City of Encinitas Neighborhood Traffic Management Program

April 27, 2005

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1.0 Introduction

Safe, pleasant residential streets that allow Encinitas residents to walk, bicycle, and socialize have been a City priority for many years. Policies and practices to encourage neighborhood traffic to proceed at appropriate speeds and through traffic to use major streets were implemented in 1991. Some neighborhoods that have been affected by those policies are satisfied, but others have concerns that have not yet been addressed. These concerns prompted development of a more comprehensive program to provide options for addressing neighborhood traffic issues and clearly define the implementation process. This handbook explains the Neighborhood Traffic Management Program.

Citizen Involvement

Encinitas citizens have first-hand knowledge and experience of traffic patterns and concerns in their neighborhoods. Every resident was invited to provide input to help identify key elements of the neighborhood traffic program. Several hundred citizens attended workshops to contribute their insights and suggestions during early stages of program development. Many more provided comments via email and letters. This input helped shape a program that provides citizens with information and tools to help them collaborate with the City to manage neighborhood traffic efficiently and effectively.

Hundreds of Encinitas residents participated in two workshops to provide input for this program.

1.1 How to Use the Handbook

The handbook is divided into 6 sections. Sections 1.0 and 2.0 provide an overview of the neighborhood traffic management program that will be useful for all readers.

Section 3.0 describes the process that is followed to initiate, design, and implement a neighborhood traffic management plan. It includes a flow chart that visually illustrates the steps required to complete the process. This section will be useful for all readers.

Section 4.0, Toolbox, explains different techniques that can be used alone or in combination with other tools to manage neighborhood traffic. This section is vitally important to the program and useful to all readers, but training to help residents understand this section will be incorporated into the first two neighborhood meetings associated with initiating a Neighborhood Traffic Calming Plan process. Residents may find the summary in the chart on page 28 a useful tool for selecting which treatments they would like to study more closely.

Sections 5.0 and 6.0 are oriented to the designer who will assist residents with the development of their neighborhood traffic management plan. These sections discuss many of the elements the designer must consider before preparing preliminary plans.

2.0 Neighborhood Traffic Management: Program Overview

Mission Statement: Develop and oversee a program that will encourage vehicles to use circulation element streets; reduce impact of vehicular traffic in neighborhoods; and improve pedestrian, bicyclist and equestrian safety within and around the City of Encinitas. Adopted by the Traffic Commission, December, 2001

2.1 Program Purpose

The purpose of managing neighborhood traffic flow and speed is to enhance safety and preserve community character in Encinitas neighborhoods. An expanded plan to manage neighborhood traffic has become necessary for those residential areas experiencing more traffic and excessive speeds.

Concerns about increasing traffic and speeds are prevalent throughout the United States. Americans are driving more than ever. Commute distances are longer and the number of trips they take are increasing. A typical single family detached home in the San Diego area generates 10 daily trips. Estate homes generate 12 trips per day. This means that even residents in areas with little traffic from outside their neighborhood may notice a substantial number of vehicles passing by their home every day.

In some neighborhoods, the street pattern may create short-cuts that attract drivers who are trying to avoid congested areas. Their short-cuts are referred to as cut-through routes. Some Encinitas residents feel their neighborhoods are experiencing cut-through traffic that has created excessively high *traffic volumes* on their streets.

In addition to concerns about traffic volume, many residents are concerned about traffic *speed.* Most Encinitas residential streets are posted for maximum speeds of 25 mph. Unfortunately, signs don't guarantee compliance. Many factors influence a driver's selection of travel speed. For example, the width and length of a street affects the driver's sense of what is an appropriate speed for the environment. The number of people visible, amount of landscaping, weather conditions, number of cars parked, and many other factors are quickly processed by the driver's mind to select a speed. The driver's temperament, trip

"Make street environments that are safe, efficient, and pleasant for all transportation system users—pedestrians, bicyclists, automobiles, skateboarders, horseback riders, transit, etc. It should create integrated systems that fit into the environment." Citizen Statement, March, 2003

purpose, and time schedule are other considerations. The result is that many drivers do not adhere to the posted speed limit.

Balance User Needs

Citizens who provided input to help develop this program emphasized balancing the needs of all who share Encinitas streets. The sample statement in the box on the previous page reflects the perspective of many citizens. They expressed their desire for living in areas that are friendly, neighborly, and have a sense of community. They wanted safe, peaceful neighborhoods and identified low traffic volume and low speeds as a major determinate of quality of life in Encinitas.

Most California citizens also place a high value on quick and easy motorized access to streets that carry them to work, school, highways and freeways, or other destinations. It is important to recognize the need for adequate, moderate speed collector streets to meet this need.

The Neighborhood Traffic Management Program seeks to reconcile the desire for quick and efficient mobility and that for quiet, low-speed streets by designing a street environment that functions well for people inside vehicles as well as for those who are not inside a vehicle.

The first step in this process is to design pedestrian-friendly neighborhood streets. In a pedestrian-friendly environment, people feel safe walking, the environment is comfortable, access to destinations is convenient, and they understand where they are and how to get where they want to go. Children and others who do not drive autos are less reliant on others for their transportation in pedestrian-friendly areas. Some workshop participants suggested that creating more pedestrian-friendly areas could help reduce the number of daily trips made to and from Encinitas households.

Bicyclists, skaters, and others using various types of non-motorized wheeled devices also share streets with motorized vehicles and pedestrians. Whether for play or for transportation, these street uses are permitted and will be considered during the process of developing neighborhood traffic management schemes.

Traffic management must also address the needs of those inside motorized vehicles. This program strives to provide convenient, efficient routes of travel for motorized vehicles. It also addresses the needs of those who provide various neighborhood services, including the occasional moving van, garbage service, and emergency service providers.

Community Character

Street design has a profound impact on the appearance of neighborhoods and the functioning of a community. Wide, sterile streets with limited landscaping encourage faster speeds and are less desirable places to live. Many of the tools in the traffic management program have the potential to enhance community character with added landscaping, reduced asphalt area, or more defined and orderly parking spaces. Many residents value the character of rural-style streets that have no curbs or gutter, but without proper treatments these streets sometimes encourage higher speeds.

2.2 Traffic Management Areas

Designing one street to slow or limit traffic can impact residents and traffic on parallel streets or other streets in the vicinity. For this reason, the Encinitas program approaches traffic management from a neighborhood perspective, rather than a street-by-street program.

For purposes of this program, neighborhoods will be defined primarily by existing boundaries such as freeways, major roads, beaches, rivers, creeks, or railroad tracks. For example, one traffic management neighborhood near the ocean might be bounded by N. Coast Highway 101, the beach, and streets such as La Costa Avenue, Leucadia Boulevard or Encinitas Blvd. Another is bounded by I-5, N. Coast Highway 101 and the same cross streets mentioned previously. Traffic management areas east of I-5 are challenging to define because development patterns vary and often include many cul-de-sac and curvilinear streets.

The optimum neighborhood size for effective traffic management outreach, public involvement, and construction is one square mile. In neighborhoods that exceed this size, collector streets or other features will be used to sub-divide the neighborhood into smaller segments. Ideally, traffic management area boundaries will define areas where neighbors share a sense of place and will work collaboratively to develop a traffic plan that enjoys broad neighborhood support.

Neighborhood boundaries will be defined by staff with input from citizens.

2.3 Techniques

There are many techniques, or tools, available for managing neighborhood traffic. These include traditional signs and markings, enforcement, education, and traffic calming treatments. A variety of tools are included in this program to allow Encinitas residents and staff many alternatives when developing a traffic management plan.

Traffic control devices include stop signs, traffic signals, speed limit and other signs, and street markings. These traffic control devices require enforcement to achieve driver compliance. Education is often used to encourage voluntary compliance and understanding of the devices.

Traffic calming treatments are changes in the street used to reduce the ability of drivers to travel at high speeds and to limit access to certain streets. This is accomplished by using one or more treatment alternatives to create a street environment that either requires drivers to steer over or around a street feature, or to take an alternative route. Other elements such as painting stripes on the street, landscaping and signing do not force a change in driver behavior, but they provide visual elements that may prompt people to drive more slowly.

The tools available to manage traffic in neighborhoods are discussed in detail in Section 4.0 beginning on page 21.

2.4 Street Types

Tool selection will be influenced by the nature of the neighborhood street and sidewalk system and by objectives established by

residents. Streets and sidewalks provide a network of routes that allow access to destinations via foot, bicycle, or motorized vehicles. Some Encinitas streets are primary routes to commerce, nearby freeways, and work or activity centers. The Neighborhood Traffic Management Program was developed to address neighborhood streets that primarily serve residential areas. Many of the options for neighborhood streets are not appropriate for larger, primary routes. Criteria and standards for these larger routes are addressed in the City's Circulation Element.

Typical rural-style residential street in Encinitas.

Rural-style Streets

There are many two lane undivided rural-style streets in neighborhoods throughout Encinitas. These paved streets are generally about 24 feet wide and do not have curbs, gutters, or sidewalks. As shown in the photo of a typical rural-style residential street, people walking in these areas are forced into the vehicle travel lanes. Many rural-style streets are winding, hilly streets that limit the ability of drivers to see people, animals, parked cars, or other objects within adequate braking distance. In some areas vegetation at street edges limit driver visibility. Rural-style streets send a message to drivers that the area is rural and it is appropriate to drive fast.

Cars parked on unimproved shoulders in front of homes line both sides of some Encinitas streets. Drivers often park several feet further from the street edge than they would on a street with curbs. In effect, this widens the usable roadway and allows faster speeds, especially around corners. Drivers are able to maintain higher speeds around corners because they can drive on the shoulder.

Some people feel the lack of curbs, gutters, and sidewalks creates a rural environment that would be lost if curbs and gutters were installed. It is harder to manage traffic on streets that do not have curbs and gutters because drivers can maneuver around many traffic calming measures. It is possible to install steel posts or other solid objects to prevent this action, but these objects are often ugly.

Another option is to install curbs and gutters that define a narrow street. As shown in some of the images on pages 10 and 11, streets with curbs, gutters, and sidewalks can have a natural feel if they are narrow and well-landscaped. These streets provide a better balance between user needs than rural-style streets that do not have curbs.

Suburban-style Streets

Suburban-style streets are paved and have curb and gutter. Suburban streets usually include sidewalks. Many have planter strips between the travel lane and sidewalk. They provide the safest and most comfortable

environment for all users when they are only 24 feet wide, with on-street parking encouraged. As shown in the photo on the right, some existing suburban-style streets in Encinitas do not have sidewalks. Parents are reluctant to let their children walk in the street because they are exposed to passing vehicles. To optimize safety, new streets and streets that are reconstructed should include sidewalks or other pedestrian paths and planter strips on both sides where feasible. See Section 2.5, Sidewalks and Crossing for additional information.

Suburban streets in Encinitas include some with sidewalks, as shown below, and some with curbs and gutters, but no sidewalks, as shown above.

Street Classifications

Both rural and suburban-style streets in Encinitas are classified by their function. Classifications include local, collector and arterial streets. These classifications are a consideration when selecting traffic calming measures or traffic control devices most appropriate for the street.

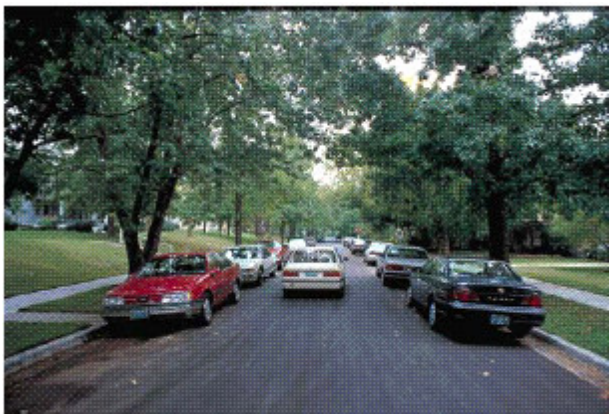
Local Streets

Local streets primarily serve as access to residences. Existing local, or residential, streets in Encinitas vary in paved width from 18 to 50 feet.

Local streets such as the one above primary provide access to residences.

Collector Streets

Collector streets provide connections between arterial streets and local streets. The Encinitas Circulation Element designates which streets are collector streets based upon the need to provide a network that allows motorists to access arterials and freeways. Development patterns play a major role in determining which streets are designated as collector streets. In neighborhoods with many connecting streets,



Example narrow local street with sidewalks, planter strips, and on-street parking.

traffic tends to be distributed evenly on each street throughout the street system. Neighborhoods with cul-de-sacs and loop streets concentrate traffic onto a few collector streets. Wide collector streets can create a barrier to pedestrian and bicycle movements across a neighborhood. Vehicle speeds are generally higher on wide streets.

Arterial Streets

Arterial streets provide long distance travel routes across and between cities. They are usually 4 to 6 lanes wide and often include medians, planter strips, and sidewalks. Arterial streets are designed to handle more traffic than is normally expected on local and collector streets.

Typical two-lane collector street in Encinitas.

Typical three-lane collector street in Encinitas.

2.5 Sidewalks and Crossings

One of the objectives of neighborhood traffic management is to create more pedestrian-friendly neighborhoods. Sidewalks and defined pathways are essential features of a safe walking environment. Walking in the street because there are no sidewalks may feel safe and comfortable to a normal, healthy adult if traffic volume and speed is low, but it presents a hazard to children, people in wheelchairs, those with visual or hearing impairments, and those who may be slower to see and react to the presence of a vehicle. Crash data from across the U.S. clearly indicates there is a higher probability of injury when walking in areas with no sidewalks. These are random events that happen seldom, but can have tragic outcomes. For Encinitas to become pedestrian-friendly, sidewalks or defined pedestrian paths are needed on both sides of streets where

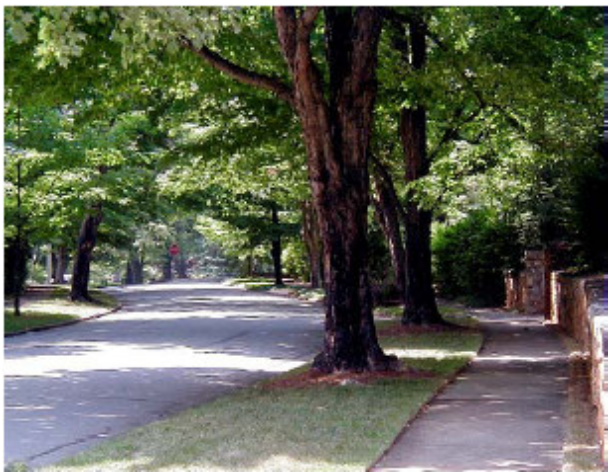
The City of Encinitas allows sidewalk and pathway materials such as decomposed granite to complement the character of a neighborhood. Applicable standards must be followed.

children play or walk to school and where friends and neighbors walk and socialize. Sidewalks can be attached to the curb, as shown in the image on the right, or separated from traffic with a planter strip, as shown in the lower photo. The planter strips provides space for landscaping and separates walkers from moving traffic. Natural or decomposed granite walkways are also appropriate in some areas.

The Encinitas Recreational Trails Master Plan contains a map of a citywide trail system and guidelines for materials and trail locations. Hard and soft surface paths are identified in the plan, as well as sidewalk connections within the trail system. Traffic management plans must be compliant with the Plan and City sidewalk standards.

Ease in crossing the street is also a key factor in designing a pedestrian and bicycle-friendly environment. The Traffic Calming Treatments section of the Toolbox includes features that can be used to minimize the length of time a pedestrian is in the street. Short crossing distances and slower vehicle speeds contribute to the comfort and security of people crossing the street.

Typical suburban local or collector street with sidewalks attached to the curb. This street is 40' wide from curb-to-curb.



Narrow, suburban local or collector street with sidewalks separated from traffic by a planter strip.

2.6 Bikeways

Bicyclists also share Encinitas streets. Their needs and concerns are important and must be considered during the development of neighborhood traffic plans. Two types of bikeway facilities that should be considered when preparing Neighborhood Traffic Management plans are described below. The City's Master Bikeway Plan should also be consulted.

Bike Paths (Multi-Use Trails)

Paths and trails that are separated from streets can provide a quiet, comfortable bicycling and walking environment. Multi-use trails add value to adjacent properties and can often provide short-cuts that link together areas that are less accessible to motorized vehicles. Trails are problematic when they parallel streets in areas with many driveways and cross streets because there is a potential

conflict at each driveway and intersection. For this reason, multi-use trails are best when located in corridors away from streets. On-street bicycle facilities may be more practical when routes are adjacent to a street.

Bike Lanes

Bike lanes are designated areas in the street adjacent to the vehicle travel lane. They are included as a tool in the traffic calming treatments because adding bike lanes to existing streets will help reduce lane widths, which contributes to slower speeds. Bike lanes in neighborhoods are most applicable on collector and residential streets carrying more than 1,500 vehicles per day.

2.7 Street Network

Street networks can have enormous impacts on traffic volumes in residential streets.

An interconnected street network either the historic grid network or an interconnected network of curved roads produce the lowest traffic volumes on any one street and on the arterial road network. These street networks minimize service costs, provide the highest level of accessibility to emergency vehicles, and produce the lowest number of internal trips because so many trips can be done be walking or bicycling.

Cul-de-sac style development with single entrances produce very light traffic volumes on the tops of cul-de-sac and very high volumes where the cul-de-sac development connects to the arterial road. Therefore, there is a huge disparity of traffic volumes for people living within this style of development. Because they are typified by single connections to aerial roads, they generate much higher traffic volume on arterial roads and greatly increase turning movement at major intersections.

These types of developments also generate a higher number of internal trips because of limited mobility for pedestrians and bicyclist within the development.

Because of people's fears and lack of knowledge of how to calm traffic, interconnections between neighborhoods are fought and often prevented. The results are longer travel distances affecting more people within their neighborhood, lowered emergency response times and higher service costs.

Therefore, to minimize emergency response times, service costs and the number and length of trips a well-interconnected street system is the long-term goal.

Identification and construction of the "missing links" within the existing street network as traffic calmed link is another goal to reduce emergency response times, trip lengths and the number of trips.

2.8 Private Roads

Many private roads have been constructed and more are likely to be constructed. If residents on these streets wish to implement traffic calming, they are encouraged to follow an abbreviated version of the process described in this Manual and their Covenant, Conditions and Restrictions. Funding will be at the cost of the Homeowners Association with the review and approval of the City.

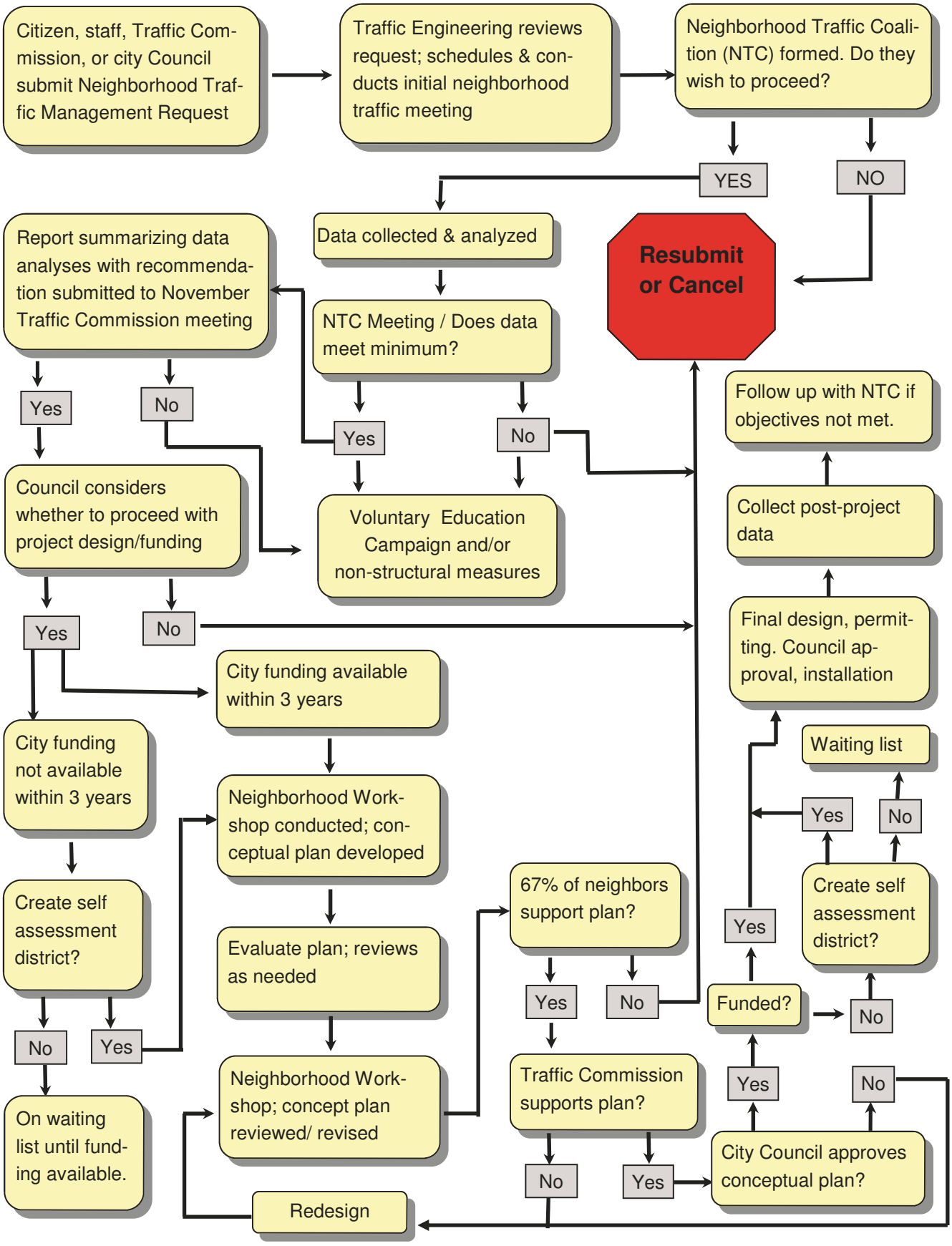
2.9 Removal and Modification to existing treatments

Over time the traffic pattern changes, the range of treatments widens, the mix of residents along a street changes and therefore a review of past traffic management projects become desirable. A review may be initiated by the residents, or the City. A review would consider the initial conditions, changes, reasons for the change, and a review to see if the change is warranted.

If warranted, a public workshop of the affected residents is held to consider the change, the data and if there is consensus, the change could be implemented and funded by the initialing body.

Project Development Process

Figure 1



3.0 Process

This section describes the process to develop and implement a neighborhood traffic management plan. The chart on page 14 illustrates the steps in the overall process. Each step is described in detail below.

3.1 Neighborhood Traffic Management Request

The process to develop a traffic management plan for any neighborhood can be initiated by residents, staff, City Council, or by a vote of the Traffic Commission.

A *Neighborhood Traffic Management Request* must be completed, signed by ten residents, and filed with the Engineering Department. The request provides preliminary information regarding the nature and location of the traffic concern. This will provide staff with information needed to conduct a field review to prepare for the preliminary neighborhood meeting.

A request can be filed at any time, but it must be received by October 1 to be considered for inclusion on the ranked list that will be developed and submitted to the Traffic Commission during November of each year.

Residents from ten different households on at least four streets in the neighborhood must agree to attend an initial meeting to learn more about neighborhood traffic management and how it can be implemented. This core group should be willing to assist the City in efforts to encourage all residents in the neighborhood to participate if a traffic management plan is developed. They will be referred to as the *Neighborhood Traffic Coalition (NTC)*, and serve as the liaison between City staff and other residents. One resident or the party filing the request must commit to host an initial meeting of 1-1/2 to 2 hours. If a plan is prepared, this group will be a key resource in explaining details to neighbors who did not attend meetings and in gaining their support for the project.

3.2 Initial Neighborhood Traffic Meeting

After reviewing the Neighborhood Traffic Management Request and affected area, City staff will contact the Host to schedule the initial meeting. This process may take up to 90 days.

The Host is to invite the ten signatories and other interested people to the initial meeting. The agenda will include:

Host: Welcome, Introductions, and Overview of Concerns

Staff: Traffic Management Presentation explaining the program purpose, proposed neighborhood boundaries, procedures, funding options, and possible outcomes. Staff will explain when and how enforcement, signs, or other preliminary steps are feasible. Staff will respond to questions and work with residents to explore their options.

If the residents who attend the meeting represent at least 4 streets within the neighborhood and they agree to take on the role of the NTC supporting development of a neighborhood traffic plan, staff will schedule data collection for the area.

3.3 Data Collection

Data is collected to determine the magnitude of the traffic concerns in comparison to other neighborhoods requesting traffic management. Some data elements will be used to rank project priorities. If a project is implemented, data can be compared to conditions after implementation to measure success. Data collection will vary based on input provided by citizens during the preliminary neighborhood meeting. Data elements could include:

1. Speed. Speeds are recorded to quantify how many drivers exceed the speed limit. Engineers use the term, *85th percentile*, to describe the speed at or below which 85 percent of the motorists on a street travel as they pass the measuring device.

2. Cut-Through Volume. The number of vehicles that enter a neighborhood, travel through, and leave without accessing neighborhood sites.

3. Truck volumes. A truck volume count may be conducted to determine if trucks are cutting through a neighborhood.

4. Origination and destination surveys. These surveys collect data to determine the number of vehicles that are cutting through a neighborhood. To collect this information, a person is stationed at the neighborhood entry point and another is stationed at the neighborhood exit point. The type, color, license number, direction of entry and time of day each vehicle enters the neighborhood is recorded. The person at the exit point notes the same information for each exiting vehicle. This information is compiled and compared. When two vehicle details match, the entry and exit times are evaluated to see if that vehicle entered and left the neighborhood within the normal travel time plus 2 minutes. The goal is to separate through traffic from traffic entering a neighborhood to pickup or drop off people or goods.

5. Crash information. Crash records from the Sheriff's Office will be used to determine the number and type of crashes that have occurred with the neighborhood within the last three years.

6. Pedestrian Generators. Schools, parks, community centers, public facilities, or other destinations that attract pedestrians will be counted to provide information for data in Figure 2 on the following page.

7. Pedestrian counts. The number of pedestrians at a selected site(s) during a specific period of time may be counted to verify pedestrian destinations.

8. Pedestrian surveys. Observational surveys can identify where pedestrian crossings are needed and where potential conflicts exist. These may be particularly appropriate for areas near schools, playgrounds, sports complexes, or other activity areas.

9. Sidewalks and pathways. Streets within the neighborhood will be assessed to determine where sidewalks or pathways are in place to provide information for data in Figure 2 on the following page.

10. Bicyclist counts. The number of bicyclists at a selected site(s) during a specific period of time may be counted.

Data collected will be compiled by City staff.

Figure 2. Data Element Values

Data Element	Points	Basis for Points
Speed	0 to 30	Extent that 85th percentile* speeds exceed speed limit; 2 points assigned for every 1 mph over speed limit
Cut-Through Volume	0 to 25	1 point for every 5 vehicles that cut-through the neighborhood during the AM or PM peak hour on an average day
Crashes	0 to 15	1 point for every nonfatal crash and 5 points for every fatal crash recorded by the Sheriff's Department in the last 3 years
Pedestrian Generators	0 to 20	5 points for every school, park, community center, library, or other public facility within the impact area
Sidewalks or pathways	0 to 10	5 points if there are not continuous sidewalks or pathways on one side of all local residential streets or both sides of all collectors; 10 points if there are no sidewalks
Total Points Possible	100	

** The 85th percentile speed is the speed at or below which 85 percent of the vehicles travel.*

Figure 2 above shows how a value is assigned to each data element. When data such as speed and volume is gathered at more than one location within a neighborhood, points will be assigned for each location and then averaged to ensure equitable comparisons.

3.4 Follow up Meeting

The NTC will host a follow up meeting at which data gathered will be presented by staff. A total score of 51 points is required for the neighborhood to qualify for traffic calming treatments. All neighborhoods qualify for resident-based educational campaigns and signs or other nonstructural traffic safety upgrades. Education campaigns will be supplemented by enforcement as resources permit. See section 4.2 for additional information.

Figure 3. Other Factors in Project Selection

- Scheduled street or utility work
- Other construction projects
- Other engineering considerations
- Fire Department priorities
- Sheriff's Department priorities
- Consistency with the General Plan
- Consistency with the Bikeway Master Plan
- Consistency with the Recreational Trails Plan
- Consistency with other adopted City plans

The City Engineer will forward all Neighborhood Traffic Management Requests, compiled data, meeting results, and a staff recommendation to the Traffic Commission, with copies to the Neighborhood Traffic

Coalition contact member. The Traffic Commission will review staff recommendations and provide a ranked listed of projects to City Council for approval.

3.5 Preliminary Project Evaluation/Recommendation

There are many neighborhoods in Encinitas that may want to participate in the Neighborhood Traffic Management Program. A ranked list of the neighborhood by total number of averaged points received will be prepared.

Figure 3 on the previous page lists factors that will influence the priority assigned to each neighborhood in addition to the data score. These factors must be evaluated by staff to ensure that resources are expended efficiently. For example, if a project is ranked first, but the street is scheduled for reconstruction soon, it is more cost effective and efficient to delay the project to coincide with other construction. Other situations such as development plans or public safety may influence priorities. Staff will prepare a recommendation that includes a full explanation of all factors considered for the November meeting of the Traffic Commission.

3.6 Council Consideration

The City Council will consider the Traffic Commission recommendation at their annual goal-setting meeting in January. Based on direction from this meeting, staff will present formal reports, project priorities, and recommendations with funding options to the Council in late February or March. Approved projects for which funding is available within three years will be scheduled for a Neighborhood Workshop as described in 3.8. Citizens in neighborhoods that are not funded within three years may elect to establish an assessment district as described in 3.7.

A neighborhood workshop will provide an opportunity for citizens to identify problems, establish objectives, learn about potential solutions, and work together to create a conceptual traffic plan.

3.7 Assessment District

If a project does not score 51 points or is ranked lower than other projects included in the City funded work plan, funding and construction will be unavailable within 3 years. The Neighborhood Traffic Coalition may poll residents to determine if they are willing to create a self-assessment district. If 67% of property owners within the neighborhood sign a covenant agreeing not to oppose an assessment district, the Neighborhood Traffic Coalition may request that the project be included in the Neighborhood Traffic Management work plan.

Staff will provide a range of likely project costs for use in determining if an assessment district covenant is an acceptable alternative. Final costs are dependent upon the plan developed.

The self-assessment district will be formed after residents develop and approve their traffic management plan. The self-assessment district will distribute project design and implementation costs fairly among all residents within neighborhood boundaries. Refer to the City's Assessment District Policy for additional information.

Another alternative is for the neighborhood to post a cash deposit to cover estimated expenses associated with conceptual plan development.

3.8 Neighborhood Workshop

The Neighborhood Traffic Coalition for each area included in the annual Neighborhood Traffic Management Program work will be contacted to help coordinate a neighborhood workshop after funding has been identified and at other points during the process. Workshops will be open to all residents who could be impacted by the traffic management plan. Coalition members will play a key role in encouraging their neighbors to participate. Sheriff's and Fire Departments will be part of the process to provide input about problems, such as crashes, enforcement, and emergency vehicle routes.

The first of these workshops will provide an opportunity for residents to identify concerns, establish objectives, learn about potential solutions, and develop a conceptual plan with the guidance of a trained professional. This meeting allows neighbors to discuss their individual preferences, explore consequences, settle any differences of opinion, and reach consensus.

3.9 Plan Evaluation/Review

The conceptual plan developed during the first neighborhood workshop reflects the advice and wishes of the neighborhood. Their concepts must undergo an engineering evaluation to refine the ideas, ensure that the measures proposed by the community are appropriate for the locations selected and objectives defined, and regulatory requirements can be met. The Sheriff's Department, Fire Department, and other City or regulatory entities will be included in the plan review as required. When necessary, staff may recommend a different treatment or placement.

It is the policy of the City to require traffic management treatments to be aesthetically pleasing and consistent with the character of the community for which they are designed. The Department will not recommend approval of plans which fail to meet this criteria.

3.10 Follow-up Neighborhood Workshop

After the review a preliminary layout will be prepared and presented at a follow-up neighborhood workshop. Once again the Neighborhood Traffic Coalition will be called upon to encourage neighbors to attend the workshop and provide feedback on the preliminary layout. The preliminary layout may include one or more alternatives. The goal of this meeting is to achieve consensus that the layout is acceptable to the neighborhood. Reaching agreement could require compromises or changes in the preliminary layout. If agreement cannot be reached during the meeting, a follow-up meeting will be scheduled where revised layouts will be

presented. After this meeting a cost estimate will be prepared.

3.11 Obtain Signatures

The Neighborhood Traffic Coalition is charged with the responsibility of obtaining the written support of 67% of the property owners within the neighborhood boundary for the proposed plan and for a covenant not to oppose a Lighting and Landscaping Sub District (LLD) to maintain the facilities once they are constructed.

3.12 Approval/Funding

After the signatures have been gathered and verified, the preliminary plan will be presented for final approval and funding. The approval process includes:

1. The Traffic Commission considers the plan. If they approve it, the plan moves to the Council. If they do not approve the plan, staff will schedule an additional workshop for the neighborhood to revise the plan. When a plan is approved by the Traffic Commission, it will be presented to the City Council for final approval and funding

2. The City Council may approve the plan or request the neighborhood revise the plan. If the plan is approved but not funded the neighborhood again has the option of creating a self-assessment district as described in 3.7. If they choose not to select this alternative, the project may be cancelled or moved to the waiting list.

In the event revisions are requested by either entity, staff will collaborate with the NTC to achieve a plan acceptable to all parties.

Projects not approved for any other reasons will be handled on a case-by-case basis.

3.13 Final Design/ Installation

Construction plans will be developed after projects are approved and funded. In some cases, the plans may call for phased implementation, with early strategies that do not require construction.

The Neighborhood Traffic Coalition will assist in the review of construction plans and in development of landscaping plans. Throughout this process, this group may be called upon to participate in discussions with impacted residents, provide input on design issues, and serve as liaison with the neighborhood.

3.14 Review

An essential step in any program is to measure the success. Following implementation of a neighborhood traffic management plan, periodic data collection will be conducted. This data will be compared to pre-project data to determine the effectiveness of the implemented plan. If the data indicates that the objectives defined by the neighborhood are not being met, a follow-up meeting will be conducted with the Neighborhood Traffic Coalition. The outcome of this meeting will determine the next steps.

4.0 Toolbox

Techniques for managing traffic range from passive approaches, such as education, to reconstruction of streets. This section contains a "toolbox" filled with potential solutions for neighborhood traffic concerns.

4.1 Traffic Control Devices

Stop signs, traffic signs, and traffic signals play a role in the management of neighborhood traffic that differs from the role of traffic calming measures. Traffic calming treatments are designed to slow vehicle speeds or divert cut-through traffic. Stop signs, traffic signs, and signals manage pedestrian, bicycle, and motorized vehicle traffic at a variety of speeds in diverse conditions. These devices, along with pavement markings, are regulated by Caltrans and by the Federal Department of Transportation to ensure uniformity throughout the United States. The regulations have evolved since the 1930's as a method to provide uniform information to all users of the roadway.

Residents often request installation of various signs to address speeding and cut-through concerns in their neighborhoods. The conditions under which these signs are used are discussed below.

Stop Signs

Stop signs are used at unsignalized intersections where right-of-way must be regulated because of speeds, crash problems, or restricted driver views. The Manual on Uniform Traffic Control Devices (MUTCD), the document defining Federal requirements for traffic control devices, states that stop signs should not be used for speed control. It further states that they should be installed in a manner that minimizes the number of vehicles that must stop. When a stop sign is used, MUTCD specifies that it should be installed on the street carrying the lowest volume of traffic. Multi-way stops, in which traffic from all directions must stop, can be installed as mitigation for crashes or to manage vehicular, pedestrian and bicycle traffic that has reached minimum volumes specified by regulating agencies.

Intersection traffic calming treatments are more effective than stop signs in controlling speeds, reducing intersection conflicts, and maintaining a smooth flow of traffic. Residents who provided input during the development of the program envisioned replacing many existing neighborhood stop signs with small roundabouts or traffic calming circles. There may be instances where stop signs are needed either as a temporary control until a traffic calming treatment can be installed, or as a permanent installation. Residents will be encouraged to explore all other possible solutions before providing their recommendation.

Traffic Signals

Traffic signals are used at intersections that meet conditions established in the MUTCD. Their purpose is to assign right-of-way and provide for the orderly movement of traffic. They are sometimes used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross. Poorly conceived or unjustified traffic signals can

create excessive delay, contribute to red light running or other violations, cause diversion of traffic onto less adequate routes that have fewer stops, increase liability, and increase the frequency of collisions.

Traffic signals can also help to create a cut-through route through several neighborhoods by providing easy access into and out of neighborhoods. Installation of traffic signals at several intersections along a collector street can turn that street into a major thoroughfare. The added traffic impacts residents on the collector street. The installation of signals needs to be carefully regulated to avoid unintended adverse consequences.

Conservative, well-planned use of signals to complement other components of a neighborhood traffic calming plan will be considered during the development of traffic management plans for Encinitas neighborhoods. However, in most cases traffic calming treatments are preferred for controlling intersection movements because of their safety, speed reduction, traffic flow, and capacity benefits.

Other Signs

There are many other regulatory signs that meet national standards and are used to provide information and manage traffic. Speed limit signs display the maximum speed allowed under local ordinances. Unfortunately, most motorists disregard signs, especially on wide, straight streets where they feel comfortable and in control of their vehicle at higher speeds. Flashing beacons are sometimes added to speed limit signs in school zones, but even these may be disregarded unless motorists feel there is a possibility of being cited. Signs that prohibit or limit other actions such as pedestrian crossings, turning movements, and parking may also be disregarded unless accompanied by a change in street design or enforcement. Signs such as Children at Play and Deaf Child do not tell a driver what to do. Where they have been used, they usually fail to affect driver behavior.

The MUTCD recommends conservative use of regulatory and warning signs because signs tend lose their effectiveness if used to excess. Overuse of signs also leads to sign clutter that is aesthetically unappealing.

Temporary signs used to conduct campaigns to reduce speeds or raise awareness are discussed in the following section.

4.2 Education and Enforcement

The education component of the Neighborhood Traffic Management Program features brochures and website information that explain the program, why it is needed, and the steps citizens can take to implement the program in their neighborhood. Residents play a key role in distributing information about the program and in helping their neighbors understand their role in developing and implementing a neighborhood plan.

Education Campaigns

Posted speed limits are the most common form of education aimed at slowing drivers. Unfortunately, experience has demonstrated

that just posting the maximum legal speed does not compel every driver to proceed at that speed. If speed limit signs were completely effective, there would be no need for a traffic calming treatment program.

There are other education approaches designed to encourage drivers to travel at slower speeds. These include printed brochures, radio or television announcements, radar speed trailers (to show drivers their speed as they pass), and programs in which drivers pledge to drive at or below speed limits to "pace" other traffic. Some advocates suggest block parties and front-yard activities to slow traffic. Several commercial enterprises offer non-regulatory signs with slogans that encourage motorists to slow down. An example is the "Keep Kids Alive" sign pictured on the right. No data is available to demonstrate the effectiveness of the these efforts. Citizens in some communities use radar guns to record speeds and report offenders to enforcement agencies. Many of these methods are resource-dependent.

Speed trailers use radar to detect motorist speed. The actual speed is displayed beneath the posted speed limit sign. They are most effective in slowing drivers when used in conjunction with sporadic enforcement, but drivers often return to previous speeds soon after the sign is moved. The photo below shows other signs that are used in Encinitas to encourage drivers to slow down.

Resident Role

As discussed in Section 2, the character and design of streets impact driving speed. Drivers, especially those most familiar with the area, may not notice how fast they are driving. In neighborhoods where most of the traffic is generated by local destinations, an educational campaign administered by residents has the potential to raise driver awareness and result in fewer vehicles exceeding posted speed limits. This type of education campaign is simple and direct. The Neighborhood Traffic Coalition (NTC) could take the lead role in organizing a campaign.

The first step is for concerned residents to voluntarily commit to driving at posted speed limits themselves. Not only does this practice set a good example, it forces drivers behind this vehicle to also obey the speed limit.

An additional step is for concerned residents to distribute copies of the City of Encinitas brochure, *What is Traffic Calming*. The City will provide brochures to the Neighborhood

Traffic Coalition. They may choose to distribute brochures to all residents, or they may prefer to target households where offending drivers reside, visit, or provide services.

Although no empirical evidence exists to demonstrate long-lasting results from this type of educational approach, it is reasonable to expect an improvement, at least temporarily. If residents continue their educational efforts, it may be feasible to sustain educational program impacts.

Enforcement

Even the most successful education campaign cannot be expected to change the practices of every driver, just as installation of a stop sign does not guarantee compliance by every driver. Enforcement is necessary. Traffic calming treatments reduce the need for enforcement by compelling the majority of motorists to slow down to maneuver through geometric changes in the roadway. But even with treatments in place enforcement may still be needed for the occasional driver whose behavior is still unacceptable for conditions. Enforcement resources are limited, although the Sheriff's Department will continue to be responsive to resident concerns to the extend possible. Combining enforcement with a resident-based education program can help maximize these limited resources.

Combined Education and Enforcement

Research conducted by the National Highway Traffic Safety Administration shows that enforcement that targets specific areas and is accompanied by focused education campaigns can boost the effectiveness of traditional enforcement methods. These campaigns often share information about when and where enforcement will be conducted. This approach encourages many drivers to change their driving habits in that area, freeing officers to ticket the few who didn't heed the message. This stepped-up enforcement program may be repeated at random intervals in the same area until drivers change their patterns.

The NTC can conduct a neighborhood-version of combined education and enforcement program by distributing brochures and sharing information that stepped-up enforcement is expected over the coming weeks. The purpose of advising drivers to expect enforcement is to raise their awareness of driving speeds.

Summary

Voluntary education campaigns offer residents an option that can be useful while waiting for development and implementation of a traffic management plan. They also provide an alternative for neighborhoods that do not qualify for traffic calming treatments. In this case, it may be just a few drivers who are causing the problem and an educational program may complete resolve the problem.

4.3 Traffic Calming Treatments

The Traffic Calming Treatments portion of the Toolbox describes physical changes to the street environment that are intended to reduce negative effects of motor vehicle use, alter driver behavior and improve bicycling and walking conditions. Each change is considered a *traffic calming treatment*.

Most treatments achieve results by requiring drivers to go over or around a permanent feature placed in their travel path. This forced maneuver is referred to as *deflection*. Vertical deflection requires a driver to go over something and horizontal deflection requires drivers to go around something. Some treatments create *diversions* that force drivers to alter their route. Some treatments rely upon changing the driver's perception of the street. For example, visually narrowing the street with striping may change the perceived width of the street, prompting drivers to drive more slowly.

Beginning on page 29, each traffic calming treatment is described and illustrated. Appropriate locations, advantages, disadvantages and cost ranges are provided. Selection of the tools to calm a neighborhood requires careful evaluation of the impact the treatment will have on residents, those providing services to residents, visitors, emergency vehicles, bicyclists, pedestrians, and those who are cutting-through the neighborhood.

The Traffic Calming Treatment Selection Guide on page 26 provides guidance for selecting treatments best suited to the street classification, width, number of vehicles, and if the treatment is appropriate on bus or emergency service (EMS) routes. Street classifications are explained in detail on page 10. The Selection Guide and the following pages are provided to help citizens evaluate which traffic calming treatments will meet their objectives as they help develop their Neighborhood Traffic Management Plan.

Unless otherwise noted, all treatments can be expected to reduce vehicle speeds. Their exact impact on speeds will vary based on the treatment, its design, street characteristics, number of vehicles parked on the street, landscaping and other visual elements within the driver's view, and the number of vehicles, bicyclists, and pedestrians using the street.

Many traffic calming treatments can be designed to include landscaping space, which adds visual appeal to the street and improves the visibility of the treatment. The additional cost and maintenance of landscaping could be perceived as a disadvantage by some. The advantages and disadvantages of landscaping are discussed in more detail beginning on page 63, but are not listed individually under each treatment. Traffic calming treatments are divided into the following categories:

- Intersection: Treatments installed where 2 or more streets intersect.
- Non-intersection: Treatments installed between intersections.
- Other: Use of curbs, parking or stripes to reduce the actual or perceived street width

Intersection Treatments

Intersections are the highest conflict areas in the street network, making them a logical location to slow traffic. Traffic calming treatments installed at intersections impact all streets forming the intersection and often provide a visual break in a long stretch of asphalt that contributes to fast speeds. Intersection treatments can improve safety by eliminating unsafe movements, slowing turning and through speeds, improving driver visibility, and shortening pedestrian crossing distances. Vehicles parked close to or at an intersection often restrict driver visibility of approaching vehicles. Many intersection treatments overcome this by physically preventing parking. Treatments often increase sidewalk space and enhance visual appeal with added landscape area.

The needs of large vehicles, including fire trucks, moving vans, transit, school buses, garbage and deliver trucks must be considered when intersection treatments are selected. For example, a treatment that slows right turning vehicles will also slow the right turns of emergency medical service (EMS) routes.

Four intersection treatments are grouped as a subcategory entitled *Diverters*. Diverters restrict entry and/or exit routes and create circuitous routes for residents and emergency providers, which increases volumes on other streets. Neighbors working together to select treatments must consider how a diverter will impact traffic flow on other streets, as well as their own travel routes. Diverters of any type are less desirable than other intersection treatments and should be used sparingly, if at all. Cut-through traffic can be discouraged with other treatments that are less restrictive.

Non-intersection Treatments

The traffic calming treatments in this section are used between intersections, usually at intervals of 400-800 feet. They may be placed in addition to intersection treatments. Careful selection of the treatment and its location is needed to minimize inconvenience to adjacent properties.

Other Treatments

Several treatments to streets that do not create horizontal or vertical deflection can have some impact on vehicle speeds. These methods all involve changing the actual or perceived width of the street. Like other treatments, their impact will vary based on street characteristics and use. In general, treatments in this category will not produce behavioral changes comparable to those achieved by diverting traffic or requiring drivers to maneuver over or around a traffic calming treatment.

Treatment Costs

Preliminary cost ranges are provided for many treatments in the program. The number of treatments per project, drainage, street characteristics, and many other factors influence cost. The estimates were calculated for a standard design on a typical street, then varied plus or minus 20 percent. These estimates provide some budgeting guidance for planning purposes. More precise costs can be calculated after the neighborhood plan is developed.

Treatment Selection

The traffic calming treatments on the

following pages were selected for inclusion in the program based on input from citizens during workshops.

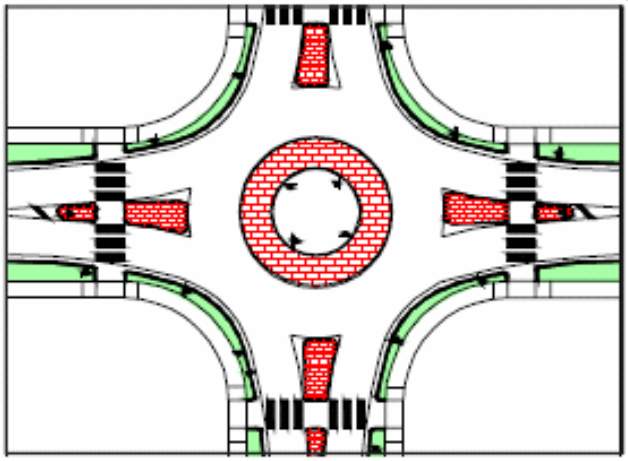
Some guidance is provided for use in evaluating treatments, but there is no formula for selecting the perfect treatment or combination of treatments. Residents must study their options, discuss the advantages and disadvantages of various treatments, and work with staff and each other to select treatments that best meet neighborhood and citywide traffic management objectives.

Traffic Calming Treatment Selection Guide

Measure	Street Width and Classification					Other Considerations		Page
	Under 26"	Over 26'	Local	Collector	Arterial	Maximum Daily Traffic Volume	EMS/ Bus Route	
INTERSECTION								
Roundabout		●	●	●	●			29
Traffic Calming Circle	●		●			5,000		31
Modified Tee Intersection	●	●	●	●				32
Intersection Table	●	●	●	●		7,500	No	33
Modified Intersection/realignment	●	●	●	●	●			34
Curb Radius Reduction	●	●	●	●	●			35
Curb Extensions/Bulb outs		●	●	●	●			36
Short Intersection Median		●	●	●				37
Gateway Treatment		●	●	●				38
Diverters								
Partial Closure	●	●	●	●			No	39
Median Barrier	●	●	●	●			No	40
Diagonal Closure	●	●	●				No	41
Street Closure	●	●	●				No	42
NON-INTERSECTION								
Oval Median		●	●	●				43
Raised Pedestrian Refuge		●	●	●				52
Short Medians		●	●	●	●			51
Median on Curve		●	●	●	●			46
Median with Tree Wells		●	●	●				45
Angled Slow Points		●	●	●		1,000 (one-lane)		48
Chicane	●		●			3,000	No	44
Driveway Link	●	●	●			3,000	No	47
Speed Hump	●		●			3,000	No	49
Speed Table	●	●	●	●		5,000	No	50
Woonerf	●		●			3,000	No	53
OTHER								
Street Narrowing - Add Curbs		●	●	●	●	20,000		54
Centerlines	●	●	●			5,000		55
Bike Lanes		●		●	●	1,500		56
On Street Parking	●	●	●	●	●			57

Roundabout

Roundabouts are circular intersections with channelized approaches. Entering traffic must yield to circulating traffic. Pedestrian crosswalks are marked one car-length from the entry and exit points. Roundabouts used in the traffic calming program will be designed for a single lane of traffic on each leg. These roundabouts will vary in size, depending upon the number, type and size of vehicles that will use them. All roundabouts are substantially smaller than large traffic circles often seen on the east coast. Traffic circles give priority to entering traffic and often use signals to control entering traffic. Unlike roundabouts, large traffic circles often operate at high speeds. Encinitas roundabouts will be designed for traffic speeds between 15 and 20 mph.



This illustration of a single-lane roundabout represents a typical design for a neighborhood street.

Street grades can impact roundabout design. Techniques such as providing different grades on the high and low sides of the roundabout and different elevations on each side of the central island can be used to minimize the impact of street grades.

Roundabouts vary in size depending upon street characteristics, traffic volume, and other factors. The roundabouts above and below are both in Fort Pierce, Florida.

Locations

- Streets over 26’ wide
- Local, collector and arterial streets
- Intersections with 3 to 8 intersecting streets and adequate right-of-way
- At sites where a small roundabout would fit, but garbage trucks, school buses, or other large trucks must turn, four options can be considered:

  - Locate roundabout at intersection before or after the one where large vehicles have to turn
  - Reroute large vehicles to another intersection
  - Add a truck apron
  - Use a raised intersection table instead of a roundabout

Roundabout

Advantages

- Reduces number and severity of crashes compared to two-way and four-way stop control and traffic signals
- Simplifies intersections with more than three intersecting streets
- Reduces vehicle delay and queues
- Reduces pedestrian delay
- Shortens pedestrian crossings
- Reduces pedestrian/vehicle conflict points
- Allows pedestrians to cross one lane of traffic, wait in the refuge area for a gap in traffic, then proceed
- Increases likelihood of driver yielding to pedestrians
- Eliminates conflicts between pedestrians and motorists when walk and green signals are provided simultaneously
- Increases intersection capacity
- Signal power and maintenance costs are eliminated
- Useful life of a roundabout is approximately 2.5 greater than that of a signal system [(1)]
- Eliminates driver confusion during power outages
- Slows vehicles, including emergency vehicles, without requiring them to stop unless other vehicles or pedestrians are present
- Emergency vehicles are not faced with through vehicles unexpectedly running the signal and hitting them at high speed. [(2)]

Disadvantages

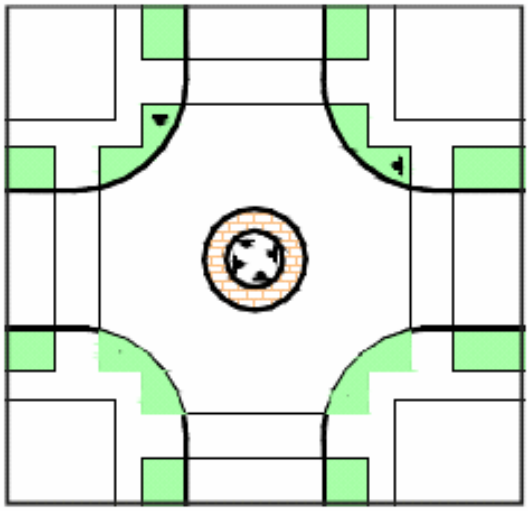
- May require additional right-of-way
- May restrict some turns by larger vehicles
- Some visually impaired pedestrians who are not trained to use roundabouts may prefer signalized intersections
- Pedestrian walk routes are more circuitous than a standard intersection
- Some on-street parking spaces may be lost

Estimated Cost:

$130,000 to $200,000

Crosswalks are located approximately one car length from the yield line at roundabouts.

Traffic calming circles consist of a raised island located in the center of an unsignalized intersection. Drivers maneuver around the central island rather than proceeding straight. Large vehicles are permitted to turn left in front of the circle. Seattle, Washington, reports intersection crash reductions of 93% following installation of these treatments. Traffic calming circles can be converted to small roundabouts by adding painted or concrete splitter islands and roundabout signing and markings. Traffic calming circles can replace two and four way stop controls on local streets.



A raised island placed in the intersection creates a traffic calming circle. Most vehicles travel around the circle as they would in a roundabout. Large vehicles such as fire trucks or moving vans are permitted to turn left in front of the circle.

Locations

- Local streets under 26' wide, with less than 5,000 vehicles per day
- Intersections with 4 streets that intersect at 90-degree angles

Advantages

- Reduced vehicle crashes compared to stop signs
- Slows vehicles, including emergency vehicles, without requiring them to stop unless other vehicles or pedestrians are present
- Landscaping reduces appearance of a long stretch of asphalt

Estimated Cost:

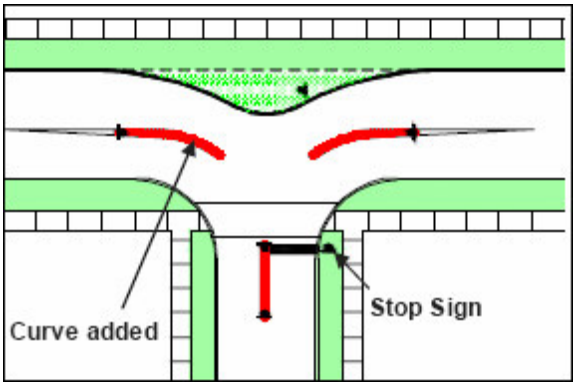
$12,000 to $18,000

Disadvantages

- Restricts larger vehicles
- Curb ramps may need to be relocated to remove crosswalks from vehicle path
- Wrong-way left turns could be problematic on busy residential or collector roads

Modified Tee Intersection

A curb extension added to the straight, through street at the top of a tee intersection modifies the travel path of through vehicles, forcing motorists to slow to negotiate the curve. The minor street, which terminates at the tee is controlled with a stop sign.



The illustration above shows how a typical tee intersection can be modified to deflect the travel path of drivers. As demonstrated in the photo below the driver must make a turning movement to proceed through the measure.

Locations

- Tee intersections
- Local and collector streets of any width

Advantages

- Eliminates high speed through movements
- Can reduce through traffic on through leg of tee

Disadvantages

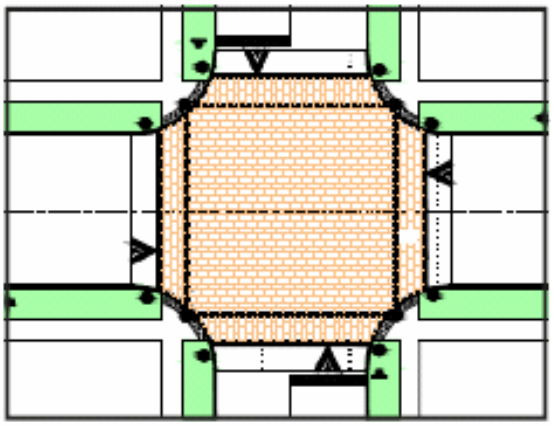
- Large through vehicles may have some difficulty maneuvering around the median

Estimated Cost:

$20,000 to $29,500

Intersection Table

An intersection table elevates the entire intersection to sidewalk level. Ramps on all streets force drivers to slow as they enter and exit the intersection. The raised area is often brick or other textured material, which can enhance its calming effect. If textured materials are used, a smooth corridor should be provided for people using wheelchairs and other personal assistance devices. One or more bollards are placed on each corner to prevent vehicles from cutting across corner space intended for use by pedestrians.



This treatment raises the entire intersection to sidewalk level to create a table. The "V" shaped markings in the illustration above are placed on each street to alert approaching drivers to the presence of ramps. The photo below demonstrates how textures and colors can add visual impact and focus.

Locations

- Local and collector streets of any width with fewer than 7,500 vehicles per day and not on a primary EMS or bus route.
- Intersections of narrow streets where traffic calming circle or roundabout would not fit
- Intersections where a roundabout or traffic circle would fit, but large vehicles such as school buses, garbage trucks could not make turns through the traffic circle/ roundabout

Advantages

- Places a visual emphasis on the intersection and pedestrians
- Minimizes loss of on-street parking, compared to a roundabout
- Allows large vehicles to make unrestricted turns, compared to a roundabout
- Can be easier to construct than a roundabout
- Can provide accessibility solutions for narrow sidewalks [3]

Disadvantages

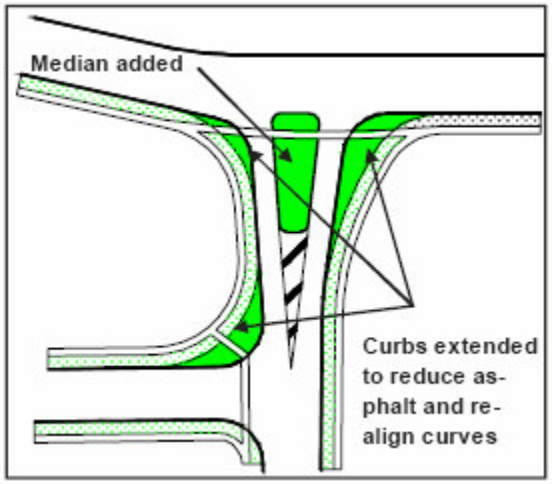
- Increases turning difficulty because drivers must go up a ramp, turn, then go down a ramp
- Emergency vehicles must almost stop at every ramp

Estimated Cost:

$100,000 to $160,000

Modified Intersection/Realignment

At some intersections, streets do not intersect at 90 degrees. This creates a skewed intersection. At other sites opposing streets are offset from each other. Some intersections have several streets intersecting on the same side of the street. In any of these situations the alignment may create large expanses of asphalt that enable drivers to turn at high speeds and create long pedestrian crossings. The principle of a realignment is to reduce the area of asphalt, realign the streets, and square any skewed approaches.



Intersections can be realigned in many different ways to tighten curves, reduce the amount of asphalt, or realign the streets. The sample in the illustration above and photo below demonstrate the principle of reducing the area of asphalt to tighten the curves and create deflection to slow traffic.

Locations

- Local and collector streets of any width

Advantages

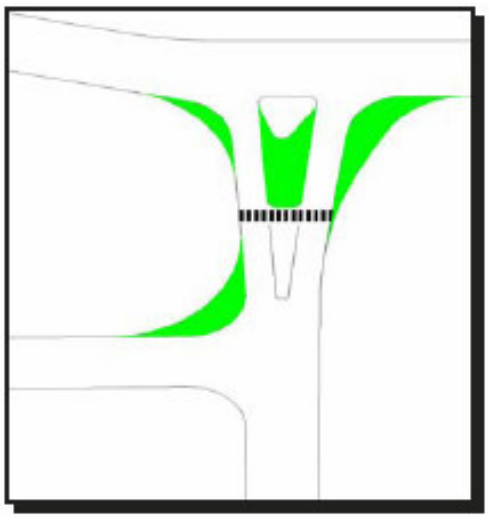
- Lower turning speeds
- Shorter pedestrian crossings
- Can discourage undesirable vehicle movements
- May provide enough additional green space to create a small park area

Disadvantages

- If not well designed, essential large vehicle movements may be restricted

Estimated Cost

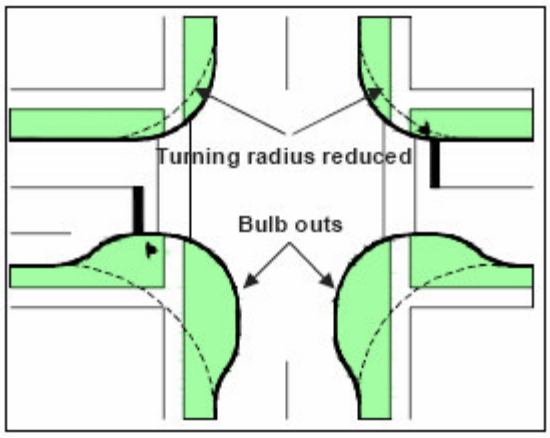
It is not possible to provide a cost estimate for this type of design because the size of the intersection street widths, angles of intersect and other factors vary from site to site.



Alternate intersection redesign with pedestrian crossing.

Curb Radius Reduction

A curb radius reduction is the reconstruction of an intersection corner using a smaller radius. A smaller radius shifts corner space from the street to the sidewalk area.



The dotted lines in the illustration above indicate the original curb line. The turning radius is reduced by extending the curb into the street. On streets with parking, the extensions can become bulb outs (see next page for details). The photo below illustrates how the extension of the curb to tighten the radius can shorten pedestrian crossing distances.

Locations

- All streets of any width
- Intersections where there are low truck or other large vehicle usage

Advantages

- Slows turning vehicles
- Can discourage cut-through traffic by forcing a driver to turn at lower speeds.
- Shortens pedestrian crossing distances
- Provides more space for curb ramps

Disadvantages

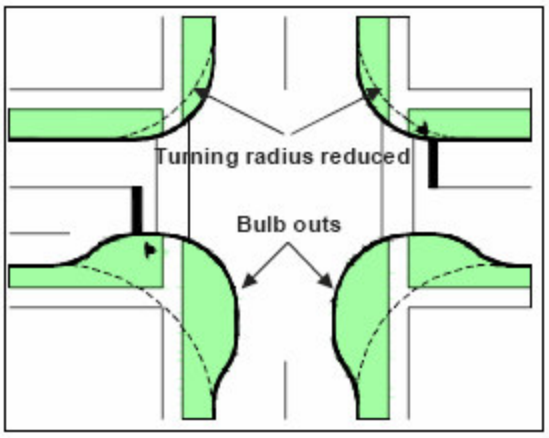
- May be more difficult for some larger vehicles to turn

Estimated Cost

$6,500 to $10,000 per corner

Curb Extensions/Bulb Outs

Curb extensions, also referred to as bulb outs or bump outs, narrow the street by extending the curb into the parking lane, shoulder area, or curb lane. For purposes of this handbook, these treatments will be referred to as bulb outs. Bulb outs do not extend into bike lanes. On-street parking impacts vary depending on existing practices and other site-specific conditions.



The dotted lines in the illustration above indicate the original curb. Where on-street parking exists, the curbs can be extended to the edge of the parking area to create bulb outs. Where there is no parking, the radius can be reduced. The photo below illustrates both designs.

Locations

- All streets over 26' wide with parking lanes, shoulder area, or overly wide curb lanes
- Downtown areas
- Near schools or other high-pedestrian activity areas

Advantages

- Shortens pedestrian crossings
- Pedestrians are more visible to drivers because the bulb out allow them to enter the crosswalk at a point where parked vehicles do not block the driver's view
- Pedestrian can see approaching vehicles more easily
- When the curb radius is reduced by the bulb out, right turning vehicles are slowed
- Improves emergency access and side street visibility by eliminating illegal corner parking
- Provides space for curb ramps, street furniture, and landscaping
- Protects on-street parking areas
- Prevents vehicle travel in unused parking areas

Disadvantages

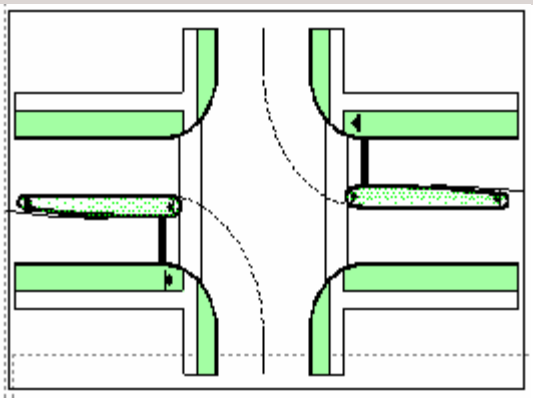
- Through vehicle speeds may not be substantially reduced unless other measures are combined with bulb outs

Estimated Cost:

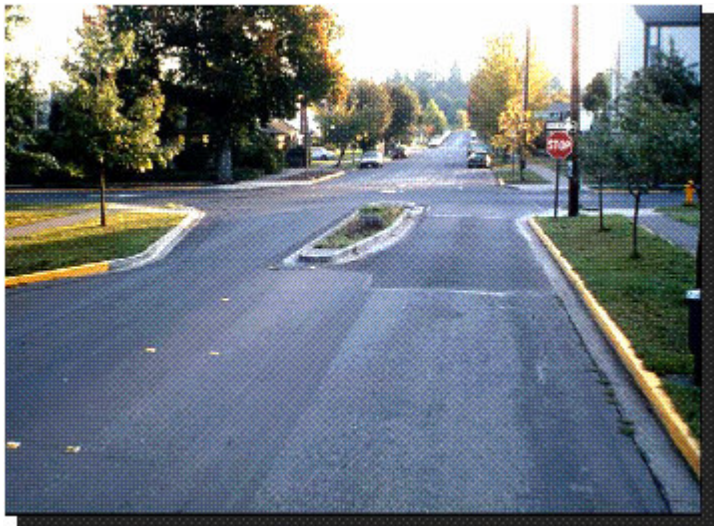
$10,000 to $16,000 per corner

Short Median at Intersection

Short medians between travel lanes at neighborhood intersections can slow turning vehicles and provide pedestrians with a refuge area. A median on each leg of an intersection prevents drivers from cutting across the intersection along a very large radius and forces drivers to make a slower, sharper turn around the median. In situations where a wide exit lane allows two vehicles to exit side-by-side, the median can be used to narrow the street to a single narrow exit lane. This will discourage cut-through traffic by delaying drivers at the exit.



A short median between travel lanes can slow turning vehicles. The width of the median will vary depending on the width of the street. In the photo below, the curb on the left side has been extended to narrow the lane. Measures are often combined to



Locations

- Local and collector streets over 26’ wide
- Intersections where drivers make high speed left turns into a neighborhood
- Especially useful if drivers are descending a hill before a left turn
- Useful to delay traffic exiting the neighborhood

Advantages

- Can serve as a neighborhood gateway
- Provides pedestrian with a refuge area

Disadvantages

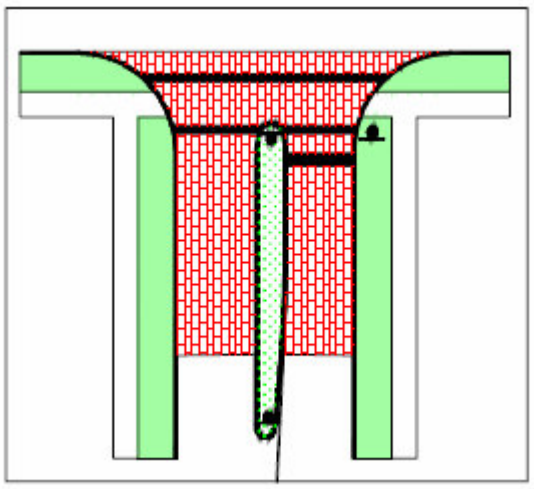
- Can restrict large vehicle turns

Estimated Cost:

$16,000 to $28,000

Gateway Treatment

Gateways include a variety of treatments at the entrance or entrances to a neighborhood or community. Gateways announce arrival in a unique place, such as a neighborhood of downtown. Many gateways are purely aesthetic or informational and have no impact on drivers unless reinforced with additional treatments within the neighborhood. One form of gateway treatment is a short intersection median that is enhanced with textured pavement to create a physical sensation. Other examples include signs in the center median, wing walls, non-movable gates, and arches over the roadway.



A short median can serve as a gateway to a neighborhood. The illustration above shows how texture can be added. The large tree in the median below is another illustration of a neighborhood gateway feature.

Locations

- Local and collector streets over 26’ wide
- Significant entrances to neighborhoods or commercial areas
- As a divider between commercial and residential areas on the same street

Advantages

- Separates arterial street type environment from a neighborhood environment
- Strengthens neighborhood identity
- Can improve wayfinding by providing a landmark

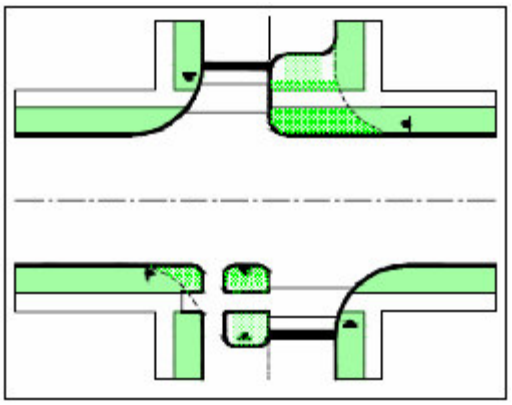
Disadvantages

- Limited effectiveness in changing driver behavior

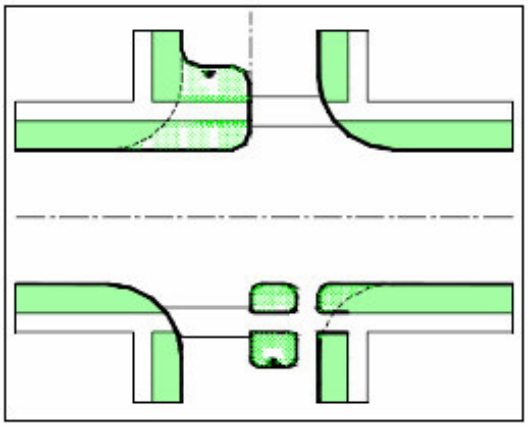
Estimated Cost:

$40,000 to $59,500

One-half of a local street can be closed at a neighborhood entry or exit point with curb extensions, bollards, or other treatments to restrict access into or out of the area. Half closures can be set up in various configurations to complement treatments on the other side of the intersection. Partial closures are rarely used because they create circuitous routes for those accessing adjacent properties. Traffic is increased on nearby streets.



These two illustrations show how a street can be partially closed to prevent traffic from continuing straight through. Various configurations can be designed to address cut-through concerns.



Locations

- Local and collector streets of any width and not on a primary EMS or bus route
- At intersections on a cut-through route

Advantages

- Eliminates cut-through traffic in one direction
- Allows two-way traffic on the remainder of the street
- Two-way bicycle access can be preserved

Disadvantages

- Restricts resident access to their property
- Inhibits access by emergency vehicle
- May cause confusion until maps reflect the change
- Increases traffic volumes on other streets
- Can impede citywide traffic circulation

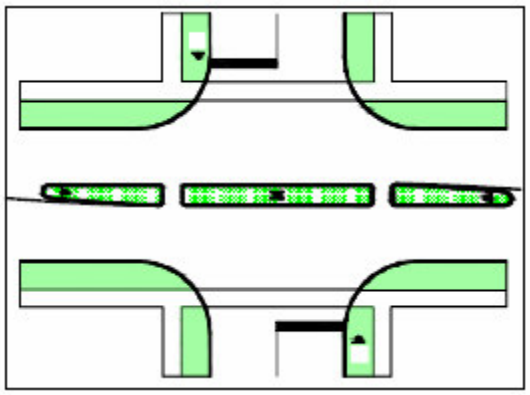
Estimated Cost:

$26,500 to $42,000

This partial closure allows traffic to exit the street, but the entry lane is blocked.

Median Barrier

A raised median between travel lanes that can extend across the intersection to block left turn and through movements from cross streets. It is a diversion tool to prevent vehicles from passing through one neighborhood, crossing a major street, and continuing into another neighborhood to create a cut-through route. Residents and service providers using that intersection can enter and leave only by turning right into or right out of out the street. All barriers that restrict traffic flow must be used sparingly to preserve convenient access and distribute traffic evenly.



A raised median through the intersection restricts access to right turning vehicles, pedestrians, and bicyclists.

Locations

- Local and collector streets of any width and not on a primary EMS or bus route.
- Intersections along cut-through routes that cross major streets

Advantages

- Median can provide a pedestrian refuge island
- Prevents cut-through traffic

Disadvantages

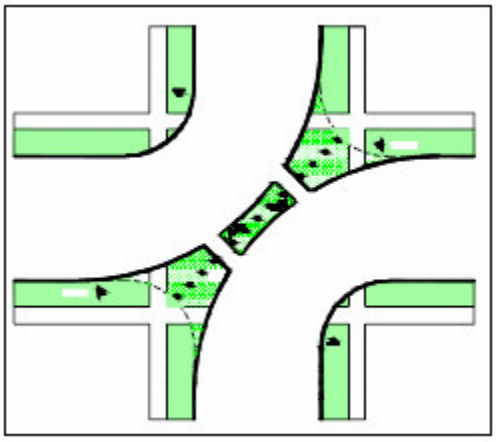
- May restrict vehicle access between neighborhoods
- Restricts resident access to their property
- Inhibits some access by emergency vehicles
- Increases traffic volumes on other streets
- Can impede citywide traffic circulation
- May cause some confusion until maps reflect the change
- Trash and silt may accumulate

Estimated Cost:

$16,000 to $22,500

Diagonal Closure

A raised median can be installed diagonally across an intersection to prevent through movements and divert traffic onto other streets. These and other partial closures are rarely used because they create circuitous routes for those accessing adjacent properties and traffic is increased on nearby streets. When used, pedestrian and bicycle access can be preserved through the diagonal median.



A raised median installed diagonally eliminates straight through vehicle traffic. The breaks in the median shown in the illustration above depict curb cuts to allow bicyclists full access.

Locations

- Local streets of any width and not on a primary EMS or bus route.

Advantages

- Eliminates through traffic
- Shortens pedestrian crossings
- Can include a bikeway connection

Disadvantages

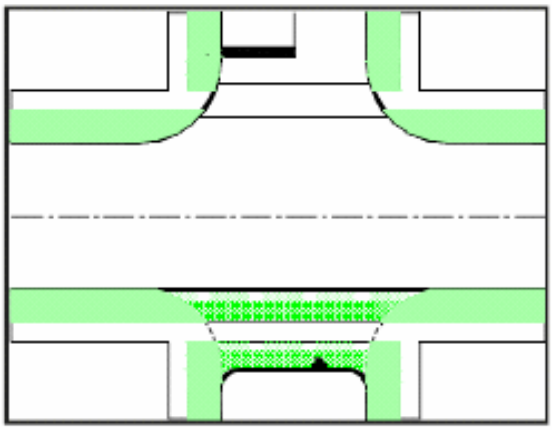
- Restricts resident access to their property
- Restricts vehicle access between neighborhoods
- Inhibits access by emergency vehicles
- May cause confusion until maps reflect the change
- Increases traffic volumes on other streets
- Can impede citywide traffic circulation

Estimated Cost:

$29,500 to $44,000

Street Closure

The most severe traffic calming treatment is a street closure. A closure prevents all vehicle access into or out of the street at that location and creates a cul-de-sac. Bicycle and pedestrian access can be retained. Bollards, barriers, and curb extensions are some of the methods used to close streets. Street closures are rarely used because they create circuitous routes for those accessing adjacent properties. Traffic is increased on nearby streets. It will be difficult to obtain approval for a closure due to the severe impact on neighborhood and citywide traffic circulation patterns.



Total closure of streets is rare because of adverse impacts on other streets in the neighborhood. When streets are closed, it can be done in a way that adds value to the surrounding area. In the photo below, a former street was converted to a linear park with a trail.

Locations

- Local streets of any width
- Streets where few properties are accessed from the street

Advantages

- Eliminates through traffic
- Reduces vehicle speeds in remainder of closed street
- Closed street can be used for a park or playground in some cases

Disadvantages

- Restricts resident access to their property
- Inhibits access by emergency vehicles
- Increases travel distances for residents, visitors and service providers
- May cause confusion until maps reflect the change
- Increases traffic on other neighborhood streets
- Eliminates an entrance to the neighborhood

Estimated Cost:

$15,000 to $22,000

Oval Median

A raised, oval-shaped median placed between narrow travel lanes forces drivers to slow to maneuver around the median. It may be necessary to extend curbs in advance of the median so driver cannot proceed straight through the curve. In such cases, the extension can become a location for trees or other landscaping features. The impact of the oval median, like other treatments, is improved by provision of landscaping. The median can also provide an island for a pedestrian crossing.

Locations

- Local and collector streets over 26' wide

Advantages

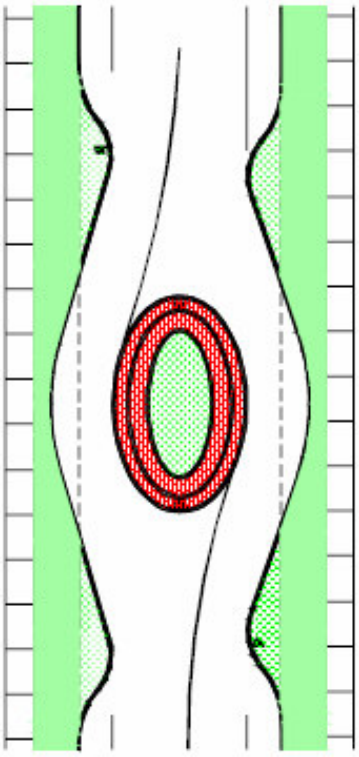
- Can be designed to different speeds
- Can provide refuge for pedestrians and bicyclists crossing the street

Disadvantages

- Requires careful design to achieve real speed reduction
- Can restrict large vehicles

Estimated Cost:

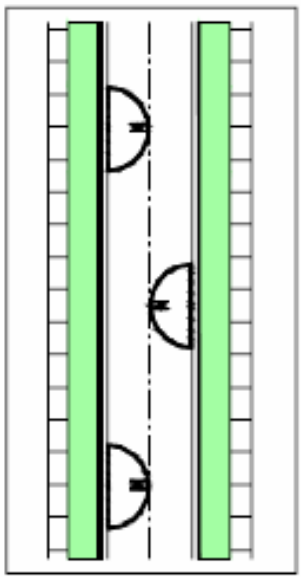
$59,500 to $90,000



A raised median in the shape of an oval is combined with a realigned curb to create a curve in the vehicle travel path. The center is often the site of a large tree or other highly visible feature.

Chicane

Chicanes are created using curb extensions that alternate from one side of the street to the other to create a single travel lane with S-shaped curves. Chicanes are sometimes referred to as deviations, serpentines, reversing curves, or twists. Chicanes rely on a curvilinear path and potential conflict between opposing traffic flows to reduce travel speeds. The design must discourage drivers from cutting straight paths across the centerline or testing their skills on the curves or speed reductions will not occur. Their use is confined to lower volume streets because traffic can pass through the chicane in one direction only.



Curb extensions on alternating sides of the street create a winding travel path wide enough for one vehicle. If another vehicle approaches, they must wait until the chicane is clear before entering.

Locations

- Local streets less than 26' wide and not a primary EMS or bus route
- Streets with less than 600 vehicles per day
- Two-lane, two-way streets
- One-lane, one-way streets

Advantages

- Potential for higher degree of speed reduction

Disadvantages

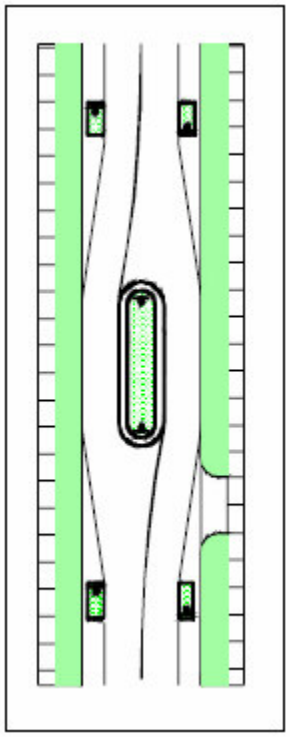
- It may be necessary to ban parking within the chicane
- Most effective where traffic volumes are balanced in each direction
- Trash may accumulate
- Bicyclists must merge with vehicles to pass through

Estimated Cost:

$12,500 to $18,500

Median with Tree Wells

A median island combined with trees wells creates a chicane effect on streets where two-way traffic must be maintained. A curvilinear path is created with curb extensions similar to those used for a chicane, but a median is installed in the center of the street to separate travel lanes. The curb extensions are generally planted with trees to increase the visual impact of the treatment.



A raised median with tree wells on either end can create an effect similar to that of a chicane, yet still allow two lanes of traffic.

Locations

- Local and collector streets over 32’ wide

Advantages

- Enables two-way traffic
- Beautifies the street

Disadvantages

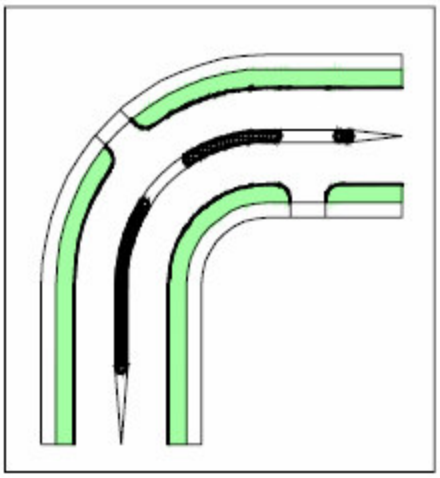
- It may be necessary to ban parking between the tree wells
- Can impact access to driveways
- Trash accumulation
- Bicyclists must merge with vehicles to pass through

Estimated Cost:

$24,000 to $36,500

Median on Curve 46

Medians of various widths can be installed on curves to prevent vehicles from crossing the centerline to facilitate travel at higher speeds. Openings in the medians may be necessary to provide access to driveways. Raised pavement markers can be used on curves to create the effect of a median when site constraints or other factors, such as emergency vehicle access, prevent use of a raised curb.



A raised median on a curve prevents vehicles from crossing the centerline. The opening in the median allows driveway access for adjacent homes.

Locations

- All streets over 26' wide

Advantages

- Stops drivers from crossing centerline on curves
- Prevents passing movements on curve
- Reduces travel lane width
- Can provide pedestrian refuge and shorten crossing distance

Disadvantages

- Can make travel around the curve by large vehicles difficult
- Can restrict access to some driveways unless openings are provided within the median at each driveway
- Trash may accumulate

Estimated Cost:

$13,000 to $20,000

Driveway Link

A driveway link converts a straight, two-lane street into a winding one-lane street lengths over distances of up to 200 feet. When carefully landscaped, the street appears to be closed. The narrowed road space and landscaping create a park-like appearance that enhances the street and facilitates increased pedestrian activity in that area.

Locations

- Local streets of any width
- Street with less than 1,500 ADT

Advantages

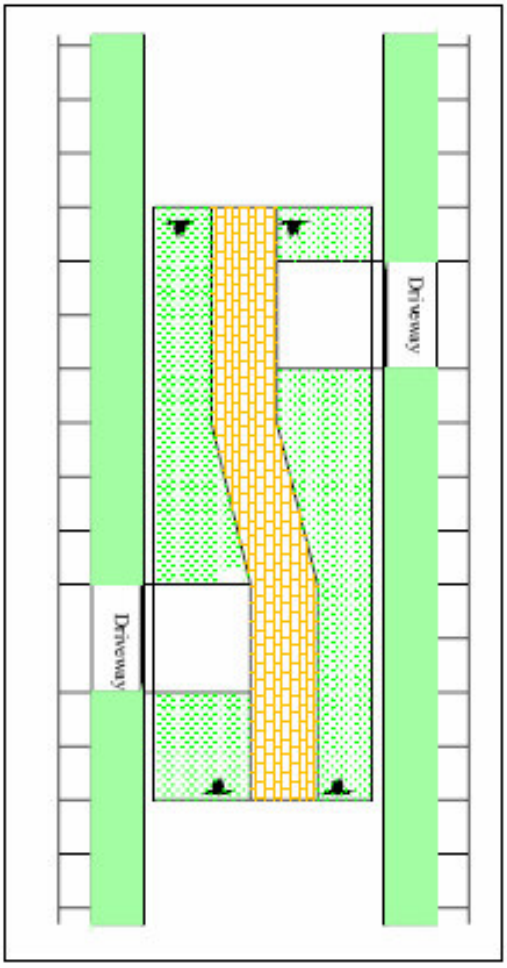
- Reallocates portions of the street to other public uses
- Creates the impression of a closed street, while maintaining the link between neighborhoods.

Disadvantages

- Length of treatment is limited by cost
- Drivers must yield to each other
- Impossible to street sweep

Estimated Cost

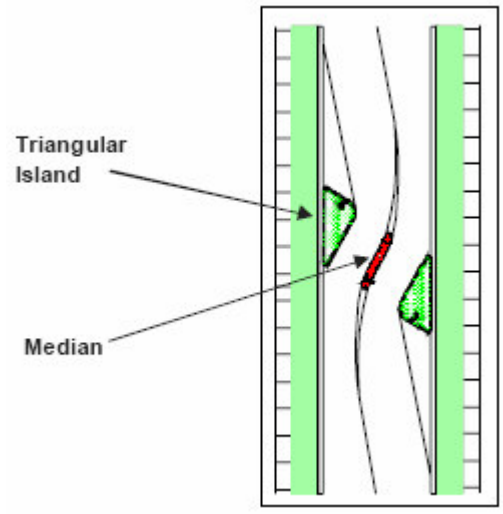
$58,500 to $99,000



The drawing above shows how a section of a two-lane street can be converted to a single travel lane. Drivers approaching the link must wait if a vehicle is approaching from the other direction..

Angled Slow Points 48

Triangular islands constructed on both sides of a street narrow the vehicle travel path a add a curve to a straight section on street. A short median is installed between the travel lanes of two-lane slow points. Drivers must slow to negotiate the turns needed to maneuver through the curve created by the islands. On single-lane slow points drivers must yield to oncoming traffic. A raised median can be added to slow points for added deflection.



Angled slow points add a tight curve to an otherwise straight street. A median is used on two lane angled slow points to ensure drivers can't "straighten" their travel route by crossing the centerline.

Locations

- Local and collector streets over 26' wide and not on a primary EMS or bus route
- Single lane slow points on streets under 26' wide with fewer than 3,000 vehicles daily

Advantages

- Create horizontal deflection while maintaining passage for large vehicles

Disadvantages

- Bicyclists must merge with vehicles to pass through
- Trash may accumulate

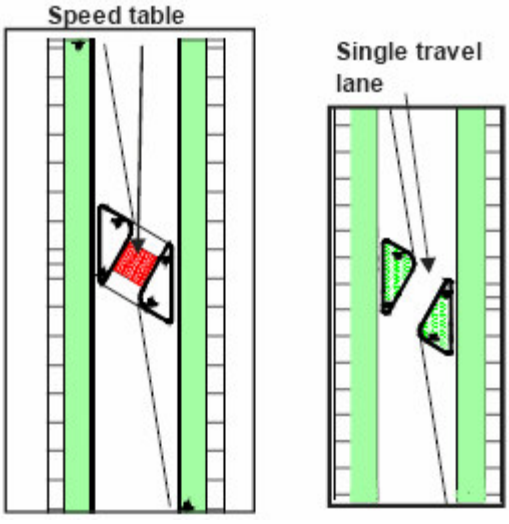
Estimated Cost:

Two lanes - $12,500 to $18,500

Single lane - $10,000 to $15,500

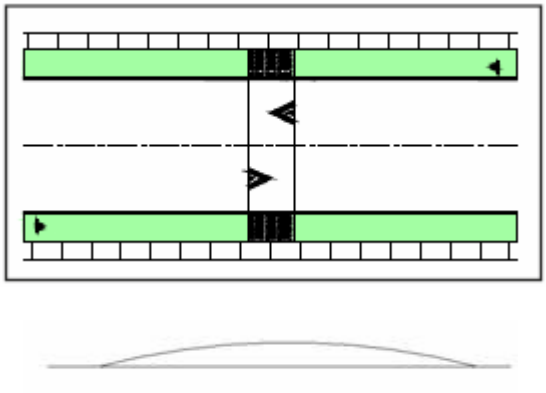
Single lane w/speed table—$13,000 to $19,000

The illustrations on the right show how angled slow points can also be single-lane. Both illustrations force traffic through a narrow, one-lane angled opening. The illustration on the right shows how a raised speed table can be added to a single lane angled slow point to create vertical deflection.



Speed Hump

Speed humps are asphalt or concrete street surfaces that span the width of the street and are raised and slightly rounded. When used in Encinitas, they are 3 high and approximately 12 feet long. Speed humps create a driving surface that is uncomfortable at higher vehicle speeds, especially when used in closely spaced pairs. The discomfort prompts drivers to slow in advance of the hump. Speed humps have a minimal impact on vehicles with good suspension systems and a severe impact on large vehicles such as buses, garbage trucks and emergency vehicles. Speed humps will only be considered where there are no other viable alternatives or where impacts are restricted to the residents of that streets only, such as on a cul-de-sac.



Speed humps are slightly rounded areas that span the width of a street to create a 3 inch rise in the street surface.

Locations

- Local streets under 26' wide and not a primary EMS or bus route
- Streets with less than 3,000 ADT

Advantages

- Bicyclists do not have to move out of their travel path to cross

Disadvantages

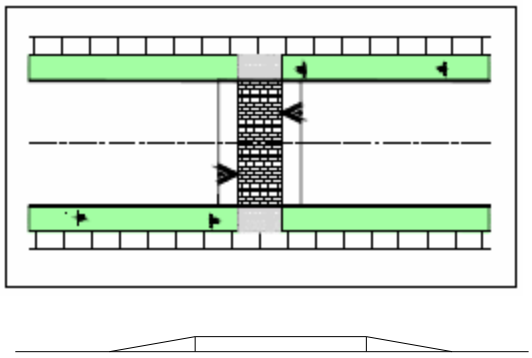
- Emergency vehicles forced to almost stop at each hump
- Vehicles braking and accelerating create noise
- Can damage vehicles at higher speeds
- Limited affect on some vehicle types
- May detract from residential property values
- Uncomfortable for passengers of buses and ambulances
- Uncomfortable for people with back injuries or other chronic painful physical conditions (3)
- Restricts mobility for people using wheelchairs if installed where there are no sidewalks

Estimated Cost:

$5,700 to $8,300

Speed Table

A speed table is an elevated, flat street surface with ramps on both sides to create a grade change on both sides of the table. A steeper grade on the approach and departure ramps will produce slower speeds. The sloped ramp leading to the platform is less jarring for vehicle occupants than a speed hump. A change in surface color and/or texture on top of the speed table can increase its effectiveness. Speed tables are effective tools for providing high visibility crosswalks schools, trails, and other mid-block crossing locations where slower speeds are desirable. They can be combined with bulb outs to shorten pedestrian crossing distances and prevent drivers from avoiding the full impact of the treatment by driving with two tires in the gutter.



A speed table is a flat surface that is slightly higher than the street. The "V" symbols in the drawing above illustrate marking to alert drivers to the ramps leading to the table. The flat surface on a speed table makes it well suited for a crosswalk. The photo below shows a speed table with a median.

Locations

- Local and collector streets of any width not a primary EMS or bus route
- Streets with less than 5,000 ADT
- Marked, unsignalized mid-block pedestrian crossings

Advantages

- More easily traversed by large vehicles than speed humps
- Provides a defined pedestrian crossing area
- Improves visibility between pedestrians and drivers
  Raises vehicles to pedestrian level
- Eliminates need for a curb ramp at the crossing

Disadvantages

- Emergency vehicles forced to almost stop at the ramps
- Can damage vehicles at higher speeds
- Vehicles braking and accelerating create noise
- Can be uncomfortable for people with back and neck problems, though less jarring than speed humps [(3)]

Estimated Cost:

$24,000 to $36,500

Short Medians

Raised medians of varying widths and lengths can replace two-way center turn lanes or reduce the width of overly wide streets. Medians can be designed to allow drivers full access to driveways.

Location

- Collector streets
- Streets over 26' wide

Advantages

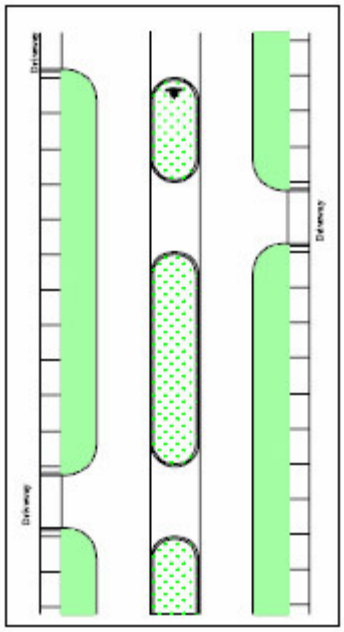
- Eliminates turning conflicts in center turn lanes
- Eliminates use of center turn lane for passing
- Can provide pedestrians with refuge area
- Can be used to narrow travel lanes

Disadvantages

- Speeds may not be reduced because no deflection is created

Estimated Cost:

$16,500 to $25,500

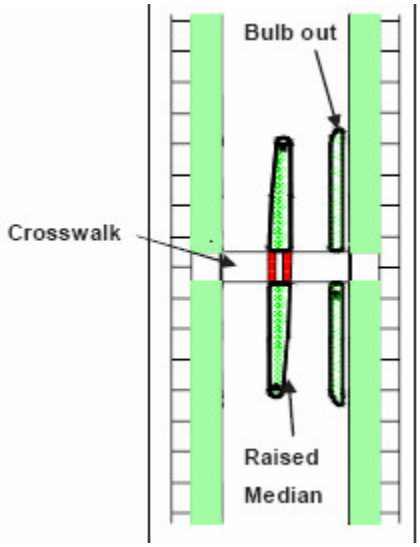


Raised medians of varying lengths can be designed allow drivers to turn into driveways.

Raised Pedestrian Refuge

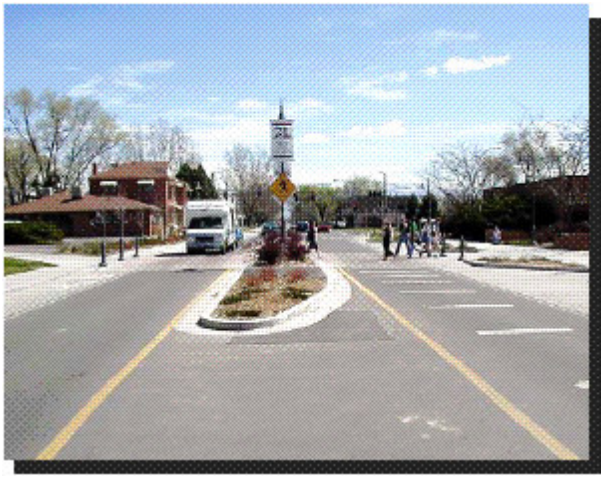
Pedestrian islands are short medians placed in the center of the roadway separating opposing lanes of traffic. The island allows pedestrians to cross one-half of the street, wait outside the traveled way until vehicular traffic yields or there is a gap in traffic that allows them to complete their crossing, then complete their crossing. Wait and crossing times are decreased. Trees will small trunks should be planted in the refuge on both sides of the crosswalk to increase visibility of the treatment.

Other treatments such as bulb outs, narrow travel lanes and others appropriate for the street can be combined with the island to achieve desired speeds and improve motorist yield behavior.



Pedestrians can cross one-half of the street at a time when a raised median is used to provide a crossing island..

In the photo below a speed table and bulb out have been added to the pedestrian island.



Locations

- Local and collector streets over 26’ wide

Advantages

- Provides pedestrians with safer, more convenient crossings
- Breaks up the continuous nature of the street

Disadvantages

- Must be combined with other treatments to create deflection

Estimated Cost:

$23,000 to $34,000

The term woonerf is used to describe public right-of-way space that is shared by vehicles and people not in cars. The street may be designed as a play area or other public space with a single 10-foot wide lane that wanders through the former street alignment. Asphalt is usually replaced with bricks or other textured materials which are graded to direct water to low areas where drains are provided to collect water.

Locations

- Local streets under 26' wide and not a primary EMS or bus route
- Streets with less than 5,000 ADT

Advantages

- Provides very low vehicle speeds
- Creates a shared space for everyone to use

Disadvantages

- Expensive

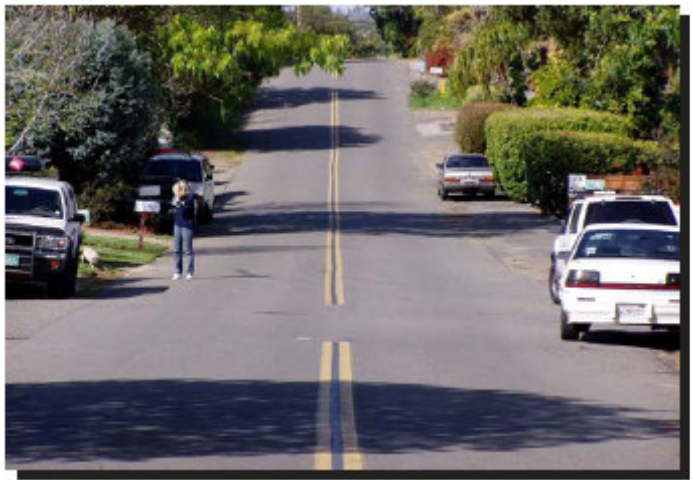
Estimated Cost

It is not possible to provide a cost estimate for this type of design without site specific details.

Narrow Street: Add Curbs

Streets without curb and gutter can create the appearance of a high-speed rural road that encourages some drivers to speed. Adding curb and gutter changes the appearance of the street to a local street and prevents vehicles from encroaching on unpaved shoulder area.

Street widths can have a significant impact on vehicle speeds. The American Association of State Highway and Transportation Officials (AASHTO) establishes guidelines for local streets 26-feet wide. This face-of-curb-to-face-of-curb width provides space for a 12-ft center travel lane and two 7-ft parking lanes. Parking on one side of the street can be allowed on streets as narrow as 20 feet. These streets function effectively because drivers can yield to oncoming cars by pulling into driveways or parking spaces that are not occupied. Reduction of travel lane width to ten feet may also yield some reduction in speeds.



These Encinitas streets illustrate how adding curbs and gutters changes the appearance of the street.

As shown in the image below, some communities provide a planter strip between curbs and the sidewalk area. Trees and landscaping are closer to the street.

Location

- Local and collector streets

Advantages

- Can help lower speeds
- Improves drainage

Disadvantages

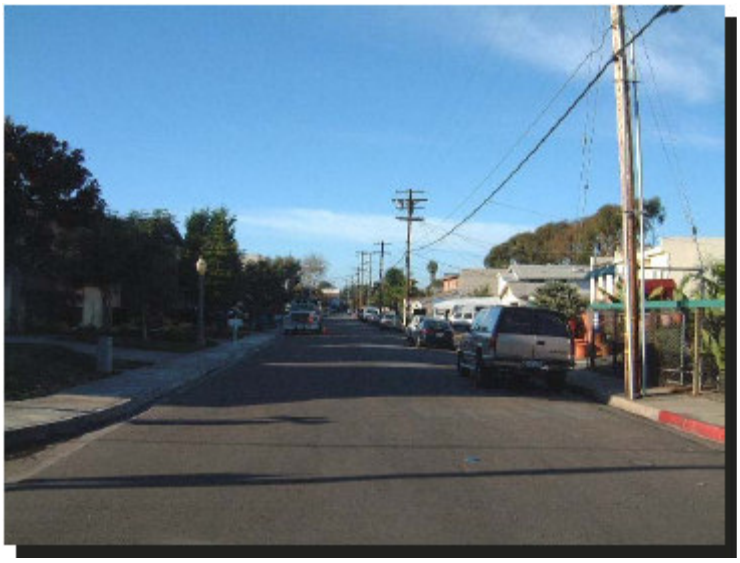
- High cost
- Lack of universal impact on drivers

Estimated Cost:

Curb and Gutter - $35 linear foot

Centerlines

Marking centerlines that divide opposing travel lanes provides drivers with a clear indication of their travel width, location and path of on-coming vehicles. Removing or not marking a centerline creates uncertainty and helps lower vehicle speeds. This treatment may be combined with marking stripes along the edges of the street for parking or for bike lanes to yield a greater impact.



Location

- Local streets of any width

Advantages

- Low cost technique
- Reduces maintenance costs

Disadvantages

- May not be effective on all drivers

Estimated Cost:

$1.50 per linear foot to remove centerlines and add white lines on street edges

Bike Lanes

Bike lanes consist of two stripes that define the space on the street for riding bicycles. The minimum width for a bike lane adjacent to a parking lane or curb is five feet. If there are no curbs and gutters, the minimum width is four feet. The stripe can narrow the travel lanes and give the overall street a more narrow appearance. They provide many other benefits to bicyclists and pedestrians, but because they do not deflect the vehicle travel path their impact on speeds may not be significant.

Bike lanes are added to a wide street with a median in the photo above. Below, bike lanes were added to a two-lane street without a median..

Location

- Collector Streets
- Streets with more than 1,500 ADT
- As designated in the Bikeway Master Plan

Advantages

- Provides separate riding space for bicyclists
- Narrows appearance of the street
- Provides lateral separation between pedestrians and traffic
- Provides a buffer area between those entering and exiting parking spaces and the moving traffic

Disadvantages

- Not effective on all drivers

Estimated Cost:

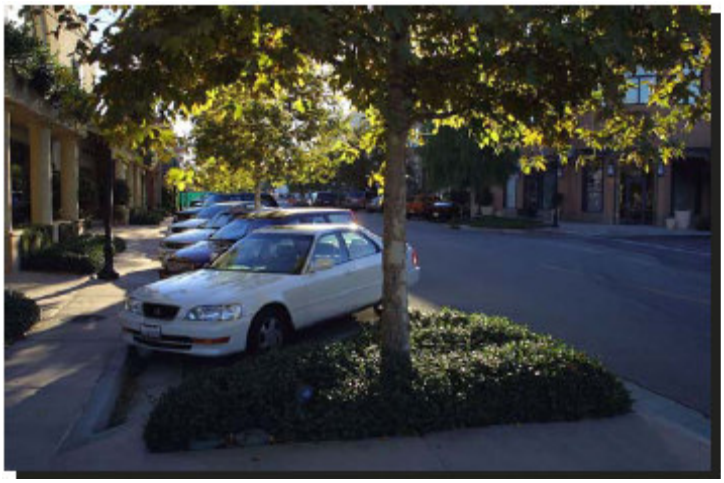
$1.50 per linear foot to remove center line and add white lines on two edges

Vehicles parked on the street effectively reduce pavement width and can reduce vehicle speeds. Drivers are sometimes reluctant to park on the street because they fear their vehicle will be hit. Bulb-outs and tree wells along the street can protect parked vehicles while improving visibility between pedestrians and motorists.

The street above is 30' wide from curb-to-curb. The parallel on-street parking narrows the travel area of the street. In cases where additional parking is needed, such as parks, diagonal parking may be feasible if street width is adequate. Bulb outs help prevent drivers from using parking areas as travel lanes when no vehicles are parked.

Alternating on-street parking from one side of the street to the other on narrow streets creates a chicane-like effect. Parallel or angled parking can be used alone or in combinations. This treatment can be used in combination with landscaping to beautify the street and screen parking areas.

Marking of parking spaces is not necessary on collector roads or local streets unless the streets are wide and there is a need to narrow the street and encourage on street parking. On these streets a single line is all that is required.



Location

- All streets

Advantages

- Reduces street width
- Provides convenient access to abutting properties

Disadvantages

- May obscure pedestrians from drivers' view

5.0 Design Considerations

This section is oriented to engineers and designers who will assist the citizens of Encinitas with the design and implementation of their neighborhood traffic plan. Citizens will rely upon the information and tools provided in preceding sections and during neighborhood meetings to develop a plan to address their concerns. Their suggestions must be reconciled with design considerations to create a plan that reflects their wishes but is compliant with guidelines and practices of the engineering profession.

The treatments in the Toolbox include designs that create horizontal or vertical deflection to require motorists to slow down, improve pedestrian crossings, or address other concerns expressed by the public or revealed by safety data. The Toolbox includes a wide variety of treatments to address a range of problems in diverse environments with variable topography and street widths. Treatments, landscape and streetscape elements, traditional access management techniques such as raised medians and right-in, right-out turn lanes, and lane markings can be used in a variety of combinations to address speeding and high levels of cut-through traffic on neighborhood streets. Treatments are generally designed to fit into existing rights-of-way with minimal new infrastructure construction, utility relocation and repair.

Traffic management in a neighborhood must be holistic. That is, the placement of each treatment must solve problems throughout the neighborhood, and not move the problem from one location to another. The designer must consider the impacts that traffic calming treatments may have on nearby areas or the overall traffic circulation patterns.

The needs of all who share the roadway environment, including bicyclists, pedestrians, transit, delivery vehicles, emergency service providers, and passenger vehicles must be considered and balanced. Special needs for visually impaired people or those using wheelchairs, walkers, and baby strollers must be accommodated. Existing landscaping, neighborhood character, and many other contextual elements must be factored in, and the public input is of great importance in any design. Normal procedures including environmental review and Coastal Development permitting required for construction plan approval must be followed.

5.1 Project Development

Each project will include public input as described in Section 3.0, Process. This collaborative approach to traffic management ensures that the designer has a complete understanding of resident concerns. The final project is more likely to be endorsed by most residents when they have assisted in the development of the conceptual plan.

The design process starts following the Neighborhood Workshop described in 3.5, on page 17. During this meeting, citizens would have identified their concerns, learned of potential solutions, and developed a conceptual plan for their neighborhood. The first step of evaluating their plan is to conduct a site inspection to review the location of each traffic

calming treatment, take notes and check the impact on driveways, drainage structures, trees, curb lines or lack of curb, utilities and overhead lights.

5.2 Overall Design Review

Variable conditions in the roadway environment make it essential that traffic calming treatments be designed for each specific site, rather than done as a "cookie cutter" approach. The designer needs to experience the problem by undertaking field reviews to gain a complete understanding of the problem and to review site conditions. Following the site review for each treatment the designer uses the basic layouts given in the following pages to confirm that the treatment chosen by the residents is the best treatment for each location and if for whatever reason, drainage problems, utility conflicts, negative impact on driveways etc., they can change the recommended treatment to a more suitable treatment for that location.

Design Speed

Design speed is a critical element of each traffic calming treatment. Establishing design speed allows each treatment to be designed according to road function and the problem to be treated. The table below summarizes suggested design speeds for the traffic calming treatments based on functional classification of the roadway.

Roadway Classification	Design Speed
Local	12 – 15 mph
Collector	15 – 20 mph

Spacing

Each traffic calming treatment has an effective range beyond which drivers return to their previous driving habits. Treatments must typically be installed at intervals of 400 to 800 feet to obtain a consistent change in driver behavior. Treatments spaced more closely than 400 feet apart could evoke dissatisfaction among residents. Spacing treatment over 800 feet apart will provide drivers with an opportunity to reach high speeds. Varying the type of traffic calming measure requires drivers to adopt different driving techniques at each location.

Driveways

Traffic calming treatments need to be located away from driveways, or in such a way that they do not completely block driveways. Turning restrictions to ingress and egress are sometimes necessary. Driveway access at roundabouts can be preserved in many designs, and reversing into a roundabout from a driveway, in the same manner as drivers have traditionally backed into traffic, may be acceptable on a low volume street.

Intersections

In most instances, capacity at neighborhood intersections where traffic calming treatments are planned is not an issue. Topography, drainage, driveway location, radii, street width can affect treatment design. It is important that vehicle turning requirements are checked. The use of AutoTurn is encouraged to check each intersection design. In some cases the treatment suggested during the neighborhood workshop may need to be changed. In this case, the designer should document and explain the rea-

son for the change during the follow-up meeting.

In the past, some intersections were constructed at skewed angles and with very large radii. Some have large areas of asphalt and accommodate high speed turning movements. The consequence to this intersection design is that drivers who enter a neighborhood at high speeds tend to maintain or increase their speed as they move further into the neighborhood. Redesigning to AASHTO guidelines may involve realigning the intersection angles to as near as possible to 90 degrees, minimizing the area of asphalt, and channelization to minimize conflicts. Examination of existing vehicle paths can help determine the extent of asphalt needed. Excess asphalt can be changed to landscape space. Provision of a raised median on some or all of the intersection approach legs can help slow traffic, reduce the openness of the intersection and provide pedestrians with refuge islands. Often the addition of a median is more effective than simply reducing the turn radii. The use of vehicle turning templates can help determine the best design approach.

Turning Templates

The use of templates for the design vehicle when designing traffic calming treatments is essential. Determine which vehicles must travel along the route to select the appropriate template. In some cases it may be practical to make a minor adjustment to a vehicle's route so the design does not have to accommodate an occasional large vehicle. This should be a City and neighborhood decision.

Traffic Signals

Traffic signals are not a traffic calming treatment. The function of a traffic signal is to transfer time from one street to another. Anecdotal evidence suggests that drivers tend to speed up along their route to compensate for time spent waiting at a signal or in attempts to avoid a "stop" signal. Signals can, however, affect traffic calming in nearby areas. By modifying existing traffic signal phasing or duration on the collector roads, cut-through traffic can be averted. For example, the green time on the arterial or collector road that is parallel to a cut-through route can be increased to encourage drivers to stay on the main road. Signals can also be modified at the entrance to a subdivision to reduce the green time on a designated approach and discourage cut-through traffic.

Emergency Vehicles

Traffic calming treatments that are effective in slowing or diverting vehicles have the same or greater impact on emergency vehicles. Sudden vertical deflection can be jarring and uncomfortable for passengers in fire trucks, which are longer and have stiffer suspension than passenger vehicles. Vertical deflection treatments may have an even greater effect on ambulances that are transporting patients.

Most traffic calming treatments have little or no impact on emergency response time because they are mostly located in the last link (street) on an emergency response route.

Design elements can be added to treatments to improve emergency vehicle maneuvering and to allow emergency access. For example, traf-

fic circles can be built with mountable aprons which allow fire trucks to pass through an intersection without compromising the measure's effectiveness in slowing passenger vehicles. Emergency service providers are supportive of the program and must be consulted with to provide input on any traffic calming design, i.e., where mountable curb may be required to accommodate their vehicles.

Americans with Disabilities Act (ADA)

The Americans with Disabilities Act, 42 U.S.C. 12101 et seq., requires removal of architectural barriers to provide access for disabled people. Federal regulations mandate installation of curb ramps or slopes to accommodate access to streets. Any alteration to a facility which may affect its usability, such as installation of a physical device in the street or a change to the curbing or sidewalk, triggers the obligation to construct curb ramps or other appropriate accommodations for the entire facility. Most traffic calming treatments fit this criteria and the designer should be aware of any required ADA improvements at the start of design.

Sidewalks

Sidewalks should be constructed to comply with current City standards and the Recreational Trails Masterplan. The Masterplan identifies locations where pedestrian paths can be provided in lieu of sidewalks. New sidewalks should follow AASHTO guidelines that recommend placement of sidewalks as near as possible to the right-of-way. Locate sidewalks one foot from the right-of-way line to allow for variations in fence lines and to accommodate overhang from plants.

Raised Islands

Raised islands are to be constructed to acceptable standards within typical minimums of 18 inches in width and a minimum area of 50 square feet. AASHTO guidelines suggest offsets for approach vehicles are important to provide vehicles with some forgiving space. Raised islands can be solid concrete pinned to the asphalt or the road pavement can be excavated and full depth curbing provided. The interior of the islands can be filled in with plain or colored and stamped concrete, paved with brick, or landscaped. The inclusion of a gutter can permit drivers to take a slightly faster path through the treatment. Where possible the gutter should be included as part of the travel way when determining deflection. If the gutter is not needed, i.e. the road slopes away from the island, then curb only around the island is preferred.

Drainage

Design of traffic calming treatments must address drainage, as many traffic control treatments can impede existing drainage flows and patterns. An exception to City standards can be made to allow construction of a raised island within the pavement utilizing a checkered steel plate with a non-slip surface that is bolted down or a 4 to 6 inch pipe that is laid in the gutter. The sidewalk is then extended over the pipe. This is a typical drainage solution for a bulb out or speed table at a pedestrian crossing. The length of the metal plate or pipe should be greater than the width of the crosswalk or sidewalk to accommodate pedestrians or people using wheelchairs that may approach the crossing at an angle. The sidewalk or curb extension should also be

landscaped in such a manner that it discourages pedestrians from crossing outside of the pathway created by the metal plate. If the curb extension is in a site where there is no pedestrian crossing, the 18 inch gap created by the gutter shall be left open. This exception is acceptable for the installation of traffic calming treatments with existing streets only. New streets must provide adequate drainage infrastructure in conformance with City standards.

The flow area along the roadway may be constrained to the width of the gutter when a raised island is added. When water is constrained to the gutter, the upstream flow area may become wider and water will eventually flow around the raised island. For raised islands designed within these guidelines as a retrofit to an existing street, an exception to the Storm Drainage Standards can be made. A bulb out or speed table is designed to slow traffic and does not lose that characteristic during rainstorms. Traffic is expected to be moving at a speed that would preclude hydroplaning through pooled water. The designer should refer to the San Diego County Flood Control District Design and Procedures for additional guidance.

When the gutter is directed around a bulb out, the runoff flow area can extend further into the travelway. In contrast, a median constructed within an existing roadway can direct vehicles closer to the gutter and the gutter flow. Both conditions shall be acceptable under these guidelines because operating speeds are expected to be low. A speed table obstructs most of the travelway and will also obstruct the gutter flow, which are exceptions to the San Diego County Flood Control District Design and Procedures. These exceptions are acceptable for the reasons described above.

Traffic calming treatments installed on streets with unimproved shoulders generally do not have a significant impact on drainage. The designer should still exercise care in these situations to avoid creating a drainage or erosion problem.

Fire hydrants and water meters

Existing water meters and fire hydrants should be relocated to conform to current standards whenever the curb and sidewalk are relocated for traffic calming treatments. Water meters for landscape irrigation should be installed wherever landscaping is included in a traffic calming measure. Backflow prevention devices are recommended to be located in areas which are least impacted by pedestrian traffic.

Visibility

Traffic calming treatments must be clearly marked and signed in compliance with the MUTCD or according to the City's conventional practices. The MUTCD includes signs that are standard, or mandatory, and signs that are optional. Careful discrimination must be used in the selection of signs in order to prevent confusing sign clutter that could arise if all possible signs are installed.

Concrete curbs dictate vehicle paths in traffic calming treatments and should provide drivers with a smooth travel path free of kinks or sudden changes in direction. Curbs should be set back from painted gore areas on approaches to most traffic calming treatments.

Raised pavement markers should always be used to improve night visibility of traffic calm-

ing treatments. Raised pavement markers can serve two purposes in some traffic calming treatments. They delineate the road centerline during after dark hours. When closely spaced, the markers discourage drivers from crossing the centerline at any time.

Lighting and landscaping must also be incorporated into traffic calming treatments to enhance visibility and ensure that drivers can identify the object and respond appropriately. It should never be assumed that the existing lighting is adequate. Some treatments may require additional safety lighting at the discretion of the City Engineer. Increasing the lighting to suitable levels could mean installing additional poles, increasing the wattage of existing street lights, or modifying light fixtures.

Landscaping

The City of Encinitas requires that traffic calming treatments be appropriately designed to meet high aesthetic values. Appropriate landscaping is highly encouraged, together with necessary irrigation and maintenance provisions. Landscaping is an essential element of traffic calming because barren, open streets encourage drivers to speed. Trees and shrubs enhance driver identification of traffic calming treatments, provide long-range visibility, enhance neighborhood appearance, and visually narrow streets.

Landscape elements for traffic calming treatments must be selected to support a slow-speed environment. Limit shrub height to 2 foot, 6 inches in areas with driveways or pedestrians, or where sight-lines are critical. Careful selection and placement of plant materials and traffic calming treatments can improve existing sight triangles. Mid-block traffic calming treatments may contain denser plantings than at intersection treatments because sight triangles are usually less critical on straight roadway sections. Plantings with low water needs are preferred to limit saturation of base and subgrade road materials.

Trees can be planted in medians, bulb outs, planter strips, and near the edges of most

When selecting the location and size of trees, the designer or reviewer should consider the following guidelines to determine if mature size and location of plant material will affect safety:

1. Draw the approaching vehicle
2. Draw the driver's head within the standard position within the vehicle
3. Draw the tree at its mature trunk and canopy thickness
4. Draw the conflicting vehicle
5. Draw two lines from the approaching driver's head toward the conflicting vehicle that just touches each side of the tree truck
6. If the sight triangle that is developed covers less than 50 percent of the conflicting vehicle, then the driver obviously will not lose sight of it. Even at 75 percent blockage the conflicting vehicle is visible to the driver. If the coverage is greater the simple solution is to move the tree several feet away from the approaching driver and redraw the sight triangle.

streets. They should not be planted in a "clear zone." AASHTO defines the clear zone as the space between a fixed physical object and the travelway. The clear zone varies according to street function. In residential areas where vehicles travel at low speeds, the clear zone is 4 feet. In some constrained conditions, the clear zone is reduced to 1.5 feet. Where parking or bike lanes are used, the parking lane or bike lane edge is the edge of the travelway. Trees can be planted at the edge of the curb and still be within AASHTO guidelines. The visual impact of street trees is greater when they are planted close to the street. When trees are planted in median areas root barriers are recommended.

Most neighborhood streets have sewer and water pipes that need to be protected from tree roots. Tree roots typically occupy the top eighteen inches of soil where they need room to gather water and nutrients and anchor the tree. For some trees, the extents of the root system can be a length that is 1-1/2 times the height of the tree. If trees are to be planted near underground or overhead utility lines, tree type selection and the use of root barriers or concrete jackets around pipes are to be considered.

The benefits of trees include increased property value, reduction in air pollution, and a reduction in storm water runoff. (Urban trees in Vancouver collectively provide 55 million cubic feet of stormwater reduction, a benefit valued at $331.6 million.) These and other facts related to urban trees should be considered when construction costs are analyzed.

Lighting

Landscaping may impact street lighting at traffic calming treatments. Additional lights may be needed to improve or maintain after dark visibility of the street and traffic calming treatments. In the "dark" areas of the City, additional or extensive use of raised pavement markers will be required with possibly additional signing and high-visibility markings to highlight traffic calming treatments.

Maintenance Issues

The introduction of traffic calming treatments will increase street maintenance. Traffic calming treatments should be incorporated into existing curb lines when possible to minimize maintenance. The minimum radii from curb line to the beginning of a traffic calming treatment should be 15 feet to permit mechanical street sweeping. Those treatments with a radius less than 15 feet will have to be swept by hand on a periodic basis.

In some cases where pedestrian crossings are incorporated within treatments, it will be necessary to blow out the pipe under the crosswalk area.

Water must be directed around the treatment and the channel cleaned where there are no convenient drainage inlets.

Ongoing inspection and maintenance of markings and signs that identify traffic calming treatments is critical for proper operation. Traffic calming treatments are to be checked as part of the overall sign and marking inspection program.

The neighborhood has an opportunity to offer advice on landscaping as they develop and approve their neighborhood traffic management plan. The City maintains landscaping within most traffic calming treatments. If the

landscaped area is less than 100 square feet, the City may require the neighborhood to provide maintenance or replace landscaping with concrete.

Where irrigation systems are installed, maintenance requirements will vary with each system. Battery operated controllers require battery replacement at regular intervals. Other controllers require a power supply and meter. Solar powered irrigation controllers may provide a viable alternative that offers reduced maintenance and installation cost.

On major roads, tree canopies should be under-trimmed to provide 13.5 feet of clear trunk height. On neighborhood streets, trees along the road edges should be under-trimmed to provide 8 feet of clear height. Larger vehicles should not be affected by lower neighborhood street tree canopy heights because larger vehicles tend to travel closer to the center of neighborhood streets due to on-street parking. Under-trimming to arterial road standards reduces the visual impact of the trees and may thereby reduce their effectiveness in any traffic calming treatment.

5.3 Treatment Design

Because of the wide variety of environments and problems, it is neither feasible nor desirable to provide standard templates for each treatment. Section 6 provides a layout for each treatment with critical dimensions. It is incumbent on the engineer to fully understand the problem and needs, and to adjust the basic design to meet the situation. To assist in this process, comments on each treatment are discussed below. Each heading includes the Toolbox page number for the treatment.

29-30. Roundabouts

Roundabouts are circular intersections with channelized approaches. Entering traffic must yield to circulating traffic. The design principles of roundabouts and the potential trade-offs are documented in Roundabouts: An Informational Guide, published by the Federal Highway Administration (FHWA). The publication acknowledges there is no one optimal design, and that simply adhering to the principles presented in the guide does not necessarily ensure good design. That is responsibility of the designer.

Design speed

Although roundabouts can be designed for speeds appropriate for traffic calmed areas, the designer must recognize that faster drivers can negotiate roundabouts 5 to 8 mph over the design speed. Recommended design speeds are listed below.

Roadway Classification	Design Speed
Local	12 – 15 mph
Collector	15 – 18 mph

When pedestrians are likely to use the roundabout, entry and exit design speeds should be about the same. Careful attention must be paid to the deflection for speed control along the through leg of the T.

Design Vehicle

Before designing a roundabout the designer needs to confirm the design vehicle for each maneuver. Often a roundabout can be designed using different design vehicle for different movements in order to produce the best overall design. The typical design vehicle for most roundabouts is a fire utility vehicle or

the ladder truck. On smaller roundabouts it is permissible to drive the fire truck over mountable splitter islands. In some locations it is not possible to design a roundabout to control vehicle speeds and permit buses to make left and right turns. Under this circumstance, a truck apron that is only 3 inches high with a tapered curb can be used. This is lower than the preferred design, but the lower height reduces the impact on bus passengers as the bus rides up onto the truck apron and down again. If the required turning movements cannot be accommodated, an intersection table, as discussed on page 29, could be used instead of a roundabout.

Splitter Islands

Splitter island curbs can be reduced to four inches to allow the large emergency vehicles to drive over the islands. The Keep Right sign must also be deleted on mountable splitter islands. This limits the ability of drivers to detect the splitter island, especially at night. Lighting is very important. Limited right-of-way may require the occasional use of painted islands, rather than raised islands. These islands do not provide the same physical protection for pedestrians the six-inch curbs provide and should be used sparingly.

Pedestrian Crossings

The safest time for a pedestrian to cross the street in a roundabout is between stopped cars. When a vehicle of average length (10 ft to 16 ft) stops at the yield point, the second car typically stops four feet behind it. The most likely area for a gap between the stopped cars is between 14 and 20 feet, between the first and second cars. Locate pedestrian crossings 20 feet back from the roundabout entry point, or as close as 15 feet if necessary to avoid driveway conflicts. The Manual on Uniform Traffic Control Devices (MUTCD) permits crosswalks as narrow as eight feet wide in areas of relatively low pedestrian volume, which may also help eliminate driveway conflicts. If necessary, the driveway can be redesigned and extended through the curb extension or bulb out at the roundabout.

Roundabouts on Hills

No research yet provides any guidance for roundabouts on a grade. Anecdotal information suggests that a 5 to 6 percent grade might be the upper limit. When designing roundabouts on hills, there are several items to consider. First, the grade on the circulating roadway can vary from –4 percent to 2 percent for through movements. A positive grade or no grade can be provided where necessary on the circulating roadway opposite the splitter island. The splitter island(s) on any leg that slopes away from the roundabout must be extended so approaching drivers see the island before they see the roundabout.

Center Island Landscaping

On large roundabouts, a clear zone of 15’ from the edge of the center island to any visual obstruction is recommended. Trees with up to a 4” trunk diameter are recommended for smaller roundabouts to provide visibility for drivers entering the roundabout as well as to provide a visual indication to oncoming drivers that there is an obstruction ahead.

Manhole Covers

Manhole covers are often located within intersections and may be in line with the curb lines of a roundabout. When they coincide with the

curb line of the central island or the outside curb line of the central island diameter, the exterior diameter can be enlarged or reduced by one or two feet to fully contain the manhole or to totally exclude it from the curb line. On rare occasions it may be necessary to have the manhole cover in the curb line, then the curb should be shaped to create a "pocket" around inside of the manhole.

Signing

The MUTCD, Part 2, Signing, defines the standard YIELD sign and standards for placement. Note that the use of the yield sign and yield marking on roundabouts are not mandated, but that when a YIELD line is used to supplement a YIELD sign, Part 2 provides Guidance suggesting the YIELD line should be located at a point where the road user should yield. The depiction of these standards and Guidance as shown in Figure 3B-26 should not be construed as precise applications of the MUTCD.

Drainage Inlets

Inlets within a standard intersection must often be moved because of conflicts with curb ramps. Curb ramps in a roundabout intersection are typically placed in advance of the right turn radius, allowing inlet placement in the center of the right turn radius.

Small Roundabouts

In narrow residential streets, the addition of raised splitter islands to small roundabouts is not always possible. In these cases, the splitter islands can be painted or raised three inches so larger vehicle can turn over the island. Keep Right signs are unnecessary and only one Yield sign per approach is used in combination with the central island one-way sign. A small tree in the center is desirable to provide increased visibility on the small roundabout.

32. Modified Tee Intersection

There are several techniques for modifying the priority of Tee intersections. The standard treatment is shown in the Toolbox. An alternate design is to permit the through movement farthest from the terminating leg to be a straight through movement with the reverse through movement diverted to their right if this layout better suits the problem being addressed.

33. Intersection Table

An intersection table allows all movements by all vehicles, an advantage over some roundabouts. To ensure vehicles stay within the intersection area bollards or other barriers must be placed around the right turn radii. The intersection table is also widened to encompass the pedestrian crosswalks so pedestrians do not have to step down and up at the curb lines.

34. Modified Intersection/realignment

At many intersections streets do not intersect at 90 degrees, radii are large, streets are offset from another street and other streets intersect nearby. The resulting variable angle and large, open expanses of asphalt often create unpredictable or erratic vehicle movements. Redesigning these intersections to more conventional geometry, in which streets intersect at or close to 90 degrees with smaller radii and have improved separation between various streets, can take many forms. The simplest method is to separate each intersection as much as possible, then determine the necessary, standard vehicle

movements. Any space not required by vehicles for standard movements is converted to landscape space. To simplify vehicle conflicts, some vehicle movements may need to be blocked with medians and islands. These types of intersection redesigns often create an opportunity to improve pedestrian crossings by providing curb extensions and short medians.

35-36. Radii Reduction, Curb Extensions, and Bulb outs

Some intersections have large radii that permit higher than desirable turning speeds. In these cases reducing the turn radii and extending the curb into the street to create a curb extension will shorten the pedestrian crossing distance and turning speed of vehicles. It is important to determine the design vehicle requirements when selecting radii for either of the above changes. In some cases the right turn exit radii of a street can be smaller than the entry radii. According to AASHTO, it is permissible to require large vehicles to turn across the centerline of the street they are entering.

Drainage must be addressed because bulb outs can reduce on-street drainage capacity and disrupt gutter flow. On streets with existing curbs and streets where no major drainage improvements are planned, there are two options:

1. The existing gutter flow can be adjusted so the water flows along the new curb line. This may require adjusting the length and location of the bulb out to accommodate an existing inlet, moving the existing inlet, or installing a new inlet on the upstream side of the bulb out to convey storm runoff to an existing inlet.
2. Leave the gutter in place between the bulb-out and the existing curb line. Install a checkered steel plate between the existing curb for the sidewalk and the new curb for the bulb-out. The bulb out should be designed to invite pedestrians to cross onto the bulb-out to access curb ramps or crosswalks at the checkerplate or over the pipe laid in the gutter. Only checkered plates that are bolted down are to be used to avoid creation of tripping hazards. Landscaping or special treatments should inhibit pedestrians from attempting to cross onto the bulb-out at any other location.

Other Considerations:

- Vertical curbs are to be used unless mountable curbs are necessary to accommodate turning trucks and buses.
- A transition radius as small as 6 feet is acceptable at bulb out connections to existing curbs, but a 15 foot radius is preferred, when possible, to facilitate street sweeping. The larger radius also makes it easier for drivers to park their vehicles. Combine mid-block bulb-outs and crosswalks whenever possible.
- Driveways can be accommodated by locating driveway aprons along the bulb out edges or by shortening the bulb out so it does not encroach on the driveway.
- If a bicycle lane is marked, the bulb out should not encroach into the lane.

Signing and Marking

An edge stripe with raised pavement markers (RPM) is used to define the edge of the travel-

way and/or edge of the street parking. If a bulb-out diverts two travels lanes into one, striping and signing is required in order to channelize vehicles into the inner lane.

37-38. Short Medians at Intersections/ Gateways

Short medians at intersections provide a number of benefits. When designing them it is useful to consider that the turning paths of vehicles turning out of a street is often narrower than the path when making a left or right turn into the street. Therefore, the exit lane can be narrower than the entry lane into the street. Typically, the exit lane can be narrowed to 10 or 11 feet with the entry lane being widened to approximately 14 feet. Use of truck templates is important to confirm the chosen lane widths.

39. Partial Closure

The design of these treatments require careful consideration regarding drainage and street sweeping. They can have square ends which require manual sweeping of the gutters or radii that permit mechanical street sweeping.

40. Median Barrier

A cut-through should be provided in the median for pedestrian and bike crossings. Median barriers can become useful as pedestrian refuges if they are six or more feet wide.

41. Diagonal Closure

It is important to ensure pedestrian and bicycle access across the diagonal closure. Bicycle access can be provided with simple a cut-through of the diagonal diverter. A barrier is sometimes necessary within the diagonal diverter to stop vehicles driving over the treatment. Trees are useful both as a barrier to errant vehicles and to highlight the treatment from a distance.

42. Street Closure

There are many techniques to close streets, from a simple barrier to conversion of a whole block to a park or playground. Treatments with extensive landscaping can change what can be an unattractive barrier to an aesthetic landscaped area. The closure can be extended to the first driveway to maximize landscape area. Bike access and sidewalks through the treatment are essential. In rare cases, a driveway section can be provided through the center of the treatment with frangible posts that the emergency vehicles can break if they absolutely must go through the treatment.

43. Oval Median

Care needs to be taken with drainage when designing these treatments. A low point is created at the intersection of the curb and gutter if the road is widened into the planter strip. Sometimes it is necessary to install a truck apron on the central island sides to allow large vehicles to pass through the treatment.

44. Chicanes

The most important part of chicane design is to ensure that the edge of each chicane island reaches the street centerline. It may be necessary to ban parking within the chicane. Chicanes are most effective where traffic volumes are balanced in each direction. Placement of chicanes will depend on site conditions such as driveway locations.

45. Median with Tree Wells

These treatments control speed by limiting the space between tree wells and the median. The longer the separation between the trees wells and the shorter median, the higher vehicle speeds will be. Trees are very important in these designs to provide good recognition of the treatments. Signing is minimal with only barrier signs and keep right signs being required. The median must be wide enough to deflect drivers a substantial distance from their travel path.

46. Medians on Curves

Typically, medians on curves are to be a minimum of 18 inches wide. In some cases where this is not possible the use of large pavement markers that are typically 8 to 12 inches wide laid at 90 degrees to the travel lane can provide a substantial barrier to drivers who wish to cut across the centerline of the street. It is important to provide openings in the medians at driveways. In some cases, the openings may be spaced such that the median will have to be extended around the curve and along the straight section of the road to provide reasonable visibility of the median.

47. Driveway Link

This treatment is designed to create the illusion that the street has been closed and a park has been created. Construction of the treatment includes a driveway through the treatment that links both sides of the street . The driveway link is a similar to a typical driveway in that it rises above the existing road level, becoming a very long speed table. Two options have been used to construct these treatments. One option is to lay pavers on top of the existing street surface; the other is a full reconstruction. Landscaping essential to limit the apparent width of the road is very important, as the deflection through the driveway may not be large.

48. Angled Slow Points

These treatments can be designed in a variety of ways. Some are useful for on narrow streets and others for use only on wide streets. They can also be used in conjunction with vertical deflection. On wide streets where a two-lane treatment is to be used, it is important to use a raised median in the center to stop drivers taking a relatively straight path through the treatment. On the single lane version, a speed table may be necessary.

49-50. Speeds Humps and Speed Tables

It is important to ensure that ramps and treatment height is not too low or ramp tapers too long. If the rate of change in vertical position is too forgiving drivers will be able to go over these treatments at a fast rate of speed. The ends of speed humps and speed tables are another critical part of the design. When the ends are designed in a forgiving, easy taper, drivers can put one set of wheels in the gutter and go over the speed hump at high speeds, sometimes in excess of 40 mph. Vertical curb to deter this behavior is preferred.

51. Short medians

This treatment is appropriate for wide streets to reduce travel lane width, provide pedestrians with crossing refuge areas and to prevent drivers from passing other vehicles. A series

of medians varying in length are located between driveways. Space between the medians is slightly wider than the driveway to allow motorists room to turn into and out of their driveways. A simple design technique is to locate each driveway, project it to the center of the road, and widen the projection by 3 to 5 feet. The space not required for driveways becomes a median. Medians do not deflect vehicles, so it is important to minimize the lane width to allow a high level of landscaping to visually narrow the street. The City of Encinitas does not landscape medians less then five feet wide.

52. Raised Pedestrian Refuge

This is a short median provided as a refuge island for pedestrians crossing the road. It should have at least 20 feet of raised island on either side of the crosswalk to give pedestrians a sense of security. These refuges can be supplemented with curb extensions to shorten crossing distance. The cut-through in the refuge can be perpendicular to the cross walk or angled at 45 degrees to encourage pedestrians to look for approaching vehicles.

53. Woonerf

This treatment is better used as part of new street construction or the reconstruction of an existing short street. The intent is to provide a very low speed vehicle environment by using a single 10 or 11 foot lane that can be used by service and emergency vehicles, but which discourages high speed by vehicles. There are many design techniques available for this treatment. Parking can be provided between curb extensions.

54. Street Narrowing

Addition of curb and gutter can physically and visually narrow a street, especially if the curb and gutter is brought in from the existing edge of pavement. The curb and gutter will improve drainage, stop damage to the planter strip, and force drivers to park on the road pavement instead of the planter strip or sidewalks. During the design of this treatment, it is useful to consider the addition of other traffic claming treatments and curb extensions to help protect parking spaces.

55. Centerlines

Centerlines create certainty. They provide drivers with clear information regarding placement and offset of approaching vehicles. This allows drivers to proceed with certainty and be comfortable traveling at higher speeds. The loss of certainty when the centerline is removed helps to slow drivers, particularly on short streets.

56. Bike Lanes

Bike lanes designate travel space for bicyclists, which increases rider comfort and the predictability of bicyclist movements. This added travel space also makes it feasible for motorists to encroach into the space designated for bicyclists and travel faster through or around traffic calming treatments. Limiting bike lanes to streets with more than 1,500 vehicles per day prevents this adverse impact in residential areas. There are generally few conflicts between bicyclists and vehicles in low-speed, low-volume residential areas.

In places where bike lanes are provided the designer must be aware that motorists will

drive over painted lines and adjust the design accordingly. One technique is to move curb extensions or islands between the bike lanes and the treatment. Care must be taken to ensure the design does not set up potential conflicts between pedestrians and bicyclists.

57. On Street Parking

On street parking should be encouraged on all residential streets. Parked vehicles can narrow the street to a single lane, forcing drivers to pull into driveways or empty spaces between parked vehicles to let an opposing vehicle pass. This reduces the speed of both vehicles.

6.0 Traffic Calming Treatment Design Guidelines

Traffic calming, or the management of traffic within neighborhoods, was originally developed in Holland and Australia in the early 1970's. Although its use is increasing throughout the U.S., there are no national design standards for the design of these treatments or for how to sign and mark them. The design guidelines that follow are a collection of traffic calming treatments based on the latest information using standard engineering design techniques and philosophies. Where possible, signs and markings from the MUTCD are shown in the guidelines. Where necessary, enhancements have been added.

Some of these treatments are based on Design Standards from Australia, which has an almost identical neighborhood environment as the U.S. Other treatments are commonly used in the U.S.

Since there is no optimum design for treatments or any consistency in the environment in which they are to be used, these guidelines are intended to serve only as a guide to indicate the basic geometry and sign layout for each treatment. The design engineer can use the basic layout and underlying philosophy to help them design each treatment to suit each location in relationship with adjacent treatments.

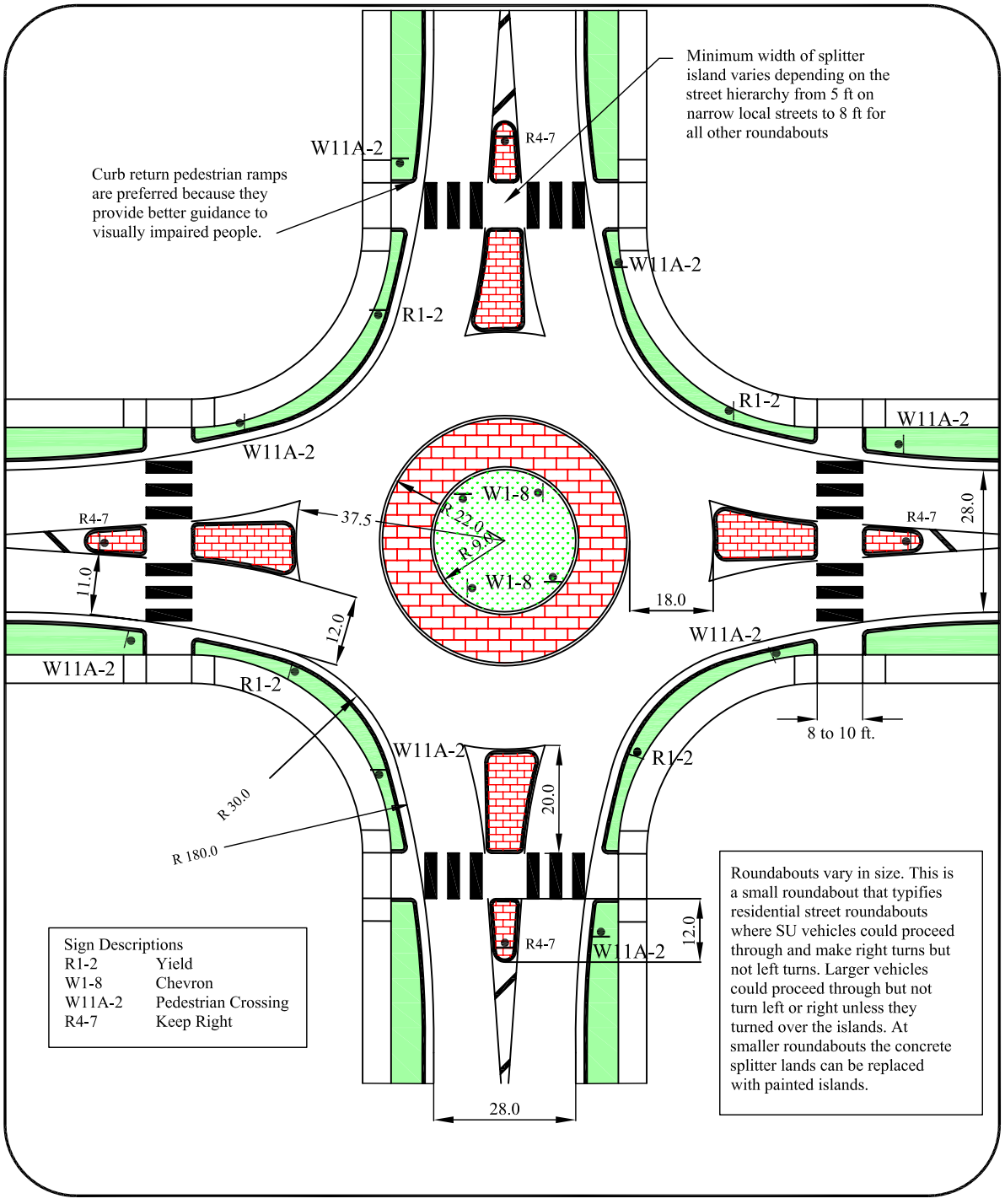
These layouts do not go into detail about drainage, utilities, lighting or landscaping. These items are specific to each situation and vary considerably. More information about the impacts of these and other items is included in section 5.0, Design Considerations.

It will be necessary for lighting to be checked, drainage adjusted or a treatment designed so that it has little to no impact on drainage. Landscaping is an important element of each horizontal deflection treatment and where possible landscape materials should be provided where feasible to enhance both the visibility and appearance of each treatment.

When designing each treatment it is necessary to confirm the design vehicle/s, each movement for design vehicle/s. Often different design vehicles can be specified for different movements. Appropriate design speeds should be selected and the speed curves included within these guidelines used to design each treatment.

Figure 4. Cross Reference Guide

Treatment	Toolbox Page #	Design Considerations Page #	Layout Figure #
Roundabout	29-30	65-67	D-1
Traffic Calming Circle	31		D-2
Modified Tee Intersection	32	67	D-3
Intersection Table	33	67	D-4
Modified Intersection/Realignment	34	67	D-5
Curb Radius Reduction	35	68	D-6
Curb Extensions/Bulb Outs	36	68	D-6
Short Median at Intersection	37	69	D-7
Gateway Treatment	38	69	D-8
Partial Closure	39	69	D-9,10
Median Barrier	40	69	D-11
Diagonal Closure	41	69	D-12
Street Closure	42	69	D-13
Oval Median	43	69	D-14
Chicane	44	69	D-15
Median with Tree Wells	45	70	D-16
Median on Curve	46	70	D-17
Driveway Link	47	70	D-18
Angled Slow Points	48	70	D-19,20,21
Speed Hump	49	70	D-22
Speed Table	50	70	D-23
Short Medians	51	70	D-24
Raised Pedestrian Refuge	52	71	D-25
Woonerf	53	71	
Narrow Street: Add Curbs	54	71	
Centerlines	55	71	
Bike Lanes	56	71	
On-street Parking	57	72	



All dimensions in feet unless otherwise noted.

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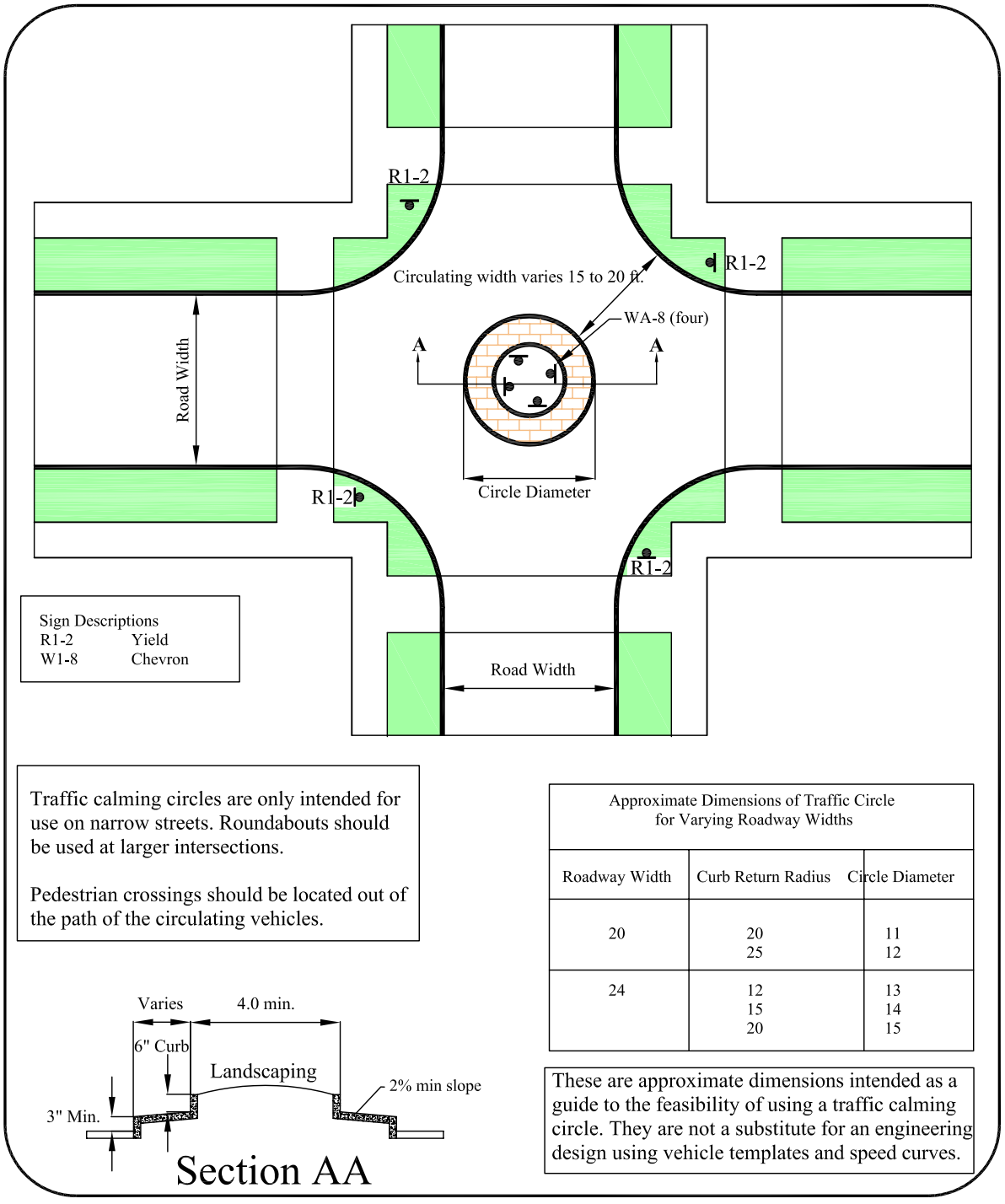
ROUNDABOUT

FIGURE D-1



Traffic calming circles are only intended for use on narrow streets. Roundabouts should be used at larger intersections.

Pedestrian crossings should be located out of the path of the circulating vehicles.

Approximate Dimensions of Traffic Circle for Varying Roadway Widths

Roadway Width	Curb Return Radius	Circle Diameter
20	20 25	11 12
24	12 15 20	13 14 15

Section AA

These are approximate dimensions intended as a guide to the feasibility of using a traffic calming circle. They are not a substitute for an engineering design using vehicle templates and speed curves.

All dimensions in feet unless otherwise noted.

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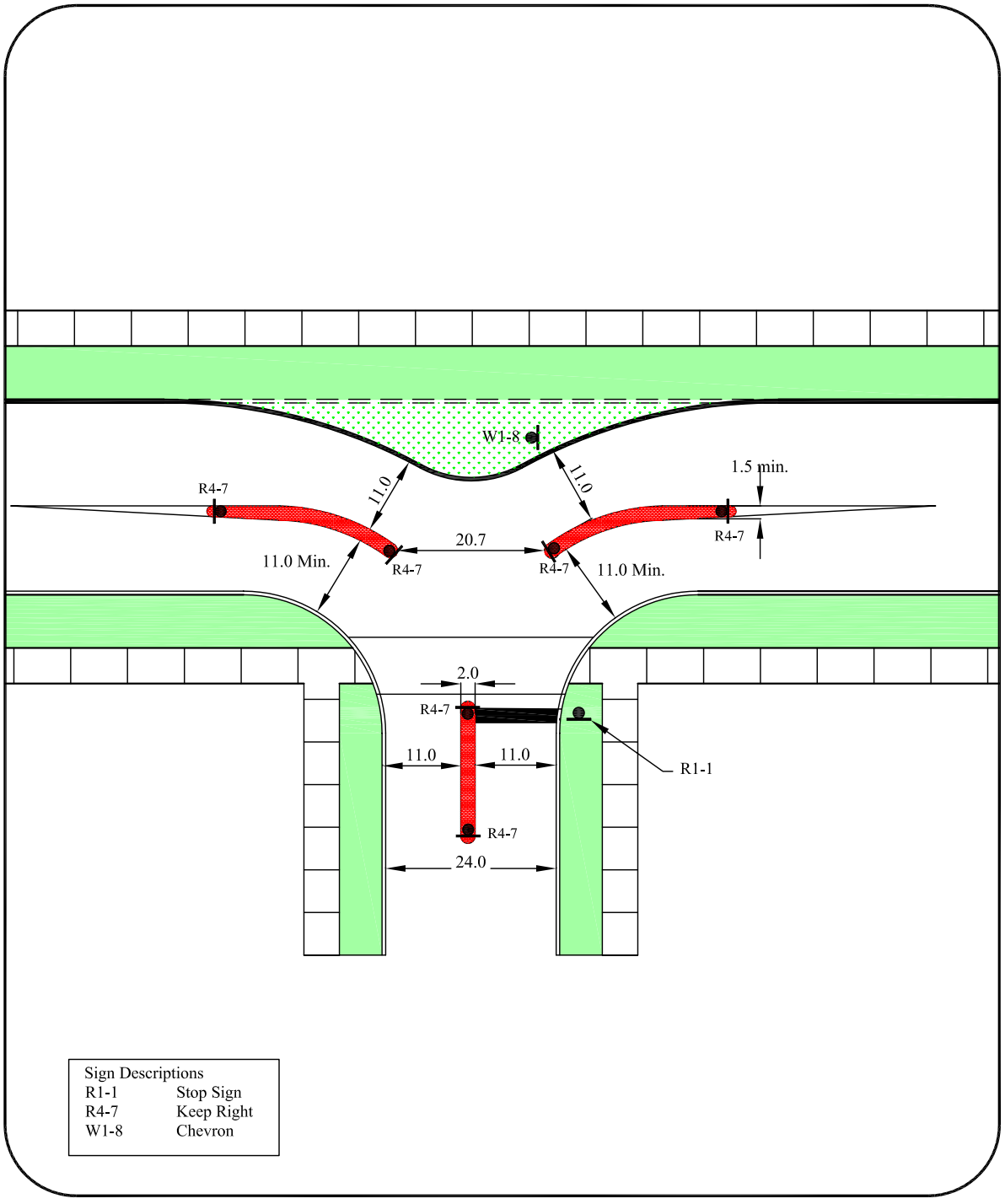
TRAFFIC CIRCLE

FIGURE D-2



All dimensions in feet unless otherwise noted.

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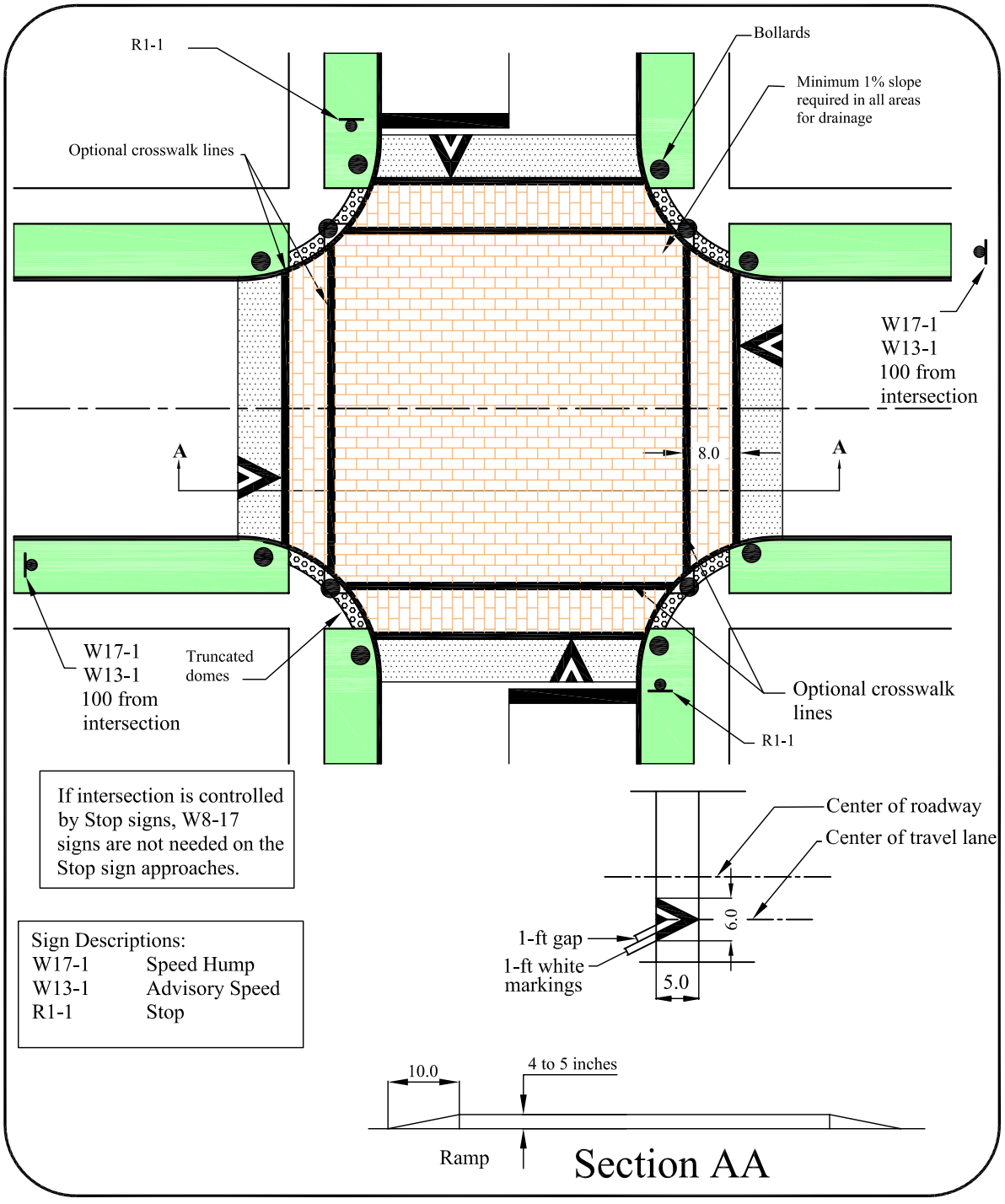
MODIFIED TEE INTERSECTION

FIGURE D-3



All dimensions in feet unless otherwise noted.

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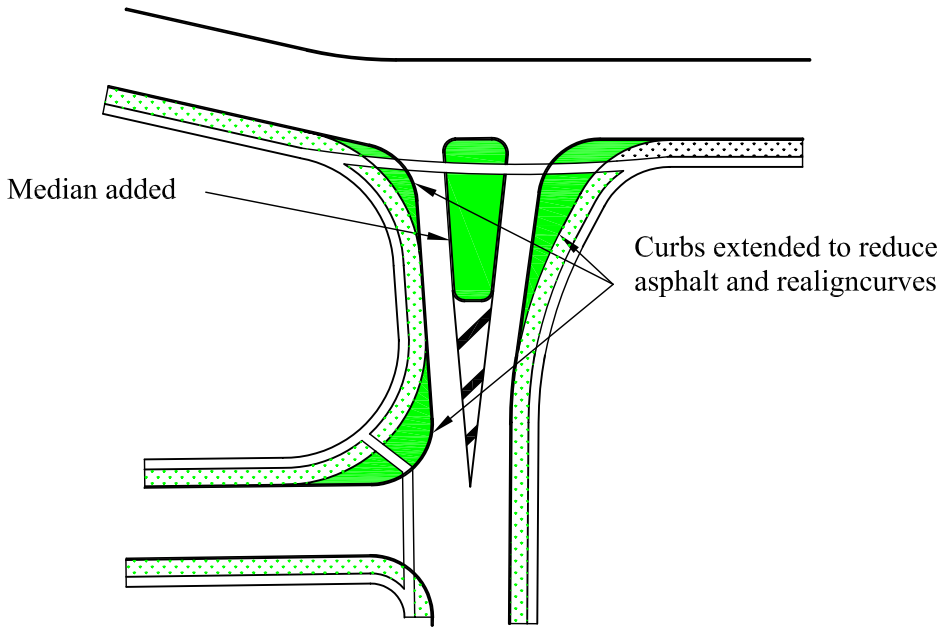
INTERSECTION TABLE

FIGURE D-4



Intersection redesigns can take many forms. This is just one example. Typical techniques include reducing corner radii, realigning streets to as near as possible to 90 degrees, adding medians, moving streets that are offset to the primary intersection away from the primary intersection, adding bulb outs, etc.

All dimensions in feet unless otherwise noted.

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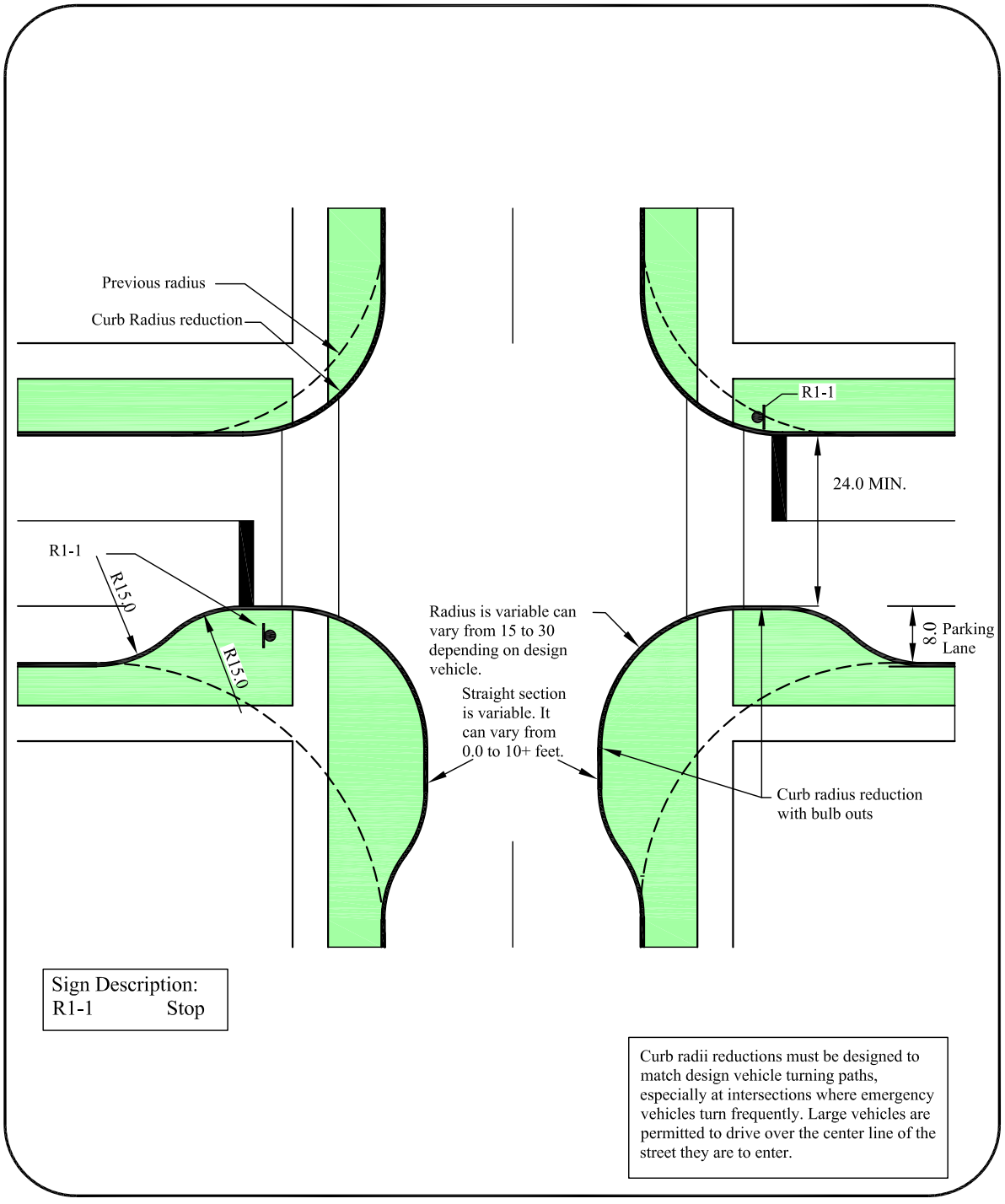
MODIFIED INTERSECTION/REALIGNMENT

FIGURE D-5



All dimensions in feet unless otherwise noted.

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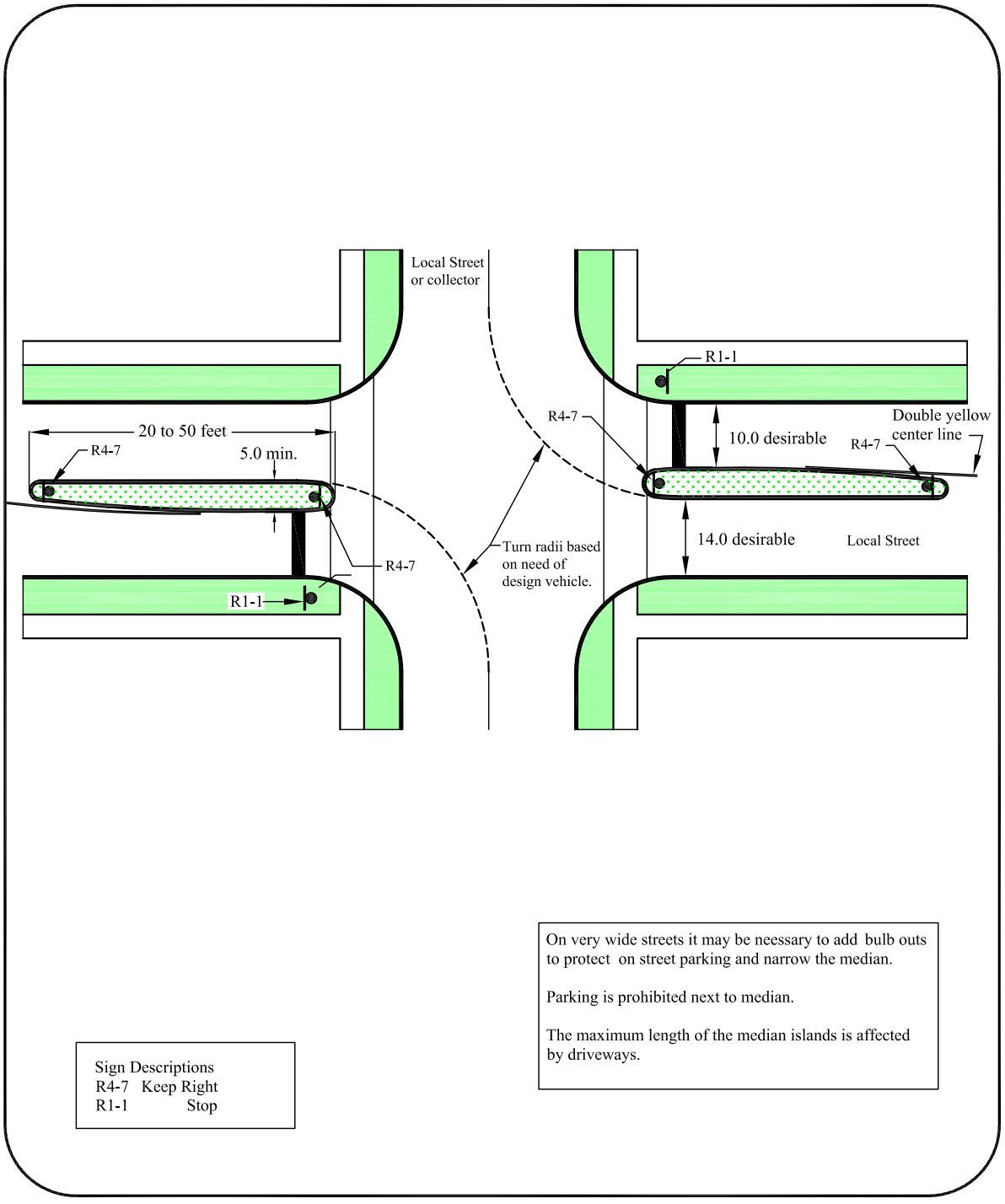
CURB RADIUS REDUCTION, CURB EXTENSIONS

FIGURE D-6



Sign Descriptions
R4-7 Keep Right
R1-1 Stop

On very wide streets it may be neessary to add bulb outs to protect on street parking and narrow the median.

Parking is prohibited next to median.

The maximum length of the median islands is affected by driveways.

All dimensions in feet unless otherwise noted.

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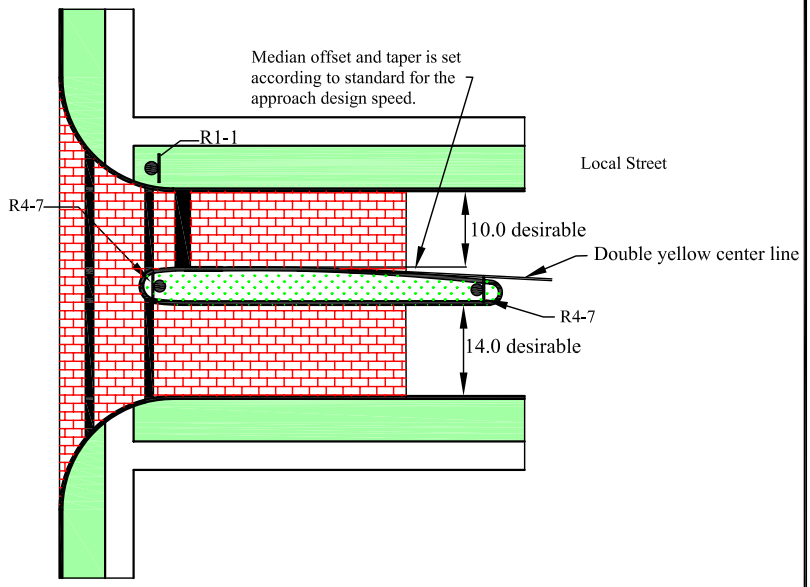
SHORT INTERSECTION MEDIAN

FIGURE D-7



A median with changes in pavement provide a change in the entry environment of a street.

Pavement changes can consist of brick paving, colored asphalt, colored concrete or a textured pavement.

The maximum length of the median islands is affected by driveways.

Parking is not permitted next to median.

Sign Descriptions
R4-7 Keep Right
R1-1 Stop

All dimensions in feet unless otherwise noted.

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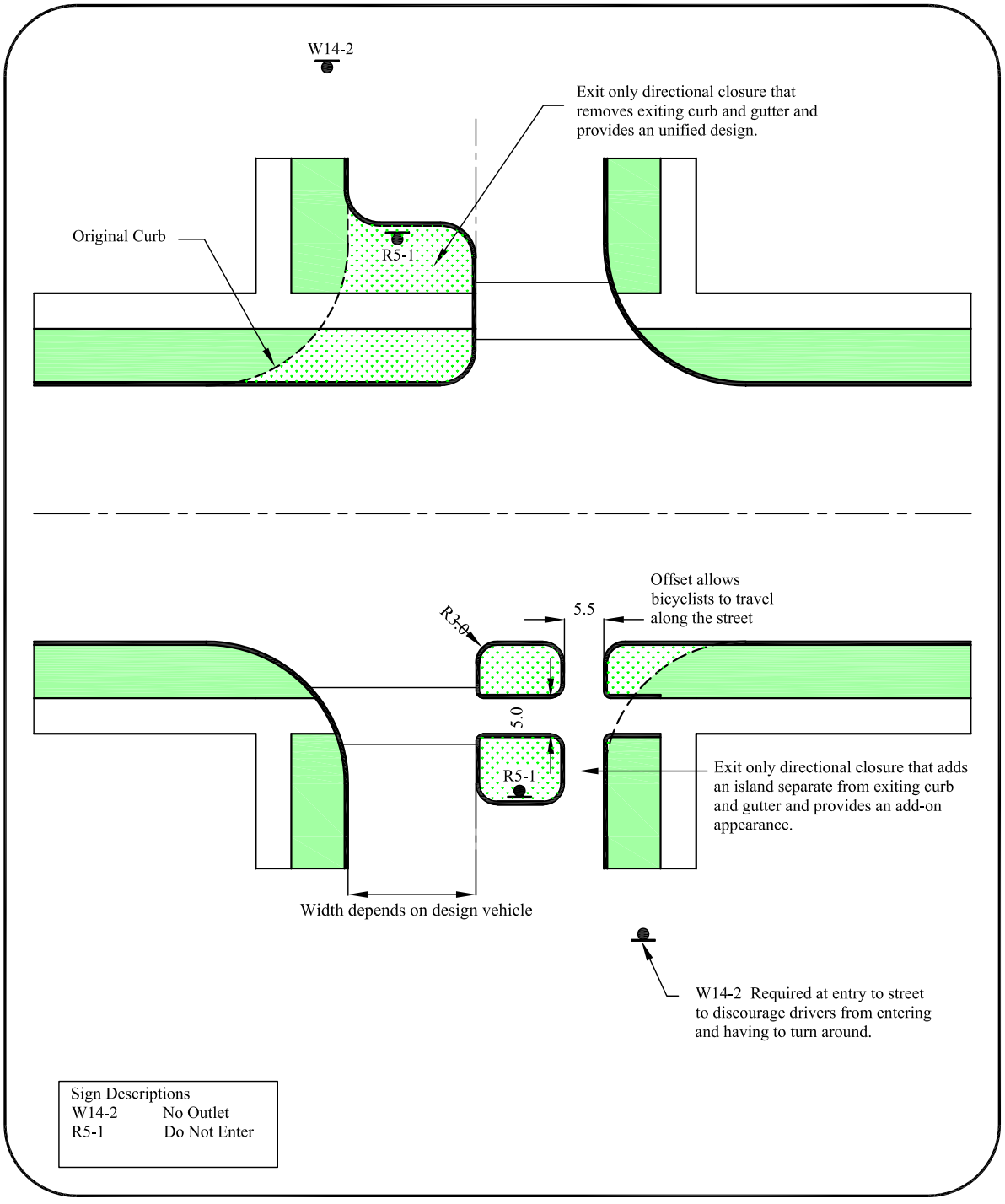
GATEWAY TREATMENT

FIGURE D-8



All dimensions in feet unless otherwise noted.

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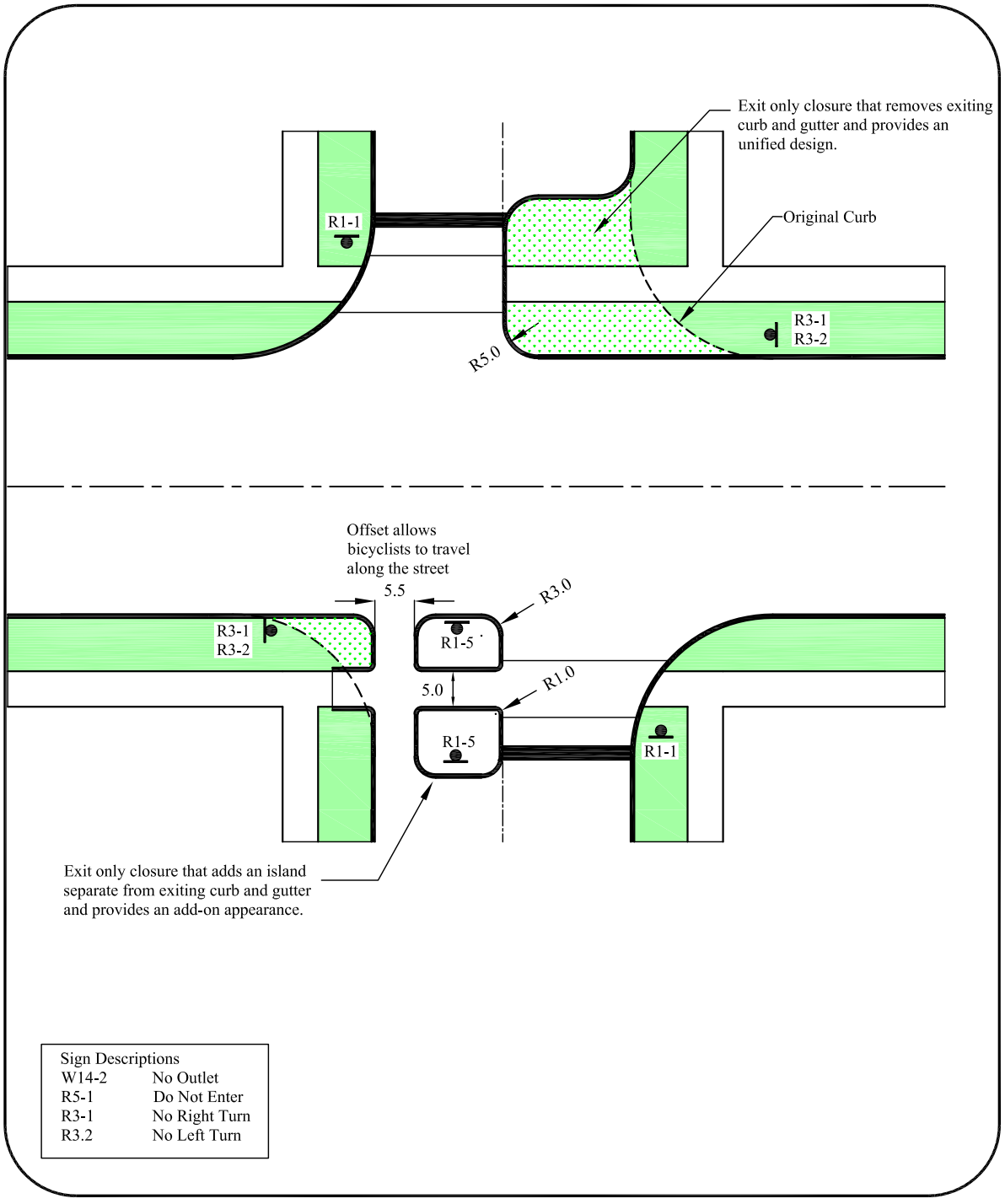
PARTIAL CLOSURE (ENTRANCE ONLY)

FIGURE D-9



Sign Descriptions	
W14-2	No Outlet
R5-1	Do Not Enter
R3-1	No Right Turn
R3.2	No Left Turn

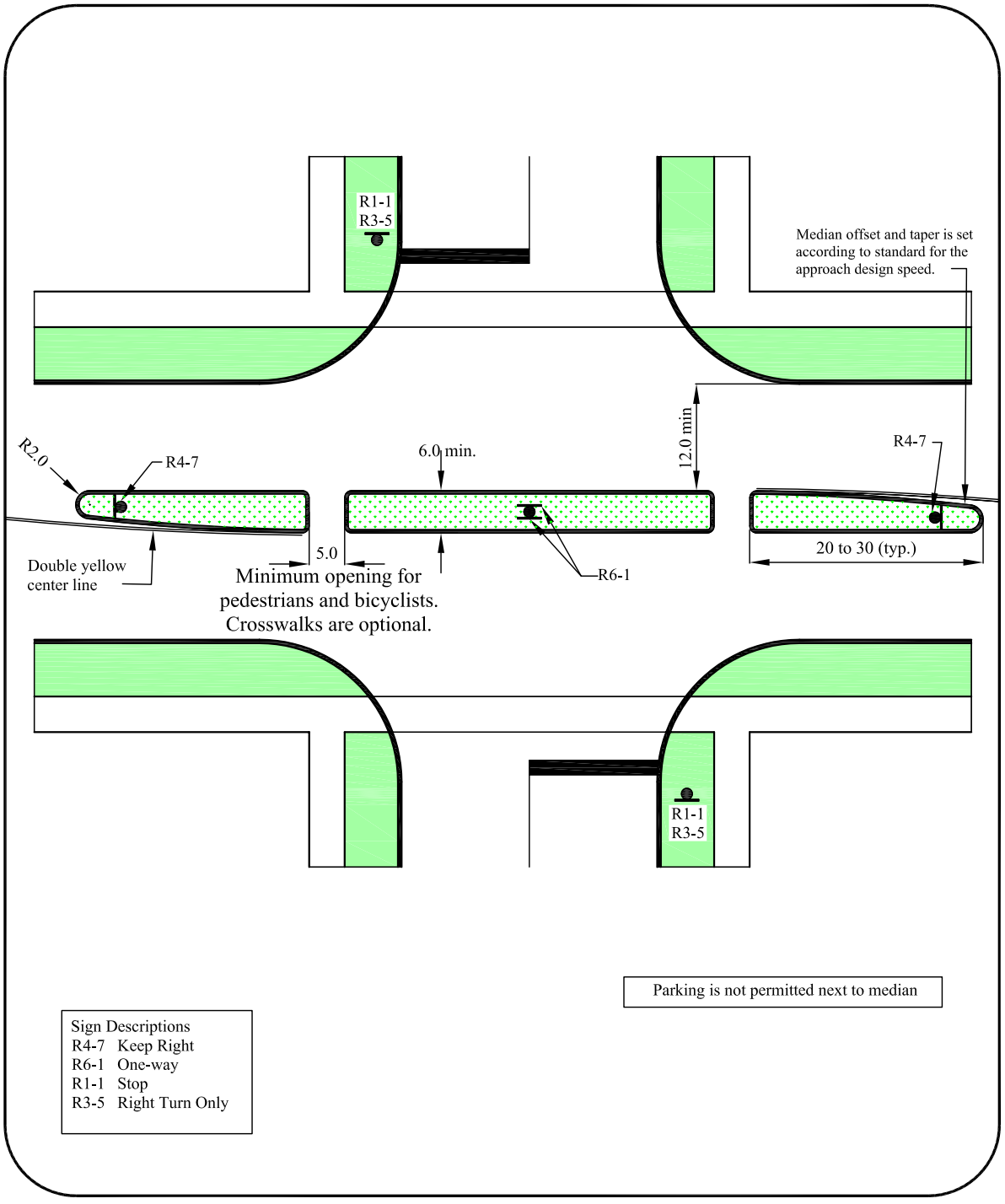
All dimensions in feet unless otherwise noted.

NOT TO SCALE

DEPARTMENT OF
ENGINEERING SERVICES

PARTIAL CLOSURE (EXIT ONLY)

FIGURE D-10



All dimensions in feet unless otherwise noted.

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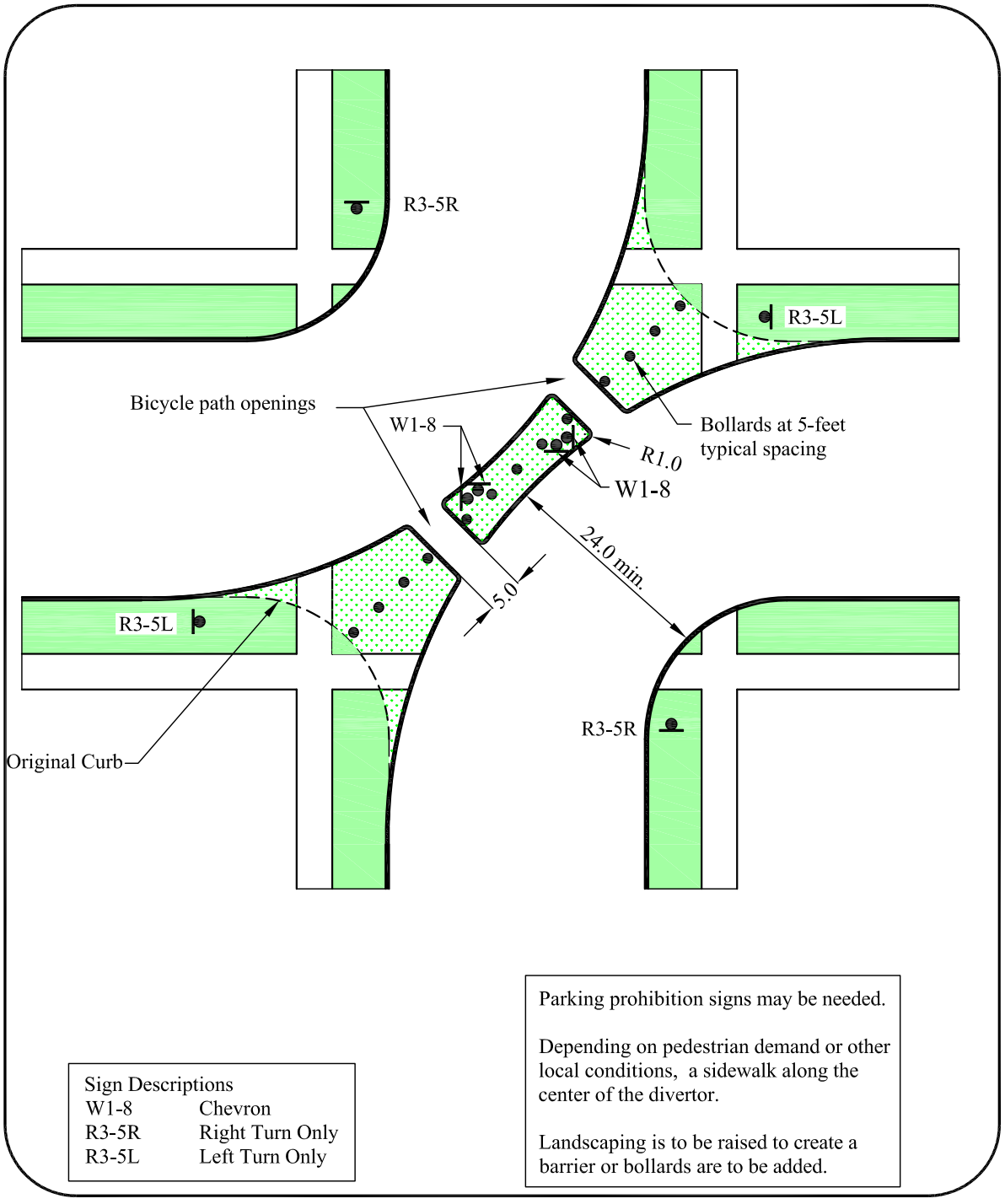
MEDIAN BARRIER

FIGURE D-11



Sign Descriptions	
W1-8	Chevron
R3-5R	Right Turn Only
R3-5L	Left Turn Only

Parking prohibition signs may be needed.

Depending on pedestrian demand or other local conditions, a sidewalk along the center of the divertor.

Landscaping is to be raised to create a barrier or bollards are to be added.

All dimensions in feet unless otherwise noted.

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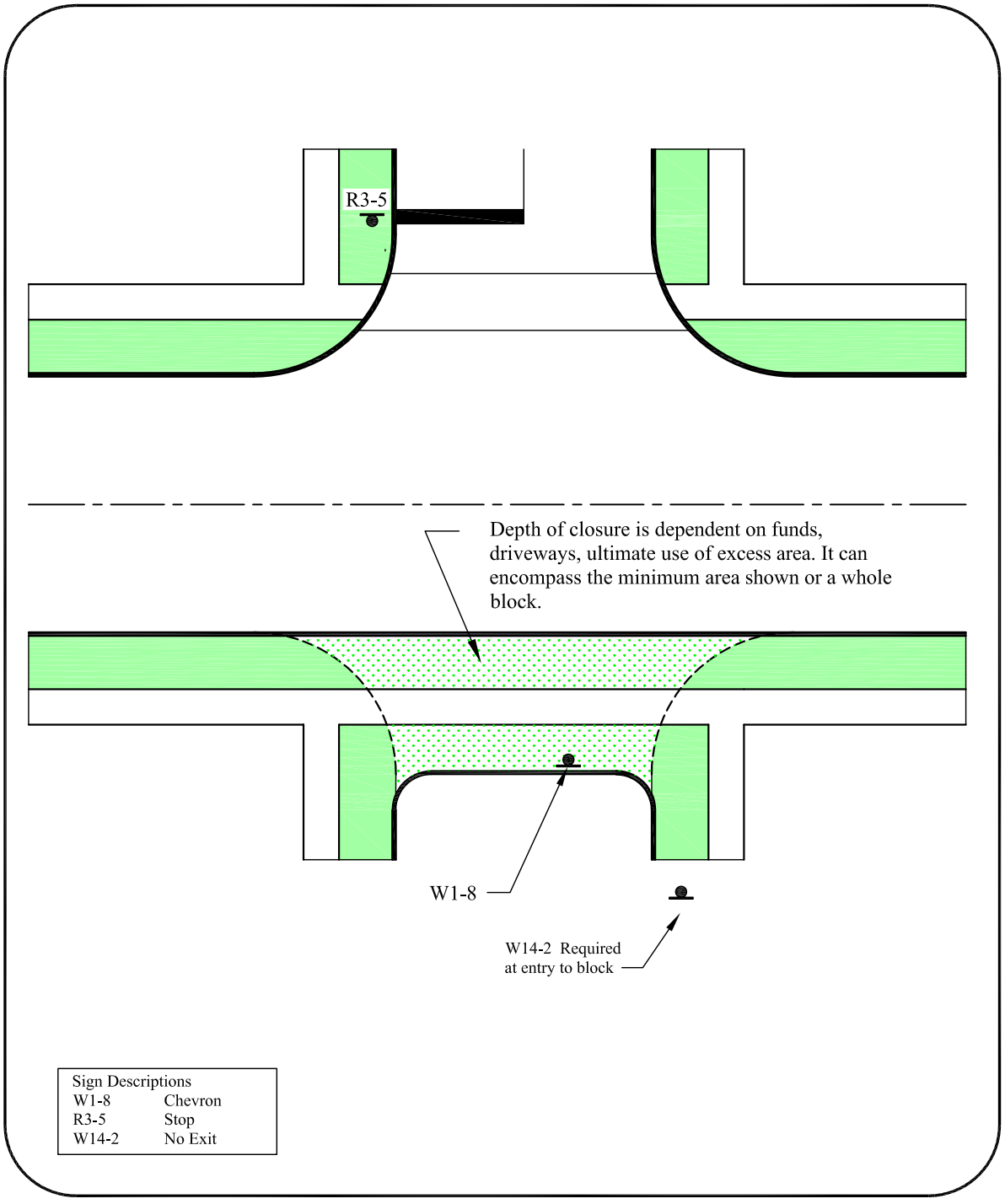
DIAGONAL DIVERTER

FIGURE D-12



All dimensions in feet unless otherwise noted.

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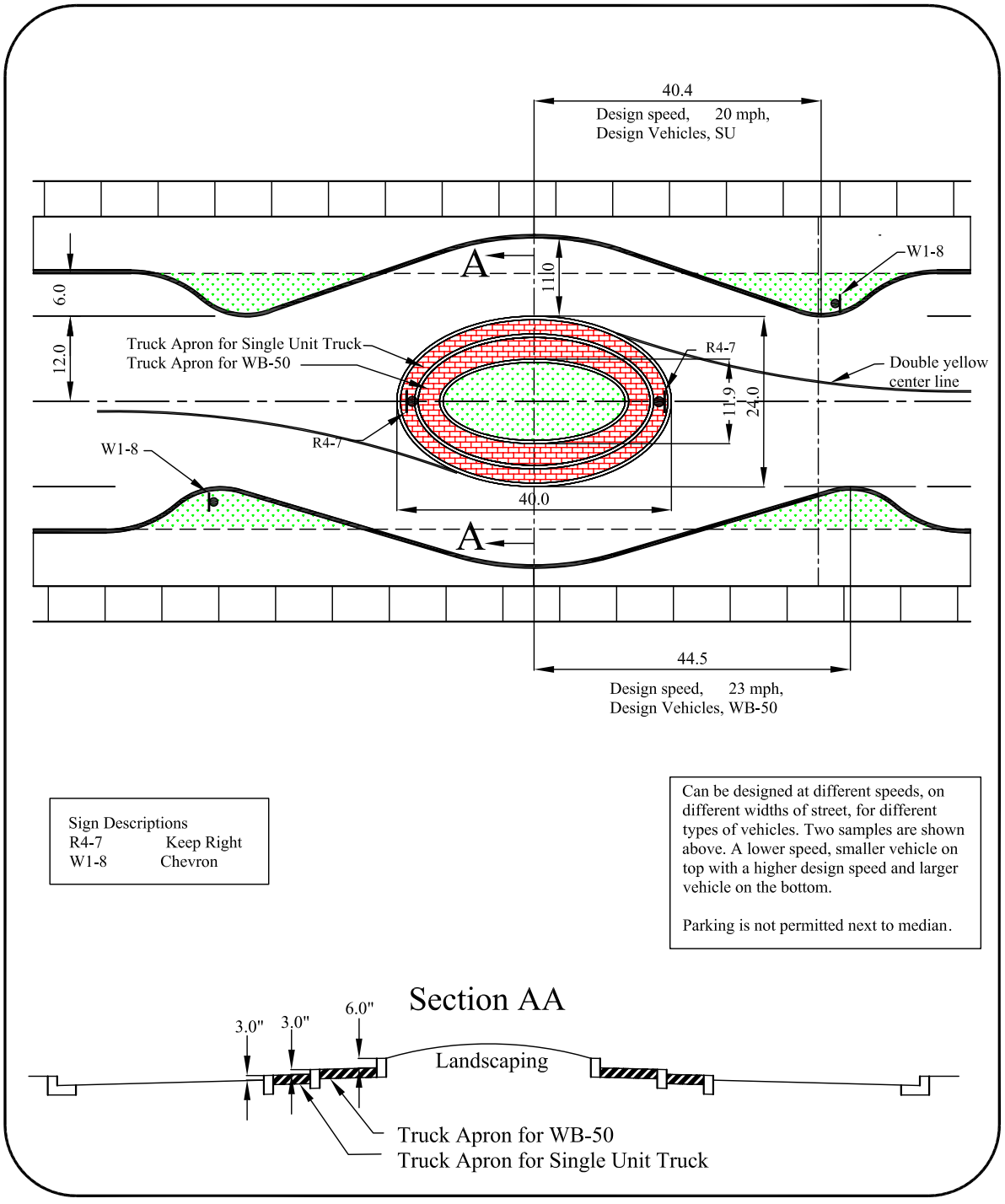
STREET CLOSURE

FIGURE D-13



All dimensions in feet unless otherwise noted.

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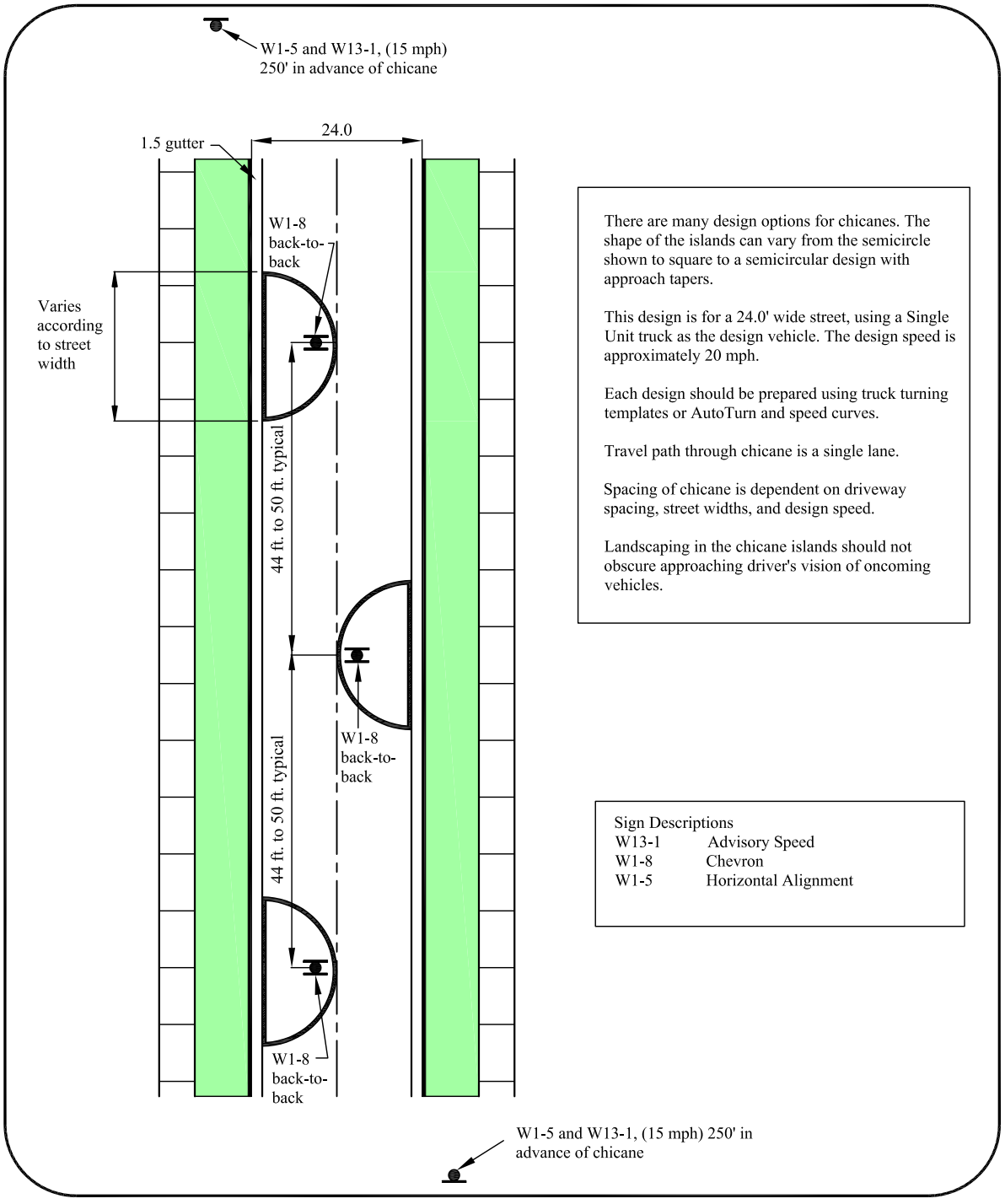
OVAL MEDIAN

FIGURE D-14



There are many design options for chicanes. The shape of the islands can vary from the semicircle shown to square to a semicircular design with approach tapers.

This design is for a 24.0' wide street, using a Single Unit truck as the design vehicle. The design speed is approximately 20 mph.

Each design should be prepared using truck turning templates or AutoTurn and speed curves.

Travel path through chicane is a single lane.

Spacing of chicane is dependent on driveway spacing, street widths, and design speed.

Landscaping in the chicane islands should not obscure approaching driver's vision of oncoming vehicles.

Sign Descriptions

W13-1	Advisory Speed
W1-8	Chevron
W1-5	Horizontal Alignment

All dimensions in feet unless otherwise noted.

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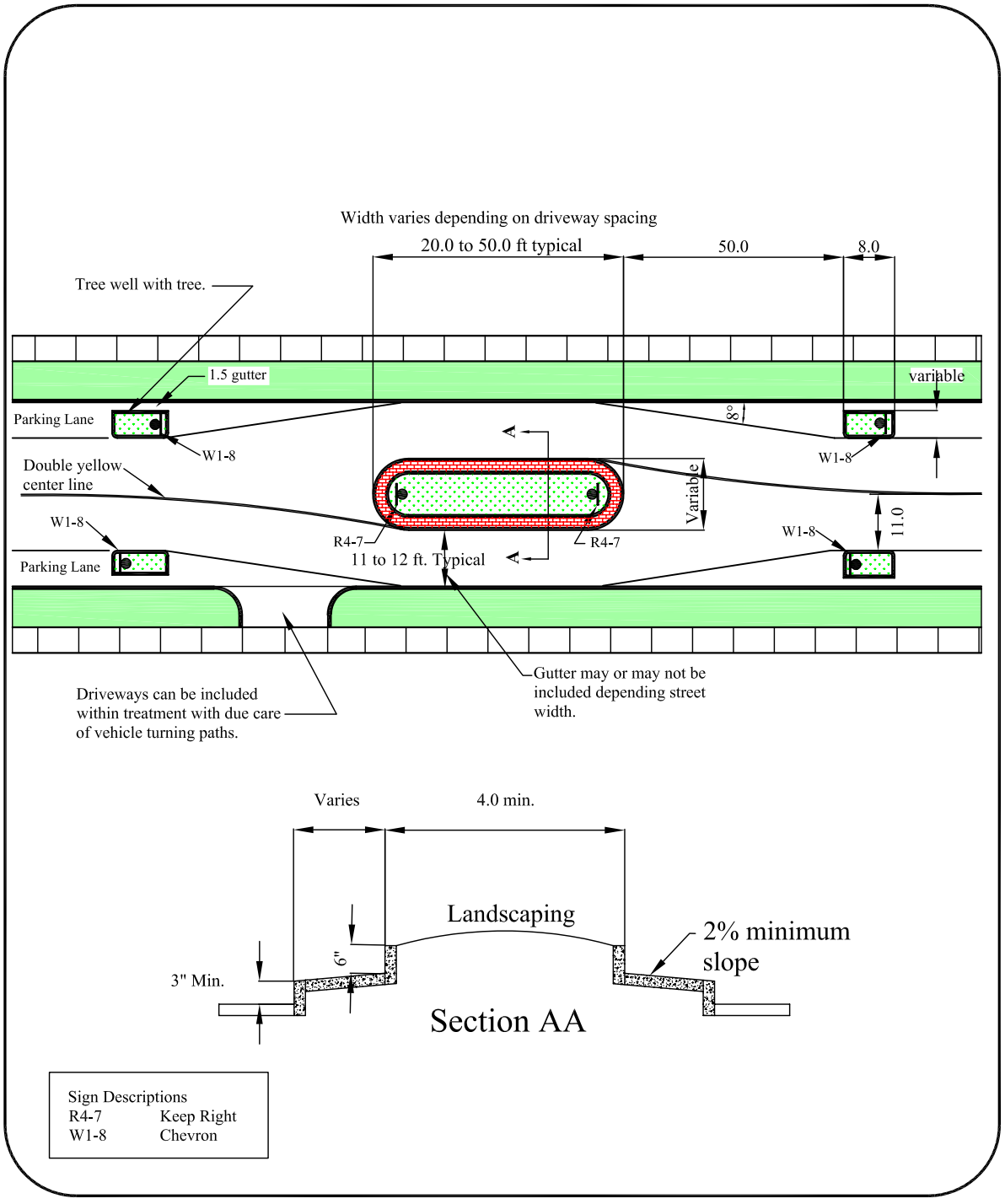
ENGINEERING SERVICES

CHICANE

FIGURE D-I5



All dimensions in feet unless otherwise noted.

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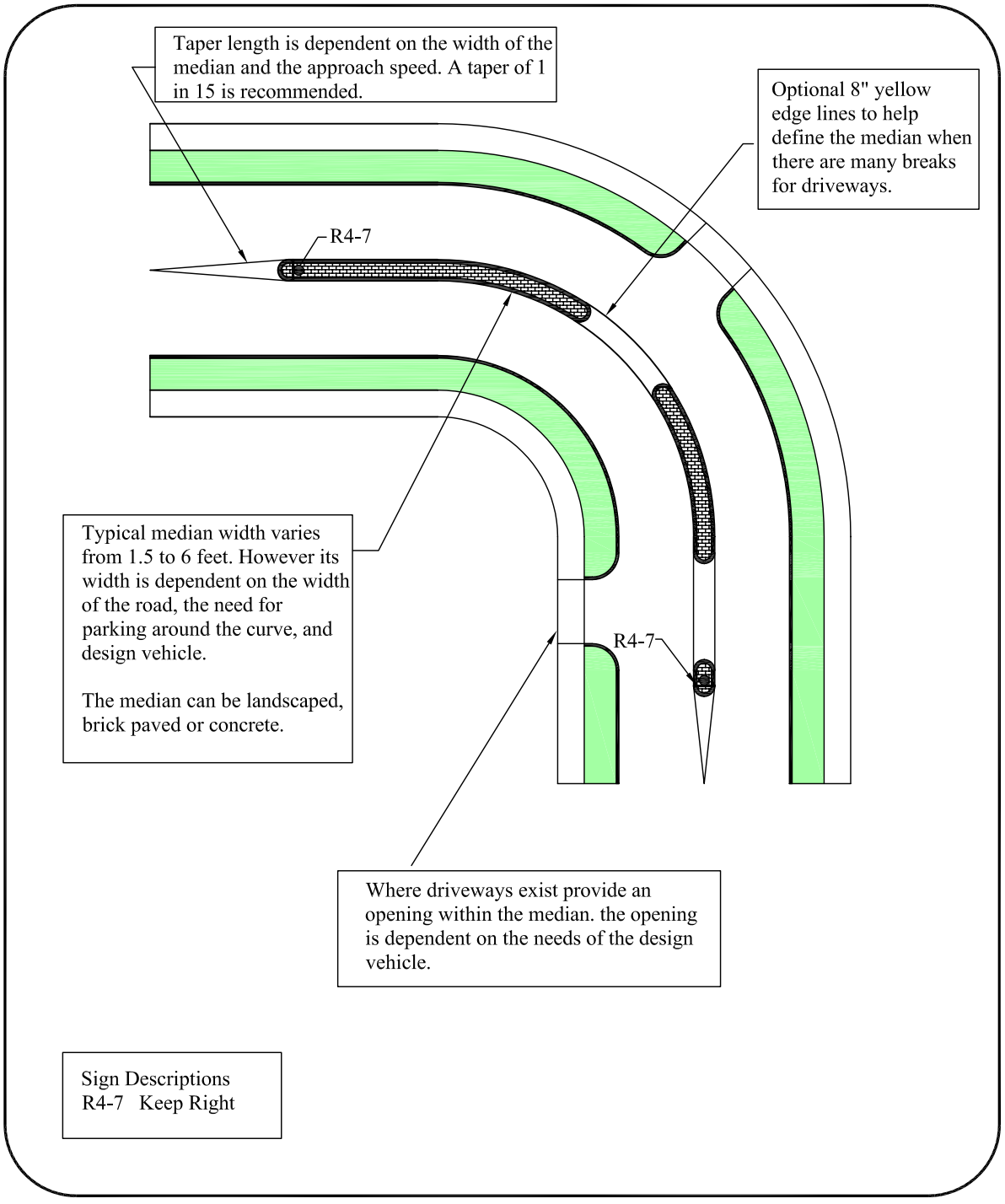
SHORT MEDIAN WITH TREE WELLS

FIGURE D-16



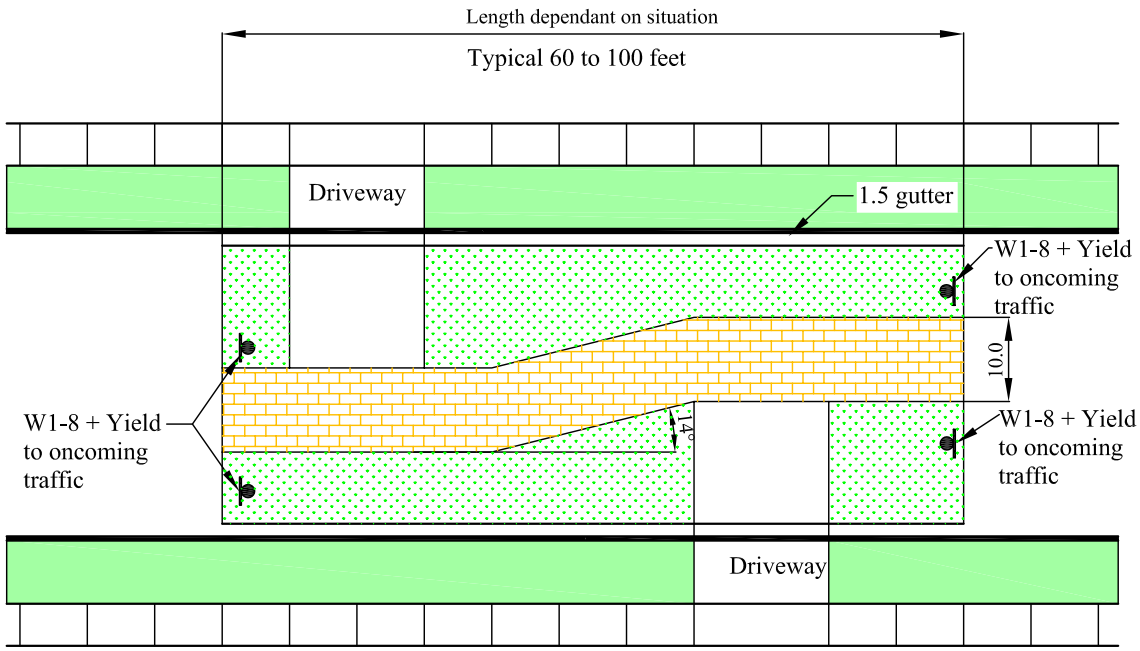
All dimensions in feet unless otherwise noted.

NOT TO SCALE

DEPARTMENT OF
ENGINEERING SERVICES

MEDIAN ON CURVE

FIGURE D-17



There are many design options for a Driveway Link. The basic design is to close the street and provide a 10-ft wide driveway through the area. The driveway can be curved, it can be angled or bent as shown. Landscaping is fairly dense to create an appearance of a closed road. The driveway is typically raised with driveway ramps at each end.

Driveways to abutting properties can access this driveway link.

Sign Descriptions	
Extra	Yield to Oncoming traffic
W1-8	Chevron

All dimensions in feet unless otherwise noted.

NOT TO SCALE

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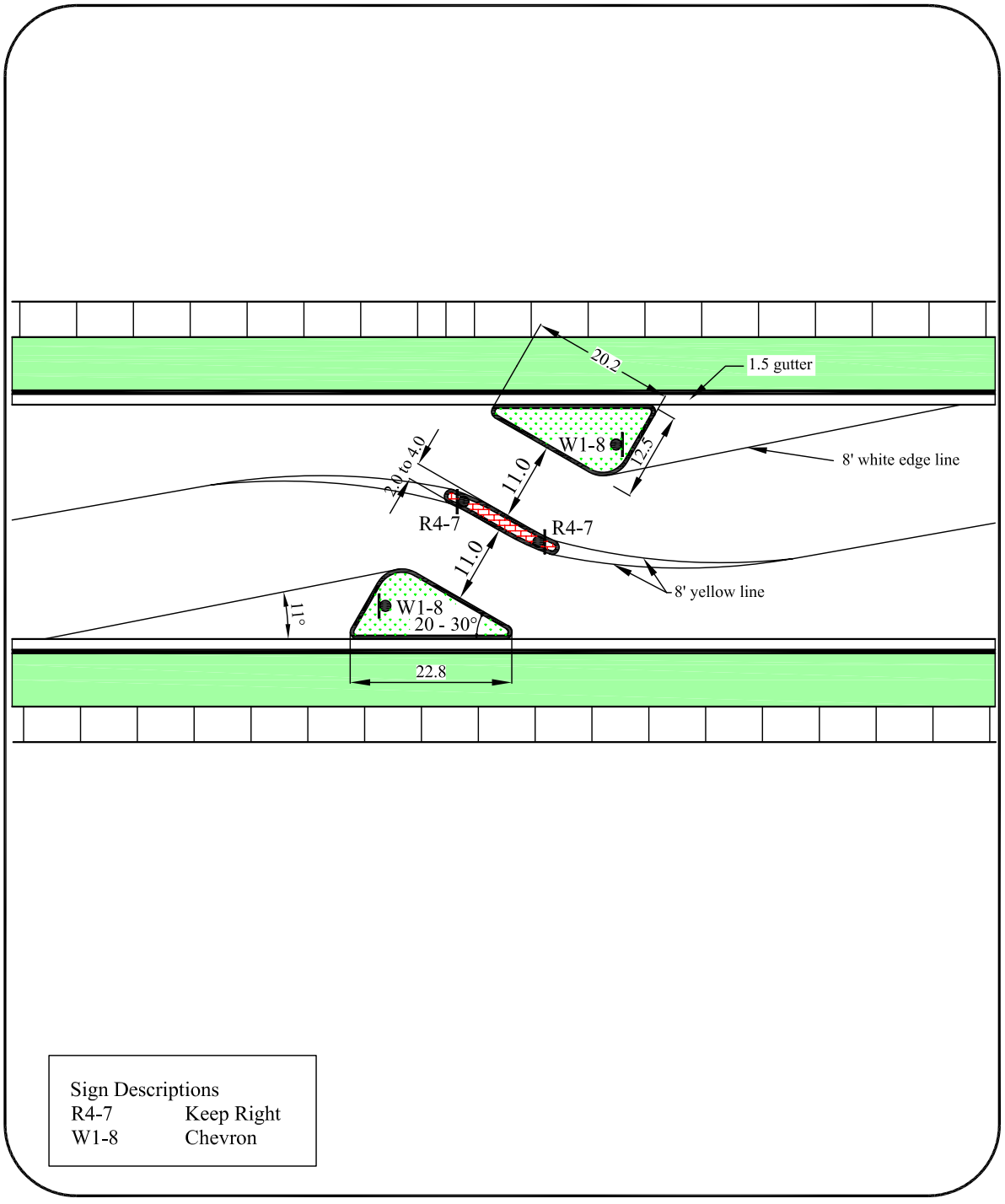
DRIVEWAY LINK

FIGURE D-18



Sign Descriptions

R4-7	Keep Right
W1-8	Chevron

All dimensions in feet unless otherwise noted.

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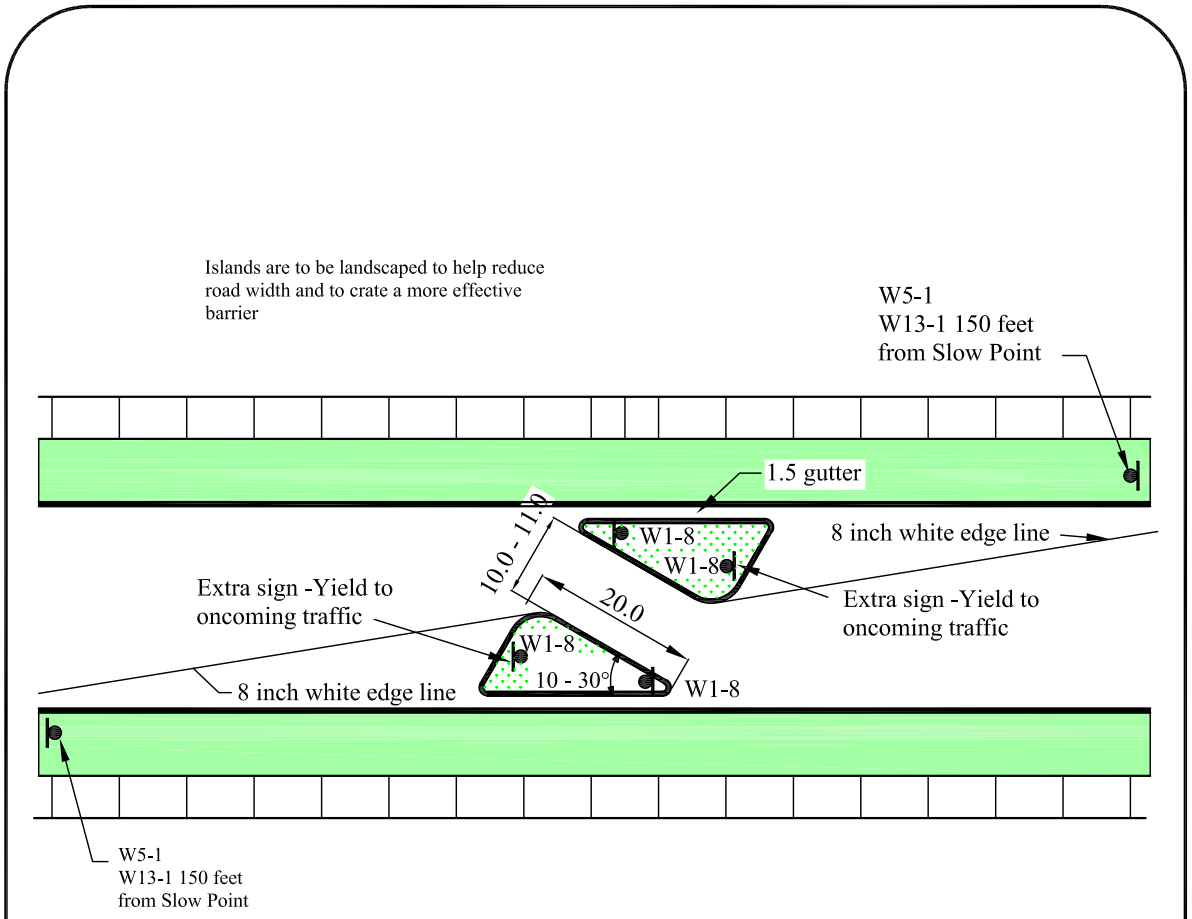
TWO LANE ANGLED SLOW POINT WITH MEDIAN

FIGURE D-19



Sign Descriptions	
W5-1	Road Narrows
W1-8	Chevron
W13-1	15 mph speed plate
Extra	Yield to Oncoming vehicles

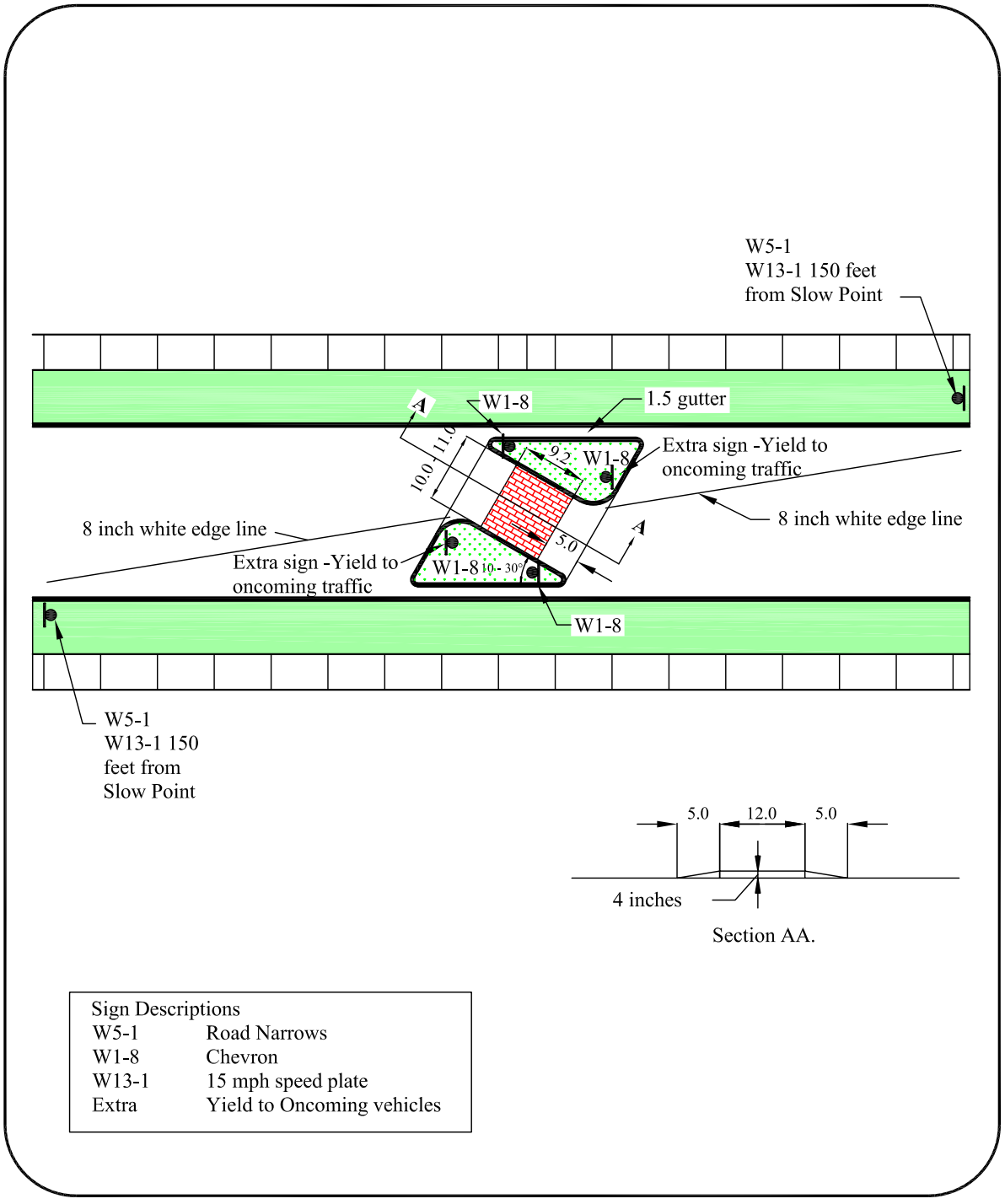
All dimensions in feet unless otherwise noted.

NOT TO SCALE

DEPARTMENT OF
ENGINEERING SERVICES

ONE LANE ANGLED SLOW POINT

FIGURE D-20



Sign Descriptions	
W5-1	Road Narrows
W1-8	Chevron
W13-1	15 mph speed plate
Extra	Yield to Oncoming vehicles

All dimensions in feet unless otherwise noted.

NOT TO SCALE

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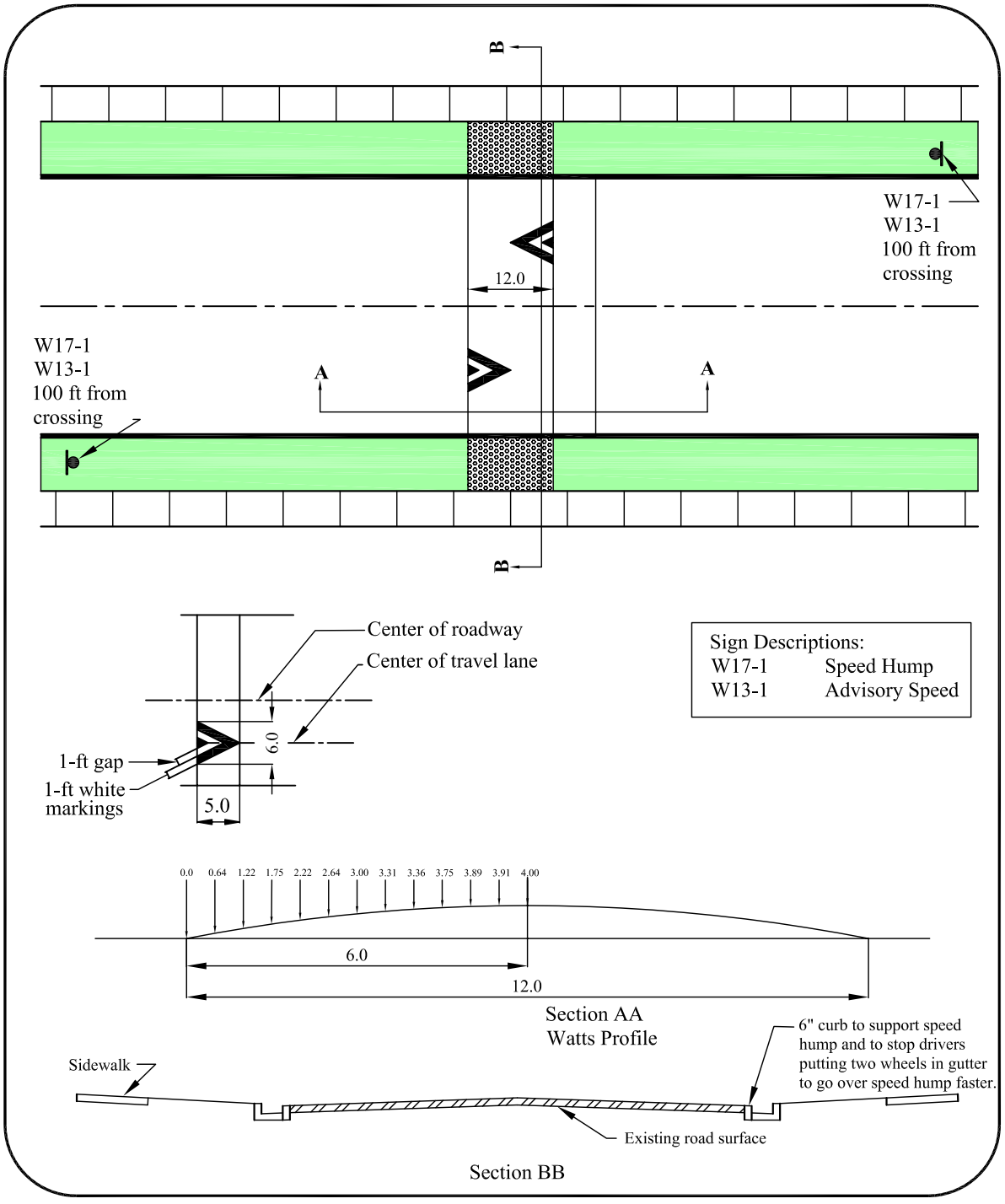
ONE LANE ANGLED SLOW POINT WITH SPEED TABLE

FIGURE D-21



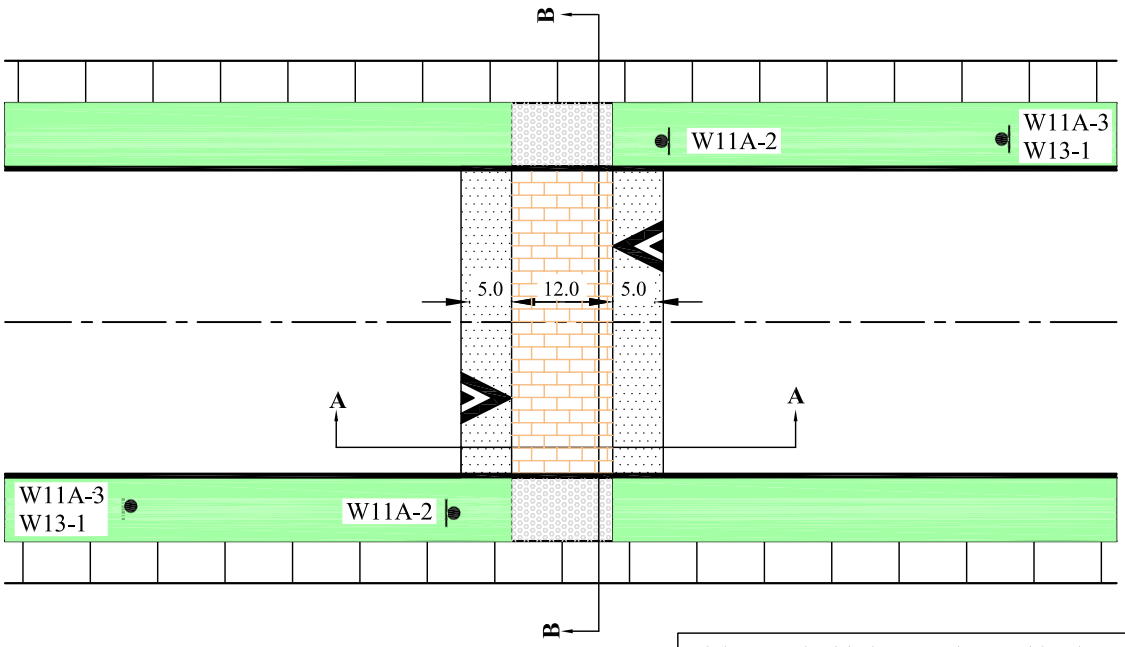
All dimensions in feet unless otherwise noted.

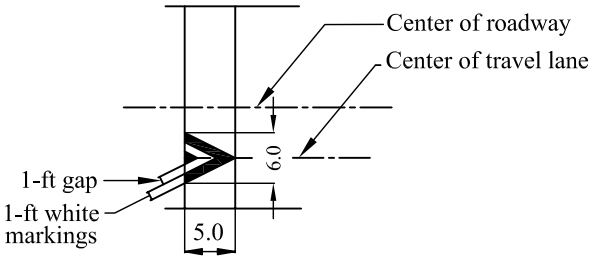
NOT TO SCALE

DEPARTMENT OF
ENGINEERING SERVICES

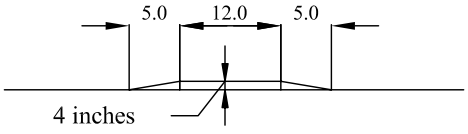
SPEED HUMP

FIGURE D-22

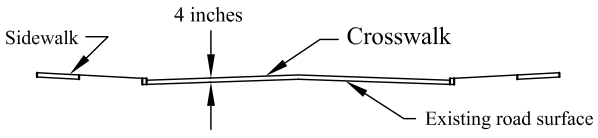




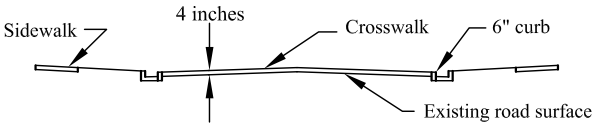
If the speed table is not to be combined with a pedestrian crossing then the crossing signs and tactile surfaces can be deleted. Drainage inlets are required on the uphill side of the raised crosswalks unless bolted down covers are provided between crosswalk and curb. Curb extensions can be added to narrow travel lanes and shorten pedestrian crossing distance.



Section AA.



Section BB with Crosswalk



Section BB when used as a speed table only

Sign Descriptions:

W11A-2	Pedestrian Crossing
W11A-3	Raised Pedestrian Crossing
W13-1	Advisory Speed Plate

All dimensions in feet unless otherwise noted.

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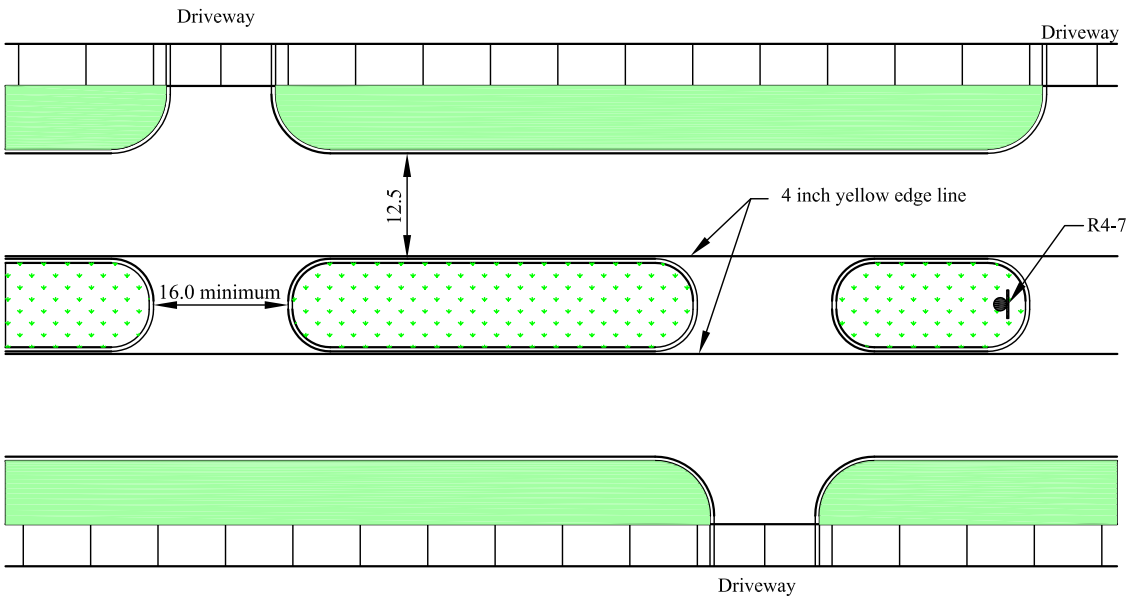
SPEED TABLE

FIGURE D-23



This treatment is a continuous median with openings opposite driveways. Each side of each driveway is projected to the center of the street and a minimum 16.0' foot wide opening is created opposite the driveways. Where the openings overlap the median opening increases in length. Where the openings do not overlap a short median is created.

The width of the median depends upon the street width and the need to provide on street parking.

Sign Descriptions
R4-7 Keep Right
Only used at the start of the medians.

All dimensions in feet unless otherwise noted.

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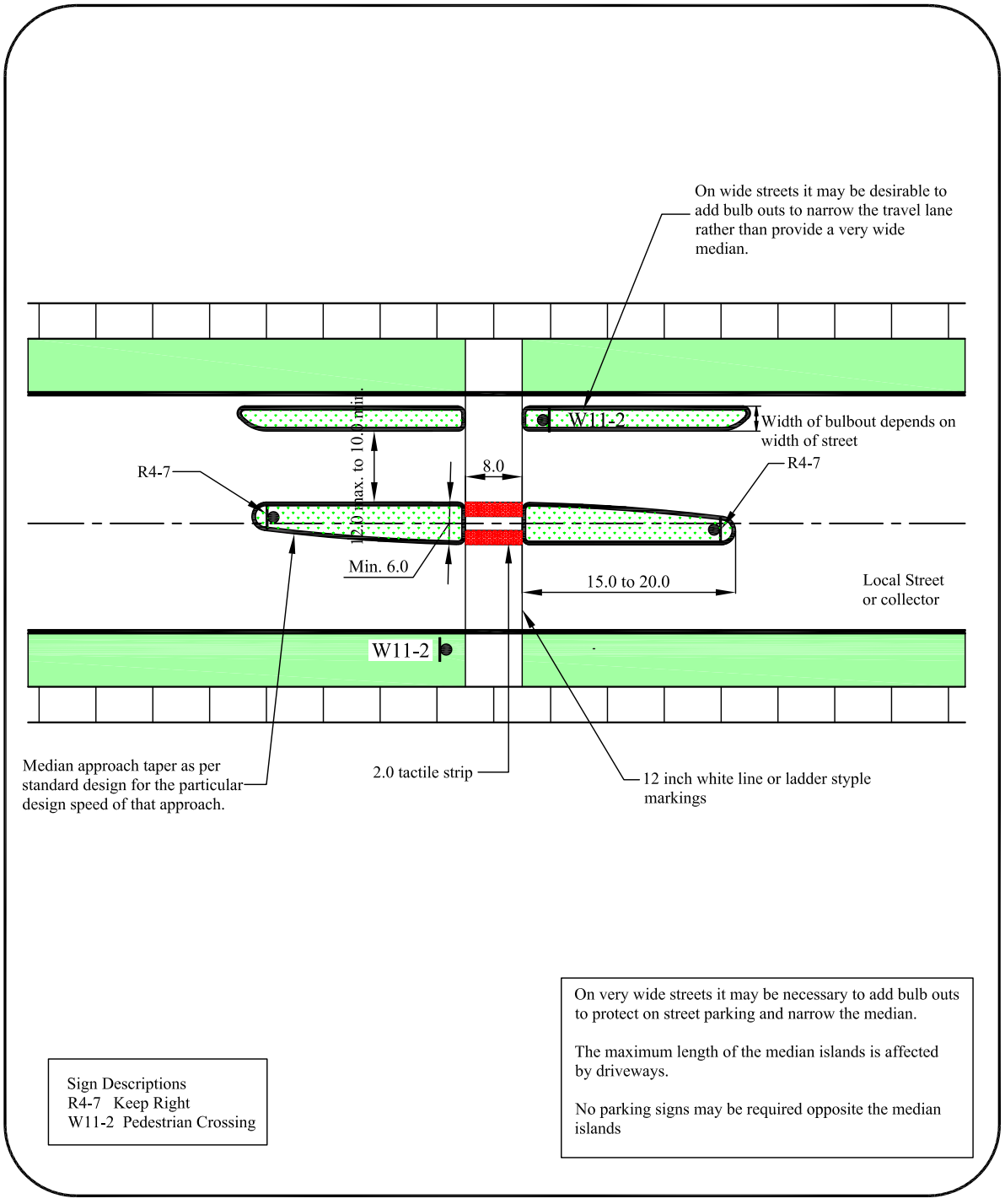
SHORT MEDIANS

FIGURE D-24



All dimensions in feet unless otherwise noted.

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RAISED PEDESTRIAN REFUGE

FIGURE D-25

Appendix

ENDNOTES

1. Roundabouts: An Informational Guide U.S. Department of Transportation, Federal Highway Administration. Page 20, Item 2.1.7. The service life of a roundabout is approximately 25 years, compared with 10 years for a typical signal

2. Roundabouts: An Informational Guide U.S. Department of Transportation, Federal Highway Administration. Page 34, Item 2.2.5. This section discusses the need to compare emergency vehicle delay at a roundabout with that of alternative traffic control measures. The discussion points out that emergency vehicles benefit from the lower vehicle speeds and the elimination of the vehicles that can travel at high speeds through to intersection and collide with their vehicle.

3. Designing Sidewalks and Trails for Access, Best Practices Guide, FHWA, 2001. Chapter 9, Traffic Calming. This publication acknowledges the universal benefits of traffic calming and cites specific examples of potential negative impacts.

4. The Manual on Uniform Traffic Control Devices (MUTCD) is approved by the Federal Highway Administrator as the National Standard in accordance with Title 23 U.S. Code, Sections 109(d), 114(a), 217, 315, and 402(a), 23 CFR 655, and 49 CFR 1.48(b)(8), 1.48(b)(33), and 1.48(c)(2). Available online at http://mutcd.fhwa.dot.gov

ADDITIONAL RESOURCES

Managing Speed: Review of Current Practice for Setting and Enforcing Speed Limits; Transportation Research Board, National Research Council Special Report 254, 1998.

A Policy on Geometric Design of Highways and Streets, 1994. American Association of State Highway and Transportation Officials.

Traffic Calming: State of the Practice; Institute of Transportation Engineers for the Federal Highway Administration, August 1999.