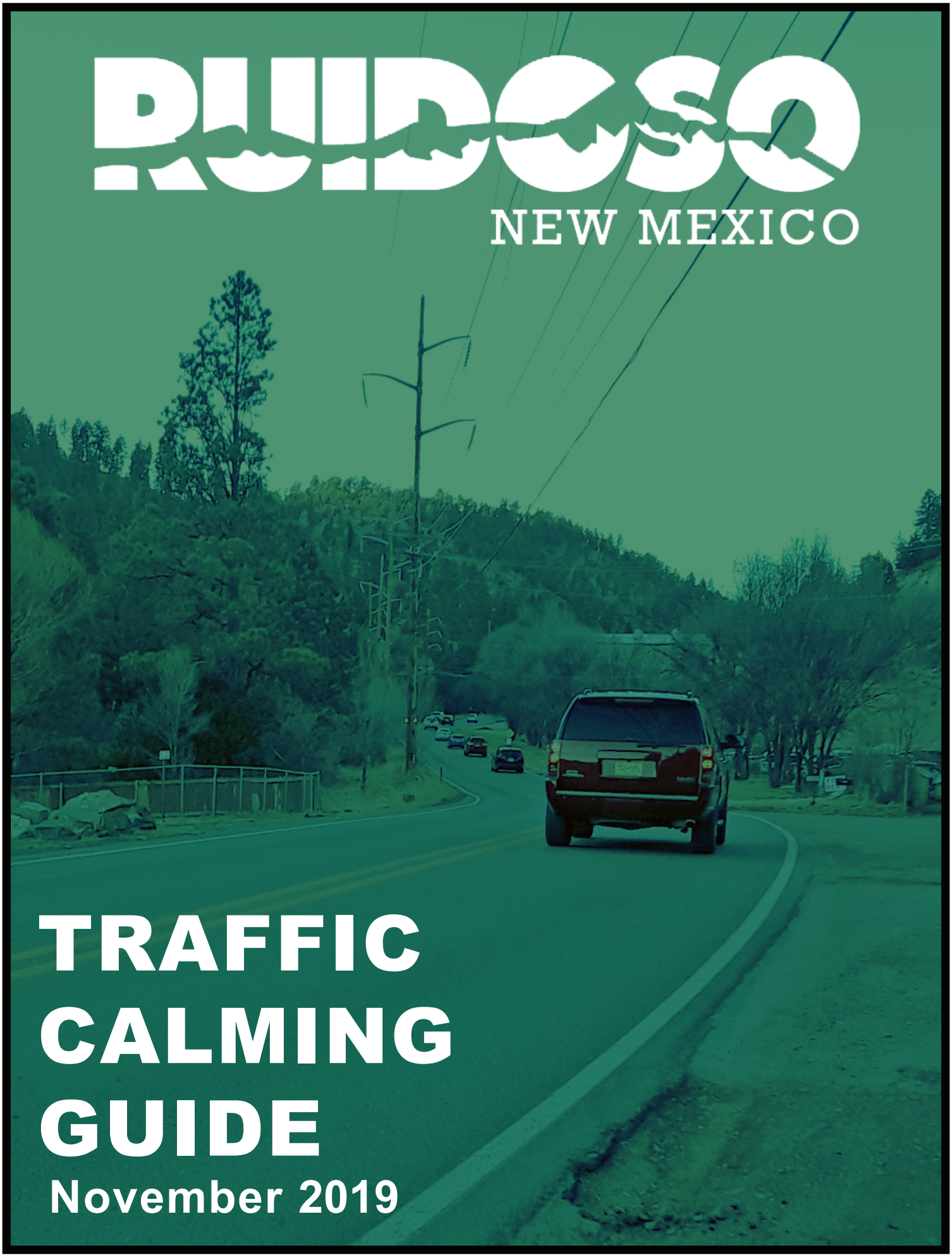
RUIDOSO

NEW MEXICO



TRAFFIC CALMING GUIDE

November 2019


(Image Source: Ruidoso.net)

PURPOSE OF THE GUIDE

This guide is intended to assist with local decision-making efforts in determining traffic calming measures along roadways owned and maintained by the Village of Ruidoso. National best practices and design guidance are considered in a context unique to Ruidoso so they may be applied to local streets where regular speeding occurs. Within this guide, a multitude of traffic calming methods have been identified, along with their effectiveness, estimated costs of installation, advantages, disadvantages, appropriateness for different roadway types, and their applicability for Ruidoso.

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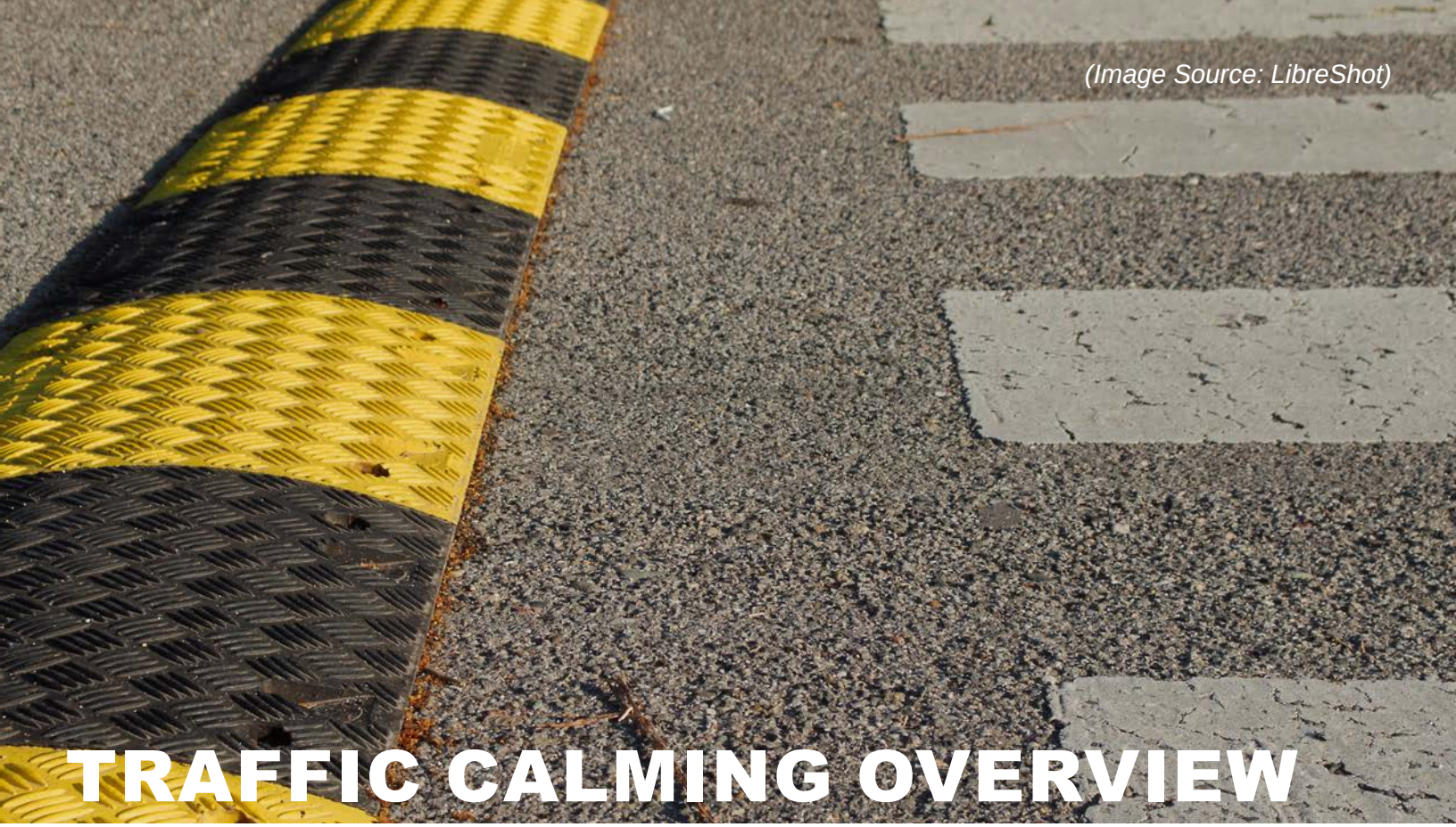
RUIDOSO NEW MEXICO

Bohannan Huston

INTRODUCTION

The Village of Ruidoso faces an unusual set of transportation challenges in which roadways may be subject to high levels of congestion during the tourist season, yet those same roadways may witness high vehicle speeds once the tourist seasons end. Among the most common issues faced by local residents is cut-through and speeding traffic along Village-owned roadways, including neighborhood and residential streets. In an effort to confront this issue, the Village of Ruidoso has developed the *Village of Ruidoso Traffic Calming Guide* to assist in addressing speeding and cut-though traffic with known traffic calming techniques.

To create this guide, a variety of existing traffic calming research, policies, and governmental guidelines have been synthesized so local decision-makers can easily understand a given method, as well as its appropriate usage. Unlike the majority of traffic calming guides, which have been developed by large municipalities, this guide is unique in that it highlights traffic calming measures that are suitable in a small-town setting and along rural roadways. While many of these techniques may be applicable to state-owned roadways, it is important to note that this guide focuses exclusively on Village of Ruidoso-owned roadways.



TRAFFIC CALMING OVERVIEW

WHAT IS TRAFFIC CALMING?

According to the FHWA, the primary purpose of traffic calming is to "support the livability and vitality of residential and commercial areas through improvements in non-motorist safety, mobility, and comfort. Traffic calming measures consist of horizontal, vertical, lane narrowing, roadside, and other features that use self-enforcing physical or psycho-perception means to produce desired effects."

HOW IS TRAFFIC CALMING MEASURED?

The ultimate goal of traffic calming is to reduce vehicle speeds and volumes to acceptable levels for a given roadway type. To measure the effectiveness of a specific traffic calming method, the 85th percentile speeds of roadway users are tracked before and after a treatment is installed. The resulting change in 85th percentile speeds is then measured, with greater reductions in speed indicating a more-effective traffic calming technique.

SOURCES OF OBSERVED SPEED REDUCTIONS

The observed speed reductions used in this guide are taken from three sources of guidance, all from the FHWA: *Engineering Speed Management Countermeasures: A Desktop Reference of Potential Effectiveness in Reducing Speed*, *Traffic Calming on Main Roads Through Rural Communities*, and *Factors Influencing Operating Speeds and Safety on Rural and Suburban Roads.* These three works synthesize the effectiveness of traffic calming treatments utilized across multiple states. The documented changes in 85th percentile speeds can then be utilized to project similar speed reductions when using the same traffic calming method in Ruidoso.

LANGUAGE FROM THE VILLAGE OF RUIDOSO COMPREHENSIVE PLAN

SECONDARY ROADS AND BYPASS ROUTES

Some of the Village's secondary roads, including Gavilan Canyon Rd, Hull Rd, and Paradise Canyon Drive are frequently used as bypass roads, especially when main roadways through Ruidoso become congested during the peak tourist seasons. However, these roadways also serve residential areas and Ruidoso residents have expressed a desire for traffic calming efforts along many of the Village's secondary routes. Measures, such as speed humps, have been applied on Buckner Drive and other secondary roadways. During the off-season, vehicle speeds through Midtown are often excessive and speed humps, flashing beacons, and radar speed control signs have been applied.

INFRASTRUCTURE VS. PAINT

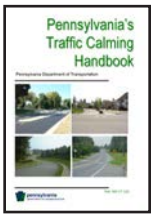
In deciding the most-appropriate traffic calming technique for a given situation, one aspect that must be considered is the cost of a specific treatment, especially when deciding between an infrastructure-based or paint-based treatment. Infrastructure improvements are typically more expensive to install, but they last longer and require less maintenance than paint-based techniques. Conversely, paint-based treatments are cheaper to install than additional infrastructure, but they require regular reapplication of paint to maintain their effectiveness.

SOURCES OF GUIDANCE

To create this guide, existing traffic calming literature was analyzed and synthesized into a concise framework unique to Ruidoso. While many different traffic calming techniques exist, it is important to note that no two traffic calming situations are the same, and what may work in one situation may not work for another. Furthermore, established guidance documents exist that should be used as references for the specific design aspects of traffic calming techniques. These documents include: the American Association of State Highway and Transportation Officials' *A Policy on Geometric Design of Highways and Streets*, FHWA's *Manual on Uniform Traffic Control Devices*, National Association of City Transportation Officials' *Urban Street Design Guide*, AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities*, and ITE's *Guidelines for the Design and Application of Speed Humps*. The sources provided below were consulted during the creation of the *Village of Ruidoso Traffic Calming Guide*.

VIRGINIA TRANSPORTATION RESEARCH COUNCIL

VTRC's *Using All-Way Stop Control for Residential Traffic Management* evaluates the effectiveness of All-Way Stop Control for residential traffic management on local residential streets.

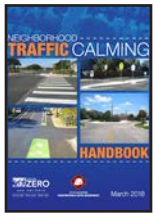


PENNSYLVANIA DEPARTMENT OF TRANSPORTATION

Due to the increasing usage of traffic calming as a traffic management tool for municipalities throughout Pennsylvania, the Pennsylvania Department of Transportation created the *Traffic Calming Handbook* to provide new and additional information on traffic calming and how it could be used on the state's roadways, as well as information on various traffic calming issues, legal authority, liability, funding, impacts on emergency services, and more.

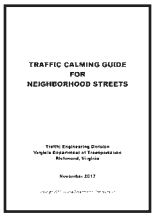
MINNESOTA DEPARTMENT OF TRANSPORTATION

MNDOT's report *Traffic Calming for High-Speed Rural Roadways* summarizes recent studies that explore the topic of traffic calming for high-speed rural roadways.



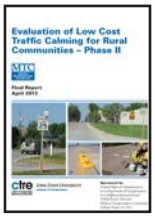
CITY OF SAN ANTONIO, TX

As part of the city's ongoing efforts to reduce the negative effects of speeding and cut-through traffic while enhancing safety for pedestrians and bicyclists, the city of San Antonio's *Traffic Calming Handbook* provides an overview of traffic calming options for residential streets and the estimated cost of their installation.



VIRGINIA DEPARTMENT OF TRANSPORTATION

VDOT's *Traffic Calming Guide for Neighborhood Streets* provides guidance and procedures for local communities to pursue traffic calming in their neighborhoods on streets maintained by VDOT, including estimated costs and observed speed reductions for specific traffic calming measures.



IOWA STATE UNIVERSITY

In a report created for The Midwest Transportation Consortium, Iowa State University's *Evaluation of Low Cost Traffic Calming for Rural Communities* provides an overview of traffic calming techniques utilized in rural Iowa.

FEDERAL HIGHWAY ADMINISTRATION

Multiple reports published by the FHWA were consulted for this traffic calming guide. The tech brief *Traffic Calming on Main Roads Through Rural Communities* provides an evaluation of the effects on speed of low-cost, traffic-calming treatments on main rural highways passing through small, rural communities. The report *Factors Influencing Operating Speeds and Safety on Rural and Suburban Roads* provides a similar overview of traffic calming treatments and their effects on vehicle speed for both a rural and suburban setting. Another report entitled *Engineering Speed Management Countermeasures: A Desktop Reference of Potential Effectiveness in Reducing Speed* summarizes existing studies on the 85th percentile speed reductions of various traffic calming techniques. A traffic calming "ePrimer" is also available on the FHWA website which provides a thorough review of current traffic calming practices. The ePrimer is available at safety.fhwa.dot.gov.

INSTITUTE OF TRANSPORTATION ENGINEERS

The Institute of Transportation Engineers (ITE) have published multiple reports regarding traffic calming techniques. The reports *Speed Control in Residential Areas* and *Traffic Calming: State of the Practice* both provide a synthesis of traffic calming examples in the United States and Canada, including information on traffic calming in residential areas and areas where high speed rural highways transition into rural communities. Several ITE "fact sheets" have also been created which detail individual traffic calming methods and their effectiveness at reducing 85th percentile speeds

A speed hump in downtown Ruidoso.

TRAFFIC CALMING GUIDE COMPONENTS

The *Village of Ruidoso Traffic Calming Guide* is intended to provide local decision-makers with a comprehensive, easy-to-digest "menu" of the various traffic calming methods that can be utilized throughout Ruidoso. To achieve this, each individual traffic calming method has been broken into different components which describe a given method, in addition to considerations that must be factored into the design, its applicability for the village of Ruidoso, and a general summary of the method. A more detailed description of the different traffic calming guide components can be found on the following pages.

CATEGORY

Many methods of traffic calming utilize similar techniques to reduce vehicle speeds. These similar methods have been grouped into four different categories, which are:

- ***Direct Feedback Signs***
- ***Infrastructure***
- ***Intersection Control***
- ***Street Markings***
- ***Cut-Through Traffic Control***

TRAFFIC CALMING METHOD

OVERVIEW

The overview section provides a comprehensive summary of the given traffic calming method. Within the overview, several specific aspects of the treatment are considered, including:

Effectiveness

The overall effectiveness of a treatment at reducing vehicle speeds is rated as either low, moderate, or very effective.

Observed Speed Reductions

FHWA observed 85th percentile speed reductions are provided in mph.

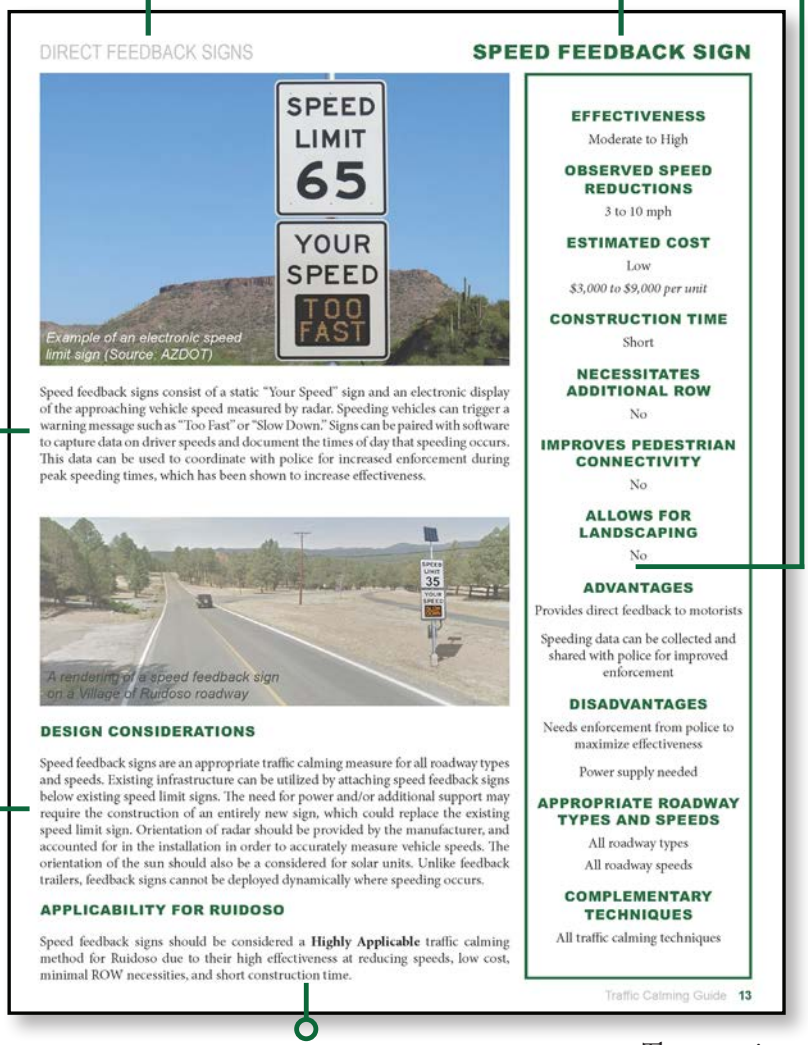
Estimated Cost

As costs will vary depending on the individual project, a general cost of installation is estimated as either low, moderate, or high (a more-detailed description of the estimated costs can be found on the following page).

Construction Time

The estimated time frame to install a treatment is rated as either short (needing under a month to install), or long (needing more than a month).

The overview also considers whether the treatment improves pedestrian connectivity or allows for landscaping, lists the advantages and disadvantages of using the treatment, the street types and speeds appropriate for the treatment, and other traffic calming methoods which have been used to compliment the given traffic calming technique.



DIRECT FEEDBACK SIGNS

SPEED FEEDBACK SIGN

Example of an electronic speed limit sign (Source: AZDOT)

Speed feedback signs consist of a static "Your Speed" sign and an electronic display of the approaching vehicle speed measured by radar. Speeding vehicles can trigger a warning message such as "Too Fast" or "Slow Down." Signs can be paired with software to capture data on driver speeds and document the times of day that speeding occurs. This data can be used to coordinate with police for increased enforcement during peak speeding times, which has been shown to increase effectiveness.

A rendering of a speed feedback sign on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Speed feedback signs are an appropriate traffic calming measure for all roadway types and speeds. Existing infrastructure can be utilized by attaching speed feedback signs below existing speed limit signs. The need for power and/or additional support may require the construction of an entirely new sign, which could replace the existing speed limit sign. Orientation of radar should be provided by the manufacturer, and accounted for in the installation in order to accurately measure vehicle speeds. The orientation of the sun should also be a considered for solar units. Unlike feedback trailers, feedback signs cannot be deployed dynamically where speeding occurs.

APPLICABILITY FOR RUIDOSO

Speed feedback signs should be considered a **Highly Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, low cost, minimal ROW necessities, and short construction time.

EFFECTIVENESS
Moderate to High

OBSERVED SPEED REDUCTIONS
3 to 10 mph

ESTIMATED COST
Low
$3,000 to $9,000 per unit

CONSTRUCTION TIME
Short

NECESSITATES ADDITIONAL ROW
No

IMPROVES PEDESTRIAN CONNECTIVITY
No

ALLOWS FOR LANDSCAPING
No

ADVANTAGES
Provides direct feedback to motorists
Speeding data can be collected and shared with police for improved enforcement

DISADVANTAGES
Needs enforcement from police to maximize effectiveness
Power supply needed

APPROPRIATE ROADWAY TYPES AND SPEEDS
All roadway types
All roadway speeds

COMPLEMENTARY TECHNIQUES
All traffic calming techniques

Traffic Calming Guide 13

DESCRIPTION

The description of a traffic calming method includes a physical description of the treatment, in addition to how it is intended to achieve traffic calming.

DESIGN CONSIDERATIONS

Design considerations notes any unique factors related to the given traffic calming technique that should be considered prior to installation, as well as the types of roadways which are appropriate for the technique.

APPLICABILITY FOR RUIDOSO

The applicability for Ruidoso section provides a rating for the given traffic calming method of either **Not Applicable**, **Somewhat Applicable**, or **Highly Applicable** as determined by the applicability matrix provided at the end of this guide, as well as any other special considerations that should be accounted for with the treatment.

ROADWAY TYPE DEFINITIONS

ARTERIAL

High-capacity urban and suburban roads meant to deliver traffic from collector roads to freeways or urban centers.

COLLECTOR

Low-to-moderate-capacity roads which provide access to residential, commercial, and public property and which serve to move traffic from local streets to arterial roads.

LOCAL RESIDENTIAL

Low-capacity neighborhood streets which serve local residents and businesses.

SOURCES OF COST ESTIMATES

The estimated cost of installing traffic calming methods were taken from the FHWA's *Traffic Calming ePrimer* and *Factors Influencing Operating Speeds and Safety on Rural and Suburban Roads*, the City of San Antonio's *Traffic Calming Handbook*, and VDOT's *Traffic Calming Guide for Neighborhood Streets*. The cost of a measure is an important consideration in its applicability for the Village of Ruidoso. However, the cost of an individual treatment can vary widely, and estimates can change for each measure due to the following five key factors:

- **Size** – the area covered by a traffic calming measure can significantly influence the cost (for example, a forced turn island at a local residential street intersection is likely to be smaller than one provided at a collector/arterial intersection);
- **Scale** – the overall project scale and number of measures constructed has a significant impact on the cost of a project (for example, the unit cost per speed hump for a single installation can be significantly more than for a series of speed humps);
- **Landscaping** – the extent and type of landscaping (and the cost of providing the appropriate environment in which to flourish) can have a wide cost range;
- **Drainage** – the addition of a traffic calming measure may influence the drainage of the roadway and improvements would be required to maintain proper roadway drainage; and
- **Utility Access Points** – the relocation or redesign of access to drains, valves, etc. can represent a significant cost.

To accommodate for this variability, a generalized construction cost (including design, materials, and construction; excluding right-of-way costs) is provided for each treatment within this guide of either Low (<$10k), Moderate ($10-$50k), and High (>$50k)

WHAT METHODS ARE INCLUDED IN THE GUIDE?

The *Village of Ruidoso Traffic Calming Guide* is intended to provide local decision-makers, city staff, and citizens with a comprehensive overview of existing traffic calming methods, and how they fit within the context of Ruidoso. Each method is presented as a stand-alone overview, which should allow the reader to move between each method to find their desired information, without having to read the entirety of the guide. In total, 20 different techniques are profiled within the traffic calming guide. Many of these techniques may be used in combination with other treatments to achieve greater speed reductions.

HOW IS APPLICABILITY FOR RUIDOSO DETERMINED?

While all traffic calming techniques have an appropriate context where they are most-effective, the ultimate goal of this guide is to determine the best methods for Ruidoso. As readers will bring in their own knowledge and desires for specific traffic calming techniques, it is important that they understand that a treatment may only be appropriate in some contexts within the Village of Ruidoso. The applicability of each treatment is provided for each technique based on various aspects profiled in the treatment's overview (e.g. effectiveness, cost, construction time, etc.). An Applicability Matrix is provided at the end of the document which synthesizes the guide, and provides general applicability ratings for Ruidoso for each method, as well as the appropriate street types the method is suitable for.

CRITERIA FOR TRAFFIC CALMING IMPLEMENTATION

All requests for traffic calming from Ruidoso citizens will be reviewed by Village staff based on one or both of the criteria below, depending on the roadway type. Upon receipt, staff will determine if the request meets the following minimum thresholds:

SPEED

To determine if speeding issues warrant the need for traffic calming, vehicle speeds from field data are collected and compared to the posted speed limit. Traffic calming measures are deemed appropriate when the observed 85th percentile speeds exceed the posted speed limit by 5 MPH or more on local roads and 10 MPH or more on collector or arterial roads.

CUT-THROUGH TRAFFIC

To determine the amount of cut through traffic in an area, the number of trips generated by single-family dwelling units in the study area must be compared to the observed traffic counts. The expected amount of traffic entering/exiting the neighborhood per day is calculated using 12 trip ends per dwelling unit per day and multiplying by the number of dwellings in the neighborhood (*Trip ends per household* ***x*** *Number of dwelling units = Vehicles expected to enter/exit neighborhood per day)*. This number is then compared to the actual number of vehicles entering/exiting the neighborhood (traffic counts) to determine the amount of projected non-study-area-generated traffic, or "non-local" traffic. In order for the minimum threshold for traffic calming to be met, the calculated non-local traffic must exceed 25% of the calculated vehicles expected to enter/exit a street per day. The threshold for cut through traffic applies to local roads only.

Upon reaching these thresholds, an engineering field review then determines the suitability of the street for traffic calming based on design considerations – extent of horizontal curves, grade and related sight distance issues, roadway drainage, extent and location of road access points, etc. – that may affect the placement and type of traffic calming implemented.

EXAMPLE

- Total vehicles entering/exiting neighborhood per day (from road tube counts) = 1,500
- Total houses in neighborhood = 100
- 12 x 100 = 1,200 local trips
- Amount of non-local traffic = 1,500-1,200 = 300 vehicles per day
- Calculated non-local traffic = (300 ÷ 1,200) = 25% cut-through traffic

TRAFFIC CALMING METHODS

Example of an electronic speed limit sign in Garrison, MN (Source: Sourcewell)

SPEED FEEDBACK SIGN

Example of an electronic speed limit sign (Source: AZDOT)

Speed feedback signs consist of a static "Your Speed" sign and an electronic display of the approaching vehicle speed measured by radar. Speeding vehicles can trigger a warning message such as "Too Fast" or "Slow Down." Signs can be paired with software to capture data on driver speeds and document the times of day that speeding occurs. This data can be used to coordinate with police for increased enforcement during peak speeding times, which has been shown to increase effectiveness.

A rendering of a speed feedback sign on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Speed feedback signs are an appropriate traffic calming measure for all roadway types and speeds. Existing infrastructure can be utilized by attaching speed feedback signs below existing speed limit signs. The need for power and/or additional support may require the construction of an entirely new sign, which could replace the existing speed limit sign. Orientation of radar should be provided by the manufacturer, and accounted for in the installation in order to accurately measure vehicle speeds. The orientation of the sun should also be a considered for solar units. Unlike feedback trailers, feedback signs cannot be deployed dynamically where speeding occurs.

APPLICABILITY FOR RUIDOSO

Speed feedback signs should be considered a **Highly Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, low cost, minimal ROW necessities, and short construction time.

EFFECTIVENESS

Moderate to High

OBSERVED SPEED REDUCTIONS

3 to 10 mph

ESTIMATED COST

Low

$3,000 to $9,000 per unit

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Provides direct feedback to motorists

Speeding data can be collected and shared with police for improved enforcement

DISADVANTAGES

Needs enforcement from police to maximize effectiveness

Power supply needed

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

All traffic calming techniques

SPEED FEEDBACK TRAILER

EFFECTIVENESS
Moderate to High

OBSERVED SPEED REDUCTIONS
3 to 10 mph

ESTIMATED COST
Low to Moderate

$8,000 to $11,000 per unit

CONSTRUCTION TIME
Short

NECESSITATES ADDITIONAL ROW
No

IMPROVES PEDESTRIAN CONNECTIVITY
No

ALLOWS FOR LANDSCAPING
No

ADVANTAGES
Provides direct feedback to motorists

Can be used dynamically to respond to speeding across the town

DISADVANTAGES
Coordination with police is needed for installation and enforcement.

Needs enforcement from police to maximize effectiveness

Must have sufficient right-of-way

APPROPRIATE ROADWAY TYPES AND SPEEDS
All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES
All traffic calming techniques

Example of an electronic speed limit trailer (Source: WANCO inc.)

Portable speed display trailers can be used as a temporary treatment in areas where speeding problems arise. As with speed feedback signs, speed feedback trailers consist of a speed limit sign, a static "Your Speed" sign, and an electronic display of the approaching vehicle speed measured by radar. Speeding vehicles can trigger a warning message such as "Too Fast" or "Slow Down." Some trailers can be paired with software to capture data on driver speeds and document the time of day that speeding occurs for increased enforcement.

A rendering of a speed feedback trailer on a Village of Ruidoso roadway

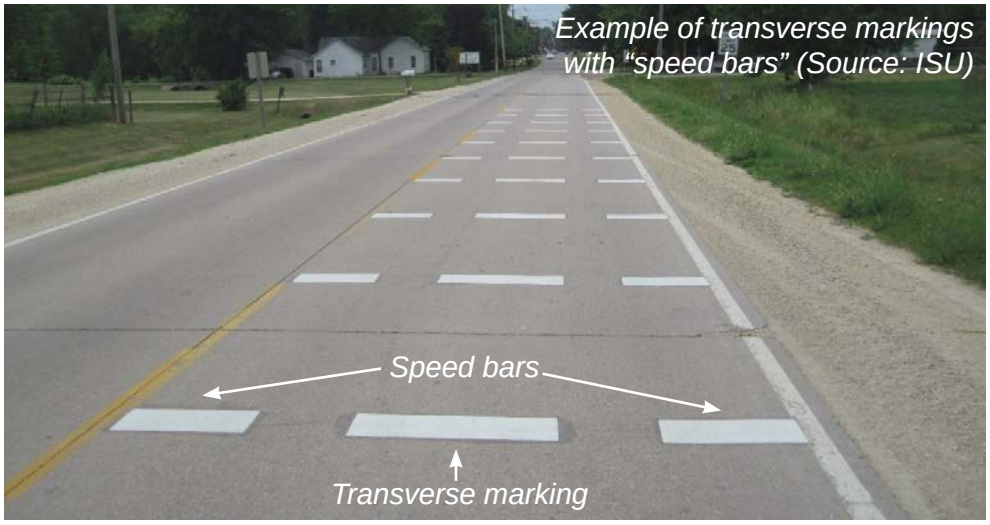
DESIGN CONSIDERATIONS

Speed feedback trailers can be used on all roadway types and speeds, given that there is sufficient room on the roadway for the trailer to be placed. Due to their mobility, speed feedback trailers can be used dynamically to respond to speeding throughout the village. Coordination with police is necessary for deployment and enforcement, and may be limited by police resources. Placement of the trailers should account for the accuracy of the radar readings as described by the manufacturer and achieving maximum visibility for drivers.

APPLICABILITY FOR RUIDOSO

Speed feedback trailers should be considered an **Applicable** traffic calming method for Ruidoso due to their high effectiveness, minimal ROW needs, ability to be deployed dynamically, and lack of any construction time or costs.

TRANSVERSE MARKINGS



Example of transverse markings with "speed bars" (Source: ISU)

Transverse markings are a series of white bars, either flat or raised, which are painted across the center of the lane and spaced progressively closer together to create the illusion that driver speed is increasing. Transverse markings by themselves have proven to be only moderately effective, but adding "speed bars" to both sides of the transverse marking provides additional visual contrast for drivers and encourages drivers to place their vehicles between the bars. Transverse bars can also be placed so that the bars become closer together and thinner to create the perception that the driver is traveling faster than they actually are.

A rendering of transverse markings with "speed bars" on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Transverse markings are an appropriate traffic calming technique for all roadway types and speeds. Bars should be spaced at intervals so that drivers are able to position their vehicles within the wheel paths, and are most-effective when placed on curves, or ~100 feet before a posted speed limit where drivers are encouraged to slow down. Approximate transverse marking spacing is 10 to 12 feet apart. The cost to install transverse markings varies based on the material, the number of transverse bars, and the width of each bar, and typically ranges between $300-$2,500.

APPLICABILITY FOR RUIDOSO

Transverse markings should be considered an **Applicable** traffic calming method for Ruidoso due to their moderate effectiveness at reducing speeds, low cost, minimal ROW necessities, and short construction time. Speed bars may be incorporated into other treatments to achieve greater speed reductions.

EFFECTIVENESS

Low to Moderate

OBSERVED SPEED REDUCTIONS

0 to 2 mph without "Speed Bar"

2 to 5 mph with "Speed Bar"

ESTIMATED COST

Low

$2,500 per installation

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Easy to install and remove

DISADVANTAGES

Markings requires continuous maintenance to be effective

Minimal speed reductions Without addition of "speed bar"

APPROPRIATE ROADWAY TYPES AND SPEEDS

Arterials, Collectors, Rural Residential

All roadway speeds

COMPLEMENTARY TECHNIQUES

Direct feedback signs, pavement marking messages, lane narrowing

ENHANCED PAVEMENT MARKING MESSAGES

EFFECTIVENESS

Low

OBSERVED SPEED REDUCTIONS

1 to 3 mph

ESTIMATED COST

Low

$300 - $1,000 per marking

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Provides a reminder of speed limit

Catches the attention of motorists

DISADVANTAGES

Markings require continuous maintenance to be effective

Effectiveness is reduced when markings begin to fade

APPROPRIATE ROADWAY TYPES AND SPEEDS

Arterials, Collectors, Rural Residential

All roadway speeds

COMPLEMENTARY TECHNIQUES

All traffic calming techniques

Example of enhanced pavement markings (Source: FHWA)

Pavement markings provide messaging to remind drivers of lawful speeds utilizing messages like "SLOW" and "SPEED LIMIT 25 MPH." Pavement marking messages have been shown to be ineffective in isolation, and other traffic calming measures must be used in combination with messages to achieve any significant reduction in travel speeds. One of the most effective methods is based on European entrance treatments in which a large red rectangle (9.5 ft by 12 ft) is used to frame on-pavement speed limit markings.

A rendering of enhanced pavement markings on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Enhanced pavement marking messages are an appropriate traffic calming technique for all roadway types and speeds. To create the enhanced pavement markings, a large red rectangle (9.5 ft by 12 ft) is used to frame on-pavement speed limit markings. An 8 inch edgeline can also be painted along the treatment to enhance visibility. While red backgrounds lead to slight speed reductions, other pavement markings, such as chevrons and/or edgeline markings, have been observed to further reduce travel speeds in conjunction with enhanced pavement marking messages.

APPLICABILITY FOR RUIDOSO

Enhanced Pavement Marking Messages should be considered an **Applicable** traffic calming method for Ruidoso due to their low cost, minimal ROW necessities, and short construction time. This method may be combined with other techniques to achieve greater speed reductions.

CONVERGING CHEVRONS

Example of converging chevrons (Source: FHWA)

A series of converging chevron markings are placed in advance of, and terminated at, a speed limit sign which establishes the speed within a given area. The distance between chevrons gradually decreases, which gives the perception of increasing speed. This technique has been shown to be especially effective when applied to curves in a roadway. A pavement marking legend "xx MPH" can also be installed at the end of a chevron series to further reinforce the posted roadway speed.

A rendering of converging chevrons on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Converging chevrons are an appropriate traffic calming technique for all roadway types and speeds. The distance between chevrons decreases from 25 ft to 18 ft, and the width of the markings decreases from 36 inches to 6 inches in the direction of travel, in order to create the perception of increased speed. The cost to install converging chevrons is typically between $100 to $200 per marking. Regular repainting of chevrons is needed to maintain the visibility and overall effectiveness of the treatment.

APPLICABILITY FOR RUIDOSO

Converging chevrons should be considered an **Applicable** traffic calming method for Ruidoso, especially on curves and other locations where site distance is limited, due to their moderate effectiveness at reducing speeds, low cost, minimal ROW necessities, and short construction time.

EFFECTIVENESS

Low to Moderate

OBSERVED SPEED REDUCTIONS

1 to 4 mph

ESTIMATED COST

Low

$100 - $200 per marking

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Easy to install and remove

DISADVANTAGES

Markings requires continuous maintenance to be effective

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Direct feedback signs, pavement marking messages, lane narrowing

Effectiveness increases when used in tandem with curves in the roadway

NARROWING TRAVEL LANES

EFFECTIVENESS

Low to Moderate

OBSERVED SPEED REDUCTIONS

0 to 5 mph

ESTIMATED COST

Low to High
Dependent upon narrowing method

CONSTRUCTION TIME

Long

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

Yes

ALLOWS FOR LANDSCAPING

Yes

ADVANTAGES

Can provide opportunity for added bike and/or pedestrian facilities

DISADVANTAGES

Paint requires continuous maintenance to be effective. Plastic marking can be used, which are more durable, but more expensive.

Minimal speed reductions

Street must be sufficiently wide

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Bike lanes, painted edgelines, median island, pavement messages

Example of a lane narrowing with bike lanes and on-street parking (Source: Scott Batson)

Travel lane narrowing reduces the lane width for vehicle travel, which is creates a feeling of being constrained and reduce driving speeds as a result. To create this effect, median and/or shoulder pavement markings, bike facilities, rumble strips, landscaping, or on-street parking are added to a street with the space gained by reducing travel lane widths. Whether on-street parking can be an appropriate traffic calming measure is a direct function of parking demand; in order for on-street parking to having a narrowing effect, the space must be occupied with parked vehicles.

Example of lane narrowing with striping buffer and bike lanes (Source: San Diego Union Tribune)

DESIGN CONSIDERATIONS

Lane narrowing is an appropriate traffic calming technique for all roadway types and speeds, provided that there is sufficient room on the street for vehicle travel once narrowing the occurs. The cost of lane narrowing can vary significantly, depending upon the specific method chosen. Adding striped shoulders, on-street parking, or bike lanes can cost as little as $750 to $1000 per mile, while dedicated concrete medians, with their additional drainage and landscaping considerations, can increase a project's cost to over $50,000, depending on the length and width of the project.

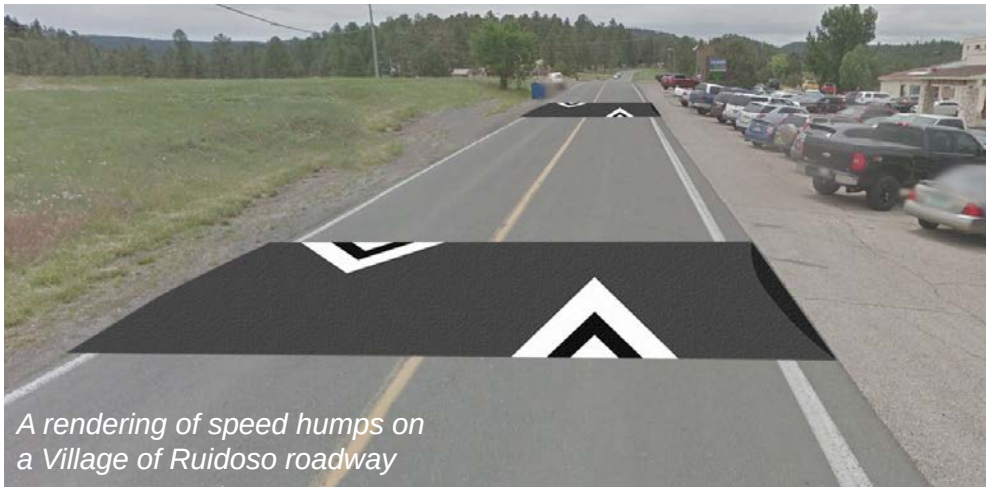
APPLICABILITY FOR RUIDOSO

Lane narrowing should be considered a Somewhat Applicable traffic calming method for Ruidoso as only a limited number of roadways have striped lanes. This technique may also be applied to the design of new roadways.

SPEED HUMPS

Example of a speed hump (Source: Nury Martinez)

A speed hump is an elongated mound in the roadway pavement surface extending across the travel way perpendicular to the flow of traffic. At typical travel speeds, a speed hump should cause sufficient discomfort to decrease travel speeds, and encourages motorists to travel at slow speeds upstream, downstream, and over the speed hump. Effectiveness of speed humps can be increased by placing humps in quick succession of one another, or combining speed humps with other traffic calming techniques like chokers or signage.



A rendering of speed humps on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Speed humps are an appropriate traffic calming measure for collectors and local residential streets with speeds under 35 MPH. However, speed humps are generally not appropriate when the pre-implementation 85th percentile speed of a roadway is 45 mph or more, and should not be placed on a sharp curve. A speed hump is typically 3-4 inches in height and 12 feet in length along the vehicle travel path axis. Unlike speed tables, speed humps cannot be used as a pedestrian crosswalk.

APPLICABILITY FOR RUIDOSO

Speed humps should be considered an **Applicable** traffic calming method for Ruidoso due to their effectiveness at reducing speeds, low cost, and short construction time. However, speed humps lack of opportunity for landscaping and pedestrian connectivity, and ROW needs can reduce the cost effectiveness of the treatment.

EFFECTIVENESS

High

OBSERVED SPEED REDUCTIONS

8 to 12 mph

ESTIMATED COST

Low to Moderate
$1,000 - $8,000 per unit

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Does not impede cyclists

Effective in reducing speeds

DISADVANTAGES

May increase road noise

Increases emergency vehicle response time by ~2 seconds per hump

Cannot be used as crosswalk

APPROPRIATE ROADWAY TYPES AND SPEEDS

Collectors, Local Residential

30 MPH or less

COMPLEMENTARY TECHNIQUES

Chokers, direct feedback signs

SPEED TABLE

EFFECTIVENESS
High

OBSERVED SPEED REDUCTIONS
6 to 11 mph

ESTIMATED COST
Low to Moderate

$2,500 - $8,000 per unit

CONSTRUCTION TIME
Short

NECESSITATES ADDITIONAL ROW
No

IMPROVES PEDESTRIAN CONNECTIVITY
Yes

ALLOWS FOR LANDSCAPING
No

ADVANTAGES
Effective in reducing speeds

Raised crosswalks can provide increased safety for pedestrians

DISADVANTAGES
May increase noise

Slows emergency response times

May impact local street drainage

APPROPRIATE ROADWAY TYPES AND SPEEDS
Collectors, Village Residential

Generally 30 MPH or less

COMPLEMENTARY TECHNIQUES
Raised crosswalks, center islands, chokers, direct feedback signs

Example of a rural speed table with a center crosswalk (Source: Raleigh Paving)

Speed tables are flat-topped speed humps that cover the entire width of a roadway to raise the wheelbase of a vehicle in order to reduce its travel speed. Speed tables are typically longer than speed humps, with a height of 3 to 3.5 inches and a length of 22 feet when applied to a residential street. Vehicle operating speeds for streets with speed tables range from 25 to 45 mph, but are typically used for roadways with speeds under 35 mph. When outfitted with crosswalk markings and signage, the speed table can become a raised crosswalk.

A rendering of a speed table on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Asphalt speed tables are an effective and appropriate traffic calming measure for collectors and local residential streets. While speed tables are designed to be traversed at under 35 mph to accommodate heavy trucks and farm vehicles, they are generally not a viable option for primary emergency vehicle response routes, streets that provide access to hospitals or emergency medical services, or on streets in consideration for future transit routes. For these routes, another form of vertical deflection – such as a speed cushion - could be an appropriate substitute. Speed tables should also be avoided on sharp curves.

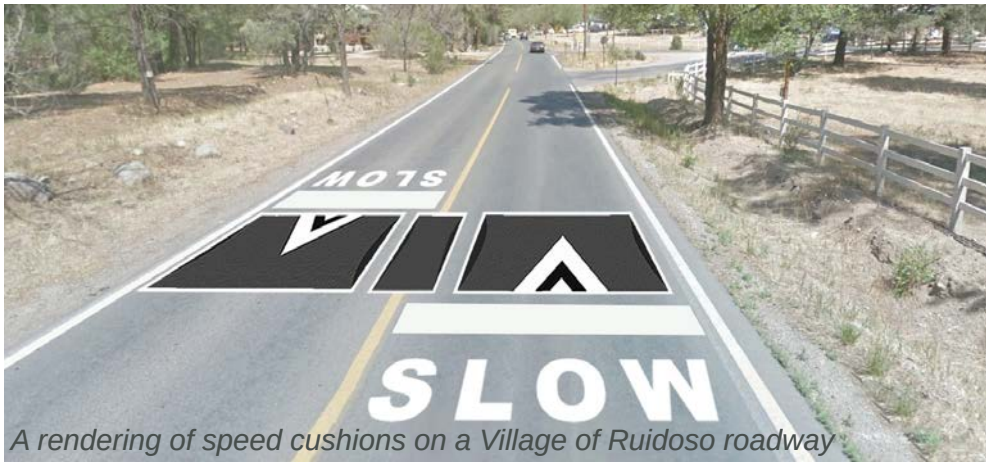
APPLICABILITY FOR RUIDOSO

Speed tables should be considered a **Highly Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, moderate cost, minimal ROW needs, and short construction time. Speed tables also provide an opportunity to improve pedestrian connectivity through the addition of raised crosswalks.

SPEED CUSHIONS

Example of modular speed humps (Source: NACTO)

Speed cushions are modular units that are either pre-manufactured or constructed with asphalt. They are applied to a road surface and designed to be uncomfortable for motorists to negotiate at high operating speeds. The height and length of the raised areas are comparable to the dimensions of a speed hump. However, a speed cushion has gaps (often referred to as "cutouts") between the raised areas to enable a vehicle with a wide track (e.g., emergency vehicles, trucks, buses, etc.) to pass though the feature without any vertical deflection. Speed cushions are effective but generally achieve lower levels of speed reduction than speed tables.



A rendering of speed cushions on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Speed cushions, either rubber or asphalt, are an effective and appropriate traffic calming measure for collectors and local residential streets of 30 mph or less. Although effective in isolation, maximum traffic calming effectiveness can be achieved by installing speed cushions in pairs. While they still slow response times, a speed cushion is often a preferred alternative to a speed hump on primary emergency response or transit routes. The state of Pennsylvania recommends a distance of 150 feet from an unsignalized intersection and 250 feet from a signalized intersection. Speed cushions should be avoided on curves.

APPLICABILITY FOR RUIDOSO

Speed cushions should be considered a **Highly Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, low cost, minimal ROW needs, and short construction time. As this treatment is modular, it can be dynamically deployed where speeding and cut-through problems arise.

EFFECTIVENESS

Moderate to High

OBSERVED SPEED REDUCTIONS

5 to 7 mph

ESTIMATED COST

Low to Moderate

$3,000 - $6,000 per set

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Effective in reducing vehicle speeds

Relatively easy for bicycles to cross

Shown to reduce traffic volumes

DISADVANTAGES

May increase noise

Increases emergency vehicle response time by ~2 seconds per hump

Cannot be used as crosswalk

APPROPRIATE ROADWAY TYPES AND SPEEDS

Collectors, Local Residential

30 mph or less

COMPLEMENTARY TECHNIQUES

Direct feedback signs, rumble strips

TUBULAR CHANNELIZER MEDIAN

EFFECTIVENESS
Low

OBSERVED SPEED REDUCTIONS
0 to 1 mph

ESTIMATED COST
Low to Moderate

$5,000 - $12,000 per installation

CONSTRUCTION TIME
Short

NECESSITATES ADDITIONAL ROW
No

IMPROVES PEDESTRIAN CONNECTIVITY
No

ALLOWS FOR LANDSCAPING
No

ADVANTAGES
Less expensive than a concrete island

Can be a temporary treatment

DISADVANTAGES
Tubes are routinely damaged by motorists and require replacement

Street must be sufficiently wide

May interfere with snow plowing

APPROPRIATE ROADWAY TYPES AND SPEEDS
All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES
Direct feedback signs, lane narrowing

Example of tubular marker median (Source: FHWA)

Center islands are formed by placing two rows of 3-foot tall tubular channelizing markers to reduce lane widths in each direction. A speed limit sign can be placed on a mountable sign support at both ends of each island. The reduced travel width for motorists is thought to increase the driver's sense of speed and encourage lower travel speeds as a result. Tubular channelizer medians have been shown to be ineffective in isolation, and must be combined with additional traffic calming treatments to achieve any significant traffic calming effect.

A rendering of tubular median on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Tubular channelizer medians are an appropriate treatment for all roadway types and speeds, provided that the road has sufficient width to accommodate their placement. While the initial cost to install a tubular marker median is between $5,000 to $12,000 per installation, the cost of this treatment increases when tubes are damaged by vehicles and need replacement. Special care should be taken to ensure that the placement of tubular markers does not interfere with emergency personnel and winter snow plowing efforts.

APPLICABILITY FOR RUIDOSO

Tubular channelizer medians should be considered a **Somewhat Applicable** traffic calming method for Ruidoso due to their minimal ROW needs, and short construction time. This method may be used as a complementary technique and combined with other techniques to achieve greater speed reductions.

MEDIAN ISLAND

Example of a median island with a crosswalk and landscaping (Source: Richard Drdul)

A Median Island involves the placement of a raised concrete island in the middle of the roadway in order to narrow the vehicle travel lanes. A median island can often double as a pedestrian refuge island if a cut in the island is provided along a marked crosswalk. The separation of travel lanes also allows pedestrians to focus on one lane at a time when crossing the street. Where there is an existing midblock crosswalk, it is desirable to locate the median island at the crosswalk. While medians are generally located at mid-block, they can also serve as a gateway to a community. "High costs, long construction time, and additional ROW needs may impact the desirability of this treatment.

Example of a median island with a crosswalk (Source: Richard Drdul)

DESIGN CONSIDERATIONS

Median islands are an appropriate treatment for all roadway types with a speed of 45 mph or less. When combined with crosswalks, medians can facilitate pedestrian crossings through a crossing area which is physically separated from vehicle travel lanes. Median islands also provide an opportunity for landscaping, lighting, and/or additional signage. It is important to consider the total width of a street when considering median islands, as they may take up space that could be better used for other treatments like wider sidewalks, bicycle lanes, landscaped buffer strips, or parking.

APPLICABILITY FOR RUIDOSO

Median islands should be considered an **Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, and potential for landscaping and improved pedestrian connectivity.

EFFECTIVENESS

Moderate to High

OBSERVED SPEED REDUCTIONS

1 to 11 mph

ESTIMATED COST

Moderate to High

$15,000 to $55,000 per island

CONSTRUCTION TIME

Long

NECESSITATES ADDITIONAL ROW

Yes

IMPROVES PEDESTRIAN CONNECTIVITY

Yes

ALLOWS FOR LANDSCAPING

Yes

ADVANTAGES

Can provide a pedestrian refuge

Provides opportunity for additional landscaping, signage, and lighting

Can act as a gateway to a community

DISADVANTAGES

Narrows travel-way for cyclists

May complicate snow plowing efforts

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Tubular chennelizers, crosswalks, painted edgelines, signage

LATERAL SHIFT

EFFECTIVENESS
Moderate to High

OBSERVED SPEED REDUCTIONS
Up to 11 mph

ESTIMATED COST
Moderate

CONSTRUCTION TIME
Long

NECESSITATES ADDITIONAL ROW
Yes

IMPROVES PEDESTRIAN CONNECTIVITY
No

ALLOWS FOR LANDSCAPING
Yes

ADVANTAGES
Narrows the roadway which may cause speed and volume reductions

Landscaping provides an opportunity to reduce impervious ground cover

DISADVANTAGES
Curb realignment may be necessary

On-street parking may be effected

May impact local street drainage

APPROPRIATE ROADWAY TYPES AND SPEEDS
All roadway types

35 mph or less

COMPLEMENTARY TECHNIQUES
Direct feedback signs, lane narrowing

Example of a lateral shift (Source: FHWA)

A lateral shift is a realignment of an otherwise straight street that causes travel lanes to shift in one direction. A typical lateral shift separates opposing traffic through the shift with the aid of a median island. Without this island, motorists can cross the centerline in order to drive the straightest path possible, thereby reducing the speed reduction effectiveness of the lateral shift. Additionally, a median island reduces the likelihood a motorist will veer into the path of opposing traffic, further improving the safety of the roadway for motorists.


Example of a lateral shift (Source: FHWA)

DESIGN CONSIDERATIONS

Lateral shifts are an appropriate treatment for all roadway types with speeds of 35 mph or less. A lateral shift generally includes a center island with curbing to prevent vehicles from crossing lanes which can be used as an opportunity for landscaping. The cost to construct a lateral shift can vary significantly, dependent upon material choice, size of offset, and the length of transition. Lateral shifts are an appropriate treatment along a primary emergency vehicle route or on a street that provides access to a hospital or emergency medical services, and low narrow medians can be straddled by fire trucks, if needed.

APPLICABILITY FOR RUIDOSO

Lateral shifts should be considered a **Somewhat Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, and landscaping potential. However, few roadways currently meet the profile or conditions for this technique to be applied.

CHICANE

Example of a chicane with bike facilities and a speed hump (Source: PedSafe)

A chicane is a series of alternating curves or lane shifts that are located in a position to force a motorist to steer back and forth out of a straight travel path. The curvilinear path is intended to reduce the speed at which a motorist is comfortable traveling through the feature. The lower speed could in turn result in a traffic volume reduction. A chicane-like effect can also be achieved through curved striping, or by alternating on-street parking from one side of the street to the other. While in some cases, on-street parking may need to be removed, a chicane can also provide an opportunity for additional on-street parking to be added to roadways which currently lack parking.

Example of a chicane with a center median (Source: NACTO)

DESIGN CONSIDERATIONS

Chicanes are an appropriate treatment for one-lane, one-way and two-lane, two-way roadways with speeds under 35 mph. Chicanes can be installed with either an open or urban cross-section (i.e. curb and gutter), and can be applied both with or without a bicycle facility. Typical installations should not require relocation of above- and below-ground utilities, though special attention should be paid to avoid the need to relocate drainage features such as catch basins, concrete channels, valley gutters, inlets, and trench drains.

APPLICABILITY FOR RUIDOSO

Chicanes should be considered a **Somewhat Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, moderate cost, and opportunity for landscaping. However, few roadways currently meet the profile or conditions for this technique to be applied.

EFFECTIVENESS

Moderate to High

OBSERVED SPEED REDUCTIONS

3 to 9 mph

ESTIMATED COST

Moderate

$8,000 to $25,000 per installation

CONSTRUCTION TIME

Long

NECESSITATES ADDITIONAL ROW

Yes

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

Yes

ADVANTAGES

Narrows the roadway which may cause speed and volume reductions

Landscaping provides opportunity to reduce impervious ground cover

Provides opportunity for the addition of on-street parking

DISADVANTAGES

Curb realignment may be necessary

On-street parking may be effected

May impact local street drainage

APPROPRIATE ROADWAY TYPES AND SPEEDS

Collectors, Local Residential

Under 35 mph

COMPLEMENTARY TECHNIQUES

Enhanced pavement markings, lane narrowing

CHOKER

EFFECTIVENESS

Low to Moderate

OBSERVED SPEED REDUCTIONS

1 to 4 mph

ESTIMATED COST

Moderate

$10,000 to $25,000 per installation

CONSTRUCTION TIME

Long

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

Yes

ALLOWS FOR LANDSCAPING

Yes

ADVANTAGES

Can be built with space for cyclists

Improves line of sight and reduces crossing distance for pedestrians

Provides opportunity for landscaping

DISADVANTAGES

Reduces the margin of error for motorists when passing

Can force cyclists into travel lanes if space is not provided for bike lanes

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

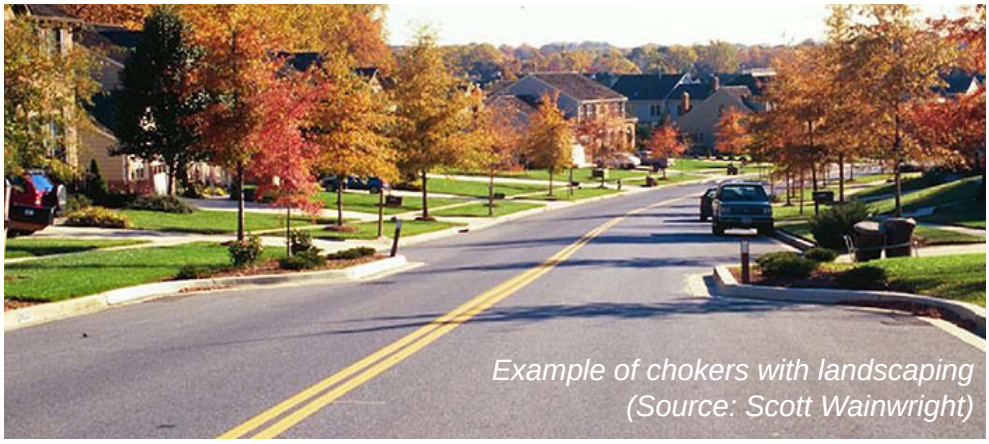
40 mph or less

COMPLEMENTARY TECHNIQUES

Speed humps, speed tables, crosswalks, lane narrowing

Example of chokers with curb and gutter cutouts (Source: James Barrera)

A choker is a horizontal, midblock extension of the curb into the street which results in a narrower roadway section. The narrower travel width created by chokers encourages reduced travel speeds as drivers perceive a reduced margin of error to operate within. Chokers also provide opportunity for landscaping, which increases the attractiveness and visibility for motorists.



Example of chokers with landscaping (Source: Scott Wainwright)

DESIGN CONSIDERATIONS

Chokers are an appropriate traffic calming treatment for all roadway types with a speed limit of 40 mph or less. Chokers can be designed with or without landscaping, curb and gutter, and bike facilities. Without proper bike facilities, cyclists can be forced to ride in vehicle travel lanes. Chokers can also be an appropriate location for a midblock crosswalk, as they reduce the distance needed by pedestrians to cross the street. It is important to note that the effectiveness of chokers is lessened if the vehicle travel lane widths are not reduced.

APPLICABILITY FOR RUIDOSO

Chokers should be considered an **Applicable** traffic calming method for Ruidoso due to their moderate effectiveness at reducing speeds, low cost, minimal ROW needs, and landscaping potential. However, few roadways currently meet the profile or conditions for this technique to be applied.

"HAWK" BEACONS

Example of a HAWK signal (Source: City of Billings, MT)

A HAWK beacon (**H**igh-Intensity **A**ctivated cross**w**al**k**) is a traffic control device used to stop traffic and allow pedestrians to cross safely. When activated, flashing yellow lights alert drivers that pedestrians will soon cross. The yellow light then turns solid, preparing drivers to stop at the intersection. When the light turns red, pedestrians receive a "walk" signal, and may proceed across the intersection. A flashing red appears when the pedestrian countdown starts, indicating that if the intersection is clear, drivers may proceed through it with caution. When the pedestrian countdown has expired, the beacon goes dark and vehicles can travel normally.

Example of a HAWK signal (Source: Buffalo News)

DESIGN CONSIDERATIONS

HAWK beacons are an appropriate traffic calming technique for all roadway types and speeds, however the FHWA recommends that they be reserved for streets with 3 or more lanes and an annual average daily traffic of over 9,000. HAWK beacons are often considered for installation at locations where pedestrians need to cross and vehicle speeds or volumes are high, but traffic signals are not available. The FHWA has observed total crash reductions of 29% and pedestrian crash reductions of 69% following installation.

APPLICABILITY FOR RUIDOSO

"HAWK" beacons should be considered **Somewhat Applicable** as a traffic calming method within Ruidoso, as there is currently a lack of research into whether they are effective at traffic calming or reducing cut-through traffic. However, HAWK beacons should be considered in instances where the primary goal is pedestrian safety.

EFFECTIVENESS

Further research required

OBSERVED SPEED REDUCTIONS

Further research required

ESTIMATED COST

High

CONSTRUCTION TIME

Long

NECESSITATES ADDITIONAL ROW

Varies

IMPROVES PEDESTRIAN CONNECTIVITY

Yes

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Greatly increases pedestrian safety

DISADVANTAGES

High cost

Uncertainty over traffic calming benefits

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Chokers, Median Islands

RUMBLE STRIPS

EFFECTIVENESS
Low

OBSERVED SPEED REDUCTIONS
0 to 1 mph

ESTIMATED COST
Low

$2,000 to $3,000 per installation

CONSTRUCTION TIME
Short

NECESSITATES ADDITIONAL ROW
No

IMPROVES PEDESTRIAN CONNECTIVITY
No

ALLOWS FOR LANDSCAPING
No

ADVANTAGES
Directs driver attention to the roadway

Can be used to heighten awareness of other traffic calming techniques

DISADVANTAGES
Rumble strips are noisy and may disturb nearby resident

Can interfere with snow plowing

APPROPRIATE ROADWAY TYPES AND SPEEDS
All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES
All traffic calming techniques

Example of Rumble Strips (Source: City of San Antonio)

Rumble strips are patterned sections of rough pavement or topical applications of raised material, which when driven over cause vibration and noise in a vehicle. This treatment is intended to direct the attention of the motorist back to the roadway. Rumble strips may be used to heighten motorists' awareness of certain conditions like a stop sign, curve or speed limit change.

Example of Rumble Strips approaching an intersection (Source FHWA)

DESIGN CONSIDERATIONS

Four types of rumble strips are widely used. Milled rumble strips are formed with a machine that cuts a smooth groove in a roadway. Rolled rumble strips are pressed into freshly laid asphalt pavement by a roller with steel pipes welded to a drum. Formed rumble strips are added to fresh concrete shoulder with a corrugated form that is pressed onto the surface. Raised rumble strips can be formed by applying asphalt material (¼ to ½ in high) as raised bars on the surface. The milled and raised types are preferred because they produce higher noise and vibration stimuli.

APPLICABILITY FOR RUIDOSO

Rumble strips should be considered a **Somewhat Applicable** traffic calming method for Ruidoso due to their low cost, minimal ROW necessities, and short construction time. Rumble strips are best used as a complementary technique, and should be combined with other traffic calming methods to achieve greater speed reductions.

TRAFFIC CIRCLES

Example of a traffic circle in Denver, CO

A traffic circle is a raised island, placed within an unsignalized intersection, around which traffic circulates. Traffic circles force motorists to reduce their speeds regardless if the vehicle is travelling straight through the intersection or making a turn. A traffic circle can take the place of an existing 4-way stop, and can operate exclusively with yield signs. Traffic circles can simply be a painted area, but they are most-effective when made with a raised curb and landscaping to reduce the openness of the intersection. Semi-permanent barriers can also be utilized to create traffic circles.

A rendering of traffic circle on a Village of Ruidoso roadway

DESIGN CONSIDERATIONS

Traffic circles are an appropriate traffic calming technique for intersections between two local residential roads with speeds of 30 mph or less. The reduced turning area provided by traffic circles can force larger trucks and emergency vehicles to make left turns in front of traffic circles, and can be accommodated by creating a mountable curb in the outer portion of the circle. Depending on the geometry of an intersection, traffic circles may force motor vehicle into pedestrian crossing areas, and it may be necessary to shift crosswalks to prevent vehicles from encroaching on pedestrians.

APPLICABILITY FOR RUIDOSO

Traffic Circles should be considered a **Highly Applicable** traffic calming method for Ruidoso due to their high effectiveness at reducing speeds, low cost, minimal ROW necessities, short construction time, and improved pedestrian connectivity.

EFFECTIVENESS

Moderate to High

OBSERVED SPEED REDUCTIONS

4 to 13 mph within the intersection

1 to 6 mph before/after intersection

ESTIMATED COST

Moderate

$10,000 to $25,000 per installation

CONSTRUCTION TIME

Short for modular treatments

Long for dedicated infrastructure

NECESSITATES ADDITIONAL ROW

Varies

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

Yes

ADVANTAGES

Can take the place of an existing 4-way stop

DISADVANTAGES

Large vehicles may have to make left turns in front of traffic circles

May force vehicle travel into existing crosswalks

APPROPRIATE ROADWAY TYPES AND SPEEDS

Local Residential

30 mph or less

COMPLEMENTARY TECHNIQUES

Signage, Rumble Strips, Enhanced Pavement Marking Messages

ROUNDABOUTS

EFFECTIVENESS
High

OBSERVED SPEED REDUCTIONS
8 to 20 mph

ESTIMATED COST
High

$150,000 to $2M per installation

CONSTRUCTION TIME
Long

NECESSITATES ADDITIONAL ROW
Yes

IMPROVES PEDESTRIAN CONNECTIVITY
Yes

ALLOWS FOR LANDSCAPING
Yes

ADVANTAGES
Can take the place of a 4-way stop or signalized intersection

Increases intersection capacity

Reduces crash rates

DISADVANTAGES
High cost

Requires significant amount of ROW

APPROPRIATE ROADWAY TYPES AND SPEEDS
Arterials, Collectors

All roadway speeds

COMPLEMENTARY TECHNIQUES
Rumble strips, signage

Example of a roundabout (Source: NHDOT)

A modern roundabout is a circular intersection, without traffic signals or stop signs, where drivers travel counterclockwise around a center island. Drivers must yield at entry to traffic already in the roundabout, then enter the intersection and exit at their desired street. By reducing the number and severity of conflict points, and because of the lower speeds of vehicles moving through the intersection, roundabouts are a significantly safer type of intersection than compared to typical intersections.

Example of a rural roundabout (Source: FHWA)

DESIGN CONSIDERATIONS

Roundabouts are found primarily on arterial and collector streets, typically as a substitute for traffic signals or all-way stops. They are larger than traffic circles, designed for higher speeds, and have raised splitter islands to channel approaching traffic to the right. Roundabouts can be used to change the operating character of a roadway as it transitions from a higher-speed operation to a lower-speed operation within a higher-density community with more pedestrian presence.

APPLICABILITY FOR RUIDOSO

Roundabouts should be considered an **Applicable** traffic calming method for Ruidoso due to their effectiveness at reducing speeds, improving pedestrian connectivity, and landscaping potential. However, their high construction costs, ROW needs, and long construction times should reserve roundabout usage for only major intersections.

STOP SIGN PLACEMENT

Example of a stop sign (Source: Michael Mroczek)

The basic purpose of stop signs is to assign right-of-way to vehicles at intersections. Numerous studies have shown that stop signs are relatively ineffective as a speed control measure, except within 150 feet of an intersection. At the point of installation, speeds are reduced, but the effect on traffic approaching or leaving the stop-controlled intersection is negligible. In fact, some motorists actually increase their speed to make up for the inconvenience of stopping or disregard the stop signs altogether. A yield sign can also be considered where a full stop is not necessary.

A stop sign in Ruby Valley, NV

DESIGN CONSIDERATIONS

Because a stop sign is an inconvenience to through traffic, it should be used only where needed. According to the FHWA, a stop sign may be warranted at an intersection where one or more of the following conditions exist: an intersection of a less important road with a main road where application of the regular right-of way rule is hazardous; a street entering a through highway or street; an unsignalized intersection in a signalized area; and other intersections where a combination of high speed, restricted view, and/or serious accident record indicates a need for stop signs.

APPLICABILITY FOR RUIDOSO

Stops signs are most effective for traffic control at major intersections and for reducing cut-through traffic. However, stop signs should be considered **Not Applicable** as a traffic calming method.

EFFECTIVENESS

Low

OBSERVED SPEED REDUCTIONS

0 mph

May increase driver speeds

ESTIMATED COST

Low

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Can take the place of an existing 4-way stop

DISADVANTAGES

Stop signs viewed to be unnecessary can increase driver speeds

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Rumble Strips, Converging Chevrons, Enhanced Pavement Messages

STOP SIGN PLACEMENT (CONT.)

STOP SIGN EFFECTS ON TRAFFIC CALMING

To better understand the role which all-way stop control could play in traffic calming efforts, the Virginia Transportation Research Council conducted a comprehensive review of existing traffic calming literature, created a questionnaire survey for transportation officials, and analyzed three different case studies on cut-through traffic to create a report entitled *Using All-Way Stop Control for Residential Traffic Management*. Among the existing literature found within the report is a before-and-after study of intersections on residential collector streets in Troy, Michigan, which found that stop signs are not effective in reducing speeds and that there was a tendency for speeds to increase slightly. Studies in seven cities in the western United States similarly concluded that speeds were not significantly changed, but tended to increase slightly. Another study of 12 intersections in North Carolina found that there was no significant difference in the vehicle speed after multiway stop signs were installed, and that the change in speed ranged from +3 to -4 mph. Finally, a study of three stop sign locations in San Francisco also revealed that the speed reduction associated with stop signs is limited to within 61 meters (200 feet) of the intersection.

STOP SIGN EFFECTS ON CUT-THROUGH TRAFFIC

Little literature was found by the Virginia Transportation Research Council on the effectiveness of all-way stop control in reducing traffic volume in general, and cut-through traffic volume in particular. A collector street study in the cities of Cupertino and San Jose revealed that, overall, AWSC did not divert commuter traffic. In one part of the 4.8 km (3 mi) street section, traffic volumes decreased from 9,000 to 7,100 vehicles per day. However, the traffic was diverted to a parallel residential street and not to an arterial.

An existing Village of Ruidoso stop sign-controlled intersection

MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES WARRANTS FOR MULTIWAY STOP CONTROL

Multiway stop control can be useful as a safety measure at intersections certain traffic conditions exist. Safety concerns associated with multiway stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Multiway stop control is used where the volume of traffic on the intersecting roads is approximately equal. The following criteria should be considered in the engineering study for a multiway STOP sign installation:

A. Where traffic control signals are justified, the multiway stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.

B. A crash problem, as indicated by 5 or more reported crashes in a 12-month period that are susceptible to correction by a multiway stop installation. Such crashes include right- and left-turn collisions as well as right-angle collisions.

C. Minimum volumes:

1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day, and

2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour, but

3. If the 85th-percentile approach speed of the major-street traffic exceeds 65 km/h or exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the above values.

D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

TRUCK ROUTE RESTRICTIONS

Example of a truck route sign (Source: Owasso Reporter)

As grocery stores, shops, restaurants, office buildings, and residences all require deliveries of goods and packages, trucks can be tempted to use residential streets to bypass traffic in order to make faster deliveries. The purpose of a truck route system is to provide rules that balance the needs of commerce and the trucking industry with the desire to minimize the impacts of trucks on sensitive land uses. This is accomplished by designating certain routes for use by trucks, and barring their usage on other, more sensative routes, like residential roadways. Trucks can be allowed on restricted routes only if they have direct business in the vicinity. To maximize the effectiveness of truck routes, consistent, readable and accurate signage is needed along the routes, and maps need to be made readily available for commercial drivers.

A truck route in St. Paul, MN (Source: twincities.com)

DESIGN CONSIDERATIONS

Truck routes can be designated by establishing a maximum weight or number of axles for vehicles for usage of a route. Commercial vehicles over the set weight or number of axles can be limited to established truck routes designed to accomodate the larger size and weight of commercial trucks. In determining appropriate truck routes, the physical design features of the roadways are important considerations that significantly affect commercial traffic operation and safety. Critical geometric design factors that directly influence truck-routing guidelines include vertical clearance, lateral clearance, sign placement, weight limits, turning radii, intersection and interchange design. A thorough review of any proposed route must include these factors and should also consider the standard design vehicle requirements for the most prevalent trucks being driven on the routes.

APPLICABILITY FOR RUIDOSO

Truck routes are effective for reducing cut-through traffic by commercial vehicles. However, truck routes should be considered **Not Applicable** as a traffic calming method.

EFFECTIVENESS

Further research required

OBSERVED SPEED REDUCTIONS

Further research required

ESTIMATED COST

Low

CONSTRUCTION TIME

Short

NECESSITATES ADDITIONAL ROW

No

IMPROVES PEDESTRIAN CONNECTIVITY

No

ALLOWS FOR LANDSCAPING

No

ADVANTAGES

Can reduce cut-through traffic by heavy vehicles on residential streets

DISADVANTAGES

Has no effect on vehicle speeds, pedestrian connectivity, or landscaping

Enforcement needed to maximize effectiveness

APPROPRIATE ROADWAY TYPES AND SPEEDS

All roadway types

All roadway speeds

COMPLEMENTARY TECHNIQUES

Signage,
Enhanced Pavement Messages

Example of an electronic speed limit sign in Ruidoso, NM.

APPLICABILITY MATRIX

While the various traffic calming methods described within this guide all have an appropriate usage depending on the circumstances, determining their applicability along Village-owned roadways is the ultimate goal of the *Village of Ruidoso Traffic Calming Guide*. To accomplish this goal, an applicability matrix was created which compares the different aspects of each traffic calming method. The matrix also indicates whether each individual traffic calming technique is an appropriate treatment for arterial, collector, and local residential roadways in both village and rural settings within Ruidoso. This approach allows the Village to consider which issues are most critical in a given location and context. In some instances, techniques that have been proven to be only somewhat effective may be most appropriate due to available resources, right-of-way limitations, or other factors.

Factors	Direct Feedback		Street Markings				Infrastructure										Intersection Control		Cut-Through	
	Speed Feedback Sign	Speed Feedback Trailer	Transverse Markings	Enhanced Pavement Marking Messages	Converging Chevrons	Narrowing Travel Lanes	Speed Humps	Speed Table	Speed Cushions	Tubular Channelizer Median	Median Island	Lateral Shift	Chicane	Choker	"HAWK" Beacons*	Rumble Strips	Traffic Circles	Roundabouts	Stop Sign Placement*	Truck Route Restrictions*
Effectiveness *Range: Low (Yellow) to High (Green)*	Moderate to High	Moderate to High	Low to Moderate	Low	Moderate to High	Moderate to High	High	High	Moderate to High	Low	Moderate to High	Moderate to High	Moderate to High	Low to Moderate	N/A	Low	Moderate to High	High	N/A	N/A
Cost *Range: Low (Green) to High (Yellow)*	Low	Low to Moderate	Low	Low	Low	Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Low to Moderate	Moderate to High	Moderate	Moderate	Moderate	High	Low	Moderate	High	Low	Low
Necessitates Additional ROW *Yes (Red) / No (Green)*	No	No	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No
Portable Treatment *Yes (Green) / No (Red)*	No	Yes	No	No	No	No	No	No	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No
Impacts Snowplowing Efforts *Yes (Red) / No (Green)*	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	No
Construction Time *Long (Red) / Short (Green)*	Short	Short	Short	Short	Short	Long	Short	Short	Short	Short	Long	Long	Long	Long	Long	Short	Short	Long	Short	Short
Improves Pedestrian Connectivity *Yes (Green) / No (Red)*	No	No	No	No	No	Yes	No	Yes	No	No	Yes	No	No	Yes	Yes	No	Yes	Yes	No	No
Allows for Landscaping *Yes (Green) / No (Red)*	No	No	No	No	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No

Appropriate Treatment for Roadway Type? (Yes / No)

Roadway Type	Direct Feedback Signs		Street Markings				Infrastructure										Intersection Control		Cut-Through Traffic Control	
Arterial - Village	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Arterial - Rural	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Collector - Village	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Collector - Rural	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Local Residential - Village	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Local Residential - Rural	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes

*On ly suitable for cut-through traffic prevention

Low	Low to Moderate	Moderate	Moderate to High	High

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