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### Iowa Local Technical Assistance Program

2711 S. Loop Drive, Suite 4700  
Ames, IA 50010-8664

Phone: 515-294-8103  
FAX: 515-294-0467

[www.intrans.iastate.edu/ltap](http://www.intrans.iastate.edu/ltap)

IOWA STATE UNIVERSITY  
Institute for Transportation

## Safety mitigation strategies for low-volume, unpaved rural roadways

by Bob Sperry, LTAP safety liaison

A recent in-depth study of crash history on Iowa's low-volume rural roads revealed an opportunity to implement low-cost safety improvements. Led by Reg Souleyrette of InTrans, the research indicates that a certain class of rural roadway—unpaved, with traffic volumes greater than 100 vehicles per day (vpd)—exhibit higher crash frequencies, rates, and densities than any other class of low-volume road examined, either paved or unpaved.

Although various factors contribute to crashes on these roadways, higher speeds and younger drivers are involved in many of them.

The 2010 research report includes several recommendations for crash mitigation, including the following:

- Enhanced law enforcement
- Younger-driver education
- Several low-cost engineering improvements, including upgraded signing, especially at horizontal curves, and road-side delineation

### Solutions in central Iowa

A follow-up study by InTrans safety personnel Tom McDonald and Bob Sperry was completed in May 2013. During this project, roadways in this particular class in central Iowa were identified, their crash histories reviewed, and selected suggested mitigation strategies deployed.

Local agency engineers and law enforcement participated in initial crash and field reviews involving 20 road segments. Many of the higher-crash roadways examined were straight, level, and “hazard free” (see Figure 1). Ultimately, based on crash rates, densities, frequencies, and severity factors, six road segments in four counties were selected for implementation of mitigation strategies.

A multi-disciplinary approach to reviewing site conditions and crash data proved valuable. It helped the team identify additional contributing factors, such as structures in the clear zone (see Figure 2), and appropriate countermeasures. This approach also resulted in increased cooperation and “buy

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Figure 1. Straight, level, “hazard free” roadway in Story County

## Acronyms and Abbreviations in Technology News

AASHTO	American Association of State Highway and Transportation Officials
APWA	American Public Works Association
FHWA	Federal Highway Administration
IHRB	Iowa Highway Research Board
InTrans	Institute for Transportation (at ISU)
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices
NACE	National Association of County Engineers
TRB	Transportation Research Board



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of Transportation

### About LTAP

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Institute for Transportation  
ISU Research Park  
2711 S. Loop Drive, Suite 4700  
Ames, Iowa 50010-8664  
Telephone: 515-294-8103  
Fax: 515-294-0467  
[www.intrans.iastate.edu/](http://www.intrans.iastate.edu/)

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## From the director: Join the team!

The Iowa LTAP team is involved with a wide range of activities that focus on assisting local transportation agencies. Some of these activities include the development and offering of training and outreach events, our newsletter, and the completion of locally focused research projects. We are always looking for local agency representation and input on these types of efforts.

For example, we work in partnership with the operators and supervisors that participate in the planning committees for the Snow Plow Operator Training, Snow Roadeo, and Motor Grader Operator Training. These planning committees are essential to the success of these efforts. They may meet only once or as often as a few times a year, and the members are also involved before and during the training through a variety of roles. Operators can also pass on their knowledge as instructors. If you would like to get involved or have any questions, please give me a call (see below).

Our newsletter advisory committee can also always use more members – this committee meets for an hour about four times a year by phone (before 8AM typically), and the members provide ideas for subjects that should be covered in the newsletter. Finally, we have technical advisory committees (TACs) for our locally focused research projects that need your input. TACs typically meet a

few times during the entire research project time period (normally a year or two). Some of these meetings may be face to face and others are through a conference call. Please consider these opportunities and contact me if you have any questions.

Fall is here, but Iowa LTAP also had a highly successful spring – our Motor Grader Operator (MOGO) Training went well. Thanks, also, to those that contacted us to host a training event at their facility. This site-based plus host-based approach to MOGO seemed to work very well. Remember, hosting a MOGO is always an option if we can get a minimum number of people to attend.

This fall we are once again offering our fall safety school at multiple locations throughout the state, a course on countermeasure design for bridge scour and instability here in Ames, and two 10-hour OSHA certification events. We are also assisting the Iowa DOT with the advertising for their SIIMS 7.2 training. Finally, by the time you get this newsletter the Streets and Roads Workshop and Conference will have been held. This year we had record registration for this event.

If you are interested in helping out with any LTAP activities, please give me a call (515-294-8817) or send me an email ([kknapp@iastate.edu](mailto:kknapp@iastate.edu)). Thanks, also, for your patience as we work to replace our recently retired LTAP librarian.

Safety mitigation continued from page 1

in” by appropriate stakeholders for developing effective remedies.

For example, in some cases where speed was a suspected factor, speed studies were conducted to identify specific locations and times for using enhanced enforcement as an effective deterrent. In cases where lack of driver skills or knowledge was a suspected factor, school officials and driver-education instructors were brought in to enhance the driver education experience.

Several low-cost mitigation strategies recommended in the 2010 research report, such as enhanced signage (see Figure 3), were deployed at the central Iowa sites. However, there was not enough time to collect follow-up crash data and evaluate the effectiveness of the countermeasures. In the future, additional research will involve such an evaluation.

## Implementing solutions now

In all of Iowa’s 99 counties, only about 4,400 total miles of roadway (an average of 45 road-miles per county) fall into this class. Given the low average number of road-miles per county and the low cost of recommended improvements, implementing appropriate mitigation strategies may be quite manageable for many counties.

Following are basic steps for identifying relatively high-crash, low-volume (but greater than 100 vpd) roadways and implementing solutions. Staff at InTrans and the Iowa LTAP are available to help.

1. Using Iowa DOT traffic estimates and county maps, identify rural, unpaved road segments with more than 100 vpd. Or request a detailed crash history map of a suspect roadway section or segment through the Iowa Traffic Safety Data

Service (ITSDS) staff at InTrans; use the online request form, [www.ctre.iastate.edu/itsds/](http://www.ctre.iastate.edu/itsds/).

2. Analyze crashes on the identified road segments for the last 10 years using the Iowa DOT Crash Mapping Analysis Tool (CMAT) to determine if there appear to be high crash frequencies, rates, or densities on any segments. The Iowa DOT Crash Analysis website, [www.iowadot.gov/crashanalysis/](http://www.iowadot.gov/crashanalysis/), is a good reference for comparing crash frequencies of similar secondary roads statewide.
3. Review and assess the road segments further with engineering staff, local law enforcement, and others who are familiar with the roads, using InTrans/LTAP staff for assistance if needed or desired. Speed studies may also be conducted using LTAP equipment and guidance if desired.
4. Identify and implement potential multi-disciplinary safety awareness and crash mitigation strategies.
5. Follow up with an analysis of benefits and document the results.

## For more information

For information or assistance, contact Bob Sperry, safety liaison, 515-294-7311, [rsperry@iastate.edu](mailto:rsperry@iastate.edu), or Tom McDonald, safety circuit rider, 515-294-6384, [tmcdonal@iastate.edu](mailto:tmcdonal@iastate.edu), at the InTrans office.

The 2010 research report, *Safety Analysis of Low-Volume Rural Roads in Iowa*, is online, [www.intrans.iastate.edu/reports/souleyrette\\_low\\_vol\\_report\\_w\\_cvr.pdf](http://www.intrans.iastate.edu/reports/souleyrette_low_vol_report_w_cvr.pdf).

The 2013 research report, *Evaluation of Mitigation for Safety Concerns on Low-Volume, Unpaved Rural Roads* is also online, [www.intrans.iastate.edu/research/documents/research-reports/low-vol%20unpaved\\_rural\\_safety\\_w\\_cvr.pdf](http://www.intrans.iastate.edu/research/documents/research-reports/low-vol%20unpaved_rural_safety_w_cvr.pdf).

An InTrans guide, *Traffic Safety Analysis for Local Agencies*, describes crash data analysis steps, Iowa crash analysis data resources and tools, and potential countermeasures, as well as possible funding for improvements. This resource is online, [www.intrans.iastate.edu/publications/\\_documents/handbooks-manuals/traffic-safety-analysis-for-local-agencies.pdf](http://www.intrans.iastate.edu/publications/_documents/handbooks-manuals/traffic-safety-analysis-for-local-agencies.pdf). ■



Figure 2. Utility pole located very close to the road shoulder, well within the clear zone, is a safety hazard

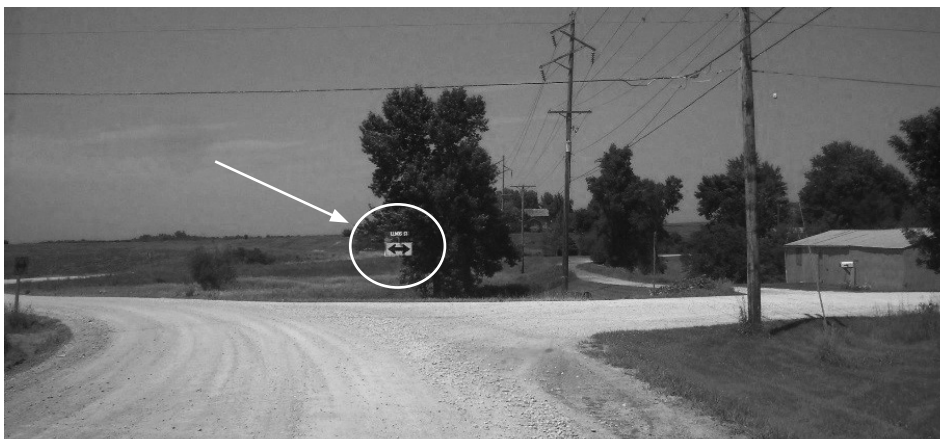


Figure 3. Double-arrow sign guides drivers, but the addition of chevrons at the curve might be a useful safety improvement

### Iowa LTAP Mission

To foster a safe, efficient, and environmentally sound transportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

### Staff

Keith Knapp  
 Director of Iowa LTAP  
 kknapp@iastate.edu

Tom McDonald  
 Safety Circuit Rider  
 tmdonal@iastate.edu

Bob Sperry  
 Local Roads Safety Liaison  
 rsperry@iastate.edu

Sabrina Shields-Cook  
 Communications Manager  
 shieldsc@iastate.edu

### Advisory Board

Donna Buchwald  
 Iowa DOT, Office of Local Systems  
 515-239-1051  
 donna.buchwald@dot.iowa.gov

Tim Herrstrom  
 Road Maintenance Foreman, Boone County  
 515-795-2825  
 bctjh@iowatelecom.net

Bret Hodne  
 Director of Public Works, City of West Des Moines  
 515-222-3480  
 bret.hodne@wdm-ia.com

Joe Jurassic  
 Transportation Engineer, FHWA–Iowa  
 515-233-7321  
 joe.juristic@fhwa.dot.gov

Ron Knoche  
 City Engineer, City of Iowa City  
 319-356-5138  
 ron-knoche@iowa-city.org

Catherine Nicholas  
 Black Hawk County Engineer  
 319-833-3008  
 engineer@co.black-hawk.ia.us

Greg Parker  
 Johnson County Engineer  
 319-356-6046  
 gparker@co.johnson.ia.us

Charlie Purcell  
 Iowa DOT, Office of Local Systems  
 515-239-1532  
 charlie.purcell@dot.iowa.gov

Roger Schletzbaum  
 Marion County Engineer  
 641-828-2225  
 schletzbaum@co.marion.ia.us

David Shanahan  
 Cherokee County Engineer  
 712-225-6715  
 dshanahan@co.cherokee.ia.us

Brad Skinner  
 Page/Montgomery County Engineer  
 712-623-5197 (Montgomery)  
 712-542-2510 (Page)  
 engineer@montgomeryco.ia.us

Jeremy Vorthorns  
 State Safety Engineer  
 Iowa DOT, Office of Traffic and Safety  
 515-239-1267  
 Jeremy.Vorthorns@dot.iowa.gov

Wade Weiss  
 Greene County Engineer  
 515-386-5650  
 wwweiss@co.greene.ia.us

# Iowa Snow Roadeo 2013

More than 55 participants competed at the 2013 Iowa Snow Roadeo, held September 12 at the Iowa State Fairgrounds. The Roadeo gave snow plow truck drivers, loader operators, and grader operators the opportunity to test their knowledge and showcase their skills by



Loader winners, left to right: Wayne Barrett (3rd place), Pat Linehan (2nd place), and Shawn Aldrich (1st place)



Grader winners, left to right: Ryan Rivas (3rd place), Brian Snyder (2nd place), and Beav McDaniel (1st place)



Truck Roadeo winners, left to right: Wayne Barrett and Chris Schnickel (3rd place), Josh Reynolds and Paul Albritton (2nd place), and Kelly Sand and Nathan Geil (1st place)

navigating courses that imitated the challenges faced by winter road maintenance personnel when removing snow from city streets and county roads.

In the loader competition, Shawn Aldrich (City of Waukeg) took first place, Pat Linehan (City of Davenport) took second place, and Wayne Barrett (City of West Des Moines) took third place.

In the motor grader competition, Beav McDaniel (City of West Des Moines) captured first place, Brian Snyder (City of West Des Moines) placed second, and Ryan Rivas (City of Des Moines) placed third.

Twenty-four two-person teams competed in the snow truck competition. Out of this challenging lineup, West Des Moines showed its strength with first-place winners Kelly Sand and Nathan Geil, followed closely by Josh Reynolds and Paul Albritton in second place and Wayne Barrett and Chris Schnickel in third place.

Congratulations to all the winners!

## Get involved!

Iowa LTAP is looking for additional members to serve on the planning committees for next year's Snow Plow Operator Training, Snow Roadeo, and Motor Grader Operator Training.

Committees may meet once or as often as several times per year. We are also looking for additional members for our newsletter advisory committee, which meets quarterly via conference call.

If you are interested, please contact LTAP Director Keith Knapp, 515-294-8817, [kknapp@iastate.edu](mailto:kknapp@iastate.edu).

## 12 tips for maintaining unpaved roads

Like fingerprints, each unpaved road is unique. The wear surface may be gravel, crushed rock, or sand, but all have one thing in common: Maintenance is required to keep the roadway in good driving condition.

Traffic displaces road surface material onto shoulders and into ditches, forming ruts in the roadway. Washboarding forms at stop signs, hills, and turns and in areas of acceleration or braking. Storms, runoff, and snowplowing also take their toll on unpaved roadways.

Following are 12 tips that can help you lengthen road maintenance intervals and avoid rework:

**1** To remove washboarding, cut the corrugations to their full depth, then regrade the area with moist material that will compact. (Corrugations filled with loose, dry materials will reform quickly in areas of high vehicle traffic.) Corrugations are best removed by using a scarifier or a serrated cutting edge.

Articulating the rear frame toward the toe of the moldboard by 2 to 5 degrees helps reduce motor graders' tendency to bounce and is extremely effective when cutting out washboards. This places one front tire slightly ahead of the other, allowing one tire to be on top of a corrugation while the other is in the bottom. As the tires roll up and down through the

washboard, the front axle will pivot up and down, keeping the front mainframe stable. Don't use the crab mode when scarifying washboarded areas. This can bend the scarifier shanks and/or linkage.

**3** Cut to the depth of major potholes to eliminate them. (Again, filling holes with loose, dry material is ineffective, as traffic quickly displaces the loose material and the holes reform.)

Typically, begin road maintenance with the moldboard top approximately 2 inches ahead of the cutting edge, and then adjust to the material and conditions. Tip the moldboard forward or back to obtain and maintain the desired cutting-rolling action. Tipping the moldboard forward will increase moldboard throat clearance. Generally, a wider throat

*12 tips continued on page 7*



# Stanley L. Ring Memorial Library: New materials

## Publications

### **P-1789 Guidelines for Road Maintenance Levels – USDA Forest Service**

This guide defines, summarizes, and illustrates the five road maintenance levels to help Forest Service line officers, road managers, transportation engineers, equipment operators, field personnel, partners, and cooperators understand and achieve consistent application of road management and maintenance standards. This Forest Service guide serves as a tool for educating the public and other resource personnel within the Forest Service about how the agency's transportation system is managed and maintained.

### **P-1790 Environmentally Sensitive Road Maintenance Practices for Dirt and Gravel Roads – USDA Forest Service**

This field guide is organized to identify visual signs of problems associated with causes and solutions for the most commonly encountered road problems. The Keys section guides the users to specific practices grouped according to the type of problem (road surface, ditch, cutbank, etc.). Additional references and links to other useful guides are included.

### **P-1791 Safety Evaluation of Transverse Rumble Strips on Approaches to Stop-Controlled Intersections in Rural Areas – FHWA Highway Safety Information System Summary Report**

The objective of this effort was to examine the impact of TRSs on crashes, specifically total crashes, injury crashes, and specific crash types, such as right-angle and run stop sign crashes. The effort also included an economic analysis to investigate the tradeoffs between different crash types.

### **P-1792 Factors Contributing to Pedestrian and Bicycle Crashes on Rural Highways – FHWA Highway Safety Information System Summary Report**

The goals of this study were to examine the differences between pedestrian and bicycle crashes in urban and rural settings in North Carolina and to identify problem areas (specific crash types and crash locations) on rural highways that are of high priority for safety treatment and treatment development.

### **P-1793 Development of a Speeding-Related Crash Typology – FHWA Highway Safety Information System Summary Report**

The goal of this study was to determine the “what,” “where,” “when,” and “who” descriptors of speeding-related crashes in order to guide the future development of new treatments and better target new and existing treatments to subgroups of drivers and types of roadways (e.g., two-lane rural) or roadway locations (e.g., unsignalized intersections).

## DVDs

### **DVD-402 FHWA Long-Term Pavement Performance program Standard Data Release 27 Reference Library – January 2013**

The FHWA's Long-Term Pavement Performance (LTPP) program Standard Data Release 27 is provided in a thumb drive or DVD format and contains a repository of documents related to understanding how experiments are designed and data are collected, as well as LTPP products and research reports resulting from use of LTPP data. Also available is the entire LTPP database developed through the LTPP program.

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*Note about delivery of materials: The library sends orders through the U.S. Postal Service. If you have an urgent need for library materials, let us know when you place your order and we will arrange faster delivery.*

### **DVD-399 Best Practices: Berming – Ohio DOT**

This video from the Ohio DOT was developed with the objective of providing a basic understanding of roadway maintenance regarding berming. Berming involves shaping shoulders for DOT operations on paved roads. This video provides Ohio DOT's best practices for both cutting shoulders and placing new material for edge ruts.

### **DVD-400 Best Practices: Spray Injection Patching – Ohio DOT**

This video from the Ohio DOT was developed with the objective of providing a basic understanding of roadway maintenance regarding spray injection patching. The video describes Ohio DOT's best practices.

### **DVD-401 Best Practices: Snow and Ice Control, Winter Formula – Ohio DOT**

This video from the Ohio DOT was developed with the objective of providing best practices for snow and ice control winter operations. The video describes Ohio DOT's best practices.

12 tips continued from page 5

opening allows better material flow along the moldboard in a wide variety of soil types. Maintaining a rolling action on the material while working reduces the horsepower required and provides maximum productivity.

**5** Material buildup in the circle area may increase circle wear. It can also stop material rolling action and cause it to be bulldozed.

Bulldozing material requires more horsepower and more traction and reduces motor grader productivity.

Apply only enough downward pressure to accomplish the task. Excessive downward pressure on a hard, dry surface causes rapid cutting edge wear, requires more horsepower and fuel, and reduces productivity.

**6**

**7** The blade's tip angle should be positioned with the cutting edge at 90 degrees to the road surface. In this position, downward pressure on the moldboard places less stress on the cutting

edge and retaining bolts. The edges also tend to ride over objects, which helps prevent machine damage.

**8** For maximum machine stability when maintaining roadways, the motor grader's main frame should be straight with the drawbar and circle-centered under the frame.

For the widest possible pass on the travel surface, keep the moldboard angle as square to the frame as possible. If material starts to flow around the leading end of the moldboard, or the rolling action dies, increase the blade angle.

**9**

**10** Keep machine travel speed as high as possible for maximum productivity but low enough to prevent machine bounce (generally, 4 to 7 mph).

**11** Moldboard angles of 10 to 30 degrees are normally used in light, free-flowing material.

Higher moldboard angles of 30 to 50 degrees are required when processing wet-sticky material, mixing large windrows, and ditching.

To cut hard material or for finishing work, tip the moldboard further forward than the start position. When finishing, tip the moldboard top 4 to 5 inches ahead of the cutting edge so the cutting edge is approximately 90 degrees to the cut surface. This moldboard tip position will generally position the drawbar parallel to the finished grade.

**12**

As always, road conditions and your fleet are factors in your agency's road maintenance practices.

— Article adapted from the original in Caterpillar's *Governmental Solutions*, Spring 2012; photo courtesy of same ■

## Conference calendar

October 2013			
8	Iowa Local Agency Safety Workshops	Spencer	Jennifer Serra
15–17	Countermeasure Design for Bridge Scour and Instability (NHI 135048)	Ames	Keith Knapp
22–23	Iowa Local Agency Safety Workshops	Solon	Jennifer Serra
29	SIIMS 7.2 Training	Fairfield	Keith Knapp
30	Iowa Local Agency Safety Workshops	Red Oak	Jennifer Serra
November 2013			
6–7	OSHA Ten-Hour Training for the Roadway Construction Industry	Waterloo	Keith Knapp
13	Municipal Streets Seminar	Ames	Denise Wagner
December 2013			
4–5	OSHA Ten-Hour Training for the Roadway Construction Industry	Des Moines	Jennifer Serra

### Conference contact information

Jennifer Serra  
515-294-4401  
jserra@iastate.edu

Keith Knapp  
515-294-8817  
kknapp@iastate.edu

Denise Wagner  
515-294-5798  
dfwagner@iastate.edu

### Event details and online registration

Watch for details and online registration information, by specific dates/events, on the online calendar, [www.intrans.iastate.edu/mors/calendar/](http://www.intrans.iastate.edu/mors/calendar/). ■

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