**General Literature Search for ORIL Research Idea Submission (November 2014-2015)**

Synthesis Study of Current Road Use Maintenance Agreements (RUMAs) among Local Government Agencies

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Ohio Department of Transportation

Synthesis Study of Current RUMA Practices among Local Government Agencies

*Prepared for*

*Ohio’s Research Initiative for Locals (ORIL)*

*November 2014*

*Prepared by*

*Zona Kahkonen Keppler*

*Transportation Literature Searches are prepared for ODOT staff to identify completed research and other authoritative information in an area of interest. The citations below are representative, rather than exhaustive of available English-language studies and other pertinent information on the topic. Primary online resources for the literature search TRID Online, TRB‘s Research in Progress (RiP), and Practice-Ready Papers databases, WorldCat, ASCE, the National Transportation Library (NTL) catalog, and other academic, engineering and scientific databases as available.*

***Keywords (singly/combinations****): Road Use Maintenance Agreements, RUMAs, Road User Agreements (RUAs), road maintenance, road user studies, truck size, truck volume, low-volume roads, shale, oil and gas, infrastructure, regional communities, rural communities, Overweight/oversize trucks, maintenance plans, coordination, partnerships, truck traffic, pavement damage, transportation planning*

***Citations:*** *Links to online copies of cited literature are provided when available. If you are interested in full reports/articles lacking a web link, please contact me and I will obtain the full report/article if possible.*

***Research idea:*** *As a ‘Home Rule’ state, Ohio’s counties, townships, and municipalities function autonomously. With the creation of the Road Use Maintenance Agreements (RUMAS) the need for identification and sharing of current and/or best practices in negotiating these agreements is desired and necessary. The research would be a synthesis study of current practices within the shale-affected counties and townships as well as other states experiencing the shale boom.*

***Summary:*** *While recent energy developments have buoyed the economies of states with shale oil and gas interests, these developments have had an impact on low-volume roads throughout the states. The transportation literature has an abundance of research on this and related topics, including roadway use agreements and partnerships.*

**Shale Energy Engineering 2014: Technical Challenges, Environmental Issues, and Public Policy**



(Link above is to entire book; many of the citations in this literature search come from this book)

This collection contains 73 peer-reviewed papers on the technical challenges associated with shale oil and gas development from a civil and environmental engineering perspective. Topics include: water resources and groundwater management and treatment; environmental issues in water disposal; geotechnical and geological aspects of shale oil and gas; hydraulic fracturing characterization and monitoring; environmental effects and practices in hydraulic fracturing; environmental regulations, risk management, and mitigation; public policy issues related to shale oil and gas; infrastructure development, **roadway management**, and site development; and pipeline detection, mapping, and monitoring. These papers will be of interest to both researchers and practitioners in all areas of shale energy engineering.

733p

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Shale Energy Engineering Conference 2014  
Location: Pittsburgh Pennsylvania, United States  
Date: 20140721 - 20140723  
Sponsors: American Society of Civil Engineers

**Road Impacts from Shale Energy Development**

See .pdf above in *Shale Energy Engineering Conference 2014*

In recent years, new hydraulic fracturing technologies have led to rapid shale oil and gas development. This development has included an unprecedented amount of heavy truck loading on low-volume, rural roads, many of which were not built to withstand such loading. Many highway agencies are concerned about the impact of these loads on the life of their pavements and have had to adapt to this new paradigm by developing polices to protect their infrastructure. Pennsylvania has seen extensive development of the Marcellus shale formation in recent years with significant impact to its road system. New York State has been preparing for future development of their Marcellus shale pending environmental reviews. This paper describes a variety of approaches used in Pennsylvania and New York to keep local roads safe during construction of these energy facilities and to provide fair reimbursement to municipalities for the loss in pavement service life that occurs from these activities. The engineering background is described for methods used to project long-term damage, quantify damage to specific roads, determine needs for pre-development pavement upgrades, and allocate damage costs to multiple users. The advantages and disadvantages of alternative approaches are discussed and provisions for **Road Use Agreements** are suggested.

Shale Energy Engineering 2014: Technical Challenges, Environmental Issues, and Public Policy

pp 633-642

Wilke, Paul W

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**Assessing the Impacts of Energy Developments on Rural Texas Highway Infrastructure**

See .pdf above for *Shale Energy Engineering Conference 2014*

While shale oil and gas developments have been a boom for the Texas economy, these developments have taken a toll on low-volume roads. Impacts of truck traffic on roads in the Eagle Ford and Barnett Shale plays and the Permian Basin are obvious in the cracks, potholes, and other major distresses. Many of Texas' Farm-to-Market, Ranch-to-Market, and local county roadway systems are not designed to withstand the heavy loads and higher traffic volumes arising from energy development. Rapid development of energy resources will continue to strain agencies until measures are taken to implement infrastructure impact plans**, road-user agreements**, or other measures to rehabilitate affected roadways. This paper uses case studies to explore four approaches for partnerships between energy companies, county officials, and other organizations. The proactive, performance-based approach strengthens pavements prior to energy development. The reactive, performance-based approach assesses impact fees associated with road maintenance after the damage. The third approach assesses impact fees that are not attached to actual roadway deterioration. The fourth approach uses policy changes to the Texas Transportation Code which allows counties to promote transportation infrastructure projects affected by oil and gas production activities. Funding for this approach arises from grants. The authors discuss what is currently being done in Texas and suggest recommendations for future work. With future exploration expected throughout, execution of **agreements** and creative reimbursement procedures will be critical to maintaining adequate levels of service and preserving working relationships between the energy industry and county governments charged with preserving roadway assets.

Miller, Timothy

Sassin, James

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pp 643-653

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**Improving Impact Analysis of the Eagle Ford Shale Oil and Natural Gas Production on Regional Rural Communities**

See .pdf above for *Shale Energy Engineering Conference 2014*

The Eagle Ford Shale, a formation located in South Texas, is 80 kilometers wide by 640 kilometers long. It was traditionally considered to be economically unfeasible as a potential natural gas- and oil-producing formation. Since the onset of hydraulic fracturing of the non-porous rock, the Shale has rapidly become one of the highest producing areas of natural gas and oil, with a positive economic impact on the communities located over it. Previous studies have shown both direct and indirect impacts of the Shale development on the **regional communities**. The intent of this study is to re-evaluate the overall impact of the Eagle Ford Shale development in consideration of a set of extended components, in addition to the production, drilling, and related activities that have traditionally been considered. This paper presents the preliminary findings for Cotulla, Texas. The findings will provide more evidence supporting the importance of considering all extended factors to better illustrate the impact of shale development on **rural communities**.

Pinzon, Gerardo J.

Ren, Jianhong-Jennifer

Jones, Kim D.

pp 474-483

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**Consideration of Shale Gas Development Impacts in Long-Range Transportation Planning**



Transportation Research Board Annual Meeting 2013 Paper #13-5115

Through the combination of two technologies—horizontal drilling and hydraulic fracturing- the U.S. natural gas industry has been able to access vast quantities of gas in tight shale formations. Shale gas development has had and will continue to have impacts on the performance of the transportation system—directly through increased heavy truck traffic and freight rail movement to supply equipment, water and chemicals, and indirectly through increased employment, that in turn generates additional travel demand. The purpose of this study was to review the state of the practice for considering shale gas impacts in long-range **transportation planning**. Recent statewide, metropolitan and rural transportation plans in areas already undergoing shale gas development in Texas, Pennsylvania, West Virginia and Ohio were reviewed. The review showed that qualitative acknowledgement of shale gas impacts on transportation is being included in some recently updated long-range plans, but the level of coverage of this issue varies substantially in different locations. Most long-range plans are not yet addressing shale gas impacts on safety, congestion or transportation-related air pollutant emissions. Potential approaches to improving the consideration of shale gas impacts in transportation planning include build-out analyses to generate potential well pad locations and enable prediction of impacts on specific roadways and system-wide indicators such as vehicle miles traveled. Further research and guidance is needed to provide a workable framework for **transportation planning** organizations to meaningfully address shale gas development in the long-range planning process.

This paper was sponsored by TRB committee ABJ00 (3) Energy Impacts on Transportation.

10p.

Tidd, Leo

Transportation Research Board 92nd Annual Meeting  
Location: Washington DC, United States  
Date: 20130113 - 20130117  
Sponsors: Transportation Research Board

**Accelerated Damage to Low Volume Highways due to Natural Gas Well Drilling Activity in Arkansas**



Transportation Research Board Annual Meeting 2013 Paper #13-3099

Natural gas drilling activity began in 2006 within the Fayetteville Shale Play Area (FSPA), a 7,400 square mile (19,166 square kilometer) area in north central Arkansas. The FSPA is located mainly within 10 Arkansas counties and contains approximately 2,580 miles (4,152 kilometers) of highways, with 1,338 miles (2,153 kilometers) of those considered lower volume highways. More than 230 miles (370 kilometers) of highways in the FSPA were also weight-restricted routes due to their lack of structural strength. By 2007, over 1,100 gas wells were being developed. By 2010, the number of active wells had grown to 3,575. This drilling activity led to the rapid deterioration of many of the lower volume state highways that were never designed to endure these types of loadings. The Arkansas State Highway and Transportation Department (AHTD) began to collect data and document the increase in **truck traffic** and the resulting pavement damage in late 2007 as the cost to maintain these routes skyrocketed and considerable public complaints were voiced. AHTD monitored and collected pavement performance information in 2008, 2009 and 2010 on 28 lower volume highway sections. Since these sections endured **truck traffic** loadings easily exceeding the expected 20-year accumulated traffic loadings in just a few months, the AHTD was able to document the progression of pavement damage over these routes and report these findings to the Arkansas Highway Commission.

This paper was sponsored by TRB committee ABJ00 (3) Energy Impacts on Transportation.

17p.

Meadors, Alan

Wright-Kehner, Elisha

Transportation Research Board 92nd Annual Meeting  
Location: Washington DC, United States  
Date: 20130113 - 20130117  
Sponsors: Transportation Research Board

**Protecting PennDOT's Infrastructure**

See.pdf in *Shale Energy Engineering Conference 2014*

The Pennsylvania Department of Transportation (PennDOT) is trying to balance the economic benefit of supporting the Shale Oil and Gas Industry while protecting the public **roadway infrastructure**. The Shale Oil and Gas Industry utilizes a horizontal drilling process and a separate, secondary process called hydraulic fracturing (fracking). This process releases the natural gas inside the shale formations, which are over a mile beneath the earth's surface. The fracking process requires approximately 19 million liters (5 million gallons) of water and other materials which can generate over 2,000 truck trips to the drilling pad. This truck traffic creates an exponential increase in **truck volume** and can severely reduce the life cycle of the roadway, which can lead to accelerated deterioration and significant repair costs. To protect PennDOT's infrastructure, numerous roadways have been posted with weight restrictions requiring haulers to obtain a permit, post security and submit a **maintenance plan** to utilize the roadway. In conjunction with PennDOT's efforts to protect the roadways, the Shale Oil and Gas Industry has invested time and money to work in partnership to protect, preserve, maintain and upgrade the roadway network.

Matter, Melody

Voda, John

pp 664-675

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Location: Pittsburgh Pennsylvania, United States  
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Sponsors: American Society of Civil Engineers

**Heavy Roadway User Permit Release Coordination**

See .pdf in *Shale Energy Engineering Conference 2014*

As oil and gas infrastructure is developed, it has become increasingly important for the **roadway users** (**heavy haulers**) to obtain release from their PennDOT roadway bonds as quickly and efficiently as possible. Heavy roadway users are interested in being released from permits on many roads across the Commonwealth of Pennsylvania to free resources for additional **infrastructure** construction and reduce liability for repair of damages. This presentation would serve to discuss the release process currently being used in PennDOT District 12-0. The process overview will include a discussion of the release requests, video review procedures, coordination within the District, and recommendations on best practices to achieve a timely release. In some cases, the roadway has been damaged by the users and repairs are required prior to release of the roadway bond. This presentation will also discuss the coordination required when **road damage** has been determined to be caused by a single and/or multiple user(s). This overview will conclude with a case study of the SR 3009 (Tom's Run Road) repair and overlay in Greene County. This project provided for the repair and installation of base repair and a new overlay on five segments (4.0 km, 2.5 miles) of state-maintained roadway. The project included **coordination** with two roadway contractors, six different roadway users and PennDOT staff, both in the District Office and in the Greene County Maintenance District. Hundreds of tons of asphalt were installed to provide a safe and reliable roadway to the public. The final result was a cost-controlled product that satisfied both the permit holders and PennDOT and resulted in the release of associated bonds.

Nale, Scott K

pp 654-663

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**Preliminary Energy Development Partnership Case Studies for Rural Texas Highway Infrastructure**



Transportation Research Board Annual Meeting 2014 Paper #14-4664

While recent shale oil and gas developments have buoyed the Texas economy, these developments have taken a toll on low-volume roads. Heavy truck traffic impacts on **roadway infrastructure** in the Eagle Ford and Barnett Shale plays and the Permian Basin are obvious in the cracks, potholes, and other major distresses that manifest in pavements throughout these areas. Many of Texas’ local county roadway systems are not designed to withstand the heavy loads and higher traffic volumes arising from energy resource development. Rapid development of energy resources will continue to strain agencies responsible for maintaining roadways until measures are taken to implement infrastructure impact plans, road-user agreements, or other measures to rehabilitate effected roadways. This paper explores partnership approaches between energy companies, county officials, and other organizations. The proactive, performance-based approach strengthens pavements prior to energy development. The reactive, performance-based approach assesses impact fees associated with **road maintenance** after the damage. A third approach assesses impact fees that are not attached to actual deterioration. The fourth approach considers policy changes to the Texas Transportation Code, which allows counties to promote transportation infrastructure projects affected by energy production activities. The authors discuss what is currently being done in Texas and suggest recommendations for future work. With future exploration and development expected throughout Texas and the United States, execution of agreements and creative reimbursement procedures will be critical to maintaining adequate levels of service and preserving strong working relationships between the energy industry and county governments charged with preserving roadway assets.

This paper was sponsored by TRB committee AFB30 Low-Volume Roads.

12p.

Miller, Timothy D

Sassin, James M

Transportation Research Board 93rd Annual Meeting  
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Date: 20140112 - 20140116  
Sponsors: Transportation Research Board

**Analyzing Investments Needed to Support Oil and Gas Production and Distribution**

<http://dx.doi.org/10.3141/2307-01>

The purpose of this study was to forecast road investment needs in the oil- and gas-producing counties of North Dakota over the next 20 years in light of its expected population growth and the growth of oil and gas production. With the essential objective of quantifying the additional investments necessary for efficient year-round transportation of oil while providing travelers with acceptable roadway service, the study focused on roads owned or maintained by **local governments**, e.g., counties and townships. Impacts and funding needs were analyzed for three types of roads: paved, gravel, and graded and drained. The analysis was based on three main data sources: oil production forecasts, traffic data, and county road surveys. The forecast output of wells was routed over the road network to pipelines, with a detailed geographic information system model in which oil movements were represented as equivalent **tractor–semitrailer** trips that follow least-cost paths. The projected inputs of sand and water and the outbound movements of salt water to disposal sites were similarly routed. These predicted inbound and outbound movements were accumulated for each impacted segment. Movements of specialized equipment were included in the analysis. Several types of potential road improvements, including reconstruction and structural overlays, were analyzed in this study. The model developed in this research can be transferred to other states where new oil fields are opening and analysis is required for additional investment in highway **infrastructure**

p1-8

Mitra, Subhro

Tolliver, Denver

Dybing, Alan

Planning 2012

Transportation Research Record: Journal of the Transportation Research Board  
Issue Number: 2307  
Publisher: Transportation Research Board

**Improving Impact Analysis of the Eagle Ford Shale Oil and Natural Gas Production on Regional Rural Communities**

See .pdf in *Shale Energy Engineering Conference 2014*

The Eagle Ford Shale, a formation located in South Texas, is 80 kilometers wide by 640 kilometers long. It was traditionally considered to be economically unfeasible as a potential natural gas- and oil-producing formation. Since the onset of hydraulic fracturing of the non-porous rock, the Shale has rapidly become one of the highest producing areas of natural gas and oil, with a positive economic impact on the communities located over it. Previous studies have shown both direct and indirect impacts of the Shale development on the regional communities. The intent of this study is to re-evaluate the overall impact of the Eagle Ford Shale development in consideration of a set of extended components, in addition to the production, drilling, and related activities that have traditionally been considered. This paper presents the preliminary findings for Cotulla, Texas. The findings will provide more evidence supporting the importance of considering all extended factors to better illustrate the impact of shale development on **rural communities**.

Pinzon, Gerardo J

Ren, Jianhong-Jennifer

Jones, Kim D

pp 474-483

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Location: Pittsburgh Pennsylvania, United States  
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**Best Management Practices for Access Roads for Shale Energy Development with Consideration to Surface Waterbodies**

See .pdf in *Shale Energy Engineering Conference 2014*

Access roads connect a drilling pad for shale energy with public roads and are most often constructed with unbound aggregate surfacing materials. With traffic volume averaged over the lifetime of the road, an access road may be considered as a very low-volume road (ADT = 400); however, a majority of the traffic occurs over 2-3 month spans during the initial construction and drilling phase of each shale oil and gas well on the pad. Research suggests that roads built and used in this manner have a great potential to produce and transport fine sediments to surface water bodies where increased sedimentation can be deleterious to the health of the ecosystem. Here, the authors present best management practices (BMPs) with consideration to traffic for shale energy development and for the design and use of access roads to minimize the production and transport of fine sediments. Emphasis is placed on adequate drainage features, quality **maintenance practices**, apposite materials, and proper traffic use.

Toman, Elizabeth Myers

Keller, Gordon R

pp 446-456

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Shale Energy Engineering Conference 2014  
Location: Pittsburgh Pennsylvania, United States  
Date: 20140721 - 20140723  
Sponsors: American Society of Civil Engineers

**The Impact of Marcellus Gas Development on the Rural Transportation Infrastructure**

<http://www.mautc.psu.edu/docs/PSU-2010-05.pdf>

Deterioration was observed to occur in the wearing surfaces, decks, and parapets for all seven of the structures inspected. To date, little to no deck condition change was observed compared to the reviewed inspection reports. However, the oldest bridge in this study was noted to be carrying the highest volume of Gas Play **truck traffic** and manifested some structural deterioration that was not included in the most recent Pennsylvania Department of Transportation (PennDOT) inspection survey. This involved the bridge’s superstructure and substructure showing sagging bridge beams. For all other bridges, an increase in traffic as a result of the Gas Play was not shown to significantly change the condition of the superstructure or substructure in the bridges. Bridge 4 received extensive rehabilitation in 2009. After the one-year interval that followed, this study found deterioration to the wearing surface, parapets, and approach slab. All roadways had varying amounts of cracking regardless of Gas Play traffic activity, which generally increased with increased **truck traffic**. Rutting significantly increased as Gas Play activity increased and was the most common form of deterioration encountered. Secondary and municipal roads have experienced significant deterioration due to the enhanced heavy truck traffic. Full-depth reclamation is being employed as a cost-effective rehabilitation methodology by the gas companies. Reconstruction of dirt and gravel municipal roads has commonly been undertaken without the benefit of good design guidelines. To address this shortcoming, the authors developed and presented a simplified design methodology for the reconstruction of this class of roads. The enhanced **heavy truck traffic** has a weak correlation to increased severity of traffic accidents. Limited data and lack of a good baseline for comparison limit the strength of associated observations. Focus on the direct impact of drilling (e.g., archaeological survey) on cultural resources, while important, doesn’t address important down-the-line impacts. As roads are rebuilt and improved, historic and prehistoric survey is critical but there are not specific resources and staff available for these issues. Local heritage leaders are currently bearing the full weight of the new issues associated with Marcellus development. Creating resources for local and regional leaders is important, so that they can develop long-term planning strategies for cultural resource management and preservation.

Scheetz, Barry E

Linzell, Daniel G

Murtha, Timothy

Donnell, Eric T

Jovanis, Paul P

Pietrucha, Martin T

79p.

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Final Report.

**Issues and Options for Oversize/Overweight Permitting of Petroleum-Related Trucks in a Performance-Based Regulatory Context: The Manitoba Experience**

See .pdf in *Shale Energy Engineering Conference 2014*

This paper presents a case study of the Manitoba experience in permitting petroleum-related **oversize/overweight (OS/OW) truck traffic**. In recent years, Southwest Manitoba, along with many regions throughout North America, has experienced rapid growth and change in the petroleum industry. This growth has fuelled economic development and also caused infrastructure challenges on rural roads that are being used by unique vehicle configurations, many of which are beyond basic truck size and weight (TSW) limits. Manitoba's OS/OW permitting program for these vehicles stems from the performance-based approach to TSW regulation being used in Canada since 1988 and relies on ongoing collaboration with the petroleum industry. Manitoba's experiences have led to several insights, which may be options for other jurisdictions facing similar issues related to OS/OW petroleum-related trucking. These insights include: (1) purposeful **collaboration** with the industry and officials in neighboring jurisdictions to understand permitting needs and barriers; (2) supplementing qualitative understanding of the industry with quantitative data; and, (3) identifying opportunities to expedite permitting procedures by issuing annual permits to routinely-configured vehicles, utilizing technologies to assist with TSW enforcement, and rationalizing permit fee structures.

Reimer, Mark J

Regehr, Jonathan D

McKee, Jan

pp 552-564

Shale Energy Engineering Conference 2014  
Location: Pittsburgh Pennsylvania, United States  
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**Understanding State Rulemaking Processes: Developing Fracking Rules in Colorado, New York, and Ohio**

<http://dx.doi.org/10.1111/ropr.12060>



Regulation of hydraulic fracturing (fracking) is managed at the state level, and policy differs from state to state. This study investigates the state rulemaking processes regarding the issue of fracking and the participation of stakeholders in the process. The authors focus on the creation of fracking policy by providing case studies of three states: Colorado, New York, and **Ohio**. Data from interviews with rule makers and stakeholders is used to assess how the process compares in these three states and why fracking regulations may differ.

Rinfret, Sara

Cook, Jeffrey J

Pautz, Michelle

pp 88-104

2014-03-00

*Review of Policy Research*  
Volume: 31  
Issue Number: 2  
Publisher: Blackwell Publishing

**Exploring Partnership Models to Promote Sustainable Rural Texas Highway Infrastructure and Energy Development**



Miller, T.

Sassin, J.

*Airfield and Highway Pavement* 2013

pp. 11-21.

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While recent energy developments have buoyed the Texas economy, these developments have affected low-volume roads throughout the state. The impacts of **heavy truck traffic** on roads in the Eagle Ford Shale and Barnett Shale plays are obvious in pavement distresses throughout these areas. Many of Texas's rural roadway systems are not designed to withstand the heavy loads and higher traffic volumes arising from energy resource development. Rapid development of energy resources will continue to strain the budgets of highway agencies until measures are taken to implement infrastructure impact plans, **road-user agreements**, or other measures. This paper explores three partnership approaches among energy companies, county officials, and other organizations. The authors discuss what is currently being done in Texas. With future development expected throughout Texas, execution of roadway use agreements will be critical to maintaining adequate levels of service and preserving strong working relationships between the energy industry and agencies responsible for maintaining roadway infrastructure.

**Risk Assessment of Oil and Gas Drilling Impacts on County Roads**



In anticipation of increasing oil and gas drilling traffic on low-volume county roads in southeastern Wyoming, the Wyoming state legislature appropriated funds to assess current county road conditions and develop transportation asset management systems that counties could implement. By assessing historical county maintenance records and current road conditions along with information on oil and gas activities, additional costs to county road and bridge departments due to oil and gas traffic were estimated, and risks to county road networks were assessed. Information was provided that assessed risks on paved roads and unpaved roads. It indicated that road damage from **heavy traffic** presents far less risk on unpaved roads since they can be rehabilitated relatively easily and inexpensively. Paved roads, on the other hand, are very expensive to rehabilitate when they fail, and it is also expensive to turn them into unpaved roads. This study provides policy makers, the Wyoming County Commissioners’ Association, with the information they need to justify implementing statewide monitoring of paved county roads’ conditions. This monitoring will provide the counties with the data and information needed to take the case for increased county road funding to the state legislature. The processes described in this paper, evaluation of local roads’ conditions and costs, can be used by any local government facing impending industrial impacts. It provides policy makers with credible data and information that will allow them to make good decisions on behalf of the public.

This paper was sponsored by TRB committee AFB30 Low-Volume Roads.

[TRB 93rd Annual Meeting Compendium of Papers](http://trid.trb.org/view/1286022)

Huntington, George

Jones, Josh

Ksaibati, Khaled

19p.

[Transportation Research Board 93rd Annual Meeting](http://trid.trb.org/results.aspx?q=&datein=all&serial=%22Transportation%20Research%20Board%2093rd%20Annual%20Meeting%22)

Location: Washington DC  
Date: 2014-1-12 to 2014-1-16  
Sponsors: Transportation Research Board

**Effects of Major Traffic Generators on Local Highway Systems**

The Minnesota Department of Transportation initiated a study focused on the effects of major traffic generators on local highway systems. Minnesota State University and SRF Consulting Group, Inc. will conduct a major research study on the topic. To assist in that research CTC & Associates was asked to conduct a preliminary investigation focused on large wind farm developments. The preliminary investigation focused on gathering information related to the two main areas of inquiry in the research project: calculating pavement damage and secondary impacts due to large vehicle traffic; and policy options for local governments to recapture the costs of roadway maintenance caused by wind farm development. The authors' findings are presented in seven sections under the major areas of inquiry followed by descriptions of seven Web sites that provide resources related to wind farm development. These are: Calculating Impacts - **pavement damage** and utility cuts; secondary impacts; and Policy Options - background; impact fees for natural resource development; local ordinances; **road agreements**; interviews with county engineers.

Prepared by CTC & Associates LLC.

30p.

[Transportation Research Synthesis](http://trid.trb.org/results.aspx?q=&serial=%22Transportation%20Research%20Synthesis%22)

Issue Number: TRS 1001  
Publisher: Minnesota Department of Transportation

**Quantification of Infrastructure Consumption under Different Axle Configurations and Wheel Loads**

Project Status: Active

Begin date: 20120501

End date: 20130831

[http://swutc.tamu.edu/res...new-research/600451-00071/](http://swutc.tamu.edu/research/new-research/600451-00071/)

Recent developments in the oil and gas energy sector in Texas have resulted in increased volumes of traffic with an associated increase in the **road deterioration** rate. This unanticipated and accelerated deterioration imposes additional burden on already insufficient maintenance and rehabilitation budgets that affect most state highway agencies in the United States. There is absolutely no doubt that the energy sector contributes immensely to the economy of the state and the region but it is also a fact that it is not sustainable to keep the highway system in a state of good repair. This project will attempt to quantify the problem. The first task will consist of identifying the main stakeholders which will include state agencies, county authorities and engineers, energy industry, service industries to the energy sector, trucking industry and other relevant parties. This will enable the project to assess the extent of the problem. At the same time a mechanistically-based methodology will be developed and utilized to estimate the damage caused to the surface transportation infrastructure. The project will use the DARWin-ME design guide and software. The outcome of the mechanistically-based analysis will produce the rational for establishing the proportion of damage that can be attributed to the traffic generated by the oil and gas industries and will be used to establish costs for addressing reconstruction, rehabilitation and maintenance needs. With the elements developed from the previous steps, a **management system** will be proposed that will enable the State Highway Agencies in the region and local authorities to make better utilization of their limited resources.

Prozzi, Jorge

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**Impacts to Montana State Highways Due to Bakken Oil Development**

Project Status: Active

Start date: 20120501

End date: 20130531

<http://www.mdt.mt.gov/other/research/external/docs/research_proj/oil_boom/final_report.pdf>

<http://www.mdt.mt.gov/research/projects/pave/oil.shtml>

Recent improvements in oil extraction technology have increased the economic viability of production from shale oil formations. Because of these technological innovations and continued interests in fostering energy independence, the Bakken formation in western North Dakota and eastern Montana has become a major focus of current and future energy development plans. In addition to western North Dakota, several regions in Montana are experiencing rapid oil and gas development, including the Bakken region of northeastern Montana and Glacier, Toole, and Liberty counties in north-central Montana. The Montana Department of Transportation (MDT) is in the early stages of determining the impact of oil development and production on Montana's highway system. Rapid oil development in neighboring western North Dakota has resulted in large-scale highway needs and suggests the possibility of substantial investment requirements in the near future in affected areas of Montana. Similar studies have been conducted in North Dakota to project infrastructure needs in order to facilitate energy development. This oil development and production activity has had an impact on Montana's infrastructure and since Montana possesses geology that is similar to western North Dakota, similar oil and gas developments may be mirrored in the affected region within the next few years. In fact, exponential growth in oil and gas well permits has occurred in Montana during the last half of 2011. Moreover, this rate of growth is expected to continue into the near future. Given the recent history of western North Dakota and escalating activity levels in Montana, the MDT must develop an understanding of the future demands and traffic patterns that will result from the origins and destinations of fracking materials, as well as the transportation infrastructure needed to move both inbound materials and outbound products to transfer locations or market. This information is essential to forecasting the highway impacts of future oil development and production in the state and identifying potential infrastructure funding gaps and solutions that will be critically important to the development and implementation of a comprehensive **highway transportation plan** to sustain Montana's needs.

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**Examination of Full-Depth Reclamation Techniques for Shale Areas across Arkansas**

Project Status: Active

Start date: 20130701

End date: 20141231

With the large increase of **traffic volume and weight** in both the Fayetteville shale and Brown Dense shale areas, many of the state roads in these areas are deteriorating at an unprecedented rate. This causes significant problems from both a safety and vehicle life perspective for both the local residents and industry **moving heavy equipment and supplies** in and out of the area. A potential rehabilitation option for these roads that has not been fully explored is Full-Depth Reclamation (FDR). FDR is a popular technique that mills a combination of an asphalt concrete surface course with a portion of the base or subbase course (at a total depth of approximately eight inches) and mixes it with a stabilizing agent. There are three primary types of stabilizing agents: Portland cement, asphalt emulsion, and asphalt foam. After the reclamation process, the structural capacity of the road is increased, allowing for heavier and more frequent traffic to utilize the roadway safely.

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**Evaluation of Impacts of Allowing Heavier Log Loads in Northern Wisconsin during Spring Thaw**

Project Status: Active

Start Date: 20110815

End Date: 20130813

Recent revisions of Wisconsin Statutes have increased the loads allowed for **logging trucks** on roadways during spring thaw. The increase to 98,000-pound loads on six axles supersedes previous regulations that allowed suspension of **oversize and overweight** permits for transportation of logs during thaw. This project intends to identify impacts of the rule change on asphalt pavement deterioration and performance. The effect of such loading on pavement life and condition has not been studied with regard to spring thaw. This research will focus on impacts of increased loading, what types of vehicles cause more damage than others and if this harm can be mitigated, what pavements may be vulnerable, and what tools would allow effective prediction of impacts. The Wisconsin Department of Transportation (WisDOT) will implement the study's cost-benefit analysis and recommendations for changes in practice by shaping preventative maintenance planning for affected roadways.

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**How API's Shale Gas Standards and Best Practices Support Sustainable Shale Gas Development**



Miller, D. (2014)

*Shale Energy Engineering* 2014

pp. 520-529.

Founded in 1919, the American Petroleum Institute (API) has a long history in the development of industry standards, starting with the first standards published in 1925 on drilling thread specifications to ensure safety in the production of oil and natural gas. Continuing on for nearly 90 years, API has led the development of petroleum, petrochemical and natural gas equipment and operating standards. These standards represent the industry's collective wisdom on subjects ranging from drill bits to environmental protection. They embrace proven, sound engineering and operating practices and safe, interchangeable equipment and materials. API maintains more than 650 standards, many of which have been incorporated into state and federal regulations. API standards are also the most widely referenced oil industry standards cited by the international regulatory community. API ensures the technical relevance of its standards by maintaining its status as an American National Standards Institute (ANSI) accredited standards developing organization. As an accredited body, API's standards program undergoes regular program audits to ensure it meets ANSI's "Essential Requirements" for openness, balance, consensus and due process. API has also been the leader in the development of standards supporting sustainable shale gas development. API published its first of five specific shale gas standards in 2009 on well integrity and, subsequently, developed standards on water resource management, environmental practices, and well cementing technology. This presentation will focus on the status of updates to these standards as well as a new standard on Community Engagement being developed to ensure well operators, drilling and well servicing companies and the communities in where the shale gas is being developed fully understand the important aspects of operations taking place in and around their neighborhoods, towns, and cities.

**Estimating Highway Pavement Damage Costs Attributed to Truck Traffic**

<http://www2.ku.edu/~iri/publications/HighwayDamageCosts.pdf>

Kansas is one of the leaders in meat production in the United States. In the southwest Kansas region, there are more than three hundred feed yards and several of the biggest meat processing plants in the nation. **Heavy trucks** (e.g., tractor-trailers) have been used primarily for transporting processed meat, meat byproducts, grain, and other related products. With the continuous growth of these industries, there will be more trucks on highways transporting meat and meat-related products in southwest Kansas. These trucks cause noteworthy damage to Kansas highway pavements, which in turn leads to more frequent maintenance actions and ultimately more traffic delays and congestion. The primary objective of this research was to estimate the highway damage costs attributed to the truck traffic associated with the processed meat (beef) and related industries in southwest Kansas. The researchers developed a systematic **pavement damage** estimation procedure that synthesized several existing methodologies including Highway Economic Requirements System (HERS) and American Association of State Highway and Transportation Officials (AASHTO) methods. In this research project, the highway section of US 50/400 between Dodge City and Garden City in Kansas was selected and its pavement data were collected for analysis. Outcomes of this research will be beneficial for the selection of cost-effective transportation modes for the meat processing and related industries in southwest Kansas. It will also help government agents to assess highway maintenance needs and to set up maintenance priorities. Meanwhile, the analysis results will be valuable for the determination of reasonable user costs. Based on findings of this research, recommendations on the selection of transportation modes are provided and promising future research tasks are suggested as well.

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180p

Period covered: 7/2008-12/2009

**Effect of Oil Field Trucks on Light Pavements**



Mason, J., Jr. (1983).

*Journal of Transportation Engineering*, 109(3), 425–439.

Oil field traffic is identified and an estimate of increased annual cost associated with a reduced pavement serviceability is determined. Identification of oil field traffic through photographic documentation yielded a count of the number of axle repetitions as well as a description of the physical characteristics of each vehicle. Equivalent 18 kip (8,154 kg) single axle load repetitions were determined using standard “W‐Tables” for Texas rural highways. The analytic procedure examines the effects of oil well traffic on a light‐duty pavement. Evaluation is based on the concept of pavement serviceability developed at the AASHTO Road Test. A reduced pavement service life results in an increased annual cost for a low volume light‐duty pavement section.

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**Best Management Practices for Access Roads for Shale Energy Development with Consideration to Surface Water bodies**.



Toman, E. and Keller, G. (2014)

*Shale Energy Engineering* 2014: pp. 446-456

Access roads connect a drilling pad for shale energy with public roads and are most often constructed with unbound aggregate surfacing materials. With traffic volume averaged over the lifetime of the road, an access road may be considered as a very low-volume road (ADT ≤ 400); however, a majority of the traffic occurs over 2-3 month spans during the initial construction and drilling phase of each shale oil and gas well on the pad. Research suggests that roads built and used in this manner have a great potential to produce and transport fine sediments to surface water bodies where increased sedimentation can be deleterious to the health of the ecosystem. Here, we present best management practices (BMPs) with consideration to traffic for shale energy development and for the design and use of access roads to minimize the production and transport of fine sediments. Emphasis is placed on adequate drainage features, quality maintenance practices, apposite materials, and proper traffic use.