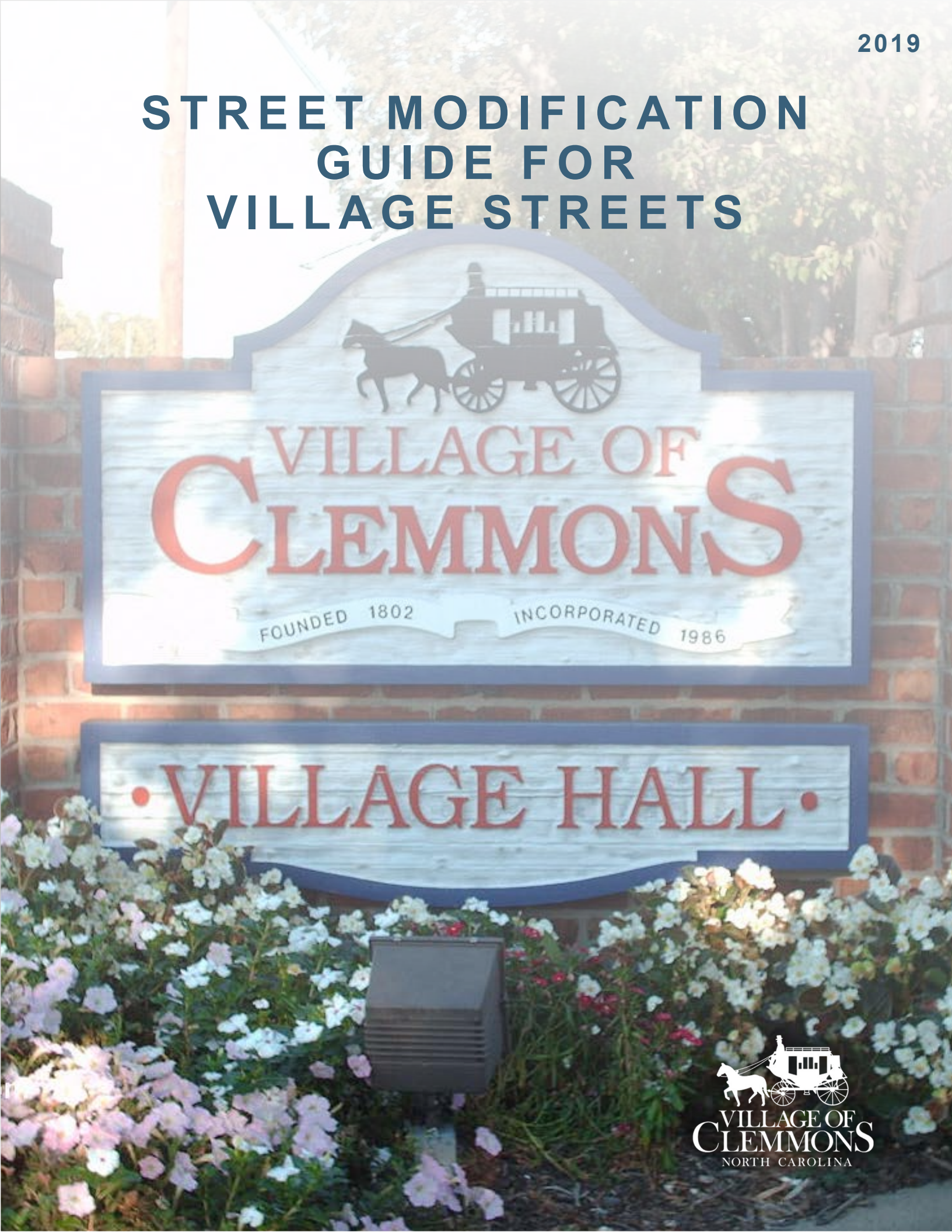
2019

STREET MODIFICATION GUIDE FOR VILLAGE STREETS



STREET MODIFICATION GUIDE FOR VILLAGE STREETS

I. INTRODUCTION AND OVERVIEW

The “Street Modification Guide for Village Streets” provides guidance and procedures for a resident to pursue modifications in their neighborhoods on existing streets maintained by the Village of Clemmons.

The purpose of street modification is to possibly lower vehicle speeds, improve site distance, or enhance pedestrian safety on neighborhood streets. Modification measures may also alleviate other issues such as cut-through traffic or through-truck traffic, where motorists or truckers use neighborhood streets to avoid and bypass other nearby roads.

The Street Modification Guide for Village Streets reflects a restructured process where local residents of the community, the Home Owners Association (HOA), or the Civic Association (CA) initiate a request for street modifications and a study. Village staff and the Transportation Committee will work with the local community to address specific issues related to a Village Street working through the Town Council as appropriate. The Transportation Committee’s involvement focuses on confirming the appropriateness of the community efforts at critical points in the process and coordinating the implementation of the approved plan.

II. STREET MODIFICATION – ROLES AND PROCESS

Roles of the Local Government, Community, and Transportation Committee

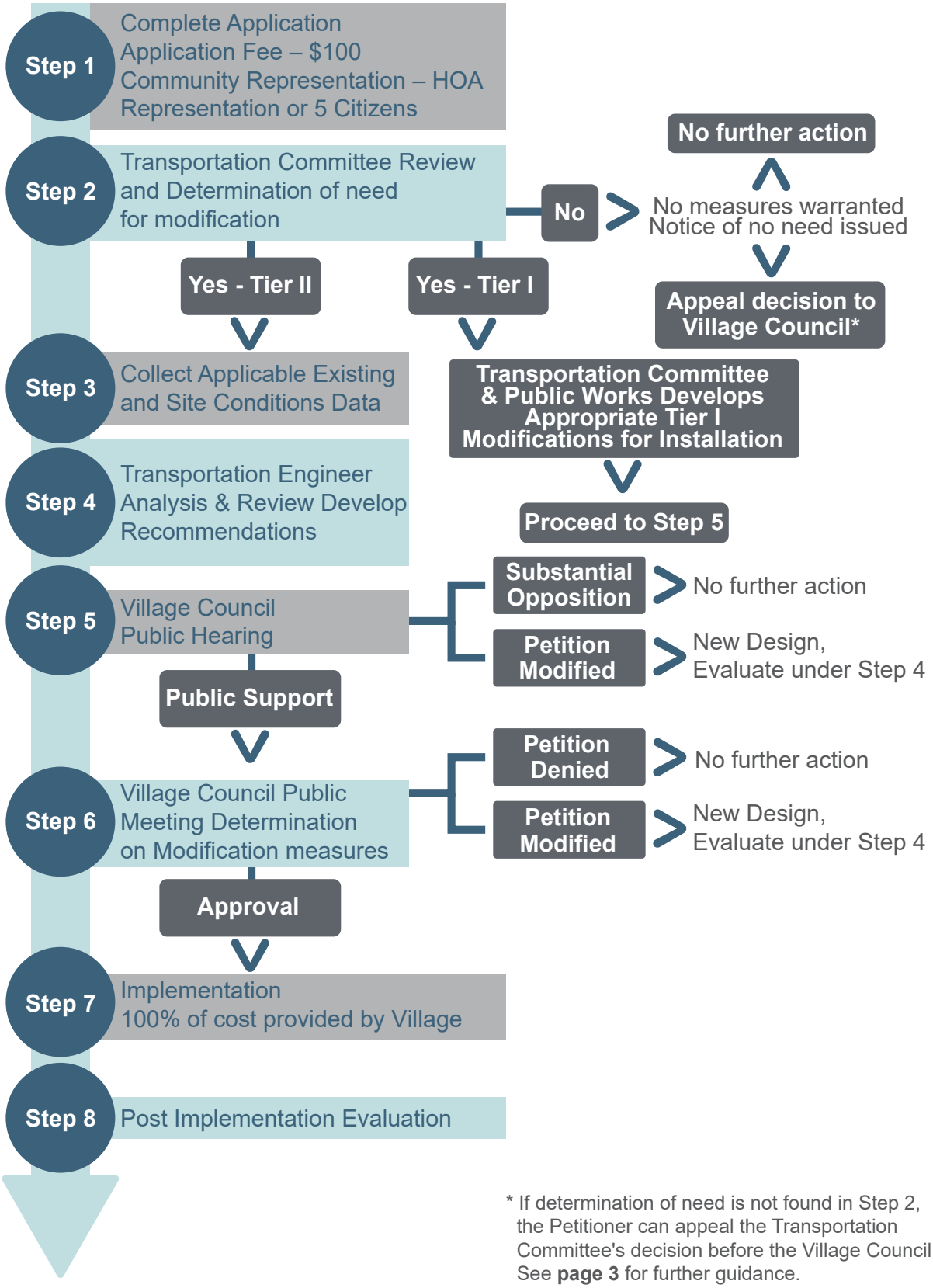
Local Government: The Village Council and Village staff work with the local community to guide and implement the street modification process and plan development (Steps 1–6 in **Figure 1**).

Transportation Committee: The Transportation Committee will confirm the eligibility and feasibility of streets proposed for modifications and the proposed improvement plan.

The Street Modification Process

The process for street modifications is on the following page (see **Figure 1**) with the details for each step laid out on the subsequent pages.

Figure 1—Street Modification Process



* If determination of need is not found in Step 2, the Petitioner can appeal the Transportation Committee's decision before the Village Council. See **page 3** for further guidance.

Step 1: Initial Contact and Project Viability Determination

To begin a street modification project, five (5) residents or a HOA representative (also known as petitioner) shall contact Village staff. Staff confirms that the street proposed for modifications meet the basic eligibility requirements within the guidelines, which are:

1. Street is within the Village of Clemmons Jurisdiction and is maintained by the Village.
2. Street is within a neighborhood setting. A typical neighborhood street for traffic calming is in a subdivision where there is a high density of residences and the street has a functional classification of “local”. A neighborhood street with similar characteristics may have a functional classification of “collector” or “arterial” and thus be appropriate for consideration as well.
3. Two-lane roadway (may have turn lanes and may have parking)
4. Subject street has a maximum posted speed limit of 35 mph. Unposted, residential streets generally have a statutory speed limit of 35 mph. However, staff must confirm the speed limit for the subject street.
5. Applicants submits $100 review fee to the Village of Clemmons.

Step 2: Transportation Committee Review

After confirming the subject street meets the basic eligibility requirements for modifications, the petitioner will obtain approval from the Transportation Committee to pursue changes to the proposed street. If there is not an HOA or CA minimum of 5 residents (or 10% of residents) along the subject street, they may secure approval from the Transportation Committee to proceed. Upon agreement by the Transportation Committee to pursue modifications on the requested street, they proceed to Step 3. If the Transportation Committee determines that no street modifications are necessary, the committee will issue a notice of no need to the petitioner.

If a determination of need is not found by the Transportation Committee, the petitioner can seek an appeal by the Village of Clemmons Council. Upon receiving the notification by the Transportation Committee, the petitioner has two (2) weeks to seek an appeal with the Public Works Director. The petitioner must respond in writing asking for the appeal to the Public Works Director. The petitioner must include the notice of no need found by the Transportation Committee in the request. Upon receipt the appeal will be heard by the Village Council within the next two (2) meetings of the Council.

Step 3: Engineering study/review

The Village will retain a traffic engineer for recommendations based on traffic count and speed and existing street conditions to determine if the street is suitable for modifications to remedy the problem. This evaluation may include the following elements:

1. An engineering field review determines the suitability of the street for traffic considering the extent of horizontal and vertical curvatures, sight distance concerns, roadway drainage, and extent and location of road access points that may affect the location, extent, and type of street modification implemented.
2. A speed study determines the 85th percentile operating speed. In order to be eligible for further consideration of traffic calming, the street must have an operating speed (85th percentile speed) of 10 mph or more above the speed limit (e.g., 35 mph or more where the speed limit is 25 mph) in at least one travel direction.
3. A traffic count determines the average daily traffic (ADT) volume on the street for both travel directions. A 48-hour traffic count conducted on a Tuesday, Wednesday, or Thursday is typical in order to determine the average daily traffic for a weekday (weekends, Mondays, and Fridays experience non-typical travel patterns). The level of traffic determines the type and extent of traffic calming considered.
4. Streets with a daily traffic volume between 600 and 4,000 vehicles per day (VPD) are appropriate for consideration of the full range of traffic calming measures in the Street Modification Guide for Village Streets.
5. Streets with less than 600 VPD are appropriate for consideration of signs, pavement marking, and administrative options.
6. Where traffic volumes on the study street exceed 4,000 VPD, alternative actions are available, such as the Additional $200 Fine Signs or Speed Display signs, under the specific programs for those signs.

The Transportation Committee and staff will review the study results, confirm the appropriateness of the street for recommended modification, and note any items or limitations that should be considered in developing the street modification plans.

Step 4: Street Modification Plan Development

The staff, in coordination and consultation with the traffic engineer, will develop a conceptual improvement plan following the requirements and considerations laid out in **APPENDIX I: Development and Implementation of the Traffic Calming Plan**, operation and maintenance aspects of the proposed street modification.

Agreement must be secured from each affected property owner of a residence or business where the physical location of a proposed traffic calming device or some portion (excluding warning signs posted for a device) lies within the roadway frontage of the property boundary.

NOTE:

The affected property owner may agree to the device affecting their property without agreeing with the entire traffic calming plan. Where a particular property owner does not concur with a particular device as it affects their property, other options such as shifting the location or proposing an alternate device should be considered.

Step 5: Community Support/Public Hearing

Once approved by the Transportation Committee, a public hearing will be scheduled to allow property owners (residences and businesses) on adjacent streets whose sole or primary access is the street identified for modifications and who would be considerably inconvenienced if they chose an alternate route.

The information presented at the public hearing to support the street modification request shall at a minimum include:

Supporting Information:

i. A map that indicates the location and approximate footprint of the proposed medications along the street and the affected property boundaries.
ii. A map that indicates the survey area including residences, businesses, and the connecting streets.
iii. Information about the nature and features of the proposed traffic-calming devices such as contained in the Street Modification Guide for Village Streets.
iv. Copies of the petition document that indicates the community support.
v. Supporting data including traffic volumes, crash, and speed data that formed the foundation of the street modification.

The petition or survey document ensures an accurate measure of community support and shall be limited to the following:

i. Only occupied residences or businesses on the impacted are included/counted in measuring and documenting community support.
ii. Each residence or business address gets a single signature or ballot/vote to indicate agreement or disagreement with the entire plan.
iii. More than 50% of the occupied residences or businesses in the survey area must support the traffic calming plan in order for the plan to be implemented.

Step 6: Village Council Approval

Upon approval by the community of the Village Council endorses the plan by a resolution. The resolution should state the following:

i. The proposed Street Modification Plan was properly presented to the community by Community Petition and Public Hearing process.
ii. The proposed improvement plan was subsequently approved by (indicate percentage) of the occupied residences and businesses within the impacted street.
iii. The intended source of funding (e.g., 100% Village of Clemmons funds).

Upon issuance of a resolution to support, the resolution and street modification plan are then conveyed to Clemmons Public Works department along with the following related documentation:

i. The engineering study/review.

ii. A map depicting the streets and residences identified as part of the impacted street.

iii. A description of the method used to measure and document community support (e.g., petition, survey, etc.)

iv. The survey documents and a summary of the survey results including the number of residences and businesses located on the impacted street and the number/ percentage that support the proposed plan.

Step 7: Implementation

After receiving approval from the Village Council, the Public Works department will install/construct the proposed improvements by utilizing Village forces or bid the project for implementation by the lowest responsive bidder. Public works will consider implementation of the street modification through contract forces or the or Village staff. The implementation of the plan by Public Works forces is dependent on their funding priorities and availability of resources, materials, and equipment.

Step 8: Evaluation

Following implementation of the street modifications, the Public Works Department along with the Traffic Consultant, will review the installation and the related traffic control devices to ensure that there is no safety, operational, or maintenance issue.

Subsequent to installation (after 3 months is suggested), a follow-up review may be conducted to evaluate the effectiveness of the street modification measures as it relates to the addressing the issue of concern.

Modification of Installed Traffic Calming Devices

Where a documented safety, maintenance, or operational issue arises following installation of a street modification, the Public Works staff may adjust, relocate, or remove the relevant improvement(s) as necessary to address the documented issue. Prior to removal or adjustment, the Public Works staff must confirm the issue and obtain approval form the Village Council.

Removal of the Street Modification

A petition for the removal of any street modification device may be approved by the Village Council subject to the following:

i. The improvement has been in place for a minimum 3-year period.

ii. The owners of five (5) separate properties located on the subject street must sign the request for removal.

iii. Subsequent steps shall be the same as the current procedure for the installation of the street modification.

iv. The cost for removal shall be borne by the petitioners for removal.

III. STREET MODIFICATION OPTIONS

The traffic calming devices included in the Street Modification Guide for Village Streets are characterized as Non-Intrusive or Horizontal, Vertical, and Narrowing devices and are discussed on the following pages.

1. Non-Intrusive Traffic Calming Devices

Non-intrusive measures include administrative measures such as a public information, campaign, or signage to promote speed reduction and utilizing pavement markings to reduce the number of lanes and/or effective travel-way widths. The effective pavement width available may be reallocated for parking lanes, bike lanes, or sidewalks.

Non-intrusive devices offer the advantage of being less invasive in that they do not physically constrain vehicle maneuvers. This is particularly desirable for streets that serve as major emergency and bus routes. Other desirable aspects of the non-intrusive devices are that they involve standard signs and pavement markings easily recognized by motorists and can generally be less costly as compared to the horizontal, vertical, and narrowing measures.

However, some non-intrusive applications may not be as effective because they do not physically constrain vehicles to reduce speed.

The following are the non-intrusive measures included in the Street Modification Guide for Village Streets:

- Community Education
- Community Gateways
- Pavement Markings (travel-way narrowing and roadway conversions)
- Speed Display Signs
- Additional $200 Fine signs

Non-Intrusive Devices – Community Education

Informing and reminding the community of speeding issues and concerns and the importance of driving safely in their neighborhood is an important step. Various resources and literature are available to inform the community on these various issues.

NOTE:

Click this link for resources.

The North Carolina Department of Transportation (NCDOT) has considerable literature and information on all aspects of safety including speeding and aggressive driving, school bus safety, bicyclists, pedestrians, teen drivers, and mature drivers which can serve to educate both motorists and pedestrians/bicyclists alike and raise the overall awareness of safety.

NON-INTRUSIVE DEVICES – PAVEMENT MARKINGS

Figure 1.1—Pavement Marking Options

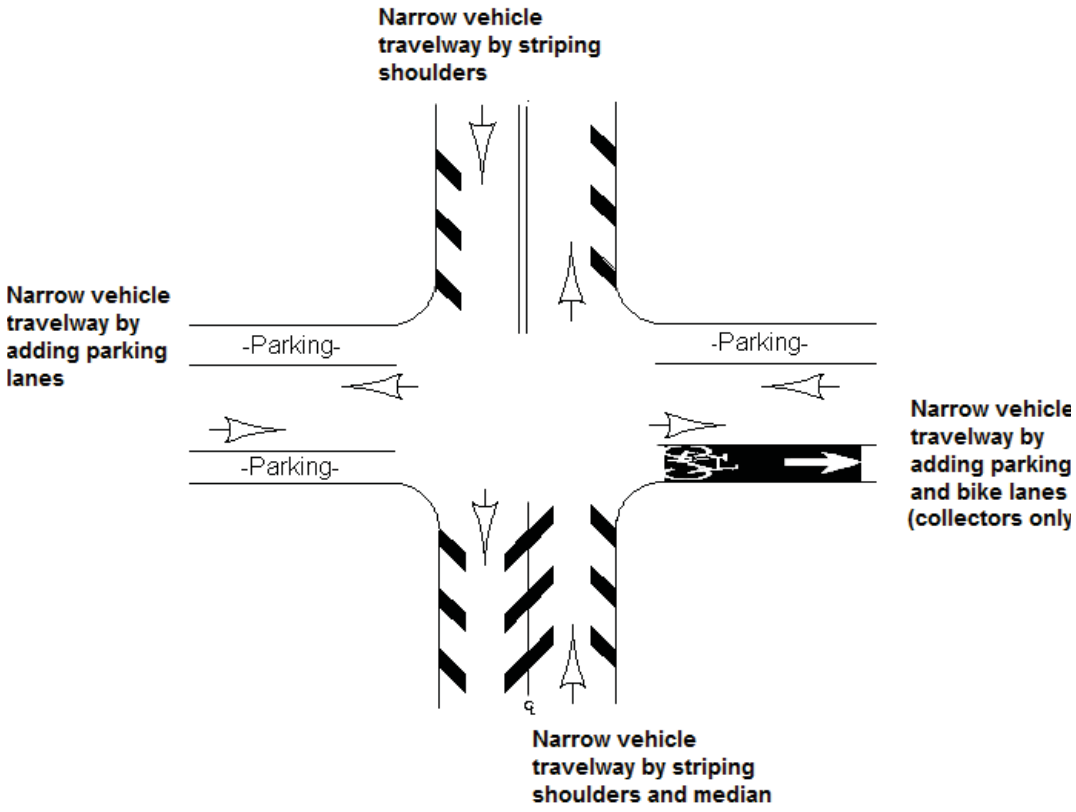


Figure 1.2—Narrow Travelway by Re-Striping Pavement

Figure 1.3—Narrow Travel-Way by Re-Striping to Add Parallel Parking Lanes

Figure 1.4—Narrow Travel-Way by Re-Striping Pavement to Add a Bike Lane

Description

Narrowing travel lanes tends to cause drivers to drive slower. The additional pavement made available by narrowing the lane width can be reallocated for parking and/or bicycle lanes **(see Figure 1.1–1.4 above)**. Incorporating this effort in conjunction with a re-paving project can save costs and minimize eradication as well as confusion to the motorists (i.e., a change with a paving project may be easier to comprehend/tolerate than a separate effort to eradicate existing markings and re-stripe).

One option when adding parking lanes is to alternate parking along opposite sides of the street which introduces a physical change in the straight-line vista of a roadway, similar to that of a chicane (discussed further on) to promote reduced speeds.

NOTE:

On local streets, bicyclists are a normal part of the vehicle mix and do not require marked or designated bike lane. Designated bike lanes are more appropriate on collector roads where they connect to a network of bike lanes on streets identified in a local and/or regional Bicycle Plan.

Placement

The desired features (e.g., bike lanes, parking, etc.), available pavement width, and allowable minimum travel-way widths (see **Appendix I–Selection of Modification**), dictate the type of pavement striping and its location.

Advantages

- Does not physically restrict driver maneuvers and thus will not impose speed reductions or time increases on emergency and/or transit vehicles
- Involves a standard traffic control device easily recognizable by motorists
- Pavement markings may be less costly to implement than some of the other devices

Disadvantages

Re-striping the pavement involves considerably more effort where significant eradication of existing pavement markings is required. Therefore, where this is the case it is recommended that this measure is implemented in conjunction with a re-paving project.

Effectiveness

FHWA suggests a reduction of 0.5 mph for narrowing lanes by pavement markings and a reduction of 4 mph for a road diet where a 4-lane road is reduced to three lanes.

Cost

An estimated cost of $5 per linear foot of pavement marking/striping, including eradication of existing markings and maintenance of traffic, is suggested. Special symbols such as bicycle emblem on a bike lane are approximately $300 each.

Examples of re-striping modifications are shown on following page.

NON-INTRUSIVE DEVICES – POLE MOUNTED SPEED DISPLAY (PMSD) SIGN

Figure 2.1—Pole Mounted Speed Display Sign

Description

A **Pole Mounted Speed Display (PMSD) Sign** combines the regulatory speed limit sign with a radar speed feedback sign that displays the real-time speed of an approaching vehicle which tends to make motorists reduce their speed.

Placement

Signs are installed only on streets with a single through-travel lane per travel direction (e.g., a two-lane, two-way or one-lane, one-way street). Generally, one sign is placed at the beginning of the street section identified for traffic calming in each travel direction, in order to reinforce the posted speed limit for vehicles entering the section of street designated for traffic calming. At least 200 feet of visibility distance should be allowed approaching the sign and at least 100 feet between any other signs.

Advantages

- These signs can potentially be used as a portable assembly that allows for placement at alternating locations.
- Does not physically restrict driver maneuvers and thus will not impose speed reductions on emergency and transit vehicles.
- Involves a standard traffic control device easily recognizable by motorists.

Disadvantages

Installing these signs may be impacted by the availability of a power source. Placement could be limited based on obstructions for solar power units.

Effectiveness

Various sources indicate an average sustained reduction in operating speeds of 5 mph may be achieved.

Cost

An estimated cost of $7,500 per installation is suggested, depending on whether solar or conventional power is used as well as the proximity of the power source.

2. Horizontal, Vertical, and Narrowing Devices

These are traffic calming devices constructed and installed on the street pavement surface to narrow the travel-way or create vertical or horizontal shifts on the roadway. These devices can be particularly effective in slowing vehicles because they physically constrain vehicles to pass over, through or around physical obstructions on the roadway.

Horizontal, vertical, and narrowing devices can also significantly affect emergency response, as well as transit, times from three to ten seconds per device depending on the type of device and the vehicle traversing it with the delay compounded by multiple devices.

Although neighborhood streets do not generally serve as primary emergency or transit routes, streets in close proximity to Fire/Rescue services and hospitals are identified by the local Fire and Rescue Chief as having significant usage by their fire and rescue vehicles should use non-intrusive devices and speed lumps to minimize impacts for emergency vehicles. Similarly, streets on major (large bus) transit routes or that experience significant use by such vehicles should consider use of non-intrusive devices and speed lumps.

Some of the horizontal, vertical, and narrowing devices, such as speed humps, can also affect bicyclists and may introduce additional maintenance costs and considerations, particularly the horizontal, narrowing devices which can create drainage issues if not appropriately located and constructed.

A disadvantage of the vertical devices is increased noise to nearby residents due to vehicles passing over the devices, particularly large trucks. This is particularly the case for speed humps and speed lumps (for passenger vehicles).

Following is a detailed description of the horizontal, vertical, and narrowing Devices included in the Street Modification Guide for Village Streets:

- Speed Lump
- Speed Table
- Raised Intersection
- Raised Median Island
- Crosswalk Refuge
- Chicane
- Choker
- Curb Extension

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – SPEED LUMP

FIGURE 3.1—Speed Lump

Figure 3.2—Speed Lump

Description

A Speed Lump is a modified Speed Hump where openings are added to accommodate emergency or other large vehicles to utilize the openings without traversing over the raised portion to minimize speed reduction. However, the sizing of the lumps ensures that passenger vehicles cannot likewise avoid traveling over at least one set of lumps.

Placement

Speed lumps are placed at mid-block.

Advantages

- Allows emergency vehicles and buses to traverse the device without reducing speed by utilizing the openings provided for those particular vehicles.
- Produces less noise than speed humps for emergency or other large vehicles.
- Speed lumps are more accommodating for bicyclists than speed humps, as bicyclists can utilize the openings to traverse the device.

Disadvantages

- These devices increase noise to nearby residents for passenger vehicles.
- May encourage passenger vehicles to cross into the opposing lane in an attempt to straddle the humps provided for emergency vehicles. Providing a centerline stripe approaching the speed lump in each travel direction may discourage this.

Effectiveness

ITE and FHWA data indicate an average reduction in operating speeds of 5-9 mph.

Cost

The estimated cost for a speed lump is similar to a speed hump—approximately $2,000 depending on drainage conditions and materials used.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – SPEED TABLE

Figure 4.1—Speed Table

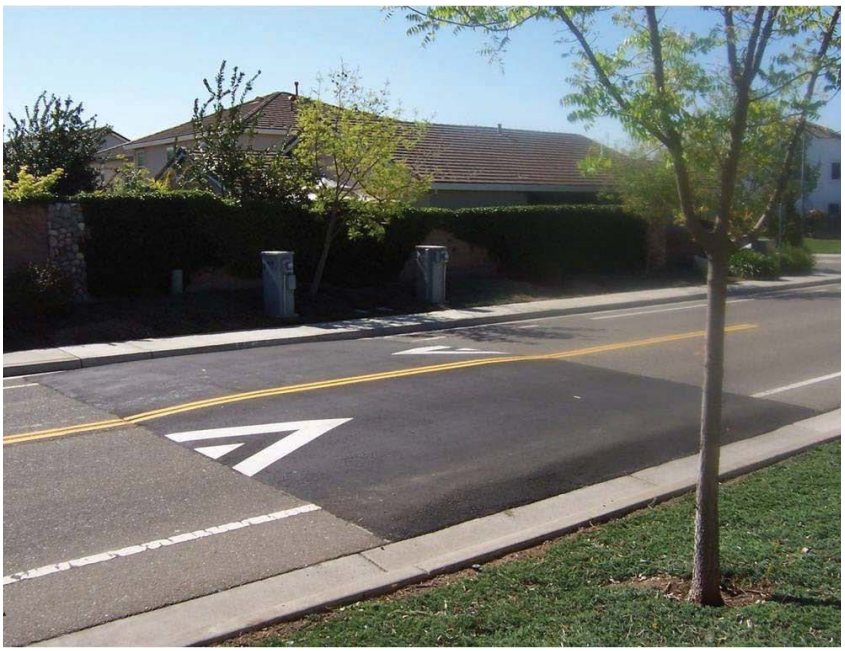


Figure 4.2—Speed Table

Description

Speed Tables are similar to speed humps except they incorporate a flat “table” and thus provide an overall gentler transition than the speed hump. The top “flat area” is sized to accommodate the most typical vehicle wheelbase (usually a passenger car) entirely on the top, but can be extended to accommodate other vehicles if desired.

Placement

Speed tables are placed at mid-block points.

Advantages

Provides a more moderate vertical transition for crossing vehicles and therefore motorists experience less discomfort than when driving over speed humps or lumps.

Disadvantages

These devices increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.

Effectiveness

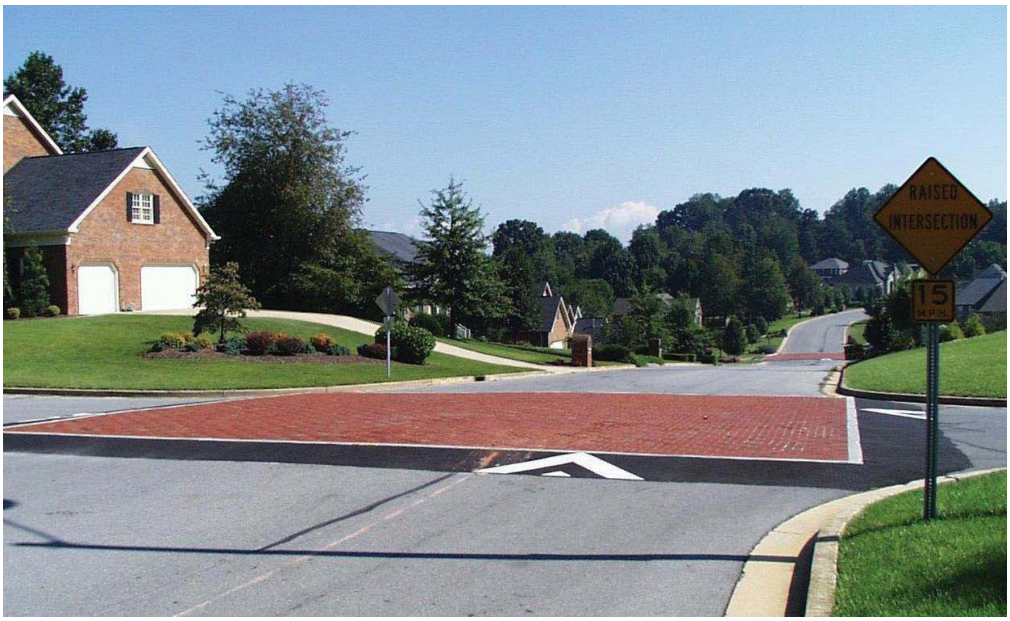
ITE and FHWA indicate an average reduction in operating speeds of about 7-9 mph for tables with the dimensions used in the Street Modification Guide for Village Streets of 22 feet (in the direction of travel). For longer tables ITE indicates a speed reduction of about 4 mph.

Cost

The estimated cost for a speed table ranges from $5,000 to $15,000 depending on drainage conditions and the materials used.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – RAISED INTERSECTIONS

Figure 5.1—Raised Intersection



Description

Raised intersections incorporate a speed table concept across an entire intersection and thus provide traffic calming on all connecting streets.

Placement

By definition, these devices are located at the intersection of two or more streets. The top, “flat area” covers the area of the intersection.

Advantages

- Raised intersections can be visually attractive.
- These devices provide traffic calming on two (2) or more streets at once.
- Similar to speed tables, raised intersections typically have longer dimensions than speed tables so drivers feel even less discomfort compared to a speed table or speed hump/lump.

Disadvantages

- Raised intersections have a significantly higher cost however, they also provide calming on two (2) or more streets at once.
- These devices likewise increase noise to nearby residents as vehicles pass over the device although to a lesser extent than speed humps.

Effectiveness

FHWA and ITE indicate an average reduction in operating speeds of about 0.3-1 mph.

Cost

The cost for a raised intersection can range from an estimated $25,000 to $70,000, depending on the number and width of the streets at the intersection to be raised.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – RAISED MEDIAN ISLAND

Figure 6.1—Raised Median Island

Description

A Raised Median Island involves placement of a raised island in the middle of the roadway in order to narrow the vehicle travel lanes.

Placement

This device is generally located at mid-block but can also serve as a gateway treatment when located at the entrance to a community.

Advantages

Provides dual use, as both a narrowing device and a gateway, when placed at the entrance to a community.

Disadvantages

- Narrows travel-way for bicyclists.
- Presents a fixed object within the travel-way that vehicles may strike, especially snow plows.

Effectiveness

FHWA indicates an average reduction in operating speeds of about 4 mph.

Cost

The estimated costs range from $6,000 to $9,000 per island.

HORIZONTAL, VERTICAL , AND NARROWING DEVICES – CROSSWALK REFUGE

Figure 7.1—Crosswalk Refuge

Figure 7.2—Crosswalk Refuge – Offset "Z"-option

Description

A raised median in the middle of the roadway (see previous “raised median” device) with a cut provided to provide refuge for pedestrians. An optional design utilizes an offset on either side of the median. Either design could also incorporate a raised crosswalk.

Placement

A crosswalk refuge is placed at an existing, marked crosswalk or where one is warranted. New crosswalks require an engineering study and must be approved by the traffic engineer and Public Works staff. Crosswalk refuges are desirable where vehicle speeds or the required crossing distance do not provide sufficient time for pedestrians to cross the street in a single movement.

Advantages

Provides additional safety in comparison to the standard crosswalk refuge, especially where there is no signal control such as at mid-block and T-intersection locations. In addition to providing a mid-block refuge for pedestrians so that they do not have to traverse the entire street, the “Z”-option crosswalk compels pedestrians to face and thus more likely to be aware of approaching traffic before crossing the remaining section of the street which may improve safety.

Disadvantages

- Narrows travel-way for bicyclists.
- Presents a fixed object within the travel-way that vehicles may strike, especially snow plows.

Effectiveness

Although data specific to a crosswalk refuge was not found, these devices are very similar to raised median islands, which achieve a decrease in operating speeds of 4 mph (see below).

Cost

The estimated cost for installing a raised concrete pedestrian refuge island (with landscaping) is about $10,000 to $30,000. The cost is less for an asphalt island or one without landscaping.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – CHICANE

Figure 8.1—Chicane (Single lane, One-Way Travel)

Figure 8.2—Chicane (Two-Way Travel)

Figure 8.3—Chicane (Two-Way Travel)

Description

Chicanes are adjacent to the curb on alternating sides of the street in sets of three (3) in order to introduce an S-shape travel path on a straight section of street that compels vehicles to slow down in order to negotiate the curved section.

Placement

These devices are at mid-block with a median or other non-traversable barrier to separate travel in each direction through the chicane.

The appropriate applications of chicanes are in **Figures 8.1–8.3**. In **Figure 8.1**, the travel directions are separated by a raised median and in **Figures 8.2** and **Figure 8.3** the travel directions are separated in the vicinity of the chicane by a raised median island.

The spacing and travel-way width between the chicanes is varied to achieve more or less vehicle speed reduction. Closer spaced constructions and narrower travel-way widths promote a greater reduction in speeds.

NOTE:

With no physical separation between the travel directions, drivers tend to cross the centerline to make their travel path as smooth as possible through the chicane, particularly an issue when there is a vehicle approaching in the opposing lane who may be doing the same. This cross-centerline behavior is a potential safety concern and contributes to a general ineffectiveness of the device in terms of speed reduction.

Advantages

Provides addition of greenery and enhances the attractiveness of the street.

Disadvantages

- Narrows travel-way for bicyclists and creates some loss of parking.
- Presents a fixed object within the travel-way that may be struck by vehicles especially snow plows.

Effectiveness

FHWA indicates an average reduction in operating speeds of 3-9 mph.

Cost

An estimated cost for asphalt chicanes of $10,000 (for a set of three chicanes) is suggested and $16,000 for a concrete set of three. Drainage may be the most significant cost consideration.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – CHOKER

Figure 9.1—2-Lane, 2-Way Choker

Figure 9.2—1-Lane, 1-Way Choker

Description

A choker is constructed at mid-block or as a curb extension to reduces the width of the travel-way. They can also serve to widen the planting strip for landscaping. These devices are often used to facilitate parking downstream.

Placement

Chokers are generally located at mid-block.

Advantages

Provides protection for parking which increases safety for pedestrians and vehicles when entering and exiting the parking area.

Disadvantages

- Narrows travel-way for bicyclists and creates some loss of parking.
- Presents a fixed object within the travel-way that may be struck by vehicles especially snow plows.

Effectiveness

FHWA data indicates an average reduction in operating speeds of 1-4 mph.

Cost

An estimated cost per set of chokers of $5,000 to $20,000 (including landscaping) is suggested depending on site conditions and the extent of landscaping.

HORIZONTAL, VERTICAL, AND NARROWING DEVICES – CURB EXTENSION (BULB-OUT)

Figure 10.1—Curb Extension (Neckdown)

Description

Curb extensions, also known as bulb-outs or neckdowns, extend the sidewalk or curb line into the parking lane thus preventing vehicles from parking too close to a crosswalk and blocking visibility of pedestrian crossings. They also reduce the speeds of turning vehicles at intersections and effectively reduce the street width, which significantly improves pedestrian crossing distance and times as well.

Placement

Curb extensions should only be used where there is on-street parking. Curb extensions at intersections reduce the speeds of right-turning vehicles and serve to narrow the roadway, which reduces the crosswalk distance for pedestrians and enhances the safety of pedestrian crossings at the crosswalk.

Advantages

Shortens crossing distances for pedestrians, which increases safety and provides parking protection downstream with the goal of decreasing vehicle speeds.

Disadvantages

Requires additional considerations for accommodation of bus routes and bicycle lanes.

Effectiveness

FHWA data indicates an increase of vehicle speeds of 1-3 mph; however, they can reduce the turning speeds of vehicles by 6-8 mph.

Cost

An estimated cost of $2,000 to $20,000 per corner is suggested, depending on design and site conditions where the accommodation of drainage is usually the most significant cost.

IV. COMBINED MEASURES

Combining one or more traffic calming devices can enhance aesthetics and have a greater speed reduction.

FHWA indicates a speed hump combined with a choker can generate an average reduction in operating speeds up to 13 mph and a speed table combined with a raised median island can create an average reduction in operating speeds up to 8 mph.

Other combinations did not indicate significant enhancement of speed reductions, but some combinations may be desirable for aesthetic reasons as well.

NOTE:

See FHWA's "Engineering Countermeasures for Reducing Speeds" for various other combinations that may be considered.

V. TRAFFIC CALMING MEASURES NOT INCLUDED IN THE GUIDE

A number of other measures were considered and either prohibited for use as a traffic calming device altogether or not recommended due to cost and ineffectiveness. These are (1) Stop Signs (2) Enforcement of Speed Limits (3) devices that impose restrictions on certain traffic movements (4) Speed Reduction Markings (5) Zig-zag pavement markings (6) In-Roadway Warning Lights and (7) Roundabouts.

1. Stop Signs are not intended for use as traffic calming devices in order to reduce vehicles speeds. Numerous studies show that unwarranted stop signs actually increase speeding on residential streets, where motorists tend to proceed through a stop without stopping in an attempt to make up lost time at stops they perceive as unnecessary. Thus, safety for pedestrians, especially for small children, is compromised due to their expectation that vehicles will stop as required when in reality they may not.
2. Although enforcement of speed limits is a traditional, proven and effective approach to reduce speeding past experience indicates that it is unreasonable to expect local enforcement agencies to continuously enforce speed limits on low volume residential streets. Therefore, this is not a sustainable measure.
3. Full or half-closures, diagonal diverters, and forced turn islands (including forced right-turns) are not considered in The Street Modification Guide for Village Streets as viable options as they impose restrictions on certain traffic movements that experience has shown to be unpopular and controversial in neighborhoods where they have been proposed.
4. Speed reduction markings are transverse markings placed on both edges of the roadway in a pattern of progressively reduced spacing to create the illusion of traveling faster and thus prompting motorists to reduce speed. However, per the MUTCD they are not suitable on long, straight sections of roadway or; areas primarily frequented by local drivers, the typical conditions where traffic calming

is most likely to be implemented. Therefore, they are not as effective and so are not included in the Street Modification Guide for Village Streets as a traffic calming measure.

5. Zigzag pavement markings involve lines painted on the pavement in a zig-zag pattern (**see Figure 16.1**) that serve to raise driver's awareness of an approaching crossing with pedestrians and bicyclists and to promote a reduction of vehicle speeds. Although they have a modest cost and appear to be effective in producing a sustained reduction in vehicles speeds, they have not been incorporated into the MUTCD and are considered experimental in nature. The U.S. Federal Highway Administration approved their use on an experimental basis in Virginia. A one-year study found both heightened awareness of the crossing by approaching motorists and a sustained speed reduction however, the extent to which speeds reduced is not clear. It is also not clear if these markings would be effective on neighborhood streets where speeds are lower and are primarily frequented by local drivers

6. In-Roadway Warning Lights involve beacons placed in the roadway surface at a marked crosswalk that flash (either automatically or manually) when a pedestrian is crossing the street and is within the crosswalk to provide additional warning to motorists. Although these devices increase driver awareness of pedestrians when device is operating properly however, when this is not the case they create a false sense of security for pedestrians and approaching motorists as well. Additionally, the devices are costly to install and maintain, have a high failure rate, and pose potential liability issues if not maintained.

7. Although roundabouts have many well-known benefits they are not generally considered traffic calming devices per se and the cost and extent of effort to implement a roundabout does not generally fit within the intended scope and budget for traffic calming on a neighborhood street. However, where appropriate a roundabout can be sought outside the traffic calming program.

APPENDIX I

DEVELOPMENT AND IMPLEMENTATION OF THE TRAFFIC CALMING PLAN

PAGE

I. SELECTION OF MODIFICATION

When developing the traffic calming plan, the following items should be followed in selecting the appropriate traffic calming measures.

1. **Involve and educate the community and decision-makers—**Inform community and decision-makers of the purpose of traffic calming, the relevant issues in the traffic calming process, and the nature of the various alternatives including their effectiveness and associated costs. Additionally, informing the community on the nature of the various traffic calming measures may enhance their overall effectiveness. The following link provides information on traffic calming and a video of various calming measures in operation.
2. **Consider all service providers and users of the street**—Key entities of the community should be consulted when developing the plan, particularly the local Fire and Rescue Chief, major bus transit operators, and affected public schools and businesses. Other users of the street such as business/trucking and bicyclists are considered as well.

    i. Emergency response times (and transit) can be significantly increased by horizontal, vertical, and narrowing devices from 3 to 10 seconds per traffic calming device, depending on the type of device and the vehicle traversing it, with the delay being compounded by multiple devices. Streets in close proximity to Fire/Rescue services and hospitals, identified by the local Fire and Rescue Chief, should use the non-intrusive devices and speed lumps to minimize the need for those users to reduce speeds. Similarly, streets on major (large bus) transit routes or that experience significant use by such vehicles should consider use of non-intrusive devices and speed lumps.

    ii. Emergency (e.g., fire trucks) and maintenance vehicles (e.g., snow plow operations) require a minimum of 15 feet of clear travel-way. Fire trucks require 15 feet of pavement in order to put down outrigger stabilizers when fighting fires. The local Fire and Rescue Chief should be consulted on the dimensions of the emergency vehicles they use to ensure they are accommodated in the proposed plan (e.g., speed lumps can be designed to accommodate specific vehicle widths).

    iii. For streets that provide primary access to industrial or business locations and that experience significant commercial truck traffic the non-intrusive measures or the horizontal, vertical, and narrowing devices that better accommodate these vehicles (e.g., speed lumps vs. speed humps) should be considered for these cases.

iv. Streets identified as part of a designated bicycle network in a local and/or regional bicycle plan or other streets where there are significant bicyclists should be considered for non-intrusive measures (particularly pavement markings that create a bike lane) and speed lumps vs. speed humps or speed tables that are more suitable for bicyclists.

3. **Implement measures on an area-wide basis**—Ideally traffic calming should take an area-wide approach to ensure that problems do not simply shift to adjacent local streets and parallel roadways. Implement traffic calming in stages where funding is not initially available for the entire plan.

4. **Consider the features of the street**—The appropriateness of a particular device depends on the traffic and pavement width.

5. **Consider appropriate traffic control devices**—(signs and pavement markings) that may affect the need as well as the type and location of the traffic calming devices. A lack of appropriate traffic control devices; particularly those that reinforce proper vehicle speeds such as speed limit signs and advisory speed warning signs, may be a contributing factor in creating undesirable conditions such as speeding and cut-through traffic. The speed limit should be posted at the beginning of the street section identified for traffic calming in each travel direction to notify motorists entering the street of the speed limit.

II. LOCATION, INSTALLATION, OPERATION, AND MAINTENANCE

The following discusses the various items pertaining to the location, installation, operation, and maintenance aspects of the traffic calming devices included in the Street Modification Guide for Village Streets.

Spacing, Location, and Placement of Horizontal, Vertical, and Narrowing Devices

Spacing

The spacing of horizontal, vertical, and narrowing devices should not exceed a distance of 500 feet between subsequent devices. As noted in NCDOT's Roadway Design Manual, studies indicate that operating speeds are 30 mph or less when the tangent sections were no longer than 500 feet. Long tangent sections can be segmented by conditions that require a complete stop such as a T-intersection or by conditions that require reduced speeds such as a traffic calming device. Therefore, the 500 feet spacing minimizes the need to place additional, redundant devices at an increased cost.

Where a closer spacing of traffic calming devices is desired, the distance between devices should not be less than 200 feet so that motorists approaching the device at 25-30 mph may appropriately perceive and respond to the device and/or any warning signs posted for the device (see section on traffic control devices pertaining to devices below).

Location

Raised Intersections are installed at an intersection.

Curb Extensions (Neckdowns or bulb-outs) are generally installed at the intersection of streets with on-street parking in order to reduce turning speeds of vehicles as well as pedestrian crossing times and; provide protection for on-street parking. They may also be placed at mid-block, similar to a chicane or choker.

Crosswalk Refuges are located where there is an existing marked crosswalk or where they meet the requirements for a new crosswalk. New crosswalks, modifications to an existing crosswalk, or any other pedestrian-related accommodations refer to the Traffic Engineer's recommendations for Pedestrian Crossing Accommodations at Unsignalized Locations.

Placement

The placement of horizontal, vertical, and narrowing devices should not interfere with existing driveways or entrances, roadway drainage and drainage structures, drainage inlets, or obstruct access to other utilities (e.g., franchise utilities such as gas, power, telephone, and water hydrants). Therefore, these devices should be placed at least:

- 5 feet from any driveway, entrance, or curb cut on a local street (additional clearance may be required for curb cuts utilized by trucks)
- 15 feet from a fire hydrant on either side
- 2 feet from a manhole or utility cover on approach or 6 feet after

Location and Placement of Non-Intrusive Measures

Pavement Markings

The conceptual drawing for pavement markings indicates various items pertaining to their placement and location.

Speed Display signs

These signs are installed in conjunction with the speed limit sign and are limited to streets having only a single through-travel lane per travel direction (e.g., two-lane, two-way or one-lane, one-way streets). The placement of these signs is generally dictated by where it is appropriate to indicate the regulatory speed limit therefore the sign locations should be approved by VOC staff. For street sections identified for traffic calming, speed limit signs would be installed at the beginning of the street section in each travel direction in order to reinforce the posted speed limit for vehicles entering the section of street. Additionally, interim signs would be placed as appropriate to reinforce notification of the regulatory speed limit.

Traffic Control Devices Pertaining to Traffic Calming Devices

Ensure that all related regulatory signs (e.g., speed limit signs), warning signs, and pavement markings pertaining to the street and the specific devices are installed.

Regulatory and warning signs as well as pavement markings generally recommended or required for the various devices are shown on the conceptual drawings. However, there may be additional signs or markings required depending on local conditions.

Horizontal, vertical and narrowing devices

Advisory speeds, where posted at a particular device, should generally indicate 15 mph.

- The recommended maximum speed for vehicles while traveling through or over those (horizontal, vertical, and narrowing) devices. The goal for vehicle speeds traveling between these devices is 25-30 mph or less. Therefore, 200 feet of distance is recommended for vehicles approaching the horizontal, vertical, and narrowing devices per Section 2C.05 of the 2009 MUTCD. This provides sufficient distance for a vehicle approaching the device at 25-30 mph to perceive the device and/or any warning signs posted for the device and reduce speed to 15 mph when passing over or through the device.

Non-intrusive devices

For the non-intrusive measures (pavement marking schemes and speed display signs) included in the Street Modification Guide for Village Streets, no specific additional regulatory or warning signage is identified, however, other signs or markings may be required depending on local conditions.

Size of Signs

See the 2009 MUTCD Section's 2B.03 and 2C.04 for regulatory and warning sign sizes. Single-lane conventional (low speed) roads are typical of the residential streets covered in the Street Modification Guide for Village Streets.

Visibility of Measures

Measures should be clearly visible day and night. Reflectors, buttons, highly reflective paint, or illumination should be used as appropriate. Landscaping (now or at maturity), or other features should not obstruct sight distances.

Maintenance

Long-term maintenance needs should be anticipated and accommodated in the design of the various devices as much as possible.

Minimum Design Vehicle

The minimum design vehicle for new subdivision streets is a single unit truck (AASHTO SU-30) therefore the traffic calming plan should determine (and address) whether this vehicle size should be accommodated on their existing streets.

Parking

On-street parking should not obstruct sight lines to installed devices for drivers, cyclists or pedestrians. Add additional “No Parking” zones where needed.

Streetscape and Landscape

Any streetscapes or landscaping installed as part of street modification measure (such as for raised median islands, chicanes, chokers, or curb extensions) shall be installed as directed by the Traffic Engineer and the VOC requirements.

Landscaping that encroaches onto the right of way can obscure pedestrians or vehicles entering the roadway from residences or side streets shall not be permitted. Any landscaping installed shall be constrained by location and height to ensure the appropriate unobstructed view is maintained to protect the safety of pedestrians, bicyclist, and motorists.

Funds for landscaping may be limited to a minimal percentage of the construction funds budgeted for a proposed street modification plan and; the neighborhood association or other community group would be solely responsible for maintaining any landscaping.

III. DRAWINGS FOR STREET MODIFICATION MEASURES

Following are conceptual drawings that provide details relating to the installation and construction of the various improvement measures based on recommendations from industry literature.

The following conceptual drawings illustrate details and requirements for the installations listed previously. The designer/installer should confirm that the installations meet all current NCDOT and MUTCD requirements that apply per NCDOT’s Roadway Design Manual, Road and Bridge Standards, and Road and Bridge Specifications. Signs and pavement markings should be in agreement with the latest version of the MUTCD.

TABLE A-1–SUBDIVISION STREET CHARACTERISTICS PERTAINING TO THE SELECTION OF TRAFFIC CALMING DEVICES

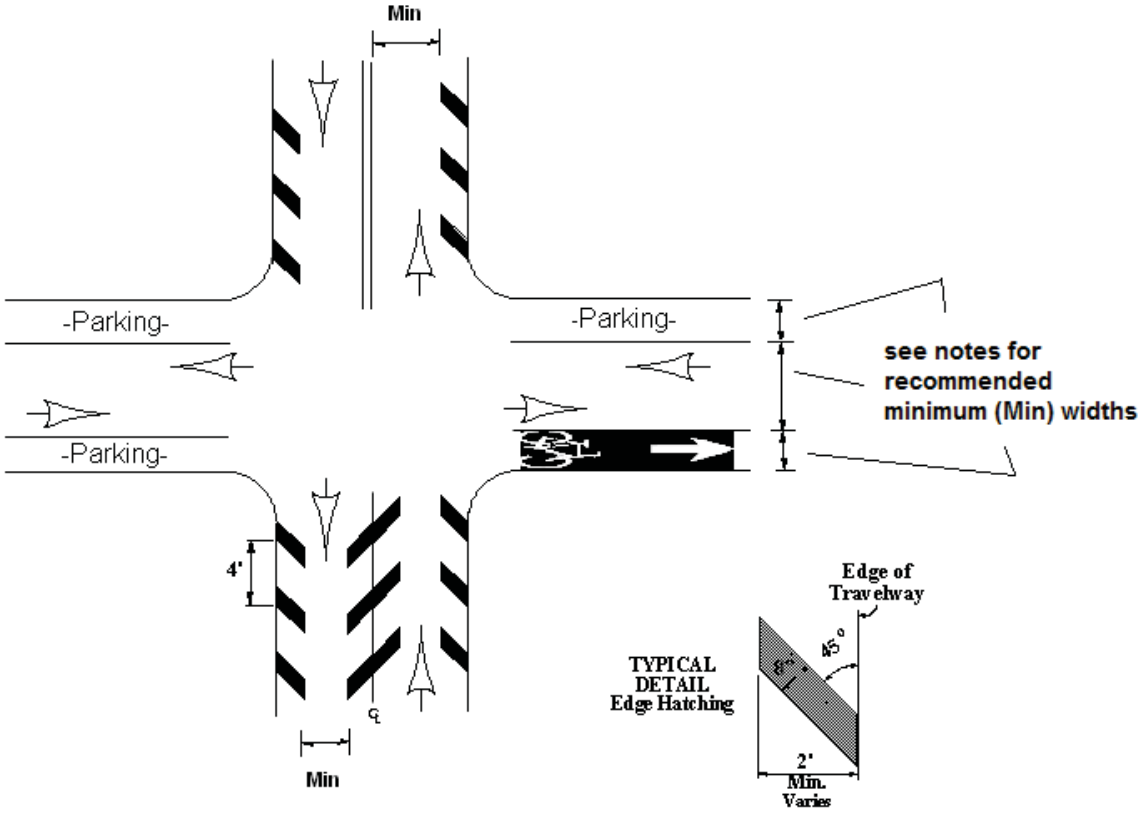
Type of Measure	Action	Street Characteristics[1]	Minimum Striped Travel-Way/ Lane Widths[2]	Other Considerations
NON-INTRUSIVE MEASURES – Pavement Markings				
Two-way, Two-lane street	Utilize pavement markings to narrow travel-way width; may include addition of parking or bike lanes (on collector streets where it is designated as a bike route or an adopted plan)	ADT < 401 vpd	18 feet*	*Physical pavement width may be greater than striped width *A parking lane requires additional pavement width (7 feet in residential or mixed-use areas and 8 feet in commercial areas) *A bike lane requires a minimum of 5 feet of pavement (6 feet preferred)[3]
		400 < ADT < 1,501 vpd	20 feet*	
		1,500 < ADT < 2,001 vpd	22 feet*	
		ADT > 2000 vpd OR Mixed use area with truck traffic > 5%	24 feet (22 feet where no crash pattern indicates wider pavement should be considered)	
One-Way, One Lane Street		Use ½ of above minimum widths vs. traffic volumes		
NON-INTRUSIVE MEASURES - Signage				
Speed Display Sign[4]	Install signs where appropriate for speed limit signs	Single lane per travel direction (two-way, two-lane or one-way, one-lane streets)	NA	Confirm the appropriate location of signs with VOC. Additional $200 Fine Signs may not be posted on arterial streets
Additional $200 fine Sign[4]				
VERTICAL MEASURES				
Speed Hump	Install physical measures on and across the travel-way		NA	Consider locations of manholes and drain inlets. Do not install adjacent to driveways or other points of access
Speed Lump				
Speed Table				Engineering study and VOC approval required for location of crosswalks
Raised Crosswalk[5]	Install physical measure on and across the travel-way at an intersection or at a mid-block location	At existing marked crosswalk or where approved by a traffic engineer and VOC staff		
HORIZONTAL MEASURES				
Chicanes	Install physical measures in groups of three along shoulder on alternating sides of street at mid-block	Requires physical separation between travel directions in vicinity of chicane and street width	10 feet minimum lane width through device for each travel direction OR ½ of above minimum travel-way width VS traffic volume – whichever is greater	Where ADT < 2,001 vpd and truck traffic (in mixed use areas) < or = 5%

Type of Measure	Action	Street Characteristics[1]	Minimum Striped Travel-Way/ Lane Widths[2]	Other Considerations
NARROWING MEASURES				
Choker	Install physical measures along the shoulder or on one or both sides of the street to narrow travel-way width at mid-block	Street meets minimum travel-way width requirements	10 feet minimum striped lane width through device for each travel direction OR ½ of above minimum travel-way width, whichever is greater. OPTION: A 15-foot travel-way width may be used at mid-block locations for "give way to opposing vehicle" operations. No pavement striping should be used in this application.	Consider locations of manholes, drain inlets, driveway or other access points for mid-block installations.
Curb Extensions (neckdown)	Install physical measures along the shoulder or both sides of the street to improve pedestrian crossings at intersections or at mid-block locations.	At existing marked crosswalks or where one is approved by the VOC and/or to accommodate on street parking		
Raised Median Islands	Install physical measures in median area of travel-way at an intersect or at a mid-block location	Street meets minimum travel-way width requirements	10 feet minimum travel lanes through device OR ½ of above minimum travel-way width vs traffic volume – whichever is greater	
Crosswalk Refuge[5]		At existing marked crosswalks or where on is approved by VOC. Street must meet minimum travel-way width requirements.		Engineering study and VOC approval required for installation of crosswalks

1. All streets are residential or mixed-use streets functionally classified as "local" with a speed limit of 25 mph or less where traffic does not exceed 4,000 vpd and trucks are 5% or less except where indicated otherwise.
2. Per AASHTO Green Book Table 5-5 for local roads and streets (travel-way widths are exclusive of curb and gutter).
3. On local streets, bicyclists are considered a normal part of the vehicle mix and do not require a marked or designated bike lane. Designated bike lanes may be established on collector roads as appropriate.
4. These signs normally governed by separate VOC policies however, when implemented within the traffic calming process they likewise meet the requirements prescribed under the respective policies. Confirm locations with VOC.
5. For requirements pertaining to pedestrian accommodations; see Traffic Engineer's recommendations for Pedestrian Crossing Accommodations at Unsignalized Locations.

FIGURE A–1

PAVEMENT MARKING OPTIONS



NOTES:

1. Each intersection leg indicates a different option for narrowing the travel-way
    a. North leg divided facility—narrow travel-way in each travel direction by hatching shoulder area
    b. South leg un-divided facility—narrow travel-way by hatching shoulder area and roadway centerline
    c. East and West legs—narrow travel-way by adding parking and bike lanes

1. See **Table A-1** of this manual for minimum widths of travel-ways, bike lanes, and parking lanes. NCDOT Roadway Standard Drawings and Division 12 Pavement Markings should also be consulted for guidance regarding placement of pavement markings, color, widths, and delineators for application regarding the proposed street modification. Recommended lane widths will be determined based on the context of the area surrounding the subject street, the conditions under which a modification is approved, and the desired outcome of the modification. However, a minimum of 10 feet will be maintained on any street modification. Bike lanes will be a minimum

of five (5) feet in width, preferred is six (6) feet in width. Parking stall dimensions will be determined based on the space available and configuration of the parking space (parallel, diagonal, 90 degree).

2. See Part 3 of the MUTCD (Section 2B.17 in the 2009 version) for requirements, options, and other considerations for pavement markings.
3. As per the 2009 MUTCD Section 3B.24 Cross-Hatching should be a minimum of 8" in width for speed limits of 45 mph or less.

FIGURE A–2

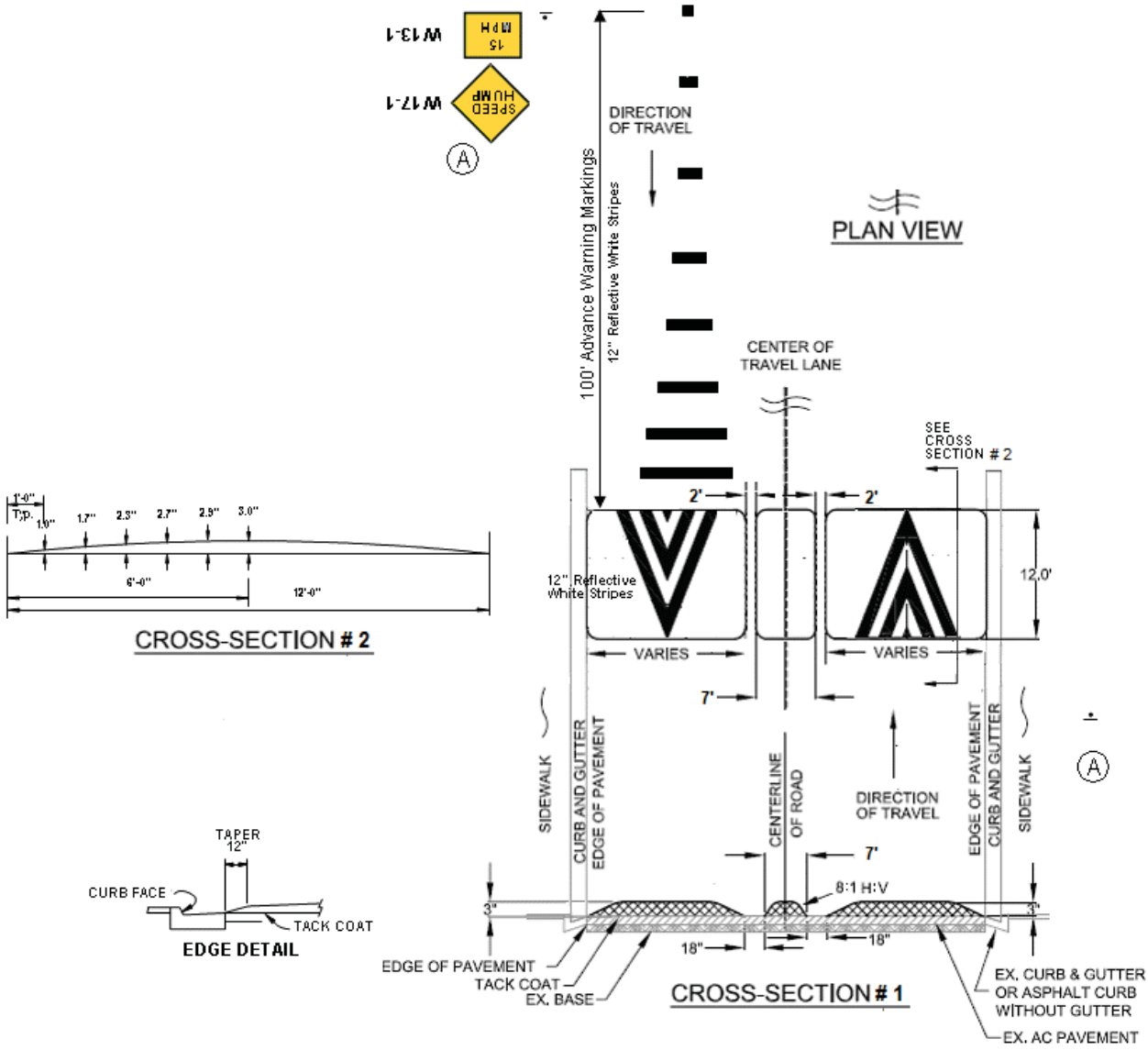
POLE MOUNTED SPEED DISPLAY (PMSD) SIGN

NOTES:

1. Sign is to be mounted on the same pole and directly below the speed limit (R2-1) sign as shown above.
2. The changeable display shall be programmed to go blank/no display when an approaching vehicle exceeds the posted speed limit by 20 mph or more.
3. The changeable display shall be programmed to display two dashes when the system is not operating.
4. Other than the speed display, the PMSD sign shall not incorporate animation, flashing, or any dynamic elements.

FIGURE A–3

SPEED LUMP



NOTES:

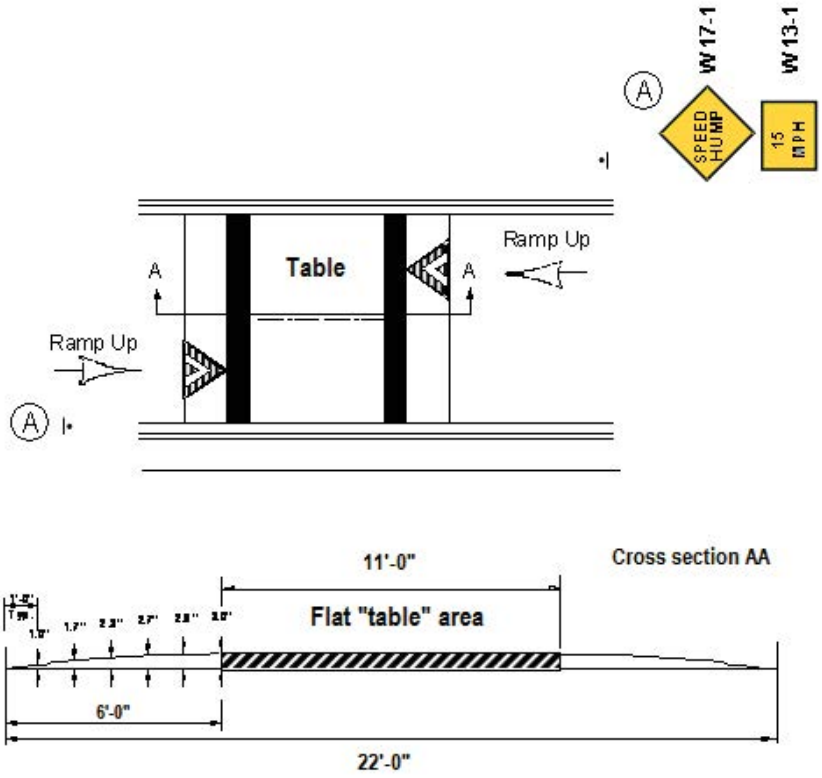
1. Leave gutter pan open to facilitate drainage.
2. Cross-section shows approximate maximum 3-inch elevation rise for speed lump.
3. Per the 2009 MUTCD:
    a. Section 3B.25—speed lump markings are not required but if used they must comply per options in Section 3B.25.

   b. Section 3B.26—the 100-foot advance warning pavement markings are optional but if used they must comply with the dimensions and spacing per Section 3B.26.
   c. Section 2C.29—advance warning sign (W17-1) is optional but if used should include the advisory speed plaque (W13-1) and sign may use “Speed Bump” instead of “Speed Hump.”

4. Cross-section #2 is identical to speed hump cross section.
5. Width of center lump is 7 feet with 2 feet of spacing between adjacent lumps which accommodates trucks, school buses, transit buses, and other larger vehicles with an 8-foot width and ensures that passenger vehicles (typical width of 7 feet) cannot avoid traveling over at least one set of lumps. However, the width of the center lump can vary based on dimensions of local emergency vehicles to be accommodated.
6. Striping to delineate the street centerline is recommended to discourage vehicles from crossing into the opposing lane in order to straddle the humps provided for emergency vehicles.

FIGURE A–4

SPEED TABLE/RAISED INTERSECTION



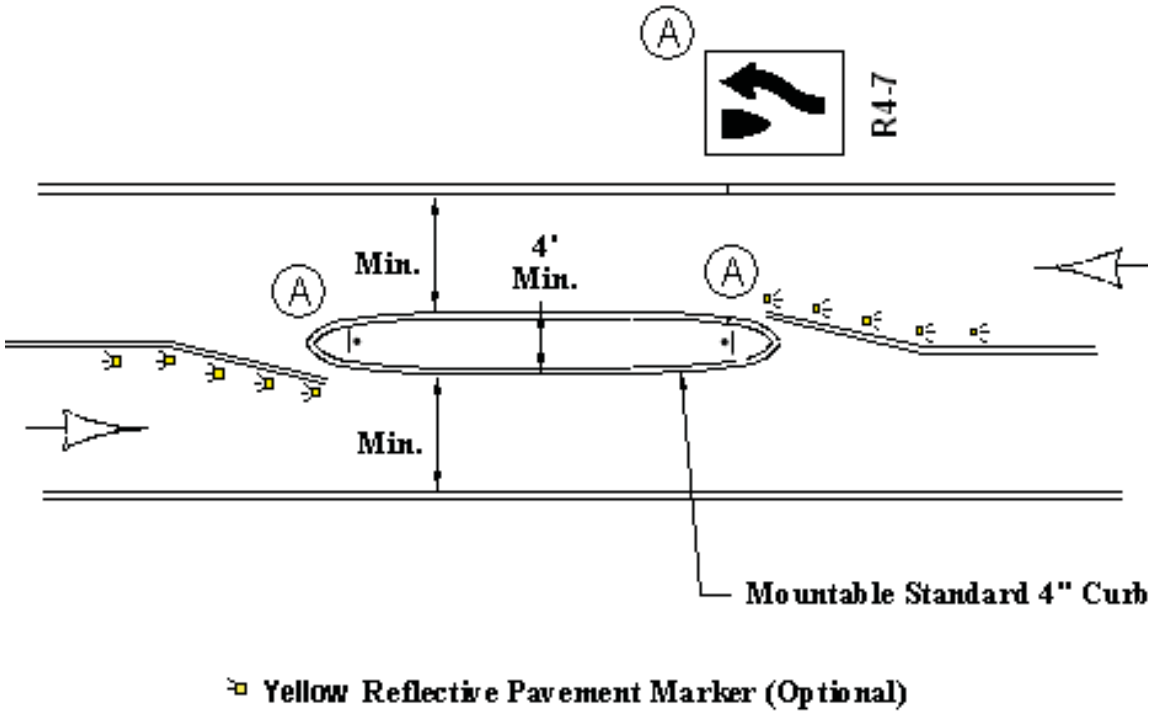
NOTES:

1. The flat “table” area length of 11 feet accommodates the typical passenger car wheelbase entirely on the top but can be extended to accommodate other vehicles if desired. A length of 20 feet accommodates the typical single unit truck (AASHTO SU-30).
2. The “Ramp-up” transition shows an approximate slope of 4.2% (rise of 3 inches over 6-foot run).
3. A raised intersection would mimic the speed table design for each approach where the “ramp-up” occurs prior to entering the intersection and the flat table area encompasses the entire area of intersection for the approaching streets and therefore in most cases will exceed 11 feet.
4. Leave gutter pan open to facilitate drainage.
5. A 12-inch wide, 1-inch depth grind around the perimeter of the device is recommended in order to allow the surface course to be keyed into the pavement for a more durable application, particularly for snow plowing.

6. Per the 2009 MUTCD:
    a. Section 3B.25—speed hump (table) markings are not required but if used they must comply with options per Section 3B.25.
    b. Section 2C.29—warning sign W17-1 is optional but if used, should include the advisory speed plaque (W13-1) and; the sign may use “Speed Bump” instead of “Speed Hump.”

FIGURE A–5

RASIED MEDIAN ISLAND

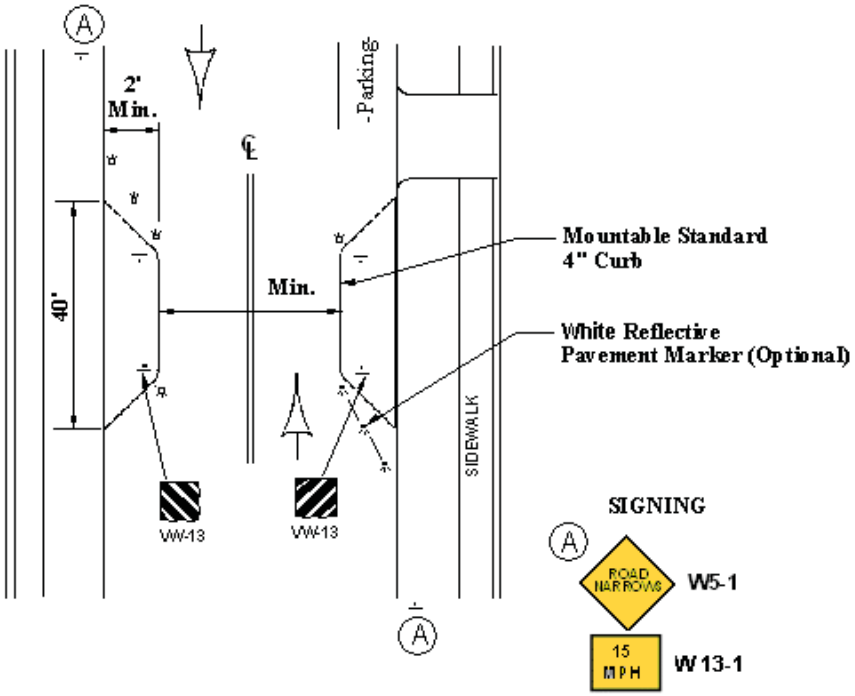


NOTES:

1. Approaches to the intersection should not exceed 6 percent and entrances should be a minimum of 75-100 feet away.
2. The transition of the approach curb and any accompanying raised pavement markers shall be in conformance to the design or operating speed of the roadway, whichever is greater.
3. Recommended lane widths will be determined based on the context of the area surrounding the subject street, the conditions under which a modification is approved, and the desired outcome of the modification. See **Table A-1** for guidance regarding travel-way width minimum requirements.
4. Per the 2009 MUTCD Section 2B.32, the R4-7 signs are recommended at locations where it is not readily apparent that traffic is required to keep to the right.

FIGURE A–6

CHOKER

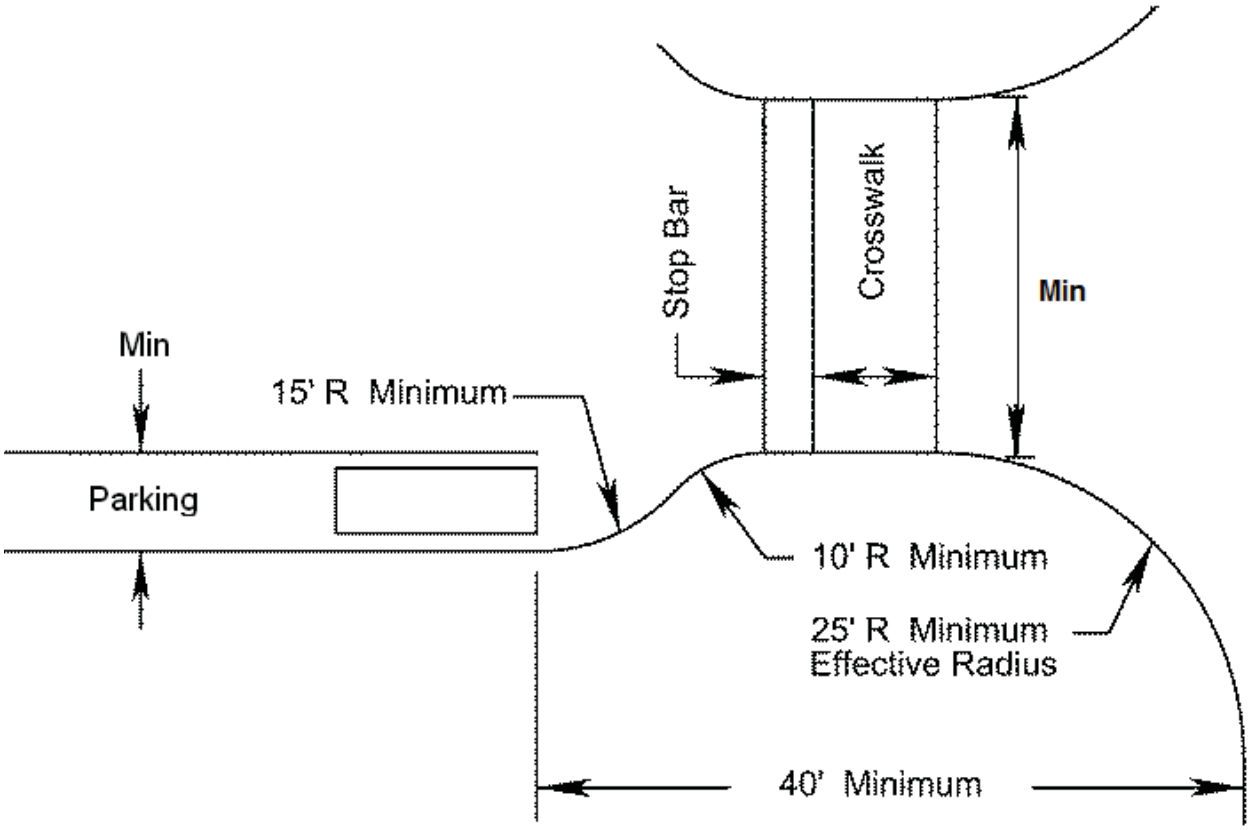


NOTES:

1. May be placed along one or both sides of the road where there is sufficient pavement width.
2. Recommended lane widths will be determined based on the context of the area surrounding the subject street, the conditions under which a modification is approved, and the desired outcome of the modification. See **Table A-1** for guidance regarding travel-way width minimum requirements.
3. May be combined with a speed table, speed hump, or speed lump (see **Figure's A-2, A-3 and A- 4**).
4. Do not stripe centerline where (min) travel-way width of 15 feet is used as described in **Table A-1** or otherwise less lane indicated in **Table A-1** for normal operation.
5. Leave gutter pan open to facilitate drainage.
6. Per the 2009 MUTCD Section 2C.19, advisory warning sign W5-1 is optional according to the following (if used may also include the advisory speed plaque W 13-1):
    a. Where the (**Min**) travel-way width allows two-way travel without requiring vehicles to use the adjacent lane or to give way to opposing traffic.
    b. On low-volume roadways where the speed limit is 30 mph or less.

FIGURE A–7

CURB EXTENSION (NECKDOWN)

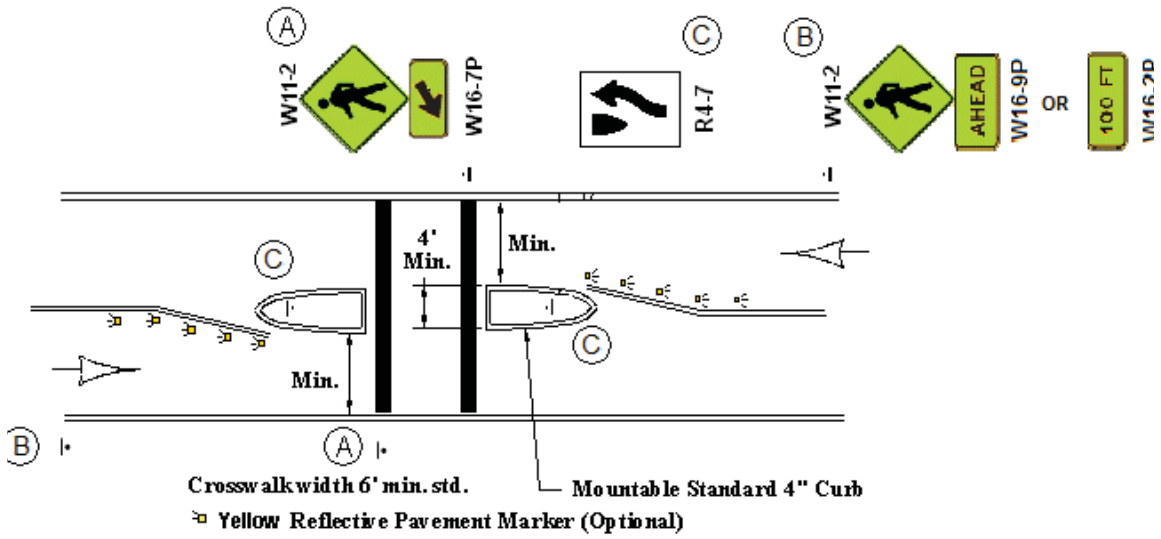


NOTES:

1. Located at an intersection with on-street parking and an existing marked crosswalk or where one is approved by VOC.
2. May also incorporate a raised crosswalk (see **Figure A-5**).
3. Where a new crosswalk is proposed for installation, or there are modifications to an existing crosswalk; for requirements pertaining to pedestrian accommodations refer to the recommendations provided by the Traffic Engineer for Pedestrian Crossing Accommodations at Unsignalized Locations.
4. See **Table A-1** for guidance regarding travel-way width minimum requirements. Recommended lane widths will be determined based on the context of the area surrounding the subject street, the conditions under which a modification is approved and the desired outcome of the modification.

FIGURE A–8

CROSSWALK REFUGE

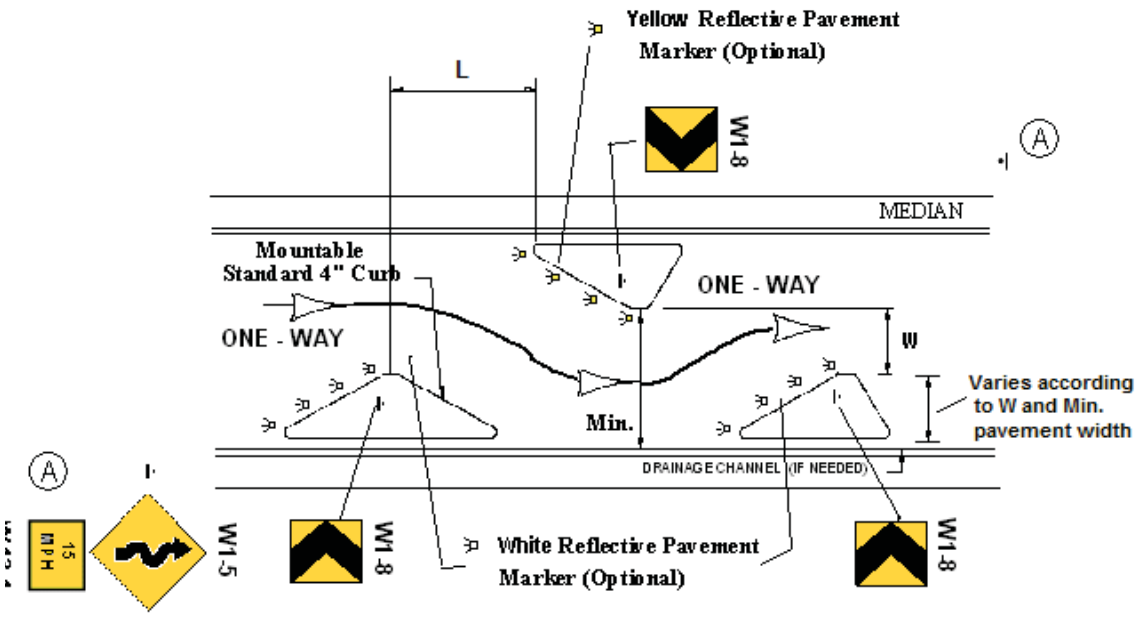


NOTES:

1. Located at mid-block where there is an existing marked crosswalk; in order to provide a refuge at mid-block for crossing pedestrians.
2. May also incorporate a raised crosswalk (see **Figure A-5**).
3. New crosswalks, or modifications to an existing crosswalk or any other pedestrian-related accommodations are governed by MUTCH and NDOT standards.
4. The CROSSWALK REFUGE device may be raised (see **Figure A-5**).
5. See **Table A-1** for guidance regarding the travel-way width minimum requirements.
6. Leave gutter pan open to facilitate drainage.
7. Per the MUTCD the W11-2 sign must be fluorescent yellow.
8. Per the 2009 MUTCD:
    a. Section 2B.32 recommends R4-7 signs at locations where it is not readily apparent that traffic is required to keep to the right.
    b. Section 2C.50 states the W11-2 may be used in advance of a crosswalk and if used; shall include supplementary plaques W16-9p or W16-2P. If used at the location of a crossing point, the W11-2 should include the supplemental W16-7P plaque.

FIGURE A–9

CHICANE



NOTES:

1. See **Table A-1** for guidance regarding the travel-way width minimum requirements.
2. See chart below for the maximum “Stagger Length” (L) for various travel-way widths (**Min**) and free View width ‘W’ to achieve the indicated passenger car speed through the chicane.

MAXIMUM STAGGER LENGTH ‘L’ REQUIRED TO ACHIEVE INDICATED PASSENGER CAR SPEED FOR TRAVEL-WAY WIDTH OF 15 FEET		
Free view width ‘W’ (feet)	Stagger length ‘L’ (feet)	
	20 mph	25 mph
+3.5	23	30
0	30	40
-3.5	36	50

3. See chart below for the maximum “Stagger Length” (L) for various travel-way widths (Min) to accommodate a single unit truck (AASHTO SU-30) for a free view width ‘W’ = 0.0 feet.

MINIMUM STAGGER LENGTH ‘L’ (FEET) FOR SU-30 TRUCK FREE WIDTH VIEW ‘W’ = 0.0 FEET			
Travel-Way Width (feet)	10	11	12
Stagger Length ‘L’ (feet)	40.0	34.0	29.0

4. The transition of the approach curb and any accompanying raised pavement markers shall be in conformance to the design or operating speed of the roadway, whichever is greater.

5. Per the 2009 MUTCD Section 2C.07, W1-5 signs are required where advisory speeds are 10 mph or more below the speed limit. W1-8 signs are required where advisory speeds are 15 mph or more below the speed limit and recommended where advisory speeds are 5 mph or 10 mph below the speed limit.

APPENDIX II

Village of Clemmons
Street Modification Application

Applicant _____ Neighborhood _____

Address _____ Location _____

_____ HOA _____

Contact Person _____ Road Name _____

Telephone Number _____ Project Limits _____

Description of Problem (cut-through traffic, speeding, safety, etc.) *Attach additional documentation as needed*

_____
_____
_____
_____
_____
_____

Verification of Eligibility (*all of the following are to be met*)

- □ Street within Village of Clemmons
- □ Street maintained by Village of Clemmons
- □ Street within a neighborhood setting
- □ Functional Classification = local residential or minor collector
- □ 35 mph (or less) speed limit
- □ Two-Lane roadway (may have turn lanes)
- □ Traffic Volumes less than 4,000 ADT

Application Completeness

- □ $100 Review Fee to Village of Clemmons.

HOA Representative: _____

Resident 1: _____ Address: _____
Resident 2: _____ Address: _____
Resident 3: _____ Address: _____
Resident 4: _____ Address: _____
Resident 5: _____ Address: _____

CHECKLIST FOR INITIAL REVIEW

- ☐ Description of impacted area, with map (The impacted area is generally a neighborhood area, but can be the same as the petition area, as defined by Transportation Committee or Village of Clemmons Staff.)
- ☐ Description of petition area, with map (The petition area is the area bounded by surrounding collector or arterial roads, as defined by local government in cooperation with SCDOT)
- ☐ Functional classification for each roadway within impacted area (Examples: Major Arterial, Minor Arterial, Major Collector, Minor Collector, Local Residential)
- ☐ Average daily traffic volumes, with directional splits for peak hours, within petition area
- ☐ Existing speed limit within impacted area
- ☐ Graphical representation of all traffic control devices, signs, markings, and signals within impacted area, including speed limits, stop signs, school zones, etc.
- ☐ Character of area including current zoning, current use, facilities such as schools, parks, hospitals, nursing homes, etc.
- ☐ Description of roadways in impacted area including width, pavement condition, curb and gutter, sidewalks, shoulder width, ditch type, etc.

Information Required TO BE FILLED OUT BY **Village of Clemmons**

☐ Speed Studies for both directions on	☐ Turning volume movements at the intersection of	☐ Percentage of cut-through traffic on

- ☐ Require additional information
- ☐ Project information completed
- ☐ Village Council approval obtained
- ☐ Petition with signatures obtained
- ☐ Approval contingent upon:

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Public Works Director Approval

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Council Approval

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