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Traffic Calming for High-Speed Rural Roadways

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This Transportation Research Synthesis provides brief summaries of recent research on a topic of current interest. Online links are active at the time of publishing, but may change.

INTRODUCTION

The Minnesota Local Road Research Board (LRRB) requested a synthesis of studies that explore the topic of traffic calming for high-speed rural roadways.

The Federal Highway Administration (FHWA) offers a description of traffic calming that includes two components:

- “The combination of mainly physical measures that reduce the negative effects of motor vehicle use and improve conditions for non-motorized street users.”
- “A number of transportation techniques developed to educate the public and provide awareness to unsafe driver behavior.”

The FHWA and the Institute of Transportation Engineers (ITE) acknowledged the challenges in reaching a consensus on a definition of traffic calming in its publication, *Traffic Calming, State of the Practices*, 1999.

A subcommittee of ITE developed the following definition:

“Traffic calming is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users.”

Many studies on traffic calming look at the effectiveness of different techniques in reducing speeds on city streets, but there is less information available about the application of traffic calming to reduce speeds on high-speed rural roadways. This synthesis examines national and international research that relates to the application of traffic calming on high-speed rural roadways.

KEY STUDIES AT A GLANCE

The following chart offers a quick look at the results of several key studies that are included in this synthesis. Written summaries of these and other studies follow. These studies apply principally to the use of traffic calming measures during the transition from high-speed rural roadways to city speed limits.



Method	Result	Study
<ul style="list-style-type: none"> Red markings with white text that displays the speed Eight-inch edgeline 	Effective at first, decreased as markings faded, increased after repainting	Dexter, Iowa (see page 3)
<ul style="list-style-type: none"> Converging chevrons On pavement speed markings Lane Narrowing 	Considered reasonably effective	Roland, Iowa (see page 3)
<ul style="list-style-type: none"> Seminole profile speed table 	Successful in decreasing speeds, resident complaints	Gilbert, Iowa (see page 3)
<ul style="list-style-type: none"> Two center islands On pavement slow markings Driver feedback sign 	Longitudinal channelizers and sign considered effective; on pavement markings not effective	Slater, Iowa (see page 3)
<ul style="list-style-type: none"> Transverse pavement markings Lane narrowing Driver feedback signs 	Transverse markings considered moderately effective; lane narrowing not effective; speed signs effective	Union (see page 3)
<ul style="list-style-type: none"> Speed humps 	Effective	NHTSA (see page 4)
<ul style="list-style-type: none"> Diverse methods 	Effective	International scanning tour (see page 5)

NATIONAL AND INTERNATIONAL RESEARCH

Several studies on traffic calming for high-speed rural roads evaluate the success of traffic calming techniques in reducing speeds as vehicles enter rural communities from high-speed rural roadways. Again, these studies examine techniques that help drivers successfully transition from the highway speed limits to city speed limits.

In Iowa, a series of recent research projects by the Center for Transportation Research and Education at Iowa State University examined low- and moderate-cost traffic calming techniques through several small Iowa communities:

• Single-Measure Traffic Calming in Dexter, Iowa, November 2007

www.operationsresearch.dot.state.ia.us/ihrb/2007/ihrb_dec2007/Dexter%20T2.pdf

A series of entrance treatments, which included red pavement markings with white text that displayed the speed, as well as an eight-inch edgeline painted along

the sets of treatment, proved effective in reducing speeds after application. Speeds were reduced for example, by two to five miles an hour. As the markings faded over time, the effectiveness decreased and increased after repainting, demonstrating the need for ongoing maintenance of pavement markings.

• Gateway Traffic Calming in Roland, Iowa, November 2007

www.operationsresearch.dot.state.ia.us/ihrb/2007/ihrb_dec2007/Roland%20T2.pdf

Roland used several traffic calming techniques, including converging chevrons, on-pavement speed markings, and lane narrowing. Results indicate that gateway entrance treatments to the community, which consisted of converging chevrons and on-street pavement markings, were reasonably effective. The gateway treatments within the community did not appear to affect speeds in a meaningful manner.

• Single-Measure Traffic Calming in Gilbert, Iowa, November 2007

www.operationsresearch.dot.state.ia.us/ihrb/2007/ihrb_dec2007/Gilbert%20T2.pdf

Gilbert installed a Seminole profile speed table, mounds that cover the full roadway width, which was successful in decreasing speeds from two to five miles per hour in both directions before and after the speed table. The effectiveness remained the same over time, but some residents complained that they did not like the speed table.

• Low-Cost Traffic Calming in Slater, Iowa, November 2007

www.operationsresearch.ot.state.ia.us/ihrb/2007/ihrb_dec2007/Slater%20T2.pdf

Slater used three different low-cost methods, including two center islands, on-pavement “SLOW” markings, and a driver speed feedback sign, which was added last. Results showed that the longitudinal channelizers that formed a center island reduced speeds significantly. The sign also helped reduced speeds, but the on-pavement markings did not appear to be effective.

• Gateway Traffic Calming in Union, Iowa, November 2007

www.operationsresearch.dot.state.ia.us/ihrb/2007/ihrb_dec2007/Union%20T2.pdf

Union treatments included simultaneous use of peripheral transverse pavement markings, lane narrowing through median and shoulder widening, and driver feedback signs. It appears that the transverse markings were moderately effective, lane narrowing was not effective, and speed feedback signs were effective.

The full report about all five sites is available at www.ctre.iastate.edu/research/detail.cfm?projectID=-226410767.

In Virginia, a national demonstration project is employing a number of traffic calming measures that promote driver compliance with posted speed limits.

- **Context Sensitive Design Case Study No. 7, Route 50, Loudoun-Fauquier Counties**

www.contextsensitivesolutions.org/content/case_studies/kentucky_50/

www.route50.org

This 24-mile long portion of rural highway U.S. Route 50 experienced issues with excessive speeds through small towns, aggressive driving in the corridor, and poor and unsafe conditions. The project included extensive community involvement in traffic calming use and environmental issues, as well as scenic, historic, and economic preservation; minimal right-of-way acquisition; and stabilized turf shoulders. Traffic calming measures include entrance features to villages along the route and within villages, raised intersections and pedestrian crosswalks, tree planted medians, small traffic circles, cobblestone or paving stone strips that signal changes in the speed limit, various paving materials to indicate parking, walking, and driving areas, strategically placed greenery along the streets, and safer pedestrian walkways. Work continues on constructing traffic calming measures.

In Pennsylvania, a focus on reducing tailgating involved the use of traffic calming techniques. The Pennsylvania Department of Transportation received a 2001 National Highway Safety Award for the project.

- **FHWA Announces National Highway Safety Awards Winners**

www.dot.gov/affairs/fhwa3701.htm

The **PENNDOT** provided pavement markings and signs that warned drivers to avoid tailgating and to leave two

“dots” or two seconds between them and the driver ahead of them. The project also included partnerships with police and other organizations and outreach. Aggressive driving and tailgating dropped 60 percent in the area.

A literature review for the *National Highway Traffic Safety Administration (NHTSA)* summarizes the results of several studies on and state experiences with traffic calming traffic calming techniques:

- **Pilot Test of Novel Speed Reducing Program, NHTSA, 2000**

www.nhtsa.dot.gov/people/injury/research/heedspeedweb/pages/appa.htm

The report notes the effectiveness of speed humps in reducing average and very high speeds, as well as chicanes, traffic islands, and roundabouts. It also includes experience with pavement markings and arrows that helped reduce speeds on curves. “The most effective traffic calming methods involve vertical shifts in the roadway,” according to the summary. “Humps have been proven to be very effective.”

The University of California at Berkeley Institute of Transportation Studies summarized several studies on speed humps and bumps:

- **Speed Humps and Bumps, Institute of Transportation Studies Library, 2007**

www.techtransfer.berkeley.edu/newsletter/07-1/resources.php

Studies and articles in this summary provide more detailed information about the use of speed humps in traffic calming, including evaluations of effectiveness and designs.

The issue of reducing speeds on rural roads also has attracted international interest in a number of studies:

- **Rural Traffic Calming in Bird Lane, February 2004**

www.products.ihs.com/cis/doc.aspx?authcode=&docnum=267412

Bird Lane in Essex experiences high levels of traffic and high speeds. To encourage non-motorized use of lane, Essex narrowed the road, designated reduced speed zones, and added speed signs. The techniques reduced mean speeds through the roadway section.

• **Geometric Design Practices for European Roads, 2001**

www.international.fhwa.dot.gov/pdfs/geometric_design.pdf

This publication reports on the results of an international scanning tour by a U.S. delegation to Sweden, Denmark, the Netherlands, England, and Germany. The delegation found helpful practices regarding public involvement, self-enforcing rural roads, design flexibility, traffic calming measures, intersection control through roundabouts, and the integration of bicyclists and pedestrians. Traffic calming devices included prewarnings, gates, narrowings, humps and tables, raised areas, staggering, roundabouts, chicanes, islands, cushions, landscaping and plantings, and pavement textures and colors. "In all countries visited the use of these devices produced the desired speed reductions, which ranged from a few km/h to 20 km/h," according to the report.

• **70th Road Safety Congress: Psychological Traffic Calming, 2005**

www.rospace.com/roadsafety/conferences/congress2005/info/kennedy.pdf

This study looked at psychological measures that contribute to effective traffic calming. The report cited the following reasons for effective traffic calming schemes: "Consistent treatment of a whole length of road, centre of village treated in addition to gateways, visual and physical road narrowing, limiting of forward visibility and breaking up of sightlines to increase driver awareness, and removal of white line in conjunction with the physical narrowing at parking bays, to create uncertainty."

• **Rural Minor Road Traffic Calming, 2004**

www.sustrans.org/uk/webfiles/info%20sheets/rural%20road%20traffic%20calming.pdf

This report looks at the types of traffic calming measures for rural roads, their appropriateness for different applications, expected results, and design details. "It is now widely known that the most effective and most accepted traffic calming schemes are those which incorporate a variety of measures," according to the report.

• **Driving Behavior: A Moving Target**

<http://onlinepubs.trb.org/onlinepubs/trnews/trnews254.pdf>

This article explores human factor research that relates to preventing crashes. It cites a crash study in Finland, which found that improved guidance with post-mounted delineators had minimal effects on nighttime speed or on crashes on 100 km/h roads and increased speeds at night on 80 km/h roads.

MINNESOTA STUDIES

The Minnesota Local Road Resource Board has conducted research on traffic calming methods to reduce speeds in city limits or in approaches to cities, as well as on human factors that influence driver behavior. Those studies include:

• **Investigating the Effects of Traffic Calming Strategies on Driver Behavior, 2002**

This report looks at the results of two simulator experiments on traffic calming and shows that the use of median islands, chokers, and planters are likely to produce measurable reductions in traffic speed.

• **Methods to Reduce Traffic Speed in High Pedestrian Areas, 2002**

Researchers compared speed data at two sites in Twin Lakes and two sites in Bemidji Lake, both under existing conditions and after installation of speed reduction techniques. Results showed the traffic calming strategy at Twin Lakes effectively reduced the main speed and improved short-term and long-term speed compliance. Bemidji Lake techniques failed to lower speeds.

• **Investigating the Effectiveness of Traffic Calming Strategies on Driver Behavior, 2002**

This report examined the impact of different types of traffic calming strategies on driver behavior, traffic flow, and speed. Results showed that traffic calming had a limited impact on average driver speed, with the greatest impacts on reducing speeds that are greater than the 85th percentile speed.

- **Investigating the Effects of Roadway Design on Driver Behavior: Applications for Minnesota Highway Design, 1999**

This research looked at the relationship between highway design and human behavior.

- **Effective Traffic Calming Applications and Implementation, 1999**

This report offers a toolbox that presents the purpose, cost, pros and cons, and effectiveness of various traffic calming applications.

- **Traffic Calming Activity in Minnesota, 1998**

This report explores the actual and perceived successes of traffic calming activity in Minnesota.

- **Creating Bicycle Transportation Networks: A Guidebook, 1996**

This guide provides a practical planning model for bicycle transportation in cities, suburbs, and small towns.

Reports are available at www.lrrb.org.

In addition, the Minnesota Departments of Public Safety and Transportation partnered with the Wright County Highway Department and the Safe Communities Coalition of Wright County to pilot a tailgating treatment program, similar to the PENNDOT program.

- **Minnesota Tailgating Pilot Project Report and Summary 2006**

www.dot.state.mn.us/trafficeng/tailgating/index.html

The project included use of elliptical dots on a stretch of Highway 55 and a public information campaign. Dots were painted on the road and signs directed motorists to maintain at least two dots between them and the next vehicle. Evaluation data showed the gap between vehicles increased from 2.35 to 2.52 seconds, or 14.1 feet. In addition, speeds at all points along the study corridor decreased from 58.6 to 56.8.

STATE RESOURCES

www.mn-traffic-calming.org/

The Minnesota Local Road Research Board developed a web site on traffic calming. The web site presents a searchable database of traffic calming projects implemented in Minnesota; traffic calming data collection guidelines, and links to additional traffic calming resources. Any city or county engineer in Minnesota can add a project to the database.

NATIONAL RESOURCES

www.FHWA.dot.gov/enviornment/tcalm/index.htm

- The FHWA web site lists the general objectives of traffic calming, traffic calming measures, links to traffic calming programs, direct links to other related agencies, a list of related studies, and upcoming events.

www.ite.org/traffic/tcdevices.htm.

- The ITE website on traffic calming provides a variety of resources, including fact sheets on several traffic calming measures and a library of reports, including Traffic Calming: State of the Practice, ITE/FHWA, 1999, which synthesizes traffic calming experiences in the United States.

www.trafficcalming.org/index.html

- This web site provides a toolkit of calming devices, results from application of traffic calming measures, and information about traffic calming programs throughout the world.

RESEARCH IN PROGRESS

A number of current research proposals deal with the traffic calming and reduction of speeds on high-speed rural roadways.

- **Transition Zones: Design from High-Speed to Low-Speed Rural Sections**

<http://rns.trb.org/dproject.asp?n=13444>

AASHTO and TRB posted a research needs statement to fund research that would develop improved treatments and procedures for designing transitions from high-speed to low-speed rural highways to lower-speed rural or suburban/urban areas.

• Low Cost Strategies to Reduce Speed and Crashes on Curves, 2007

Center for Transportation Research and Education, Iowa State University

<http://www.ctre.iastate.edu/research/detail.cfm?projectId=-1352703394>

Part of a FHWA national field examination of low-cost dynamic speed signs on rural roadways, this project will look at low-cost measures to reduce speeds and crashes on high-crash horizontal curves. The FHWA portion will fund installation and evaluation of at least four speed feedback signs on curves in Iowa; the portion funded by the Iowa Highway Research Board will evaluate the signs as well as other treatments to reduce speeds and subsequent crashes on rural roadway curves. The study will gather before-and after-data on crashes, speeds, and volumes.

• Effectiveness of Speed Minders in Reducing Driving Speeds on Rural Highways in Pennsylvania

The Pennsylvania Department of Transportation will evaluate its use of speed minders, or dynamic speed

display signs, which communicate motorists' speeds, on roadways that transition from high-speed to low-speed primarily on rural highways.

• High-Risk Rural Roads (HRRR) Guide to Assist Local Road Officials Increase Safety on HRRR

This research will result in a guide for local officials to help reduce fatalities and injury on rural, local roads.

• Traffic Calming Guidelines

This Canadian-sponsored study will work to develop traffic calming guidelines for use on local and collector roads. The end product, a manual, will define traffic calming, outline a public consultation and implementation process, identify traffic calming measures, and offer design guidelines.

• Effectiveness of Enhanced Edge Lines to Reduce Road Departure Crashes on Rural Roads

This Minnesota study proposes to look at the effectiveness of rumble strips, wider edge lines, and other edge line modifications in reducing road departure crashes on rural roads.

Summary

Much of the past research on traffic calming measures for high-speed rural roads focuses on the issue of reducing speeds as vehicles travel from a rural highway section into a rural community. The most recent package of studies in Iowa evaluated the effectiveness of different traffic calming measures in five rural locations. Other studies also explore the effectiveness of a traffic calming measure, and several look at the process of selecting appropriate traffic calming measures and involving community members in selection and other context sensitive design techniques.

In addition, national and state resources make it possible to learn more about the experiences of others as they use different traffic calming measures. These resources can provide information to aid in the evaluation of traffic calming measures.

Less is known about the use of traffic calming measures in reducing speeds on stretches of high-speed rural roadways, but proposed research is beginning to focus more on this area, including a proposed study in Iowa on measures to reduce speeds on curves of rural roads.