# Indiana Rural Roads and Bridges: The Crumbling Reality and What it Will Take to Mend These Critical Economic Arteries

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# The Crumbling Reality and What it will Take to Mend These Critical Economic Arteries

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**John Marron, AICP**, was previously a senior policy analyst at the Indiana University Public Policy Institute. His research work focused largely on housing and community development, community-based planning, aging and quality of life issues, economic development, and abandoned property reuse.

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# Executive Summary

Nearly $6.4 billion. That's how much it would cost to bring all of Indiana's rural roads up to an acceptable level and to repair or replace all of Indiana's functionally obsolete or structurally deficient bridges. The number is nearly triple the state's financial reserves. It's quadruple the amount of new money legislators injected into the road funding formulas during the General Assembly's 2016 session. It's an enormous amount of money, yet for a state that rightly calls itself the Crossroads of America, the investment is necessary to ensure Indiana's farmers and all who make a living in agriculture have a route to continued economic strength.

## *Local road and bridge challenges for agriculture*

Farmers and others involved in the $42.6 billion sector of Indiana's economy (Indiana Business Research Center, 2015) confirmed what the data in this report indicated—they need better roads to more efficiently produce the grain, livestock, and other commodities that literally feed us. This study found the conditions in agriculture that affect the efficient movement of farm equipment from location to location and product from farm-to-market include:

- the size of agricultural equipment;
- movement of product predominantly by truck; and
- the weight of agricultural equipment and truck loads, with heavier truck loads possible in the future.

Each of these changes are important to the competitiveness of Hoosier products.

Farming and agribusiness focus group participants identified problematic infrastructure issues that have arisen as a result of these trends, and historically challenging infrastructure design and conditions that cost them time and money because of longer farm-to-market routes:

- Roundabouts that are undersized and curbed
- Rough pavement
- Poor visibility at crossings
- Peaked or troughed crossings and bridges
- Low overpasses
- Narrow roads and intersections that make it hard to move farming equipment
- Road width at intersections hampered by signs, utility poles, mailboxes, crops, and trees
- Freeze/thaw and enforcement of frost limits
- Paved roads vs. chip-and-seal vs. gravel vs. dirt
- Drainage around roads
- Conflicts with urban and suburban road users

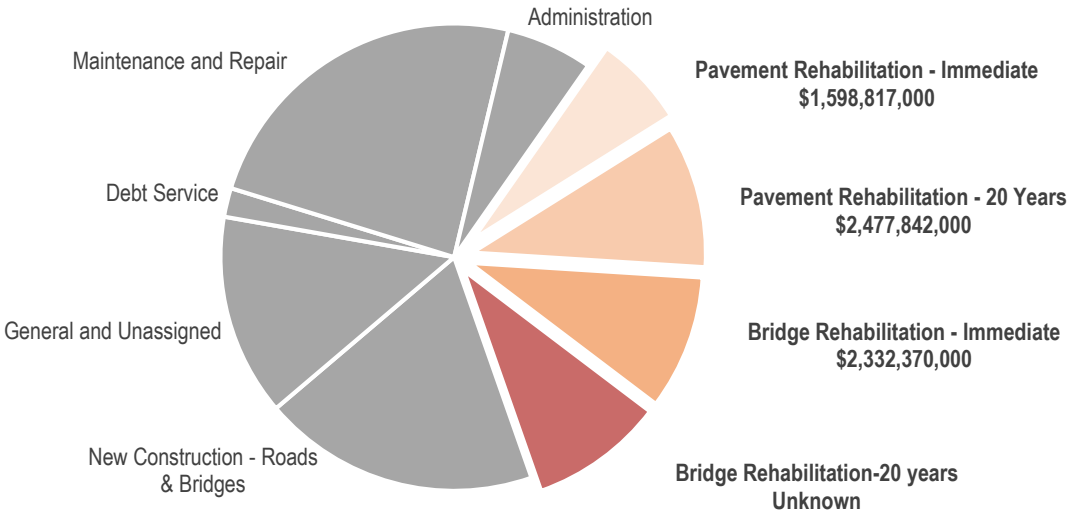
These stakeholders frequently reported these issues result in longer trips from farm-to-farm and from farm-to-market, costing both time and money.

## *Road and bridge rehabilitation needs, spending, and funding gap*

The research team developed estimates for county road and bridge rehabilitation needs, spending, and the funding gap for 20 years (2016-2035). Estimates are based on data for 16 study counties that are extrapolated to the state. The strategy employed for establishing costs is based on asset management, often referred to as "doing the right treatment at the right time." This preferred approach utilizes treatment options to improve and extend the life of capital assets, and is a more effective and economical strategy than the more common "worst first" strategy. For road pavements, the quality goal is to raise and maintain pavements at a PASER 6 (good) across the county network. For bridges, the quality goal is to address all current structurally deficient and functionally obsolete bridges immediately and to address additional bridges that reach these ratings in the future. Needs include the costs to address immediate needs to update all infrastructure to the minimum quality level described and total needs to maintain county infrastructure over 20 years (Figure ES1). The spending gap is reported using three scenarios in which

immediate needs are addressed over 1, 3, or 5 years. Table ES1 summarizes the findings for needs, spending, and the funding gap for road and bridge rehabilitation

**Figure ES1. Twenty-year county road and bridge needs (2016-2035)**




Note: Gray wedges represent theoretical spending on the elements typically reported in annual operational reports.

**Table ES1. Twenty-year statewide summary of county road and bridge rehabilitation needs, spending, and funding gap (2016-2035; 2015 dollars)**

| | | Pavement Rehabilitation | Bridge Rehabilitation | Total Rehabilitation |
|---|---|---|---|---|
| Paved Mileage/Bridges | | 56,760 | 13,090 | N/A |
| Needs | Immediate | 1,598,817,000 | $2,332,370,000 | $3,931,187,000 |
| | 20-Year | $4,076,659,000 | Immediate + deterioration | $6,409,029,000 + bridge deterioration |
| Annual Spending | | $119,233,000 | $126,050,000 | $245,283,000 |
| Annual Funding Gap –Scenario 1 | Year 1 | -$1,505,144,000 | -$2,206,320,000 | -$3,711,464,000 |
| | Years 2-20 | -$27,411,000 | Spending - deterioration | -($27,411,000 + bridge deterioration gap) |
| Annual Funding Gap – Scenario 2 | Years 1-3 | -$487,055,000 | -($651,407,000 + Deterioration) | -($1,138,462,000 + bridge deterioration) |
| | Years 4-10 | -$33,498,000 | Spending - deterioration | -(33,498,000 + bridge deterioration gap) |
| Annual Funding Gap – Scenario 3 | Years 1-5 | -$284,753,000 | -($340,424,000 + Deterioration) | -($625,177,000 + bridge deterioration |
| | Years 6-20 | -$35,791,000 | Spending - deterioration | -(35,791,000 + bridge deterioration gap) |

## *Funding options–augmented motor fuel taxes*

Gasoline and diesel taxes are the primary source of transportation funding in Indiana. Due to inflation and improved fuel efficiency, these taxes are increasingly inadequate to maintain the transportation system. The research team provides a forecast of Indiana's fuel tax revenue based on the current policy and three alternative taxation options: (1) indexing to inflation, (2) indexing to inflation and fuel economy, and (3) a vehicles miles traveled (VMT) fee on

vehicles. These projections indicate that by 2035, revenue from fuel taxes will decrease by 41.0 percent under the current taxation policy (Table ES2). Indexing fuel taxes to inflation results in a decrease in the tax revenue by 12.4 percent. Indexing using only inflation is inadequate to maintain funding (in real dollars) because fuel efficiency outpaces inflation. Indexing fuel taxes to inflation and fuel economy increases the fuel tax revenue by 30.1 percent in 2035. Switching to a mileage fee increases revenue by 22.9 percent in 2035.

**Table ES2. Fuel consumption, tax revenue, and tax distributions by scenario (2016-2035; 2015 dollars)**

| | | 2035 | | | | 2035 (Percent Change) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2016 | Base-line | CPI | CPI-MPG | VMT | Base-line | CPI | CPI-MPG | VMT |
| **Consumption (in million gallons)** | | | | | | | | | |
| Gasoline | 2,995 | 2,094 | 2,081 | 2,064 | 2,055 | -30.1% | -30.5% | -31.1% | -31.4% |
| Diesel | 1,517 | 1,872 | 1,871 | 1,869 | 1,095 | 23.5% | 23.4% | 23.2% | -27.8% |
| **Excise Tax Revenue (in million dollars)** | | | | | | | | | |
| Total | $769 | $454 | $674 | $1,001 | $945 | -41.0% | -12.4% | 30.1% | 22.9% |
| Gasoline | $530 | $253 | $375 | $555 | | -52.4% | -29.4% | 4.6% | |
| Diesel | $239 | $201 | $299 | $446 | | -15.9% | 25.4% | 87.0% | |
| **Revenue to state, counties, and cities from all sources (in million dollars)** | | | | | | | | | |
| SHF INDOT | $592 | $416 | $534 | $709 | | -29.7% | -9.8% | 19.8% | |
| Counties | $339 | $237 | $305 | $408 | | -30.1% | -9.9% | 20.3% | |
| Cities and Towns | $147 | $138 | $149 | $162 | | -6.1% | 1.0% | 10.4% | |

Note: “All sources” include gasoline and diesel taxes, Major Moves Draw, permits, sales tax, etc.

This analysis suggests that indexing fuel taxes to inflation or implementing a VMT-fee would address the challenge of financial sustainability by providing a revenue source that increases at or exceeds the rate of inflation between now and 2035. Policies that link fuel taxes to a measure of inflation would arrest the decreasing purchasing power of current revenue streams. While the fuel tax would remain constant in real terms, increases in population, real income, which ultimately drives up vehicle miles traveled, will result in increased revenue. However, the issue of increased fuel economy is not addressed by indexing fuel taxes to inflation.

From a revenue perspective, the VMT fee is the only scenario that is sustainable in the long-run because it is not linked to fuel economy. Indexing the fuel tax to inflation does not disconnect motor fuel tax revenue from the increase in fuel efficiency. In the VMT scenario, the increase in revenue is linked to the number of vehicles on the road and the amount of miles driven. The politics of adopting a taxing structure that requires the government to monitor driving habits is politically or technologically difficult to achieve in the near term. There also is widespread public opposition to the enactment of a VMT fee, with reasons including that the taxation is unfair to rural drivers, to people who drive more as part of their job, and to people who drive fuel-efficient vehicles (Duncan & Graham, 2013).

Table ES3 shows the annual cost per vehicle for 2016, the baseline, and the three scenarios. For cars and light trucks, which constitute the majority of vehicles on the road, gasoline taxes are reduced under the baseline and the CPI scenario. This is because of gains in fuel efficiency. Indexing fuel taxes to both CPI and for fuel efficiency increases gas taxes paid per vehicle increase, but very modestly. For medium- and heavy-duty trucks fuel efficiency is not improving as much over the projection period so the increases under the CPI-MPG and the VMT scenarios are greater.

**Table ES3. Estimated annual fuel tax costs for selected vehicle types (2015 dollars)**

| Vehicle Type | 2016 | 2035 | | | |
|---|---|---|---|---|---|
| | | Baseline | CPI | CPI MPG | VMT |
| Gasoline Car | $95.16 | $46.56 | $72.46 | $110.77 | $113.31 |
| Gasoline Truck | $160.11 | $78.33 | $121.91 | $186.37 | $190.64 |
| Diesel Truck (Light Duty) | $103.86 | $55.87 | $87.24 | $134.01 | $168.90 |
| Diesel Truck (Freight Heavy Duty) | $2,073.24 | $1,340.15 | $1,965.60 | $2,900.34 | $2,154.26 |

Cost per mile decreases for cars and light trucks may be useful in communicating with taxpayers and increasing acceptance of a fiscal solution. For these vehicle types, the cost per mile decreases for all policy scenarios (Table ES4). This is a direct consequence of the increasing fuel efficiency which outpaces growth in VMT.The cost per driver is decreasing under all tax scenarios and a change in tax rate only affects how much it decreases. The variation across the different tax scenarios is small because taxes are a relatively small proportion of the overall cost-per-mile. It is the large amount of fuel consumed (gallons) and miles driven multiplied by a few cents in fuel tax or by the VMT fee that makes a big difference in revenue. The fuel efficiency for medium- and heavy-duty trucks, however, is not expected to improve significantly over the projection period and those vehicle owners are affected more by the increase in fuel price than the light trucks and cars.

**Table ES4. Cost-per-mile in 2016 and 2035 under various tax scenarios (2015 Dollars)**

| Vehicle Type | 2016 | 2035 | | | | 2035 (Percent Change) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Base-line | CPI | CPI-MPG | VMT | Base-line | CPI | CPI-MPG | VMT |
| Gasoline Car | $0.126 | $0.098 | $0.100 | $0.103 | $0.092 | -22.3 % | -20.5 % | -18.0 % | -26.8 % |
| Gasoline Truck | $0.171 | $0.133 | $0.136 | $0.141 | $0.125 | -22.3 % | -20.5 % | -18.0 % | -26.8 % |
| Diesel Truck (Light Duty) | $0.139 | $0.143 | $0.143 | $0.144 | $0.138 | 3.1 % | 3.5 % | 4.1 % | -0.7 % |
| Diesel Truck (Freight Heavy Duty) | $0.268 | $0.296 | $0.298 | $0.299 | $0.292 | 10.5 % | 10.9 % | 11.5 % | 8.8 % |

## *Funding options–Local Option Highway Use Tax (LOHUT)*

Local Option Highway Use Tax (LOHUT) has been available to local governments in Indiana since 1980. Counties that adopt this tax must adopt the vehicle excise surtax and the wheel tax. Each of the two components apply to a distinct set of vehicle types.

Fifty-one counties have adopted this tax (LTAP, 2016). In 2016, HB1001 and SB67 passed allowing counties to double the vehicle excise surtax and the wheel tax with the adoption of an INDOT-approved transportation asset management plan (AMP). In addition, municipalities with a population greater than 10,000 are allowed to impose an additional municipal motor vehicle license excise tax and a municipal wheel tax. Total estimated potential revenue from LOHUT adopted by counties in 2017 is $217 million and $108 million with and without AMP, respectively. Projected potential revenue in 2035 is estimated to be $228 million and $114 million with and without AMP, respectively. Potential revenues vary across counties. Because this tool taxes vehicles, more urban and suburban counties can generate more revenue. County-adopted LOHUT revenues are distributed to county government as well as the cities and town within each adopting county. Potential revenue for LOHUT adopted by cities and towns is not estimated here.

## *Other local options*

The network of rural roads and bridges under the jurisdiction of county governments and the gap between current and needed funding for rehabilitation are vast. Clearly, more state support is needed, but funds to address the entire

rehabilitation funding gap combined with needs for new infrastructure and maintenance seems unlikely. In addition, the complex formula for distributing increases to gas tax or a replacement source may not deliver adequate resources to all counties. In light of that, local governments must identify additional local resources, make choices among local needs, and do more to wring additional utility out of all federal, state, and local dollars.

Several local tools are described within the report, including: utilizing debt; cost sharing mechanisms; planning for infrastructure improvements using asset management or capital improvements planning; managing infrastructure inventory using a “fix-it-first” strategy; selective reduction of the bridge inventory; returning selected paved infrastructure to gravel; prioritizing farm-to-market routes; aligning land use and transportation planning; joint purchasing; and outsourcing.

# Introduction

The U.S. Postal Service chose a quintessential image to depict Indiana's bicentennial celebration on a stamp: the sun setting over a lush corn field. Across the county road is a soybean field. Both stretch into the flat horizon, a bounty brought through hard work and good fortune. But what if that bounty can't be brought to market? What if the machinery that plants and harvests these crops can't get to the fields?

Take another look at that road bisecting those fields. It's a narrow, compacted dirt road barely wide enough for a combine to pass or sturdy enough for a semi-truck full of grain. Indiana's extensive network of roads like these is the critical link between field and market, and this network is increasingly in need of repair and maintenance. It's not just roads; the bridges in rural Indiana need extensive work as well.

This is a very real economic issue for the farmers who grow grains and raise livestock, for the people who move their goods, and the businesses that support them. Agriculture remains a big business in Indiana. In 2012, there were nearly 59,000 farms in the state that use nearly two-thirds of the Hoosier soil for their operations. These farmers sold more than $11.2 billion in unprocessed commodities. Add the effect of the ancillary businesses that support agriculture and those that process those commodities and agriculture is a $42.6 billion business in the state, ranking it 10th in the nation (Kinghorn, 2015; USDA NASS, 2014 & MIG, Inc., 2012 as cited in Kinghorn, 2015).

Farming, moving product to market, and Indiana's agriculture business becomes far less efficient with poor rural roads and bridges. The Indiana Soybean Alliance estimates that a 20 mile round trip detour around a closed bridge or other travel impediment costs farmers $0.07 per bushel of soybeans.[1] The quality of Indiana's rural roads varies, but there is one constant—the need to invest additional money to improve and maintain these vital commercial links to the world's markets. Indiana's rural areas, where most of the state's agriculture business is conducted, need better roads to survive and thrive.

Elected officials from Angola to Evansville understand the importance of transportation to Indiana's economy, whether it's the rural roads or interstate highways. While county commissioners weigh whether to improve ditching or how much mileage to chip-and-seal, state legislators consider how to split the proceeds from the myriad sources of transportation funding. There is plenty of tension in the system considering the complex formulas used to distribute these funds. Local officials often wonder whether their General Assembly counterparts recognize the vast majority of Indiana's road miles are built and maintained by counties. Members of the legislature, however, wonder why more counties don't use revenue-raising tools already available to them to help meet their needs.

To address this critical issue, the Indiana Soybean Alliance commissioned a team of researchers led by Indiana University's Public Policy Institute (PPI) to conduct research to estimate the infrastructure needs, spending, and spending gap for roads and bridges under the jurisdiction of county government; identify potential state and local funding mechanisms to fill the funding gap; and to identify ways local governments can maximize the utility of their limited resources. In addition to PPI, the research team included the Indiana Local Technical Assistance Program at Purdue University and the Indiana Fiscal Policy Institute.

# Local Road and Bridge Challenges for Agriculture

Changes in the agriculture sector create changing infrastructure needs. Agricultural equipment has become larger and heavier. The movement of product from farm to market is accomplished principally by semi-truck. Over time

[1] The estimate is derived from operational oosts documented in Torrey, IV, F.W. & Murray, D. (2015, September).

these trucks have become bigger and heavier. Farm-to-market trips that once were accomplished at harvest occur throughout the year.

To identify specific challenges agricultural stakeholders face, the Indiana Soybean Alliance and the project team conducted six focus groups around the state in November and December 2015. Events were held in Frankfort, Morristown, Delaware County, Milroy, Avilla, and Mount Vernon. Approximately 75 stakeholders from 24 counties attended, representing a variety of agricultural interests, including: grain, specialty crop, and livestock farmers; processors; truckers; commercial haulers; ethanol producers; grain markets; co-op leaders; state-level elected officials; local elected and appointed officials; paving and farm drainage contractors; school bus drivers; and firefighters and EMS personnel.

Participants were asked to provide input on: the vehicles and equipment they use; bridge dimensions and capacity; road width; turning radii; railroad, river, and highway crossings; overpass clearances; line of sight and visibility issues; the responsiveness of local officials to challenges; and an overall rating for local roads and bridges.

Complete results from these focus groups appear in Appendix A. Almost all stakeholders identified some type of impediment on rural road networks that require them to detour and make farm-to-farm and farm-to-market trips longer and more expensive. Many farmers indicated that they are forced to send advance vehicles over their planned travel routes to ensure they are able to travel the planned path. Specific challenges included.

- In some cases, respondents focused on the state highway network, particular farmers who also are truckers and commercial haulers. Other stakeholders focused principally on local infrastructure issues.
- Respondents expressed concern about roundabouts that are being installed on the state highway network by the Indiana Department of Transportation. Challenges seem to stem from inadequate size for these intersections and from the installation of curbs.
- Several respondents expressed concern about having an adequate pavement on which to drive trucks and farm equipment. They talked about the tradeoffs between a maintained dirt or gravel road and a poorly maintained paved road.
- Some stakeholders complained about the rough ride associated with rough pavement in some locations. Stakeholders who drive a lot avoid particular roads for this reason.
- Crossing at intersections is challenging. In some cases, it is difficult to see drivers who are approaching. In other cases, the speed of traffic and geography make it difficult to cross safely.
- Respondents indicated that peaked and troughed crossings and bridges are challenging for both trucks and farm equipment.
- Many stakeholders indicated experiencing challenges with road and intersection width as a result of the location of signs, utility poles, mailboxes, crops, and trees.
- Stakeholders expressed that detours on one set of roads affects the use of other roads. For example, when a principal farm-to-farm or farm-to-market route is blocked, traffic moves to other routes causing issues for farmers using those roads and bridges.
- Farmers are affected in some places by significant flooding. Inadequate drainage around roads presents issues during wet periods and undermines the quality of the adjoining pavement.
- Frost limits create challenges for farmers who want to take product to market during late winter/early spring.
- Farmers and truckers who work in urban and suburban counties experience conflict with non-rural road users.
- Respondents expressed concerns about using same revenue sources for other types of transportation needs when basic road and bridge needs are not met.
- Respondents indicated that local officials are able to respond more quickly to maintenance needs than roads and bridges that need significant rehabilitation.
- Some respondents expressed concern that local governments use a short-sighted repair strategy that may not be an efficient use of the available resources.

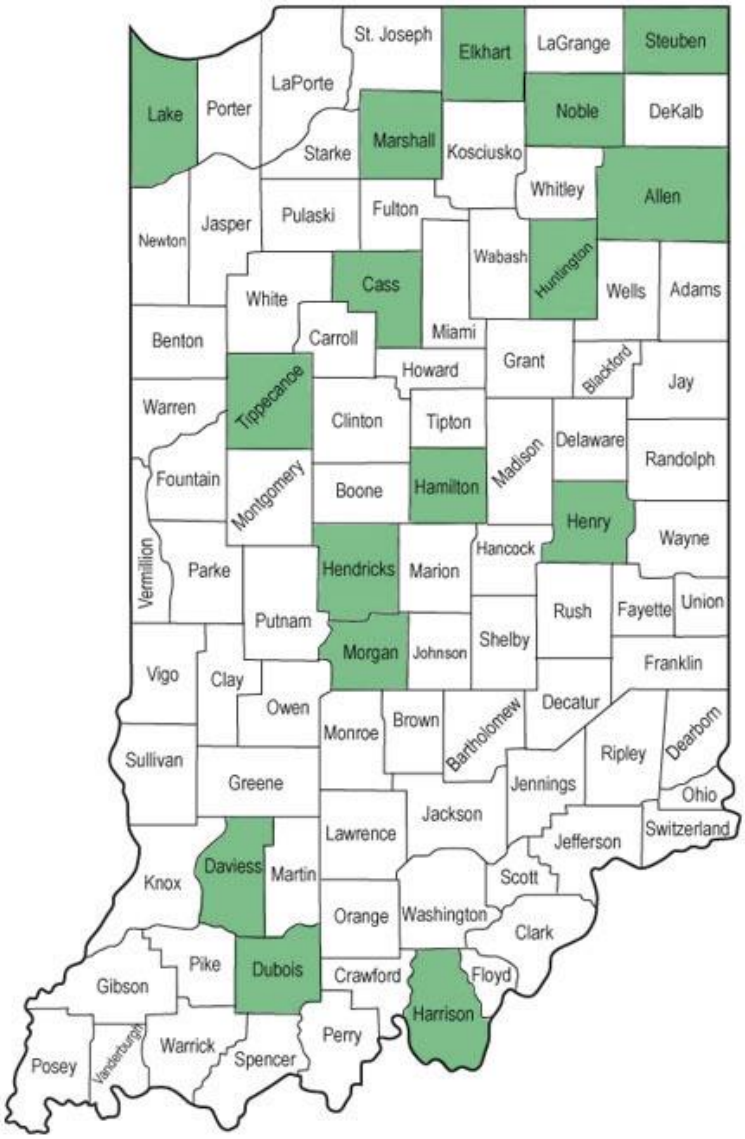
# Road and Bridge Rehabilitation Needs, Spending, and Funding Gap

The research team developed estimates for county road and bridge rehabilitation needs, spending, and the gap between needs and spending. Methodologies for each sub-element are provided below. The strategy employed for establishing costs is based on asset management, often referred to as "doing the right treatment at the right time." This preferred approach utilizes treatment options to improve and extend the life of capital assets; and is a more effective and economical strategy than the more common "worst first" strategy. For road pavements, the quality goal is to raise and maintain pavements at a PASER 6 (good) across the county network. For bridges, the quality goal is to address all current structurally deficient and functionally obsolete bridges immediately and to address additional bridges that reach these ratings in the future. Needs include the costs to address immediate needs to update all infrastructure to the minimum quality level described and total needs to maintain county infrastructure over 20 years. The spending gap is reported using three scenarios in which immediate needs are addressed over 1, 3, or 5 years.

## Study counties

Much of the research contained here is based on data and analyses completed for the 16 counties that completed Pavement Surface Evaluation Ratings (PASER) for their road inventories prior to the outset of this research effort. These counties are Allen, Cass, Daviess, Dubois, Elkhart, Hamilton, Harrison, Hendricks, Henry, Huntington, Lake, Marshall, Morgan, Noble, Steuben, and Tippecanoe (Figure 1). The study counties include 10,811 paved road miles, 19 percent of the state's 56,760 paved road miles. The study counties have 2,602 bridges, 20 percent of the state's 13,090 bridges. PASER is described in more detail in the next section of the report.

**Figure 1. Study counties**




## Rural road rehabilitation needs

The PASER rating scale is from 1 to 10, with 1 being the lowest and 10 the highest. Table 1 describes each rating, from failed to excellent by the visible distress present and the recommended treatment to correct those deficiencies. Table 2 summarizes county road inventories and PASER ratings, including specifically the total number of road miles, paved road miles, gravel road miles, and the percentage of paved mileage with each PASER rating. For example, Allen County has 1,293 miles of roadway including 1,254 miles of roads that are paved and 39 miles that are gravel. For paved roads, 2 percent are rated a PASER 2 and 38 percent are rated a PASER 6. Across the study counties, there are 10,811 paved road miles and 1,507 gravel road miles. For paved roads, 4 percent are rated PASER 2 and 19.5 percent are rated PASER 6.

**Table 1. Asphalt pavement PASER ratings**

| Rating | Definition | Visible Distress | Treatment Measures |
|---|---|---|---|
| 10 | Excellent | None | New construction |
| 9 | Excellent | None | Recent overlay. Like new. |
| 8 | Very Good | No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than ¼") | Recent sealcoat or preservation application. Little or no maintenance required. |
| 7 | Good | Very slight or no raveling. Surface shows some traffic wear. Minor longitudinal cracks due to reflection or paving joints. Transverse cracks spaced ~10' or more apart, little or slight crack raveling. No patching or few patches. | First signs of aging. Maintain with crack filling or crack sealing. |
| 6 | Good | Slight raveling and traffic wear. Longitudinal cracks, some spaced less than 10'. First sign of block cracking. Slight to moderate flushing or polishing. Occasional patching. | Shows signs of aging. Sound structural condition. Could extend life with sealcoat. |
| 5 | Fair | Moderate to severe raveling. Longitudinal and transverse cracks show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition. | Surface aging. Sound structural condition. Needs minor patching or wedging and surface seal or hot mix asphalt (HMA) overlay. |
| 4 | Fair | Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Severe block cracking. Patching in fair condition. Slight rutting or distortions. | Significant aging and in need of strengthening. Needs major patching or wedging and surface seal or HMA overlay. |
| 3 | Poor | Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25 percent of surface). Patches in fair to poor condition. Moderate rutting or distortion. Occasional potholes. | Needs patching and repair prior to major overlay (4"+) or reconstruction/reclamation. |
| 2 | Very Poor | Major alligator cracking. Severe distortions (over 2" deep.) Extensive patching in poor condition. Potholes. | Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective. |
| 1 | Failed | Severe distress with extensive loss of surface integrity. | Needs total reconstruction. |
| 0 | Gravel | Gravel surface. | Periodic grading. |

Source: Wisconsin Transportation Information Center, *Asphalt Roads PASER Manual* (2013 version)

**Table 2. Road inventory and PASER ratings for study counties**

| County | Roadway Miles | Percent Paved Miles in Each PASER Rating | | | | | | | | | | Paved Miles | Percent Gravel Miles | Gravel Miles |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | |
| Allen | 1,293 | 0 | 2 | 0 | 8 | 0 | 38 | 0 | 40 | 0 | 12 | 1,254 | 3 | 39 |
| Cass | 766 | 1 | 4 | 9 | 16 | 17 | 17 | 21 | 8 | 7 | 0 | 674 | 12 | 92 |
| Daviess | 800 | 1 | 0 | 0 | 5 | 5 | 10 | 36 | 27 | 15 | 1 | 360 | 55 | 440 |
| Dubois | 659 | 0 | 0 | 0 | 1 | 11 | 28 | 30 | 16 | 9 | 5 | 527 | 20 | 132 |
| Elkhart | 1,137 | 0 | 6 | 0 | 3 | 16 | 41 | 20 | 10 | 4 | 0 | 1,069 | 6 | 68 |
| Hamilton | 592 | 0 | 0 | 1 | 0 | 11 | 29 | 42 | 5 | 12 | 0 | 568 | 4 | 24 |
| Harrison | 820 | 0 | 0 | 1 | 7 | 16 | 17 | 17 | 32 | 5 | 5 | 787 | 4 | 33 |
| Hendricks | 770 | 0 | 2 | 10 | 27 | 24 | 16 | 12 | 4 | 0 | 5 | 770 | NR | 0 |
| Henry | 753 | 1 | 8 | 20 | 18 | 18 | 12 | 14 | 8 | 1 | 0 | 678 | 10 | 75 |
| Huntington | 655 | 0 | 0 | 0 | 3 | 3 | 2 | 49 | 37 | 6 | 0 | 603 | 8 | 52 |
| Lake | 529 | 5 | 10 | 17 | 18 | 15 | 15 | 8 | 8 | 3 | 1 | 497 | 6 | 32 |
| Marshall | 814 | 9 | 18 | 36 | 24 | 7 | 5 | 1 | 0 | 0 | 0 | 757 | 7 | 57 |
| Morgan | 678 | 0 | 4 | 30 | 42 | 10 | 4 | 5 | 5 | 0 | 0 | 664 | 2 | 13 |
| Noble | 808 | 0 | 2 | 4 | 8 | 20 | 39 | 18 | 6 | 3 | 0 | 728 | 10 | 81 |
| Steuben | 644 | 5 | 7 | 8 | 25 | 25 | 6 | 6 | 6 | 6 | 6 | 419 | 35 | 225 |
| Tippecanoe | 600 | 1 | 1 | 3 | 6 | 18 | 32 | 28 | 8 | 1 | 2 | 456 | 24 | 144 |
| Total | 12,318 | 1.4 | 4.0 | 8.7 | 13.2 | 13.5 | 19.5 | 19.1 | 13.7 | 4.5 | 2.3 | 10,811 | 13.7 | 1,507 |

Note: NR = None reported

Source: 2015 PASER rating data submitted by county highway departments to Purdue LTAP.

Rehabilitation and preservation unit costs are based on the LTAP report, *Assessment Procedures for Paved and Gravel Roads* (Figueroa, Fotsch, Hubbard, & Haddock, 2013, Tables 5-3 and 5-4). Costs to improve pavements rated PASER 1 – PASER 5 to a PASER 6 are shown in Table 3. The recommended treatment for PASER 1 – PASER 3 is reconstruction (rebuilding down to the subgrade), resulting in a PASER 10 pavement with an estimated life of 20 years. The recommended treatment for a PASER 4 pavement is patching and overlay, resulting in a PASER 10 pavement with an estimated life of 14 years. The recommended treatment for PASER 5 and PASER 6 pavements is patching and surface seal with an expected life of 7 years.

**Table 3. Initial treatment costs and expected pavement life for rehabilitated pavement**

| PASER Rating | | Cost per Mile | Expected Life (years) |
|---|---|---|---|
| Initial | Final | | |
| 1 | 10 | $112,000 | 20 |
| 2 | 10 | $112,000 | 20 |
| 3 | 10 | $112,000 | 20 |
| 4 | 10 | $82,000 | 14 |
| 5 | 6 | $15,000 | 7 |

Many pavements will need multiple treatments over the course of the 20-year study period to maintain a PASER 6. Inflation in the costs of goods and services will increase costs of these treatments over time. To account for this reality, costs were adjusted using a 3-percent inflation rate, compounded annually. This rate reflects the average annual rate of inflation over the history of the U.S. Bureau of Labor Statistics Consumer Price Index for All Urban Consumers. Adjusted costs are shown in Table 4.

**Table 4. Future treatment costs for rehabilitated pavement**

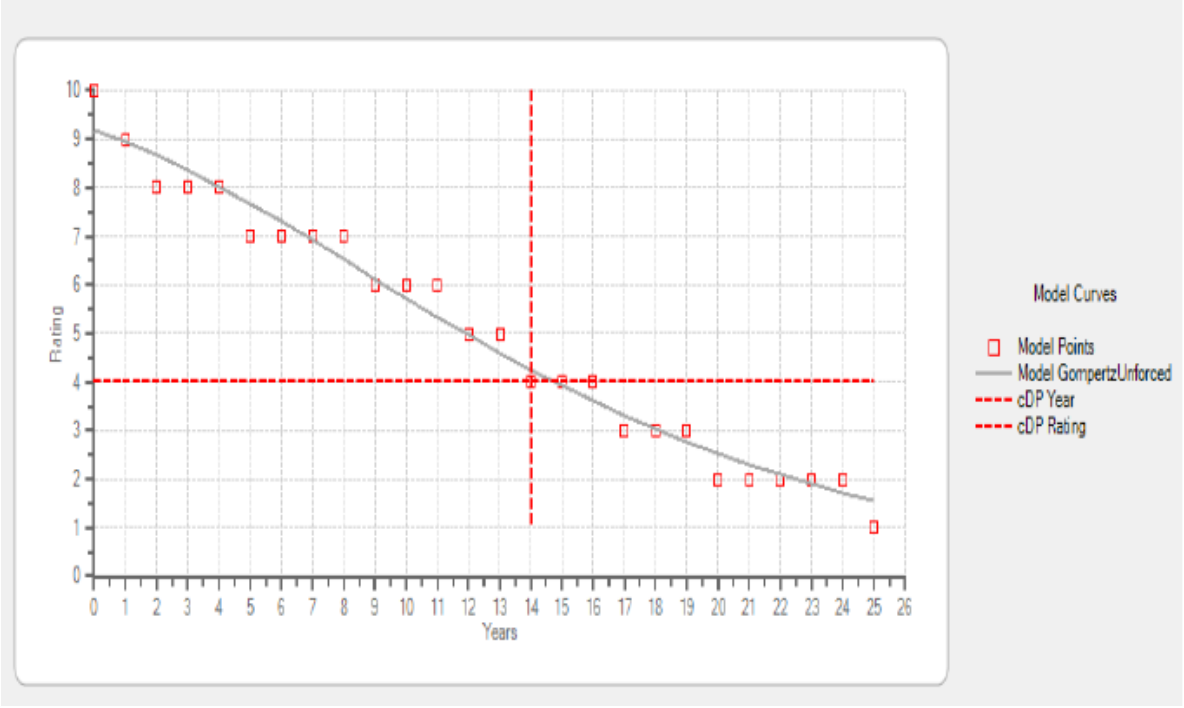
| PASER Rating Improvement | Initial Cost | Treatment Year | Future Cost (with 3 percent annual inflation) |
|---|---|---|---|
| 4 to 10 | $82,000 | 14 | $124,032 |
| 5 to 6 | $15,000 | 7 | $18,448 |
| 5 to 6 | $15,000 | 14 | $22,688 |
| 5 to 6 | $15,000 | 19 | $26,303 |

The study team consulted several sources to identify appropriate pavement deterioration data. One of those sources, *Pavement Surface Evaluation and Rating Study PASER) for the City of Flat Rock* (2015), prepared by C.E. Raines Company, included an Asphalt Deterioration Curve for PASER ratings (Figure 2). These data were used to determine the timing of treatments. The vertical scale is the PASER rating numbers and the horizontal scale is time in years. Using this curve, for example, a PASER 10 pavement will deteriorate to a PASER 5 in 12 years. Deterioration by PASER rating is summarized in Table 5.

Using rehabilitation costs in Tables 3 and 4 and the deterioration values in Table 5, 20-year needs were calculated for the road inventory in the study counties for each PASER rating. These calculations are summarized in Table 6.

The cost to keep all roads in the 16 county study area at a PASER 6 for the next 20 years is the summation of each PASER category by county shown in Table 7 or $776,476,000. County needs range from $88.6 million for Marshall County to $20.9 million for Daviess County.

**Figure 2. PASER deterioration curve**




Note: Chosen model – Gompertz Growth Model unforced through zero.

Source: C.E. Raines Company, *Pavement Surface Evaluation and Rating Study (PASER) for the City of Flat Rock*. Reprinted with permission.

**Table 5. Pavement deterioration to PASER 5 in years by number of paved road miles in study counties**

| PASER Rating | Miles | Time to PASER 5 (Years) |
|---|---|---|
| 1 | 136 | - |
| 2 | 447 | - |
| 3 | 919 | - |
| 4 | 1,407 | - |
| 5 | 1,401 | - |
| 6 | 2,322 | 2.75 |
| 7 | 1,862 | 5.25 |
| 8 | 1,611 | 8 |
| 9 | 408 | 11 |
| 10 | 298 | 12 |
| TOTAL | 10,811 | - |

**Table 6. Rehabilitation needs for study counties by initial PASER rating**

| PASER Rating | | | |
|---|---|---|---|
| Initial | Final | Year | Cost |
| 1 | 10 | 0 | $15,187,491 |
| 5 | 6 | 13 | $3,076,666 |
| Total | | | $18,264,158 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 2 | 10 | 0 | $50,037,501 |
| 5 | 6 | 13 | $10,136,546 |
| Total | | | $60,174,047 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 3 | 10 | 0 | $102,974,122 |
| 5 | 6 | 13 | $20,860,393 |
| Total | | | $123,834,514 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 4 | 10 | 0 | $116,405,761 |
| 5 | 6 | 13 | $31,924,009 |
| Total | | | $148,329,770 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 5 | 6 | 0 | $21,016,740 |
| 5 | 6 | 7 | $25,847,939 |
| 5 | 6 | 14 | $31,789,705 |
| Total | | | $78,654,384 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 6 | 6 | 0 | $- |
| 5 | 6 | 2.75 | $34,828,254 |
| 5 | 6 | 9.75 | $42,834,359 |
| 5 | 6 | 16.75 | $52,680,859 |
| Total | | | $130,343,473 |

| PASER Rating | | | |
|---|---|---|---|
| Initial | Final | Year | Cost |
| 7 | 7 | 0 | $- |
| 5 | 6 | 5.25 | $34,357,908 |
| 5 | 6 | 12.25 | $42,255,893 |
| 5 | 6 | 19.25 | $48,986,161 |
| Total | | | $125,599,961 |
| **PASER Rating** | | | **Cost** |
| Initial | Final | Year | |
| 8 | 8 | 0 | $- |
| 5 | 6 | 8 | $29,711,955 |
| 5 | 6 | 15 | $36,541,956 |
| Total | | | $66,253,911 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 9 | 9 | 0 | $- |
| 5 | 6 | 11 | $7,532,104 |
| 5 | 6 | 18 | $10,738,980 |
| Total | | | $18,271,084 |
| **PASER Rating** | | | |
| Initial | Final | Year | Cost |
| 10 | 10 | 0 | $ - |
| 5 | 6 | 13 | $6,750,699 |
| Total | | | $6,750,699 |

**Table 7. Twenty-year pavement rehabilitation costs by study county (rounded to thousands)**

| County | 20-year Pavement Rehabilitation Costs |
|---|---|
| Allen | $64,679,000 |
| Cass | $50,910,000 |
| Daviess | $20,851,000 |
| Dubois | $29,142,000 |
| Elkhart | $67,113,000 |
| Hamilton | $34,115,000 |
| Harrison | $43,610,000 |
| Hendricks | $59,872,000 |
| Henry | $59,613,000 |
| Huntington | $34,463,000 |
| Lake | $44,211,000 |
| Marshall | $88,576,000 |
| Morgan | $68,426,000 |
| Noble | $47,731,000 |
| Steuben | $33,907,000 |
| Tippecanoe | $29,257,000 |
| Total | $776,476,000 |

Statewide immediate needs for pavement rehabilitation was calculated using the costs identified for Year 0 for initial PASER ratings 1 – 5 in Table 6 and extrapolating to the state using the relative number of road miles in the 16 county study area (10,811) and county miles statewide (56,760). The immediate statewide estimate for county pavement rehabilitation is $1,599,175,000.

The 20-year statewide cost for pavement rehabilitation was calculated by multiplying the needs established for the 16 county study area by the relative number of paved miles in the study area and the state. The 20-year statewide need for county pavement rehabilitation is $4,076,661,000. If the costs are distributed evenly over the 20-year period, the annual need is $203,833,000.

## Road rehabilitation spending

Annual pavement rehabilitation spending was calculated for each study county by aggregating the cost of road projects identified as “rehabilitation” and “resurfacing” by year from *County Highway Department Annual Operational Reports*, Section III. Projects that were purchased using municipal bonds were excluded. Two counties, Hendricks and Daviess, did not report project costs on Section III for any of these years. They are excluded from the spending and spending gap analyses for pavement rehabilitation.

Average annual spending per county was calculated using the years for which each county had normal Section III data. Spending in the 14 counties were totaled and extrapolated to the state using the relative paved road miles. Average annual pavement rehabilitation spending varies by county with Allen County reporting the highest annual average spending for road rehabilitation ($3,643,000) and Marshall County reporting the lowest ($729,000) among study counties (Table 8). Extrapolated annual statewide spending for county pavement rehabilitation is $119,233,000.

**Table 8. Average county spending for pavement rehabilitation 2003-2014 (2015 dollars rounded to thousands)**

| County | Average Pavement Rehabilitation Spending |
|---|---|
| Allen | $3,643,000 |
| Cass | $1,106,000 |
| Daviess | Not Available |
| Dubois | $1,225,000 |
| Elkhart | $2,543,000 |
| Hamilton | $898,000 |
| Harrison | $3,068,000 |
| Hendricks | Not Available |
| Henry | $947,000 |
| Huntington | $105,000 |
| Lake | $1,453,000 |
| Marshall | $729,000 |
| Morgan | $1,332,000 |
| Noble | $1,258,000 |
| Steuben | $793,000 |
| Tippecanoe | $887,000 |
| 14 County Total | $19,986,000 |
| Statewide Total | $119,233,000 |

Note: Hendricks and Daviess counties are excluded from the spending and gap analysis because their Highway Operation Reports did not include costs for individual or collective pavement rehabilitation projects.

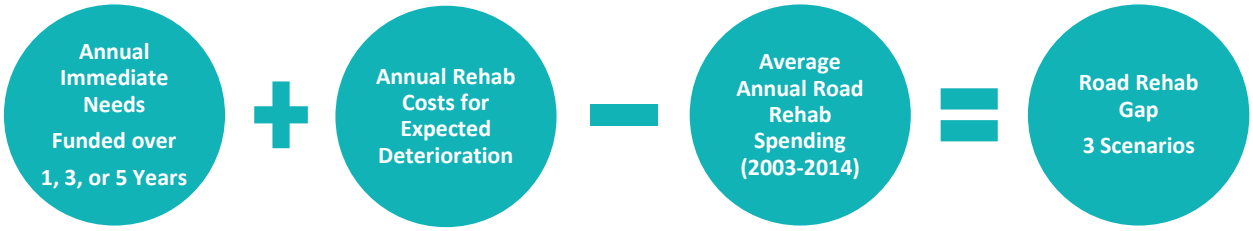
Source: Annual operational reports (County Highway form 16), 2003-2014, Section III Construction and Reconstruction.

## Road rehabilitation funding gap

The road rehabilitation funding gap is the difference between annual needs (immediate and future) and current annual spending (Figure 3). As shown in Table 9, the funding gap was calculated for three separate scenarios that spread the immediate needs over 1, 3, and 5 years. In each, the pavement rehabilitation needs for the initial (1 year, 1-3 years, or 1-5 years) and subsequent time periods were compared to average annual spending. In cases when local average spending exceeds the annualized period needs, the gap was reset to zero. This decision was made because (1) funding is not fungible across counties and (2) the likelihood that funding will be repurposed for other county priorities. This resulted in zeroing out the calculated surplus for Allen, Harrison, Lake, Morgan, and Steuben counties for the years after the immediate needs are addressed. The adjusted gap was aggregated across the counties with available data. The 14-county study gap was extrapolated to a statewide county gap using relative road miles.

The annualized 20-year statewide gap between road rehabilitation needs and spending, in which immediate and longer term needs are divided evenly across 20 years, is an estimated -$96 million. Under Scenario 1, in which the immediate pavement rehabilitation needs are assigned to Year 1, the Year 1 funding gap is -$1.5 billion and the annual gap for Years 2-20 is -$27 million (Table 9). Under Scenario 2, in which immediate needs are spread over Years 1-3, the Years 1-3 annual funding gap is -$487 million and the Years 4-20 gap is -$33 million. For Scenario 3, in which immediate needs are spread over Years 1-5, the Years 1-5 annual funding gap is -$285 million and the gap for Years 6-20 is -$36 million. During the 2003-2014 period, counties received atypical funding in some years including additional MVH/LRS distributions and ARRA grants. As such, without similar additional distributions in the future, the estimated funding gap is likely conservative.

**Figure 3. Pavement rehabilitation funding gap schematic**




## Bridge rehabilitation needs

Bridge rehabilitation needs were developed using bridge condition data and INDOT repair/replacement unit cost multipliers. Bridge conditions data for the bridges in the study counties were obtained from the 2014 Federal Highway Bridge Database and the Indiana Bridge Inspection Application System (BIAS) which is updated every two years.

When bridges are inspected and evaluated the two categories that require action are structurally deficient and functionally obsolete bridges. A structurally deficient bridge is one for which the substructure (foundation and piers), the superstructure (girders), or the deck is in poor condition and needs to be replaced. If a particular bridge element has an NBI rating of less than 5 that element is considered structurally deficient. A functionally obsolete bridge is one that has a restricted load rating capacity or that is too small to carry certain vehicles. To address these deficiencies, the bridge has to be replaced.

Repair/replacement costs for each structurally deficient or functionally obsolete bridge in the study counties was estimated by using bridge deck area and the appropriate unit cost multiplier. Unit costs were obtained from INDOT's unit cost database:

- Replace bridge - $140/square foot
- Replace superstructure - $100/square foot
- Replace deck - $80/square foot
- For bridge replacements the length is increased by 30%
- Bridges in these categories have approach work that extends 300 ft. from each end (on average). Approach work is estimated at $1,000/linear foot.
- Design work is estimated at 10% of the construction cost

For example, the Cass County inventory of structurally deficient and functionally obsolete bridges and rehabilitation cost estimates are shown in Table 10. Cass County has three bridges that are structurally deficient and one bridge that is functionally obsolete. Improvement costs are calculated. A similar calculation was done for each of the 15 other study counties. The aggregated needs for the study counties are shown in Table 11.

These numbers were extrapolated to the state by applying the percentage of structurally deficient and functionally obsolete bridges in the study counties to the remaining bridges in the state and by applying the average repair cost per bridge by type of deficiency/failure to the estimated number of bridges in each category. Average repair costs for structurally deficient and functionally obsolete bridges are $802,000 per bridge and $1,356,000 per bridge, respectively. Across the 16 study counties there are 7.1% structurally deficient bridges and 9.5% functionally obsolete bridges. The statewide costs to fix structurally deficient and functionally obsolete bridges are $734,451,000 and $1,597,918,000, respectively. The total statewide repair cost to address these immediate needs is $2,332,370,000.

**Table 9.I C unty road rehabilitation needs, average spending, and funding gap (rounded to thousands)**

| County | Paved Mileage | Needs | | Road Rehabilitation Spending | Annual Funding Gap – Scenario 1 | | Annual Funding Gap – Scenario 2 | | Annual Funding Gap – Scenario 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Immediate | 20-Year | | Year 1 | Years 2 – 20 | Years 1-3 | Years 4-10 | Years 1-5 | Years 6-20 |
| Allen | 1,254 | $11,035,000 | $64,679,000 | $3,643,000 | -$7,394,000 | $0 | -$2,419,000 | $0 | $0 | $0 |
| Cass | 674 | $21,130,000 | $50,910,000 | $1,106,000 | -$20,026,000 | -$452,000 | -$6,511,000 | -$534,462 | -$3,986,000 | -$579,000 |
| Daviess | 360 | $2,149,000 | $20,851,000 | Not Available | N/A | N/A | N/A | N/A | N/A | N/A |
| Dubois | 527 | $1,303,000 | $29,142,000 | $1,225,000 | -$77,000 | -$230,000 | $0 | -$271,114 | -$62,000 | -$276,000 |
| Elkhart | 1,069 | $12,379,000 | $67,113,000 | $2,543,000 | -$9,834,000 | -$328,000 | -$3,774,000 | -$279,111 | -$2,036,000 | -$392,000 |
| Hamilton | 568 | $1,573,000 | $34,115,000 | $898,000 | -$677,000 | -$801,000 | -$451,000 | -$855,252 | -$792,000 | -$795,000 |
| Harrison | 787 | $7,289,000 | $43,610,000 | $3,068,000 | -$4,222,000 | $0 | -$31,000 | $0 | $0 | $0 |
| Hendricks | 770 | $30,168,600 | $59,872,000 | Not Available | N/A | N/A | N/A | N/A | N/A | N/A |
| Henry | 678 | $33,859,00 0 | $59,613,00 | $947,000 | -$32,898,000 | -$408,000 | -$10,741,000 | -$495,887 | -$6,416,000 | -$572,000 |
| Huntington | 603 | $1,755,000 | $34,463,000` | $105,000 | -$1,649,000 | -$1,608,000 | -$540,000 | -$1,798,511 | -$1,372,000 | -$1,689,000 |
| Lake | 497 | $26,266,000 | $44,211,000 | $1,453,000 | -$24,827,00 | $506,000 | -$7,680,000 | $0 | -$4,174,000 | $0 |
| Marshall | 757 | $69,107,500 | $88,575,000 | $729,000 | -$68,379,000 | -$311,000 | -$22,496,000 | -$399,882 | -$13,234,000 | -$541,00 |
| Morgan | 664 | $49,149,000 | $68,426,000 | 1,332,000 | -$47,850,000 | $0 | -$15,195,000 | $0 | -$8,707,000 | $0 |
| Noble | 728 | $11,836,000 | $47,731,000 | 1,258,000 | -$10,581,000 | -$627,000 | -$4,106,000 | -$598,121 | -$2,443,000 | -$685,000 |
| Steuben | 419 | $19,500,000 | $33,906,000 | 793,000 | -$18,734,000 | $0 | -$5,841,000 | -$32,032 | -$3,280,000 | -$111,00 |
| Tippecanoe | 456 | $6,028,000 | $29,257,000 | $887,000 | -$5,141,00 | -$336,000 | -$1,852,0009 | -$350,595 | -$1,227,000 | -$359,00 |
| 14 County Total | 9,681 | $272,207,000 | $695,752,000 | $19,986,000 | -$252,289,000 | -$4,595,000 | -$81,639,000 | -$5,614,967 | -$47,730,000 | -$5,999,000 |
| Statewide Total | 56,760 | 1,598,817,000 | $4,076,659,000 | $119,233,000 | -$1,505,144,000 | -$27,411,000 | -$487,054,835 | -$33,498,000 | -$284,753,000 | -$35,791,000 |

Notes:

1. Hendricks and Daviess counties are excluded from the gap analysis because their Highway Operation Reports did not include costs for individual or collective pavement rehabilitation projects.
2. During the 2003-2014 period, counties received atypical funding in some years including additional MVH/LRS distributions and ARRA grants. As such, without similar additional distributions in the future, the estimated funding gap is conservative.

Source: Annual operational reports (County Highway form 16), 2003-2014, Section III Construction and Reconstruction.

**Table 10. Cost calculations for rehabilitation of structurally deficient and functionally obsolete bridges in Cass County**

| Structure Number | Features | Facility Carried | Deck | Length (ft) | Width (ft) | Deck NBI | Super-structure NBI | Sub-structure NBI | Culvert | Deck | Action | Improvement Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Structurally Deficient Bridges** | | | | | | | | | | | | |
| 0900014 | Hancock Ditch | CR 900 W | 3 | 27.88 | 18.0 | 4 | 4 | 4 | N | Steel | Replace Bridge | $737,037 |
| 0900056 | Crooked Creek | CRF 500 W | 3 | 37.0 | 40.0 | N | N | N | 4 | Steel | Replace Culvert | $ 207,747 |
| 0900077 | Minnow Creek | CR 325 @ | 3 | 31.5 | 40.0 | N | N | N | 4 | Steel | Replace Culvert | $176,493 |
| **Sub-total** | | | | | | | | | | | | **$1,233,406** |
| **Functionally Obsolete Bridges** | | | | | | | | | | | | |
| 0900090 | Big Rock Creek | CR 600 W | 3 | 26.5748 | 49.86877 | N | N | N | 6 | Steel | Replace Culvert | $ 204,088 |
| **Sub-total** | | | | | | | | | | | | **$204,088** |
| **Total Immediate Bridge Rehabilitation Needs** | | | | | | | | | | | | **$1,437,495** |

**Table 11. Immediate bridge rehabilitation costs for study counties (rounded to thousands)**

| Study | Bridges | Structurally Deficient Bridges | Functionally Obsolete Bridges | Repair Costs for Structurally Deficient Bridges | Repair Costs for Functionally Obsolete Bridges | Total Repair Cost |
|---|---|---|---|---|---|---|
| Allen | 390 | 44 | 29 | $30,780,000 | $49,154,000 | $79,935,000 |
| Cass | 121 | 3 | 1 | $1,233,000 | $204,000 | $1,437,000 |
| Daviess | 125 | 4 | 20 | $342,000 | $19,423,000 | $19,765,000 |
| Dubois | 164 | 14 | 16 | $7,071,000 | $14,291,000 | $21,362,000 |
| Elkhart | 172 | 14 | 24 | $7,368,000 | $38,960,000 | $46,327,000 |
| Hamilton | 305 | 0 | 32 | $0 | $50,965,000 | $50,965,000 |
| Harrison | 74 | 0 | 6 | $0 | $5,743,000 | $5,743,000 |
| Henry | 142 | 4 | 10 | $2,619,000 | $4,309,000 | $6,928,000 |
| Hendricks | 240 | 19 | 39 | $17,382,000 | $32,402,000 | $49,783,000 |
| Huntington | 114 | 3 | 4 | $3,819,000 | $8,604,000 | $12,423,000 |
| Lake | 178 | 22 | 32 | $26,690,000 | $67,911,000 | $94,601,000 |
| Marshall | 116 | 9 | 4 | $9,922,000 | $5,416,000 | $15,337,000 |
| Morgan | 140 | 22 | 14 | $18,177,000 | $10,335,000 | $28,512,000 |
| Noble | 64 | 13 | 2 | $13,362,000 | $1,898,000 | $15,260,000 |
| Steuben | 49 | 0 | 0 | 0 | 0 | 0 |
| Tippecanoe | 208 | 14 | 14 | $9,520,000 | $25,405,000 | $34,924,000 |
| 16-County Total | 2,602 | 185 | 247 | $148,285,000 | $335,019,000 | $483,304,000 |
| Statewide Total | 13,090 | 939 | 1,244 | $734,451,000 | $1,597,918,000 | $2,332,370,000 |

Note:The number of bridges statewide comes directly from the 2014 Federal Highway Bridge Database The remaining statewide figures are calculated.

Sources:
1. 2014 Federal Highway Bridge Database, Federal Highway Administration
2. Indiana Bridge Inspection Application System (BIAS), Indiana Department of Transportation.

Unlike for road rehabilitation, deterioration curves are not available for bridges. Bridge design is more varied, depending on factors such as steel or concrete construction, the type of bridge, weather effects, etc. A true 20-year bridge rehabilitation cost would then be the immediate needs ($2,332,370,000) plus the cost to address ongoing deterioration.

## Bridge rehabilitation spending

Annual average bridge rehabilitation spending was calculated by aggregating the cost of bridge projects identified as "new/rehabilitation" that had existing bridge inventory numbers by year from Annual operational reports (County Highway form 16). *Section III - Construction and reconstruction projects* (Table 12). Projects that were purchased using municipal bonds were excluded. Hendricks County did not report project costs on Section III for any of these years. They are excluded from the spending and spending gap analyses for bridge rehabilitation.

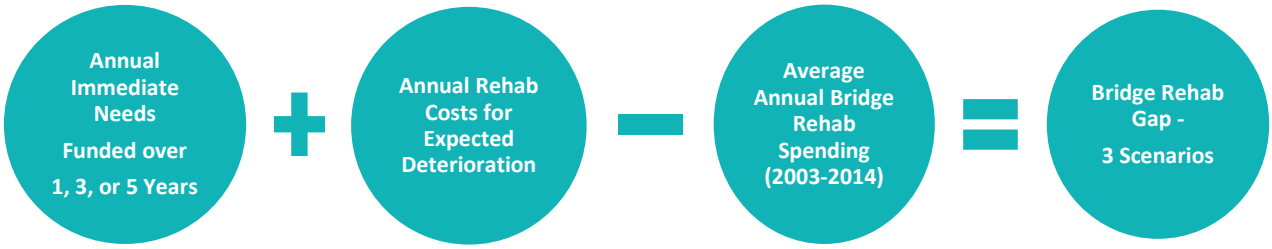
Average annual spending per county was calculated using the years for which each county had normal Section III data. Spending in the 15 counties are totaled and extrapolated to a statewide number using the relative number of bridges.

## Bridge rehabilitation funding gap

The bridge rehabilitation funding gap is the difference between needs and annual spending. As shown in Table 12, the spending gap was calculated for three separate scenarios that spread the immediate needs over 1, 3, and 5 years. In each, the bridge rehabilitation needs for the initial (1 year, 1-3 years, or 1-5 years) and subsequent time periods were compared to average annual spending. In cases when local average spending exceeds the annualized period needs, the gap was reset to zero. This decision was made because (1) funding is not fungible across counties and (2) the likelihood that funding will be repurposed for other county priorities. This resulted in zeroing out the calculated surplus for Allen, Harrison, Lake, Morgan, and Steuben counties for the years after the immediate needs are addressed. The adjusted gap was aggregated across the counties with available data. The 15-county study gap was extrapolated to a statewide county gap using the relative number of bridges. The costs associated with bridges that will deteriorate to either structurally deficient or functionally obsolete in the future is unknown. These costs are delineated by adding the term "- deterioration costs."

The annualized 20-year statewide immediate need bridge rehab gap is an estimated -$36,632,000 plus the cost of future deterioration). Under Scenario 1, in which the immediate bridge rehabilitation needs are assigned to Year 1, the Year 1 funding gap is -$2.2 billion. Under Scenario 2, in which immediate needs are spread over Years 1-3, the Years 1-3 annual funding gap is -$651 million plus cost to address deterioration). For Scenario 3, in which immediate needs are spread over Years 1-5, the Years 1-5 annual funding gap is -$340 million plus cost to address deterioration). During the 2003-2014 period, counties received atypical funding in some years including additional MVH/LRS distributions and ARRA grants. The costs of ongoing deterioration also is unknown. Given these two realities, the estimated funding gap is conservative.

**Figure 4. Bridge rehabilitation funding gap schematic**




## Comparing studies of local road and bridge needs

Several studies over the last seven years document local road and bridge needs. All indicate the need and funding gap for counties and cities and towns is real and large (Table 13). Comparing them is difficult because none of the studies are a direct match. Each has a different perspective on assessing Indiana's local infrastructure, with differences in geographic scope, time horizon, and methodology.

The current study addresses only the roads and bridges under the jurisdiction of county governments and took an engineering based approach using condition ratings from inspections of roads and bridges, published deterioration effects on pavements and repair and construction costs collected by INDOT and LTAP, and published county highway department annual operations reports to calculate needs and funding gaps. The needs calculations are based on a 20-year time horizon that captures an initial rehab event for all roads and then a second event for many. Needs calculations also assume that rehabilitation will be made to establish at least a good level of quality. This was accomplished by using data collected in 16 counties, approximately 19 percent of the rural road miles and bridges in the state, and extrapolating from those data to determine statewide numbers.

In 2009, LTAP published the study *Needs assessment for local roads and streets*. Results were based on road scan data and bridge data collected in eight counties. The LTAP study had a smaller representative sample than the one used in the current study and included city and town road miles. For rehab of county roads and bridges, this report estimates $4.7 billion in immediate needs and $800 million in long-term annual needs.

In 2012, the MPO Council published *Infrastructure funding vs need for MPO regions* documenting road and bridge needs for the ten-year time period 2015-2025. The study estimates needs in 39 MPO counties and included cities and towns using lifecycle costs for pavements and bridges and MPO project lists. Reported needs were approximately $15.5 billion for current roads and bridges and $8.8 billion in new capacity projects during this time period. Needs are reported in the aggregate. They are not parsed for counties and cities and towns.

In 2014, the Indiana Soybean Alliance commissioned the *Indiana Transportation Infrastructure Survey* (Strategic Marketing and Research, Inc. LLC, 2014). This was a statewide survey with 325 responses from cities and counties representing 86 of the 92 counties. The reported spending gap was approximately $413 million for a 3-4 year time horizon and $579 million for a 5-10 year time horizon. These needs include road and bridge maintenance and preservation and some new capacity. Needs are reported in the aggregate. They are not parsed for counties and cities and towns.

**Table 12. County bridge rehabilitation needs, average spending, and funding gap (rounded to thousands)**

| County | Bridges | Needs | | Annual Bridge Rehabilitation Spending (2003-2014) | Annual Spending Gap – Scenario 1 | | Annual Spending Gap – Scenario 2 | | Annual Spending Gap – Scenario 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Immediate | 20-Year | | Year 1 | Years 2 – 20 | Years 1-3 | Years 4-10 | Years 1-5 | Years 6-20 |
| Allen | 390 | $79,935,000 | Immediate + deterioration | $3,926,000 | -$12,061,000 | Spending - Deterioration | -($22,719,000 + Deterioration) | Spending - Deterioration | -($12,061,000 + Deterioration) | Spending - Deterioration |
| Cass | 121 | $1,437,000 | Immediate + deterioration | $732,000 | $445,000 | Spending - Deterioration | -Deterioration | Spending - Deterioration | -Deterioration | Spending - Deterioration |
| Daviess | 125 | $19,765,000 | Immediate + deterioration | $162,000 | -$3,791,000 | Spending - Deterioration | -($6,427,000 + Deterioration) | Spending - Deterioration | -($3,791,000 + Deterioration) | Spending - Deterioration |
| Dubois | 164 | $21,362,000 | Immediate + deterioration | $204,000 | -$4,068,000 | Spending - Deterioration | -($6,917,000 + Deterioration) | Spending - Deterioration | -($4,068,000 + Deterioration) | Spending - Deterioration |
| Elkhart | 172 | $46,327,000 | Immediate + deterioration | $3,355,000 | -$5,911,000 | Spending - Deterioration | -($12,088,000 + Deterioration) | Spending - Deterioration | -($5,911,000 + Deterioration) | Spending - Deterioration |
| Hamilton | 305 | $50,965,000 | Immediate + deterioration | $3,461,000 | -$6,732,000 | Spending - Deterioration | -($13,527,000 + Deterioration) | Spending - Deterioration | -($6,732,000 + Deterioration) | Spending - Deterioration |
| Harrison | 74 | $5,743,000 | Immediate + deterioration | $588, | -$561,000 | Spending - Deterioration | -($1,326,433 | Spending - Deterioration | -($561,000 + Deterioration) | Spending - Deterioration |
| Hendricks | 142 | $49,783,000 | Immediate + deterioration | Not available | N/A | N/A | N/A | N/A | N/A | N/A |
| Henry | 240 | $6,928,000 | Immediate + deterioration | $389,000 | -$996,000 | Spending - Deterioration | -($1,920,000 + Deterioration) | Spending - Deterioration | -($996,000 + Deterioration) | Spending - Deterioration |
| Huntington | 114 | $12,423,000 | Immediate + deterioration | $447,000 | -$2,038,000 | Spending - Deterioration | -($3,695,000 + Deterioration) | Spending - Deterioration | -($2,038,000 + Deterioration) | Spending - Deterioration |
| Lake | 178 | $94,601,000 | Immediate + deterioration | $1,453,000 | -$17,467,000 | Spending - Deterioration | -($30,081,000 + Deterioration) | Spending - Deterioration | -($17,467,000 + Deterioration) | Spending - Deterioration |
| Marshall | 116 | $15,337,000 | Immediate + deterioration | $601,000 | -$2,466,000 | Spending - Deterioration | -($4,511,000 + Deterioration) | Spending - Deterioration | -($2,466,000 + Deterioration) | Spending - Deterioration |
| Morgan | 140 | $28,512,000 | Immediate + deterioration | $703,000 | -$4,999,000 | Spending - Deterioration | -($8,801,000 + Deterioration) | Spending - Deterioration | -($4,999,000 + Deterioration) | Spending - Deterioration |
| Noble | 64 | $15,260,000 | Immediate + deterioration | $254,000 | -$2,798,000 | Spending - Deterioration | -($4,833,000 + Deterioration) | Spending - Deterioration | -($2,798,000 + Deterioration) | Spending - Deterioration |
| Steuben | 49 | $0 | Immediate + deterioration | $46,000 | $0 | Spending - Deterioration | -Deterioration | Spending - Deterioration | -Deterioration | Spending - Deterioration |
| Tippecanoe | 208 | $34,924,000 | Immediate + deterioration | $4,555,000 | -$2,430,000 | Spending - Deterioration | -($7,086,000 + Deterioration) | Spending - Deterioration | -($2,430,000 + Deterioration) | Spending - Deterioration |
| 15 County Total | 2,362 | $433,521,000 | Immediate + deterioration | $20,876,683 | -$412,690,000 | Spending - Deterioration | -($123,930,000 + Deterioration) | Spending - Deterioration | -($66,318,000 + Deterioration) | Spending - Deterioration |
| Statewide Total | 13,090 | $2,332,370,000 | Immediate + deterioration | $126,050,000 | -$2,206,320,000 | Spending - Deterioration | -($651,407,000 + Deterioration) | Spending - Deterioration | -($340,424,000 + Deterioration) | Spending - Deterioration |

Notes:
1. Hendricks County is excluded from the gap analysis because their Highway Operation Reports did not include costs for individual bridge projects.
2. During the 2003-2014 period, counties received atypical funding in some years including additional MVH/LRS distributions and ARRA grants. As such, without similar additional distributions in the future, the estimated funding gap is conservative.

Source: Annual operational reports (County Highway form 16), 2003-2014, Section III Construction and Reconstruction

**Table 13. Comparing transportation needs studies**

| Study | Geographic Coverage | Time | Roads and Bridges | Need | Funding Available | Gap |
|---|---|---|---|---|---|---|
| LTAP (2009) | Cities, towns, and counties statewide. Rehab only, no new capacity. | Short-term and annual costs for 5-10 years | Road and Streets | Short-term:<br>Counties (paved) - $1.92 billion<br>Counties (gravel) - $39 million (materials only)<br>Cities and towns - $1.542 billion<br>Total: $3.50 billion<br><br>Long-term (maintenance cycle) annual:<br>County (paved) - $413 million<br>County (gravel) - $31 million (materials only)<br>Cities and towns - $350 million<br>Total: $794 million<br><br>Extrapolated from 8 county road condition survey to establish PASER and IRI ratings (Adams, Fayette, Floyd, Fountain, Hamilton, Lawrence, Pike, and White counties). Cost to upgrade roads that reach PASER 4 or less) using cost only of surface treatments and functional overlays. | Counties - $44.2 million (LRS) annually<br>Cities and towns - $35 million annually<br>Total: $79 million annually | Short-term need +<br><br>Long-term annual:<br>Counties - $400 million<br>Cities and towns - $315 million<br>Total: $715 million |
| | | | Bridges | Short-term:<br>Bridges - $962 million<br>Culverts - $207 million<br>Total – $1.169 billion<br><br>Long-term (annual):<br>Bridges - $144 million<br>Culverts - $67 million<br>Total - $207 million | $90 million annual (including cumulative bridge, major bridge, federal aid) | Short-term need +<br><br>$117 million annual |
| | | | Traffic Safety | Traffic signs (short-term)<br>Counties - $7 million<br>Cities and towns - $16 million<br>Total - $22 million<br><br>Traffic signs (long-term, annual):<br>All: $6 million<br><br>Pavement markings (short-term)<br>Counties - $20 million<br>Cities and towns – no data<br><br>Minimum pavement width (short-term):<br>$684 million | No dedicated funds for these purposes | Short-term needs for pavement markings and pavement width<br><br>Traffic signs - $6 million annual |

**Table 13. Comparing transportation needs studies (continued)**

| Study | Geographic Coverage | Time | Roads and Bridges | Need | Funding Available | Gap |
|---|---|---|---|---|---|---|
| MPO Council (2012) | Cities, towns, and counties in 39 MPO counties (Bartholomew, Boone, Carroll, Clark, Clay, Dearborn, DeKalb, Delaware, Elkhart, Floyd, Gibson, Hamilton, Hancock, Hendricks, Howard, Johnson, Kosciusko, Lake, LaPorte, Madison, Marion, Marshall, Monroe, Morgan, Parke, Porter, Posey, Putnam, Shelby, St. Joseph, Sullivan, Tippecanoe, Vanderburgh, Vermillion, Vigo, Warrick, and Wells counties)<br><br>76% of state population (4,950,207)<br>55% of paved road mileage (36,966 mile)<br>52% of bridges (6,672)<br>Some of the projects identified here are for desired new capacity. | 2015-2025 | Pavement Program | 10 Year: $11.684 billion<br>Annual: $870 million<br><br>Source: Life cycle needs and 2010 costs per mile | 10 Year: $1.578 billion<br>Annual: $158 million<br><br>Sources: MVH, LRS, LOHUT distributions, local engineers | 10 Year: $10 billion<br>Annual: $712 million<br><br>Unmet annual need: 82% |
| | | | Major Projects | $8.874 billion<br><br>Source: MPO project list, including local and state roads (fiscally constrained projects additional illustrative projects identified) | | |
| | | | Bridge Program | 10 Year: $3.824 billion<br>Annual: $285 million<br><br>Source: Life cycle needs, 2010 bridge costs, local engineers. | 10 Year: $602 million<br><br>Annual: $60 million<br>Sources: Current rehabilitation and reconstruction costs, local engineers | 10 Year: $3.223 billion<br>Annual: $225 million |
| | | | Bridge Projects | $1.004 billion (to address 805 structurally deficient and 783 functional obsolete). | | |
| Indiana Transportation Infrastructure Survey (2014) – SMARI LLC/Indiana Soybean Alliance | Statewide (survey of 325 city and county officials from 86 of 92 counties responded). Survey respondents indicated that the biggest need is for road rehabilitation, but some of the need identified here could be for new capacity. | Annual Short-term (3-4 years)<br><br>Annual Long-term (5-10 years) | Roads and Bridges | | | Annual (3-4 years): $413 million<br>Annual (5-10 years): $579 million |
| LTAP/IU PPI (2016) | County Roads and Bridges Statewide (based on 16 county sample including Allen, Cass, Daviess, Dubois, Elkhart, Hamilton, Hendricks, Henry, Hamilton, Huntington, Lake, Marshall, Morgan, Noble, Steuben, and Tippecanoe counties) – Rehab only, no new infrastructure | 20 Years including short-term costs and annual costs. | Roads | Pavement Rehab<br><br>Short-term: $1.599 billion<br><br>Long-term (includes short-term): Paved – $4.076 billion | | If counties spend an historical average annual amount (2003-2014) on rehabilitation and immediate needs are spread over 5 years, the annual gap for road rehab in years 1-5 is $284 million and in years 6-20 is $36 million. |
| | | | Bridges | Short-term:<br>$2.332 billion<br><br>Long-term:<br>Cost associated with bridges that deteriorate. (Reliable data for the deterioration of bridges over time does not exist currently) | | If counties spend an historical average annual amount (2003-2014) on rehabilitation and immediate needs are spread over 5 years, the annual gap for bridge rehab in years 1-5 is $340 million. This does not include additional needs that will be associated with bridge deterioration for bridges not currently designated functionally obsolete or structurally deficient. |

# The Need Established, Now What?

The General Assembly has made numerous changes to the state's road funding formulas over recent legislative sessions. The 2016 session saw more of those changes. With HB 1001, the General Assembly created the Funding Indiana's Roads for a Stronger, Safer Tomorrow (FIRSST) Task Force charged to produce a comprehensive transportation funding plan for action in the 2017 budget session. It also created new sources of local tax revenue, which included a number of policy changes that could affect funding for rural roads. Among the provisions in the bill are the following:

- A new transfer of state reserves exceeding 11.5 percent of general revenue appropriations. The State Highway Fund will receive 55 percent of the money and the newly-created Local Road and Bridge Matching Grant Fund will get 45 percent.
- Incentivizes use of transportation asset management plans approved by the Indiana Department of Transportation (INDOT) by allowing a county that uses a plan to impose the county vehicle excise surtax and the county wheel tax at higher rates and to participate in the Local Road and Bridge Matching Grant Fund.
- Authorizes local municipalities to impose their own vehicle excise surtax and wheel tax.
- Diverts $100 million from the Major Moves 2020 Trust Fund to the State Highway Fund and stipulates the money must be used to preserve and reconstruct existing roads under INDOT's jurisdiction.

According to the fiscal note prepared by the Legislative Services Agency, all of this would mean an extra $319.4 million for the State Highway Fund and $185 million for the new Local Road and Bridge Matching Grant Fund in 2017 (Indiana Legislative Services Agency, 2016b). Counties could realize $183 million more a year if all used asset management plans and implemented the county excise surtax and wheel tax. Municipalities would realize an estimated $90 million more if each one implemented these taxes at maximum rates.

The legislation creates a significant new pool of matching grants for counties, cities, and towns to tap, but it also requires them to implement asset-management plans and raise additional revenue through increased or newly implemented excise surtaxes and wheel taxes. The General Assembly clearly believes in helping those that help themselves when it comes to funding rural roads, a trend that likely will continue in the 2017 session and beyond.

With Senate Bill 67 (2016), the General Assembly provided a one-time $504 million burst of funding for local roads by tapping the local option income tax (LOIT) trust fund. The move reduced the LOIT trust to about 15 percent and distributed the remaining funds based on existing formulas. The bill also dictated "75 percent of the distributions made to a county, city, or town must be: (1) used exclusively for local road construction, maintenance, or repair, or capital projects for aviation, including capital projects of an airport authority; or (2) deposited in a rainy day fund and later used for those purposes. It provides that any remaining distribution to a county, city, or town may be used for any purposes of the county, city, or town (Indiana Legislative Services Agency, 2016b)." The benefits of the new access to these funds vary widely by county. For example, Vermillion County along the Illinois border did not receive any funds from the new disbursement while suburban Hamilton County received the largest distribution at $65.7 million. This is not a surprise given the way local option income taxes are collected and disbursed in Indiana. Most of the state's population lives in urban or suburban counties, which accounts for the clustering of LOIT collections and disbursements. It also means relatively little of the half-billion dollar windfall will reach projects for rural roads and bridges.

While these bills provide additional resources to address local road and bridge needs, they are not enough to address all needs identified in this and other studies. The network of rural roads and bridges under the jurisdiction of county governments and the gap between current and needed funding for rehabilitation are vast. Clearly, more state support is needed, but funds to address the entire rehabilitation funding gap and needs for new infrastructure and maintenance seems unlikely. In addition, the complex formula for distributing increases to gas tax or a replacement

source may not deliver adequate resources to all counties. In light of that, local governments must identify additional local resources, make choices among local needs, and do more to wring additional utility out of all federal, state, and local dollars. The remainder of this section of the report addresses several funding options and tools to increase the efficiency and effectiveness of existing resources.

# Funding and financing options

The first group of tools address the identification of additional financial resources, including increasing state motor fuel taxes, maximizing the adoption of LOHUT, and using financing and cost sharing mechanisms.

## *Augment motor fuel taxes*

Several developments over the past decades have put pressure on road and infrastructure funding. Some of those developments are related to technological progress (e.g., increased fuel economy) while others are related to either policy (e.g., non-adjustment of fuel taxes to inflation) or the state of the economy (e.g., reduction in vehicle miles traveled due to economic downturn). The current primary revenue-related issue for transportation infrastructure is the extent to which construction and maintenance are tied to gasoline and diesel consumption. This applies to Indiana, other states, and to the federal level. Transportation revenues from all states have stagnated since 2001 and road construction and maintenance expenditures have outpaced revenues.

Gasoline and diesel taxes are the primary source of transportation funding in Indiana.[2] Due to inflation and improved fuel efficiency, these taxes are increasingly inadequate to maintain the transportation system. The research team provides a forecast of Indiana's fuel tax revenue based on the current policy and three alternative taxation options: (1) indexing to inflation, (2) indexing to inflation and fuel economy, and (3) a vehicles miles traveled (VMT) fee on vehicles. These projections indicate that by 2035, revenue from fuel taxes will decrease by 41.0 percent under the current taxation policy. Indexing fuel taxes to inflation results in a decrease in the tax revenue by 12.4 percent. Indexing using only inflation is inadequate to maintain funding (in real dollars) because fuel efficiency outpaces inflation. Indexing fuel taxes to inflation and fuel economy increases the fuel tax revenue by 30.1 percent in 2035. Switching to a mileage fee increases revenue by 22.9 percent by 2035.

The current tax structure and fuel economy are the two principal reasons for the stagnation of fuel tax revenue in real terms (Greene, 2011; Gomez & Vassallo, 2013).[3] First, the non-adjustment of the cents-per-gallon fuel tax leads to a decrease of the real fuel tax rate over time due to inflation. For example, the Indiana gasoline and diesel taxes were set to $0.18 and $0.16 in 2003 and 1997, respectively. Since the last adopted increase (2003-2015), the purchasing power of the gasoline tax declined by 22 percent. Since the last adopted increase (1997-2015), the purchasing power of the diesel tax has decreased 31 percent. Second, the increase in fuel efficiency is outpacing the increase in VMT. With increasing population and miles driven, the consumption of gasoline, diesel, and other fuels should be expected to increase. However, since fuel economy is increasing as well, and more importantly at a faster pace, total fuel consumption is decreasing. In 2012, the average fuel efficiency of the U.S. light-duty vehicle fleet was 23.3 and 17.1 miles per gallon (MPG) for short wheelbase and long wheelbase vehicles, respectively. Newly sold 2015 midsize gasoline cars and large gasoline pick-up trucks have average fuel efficiencies of 35.5 and 25.7 MPG, respectively. Those values are expected to increase to 41.7 MPG by 2020 and to 50.0 MPG by 2025.

The consequences of these changes are visible in the revenue available to maintain Indiana infrastructure. Between 2003 and 2013, the amount of money distributed annually to the Indiana Department of Transportation (INDOT), counties, and cities and towns decreased on average by 3.1 percent, 2.4 percent, and 2.4 percent, respectively. Note that between 1985 and 2014, gasoline and diesel consumption increased annually by 0.7 percent and 2.1 percent,

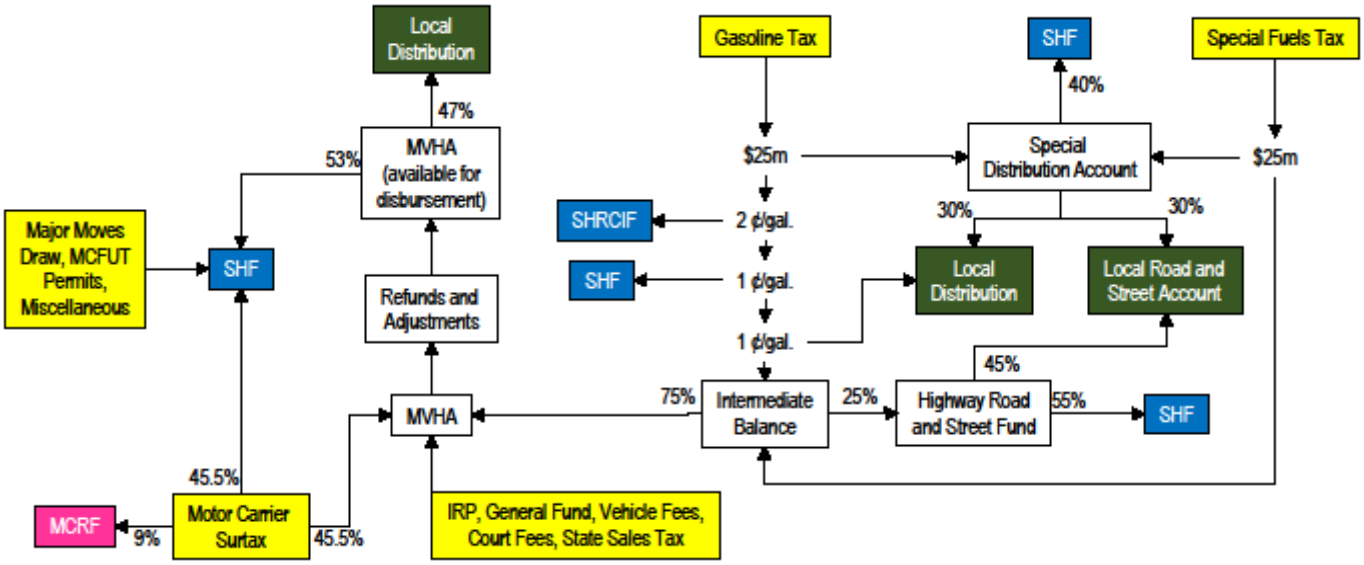
[2] Indiana has taxes on gasoline and "special fuels" (diesel and E85). Our model includes all three fuels but since gasoline and diesel are responsible for the majority of the revenue, we simply refer to it as "gasoline and diesel taxes" or collectively as "fuel taxes."
[3] Note that all dollar values in this section are in real 2015 dollars.

respectively, but fuel tax revenue decreased in real terms by 0.9 percent annually because the increase in total VMT is offset by an increase in fuel efficiency for gasoline.[4]

## *Modelling fuel tax revenue and distribution*

The basis for taxation of various transportation revenue-generating systems can be broadly categorized as vehicle ownership (e.g., registration fees, licensing fees), highway user fees (e.g., VMT fees, tolling, congestion pricing), energy consumption (e.g., motor fuel taxes, sales taxes on fuels), and beneficiary/local option fees (e.g., transportation impact fee) (TRB, 2011). Fuel tax revenue is determined by the aggregate amount of gasoline and diesel purchased which depends on multiple factors, including but not limited to fuel prices, tax rates, number of vehicles, fuel economy, VMT per vehicle, and other factors. To project Indiana gasoline and diesel tax revenue over the next 20 years (2016 - 2035), the research team constructed a forecasting model based on the 2014 Annual Energy Outlook (AEO) (U.S. Energy Information Administration, 2014). The advantage of using the AEO projections is that they already take into account the evolution of vehicle composition and fuel economy based on macroeconomic factors, technological progress, and policies. The model also relies on estimates from literature to supplement missing or inconsistent data. All modeling utilizes the 2014 AEO reference case which assumes no change in current policies and a 2.4 percent average annual growth of gross domestic product (GDP) until 2040. Nineteen vehicle types are modeled including automobiles, buses, trucks, truck tractors, and motorcycles differentiated by public and private ownership.

**Figure 5. Simplified distribution chart for Indiana transportation funding**




Note: A detailed version for 2015 can be found in the Indiana Handbook of Taxes, Revenues, and Appropriations available at https://iga.in.gov/legislative/2014/publications/handbooks/

As shown in Figure 5, the Motor Vehicle Highway Account (MVHA) is funded by gasoline and diesel taxes as well as by Major Moves Draw, Motor Carrier Fuel Use Tax (MCFUT), vehicle fees (registration, title, and license fees), Motor Carrier Surtax, International Registration Plan (IRP), states sales tax, and miscellaneous revenues.[5] Not all collected vehicle fees are made available to the MVHA. A portion of the fees are reserved for Crossroads 2000 and are used for the reconstruction of state highways. In addition, the 1969 rate increase in vehicle fees is allocated to the Highway Road & Street Fund. In July 2014, Indiana replaced the prepaid sales tax with a gasoline use tax that is based on the

[4] Revenue reported to the Federal Highway Administration (FHWA): https://www.fhwa.dot.gov/policyinformation/statistics.cfm

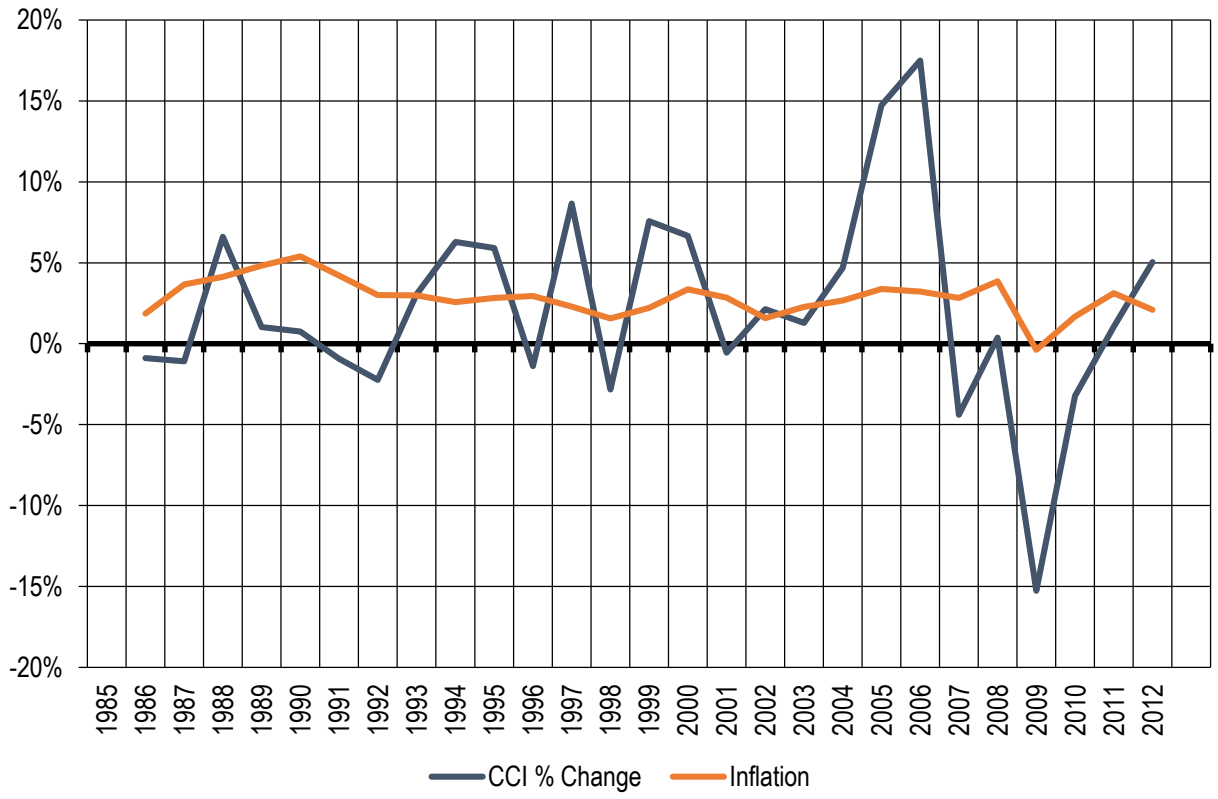
[5] The gasoline and diesel tax revenue is modeled explicitly based on the AEO projections whereas the other revenue sources are forecasted either using a linear or a log-linear trend based on the data from 2003-2015.

average price (excluding state and federal taxes) in the previous month. The model includes the use tax as part of the cost incurred by drivers since it depends on the price of gasoline. The revenue from this use tax goes to the general fund and is not reported in this section.[6]

### *Scenarios*

The model shows how 2016 tax revenue, $769 million, will change in the future and its sensitivity to various policies. In particular, the model is used to explore three alternative policy scenarios in addition to the baseline. In a first scenario, fuel taxes are indexed to inflation using the Consumer Price Index (CPI). Alternatively, the value of the gasoline and diesel tax could be indexed using the National Highway Construction Cost Index (NHCCI). However, the variability of the NHCCI makes a reliable prediction of fuel tax revenue and the amount charged to drivers difficult to achieve (Figure 6). In a second scenario, fuel taxes are indexed to inflation and the fleet fuel economy of vehicles, addressing both the non-adjustment of fuel taxes to inflation and increasing fuel economy. The third scenario, analyzes the revenue associated with implementing a VMT fee.

**Figure 6. Comparing the National Highway Construction Cost Index and the Consumer Price Index**




The VMT fee is held constant in real terms over the projection period to avoid decreasing buying power. The fee is imposed in the amount of the current state excise tax for five vehicle categories: (1) cars, (2) light trucks, (3) light-, (4) medium-, and (5) heavy-duty freight vehicles. This categorization groups vehicles of similar weights in one category. Assuming that fuel taxes as well as VMT fees are implemented to pay for road wear and tear, vehicles that have a similar weight and cause similar damage pay the same amount. The increase in tax revenue in the VMT fee scenario is linked to the number of vehicles on the road and the amount of miles driven. Note that the results with respect to

[6] Our model and projections do not include special cases or one time transfers from the general fund to the MVHA.

the VMT fee include battery electric vehicles that were not included in the previous scenarios since they do not use motor fuel.

### *State level forecasts (2016-2035)*

The model shows that the amount of gasoline consumed in Indiana will decline from 2.995 to 2.094 billion gallons between 2016 and 2035, down 1.8 percent annually and more than 30 percent in the aggregate (Table 14). This decline is the result of an increase in fuel economy despite the increase in population and the associated increase in VMT. For diesel, consumption increases from 1.517 to 1.872 billion gallons over the same period which represents an annual increase of 1.1 percent. Diesel consumption will increase due to an increasing number of freight trucks and stagnating fuel economy improvements for heavy trucks (Figure 7). Gasoline and diesel consumption are very inelastic with respect to price and thus, consumption is not significantly influenced by the tax policy chosen.

The effect of decreasing gasoline consumption on tax revenue is exacerbated by the non-adjustment of the fuel tax to inflation. The gasoline and diesel tax rates are currently $0.18 and $0.16 per gallon, respectively. Because those rates are not adjusted to inflation, the real value of those rates will be $0.121 and $0.107, respectively in 2035. The effect of the increase in fuel efficiency and the decrease in the real tax rate are shown in Figure 8. Over the 20-year period, the cumulative amount of revenue generated from fuel taxes in the baseline will be $11.922 billion. Annual fuel tax revenue will be $454 million in 2035.

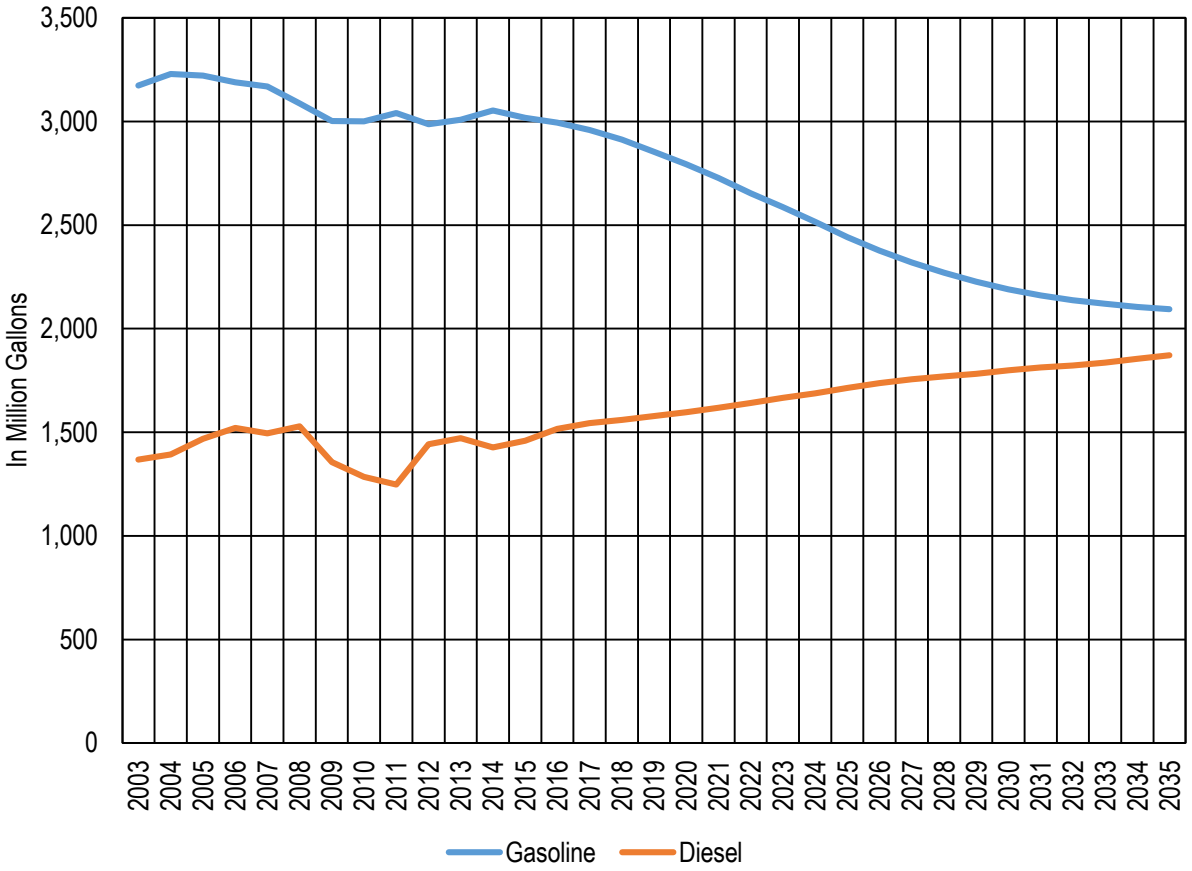
**Table 14. Fuel consumption, tax revenue, and tax distributions by scenario (2016-2035; 2015 dollars)**

| | | 2035 | | | | 2035 (Percent Change) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2016 | Base-line | CPI | CPI-MPG | VMT | Base-line | CPI | CPI-MPG | VMT |
| **Consumption (in million gallons)** | | | | | | | | | |
| Gasoline | 2,995 | 2,094 | 2,081 | 2,064 | 2,055 | -30.1% | -30.5% | -31.1% | -31.4% |
| Diesel | 1,517 | 1,872 | 1,871 | 1,869 | 1,095 | 23.5% | 23.4% | 23.2% | -27.8% |
| **Excise tax revenue (in million dollars)** | | | | | | | | | |
| Total | $769 | $454 | $674 | $1,001 | $945 | -41.0% | -12.4% | 30.1% | 22.9% |
| Gasoline | $530 | $253 | $375 | $555 | | -52.4% | -29.4% | 4.6% | |
| Diesel | $239 | $201 | $299 | $446 | | -15.9% | 25.4% | 87.0% | |
| **Revenue to state, counties, and cities from all sources (in million dollars)** | | | | | | | | | |
| SHF INDOT | $592 | $416 | $534 | $709 | | -29.7% | -9.8% | 19.8% | |
| Counties | $339 | $237 | $305 | $408 | | -30.1% | -9.9% | 20.3% | |
| Cities and Towns | $147 | $138 | $149 | $162 | | -6.1% | 1.0% | 10.4% | |

Notes:
1. "All sources" include gasoline and diesel taxes, Major Moves Draw, permits, sales tax, etc.
2. Local Road and Street Account funds are distributed to counties, cities, and towns based on population, road mileage, and vehicle registrations.

Linking gasoline and diesel tax rates to the CPI generates $14.33 billion of cumulative revenue over 20 years. Linking the fuel taxes to inflation leads to a decrease in excise tax revenue from $769 million in 2016 to $674 million in 2035 due to improved fuel efficiency. This is, however, more revenue that in the baseline scenario ($454 million in 2035). The real gasoline and diesel tax rates would be maintained at $0.18 and $0.16 per gallon, respectively.

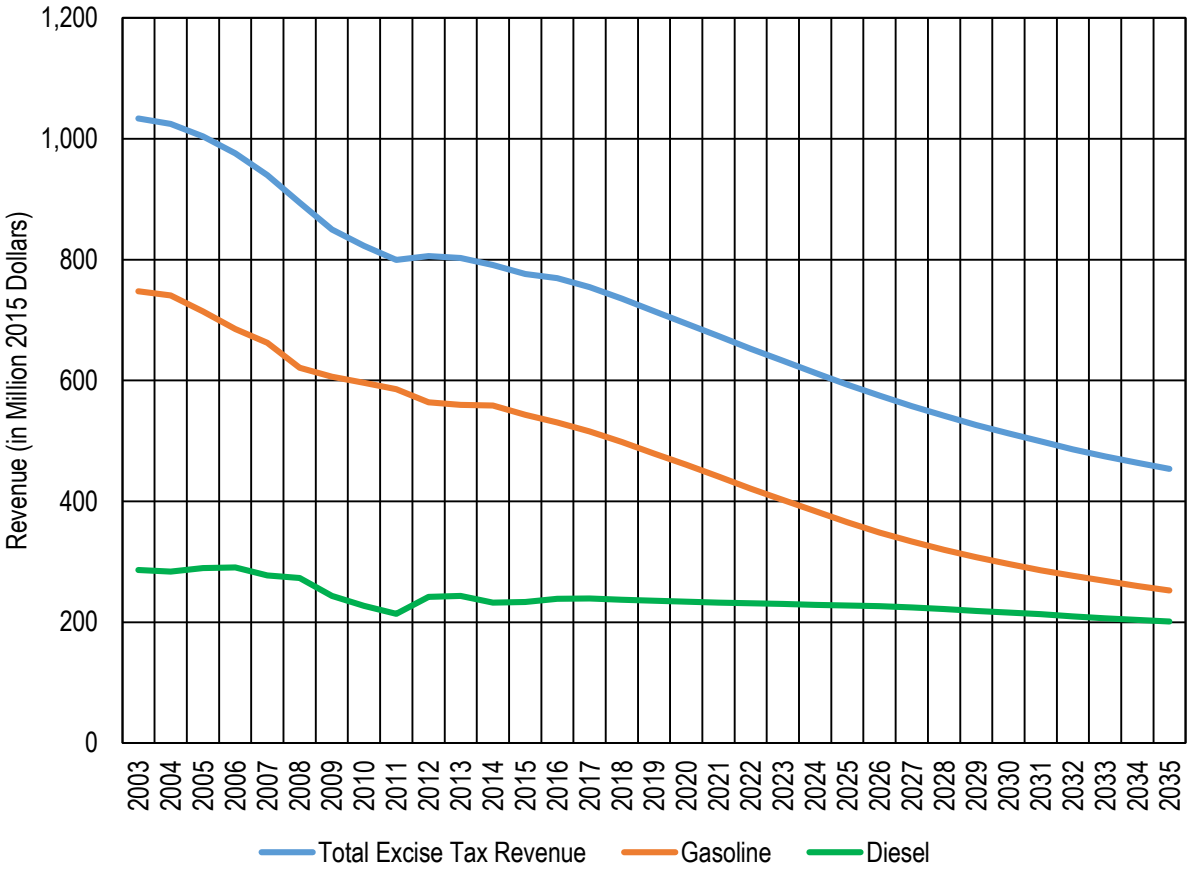
**Figure 7. Consumption of gasoline and diesel under the baseline (in million gallons)**




Linking the fuel tax to inflation and the increase in fuel economy generates $1,001 billion annual excise tax revenue in 2035 or a total of $17.737 billion over 20 years. The real gasoline and diesel tax rates would be $0.266 and $0.236 per gallon for 2035, respectively.

Replacing the current fuel taxes with a VMT fee generates $945 million in 2035 which is relatively close to revenue generated by indexing fuel taxes to inflation and the increase in MPG. A total of $17.534 billion is collected over the projection period. The similarity of results between the VMT fee and the CPI/MPG-indexed fuel tax can be explained intuitively by the fact that the indexing holds the current fuel tax rate constant over time and thus, the difference between the revenue is due to the vehicle miles driven under both scenarios. Revenue distributions to the state, counties, and cities and towns for the VMT fee is not included in Table 14 since a restructuring of the current distribution scheme would be necessary as revenue would no longer be differentiated by fuel. The scenario linking fuel taxes to inflation and the fuel economy might be more realistic in the short- to medium-run since the VMT fee is challenged by societal and political acceptance.

**Figure 8. Excise tax revenue for the baseline scenario**




### *Local level forecast*

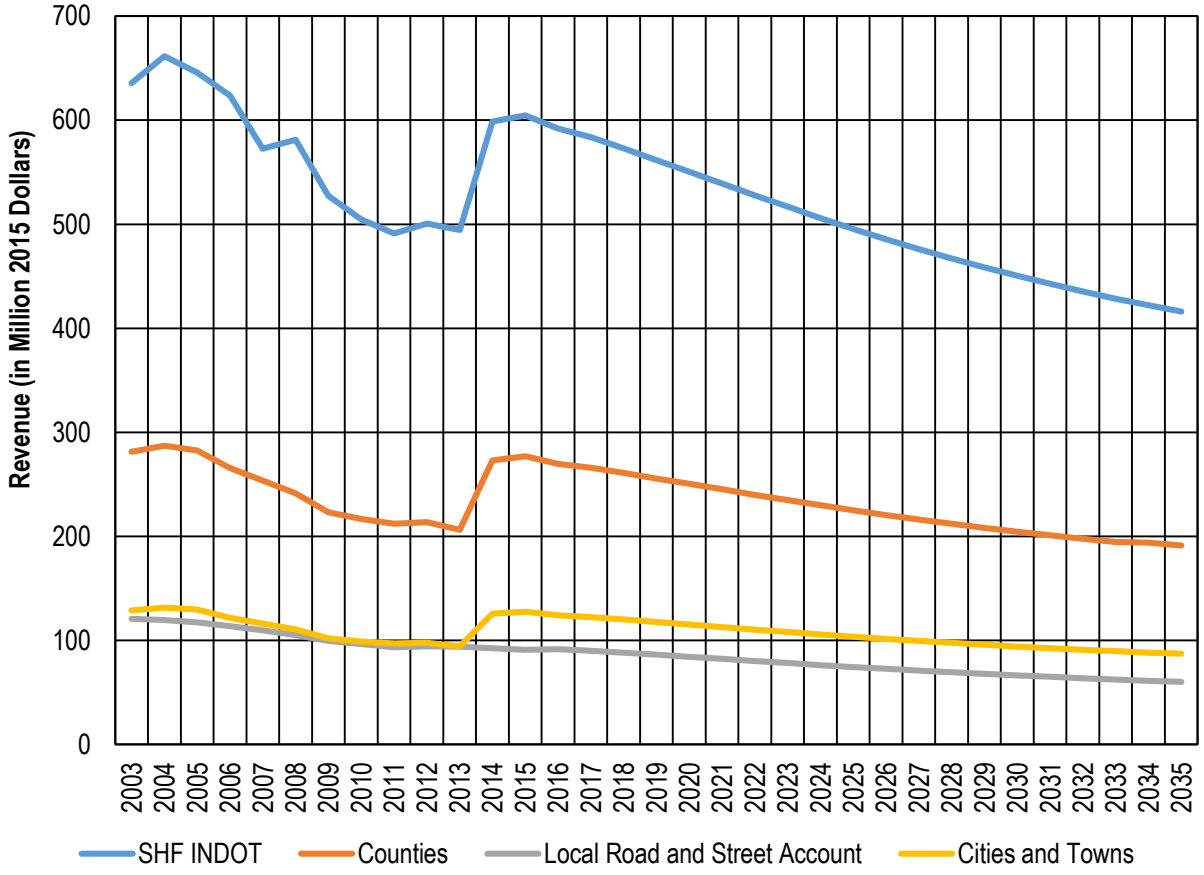
Local governments receive distribution through two elements of the distribution schematic shown in Figure 5: "local distributions" and Local Road and Street Account distributions (Indiana Legislative Services Agency, 2016a). From "local distributions", cities and towns receive 31.9 percent and the allocation is based on population. Counties receive 68.1 percent from the "local distribution" and the distribution is as follows: 5 percent is distributed equally to all counties; 30 percent is distributed to counties based on vehicle registration; and the remaining 65 percent goes to the counties based on road mileage. For example, in 2016, counties will receive approximately $270 million (68.1 percent from the "local distribution"), and cities and towns receive approximately $124 million (31.9 percent). For the Local Road and Street Account**,** a two-step method of distribution is implemented. Funds are allocated to counties proportionally based on car registrations. In counties with population more than 50,000, 60 percent is based on the relative population of the unit to total population of the county and 40 percent is based on the ratio of the unit's street mileage to total road mileage in the county. In counties with population less than 50,000, 20 percent is based on the relative population of the unit to total population of the county and 80 percent is based on ratio of unit's street mileage to total road mileage in the county. Units, in this case, include counties, cities, and towns.

Table 15 and Figure 9 show the distributions of revenue to the State Highway Fund (SHF INDOT), counties, Local Roads and Street Account, and cities and towns. The amount of revenue received by counties and cities, and towns from the Special Distribution Account will not change by including sales tax revenue or increasing the gasoline and diesel tax because funding of the account is fixed at $50 million. The increase from 2013 to 2014 is due to the transfer of 1 percent of the sales tax to the MVHA as well as the transfer of expenses, such as for the State Police and the Bureau of Motor Vehicles to other revenue sources. The increase in fuel economy as well as the subsequent decline in fuel consumption are independent of political and macroeconomic decisions and conditions. The 2015 Annual Energy Outlook projects an increase in gasoline and diesel prices by 2.14 percent and 2.31 percent annually,

and in real terms over the 2015 growth rates do not result in more revenue since gasoline and diesel prices have been particularly low over the last year.

Table 14 illustrates that the decline in revenue available at the local level is not translated 1:1 from the decline of the fuel tax since other types of revenue are included (Figure 5). It is noteworthy that the decline for the average county and/or city and town under the baseline is between 29.7 percent and 30.1 percent whereas fuel tax revenue declines by 41 percent. Also, while indexing the fuel tax to inflation, the decline of revenue between 2016 and 2035 ranges between 7.3 percent and 9.9 percent. Table 16 shows the revenue to counties from all sources in 2016, 2035 and the cumulative amount for the baseline as well as the two indexing scenarios.

**Figure 9. Distribution of the Motor Vehicle Highway Account (MVHA) funding including fuel taxes and all other revenues**




Note: The Local Road and Street Account is distributed to counties and cities and towns.

**Table 15. Tax revenue distributions by scenario and by county (2015 dollars in millions)**

| County | 2016 | 2035 ($ millions) | | | Cumulative 2016 to 2035 ($ millions) | | |
|---|---|---|---|---|---|---|---|
| | | Baseline | CPI | CPI-MPG | Baseline | CPI | CPI-MPG |
| Adams | 2.78 | 1.95 | 2.50 | 3.32 | 46.37 | 52.05 | 60.33 |
| Allen | 9.66 | 6.70 | 8.72 | 11.73 | 160.45 | 181.37 | 211.88 |
| Bartholomew | 3.65 | 2.55 | 3.29 | 4.40 | 60.84 | 68.49 | 79.66 |
| Benton | 2.20 | 1.55 | 1.98 | 2.61 | 36.81 | 41.20 | 47.61 |
| Blackford | 1.35 | 0.95 | 1.22 | 1.61 | 22.56 | 25.31 | 29.34 |
| Boone | 3.45 | 2.42 | 3.11 | 4.14 | 57.53 | 64.70 | 75.14 |
| Brown | 1.68 | 1.18 | 1.51 | 2.01 | 28.01 | 31.45 | 36.45 |
| Carroll | 2.80 | 1.97 | 2.52 | 3.34 | 46.74 | 52.41 | 60.67 |
| Cass | 3.44 | 2.41 | 3.10 | 4.12 | 57.38 | 64.45 | 74.76 |
| Clark | 3.50 | 2.44 | 3.16 | 4.24 | 58.28 | 65.79 | 76.74 |
| Clay | 2.62 | 1.84 | 2.36 | 3.13 | 43.70 | 49.04 | 56.84 |
| Clinton | 3.06 | 2.15 | 2.75 | 3.66 | 51.05 | 57.34 | 66.51 |
| Crawford | 1.66 | 1.17 | 1.49 | 1.97 | 27.68 | 31.01 | 35.87 |
| Daviess | 3.03 | 2.13 | 2.73 | 3.62 | 50.62 | 56.78 | 65.76 |
| Dearborn | 2.81 | 1.97 | 2.53 | 3.36 | 46.80 | 52.59 | 61.03 |
| Decatur | 2.56 | 1.80 | 2.30 | 3.06 | 42.68 | 47.91 | 55.52 |
| DeKalb | 3.18 | 2.23 | 2.87 | 3.82 | 53.10 | 59.68 | 69.28 |
| Delaware | 4.20 | 2.93 | 3.78 | 5.07 | 69.84 | 78.73 | 91.69 |
| Dubois | 3.02 | 2.11 | 2.72 | 3.62 | 50.30 | 56.55 | 65.66 |
| Elkhart | 7.20 | 5.02 | 6.49 | 8.69 | 119.88 | 135.11 | 157.32 |
| Fayette | 1.73 | 1.21 | 1.56 | 2.07 | 28.86 | 32.44 | 37.65 |
| Floyd | 2.68 | 1.87 | 2.42 | 3.23 | 44.61 | 50.29 | 58.56 |
| Fountain | 2.39 | 1.68 | 2.15 | 2.85 | 39.97 | 44.82 | 51.90 |
| Franklin | 2.52 | 1.77 | 2.26 | 3.00 | 41.99 | 47.12 | 54.60 |
| Fulton | 2.85 | 2.01 | 2.56 | 3.39 | 47.57 | 53.33 | 61.73 |
| Gibson | 3.59 | 2.52 | 3.23 | 4.29 | 59.96 | 67.31 | 78.02 |
| Grant | 3.65 | 2.55 | 3.29 | 4.39 | 60.77 | 68.39 | 79.50 |
| Greene | 3.35 | 2.35 | 3.01 | 4.00 | 55.85 | 62.70 | 72.68 |
| Hamilton | 6.49 | 4.49 | 5.86 | 7.90 | 107.69 | 121.87 | 142.55 |
| Hancock | 3.63 | 2.54 | 3.27 | 4.36 | 60.43 | 67.99 | 79.00 |
| Harrison | 3.54 | 2.48 | 3.18 | 4.24 | 58.97 | 66.29 | 76.95 |
| Hendricks | 5.31 | 3.70 | 4.79 | 6.41 | 88.39 | 99.62 | 116.00 |
| Henry | 3.44 | 2.41 | 3.10 | 4.13 | 57.38 | 64.54 | 74.97 |
| Howard | 3.43 | 2.40 | 3.10 | 4.14 | 57.20 | 64.43 | 74.97 |
| Huntington | 2.91 | 2.03 | 2.62 | 3.48 | 48.44 | 54.45 | 63.23 |
| Jackson | 3.22 | 2.25 | 2.90 | 3.86 | 53.60 | 60.27 | 70.01 |
| Jasper | 3.63 | 2.55 | 3.27 | 4.35 | 60.65 | 68.09 | 78.94 |
| Jay | 2.68 | 1.89 | 2.41 | 3.20 | 44.79 | 50.22 | 58.13 |
| Jefferson | 2.39 | 1.68 | 2.15 | 2.86 | 39.84 | 44.76 | 51.93 |
| Jennings | 2.70 | 1.90 | 2.43 | 3.23 | 45.14 | 50.68 | 58.75 |
| Johnson | 4.48 | 3.11 | 4.04 | 5.42 | 74.44 | 84.02 | 97.98 |
| Knox | 3.39 | 2.38 | 3.05 | 4.06 | 56.61 | 63.57 | 73.72 |
| Kosciusko | 5.26 | 3.69 | 4.73 | 6.29 | 87.71 | 98.52 | 114.28 |
| LaGrange | 3.04 | 2.14 | 2.73 | 3.63 | 50.75 | 56.93 | 65.95 |
| Lake | 7.69 | 5.31 | 6.95 | 9.40 | 127.51 | 144.53 | 169.34 |
| LaPorte | 5.32 | 3.71 | 4.79 | 6.40 | 88.53 | 99.69 | 115.98 |
| Lawrence | 3.07 | 2.15 | 2.77 | 3.69 | 51.22 | 57.59 | 66.87 |

**Table 15. Tax revenue distributions by scenario and by county (2015 dollars in millions) (continued)**

| County | 2016 | 2035 ($ millions) | | | Cumulative 2016 to 2035 ($ millions) | | |
|---|---|---|---|---|---|---|---|
| | | Baseline | CPI | CPI-MPG | Baseline | CPI | CPI-MPG |
| Madison | 4.99 | 3.48 | 4.50 | 6.03 | 83.08 | 93.66 | 109.10 |
| Marion | 38.36 | 26.43 | 34.68 | 46.99 | 635.83 | 721.41 | 846.13 |
| Marshall | 3.84 | 2.69 | 3.45 | 4.60 | 63.96 | 71.89 | 83.44 |
| Martin | 1.44 | 1.01 | 1.30 | 1.72 | 24.07 | 26.98 | 31.22 |
| Miami | 3.15 | 2.21 | 2.84 | 3.77 | 52.59 | 59.04 | 68.45 |
| Monroe | 4.16 | 2.90 | 3.75 | 5.03 | 69.32 | 78.14 | 90.99 |
| Montgomery | 3.36 | 2.36 | 3.02 | 4.02 | 56.04 | 62.96 | 73.05 |
| Morgan | 3.80 | 2.66 | 3.42 | 4.57 | 63.31 | 71.23 | 82.78 |
| Newton | 2.36 | 1.67 | 2.12 | 2.81 | 39.48 | 44.23 | 51.16 |
| Noble | 3.53 | 2.47 | 3.18 | 4.23 | 58.86 | 66.14 | 76.75 |
| Ohio | 0.69 | 0.48 | 0.62 | 0.82 | 11.47 | 12.87 | 14.91 |
| Orange | 2.28 | 1.61 | 2.05 | 2.72 | 38.13 | 42.77 | 49.54 |
| Owen | 2.43 | 1.71 | 2.19 | 2.90 | 40.60 | 45.55 | 52.75 |
| Parke | 2.56 | 1.81 | 2.30 | 3.05 | 42.81 | 47.96 | 55.47 |
| Perry | 1.95 | 1.37 | 1.76 | 2.33 | 32.58 | 36.58 | 42.41 |
| Pike | 1.98 | 1.40 | 1.79 | 2.36 | 33.17 | 37.16 | 42.99 |
| Porter | 5.53 | 3.85 | 4.99 | 6.68 | 92.02 | 103.79 | 120.95 |
| Posey | 2.78 | 1.95 | 2.50 | 3.32 | 46.41 | 52.08 | 60.36 |
| Pulaski | 2.90 | 2.05 | 2.61 | 3.44 | 48.47 | 54.27 | 62.73 |
| Putnam | 3.07 | 2.15 | 2.77 | 3.68 | 51.23 | 57.56 | 66.79 |
| Randolph | 3.13 | 2.20 | 2.81 | 3.73 | 52.19 | 58.56 | 67.85 |
| Ripley | 2.89 | 2.03 | 2.60 | 3.46 | 48.21 | 54.16 | 62.83 |
| Rush | 2.67 | 1.88 | 2.40 | 3.18 | 44.57 | 49.96 | 57.81 |
| Scott | 1.56 | 1.08 | 1.41 | 1.91 | 25.92 | 29.39 | 34.43 |
| Shelby | 3.56 | 2.51 | 3.20 | 4.25 | 59.50 | 66.71 | 77.22 |
| Spencer | 2.74 | 1.92 | 2.47 | 3.29 | 45.63 | 51.33 | 59.64 |
| St. Joseph | 8.01 | 5.65 | 7.20 | 9.51 | 133.92 | 149.92 | 173.25 |
| Starke | 2.62 | 1.84 | 2.36 | 3.12 | 43.71 | 49.03 | 56.79 |
| Steuben | 2.75 | 1.92 | 2.47 | 3.29 | 45.79 | 51.47 | 59.77 |
| Sullivan | 3.00 | 2.12 | 2.70 | 3.58 | 50.20 | 56.25 | 65.07 |
| Switzerland | 1.37 | 0.97 | 1.23 | 1.63 | 22.93 | 25.68 | 29.71 |
| Tippecanoe | 5.36 | 3.74 | 4.83 | 6.47 | 89.22 | 100.56 | 117.10 |
| Tipton | 2.12 | 1.49 | 1.90 | 2.53 | 35.35 | 39.65 | 45.91 |
| Union | 1.07 | 0.75 | 0.96 | 1.28 | 17.91 | 20.07 | 23.23 |
| Vanderburgh | 4.88 | 3.39 | 4.41 | 5.92 | 81.20 | 91.71 | 107.04 |
| Vermillion | 1.61 | 1.14 | 1.45 | 1.93 | 26.96 | 30.25 | 35.04 |
| Vigo | 4.27 | 2.98 | 3.85 | 5.14 | 71.15 | 80.10 | 93.16 |
| Wabash | 2.95 | 2.07 | 2.65 | 3.53 | 49.16 | 55.25 | 64.12 |
| Warren | 1.91 | 1.35 | 1.71 | 2.26 | 31.87 | 35.68 | 41.24 |
| Warrick | 3.73 | 2.62 | 3.36 | 4.47 | 62.32 | 69.98 | 81.14 |
| Washington | 2.98 | 2.10 | 2.69 | 3.56 | 49.82 | 55.91 | 64.79 |
| Wayne | 3.37 | 2.35 | 3.04 | 4.06 | 56.14 | 63.21 | 73.52 |
| Wells | 2.82 | 1.98 | 2.54 | 3.37 | 47.05 | 52.81 | 61.22 |
| White | 3.33 | 2.34 | 2.99 | 3.97 | 55.57 | 62.34 | 72.21 |
| Whitley | 2.79 | 1.95 | 2.51 | 3.34 | 46.45 | 52.22 | 60.64 |

### *Taxpayer impacts*

Policymakers and taxpayers are interested in the financial effects on individual drivers in terms of annual cost per vehicle and cost-per-mile. Table 16 shows the annual cost per vehicle for 2016, the baseline, and the three scenarios. For cars and light trucks, which constitute the majority of vehicles on the road, gasoline taxes are reduced under the baseline and the CPI scenario. As explained earlier, this is because of gains in fuel efficiency. Indexing fuel taxes to both CPI and for fuel efficiency increases gas taxes paid per vehicle increase, but very modestly. For medium- and heavy-duty trucks fuel efficiency is not improving as much over the projection period so the increases under the CPI-MPG and the VMT scenarios are greater.

**Table 16. Estimated annual fuel tax costs for selected vehicle types (2015 dollars)**

| | | 2035 | | | |
|---|---|---|---|---|---|
| Vehicle Type | 2016 | Baseline | CPI | CPI MPG | VMT |
| Gasoline Car | $95.16 | $46.56 | $72.46 | $110.77 | $113.31 |
| Gasoline Truck | $160.11 | $78.33 | $121.91 | $186.37 | $190.64 |
| Diesel Truck (Light Duty) | $103.86 | $55.87 | $87.24 | $134.01 | $168.90 |
| Diesel Truck (Freight Heavy Duty) | $2,073.24 | $1,340.15 | $1,965.60 | $2,900.34 | $2,154.26 |

For cars and light trucks, the cost per mile decreases for all policy scenarios (Table 17). This is a direct consequence of the increasing fuel efficiency which outpaces growth in VMT. In this context, it is important to understand that the cost per driver is decreasing under all tax scenarios and a change in tax rate only affects how much it decreases. This finding may be useful in communicating with taxpayers and increasing acceptance of a fiscal solution. Conversely, the potential policy argument that an increase in gasoline and diesel taxes would create additional burden for taxpayers is not valid. As noted above, the fuel efficiency for medium- and heavy-duty trucks is not improving significantly over the projection period and those vehicles are affected more by the increase in fuel price than the light trucks and cars.

The variation across the different tax policies is small which is due to the fact that the taxes are only a relatively small proportion of the overall cost-per-mile. It is the large amount of fuel consumed (gallons) and/or miles driven that makes a big difference in revenue if multiplied by a few cents in fuel tax or by the VMT fee, respectively.

**Table 17. Cost-per-mile (2015 Dollars) in 2016 and 2035 under various tax scenarios**

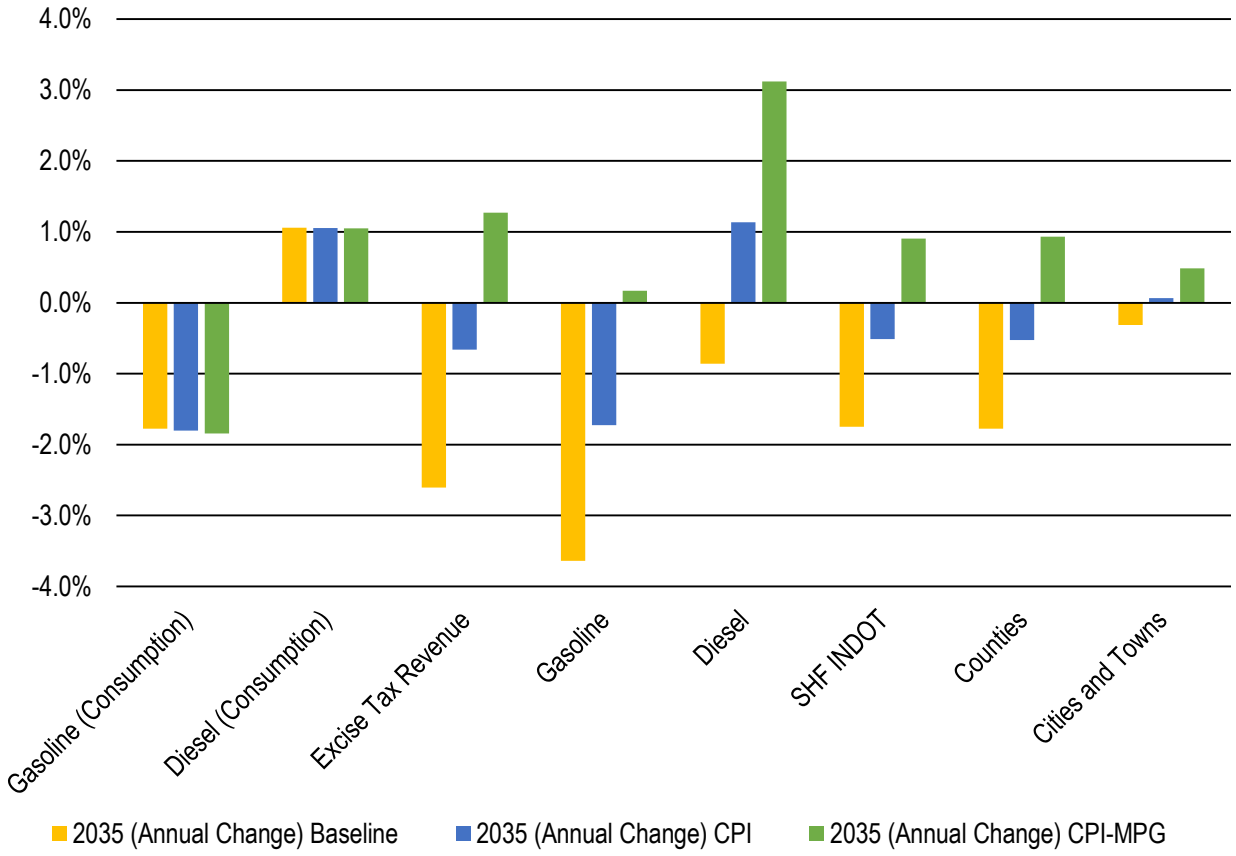
| | | 2035 | | | | 2035 (Percent Change) | | | |
|---|---|---|---|---|---|---|---|---|---|
| Vehicle Type | 2016 | Base-line | CPI | CPI-MPG | VMT | Base-line | CPI | CPI-MPG | VMT |
| Gasoline Car | $0.126 | $0.098 | $0.100 | $0.103 | $0.092 | -22.3 % | -20.5 % | -18.0 % | -26.8 % |
| Gasoline Truck | $0.171 | $0.133 | $0.136 | $0.141 | $0.125 | -22.3 % | -20.5 % | -18.0 % | -26.8 % |
| Diesel Truck (Light Duty) | $0.139 | $0.143 | $0.143 | $0.144 | $0.138 | 3.1 % | 3.5 % | 4.1 % | -0.7 % |
| Diesel Truck (Freight Heavy Duty) | $0.268 | $0.296 | $0.298 | $0.299 | $0.292 | 10.5 % | 10.9 % | 11.5 % | 8.8 % |

### *Discussion of results*

Figure 10 summarizes the effect of the baseline and the alternative tax scenarios on the tax revenue. The analysis above suggests that indexing fuel taxes to inflation or implementing a VMT-fee would address the challenge of financial sustainability by providing a revenue source that increases at or exceeds the rate of inflation between now and 2035. Policies that link fuel taxes to a measure of inflation would arrest the decreasing purchasing power of current revenue streams. While the fuel tax would remain constant in real terms, increases in population, real income, which ultimately drives up vehicle miles traveled, will result in increased revenue. However, the issue of increased fuel economy is not addressed by indexing fuel taxes to inflation.

From a revenue perspective, the VMT fee is the only scenario that is sustainable in the long-run since it is not linked to fuel economy. Indexing the fuel tax to inflation does not disconnect the motor fuel tax revenue from the increase in fuel efficiency. In the VMT scenario, the increase in revenue is linked to the number of vehicles on the road and the amount of miles driven. The adoption of a VMT fee, however, likely faces a number of challenges. The politics of adopting a taxing structure that requires the government to monitor driving habits is politically or technologically difficult to achieve in the near term (Duncan & Graham, 2013). There also is widespread public opposition to the enactment of a VMT fee, with reasons including that the taxation is unfair to rural drivers, to people who drive more as part of their job, to people who drive fuel-efficient vehicles, and to people who are concerned about privacy issues (Duncan & Graham, 2013). The VMT-fee does not encourage energy efficient vehicle design which could be cited as a potential disadvantage given the increasing concern about pollution and environmental damages. One possible solution could be to make the VMT fee a function of vehicle weight, fuel efficiency, type of road, and time-of-use.

**Figure 10. Summary of average annual fuel and revenue changes, 2016 and 2035, for baseline, CPI and CPI-MPG scenarios**




The predictability of tax revenue received by the state, counties, and cities and towns is an important issue for policymakers. Ideally, the policy chosen to address long-term road and bridge funding minimizes the exposure to fluctuations in prices and inflation. As aforementioned, the distribution of the proceeds from the gasoline and diesel tax to the local level is composed of three parts: (1) a fixed amount independent of the fuel consumption or the tax rate, (2) a fixed per gallon amount from the fuel consumption, and (3) a percentage of overall fuel consumption. There are advantages and disadvantages with each of those three components depending on the change of gasoline and diesel prices as well as inflation. The fixed amount is immune to fluctuations in the fuel consumption and the tax revenue. This can be advantageous in periods of declining prices but does not offer any additional revenue in case of a price increase. In addition, without any adjustment to inflation, the real value of this amount declines over time. The

same problem arises from a fixed-per-gallon amount channeled to the local level that is not only subject to inflation but also fluctuations with fuel consumption.

## *Local Option Highway User Tax (LOHUT)*

In 1980, the Indiana General Assembly introduced the LOHUT specifically for road and bridge funding. The LOHUT is composed of two county specific taxes (Ayers, 2012):

- Vehicle excise surtax: The surtax is paid at the time of registration and applied to cars, motorcycles and trucks under 11,000 pounds. The excise surtax ranges from 2 percent-10 percent of the excise tax and must be the same rate/amount on each motor vehicle depending on the original cost and age.
- Wheel tax: The wheel tax applied to all vehicles not subject to the surtax, e.g., buses, RVs, trailers, trucks, tractors. It ranges between $5 and $40 per vehicle and may differ within each vehicle category based on weight. Public entities and certain nonprofits are excluded.

Counties that adopt LOHUT must collect both component taxes. Also, taxes are paid at the time of registration and the state retains $0.15 per transaction. In total, 51 counties collect LOHUT and additional counties are considering implementing this tax (LTAP, 2016). In counties with populations of more than 50,000, 60 percent is distributed based on the relative population of the county, cities, and towns, and 40 percent based on the relative street mileage of these units. For counties with populations of 50,000 or less, 20 percent is distributed based on the relative population of the county, cities, and towns, and 80 percent based on the relative street mileage of these units.

As described above, HB 1001 and SB 67 allow counties to double the vehicle excise surtax and the wheel tax with the adoption of an approved INDOT transportation asset management plan (AMP). In addition, municipalities with a population greater than 10,000 are allowed to impose an additional municipal motor vehicle license excise tax and a municipal wheel tax.

Table 18 shows the range of costs to taxpayers per vehicle in counties adopting LOHUT prior to the 2016 legislation and post legislation with the adoption of an AMP. Tables 19 and 20 estimate potential LOHUT revenue by county with full adoption and without an AMP from 2017 to 2035. The revenue in the initial year is based on data from LTAP and represents an estimate for each county. Potential revenues from LOHUT are projected through 2035 using population projections since number of vehicles by county will ultimately be driven by the number of people in each county[7]. It is very difficult to estimate the growth in vehicles by county and thus, linking the growth in LOHUT to population is a good approximation.

Total estimated potential revenue from LOHUT adopted by counties in 2017 is $217 million and $108 million with and without AMP, respectively. Projected potential revenue in 2035 is estimated to be $228 million and $114 million with and without AMP, respectively. This represents an average annual statewide growth rate of 0.26 percent. The growth of revenue is not uniform across counties since some counties are projected to face a decline in population. The minimum and maximum growth of LOHUT by county is -0.96 percent (Blackford County) and 1.82 percent (Hamilton County) with a median of 0 percent.

[7] The population projections are available at http://www.stats.indiana.edu/pop_proj/index.html.

**Table 18. Range of costs per vehicle with adoption of LOHUT with and without the adoption of an asset management plan**

| LOHUT Component | Vehicles | Without Asset Management Plan | With Asset Management Plan |
|---|---|---|---|
| County Excise Surtax | • Passenger vehicles<br>• Motorcycles<br>• Trucks under 11,000 gross weight<br>• Motor driven cycles | $7.50 - $25.00 per vehicle* | $7.50 - $50.00 per vehicle* |
| County Wheel Tax | • Buses (except those owned by public entities, religious, or nonprofit youth organizations)<br>• Recreational vehicles<br>• Semi-trailers<br>• Tractors<br>• Trailers<br>• Trucks | $4.00 - $40.00 per vehicle | $4.00 - $80.00 per vehicle |

Note: *The range is based on the flat rate option that counties have when adopting the county license excise surtax. Most counties select this option. Counties also have the option to adopt a 2% – 10% rate without an asset management plan and a 2%-20% rate with an asset management plan. It is possible that in some cases, the amount paid by a particular motorist, may exceed $25.00 and $50.00, respectively.

**Table 19. Estimated Local Option Highway User Tax with an asset management plan (in million 2015 dollars)**

| County | 2035 | 2016-2035 | County | 2035 | 2016-2035 |
|---|---|---|---|---|---|
| Adams | 1.65 | 30.25 | Lawrence | 2.16 | 42.03 |
| Allen | 6.49 | 117.68 | Madison | 3.04 | 58.74 |
| Bartholomew | 2.48 | 45.80 | Marion | 40.88 | 749.46 |
| Benton | 0.49 | 9.66 | Marshall | 2.57 | 48.02 |
| Blackford | 0.53 | 11.01 | Martin | 0.59 | 11.39 |
| Boone | 2.30 | 39.59 | Miami | 1.72 | 33.83 |
| Brown | 1.22 | 24.18 | Monroe | 3.56 | 63.60 |
| Carroll | 1.27 | 24.65 | Montgomery | 1.84 | 35.34 |
| Cass | 1.68 | 32.78 | Morgan | 3.44 | 64.13 |
| Clark | 2.67 | 47.52 | Newton | 0.86 | 17.22 |
| Clay | 1.39 | 26.69 | Noble | 2.45 | 46.22 |
| Clinton | 1.51 | 29.06 | Ohio | 0.37 | 6.96 |
| Crawford | 0.65 | 12.71 | Orange | 1.39 | 26.50 |
| Daviess | 1.79 | 32.03 | Owen | 1.27 | 24.91 |
| Dearborn | 2.52 | 46.64 | Parke | 0.89 | 17.53 |
| Decatur | 1.40 | 26.31 | Perry | 0.96 | 18.77 |
| DeKalb | 2.19 | 41.26 | Pike | 0.82 | 15.82 |
| Delaware | 2.18 | 42.19 | Porter | 4.81 | 86.86 |
| Dubois | 2.25 | 41.94 | Posey | 1.41 | 28.63 |
| Elkhart | 6.78 | 122.39 | Pulaski | 0.85 | 16.90 |
| Fayette | 0.93 | 18.60 | Putnam | 1.89 | 35.67 |
| Floyd | 1.70 | 31.73 | Randolph | 1.25 | 24.73 |
| Fountain | 0.87 | 17.41 | Ripley | 1.85 | 33.96 |
| Franklin | 1.50 | 28.11 | Rush | 0.93 | 18.73 |
| Fulton | 1.26 | 24.05 | Scott | 1.16 | 21.71 |
| Gibson | 1.83 | 34.08 | Shelby | 2.27 | 43.28 |
| Grant | 1.67 | 33.12 | Spencer | 1.28 | 24.79 |
| Greene | 1.71 | 33.16 | St. Joseph | 6.10 | 115.04 |
| Hamilton | 4.07 | 66.47 | Starke | 1.39 | 26.92 |
| Hancock | 3.24 | 56.07 | Steuben | 1.86 | 36.17 |
| Harrison | 2.82 | 51.15 | Sullivan | 1.02 | 19.90 |
| Hendricks | 5.90 | 98.16 | Switzerland | 0.69 | 12.13 |
| Henry | 2.02 | 39.99 | Tippecanoe | 4.34 | 77.80 |
| Howard | 2.21 | 43.16 | Tipton | 0.86 | 17.25 |
| Huntington | 1.65 | 32.54 | Union | 0.44 | 8.36 |
| Jackson | 2.22 | 42.03 | Vanderburgh | 3.85 | 71.82 |
| Jasper | 2.32 | 41.98 | Vermillion | 0.72 | 14.24 |
| Jay | 1.06 | 20.29 | Vigo | 2.63 | 49.97 |
| Jefferson | 1.52 | 29.05 | Wabash | 1.50 | 30.02 |
| Jennings | 1.72 | 32.15 | Warren | 0.61 | 11.71 |
| Johnson | 3.97 | 69.29 | Warrick | 3.38 | 60.93 |
| Knox | 1.74 | 33.70 | Washington | 1.69 | 31.62 |
| Kosciusko | 3.76 | 70.06 | Wayne | 1.65 | 32.08 |
| LaGrange | 1.98 | 36.14 | Wells | 1.52 | 29.23 |
| Lake | 2.86 | 53.73 | White | 1.42 | 28.12 |
| LaPorte | 3.43 | 65.81 | Whitley | 2.13 | 39.58 |

**Table 20. Estimated Local Option Highway User Tax (LOHUT) without an asset management plan (in million 2015 dollars)**

| County | 2035 | 2016-2035 | County | 2035 | 2016-2035 |
|---|---|---|---|---|---|
| Adams | 0.82 | 15.08 | Lawrence | 1.08 | 20.96 |
| Allen | 3.23 | 58.67 | Madison | 1.51 | 29.29 |
| Bartholomew | 1.24 | 22.84 | Marion | 20.38 | 373.65 |
| Benton | 0.24 | 4.82 | Marshall | 1.28 | 23.95 |
| Blackford | 0.26 | 5.49 | Martin | 0.29 | 5.68 |
| Boone | 1.15 | 19.74 | Miami | 0.86 | 16.87 |
| Brown | 0.61 | 12.05 | Monroe | 1.78 | 31.71 |
| Carroll | 0.63 | 12.29 | Montgomery | 0.92 | 17.62 |
| Cass | 0.84 | 16.34 | Morgan | 1.72 | 31.98 |
| Clark | 1.33 | 23.70 | Newton | 0.43 | 8.59 |
| Clay | 0.69 | 13.31 | Noble | 1.22 | 23.05 |
| Clinton | 0.75 | 14.49 | Ohio | 0.19 | 3.50 |
| Crawford | 0.32 | 6.34 | Orange | 0.69 | 13.22 |
| Daviess | 0.89 | 15.97 | Owen | 0.63 | 12.42 |
| Dearborn | 1.26 | 23.25 | Parke | 0.44 | 8.74 |
| Decatur | 0.70 | 13.12 | Perry | 0.48 | 9.36 |
| DeKalb | 1.09 | 20.57 | Pike | 0.41 | 7.89 |
| Delaware | 1.09 | 21.04 | Porter | 2.40 | 43.31 |
| Dubois | 1.12 | 20.91 | Posey | 0.70 | 14.27 |
| Elkhart | 3.38 | 61.03 | Pulaski | 0.43 | 8.43 |
| Fayette | 0.46 | 9.28 | Putnam | 0.94 | 17.79 |
| Floyd | 0.85 | 15.82 | Randolph | 0.62 | 12.33 |
| Fountain | 0.44 | 8.68 | Ripley | 0.92 | 16.93 |
| Franklin | 0.75 | 14.02 | Rush | 0.47 | 9.34 |
| Fulton | 0.63 | 11.99 | Scott | 0.58 | 10.82 |
| Gibson | 0.91 | 16.99 | Shelby | 1.13 | 21.58 |
| Grant | 0.83 | 16.52 | Spencer | 0.64 | 12.36 |
| Greene | 0.85 | 16.53 | St. Joseph | 3.04 | 57.36 |
| Hamilton | 2.03 | 33.14 | Starke | 0.69 | 13.42 |
| Hancock | 1.62 | 27.95 | Steuben | 0.93 | 18.04 |
| Harrison | 1.41 | 25.50 | Sullivan | 0.51 | 9.92 |
| Hendricks | 2.94 | 48.94 | Switzerland | 0.34 | 6.05 |
| Henry | 1.01 | 19.94 | Tippecanoe | 2.17 | 38.79 |
| Howard | 1.10 | 21.52 | Tipton | 0.43 | 8.60 |
| Huntington | 0.82 | 16.22 | Union | 0.22 | 4.17 |
| Jackson | 1.11 | 20.96 | Vanderburgh | 1.92 | 35.81 |
| Jasper | 1.16 | 20.94 | Vermillion | 0.36 | 7.10 |
| Jay | 0.53 | 10.12 | Vigo | 1.31 | 24.92 |
| Jefferson | 0.76 | 14.49 | Wabash | 0.75 | 14.97 |
| Jennings | 0.86 | 16.03 | Warren | 0.30 | 5.84 |
| Johnson | 1.98 | 34.55 | Warrick | 1.68 | 30.38 |
| Knox | 0.87 | 16.80 | Washington | 0.84 | 15.77 |
| Kosciusko | 1.88 | 34.94 | Wayne | 0.82 | 16.00 |
| LaGrange | 0.99 | 18.02 | Wells | 0.76 | 14.57 |
| Lake | 1.42 | 26.74 | White | 0.71 | 14.02 |
| LaPorte | 1.71 | 32.81 | Whitley | 1.06 | 19.74 |

## *Utilize debt to complete additional projects in the short-term*

For some counties, it may take decades to clear the significant immediate needs for road and bridge rehabilitation. Debt, in some form, may allow some counties to undertake additional projects in the short-term.

Debt instruments provide access to additional funds in the short-run that can be paid back with revenue over time. Indiana communities have long employed a "pay as you go" strategy, using current revenue or savings from previous year's revenues (fund balances) to purchase infrastructure. Debt can provide a method for amassing the resources necessary to make critical capital investments that could not be made otherwise. Debt also allows the cost of the infrastructure (principal and interest) to be borne by the users of the infrastructure rather than by previous users/taxpayers.

### ***Bonding***

Tax exempt municipal bonds are one form of debt instrument available. A few counties with sufficient population and the administrative and financial wherewithal are using this option. It probably is not a prudent choice for many rural counties with small populations and tax bases (Elmer, 2005a):

Benefits:

- Access to resources
- Benefit from the present value of future funding
- Tax exempt status of the bonds can provide interest rate benefits to the borrowing entity

Challenges:

- Significant administrative costs make it not a cost effective tool for small projects
- Requires a financial advisory and bond counsel; small local governments may find managing a bit daunting

#### ***Commercial lending***

Counties may choose to use traditional commercial lending:

Benefits:

- Community banks may be willing to make smaller loans
- Allows projects to be completed more quickly than otherwise
- The process for completing the loan is very much like loans made to individuals

Challenges:

- It may be difficult to identify banks that are willing to lend
- Interest rates are likely to be higher than for the other debt options
- As with all loans, the county must have the clear ability re-pay the loan

#### ***State infrastructure bank***

Indiana created a state infrastructure bank (SIB) in 1997 under the pilot program established by the National Highway System Designation Act of 1995 with a capitalization grant of $3,390,000. States were required to match the federal money with a 20 percent match. (Federal Highway Administration, USDOT, 2016). The number of loans made through this source has been limited. In 2008, there had been two loan agreements distributing $6 million. In 2012, there was at least one additional loan for $4.3 million. Using the Indiana State Infrastructure Bank program typically would require a similar level financial administrative capacity as local governments that issue tax exempt bonds.

State infrastructure banks are essentially revolving fund mechanisms to finance highway and transit projects. SIBs typically provide projects direct loans with attractive interest rates (Burwell & Puentes, 2009). Federally-funded SIBs are capitalized with Federal-aid surface transportation funds and matching State funds. Several states have established SIBs or separate SIB accounts capitalized solely with state funds. As loans or other credit assistance

forms are repaid to the SIB, its initial capital is replenished and can be used to support a new cycle of projects (Federal Highway Administration, USDOT, 2016).

An SIB acts as a lender or a guarantor. Thus, the SIB has to be concerned with returns on the investment, often by prioritizing projects with their own revenue streams or by collecting payments comprised of future tax revenues if the borrower is a county, city, or special district. This distinction means that the ability for repayment is often one of the key criteria for an SIB in selecting projects to fund, and that often these projects include ongoing revenue streams through tolls or other user fees (Christman & Riordan, 2011):

Benefits:

- Below-market interest rates and loan guarantees
- Can provide funding in a timely manner, reducing delays that may occur with other types of funding
- Revolving program provides ongoing opportunities to borrow

Challenges:

- May be difficulty in identifying revenue streams for smaller-scale local projects
- State's project backlog may tie up federal highway funds
- Other credit options in the municipal bond market may cause underutilization of the SIB
- Federal requirements must be met for these loans (state-only funded banks avoid this disadvantage)
- The Indiana SIB would need to be further capitalized to be an effective tool for local governments

### *Indiana Bond Bank – Pool Program and Community Funding Resource*

The Indiana Bond Bank has a number of programs to help local governments. The current Pool Program and upcoming Community Funding Resource program combine the debt of many entities into a 'pooled' financing. Pooled debt is issued roughly quarterly. For the Pool Program, projects typically are at least $200,000 and can be financed for terms between 7 and 30 years. The upcoming Community Funding Resource will provide resources for needs less than $2 million and for terms less than 10 years. There will be no minimum. This also will be a pooled program. In both programs, entities benefit from the experience of the Bond Bank, as well as competitive interest rates and shared fixed costs. The Bond Bank prepares the offering documents. As with other loan programs, the borrowing entity must have the financial capacity/revenue stream to repay the loan and the financial administrative capacity to issue bonds with the assistance of a municipal (financial) advisor and bond counsel. The Bond Bank helps communities get through the loan process and can assist them in accessing the appropriate expertise. (Indiana Finance Authority, 2016; R. Mangus, phone interview, June 22, 2016)

## *Cost sharing, including enabling local transportation improvement districts*

The adoption of new state and local funding options are important at the macro level, however, they don't necessarily guarantee a focus on specific farm-to-farm or farm-to-market roads and bridges. In light of this, it may be helpful to pursue cost sharing arrangements in which landowners who benefit from particular infrastructure improvements contribute to the cost. In a number of places, this is accomplished on an ad hoc basis through relationships between owners and local officials. A second, more formal option would be enabling legislation for funding like that contemplated for special assessments in Economic Improvement Districts (IC 36-7-22). While this specific enabling legislation is aimed at downtowns and retail areas, it provides a structure that could be mimicked for special assessments within a transportation improvement district, including the following elements:

- Establishing the purpose of the local improvement district
- Allowing owner to petition the local fiscal body for a district by:
    - Establishing district boundaries;
    - Establishing project to be carried out in the district, the costs of those projects, and the benefits to property owners;
    - A plan for the application of the special assessment revenue to the projects;
    - A proposed formula for determining benefit for each parcel (which can be differentiated);

    - The number of years the assessment will be levied, and
    - A proposed list of members for the improvement district board for consideration by the legislative body
- Establishing a process for decision making, budgeting, purchasing, etc., within the district
- Establishing due process and accountability elements

Benefits:

- Directs funding to very specific needs
- Access to additional resources

Challenges:

- Requires owner willingness to pay
- The special assessments mentioned here typically would be collected with the property tax bill. Although the special assessments are not property taxes, they may engender the same ill feelings that property taxes often do.

## Make local decisionmaking objective and overt

Maintaining a road and bridge conditions inventory and planning anticipated improvements over multiple years has the potential to improve local decision making and get more utility out of transportation funding. Two tools, asset management and capital improvements are presented here. The success fof both is dependent on the collection of regular information about assets, conditions, traffic, and trip patterns.

### *Asset management*

Asset management planning involves quantifying the condition of assets (for this study's purposes, roads and bridges), and developing a multi-year treatment plan that optimizes available funding and asset conditions. It provides critical information and a process for local decision making about asset investments.

Asset management plans (AMP) should include the following essential components:

- Knowing what you have (an inventory of assets and the condition of those assets)
- Establishing a level of service
- Prioritizing needs
- Managing assets over a life cycle (for the long term)

Key concepts in any asset management program include the following:

- Abandon a "worst first" approach
- Adopt a more strategic approach that minimizes deterioration and maintains pavements before they require rehabilitation or replacement, thus getting a greater service life from the pavement and minimizing spending
- Use "the right treatment on the right road at the right time" to optimize pavement condition and performance while minimizing expenditures
- Consider the system or network as a whole rather than as a series of independent projects
- Create a mix of fixes for the network; estimate costs and funding levels to determine "the right fix at the right place at the right time"
- Set priorities and develop a multi-year program

In 2016, the Indiana General Assembly passed HEA 1001, which requires local agencies to have an asset management plan to qualify for the Community Crossings Matching Grant, a state funding grant program and to gain access to increased Local Option Highway User Taxes (LOHUT). The specific AMP technical requirements were developed by a joint committee consisting of local representatives, LTAP staff, and INDOT staff. The specific INDOT-approved plan elements and requirements for pavements and bridges are described below.

### *Pavement*

For pavement asset management plans, local agencies must development a pavement inventory (Table 21) and a treatment plan (Table 22). LTAP recommends a five-year time horizon. Additional requirements include:

- Identifying the pavement rating system used; common systems are the PASER system, PCI system; and in some cases IRI (a roughness coefficient obtained through pavement measurements);
- Defining performance goals and expected level of service;
- Developing and describing the process used to develop the treatment plan;
- Developing and describing the monitoring program; and
- Describing drainage and right-of-way conditions.

**Table 21. Pavement inventory example**

| | Roadway | | From | | To | | Length | Width | Surface | | Year | Functional |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Designation | Name | Suffix | Name | Suffix | Name | Suffix | (miles) | (feet) | Type | Rating | Rated | Classification |
| CR 200-01 | CR 200 | | CR 400 | | CR 450 | | 0.5 | 18 | Asphalt | 6 | 2016 | Rural |
| CR 200-02 | CR 200 | | CR 450 | | CR 500 | | 0.5 | 18 | Asphalt | 5 | 2016 | Rural |
| Main 01 | Main | St | Rose | St | Elm | Blvd | 0.15 | 24 | Asphalt | 7 | 2016 | Principal Arterial |
| Main 02 | Main | St | Elm | Blvd | SR 25 | | 0.2 | 24 | Asphalt | 7 | 2016 | Minor Collector |
| Main 03 | Main | St | SR 25 | | CR 250 | | 0.25 | 24 | Chip Seal | 6 | 2016 | Minor collector |

**Table 22. Pavement treatment plan example**

| Year | Rating | Treatment Used | Estimated Cost per Mile | Estimated Miles | Estimated Cost |
|---|---|---|---|---|---|
| 2016 | 7-10 | Crack Seal | $4,000 | 50 | $200,000 |
| 2016 | 5-6 | Chip Seal | $20,000 | 25 | $500,000 |
| 2016 | 3-4 | 2" overlay | $75,000 | 5 | $150,000 |
| 2016 | 1-2 | Reconstruction | $225,000 | 2 | $450,000 |
| 2017 | 7-10 | Crack seal | $4,100.00 | 50 | $205,000 |
| 2017 | 5-6 | Chip seal | $22,000 | 22 | $484,000 |
| 2017 | 3-4 | 2" overlay | $78,000 | 4 | $312,000 |

### *Bridges*

The requirements for bridge asset management plans are similar to those for pavements. A complete inventory and conditions data are required, including whether each bridge is functionally obsolete or structurally deficient. The plan also must identify planned projects, as well as their timing and estimated cost (Table 23).

## *Capital improvement planning*

Capital improvement planning typically is a short-range plan (three to ten years) that selects and sequences local government capital projects and equipment purchases. The development of a capital improvement plan typically involves several steps. Some of these steps are similar to those described above for *asset management*:

- Develop the planning process, criteria for qualifying as a capital project, and criteria that will be used to evaluate and select capital projects.
- Create/update a list of capital assets, current conditions, and rehabilitation and repair needs. A regular system of evaluating asset conditions is important to effective capital improvements planning. New assets will be incorporated into an agency Asset Management Plan.
- Conduct a fiscal analysis of available funding, including current fund balances, funding trends, and ongoing fixed costs such as bond payments or other debt service.
- Review projects that were previously approved projects, not yet implemented, or incomplete. Include these projects in the inventory of capital assets and needs and the fiscal analysis
- Review the capital needs reflected in goals and recommendations established in local plans

(comprehensive plans, economic development plans, redevelopment plans, etc.). This may include new or improved infrastructure to serve planned growth or economic development.

- Solicit proposed capital projects for the period of the plan, including justification of need, relative urgency, estimates of project costs, estimates of future operation and maintenance (O&M) costs, the relationship to existing and proposed projects, proposed sources of funding and a proposed implementation schedule.
- Evaluate proposed projects against local goals and needs as well as fiscal goals and available resources. It can be useful to evaluate projects for their lifecycle cost or using the time value of money.
- Review proposed projects against the local government fiscal goals and available resources.
- Select projects for each year reflected in the plan with a particular focus on the most current year.
- The plan can be adopted formally by the planning commission and county commissioners or prepared and implemented informally by particular local agencies, such as the County Engineer or the County Highway Department.
- The plan should be reviewed annually to confirm the next year's projects and funding in light of progress on previously selected projects, etc.

Benefits:

- Allows the anticipation of needs rather than reacting to problems as they arise one by one.
- Allows time to get the necessary resources in place
- Identifies the most economical ways to construct and finance projects
- Provides time to explore funding sources and can help communities be ready for federal and state funding options.
- Provides a forum for planning for projects that are planned, built, and paid for over several years. Local capital projects often take three to five years from planning to completion.
- Provides a process by which decision makers can collectively establish local priorities for an extended period of time
- Provides a way for employees and citizens to understand local decisions
- Programming infrastructure to support local goals as identified in comprehensive, economic development, redevelopment, and other local plans.
- Provides a mechanism that draws attention regularly to capital assets and increases the likelihood of good maintenance and an extended life (Elmer, 2005b; Fillmore, 2014).

## Local investment/disinvestment options

In light of limited resources, local governments likely will need to make strategic decisions about which infrastructure is critical and where to focus resources. Five options are explored here: a fix it first strategy, selective reduction of the bridge inventory, returning paved roads to gravel, prioritizing farm-to-market routes, and aligning land use and transportation planning.

### *"Fix- it- first" strategy*

Application of a fix-it-first strategy at the local level involves prioritizing the rehabilitation and repair of existing infrastructure over new additions to the road and bridge network. At the state level, new inventory often gets a significant amount of resources at the expense of further deterioration within the existing inventory.

This strategy requires a good asset inventory and use of an asset management approach. Rehabilitation and repair are made to the most heavily travelled infrastructure first. Additions to the network are evaluated using a rigorous cost-benefit analysis, including consideration of the life cycle cost to maintain those assets over time (Braun & Shounce, 2011, pp 4-5; Kahn & Levinson, 2011; Smart Growth America, n.d.).

Benefits:

- More sensible land use; encourages development in existing centers and corridors
- Reduced cost to build and maintain new infrastructure
- Minimizes long-term cost to taxpayers

Challenges:

- More applicable to counties that have an urban or suburban character and are experiencing significant population growth
- Prioritizes most travelled infrastructure first. In some cases, that may not prioritize agriculture-serving roads and bridges.

## *Selective reduction of bridge inventory*

Budget limitations have caused some local agencies to place load limits on structurally deficient bridges and to close functionally obsolete bridges. Bridges are closed when the load rating becomes less than 3 tons, or when the superstructure has deteriorated to where the load rating is not able to support typical traffic loads. Other factors that can cause bridge closure are: excessive substructure deterioration, foundation scour, high risk factors (e.g. structure type or lack of load redundancy), or impact damage. After a bridge is closed for one of these reasons it tends to remain closed due to shortage of funds. Typically counties prioritize bridge projects. Bridges often aren't put on the priority list due to funding requirements. Statistics on bridge closure are not available to explore the use of this strategy by local governments.

Local governments should consider a number of factors when considering the prudence of retiring bridges permanently, including the functional classification of the roadway, average daily traffic volume, average daily truck traffic, economic development opportunities, detour length, access to schools and relationship to school bus routes, and emergency route need.

Benefits:

- Eliminate low value bridges to allow resources to be spent on more strategic ones.

Challenges:

- May affect some users negatively
- Expensive to upgrade strategic bridges

**Table 23. Bridge inventory and treatment plan example**

| Bridge Number | NBI # | Deck (Rating) | Super-structure (Rating) | Paint System (Rating) | Substructure (Rating) | Channel (Rating) | Culvert (Rating) | Sufficiency Rating | Structurally Deficient | Functionally Obsolete | Work Type | Planned Repair Year | Estimated Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BR 1 | 140 | 7 | 7 | 8 | 8 | 7 | N | 90.2 | | | Preventive Maintenance | 2017 | $20,000 |
| BR 2 | 26005 | 6 | 6 | N | 6 | 6 | N | 90.1 | | | Bridge Deck Overlay | 2020 | $150,000 |
| BR 3 | 24260 | 4 | 6 | 6 | 6 | 7 | N | 71.2 | | | Bridge Deck Replacement | 2018 | $300,000 |
| BR 4 | 7798 | N | N | N | N | N | N | 96.7 | | | | | |
| BR 5 | 11120 | 4 | 4 | N | 6 | 5 | N | 65.1 | | | Superstructure Replacement | 2024 | $500,000 |
| BR 6 | 7780 | 4 | 4 | 6 | 6 | 4 | 3 | 83.1 | | | | | |
| BR 7 | 980 | 6 | 6 | 6 | 6 | 6 | 3 | 99.3 | | | | | |
| BR 8 | 990 | 5 | 5 | 6 | 4 | 7 | 3 | 35.1 | | | Bridge Replacement | 2022 | $1,000,000 |
| BR 9 | 1070 | 6 | 6 | 5 | 5 | 6 | 3 | 80.9 | | | | | |
| BR 10 | 1080 | 6 | 6 | 5 | 5 | 6 | 3 | 78.9 | | | | | |
| BR 11 | 1110 | 7 | 7 | 8 | 8 | 7 | N | 90.2 | | | Preventive Maintenance | 2019 | $20,000 |
| BR 12 | 1120 | 6 | 6 | N | 6 | 6 | N | 90.3 | | | Bridge Deck Overlay | 2016 | $150,000 |
| BR 13 | 1170 | 4 | 6 | 6 | 6 | 7 | N | 71.2 | | | Bridge Deck Replacement | 2020 | $300,000 |
| BR 14 | 1180 | 7 | 7 | 6 | 6 | 7 | 6 | 96.3 | | | | | |
| BR 15 | 1000 | 7 | 7 | 5 | 5 | 7 | 5 | 67.5 | | | | | |
| BR 16 | 1010 | 7 | 7 | 8 | 8 | 7 | 6 | 99.3 | | | | | |
| BR 17 | 1020 | 4 | 4 | N | 6 | 5 | N | 65.1 | | | Superstructure Replacement | 2017 | $500,000 |
| BR 18 | 1030 | 7 | 7 | 6 | 6 | 7 | 4 | 98.1 | | | | | |
| BR 19 | 1040 | 7 | 7 | 6 | 6 | 7 | 4 | 98.1 | | | | | |
| BR 20 | 1090 | 5 | 4 | 5 | 5 | 7 | 4 | 22.1 | | | Bridge Replacement | 2018 | $1,000,000 |
| BR 21 | 1100 | 6 | 6 | 5 | 5 | 6 | 4 | 96 | | | | | |
| BR 22 | 1130 | 7 | 7 | 8 | 8 | 7 | N | 90.2 | | | Preventive Maintenance | 2020 | $20,000 |
| BR 23 | 1140 | 6 | 6 | N | 6 | 6 | N | 90.2 | | | Bridge Deck Overlay | 2023 | $150,000 |
| BR 24 | 1150 | 4 | 6 | 6 | 6 | 7 | N | 71.2 | | | Bridge Deck Replacement | 2024 | $300,000 |
| BR 25 | 1160 | 6 | 6 | 5 | 5 | 6 | 4 | 93.6 | | | | | |
| BR 26 | 1050 | 5 | 5 | N | N | 5 | 3 | 85.3 | | | | | |
| BR 27 | 1060 | 6 | 6 | N | N | 6 | 3 | 86.3 | | | | | |
| BR 28 | 24130 | 4 | 4 | N | 6 | 5 | N | 65.1 | | | Super-structure Replacement | 2018 | $500,000 |

## *Returning paved infrastructure to gravel*

One of the potential approaches for managing local networks is the reversion of poor pavements to gravel. Anecdotal information suggests that some local rural agencies are using this option. The magnitude and frequency, however, is not measureable currently on a statewide basis.

Poor pavement conditions and cost savings or avoidance typically are the overriding factors local agencies consider in reverting paved roads to gravel. Roads considered for conversion typically are local quality pavements with conditions scores, such as:

- 30 percent of the surface area falling below an acceptable PASER, IRI or PCI;
- PCI between 1-13;
- PASER between 1-2; and
- Average Annual Daily Traffic (AADT) below 100.

There are approximately 9,240 miles of gravel roads across the state. The use of gravel varies across counties from 2 percent to 55 percent of the county inventory. The average coverage for gravel is about 14 percent. The conversion of these roads, including recycling the paved surface, stabilization of base, and applying a new gravel surface costs approximately $42,000 per mile. LTAP estimates annual maintenance costs per mile in a range between $2,000 (low) and $7,650 (high) (Figueroa, Fotsch, Hubbard, & Haddock, 2013). Using the moderate cost, $5,000 per mile, and adjusting for inflation over time (Table 24), the cost to maintain gravel roads for the next 20 years in Indiana is $1,173,480,000.

**Table 24. Annual cost per mile for gravel road maintenance**

| | Now | 5 Years | 10 Years | 15 Years |
|---|---|---|---|---|
| Annual maintenance cost | $5,000 | $5,800 | $6,800 | $7,800 |

Source:. “Assessment procedures for paved and gravel roads.” Indiana Local Technical Assistance Program (LTAP) Publications.

When pavements are reverted to gravel, local agencies may save on annual maintenance cost, but without careful consideration, may compromise serviceability for agricultural and other purposes due to uncertain weather and road conditions. LTAP does not have statewide records on the reversion of gravel road miles, thereby preventing analysis of how these changes and costs have impacted counties. Decision making about reversions should include a number of additional factors:

- Road condition: Is the road in a condition requiring maintenance, rehabilitation, or reconstruction?
- Safety: will a gravel road provide greater safety than the currently deteriorated road condition?
- Number of residents along the road: How will the deteriorated road condition affect the ride quality, dust impact, vehicle operating costs, and vehicle productivity in comparison to a gravel road?
- Traffic volume and vehicle fleet distribution/type: Is the traffic volume and classification conducive to gravel road maintenance considering the available gravel quality and precipitation? Is the traffic volume great enough that the frequent maintenance required for gravel roads viable?
- Network significance of the road: Is the candidate road part of a public transportation or emergency vehicle route?
- Land use of the area accessed by the road: How frequent will trucks with sensitive loads, motorcycles, vehicles towing trailers and boats, and other vehicles that would prefer paved routes use the road?
- Economics of road treatment: Which option, de-paving and maintaining a gravel road or repaving and maintaining a paved road, is more cost efficient over the life of the road?
- Maintenance capability: Will the availability and affordability of maintenance equipment and skills be more viable for a paved or gravel road?
- Environmental issues: How will construction and maintenance activities for each option (paved vs. gravel) affect the air and water quality of the surrounding area?

- Dust and erosion control: Is the project located in an area requiring dust and erosion control for gravel roads? (This element affects the maintenance capability and environmental issues as well.)
- Public issues: What is the public opinion? Does the public understand the decision process and economics of the decision?

## *Set as a priority and plan for local farm-to-market truck routes*

In light of significant road needs across counties and limited resources, one option for focusing resources can be to prioritize local farm-to-market truck routes for rehabilitation and upgraded capacity.

Some states establish farm-to-market (or adequate truck route) infrastructure as a priority for funding. In Iowa, eight percent of the Road Use Tax Fund is dedicated to improving these roads. In FY 2013-14 approximately $83 million was distributed from the Road Use Tax Fund to the Farm-to-Market Road Fund. Formally, these improvements are focused "roads under county jurisdiction which serve principal traffic generating areas and connect such areas to other farm-to-market roads and primary roads" and related bridges, culverts, and railroad crossings. Counties have three years to spend their annual allocations or the funds are distributed among all counties (Stevenson, 2014; Schroeder, 2015).

Illinois established the Truck Access Route Program (TARP) to support local governments in upgrading roads to accommodate 80,000 pound truck loads. The Illinois Department of Transportation does an annual solicitation for projects in the fall. Local governments can request $45,000 per lane mile and $22,000 per intersection. State participation cannot exceed the lesser of 50 percent of total construction costs or $900,000. A small portion of this funding also has been earmarked for use with the Economic Development Program (EDP). Local governments can request TARP funding for an EDP route. These routes must connect to an existing truck route and end at another truck route or generator. When used in conjunction with EDP, the limit for state participation is $150,000 (Illinois Department of Transportation, n.d.; South Central Illinois Regional Planning and Development Commission, n.d.).

County leaders also can choose these types of improvements as priorities for action and funding. First, each county considering this strategy should analyze current local truck trip patterns, truck traffic origins and destinations, road conditions, trip impediments/barriers to evaluate the prudence of establishing a limited number of truck routes. Improvements can be scaled from selective improvements to remove impediments to a fully upgraded design appropriate for frequent truck traffic (Prozzi & Harrison, 2004; Prozzi, Harrison, & Nash, 2006). A similar analysis could also be used to identify and select the most beneficial improvements to support farm-to-farm equipment movements.

Benefits:

- Improved selected infrastructure
- Elimination of strategic detours

Challenges:

- These improvements can be expensive
- In counties with very limited resources, these improvements may require large investments of limited resources and require postponing other investments

## *Aligning land use and transportation planning*

Transportation and land use decisions are connected. "Land uses affect transportation by physically arranging the activities that people want and need to access. Changes in the location, type, and density of land uses change people's travel choices, thereby changing transportation patterns. ". . . transportation affects land uses by providing a means of moving goods [and people] from one place to another" (Vijayan, n.d.). These dynamics and issues are often talked about in the context of urban and suburban places, but are also important in the rural context and in light of limited resources for road and bridge infrastructure.

In the context of rural Indiana, counties should plan proactively for both transportation and land use, rather than reactively. By doing so, counties have the opportunity to maximize the utility of the transportation investments that are made. The following actions should be considered:

- Ensure that the highway department, plan commission, and other county agencies are participating in transportation, land use, and economic development planning processes to ensure that the effects of decision-making is accounted for in each.
- Establish land use regulations that support county road and bridge investments and the purpose for which the investments are made. For instance, if a county invests in local farm-to-market truck routes, it may want to direct new housing development away from these areas. The addition of driveways and entering residential traffic reduces the utility of an upgraded corridor for the purpose of moving product by truck to market. Similarly, land use regulations can be used to guide development away from areas of the county that aren't planned for improvements.
- Plan for like land uses together. For example, if the county is planning for farm-to-market transportation and also desires an industrial park that will generate truck traffic, the location of the industrial park and of the transportation improvements should be planned for together.
- Coordinate with other local governments in or near the county that are making transportation, water, and sewer infrastructure investments. Of course, county road networks are connected to networks in cities and towns and adjacent counties. While the county doesn't necessarily have control over those decisions, advanced knowledge allows those external investments to be considered in transportation planning and the potential that negative effect can be mitigated through negotiation (ICF Consulting, 2005; Smart Growth America, 2015; Vijayan, n.d.).

Benefits:

- Mutually reinforcing land use and transportation decision making has the potential to increase the utility of particular directed investments and mitigate the need for improvements in other locations
- Requires planning for a longer time horizon

Challenges:

- This type of planning requires local staff with expertise and time to coordinate efforts
- Land use regulation is accepted to varying degrees across the state
- This strategy doesn't mitigate past land use decision making, although those details can be considered when planning for transportation
- Results may take some time to see

## Joint purchasing and outsourcing

Local governments may be able to gain efficiencies by using joint purchasing and by outsourcing additional construction and maintainance.

### *Collaborate with other local governments on the purchase of road and bridge construction, maintenance, and materials*

Joint purchasing of construction and maintenance materials or services is one way to gain cost savings or efficiencies. The exact services and details will vary depending on the circumstances in particular counties. A general step-by step process is described here:

1. Explore intra-organizational efficiencies that can be accomplished within the local government. Making changes solely is, of course, easier than managing a relationship with another local government. In some cases, such as the state's Quantity Purchasing Agreement (QPA) for road salt can be access without the transaction costs of building and maintaining a new agreement.
2. Select services or materials for potential collaboration.
3. If collaborating for the first time or with another local government for the first time, consider starting small to build a working relationship and trust.
4. Agree on joint goals and objectives for the collaboration.

5. Evaluate collaborative options. Validate opportunities with supporting facts and figures. Consider carefully the business case for potential collaborations, including costs and benefits.
6. Negotiate details of the agreement, including duration, cost allocation, treatment of employees, facilities, vehicles, equipment, and other assets, ownership and insurance, an exit clause, service levels
7. Create a transition plan.

Organizations such as the Association of Indiana Counties, the Indiana Association of County Commissioners, and Purdue LTAP are sources of technical expertise for counties wishing to embark on collaborative arrangements.

Benefits:

- Improved services
- Networking, learn from the external expertise, and gain access to new best practices
- Cost savings and efficiencies (lower prices through purchasing leverage, lower transaction costs, and shorter lead times)
- Access to additional resources
- Allows local government to do things they wouldn't be able to do otherwise
- Reduces duplication of personnel, equipment, etc.
- Allows access to, full utilization of specialized personnel or equipment
- Shared risk

Challenges:

- Requires elected and appointed official buy-in
- Territorial leadership
- Home rule mindsets; concerns about sacrificing some local autonomy; fear of loss of control
- Conflicts with political and socio-economic priorities; for example, many local elected officials are committed to using local business, projects, and labor
- Personalities
- Unwillingness to consider new ideas
- Rightsizing personnel
- Short-term focus vs. long-term focus
- Conflicting priorities among collaborators
- Need for participants in the negotiations to have the power to act on behalf of the local government
- Availability of suitable partners nearby; partners may be other types of local governments (cities and towns, schools districts, etc.
- Local government size
- Public works statute (IC 36-1-12-3) limits projects that can be accomplished with own-source labor
- Unions/labor agreements
- Duration must be sufficient for operational stability (Howard, et al., 2013; Murray, Rendell, Holland & Locker, 2011)

## *Outsource road and bridge construction and maintenance*

Outsourcing road construction and maintenance to road/bridge contractors is another potential method for gaining cost savings and efficiencies. The exact services and details will vary depending on the circumstances in particular counties. Larger projects may require outsourcing. IC 36-1-12-3 sets forth specific requirements for when a county government is allowed to perform public works projects with its own workforce or is required to outsource projects. Counties may use internal workforce for projects up to $250,000. For projects between $100,000 and $250,000, counties must follow a specific public process in order to choose to use its own workforce.

Benefits:

- Improved services
- Possible cost savings and efficiencies
- Access to additional resources
- Allows local government to do things they wouldn't be able to do otherwise
- Allows access to specialized personnel or equipment that small counties might struggle to support

Challenges:

- Requires elected and appointed official buy-in
- Home rule mindsets; concerns about sacrificing some local autonomy; fear of loss of control
- Conflicts with political and socio-economic priorities; for example, many local elected officials are committed to using local business, projects, and labor
- Availability of outsourcing firms
- Lack of critical mass of needs; small projects less likely to gain savings or efficiencies
- Competition for contractors; can raise prices
- Rightsizing local government personnel after outsourcing
- Unions/labor agreements

# Conclusions

There appears to be increased willingness among state and local officials to construct a plan to address these needs, but tensions remain an impediment to progress. Local officials often express frustration that funding formulas favor state and federal highway work at the expense of the extensive network of rural roads. Even when state legislators do initiate special funding for local governments it leaves officials in rural counties frustrated. Senate Bill 67, for instance, was enacted during the most recent session of the General Assembly. It returned more than $504 million to local governments, three-quarters of it earmarked for road projects. Since the money came from local option income taxes, however, it was distributed using existing formulas. That meant the bulk of the money was distributed to urban and suburban counties, not the less populated rural counties. The Major Moves 2020 Trust Fund generated by the state's lease of the Indiana Toll Road has funded mostly state and interstate projects. Formulas for distributing fuel taxes favor state and interstate roads. The local options that do exist require local officials to enact special taxes or surtaxes to generate additional revenue for repair, maintenance and construction or rural roads and bridges. And that's the tension point for state officials. Only 51 of the state's 92 counties (LTAP, 2016), for instance, have instituted a wheel tax. Until it was required by a new law, most local governments didn't make use of asset management plans for their roads. State legislators have made it clear in recent legislation that local governments must contribute a greater share of local funding to secure more from the state formulas and grants.

There is reason to believe the tension between state and local officials may ease when it comes to road funding. The General Assembly created a new approximately $185 million matching grant fund that funnels more money to counties, especially if they're using asset-management plans. And a legislative task force charged with creating a comprehensive transportation funding plan began meeting in July with plans for a legislative agenda ready the 2017 session begins in January.

The distribution of motor fuel taxes to local governments is based largely on vehicles and population which favors more urban and suburban counties. A review of local road and bridge needs and spending data suggests that an altered or bifurcated method for distributing motor fuel taxes or other funding sources among local governments is needed to ensure that the most rural counties are able to address their infrastructure needs. Mechanisms such as the matching grant fund provide one way to ensure that rural counties have more resources.

The analysis of road and bridge needs employed here is empirical and similar to the asset management planning process now required by the Indiana General Assembly for access to additional LOHUT funding and special grant funding. The availability of additional PASER rating data and the local priorities documented in AMPs will provide regular data for subsequent evaluations of needs.

The research team utilized the annual county highway operations reports to establish rehabilitation spending for roads and bridges. These reports, if standardized, contain additional information that could be used to analyze local needs and to assist in local decision making. The research team recommends the following adjustments to make these reports more useful as a tool for analysis:

- Discourage the over-categorization of department activities as “administration” and “general”
- Establish a clearer connection between the categories in Section III and “construction and reconstruction” and “maintenance and repair in Section II
- Encourage units to catalog projects and costs more completely in Section III—it can be a useful tool for analysis of spending and for communicating spending to policymakers and the public
- Provide additional guidance on how to report bonding and debt service within these reports
- In general, review of reports and guidance to those departments would be useful

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# Appendix A: Full Stakeholder Focus Group Results

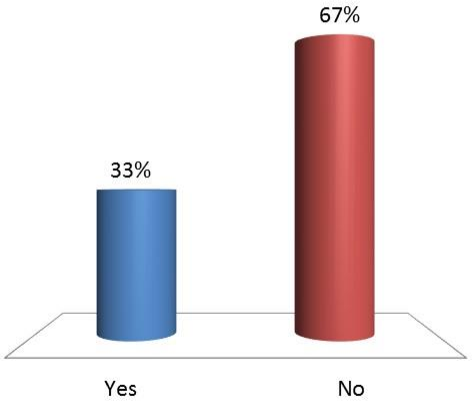
To identify specific challenges agricultural stakeholders face, the Indiana Soybean Alliance and the project team conducted six focus groups around the state: Frankfort (November 16, 2015); Morristown (November 17, 2015); Delaware County (November 17, 2015); Milroy (November 20, 2015);Avilla (December 4, 2015); Mt. Vernon (December 11, 2015). Results from these meetings are presented below.

# Indiana Rural Roads and Bridges

Frankfort, IN
11-16-2015

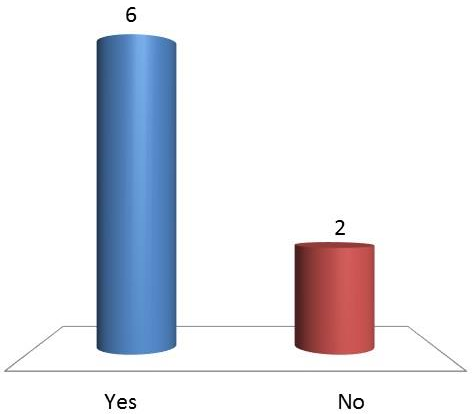
## Do bridge dimensions cause you to avoid bridges in your areas?

A. Yes
B. No



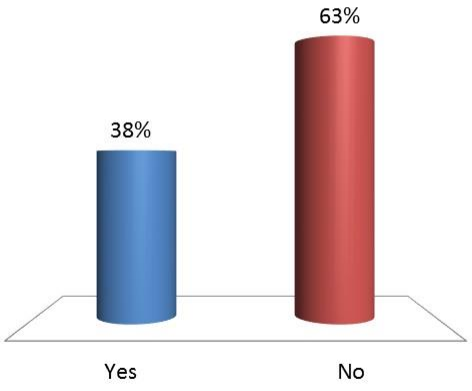
## Are you impacted by bridge capacity and / or condition in your area?

A. Yes
B. No



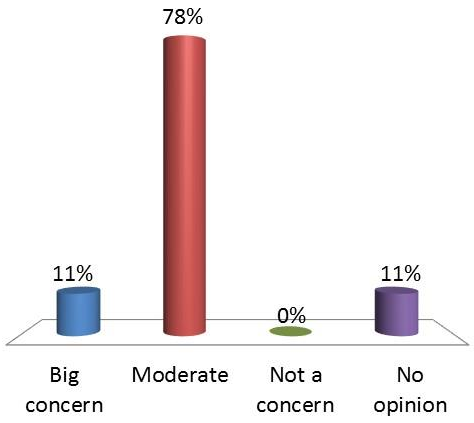

## Does road width impact your ability to transport grain in your area?

A. Yes
B. No



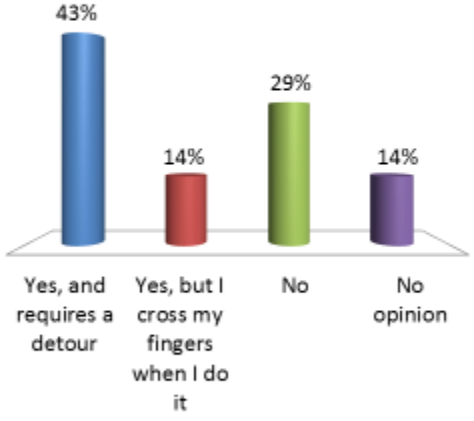
# Is turning radius on the roads in your area a concern?

A. Big concern
B. Moderate
C. Not a concern
D. No opinion



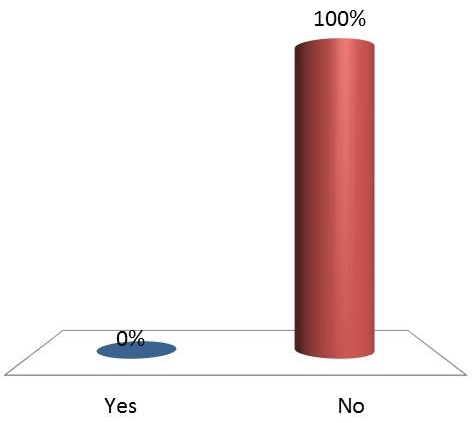

# Are there places that are hard to get across like RR tracks, rivers, highways, etc.?

A. Yes, and requires a detour
B. Yes, but I cross my fingers when I do it
C. No
D. No opinion



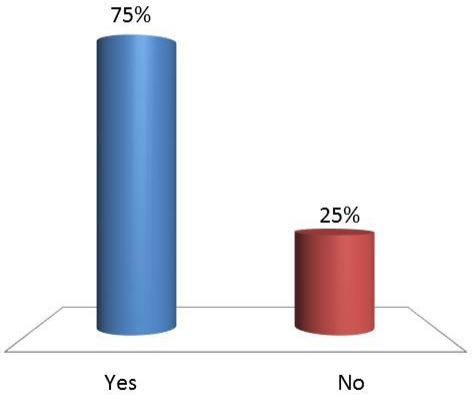
## Any issues with clearance on overpasses?

A. Yes
B. No



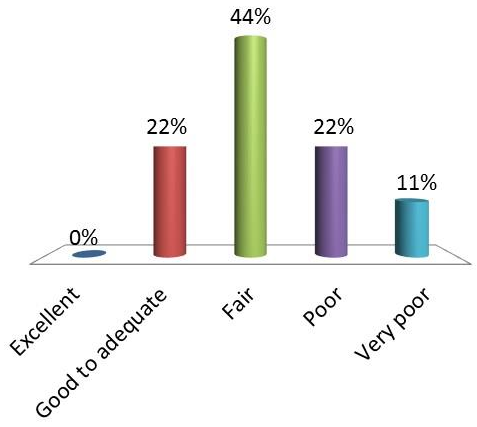

## Do you have issues with line of sight or visibility in your area?

A. Yes
B. No



# Overall, how would you rate road and bridge infrastructure in your area?

A. Excellent
B. Good to adequate
C. Fair
D. Poor
E. Very poor




**Attendees**

- ~10 participants
- Boone, Cass, Clinton, Fulton, and Starke counties
- Farmers – corn, soy, livestock (hogs)
- Processor
- Truckers
- Commercial haulers

**Equipment**

- Grain carts 15-20 feet (biggest change)
- Semi-trucks (many with long trailers, 53 ft.)
- School buses

**Roads - width, pavement condition, etc.**

- Good in Clinton and Boone counties
- Clinton County has side ditches
- New road with cement curbs – hard to navigate with farm equipment
- Roundabouts (at SR 32 and US 421) – not designed for semi-trucks, drivers don't always know how to use them
- Concerns about treatment of potholes – patch vs. really fixing
- Lots of doglegs on county roads, take more time to navigate. One participant doesn't use 75 because of all the jogs
- Haul hogs to Logansport and Dephi, lots of traffic 24-7. Some spots are good, possible that some traffic helps.
- My drivers refuse to run across SR 25
- In Benton County, the geometry of the roads is ok, surfaces are rough
- Frost limits
- Snow is hard on roads, particularly chip and seal
- Federal and state standards sometimes cause counties to over-engineer

- Use pug mix
- Make choices about routes depending on available highway interchanges

**Bridges**

- Between Logansport and Lafayette bridges are level.
- Width can be a challenge

**Intersections – turning radii, line of sight/visibility, etc.**

- Turning radii a problem in Fulton County
- Turning radii not a problem in Cass County
- Turning radii a problem about 50% in Starke County
- Sight issues caused by trees, crops, unclean fence lines
- Clinton County is pretty good at addressing sight issues
- In Cass County, they can plant within 5 feet

**Responses to road and bridge limitations**

- Detours put more pressure on other roads
- Locals work to address issues, respond to complaints

**Other**

- Planning for new uses including an ethanol plant. Challenging when limited ingress and egress.
- Need to be planning for even bigger trucks

# Indiana Rural Roads and Bridges

Morristown, IN
11-17-2015

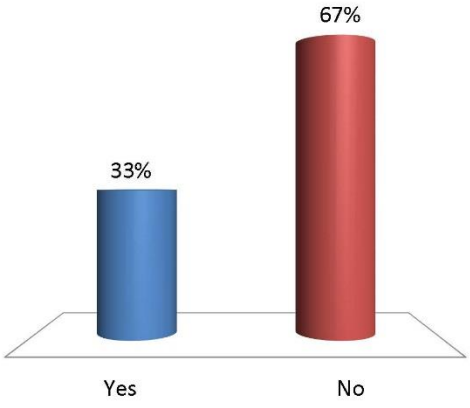
INDIANA UNIVERSITY
PUBLIC POLICY INSTITUTE

INDIANA SOYBEAN ALLIANCE

INDIANA CORN Marketing Council

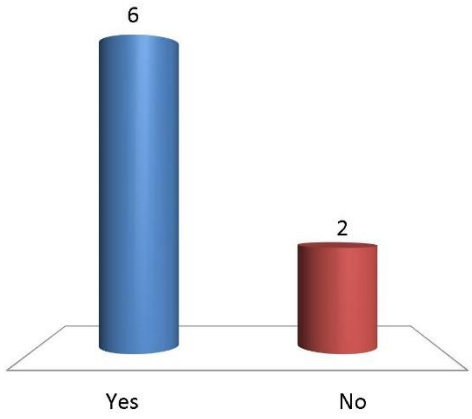
## Do bridge dimensions cause you to avoid bridges in your areas?

A. Yes
B. No



## Are you impacted by bridge capacity and / or condition in your area?

A. Yes
B. No




## Does road width impact your ability to transport grain in your area?

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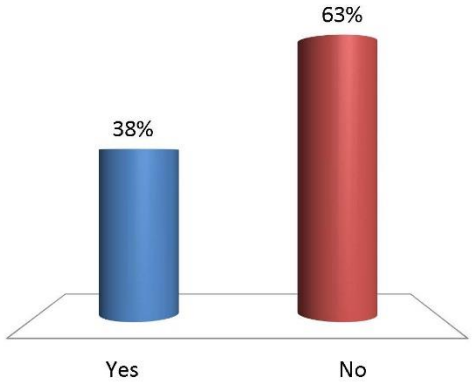
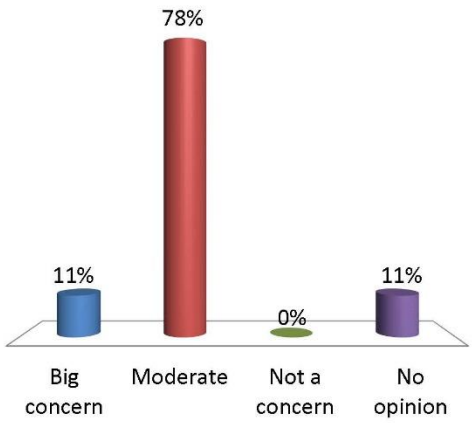


## Is turning radius on the roads in your area a concern?

A. Big concern
B. Moderate
C. Not a concern
D. No opinion




## Are there places that are hard to get across like RR tracks, rivers, highways, etc.?

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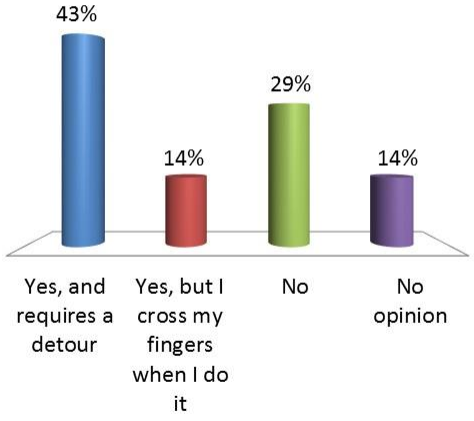
C. No
D. No opinion



# Any issues with clearance on overpasses?

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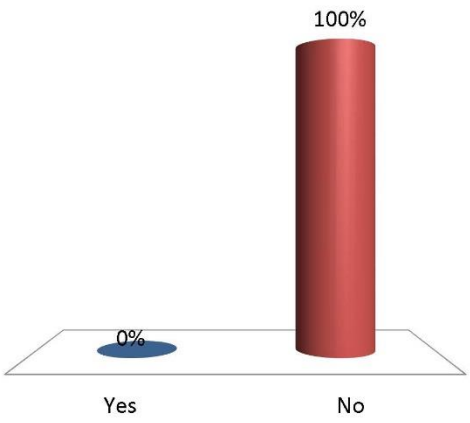
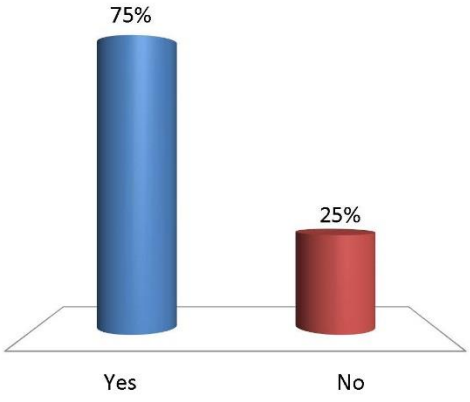
B. No




# Do you have issues with line of sight or visibility in your area?

A. Yes
B. No



## Overall, how would you rate road and bridge infrastructure in your area?

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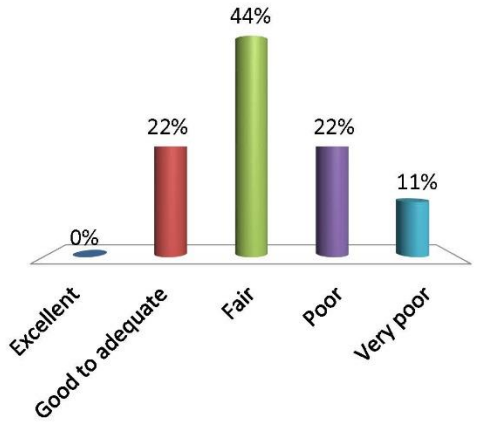
B. Good to adequate
C. Fair
D. Poor
E. Very poor




**Attendees**

- 18 participants
- Farmers – soy, corn, dairy
- Hamilton, Hancock, Madison, Rush, Shelby, Wayne (and surrounding) counties
- Truckers
- Farm Drainage
- Soy Processing
- School bus driver

**Equipment**

- Combines
- Grain carts
- Semi-trucks
- Drainage equipment
- School buses

**Roads – width, pavement condition, etc.**

- Have to slow down for curves
- Tree canopy and low power/cable lines can be obstacles
- Rough pavement
- Drainage
- Roundabouts - combine runs up on curb
- 40 miles of gravel roads in Hancock County
- Shelby County is completely paved
- Hamilton County has wide rights–of-way
- Crops – corn; forces us to treat intersections as 4-way stops

**Bridges**

- Need help to guide combine through
- Varied culvert conditions (width and cement vs. pipe and gravel); starting to fix some

- Historic bridge with a 12-ton limit
- Weight limits in Wayne County – some aren't marked
- Need a study of rubber on the road (weight distributed across the axles)
- Cry baby bridge

**Intersections – turning radii, line of sight/visibility, etc.**

- Augers catch
- Stop signs, telephone poles, trees, and mailboxes can be an obstacles
- Greenfield – on busy roads
- Poles ideally need to be back 5-6 feet back from intersection
- Struggle to turn school bus

**Crossings – rivers, highways, railroads, etc.**

- Issues with clearing railroads
- Overpasses can be a challenge with combines and grain carts
- Line of sight issues at railroad crossings

**Responses to limitations**

- Do reconnaissance runs to make sure trips will work

**Other**

- Funding
  - Concern about adopting wheel tax and repurposing other funds away from roads
  - Casino money previously helped with roads

## Delaware County—November 17, 2015

**Selected voting results (Powerpoint was not available).**

- Does road width impact your ability to transport grain in your area?54% Yes
- Are you impacted by bridge capacity and / or condition in your area? Yes 92%
- Is turning radius on the roads in your area a concern? 69% Yes
- Are there places that are hard to get across like RR tracks, rivers, highways, etc.? 69% Yes, and requires a detour; 15% Yes, but I cross my fingers when I do it
- Any issues with clearance on overpasses? 15% Yes
- Overall, how would you rate road and bridge infrastructure in your area? 0% Excellent; Good 0%; 31% Fair; 31% Poor; 31% Very Poor

**Attendees**

- ~13 attendees
- Delaware, Henry, Randolph, Madison, Blackford, Jay and Grant counties
- Farmers – soy, corn, tomatoes, livestock
- Truckers
- County commissioner
- Agriculture engineer – livestock
- Grain company
- Co-op
- Paving company

**Equipment**

- Semi-trucks
- Combines
- Grain carts
- Tractors and planters

- Drill
- Tanker trucks

**Roads – width, pavement condition, etc.**

- State road guardrails force use to use space across center line
- Utility lines, signs, and tree branches create obstacles
- Road signs are at semi window height
- Roads with too big a crown can upset trucks
- Often meet cars when delivering; no place to move over
- There isn't always a shoulder, ditches aren't even
- Sometimes meet other farm equipment
- Often choose to use state highways
- Blacktop roads don't have center lines
- Insufficient subgrade
- Affected by freeze thaw
- Need to undo bad projects
- I asked the county to return my road to gravel; I offered to maintain, county said no
- Side ditches often are as important as the road; need good roads and drainage
- We use roads throughout the year (farming, selling product, feed deliveries, etc.)
- Blackford and Madison county roads generally are better
- Jay County has some gravel
- Henry County roads are bad
- Gravel road can vary from smooth to really rough
- Henry and Randolph Counties are returning some roads to gravel
- Drivers unfamiliar with farming realities create challenges

**Bridges**

- It took 10 years to fix the bridge on 700N
- Bridges not big enough for equipment
- Weight limits
- Forced to balance equipment while hanging off edges
- Sides are built up, create an obstacle
- More difficult in the dark
- Moving toward riprap abutments
- Some bridges are low and skinny
- Sometimes can use one route when loaded and another when empty, more options with the latter
- Worry about crushing culverts
- Sometimes making choices between bridge limitations and bad road conditions (potholes)

**Intersections – turning radii, line of sight/visibility, etc.**

- Choose other roads to avoid particularly narrow intersections
- In some cases, just not enough space
- Utility poles and signs are obstacles
- Roundabouts typically are not big enough, forced to hit sides
- Generally need bigger geometry
- Trucks and farm equipment experience line of site issues
- Crops planted right up to the road
- Drivers run stop signs, at times because signs are partially obscured by crops

**Crossings – rivers, highways, railroad tracks, etc.**

- One is 9'6" (really low)
- Problems using with other users around

- Sometimes have to turn from a county road to far lanes of 4-lane highway, medians aren't big enough to stop in the middle
- Challenge to get a tractor across the highway during busy traffic; people use the highway as a local road; 45 mph zone, not sure if a stoplight would really help
- Difficult to cross Cardinal Greenway, pedestrian bridge (have to use state highway instead)
- Trees limbs and highway signs create sight issues

**Responses to road and bridge limitations**

- Drive extra miles to avoid
- Damage infrastructure when there is no other choice of route
- Sometimes choose state highway over local road – we are wide and slow, affects other drivers
- Sometimes send a pickup first to manage traffic
- Some drivers are understanding, others are not

**Other**

- Rules for heavier loads (91,000 lbs)
- Lots of urban sprawl (Delaware County)
- Highway workers in Delaware County are unionized
- Miles are the goal, not completely functional roads
- Need traffic study around agribusinesses
- Issues with farm equipment are concentrated for about 30 day in the fall and 10-15 days in spring
- Issues are worse in snow
- Funding
    - Agricultural TIF?
    - Dedicating some property taxes for roads
    - Lots of politics in Delaware County; wheel tax didn't happen

# Indiana Rural Roads and Bridges

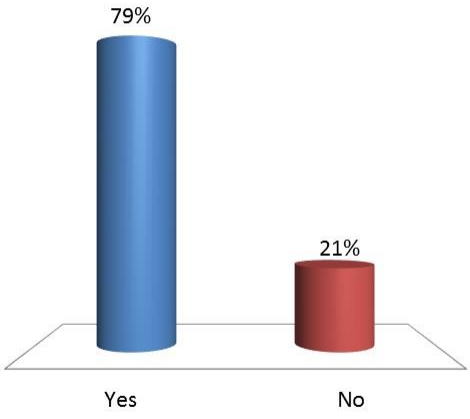
Milroy, IN
11-20-2015

INDIANA UNIVERSITY
PUBLIC POLICY INSTITUTE

INDIANA SOYBEAN ALLIANCE | INDIANA CORN Marketing Council

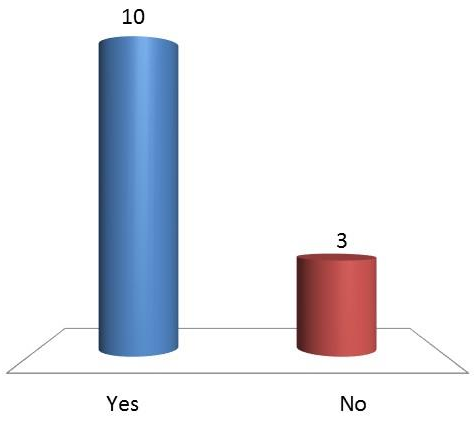
## Do bridge dimensions cause you to avoid bridges in your areas?

A. Yes
B. No



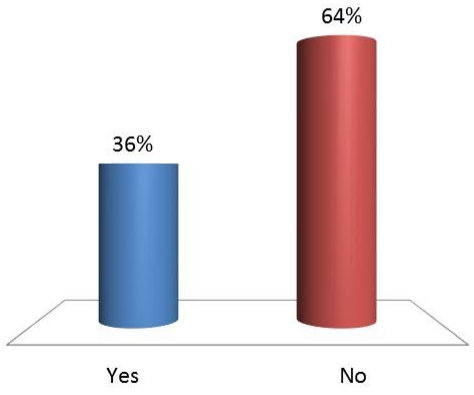
## Are you impacted by bridge capacity and / or condition in your area?

A. Yes
B. No



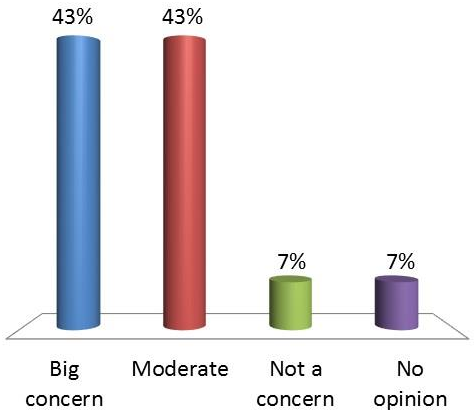

## Does road width impact your ability to transport grain in your area?

A. Yes
B. No



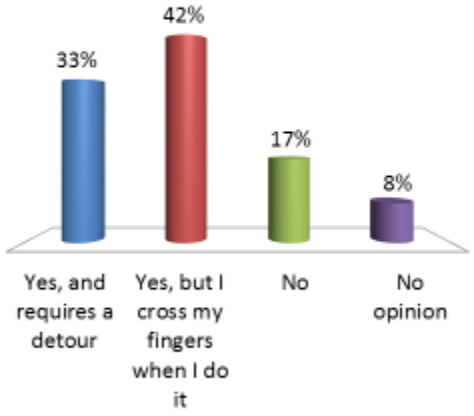
# Is turning radius on the roads in your area a concern?

A. Big concern
B. Moderate
C. Not a concern
D. No opinion



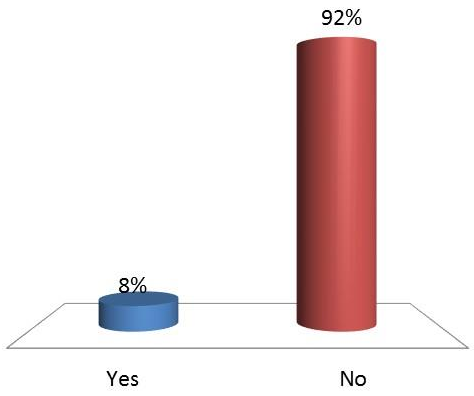

# Are there places that are hard to get across like RR tracks, rivers, highways, etc.?

A. Yes, and requires a detour
B. Yes, but I cross my fingers when I do it
C. No
D. No opinion



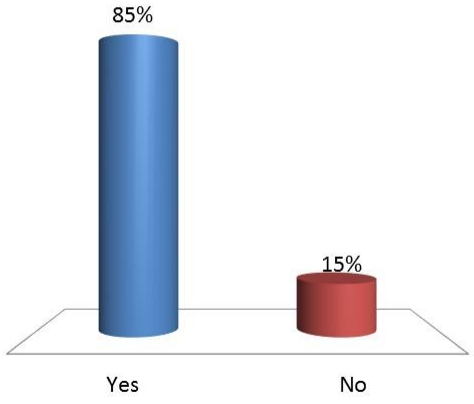
## Any issues with clearance on overpasses?

A. Yes
B. No



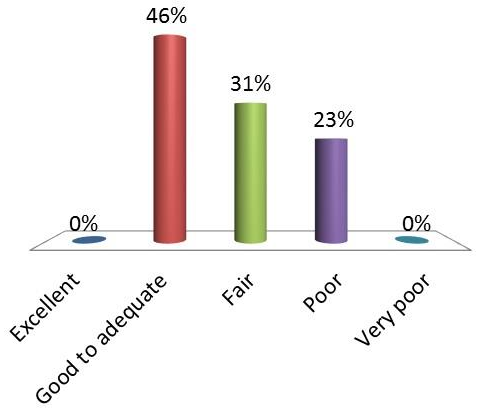

## Do you have issues with line of sight or visibility in your area?

A. Yes
B. No

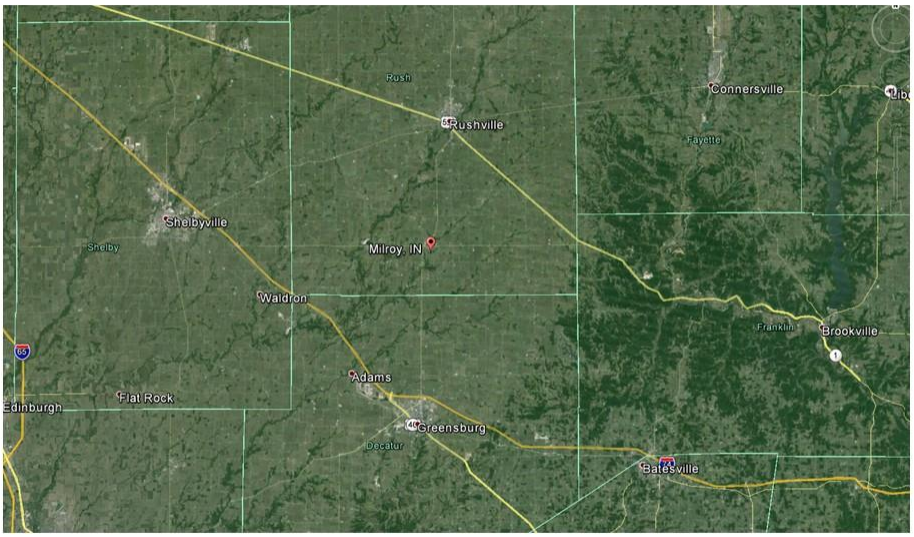


# Overall, how would you rate road and bridge infrastructure in your area?

A. Excellent
B. Good to adequate
C. Fair
D. Poor
E. Very poor




## Location of Farms



**Attendees**

- ~16 participants
- Decatur, Franklin, Henry, Rush, and Shelby counties
- State legislators
- County elected and appointed officials
- Farmers—corn, soybeans, livestock, dairy
- Trucking
- Farm drainage contractor
- Stone quarry
- EMS

**Types of equipment**

- Combines
- Manure spreaders (16 – 18 feet)
- Semi-trucks
  - Have gotten heavier over time; 73,280 lbs in 1970s to 80,000 lbs to 92,000-94,000 lbs
  - Length can be a challenge
- Sprayers (challenges with width and height)
- Planters (as long as semi-trucks)
- School buses
- Fire trucks
- A variety of needs, still have some horse and buggy in our county
- Equipment farmers use has changed over time

**Roads – width, pavement conditions, etc.**

- Combines are a challenge on narrow roads
- State road guardrails
- Telephone poles, signs mailboxes, landscaping, fences, trees, and planted crops further reduce effective width along roads
- Side ditches are missing, sometimes run onto field
- Struggle when meeting another vehicle on the road.
- Width of equipment and edge conditions often mean we can't get off the middle of the road
- Franklin County roads are the best they have ever been
- Rush County has improved conditions over the years; good highway superintendent
- Henry County has worst roads – road surface rough
- Frost and freeze limits in winter
- Hilly, curvy roads in this part of the state; in some places need more guardrails

**Bridges**

- Low water crossings (11 feet wide, 6 foot drop) (Franklin County)
- Several not wide enough for equipment
- County has replaced some headwalls
- Bridge slabs – have to think carefully about crossing these
- Some bridges flood with heavy rains
- Some bridges have constraining load limits (3, 5, or 10 ton)
- In some cases, approaches have significant slope. Can be a bigger challenge when there is snow. In some places woods shade those areas and keep snow from melting
- Sometimes make the calculation of weight and length (axles) to make decision about crossing; sometimes use longer trailers to accommodate bridge limitations
- Some ditches are too deep to provide additional effective width
- Rush County now posts bridge limits; they used to only post bridges with 15 tons or less

- There has been more focus on bridge inspections over the last several years. Counties are mandated to inspect on a particular schedule. Consumes more of county highway budget.

**Intersections – turning radii and other challenges**

- Geometry can be a challenge (regular 4-way and T intersections)
- Turns can be a challenge particularly when intersections have obstacles such as telephone poles, mailboxes, landscaping, crops, signs, trees
- Bigger trucks are more of a challenge

**Crossings – rivers, highways, railroads, etc.**

- Some overpasses are too low
- Sometimes humps under overpasses that reduce actual height that can fit
- Hills on SR 3 make it difficult to see traffic
- Speeding vehicles make it difficult to out even when clear, takes time to pull out
- Typical road signage creates a sight hazard from semi's and other tall equipment

**Responses to road and bridge limitations**

- Must detour when roads won't allow passage. In some cases 5 miles. In extremes, can be 10-15 miles.
- For emergency vehicles, several of these limitations can cost precious time
- Sometimes use pilot vehicles to move particularly large equipment around
- Complaints go to county commissioners

**Other**

- Road construction and detours can present additional challenges, not always marked or communicated well
- Rush County uses sand rather than salt on county roads in winter
- In Rush County, perceptions and needs seem to vary by township
- Non-farm drivers need training about how to deal with large farm equipment
- It is important that we plan now for the farming in the coming decades
- Cost of road and bridge inputs are increasing
- Funding
    - Concerns about where transportation money goes. Roads vs. trails, transportation history assets.
    - Wheel tax is seen as a required precursor to additional funding
    - Concerns about using new road money to allow previous money to be spent on other priorities
    - MVH formulas favor cities and towns

# Indiana Rural Roads and Bridges

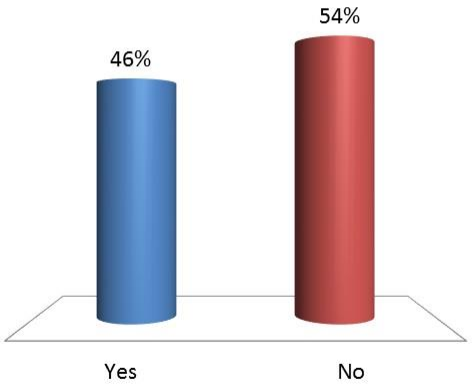
Avilla, IN
12-4-2015

INDIANA UNIVERSITY
PUBLIC POLICY INSTITUTE

INDIANA SOYBEAN ALLIANCE | INDIANA CORN Marketing Council

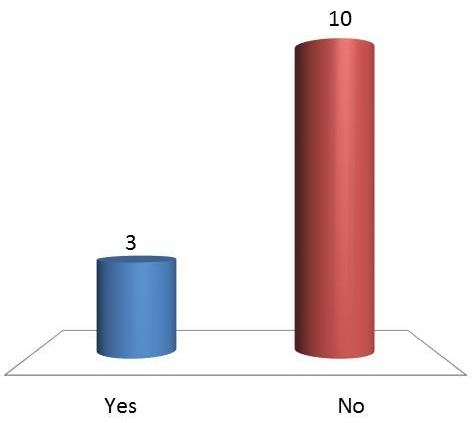
## Do bridge dimensions cause you to avoid bridges in your areas?

A. Yes
B. No



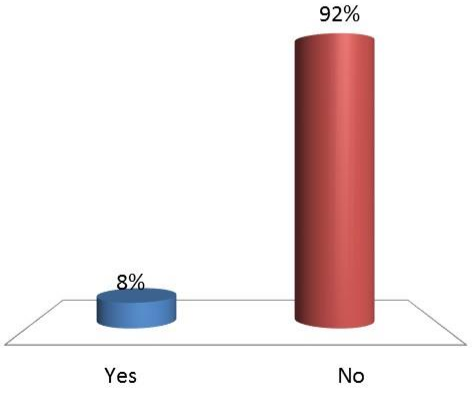
## Are you impacted by bridge capacity and / or condition in your area?

A. Yes
B. No



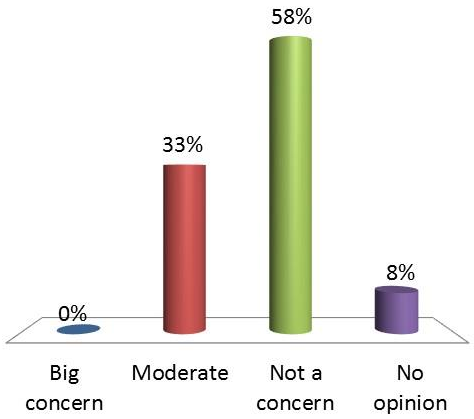

## Does road width impact your ability to transport grain in your area?

A. Yes
B. No



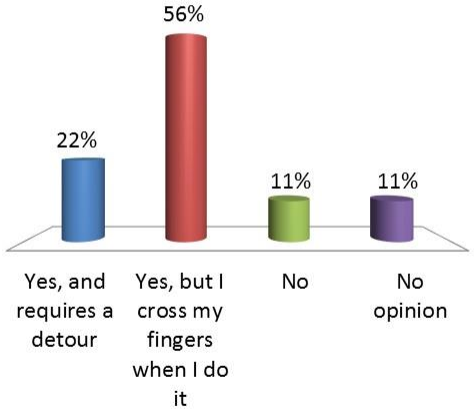
# Is turning radius on the roads in your area a concern?

A. Big concern
B. Moderate
C. Not a concern
D. No opinion



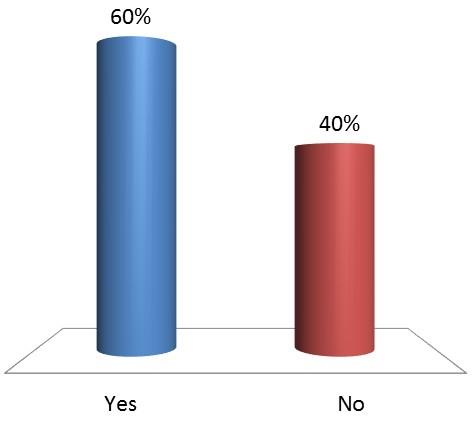

# Are there places that are hard to get across like RR tracks, rivers, highways, etc.?

A. Yes, and requires a detour
B. Yes, but I cross my fingers when I do it
C. No
D. No opinion



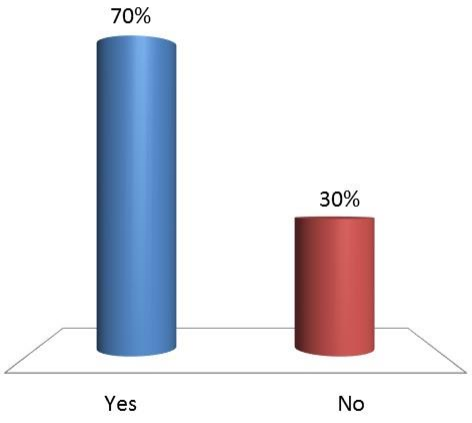
## Any issues with clearance on overpasses?

A. Yes
B. No



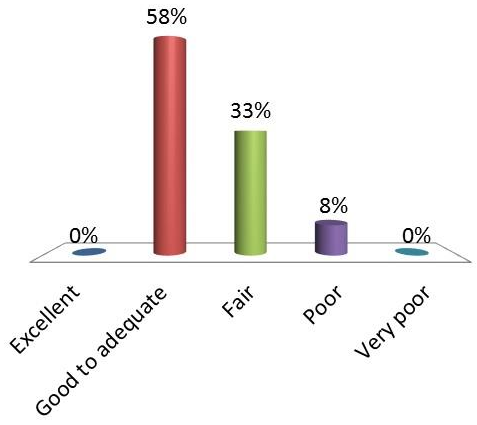

## Do you have issues with line of sight or visibility in your area?

A. Yes
B. No



# Overall, how would you rate road and bridge infrastructure in your area?

A. Excellent
B. Good to adequate
C. Fair
D. Poor
E. Very poor




**Attendees**

- ~15 attendees
- Elkhart and Noble counties
- Farmers – corn, soybeans, livestock
- Trucking
- Seed sales
- Soy processing

**Equipment**

- Semi-trucks – getting heavier (97,000 lbs, multiple axles or permit)
- Silage wagons (create more of a challenge when really full)
- Amish buggies (steel wheels can cause damage)

**Roads – width, pavement condition, etc.**

- Road width generally not a problem.
- Gravel roads vs. mud paths
- Holes in chip and seal roads
- Roads in our small towns can be challenging
- Don't enforce frost laws
- Used to see more signs (bridge limits, frost limitations)
- Traffic volume in some areas (near Elkhart and Goshen)

**Bridges**

- Bridges with camel back (peaked in middle)
- Some with capacity issues, condition issues

**Intersections – turning radii, sight lines/visibility, etc.**

- For semi-trucks, this is a major concern if you can't use both lanes
- Goshen
- Main intersection in Albion
- Sometimes have to wait

- County isn't good about keeping driveways back from intersection
- Crops, trees/brush, and hills create sight line issues

**Crossings – rivers, highways, railroad tracks, etc.**

- Some issues with overpasses
- Trains blocking tracks
- Overpass at CR 6 and SR 29 – close road rather than fixing the grade underneath
- Railroad bridges near Lingonier and Albion are closed because they have not been replaced
- Some viaducts are too low
- State Roads 6 an 9 – can't always see clearly to be able to get out
- Railroad blocking the tracks

**Responses to road and bridge limitations**

- Sometimes have to go way around
- Avoid the most hazardous roads

**Other**

- Discussion about increasing truck weight limits. Competitively disadvantage over Michigan. Conversion is expensive.
- Issues with other drivers and sharing the road.

# Indiana Rural Roads and Bridges

Mt Vernon, IN
12-11-2015

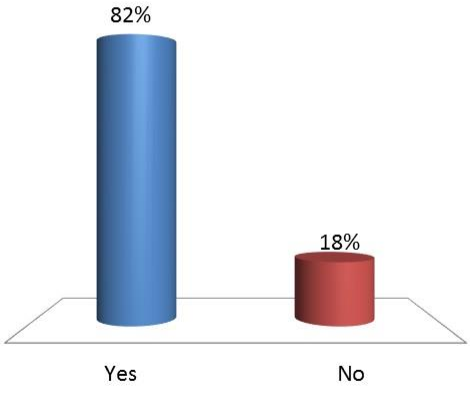
INDIANA UNIVERSITY
PUBLIC POLICY INSTITUTE

INDIANA SOYBEAN ALLIANCE

INDIANA CORN Marketing Council

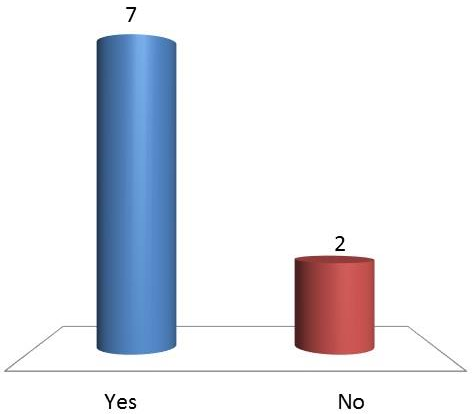
## Do bridge dimensions cause you to avoid bridges in your areas?

A. Yes
B. No



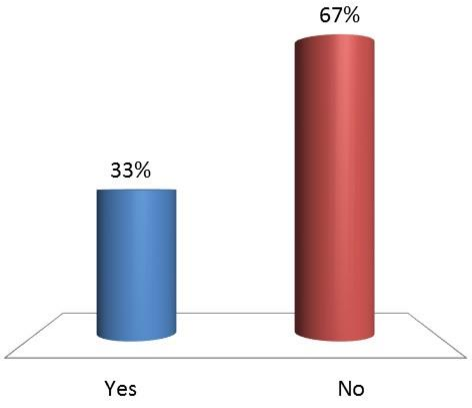
## Are you impacted by bridge capacity and / or condition in your area?

A. Yes
B. No



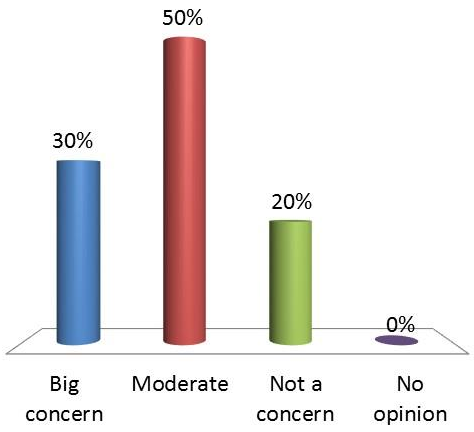

## Does road width impact your ability to transport grain in your area?

A. Yes
B. No



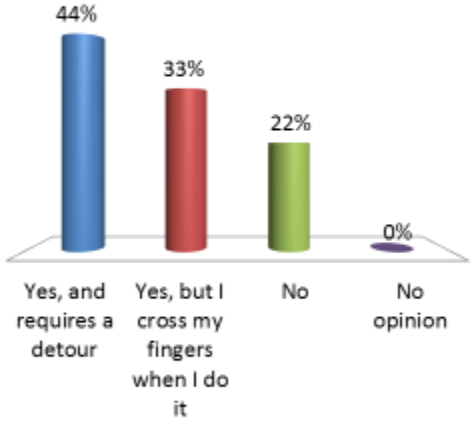
# Is turning radius on the roads in your area a concern?

A. Big concern
B. Moderate
C. Not a concern
D. No opinion



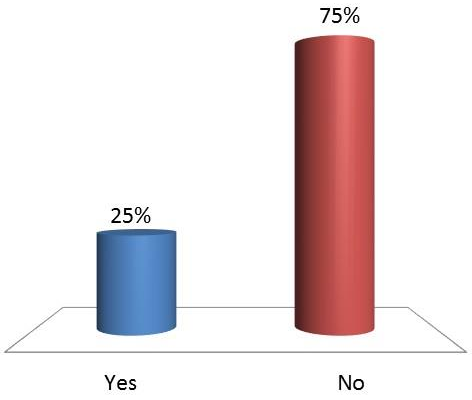

# Are there places that are hard to get across like RR tracks, rivers, highways, etc.?

A. Yes, and requires a detour
B. Yes, but I cross my fingers when I do it
C. No
D. No opinion



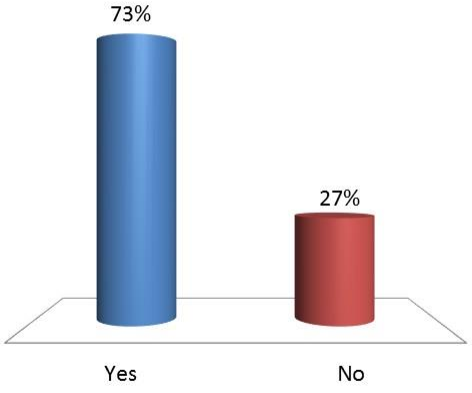
# Any issues with clearance on overpasses?

A. Yes
B. No



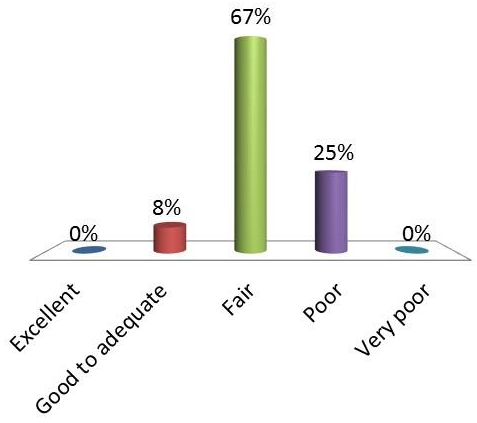

# Do you have issues with line of sight or visibility in your area?

A. Yes
B. No



# Overall, how would you rate road and bridge infrastructure in your area?

A. Excellent
B. Good to adequate
C. Fair
D. Poor
E. Very poor




**Attendees**

- ~15 attendees
- Farmers – grain, cattle, dairy
- Gibson, Posey, and Vanderburgh counties
- Haulers
- Area plan commission
- Ethanol plant
- Grain marketing

**Equipment**

- Cultivator, tiller and combine (widest)
- Semi-trucks

**Roads – width, pavement condition, etc.**

- 8 foot lanes plus 12 inch shoulders
- Often hit semi mirrors on obstacles
- Every time roads are repaved they get a little narrower (to avoid issue on edge)
- Mailboxes and telephone poles create obstacles
- Vanderburgh typically has better, upgraded roads. Virtually all paved.
- Gibson and Posey counties face similar issues
- Posey County has 780 miles of road, 375 miles are gravel or chip and seal
- Posey County has paved a significant part of the inventory in the last 10 years; using EDIT taxes
- Low telephone and electric poles are easy to hit with semis and farming equipment
- Freeze/thaw issues on chip and seal roads (4-8 weeks in the spring); limits when we can haul product from the farm
- Issues when temps are really hot (95 degrees)
- Roundabout at US 41 and Princeton

- We have drainage issues. 2-3 times a year flooding closes several roads, sometimes for a week or more. We need a long-term solution for retention/detention of water to solve. Will need to take flooding into account when designing new bridge.
- Roads don't necessarily have side ditches
- Winding roads cause issues, particularly 90 degree doglegs
- Some property owners "lovingly" place rocks near the right of way

**Bridges**

- Some too narrow
- Concrete banisters
- Culverts with guardrails
- Steel-riveted bridge with 7 ton limit
- Creosote pilings
- Several have weight limits, including 30 in Posey County
- 8 closed bridges in Posey County
- Some challenging bridges are close to farms, a real headache
- Mulberry Street Bridge (functionally obsolete)

**Intersections – turning radii, line of sight/visibility, etc.**

- Ditches, telephone poles, and trees are obstacles that make intersections difficult
- If the turn is 90 degrees, we need the whole road/intersection
- Brush can keep us from seeing traffic on road

**Crossings – rivers, highways, railroads, etc.**

- Struggle to get across railroad tracks
- We need a way to get across railroad tracks in Mt. Vernon when there's a train parked there. Issue for farming and emergency vehicles.

**Responses to road and bridge limitations**

- Have to drive 2 miles out of the way, takes a long time with slow equipment (bridge)
- Detours impact public when we are forced to choose a more heavily travelled road (bridge)
- Sometimes use a chase truck/escort (road)
- County is generally responsive, but sometimes I have to solve an issue myself (clearing ditch, etc.)

**Other**

- Conflicts in urban areas and with urban drivers
- Paved roads encourage speeding. Attract drivers who live in rural areas (induced traffic)
- Need a bypass on the west, partly for the traffic from the new fertilizer plant. Without, will have to drive into Mt. Vernon.
- Other drivers don't respect our limitations
- Property owners act as though they own to the middle of the road
- We need to educate the non-farm public

# Appendix B: Illustration of Local Conditions and Needs

To better understand how Indiana's rural roads and bridges stack up to those in other Midwestern states, this report developed a cluster analysis based on the typology of county types and then teased out the application of needs, spending gap and funding options to two hypothetical counties based on real data.

## Methodology

To construct a typology of county types to examine the application of varying transportation treatments across types of counties throughout Indiana, quantitative data for all counties in the Soy Transportation Coalition states were tabulated and analyzed through a cluster analysis. Data were selected based on their relationship to soy production and likely impact on the transportation system as it related to moving grain from its place of production to point of sale. In this manner, counties that have high grain production were segmented from those that do not produce (e.g., Appalachian areas and urban centers) and then areas within the higher producing counties were segmented based on geographic size, population, climate, elevation, and existing infrastructure.

These data included demographic data (population, population density)[8], infrastructure (bridges, structurally deficient/obsolete bridges as a percent of all bridges[9], linear distance of interstates[10], and linear distances of railroads[11]), size of county (square miles)[12], elevation data (mean elevation and elevation range)[13], climatological data (mean minimum January temperatures)[14], and soy production data (five-year averages of acres in soy production and average yield per acre)[15]. A categorical variable representing metropolitan area counties, micropolitan area counties, and counties that are not in either was also included.[16] Additional data were originally included but were eliminated after tests for collinearity were performed; these data included additional bridge data (counts for structurally deficient and obsolete bridges), additional descriptive statistics for elevation, and average annual total soybean yields (not normalized by acreage).

Once the data set was assembled, Pearson correlations were used to examine collinearity of variables. Variables that had strong collinearity (>.7, <-.7) were examined and considered for removal from the cluster analysis. If the variables were determined to be measuring the same element (e.g., minimum elevation and mean elevation), one was removed; if measures were determined to be measuring different elements that happened to be related (e.g., linear distance of interstates and population density) both measures were included.

[8] Derived from the US Census, American Community Survey, 5-year estimates (2010-2014). Population density calculated in GIS using population data and square miles.
[9] Data are derived from the US Department of Transportation, Federal Highway Administration, National Bridge Inventory for 2014.
[10] Derived from primary roads from 2014 TIGER files; primary roads are defined as divided, limited-access highways within the Federal interstate highway system or under state management.
[11] Derived from 2014 TIGER files. This file includes spur lines and rail yards, mass transit rale lines, and special purpose rail lines.
[12] Derived from the ALAND field in 2014 TIGER files with the conversion between units being calculated through GIS.
[13] Data are derived from the US Geological Survey National Elevation Dataset as provided to analysts by USGS staff in September 2015. Dates of actual measurement vary by grid.
[14] Derived from the National Climactic Data Center, utilizing mean minimum January temperatures from 1981 to 2010. Data are for NOAA climate divisions (sub-regions within states); when a county is entirely within one region, it reflects the data for that climate division; when a county is split between regions, the measure reflects an average of the divisions within which it is a part.
[15] Data derived from the US Department of Agriculture, National Agriculture Statistics Service, data for soybeans from 2011 through 2015. Reported data are averages across five years; for counties without five years of data, averages for years available are reported. If no data are reported for any of the five years, it is assumed that there is no productivity for the purposes of the analysis. The USDA National Agricultural Statistics Service produces data for most counties; however, a small percentage of counties did not have data for each of the past five years and others had no data for any of the five years. When data were available for some years, an average of the years available was used in the analysis. When no data were available, the county was coded as having no production.
[16] Metropolitan, micropolitan, and rural areas are identified as published by the US Office of Management and Budget.

A k-means cluster analysis was performed on the remaining measures. Data were plotted using within groups sum of squares and number of clusters extracted to determine the appropriate number of clusters (7) and then the cluster analysis was performed. Both analyses were performed using R. Cook County, Illinois, was identified as a cluster unto itself; it was subsequently incorporated into the cluster with other urban centers throughout the region. Upon completion of the cluster analysis, the mean values for each measure was examined within clusters to distinguish differences between clusters and define the characteristics of individual clusters.

The clusters identified generally were distinguishable by the geographic size of the counties (square miles), population, population density, and soy production. The six resulting clusters (with Cook County, Illinois, included with other urban centers), are as follows:

- Large rural counties, high soy productivity (15 counties)
- Average-sized rural counties, high soy productivity (210)
- Smaller rural counties, high soy production (363)
- Geography varies, low soy production (519)
- Mix of urban/rural/suburban, modest soy production (73)
- Urban and suburban, low soy production (17) (Figure B1)

Of the six clusters, five are present in Indiana; there are no counties classified as large rural counties with high soy productivity. Marion County is the only urban/suburban low soy productivity county. Other urban areas throughout Indiana generally fall into the mix of urban/rural/suburban with modest soy production; these areas are typified by areas of relatively dense human settlements in one part of the county and highly productive agricultural areas outside of those areas (e.g., Lafayette/West Lafayette situated within Tippecanoe County). The distinguishing characteristic between highly productive areas is generally the size of the county (Montgomery County is medium-sized, highly productive, whereas Fountain County is smaller-sized and highly productive). The remaining areas are areas that are low production areas – generally, but not exclusively, due to topography of those counties.

### *Local examples*

Three typologies occur within the 16 study counties used as the basis for establishing county road and bridge needs, spending, and spending gap:

- Smaller rural counties, high soy production (363)
- Geography varies, low soy production (519)
- Mix of urban/rural/suburban, modest soy production (73)

Using the study counties classified as *smaller rural counties, high soy production* and the *mix of urban/rural/suburban, modest soy production*, the research team created two composite counties that represent median values for various parameters related to the infrastructure and farming and farm-to-market needs in these county types (Figure B2).

**Figure B1. Typology of counties**

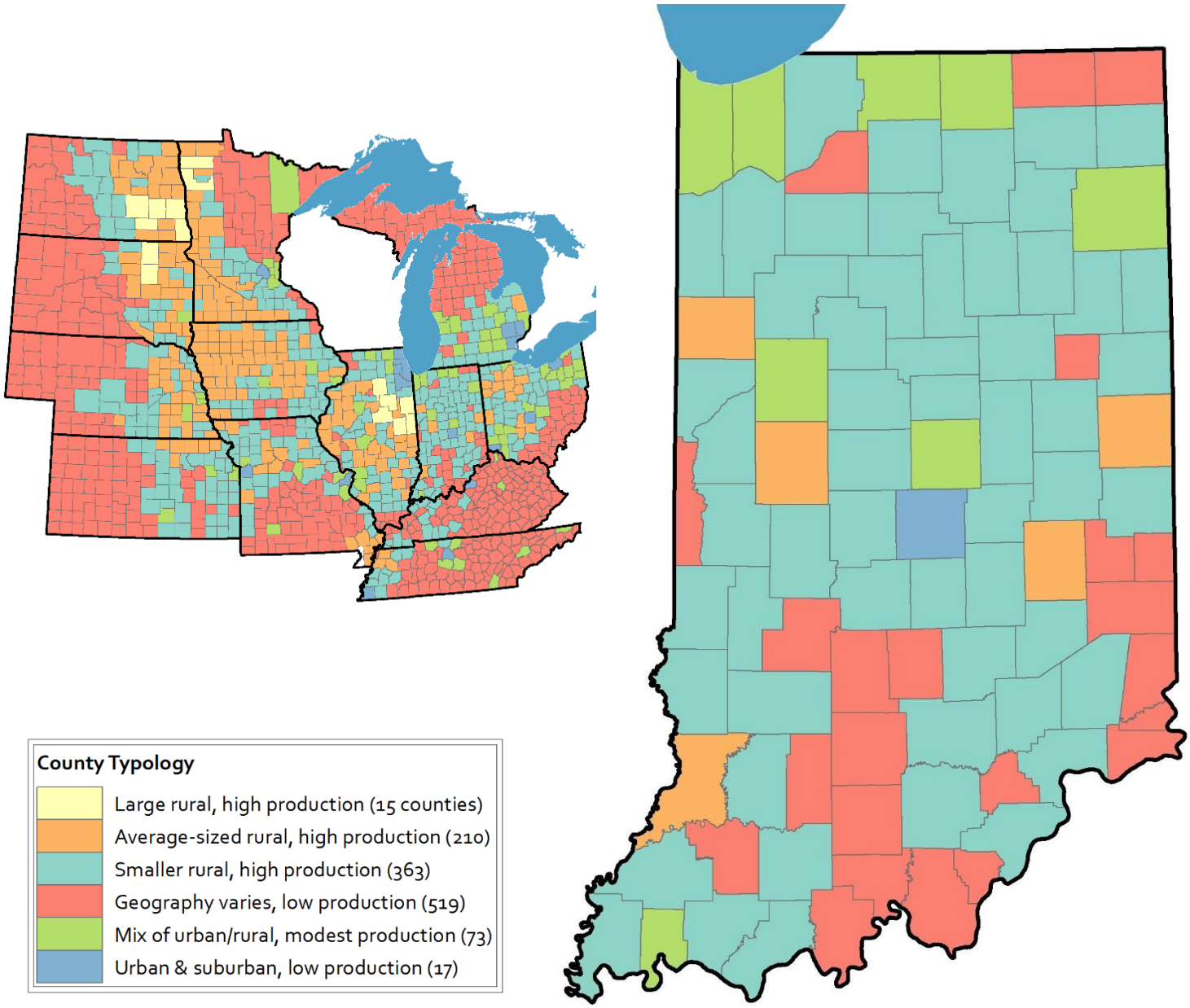


**Figure B2. Data for composite study counties**

| COUNTY A Smaller Rural, High Production | | COUNTY B Mix of Urban and Rural, Moderate Production | |
|---|---|---|---|
| Population | 50,000 | Population | 300,000 |
| Population density (persons per square mile) | 122 | Population density (persons per square mile) | 600 |
| Square miles | 410 | Square miles | 500 |
| Elevation range (ft) | 100 | Elevation range (ft) | 110 |
| Miles interstate | 10 | Miles interstate | 130 |
| Miles railroad | 70 | Miles railroad | 200 |
| | | | |
| Soy production annual acres (5-Year Avg) | 64,000 | Soy production annual acres (5-Year Avg) | 57,000 |
| Soy production annual yield (5-Year Avg; bushels) | 3.08 million | Soy production annual yield (5-Year Avg; bushels) | 3.05 million |
| Soy production yield per acre (5-Year Avg; bushels per acre) | 48.6 | Soy production yield per acre (5-Year Avg; bushels per acre) | 53.3 |
| | | | |
| Paved miles | 674 | Paved miles | 568 |
| Gravel miles | 24 | Gravel miles | 39 |
| Total rural road miles | 698 | Total rural road miles | 607 |
| % of Paved miles below PASER 6 | 39% | % of Paved miles below PASER 6 | 25% |
| 20-Year road rehabilitation need | $51.1 million | 20-Year road rehabilitation need | $44 million |
| | | | |
| Structurally deficient bridges | 13 | Structurally deficient bridges | 14 |
| Functionally obsolete bridges | 2 | Functionally obsolete bridges | 24 |
| Bridges (Total) | 121 | Bridges (Total) | 172 |
| Immediate rehabilitation need | $15.2 million | Immediate rehabilitation need | $46 million |