# Stamford Neighborhood Traffic Calming Final Report

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Disclaimer: The contents of this report represents the knowledge, experience, and expertise of the citizens of Stamford, the City of Stamford, and Urban Engineers and authors in providing ideas and concepts to improve safety, access, mobility, and livability through traffic calming and traffic management strategies. This report does not constitute a standard, specification, or regulation, and is not intended to be used as a basis for establishing civil liability. This report presents concepts that can be developed for construction through proper and sound engineering. Adherence to the principles found in this report can lead to an overall improvement in neighborhood traffic safety.

The Urban Engineers team prepared this report for the City of Stamford. For more information on details found in this report contact the Urban Engineers Project Director , Hartford Square West Suite 2-303, 75 Charter Oak Avenue, Hartford, CT 06106, (860) 246-7200. This project was funded by the City of Stamford.

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# I. Introduction

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The City of Stamford initiated the Traffic Calming Master Plan project in order to improve quality of life by minimizing speeding and cut-through traffic in residential neighborhoods. In the past many complaints about these issues were addressed through the installation of speed humps. However, this approach was found to divert traffic onto neighboring streets, creating new traffic issues as well as increasing emergency response times. The City decided to initiate a process to address neighborhood traffic issues on a block by block basis while building consensus amongst neighborhood residents on the best approach for enhancing safety. A detailed, comprehensive plan including immediate and long range solutions was developed to address traffic concerns. The plan includes a variety of traffic calming devices and techniques.

The Master Plan serves as a blueprint showing traffic calming improvements that can help slow speeding vehicles, reduce cut-through traffic, and better manage traffic on non-residential streets. This report describes the “bottom to top” or grassroots community process that was used to develop the Traffic Calming Master Plan. To the extent practically possible, the recommendations contained within the Master Plan are a direct result of input received from Stamford’s residents and other stakeholders from within the community.

Traffic calming measures considered for the Stamford Master Plan included intersection treatments, such as curb extensions, roundabouts, raised intersections, and intersection realignments, as well as mid-block treatments, including road diets, speed tables, chicanes, and median islands. When developing the plan, the consultant applied these treatments holistically, taking care not to simply move problems from one location to another. Thus, when measures are proposed for one street, impacts on neighboring streets were studied prior to finalizing the recommendation.

The first step of the development of the Traffic Calming Master Plan involved compiling traffic data, including volumes, speeds, and crash records. Mapping which provided details on each accident that occurred within the City over a three year period was prepared using AutoCAD software. This data was later used to validate concerns identified by neighborhood stakeholders. Urban Engineers then familiarized itself with each neighborhood through a series of site inspections. Field measurements were taken, and existing relevant studies were reviewed. Urban Engineers then conducted focus groups for stakeholders with unique traffic-related concerns and needs. Focus groups were held with the public schools, emergency service providers, transit authorities, public works, planning and zoning, the downtown special services district, the parent teacher organization, the chamber of commerce, and visual impairment mobility experts. Next, Urban Engineers conducted a citywide kick-off “charrette” or workshop open to anyone with an interest in the project. The purpose of the kick-off charrette was to provide attendees with background information about the project, demonstrate how Urban would work with the neighborhoods, and to discuss the proposed project schedule.

Each of Stamford’s neighborhoods then hosted a highly interactive “opening charrette” for all residents with an interest in traffic calming. The neighborhoods included Bulls Head, Castlewood/Cedar Heights, Cove, Downtown, East Side, Glenbrook, Hubbard Heights, Newfield, North Stamford, Roxbury, Shippan, South End, Springdale, Waterside, West Side, and Westover. The opening charrettes began with a presentation designed to familiarize the attendees with traffic calming. Residents were then led through a series of activities where they prioritized traffic-related issues. Following these activities the attendees were divided into groups of six to eight people and each group received a map of the neighborhood. Using information on traffic calming techniques, and working from their established priorities, they discussed, and then selected tools to address the needs of their neighborhood. Following the design session, each group reported their suggestions to Urban Engineers and fellow neighborhood residents.

Based on suggestions from the opening charrette, as well as a review of existing plans and traffic data, Urban Engineers developed a system-wide set of traffic calming solutions for each neighborhood and prepared conceptual maps showing its recommendations for each neighborhood. Although the maps closely reflected the residents’ suggestions, not all requests were included in the final plan. All suggestions were evaluated by factors such as whether the cost far outweighed the benefit, if the device was perceived as needed by the majority of stakeholders or whether or not the traffic calming treatment could be practically engineered.

The neighborhood maps were presented to each neighborhood during a "closing charrette." The closing charrettes gave residents an opportunity to view the neighborhood plans that they helped build, and to recommend any changes or additions. Comments from the closing charrettes were recorded and appropriately incorporated into the neighborhood plans. The individual neighborhood plans were then combined into a single document. This document serves as the actual Master Plan and is layered on an AutoCAD document furnished to Urban Engineers by the City. It was designed so that a user could easily find a street of interest and look up the type of traffic calming device, if any, proposed for that street.

All the traffic calming devices shown in the Master Plan will not be built at one time. To do so would be too disruptive and too expensive. Rather, traffic calming plan implementation is expected to be done as opportunities arise. These types of opportunities will occur when streets are reconstructed, when new developments requiring changes in the street are proposed and when other objectives require spending funds in different city neighborhoods. Some of the funding is expected to come directly from or through the State. Cost estimates, therefore, were developed using methods consistent with those prescribed by the State of Connecticut Department of Transportation. Costs for the traffic calming treatments vary due to differences in the quality of materials and landscaping. Therefore high-end and low-end options were developed. Incorporating traffic calming into scheduled construction projects and routine maintenance may reduce these costs. At some locations the City may choose to implement traffic calming devices as a stand-alone project. In these situations the City may attempt to fund the project through several potential sources including federal and state grants, local general funds, and development impact fees. Urban Engineers identified several funding programs that the City may wish to apply to for funding.

# II. Background

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## History of Traffic Calming

Cities in the Netherlands were among the first to implement programs aimed at easing the effects of motor vehicles on residential streets. The Dutch "woonerven" or "living yards1" which were first utilized in the early 1970's, were designed to force motor vehicles to travel at a walking pace and allow residents to use the street as an extension of their homes. Street furniture such as tables, benches, and sand boxes, and other obstacles such as curb cuts, plants, textured pavements, and speed humps were installed within the roadway in order to achieve pedestrian friendly street conditions. Although construction costs for woonerven were fairly high, the woonerven measures have proven effective and elements of these streets have influenced residential traffic management throughout Europe and the U.S.

While cities such as Montclair, NJ and Grand Rapids, MI experimented with street closures and traffic diverters as early as the late 1940's. However, the 1971 Stevens Neighborhood program in Seattle, WA may have been the first area-wide traffic calming project in the United States. The Stevens neighborhood project encompassed a 12-square block area of streets in a grid pattern that were being used by cut-through traffic from nearby arterials. Diagonal diverters and traffic circles were installed at several intersections. The program reduced traffic volumes on the residential streets by 56 percent, reduced accidents from 12 per year to zero during the two years following implementation, and was well-received by local residents.[1]

Compared to many west coast, southern, and mid-Atlantic states, the Northeast region of the U.S. is relatively inexperienced in calming traffic.[2] While traffic calming treatments have been utilized in our region, they are often limited to residential streets and frequently installed in a reactive manner. Thanks to municipalities such as Cambridge, MA, Hartford, CT, and now Stamford, traffic calming is beginning to play a larger role in the Northeast. The City of Hartford recently developed what is believed to be the nation's first citywide Traffic Calming Master Plan. While other municipalities have created plans for individual neighborhoods, none have developed a plan covering all residential areas within the city. Stamford's Traffic Calming Master Plan promises to be an equally monumental accomplishment. The City's proactive approach towards traffic calming offers numerous opportunities for streets designed for automobile traffic to be made more inviting to all users.

## Objectives of Traffic Calming

Traffic calming, as defined by the Institute of Transportation Engineers is "the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users.[3]" Objectives of traffic calming include but are not limited to:

- Encouraging safe and appropriate travel speeds
- Reducing cut-through traffic on residential streets
- Lowering both the frequency and severity of collisions
- Improve safety for pedestrians, bicyclists, and other modes of transportation
- Enhance the overall livability and aesthetics of neighborhoods
- Compliment police enforcement

## Applicability and Appropriateness of Traffic Calming in Stamford

To date, the City of Stamford has installed over 100 speed humps. The speed humps were installed largely as spot treatments aimed at addressing speeding or cut through traffic problems on specific streets. In some instances, the speed humps have resolved traffic issues on the targeted street, only to transfer them to an adjacent street as drivers seek alternative routes. The transfer of speeding and cut-through traffic issues highlights the need for an area wide approach towards traffic calming. The City has responded by defining sixteen separate neighborhoods and using a well defined process to develop a holistic traffic calming plan for each. Care was taken to avoid recommendations which would merely transfer the issue from one location to another. Planning traffic calming deployments at this scale has also allowed the project team to work with residents one neighborhood at a time in order to achieve consensus. The sixteen neighborhood plans combined form a Master Plan which covers the entire City of Stamford.

Another contrast between previous deployments and the citywide Traffic Calming Master Plan are the treatments that are being used. Previous traffic calming efforts relied mostly on the use of speed humps. Humps are not recommended anywhere in the citywide plan due to their tendency to increase emergency response times, reduce property values, and the noise created by vehicles traversing them. In the Master Plan a variety of treatments were considered including roundabouts, curb extensions, chicanes, medians, enhanced crosswalks, bicycle lanes, and intersection realignments. Land use and functional classification were key considerations used to determine the appropriateness of a treatment for a particular street. It should also be noted that City owned streets are the primary focus of the plan. Information on each of the treatments utilized may be found in Chapter VII of this report.

# III. Funding

# III. Funding

Typically, the construction of traffic calming treatments will be funding through the City's Capital Improvement Program.  The program is used to finance the enhancement of City-owned property including roadways, bridges, buildings, utility systems, parks, and equipment.  Improvements implemented through this program enhance the value of preexisting infrastructure and constitute a long term investment in the City.

In some situations the City may be able to apply for federal or state grants in order to reduce the burden on its Capital Improvement Program.  The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) signed into law in August of 2005 addresses many of the challenges faced by the nation's transportation systems, including the need to improve safety.  SAFETEA-LU advances improved Federal surface transportation programs by concentrating on transportation issues of national importance, while giving State and local transportation policy maker's additional flexibility for addressing challenges in their municipalities.

ConnDOT's Statewide Transportation Improvement Program identifies a number of major Federal-aid programs from which funds may be available for the construction of traffic calming treatments.  A short description and the federal/state funding ratios for each program follow:

National Highway System (80/20)
National Highway System funds may be distributed for any type of roadway improvement designed as part of the NHS, including all Interstate routes, as well as other freeways designated as "principal arterials."

Surface Transportation Programs (STP)
STP funds benefit roads that have been classified as collectors or arterials by the Federal Highway Administration.  This broad program includes the following sub-programs:

> STP-Urban Program (80/20)
> STP-Urban program funds are bookmarked for streets in urban areas and can be used for a wide range of projects including roadway widening, roadway reconstruction, transit projects and ridesharing.  This is the largest of the STP programs, as fifty percent of all STP funds go towards the Urban program.
>
> STP-Anywhere Program (80/20)
> STP-Anywhere program funds can be used for transportation projects in any area-regardless of rural or urban designation.  ConnDOT usually determines where these funds will be spent.
>
> STP-Enhancement Program (80/20)
> STP-Enhancement Program funds are awarded to programs that relate to intermodal transportation systems.  Eligible enhancement areas include the provision of facilities for pedestrians and bicyclists.  Regional Planning Organizations submit their highest priority eligible programs to ConnDOT which distributes the STP-Enhancement Program funds.

Highway Safety Improvement Program (90/10)
The Highway Safety Improvement Program provides funding for projects aimed at significantly reducing accidents involving fatalities and serious injuries.

High Priority Projects (80/20)
High Priority Projects (HPP) funds are earmarked for specific projects by Congress and are not flexible.

Congestion Mitigation and Air Quality Program (80/20)
Congestion Mitigation and Air Quality (CMAQ) program funds are available for projects which are expected to reduce congestion and improve air quality. Priority is given to those projects that are included in an approved State Implementation Plan as a Transportation Control Measure and have air quality benefits.

Safe Routes to School (100)
Safe Routes to School funding is available for projects designed to enable and encourage children to walk or bicycle to school; to make walking and bicycling along these routes safer and more appealing; and to facilitate the planning, development, and implementation of projects that enhance safety, and lower traffic, fuel usage, and air pollution near schools.

Other potential funding sources for the construction of traffic calming treatments include Local Capital Improvement Program (LoCIP) and Community Development Block Grant (CDBG) Program funds. The Connecticut Office of Policy and Management distributes funds through its Local Capital Improvement Program for projects such as road, bridge or public building construction. To be considered for LoCIP funds a municipality must submit a simple application which includes the location, description, and cost of the project. The CDBG Program is a federal program aimed at promoting community revitalization in metropolitan cities and urban counties. Projects eligible for CDBG funds include the reconstruction of public infrastructure and rehabilitation of residential and nonresidential properties. The Federal 402 Program, which assists states, counties, and communities seeking to initiate programs to address traffic safety problems, is an additional potential funding source.

The City of Stamford currently permits neighborhoods to pay all or a portion of construction costs for traffic calming devices. Neighborhoods wishing to do so are advised to notify the City to determine if their desire to contribute funds could improve the treatment's priority ranking. Several other cities have allowed residents to fund a portion of or the full construction costs of traffic calming treatments, including Phoenix, AZ, Boulder, CO, Portland, OR, and several California cities.[4] These communities have found that requiring residents to participate financially in their traffic calming programs has led to an increased commitment to developing cost effective plans and a greater sense of ownership. Public funding also allowed the communities to offer a wider range of treatments than would city funded programs. However, publicly funded programs require the resolution of several important administrative issues. Decisions must be made regarding how the funds are to be collected, be it through special improvement districts or direct billing. There is also the issue of identifying those residents that are required to participate in the program. This may be determined based on distance from the treatment, street frontage, or other means.

The cost of traffic calming devices may be reduced by incorporating their implementation into already scheduled construction projects and/or routine maintenance. For example, road diets can be implemented as part of regular resurfacing and re-striping programs. Appointing an administrator to monitor upcoming construction projects and identify opportunities for incorporating traffic calming treatments may help municipalities to take full advantage of such cost saving measures.

# IV. Design Issues

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## Emergency Vehicle Operations


Traffic calming devices which are properly designed and strategically located have minimal impact on emergency response times. In fact, some traffic calming treatments benefit responders. For example, a roundabout controlled intersection is often preferable to one controlled by unwarranted stop signs or a signalized intersection where significant queuing occurs. Curb extensions can prevent drivers from parking too close to intersections and obstructing the turning radius of fire trucks and other large vehicles.

Treatments which provide vertical deflection are undesirable, particularly on emergency response routes as they can cause delays of 10 seconds per device. Not only do such treatments increase emergency response times. They also can cause increased equipment fatigue, as repeated exposure to these treatments can accelerate stress fractures of ladders, cabinets, and other equipment.[5] Devices such as diverters and street closures limit access and should therefore be used only as a last resort or designed so that they may be mounted by emergency response vehicles.

Treatments that utilize horizontal deflection or visual improvements (i.e. pavement markings) tend to have less impact on emergency response times. Emergency response impacts associated with each treatment included in the Stamford Master Plan may be found in Chapter VII.

## Landscaping

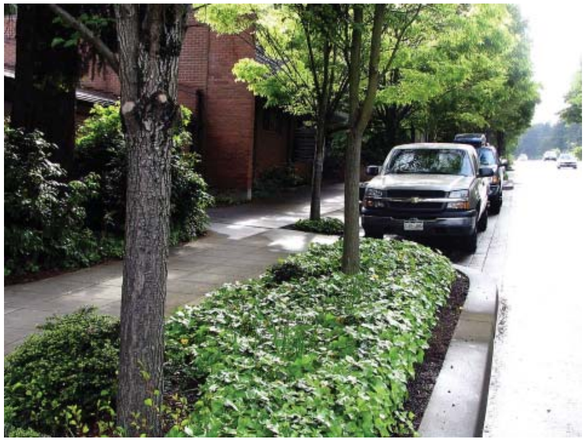

Photo credit: Glatting Jackson Kercher Anglin, Inc.

Landscaping can enhance the effectiveness of traffic calming devices by attracting drivers' attention and visually dividing long straight portions of roadway. Attractively landscaped traffic calming treatments can improve the overall aesthetic of a neighborhood and increase property values. Additional benefits include reduction in storm water runoff and reduction in air pollution.

Several factors must be carefully considered when selecting landscaping for a treatment. Plantings should not negatively impact sight distance, particularly at intersections. Large trees and rocks should be avoided in certain applications, as they may constitute fixed objects which could be hazardous to motorists or pedestrians when struck. Landscaping should be selected and located so that it does not obscure signage.

The City of Stamford will provide initial landscaping following the construction of new traffic calming features. Volunteers will be responsible for maintenance as well as any necessary replacement of landscaping. Maintenance may be performed by neighborhood organizations, individual residents, clubs, businesses, or other groups wishing to volunteer. Should the volunteers fail to properly maintain the landscaped area properly, or should no volunteers be available, the City will replace the landscaping with grass or pavement.

## Snow Removal

Photo credit: Glatting Jackson Kercher Anglin, Inc.

Traffic calming treatments have been utilized by many municipalities that experience considerable snowfall during winter months. While there have been some reports of minor damage to curbing or additional time required for removal, the devices have not prevented public works staff from removing snow and preventing unsafe conditions. The following approaches may be utilized to facilitate efficient snow removal on calmed roadways[6]:

1. **Clearly identify treatments**. Advanced warning signage can alert drivers to the presence of vertical deflection devices such as speed tables, allowing them to slow their plow upon approach, and preventing damage to the treatment. Treatments which may be unexpected, such as midblock curb extensions, should also be identified, either through signage, object markers, bollards, or landscaping.

2. **Use appropriate equipment.** Rubber tipped blades can prevent damage to raised devices. Rollers can be attached to plow blades, causing them to lift when a fixed object is struck.

3. **Design devices appropriately.** Sinusoidal speed humps are preferable to those with parabolic profiles, since they have a zero slop gradient at each end. Speed tables, raised crosswalks, and raised intersections with gradual ramps can be more easily negotiated by plow drivers.

4. **Assign snow removal staff to set routes.** Drivers assigned to set routes will become familiar with the locations of treatments in the area.

## Drainage

Drainage characteristics must be taken into consideration both during the selection of an appropriate traffic calming treatment and during design. Drainage impacts may be minimized during design by avoiding disruption to runoff paths to catch basins. When alterations to the drainage path are necessary, installation of additional drainage structures should be considered. Otherwise, water and/or ice may accumulate, creating hazardous conditions for drivers and pedestrians.

## ADA Requirements

Photo credit: Glatting Jackson Kercher Anglin, Inc.

The Americans with Disabilities Act requires states and local governments to make pedestrian crossings accessible to disabled individuals by providing curb ramps. The obligation to provide curb ramps is triggered by any alteration to the roadway affecting its usability, including installation of physical devices in the street or changes to the curbing or sidewalk. Many traffic calming treatments meet this criteria, and therefore, curb ramps should be incorporated into their design. The ADA requires that curb ramps meet specific standards for width, slope, cross slope, placement, and other features. Curb ramps must also include a "detectable warning" consisting of a tactile surface colored to contrast with the surrounding sidewalk. The detectable warning alerts blind and low vision individuals to the presence of a crossing. The City of Stamford's standard details for curb ramps accommodate all ADA requirements.

The American with Disabilities Accessibility Guidelines also regulates the design of cross-slopes, locations where the slope of the sidewalk is perpendicular to the direction of travel. Cross slopes typically occur where sidewalks and driveways intersection. Cross-slopes should not exceed two percent, and preferably not 1.5 percent in order to facilitate the use of wheelchairs, scooters, and other mobility devices. The City's standard details for typical sidewalks comply with these criteria.

# V. Legal Issues

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As proposed traffic calming improvements are advanced through the design and construction phases, the City of Stamford will adhere to the following guidelines so that legal liability may be minimized:

1. Prior to construction, document the rationale for implementing the selected traffic calming treatment. Typical rationales include safety, proximity to schools, and/or maintaining retail viability. Supporting data such as accident data and available traffic count data should also be documented.

2. Adhere to standards documented in manuals such as Manual on Uniform Traffic Control Devices, AASHTO's A Policy on Geometric Design of Highways and Streets, and ITE's Guidelines for the Design and Application of Speed Humps.. Each treatment should be considered individually, as different locations will present unique issues in terms of sight distance, grade, speed, volume, and other roadway conditions.

3. During construction, inspect the treatments to verify that the contractor builds the device according to design standards. Varying dimensions or other elements from the design may result in ineffective or hazardous conditions.

4. Provide sufficient maintenance and protection of traffic during construction. Signage should be used to alert drivers to the presence of a new treatment.

5. Once the treatment has been constructed, evaluate its effectiveness. This may be accomplished by monitoring the sites crash history or collected automatic traffic recorder counts. If the treatment does not achieve the intended result, modifications to the design or an alternate treatment may be needed. Evaluating the effectiveness of traffic calming treatments also allows the municipality to identify deployments that will achieve maximum benefit in other areas targeted for improvement.

Furthermore, an awareness of previous legal decisions can help the City to avoid future legal issues. The City of Stamford has conducted a literature review of past traffic calming related court rulings both within the City and in other municipalities throughout the nation. A summary of the findings of this review follows:

Courts have consistently maintained that discretionary decisions are immune from tort claims due to sovereign immunity. Discretionary decisions are those in which a public official must chose between valid alternatives. Discretionary decisions may include the choice to spend limited funds to address one safety concern rather than another or the decision to construct a selected traffic calming treatment in lieu of an alternative device. In such matters, courts have avoided allowing a judge or jury to effectively second guess the judgment of the responsible government official.

Courts have made exceptions in several cases involving speed bumps. Speed bumps are rounded, raised pavement structures, with heights ranging from 3 to 6 inches and lengths between one and three feet. Speed bumps typically force drivers to reduce speeds to five miles per hour or less. As a result, they are typically reserved for parking lots and private driveways. Speed bumps should not be confused with speed humps, which are much more gradual and may therefore be traversed at speeds of up to 20 miles per hour.

In January 1980, the Stamford Superior Court ruled that speed bumps which were installed by a private neighborhood association were a nuisance due to the potential three minute delay they could add to emergency response times as well as the potential for additional injury to be inflected upon patients who would be forced to travel over the abrupt bumps.[7] A Greenwich court ruling identified speed bumps as a public nuisance based on testimony from emergency response personnel and similar concerns.[8] It should be noted that in each case, the bumps were not installed by the municipality's legal traffic authority.

Ministerial functions concern decisions involving little margin for personal judgment. Examples of ministerial functions include the duties to alert motorists of traffic calming treatments that necessitate slowing down, to maintain treatments in a safe condition, and to construct treatments per design specifications.[9] Such functions are not subject to sovereign immunity and may be subject to tort claims. Because State laws necessitate administrative resolutions to be fully explored before lawsuits are filed, damage claims are more common than lawsuits. However, both lawsuits and damage claims are relatively rare.

Reid Ewing conducted a survey of nearly 50 cities and counties with traffic calming programs and reported on their legal experiences in "Traffic Calming : State of the Practice." The following claims, in which damage occurred as a result of ministerial negligence, were reported:

- In Seattle, Washington a vehicle ran over a traffic circle, sustaining $600 worth of damage to its undercarriage. An object marker had been dislodged from the circle and was not replaced due to lack of inventory.
- In Seattle, a vehicle ran over a traffic circle which was still under construction and had to be realigned at a cost of $30. Construction barricades had been removed from the circle prematurely.
- Also in Seattle damages were paid when an automobile bottomed out on a poorly designed speed hump. The hump was only slightly longer than a speed bump and six inches high. The City later standardized the design of their speed humps.
- In Fort Lauderdale, Florida damages were paid when a vehicle struck a choker. While one side of the choker included a vertical monument, the other side had no monument due to objections by the adjacent property owner.
- Montgomery County, Maryland agreed to pay $2,500 in medical expenses when the passenger of a van was injured while traveling over a speed hump that was allegedly too high.
- In another case, Montgomery County paid $300 for removal of tape and glue from pavement markings that had come off a speed hump and adhered onto the undercarriage of a car that had bottomed out.

There have also been a number of reported cases in which firefighters sustained injuries while traversing speed humps. These injuries have mainly occurred when firefighters traveling in the forward passenger side of the fire truck struck their head on the vehicle's roof. Preliminary investigations by the Fresno, California Fire Department indicate that the prevalence of injuries to firefighters seated in this location may be explained by the presence of "bench type" as opposed to "air-ride" seating and a roof height that is less than that at other riding positions.[10] In 1997 a Montgomery County, Maryland firefighter responding to a fire call injured his neck and back while traversing a speed hump. He received the injuries despite wearing a seatbelt and was later released on full disability retirement. Similar injuries have been reported by multiple firefighters in both Sacramento and Fresno, California, some of which also lead to disability claims.[11]

# VI. The Stamford Process

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There is no more powerful way to build community spirit and "developed ownership" of a plan than through a carefully crafted and highly interactive public outreach program. The public outreach program is essential because traffic calming:

- Is new and not fully tested inside most neighborhoods
- Can be contentious
- Occurs right in front of a person's house or driveway, and it impacts them greatly
- Requires a selection of tools meeting highly specific needs of a block. If chosen by anyone form the outside, these tools will be rejected or not fully appreciated
- Must be "owned" by those with the problem
- Requires salesmanship – and the sales people are those who want the change
- Requires expulsion of myths and obsolete tools that neighbors must discard
- Requires buy-in from diverse groups within the community including emergency services, executive management and the citizenry
- Must be cared for, maintained and owned once it is implemented
- Is only part of the answer; each neighborhood must monitor motorist behavior, evaluate it, and fine-tune it over time

The public process was approached on a neighborhood by neighborhood basis. Working with one neighborhood at a time allowed the project team to meet with manageable sized groups and focus on each neighborhood's unique needs. Sixteen neighborhoods were identified with assistance from the Stamford Partnership. These sixteen neighborhoods, which encompass the entire City of Stamford, are:

- Bulls Head
- Cedar Heights/Castlewood
- Cove
- Downtown
- East Side
- Glenbrook
- Hubbard Heights
- Newfield
- North Stamford
- Roxbury
- Shippan
- South End
- Springdale
- Waterside
- West Side
- Westover

Over six hundred residents, business owners, and other stakeholders participated in the public involvement phase of the project. The public outreach process was approached as follows:

**Step 1: Data Collection**

Prior to entering a neighborhood, Urban Engineers gathered data which would be used to validate concerns that stakeholders identified and to determine appropriate solutions for these concerns. This data included:

- Speed – average speed and 85th percentile speed
- Volume – daily and peak hour volumes
- Adjacent arterial roads – any potential issues which may spillover
- Crashes – crash data, by type, for the most recent three years
- Parking – location, capacity, and use
- Pedestrian and bicycle activity
- Emergency service routes
- Transit and local bus routes
- Locations of schools, parks, and other such facilities

**Step 2: Neighborhood Orientation**

Urban Engineers was oriented to each neighborhood through a site inspection. This process was complemented by personal exchanges with area residents, photographs, and a windshield audit of all principal streets in the neighborhood. Urban Engineers measured street widths, estimated block lengths, observed motorist behaviors, conducted impromptu interviews, gathered available maps and generated new ones. Past traffic complaints collected by the City's Citizens Service Center were collected. Relevant studies conducted by others were also collected.

**Step 3: Focus Groups**

A series of focus groups were conducted at which Urban Engineers had the opportunity to discuss traffic calming with members of several key organizations. Urban met with representatives of Stamford public schools, emergency service providers, transit authorities, public works staff, planning and zoning staff, the downtown special services district, the parent teacher organization, and the chamber of commerce transportation committee. During the focus groups Urban provided the attendees with background information on the project, discussed challenges that their organizations are currently experiencing, identified concerns that the attendees may have had about traffic calming, and talked about goals that the groups had for this project. Minutes for the various focus groups are located in Appendix B. The proceedings are briefly summarized below.

*Stamford Public Schools*: Representatives from Stamford Public Schools expressed that they would like children to have improved egress to their bus stops as well as safer routes for walking to school. They asked that the traffic calming treatments be designed so that they do not have a negative impact on school buses. The attendees requested that sign pollution be avoided. They also requested that the Traffic Calming team make a sufficient amount of field visits to the areas surrounding schools and bus stops so that the unique characteristics of each area are clearly understood.

*Emergency Service Providers*: Urban Engineers met with several firemen and police officers to discuss issues including the impact of traffic calming devices on emergency response vehicles. They informed Urban that treatments which create vertical deflection have an impact on their response times, although not a major one. The Belltown Fire Department provided Urban with mapping showing primary response routes for the entire City. The fire department representatives also provided Urban with the turning radii of their largest vehicles. This information will allow Urban to design typical intersection treatments which do not hinder the turning movements of these vehicles. Specific areas of concern were discussed including High Ridge Road and Long Ridge Road which have experienced a high number of accidents in recent years, as well as Buxton Farms Road which is perceived as a problem in terms of pedestrian safety.

*Transit Authorities*: The main concern expressed at this focus group was the ability of transit users to reach the train station in a timely manner. The attendees stated that Urban should be cognizant of construction taking place in the area surrounding the train station, including the building of a new parking garage and new development at the Bank of Scotland. The transit authorities recommended that more bicycle lanes be implemented on roads leading to the train station. They also informed Urban that many shuttle vans and buses drop passengers off beneath the I-95 overpass. Safety could be improved in this area by providing pedestrians with a safer path from the drop off point to the station.

*Public Works*: Members of Stamford's Public Works Department requested that Urban avoid using speed humps in the Master Plan. In the past speed humps have been overused because they could be installed quickly and were cost-efficient, but they are not the best solution for traffic problems. Public Works staff also requested that traffic calming treatments be installed in locations where they will be easily visible to plow operators. Visibility of some treatments could also be enhanced by reflective pavement markings or signage. This focus group stressed the importance of using aesthetic treatments and recommended getting residents, businesses, and neighborhood associations involved in landscaping the devices. Finally, the group stated that if the project to be considered a success Urban must listen to the input of the community and residents must be happy with the results of the Master Plan.

*Planning and Zoning*: Stamford's Planning Department recommended that the Urban Team familiarize itself with major projects taking place in the City such as the Antares development and the Mill River Parkway Improvements. Improving pedestrian safety around the Mill River Parkway is an important concern. The scheduled developments may provide opportunities for traffic calming treatments to be implemented as part of ongoing construction with a cost saving benefit. Planning also requested that Urban research potential funding sources that the City could apply for when it come time to implement the treatments.


*Downtown Special Services District*: The DSSD stressed the importance of curbside parking. Most business owners feel that the success of their operation relies heavily on the spaces located directly in front of the business. The Traffic Calming Master Plan should utilize treatments that increase parking, if possible, such as the recent conversion to diagonal parking on Bedford Street. The DSSD recommended that Urban look for opportunities to calm traffic on streets with restaurants that promote outdoor dining. Many downtown restaurants offer outdoor dining; however in some areas speeding traffic is detrimental to the experience. The DSSD also identified a need to improve the pedestrian crossing on Broad Street between Bedford Street and Summer Street. A second focus group with the DSSD was later held for members who could not attend the first session. During this meeting several additional ideas were brought forth including making streets such as Tresser Boulevard, Washington Boulevard, and Greyrock Place more pedestrian friendly by widening sidewalks, allowing exclusive pedestrian phases, and calming traffic. Tresser Boulevard should be narrowed because the crosswalks are currently too long. Many of the crosswalks are faded as well. It was also recommended that progression (the coordination of traffic signals in order to minimize delay) should be improved throughout the downtown's outer loop and shorter cycles should be implemented in order to give pedestrians more opportunities to cross.

*Parent Teacher Organization*: Stamford's Teacher Organization discussed their concern over the lack of sidewalks on streets which children use to walk to their bus stops. They feel this is a significant safety issue, especially given the distances between some children's homes and the bus stops. Members of the PTO requested that the traffic calming team explore ways of improving safety around the Toquam, Springdale, and Roxbury Schools. General safety concerns include stop sign running, failure to yield to pedestrians in crosswalks, and the passing of stopped school buses.

*Chamber of Commerce*: The Chamber of Commerce's Transportation Committee requested that the traffic calming team investigate the feasibility of converting Summer Street and Bedford Street back into two-way streets. Converting these streets into two-ways may reduce speeds and improve safety; however the committee was unsure as to whether the roadways would then be able to accommodate the same demand. Their chamber also requested that the one way streets connecting Summer and Bedford be converted two-way roads. The chamber expressed an interest in seeing raised intersections installed at intersections such as Summer at Broad Street where pedestrians volumes are very high. Members of the chamber also stated a preference for roadway narrowing to be implemented through the addition of on-street parking as opposed to the construction of concrete medians. While the medians provide refuge for pedestrians crossing at intersections they seem to encourage speeding at midblock locations.

*Visual Impairment Mobility*: During this focus group Urban was advised that for the visually impaired crossing the street is the root of independence. Sidewalks should be available wherever possible and they should be devoid of obstructions. Audible signals are helpful when they are located at intersections with traffic control. However, if they are not used in conjunction with traffic control then they may provide a false sense of security. Participants also informed Urban that pedestrians who are legally blind but have some vision are often able to see sharp contrasts between painted crosswalks and pavement. Crosswalks with painted white stripes are often the most visible. Pedestrians who are completely blind find tactile pavement more helpful. Handicap ramps should be situated perpendicular to the roadway in order to help visually impaired pedestrians cross the road in a straight path.

| Focus Group | Key Concerns |
|---|---|
| Stamford Public Schools | • Improved egress to bus stops<br>• Safer routes for walking to school |
| Emergency Service Providers | • Frequent accidents on High Ridge and Long Ridge Roads<br>• Pedestrian safety on Buxton Farms Road |
| Transit Authorities | • Allow transit users to reach station in a timely manner<br>• Provide safe path from shuttle/bus drop off point to station |
| Public Works | • Avoid the use of speed humps<br>• Use treatments at locations where they will be visible to snow plow operators<br>• Use treatments that will aesthetically enhance the neighborhood<br>• The neighborhood plans must reflect input received from the community |
| Planning & Zoning | • Improve pedestrian safety around the Mill River Parkway<br>• Research potential sources of funding for the implementation of traffic calming treatments |
| Downtown Special Services District | • Utilize traffic calming treatments that enhance on-street parking<br>• Calm traffic on streets with restaurants featuring outdoor dining<br>• Improve safety for pedestrians crossing Broad Street between Summer and Bedford<br>• Improve the pedestrian experience by widening sidewalks, allowing exclusive pedestrian phases, and reducing speeds.<br>• Tresser Boulevard is too wide and pedestrians must cross an uncomfortably long distance to get across the street. |
| Parent Teacher Organization | • Improve egress to bus stops, especially on streets with no sidewalk<br>• Address vehicles running stop signs, failing to yield to pedestrians, and illegally passing buses |
| Chamber of Commerce | • Consider converted Summer and Bedford Streets back to two-way roads<br>• Broad at Summer experiences high pedestrian volumes and would benefit from a raised intersection<br>• Narrow roadways by allowing additional on-street parking |
| Visual Impairment Mobility | • Keep sidewalks clear of obstructions.<br>• Use high contrast sidewalks and tactile surfaces wherever possible.<br>• Handicap ramps should be situated perpendicular to roadways. |

**Step 4: Kick-Off Charrette**
A citywide Kick-Off “charrette” or workshop was held for anyone with an interest in the project. During this charrette, approximately sixty-five attendees learned about the project, how it was going to be conducted in the sixteen neighborhoods and what the proposed schedule was. Urban Engineers presented information on traffic calming techniques, explaining where and why they are used. Through a number of interactive tasks, attendees got a taste of how Urban Engineers would work with each neighborhood to develop their own solutions. Those in attendance represented all but one of the project neighborhoods. Minutes from this charrette can be found in Appendix B.

**Step 5: Opening Charrettes**
Public process has been broken in America for a number of years. Town development, roadway, and traffic calming projects are sometimes halted due to a failure of stakeholders to participate, to cooperate with one another, or to take ownership of the problems and solutions that affect them the most.
To overcome this challenge, Urban Engineers used an inventive and more effective public process that was developed by an Urban Engineers team member and that specifically relates to streets, traffic management, walking, bicycling, and safety. This new process places high levels of trust in the public, and was designed to make citizens and other key stakeholders the designers and owners of their own neighborhood plan.
Each neighborhood hosted an “opening charrette” for all residents with an interest in traffic calming. The public participated in a two and a half hour evening session that included host introductions and a 40-minute traffic calming orientation presentation by Urban Engineers. Residents were led through a series of activities where they learned to collaborate and discovered the common values that they hold. They identified key traffic calming issues for their neighborhood and set priorities for treatments. Following the priorities setting, citizens worked in groups of six to eight people around a table with maps of their neighborhood. Using information on traffic calming techniques, and working from their established priorities, they discussed, and then selected tools to address the needs in their neighborhood. Following the design session, each table reported out their findings. Consensus is achieved, and key comments are entered in the consultant recordings of the event.

Additional input was received from residents through Urban Engineers’ traffic calming website, www.stamfordtrafficcalming.com. Input was encouraged through the entire Master Plan development not only through the website but through write-ins, phone calls and one on one office and field meetings. Urban Engineers tried to make sure that anyone who had a traffic-related concern that could be addressed by traffic calming was heard and included in the process.

**Step 6: Engineering**
Based on the suggestions from the charrette, and input received through the project website, letters, phone calls, and the Citizens Service Center, the project team developed a system-wide set of solutions to the speeding and volume concerns. Location evaluations of each device were conducted through field observations and data collection to determine the feasibility of installing a particular type of traffic calming measure. Staff considered impacts to storm water drainage, handicap access, maneuverability of buses and emergency vehicles, snow plows and garbage trucks along with other issues that may impact or be impacted by proposed construction. To check that a traffic calming measure proposed for a particular location did not inadvertently shift traffic problems from one residential street to another, the engineering team undertook a holistic approach that simultaneously considered impacts to adjacent streets.

**Step 7: Closing Charrettes**
Each neighborhood hosted a “closing charrette” at which the project team presented its plan for the neighborhood. Residents were presented with a system-wide map showing the recommended traffic calming treatments. These treatments reflected appropriate comments made by participants at the opening charrettes. Comments were received and incorporated into the final version of this report, which include the final conceptual design map, and recommend implementation priorities. Minutes of all charrettes are included in Appendix B.

**Step 8: Plan Development**

Following the conclusion of the closing charrettes, Urban Engineers began developing the Master Plan which consisted of transcribing the suggested neighborhood plans into a single document. This document served as the actual Master Plan and is layered on an AutoCAD document furnished to Urban Engineers by the City. It was designed so that a user can easily find a street of interest and look up the type of traffic calming device, if any, proposed for that street.

# VII. Traffic Calming Overview

# VII. Traffic Calming Overview

The traffic calming measures utilized in the Stamford Master Plan were selected based on roadway and site conditions in addition to traffic volumes and speeds. The treatments can be grouped into four categories – visual treatments, horizontal deflection treatments, vertical deflection, and treatments, and access restricting treatments. Visual treatments calm traffic by altering the appearance of the roadway and thus impacting driver perception. This group of treatments should be the first options to consider as they have greatest impact, are the most aesthetically pleasing, and tend to be the least expensive to implement. The second group of treatments to consider is horizontal deflection treatments. These measures calm traffic by impacting the path of the driver. Vertical deflection and access restricting treatments should be used cautiously. These treatments introduce vertical obstacles into the roadway and/or reduce the connectivity of the roadway network. Such treatments can be disruptive for both emergency response vehicles as well as local residents.

Description of the visual, horizontal deflection, and vertical deflection treatments used in the Master Plan may be found below, along with information on each treatments advantage, disadvantages, their effectiveness as quantified by previous studies, their impacts on emergency response, and typical costs. The potential uses and benefits for each treatment are also summarized in tabular form. Detailed cost estimates are included in Appendix D.

# Bicycle Lanes

Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Description:***

Bicycle lanes demarcate a portion of the roadway designated for bicyclists' use.

***Advantages:***

- Alert drivers to the fact that cyclists have a right to use the road
- Allow bicyclists to have a greater sense of safety
- Promote orderly traffic flow
- When bicycle lanes are implemented by reclaiming excess lane width or eliminating a travel lane travel speeds are likely to decrease

***Disadvantages:***

- Can complicate motor vehicle turning movements at intersections when drivers and bicyclists don't merge beforehand
- Safety concerns may arise when bicyclists make left turns from a bike lane or drivers make right turns through bike lanes

***Effectiveness:***

- In Davis, California streets on which bicycle lanes were implemented saw a 31 percent decrease in crashes[17]
- In Corvallis, OR collisions involving bicycles were reduced from 40 in the year prior to the implementation of 13 miles of bicycle lanes to 16 in the year following implementation[18]
- In Eugene, OR bicycle lanes on a major avenue lead to a nearly 50% reduction in crashes per mile bicycled and motor vehicle collisions decreased as well. Furthermore, the bicycle lanes lead to an increase in bicycle use[19]

***Emergency Response:***

- As the implementation of bicycle lanes generally involves only pavement markings and signage, the impact on emergency service providers is minimal

***Cost:***

- Bicycle lanes have an approximate implementation cost of $4.00 per lineal foot

# Enhanced Crosswalks

***Description:***

An enhanced crosswalk is a high visibility pedestrian crossing. Crosswalk visibility can be enhanced through the use of fresh paint, adhesive pavement markings, stamped concrete, textured pavers, synthetic asphalt compounds, or other materials.

***Advantages:***

- Alert drivers to the likelihood of a pedestrian crossing the roadway
- Encourage pedestrians to cross at locations with clear sightlines, proper illumination, narrower roadway width, or where pedestrian signals are located
- May reduce vehicle-pedestrian conflicts
- Enhance appearance of street

***Disadvantages:***

- May cause pedestrians to have a false sense of security
- Pedestrians may assume that oncoming vehicles will yield due to the crosswalk
- Some crosswalks may lead to an increase in rear end collisions caused by pedestrians not waiting for a safe gap in traffic before crossing[20]
- Textured pavements ay cause maintenance issues depending on stability of the roadway base
- Poorly maintained textured pavements may create a tripping hazard

***Effectiveness:***

- A study conducted by the FHWA revealed that during the daytime drivers yielded to pedestrians at high-visibility crosswalks 43.2% of the time, compared to 20.0% for standard crosswalks
- At night, drivers yielded to pedestrians at high-visibility crosswalks 25.3% of the time, compared to 16.7% for standard crosswalks[21]

***Emergency Response:***

- Enhance crosswalks have minimal impact on emergency service response

***Cost:***

- The estimated construction cost for an enhanced crosswalk ranges from approximately $4,000 to $27,000
- Low-end cost estimate was obtained by providing painted lines rather than granite curb and concrete pavers
- Costs may be reduced if enhanced crosswalks are installed on streets with flexible bases

# Inset Parking

***Description:***

Inset parking is on street parking that is buffered by curb extension. Inset parking may be provided in order to provide convenient access to retail areas, to supplement off street parking or replace it where it logistically or economically impractical, or to create a traffic calming effect. In addition to the parking benefits, the curb extensions which provide the buffer offer numerous pedestrian benefits. Inset parking may be situated parallel, angled, or perpendicular to the curb.

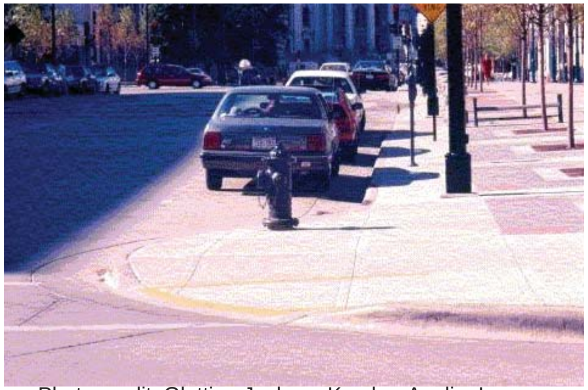


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***

- Provides consumers with convenient access to multiple destinations in urban areas, particularly in central business districts
- Allows land that may otherwise have been used for off-street parking lots or garages to be developed for more economically, culturally, and aesthetically beneficial uses, which attract people to the area
- Less area is required to implement on street parking than to create off-street parking
- Inset parking may be used on commercial or residential roadways to eliminate excessive width and discourage drivers from speeding
- Vehicles parked on the street provide a buffer between pedestrians and the roadway which reduces the noise levels that are perceived
- Curb extensions utilized in inset parking can prevent drivers from parking too close to an intersection and obstructing sight lines

***Disadvantages:***

- Vehicles entering and exiting from on street parking spaces create more opportunities for conflict
- Drivers searching for available spaces may delay through traffic
- Sufficient roadway width must be available in order to accommodate inset parking

***Effectiveness:***

- Off street parking typically uses 513 square feet per space while on street parking uses only 176 square feet per space on average. A town center with 2,000 parking spaces could reclaim over 2.3 acres of land by relocating only 15% of its off-street parking spaces to curbside
- On-street parking is often preferred by drivers. According to a survey of West Hartford, CT, Northampton, MA, and Brattleboro, VT only 59% of off-street parking operated at capacity during the busy holiday season while on-street parking spaces operated at 95% capacity[22]
- One study concluded that parking prohibitions installed on major streets with parking utilization rates of about one million annual space-hours per mile or more could be expected to reduce midblock accident rates by up to 75%[23]

***Emergency Response:***

- Signs, painted curbs, and/ or curb extensions may be used to prevent drivers from parking in spaces where their vehicle may hinder emergency operations
- Open spaces should be maintained for fire-fighting operations at regular intervals set by the fire department or fire marshal
- Generally, space is needed every 200-300 feet, or at each mid-block hydrant location[25]

***Cost:***

- There is no cost associated with inset parking. Rather inset parking is created through the installation of curb extensions, which narrow the roadway and create a buffer between traffic and existing on street parking.

# Road Diets

***Description:***
A road diet is a technique which involves reducing the number of travel lanes on a roadway. The area gained from the removed travel lanes may be used to provide street parking, bicycle lanes, or a two-way left turn lane.

***Advantages:***

- Cost-effective method for reducing speeds and improving safety
- Allow prudent drivers to set the speed at which a queue of vehicles travels and prevent impatient drivers from passing on the left
- Bicycle lanes can often be incorporated into the design of a road diet

***Disadvantages:***

- May be less effective during off-peak hours when vehicles are less likely to travel in queues
- When a road diet is implemented on a street which carries over 20,000 vehicles per day some drivers may have difficulty pulling in and out of driveways[26]

***Effectiveness:***

- As of March, 2006, six road diets have been implemented in Hartford, CT as a result of the city's Neighborhood Traffic Calming Master Plan. Before-and-after traffic count data shows that speeds on these streets were reduced by up to six miles per hour after the implementation of the road diets. On average, speeds were reduced by three to four miles per hour. Accident rates decreased after road diet implementation on all six streets.

***Emergency Response:***

- Road diets do not create vertical or horizontal deflection and as a result impact to emergency responders is minimal
- Median turn lanes and bicycle lanes may still be used by emergency service vehicles to maneuver

***Cost:***

- Road diets have an estimated construction cost of $16.00 per lineal foot

# Shoulder Markings

***Description:***

Narrowing travel lane widths to ten or eleven feet can provide a visual traffic calming effect that lead drivers to reduce speeds. This may be accomplished by adding shoulders or increasing the width of existing shoulders

Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***

- Lane narrowing makes drivers feel less comfortable traveling at excessive speeds
- Can lead to a sustained speed reduction along the entire length of a roadway
- Calming effect is subtle and can cause drivers to slow down without becoming frustrated as they might with a spot vertical treatment
- Inexpensive to implement

***Disadvantages:***

- Lane narrowing may increase the likelihood of sideswipe collisions

***Effectiveness:***

- According to the Highway Capacity Manual, reducing travel lane widths by two feet results in an average speed reduction of up to 4.7 miles per hour, depending on the width of the adjacent shoulders

***Emergency Response:***

- The utilization of shoulder markings reduces travel lane width without narrowing the paved area. The shoulder area may still be used by emergency responders and passenger vehicles making way for them

***Cost:***

- Shoulder markings have an approximate implementation cost of $4.00 per lineal foot

# Sidewalks

***Description:***

Sidewalks are paved areas that provide pedestrians with a travel way separated from the roadway. Sidewalks should have a level surface, curb, and preferably a buffer such as a grass strip, bicycle lane, or on street parking to separate them from traffic. Curb ramps provide transition between the sidewalk and street. The Americans with Disabilities Act recommends that two curb ramps be installed on each intersection corner so that pedestrians are guided into crosswalks rather than the middle of an intersection. This is particularly helpful for pedestrians with visual impairments.

Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***

- Improve pedestrian safety be separating pedestrians from motor vehicle traffic
- Encourage pedestrian travel by providing access to key destinations such as schools, parks, transit stops, and retail areas

***Disadvantages:***

- Can be costly to construct
- Right of way restrictions and utilities can make it difficult to retrofit sidewalks on existing streets

***Effectiveness:***

- A study by Knoblauch, Tusing, Smith, and Pietrucha indicated that pedestrian crashes are less than half as likely to occur on streets with sidewalks as opposed to those without sidewalks[27]
- A separate study prepared by the University of North Carolina Highway Safety Research Center indicated that crashes were 88.2 percent less likely to occur on streets with sidewalks (after accounting for traffic volumes and speed limits)[28]

***Emergency Response:***

- Sidewalks do not have a negative impact on emergency response times

***Cost:***

- For sidewalks the approximate construction costs range from $62,000 to $101,000
- Low-end cost is obtained by replacing granite curbing with a bituminous concrete curb and bituminous surface

# Chicanes

***Description:***
A chicane is a series of raised islands which alternate from one side of the street to the other forcing drivers to navigate an S-shaped curve.

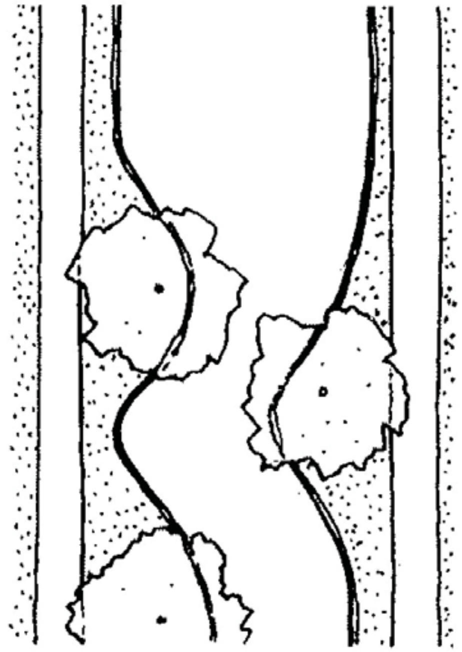


Photo credit: Making Streets That Work, Seattle 1995

***Advantages:***
- Can be used to slow speeds over the entire length of a long block
- Provide an opportunity to add landscaping and enhance aesthetics
- May be implemented at low cost by permitting parking on alternating sides of the street

***Disadvantages:***
- May eliminate on-street parking spaces, depending on the conditions of the street prior to implementation
- Driveways must be avoided if curbed islands are installed rather than a simple parking chicane
- Some drivers may disregard the chicane and cross over the centerline
- Increased snow removal time

***Effectiveness:***
- After a one-lane chicane was installed on a Seatlle, WA street, speeds were reduced to 16 mph near the chicane's islands and 29mph midblock. Volumes decreased from 1900 vehicles per day to 1000 vehicles per day.
- In Nepean, ON the installation of a two-lane chicane lead to speeds being reduced by 7 miles per hour. Volumes decreased from 1150 vehicles per day to 900 vehicles per day.
- Speeds dropped from 31 mph to 27 mph following a chicane installation in Scarborough, ON
- Though a study of one Hartford street on which a parking chicane had been installed indicated that the chicane had had little effect on 85th percentile speeds, the results were questionable due to a lack of information on the exact locations of the before counts

***Emergency Response:***
- Traffic calming devices that provide horizontal deflection, such as chicanes, are generally preferred by emergency responders over devices such as speed tables which cause vertical deflection
- Emergency Response: Traffic Calming and Traditional Neighborhood Streets estimates the average delay caused to emergency response vehicles by chicanes as being between one and four seconds depending on the street's classification[29]
- Chicanes provide effective locations for the installation of fire hydrants, as they prevent passenger vehicles from parking adjacent to the curb and obstructing hydrants

***Cost:***
- Chicanes have an estimated cost between approximately $6,000 and $19,000 per 300 lineal feet. The low-end parking chicane treatment utilizes painted markings rather than granite curbing and landscaping.

# Curb Extensions

***Description:***
Curb extensions, or bulbouts, extend the sidewalk or curb line into the street, reducing the street pavement width.

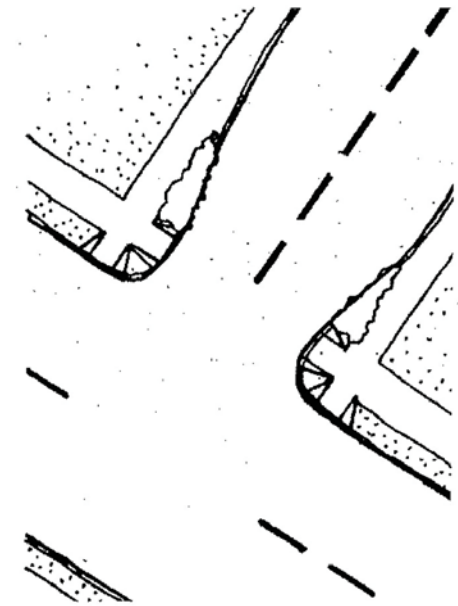


Photo credit: Making Streets That Work, Seattle 1995

***Advantages:***
- Improved pedestrian safety
- Prevent vehicles from parking at corners and obstructing sight lines
- Increased visibility
- Encourage pedestrians to cross at crosswalks
- Shortened crossing distances for pedestrians
- Reduce the speeds of turning vehicles
- Provide a location for landscaping and public amenities

***Disadvantages:***
- Drainage issues must be taken into consideration when designing a curb extension
- May create conflicts with bicycle lanes
- May make turning movements more difficult for trucks and longer vehicles
- More time required for snow removal

***Effectiveness:***
- In The Effects of Traffic Calming Measures on Pedestrian and Motorist Behavior the impact of curb extensions on pedestrian and motorist behavior was evaluated by measuring the percentage of pedestrians for whom motorists stopped or yielded at study locations in Cambridge, MA and Seattle, WA[30]
- Although the sample sizes for the Cambridge sites were small, the data showed that curb extensions led to a large increase in the percentage of pedestrians for whom motorists yielded
- In Seattle the number of pedestrians for whom motorists yielded decreased by 6%; however, the results were not statistically significant. Pedestrian Safety Impacts of Curb Extensions: A Case Study (Johnson, 2005) compared pedestrian and motorist behavior at two sides of an intersection—one side with curb extensions and the other without.[31]
- The average number of vehicles that passed a waiting pedestrian before yielding was approximately 34% to 43% lower on the side with curb extensions. The difference is best explained by the increased visibility offered by the curb extension.

***Emergency Response:***
- The delay caused to emergency responders as being minimal to none for through movements[32]
- Curb extensions often aid responders by preventing vehicles from parking too close to intersections and obstructing turning movements. This makes curb extensions especially beneficial at main streets, schools, and other locations with heavy parking demand.

***Cost:***
- The cost of installing a single curb extension is estimated to be approximately $25,000

# Intersection Realignment

***Description:***
Intersection realignment involves modifying an intersection's geometry in order to improve approach angles, remove sight distance issues, and eliminate excess asphalt.

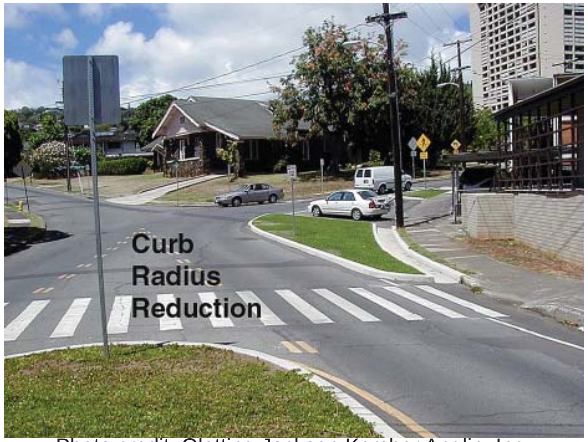


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***
- May be used to eliminate offset intersections in order to prevent driver confusion
- Converting an offset intersection into a simplified four-legged intersection often allows traffic signal phases to be combined, thus improving capacity
- May be used to introduce deflection as a means of reducing speeding
- Eliminating unwarranted asphalts improves driver safety by narrowing the roadway and eliminating potential conflicts associated with lane changes
- Can improves pedestrian safety by reducing crossing distances. Reduced crossing distances also allow for pedestrian clearance intervals on traffic signals to be shortened.
- Reclaimed asphalt can be landscaped and become part of a public park or neighborhood gateway

***Disadvantages:***
- Modifying an intersection's geometry is typically an expensive undertaking, particularly when traffic signal hardware must be adjusted and when drainage and utilities must be relocated
- Alternative treatments such as roundabouts can often provide similar benefits at a lesser cost
- At some locations additional right of way may need to be acquired in order to realign an intersection

***Effectiveness:***
- A 2000 study of twelve Connecticut intersections involving either a curve on the main road being straightened, or a skewed approach leg being realigned, found crashes to be reduced by 44% following treatment
- Both roadway improvements tended to have the greatest benefit in reducing more severe collision types such as run-off-road and head-on crashes, while less severe crash types sometimes increased[33]

***Emergency Response:***
- Curb radius reductions associated with intersection geometry improvements generally reduce speeds during right hand turns from 20-30 mph to 10-15 mph. They do not however impact left hand turns.
- In many applications, curb radius reductions aid responders by keeping parked cars away from corner entries[34]

***Cost:***
- Providing an estimate of the construction cost for intersection realignments is somewhat complicated because each realignment is unique
- A complex realignment involving a signalized intersection is estimated to cost roughly $260,000
- For a less complex, typical four-way intersection the cost may be approximately $175,000

# Medians

***Description:***
Medians are raised islands located near the centers of roadways.

***Advantages:***
- Slow drivers by reducing lane widths
- Additional speed reduction may be achieved if horizontal deflection is involved
- Provide refuge for pedestrians crossing the street
- Provide an opportunity to incorporate landscaping
- Medians also may be used to prevent traffic from accessing adjacent properties

***Disadvantages:***
- On-street parking may need to be eliminated in some locations
- Longer medians may block access to driveways and force left-turning vehicles to make U-turns

***Effectiveness:***
- Traffic data collected on a paved street in New Mexico showed 85th percentile speeds to be 33 mph with a temporary midblock island in place, compared to 48mph without the island[35]
- Anne Arundel County, MD saw speeds being reduced by 2 mph when medians were installed alone. Speeds were reduced by 5 mph when medians were installed in conjunction with curb extensions.

***Emergency Response:***
- Most medians narrow lanes and have a visual impact on drivers, but do not provide horizontal deflection. These medians have no effect on emergency response times.
- Medians that create horizontal deflection may cause delays of three to six seconds for responders[36]

***Cost:***
- The estimated cost of median islands ranges from approximately $16,000 to $39,000

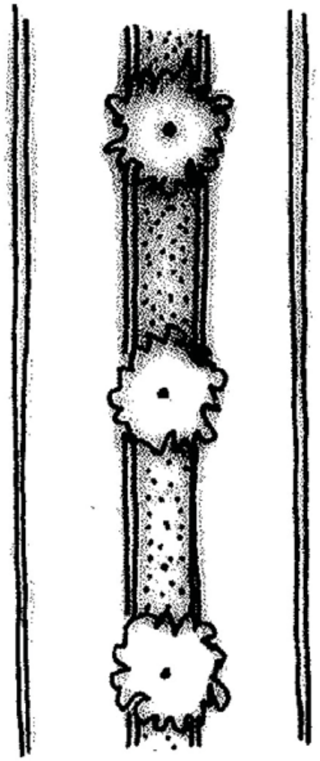


Photo credit: Making Streets That Work, Seattle 1995

# Roundabouts

***Description:***

Roundabouts are circular, raised islands with deflector islands located at centers of intersections on collector or arterial streets. Traffic enters and circulates within roundabouts in a counterclockwise direction and exits by turning right onto the desired street.

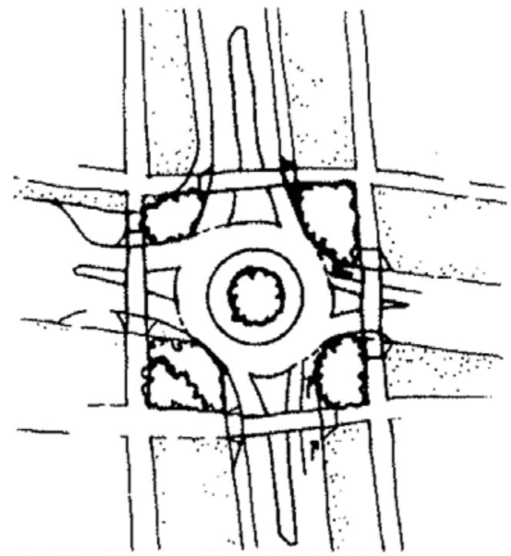


Photo credit: Making Streets That Work, Seattle 1995

***Advantages:***

- Slow vehicles as they travel through the intersection
- Break up sight-lines on straight streets which may also help reduce speeds
- Improve safety by eliminating several types of potential conflicts at intersections
- A variety of attractive landscaping options can be applied to roundabouts
- May serve as gateways to neighborhoods or downtown areas

***Disadvantages:***

- Some difficulty may be encountered in retro-fitting a roundabout at an existing intersection
- If modifications to the existing curb-line are required to improve the fit, construction costs may become expensive
- Maintenance is a concern, as roundabouts are more difficult for plows and street sweepers to navigate
- Roundabouts may require an educational campaign or learning period, as some vehicles tend to make direct left turns rather than traveling counterclockwise around the circle

***Effectiveness:***

- The Traffic Calming: State of the Practice survey includes 45 roundabouts for which before and after speed data was collected.[37] On average, 85th percentile speeds downstream from the roundabouts were reduced by 3.9 miles per hour.
- Data collected at 49 locations with roundabouts showed that traffic volumes decreased by five percent
- Before and after accident data was collected at 130 locations. The data showed that the average annual number of accidents decreased at these locations by 71 percent.

***Emergency Response:***

- Roundabouts often improve response time when they replace stop signs or traffic signals at an intersection
- Mini-roundabouts have little impact on turning movements since emergency service vehicles are permitted to make a direct left turn rather than travel counterclockwise around the roundabout
- Through movements at mini-roundabouts may be delayed by three to six seconds according to Emergency Response: Traffic Calming and Traditional Neighborhood Streets[38]
- Roundabouts at larger intersections may create left turn delays of two to ten seconds because direct left –turns are not permitted. However, larger roundabouts have little impact on travel times for through movements.

***Cost:***

- The probable construction cost for roundabouts ranges from approximately $125,000 for the low-end treatment to $250,000 for a high-end treatment
- The estimate is based on a 15’ radial device and includes the cost of constructing mountable curbing and splitter islands, as well as signage and landscaping
- The low-end cost estimate is based on bituminous concrete curbing being substituted for granite curbing and decorative pavers. Alternatively, dollars may be saved in situations where a roundabout is installed on a flexible base street as opposed to a street with a rigid base.

# Raised Crosswalks

***Description:***

Raised crosswalks are speed tables, or flat topped speed humps, which serve as pedestrian crossings. Their flat top should be constructed at the same elevation as the adjacent sidewalk in order to facilitate pedestrian access.

Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***

- Provide vertical deflection which forces drivers to reduce their speeds
- Alert drivers to the presence of the crosswalk and improve pedestrian visibility
- Reduction in vehicle-pedestrian conflicts
- Relatively inexpensive treatment to implement

***Disadvantages:***

- Usually only appropriate on local streets and minor collectors, as they may lead to delay on streets with higher traffic volumes
- May impact drainage, resulting in additional expenses
- May require additional effort for snow removal
- Increased emergency response times
- Some noise may be created by braking and acceleration
- Traffic may be diverted to adjacent streets

***Effectiveness:***

- The City of Boulder, Colorado determined that yielding percentages increased from 69% before implementation to 91% after a raised crosswalk for constructed39
- In Cambridge, Massachusetts, yielding percentages increased from 10% to 55% after installation40
- The design of a raised crosswalk is similar to that of a speed table and therefore similar impacts on speeds can be expected

***Emergency Response:***

- The delay associated with a raised crosswalk is also similar to that of a speed table. It may vary between two to nine seconds depending on the size and weight of equipment.

***Cost:***

- Estimated construction costs for raised crosswalks range from approximately $28,000 to $60,000
- The high-end cost includes reconstruction of the concrete road base to the new grade, decorative concrete pavers, and granite curb. The low-end cost substitutes a bituminous concrete surface for the granite curb and decorative pavers.

# Raised Intersections

***Description:***
Raised intersections physically raise the street to sidewalk height. Vehicle ramps are provided on each of the intersection approaches.

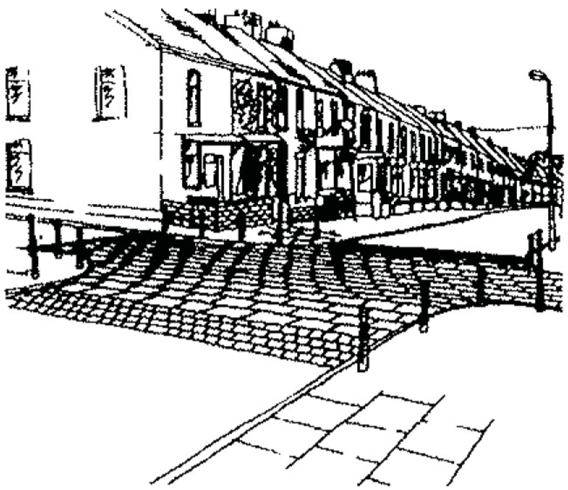


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***
- Effective way to mitigate speeding
- Increased pedestrian visibility
- Encourage motorists to yield to pedestrians
- Provide an aesthetic benefit when designed with pavers or other attractive features.

***Disadvantages:***
- Expensive to construct
- Traffic may be diverted to adjacent streets
- Additional improvements may be required in order to accommodate storm drainage
- Should not be utilized on emergency response routes, due to the delays caused by the vertical deflection

***Effectiveness:***
- The Traffic Calming: State of the Practice survey included three locations at which speed data was collected before and after the construction of a raised intersection.[41] Data was collected downstream from the raised intersections although the distance from the intersection varied. On average 85th percentile speeds decreased at these locations by three miles per hour.
- No before and after comparisons of volumes and collisions were available. However, it is likely that the installation of a raised intersection, like other traffic calming treatments, would lower average volumes.
- Collisions could be expected to decrease due to the reduction in speed

***Emergency Response:***
- Emergency Response: Traffic Calming and Traditional Neighborhood Streets estimates the average delay caused to emergency response vehicles by raised intersections as being between two and eight seconds depending on the width of the intersection, travel speed, and whether or not a turn is made[42]

***Cost:***
- Raised intersections have an estimated low-end construction cost of approximately $85,000 and a high-end cost of $195,000. The majority of the cost savings associated with the low-end estimate come from substituting a bituminous concrete surface for the granite curbing and decorative pavers.

# Speed Tables

***Description:***
Speed tables are essentially flat-topped speed humps having three parts: a ramp up, a flat top section, and a ramp down.

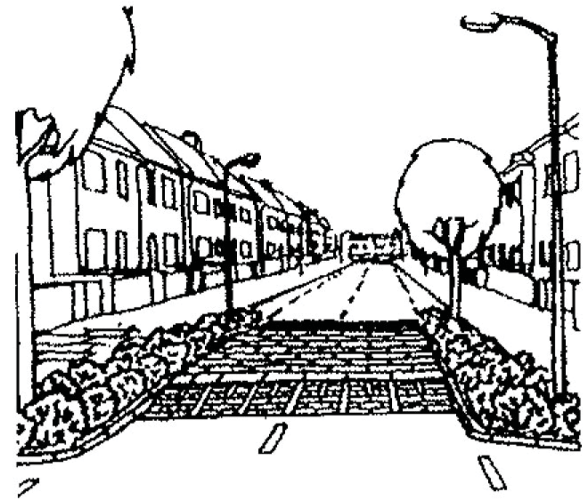


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***
- Effective means of reducing vehicle speeds
- Construction and maintenance costs are minimal
- In areas with high pedestrian volumes speed tables may be utilized as raised crosswalks
- Speed tables produce less noise than speed humps due to their flat tops and longer cross sections

***Disadvantages:***
- Have less of an effect on trucks and sports utility vehicles
- Can cause speed problems to be shifted to a parallel adjacent street
- While many residents request speed humps or tables, few want them placed directly in front of their property
- Create larger delays for emergency response vehicles than do most other traffic calming devices

***Effectiveness:***
- Traffic Calming: State of the Practice includes a survey of 58 twenty-two-foot speed tables at which before and after speed data was collected downstream from the devices.[43] On average, the 85th percentile speeds at these locations decreased by 6.6 miles per hour after the installation of the speed tables.
- At 46 speed tables for which volume data was also collected, the number of vehicles per day decreased by 12 percent
- Before and after collision data was compared for eight locations where speed tables were installed. The average number of collisions was found to decrease by 45 percent.

***Emergency Response:***
- Emergency Response: Traffic Calming and Traditional Neighborhood Streets estimates the average delay caused to emergency response vehicles by speed tables as being between two and nine seconds depending on the size and weight of the vehicle[44]
- Speed tables are a lesser obstacle for emergency service vehicles than speed humps due to their gradually sloping ramps and their flat tops

***Cost:***
- Estimated construction costs for speed tables range from approximately $28,000 to $60,000. The high-end cost includes reconstruction of the concrete road base to the new grade, decorative concrete pavers, and granite curb. The low-end cost substitutes a bituminous concrete surface for the granite curb and decorative pavers.

# Diverters

***Description:***
A diverter is an island or curbed closure used to prevent through and/or certain turning movements at an intersection. Types of diverter include diagonal, star shaped, truncated, and forced turn.

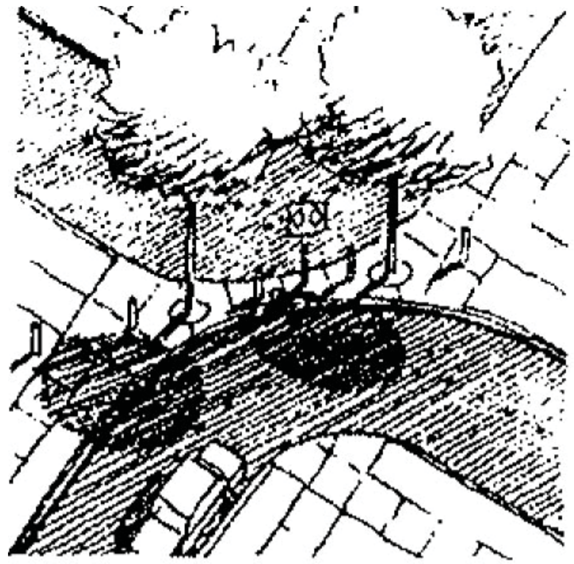


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***
- Can be used to control volumes on residential streets by discouraging cut through traffic
- Can be designed to permit pedestrian and bicycle access
- Can be landscaped to provide additional green space

***Disadvantages:***
- Very restrictive treatment
- Inconvenient for neighborhood residents, who use the streets the most
- May divert traffic to adjacent streets
- Some drivers may attempt to driver over the diverter or onto adjacent properties
- Should have very strong neighborhood support and residents should understand the implications before it is constructed

***Effectiveness:***
- Properly designed diverters are a very effective way of controlling traffic volumes although convenience and street connectivity are sacrificed as a result
- In Vancouver, BD traffic volumes were reduced 20% to 70% following the introduction of diverters
- Volumes dropped from 3050 vehicles per day to 500 vehicles per day after two diverters were installed on a street in Regina, SK

***Emergency Response:***
- Diverters can be designed to allow emergency response vehicles to driver over them. In such situations delays of six to ten seconds are typical.
- If a diverter is not designed to allow emergency access, responders may be forced to use an entirely different route resulting in potentially significant delay times[45]

***Cost:***
- Estimated construction costs for diverters range from approximately $27,000 to $60,000. The low-end construction cost was obtained by substituting bituminous concrete curbing and surface for granite curbing and landscaping.

# Street Closure

***Description:***
Streets closures are implemented by constructing physical barriers that prevent vehicles from entering a street while still permitting pedestrian and bicycle access.

***Advantages:***
- Prohibit cut through traffic from using neighborhood streets
- Can be landscaped to create a park or public space
- Can be designed to allow bicycle and pedestrian access
- Can provide refuge for pedestrians and shorten crossing distances

***Disadvantages:***
- Highly restrictive treatments which inconvenience residents
- Force residents to drive further to access their homes
- Can relocate cut through traffic to adjacent streets
- Some drivers may attempt to drive over or around closures

***Effectiveness:***
- While closures effectively prevent cut through traffic from using a street connectivity is lost and neighborhood residents suffer the greatest inconvenience

***Emergency Response:***
- Street closures may be designed to permit emergency service access
- If emergency service vehicles are not accommodated delays of one to four minutes can be introduced depending on the alternate routes that are available[46]

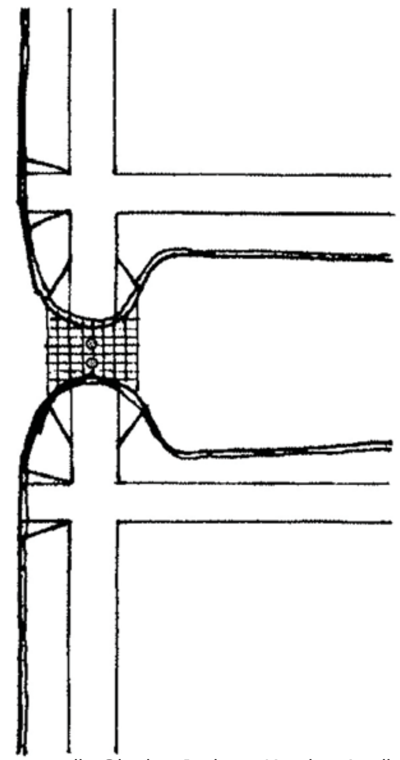


Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Cost:***
- The estimated cost of street closures ranges from approximately $13,000 to $26,000.  For the low-end estimate, the cost was reduced by using bituminous curbing and a bituminous concrete surface rather than landscaping.

# One-Way Streets

***Description:***

A one way street is a road on which vehicles are permitted to travel in a single direction. It is designated as such through the use of "one way" and "do not enter" signs. One way streets are often implemented in pairs with opposite directions of travel being permitted on adjacent streets in order to improve operations.

Photo credit: Glatting Jackson Kercher Anglin, Inc.

***Advantages:***

- Can be used to address cut through traffic problems or turning conflicts at intersections
- Reduce the number of vehicle-pedestrian conflicts as well as overall collisions[47]
- Traffic volumes generally decrease following the conversion of a two way street to a one way street

***Disadvantages:***

- Converting a street to one-way operation limits the connectivity of the roadway network and inconveniences drivers, especially neighborhood residents who use the street the most
- Because additional width is allocated to the remaining direction of travel speeds are likely to increase as a result of the conversion

***Effectiveness:***

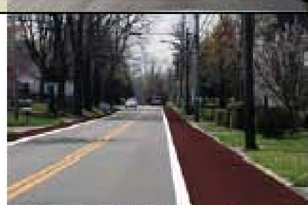
- Following the implementation of a one-way streets traffic volumes on the street typically decrease by 20 to 30 percent
- When a system of one-way streets is implemented total accidents can decrease by as much as 30 percent
- On long continuous one-way streets accident rates may increase[48]
- Typically, one-way street conversions lead to speed increases of three to five miles per hour if no other treatments are installed[49]

***Emergency Response:***

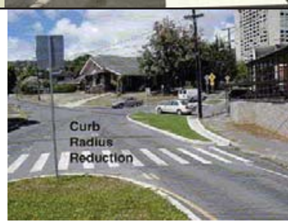
- On average a system of one-way streets increases the distance that emergency service providers must travel by two block lengths[50]

***Cost:***

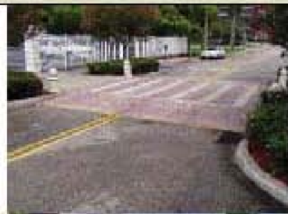
- The cost of converting a two-way street to a one-way street is minimal, as it can be accomplished through signage alone

| *Visual Treatments* | *Example* | *Definition* | *Vehicle Volume* | *Vehicle Speed* | *Vehicle Safety* | *Pedestrian Safety* | *Bicycle Safety* | *Appropriate Location* |
|---|---|---|---|---|---|---|---|---|
| Bicycle Lanes |  | Lane designated for bicycle use | -- | ▼ | -- | ▲ | ▲ | Both |
| Enhanced Crosswalks |  | High visibility pedestrian crossing | -- | -- | -- | ▲ | -- | Both |
| Inset Parking |  | On street parking buffered by curb extensions | -- | ▼ | -- | -- | -- | Both |
| Road Diets |  | Technique involving the removal of excess travel lanes | -- | ▼ | ▲ | ▲ | ▲ | Arterial |
| Shoulder Markings |  | Roadway edge running adjacent to travel lanes. Can be used to narrow travel lanes. | -- | ▼ | ▲ | ▲ | ▲ | Both |
| Sidewalks |  | Paved area designated for pedestrian use | -- | -- | -- | ▲ | -- | Both |

▲ - Treatment will typically increase the condition
▼ - Treatment will typically decrease the condition
-- - Treatment will typically not impact the condition

| *Horizontal Deflection Treatments* | *Example* | *Definition* | *Vehicle Volume* | *Vehicle Speed* | *Vehicle Safety* | *Pedestrian Safety* | *Bicycle Safety* | *Appropriate Location* |
|---|---|---|---|---|---|---|---|---|
| Chicanes |  | Meandering travel path created with raised island or pavement markings and signage | -- | ▼ | ▲ | ▲ | ▼ | Residential |
| Curb Extensions |  | Extension of sidewalk or curb line | -- | ▼ | -- | ▲ | -- | Both |
| Intersection Realignment |  | Modification of an intersection's geometry in order to improve approach angles, remove sight distance issues, or eliminate excess asphalt | -- | ▼ | ▲ | ▲ | ▲ | Both |
| Medians |  | Raised island in the roadway center | -- | ▼ | ▲ | ▲ | -- | Both |
| Roundabouts |  | Raised circular island. Traffic enters the intersection, circulates in a counterclockwise direction, and exits by making a right turn | -- | ▼ | ▲ | ▲ | -- | Both |

▲ - Treatment will typically increase the condition
▼ - Treatment will typically decrease the condition
-- - Treatment will typically not impact the condition

| *Vertical Deflection /Access Restricting Treatments* | *Example* | *Definition* | *Vehicle Volume* | *Vehicle Speed* | *Vehicle Safety* | *Pedestrian Safety* | *Bicycle Safety* | *Appropriate Location* |
|---|---|---|---|---|---|---|---|---|
| Raised Crosswalks |  | Flat topped speed humps that serve as pedestrian crossings | ▼ | ▼ | ▲ | ▲ | -- | Residential |
| Raised Intersections |  | Intersection elevated to sidewalk height with ramps on approaches | -- | ▼ | ▲ | ▲ | ▲ | Both |
| Speed Tables |  | Flat topped speed humps with ramps on either side | ▼ | ▼ | ▲ | ▲ | -- | Residential |
| Diverters |  | Island or curbed closure used to prevent through and/or certain turning movements | ▼ | ▼ | ▲ | ▲ | ▲ | Residential |
| Street Closures |  | Physical barriers used to prevent vehicles from entering a street | ▼ | -- | ▲ | ▲ | ▲ | Residential |
| One-Way Streets |  | Vehicle travel restricted to one direction | ▼ | ▲ | ▲ | -- | -- | Residential |

▲ - Treatment will typically increase the condition
▼ - Treatment will typically decrease the condition
-- - Treatment will typically not impact the condition

# VIII. Implementation

# VIII. Implementation

## Priority and Ranking

Charrette participants were asked to prioritize the traffic related issues impacting their neighborhoods during both the opening and closing charrettes. Results of these votes may be found in the meeting minutes located in Appendix B. These votes will factor into the City's decision making process when determining the order in which the proposed traffic calming treatments are constructed. However, the votes will not play a defining role. The availability of funds will factor into this decision making process, as funds which may be available for certain locations, such as the areas surrounding schools, may not be applicable to other areas. Independently scheduled construction projects will also factor into the decision making, as it will be less costly to incorporate the implementation of treatments into larger construction projects than to build them as stand alone projects.

Additionally, a scoring system will be used to incorporate technical data into the implementation process. The scoring system assigns points based on a location's daily and peak hour traffic volumes, percentage of cut through traffic, 85th percentile speeds, accident history, and nearby accident generators. The criteria are described below:

- **Traffic Volume (24 Hour)**
  Traffic volumes will be measured for a 24 hour period on the streets in the traffic calming area. Points will be allocated based on the following table:

| 24 Hour Volume | Points |
|---|---|
| 0 - 1000 | 0 |
| 1001 - 1500 | 1 |
| 1501 - 2000 | 2 |
| 2001 - 2500 | 3 |
| 2501 - 3000 | 4 |
| >3000 | 5 |

- **Traffic Volume (Peak Hour)**
  Traffic volumes will be measured during the peak hour for both directions on the streets in the traffic calming area. Points will be allocated based on the following table:

| Peak Hour Volume | Points |
|---|---|
| 150 - 200 | 0 |
| 201 - 250 | 1 |
| 251 - 300 | 2 |
| 301 - 350 | 3 |
| 351 - 400 | 4 |
| >401 | 5 |

- **Percentage of Cut Through Traffic**

Cut through traffic will be measured during the peak hours. The highest peak hour period percentage will be used to allocate points based on the following table:

| Cut Through Traffic (Highest Peak Hour Period) | Points |
|---|---|
| 0% - 20% | 0 |
| 21% - 40% | 2 |
| 41% - 60% | 4 |
| 61% - 80% | 6 |
| 81% - 100% | 8 |

- **Traffic Speed**

The site specific existing 85th percentile speed will be used in the evaluation process, and not the posted speed limit. Points will be allocated based on the following table:

| Site Specific 85th Percentile Speed | Points |
|---|---|
| 0 - 25 mph | 0 |
| 26 mph - 30 mph | 5 |
| 31 mph - 35 mph | 10 |
| >35 mph | 15 |

- **Accident Data**

Site specific evaluation shall be limited to accidents in the traffic calming area. The analysis shall be limited to the total number of reported accidents over a period of the recent past three years. One point shall be assigned for each reported accident that is susceptible to correction by a traffic calming measure

- **Neighborhood Features**

Points for neighborhood features will be assigned based on the type of activities that are in the neighborhood. Generators will be considered in terms of likely pedestrian and bicycle activity. The following table will act as a guide:

| Activity Generators | Points |
|---|---|
| Low (Schools within 1 mile radius) | 2 |
| Medium (Elderly Housing, Community Center) | 5 |
| High (Schools within 1/4 mile radius) | 10 |

The overall score calculated for each location where a traffic calming treatment is to be built will be presented at a steering committee meeting.

## Standard Details

Standard details were developed for each of the proposed traffic calming treatments, and are included in the Master Plan documents. They are not intended to be used for construction at specific locations, as roadway geometry, usage, and subsurface conditions, will vary significantly from location to location. The intent of each detail is to provide a concept for the design of the device being proposed and the materials that may be used for its implementation.

Field observations were made in order to confirm that these treatments could be installed in the recommended locations with respect to existing surface features such as driveways and drainage structures. However, further investigation should be conducted at the beginning of the preliminary design process. It is expected that the designer will complete utility or subsurface research

The dimensions indicated on the details are provided for illustrative purposed. These dimensions should be verified by the designer to accommodate actual field conditions and design requirements.

All traffic calming devices and signs to be constructed are to be designed in conformance with the requirements of the latest editions of AASHTO's Policy On Geometric Design of Highways And Streets, the Manual on Uniform Traffic Control Devices, and all Federal, State, and Local requirements, including accessibility (ADA) requirements.

At locations where the deployment of a traffic calming treatments results in the relocation of a catch basin or manhole, the new catch basin or manhole should be installed in accordance with City standards.

## Installation and Evaluation

Traffic calming measures can be installed on either a temporary or permanent basis.

Temporary measures should be considered if traffic flow may be severely affected by the installation of traffic calming measures. After installation, traffic patterns and community approval may not be as expected. Temporary measures provide an opportunity to review the design in the field without a major removal expense if the project does not satisfy the original goals. If traffic calming measures are installed on a temporary basis, the temporary measures should resemble the permanent measures as much as possible, and should be marked, signed, and lit as if they were permanent measures. In addition, they must be designed using crashworthy devices so that they do not impose a safety hazard if struck by an errant vehicle. Particularly for programs that are just getting started, temporary installations provide a valuable means for the city ot gauge the depth of community support for measures that many citizens may be unfamiliar with. As a program develops and citizens gain greater familiarity with certain traffic calming measures, testing becomes less critical.

When temporary measures are installed, a three to twelve-month test period should be considered. In most cases, a three to six-month test is sufficient. Measures, such as diverters, that significantly alter traffic patterns may require a six to twelve-month test period. The test period should extend into the snow season whenever possible. This will provide the opportunity to detect any snow removal problems that may exist as a result of using the traffic calming measure. After the measure has been in-place for the specified time period, engineers or technical personnel should gather appropriate speed, volume, and other data to determine whether the measure has had the desired effect. The test period also provides the neighbors with the opportunity to decide whether the advantages gained from slower vehicle speeds, lesser volumes, and, in many cases, safer streets are worth the extra braking, the noise that some measures produce, extra seconds added to an emergency response call, longer trips to and from home, and other associated effects. Adjacent streets should also be monitored to verify that traffic problems have not shifted elsewhere. Many communities also use the temporary installation period to test the impact of emergency service vehicles. Some communities have reported that the fears of citizens regarding the effects of traffic calming measures on emergency response times are allayed when they see how well the vehicles can navigate the measures.

Following the temporary installation period, the neighborhood and the City must decide whether to install the measure on a permanent basis. At this point, they may also decide to modify the original traffic calming plan. While many aspects a traffic calming treatment's benefits can best be measured through qualitative methods, community input provides qualitative feedback which is also useful. The City will work with individuals who volunteered to participate in a steering committee during the original neighborhood charrettes to gauge community support and make this important decision. A list of steering committee volunteers may be found in Appendix C.

Whether the measure is installed permanently at the onset or after a temporary installation, follow-up traffic studies should be conducted. Traffic data gathered after a permanent installation may aid the decision-making process on measures in other parts of the municipality, and can be used to justify additional traffic calming expenditures. In the event that resistance develops to the measure in question, follow-up studies may explain why.

Resistance to traffic calming measures may develop after they have been in-place for a number of months, or measures may prompt opposition among members of the community immediately after installation. If initial opposition occurs, it often passes over time and should not be acted upon unless safety is a concern. The following parameters may assist you in determining the benefits derived from the installation of traffic calming measures:

- Before and after crash statistics for motor vehicle crashes, motor vehicle/bicycle crashes, and motor vehicle/pedestrian crashes. The crash studies should indicate how crash trends in the project area have been affected and should cover a length of time sufficient to identify long-term effects.
- Before and after speed studies to determine the 85th percentile speed. Ideally, speed studies should be performed upstream of, at, and downstream of the traffic calming measure to identify its effect on vehicle speeds.
- Before and after user volume, including peak hour volumes, the average daily traffic (ADT) and the direction design hourly volume (DDHV). Traffic counts should be made on the street where traffic calming will be installed and on the streets to which traffic is expected to divert. The "after" counts should be made when traffic patterns have stabilized.

The removal of traffic calming measures should only be considered after they have been in-place and monitored for six months to a year, and then only with the support of the neighborhood, unless a safety problem has developed. If a safety problem develops, the city should take steps to modify the traffic calming measure or remove it.

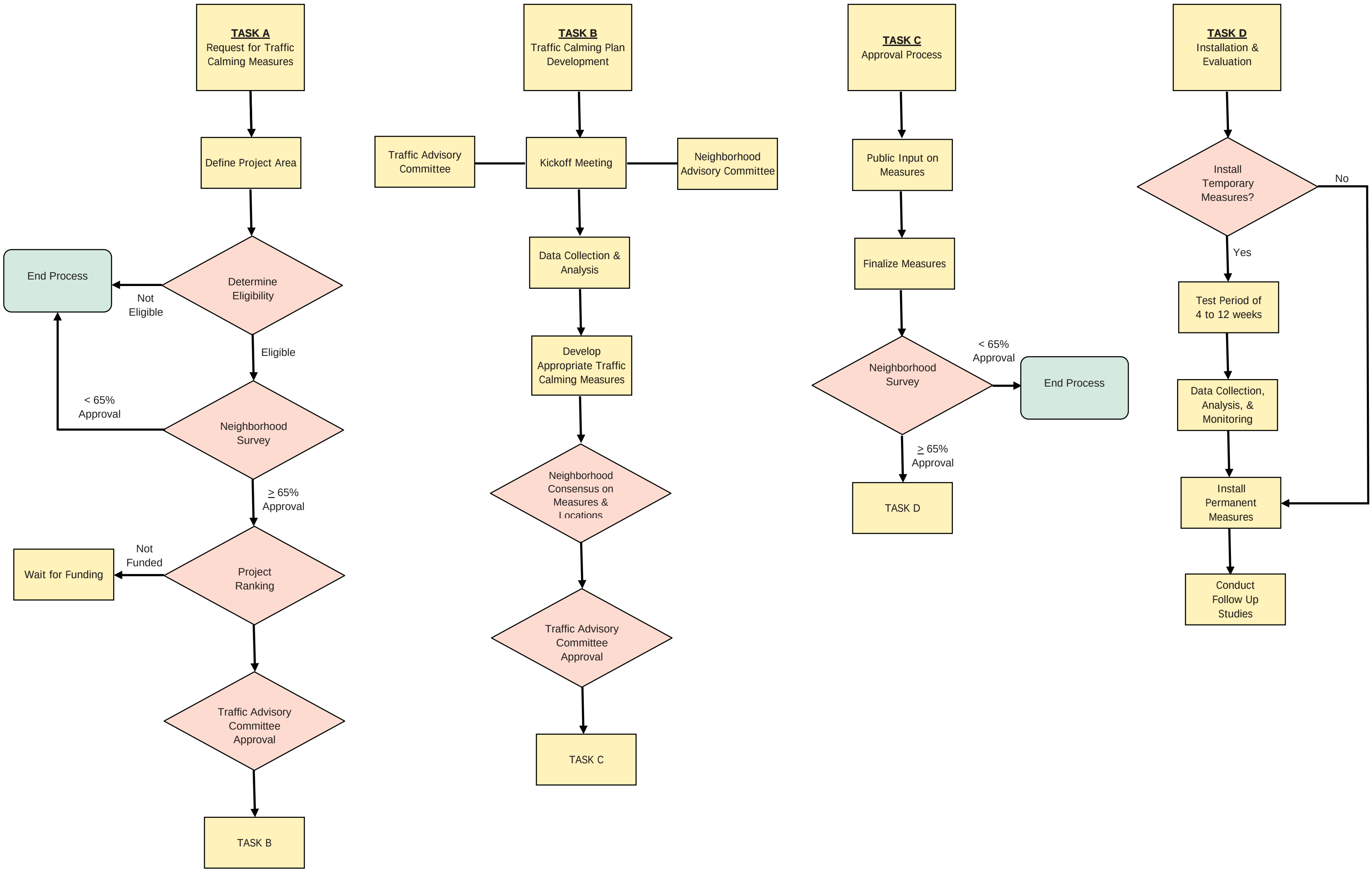
## Future Considerations

It is anticipated that as Stamford's population grows, land uses evolve, and traffic patterns change, new traffic issues will present themselves. The City has therefore developed a study and approval process which can be used to address speeding, cut through traffic, and safety issues which were not addressed by the Master Plan. The process is described below and summarized in Figure 1:

**TASK A: SUBMITTAL OF REQUEST FOR STUDY ALONG WITH SUPPORTING DATA**

**A. Request for Study**: A neighborhood group or a local official formally submits a request to the City's Traffic Advisory Committee (TAC) for a traffic calming study at a particular location. The TAC is a standing committee which coordinates all requests for traffic measures including traffic calming measures. This committee typically includes the Director of Operations, Fire Chief, Police Chief, Land-use Bureau Chief, Traffic Enforcement, Highway Maintenance, Engineering Bureau, Traffic Engineering, etc.

# Figure 1
# Study & Approval Process for Future Traffic Calming Treatments



**B. Collect and Compile Supporting Data**: After the request for study has been reviewed, the City must gather preliminary information such as project area, street classification, and land use to determine if the project warrants further study and evaluation. The following is a brief description of the preliminary information needed:

1. *Identification of Project Area*: The City and the neighborhood group must first determine the project area, or the area that would be affected by the installation of traffic calming measures. The project area will also be used to designate the neighborhood from which community approval must be sought throughout the study and approval process. The project area should include the study street, cross streets on either side of the measure(s), any street which relies on the study street for access, and the two parallel local service streets. Other local streets that may be affected by the implementation of the traffic calming measures should also be included.

2. *Street Functional Classification and Land Use*: Traffic calming measures may be considered on the following roadway based on functional classification, land use patterns, and posted speed limits:

- Local residential streets
- Collector streets with predominantly residential land uses
- Arterial roads within downtown districts or commercial areas (with posted speeds of 30 mph or less)

Although traffic calming measures may be appropriate in downtown districts and commercial areas, the applications are typically limited to less intrusive types of traffic calming measures, such as curb extensions, median islands and enhanced crosswalks. In locations where posted speed limits are 30 mph or less, a wider variety of measures may be appropriate, especially where pedestrian activity is high.

After the project area, street classification, and land use have been determined, the local government must decide if the traffic calming project meets the necessary preliminary requirements to be considered for traffic claming measures. If it does, then the study and approval process should be continued. If the preliminary requirements are not met, the neighborhood group or the local official that initiated the "request for study" should be notified why traffic calming is not appropriate at that location.

3. *Document Speeding or Cut-Through Problem and Determine Eligibility:* Depending on the traffic problem that is being addressed, one of the following criteria should be considered:

- *Average daily traffic (ADT) volume*: As a minimum requirement, the ADT should exceed 1,000 vehicles/day or the peak hour volume should exceed 100 vehicles for the roadway to be considered for traffic calming.
- *Speeding*: When speeding is the primary concern, the 85th percentile speed should exceed 10 mph over the posted speed limit before traffic calming is considered
- *Cut through*: When cut-through traffic is the primary issue, the cut-through traffic on the local residential street should be 40% or more of the total one hour, single direction volume. In addition, a minimum of 100 cut-through trips in one hour, in one direction, should be set as a minimum requirement.

These minimum criteria may need to be modified to better reflect local traffic conditions.

4. *Neighborhood Traffic Calming Survey*: Community approval is one of the most important steps in any traffic calming program. The best way to determine community approval is through a neighborhood survey. To do this, the TAC, or the interested neighborhood group must compile a list of all residents and businesses in the project area and conduct either a mail or door-to-door inquiry to document interest in the traffic calming project. Using a minimum of 2/3 of the project area approval from the households and businesses is a good

basis for further traffic calming studies response. The traffic calming process should not move forward from this point until the minimum requirement is obtained.

**C. Project Ranking**: After the required studies have been completed for a potential project, the project should be compared with other pending projects using the established project ranking system. Projects for which funding is available can proceed through the remaining steps of the study and approval process. If money is not available to fund all of the projects, the lower ranked projects will need to be put on hold until additional funding is identified.

**D. Pass Resolution**: The TAC will determine if the conditions warrant further study

**TASK B: TRAFFIC CALMING PLAN DEVELOPMENT**

**A. Kick-off Meeting**: The first step in the development of a new traffic calming plan is to hold a “kick-off” meeting. This meeting should be conducted by the traffic engineer. All households and businesses that will be affected by the installation of the traffic calming measure(s) should be invited to this meeting. The meeting should be held at a time and place that facilitates maximum participation by those affected. Representatives from the jurisdiction’s Elected Representatives, emergency service department (fire, police, and rescue), public works departments, local schools, and the transit agency should also be invited to attend. It is important that all of these entities be included in the development of the traffic calming plan to ensure that the project addresses all the needs and concerns of the community.

**B. Steering Committee**: A steering committee should be developed from the residents that attended the initial meeting(s). A list of residents who have already volunteered to participate in steering committees can be found in Appendix C. The committee will help provide focus to the plan development process by providing a link between the neighborhood and the City of Stamford. The steering committee can also help assist the traffic engineer and the TAC in organizing future community events, reviewing preliminary traffic calming plans and reports, and other areas where neighborhood participation is needed.

**C. Traffic Advisory Committee**: At this point, the TAC should be convened to oversee the development of the traffic calming plan.

**D. Plan Development**: The municipal engineer, with assistance from the TAC and the steering committee should gather more extensive data that can be used to further define the traffic problem affecting the neighborhood. In addition, the data may help identify appropriate solutions or define which traffic calming measures are appropriate for the particular application. Although TAC and steering committee personnel can assist in this endeavor, traffic data collection and analysis must be performed by appropriate traffic engineering or technical personnel.

1. *Collect and Analyze Data*: The following data may be helpful when determining appropriate solutions to the traffic problems at a particular location:

- Speed-average speed and 85th percentile speed (previously discussed)
- Volume-daily and peak hour volumes on the project street and other streets within the project area. If cut-through traffic volumes are believed to be excessive, a license plate survey could be conducted along with turning movement counts
- Adjacent arterial roads-determine if problems on area streets are related to poor traffic conditions on adjacent arterial roads. In this case, deficiencies on the arterial streets should be addressed first if they are the responsibility of the local municipality
- Crashes-crash data, by type, for the most recent three years
- Parking-location, capacity, and use
- Pedestrian and bicycle activity-identify vulnerable groups like children and the elderly

- Emergency service routes
- Transit and local bus routes
- Locations of schools, parks, and other such facilities

2. *<u>Identify Appropriate Traffic Calming Measures</u>*: After the traffic data has been compiled, appropriate traffic calming measures can then be identified. List information about a number of different traffic calming measures to assist in this effort. Identifying appropriate measures includes the following:

   - Identification of which traffic calming measures are designed to solve the documented problems
   - Appropriateness of a particular traffic calming measure to the location where it will be installed.

**E. Concur on Measure, Location, and Design**: At this point, the project engineer should present the findings of the data analysis to the steering committee and TAC. Also, the engineer should describe which traffic calming measures are best able to address the problems identified, and discuss neighborhood opinions about traffic calming. Through this and subsequent meetings, the local government, the steering committee, and the TAC should work toward a consensus on the most appropriate traffic calming measures, their design, and specific locations.

## TASK C: APPROVAL PROCESS

**A. Public Information Meeting**: Once consensus has been reached by the City and the traffic calming committees, the preliminary and final traffic calming plans should be presented at a public information meeting. Notices for these meetings may be distributed door-to-door, mailed, or announced via a press release. The community should typically be presented with a single plan, with options for specific locations. Then, if necessary, plans may be modified before they are submitted to the community for approval.

**B. Finalize Plan**: Following public review, any necessary modifications are made to the traffic calming plan. Additional public meetings can be held if the changes are very substantial. Otherwise, the plan is ready for community approval.

**C. Neighborhood Survey**: Once the traffic calming plan is completed, a second neighborhood survey should be conducted. A 2/3 population of the project area neighborhood approval threshold should again be used to indicate continued community support for the traffic calming project. If less than 2/3 of population is obtained, additional modifications to the plan may be needed.

**D. City Approval**: After 2/3 community approval is obtained the traffic calming plan must be officially approved by the TAC. At this point, the funding source should be clearly identified and money set aside for implementation and maintenance.

## TASK D: INSTALLATION AND EVALUATION

The same process proposed for installing and evaluating traffic calming treatments recommended in the Master Plan may also be used for future traffic calming deployments that have successfully passed the approval process outlined in Task C.

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