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Roadway Impacts of Industrial Silica Sand (Frac Sand) Mining

By Isaac Orr and Mark Krumenacher*

Third in a series

#137 (May 2015): Environmental Impacts of Industrial Silica Sand (Frac Sand) Mining
#138 (June 2015): Economic Impacts of Industrial Silica Sand (Frac Sand) Mining
#139 (September 2015): Roadway Impacts of Industrial Silica Sand (Frac Sand) Mining

Introduction

Industrial silica sand has been mined in the upper Midwest for more than one hundred years. In Wisconsin, an estimated 2,500 non-metallic mines, including limestone and granite quarries in addition to sand and gravel mines, provide aggregate for construction, stones for monuments, and sand for glassmaking, foundries, livestock bedding, and oil and natural gas development.[1]

> As many as 9,000 non-metallic mines exist in Illinois, Iowa, Minnesota, and Wisconsin, approximately one mine per 3,000 residents.

Illinois and Minnesota likely have a similar number of non-metallic mines, and the Iowa Department of Agriculture reports there are 1,100.[2] As many as 9,000 non-metallic mines exist in these four Midwest states, about one mine per 3,000 residents.[3] These mines represent an

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[1] Wisconsin Department of Natural Resources, "Overview of Non Metallic Mining in Wisconsin," April 15, 2015, http://dnr.wi.gov/topic/mines/nonmetallic.html.

[2] Iowa Department of Agriculture, "Mines and Minerals Bureau: Minerals," http://www.iowaagriculture.gov/MinesAndMinerals/minerals.asp.

[3] Wisconsin Department of Natural Resources, *supra* note 1.

enormous amount of economic activity operating without widespread regional impacts on human health or the environment. Until recently these mines have been operating without widespread public recognition or opposition.

More recently, industrial sand mining has become a more contentious issue, largely because environmental groups have taken note of the growing number of industrial sand facilities meeting the growing demand for industrial silica sand used for hydraulic fracturing, commonly referred to as "frac sand."

In 2010, for example – prior to the widespread use of hydraulic fracturing for oil and gas development – Wisconsin, the nation's leading supplier of frac sand, hosted just five industrial sand mines and five processing plants. Now, the Wisconsin Department of Natural Resources (WDNR) reports 63 active mines, 45 processing facilities, and 27 trans-load stations, and more mines and processing plants have been permitted but are not yet operational.[4]

The U.S. Geological Survey (USGS) estimates mines in Illinois, Iowa, Minnesota, and Wisconsin now account for 72 percent of the nation's frac sand production. Wisconsin is the largest producer of industrial sand, contributing 44 percent of the frac sand sold nationwide. The state's share of the industrial sand market may increase in the future if permitted mines become operational.[5,6]

> The rapid growth in the number of industrial sand facilities and the sand's end use for oil and natural gas development have generated new public awareness about this old industry.

The rapid growth in the number of industrial sand facilities and the sand's end use for oil and natural gas development have generated new public awareness about this old industry, making this once below-the-radar industry a subject of controversy in certain areas.

Some residents in industrial-sand mining areas express environmental concerns, such as the potential impact of sand mining on air and water quality; economic concerns, whether sand mining is a net benefit to mining communities and the state as a whole; and social concerns, how sand mining is affecting the quality of life in affected communities.

Previous installments in this series of studies have presented policymakers and the general public with the latest scientific data on the environmental and economic aspects of industrial sand

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[4] Wisconsin Department of Natural Resources, "Locations of Industrial Sand Mines and Processing Plants in Wisconsin," January 16, 2015, accessed June 21, 2015, http://dnr.wi.gov/topic/Mines/ISMMap.html.

[5] Don Bleiwas, *Estimates of Hydraulic Fracturing (Frac) Sand Production, Consumption, and Reserves in the United States*, United States Geological Survey, May 26, 2015, http://www.rockproducts.com/frac-sand/14403-estimates-of-hydraulic-fracturing-frac-sand-production-consumption-and-reserves-in-the-united-states.html#.VYOULUb3iKN.

[6] Previous installments in this *Policy Study* series stated Wisconsin provided upwards of two-thirds of the nation's frac sand. That estimate was based on reports from PacWest Consulting Partners, now owned by IHS, the best information available before the May 26, 2015 release of the USGS report, *ibid.*

mining.[7,8] This new *Policy Study*, "Roadway Impacts of Industrial Sand (Frac Sand) Mining," examines the impact of industrial sand mining on local, county, and state roads.

> Local officials at the county, town, and village level have the statutory authority and adequate tools to protect public infrastructure used by industrial sand operations and other industries.

Because local units of government generally have the primary regulatory responsibility for industrial sand mining in the Midwest,[9] this *Policy Study* is written especially for them and the constituents they serve. It addresses the potential impacts of industrial sand operations on the public roadways and provides an overview of successful methods used to minimize those potential drawbacks while maximizing the benefits of industrial sand mining to the community.

Part 1 of this study introduces the main factors that influence the lifespan of a road: traffic conditions and environmental conditions. Part 1 also discusses how heavy truck traffic affects infrastructure compared to lighter vehicles, and it examines how increased volume of heavy trucks transporting industrial sand may affect light-duty roadways.

Part 2 examines a case study of road upkeep and maintenance agreements (RUMAs) from Chippewa County, Wisconsin. This case study discusses a series of agreements negotiated between industrial sand companies and local government authorities to help ensure any damage to local infrastructure is repaired by the mine operator and not at taxpayer expense. These agreements can serve as examples for local officials in other states.

Part 3 of this study considers the historical impacts of transporting industrial sand in Illinois, Iowa, Minnesota, and Wisconsin and provides a starting point for local officials to consider in developing effective RUMAs. Part 4 offers concluding remarks.

Although mining opponents often cite the potential effects on public roadways as a reason to restrict or ban industrial sand mining, this *Policy Study* concludes local officials at the county, town, and village level have the statutory authority and adequate tools to protect public infrastructure used by industrial sand operations and other industries. Industrial sand operators have spent millions of dollars upgrading and maintaining local and county roadways to meet their needs for transporting industrial sand and providing safe and efficient transportation for members of the community.

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[7] Isaac Orr and Mark Krumenacher, "Environmental Impacts of Industrial Silica Sand (Frac Sand) Mining," *Heartland Policy Study* No. 137, The Heartland Institute, May 2015, www.heartland.org/sites/default/files/05-04-15_orr_and_krumenacher_on_frac_sand_enviro_impacts.pdf.

[8] Isaac Orr and Mark Krumenacher, "Economic Impacts of Industrial Silica Sand (Frac Sand) Mining," *Heartland Policy Study* No. 138, The Heartland Institute, June 2015, www.heartland.org/sites/default/files/05-29-15_orr_and_krumenacher_on_frac_sand_economics.pdf.

[9] Wisconsin Department of Natural Resources, "Mines, pits, and quarries," updated April 15, 2015, http://dnr.wi.gov/topic/mines/.

Part One
Impacts on Infrastructure

Roads, like all other structures, deteriorate over time. Citizens in communities near industrial sand operations often express concern that the increasing volume of heavy truck traffic hauling industrial sand from the mine to processing facilities will accelerate the rate of wear on county and local roads, and that the cost of repairing those roads will be borne by taxpayers rather than industrial sand operators.

Deterioration is primarily the result of two factors: the traffic load, which is greatly affected by the volume of traffic, especially heavy vehicle traffic; and environmental factors. Over the lifetime of a road, a combination of these factors will cause the materials used to build the road to fail, resulting in cracking, rutting, and potholes in addition to other structural failures.

> Several factors influence the degree to which roads are affected by traffic, including vehicle weight, average daily traffic, and the distribution of the vehicle's weight over its axles.

Although many industrial sand operations use public roads to transport sand from a mining location to a processing plant, the infrastructure impact of particular operations will vary from site to site based on the business model. Some industrial sand facilities process their sand at the mine site; others have conveyor belts or slurry systems to transport sand from mine to processing plant; and other operations haul sand almost exclusively on public roads.

Several factors influence the degree to which roads are affected by traffic, including vehicle weight, average daily traffic (ADT) (the number of vehicles traveling a given stretch of road in a day), and the distribution of the vehicle's weight over its axles. Excessive vehicle weight is one factor that can be controlled.[10]

The relationship between vehicle weight and a vehicle's potential impact on a road is exponential, not linear, meaning heavier vehicles have a significantly greater impact than lighter vehicles. Figure 1 shows the relative weight of common vehicles on the road today. For example, a normal passenger car weighs approximately 1.5 tons, or 3,000 pounds, whereas a semi-tractor-trailer can weigh 40 tons, or 80,000 pounds.

Although a loaded tractor-trailer is approximately 26 times heavier than a passenger car, reports estimate a fully loaded tractor-trailer traveling on a road not designed for heavy traffic may have an impact equivalent to 5,000 cars.[11] Other studies estimate the impact of one tractor-trailer to be

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[10] Government Accountability Office, *Comptroller General's Report to the Congress: Excessive Truck Weight: An Expensive Burden We Can No Longer Support*, CED-79-94, July 16, 1979, http://www.gao.gov/products/CED-79-94.

[11] Zach Patton, "Too Big for the Road," *Governing*, July 2007, http://www.governing.com/topics/transportation-infrastructure/Too-Big-The-Road.html.

equivalent to 9,600 passenger vehicles, depending on the design of the road.[12]

The most common truck types for transporting industrial sand are five-axle semi-tractor-trailers (Gross Vehicle Weight, or GVW, of 80,000 lb.) and quad-axle dump trucks (GVW 73,000).[13]

Although the total weight of a vehicle is an important consideration, the distribution of that weight over the axles of the vehicle has a greater influence over how the vehicle may impact a road. For example, doubling the axle weight from 18,000 lb. to 36,000 lb. on a single axle has 15 to 24 times the impact on a road not designed for that weight.[14] Increasing the number of axles, while maintaining even load distribution, can reduce the impact of heavy vehicles on rural roads.[15]

Environmental factors affect pavement mainly through rainfall and temperature. Rainfall can penetrate the structure of the road and alter the properties of the different layers, making the pavement more vulnerable to traffic loads, especially heavy-vehicle traffic. Temperature also affects the properties of the pavement by generating stresses and causing the road materials to expand and contract.[16]

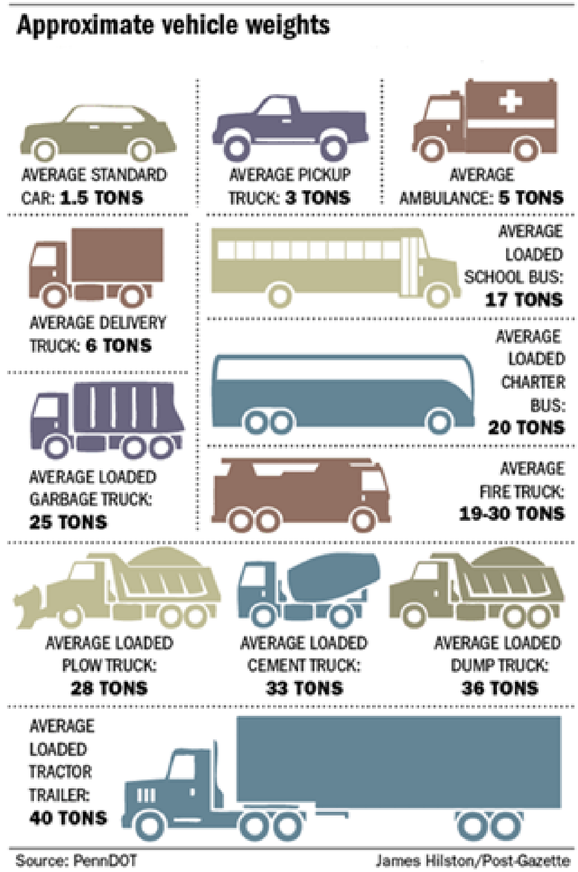

Figure 1: Typical weights of various vehicles. Although overall vehicle weight has an impact on roadways, the distribution of the weight over the axles of the vehicles has a greater affect. *Source*: Pennsylvania Department of Transportation.

The combined effect of water in the pavement layers and low temperature (i.e. temperatures below the freezing point) creates frost heaving

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[12] Pavement Interactive, “Equivalent Single Axle Load,” pavementinteractive.org, accessed June 30, 2015, http://www.pavementinteractive.org/article/equivalent-single-axle-load/.

[13] Thomas Beekman and Brent Pickard, “Transportation Impacts of the Wisconsin Fracture Sand Industry,” Wisconsin Department of Transportation, Northwest Region, March 2013, https://www.heartland.org/policy-documents/transportation-impacts-wisconsin-fracture-sand-industry.

[14] Dave H. Timm and David E. Newcomb, “Lies, Damned Lies, and Traffic Forecasting,” *Hot Mix Asphalt Technology*, July/August 2002, https://www.asphaltpavement.org/PDFs/Lies_Damned_Lies.pdf.

[15] Local Road Research Board, “Effects of Agricultural Equipment on Pavement Performance,” Minnesota Department of Transportation, October 2012, http://www.dot.state.mn.us/research/TS/2012/201208TS.pdf.

[16] C.S. Papacostas and P.D. Prevedouros, *Transportation Engineering & Planning*, Third Edition (Pearson Education, Inc., 2001), p. 88.

(expansion). In thawing periods the bearing capacity of a pavement may be greatly reduced, which is why local officials in Illinois, Iowa, Minnesota, Wisconsin, and other northern states limit the weight per axle allowed to drive over rural roads in the spring.[17]

It is important for local governments to understand the existing conditions of the roads serving potential mining operations.

On the federal and state highway systems, where the majority of longstanding industrial sand operations developed, the bridges and roads are structurally capable of handling traffic at the expected volumes and weight without damage or unusual wear. Most local roads, however, were designed and constructed based on the normal and historical vehicle traffic for that specific area. Traffic volumes in most rural areas are light, so most rural roads are not designed to withstand heavy truck traffic, including that generated by industrial sand hauling.[18,19]

The impact of heavy trucks and machinery on local and county roads not designed for such use is quantifiable, and the cost of repairing roads damaged by heavy vehicles can be estimated using standard civil engineering practices such as a traffic impact analysis (TIA).

It is important for local governments to understand the existing conditions of the roads serving potential mining operations. Consulting with the local highway department or a geotechnical engineer for an engineering analysis of existing road design will identify needed improvements.[20]

For example, a report by the National Center for Freight and Infrastructure Research and Education Center (NCFIRE) details the impact of frac sand hauling on county and rural roads in Chippewa County, Wisconsin. County officials hired an engineering consultant to evaluate a number of possible routes to determine road conditions under projected truck traffic.[21] The case study is reported in more detail in Part Two below.

Several tests – subsurface exploration, nondestructive pavement testing using a deflectometer, and geotechnical and pavement engineering analysis for approximately 43 lane miles – were conducted to examine the current condition and determine what improvements would be

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[17] *Ibid.*

[18] Minnesota Department of Transportation, "Transportation and the silica sand industry in Minnesota," accessed June 26, 2015, http://www.dot.state.mn.us/frac/.

[19] Bruce G. Stelzner, "Frac Sand Mining- Local Government Roadway Impact," Transportation Development Association, December 2011, http://www.tdawisconsin.org/data/publications/wtda-sand-mine-article-dec-2011.pdf.

[20] *Ibid.*

[21] AET, Inc., *Frac Sands Haul Roads Project, Chippewa County* (Geotechnical Exploration, Pavement Testing, Engineering Analysis and Review Report No. 28-00380), American Engineering Testing, Inc., 2011.

necessary to accommodate the estimated traffic volumes along an industrial sand haul route. A digital video log captured pavement surface conditions. To measure pavement thickness and to identify thin pavement locations, ground-penetrating radar was used at one-foot intervals in both traveling directions.[22]

Another method of calculating the impact of various vehicles is to convert each access into an Equivalent Single Axle Load, commonly referred to as an ESAL. An ESAL represents the impact on pavement per pass of a standard single 18,000-lb. axle with dual tires, which as noted in Figure 2 is the amount of weight placed on an axle from a tractor-trailer. Table 1 shows the relative impact of vehicles, measured in ESALs, to give the reader a general understanding of the impacts imposed on roads by each type of vehicle.[23]

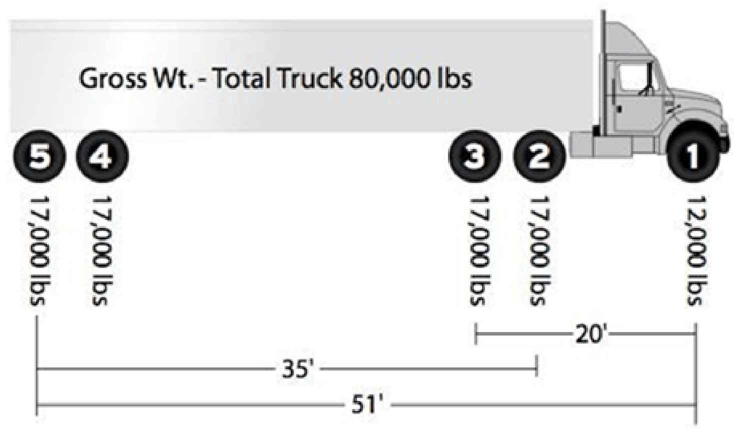

Figure 2: The weight of a fully loaded tractor trailer and its distribution over its axles. The axle weights for trucks hauling sand is heavier than semis because they have fewer axles and as a result, their per-axle weight and their subsequent impact on roads will be greater. *Source*: Utah Department of Transportation, "Chapter 21, Bridge Table Calculations," July 5, 2013, http://www.udot.utah.gov/main/f?p=100:80:0:::1:T,V:4206.

After the costs of improving a road to accommodate industrial sand activities are estimated, a host community can budget or negotiate with the sand company for a roadway use agreement to upgrade or maintain roads to accommodate the anticipated volume and weight along the haul routes. These agreements between local governments and private companies are often referred to as road upkeep and maintenance agreements (RUMAs) and are used in a variety of circumstances – such as hauling waste to landfills and hauling construction aggregate, concrete, and asphalt used in road construction – where town or county roads are used as a segment of the hauling route.

Vehicle weight is the most important factor in pavement design because it largely determines the thickness of the pavement structure needed. In general, pavements are designed to handle the heaviest vehicle traffic they are expected to receive.[24,25] Civil engineers use different types of materials, such as concrete or hot mix asphalt (HMA), applied in different thicknesses, including

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[22] Maria Hart, Teresa Adams, and Andrew Schwartz, "Transportation Impacts of Frac Sand Mining in the MAFC Region: Chippewa County Case Study," National Center for Freight & Infrastructure Research & Education, 2013, http://midamericafreight.org/wp-content/uploads/FracSandWhitePaperDRAFT.pdf.

[23] Pavement Interactive, "Trucks and Buses," Pavementinteractive.org, August 16, 2007, http://www.pavementinteractive.org/article/trucks-and-buses.

[24] C.S. Papacostas and P.D. Prevedouros, *supra* note 16.

[25] Bruce G. Stelzner, *supra* note 19.

Table 1 Relative Impact of Different Vehicles on the Public Roadway			
Class	**Type**	**Description**	**Typical ESALs per Vehicle**
1	Motorcycles	All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handle bars rather than wheels. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheel motorcycles. This vehicle type may be reported at the option of the State.	negligible
2	Passenger Cars	All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.	negligible
3	Other Two-Axle, Four-Tire Single Unit Vehicles	All two-axle, four tire, vehicles, other than passenger cars. Included in this classification are pickups, panels, vans, and other vehicles such as campers, motor homes, ambulances, hearses, and carryalls. Other two-axle, four-tire single unit vehicles pulling recreational or other light trailers are included in this classification.	negligible
4	Buses	All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or three or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles. All two-axle, four-tire single unit vehicles. Modified buses should be considered to be a truck and be appropriately classified.	0.57
5	Two-Axle, Six-Tire, Single Unit Trucks	All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having two axles and dual rear wheels.	0.26
6	Three-Axle Single Unit Trucks	All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.	0.42
7	Four or More Axle Single Unit Trucks	All trucks on a single frame with four or more axles.	0.42
8	Four or Fewer Axle Single Trailer Trucks	All vehicles with four or fewer axles consisting of two units, one of which is a tractor or straight truck power unit.	0.30
9	Five-Axle Single Trailer Trucks	All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power unit.	1.20
10	Six or More Axle Single Trailer Trucks	All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.	0.93
11	Five or Fewer Axle Multi-Trailer Trucks	All vehicles with five or fewer axles consisting of three or more units, one of which is a tractor or straight truck power unit.	0.82
12	Six-Axle Multi-Trailer Trucks	All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power unit.	1.06
13	Seven or More Axle Multi-Trailer Trucks	All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power unit.	1.39
Because the relationship between vehicle weight and the vehicle's impact on the road is exponential, not linear, passenger vehicles have a negligible impact on the public roadways, whereas heavier vehicles, such as buses and heavy trucks, cause a substantially bigger impact on the road. *Source:* Pavement Interactive, "Trucks and Buses," August 16, 2007, http://www.pavementinteractive.org/article/trucks-and-buses/.			

different thicknesses of the underlying base material, commonly called the "subgrade," to construct roads able to withstand the estimated traffic volume, weights, and natural conditions they will experience during their lifetimes.

Knowledge of these factors is important for local policymakers tasked with the responsibility of negotiating RUMAs. A comprehensive agreement may include recitals (background facts of the agreement); terms and conditions; specific roadway routes to be used for hauling sand; the owner of the industrial sand facility and authorized representatives and the county authorized representatives; terms for payments of both roadway improvements and long-term roadway maintenance; cooperation and potential emergency actions; provisions for insurance, remedies, and enforcement; severability clauses; ability to assign to a third party; processes for modifications; and the process for termination.[26]

Specific terms and conditions of RUMAs will vary depending on a variety of factors, including the condition of the road prior to sand hauling activity and the volume of traffic projected to use the road. Additionally, different states have different laws regarding methods local governments may use to recoup costs for maintenance of roadways under their jurisdiction.

This *Policy Study* presents the findings of a study by the National Center for Freight and Infrastructure Research and Education evaluating the RUMAs negotiated in Chippewa County, Wisconsin.

To provide guidance to local policymakers in the upper Midwest as they negotiate road use agreements with industrial sand operators or other businesses generating significant volumes of heavy-truck traffic in their jurisdictions, Part Two of this *Policy Study* presents the findings of a study by the National Center for Freight and Infrastructure Research and Education evaluating the RUMAs negotiated in Chippewa County, Wisconsin.

Part Two
Chippewa County, Wisconsin Road Upkeep and Maintenance Agreement (RUMA) Case Study

Chippewa County in north-central Wisconsin has 85 non-metallic mines within its borders. Several are industrial sand operations.[27] Sand from these mines is transported to eight sand processing plants – four wash plants and four dry plants – over a network of town, county, and state roads.

The National Center for Freight and Infrastructure Research and Education (NCFIRE)[28] prepared a case study of five industrial sand operations in Chippewa County to understand how local governments are using road upkeep and maintenance agreements to fund road repairs to frac

[26] *Ibid.*

[27] Rod Stetzer, "Frac sand slowdown not showing up in permits," *The Chippewa Herald*, June 20, 2015, http://chippewa.com/news/local/frac-sand-slowdown-not-showing-up-in-permits/article_939a4a2d-bf49-562d-93bf-9aa91fe1d133.html.

[28] Maria Hart, Theresa Adams, and Andrew Schwartz, *supra* note 22.

sand haul routes. The NCFIRE white paper serves as a model for how local governments can use RUMAs to recover the cost of road damage and fund maintenance and grade-crossing improvements. The RUMAs reviewed by NCFIRE document the variability in the length and condition of haul routes and the financial solutions negotiated among county and local governments and industrial sand operators.

The NCFIRE study is a comprehensive analysis of RUMAs negotiated with industrial silica sand operators. This *Policy Study* presents relevant findings of the NCFIRE study only briefly to highlight the benefit to policymakers of crafting RUMAs for sand-mining operations and other situations where town or county roads may be at risk of damage.

Many resources are available to local government officials as they decide which road engineering options to pursue.

In Wisconsin, state statutes under Chapter 348 cover weight limitations local governments can place on roads under their jurisdiction, and Chapter 349 outlines state and local authority to restrict traffic. Of particular interest is Wis. Stat. 349.16(1)(c), which authorizes the pursuit of reimbursements for road damage. Every Chippewa County RUMA includes the following recital: "Whereas Wis. Stat. 349.16(1)(c) authorizes the County highway commissioner to enter into an agreement on behalf of County with any owner or operator of any vehicle being operated on a highway maintained by County that provides that the County will be reimbursed for any damage done to the highway."[29,30]

Many resources are available to local government officials as they decide which road engineering options to pursue. The Wisconsin Department of Transportation's (WisDOT) Facility Development Manual (FDM) provides policy, procedural requirements, and guidance encompassing the development process of all types of highway improvements on the state trunk highway system and for other infrastructure projects that may receive state or federal funding.[31]

The FDM's Procedure 7-35-10, Traffic Impact Analysis (TIA), consists of an engineering study comparing before and after traffic conditions on a roadway network expected from a proposed land-use change. A TIA is required when new driveways (access points) are needed for the construction of a traffic-generating enterprise or industry.[32] WisDOT approaches a TIA from a safety and operational standpoint. TIAs produce a list of recommended roadway changes and the costs of engineering, real estate, and construction. The permitting agency then must assign those costs to the project's scope, which determines work to be completed during the project lifecycle.

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[29] *Ibid.*

[30] Wisconsin State Legislature, State Statute 349.16 Authority to impose special or seasonal weight limitations," State of Wisconsin, https://docs.legis.wisconsin.gov/statutes/statutes/349/II/16/1/c.

[31] *Ibid.*

[32] Bureau of Traffic Operations, "Traffic Impact Analysis Guidelines," Wisconsin Department of Transportation, 2012, http://www.village.germantown.wi.us/DocumentCenter/View/80/.

If the proposed haul routes are over county or local roads, the conditional use permit is then reviewed by the county highway commissioner, who negotiates a RUMA on behalf of the county. In some instances, county highway commissioners have helped other local governments negotiate RUMAs; the Chippewa County highway commissioner, for example, negotiated on behalf of a town in Chippewa County. If the proposed mine haul routes are over state roads, the county is not involved.[33]

Many factors will influence the terms of an agreement, and outcomes of the negotiations will vary from operator to operator based on the condition of the haul route, the operator's business model, and its payment schedule preferences. It is in the interest of the operator to negotiate with the county, because counties have the authority to post weight limit restrictions on their roads and can thereby reduce the operator's level of production. The negotiation process in Chippewa County has helped build relationships among county staff and mine operators.[34]

The negotiation process in Chippewa County has helped build relationships among county staff and mine operators.

To assess pavement conditions in Chippewa County, a pavement condition survey was conducted and the truck haul routes were rated using the PASER system, a visual inspection tool developed at the University of Wisconsin–Madison Transportation Information Center. PASER rates roads from 1 to 10, with 1 being the lowest-quality road, needing complete reconstruction, and 10 being the best road, needing no additional maintenance.[35] The survey of haul routes used by sand operations showed the majority of roads were in good condition for current and historical traffic counts.

Additionally, the Minnesota Department of Transportation's (MNDOT) TONN method was used to calculate load capacity and required overlay for the test roadway segments. The recommended Seasonal Load Restriction (SLR) rating (known as the "TONN Rating") calculates the recommended seasonal load restriction based on pavement deflections collected with a Falling Weight Deflectometer (FWD).[36]

Table 2 shows the anticipated design modifications needed for current traffic versus proposed industrial sand hauling traffic in Chippewa County, with and without spring season weight limits. The table also shows the thickness of asphalt overlay needed for each road to handle

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[33] *Ibid.*

[34] Maria Hart, Theresa Adams, and Andrew Schwartz, *supra* note 22.

[35] Donald Walker, "Pavement Surface Evaluation Rating: PASER Asphalt Roads Manual," Transportation Information Center: University of Wisconsin Madison, 2002, http://epdfiles.engr.wisc.edu/pdf_web_files/tic/manuals/Asphalt-PASER_02_rev13.pdf.

[36] Minnesota Department of Transportation, "Pavement Design," State of Minnesota, http://www.dot.state.mn.us/materials/pvmtdesign/fwd.html.

Table 2 Overlay Thickness Required for Next 10 Year Traffic (inches)							
				Current Traffic		**With Sand Hauling**	
Section	**Roadway**	**From**	**To**	**Without Limits**	**With Limits**	**Without Limits**	**With Limits**
1	186th Ave	50th St.	CTH DD	0.9	0.0	4.6	4.1
2	190th Ave	CTH DD	22nd St.	1.4	0.5	5.0	4.5
3	22nd St.	195th Ave	STH 64	1.2	0.3	6.0	4.3
4	CTH DD	STH 64	CTH A	0.9	0.0	4.0	3.4
5	135th Ave	CTH DD	20th St.	1.8	1.0	5.9	5.5
6	20th St.	135th Ave	End AC	0.0	0.0	3.1	2.4
8	135th Ave	20th St.	County Line	3.0	0.6	6.0	4.6
9	CTH B	90th St.	55th St.	4.0	1.7	4.9	4.4
11	CTH B	End Construction	STH 40	5.5	2.4	5.5	4.8
12	CTH A	CTH DD	40th St.	0.8	0.0	3.0	2.3
13	CTH A	CTH DD	50th St.	0.8	0.0	3.3	2.6
14	CTH A	50th St.	60th St.	1.3	0.0	4.9	3.2
15	CTH Q	USH 53	CTH SS	0.0	0.0	2.8	2.0
16	CTH SS	CTH Q	CTH M	0.0	0.0	0.9	0.0
17	CTH M	CTH SS	PC	0.0	0.0	2.0	1.2
18	CTH M	PC	USH 53	0.0	0.0	1.8	0.9

The figures refer to the roads used in the different haul routes and the amount of asphalt that would have to be applied in order to meet current needs and the needs of the roads with sand hauling. Some roads, such as Section 11, are in need of asphalt overlays under normal conditions, whereas other roads, such as Section 16, will only require minimal overlays even with sand hauling without weight limits, demonstrating that haul routes, and therefore RUMAs, will vary significantly in response to a variety of factors. Sections 7 and 10 are not included in the table because they have a gravel surface with a granular overlay, meaning there was no need to conduct a pavement analysis. *Source*: Donald Walker, "Pavement Surface Evaluation Rating: PASER Asphalt Roads Manual," Transportation Information Center: University of Wisconsin Madison, 2002, epdfiles.engr.wisc.edu/pdf_web_files/tic/manuals/Asphalt-PASER_02_rev13.pdf.

current conditions and to accommodate the hauling of industrial sand. The thickness of structural asphalt overlay needed varied with each road, with required depths ranging from 0.9 to 6.0 inches.[37]

The Wisconsin DOT TIA process was used to make evaluations and helped identify other design engineering needs such as pavement width, land acquisition needs for right of way, and turning movement considerations at access points. Routes were selected based on the findings of the report and negotiations were finalized. None of the negotiated agreements restricts traffic along the haul routes. In the financial particulars for all agreements, there are provisions allowing

[37] Donald Walker, *supra* note 35.

Chippewa County to charge operators for additional costs the county incurs beyond those explicitly mentioned in the agreements.[38]

Figure 3 shows the location of the five active sand operations included in the NCFIRE case study, in addition to the haul routes and locations of the processing plants in the Chippewa County area. Each of the five mining operators negotiated a separate RUMA, and each of these agreements is described below to provide a general idea of the varying ways RUMAs can be negotiated. Table 3 on page 17 summarizes the terms of the agreements.

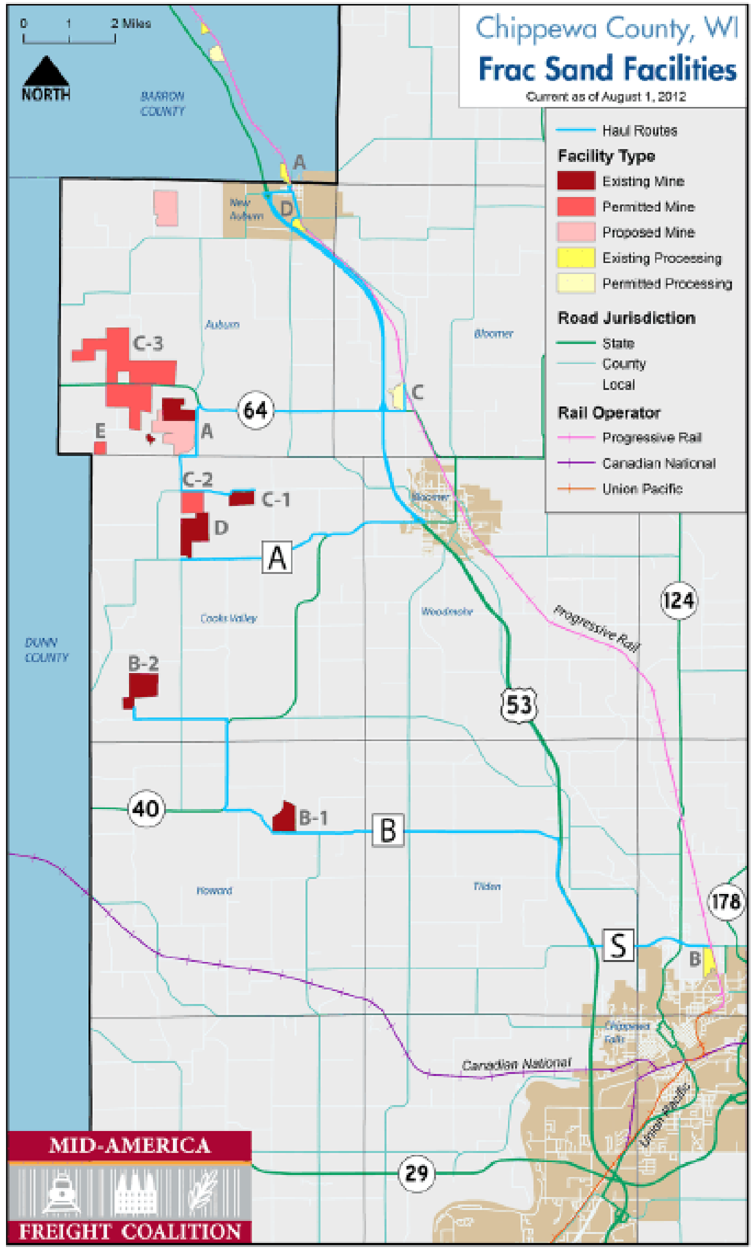

Figure 3: The locations of industrial sand mines, processing plants, and haul routes in Chippewa County, Wisconsin included in the NCFIRE case study.

Operator A

The Operator A mine is located in the town of Auburn on County Trunk Highway (CTH) DD near State Highway (STH) 64. According to the road use agreement dated May 2011, Operator A would reimburse the county about $300,000 in a lump-sum single payment to reconstruct the 0.2 miles of CTH DD between the mine entrance and STH 64.

The operator owns a processing plant on the Barron County side of New Auburn along the Progressive Railroad line. The haul route from the mine to the plant is CTH DD to STH 64 to U.S. Highway (USH) 53 to CTH M and then over local streets in New Auburn for an approximate total distance of 10.9 miles. The haul route includes 9.9 miles of state roads, 0.8 miles of county roads, and 0.2 miles of village roads.

[38] *Ibid.*

Further maintenance is not expected on CTH DD as it has been built for a 30-year lifespan. The parties agreed the county could invoice the operator for exceptional maintenance. CTH M, a short section of urban county road located within the village, is in relatively good condition; agreements with both Operators A and D, who share this route, were left open for future discussions over upkeep and improvements. It is most likely those operators will share in the expense of future upkeep or improvements on this section of roadway.

Operator A's mine, which has a wet plant, was initially permitted for 135 acres. The permit was recently expanded to include 334 more acres, for a total of 469 acres.[39]

Operator B

Operator B has two mines that supply sand to a processing plant in Chippewa Falls. One mine is located at 5312 CTH B in Howard (B-1 mine). The town imposed conditions preventing sand from being extracted, blasted, or hauled from the mine site between May 1 and October 15. The acreage for this mine is 185 acres. A second mine, located at 20th Street in Cooks Valley (B-2 mine), was developed partly in response to the imposed restrictions on the B-1 mine. The two mines share a haul route for approximately 11 miles.

Chippewa Falls imposed conditions preventing sand from being extracted, blasted, or hauled from the mine site between May 1 and October 15.

The Town of Cooks Valley negotiated, with the assistance of the county commissioner, a road upgrade and right of way permit. The permit covers the town roads starting at the mine entrance on 20th Street to 135th Avenue to its intersection with STH 40, a distance of 3.3 miles. Operator B agreed to bear costs of rebuilding the road to WisDOT FDM standards needed for sand hauling, but no dollar amounts were specified in the permit. The town also negotiated a road maintenance agreement in which the operator agreed to cover all exceptional maintenance – work above normal maintenance such as increased snow plowing or more frequent pavement repairs that may be required for commercial trucks.

Each road use agreement states any and all monies paid to the county by the operator must be used exclusively for the operator's haul routes.

The 11-mile one-way haul route for the B-1 mine starts on a county highway and follows the same B-2 mine route on county and state highways and the RUMA includes a short section of county highway not used by the mine. The RUMA called for three equal payments to reflect a phased reconstruction of 7.45 miles at a total cost of about $2.9 million along four segments of the travel route.

The cost for a route segment upgraded before the RUMA was finalized was $548,671 per mile. Based on that unit cost per mile, the RUMA included an estimate of $2.9 million including an

[39] *Ibid.*

additional $35,000 for a cattle crossing, for upgrading the remaining 7.45 miles of trucking route. Initial payment occurred at the execution of the agreement, and subsequent payments will be due at the beginning of each construction phase. The operator will be responsible if costs exceed estimates. If payments exceed actual costs, the county will refund the excess payments to the operator.

The B-1 mine haul route includes 2.5 miles of state roads and 8.5 miles of county roads. The haul route for the B-2 mine includes 3.3 miles of town roads; 4.5 miles of state roads; and 9.9 miles of county roads.

Operator C

Town (1.6 miles), county (2.2 miles), and state roads (4.5 miles) comprise the haul route for Operator C. Two road use agreements were negotiated, one at the town level and one for the county.

As with other haul routes, town (1.6 miles), county (2.2 miles), and state roads (4.5 miles) comprise the haul route for Operator C. Therefore, two road use agreements were negotiated at the town and county level. The town RUMA covered 1.6 miles, from the mine entrance to a county road. The particulars in regard to funding construction and setting up a maintenance account were practically identical to the county RUMA except improvement to the town road would require a 5.5-inch hot-mix asphalt (HMA) overlay.

> The RUMA between Chippewa County and Operator C established that the county would be reimbursed for improvements and required Operator C to fund a construction account in the amount of $500,000.

The county RUMA established that the county would be reimbursed for improvements and required Operator C to fund a construction account in the amount of $500,000. The county would improve 2.2 miles of county road, by adding approximately a 3.5-inch HMA overlay, shouldering, and other incidentals. The work was to be completed within 60 days of execution of the agreement.

If costs exceeded $500,000, the operator would be billed for the difference. If the costs came in under budget, the remaining funds would be transferred to a county maintenance account reserved solely for this haul route. The account would be funded through a monthly payment of 5 cents per ton of sand hauled from the mine.

Operator D

Operator D’s mine entrance is located on as county road and its processing plant is in the village of New Auburn on the Progressive Railroad line. The 15-mile haul route includes 8.4 miles of state roads and 6.6 miles of county roads. The mine size is 176 acres.

The February 2012 agreement identified 2.97 miles of a county road that needed to be upgraded. Estimates were based on the rehabilitation work done on another county road in 2011. A unit cost of approximately $600,000 per mile was used as a baseline estimate. A 9.5-inch HMA overlay was also required, to accommodate truck traffic for 20 years. The estimated cost of the HMA was about $700,000. (The AET report reported overlay depths for 10 years.) In addition, improvements at the mine entrance (about $250,000) and to the processing plant entrance (about $200,000) were included. The estimated total of about $3.8 million also included costs such as safety edge, which slopes the side edge of asphalt pavement to 30º rather than a straight vertical drop to the shoulder,[40] and an inflation factor of 5 percent.

In the RUMA, the operator agreed to pay $3.8 million upfront. If the costs were to exceed the estimates, the operator would pay the difference. The RUMA also stipulated unused funds would transfer to a maintenance account to cover all exceptional maintenance costs.

The parties also agreed the operator would pay for grade crossing improvements at a county road in addition to the above-listed amounts.

Operator E

> Operator E will videotape the truck route as a baseline for needed repairs and to establish the condition the road must be in at the end of the agreement.

A developer's mining agreement was negotiated between the Town of Auburn and Operator E, including RUMA stipulations. A road use agreement was not negotiated with the county because the indicated haul route includes only town and state roads.

Under the agreement, sand will be hauled over Town of Auburn roads for 1.8 miles. In the developer's mining agreement, Operator E will videotape the truck route to serve as a baseline for needed repairs and to establish the condition the road must be in at the end of the 10-year agreement. The operator will determine an escrow amount based on the cost of road repair per mile times the total number of miles of town roads.

To determine the cost of road repair, the town board will obtain bids from at least three contractors within 60 days of the date the agreement becomes effective. The bids will be based on an estimate of the cost per mile for replacing a class B town road of 20 feet in width, with broader reinforced corners, 12 inches of base materials, and four inches of asphalt. The bids will not include the cost of reconfiguring the road or expanding the road surface beyond 20 feet. Bids will be averaged to determine the cost of road repair.

Contributions to an escrow account to fund road repairs will be made on a monthly basis at a rate of 20 cents per ton of sand hauled. Payment can be suspended when the escrow account reaches the amount determined by the operator and the local government. The operator will be required

[40] U.S. Department of Transportation, Federal Highway Administration, "The Safety Edge Pavement Edge Treatment," http://safety.fhwa.dot.gov/roadway_dept/pavement/safedge/brochure/.

to maintain records of haul miles for each truck each day and submit records and payments on a monthly basis. The town may adjust the escrow rate to reflect actual costs of road construction. The operator will be responsible for additional payments if the escrow account is insufficient.

Haul Routes by Jurisdiction

According to the NCFIRE study, state trunk highways under the jurisdiction of Wisconsin DOT are the roads most commonly used for industrial sand transportation, with Wisconsin DOT region staff calculating 430 miles of state roads are being used in the northwest region of the state as industrial sand hauling routes. The state highways are designed to handle truck traffic associated with interstate and intrastate commerce, so increased use for industrial sand trucking does not result in extraordinary maintenance costs on these highways.

Table 3 summarizes the RUMAs negotiated between town and county governments in Chippewa County. In total, 10.6 miles of road were under agreement for the county government and 4.9 miles of road for town governments. These are roads that, at the onset of mine construction, were not designed to withstand predicted truck traffic volume and needed upgrades to accommodate mine traffic. A larger number of county road miles (18.6) did not need upgrades to accommodate industrial sand transportation.

Conclusions About NCFIRE Study

The ability of local road systems to handle a high volume of heavy vehicle traffic varies depending on several factors. Sand-related traffic tends to be localized, with trucks typically moving on limited routes between the mine, processing facilities, and rail loading facilities. This traffic can result in deterioration of haul routes not designed for high vehicle weights.[41]

Local government officials should take a data-driven approach to evaluating the condition of the roads along a proposed haul route, determining which, if any, roads will need upgrades and repairs. Such an approach provides local officials – many of whom have other careers, time commitments, and varying levels of road experience – with the data and engineering advice necessary to negotiate appropriate RUMAs that follow industry best practices and adequately cover the cost of any necessary road maintenance.

A data-driven approach is also fair because all major traffic-generating enterprises are treated equally. The industrial sand industry should not be singled out while other industries that generate heavy traffic are not required to contribute to the cost of road repairs. Fairness in the assignment of roadway repair costs is a significant concern of the industrial sand mining industry.[42,43]

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[41] Minnesota Department of Transportation, *supra* note 18.

[42] Maria Hart, Theresa Adams, and Andrew Schwartz, *supra* note 22.

[43] Bruce G. Stelzner, *supra* note 19.

Chippewa County Road Upgrade and Maintenance Agreements as of August 1, 2012											
Operator	**RUMA Jurisdiction**	**Permit Issue Date**	**RUMA Date**	**Construction Initial Acct Deposit**	**Maintenance Account**	**One-Way Haul Route Length (mi)**	**State Roads (mi)**	**Total County Roads (mi)**	**County/Town Roads in RUMA**	**County Roads - No upgrades needed**	**Comment**
A	Chippewa County	5/6/11	5/19/11	$311,510	Single payment	10.9	9.9	.8	0.2	0.6	Haul route also includes .2 miles over village roads. Roads used by other Operators: CTH DD, STH 64, USH 53, CTH M
B-1	Chippewa County	4/29/09	9/2/11	$2,888,089	Three equal payments	11 (12.45*)	2.5	9.9	5.2*	4.75	*RUMA extends beyond mine entrance. RUMA beings at STH 43/CTH B
B-2	Town of Cooks Valley	10/14/11	12/20/11	TBD	-	17.7	4.5	9.9	3.3 (Town)	9.9	Shares 11 miles with S&S Misc route. * Includes 5.2 miles under other RUMA
C-1	Chippewa County	6/8/11	NA	$500,000	5 cents/ton until balance reaches $500,000	8.3 (80)*	4.5 (3.3)	2.2 (2.2)	2.2 (2.2)	–	* Processing plant not yet constructed. Temporary haul route 80 miles one-way. Chippewa mileage in ( ).
	Town of Cooks Valley	NA	2011	$498,772	*		–	–	1.6 (Town)		
D	Chippewa County	5/10/11	2/16/12	$3,800,000	$35,000/year until balance reaches $500,000	15.0	8.4	6.6	3.0	3.6	Grade crossing improvements to be paid by operator
Total mileage mines in production August 1 (one-way)						134.60	28.6	29.4	10.6/4.9	18.9	
Permitted Mines yet to be constructed											
C-2	NA	5/25/12	No RUMA	-	-	7.1	4.4	2.2	2.2	2.7	Permitted mine, no construction yet. Route already has RUMA.
C-3	NA	5/25/12	No RUMA	-	-	6.4	6.4	NA	NA	NA	Permitted mine, no construction yet.
E	Town of Auburn	7/30/12	8/8/12	-	-	TBD	TBD	NA	1.8	TBD	Operator still to determine processing location and transportation.
Potential mileage full build-out (one way)						**76.4**	**39.4**	**31.6**	**14.6/4.9**	**21.6**	

The NCFIRE case study found RUMAs to be an effective mechanism for truck haul routes under a single jurisdiction, but where a haul route may include multiple towns, counties, or states, differences in impact assessment become complex and create administrative loads both for locals and industry, as RUMAs must be negotiated for every jurisdiction. This administrative load means counties and towns will need to develop procedures for managing maintenance accounts and possibly dedicate staff to this new industry.[44]

Effective RUMAs protect local governments and taxpayers from undue financial burdens and facilitate road safety by designating haul routes and repair and financing schedules.

Despite claims made by sand-mining opponents that industrial sand operations burden taxpayers with costly road repairs, the NCFIRE case study documents how state, county, and local governments are working with industrial sand operators to recover the cost of upgrading and repairing local roadways to meet new heavy-traffic volumes.

Effective RUMAs protect local governments and taxpayers from undue financial burdens and facilitate road safety by designating haul routes and repair and financing schedules. Payment methods vary from up-front lump-sum payments from operators to local governments for road maintenance to agreements based on per-ton per-mile fees assessed as industrial sand operators use roads for sand transport.

Part 3
State-Specific Impacts and Damage Mitigation Strategies

Part 3 of this *Policy Study* provides background information on the impact of industrial sand mining on local infrastructure in Wisconsin, Minnesota, Illinois, and Iowa; describes the powers designated for local and county governments to negotiate agreements with industrial sand operators; and identifies practices available to protect public roadways and ensure equal treatment for all traffic-generating industries. The order in which these states are discussed is based on the volume of available information; states with the most information are discussed first.

Wisconsin

Wisconsin is the largest industrial-sand producing state in the country. The USGS estimates 44 percent of the frac sand produced in the United States originates in Wisconsin, with the vast majority of this production capacity coming online since 2010.[45] In 2010, only five mines and five or six processing plants were operational in the state. As of May 2014, the Wisconsin Department of Natural Resources (WDNR) reported 63 active mines, 45 active processing

[44] Maria Hart, Theresa Adams, and Andrew Schwartz, *supra* note 22.

[45] Don Bleiwas, *supra* note 5.

facilities, and 27 rail-loading stations. Figure 4 depicts the growth in industrial sand facilities over the past five years.[46]

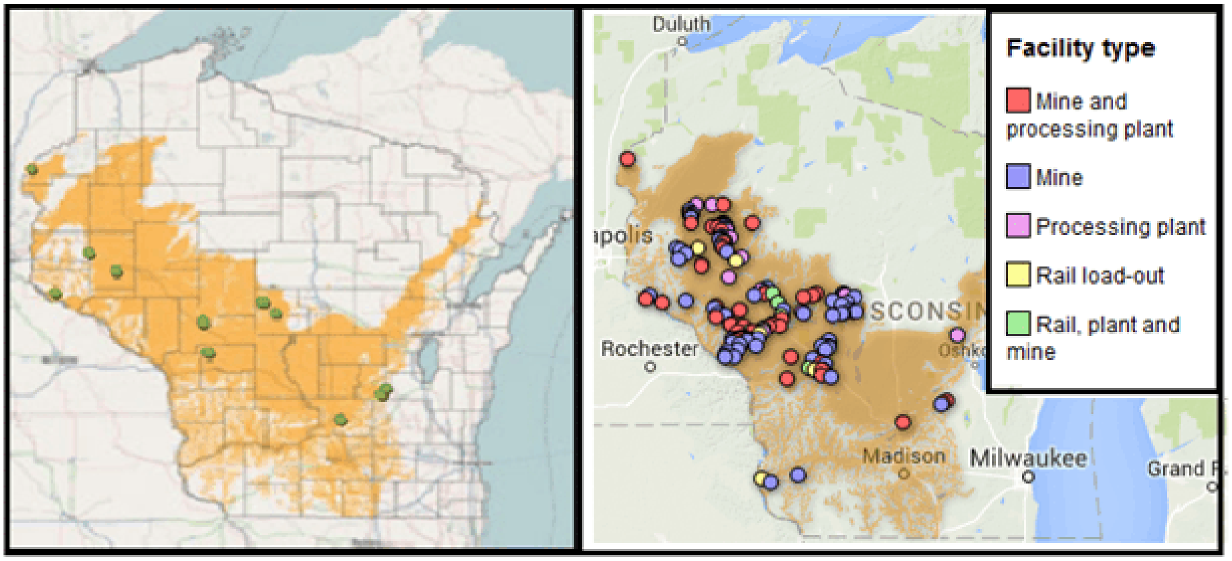

Figure 4: Growth in the industrial sand mining industry in the state of Wisconsin. The map on the left indicates active industrial sand mines and processing plants in 2009; the map on the right shows industrial sand mines, processing plants, and rail loading stations as of May 2014.

In Wisconsin, local jurisdictions – towns, villages, cities, and counties – have the most regulatory control over industrial sand activities. Depending on the zoning category, the local city or township can impose specific regulations such as hours of operation, truck routes and speeds, and road repair liabilities.[47] These local government powers are important because most of the transportation impacts of industrial sand hauling will be on local roads.

Wisconsin state statutes provide local officials the authority to protect the roadways in their jurisdiction. State Statute 348.16 authorizes local governments to set weight restrictions on Class B highways, which include county and town highways and village and city streets.[48]

Wisconsin Statute 348.17 gives local governments the authority to impose special or seasonal weight limits, which can extend the life of a road by restricting traffic when pavements are vulnerable in the spring.[49]

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[46] Thomas Beekman and Brent Pickard, *supra* note 13.

[47] Maria Hart, Theresa Adams, and Andrew Schwartz, *supra* note 22.

[48] Wisconsin State Legislature, Statute 348.16, "Weight Limits on Class B Highways," State of Wisconsin, https://docs.legis.wisconsin.gov/statutes/statutes/348/III/16.

[49] Wisconsin State Legislature, Statute 348.17, "Seasonal or Special Weight Limits," State of Wisconsin, https://docs.legis.wisconsin.gov/statutes/statutes/348/III/17.

Under Wisconsin Statute 349.16, which allows local units of government to enter into road maintenance agreements with industrial sand companies, those companies have spent millions of dollars to upgrade and maintain local roads likely to be affected by transportation of their products. The Wisconsin Department of Transportation (WisDOT), Northwest Region, reports those agreements have worked to the mutual benefit of sand mining firms and local units of government.[50]

> Inconsistencies in the application of RUMA authority by some local governments have raised concern.

Despite the general success of those agreements, however, inconsistencies in the application of this authority by some local governments have raised concern among the sand industry and some state legislators. Those concerns make abundantly clear the importance of using factually based engineering studies to develop RUMAs and assign roadway damage costs appropriately. Local governments are encouraged to obtain a traffic impact analysis (TIA), with the engineers following the best-practice protocols established by the WisDOT Facility Development Manual (FDM).[51]

The Wisconsin Counties Association has drafted a model County Highway Upgrade and Maintenance Agreement, provided in Appendix 6 of its publication, *Frac Sand Task Force Best Practices Handbook*. That model agreement provides a template upon which local government officials can build as they work with frac sand operators to establish haul routes and upgrade roads.[52] The Wisconsin Towns Association and Wisconsin County Highway Association also offer their members information and training regarding these statutory authorities.

Although local officials can regulate traffic on roads under their jurisdiction, they cannot establish weight restrictions or hours of operation on state roads, which are under the jurisdiction of WisDOT. The maintenance and improvement costs for these roads are borne by WisDOT, not local governments.

WisDOT, Northwest Region, reports the overall impact of frac sand mining on the state highway system will be relatively minor, constrained to a small percentage of state highway segments or locations and primarily in the form of improvements at public and private road intersections where sand industry traffic may be entering or exiting the state highway system. Most of these improvements have been covered at sand industry expense following the local permitting process.[53]

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[50] Thomas Beekman and Brent Pickard, *supra* note 13.

[51] Bureau of Traffic Operations, *supra* note 32.

[52] Wisconsin Counties Association, “Frac Sand Task Force: Best Practices Handbook,” March 2013, https://www.wicounties.org/uploads/legislative_documents/final-compiled-frac-sand-handbook-wca-board-approved-06.14.13.pdf.

[53] Thomas Beekman and Brent Pickard, *supra* note 13.

Impact on the state highway system is further reduced by the fact that operations of several of the high-volume industry players have no impact on highways. Badger Mining in Taylor, Preferred Sands in Blair, Fairmont Santrol in Pierce County, Hi-Crush in Augusta and Whitehall, and Unimin in Tunnel City are all major producers whose mining, processing, and rail trans-load facilities are in a single location.[54]

Officials at WisDOT either have or are currently studying a number of roadway segments for potential corrections to some substandard features should proposed sand projects come online. Among the highways that have been or are currently being studied for this reason are STH 88 in Buffalo County, USH 8 in Barron County, and STH 25/STH35 in Buffalo County (see Figure 5).

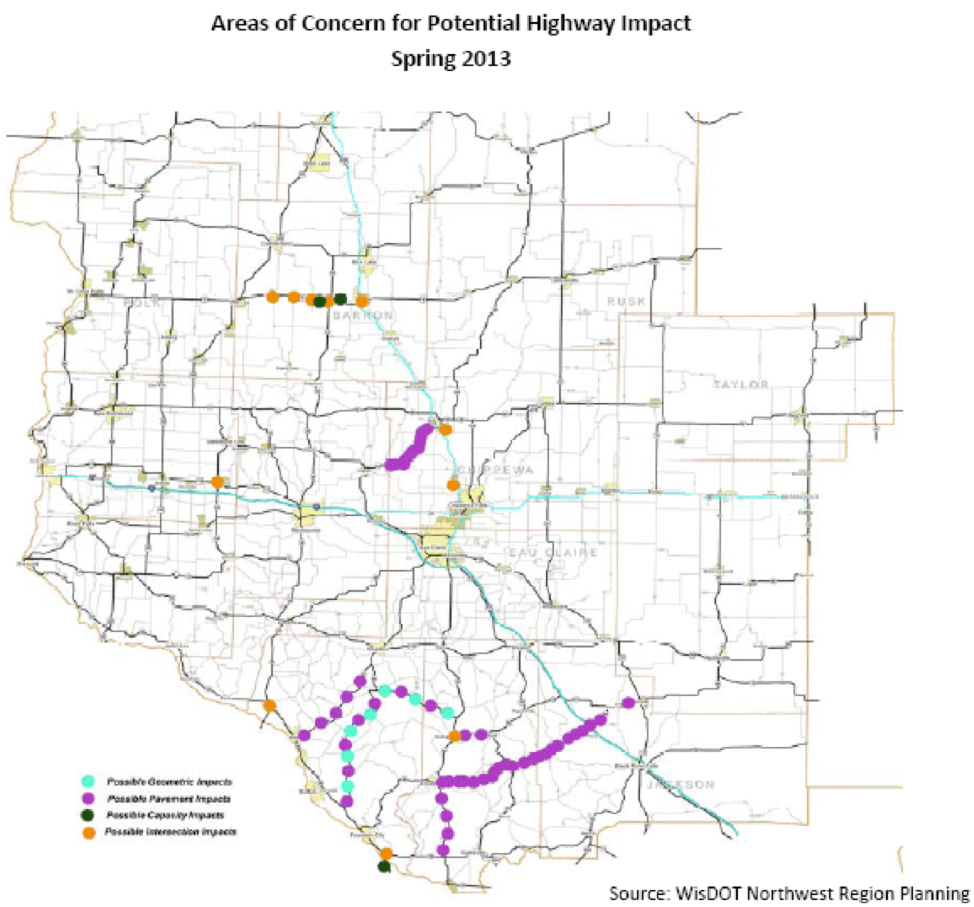

Figure 5: Areas of the Wisconsin road system on which frac sand may be hauled. The vast majority of the state road system is designed to accommodate high volumes of heavy truck traffic, including industrial sand traffic, and these roads will not sustain premature or excessive wear as a result of frac sand transportation. A small portion of state roads may incur damage as a result of sand hauling. Wisconsin DOT finances repairs for these roads. *Source:* Thomas Beekman and Brent Pickard, "Transportation Impacts of the Wisconsin Fracture Sand Industry," Wisconsin Department of Transportation, Northwest Region, March 2013.

[54] *Ibid.*

The most frequent improvement will be at intersection locations on industry truck hauling routes. Most of these locations will require the addition of turn lanes; some may involve a full reconstruction to install traffic signals or a modern roundabout. In those situations where traffic signals or roundabouts may be needed, it is likely the intersection is already operating with high volumes prior to adding the sand traffic. As a rule, sand traffic is not voluminous enough or concentrated enough by itself to cause capacity or level of service problems.[55]

WisDOT regional planning staff work cooperatively with local units of government to provide recommendations for improvements to local road connections that may be accomplished through the local governments' permitting authority, and to help local governments develop any needed impact mitigation for the STH system from sand mining to include in the local permit requirements.[56]

WisDOT regional planning staff work cooperatively with local units of government to provide recommendations for improvements to local road connection.

Minnesota

Minnesota produces approximately 9 percent of the frac sand mined in the United States, making it the fourth-largest frac-sand-producing state.[57] While Wisconsin experienced more than a tenfold increase in the number of new mines during the recent industrial sand boom, the number of new sand mines developed in Minnesota since 2010 was relatively small, with all but one of the new mining operations established within existing non-metallic mines, primarily along the Minnesota River Valley. The one exception was a 19-acre mine permitted in Winona County.

The reason for the difference in growth is geology. Mining is concentrated in southeastern Minnesota in the Driftless Area along the Mississippi River Valley and in the Minnesota River Valley, where erosion has removed the overburden in the valley, leaving deposits of high-quality silica sand near the surface. Where silica sand is present in the state outside of the Minnesota and Mississippi River Valleys it is not located near rail infrastructure.

The Minnesota Department of Natural Resources (MNDNR) reports there are nine industrial sand mines in the state, with most of those mines located in southeastern Minnesota (see Figure 6).[58] These industrial sand operations, as well as additional proposed mining and processing sites in southeastern Minnesota, have raised concerns about the potential impacts these operations will have on local roadways.

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[55] *Ibid.*

[56] *Ibid.*

[57] Don Bleiwas, *supra* note 4.

[58] Minnesota Department of Natural Resources, "DNR and Silica Sand," 2015, accessed July 7, 2015, http://www.dnr.state.mn.us/silicasand/index.html.

Figure 6: A map of active industrial sand mining sites in Minnesota.

With eight of the nine mines being located within existing non-metallic mines, the transportation infrastructure was already established along U.S. and state highways, and officials at the Minnesota Department of Transportation (MNDOT) report relatively little road damage has resulted from transporting industrial sand.[59] However, MNDOT reports some locations in the city of Winona have suffered localized road impacts from sand hauling, although MNDOT did not report the cause, nature, or extent of any damage.[60]

According to MNDOT reports, the bridges and roads in the federal and state highway systems are structurally capable of handling traffic at the volumes projected for this growth in frac sand mining operations without incurring damage or unusual wear.[61] The amount of traffic generated from transporting silica sand on state and federal roads constitutes a small percentage of the overall heavy-truck traffic on state and federal roadways.

> Officials at the Minnesota Department of Transportation report relatively little road damage has resulted from transporting industrial sand.

MNDOT reports heavy commercial vehicles (HCVs) associated with sand mining account for approximately 15 percent of the HCVs on the Highway 43 Winona Bridge. HCVs from all industries account for just 9 percent of the total number of vehicles using the bridge. MNDOT also reports most of the bridges and roads in the county-state-aid system are designed to handle heavy vehicles such as sand trucks, reducing the likelihood of damage caused by sand hauling on these roads.[62]

Roads designed for local, light-duty, low-volume traffic may incur damage if used as haul routes for heavy truck traffic. A chapter in the Minnesota Environmental Quality Board's (EQB) report titled *Tools to Assist Local Government Officials in Planning for and Regulating Silica Sand Projects* aims to educate local government officials about best practices available to them to maintain the public roadways under their jurisdiction.[63]

As in the NCFIRE case study for Chippewa County, the EQB report emphasizes the importance of obtaining a scientific, factually based engineering study assessing the current condition of roads along the proposed haul route using a targeted traffic impact analysis for the entire route, allowing operators and local government officials to designate a haul route that is mutually acceptable to all parties.

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[59] Tesla Mitchell, "Country Roads Still Taking Winona County Residents Home—But it's a Bumpy Ride," *Winona Daily News*, July 06, 2014, www.winonadailynews.com/news/local/govt-and-politics/country-roads-still-taking-winona-county-residents-home--/article_e7b9df19-8e55-59c8-9c43-777df3875ed1.html.

[60] Minnesota Department of Transportation, *supra* note 17.

[61] *Ibid.*

[62] *Ibid.*

[63] Minnesota Environmental Quality Board, "Tools to Assist Local Government Officials in Planning for and Regulating Silica Sand Projects, March 19, 2014, www.eqb.state.mn.us/documents/5.%20Tools%20for%20Local%20Govt%20March%207%202014.pdf.

A factually based study also allows local government officials to identify portions of road in need of rehabilitation, corrective design, or construction; identifies for local officials any need to modify the designated route and establish refined maintenance schedules for repairs; gives local governments the necessary data and engineering advice to negotiate adequate RUMAs; and identifies seasonal weight restrictions deemed necessary along the haul route.

When designating a haul route, local government officials should operate from the principle that public roads are provided for the free movement of all persons and their goods.

According to the EQB report, much of the risk of impacts on roadways due to new heavy commercial truck traffic can be mitigated by targeted monitoring of load weights and reported traffic volumes. Monitoring should include audits of weights recorded on strategically placed private scales; solid-state scale devices on loading equipment, conveyors, and trucks; and regular, routine communication between the operator and road personnel at the local government, the county, and MNDOT to monitor truck weights and flows.[64]

When designating a haul route, local government officials should operate from the principle that public roads are provided for the free movement of all persons and their goods. They should acknowledge unusual or unforeseen levels of wear caused by a user or users place a mutual responsibility on both parties if regular use of the public road is to be maintained.

Under current Minnesota law, if a haul route falls under the jurisdiction of two or more local government units (LGUs), only the LGU issuing the conditional use permit may negotiate a road maintenance agreement. MNDOT recommends the issuing LGU allow other affected LGUs to participate in the permitting process, providing them an avenue for input in the preferred routing, traffic impact studies, and any road use compensation agreements, because the affected non-permitting LGUs have no other way to request consideration under current state law.

The duty of local governments to maintain the public roadways in their jurisdiction may require negotiation of a RUMA as part of the process for granting a conditional use permit, because almost all local government units in central and southeast Minnesota have insufficient funds to maintain local road segments under heavy use for transporting industrial sand.[65]

Minnesota state statutes authorize local governments to enact a tax, the Aggregate Material Removal Tax (Minnesota Statute 298.75, subd. 2a, b, and d), of no more than 15 cents per ton of material transported, sold, or imported into the county. Research on road wear calculated as Equivalent Single Axle Loadings (ESALs), conducted by Mankato State University under commission from the Local Road Research Board (LRRB), found intensive use of a road by commercial trucks loaded to the maximum legal vehicle weight limits may significantly shorten

[64] *Ibid.*

[65] *Ibid.*

a road's design life and incur a direct maintenance or replacement cost of up to 22 cents per ton per mile of substandard roads subjected to intensive heavy commercial use.

Depending on the length of the substandard road segment and other relevant conditions, the aggregate tax may therefore be inadequate to provide the revenue needed for road upgrades and repairs. A further complicating factor is Minnesota Statute 298.75, subd. d,, prohibiting collection of "additional host community fees" if the aggregate tax is collected. This prohibition could be interpreted as preventing a negotiated road use fee from being included in a conditional use permit.[66]

Local governments in Minnesota may benefit by negotiating a RUMA with industrial sand operators as part of the authorization of a conditional use permit, instead of using the aggregate tax. Such RUMAs should be narrowly tailored and based on a data-driven engineering study, and funds collected under the agreement should be dedicated specifically to the repair of the designated haul route.

> Local governments in Minnesota may benefit by negotiating a RUMA with industrial sand operators as part of the authorization of a conditional use permit, instead of using the aggregate tax.

To aid local governments in determining proper fees for road upkeep, the Minnesota County Engineers Association, Local Road Research Board, Mankato State University, and MNDOT have developed a road wear calculator that in part identifies a fee of up to 22 cents per ton-mile applied to the length of the deficient segments under load, based on ESAL and design life considerations. The road wear calculator is available to potential users on the MNDOT website, and MNDOT and county engineers offer technical assistance in applying the calculator to local conditions. This calculated fee should apply only until the necessary repairs and upgrades are accomplished to put the road segment into a heavy-duty category in a good state of repair.

Other negotiated alternatives may include payment methods also used in Chippewa County, such as a lump-sum payment to the road authority to complete upgrades before mine startup, an annual fee to assist accelerated repair schedules, and contracting for supplemental road crews by the operator in coordination with local government activities.

Minnesota officials can consult Appendix A of the NCFIRE study to borrow language from RUMAs used in Wisconsin, though officials should consult legal counsel to ensure agreements are in compliance with Minnesota law.

Illinois

Illinois is now the second-largest producer of industrial sand in the United States. Historically, Illinois was the largest producer of industrial silica sand, supplying much of this sand to

[66] *Ibid.*

glassmaking and foundry end-users for more than 100 years. But the industry's growth in Illinois has been slow; only two new mines have opened within the past few years, and at least two other mines are permitted but have not yet opened.

Before the recent sand boom, Wisconsin and Illinois had about the same number of mines. The reason for the slower growth in Illinois is geology. Sand in Illinois is not easily accessible. It is either eroded or buried under substantial glacial deposits or other bedrock. Most industrial sand mined in Illinois is in La Salle County, which has six active sand mining operations. One active mining operation is in Ogle County.

With the exception of the two new mines, the existing operations range in age from decades to more than a century. These older operations are located on U.S., state, or county highways designed decades ago to accommodate heavy truck traffic. One of the two new mines has direct access to a U.S. highway. The other new mine accesses a county highway designed for heavy trucks via an upgraded township road that serves only the mine and a campground.

> Illinois lawmakers have directed the state's Department of Transportation to conduct an in-depth study of the impact of agricultural, manufacturing, mining, and other industrial operations in several counties.

Illinois lawmakers have directed the state's Department of Transportation (IDOT) to conduct an in-depth study of the impact of agricultural, manufacturing, mining, and other industrial operations in Bureau, DeKalb, Grundy, Kendall, La Salle, Lee, Livingston, Marshall, Putnam, and Woodford counties.[67] The study will investigate, among other things, the impact of road use and potential traffic pattern disruptions by transporting sand. It will also consider potential road improvement plans to alleviate additional highway traffic caused by the expansion of existing and proposed sand mining operations. IDOT must present its findings to lawmakers by January 1, 2017.[68]

Iowa

Iowa produces 4 percent of the frac sand mined in the United States, making it the fifth-largest frac-sand-producing state (tied with Arkansas and Nebraska), despite having only one industrial frac sand mining operation, located in Clayton, Iowa. Neither the Clayton County Engineer's Office nor the industrial sand operator responded to calls for comment on any RUMAs that may have been negotiated between the operator and local government.

Industrial sand mining in Iowa has limited potential for expansion, for both geological and regulatory reasons. Prime industrial sand deposits are found in only three Iowa counties:

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[67] "Sand mine study bill heads to governor's desk," *The Daily Journal*, June 1, 2015, http://www.daily-journal.com/news/local/sand-mine-study-bill-heads-to-governor-s-desk/article_f68ed1f6-43dd-5f0e-b756-676ba6862f15.html.

[68] *Ibid.*

Allamakee, Clayton, and Winneshiek. In many areas of these counties, desirable sand deposits are overlain by layers of limestone, limiting the number of sites suitable for industrial sand mining.

> Industrial sand mining in Iowa has limited potential for expansion, for both geological and regulatory reasons.

As to regulatory impediments, Allamakee County, for example, has enacted an industrial sand mining ordinance that is so strict it effectively bans industrial sand mining in the county. The ordinance states a mining operation cannot use chemicals to wash or process silica sand or apply any chemical or toxic substance in excavating silica sand. In addition, industrial sand mines are not allowed to be located within 1,000 feet of any spring, cave, sinkhole, or any other feature of the karst topography prevalent in the county, among other restrictions. The ordinance defines the county's dominant features so narrowly that it essentially keeps out industrial sand operations.[69]

In Winneshiek County, a moratorium prohibiting industrial sand mining has been in effect since June 2013 and runs to October 2015.[70] As a result, there are no data pertaining to the impact of industrial sand mining on Winneshiek County roadways. Local government officials in Iowa can, however, obtain engineering analyses to determine whether a given road is designed to accommodate mine traffic and what upgrades might be necessary to accommodate industrial sand mining.

Part Four
Concluding Remarks

Industrial sand mining opponents claim mining, transporting, and processing industrial sand will lead to widespread damage to public roads, leaving the cost of repairs for governments and ultimately taxpayers. Research conducted in Minnesota and Wisconsin shows this has not occurred.

Local governments have negotiated road upkeep and maintenance agreements (RUMAs) to minimize damage to local and county roads attributed to industrial sand mining and ensure any damage that does occur is repaired at the expense of the industrial sand operator. Under these agreements, industrial sand operators have paid millions of dollars to repair, upgrade, and maintain local and county roadways in counties around the state of Wisconsin. These agreements serve as an example for other local officials in sand-producing areas throughout the upper Midwest.

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[69] Amber Rouse, "Three Counties Take Different Approaches to Frac Sand Mining," The Gazette, August 31, 2014, http://thegazette.com/subject/news/three-counties-take-different-approaches-20140831.

[70] Dean Thompson and Dennis Karlsbroten, "Report to the Winneshiek County Board of Supervisors Regarding Moratorium Resolutions 13-65 and 15-18," March 2, 2015, http://www.winneshiekcounty.org/uploads/PDF_File_43186469.pdf.

Chippewa County, Wisconsin provides several examples for local government units in other sand-producing counties in Wisconsin and other states, providing insight into the variety of mechanisms available to them in the form of RUMAs, including assessing road conditions, drafting repair and maintenance schedules, and collecting payments from operators to finance road repairs.

State statutes give local governments broad authority to enact RUMAs for traffic-generating enterprise impacts, including sand mines.

State statutes give local governments broad authority to enact RUMAs for traffic-generating enterprise impacts, including sand mines. This process for evaluating roadway and access impacts for commercial and industrial developments has proven highly effective and provides local governments the authority and best practices they need to ensure roadways are kept in good condition for all public uses and all commercial and industrial developments that affect the roadways are treated fairly.

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About the Authors

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Isaac Orr is a research fellow at The Heartland Institute. He previously worked as a research analyst and writer in the office of Wisconsin state Senator Frank Lasee, and prior to that interned with the Rancher's Cattleman Action Legal Fund. He graduated in 2010 with honors from the University of Wisconsin-Eau Claire, with a B.A. in political science and a minor in geology.

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Krumenacher is a professional geologist with licensure nationally and in several states and is a certified hazardous materials manager. He has managed and conducted geologic, hydrogeologic, and engineering studies, remedial investigations, environmental assessments, pre-acquisition environmental due diligence, and hazardous waste management at various properties including surface and underground mines; large industrial, commercial, and urban redevelopment projects; federal Superfund sites; and state-lead environmental projects.

He has provided testimony regarding aggregate and industrial mineral mining before municipal, township, and county units of government as well as nongovernment organizations, local environmental groups, and community advisory councils to help address residents' concerns about mining. He is actively involved with several mining associations.

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