 2010 Inter-PADD Crude Flows: Pipeline and Rail.



Source: Energy Information Administration.

Figure 3. 2014 Inter-PADD Crude Flows: Pipeline and Rail.

SURFACE TRANSPORTATION BOARD

STB, which is part of the U.S. Department of Transportation, is the economic regulator of freight railroads. Serving as both an adjudicatory and a regulatory body, STB oversees railroad rates, service issues, rail restructuring transactions, and other activities. STB provides the quarterly

commodity statistics and the carload waybill data used in the EIA CBR database described previously. STB also receives data from Class I railroads on the weekly total cars on the line by car type (including tank), system-average train speed by train type (including crude oil units), total number of trains held short of destination or scheduled interchanges for longer than six hours by train type and class (including crude oil units), and total number of loaded and empty cars in revenue service that have not moved in greater than 120 hours, and greater than 48 hours but less than or equal to 120 hours (including crude oil).

CHAPTER 3: SITE VISITS TO PARTICIPATING TPF STATES

The research supervisor made site visits to the states participating in the TPF project. The site visits provided the opportunity to gather information firsthand on the types of energy sector developments in each state, the impacts of these developments on the transportation system, and the approaches being used to address different issues. Topics for additional information sharing during the TPM member states meeting and further research needs were also identified. Table 1 lists the dates of the site visits, which were conducted from August through November 2015. Additional conference calls were conducted in some cases when individuals were not able to participate in the meetings during the site visits.

Table 1. List of Site Visits and Dates Visited.

State	Location	Dates
California	Benicia	October 30, 2015
Louisiana	Baton Rouge	September 22, 2015
Montana	Helena	October 8–9, 2015
North Dakota	Bismarck	September 16–18, 2015
Ohio	New Philadelphia	September 9–10, 2015
Pennsylvania	Harrisburg	August 17–18, 2015
Texas	Multiple sites	Multiple dates
Washington	Seattle	August 27, 2015

Source: Texas A&M Transportation Institute.

The site visits included meetings and tours of areas impacted by energy sector developments, energy facilities, and research facilities. Organized by the TPF state personnel, each site visit was different, reflecting the situations, issues, and topics of interest in the state. A common set of questions, presented in Figure 4, was provided in advance by the research supervisor to help ensure information on the key topics was collected in each state. Additional researchers assisted with the Texas site visits, which took advantage of ongoing research and assistance to TxDOT districts and divisions.

Transportation and Energy Sector Developments
Transportation Pooled Fund Project
Ohio State Department of Transportation

Site Visit – September 9-10, 2015

1. What are the general energy sector developments facing Ohio and ODOT (oil and gas drilling and extraction, transporting crude oil by rail, wind turbine farms, etc.)?
2. What are the key issues associated with these energy sector developments (heavy use of roadways, safety concerns with crude by rail, etc.)?
3. What approaches have been taken to address these concerns (pavement rehabilitation, hardening infrastructure in advance of developments, etc.)?
4. What other state agencies are involved in permitting and/or oversight of oil and gas drilling, wind farms, transporting crude oil by rail, and other energy developments?
5. Does ODOT obtain information from these agencies on a regular basis?
6. How does ODOT interact with county, city, and township governments on these issues?
7. Is there a multi-agency coordinating group in the state?
8. Are there special programs or funding sources to address the transportation needs resulting from energy sector developments?
9. How does ODOT interact with the private sector – energy developers, railroads, trucking industry, etc. – on these topics?
10. Is ODOT able to obtain information on planned developments and trends, allowing more proactive approaches, or does the department end up being more reactive to activities that have occurred?
11. Are there experiences, lessons learned, or best practices from ODOT that you would like to share with other states?
12. What information would you like to learn from other states?
13. What additional research would you find beneficial for addressing the issues you face?
14. Other topics of interest.

Source: Texas A&M Transportation Institute.

Figure 4. List of Common Questions for State Site Visits (Ohio Example).

This chapter highlights the meetings and tours conducted during the state visits. The major topics and issues discussed are summarized. More information on examples from the states is provided in the state-of-the-practices synthesis presented in Chapter 5.

CALIFORNIA

The California site visit was conducted on October 30, 2015. As highlighted in Figure 5, the site visit included meetings with representatives from Caltrans, Valero, Union Pacific Railroad (UP), and Wilson Public Affairs and a tour of the Valero Benicia Refinery. The meeting and tour focused on the Valero Benicia Refinery rail project, which would increase the current rail facilities to accommodate crude oil delivery by rail.

California Site Visit
Benicia

October 30, 2015

- Meeting with Caltrans personnel and representatives from Valero, UP, and Wilson Public Affairs:
  - Patrick Tyler, Research Office, Caltrans.
  - Todd LaCasse, Freight Planning Branch, Caltrans.
  - Chris House, director of health, safety, environmental, and public affairs, Valero Benicia Refinery.
  - Donald Cuffel, manager of environmental engineering, Valero Benicia Refinery.
  - Joe Bateman, fire chief, Valero Fire Department.
  - Francisco Castillo, director of corporate relations and media, UP.
  - Christy Wilson, Wilson Public Affairs.
- Tour of the Valerio Benicia Refinery and docks.

Figure 5. California Site Visit.

California has some level of energy-related activity in natural gas, oil, biofuels, wind, solar, and nuclear. Kern County and the San Joaquin Valley continue to be the center of traditional oil developments in the state. California ranks second among states in the country for installed wind capacity and first for the number of wind turbines. The major wind resources are located in Altamont Pass, outside San Francisco; Alameda and Contra Costa Counties; San Gorgonia Pass, near Palm Springs in Riverside County; and Tehachapi Pass, near Tehachapi in Kern County.

As illustrated in Figure 6, there are also 20 refineries in the state—12 refineries producing transportation fuels that meet California standards and 8 smaller refineries producing asphalt and other petroleum products. According to the California Energy Commission, refineries in the state process approximately 1.6 million barrels of crude oil per day and supply transportation fuel in the state and to neighboring states (*5*).

In 2014, California refineries received 787 thousand barrels per day (TBD) of crude oil from marine vessels (imported); 190 TBD by marine vessels (Alaska); 664 TBD by a California source via pipeline; and 15 TBD by rail/truck. Projects to add CBR facilities are in the permitting process or under consideration at refineries in the state. Adding CBR facilities enhances flexibility, and reduces the risks and dependency on marine-transported imported oil (*5*).

Source: California Energy Commission.

Figure 6. California Oil Refinery Locations.

The Valero Benicia Refinery in northern California is in the permit-review process to add receiving CBR capabilities at the facility. The site visit included a presentation on the project and a tour of the refinery. Information on this project is presented in Chapter 5 as an example of expanding local CBR capabilities.

In addition to discussing the project, meeting participants discussed safety features associated with transporting both crude oil feed stock and the refinery's products. The refinery's fire department has a national aid agreement with the City of Benicia. The refinery fire chief noted that the national aid agreement is one of the most robust agreements in the San Francisco Bay area. He also stressed the difference between *hazardous* and *dangerous*, noting that Valero takes numerous measures to address hazards. Valero and UP personnel discussed the risk assessments and measures taken to ensure safe operations of transporting crude oil by rail. Valero personnel highlighted the excellent safety record at the refinery, including designation by the State of California Division of Occupational Safety and Health's Voluntary Protection Program STAR site.

LOUISIANA

The Louisiana site visit was conducted September 22, 2015. As presented in Figure 7, the site visit included meetings with DOTD personnel and a tour of the Pavement Research Facility (PRF) in Baton Rouge.

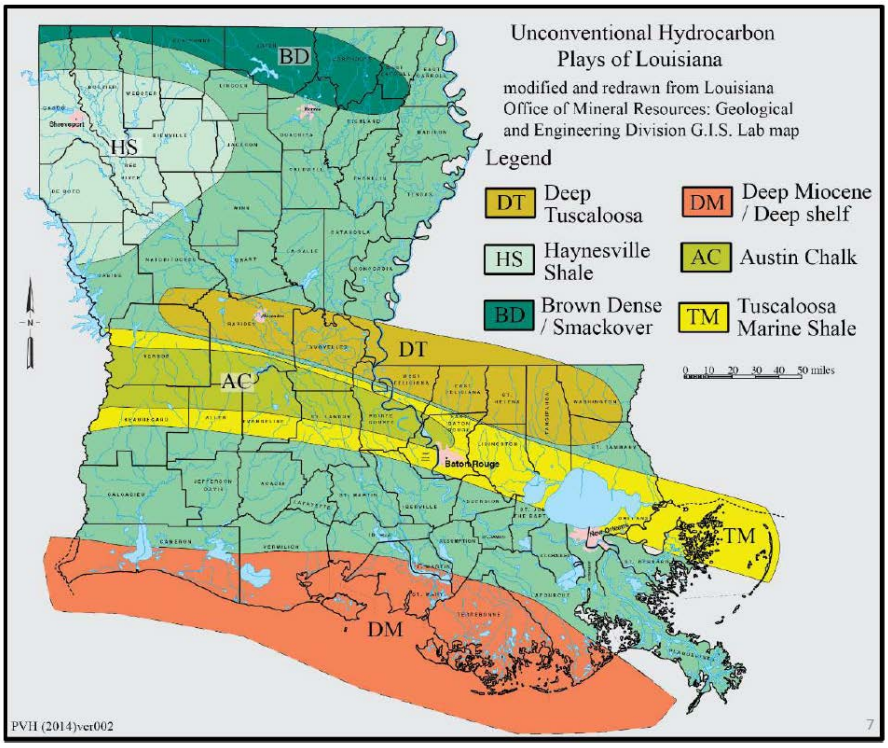
Louisiana Site Visit
Baton Rouge

September 22, 2015

- Meeting with DOTD personnel:
  - Skip Paul, director, Louisiana Transportation Research Center (LTRC).
  - David North, District 04 engineer administrator, Shreveport District.
  - Randall Withers, director, Port Priority Program.
  - Zhong Wu, adjunct professor, Louisiana State University (LSU), and LRTC Accelerated Pavement Research Program manager.
- Tour of the PRF.

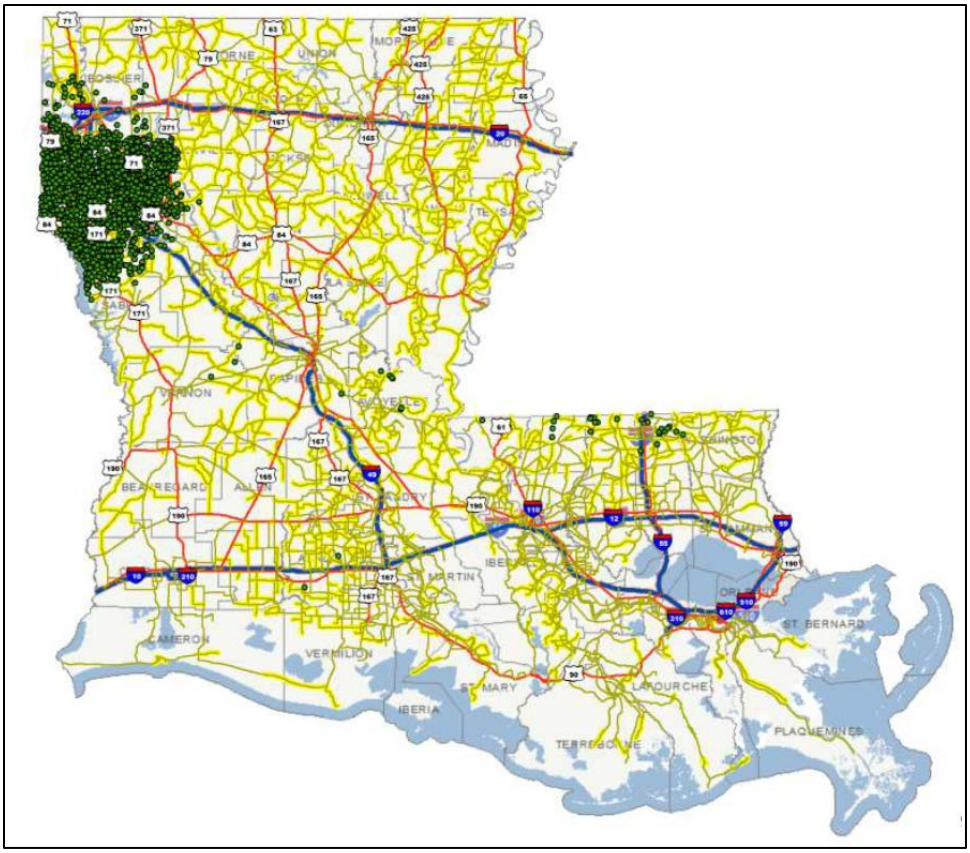
Figure 7. Louisiana Site Visit.

Oil and gas production represents the major energy sectors in Louisiana, although the state also has some coal mining and nuclear power generation. As illustrated in Figure 8, six unconventional hydrocarbon plays cover the state. The Haynesville shale in the northwest corner of the state has been the focus of recent exploration, drilling, and production. In 2015, there were approximately 240,000 oil and gas wells in the state. Figure 9 highlights the location of the shale wells as of July 13, 2015. Of the 3,131 shale wells, 3,084 are located in the Haynesville Play, and 47 are in the Tuscaloosa Play.



Source: Louisiana Department of Transportation and Development.

Figure 8. Major Shale Plays in Louisiana.



Source: Louisiana Department of Transportation and Development.

Figure 9. Location of Shale Wells in Louisiana.

The major concentration of the 3,084 wells in the Haynesville Shale Play are south of Shreveport. The volume of heavy-truck traffic transporting equipment, sand, water for fracking, and crude oil increased dramatically between 2012 and 2015. The increased traffic damaged roadways and bridges, increased traffic congestion, and raised safety concerns. Figure 10 presents one example of roadway damage to Highway 346 due to heavy trucks from shale developments.

Also of concern to DOTD is the impact of heavy trucks on bridges, especially those with timber pile substructures. Figure 11 illustrates damage to one of the 58 bridges in District 04 with timber pile substructures. Figure 12 presents examples of unauthorized access by trucks to I-49.

Source: Louisiana Department of Transportation and Development.

Figure 10. Roadway Damage Due to Heavy Trucks.

Source: Louisiana Department of Transportation and Development.

Figure 11. Bridge in District 04 with Damaged Timber Pile Substructure.

Source: Louisiana Department of Transportation and Development.

Figure 12. Unauthorized Access to I-49.

LTRC, sponsored jointly by DOTD and LSU, has a number of research projects underway examining pavement issues resulting from the heavy-truck traffic in the Haynesville Shale Play. Many of these projects are using the PRF in Baton Rouge, which includes an accelerated loading facility to provide traffic loading. Current research is focusing on evaluating bonded concrete overlays over asphalt under accelerated loading and roller compacted concrete over soil cement under accelerated loading. More information on this project is provided in Chapter 5.

MONTANA

The Montana site visit occurred on October 8–9, 2015 in Helena. As presented in Figure 13, meetings were held with MDT and Federal Highway Administration (FHWA) personnel. Follow-up calls were also held with MDT personnel unable to attend the meetings. Given the distance to the shale development area in eastern Montana, no tours were conducted as part of the site visit.

Montana Site Visit
Helena

October 8–9, 2015

- Meetings with MDT and FHWA personnel:
  - Lynn Zanto, MDT.
  - Chris Dorrington, MDT.
  - Victoria Haymond, MDT.
  - Joe Radonich, MDT.
  - Shane Mintz, District 4 administrator, MDT.
  - Gary Neville, District 5, MDT.
  - Lesly Tribelhorn, MDT.
  - Damian Krings, MDT.
  - Jean Riley, Planning Division, MDT.
  - Paul Johnson, Planning Division, MDT.
  - Jim Skinner, Planning Division, MDT.
  - Heidy Bruner, Environmental Division, MDT.
  - Dustin Rouse, Engineering Division, MDT.
  - John Althof, Safety Division, MDT.
  - Dennis Hult, Motor Carrier Services (MCS), MDT.
  - Michael Pool, MCS, MDT.
  - Jim Davies, Materials Division, MDT.
  - Darin Reynolds, Materials Division, MDT.
  - Becky Duke, MDT.
  - Brian Hasselbach, FHWA Montana Division.
  - Dave Hand, District 3, MTD.
  - Matt Ladenbury, District 3, MTD.
  - Ed Toavs, District 1, MTD.
  - Steve Felix, District 1, MTD.
- Follow-up conference calls were made with Debbie Alke and Tim Conway with the Aeronautics Division and Doug McBroom with the Maintenance Division.

Figure 13. Montana Site Visit.

Energy sector development in Montana includes coal, natural gas, oil, and wind. Coal mining continues to be an important industry in the state. The Bakken Shale Play covers the northeastern corner of the state and includes the Elm Coulee Oil Field in Richland County. The northeastern portion of the state has also been impacted by the oil developments in neighboring North Dakota. For example, most of the aggregates used in North Dakota roadway projects come from Montana. The state is also impacted by oil developments in Canada. The movement of oversized and overweight superloads through Montana to oil fields in Canada is one example of these impacts. Wind farms are located in the central portion of the state, including the Great Falls area and the Livingston/Bozeman area.

A wide range of topics were discussed during the Montana site visit. MTD personnel also provided links to related reports, plans, and websites. The department has conducted a number of truck route and corridor studies to address concerns about increased traffic in the eastern portion of the state. An example of one study is presented in

Chapter 5. Much of this traffic is the result of the developments of the Bakken Formation in North Dakota. The different methods used for coordinating with the NDDOT were discussed.

One of the concerns raised by MDT personnel was oversized/overweight (OS/OW) vehicles, including superloads traveling to the oil fields in Canada. The need to prepare corridors for OS/OW vehicles was discussed, including taking down wires and poles, and making other accommodations.

Personnel also noted that the increased truck traffic and the increase in CBR had an impact on railroad grade crossings. Many of these crossings are on county and city streets, resulting in traffic being blocked for longer periods of time. Other topics discussed focused on expanding the traffic-counting program in eastern Montana, traffic safety studies and the need for additional safety countermeasures, pavement design for heavier loading, and work zone practices. Other topics included environmental impacts and cumulative impact analyses, rail improvements, loss of MDT staff in eastern Montana to the oil and gas industry, aviation impacts, and concerns over the long-term impacts to bridges from heavy-vehicle traffic.

NORTH DAKOTA

The North Dakota site visit was conducted on September 16–18, 2015. As highlighted in Figure 14, the site visit included meetings and a full-day tour of energy developments in the western part of the state. Topics covered in the first afternoon meeting included an overview of oil exploration and production in the state, changes in traffic volumes, network planning, asset management, truck permitting, overweight enforcement, and pavement management. Increased state funding, project development, and consultant oversight were also discussed.

North Dakota Site Visit
Bismarck

September 16–18, 2015
- Meeting with NDDOT and FHWA personnel:
  - Tom Bold, NDDOT.
  - Stewart Milakovic, NDDOT.
  - Chad Orn, NDDOT.
  - Kent Lebon, NDDOT.
  - Rebecca Geyer, NDDOT.
  - Joel Wilt, NDDOT.
  - Dave Leftwich, NDDOT.
  - Brenda Redwing, FHWA North Dakota Division.

September 17, 2015
- Tour of western North Dakota—Bismarck, Washburn, New Town, Watford City, Killdeer, Dickinson, and Bismarck—that included wind farms, surface coal mining, oil wells, Garrison Dam, and transloading facilities.
- Lunch meeting with district personnel and discussion of coordinating with local governments and other stakeholders.

September 18, 2015
- Meeting with NDDOT, FHWA, and Upper Great Plains Transportation Institute personnel.

Figure 14. North Dakota Site Visit.

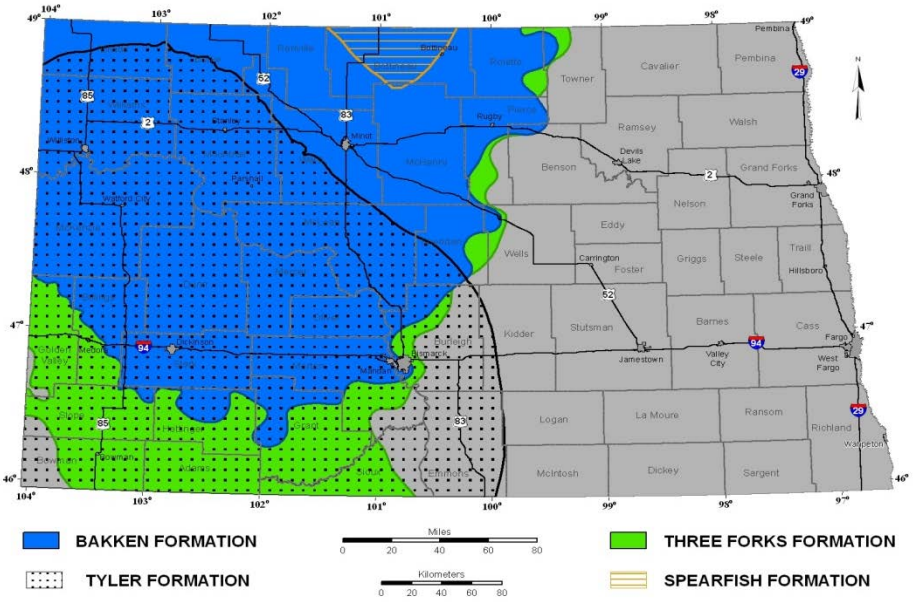
The full-day tour itinerary covered a wind farm and surface coal mining north of Bismarck, and oil developments and new transportation projects in New Town, Watford City, and Killdeer. A luncheon meeting in Watford City included a discussion of retaining and hiring staff, construction challenges, local coordination and outreach, and NDDOT's role in addressing county challenges. Studies conducted by the Upper Great Plains Transportation Institute at North Dakota State University were highlighted in the final meeting on the third day of the site visit.

The development of the Bakken Shale Play in North Dakota has been a major focus of the recent oil boom in the United States. The state also has coal, biofuels, and wind resources. Surface coal mining occurs in some areas, including north of Bismarck. The Baldwin Wind Farm north of Bismarck, the Harland Wind Farm north of Minot, the Crookston Wind Farm near the border with Minnesota, and the Bison Wind 1B Farm near the South Dakota border are examples of wind production facilities in the state.

North Dakota has experienced boom and bust cycles with oil developments over the past 60 years. The initial discovery of oil in the state in the 1950s resulted in development of now-traditional vertical wells. Interest in oil extraction was rekindled during the Arab oil embargo of the late 1980s and early 1980s. The current boom resulting from fracking in the Bakken Shale

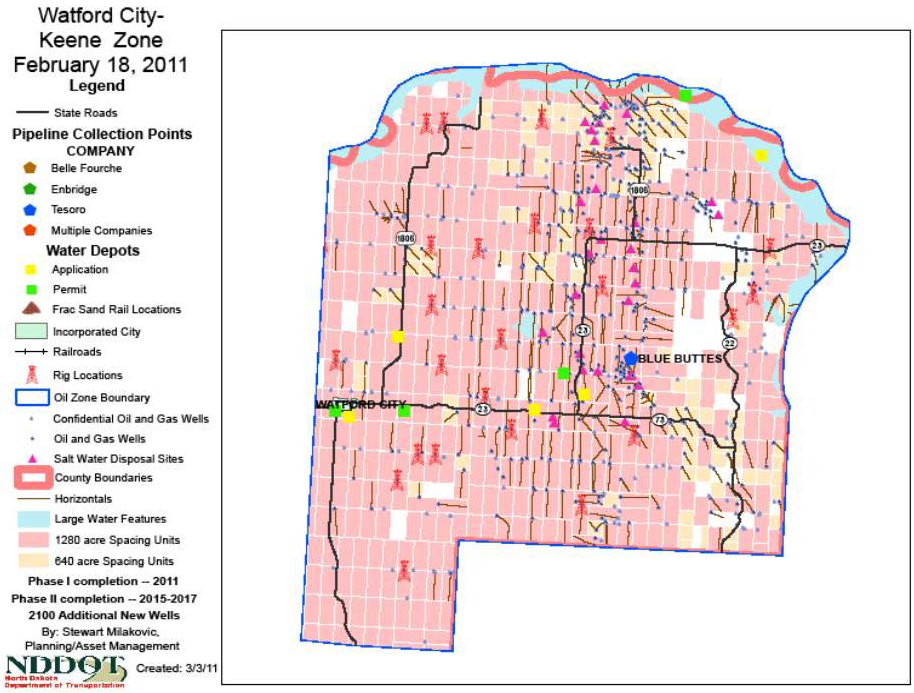
Play was initiated in 2009, with a peak between 2012 and 2014. Figure 15 illustrates the location of the Bakken Formation. Figure 16 provides an example from 2011 of rig locations, applications, and other information in the area around Watford City. Figure 17 illustrates the traffic congestion resulting from the dramatic increase in truck and passenger vehicle traffic in the oil patch area.

In response to these issues and with increased funding from the North Dakota Legislature, NDDOT has undertaken a major construction program in the area focusing on major energy corridors. Projects include roundabouts, bypasses and truck reliever routes, additional turn and bypass lanes, bridge replacements, and other improvements. More information on these projects and the increased funding from the state legislature is presented in Chapter 5.



Source: North Dakota Department of Transportation.

Figure 15. Major Shale Formations in North Dakota.



Source: North Dakota Department of Transportation.

Figure 16. Example of Map with Oil and Gas Developments.

Source: North Dakota Department of Transportation.

Figure 17. Traffic Congestion in the North Dakota Oil Patch.

OHIO

The Ohio site visit was conducted on September 9–10, 2015. As presented in Figure 18, it included meetings with personnel from ODOT and the Ohio State Highway Patrol (SHP), and oil and gas industry representatives.

Energy sectors in Ohio include coal, natural gas, oil, biofuels, wind, solar, and nuclear. The state has experienced recent development of the Marcellus Shale Play in the southeastern portion of the state.

Representatives at the meetings noted that Ohio is facing the same issue as other states, including increases in heavy trucks on roads not constructed to carry the weight and OS/OW vehicles. Figure 19 illustrates an example of an OS/OW vehicle related to the energy sector. Figure 20 highlights local signs for energy sector truck drivers. Three elements from the site visit are highlighted here and described in more detail in Chapter 5—the general coordination approaches used in the state, the Road Use Maintenance Agreement (RUMA), and the Ohio Department of Natural Resources (ODNR) oil and gas website (*6*).

Ohio Site Visit
New Philadelphia

September 9, 2015

- Meeting with ODOT and Ohio SHP:
  - Anna Kuzmich, ODOT.
  - Sargent Greg McCutcheon, Ohio SHP.
  - Dave Gardner, ODOT.
- Tour of southeastern Pennsylvania oil and gas developments.

September 10, 2015

- Meeting with ODOT, Ohio SHP, and energy industry personnel. Attended in person:
  - Anna Kuzmich, ODOT.
  - Christina Wagner, ODOT.
  - Sargent Greg McCutcheon, Ohio SHP.
  - Jake Holland, Chesapeake Energy.
  - Ryan Dean, Ascent Resources.

  Attended by phone:
  - Jim Pritt, Enervest.
  - Bryan Radabaugh, Antero Resources.
  - Zac Powell, Antero Resources.
  - Randall Randolph, Antero Resources.
  - Jeff Breen, MarkWest Midstream.
  - T.J. Blizzard, Eclipse Resources.

Figure 18. Ohio Site Visit.

ODOT and other state agencies have used a number of methods to coordinate activities in the area, including working with industry representatives. ODOT established a statewide shale coordinator, located in District 11, which is the center of the oil and gas development. Ohio SHP has also assigned an officer in the area to focus enforcement and to outreach to industry. The ODOT shale coordinator conducts regular meetings with industry personnel, county and township officials, and other groups. District 11 also publishes weekly updates on maintenance work and other activities.

The RUMA was developed in response to concerns relating to the extensive damage to county and township roads by the high volume and heavy loading of oil and gas traffic. Under Senate Bill 315, the RUMA is a requirement of ODNR's non-conventional horizontal drilling permit application. The RUMA process was created as a mutual tool for the industry and local governments to ensure roads are available to the industry during periods when frost regulations

are in effect and to ensure the roads and bridges are upgraded if they are structurally insufficient to carry the projected traffic loads. The RUMA is also intended to provide any excess maintenance that the additional truck traffic would create. The industry is required to obtain an RUMA or submit an affidavit stating it has made a good faith effort to obtain one before receiving the permit. The document itself is not a part of the legislated requirement. The RUMA has provided a mechanism for counties and townships to fund improvements, road repairs, and maintenance to roads impacted by the oil and gas industry.

The ODNR Oil and Gas website maintains several key resources for industry, local government, and citizens to gain insight on key developments in energy development both inside and outside of Ohio. One of these resources is the Ohio Oil and Gas Well Locator, which is an interactive geospatial information system–based map enabling users to search for oil and gas wells and related information in Ohio.

Source: Ohio Department of Transportation.

Figure 19. Example of OS/OW Vehicle in Ohio.

Source: Texas A&M Transportation Institute.

Figure 20. Example of Local Signs for Energy Sector Truck Operators.

PENNSYLVANIA

The Pennsylvania site visit was conducted on August 17–18, 2015. As highlighted in Figure 21, it included meetings with PennDOT staff in Harrisburg and Montoursville and a tour of north central Pennsylvania. Three elements are highlighted in this section—the Posted and Bonded Roadway Program, the Marcellus Shale Coalition (MSC), and the Pennsylvania Department of Environmental Protection well permitting and production websites. More information is provided on these elements in Chapter 5.

Pennsylvania Site Visit
Harrisburg

August 17, 2015

- Meeting with PennDOT personnel and consultants:
  - David Mallin, programs section chief, Bureau of Maintenance and Operations, PennDOT.
  - Halley Cole, chief pavement unit, Bureau of Maintenance and Operations, PennDOT.
  - Benjamin Harlan, PennDOT.
  - Melody Matter, McCormick Taylor.

August 18, 2015

- Meeting with District 3-0 personnel in Montoursville:
  - David Neylon, Posted and Bonded Roads Program coordinator.
- Tour of north central Pennsylvania oil and gas developments.

Figure 21. Pennsylvania Site Visit.

Pennsylvania has a long history of energy sector developments. Coal mining has been a key industry in the state since the early 1800s. The state's extensive reserves of high-quality coal helped fuel the industrial revolution in the late 1800s and early 1900s. Much of the railroad network in Pennsylvania was constructed to serve the transport of coal, and the availability of coal spurred the iron and steel, chemical, glass, and metal-fabricating industries in the state. In addition to the recent development of the Marcellos and Utica Shale Plays in the state, wind energy projects have also been developed. Pennsylvania ranks 16th among states in installed wind power capacity with more than 20 wind farms in operation, primarily in the southwestern portion of the state.

Figure 22 illustrates the damage to state roadways from oil and gas industry vehicles. PennDOT used the existing Posted and Bonded Roadway Program to address these needs. The program allows PennDOT to post weight restrictions on roadways and to bond users who haul on the roadways.

Under the program, PennDOT conducts a traffic and engineering study to evaluate the pavement and geometric conditions of a roadway. As warranted, the appropriate weight restriction is determined, and the roadway is posted with the weight restriction. A hauling permit is required to operate vehicles over the posted limit once a road is posted. A company must enter into an Excess Maintenance Agreement (EMA) with PennDOT to use a posted roadway. Under the EMA the company is responsible for maintaining the roadway to the current conditions and is responsible for road repairs beyond normal maintenance. If more than one company has an

EMA to operate in a roadway, they must collectively determine the appropriate cost sharing for any road damage. The EMA also requires companies to provide a bond of $12,500 per paved mile of roadway and submit a road maintenance plan.

Source: Pennsylvania Department of Transportation.

Figure 22. Roadway Impacts—Pavement to Mud and Then Restored.

MSC was established in 2008. It is the largest shale development trade association in the Appalachian Basin. It is comprised of representatives from approximately 300 companies in the oil and gas industry in the state. The coalition maintains a website and sponsors conferences, workshops, trainings, and other events. It conducts regular meeting with top PennDOT officials and helps promote coordination within the state.

The Pennsylvania Department of Environmental Protection maintains a website (*16*) with information on oil and gas operations throughout the state. The interactive website allows users to obtain information on oil and gas well locations and production levels.

TEXAS

As presented in Figure 23, a variety of sources were used to obtain information on recent energy sector developments in Texas and the impact of those developments on the transportation system. TTI researchers have been working with TxDOT personnel on energy-sector-related transportation issues for a number of years. Recent research projects and technical assistance provided to the TxDOT Maintenance Division and districts impacted by the energy boom provided rich background information for use in this project. Recent studies conducted through TTI's PRC and national centers were also used.

Texas Information Sources

- Ongoing research projects.
- Ongoing technical assistance to TxDOT Maintenance Division and districts.
- 2014 workshop in Arlington, Texas.
- 2015 workshops in Arlington, Midland, and San Antonio.
- November 18, 2015, conference call with Greg Miller, director of planning and programming with the TxDOT Aviation Division.

Figure 23. Texas Information Sources.

Texas has a long history of oil and gas development, as well as boom and bust cycles that have accompanied those developments. The Spindle Top strike near Beaumont in 1901 ushered oil developments in the state and nation. By the 1940s, Texas was the dominate oil production state in the country. That domination continues and spawned the petrochemical industry and other industries located along the Texas Gulf Coast.

Texas has also been a leader in the wind energy industry. Texas ranks first among states in installed wind capacity and number of wind turbines. The majority of wind farms are located in northwest Texas, but there are also developments along the Gulf Coast in southeast Texas. The state has a number of manufacturing facilities associated with wind power production, and wind turbines are imported through Texas ports and transported to sites in Texas and other states.

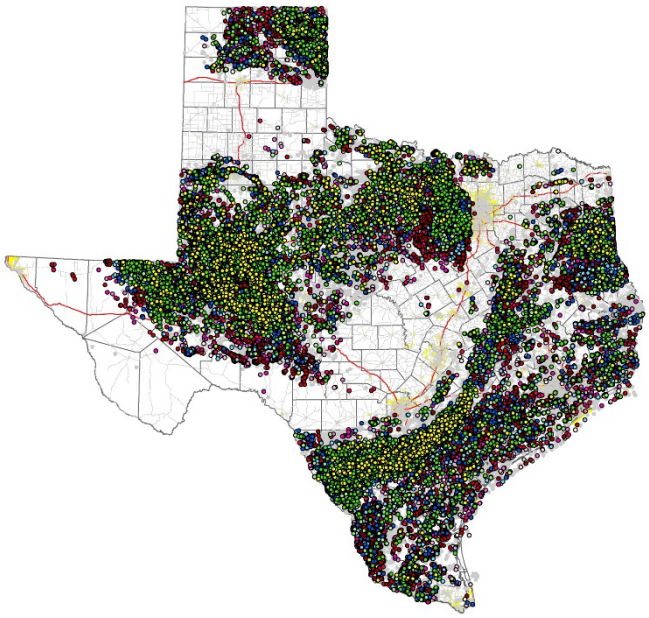
The advent of fracking resulted in major development of the Barnett, Permian Basin, and Eagle Ford Shale Plays in the state. The number of oil and gas wells increased dramatically between 2010 and 2014. In 2014, almost half the active oil and gas rigs in the United States were in Texas. Figure 24 illustrates the completed oil and gas wells in Texas by 2014.

Similar to other states, Texas experienced significant increases in heavy-truck traffic servicing these wells. Trucks are needed for constructing the well initially, drilling the well, fracking the formation, and completing the well. Trucks are also used for ongoing servicing of wells. Much of the increased truck traffic is occurring on roadways not designed for heavy loads. Figure 25 and Figure 26 illustrate the large volumes of trucks on rural roads in Texas and the resulting damage. Figure 27 highlights problems with oil industry OS/OW vehicles hitting bridges. Local

airports have also seen increases in air travel, resulting in expansion and improvements at some airports.

TxDOT has sponsored numerous research and technical assistance projects to address the issues resulting from increased truck traffic, additional OS/OW vehicles, and other concerns. The department has also undertaken multi-agency and industry outreach effects, public safety campaigns, and other activities to address concerns.

In addition, the voters in the state approved constitutional amendments in 2014 and 2015 to redirect funding to support needed transportation improvements in areas impacted by recent oil and gas developments. Examples of these activities are highlighted in Chapter 5.



Source: Texas A&M Transportation Institute.

Figure 24. Completed Oil and Gas Wells in Texas by 2014.

Source: Texas Department of Transportation.

Figure 25. Trucks Serving Oil and Gas Wells in Texas.

Source: Texas Department of Transportation.

Figure 26. Roadway Damage Due to Heavy Trucks.

Source: Texas Department of Transportation.

Figure 27. OS/OW Vehicles Hitting Bridges.

WASHINGTON

The Washington State site visit was conducted on August 27, 2015. Highlighted in Figure 28, the site visit began with a tour of the rail corridor south of downtown Seattle, followed by a meeting with WSDOT Freight Systems Division staff. Burlington Northern Santa Fe Railway and UP operate freight service in the corridor, including trains carrying crude oil from North Dakota and Canada. Passenger rail also operates in the corridor, with AMTRAK and commuter rail service.

Washington State Site Visit
Seattle

August 27, 2015

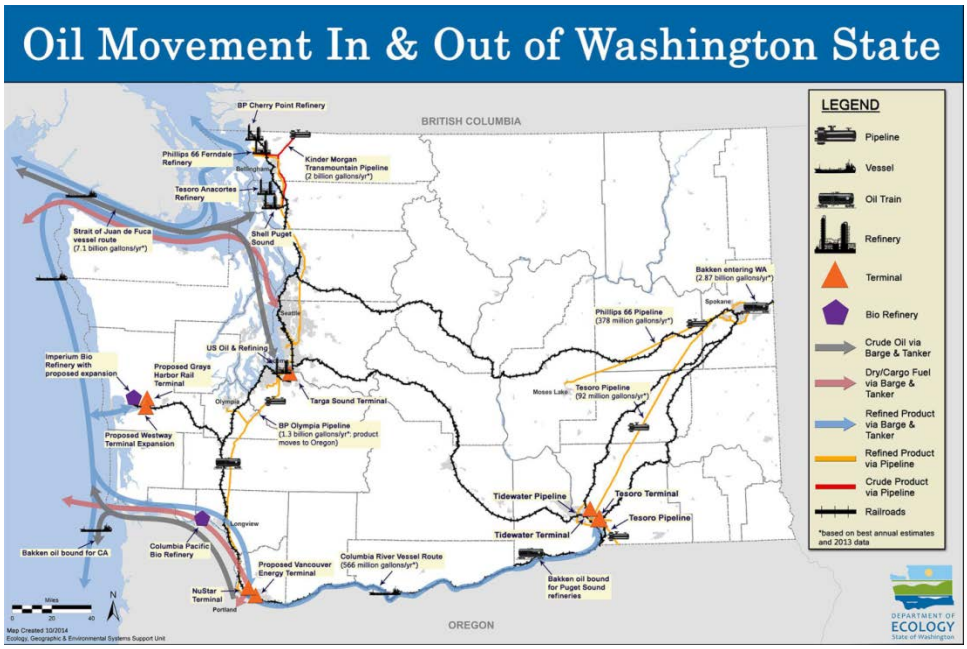
- Tour of the rail corridor (freight and passenger) south of downtown Seattle with WSDOT Freight Office staff.
- Meeting with WSDOT Freight Systems Division staff:
  - Barb Ivanov, director.
  - Chris Herman, Freight Rail Program.
  - Wenjuan Zhao, Freight Data Program.
  - Matthew Pahs, Freight Planning Program.

Figure 28. Washington State Site Visit.

The increase in CBR shipments in the state is documented in the Washington 2014 Marine and Rail Oil Transportation Study (*7*). Figure 29 illustrates the location of the existing and proposed refineries, the railroad network, the marine transport system, and the major oil pipelines in the state. Figure 30 shows the rail lines just south of downtown Seattle.

Until 2011, approximately 90 percent of the crude oil entering the state was by tanker ship from Alaska. Most of these shipments were destined for oil refineries in the state, including four in the northwest corner. Between 2011 and 2013, shipments of oil by rail increased to 700 million gallons. In 2014, approximately 70 percent of the crude oil entering the state was by tanker ship, with rail and pipeline shipments accounting for the remaining 30 percent. In June 2014, 19 loaded unit trains per week carried nearly 57 million gallons of crude oil from North Dakota and Canada to refineries in Washington and California. Based on current expansions in refinery capacity over the next decade, this could increase to 137 unit trains or 411 million gallons in weekly volumes (*7*).

WSDOT personnel discussed a number of issues with the increase in CBR shipments, including the use of the 1-mile tunnel under downtown Seattle. Topics of interest included experience in other states with CBR trains operating in tunnels, criteria for railroad grade crossing improvements, and ways to address safety concerns.



Source: Washington State Department of Ecology.

Figure 29. Oil Movement in and out of Washington State.

Source: Texas A&M Transportation Institute.

Figure 30. Rail Lines South of Downtown Seattle.

CHAPTER 4: PARTICIPATING STATES MEETING

This chapter discusses the meeting of representatives from the participating TPF member states, which was held on March 23–24, 2016, at the TTI State Headquarters and Research Building in College Station, Texas. Figure 31 presents the agenda for the meeting, and Figure 32 includes the meeting participants.

Transportation Pooled Fund Project:
State Responses to Energy Sector Developments
Participating States Meeting
March 23–24, 2016
State Headquarters and Research Building, Room 144
College Station, Texas
Agenda

Wednesday, March 23
TTI, State Headquarters Research Building, Room 144

9:00 a.m. Introductions and Review Agenda

9:15 a.m. Overview of Site Visits to TPF States

9:30 a.m. Activities in TPF States (Please note, rather than formal presentations, the intent is for interaction among participants. Please feel free to bring handouts or a few PowerPoint® slides.)

- Funding Approaches—Examples
  - Pennsylvania—Posted and Bonded Roadway Program
  - Ohio—Road Use Maintenance Agreement (RUMA)
  - Texas—Proposition 1
  - North Dakota—Legislative Funding Increase
- Outreach and Coordination—Examples
  - ODOT Statewide Shale Coordinator
  - Ohio State Highway Patrol Officer Assigned to Area
  - Ohio—Regular Meetings with Industry
  - NDDOT—Employee Retention and Recruitment
  - NDDOT—County Liaison
  - Pennsylvania—Marcellus Shale Coalition

10:30 a.m. Break

10:45 a.m. Activities in TPF States (Continued)

- Pavement Techniques for Rapid Response, Materials, and Thickness
  - Texas, Pennsylvania, and Louisiana Examples
- Safety Improvements
  - Examples of Safety Improvements in All States
  - Texas Crash Data Analysis

12:00 p.m. Working Lunch

Figure 31. Meeting Agenda.

1:00 p.m.	Activities in TPF States (Continued)
	• Use of Right of Way
	  o Water Lines in Texas
	  o Examples from Other States
	• Oversize/Overweight Vehicles and Corridors
	• Crude by Rail, Railroad Grade Crossings

2:30 p.m.	Break
2:45 p.m.	Activities in TPF States (Continued) • Identifying and Predicting Impact Areas • Planning Approaches and Data Needs • Other Topics
4:30 p.m.	Conclude for the Day and Return to Hotel
Thursday, March 24 **TTI, State Headquarters Research Building, Room 144**	
9:00 a.m.	Discussions of Issues and Possible Follow-Up Activities
10:00 a.m.	Check-In, Overview of Crash Test, and View Crash Test—Embassy Security Device
11:45 a.m.	Return to SHRB
12:00 p.m.	Working Lunch, Discussion of Research Needs, Follow-Up Activities, and Concluding Comments

Source: Texas A&M Transportation Institute.

Figure 31. Meeting Agenda (Continued).

The meeting began with self-introductions and a PowerPoint presentation by the research supervisor summarizing the site visits. The meeting was organized to provide time for discussion and interaction among the participants and on topics and issues identified during the site visits. As highlighted in the Figure 31, topics discussed included funding approaches, outreach and coordination, and pavement techniques for rapid response. Safety improvements, use of roadway rights of way, OS/OW vehicles and corridors, and CBR were also discussed. Other topics covered in the meeting were identification and prediction of impact areas, planning approaches and data needs, and freight plans. The meeting concluded with a discussion of ongoing issues, research needs, and follow-up activities.

The discussion at the meeting, along with information obtained during the site visits and literature review, was used to develop the state of the practice contained in Chapter 5. The discussion of research needs and follow-up activities was used as input to the future research topics outlined in Chapter 6.

Transportation Pooled Fund Project:
State Responses to Energy Sector Developments
Participating States Meeting
March 22–24, 2016
College Station, Texas
Attendees from Participating States

California Department of Transportation (Caltrans)
- Todd LaCasse, Freight Planning Branch
- Patrick Tyner, Research Office

Louisiana Department of Transportation and Development (DOTD)
- David North, Shreveport (04) District Engineer Administrator
- Kirk Zeringue, Louisiana Transportation Research Center

Montana Department of Transportation (MDT)
- Dustin Rouse, Pre-construction Engineer, Engineering Division

North Dakota Department of Transportation (NDDOT)
- Rebecca Geyer, Planning/Rail Section Leader

Ohio Department of Transportation (ODOT)
- Anna Kuzmich, Statewide Shale Coordinator
- Lloyd MacAdam, Deputy Director, District 11

Pennsylvania Department of Transportation (PennDOT)
- Halley Cole, Chief, Pavement Unit, Bureau of Maintenance and Operations
- Benjamin Harlan, Bureau of Maintenance and Operations, Asset Management/ Marcellus Shale

Texas Department of Transportation (TxDOT)
- Joe Adams, Research and Technology Innovation
- Mark McDaniel, Branch Manager, Roadway Asset Management and Engineering Services, Maintenance Division
- Caroline Mays, Director, Freight and International Trade Section
- Valente Olivarez, Jr., Deputy District Engineer, Corpus Christi District

Washington State Department of Transportation (WSDOT)
- Matthew Pahs, Freight Planning Program

Others Attending
- Katie Turnbull, Jon Epps, Dave Newcomb, Cesar Quiroga, Jeff Borowiec, Curtis Morgan, and David Bierling, TTI
- Leah Anne Dundon, Ph.D. student, Vanderbilt University

Source: Texas A&M Transportation Institute.

Figure 32. Attendees at the TPF Member Meeting.

CHAPTER 5: STATE OF THE PRACTICE

This chapter summarizes the state of the practice in the TPF states for responding to impacts associated with energy sector developments. Information is presented on funding approaches, and identification and prediction of impact areas, planning, and data needs. Pavement treatments and rapid response techniques, energy sector use of roadway right of way, and safety issues and studies are described. CBR studies, planning issues, identification of impact areas, and freight plans and freight corridor studies are also highlighted. Approaches for outreach and coordination with industry, law enforcement agencies, and local governments are discussed. Methods for retaining and recruiting personnel are summarized.

FUNDING APPROACHES

This section presents information on approaches for funding road and bridge improvements related to energy sector developments in Pennsylvania, Ohio, North Dakota, and Texas. Information is also provided on the oil spill response tax and the oil spill administration tax in Washington State.

Pennsylvania—Posted and Bonded Roadway Program

Information on the Pennsylvania Posted and Bonded Roadway Program was obtained from the site visit PowerPoint presentation (*8*), "Chapter 15—Weight Restrictions on Highways" in PennDOT's *Publication 23—Maintenance Manual* (*8*), papers presented at the 2014 ASCE Shale Energy Engineering Conference (*9*), and discussions at the March 2016 TPF meeting in College Station. Basic elements of the program are summarized in this section.

The Posted and Bonded Roadway Program in Pennsylvania was initiated approximately 30 years ago. It is based on law (Title 15 Vehicle Code: Chapter 49—Size, Weight, and Load), regulation (Title 67 Transportation: Chapter 189—Hauling in Excess of Posted Weight Limit), and policy ("Chapter 15—Weight Restrictions on Highways" in PennDOT's *Publication 23—Maintenance Manual*).

The Posted and Bonded Roadway Program has been used extensively recently to address developments in the Marcellus Shale Play and the resulting road damage caused by heavy trucks servicing different aspects of the energy sector. The program places responsibility for maintaining roadways on the businesses using the roadways. The program includes a number of steps to document, monitor, and maintain the condition of roadways.

First, PennDOT conducts a traffic and engineering study to evaluate the pavement and geometric conditions of a roadway. The study includes reviews of pavement and geometric conditions, including photographs and video documentation. If warranted, the appropriate weight restriction is determined (typically 10 tons), and the roadway is posted with the weight restriction. Once a road is posted with a weight restriction, a hauling permit must be obtained to operate vehicles

over the posted limit. To obtain a hauling permit, a company using the roadway must enter into an EMA with PennDOT. Under the EMA, the company is responsible for maintaining the roadway to the current conditions and for road repairs beyond normal maintenance. As part of the EMA, the company must provide a bond of $12,500 per paved mile of roadway and must submit a maintenance plan documenting how the roadway will be maintained.

PennDOT monitors the condition of posted roadways on a regular basis, using a condition roadway survey. PennDOT personnel regularly travel the posted roads and use the survey to assess conditions, using a none/minimum, low, medium, or high rating system for damage.

If roadway damage is identified, PennDOT sends a five-day letter to all companies with a bond on the roadway notifying them of the damage and the need to make repairs. If more than one company has an EMA to operate on a roadway, it is their collective responsibility to determine the appropriate cost sharing for any road damage. PennDOT has a spreadsheet companies can use to estimate cost sharing, but PennDOT staff reported that most companies hire a consultant to help with the process. PennDOT's field inspectors identify needed improvements, and the companies are responsible for hiring contractors to complete the repairs.

PennDOT may suspend hauling operations if a roadway condition survey identifies critical damage making a roadway unsafe or impassable. PennDOT staff noted that companies are also required to submit plans identifying the location of wells and the number of trucks anticipated to serve the wells. PennDOT staff noted that the department has good working relationships with energy sector companies and haulers, and that the process works well.

The number of roads and mileage included in the Posted and Bonded Roadway Program increased beginning in 2010 in response to truck traffic resulting from energy sector developments. The number of five-day letters to bondees to repair damaged roadways also increased from 68 in 2010 to 143 in 2011 in response to heavy-truck traffic. The annual number of five-day letters from 2012 to 2016 ranged between 117 and 136. Postings have been removed from some roadways based on improvements made by the oil and gas industry. The PennDOT website, www.papostedroads.pa.gov, includes an interactive map of posted and bonded roadways and spreadsheets with bondees by county.

Some changes have been made in the Posted and Bonded Roadway Program in response to recent state legislation. As described next, Act 13 approved in 2013 introduced a Marcellus Shale Wells impact fee. It also exempted additional at-risk haulers from the program. Act 89, passed in 2013, exempted certain forest products and coal haulers, as well as haulers with less than 700 loaded loads per year per route, from the program.

Pennsylvania—Marcellus Shale Wells Impact Fee

Act 13 placed an impact fee on drilled Marcellus Shale wells. Sixty percent of the impact fee revenue is distributed to the counties and municipalities where the wells are located. The revenues can be used for road, bridge, and infrastructure projects, as well as other services impacted by the oil and gas drilling and extraction. The remaining 40 percent is deposited into the Marcellus Legacy Fund for various statewide uses.

The impact fee generated approximately $204 million in 2011, $202 million in 2012, $226 million in 2013, and $223 million in 2014. The fee changes annually based on natural gas prices and the Consumer Price Index. The Pennsylvania Public Utility Commission is responsible for assessing, collecting, and distributing the impact fee (*11*).

Ohio—Road Use Maintenance Agreements

The RUMAs are used by counties and townships in Ohio, which is a home rule state. The 88 counties and 1,309 townships are responsible for most of the roadways in the state. The shale development is occurring in the southeast section of the state. There are a large number of unpaved county and township roads in the area. The RUMA was developed in response to concerns relating to the extensive damage to county and township roads by the high volume and heavy loading of trucks serving oil and gas facilities.

An RUMA is a requirement of ODNR's non-conventional horizontal drilling permit application. The RUMA process was created as a mutual tool for the industry and local governments to ensure roads are available to the industry during frost law periods and to ensure the roads and bridges are upgraded if they are structurally insufficient to carry the projected traffic loads. An RUMA is also intended to provide any excess maintenance that the additional truck traffic creates. The industry is required to obtain an RUMA or submit an affidavit stating it has made a good faith effort to obtain one before receiving the permit. The document itself is not a part of the legislated requirement. The RUMA provides a mechanism for counties and townships to fund improvements, repairs, and maintenance to roads impacted by the oil and gas industry (*6*).

ODOT personnel help facilitate interaction between local government officials and industry representatives. The ODOT statewide shale coordinator hosts quarterly meetings with county and township officials, industry representatives, and other groups. ODOT personnel reported having good working relationships with the industry. Improvements are typically made before a project is initiated. According to ODOT personnel, most companies hire a contractor directly as part of an RUMA, rather than the county or township.

A total of 167 RUMAs were signed between local governments and oil and gas companies from September 2012 through September 2013. There were 432 well pads drilled or in operation by 36 companies during this period (*6*).

North Dakota—Increased State Funding

Historically, NDDOT has focused primarily on using available federal funding for projects on the federal system. State funding was limited to ensuring local match requirements were met. This traditional approach changed when the North Dakota Legislature provided $228.6 million for the 2011–2013 biennium for transportation projects in areas of the state impacted by the oil boom. The legislature increased the amount of state funding for the transportation projects to $1,161.6 million for the 2013–2015 biennium. The state funding level was reduced to $991.1 million for the 2015–2017 biennium (*12*). The types of projects constructed with this funding are described later in this chapter.

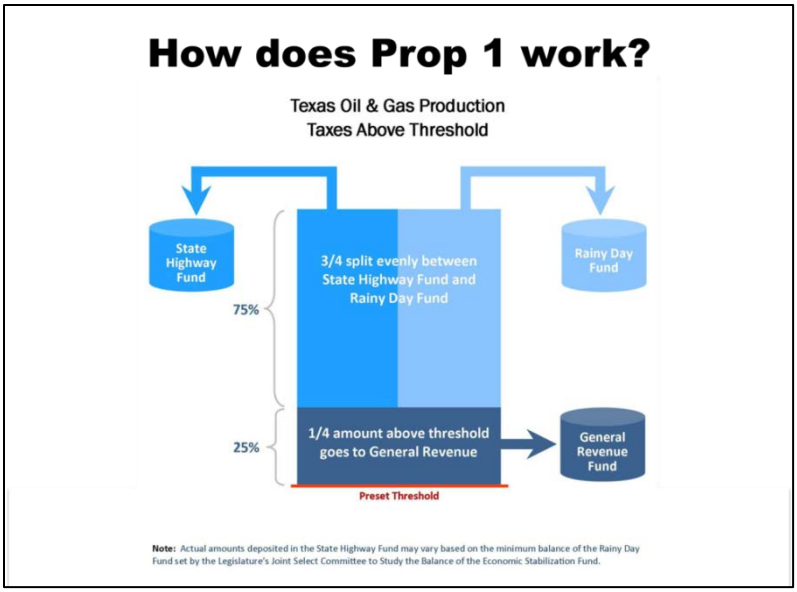
Texas—Proposition 1 and Proposition 7

Proposition 1 and Proposition 7 are constitutional amendments in Texas, approved by the voters in 2014 and 2015, respectively. As illustrated in Figure 33, Proposition 1 redirected half of the money from the Texas oil and gas production taxes above the threshold that would normally have gone to the Economic Stabilization Fund (called the Rainy Day Fund) to the State Highway Fund. The funds may only be used for constructing, maintaining, and acquiring right of way for public roadways other than toll roads for the following purposes:

- 45 percent for mobility and added capacity projects in urban areas to decrease congestion and increase the safe and efficient movement of traffic.
- 25 percent for projects that improve regional connectivity along strategic corridors of the state.
- 20 percent for statewide maintenance and preservation projects.
- 10 percent for roadway safety and maintenance projects in areas of the state impacted by increased oil and gas production activity.

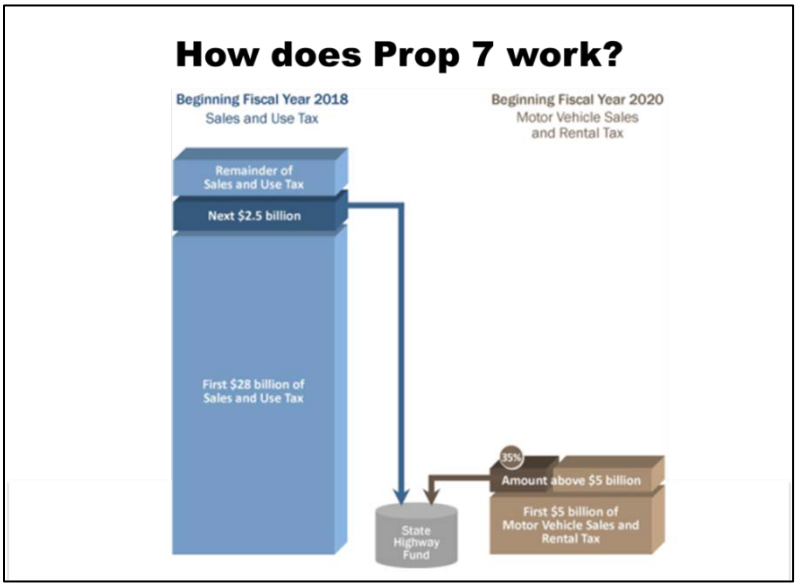
Approximately $1.7 billion was available to TxDOT from Proposition 1 the first year. With the slowdown in the industry, it is anticipated that approximately $750 million will be available in 2016 (*13*).

Proposition 7 was approved by Texas voters in November 2015. As illustrated in Figure 34, Proposition 7 dedicates a portion of the state's general sales and use taxes and motor vehicle sales and rental taxes to the State Highway Fund for use on non-tolled projects. Beginning in September 2017, if general state sales and use tax revenue exceeds $28 billion in a fiscal year, the next $2.5 billion will be directed to the State Highway Fund. Beginning in September 2019, if state motor vehicle sales and rental tax revenue exceeds $5 billion in a fiscal year, 35 percent of the amount above $5 billion will be directed to the State Highway Fund (*13*).



Source: Texas Department of Transportation.

Figure 33. Proposition 1 Process.



Source: Texas Department of Transportation.

Figure 34. Proposition 7 Process.

Washington State Oil Spill Response Tax and Oil Spill Administration Tax

The Washington State Department of Revenue website (*14*) provides information on the oil spill response tax and the oil spill administration tax. The oil spill response tax and the oil spill administration tax are taxes on the receipt of crude oil or petroleum products at a marine terminal in Washington from a waterborne vessel or barge operating on the navigable waters of Washington or at a bulk rail terminal in Washington. The tax is imposed on the person who owns the crude oil or petroleum products when the crude oil or petroleum products are received

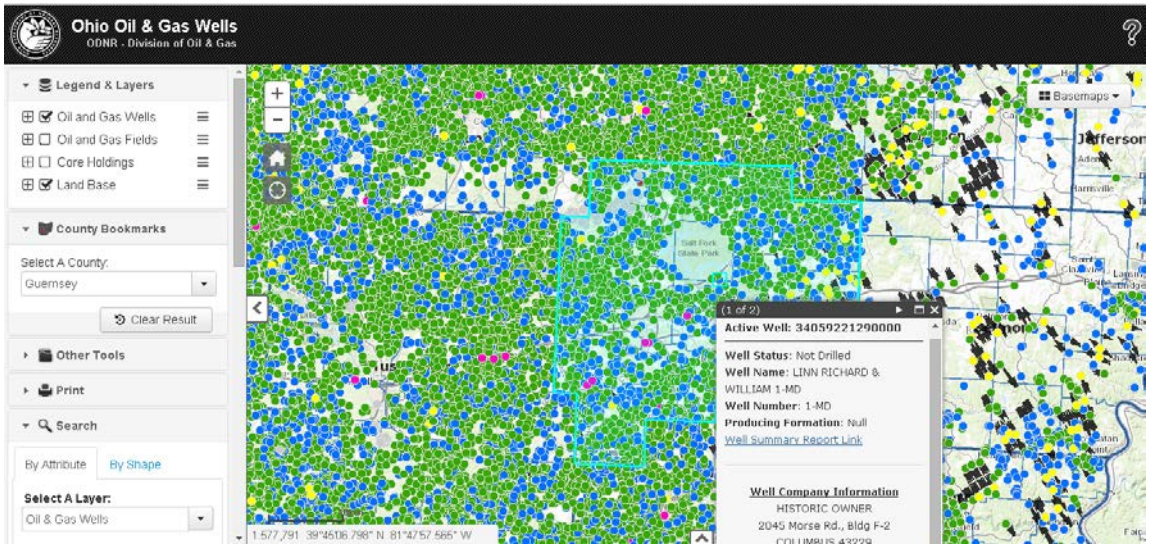
in the storage tanks. The rate of the oil spill administration tax is 4 cents per 42-gallon barrel. The rate of the oil spill response tax is 1 cent per 42-gallon barrel (*14*).

IDENTIFICATION AND PREDICTION OF IMPACT AREAS, PLANNING, AND DATA NEEDS

One of the topics discussed during the site visits and the TPF meeting was obtaining information from other state agencies responsible for issuing oil and gas drilling permits to help identify areas that will experience increases in heavy-truck traffic. This information may allow transportation agencies to take a more proactive rather than reactive role in addressing infrastructure needs. Other sources may also be used to obtain this information. In addition, many states have analyzed the number of trucks needed to frack and maintain a well. These estimates have been used to better define the possible impacts and to design facilities and pavements that will withstand the heavy-truck volumes.

Ohio Department of Natural Resources Oil and Gas Website

As noted in Chapter 3, the ODNR oil and gas website provides a resource for industry, local governments, and citizens to obtain information on oil and gas developments in the state. The interactive Ohio Oil and Gas Well Locator provides an online search database on the location and status of oil and gas wells in the state (*15*). Information on individual wells includes its status, such as whether it is active or inactive, and links to permits and well summary reports from the Risk Based Data Management System (RBDMS). Figure 35 provides an example of one map displaying oil and gas wells.



Source: Ohio Department of Natural Resources.

Figure 35. Ohio Oil and Gas Well Locator on the Ohio Oil and Gas Wells Web Page.

The RBDMS contains comprehensive well data for over 100,000 wells permitted since 1980. Historical well card information from the Division of Geological Survey for wells permitted before 1980 is included in the database. In 1996, the Ohio Division of Oil and Gas developed the database into a fully functional oil and gas well database tied into the permit application module and process. All information captured as part of the permitting process is reflected in the RBDMS. Well permit forms are broken down into searchable reports and forms within the main screen, based on production, location, and company. In 1998, wells were given X/Y geospatial coordinates and also assigned a unique American Petroleum Institute (API) well number for linkages to the national database.

Oil and gas well producers are required to submit quarterly production data to the RBDMS. These production data are available for downloading on the site, with quarterly and annual data sets. Annual production information may be obtained electronically, by year, beginning in calendar year 1984. Each record has the following fields: production year, county, township, API well number, permit number, owner name, well name, well number, oil (1 barrel = 42 U.S. gallons), gas (1 MCF = 1,000 cubic feet of gas), brine (1 barrel = 42 U.S. gallons), days in production, date completed, and plugging date (if applicable).

Pennsylvania Department of Environmental Protection

Similar to Ohio, Pennsylvania also has an oil and gas well production reporting database, website, and information system maintained by the Pennsylvania Department of Environmental Protection (*16*). The site provides the public with data and information on oil and gas operations across the state. It allows users to view historical oil and gas well production information from conventional shallow wells and newer unconventional wells, as well as data on the waste each operation produces. All information presented is reported by the industry in accordance with Pennsylvania law. Users can search for information by well permit number, by operator ID, by county, or for the entire state. The site also allows users to generate and download raw data for further analysis. Well location data are also provided with X/Y geospatial coordinates.

Texas—Forecasting Impacts Project

TTI conducted a recent research project for TxDOT examining data sources and techniques for forecasting the impacts of energy sector developments. The data sources include oil/gas permits and salt water disposal wells from the Texas Railroad Commission, water sources, material/equipment suppliers, OS/OW permit data, weigh-in-motion station data, and the gas pipeline network. These data were used to estimate energy sector truck trends. Private sector sources that provide forecasts for well locations for a fee were also examined.

PAVEMENT TREATMENTS AND RAPID RESPONSE TECHNIQUES

The large number of heavy trucks required to frack and service an oil or gas well causes substantial damage to roadways. Roads in rural areas, which were not designed for heavy-truck

volumes, are especially vulnerable. Many of the states participating in the TPF project have examined and implemented new pavement treatments and rapid response techniques to respond to these issues.

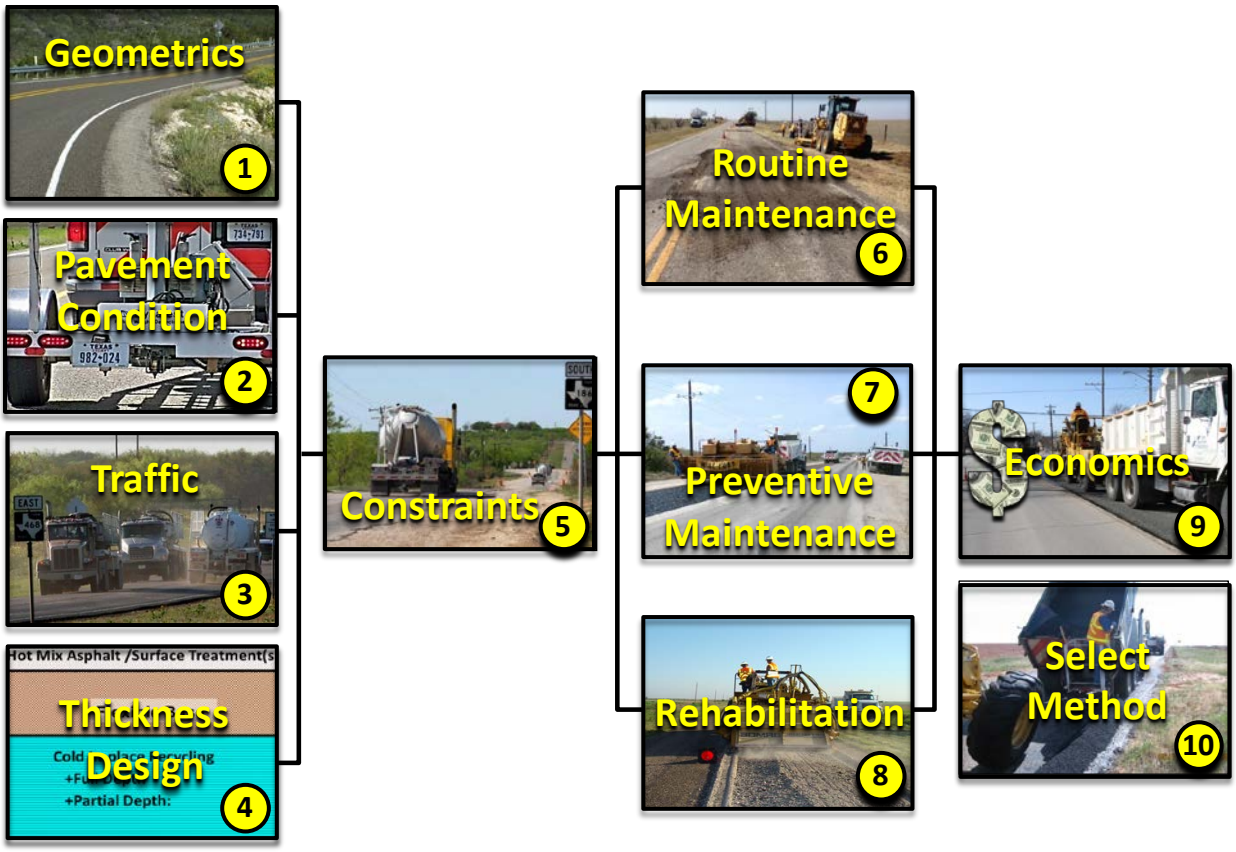
Texas—Pavement, Road Repair, and Response Techniques

TTI has conducted a number of research projects for TxDOT examining roadway and pavement issues associated with increased heavy-truck traffic in areas impacted by energy sector developments. TTI has also provided technical assistance on pavements, rapid road repair, and work zone safety to the TxDOT Maintenance Division and south and west TxDOT districts.

The major tasks supporting the Maintenance Division focus on identifying and summarizing current maintenance and rehabilitation practices, characterizing traffic in energy sector regions, and developing a framework for identifying economical maintenance and rehabilitation decisions. Support is also being provided to assess specific pilot projects and to conduct workshops and outreach activities. Three types of documents—research reports, implementation reports, and two-page summaries or briefs—are being prepared on the different tasks. The following four Energy-Sector Briefs provide examples of the information being provided.

- "14-1: TxDOT/TTI Joint Effort to Address Roadway Damage Resulting from Energy Development." This brief highlights the impacts from energy sector developments on roadways in Texas and the challenges TxDOT faces in addressing accelerated pavement deterioration. The activities undertaken by TxDOT and TTI to address these concerns are outlined (*17*).
- "14-2: Recommended Shoulder Widths." This brief describes the degradation and failure of roadway shoulders, especially on Farm-to-Market (FM) roads with paved widths of 18 to 20 feet, from increases in heavy energy sector truck traffic. A number of techniques for addressing these issues are presented, including increasing shoulders widths to 6 feet on high-volume roadways (*18*).
- "14-3: Shoulder/Edge Repair Techniques." This brief summarizes current practices among TxDOT districts to repair deteriorated shoulders. Removal and replacement of materials, patching, strip seals, and fog seal are used. Widening of the roadway is the most important activity used to address roadway damage caused by heavy trucks in areas impacted by energy sector developments (*19*).
- "14-4: Rehabilitating Oil-Field-Damaged Roads with Foamed Asphalt." This brief presents information on testing the use of foamed asphalt on a 1-mile section of FM 99. Foamed asphalt is a stabilization technique that is used internationally but has had few U.S. applications. The test and the research project are examining the ability of foamed asphalt to meet early roadway opening requirements and to provide a structurally sound base layer (*20*).

As part of ongoing technical assistance to the TxDOT Maintenance Division, TTI researchers prepared and delivered the *Implementation Briefing on Repair of Road Damage Associated with Energy Development and Production* (*21*) to 10 TxDOT districts impacted by energy sector developments. The briefings, which were held in July and August 2016, covered repair guidelines and routine maintenance, preventive maintenance, rehabilitation, performance, and selected strategies. Figure 36 illustrates the repair guidelines developed as part of the project. The guidelines cover geometrics, pavement condition, traffic, and thickness design. The guidelines also address possible constraints, as well as routine maintenance, preventive maintenance, rehabilitation, economics, and selective method.



Source: Texas A&M Transportation Institute.

Figure 36. Road Repair Guidelines.

Detailed information is provided on each of these steps. For example, a Microsoft® Excel® template is provided for use in calculating equivalent single-axle loads (ESALs) to develop appropriate pavement thicknesses. Repair guidelines for routine maintenance cover shallow patch, deep patch, level-up patch, and shoulder/edge repair. Preventive maintenance addresses fog seal, chip seal (seal coat), slurry/microsurface, and hot-mix asphalt.

Pennsylvania—Pavement Repair and Improvement Methods

Under the Posted and Bonded Roadway Program described previously, the oil and gas companies using the roadways are responsible for making any needed repairs or improvements. A paper presented at the 2014 ASCE Conference in Pittsburgh (*10*) described the roadway repair and upgrade methods used by Chesapeake Energy Corporation. Chesapeake provides a good example of a major participant in the Posted and Bonded Roadway Program.

Chesapeake drilled its first well in the Marcellus Shale Formation in the state in late 2008 and bonded its first roadway in 2009. At the end of 2010, the company had reconstructed 153 miles of roadways at a cost of approximately $100 million. By mid-2011, Chesapeake had approximately 620 miles of bonded roadways, and by the end of 2013, the company had reconstructed 388 miles of roads at a cost of $300 million.

According to the paper, Chesapeake examines the roadways before constructing a new well pad and identifies the best route for vehicles servicing the well. Key factors considered in route selection include roadway conditions, accommodation of large loads, and safety. All contractors are notified of the route, and Chesapeake monitors and enforces use. Chesapeake conducts an assessment prior to using a roadway. The assessments may include field observations, checking with county maintenance personnel, and reviewing pavement records. More extensive geotechnical testing may be conducted, including taking and analyzing field samples on roadways in need of repair and upgrades. Existing conditions, including any damage, are documented, and repairs and upgrades are made as needed.

Based on the Chesapeake experience, repairs and upgrades may take different forms. The most commonly reported methods include base repair, base repair with pavement overlay, and full reconstruction using cement full-depth reclamation (FDR). Additional improvements may also be made as part of any project. According to the paper, base repairs are made when the pavement has a suitable subbase and the damage is limited. Damaged areas are milled 4 to 6 inches deep and patched with asphalt, and the edges are sealed. A full pavement overlay is added with more severe or widespread damage.

The paper reported that the Superpave asphalt mixture design used on pavement overlay projects depends on the projected truck volumes. A 90-to-140 millimeter (3.5- to 5.5-inch) thick, 25 millimeter (1-inch) asphalt base course along with a 40 millimeter (1.5-inch) thick, 9.5 millimeter (0.4-inch) asphalt wearing course is used on roads with high projected truck volumes, defined as 200 to 250 trucks a day for 10 years. A 75 millimeter (3-inch) thick asphalt binder course is used with roadways anticipated to have up to 100 trucks a day for 10 years. In these cases it is anticipated that PennDOT will sealcoat the roadway surface as part of normal maintenance. A 9.5 millimeter (0.4-inch) asphalt scratch, or leveling course, is applied before the Superpave asphalt mixture design for pavement overlays with base repair. The work is

performed in accordance with PennDOT's construction specifications, with inspectors monitoring the projects.

Cement FDR with a pavement overlay is used on major reconstruction projects. Geotechnical testing is used to classify the soils and identify the moisture content and unconfined compressive strength. The test results and anticipated truck volumes are used to identify the percentage of cement and the depth of the FDR. Steps in the FDR process include pre-pulverizing the existing road and subbase to the proposed depth, grading and compacting the roadway to the profile, and applying the cement with a pneumatic spreader.

Louisiana—Roller-Compacted Concrete for Low-Volume Roads

LTRC is conducting a study on the alternative use of roller-compacted concrete (RCC) on low-volume roads for DOTD. The project results will be of benefit for areas in the state impacted by energy sector developments. As part of the project, six full-scale RCC pavement sections, including three RCC slabs thicknesses (4 inches, 6 inches, and 8 inches) and two base types (soil cement base and cement treated base) were constructed and tested under the accelerated pavement testing (APT) at LTRC's PRF site. The objective was to evaluate the structural performance and load-carrying capacity of thin RCC pavements constructed over different base materials. Each section was instrumented with multiple pressure cells and strain gages. A variety of nondestructive tests were conducted.

While the project will be completed in July 2016, according to LTRC, the APT results generally indicated that all RCC test sections had very high load-carrying capacity, and four sections were successfully loaded to a fatigue cracking failure. Observations indicated that the fatigue cracking first showed up on pavement surfaces in the longitudinal direction within weak subgrade areas, and then propagated and expanded to a final fatigue cracking pattern. The longitudinal cracks could be initiated either at the tire edge or in the middle of a tire print, depending on the slab thickness of RCC and the strengths of underneath layers. Instrumentation results were used to characterize the fatigue damage under different local magnitudes. An RCC fatigue prediction model based on the APT performance will be proposed for thin RCC pavement over cement stabilized base at the completion of the project (*22*).

SAFETY ISSUES AND IMPROVEMENTS

North Dakota—Safety Improvement Projects

NDDOT constructed a number of safety and capacity projects to address the increased traffic in the areas impacted by energy sector developments. These improvements included traffic signals and lighting, turning and bypass lanes, roundabouts, truck reliever routes, and bridge replacements. The first roundabout was constructed in 2012, and five more were completed by 2016. These roundabouts are designed to accommodate large trucks. Bypass and truck reliever routes were constructed in Dickinson, Watford City, Alexander, New Town, Williston, and

Killdeer between 2012 and 2014 (*12*). Figure 37 illustrates the new truck reliever route in New Town, North Dakota.

Source: North Dakota Department of Transportation.

Figure 37. Truck Reliever Route in New Town, North Dakota.

Texas—Safety Studies and Public Safety Campaigns

TTI has conducted research for TxDOT and studies through TTI's PRC examining roadway safety concerns associated with energy sector developments. A recent study focused on three areas of the state—counties in the Barnett Shale Play, counties in the Permian Basin, and counties in the Eagle Ford Shale Play. Data on the number of horizontal and vertical wells, all crashes, crashes in rural areas, crashes involving commercial motor vehicles (CMVs), and rural CMV crashes were examined. The number of crashes in the Barnett shale region decreased as the drilling activities in that area decreased. The number of rural CMV crashes in the Eagle Ford Shale Play and the Permian Basin increased as the number of wells drilled, especially horizontal wells, increased. The change in rural CMV crashes per 100 lane-miles was also highest in counties in the Eagle Ford Shale Play and Permian Basin (*23*). The study also developed a regression analysis that can be used to predict the number of rural CMV crashes that may be anticipated based on increases—or decreases—in the number of new horizontal wells in an area.

TxDOT has incorporated messages related to heavy-truck traffic into its overall *Be Safe. Drive Smart* safety campaign. Figure 38 illustrates the printed message used in newspapers, pamphlets, and flyers. The campaign also features radio and television public service announcements.

Source: Texas Department of Transportation.

Figure 38. TxDOT Safety Campaign.

OUTREACH AND COORDINATION WITH OIL AND GAS INDUSTRY GROUPS, STATE AND LOCAL LAW ENFORCEMENT AGENCIES, AND LOCAL GOVERNMENTS

Examples of outreach and coordination from Ohio, Pennsylvania, Texas, and North Dakota are summarized in this section. The ODOT statewide shale coordinator position, outreach to industry and communities, and coordination with Ohio SHP is presented first, followed by an overview of the Pennsylvania-based Marcellus Shale Coalition. Information on the Task Force on Texas' Energy Sector Roadway Needs and the NDDOT Western Transportation liaison is also highlighted.

Ohio—ODOT Statewide Shale Coordinator, Outreach to Industry and Communities, and Coordination with Ohio SHP

The ODOT statewide shale coordinator position was established in 2012. Based in ODOT District 11 in southeastern Ohio, responsibilities of the position include coordination and outreach to the shale industry, local governments, SHP, and other groups. Anna Kuzmich, the coordinator, holds regular meetings with industry and local officials, and provides assistance on RUMAs and shale-related transportation issues. The position also coordinates activities within ODOT, interacting with personnel from other districts and the central office. The coordinator assists oil and gas companies identify the best routes for trucks moving equipment and products to service well sites. The position also helps identify routes for OS/OW vehicles hauling superloads, such as storage tanks and special equipment.

Ohio SHP also assigned an officer, Sergeant Greg McCutcheon, to the area in 2012. The officer focuses on enforcement and outreach to the energy industry and its service providers. The outreach program includes safety-related meetings with companies. Other activities include attending the regular meetings ODOT holds with industry and community representatives, following up on specific issues, and providing feedback to ODOT on concerns the department can address.

Pennsylvania—MSC

MSC was established in 2008. Based in Pittsburgh, MSC is the largest shale development trade association in the Appalachian Basin. It is comprised of approximately 300 companies in the oil and gas industry in the region. The MSC conducts regular meetings with PennDOT officials and helps promote coordination within the state.

MSC focuses on providing information to policy makers, the public, the media, and regulators on natural gas exploration, production, and midstream activities in the Marcellus and Utica Shale Plays. The MSC website (http://marcelluscoalition.org) contains information about the organization, all aspects of the production process, fact sheets, recommended practices, and links to other related websites. Information on transportation and infrastructure is included in the production process discussion. MSC also sponsors and co-sponsors conferences, workshops, training sessions, and other events.

Texas—Task Force on Texas' Energy Sector Roadway Needs

TxDOT formed the Task Force on Texas' Energy Sector Roadway Needs in March 2012. In addition to TxDOT, the task force includes representatives from the following groups.

- Texas Department of Public Safety.
- Texas Commission on Environmental Quality.
- Railroad Commission of Texas.
- Texas Department of Motor Vehicles.
- Texas Association of Counties.
- America's Natural Gas Alliance.
- Association of Energy Service Companies.
- Midland-Odessa Transportation Alliance.
- Texas Alliance of Energy Producers.
- Texas Competitive Power Advocates.
- Texas Farm Bureau.
- Texas Independent Producers and Royalty Owners Association.
- Texas Trucking Association.
- Texas Oil and Gas Association.

- Texas Pipeline Association.
- The Wind Coalition.

The task force was formed to help investigate the impacts of energy exploration and development-related activities on the transportation infrastructure and possible approaches to address these impacts. Much of the task force's work was organized around four subcommittees focusing on funding and finance, public awareness, safety, and innovation and prevention. The task force and the subcommittees held numerous meetings throughout the state during 2012 and developed a report that was presented to the Texas Transportation Commission on December 13, 2012 (*24*).

The report is organized around the topics examined by the subcommittees and possible approaches for addressing identified issues. The finance subcommittee discussed a wide range of funding options for needed roadway improvements, including RUMAs similar to those used in Ohio, commercial driver's license fee increases, public-private partnerships, county road districts, establishment of taxes on tires on OS/OW vehicles, and truck fees. The report notes that implementing most of these approaches would require legislative action. The report also notes that none of the options were endorsed or recommended by the task force, TxDOT, or other state agencies.

The public awareness and safety subcommittees combined their activities and focused on the need for a public awareness safety campaign in areas experiencing increased energy sector traffic. As discussed previously in the safety section, TxDOT has included truck safety in energy sector areas in recent public awareness campaigns.

Topics discussed in the innovation and prevention subcommittee included identifying better methods to identify current and future energy sector activities, developing statewide driveway standards, providing temporary commercial vehicle inspection stations, and using temporary water lines in state roadway rights of way. Follow-up activities have occurred on many of these topics, including the use of temporary water lines discussed previously. This subcommittee also discussed enhanced energy evacuation coordination in energy sector areas.

North Dakota—Western Transportation Liaison

NDDOT established the western transportation liaison position in January 2014. The position works closely with city and county officials in the state's oil and gas region. Dave Leftwich, who retired in November 2013 after 39 years with the department, served as the first liaison.

Based in Bismarck, Mr. Leftwich worked part-time from an office in Watford City, traveling throughout the region to meet with city, county, and tribal staff and elected officials to obtain information on concerns, issues, and local projects. He also helped with coordinating NDDOT projects with local activities. Mr. Leftwich transitioned out of the position in 2016, and the

liaison responsibilities were combined with the state's energy impact coordinator. The governor of North Dakota established this position in 2012 to monitor local impacts resulting from the rapid growth in energy development and to serve as a liaison to the governor, cabinet members, and other state officials.

USE OF STATE ROADWAY RIGHT OF WAY

The use of roadway right of way for energy-sector-related activities was discussed during the TPF member meeting. Information was presented on the use of state roadway right of way in Texas for temporary water lines. A current TxDOT research project being conducted by TTI is examining this topic.

Texas—Use of Right of Way for Temporary Water Lines

Senate Bill 514 was enacted in 2013, allowing saltwater pipeline operations to install, maintain, and operate pipeline facilities though, under, along, across, or over a public road, so long as the operator complied with federal, state, and local regulations. Saltwater pipelines were defined as those carrying produced water. In 2015, House Bill 497 (HB 497) expanded this definition to include water used for drilling or operating a well. HB 497 further allows pipelines to occupy a public roadway right of way via a lease agreement requiring the pipeline operator to pay fair market value for using the right of way and for administrative costs.

TxDOT districts are responsible for issuing permits for the use of temporary water pipelines in state roadway rights of way and enforcing their use. Permits for the temporary water lines are valid for 90 days and may be renewed. The number of permits issued and some elements of the program vary between districts. The Corpus Christi District, which includes most of the Eagle Ford Shale Play, has experienced the largest use of temporary water lines in roadway rights of way. Figure 39 presents examples of temporary water lines in Texas (*25*).

TTI is conducting a current TxDOT research project examining the use of roadway rights of way for temporary water lines. The project is reviewing temporary pipeline installation practices in different TxDOT districts. A guidebook to permit, install, operate, and maintain temporary pipelines will be developed as part of the project. If installed and maintained property, water lines could reduce the number of truck trips to hydraulic fracture and service a well.

Source: Texas A&M Transportation Institute.

Figure 39. Example of Temporary Waterline in State Roadway Right of Way in Texas.

FREIGHT PLANS AND CORRIDOR STUDIES

TPF members discussed state freight plans, truck route and corridor studies, and OS/OW corridors. The relationship of these plans and transportation impacts from energy sector and corridor studies developments were discussed. This section summarizes freight plans from Texas, California, and Montana.

Texas State Freight Mobility Plan

The Texas Freight Mobility Plan was completed in early 2016 (*26*). The plan addresses all freight modes in the state—trucks, rail, air, seaports and waterways, and pipelines. It includes strategic goals, policies, and strategies. The plan examines the performance of the state's freight system, analyzes trends and issues, and presents a forecast for freight growth. The document presents a freight transportation improvement strategy and a freight transportation implementation plan. The plan also describes the major freight corridors in Texas, the vehicles allowed, and the movement of different energy sector equipment (wind turbines from Texas ports to west Texas, western states, and Canada).

California Sustainable Freight Action Plan

The development of the California Sustainable Freight Action Plan was undertaken in response to Executive Order B-32-15 issued by Governor Brown in July 2015. The order prioritizes a transition to a more efficient and less polluting freight transportation system in the state. The plan is being developed by Caltrans, the California State Transportation Agency, the California Environmental Protection Agency, the Natural Resources Energy Agency, the California Air Resources Board, the California Energy Commission, and the Governor's Office of Business and Economic Development. A draft discussion issuance document was published in May 2016 (*27*).

The draft plan describes the current policy drivers in the state, the vision and guiding principles, and the freight targets. It also presents potential funding sources for new investments in the states freight transportation system, actions state agencies can take to support these investments, and possible pilot projects. It is anticipated that the plan will be finalized by July 2016.

Montana—Corridor Planning Studies

Two examples of corridor planning studies conducted by MTD are highlighted in this section. A corridor planning study is a planning-level assessment occurring before project-level environmental compliance activities under the National and Montana Environmental Policy Acts. It is intended to determine what, if anything, can be done to improve the corridor. The studies are also intended to facilitate transitions from transportation planning to environmental review and possible project development. Two examples of recent studies focusing on energy sector development are the MT16/MT200 Glendive to Fairview Corridor Planning Study (*28*) and the Culbertson Corridor Planning Study (*29*).

Both studies examined the planning level of reviews of safety, operational, and geometric conditions and environmental resources to identify needs and constraints. The studies also provided for early outreach and coordination with resource agencies, the public, and interested stakeholders. Both studies considered a range of improvements and construction projects. The Culbertson Study recommended 13 of 20 improvement options for future considerations. Alternative truck routes were also analyzed, and one alternative was advanced for further consideration. The Glendive to Fairview Study examined corridor-wide and location-specific improvements to address a wide range of issues and focused on immediate, short-term, mid-term, long-term, and as-needed time frames. The high-priority improvements included intersection alignments, passing lanes, signals, pavement markings, turn lanes, education and enforcement efforts, and a future access management study.

RETAINING AND RECRUITING PERSONNEL

State departments of transportation reported difficulty in retaining and recruiting personnel during the height of the oil and gas boom due to higher paying jobs in the energy sector. Two examples of approaches for retaining and recruiting needed personnel are highlighted in this section. The NDDOT Oil Patch Rental Allowance Program and other incentives are highlighted first, followed by the ODOT use of temporary summer seasonal personnel and the Highway Worker I category while individuals are obtaining their commercial driver's license (CDL).

North Dakota—Oil-Patch Rental Allowance Program and Other Incentives

NDDOT used a number of methods to recruit new and retain existing employees in the districts experiencing the oil boom. The Oil-Patch Rental Allowance Program provided additional monthly rent supplements for some employees. Under the program, the department monitored apartment rental rates in eight cities throughout the state. The rental rates in Dickinson,

Williston, Minot, and Bismarck in the western part of the state experiencing the oil boom are much higher than rates in other areas of the state. The total statewide average was compared with the statewide average without the western cities to help identify the supplement range. A total of 277.5 positions were identified as eligible for the rental supplement. Approximately $2.4 million was allocated for the 12-month period from July 1, 2015, to June 30, 2016, for the program. The supplements ranged from $300 to $700 a month depending on the location. Recruiting bonuses were also used to attract qualified employees. NDDOT provided bonuses to new engineering technicians statewide and to all new employees in the Minot, Williston, and Dickinson Districts.

Ohio—Temporary Highway Worker I

ODOT cannot hire highway technicians, who drive trucks, unless they have a CDL. ODOT can hire temporary summer seasonal workers in the Highway Worker 1 category, however, which does not require a CDL. The duties of a Highway Worker 1 include flagging, mowing, and other non-truck driving activities. Individuals hired in this category work a maximum of 32 hours a week and are encouraged to get their CDL within three to six months. Personnel obtaining their CDL have the potential to be hired as a winter seasonal highway technician at 40 hours a week during snow and ice operations. They may also be candidates for full-time positions that become available.

CRUDE-BY-RAIL STUDIES

Most of the TPF states experienced increases in CBR shipments during the study period. Concerns voiced with these increases during the site visits and the TPF meeting included safety and traffic impacts at railroad grade crossings from longer and more frequent trains, the increased potential for oil spills, and the potential for derailments. The examples from TPF states are summarized in this section. The potential new rail access at the Valero Benicia Refinery in northern California is presented first, followed by the Washington State Marine and Rail Oil Transportation Study.

California—New Rail Access to Valero Benicia Refinery

The Valero Benicia Refinery in northern California is in the permit-review process to add receiving CBR capabilities at the facility. The Valero Benicia Refinery is located on the north side of the San Francisco/Suisun Bay. Other refineries in the area located on the south side of the bay include Philips 66 Rodeo, Shell Martinez, and Tesoro Avon. The Valero Benicia Refinery was constructed in 1969 by Humble Oil (now Exxon). It is located on the site of the former Benicia Army Arsenal and was the second-to-last refinery permitted in the United States.

Modifications and upgrades made over the years, including those after acquisition by Valero in 2000, have made the refinery one of the more complex and competitive in the country. As illustrated in Figure 40, the refinery includes 425 acres and a 475-acre buffer zone.

Approximately 450 full-time employees work at the refinery, with an additional 250 continuing service contractors. The refinery's current crude slate includes a variety of international crudes, San Juaquin Valley, and Alaska North Slope (ANS). The refinery receives approximately 75 percent of the crude slate by ship at the refinery docks and 25 percent by pipeline. The crude slate has shifted over the past five years. When Valero acquired the refinery in 2000, ANS crude accounted for approximately 80 percent of the total feedstock. Currently, ANS crude accounts for only about 10 percent of the total feedstock. The versatile, high-conversion facility has the capability to process heavy sour, medium/highlight sour, and other feedstock (*5*, *30*).

Source: Valero.

Figure 40. Aerial View of Valero Benicia Facility.

The refinery's permitted capacity is 165,000 bbl. The refinery's products include California Air Resources Board Oxygenated Blending gasoline, ultra-low-sulfur diesel, jet fuel, liquid petroleum gas, fuel oil, and asphalt. The refinery is a major supplier of military jet fuel in northern California, which is transported by pipeline and supplies approximately 27 percent of the northern California asphalt market, which is shipped by truck.

The CBR project would provide an alternative means of receiving crude oil feedstock, allowing flexibility to reduce foreign crude imports and increase domestic crude oil use. It would not change the refinery processing. The major elements of the project include constructing two offloading rail spurs, a parallel railcar storage and departure spur, and one offloading track capable of offloading two parallel rows of crude oil railcars and transferring crude oil to existing storage tanks. All of these components would be installed on refinery property. A 4,000-foot pipeline and associated components would also be installed on refinery property connecting the offloading rack and existing crude oil storage tanks. Approximately 1,500 feet of existing tank farm dike wall and an existing fire water pipeline would be relocated on refinery property to

accommodate the new rail tracks and offloading rack. An existing service road would also be relocated on the property (*30*).

The project would allow up to 70,000 barrels of crude oil a day to be delivered by rail, with a maximum of 100 railcars per day in two deliveries. The volume of crude oil delivered by ship would decrease by the same 70,000 barrels a day, reducing ship deliveries by approximately 73 vessels for an 82 percent decrease. An estimated 20 additional full-time or contract workers would be needed in the project. The major impact of the project would be the potential blocking of the train traffic at an at-grade crossing. Valero's consultants modeled this impact, with the simulation showing a queue forming but not causing major disruptions.

Washington State—Marine and Rail Oil Transportation Study

As noted in Chapter 3, the increase in CBR shipments in the state is documented in the Washington 2014 Marine and Rail Oil Transportation Study (*7*). Figure 29 illustrates the location of the existing and proposed refineries, the railroad network, the marine transport system, and the major oil pipelines in the state.

The study, which was authorized by the Washington Legislature in 2014, addressed the risks to public health and safety and to the environment associated with the transport of oil in the state. The detailed study involved a number of activities conducted by other state agencies and organizations. The Washington State Emergency Management Division surveyed local and tribal planning and fire districts on readiness to respond to CBR incidents. The Washington State Department of Ecology reviewed oil spill prevention and readiness measures at the federal and state levels. The Washington State Utilities and Transportation Commission examined safety records for approximately 350 rail crossings in the state. A workshop was conducted on oil spill risks in the Salish Sea area. The final report included detailed information on these topics and the transportation of oil by all modes.

The study includes 43 findings and recommendations for legislative, regulatory, and volunteering activities. The recommendations focus on activities to maximize public safety and protect the environment, tribal treaty rights, and Washington's natural and economic resources. The recommendations address risk-based mitigation measures for all modes, oil spill planning and response, and local, county, and state responses. In addition, the report identifies gaps in currently available information and recommends these gaps be addressed in future studies.

CHAPTER 6: FUTURE RESEARCH

Participants identified a numbers research needs, topics for additional information sharing, and follow-up activities during the site visits and the March 2016 meeting in College Station. This section summarizes possible research topics and ongoing technology transfer activities. More detailed research needs statements will be developed for specific funding sources, such as NCHRP, TPF projects, and other programs based on feedback from the participating states.

RESEARCH

Continue and Broaden Scope of Current TPF Project—Monitor Energy Sector Developments and Examine Critical Freight Corridors and Inland Ports

Representatives from some of the TPF states expressed interest in continuing the current project with an expanded scope. The project would continue to monitor the impact of energy sector developments on the transportation system, but focus on critical freight corridors and inland ports.

As noted, the TPF scope would be expanded to include research on rural critical freight corridors and inland ports. The approaches being used in participating states would be documented, and best practices would be identified. The research would include methods for coordination with other state agencies and offices within a department of transportation involved in OS/OW permitting and operation, and would coordinate with other states. Issues associated with the movement of superloads, which are often related to the energy sector, would be examined, including damage to bridges, the need to move utilities in some corridors, and traffic impacts. The potential to develop superload freight corridors would be examined. In addition to expanding the TPF, the FHWA Office of Freight may have an interest in participating in the project.

Driver Behavior in Rural Areas Impacted by Energy Sector Developments

This research project would focus on examining driver behavior in rural areas impacted by energy sector developments. Examples of driver behaviors that may cause extra safety concerns in these areas include driver drowsiness due to long work shifts, transplanted workers not used to winter driving conditions, impatient drivers at railroad crossings, and driving under the influence of drugs and alcohol. Possible sources of funding for this topic include the safety TPF project lead by MDT and future Federal Railroad Administration Broad Area Announcements.

Retaining and Recruiting Employees

This research project would expand on the assessment of methods to retain and recruit employees conducted under this TPT project. The examples from North Dakota and Ohio illustrate approaches that have been used. As the oil and gas industry recovers, the need to retain

and recruit employees will reemerge as a priority. This project would examine approaches used to retain and recruit employees in states impacted by energy sector developments. It would also explore how industries and agencies have addressed similar issues in other fields. This research would be appropriate for consideration as an NCHRP synthesis project.

Environmental Justice Issues

This research would examine potential environmental justice (EJ) issues and approaches being used to address EJ concerns with transportation and land use projects in energy sector areas. It does not appear that this topic has been examined in existing research projects. Researchers would examine possible EJ issues and approaches to mitigate concerns. The NCHRP synthesis program is a possible funding source.

Energy Sector Use of Roadway Right of Way

This project would conduct additional research on uses of roadway right of way for water lines and other uses related to energy sector developments. The use of state roadway right of way for temporary water lines in Texas was highlighted in this report. The current TTI research project will provide guidelines for use of temporary water lines in Texas. Other states, including Pennsylvania, allow use of state roadway rights of way for water lines and other applications. Additional research on the methods, procedures, and experiences in other states would be beneficial. The NCHRP synthesis program is a possible funding source.

Use of Real-Time and Private Sector Data for Analyzing Truck Traffic

This research would examine the use of data from INRIX, ATRI, GPS, NPMRDS, and other commercial travel data providers for planning and monitoring truck traffic in areas impacted by energy sector developments. The project would focus on the use of data from these sources for proactive, rather than reactive, decision making by public agencies.

Most of the energy sector impacts are occurring in rural areas on roadways not typically covered by many of these data sources. The availability and quality of data from these and other services would be assessed. This research would focus on the availability and quality of data in these areas, and would examine how the data can be used to inform and improve investment decisions by transportation agencies responsible for building, operating, and maintaining the roadway system in these areas. The research would also examine how the data can be used to identify critical rural freight corridors, including corridors for OS/OW vehicles and superloads (wind turbines, etc.), and how these corridors can be coordinated between states. It would include a review of the Caltrans District 3 and 10 pilots as one example of this approach and would consider the need for sustainable data sources. Possible funding sources include the NCHRP program or projects within individual states.

Industry Engagement

This project would examine approaches being used in participating states to engage industry in the discussion of transportation impacts and investments, especially methods to proactively identify and address needed improvements. The NCHRP synthesis program is a possible funding source.

Predictive Models

This project would conduct additional research on predictive models, especially where impacts will occur as oil and gas prices begin to increase in the future. Examining possible triggers for increased drilling and energy developments would be part of the project. The project would build on existing research and data in some of the TPF states. The NCHRP program and projects in individual states may be appropriate funding sources.

Pavement and Quick Response Methods

This project would conduct additional research on new materials and methods to rehabilitate and maintain pavements, bridges, and other structures damaged by the heavy-truck traffic resulting from energy sector developments. The research would consider new materials and innovative methods to reduce costs, extend the life of repaired facilities, and enhance environmental sustainability. Consideration would also be given to opening the facilities to traffic in a timely manner. The NCHRP program, a TPF project, and projects in individual states may be logical funding sources for this project.

OUTREACH: CONFERENCES, WORKSHOPS, AND MEETINGS

Continuing the ongoing sharing of information among participating states, as well as outreach to additional states experiencing impacts from energy sector developments, through a variety of methods would be beneficial. The 2014 Workshop on Transportation and Energy Sector Developments in Arlington, Texas, was successful in developing interest in this TPF, and further efforts would enhance information sharing and promote added research. A workshop or symposium in early 2017 or 2018 would be logical timing. The TRB Transportation and Energy Development Joint Subcommittee may be a logical group to help convene these activities, along with FHWA, individual states, TPF projects, and universities.

REFERENCES

1. Transportation Research Board. *NCHRP Synthesis 469: Impacts of Energy Developments on U.S. Roads and Bridges.* Washington, D.C., 2015.
2. Transportation Policy Research Center. *Energy Development Impacts on State Roadways: A Review of DOT Policies, Programs, and Practices across Eight States.* PRC 14-29F. Texas A&M Transportation Institute, College Station, Texas, November 2014.
3. ACSE. *Proceedings of the American Society of Civil Engineers, Shale Energy Engineering 2014: Technical Challenges, Environmental Issues, and Public Policy.* 2014.
4. U.S. Energy Information Administration. Mission and Overview. www.eia.gov/about/mission_overview.cfm.
5. Schremp, Gordon. "Crude Oil Overview and Changing Trends." PowerPoint presentation, IEPR Commissioner Workshop—Trends in Crude Oil Market and Transportation, California Energy Commission, July 20, 2015.
6. Ohio Department of Transportation and Ohio Department of Natural Resources. *RUMA Review Summary.* 2013.
7. Washington State Department of Ecology. *Washington State 2014 Marine and Rail Oil Transportation Study.* March 2015.
8. Pennsylvania Department of Transportation. "PennDOT's Best Practices for Accountability for the Shale Industry." PowerPoint presentation for the Texas A&M Transportation Institute site visit, August 17, 2015.
9. Pennsylvania Department of Transportation. *Publication 23—Maintenance Manual.* 2013.
10. Matter, Melody, and John Voda. "Protecting PennDOT's Infrastructure." *Proceedings of the American Society of Civil Engineers Conference, Shale Energy Engineering 2014: Technical Challenges, Environmental Issues, and Public Policy*, 2014, pp. 664–675.
11. Marcellus Shale Coalition. "Pennsylvania's Impact Fee Fact Sheet." 2015.
12. North Dakota Department of Transportation. Project site visit PowerPoint presentation, September 16–18, 2015.
13. Texas Department of Transportation. "Proposition 1 and Proposition 7 Fact Sheet," http://www.txdot.gov/government/legislative/state-affairs/ballot-proposition.html, and http://www.txdot.gov/government/legislative/state-affairs/ballot-proposition-7.html.
14. Washington State Department of Revenue. Oil Spill Response Tax and Oil Spill Administration Tax, http://dor.wa.gov/content/findtaxesandrates/othertaxes/tax_oilspill.aspx.
15. Ohio Department of Natural Resources, Division of Oil and Gas Resources. Ohio Oil and Gas Well Locator. http://oilandgas.ohiodnr.gov/well-information/oil-gas-well-locator.
16. Pennsylvania Department Environmental Protection, Office of Oil and Gas Management, http://www.dep.pa.gov/business/energy/oilandgasprograms/oilandgasmgmt/Pages/default.aspx.

17. Texas A&M Transportation Institute. "14-1: TxDOT/TTI Joint Effect to Address Roadway Damage Resulting from Energy Development." College Station, Texas, 2016.

18. Texas A&M Transportation Institute. "14-2: Recommended Shoulder Widths." The Texas A&M University System, College Station, Texas, 2016.

19. Texas A&M Transportation Institute. "14-3: Shoulder/Edge Repair Techniques." College Station, Texas, 2016.

20. Texas A&M Transportation Institute. "14-4: Rehabilitating Oil-Field-Damaged Roads with Formed Asphalt." College Station, Texas, 2016.

21. Texas A&M Transportation Institute. "Repair of Road Damage Associated with Energy Development and Production." Implementation briefing and PowerPoint presentation, College Station, Texas, July 2016.

22. Louisiana Transportation Research Center. "Roller Compacted Concretion for Low Volume Roads: Project Abstract." 2016.

23. "Energy Developments and the Transportation System in Texas – Safety Impacts." PowerPoint presentation at the Transportation Pooled Fund Project: State Responses to Energy Sector Developments Participating States Meeting, College Station, Texas, March 22-24, 2016.

24. Texas Department of Transportation. *Task Force on Texas' Energy Sector Roadway Needs: Report to the Texas Transportation Commission.* December 13, 2012.

25. Quiroga, Cesar. "Technical Memorandum—Task Report Number 4, Review Standards, Specifications, and Available Literature." Texas A&M Transportation Institute, College Station, Texas, June 30, 2016.

26. Texas Department of Transportation. *Texas Freight Mobility Plan.* January 25, 2016.

27. California Department of Transportation. *California Sustainable Freight Action Plan-Draft Discussion Document.* May 3, 2016.

28. Montana Department of Transportation. *MT16/MT200 Glendive to Fairview Corridor Planning Study.* July 2012.

29. Montana Department of Transportation. *Culbertson Corridor Planning Study.* October 2012.

30. Valero. Valero Benicia Refinery Rail Project PowerPoint presentation on the Valero Benicia Refinery, City of Benicia Planning Commissioners Site Visit, July 7, 2014; and August 21, 2015.