A TIERED APPROACH TO NEIGHBORHOOD TRAFFIC MANAGEMENT

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ABSTRACT

The City of Ventura has had an existing policy relative to the closure or modification of traffic flow on public streets since December 1993. Although the policy empowered neighborhoods to address traffic issues, the City continued to receive numerous requests to intervene and address speeding and cut-through traffic. Neighborhoods were unable to reach consensus on how to address these issues under the existing traffic flow modification policy. Public concerns about traffic volumes and speeds continued to increase. To address this ongoing issue, a new comprehensive tiered approach to neighborhood traffic management was developed and approved by the City Council in June 1997.

The proposed program expands the City's current approach to mitigate cut-through traffic and speeding problems and is based on well established techniques that are used by many other agencies throughout the world. What is different about Ventura's approach is the program offers a variety of 29 traffic calming options which are tiered into four levels. Level 1 is the least restrictive while Level 4 involves closing streets. Levels 1 and 2 options involve minimal physical changes. Levels 3 and 4 implement major physical changes. Under the City's program, the majority support is established at 67% of impacted residents and requires residents to pay for any Level 3 or 4 physical changes which can only be selected by residents after the Level 1 and 2 options have been tried. The Level 3 and 4 options are also being phased in over a three year period and streets with multiple speeding and/or cut-through traffic complaints are identified. Copies of the City's policy and overall program will be made available to members of the audience.

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ADMINISTRATIVE REPORT

Date : June 10, 1997

Agenda Item No. : ~~ADVANCE~~ 17

Council Action Date : June 23, 1997

To : DONNA LANDEROS, CITY MANAGER

From : EVERETT MILLAIS, DIRECTOR OF COMMUNITY SERVICES

Subject : **NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING POLICY**

RECOMMENDED ACTION

It is recommended that the City Council:

a. Accept the Neighborhood Traffic Management and Calming Program Report;

b. Rescind Resolution No. 93-130 which established a policy relative to the closure or modification of traffic flow on local public streets; and

c. Adopt the Neighborhood Traffic Management and Calming Policy Resolution provided in Exhibit A.

SUMMARY

The existing policy relative to the closure or modification of traffic flow on local public streets, Resolution No. 93-130, was approved by City Council on December 20, 1993. Although that policy empowers neighborhoods to address traffic issues, the City continues to receive numerous requests to intervene and address speeding and cut-through traffic. Neighborhoods have not been able to reach consensus on how to address these issues under the existing traffic flow modification policy. Public concerns about traffic volumes and speeds continue to increase in the City. To address this ongoing issue, a new comprehensive Neighborhood Traffic Management and Calming Program has been developed.

The proposed program expands the City's current approach to mitigate cut-through traffic and speeding problems, and it is based upon techniques that are being used by many other agencies throughout the United States. The proposed program offers a variety of traffic calming options which are tiered: Level 1 is the least restrictive, while Level 4 is the most restrictive.

ALTERNATIVES

The City Council could direct staff to continue with the existing Traffic Flow Modification Policy Resolution 93-130.

FISCAL IMPACTS

The fiscal impact will be dependent upon the direction provided by the City Council. The Level 1 and 2 traffic calming options can be performed within the existing City budget.

Additional resources, which might be needed in the future, are dependent upon the City's initial experience should the recommended program be approved. Although the existing budget can "absorb" the expenditures needed for the initial program, additional resources will be required if numerous studies, such as the Hillside Street Study, are to occur or if the City Council decides to pursue Level 3 and 4 options for streets in various parts of the City.

Should the City Council direct staff to implement Level 3 and 4 traffic calming options, the costs will vary. The proposed Neighborhood and Traffic Calming Program requires citizens to pay for the design and construction of all Level 3 and 4 calming measures. The City would only pay for the cost of the trial installations. Should the City Council decide that the City should pay for all permanent installations, it is anticipated that the City would have to budget $100,000 to $150,000 per year in the Capital Improvement Plan to cover the design and construction costs. There would be additional administrative costs.

DISCUSSION

The proposed program and potential impacts of the Neighborhood Traffic Management and Calming Program are contained in the attached report. The report provides a summary of the various traffic calming options available, detailed descriptions of each device and information about the effect on emergency vehicle response times.

Exhibit "A" provides a new resolution that rescinds Resolution No. 93-130 which established a policy relative to the closure and modification of traffic flow on local public streets, and replaces it with a new policy establishing the Neighborhood Traffic Management and Calming Program. The new resolution incorporates several changes:

- The proposed program broadens the options available to residents wishing to calm traffic in their neighborhoods.

- Majority support is established at 67% of impacted residents, a reduction from the previous 80% threshold.

- A new Neighborhood Traffic Management Process has been incorporated that defines how the City will address neighborhood traffic concerns.

- The Petition Process requesting traffic calming options has been streamlined to be more efficient and less time consuming.

The Engineering Division and Police Department have received complaints about speeding and cut-through traffic on residential streets for many years. For the last ten years, this has been documented and multiple complaints have been received on 45 streets. Under the proposed program, it is anticipated that there will be a flood of requests for Level 3 or 4 devices on these streets. In order to better manage these requests, it is proposed that Levels 1 and 2 measures will be implemented on requested streets, based on available staff resources. The proposed program would also require the neighborhood property owners requesting the Level 3 or 4 options to pay for their installation.

In order to determine how successfully the City's proposed traffic calming program will address neighborhood concerns for Level 3 and 4 options, it is proposed that the Neighborhood Traffic Management and Calming Policy be implemented in three phases as follows.

- Between July 1, 1997 and June 30, 1998, Phase 1 comprising the Pierpont Keys, Catalina, Downtown and Avenue communities as designated on the City's Comprehensive Land Use Plan Map dated August 1, 1995 will be eligible to participate in the program.

- Between July 1, 1998 and June 30, 1999, all areas in Phase 1, as well as areas in Phase 2 which include the Loma Vista, Arundell, Preble, Camino Real, Arroyo Verde, Olivas and Thille communities as designated on the City's Comprehensive Land Use Plan Map dated August 1, 1995, will be eligible to participate in the Neighborhood Traffic Management and Calming Program.

- After June 30, 1999 all areas of the City will be eligible to participate in the Neighborhood Traffic Management and Calming Program established by this resolution.

Prepared by: Nazir Lalani, City Transportation Engineer
for

Everett Millais
Director of Community Services

Reviewed as to fiscal impacts

Marilyn E. Leuck
Director of Management Resources

FORWARDED TO THE CITY COUNCIL

Donna Landeen
Office of the City Manager

NL:47-201.wpd

EXHIBIT A

PROPOSED NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING POLICY RESOLUTION

RESOLUTION NO. 97-53

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SAN BUENAVENTURA RESCINDING TRAFFIC FLOW MODIFICATION POLICY RESOLUTION NO. 93-130 AND ESTABLISHING A NEW POLICY RELATIVE TO NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING PROGRAM FOR RESIDENTIAL PUBLIC STREETS

BE IT RESOLVED by the City Council of the City of San Buenaventura as follows:

SECTION 1: Resolution No. 93-130 currently provides a policy relating to traffic flow modifications on residential City streets.

SECTION 2: The City Council wishes to rescind Resolution No. 93-130 to be replaced with the following new policy relative to Neighborhood Traffic Management and Calming Program for residential public streets.

STATE LAW

The State of California has preempted the field of traffic control (see section 21 of the Vehicle Code), and no local authority is allowed to enact or enforce any ordinance on the matters covered by the Vehicle Code unless expressly authorized by statute.

It is the policy of the State that all persons have an equal right to use the streets and highways, and localities have no carte blanche and, absent express authority, may not determine which traffic shall and which shall not use streets. Based upon this policy, in the absence of specific State legislative authority to the contrary, a city may not restrict the right to travel upon one of its streets to its residents or to other exempted drivers. Some examples in the Vehicle Code of such specific authority to regulate travel upon streets are: if the City Council determines the street is no longer needed for vehicular traffic [§ 21101(a)]; if needed to implement the Circulation Element of a General Plan [§ 21101(f)]; if due to criminal activity (§ 21101.4); regulating or prohibiting processions or assemblages [21100(a)]; and on streets dividing school grounds to protect students attending such school or school grounds. When a local agency decides to utilize the express delegation of such authority, the local agency may only utilize "official traffic control devices" authorized by the Vehicle Code Section 21400. Additionally, local authorities may not place gates or other selective devices on any street which deny or restrict the access of certain members of the public to the street, while permitting others unrestricted access to the street.

PURPOSE OF POLICY

Consistent with State law and policy, it is the general policy of the City to not allow temporary or permanent closure of any public street to vehicular traffic. Requests for implementation of Neighborhood Traffic Management and Calming measures on a public street will be considered,

however, based on a petition which meets all the criteria and procedures outlined herein. The City will carefully review each request to ensure that the proposed location and attending circumstances meet all the criteria outlined in this policy and in State law. The purpose of this policy is to set forth the process and criteria by which implementation of Neighborhood Traffic Management and Calming measures public streets may be considered. The policy also identifies the conditions under which such measures may be enacted. This policy only applies to requests initiated by citizens. This policy will not apply to measures on public streets initiated by the City Council to address specific traffic safety issues or to comply with State and Federal standards and warrants. This policy also will not apply to temporary changes in traffic that are needed to stage special events in the City. The goal of the Neighborhood Traffic Management and Calming program is to enhance and protect the quality of life in the City's neighborhoods by making them more safe for children, pedestrians, and residents living in these neighborhoods.

NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING MEASURES

Neighborhood traffic management calming measures covered by this policy include all "official traffic control devices" authorized by the California Vehicle Code. Some of the methods authorized in particular circumstances might include traffic islands, curbs, traffic barriers, or other roadway design features, removing or relocating traffic signals and one-way traffic flow.

QUALIFYING CRITERIA

Requests for the implementation of neighborhood management and calming measures on public streets, including reopening previously closed streets, will be considered by the City for those streets meeting all of the following criteria:

a. The street should be primarily residential in nature.

b. Volumes are approximately equal to or exceed 800 vehicles per day

c. Public Safety Agencies have not provided sufficient evidence of any major public safety concerns regarding the neighborhood traffic management and calming measures.

d. The changes in traffic flow will not result in unreasonable liability exposure for the City.

e. The requested action is authorized by legislative authority in State law.

f. The changes in traffic flow will not divert significant amounts of traffic to other residential streets.

NEIGHBORHOOD TRAFFIC MANAGEMENT PROCESS

The following process will be used by the City to address neighborhood traffic concerns:

a. A resident alerts the City to a problem area. If the problem specifically involves speeding or cut-through traffic, the complaint is processed through the Neighborhood Traffic Management and Calming Program.

b. If a neighborhood meeting is requested, the City provides information to the resident as to the options available under the City's Program. The City instructs the resident to complete and return the "Neighborhood Action Request Form." The form requests a written description of the location of concern and requires signatures from seven separate residents per block of the impacted street(s).

c. If the form is returned, the City schedules a neighborhood meeting to identify the concerns and issues. It is anticipated that a traffic engineer from the City's Community Services Department as well as a uniformed police officer will attend the meeting.

d. The City may prepare an existing condition traffic analysis. Level 1 or Level 2 Traffic calming options may be recommended by City staff to the residents living on the streets that have submitted Neighborhood Action Request forms at a follow-up neighborhood meeting.

e. If the Level 1 or Level 2 options are not adequate after being in-place for an appropriate amount of time, the City may conduct after studies to determine whether further Level 3 or 4 measures are appropriate. This will include consulting the Police and Fire Departments to determine if the street is critical to emergency vehicle response and, therefore, not eligible for certain options.

f. If area wide support is demonstrated through a petition process, the City will implement Level 3 or Level 4 measures using temporary materials at City expense for a trial period of 180 days after appropriate environmental clearances have been obtained. This will also require support of all residents in the immediate vicinity of the devices. At the end of the trial period, residents may select to have the Level 3 or 4 devices removed or made permanent.

g. If residents elect to have the Level 3 or 4 devices installed permanently, they may be required to hire a qualified consultant to prepare design plans, and hire a contractor to install the measures permanently within 180 days under a City encroachment permit at their expense. If residents fail to complete permanent installation within 180 days, the City has the option to remove the temporary measures at the City's expense.

h. If the residents elect to have the Level 3 or 4 devices installed permanently, but decide later on that the devices are not desirable, an encroachment permit will be issued by the City to allow them to have the devices removed by an approved contractor at their expense.

PETITION REQUIREMENTS

The following procedures must be followed for submitting a petition for Level 3 or Level 4 measures to the City:

a. The City Transportation Engineer will recommend and examine the technical feasibility and anticipated impacts of the proposed neighborhood traffic management and calming measures. This review will include items such as State law, the Circulation Element of the City's General Plan, the type of road or street involved, compliance with engineering regulations, existing traffic conditions, projected traffic conditions, the potential for traffic diversion to adjacent streets, impacts to emergency vehicle response times and the increased liability exposure for the City or conflicts with future planned improvements.

b. The City Transportation Engineer will determine the boundary of the "affected area" to be petitioned. The affected area will include but not be limited to those properties where normal travel routes to and from the "affected area" are to be altered by the neighborhood traffic management and calming measures, and/or properties which are significantly impacted by traffic that is to be diverted.

c. The petition requesting the neighborhood traffic management and calming measures must be supported by a minimum of 67 percent of the total number of citizens affected by the proposed changes in traffic flow, as determined by the City Transportation Engineer. The citizens should include property owners, tenants, business owners within the "affected area" who might be significantly affected by the proposed measure. Persons submitting petitions must attempt to contact all affected parties. At a minimum, 90 percent of all affected persons who may need to use the street(s) on a daily basis must be contacted for the petition to be accepted by the City. This requirement will be satisfied by signatures from 90 percent of the affected parties indicating support or non-support for the neighborhood traffic management and calming measures.

d. At a minimum, petitions submitted to the City for review must include the following unless otherwise waived by the City Council:

- A statement that all persons signing the petition acknowledge it is the City's policy that they will be responsible for all costs directly associated with the construction of permanent neighborhood traffic management and calming measures in order to facilitate the funding of the ultimate improvements needed to implement the street closure or traffic flow modifications.

- The petition language must also clearly explain, and show on a drawing or plan, the location, and the nature of the proposed traffic flow modifications.

- The petition language and attached drawing must be reviewed and approved by the City Transportation Engineer prior to circulation to ensure its accuracy and ability to be clearly understood.

A sample petition has been provided as an attachment to this policy.

PETITION REVIEW PROCESS

The following process will be used to review all petitions associated with a proposed neighborhood traffic management and calming measures:

a. The City Transportation Engineer will review any petition to verify compliance with all petition requirements set forth above. Any petition not complying with these requirements will not be accepted for consideration. If the petition contains all of the required information under this policy, a letter will be sent out by the City to all who signed the petition, affected property owners, tenants, and business owners requesting verification of their support or opposition to the proposed neighborhood traffic management and calming measures by signing a signature sheet that is included in the letter.

b. If the petition contains all of the required information under this policy, the proposed neighborhood traffic management calming measures will be referred to all affected public agencies in conjunction with the environmental review process. At a minimum, these agencies will include all City Departments, the local office of the California Highway Patrol, County Sheriff and Fire Departments, Ventura County Public Works Agency, all affected local utility companies, Ventura Unified School District, South Coast Area Transit, the local office of California Department of Transportation and any other agencies affected by the traffic flow modification.

c. If the petition contains all of the required information under this policy and can be properly verified, the City will proceed with implementing the Level 3 or Level 4 traffic flow modifications.

SECTION 3: The City Council has the sole discretion, subject to all applicable laws, to approve, modify, continue or deny any traffic flow changes request regardless of any support or lack thereof via the petition process.

SECTION 4: This policy is to be implemented in three phases. Between July 1, 1997 and June 30, 1998, Phase 1 comprising the Pierpont Keys, Catalina, Downtown and Avenue communities as designated on the City's Comprehensive Land Use Plan Map dated August 1, 1995 will be eligible to participate in the Neighborhood Traffic Management and Calming Policy established by this resolution.

Between July 1, 1998 and June 30, 1999, all areas in Phase 1 as well as areas in Phase 2 which include the Loma Vista, Arundell, Preble, Camino Real, Arroyo Verde, Olivas and Thille communities as designated on the City's Comprehensive Land Use Plan Map dated August 1, 1995 will be eligible to participate in the Neighborhood Traffic Management and Calming Program established by this resolution. After June 30, 1999, all areas of the City will be eligible to participate in the Neighborhood Traffic Management and Calming Program established by this resolution.

SECTION 5: Based on the foregoing, the City Council of the City of San Buenaventura hereby adopts this resolution establishing a 0policy relative to Neighborhood Traffic Management and Calming Program for residential public streets.

PASSED AND ADOPTED this 23 day of June, 1997.

Mabi Covarrubias Pliska
DEPUTY City Clerk

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NEIGHBORHOOD ACTION REQUEST FORM

NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM (NTMP)

We, the undersigned, request a neighborhood meeting at the location stated below. After reviewing this information, we believe our neighborhood traffic situation warrants the City's Neighborhood Traffic Management Program. The following signatures representing at least seven different residents in the neighborhood indicate the neighborhood's commitment to work with the NTMP for a safer traffic environment within our neighborhood.

PRINT NAME	ADDRESS	PHONE (Day/Time)
1.		
2.		
3.		
4.		
5.		
6.		
7.		

Contact Name _____ Day Phone:_____

Address: _____ Today's Date:_____

Neighborhood: _____

Location of Concern: _____

What concerns do you have at this location? _____

_____

_____

Thank you for taking the time to complete the Neighborhood Action Request Form. After completing the form, please return it to City Transportation Engineer, P. O. Box 99, Ventura, CA 93002.

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PETITION TO MODIFY THE TRAFFIC FLOW ON _____ STREET

BETWEEN _____ AND _____

BY THE INSTALLATION OF _____(Nature of Changes)_____

AT _____(Location)_____

DATE: _____

BEFORE YOU SIGN THIS PETITION, KNOW WHAT YOU ARE SIGNING! ITIS RECOMMENDED THAT YOU FIRST READ THE CITY'S NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING POLICY.

We, the undersigned residents of the area shown on the attached map do/do not petition the City of San Buenaventura to _____ on _____ Street as shown on the attached drawing.

All persons signing this petition acknowledge it is the City's policy that they will be responsible for all costs directly associated with physical changes needed to implement neighborhood traffic management and calming measures in order to facilitate the funding of the ultimate improvements needed to accomplish traffic flow modifications.

All persons signing this petition do hereby certify that they reside within the area impacted by the proposed traffic flow change as shown on the attached map.

Contact person: _____ Phone: (___) _____

SIGNATURE	PRINT NAME	PRINT STREET ADDRESS	ZIP

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NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING PROGRAM

PREPARED BY:

CITY OF SAN BUENAVENTURA
DEPARTMENT OF COMMUNITY SERVICES

Engineering Division
501 Poli Street
Ventura, CA 93001

June 1997

1. BACKGROUND

One of the most persistent and emotional complaints that the City receives is speeding on residential streets. Each year, more than 200 requests are received by various City departments to study streets where residents have concerns about excessive traffic speeds and/or volumes. Over the past ten years, over 120 streets have been reported to the City. Of these 120 streets, the 43 locations shown in Attachment 1 include those streets where the City has received a long history of many complaints. Proper street design is essential in encouraging lower speeds and maintain the integrity of residential neighborhoods. New streets are designed to minimize through traffic in a neighborhood. Subdivisions are now designed to avoid long straight stretches of streets in new residential areas. Long stretches of streets encourage higher speeds. Existing residential streets with long stretches of more than 1,000 feet are consistently complaining of higher speeds. Residential streets carrying volumes of more than 1,000 vehicles per day are generally considered unacceptable to adjacent residents.

This report presents a Neighborhood Traffic Management and Calming Program aimed at making existing residential streets more livable by reducing traffic speeds and volumes.

1.1 Traffic Calming for Livable Neighborhoods

Traffic calming is the combination of both policies and measures that help decrease the negative impacts to local streets and neighborhoods caused by motor vehicles. Although traffic calming techniques did not begin to be readily implemented in the United States until the 1980's, there are many examples that already exist. In Europe and Australia, some of these same techniques have been used long before the 1970's. Many of the successful techniques used there are into their second and third generation. Their effectiveness has been proven and many appear to be part of the original street design rather than as an afterthought.

Traffic calming techniques were developed to reduce speeding problems and heavy traffic flow on residential streets. By making some residential streets more "calm" it makes the neighborhood more livable. Although "livable" in terms of a neighborhood does not have a precise definition, a livable neighborhood can be described as having the following characteristics:

- Ability to feel safe and secure,
- Opportunity to interact with neighbors,
- Ability to experience a sense of home and privacy, and
- A sense of community identification.

In essence, when a citizen calls to request a stop sign to slow traffic on their street, they are requesting the city make their street more livable.

Because no single answer for the problem of speeding vehicles on residential streets exists, many different traffic calming techniques have been developed. These techniques range from the traditional, such as radar display boards and selective police enforcement to non-traditional such as street chokers and roundabouts. A discussion of all the techniques is found on the following pages. A major component of introducing traffic calming techniques is a comprehensive citizen education/participation campaign. A citizen education/participation campaign encourages the neighborhood to take responsibility for the solution too. Experience has shown that a majority of the speeding violations in the residential area are from residents who live in the neighborhood.

1.2 Neighborhood Traffic Management Options

A summary of available neighborhood traffic management options is provided in Attachment 2. The information in Attachment 3 provides a brief description of the positive and negative effects of implementing each option. The options presented have been chosen for their impact on speeds and volumes on residential streets. Although some of the options could be used on non-residential streets, the focus of the traffic calming program is on local residential streets. The options have been structured into four levels. Level 1 is the least restrictive, while Level 4 is the most restrictive. The overall objectives for the Neighborhood Traffic Management program are:

1 Improving neighborhood livability by mitigating the impact of vehicular traffic on residential neighborhoods.

2. Promotion of safe and pleasant conditions for motorists, bicyclists, pedestrians and residents on neighborhood streets;

3. Encouraging citizen involvement and effort in neighborhood traffic management activities;

4. Making efficient use of City resources by prioritizing traffic management requests; and

5. Supporting the Comprehensive Plan policy that livability and safety of established residential neighborhoods be protected in transportation operations.

1.3 Current City Practices

The City currently undertakes most of the techniques described as Levels 1 and 2 actions. Neighborhood meetings, speed studies, volume studies, other traffic observations and provides enforcement are provided as appropriate. Additionally, all roadway signing and striping are reviewed and modifications or additions made as necessary. The Engineering Division routinely utilizes its radar speed trailer on streets where vehicle speeds have been reported as a problem. In some instances the trailer does not appear particularly effective in reducing driver's speeds. However, in other instances speed reductions are clearly noted. In almost all instances the speed trailer deployment is supported by the concerned

residents because of a real or perceived decrease in speeds or by educating the residents to the fact that speeds are not as high as had been perceived. Overall, the City's current Levels 1 and 2 efforts are comparable to what is found in most similar communities.

1.4 Proposed Neighborhood Traffic Management Process

Traffic calming techniques work best when incorporated into a "traffic calming" or "neighborhood traffic management program." Successful programs include the planning process, overall community participation and local authority support. Because residents are the main initiators of traffic calming requests, they need to be part of the process as much as possible. By developing a program early on that addresses neighborhood traffic safety concerns on an area wide basis, it encourages citizens to become actively involved in the improvement process. In this way, the City and the neighborhood can work together to create more livable neighborhoods. City staff would use the Neighborhood Traffic Management and Calming Process proposed in Attachment 1 to address citizens concerns.

2. IMPACTS OF TRAFFIC CALMING DEVICES

Before the City decides to pursue Levels 3 and 4 traffic calming options, it is important that the impacts be carefully considered. While Levels 3 and 4 options can be successful, they can also result in problems more significant than the original concern. This section of the report will describe the possible impacts of Levels 3 and 4 traffic calming tools. In most instances, the benefits are quite obvious and predictable while the disadvantages can be much more unexpected. Consequently, a greater emphasis has been placed on the potential problems so that decisions can be made in a more fully informed manner.

2.1 Effectiveness of Traffic Calming Devices

Physical actions such as the installation of speed humps, traffic circles, street closures, etc. are almost always successful in forcing traffic to behave in an intended fashion. In certain situations, they can achieve the desired result by utilizing a one-time capital expenditure and generally low ongoing maintenance costs. Levels 3 and 4 traffic calming actions are generally viewed as much more "permanent" solutions than Levels 1 and 2 actions. In most instances the alternative approach to the desired result involves repetitive and costly ongoing Levels 1 and 2 traffic calming actions. There are significant potential benefits to utilizing Levels 3 and 4 traffic calming actions which is why some communities have implemented Levels 3 and 4 actions and many other communities are exploring their possible use.

2.2 Effect on Emergency Vehicles Response Times

Any traffic calming tool that might be effective because it physically controls traffic generally has a much more negative impact on several classes of emergency vehicles. The City, as well as its residents and businesses, place a very high priority on minimizing emergency response times. Installation of most physical traffic calming tools can significantly worsen emergency response time. This is especially true for fire apparatus and ambulances. Because of the heavy weight of fire engines and the delicate instruments and patients within ambulances, these vehicles must almost come to a complete stop when they encounter a bump, dip or sharp curve. Creating bumps, dips and sharp curves is often precisely the objecjtive being sought by many of the traffic calming tools. While these maneuvers will cause moderate discomfort and delay for normal passenger vehicles, they cause a much greater problem for emergency response vehicles. Attachment 4 provides information on recent studies that have been done to qualify the effect of traffic calming devices on emergency response time.

These studies show the following average delays to emergency vehicles for certain types of devices:

TYPE OF DEVICE	AMBULANCES	FIRE TRUCKS
Each Speed Hump	2.3-9.7 seconds	3-5 seconds
Each Traffic Circle	Not Available	1.3-10.7 seconds

The City's Fire Department is concerned about the affect these devices have on response times and has requested initial review of all proposed changes involving Level 3 and 4 options with the ability to veto any changes affecting critical access streets. This impact will have to be addressed for each area for which Level 3 and 4 traffic calming options are requested.

2.3 Traffic Diversion

Another concern is that in many instances implementing traffic calming devices would be likely to move the problem rather than solve the problem. In most instances the placing of impediments on a particular neighborhood street may merely divert some of all of that traffic to other neighborhood streets.

2.4 Impacts to Transit and Utility Vehicles

Some of the traffic calming options in Levels 3 and 4 could potentially have severe impacts on bus routes and utility vehicles such as trash trucks. Providers of these services will have to be consulted whenever neighborhoods select Level 3 and 4 options.

2.5 Considerations for Other Roadway Users

In addition to the safety concerns already discussed in this report, Levels 3 and 4 traffic calming actions can often have unintended negative safety impacts on certain roadway users. They can result in worsening the situation for a range of roadway users such as bicyclists, roller skaters, skate boarders, joggers, pedestrians and parked cars.

2.6 Noise Impacts

The noise impact to adjacent residents resulting from vehicles braking, going over and around traffic calming devices can have a major impact on the acceptability of these devices by residents living closest to them. The unanimous support of residents living immediately adjacent to locations where physical changes are proposed will be essential to the success of any project.

2.7 Loss of Parking

It is often necessary to prohibit on-street parking in the immediate vicinity of the intersection in order to accommodate the realigned vehicle path. There are also significant on street parking impacts from several options in Levels 3 and 4.

2.8 Liability Exposure Implications

Many Level 3 and 4 traffic calming actions can also result in varying degrees of liability exposure to the City. The most likely source of increased liability exposure would be that resulting from City implementation of traffic calming action. This exposure would probably stem from two general categories of negative impacts. The first would be liability which might arise from the negative impact to emergency vehicle response times. Delay of emergency response could result in a civil action by an injured party from allegations that the emergency vehicle response was delayed by traffic calming devices.

It is also possible that traffic calming devices themselves might result in damage or injury. Certainly if a traffic calming device were not properly designed with all appropriate lighting, signing and pavement markings, liability exposure could result. But there is also potential liability from properly designed and installed traffic calming actions. If the device itself causes driver behavior which results in damage to property or injury, the City could potentially be held liable. For instance, if a driver maneuvered in order to avoid a traffic calming device and as a result struck a parked car, pedestrian, cyclist, etc., there is the potential for City liability exposure. Agencies have been held liable for not maintaining warning signs and markings in excellent condition. These are just a few examples of the potential, unintended, but known negative impacts of traffic calming devices.

2.9 Visual Impacts and Aesthetic Concerns

While some traffic calming devices can have favorable aesthetic impacts, others can be, by their nature, unsightly. Devices such as speed humps and diverters most often pose no opportunity for the incorporation of aesthetics and can have negative visual impacts. Virtually all Level 3 and 4 traffic calming actions require reflective devices, signs and striping which may negatively effect the aesthetics of a neighborhood.

2.10 Increased Maintenance Costs

Street maintenance costs will increase in two areas. Landscaping associated with such devices as trffic circles, chokers and slow points will require regular maintenance. Devices such as speed humps will have to be reinstalled each time a residential street is overlayed which will increase costs by $20,000 per mile.

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ATTACHMENT 1

RESIDENTIAL STREETS WITH MULTIPLE SPEEDING COMPLAINTS AND/OR TRAFFIC VOLUME CONCERNS

RESIDENTIAL STREETS WITH MULTIPLE SPEEDING COMPLAINTS AND/OR TRAFFIC VOLUME CONCERNS

Ashwood Avenue
Aurora Drive
Beachmont Street
Brent Street
Bryn Mawr Street
Cachuma Avenue
Cedar Street
Channel Drive
Chrisman Avenue
Citrus Drive
Colina Vista
College Drive
Crowley Avenue
Darling Road
Dean Drive
Dos Caminos Avenue
Dunning Street
Fairview Drive
Foothill Road
Frances Street
Glen Ellen Drive
Hyland Avenue
Halifax Street
Highpoint Drive
Jasper Avenue
Lafayette Street
Lark Avenue
Lemon Grove Avenue
Loma Vista Road
McMillan Avenue
Neath Street
Ocean Avenue
Olive Street
Palomar Avenue
Porter Lane
Preble Avenue
Ramona Street
San Nicholas Street
Saranac Street
Saticoy Avenue
Seneca Street
Seton Hall Avenue
Sunset Drive
Teloma Drive
Varsity Street
Via Arroyo Circle
Via Ondulando
Vince Street

ATTACHMENT 2

SUMMARY OF NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING OPTIONS

NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING OPTIONS[1]

(Not in priority order)

LEVEL	TRAFFIC[1] MANAGEMENT OPTION (Page No.)	SPEED REDUCTION	VOLUME REDUCTION/ TRAFFIC DIVERSION	NOISE POLLUTION	LOSS OF ON STREET PARKING	ACCESS RESTRIC-TION	BUS ROUTE AND EMERGENCY VEHICLE RESPONSE IMPACTS	INCREASE IN STREET MAINTEN-ANCE	INSTALLATION COST
1	Higher Visibility Crosswalks (3-2)	Possible	No	No Change	None	None	None	Yes	$1,000 -5,000
1	Neighborhood Meeting (3-3)	Possible	Possible	No Change	None	None	None	No	-
1	Police (3-4) Enforcement	Yes	Possible	No Change	None	None	None	No	$90,000[2]
1	Police Presence (3-5)	Possible	No	No Change	None	None	None	No	-
1	Posting 25 MPH Speed Limits/ radar warning signs (3-6)	Possible	No	No Change	None	None	None	No	$200 per sign
1	Radar Trailer(3-7)	Yes	No	No Change	None	None	None	No	-
1	Rumble Strips (3-8)	Yes	Possible	Yes (High)	None	None	None	Yes	$5,000
1	Striping Narrower Lanes (3-9)	Yes	Possible	No Change	None	None	None	Yes	$1,000 -3,000
2	Commercial Vehicle (3-10) Restrictions	Possible	Yes	Yes	None	Yes	None	No	$ 1,000

[1] Attachment 5 provides more detailed descriptions as well as the advantages and disadvantages of each option.
[2] For each additional officer and equipment.

NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING OPTIONS

(Not in priority order)

LEVEL	TRAFFIC[1] MANAGEMENT OPTION (Page No.)	SPEED REDUCTION	VOLUME REDUCTION/ TRAFFIC DIVERSION	NOISE POLLUTION	LOSS OF ON STREET PARKING	ACCESS RESTRIC-TION	BUS ROUTE AND EMERGENCY VEHICLE RESPONSE IMPACTS	INCREASE IN STREET MAINTEN-ANCE	INSTALLATION COST
2	Neighborhood Monitoring Program (3-11)	Yes	No	No Change	None	None	None	No	-
2	Stop Sign Reversal (3-12)	Possible	No	Increase	None	None	None	No	$ 500
3	Chokers (3-13)	Yes	Possible	No Change	Yes	None	Yes	No	$5,000 -$15,000
3	Gateways (3-14)	Yes	Yes	Decrease	None	Yes	None	No	$5,000 -$15,000
3	Intersection (3-15) Channelization	Yes	Possible	No	Yes	None	No	Possible	$30,000
3	Median Barrier (3-16)	Possible	Yes	Decrease	None	Right Turn Only	Yes	No	$20,000 -$10,000
3	Neckdowns (3-17)	Possible	Possible	No	Yes	None	Some Constraint	Yes	$10,000 -$20,000
3	One Way Streets (3-18)	No	Yes	No Change	None	Yes	Yes	No	$ 1,000 -$5,000
3	Raised (3-19) Intersections	Yes	No	Yes	Yes	None	Yes	Yes	$50,000 -$100,000
3	Roundabouts (3-20)	Yes	Possible	No Change	Yes	None	Some Constraint	Yes	$10,000

NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING OPTIONS

(Not in priority order)

LEVEL	TRAFFIC[1] MANAGEMENT OPTION (Page No.)	SPEED REDUCTION	VOLUME REDUCTION/ TRAFFIC DIVERSION	NOISE POLLUTION	LOSS OF ON STREET PARKING	ACCESS RESTRIC-TION	BUS ROUTE AND EMERGENCY VEHICLE RESPONSE IMPACTS	INCREASE IN STREET MAINTEN-ANCE	INSTALLATION COST
3	Serpentine (3-21)	Yes	Possible	Increase Possible	Yes	None	Yes	Possible	$50,000 -$75,000
3	Single Lane Slow Point (3-22)	Yes	Possible	Unknown	Yes	None	Yes	Yes	$5,000 -$15,000
3	Speed Humps (3-23)	Yes	Yes	Increase	Yes	None	Yes	Yes[3]	$3,000 per hump
3	Turning Restrictions Using Delineators (3-24)	Possible	Yes	Decrease	None	Yes	Yes	Yes	$1,000
3	Two Lane Slow Point (3-25)	Yes	Possible	Increase Possible	Yes	None	Some Problems	Possible	$40,000
4	Cul-De-Sac (3-26)	Yes	Yes	Decrease	Yes	Total	Yes	No	$50,000
4	Diagonal Diverter (3-27)	Yes	Yes	Decrease	Possible	Left or Right Turn Only	Yes	No	$15,000
4	Half Closures (3-28)	Possible	Yes	No Change	Yes	Yes	Yes	No	$15,000
4	Mid Block Street Closures (3-29	Yes	Yes	Decrease	Yes	Yes	Yes	Yes	$50,000
4	Photo (3-30) Enforcement	Yes	No	No	No	None	None	No	$165,000[4]

[3] Speed humps have to be reinstalled each time a street is resurfaced.

[4] Initial Start up Cost For Citywide Program. Ongoing costs are approximately $85,000/year.

ATTACHMENT 3

DETAILED DESCRIPTIONS OF NEIGHBORHOOD TRAFFIC MANAGEMENT AND CALMING OPTIONS

Higher Visibility Crosswalks

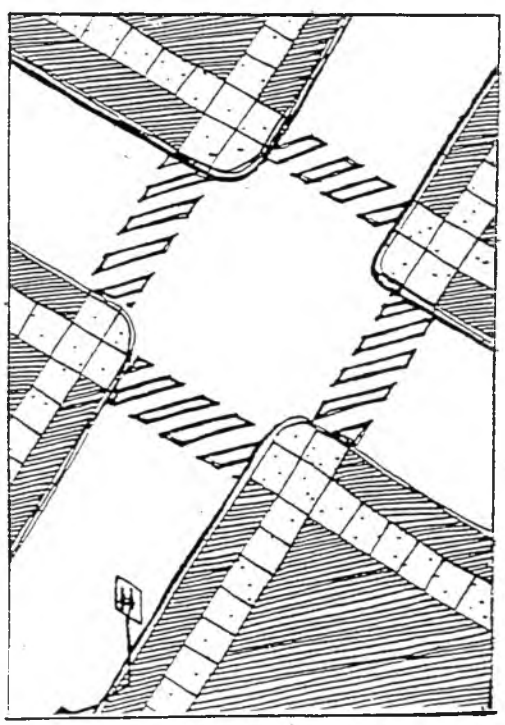
Description: The crosswalk is designed to increase driver recognition by using one of the following techniques: raising the crosswalk to a grade higher than the roadway, designing the crosswalks with paving blocks or contrasting color concrete or painting the crosswalks with "zebra" stripes between the outer boundary stripes. Higher visibility crosswalks would only be used at uncontrolled crosswalks. Some cities have tried using large "dot" markers (similar to the ones found on the internal crosswalks at the Factory Stores) or reflectorized pavement markers. At this time staff is not recommending either technique be used on residential streets.

Positive Aspects:

- Indicates to pedestrians an acceptable or preferred crossing location.
- More visible to drivers then traditional crosswalks.

Negative Aspects:

- Pedestrians may place too high a level of reliance on the ability of a crosswalk to control driver behavior.
- More maintenance required than with traditional crosswalks.



Neighborhood Meeting

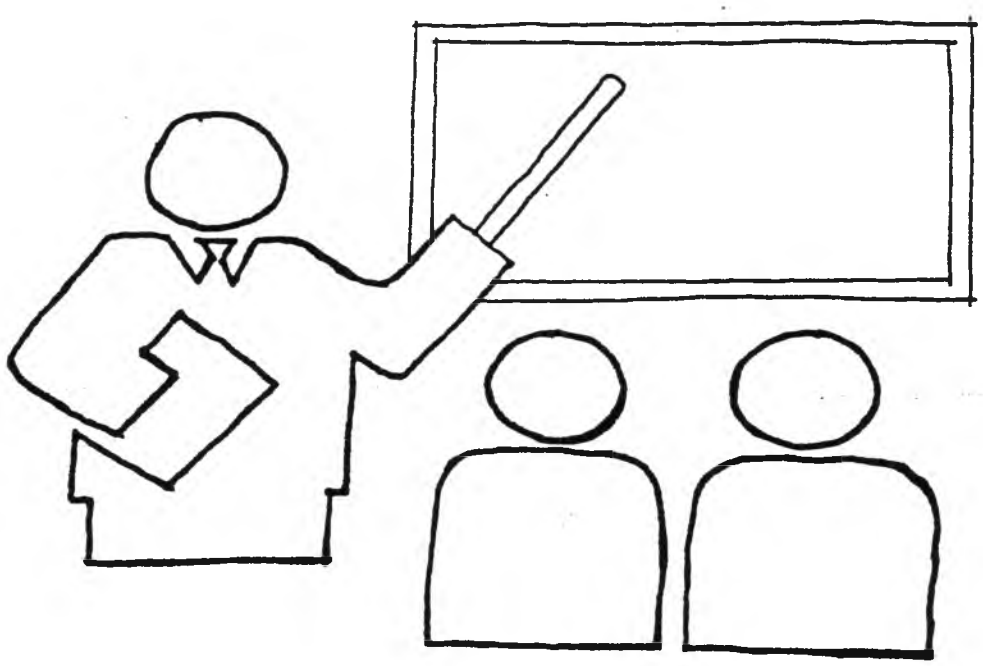
Description: Hold a neighborhood meeting at a time and location convenient for residents to attend and express their concerns. The meeting would be used to clearly identify the issues of concern.

Positive Aspects:

- Clearly identifies issues of concern.
- Allows all residents to air their views.
- Establishes clear lines of communication between City staff and residents.

Negative Aspects:

- Meetings have to be focused on specific issues and not allowed to become a forum to address all the City's problems.
- Potentially time consuming if meetings are repetitious.



Police Enforcement

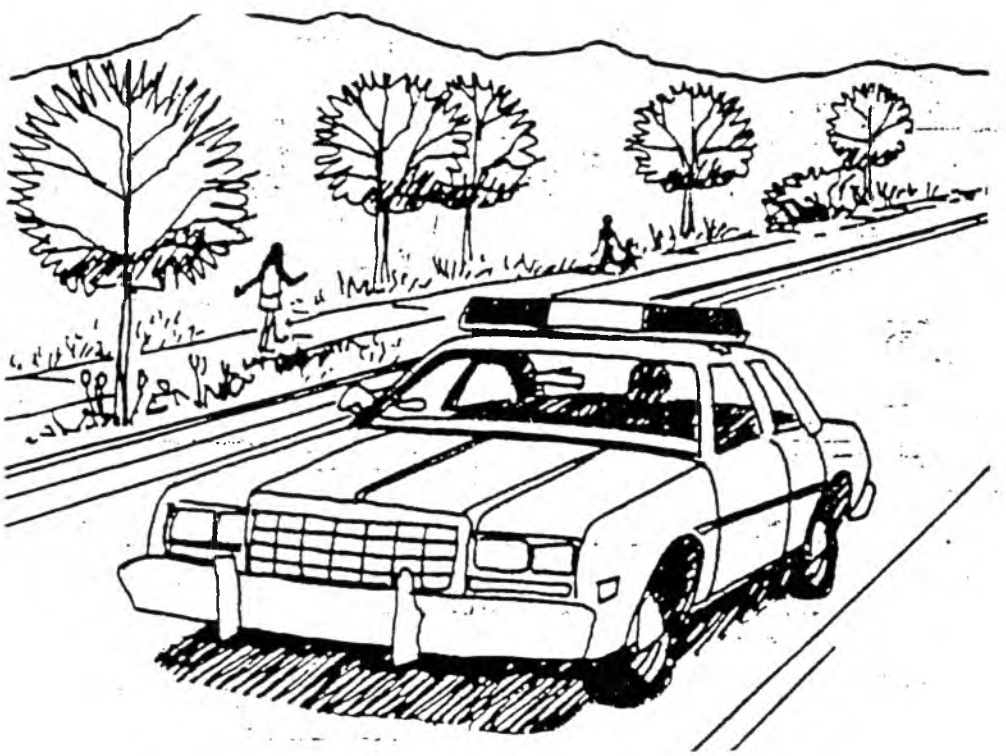
Description: The Police Department deploys traffic motorcycle officers to perform radar enforcement on residential streets for at least two hours a day. A priority list would be provided to the Police Department each week based on citizen requests.

Positive Aspects:

- Visible enforcement would reduce speed.
- Driver awareness about speeding on residential streets and safety is increased.
- Program is flexible and can be tailored to suit the citizens' needs.
- Response can be quick and effective

Negative Aspects:

- Long-term benefits of speed reduction are unsubstantiated without regular periodic enforcement.



Police Presence

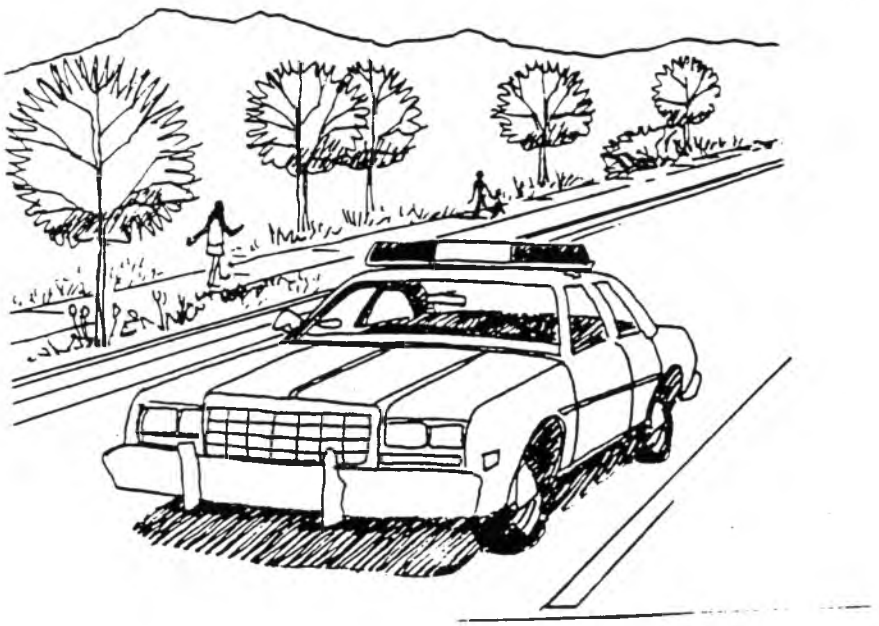
Description: Position a police vehicle on the street as a visible aspect of enforcement to discourage speeding.

Positive Aspects:

- Shows an enforcement presence.
- May help to show vehicle speeds.

Negative Aspects:

- Residents may quickly realize that the presence of the vehicle does not result in speeding citations.
- Police Department resources will be needed to deploy vehicles.



Posting 25 mph Speed Limits/Radar Warnings

Description: This option involves posting 25 mph speed limit or radar warning signs on the street to regulate the speed of traffic. Costs are typically $200 per sign installation if a pole has to be erected.

Positive Aspects:

- Low cost installation that are popular with residents.
- Reduces traffic speeds if backed up with regular enforcement.

Negative Aspects:

- High potential for violation when not enforced.
- Increases cost of sign maintenance.

Radar Trailer

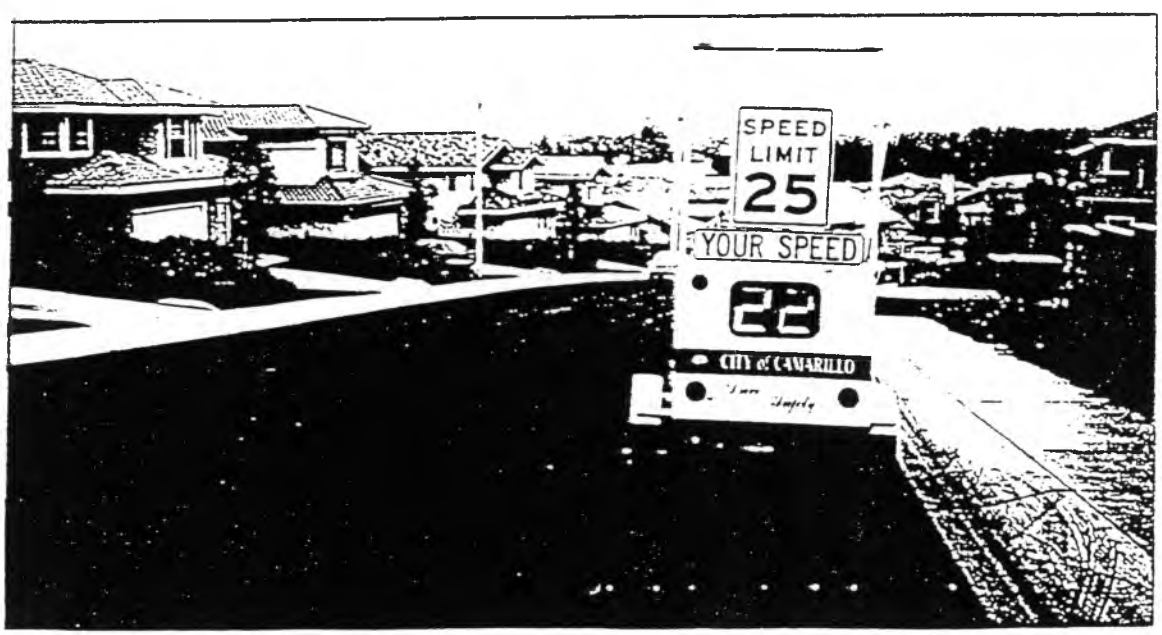
Description: A portable radar speed meter capable of measuring vehicle speed graphically and displaying the speed of the motorist.

Positive Aspects:

- Speeds may be reduced during short intervals where the radar trailer is located.
- An effective public relations and educational tool.

Negative Aspects:

- Not an enforcement tool.
- Not effective on multi-lane roadways that have significant traffic volumes. In these cases there is limited ability to differentiate between more than one approaching vehicle.



Rumble Strips

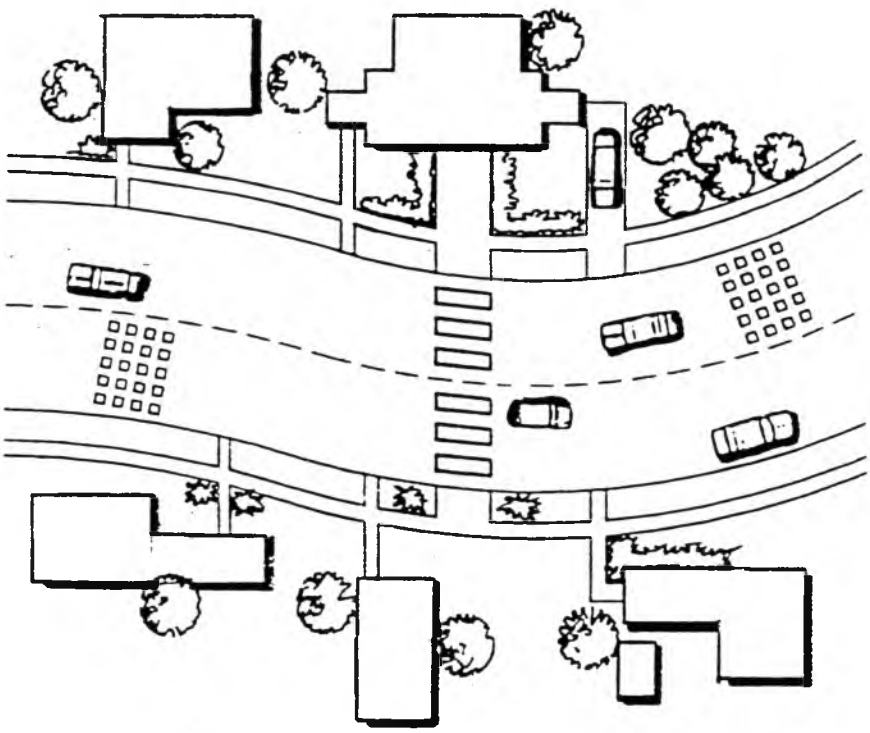
Description: Dots are glued to the pavement to create a strip that causes the vehicle to rumble as it traverses through them. This causes vehicles to slow down. Each installation costs less than $500 for two approaches.

Positive Aspects:

- Vehicles are slowed down by 5 mph.
- Driver's attention is alerted to heighten safety.
- Low cost installation than can easily be removed or changed.

Negative Aspects:

- Very high level of noise pollution for adjacent residents.
- High maintenance is required to reattach dots to the pavement.



Narrowing Lanes

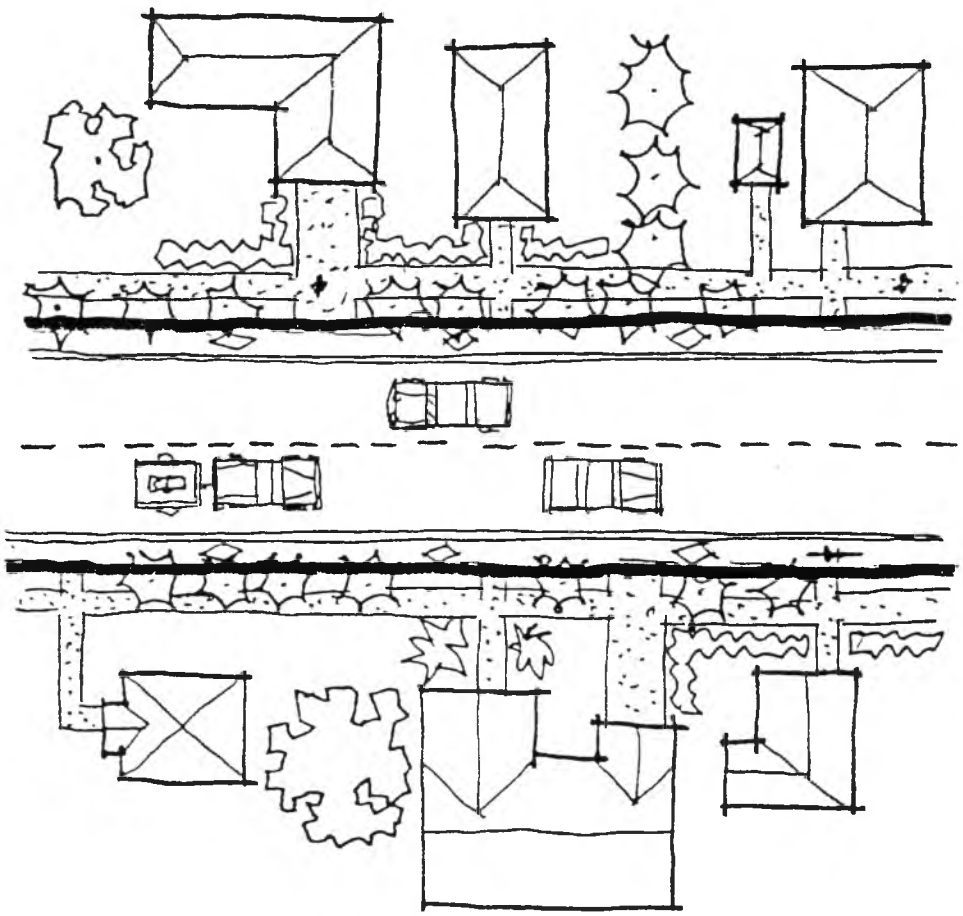
Description: Striping is used to create narrow 10 feet wide lanes. This gives drivers the feel of a narrow street that does not lend itself to high speeds. The cost vary depending on the length of street, but are not anticipated to exceed $3,000 per mile.

Positive Aspects:

- Changes can be quickly implemented.
- The striping can be easily modified if paint is used.
- Speed may decrease and safety is improved through the provision of positive guidance to drivers.

Negative Aspects:

- Would increase regular maintenance.
- Residents do not always perceive striping is an effective tool for speed reduction.
- Cost of resurfacing residential streets will increase.



Commercial Vehicle Restrictions

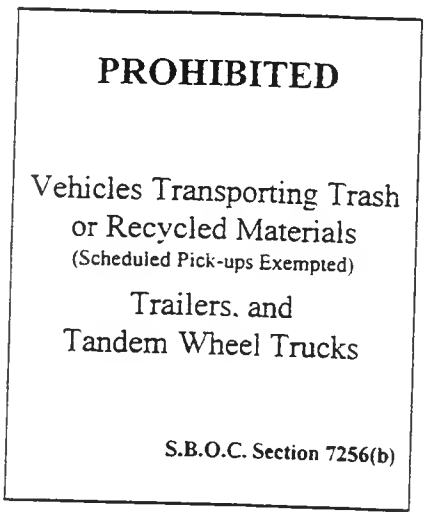
Description: After the adoption of appropriate resolution by the City Council, post commercial vehicle restrictions on signs and enforce the restrictions.

Positive Aspects:

- Restricts commercial vehicles using the street.
- Reduces traffic noise speed and volumes.

Negative Aspects:

- Requires additional maintenance of signs
- Requires enforcement to be effective.



36" X 45"

Neighborhood Monitoring Program

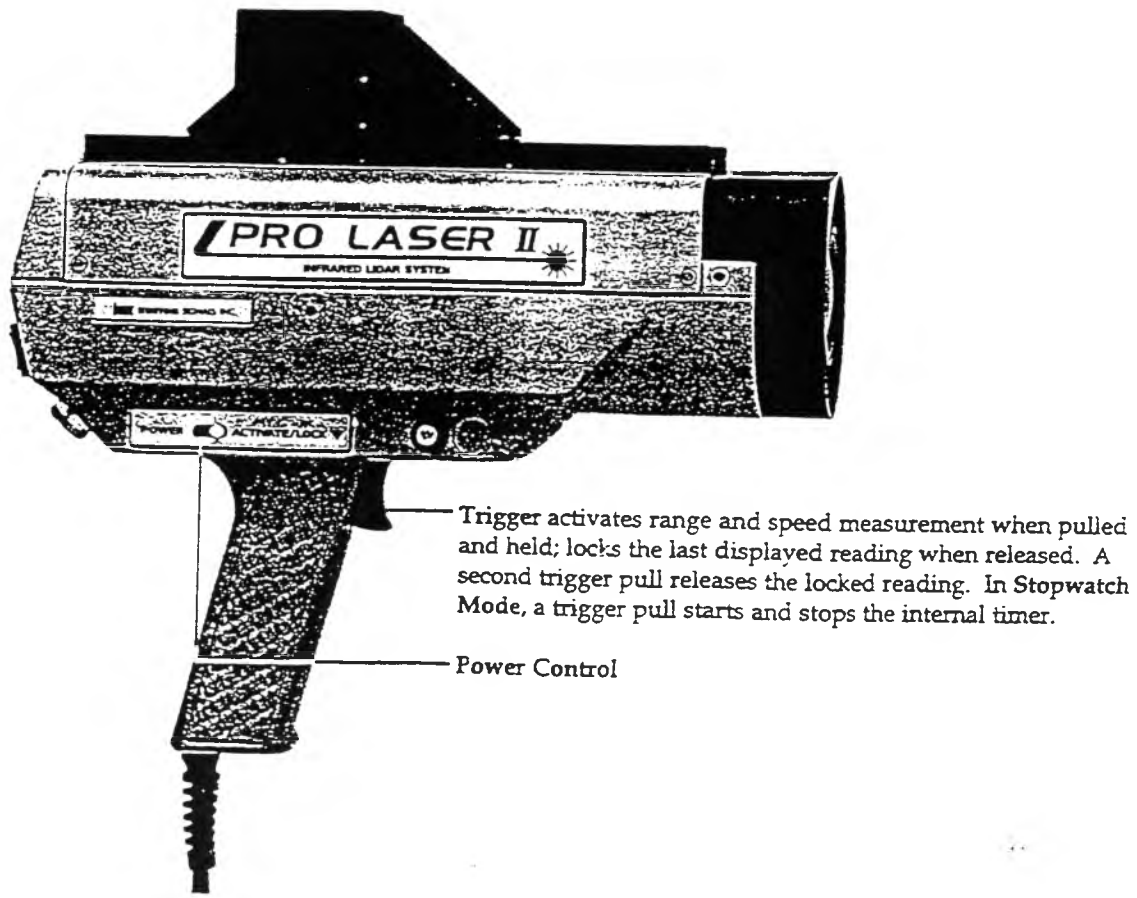
Description: A hand-held radar gun is made available, with instructions provided by city staff, to neighborhoods to determine the amount of speeding and to determine who is speeding in the neighborhood. For example, a resident or group of residents meets with City staff in the neighborhood and instructions are given to the use of the radar gun. The resident then spends several hours registering the speed of cars passing on the street. The residents have a first hand account of whom the speeders are and how fast they are going.

Positive Aspects:

- Effect on speeders is limited to within sight distance of the radar gun.
- May have long-term effects as neighbors become more aware of who is speeding and interact with each other in social settings.
- Speeds may be reduced during short intervals when the radar gun is in use.
- An effect public relations and educational tool.
- Neighbors feel they are part of the solution.

Negative Aspects:

- Not an enforcement tool
- Not effective on multi-lane roadways that have significant traffic volumes. In these cases there is limited ability to differentiate between more than one approaching vehicles.



Stop Sign Reversal

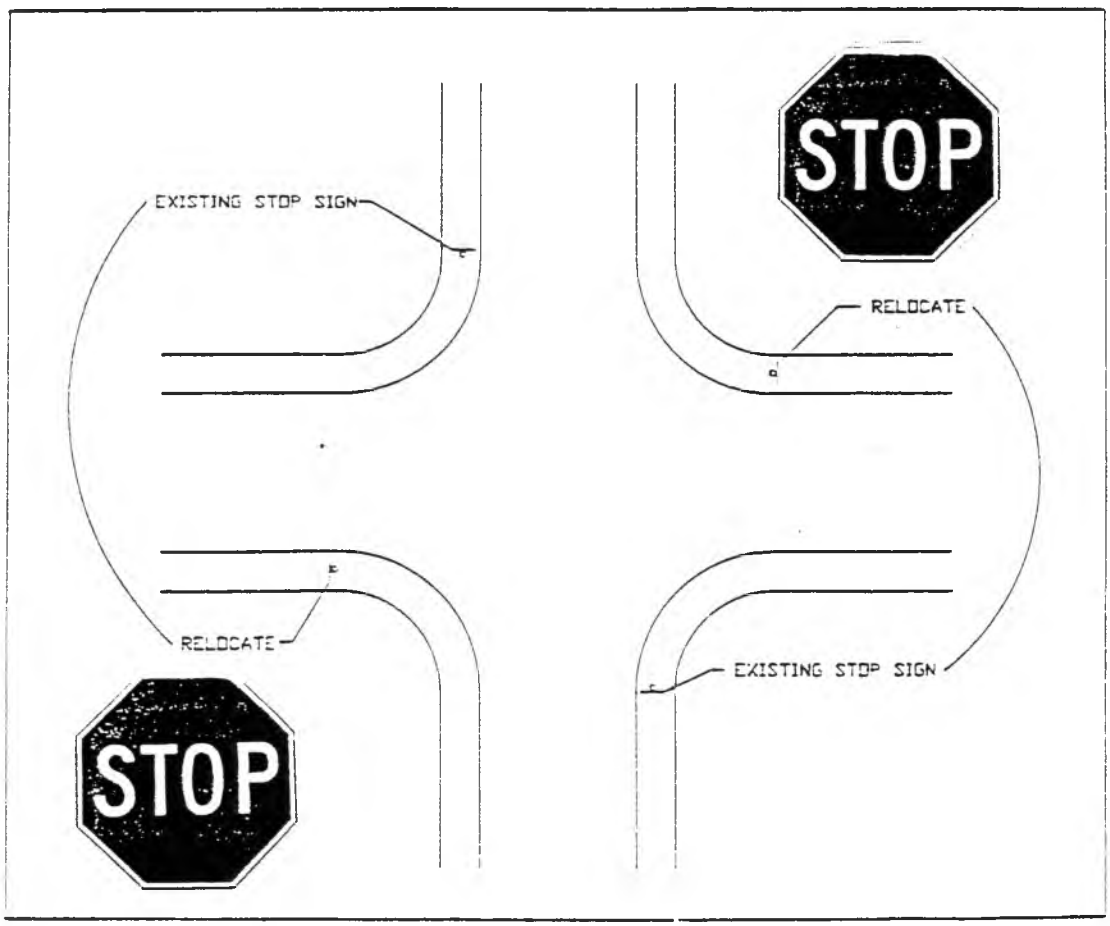
Description: Two stop signs are placed at all four legged intersections in the City. The signs are placed on the lower volume approaches. If the volumes are balanced, the stop sign locations could be switched to stop the other street. The cost for switching stop signs would be less than $500.

Positive Aspects:

- Change can be easily made.
- Traffic speed may be reduced in the vicinity of the stopped approaches.

Negative Aspects:

- The speeds may increase on the unstopped approaches.
- There is high potential for violation of stops unless enforced periodically.
- Not always favorable to residents immediately adjacent to new stop sign locations.
- Potential for rear end accidents is increased in the short term.



Chokers

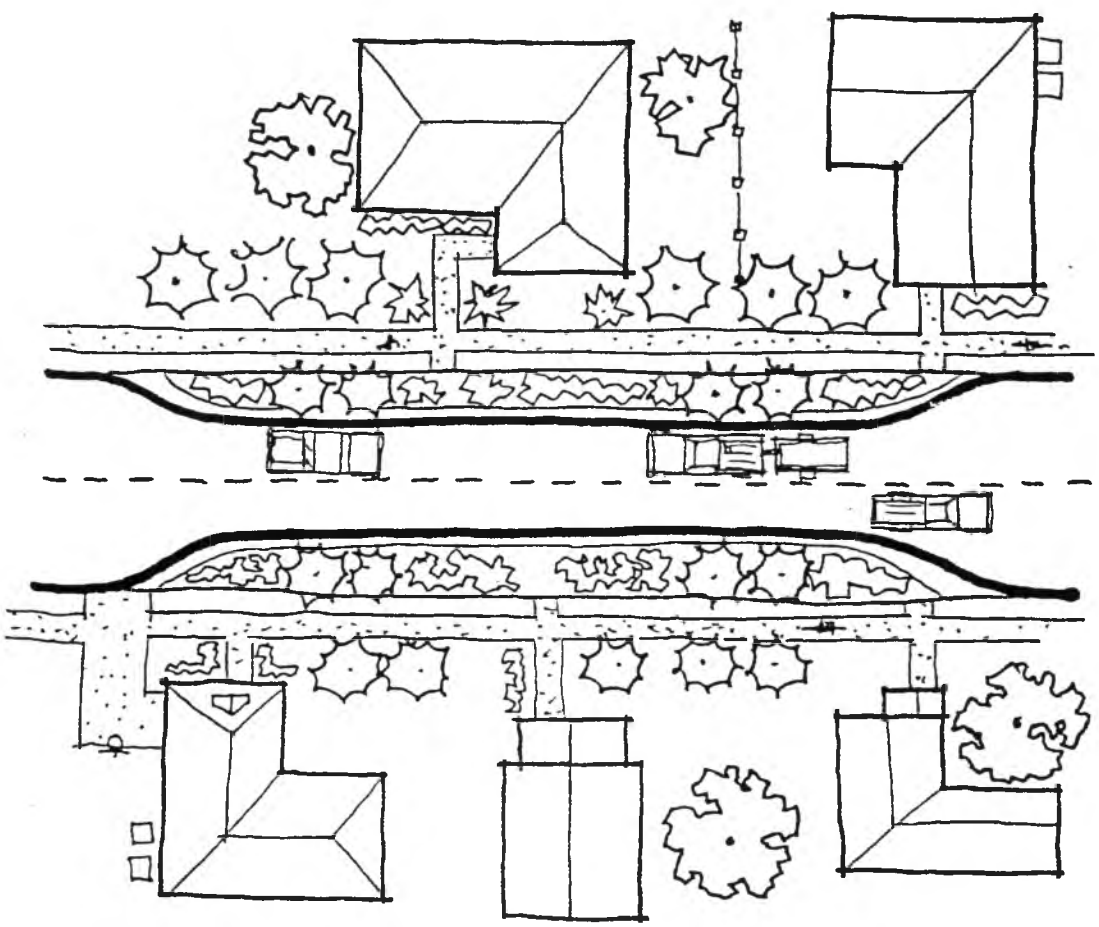
Description: Narrowing of a street at an intersection, mid-block or a segment of a street in order to reduce width of the traveled-way by construction of a wider sidewalk or landscape strip.

Positive Aspects:

- Slight slowing is normally the result.
- Shorter pedestrian crossing distances and better motorist-pedestrian visibility of each other.
- Creates added streetscape area for pedestrians and/or landscaping
- Can discourage truck entry.
- Allows signs to be placed closer to driver's cone of vision.

Negative Aspects:

- Potential obstacle for motorist to run into.
- May impede bicycle mobility and safety.
- May result in loss of curbside parking.
- Can impede legitimate truck movements.
- May require reworking of surface drainage.



Gateways

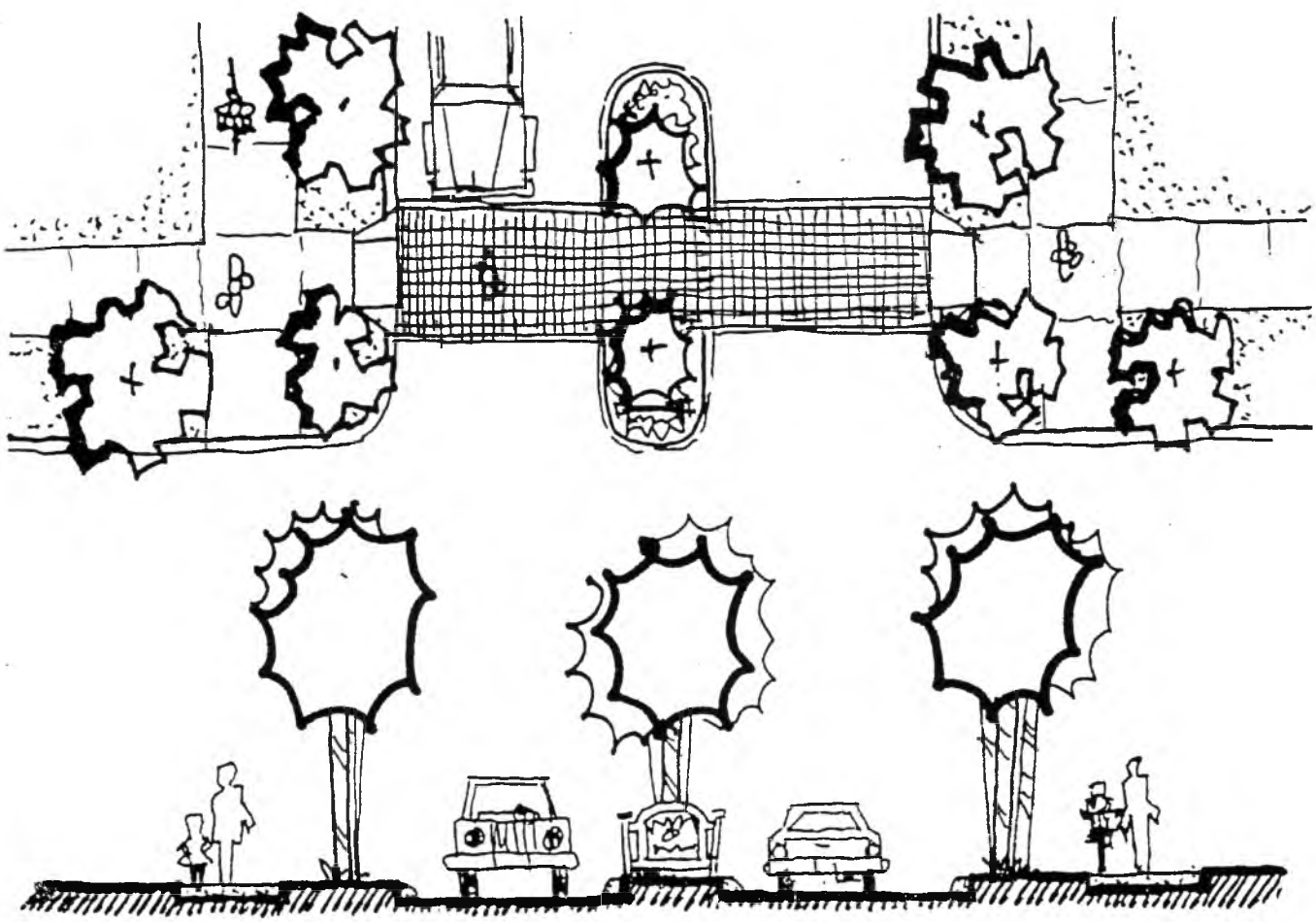
Description: A special entrance feature, similar to a choker, that narrows a street at the intersection in order to reduce width of the traveled-way. This is not a gate. Chokers are usually located within the block or at intersections. Gateways are considered more dramatic and provide identity to a neighborhood. The exact configuration of the gateway treatment will depend upon the location of the gateway, i.e., conflicts with driveways. Medians can also be added to street to slow turning movements and enhance the street.

Positive Aspects:

- Creates an identity to a neighborhood.
- Creates added streetscape area for landscaping or monuments.
- Can discourage truck entry.
- Allows signs to be placed closer to driver's cone of vision.

Negative Aspects:

- Can impede legitimate truck movements.
- Increased maintenance costs.



Intersection Channelization

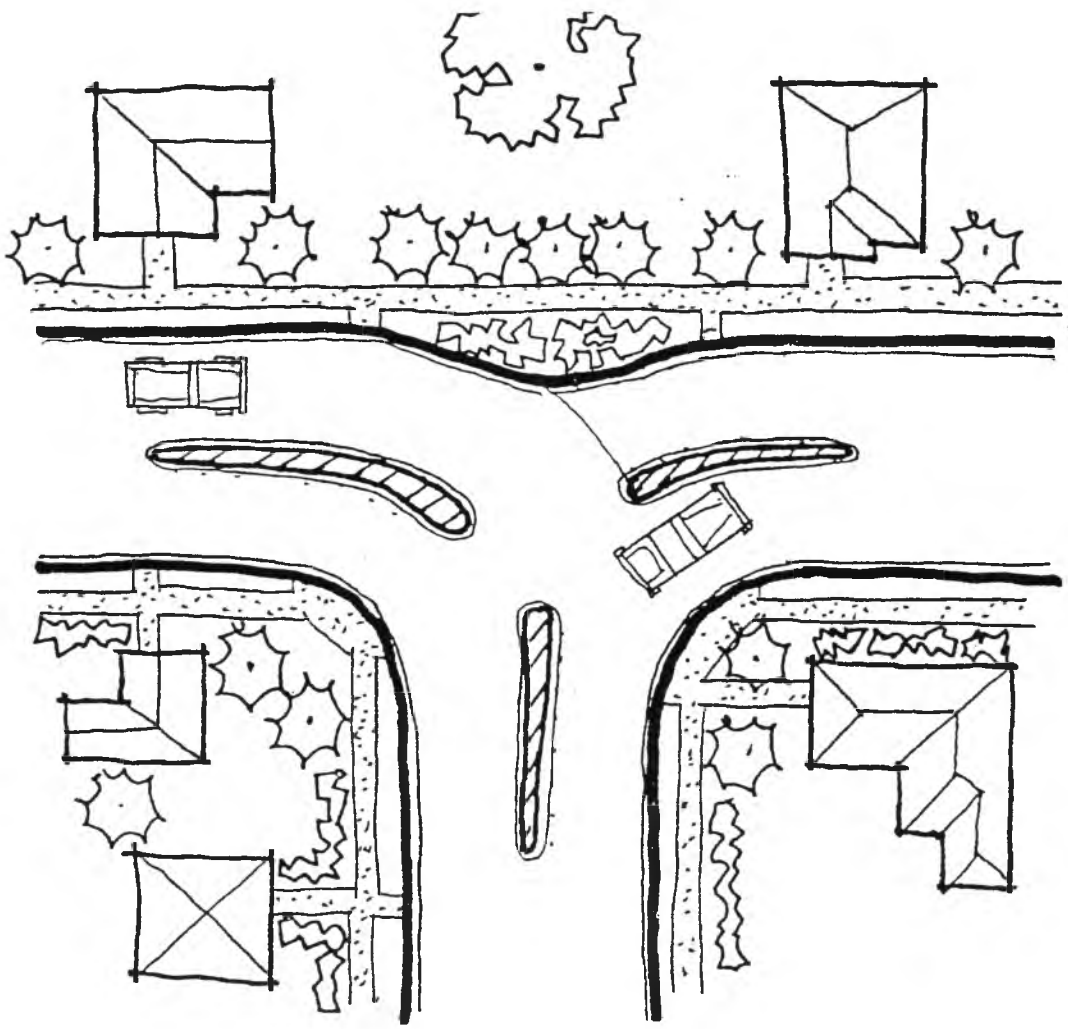
Description: T-intersections are channelized so that vehicles are not traveling in a straight path. This has the effect of slowing vehicles down.

Positive Aspects:

- Slows vehicle speeds.
- No significant impedance of fire and transit service.

Negative Aspects:

- Landscaping and signing/striping maintenance will be required.
- Loss of on-street parking will occur.



Median Barrier

Description: A physical barrier on a non-local street which can effectively eliminate left turns from that non-local street onto a local street, and eliminate local street straight-through and left turn traffic across the non-local street. A median barrier can take many forms, ranging from a closely-spaced row of flexible delineator posts to a series of pre-cast curb sections affixed to the pavement to a temporarily-placed but immovable 3' high concrete barrier (K-Rail) to an asphalt/concrete curbed island with or without a decorative landscaping and surface treatment. Costs vary widely among those options. This device is also known as a"worm."

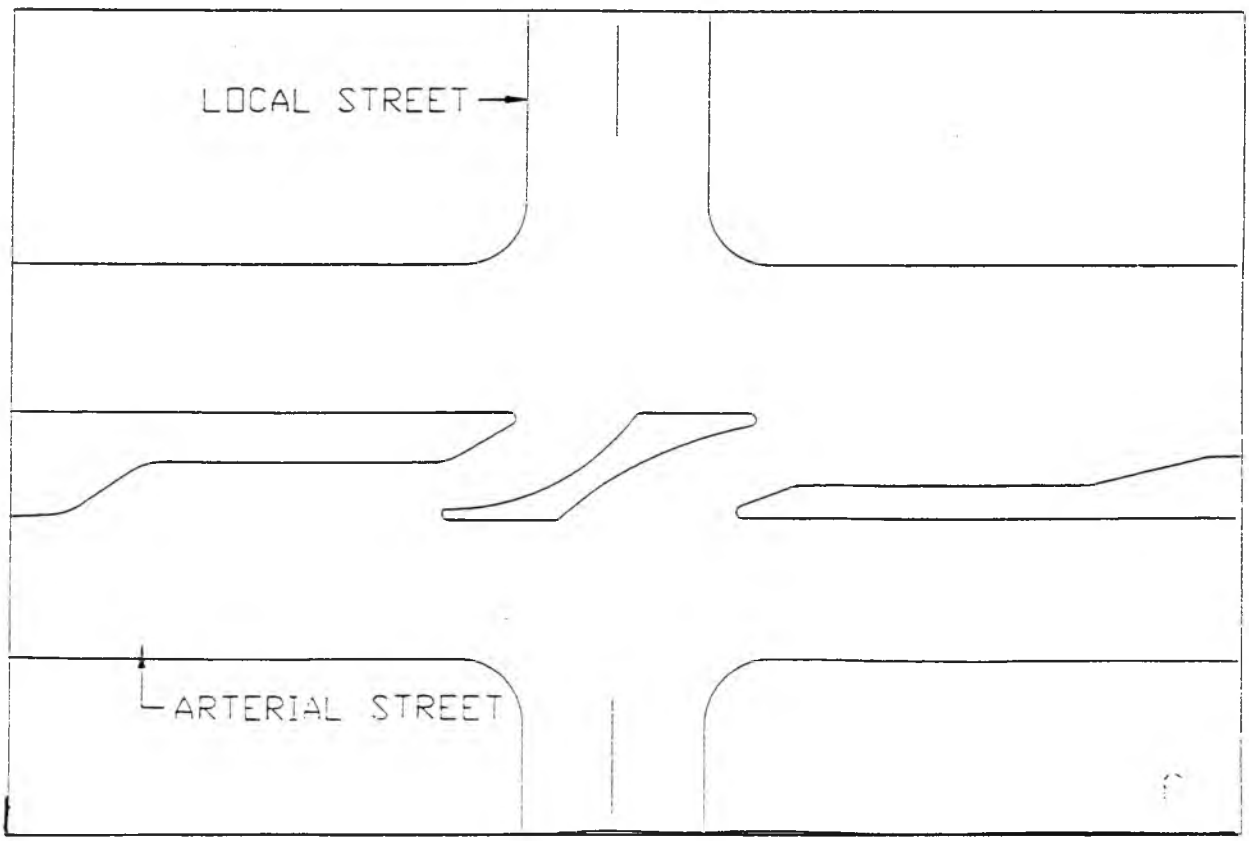
A full median with no breaks can also be used to prohibit all left turns.

Positive Aspects:

- Makes the intersection more safe by reducing the number of conflicting movements.
- Reduces local street volumes.
- Negates the possible need for future expensive traffic signal

Negative Aspects:

- The physical barrier may shift traffic to other locations where left-turn opportunities exist.
- This tool may inconvenience local residents who will be forced to drive longer more circuitous paths to reach their destination.



Neckdowns

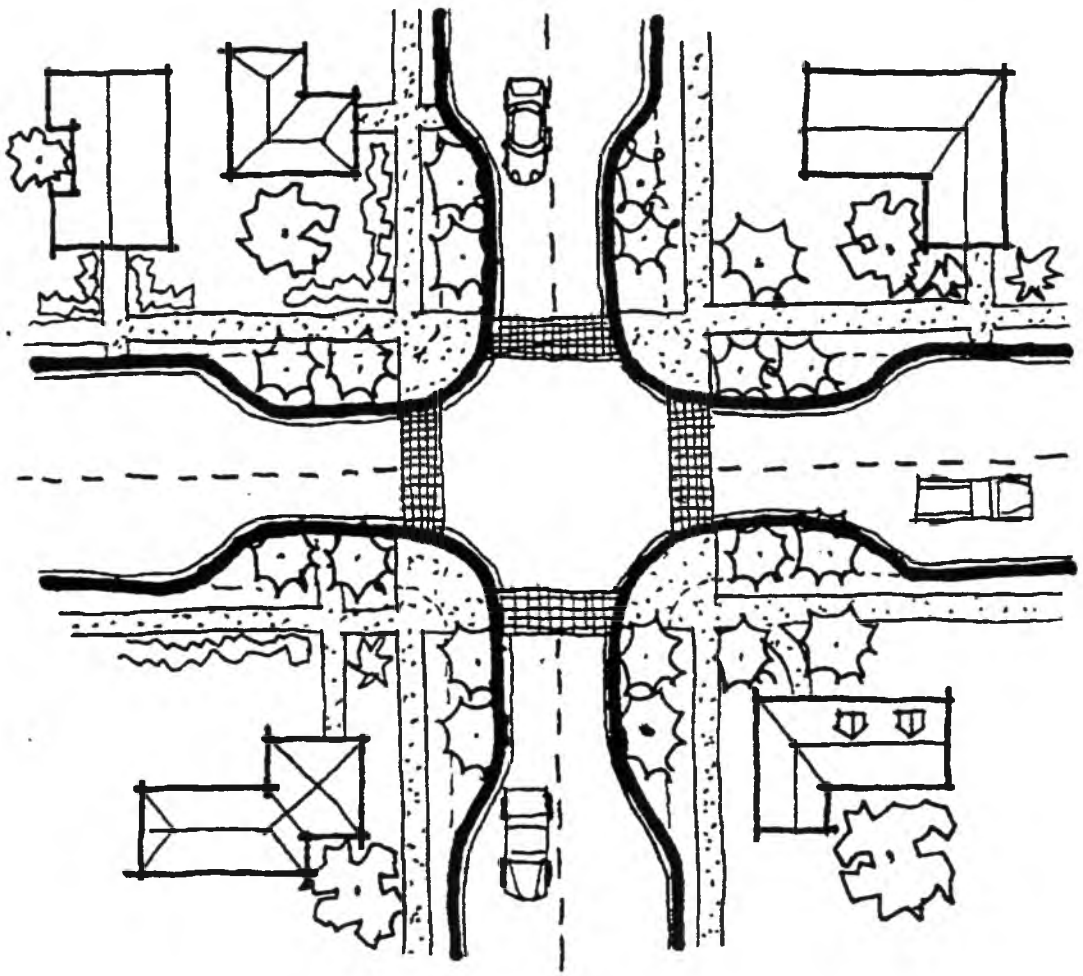
Description: Physical curb reduction of road width at intersections by widening of street corner to discourage cut through traffic and to help define neighborhoods.

Positive Aspects:

- May be aesthetically pleasing, if landscaped.
- Good for pedestrians due to shorter crossing.
- Can be used in multiple application.

Negative Aspects:

- Increased landscaping maintenance.
- Landscaping may cause right distance problems.



One-Way Street(s)

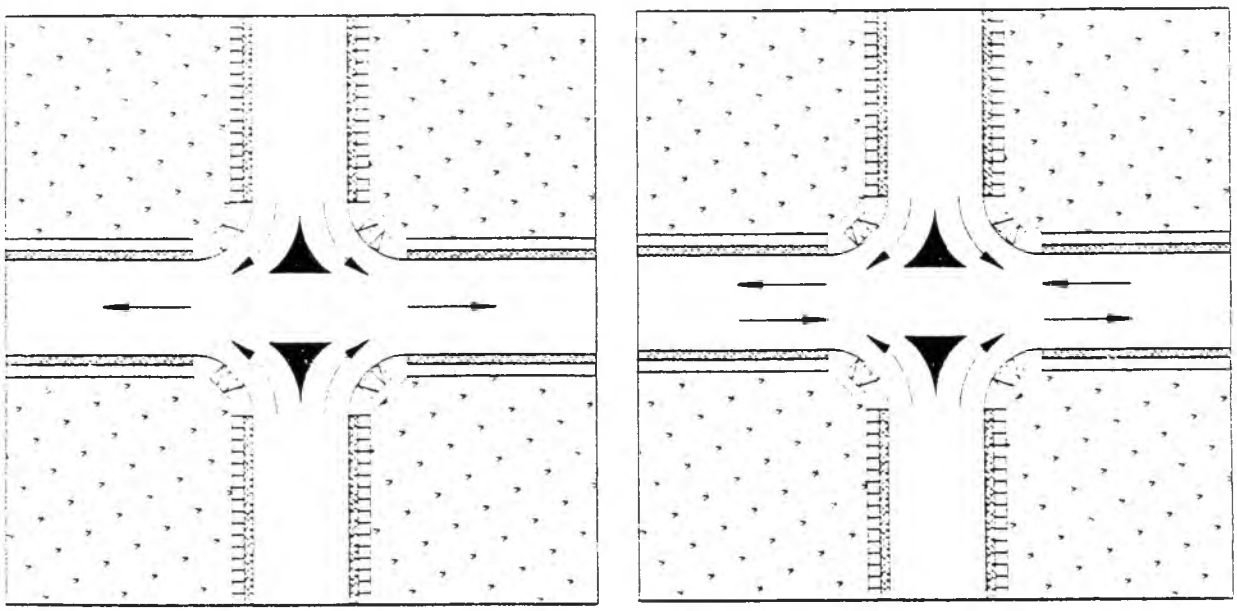
Description: One or more streets designated as "one-way."

Positive Aspects:

- May reduce total volume on subject street
- Adds vehicle capacity to a street.
- Safety is inherently greater on one-way segments, but care must be taken to handle intersection treatments properly.

Negative Aspects:

- Can encourage increased speeds
- Adverse travel distance results for local residents.
- May shift diverted traffic to another local street.



Raised Intersections

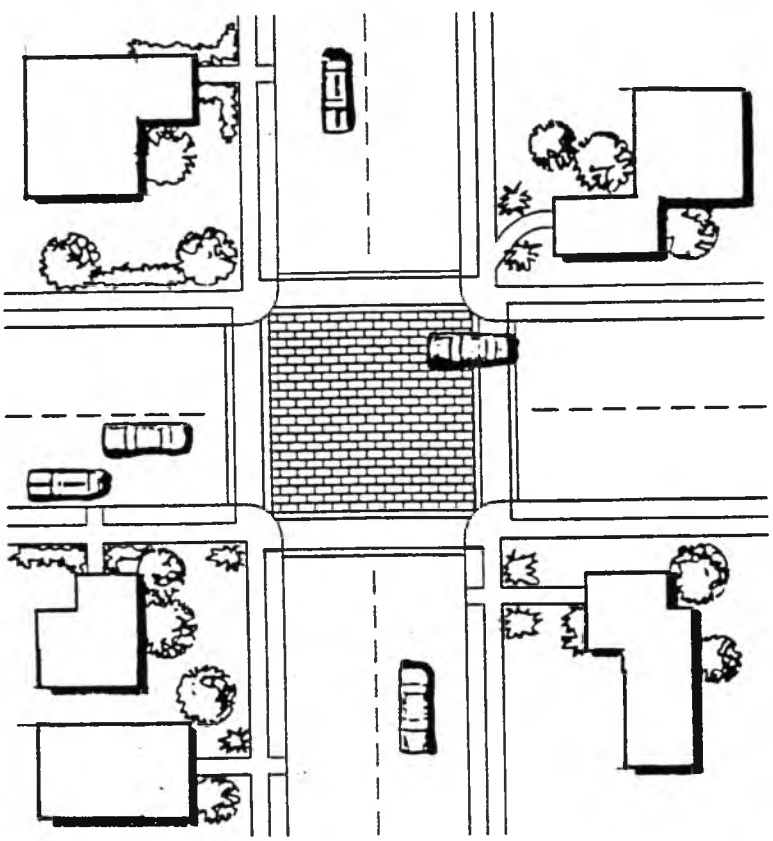
Description: A raised plateau of roadway where roads intersect. The plateau is generally about 4" higher than the surrounding streets. This application is best for locations with high pedestrian volumes with significant safety concerns related to traffic speeds.

Positive Aspects:

- Effective speed reduction.
- Aesthetically pleasing if well designed.
- Good pedestrian safety treatment.
- Can be used on higher or lower volume streets.

Negative Aspects:

- Expensive to construct and maintain.
- Affects emergency vehicle response time.



Roundabout

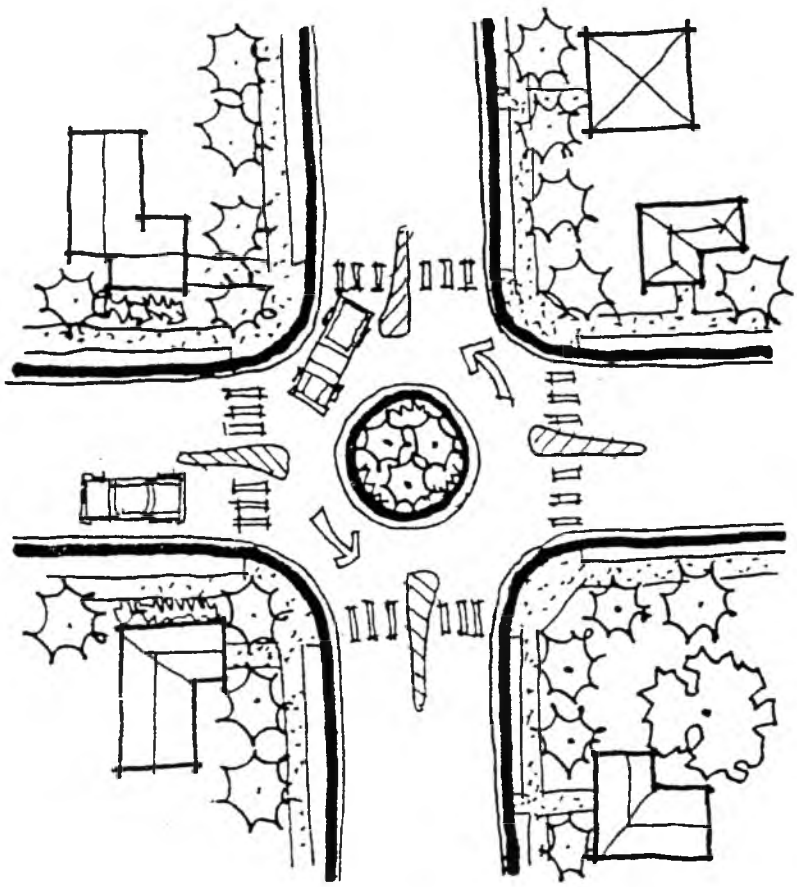
Description: A small circular island placed in the center of an existing local street intersection, thus creating a small "roundabout." Some may also refer to this device as a traffic circle.

Positive Aspects:

- A noticeable reduction in speeds.
- Reduces accident potential.
- Under certain conditions capacity can be increased.
- Can be used instead of stop signs.

Negative Aspects:

- Required safety signing may detract from its aesthetic quality.
- Pedestrians and bicyclist must adjust to less traditional crossing patterns.
- Some parking may be lost on approaches to accommodate vehicles' deflected paths.
- May increase accidents until drivers become accustomed to change.



Serpentine

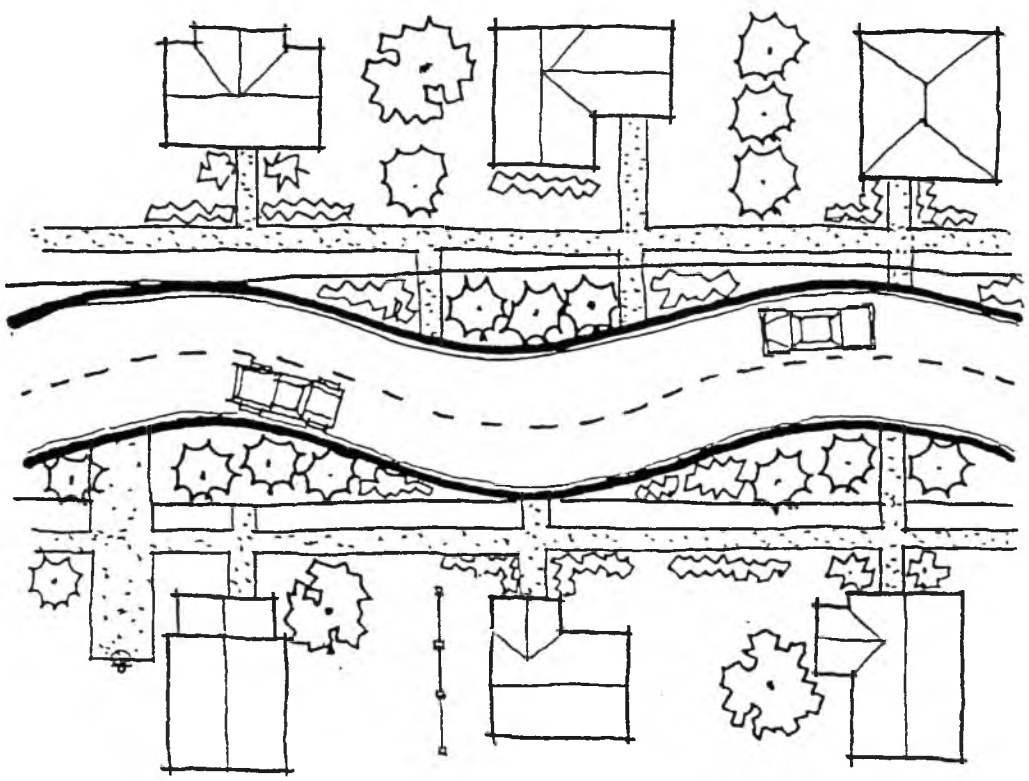
Description: A narrow serpentine road is created for several hundred feet using curbs and landscaping.

Positive Aspects:

- Reduces vehicle speeds.
- May reduce through traffic volumes.

Negative Aspects:

- Increased maintenance for landscaping and pavement
- Significant loss of on-street parking.
- Most residents would have driveway affected by the type of installation.
- Fire and transit services would be affected.



Single Lane Slow Points

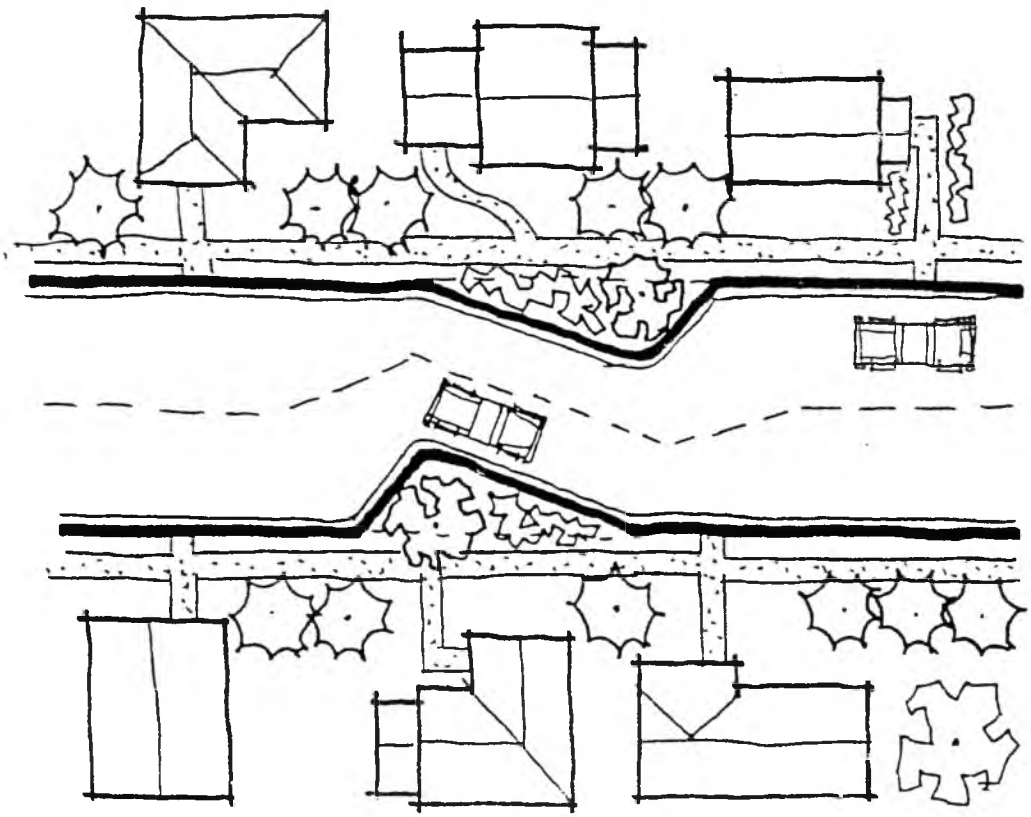
Description: A single lane slow point is created by constructing a landscaped island on side of the street. Vehicles have to slow down to go through the narrow area and to yield to oncoming traffic.

Positive Aspects:

- Reduces vehicular speeds.
- No significant impedance to fire and transit services.

Negative Aspects:

- Loss of on-street parking.
- Landscaping will have to be maintained.
- Potential for head-on collisions.



Speed Humps

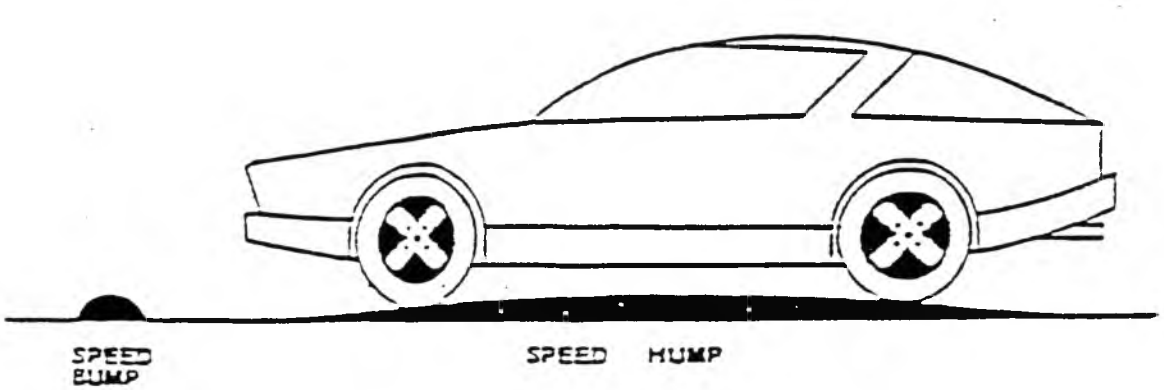
Description: Mounds of paving material placed across a roadway for the purpose of causing motorists to reduce their operating speed while driving on the roadway.

Positive Aspects:

- Reduces speed.
- Can cause traffic to shift to arterial system and no longer cut through the neighborhood.

Negative Aspects:

- Can cause traffic to shift to parallel residential streets.
- Affects emergency response times
- Contents of vehicles can be jarred.
- Increase in noise adjacent to hump.



Turn Restriction Using Delineators

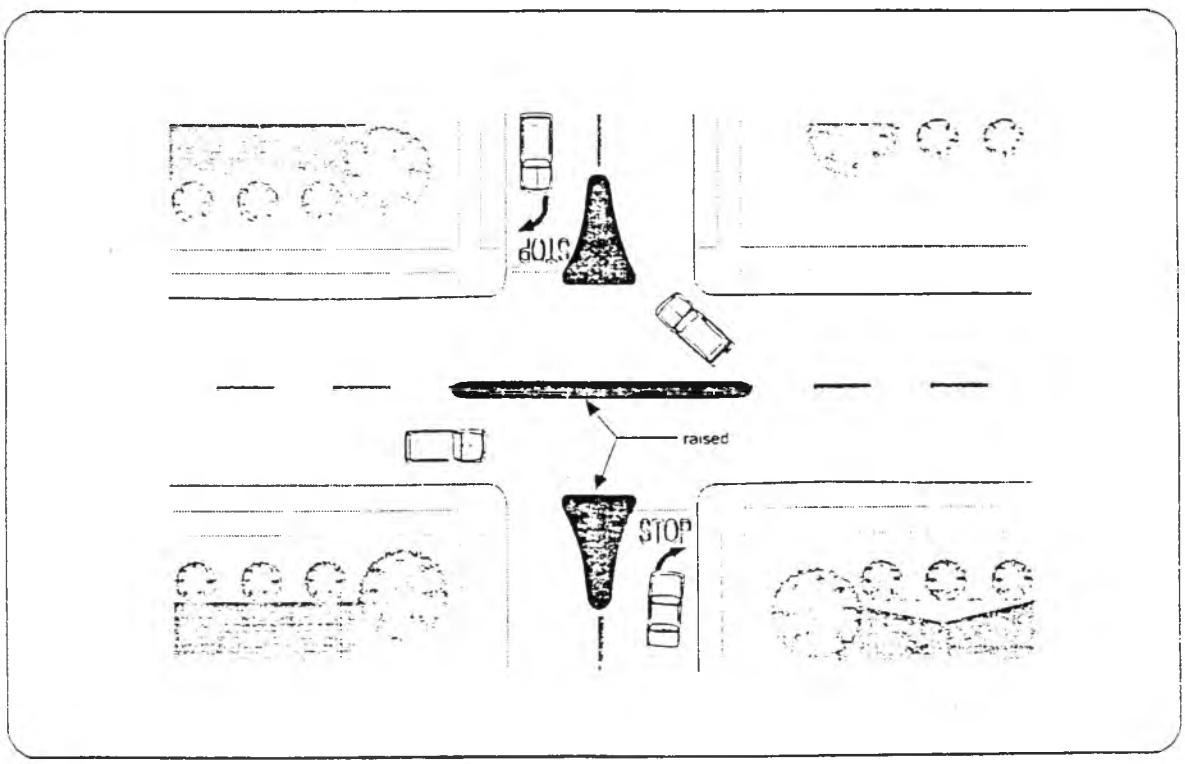
Description: Delineators glued to the pavement surface are used to create a barrier to prevent vehicles from making certain movement in and out of a local street. The delineators are typically placed along the centerline of the major collector street. Cost would average $500-$1,000 depending on the number of delineators used.

Positive Aspects:

- Reduces through volume of traffic.
- Reduces rear-end and left-turn accidents at major or collector street intersection with local streets.
- Low cost installation that can be easily removed or changed.

Negative Aspects:

- Little reduction in traffic speeds.
- Could potentially make it more circuitous for residents to reach their destinations.
- May divert traffic onto adjacent streets.



Two Lane Angled Slow Point

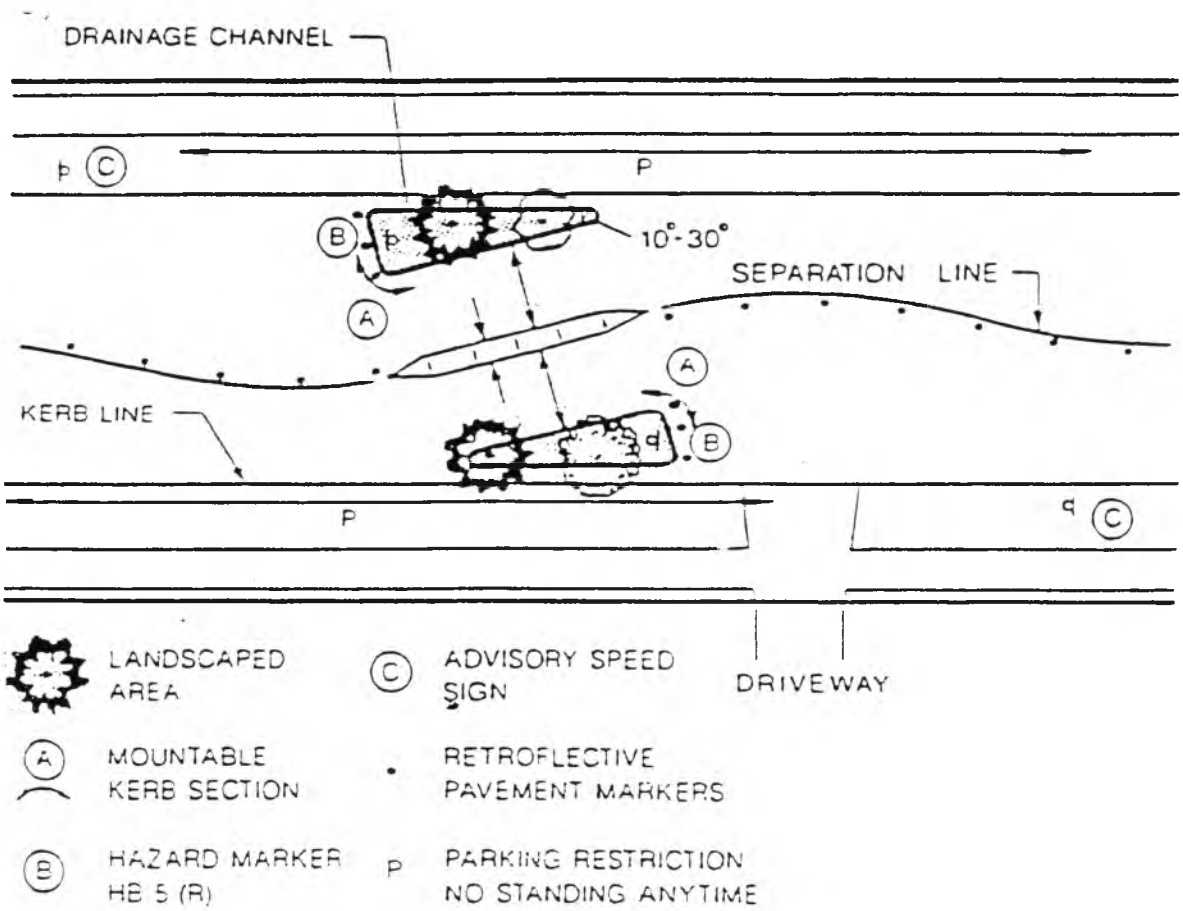
Description: Three islands are used to create an angled path of travel for vehicles. The effect of angling the travel path slows vehicles down. The volume of traffic may well be unaffected. The islands adjacent to the curb are typically landscaped.

Positive Aspects:

- Slows vehicle speeds.
- Fire and transit vehicles are not impeded significantly.

Negative Aspects:

- Loss of on-street parking
- Landscaping and signing/striping has to be regularly maintained.



Cul-de-sac

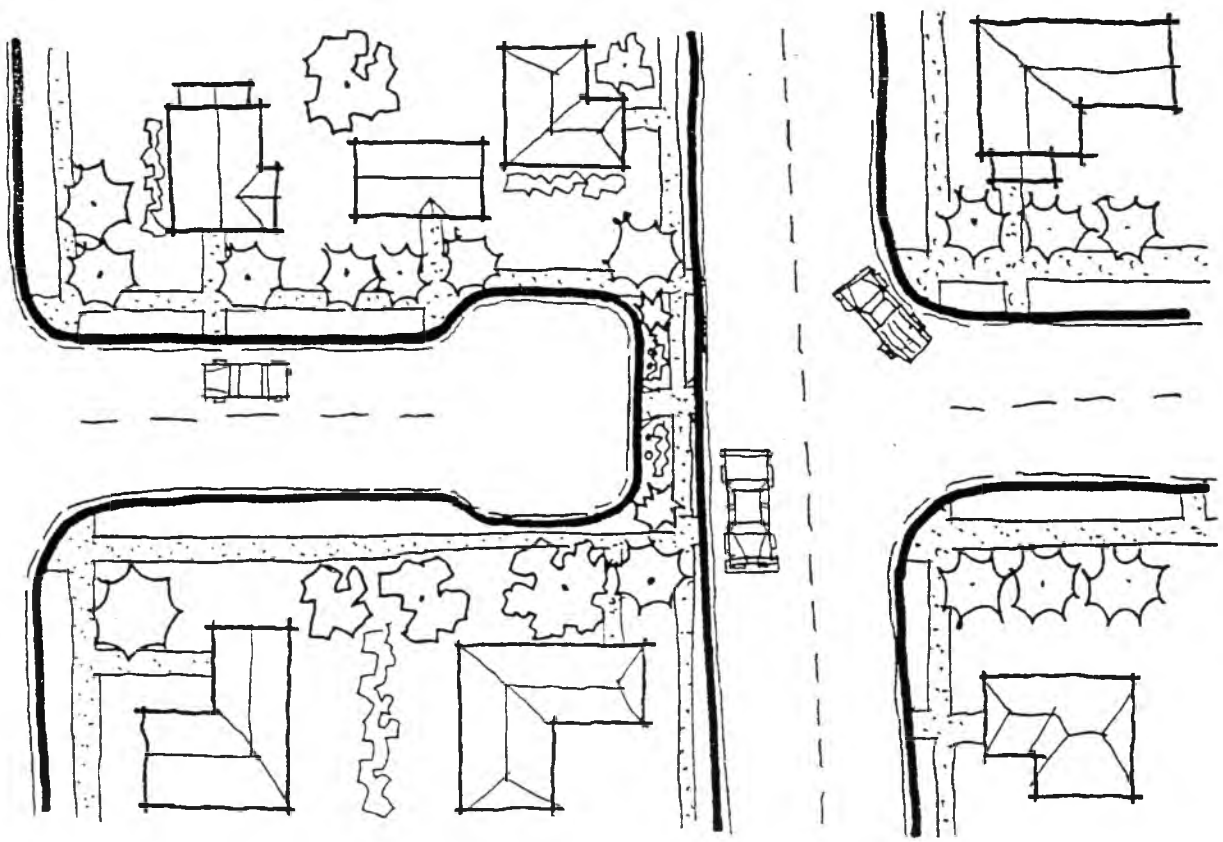
Description: Complete closure of a street either at an intersection or at a mid-block location.

Positive Aspects:

- Very effective at eliminating most of the previously speeding traffic on the block.
- Very effective at reducing volumes.
- Can be landscaped for an attractive effect to convey street discontinuity.
- Mid-block type can be effectively used where abutting land uses change.
- Improved traffic safety.

Negative Aspects:

- Can negatively affect response times for emergency service.
- In large neighborhoods, can shift a problem elsewhere unless a strategic pattern of cul-de-sacs are used.
- Can generate confusion on the part of users unless signed carefully.
- May inconvenience local residents.



Diagonal Diverter

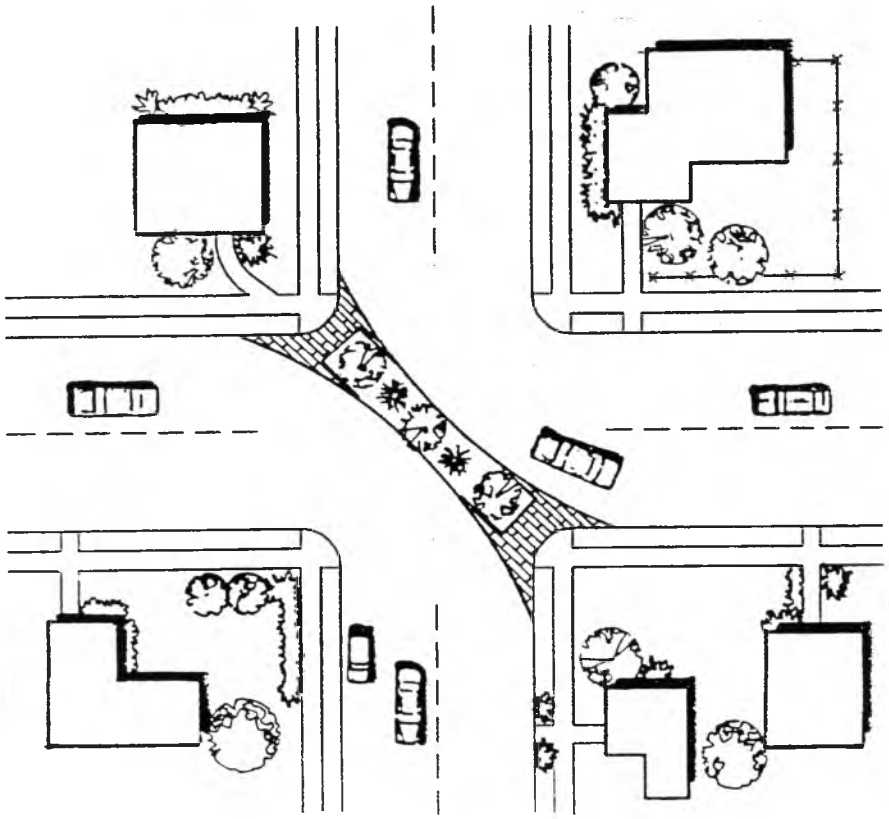
Description: Barriers between diagonally opposite corners of a 4-legged intersection, thus creating two unconnected L-shaped intersections.

Positive Aspects:

- Reduces speed.
- Can achieve a 20%-70% reduction in volumes.
- Reduces accident potential by eliminating conflicting traffic movements.
- Advantage over complete street closure (cul-de-sac) in that it has a lesser impact on circulation, as it actually creates no dead-end streets. Local residents and service vehicles may view this as a benefit in that their routes can be more direct.
- Can be attractively landscaped.

Negative Aspects:

- In a large neighborhood, can shift problems elsewhere unless a strategic pattern of diverters is used.
- May inconvenience local residents who are forced to drive longer more circuitous paths to/from their homes.



Half Closures

Description: The street is partially closed to traffic by the construction of a physical barrier at the entrance to the neighborhood to reduce cut through traffic.

Positive Aspects:

- Reduces cut through traffic.
- May reduce traffic speeds.

Negative Aspects:

- May require additional maintenance.
- Could be violated, especially in the late evening.

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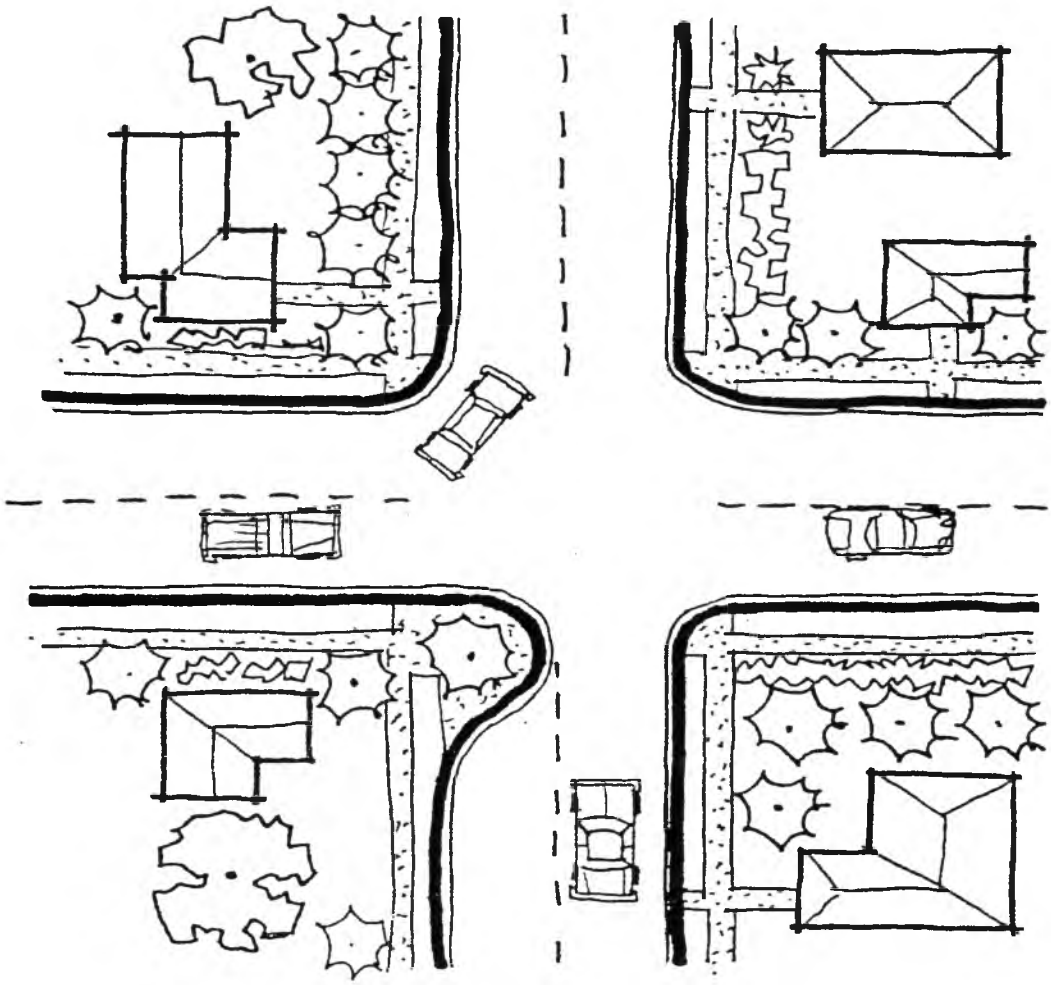


Mid-Block Road Closure

Description: Cul de sacs are created by closing the street mid-block using a landscaped island. Pedestrian access is provided across the island. The closure must be located between driveways serving adjacent residences.

Positive Aspects:

- Reduces through traffic volumes.
- Reduces speeds in the vicinity of the closure

Negative Aspects:

- Traffic may be diverted onto adjacent parallel streets.
- Maintenance of the landscaped areas will have to be provided for.
- Emergency access will be impeded.
- Local residents may be forced to drive more circuitous routes.
- There is loss of on-street parking.

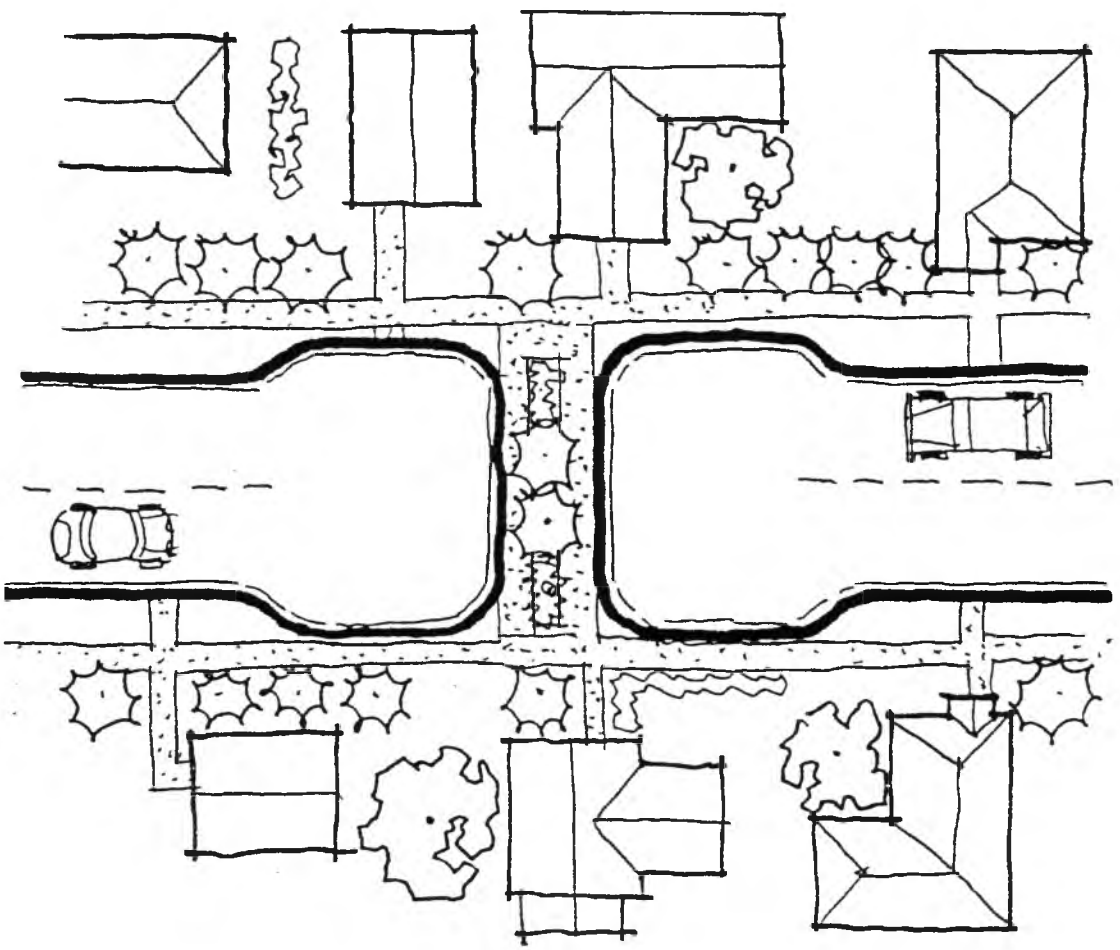


Photo Enforcement

Description: There are two uses for photo enforcement. One use is to have a camera mounted at intersections that records the license plates of cars that run red lights. The other is a camera and radar unit located in a portable trailer installed on a public street. The radar unit determines if a car is exceeding the speed limit and the camera takes a picture of their license plate after they have passed. In both cases, through tracing the license plate number, a ticket is mailed to the vehicle owner.

Positive Aspects:

- Once the public is aware of the photo enforcement, it is a very effective tool at eliminating red light runners and speeding traffic on the block.
- Cost effective, private companies will install and maintain the equipment in exchange for keeping the revenues generated by speeding tickets.

Negative aspects:

- Residents may not like the "Big Brother is watching you" feeling.

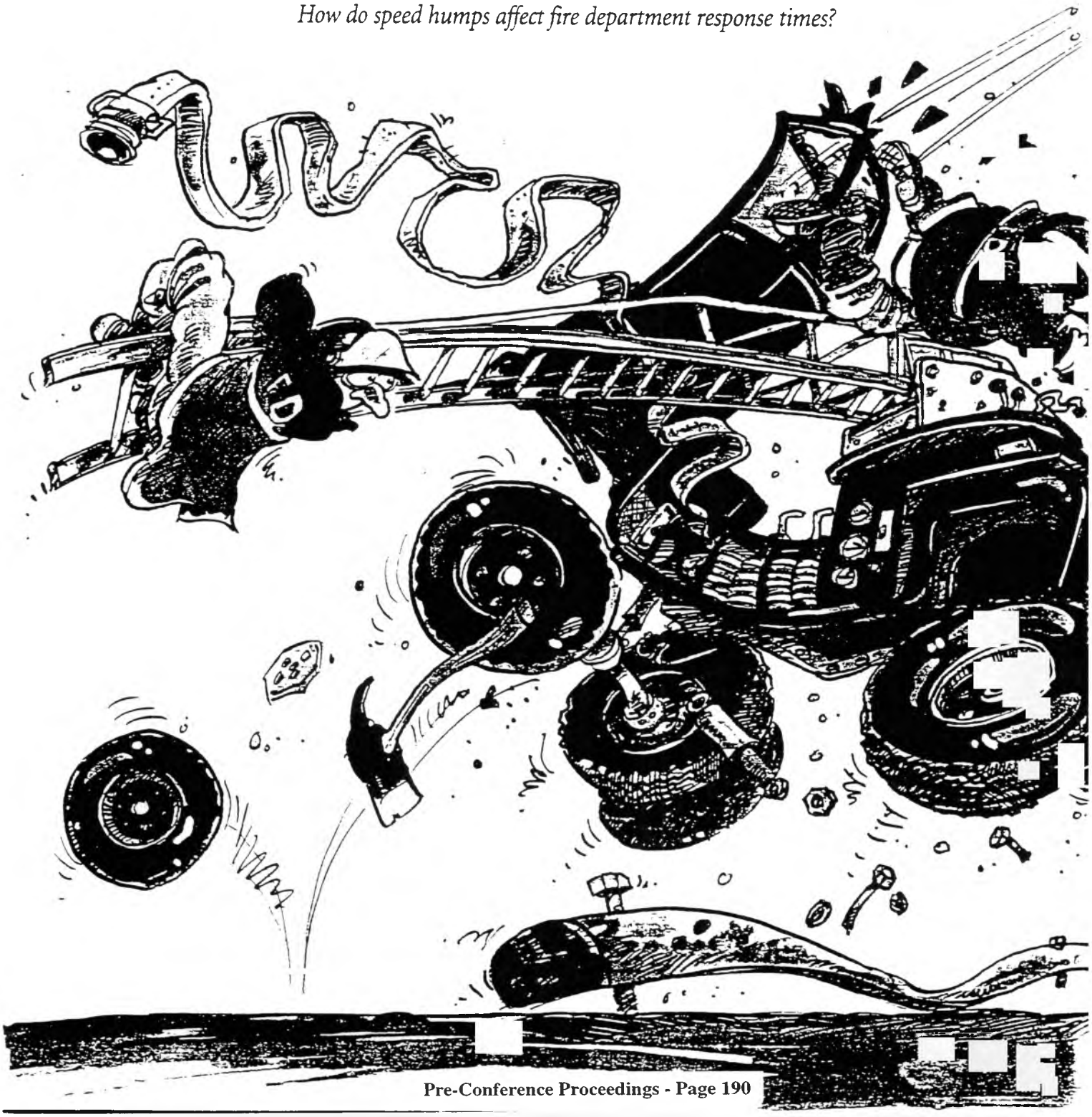
ATTACHMENT 4

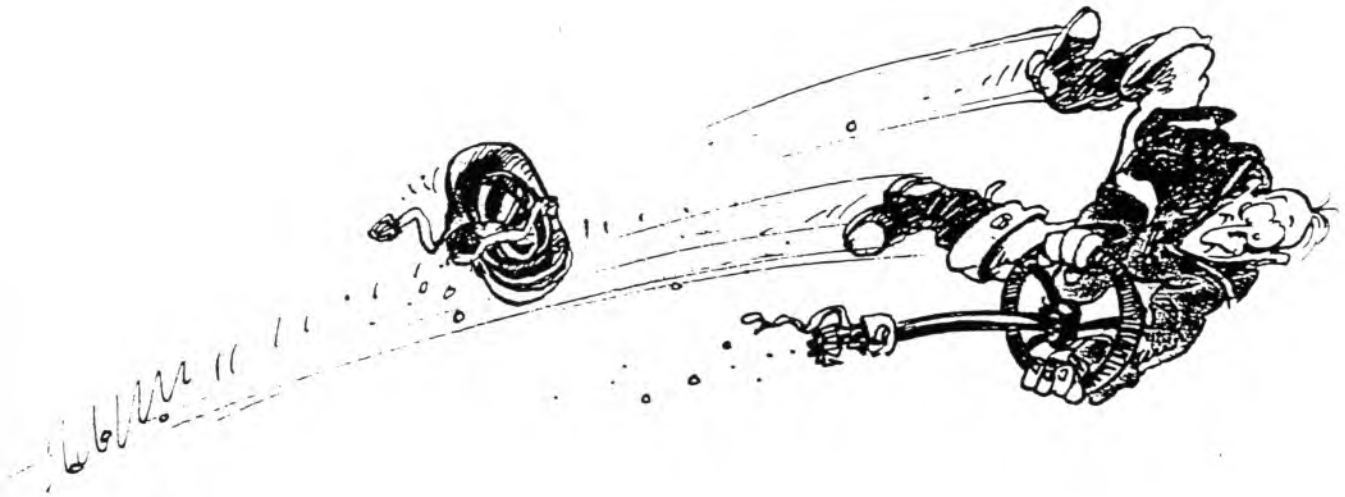
EMERGENCY VEHICLE RESPONSE TIME STUDIES

Things That Go **Bump in the Night**

Lindy McGinnis

How do speed humps affect fire department response times?



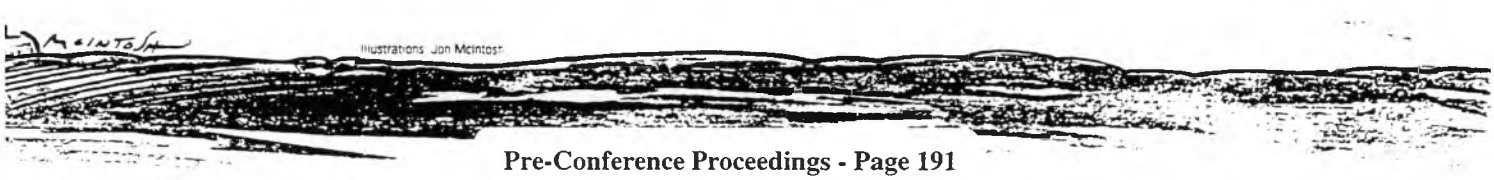


Cities all over the United States are busy building speed humps to cut down on the flow of traffic through residential neighborhoods. And they seem to work—cars have to slow down to get over them in one piece. But so do fire trucks.

All over the United States today, communities are implementing neighborhood traffic management programs to provide a safer, more livable environment. Physical barriers, such as cul-de-sacs, and traffic diverters, such as speed humps, have sprung up nationwide. Street closures are being approved by many city councils, and many newer subdivisions are installing entrance gates and cutting down on the number of streets into the developments—all to limit access to neighborhoods.

Austin, Texas, like at least 47 other cities around the country, has chosen to deal with its problem traffic by implementing a speed hump program. And it's been happy with the results: In the two years the program's been in existence, the Public Works and Transportation Department has been asked to build speed humps on more than 600 city streets.

Obviously, the city feels that speed humps work. They cut



down on unwanted traffic in residential neighborhods. But they also reduce the fire department's response times.

Neighborhood traffic management strategies

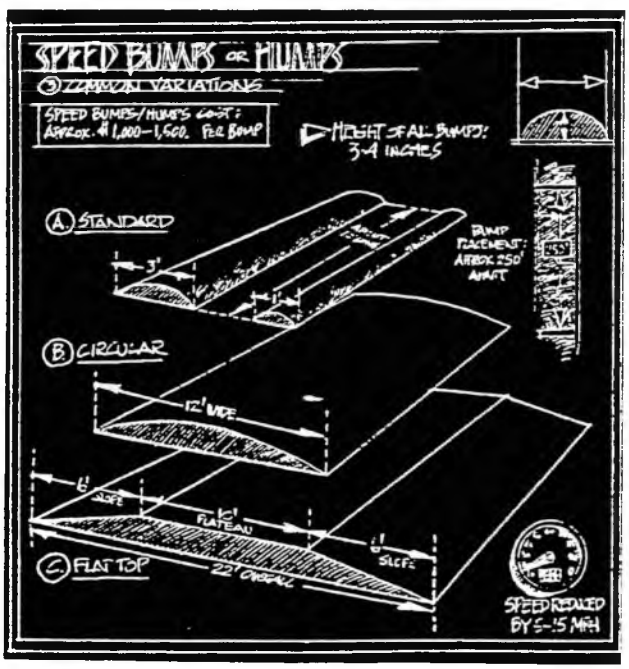
Traffic management programs often focus entirely on installing one or two types of control devices, with little or no areawide planning. A neighborhood group complains, and a speed hump, stop sign, or some other device is installed—and that's the end of it. Occasionally, this strategy is successful. Residents on streets where the devices were installed are happy, and any complaints other residents and drivers might have soon die down.

However, the literature seems to suggest that the more successful traffic calming initiatives are broader in scope, using more than one strategy and a variety of control devices. These broader initiatives focus on transportation improvements using passive strategies, active strategies, or a combination of both. Passive strategies use subtle or psychological means to influence drivers to behave in a desired fashion, while active strategies prevent or reduce traffic movement by changing street configurations or putting up physical barriers.

Passive traffic control devices include traffic signs and signals, brush trims, textured pavements, markings at pedestrian crosswalks, educational programs, and traffic enforcement. These devices are meant to improve safety and reduce accidents by making drivers more aware of their actions. Educational programs and enforcement efforts are generally accepted as the more effective passive techniques for dealing with issues related to speeding, and, to a lesser degree, traffic volume.

Active traffic control devices include speed humps, traffic circles, cul-de-sacs, chokers or curb extensions, gates across roadways, medians, and street closures. These "hard" control devices are largely self-enforcing and create a visual impression, real or imagined, that a street isn't intended for through traffic.

The most common hard control device is the speed hump. The two most common speed humps are the 12-foot-long circular hump 3 to 4 inches high and the 22-foot-long flat-topped hump with a plateau 10 feet long and 3 to 4 inches high and a circular arc approach 6 feet long. The recommended spacing for speed humps is 200 to 250 feet apart.



Speed humps are relatively inexpensive to install—usually between $1,000 and $1,500 per hump—and they successfully slow traffic. However, they can also increase noise pollution and block the paths and hinder the mobility of emergency apparatus. They can damage vehicles and cause trauma to patients being transported to hospitals. They may affect how fire departments respond to calls, and they may interfere with firefighting operations. Traffic control devices may even affect how the locations of new stations are determined. Their biggest disadvantage? They reduce emergency response times.

The impact of traffic management on emergency response

Response time is a key emergency service performance indicator, and traffic management plans, especially those that incorporate traffic barriers, adversely affect it. According to the U.S. Department of Transportation, such devices may force apparatus to use longer, less direct routes and confine them to the busier streets, possibly exposing them to significant delays and even collisions. Apparatus may also end up on the wrong side of a barrier from a fire, or they may have to slow down significantly to maneuver through or around barriers. Traffic barriers may also preclude the practice of routing apparatus from the same station along parallel streets to prevent a single traffic accident from delaying them all. Finally, traffic barriers may make an entire area temporarily inaccessible to fire apparatus. This occurs when the barriers close several residential streets, and one or more unanticipated problems, such as street repair, force traffic from the blocked streets to jam the remaining open streets.

In addition to having an impact on response time and capability, traffic management barriers may affect operations at a fire scene by interfering with the apparatus' ability to maneuver, hampering the effective deployment of apparatus and equipment, particularly tiliered aerial ladder apparatus; impeding access to the water supply; and making it difficult to divert traffic from the fire scene.

Obviously, many emergency agencies in cities around the country are alarmed by these developments. For example, the city of Berkeley, California, recently put its speed hump program on hold because the fire department was worried that most, if not all, of their primary response routes would have traffic devices that would delay fire department response.

"The Fire Bureau wanted to know where it would all end," said Susan Sanderson, a transportation planner. "How long would it be before there were speed humps on every street? I thought the question was ridiculous at first, until, on closer inspection, I realized that speeding was so ubiquitous that speed humps probably would be needed on every street if that was our only solution to speeding."

Austin Fire Chief Robin Paulsgrove and Austin's Director for the Emergency Medical Services (EMS) Department voiced similar concerns when they learned that the city's Public Works and Transportation Department had received requests for speed humps on more than 600 streets in the 18 months the speed hump program had been in place. By comparison, Dallas had approved only about 210

speed humps on a third as many streets. And Dallas, at approximately 400 square miles, is considerably larger than Austin, which covers about 220 square miles.

The speed humps—30 of them, both curved and flat-topped—were installed in March 1995 in six Austin neighborhoods to test their effectiveness in reducing vehicle speed. They did the job. Data collected before and after the speed humps were installed indicate that the curved speed humps reduced vehicle speeds by 5 to 15 miles per hour, while the flat-topped humps reduced speeds by 7 to 10 miles per hour.

According to surveys conducted in the first four pilot neighborhoods, to which an average of 57 percent of the recipients responded, 87.5 percent of the residents felt that traffic speeds had slowed on their streets. The majority—74 percent—of residents in two neighborhoods also felt that traffic volume had decreased, while 59 percent of residents in the other two neighborhoods noticed a change in traffic volume. Overall, 70 percent of the residents had a favorable opinion of speed humps as a speed reduction measure, and 55.5 percent felt that the speed humps had improved the quality of life in the neighborhood.

However, both the Austin Fire and EMS Departments worried that multiple humps would decrease response and patient transport times and that they'd subject paramedics in the back of EMS units to injury if they lost their balance when crossing one.

In March 1996, the city manager, Jesus Garza, asked the Fire and EMS Departments to measure the delay in response times for emergency vehicles responding over speed humps. A fire engine, a fire truck, and an EMS ambulance were used to conduct the tests on a residential street with a posted speed limit of 30 miles per hour. The street contained five curved speed humps spaced between 358 and 433 feet apart. A similar street of about the same length containing no speed humps was used for comparison. The roads were closed to traffic during the tests.

Each vehicle made two runs on each of three tests, using a different driver for each run. The vehicles crossed each hump at 15 miles per hour, at 20 miles per hour, and at a speed chosen by the drivers. A fourth test was conducted using an EMS unit that crossed the humps at a speed decided by the driver, with EMS medics in the back simulating care to a critical patient. Stop watches were used to time each run, and radar guns measured the vehicles' speeds. Videos were made to show how crossing the humps affected the vehicles.

For the various combinations of tests, the time needed to travel a length of street that had no speed hump was compared to the time needed to travel a length of street with the speed humps. The difference between the two travel times equaled the total delay. The total delay time divided by the number of humps equaled the delay per speed hump.

The tests revealed that 20 miles per hour was close to, or more than, the reasonable safe speed to cross a speed hump. None of the drivers felt that they could maintain good control of their vehicles at 20 miles per hour, and they feared that the jolts would damage the vehicles.

The drivers' individual performances didn't appear to influence the outcome significantly. Their choices of speed in the runs during which they used their own discretion were relatively consistent.

The time delay for each speed hump was found to vary between 2.3 and 9.7 seconds. The shortest delay of 2.3 seconds occurred with an empty ambulance traveling at an average discretionary speed of 16.8 miles per hour. The greatest delay also occurred with the ambulance. When transporting a patient, the ambulance's average speed slowed to 6.6 miles per hour, and the average delay per hump rose to 9.7 seconds. In the runs with the fire engine and truck, the average delays per hump were in the 3- to 5-second range.

The significance of the delay is apparent when you consider that most streets with speed humps have more than one. In the case of an ambulance transporting a patient, this can mean a delay on the way to the hospital of close to one minute for every street with multiple humps.

Average emergency response times in Austin speed hump route

In seconds

Driver discretion	Hump #1	#2	#3	#4	#5	Average
Ambulance	3.22	13.27	25.80	36.48	47.61	2.26
Engine	3.56	13.88	26.13	39.69	60.22	2.83
Truck	3.83	15.60	28.67	40.77	51.14	2.99

15 MPH	Hump #1	#2	#3	#4	#5	Average
Engine	3.18	15.84	28.69	41.14	53.29	3.69

15 MPH	Hump #1	#2	#3	#4	#5	Average
Ambulance	3.85	16.33	30.54	42.65	57.41	4.56

With patient	Hump #1	#2	#3	#4	#5	Average
Ambulance	4.79	20.96	41.27	59.60	78.80	9.67

Chart: Deb Feroe

Resolving the conflicts

So how does a city solve its traffic problems without jeopardizing its emergency services?

Solving neighborhood traffic problems is as much a political problem as a technical one. Many attempts to resolve traffic issues fail because well-meaning elected officials, engineers, or planners listen to a small, vocal group from the community and implement a traffic plan, only to face resentment from affected parties who weren't involved in the process. To avoid this problem, communities must include all affected parties, including emergency service providers, in the planning process.

Because traffic management programs appear to increase neighborhood livability, there will be a great deal of pressure on elected officials to approve such programs in their communities. It's critical that they not react hastily and pressure city officials to come up with a quick fix.

When asked to make decisions about traffic management programs, elected officials must clearly understand the tradeoffs that will occur in emergency response times and capabilities. Citizens will inevitably complain when response times are slowed, and elected officials will have to support their city's emergency agencies against these complaints. Emergency response providers will never come to consensus on traffic management projects if they fear that the resulting reductions in response times will be blamed on their incompetence or lack of operational efficiency.

Planning professionals should also take into account the negative effects such a plan will have on emergency agencies. They mustn't leap

to obvious solutions. Solutions that may seem obvious often have hidden problems that aren't discovered until the programs have been implemented.

It's essential that planning professionals include the city's emergency service agencies in the planning process. Traffic management plans should minimize any adverse effects traffic-calming devices might have on response time and firefighting operations by making barriers traversable, designing barriers so that they don't block primary access routes in the vicinity of potential multiple-alarm fire sites, and providing additional fire hydrants where barriers block existing hydrants. Each plan should be designed so that no portion of a neighborhood becomes isolated from emergency service.

Planning professionals should incorporate a variety of mitigation tools and strategies in their plans, and tailor control devices to the specific situation. No active control devices of any kind should be considered on primary emergency response routes, and horizontal devices, such as one-way streets, rather than vertical devices, such as speed humps, should be considered on secondary emergency response routes. Emergency vehicles have more difficulty with vertical mitigation devices than they do with horizontal mitigation devices.

Planners should try passive strategies first and phase in more active strategies only if necessary. One example is the three-phase Neighborhood Traffic Safety Program in King County, Washington. In Phase I, passive, less restrictive measures are used to educate the residents on traffic safety issues. Phase II focuses on physical traffic control devices, such as speed humps and traffic circles, which may be considered only after Phase I measures prove ineffective. Phase III includes the development of major projects that require special funding, such as a capital improvement program.

Planners may also want to develop a new street classification for primary emergency response routes, as the city of Portland, Oregon, is in the process of doing. The new classification will restrict the types of traffic-calming devices that can be placed on streets that have been identified as emergency response routes.

Finally, planners must develop reliable methods to assess accurately the costs and benefits to the different interest groups that will result from the traffic changes.

What planners don't want to do is give individual neighborhoods carte blanche to pay for any type of traffic control device they want themselves. Just because a neighborhood is willing to fund a project shouldn't mean that it can install a device that fails to meet the community's criteria for traffic mitigation.

What emergency response agencies can do

It's understandably difficult for emergency service providers to accept that many people value livability more than rapid emergency response or the efficient movement of traffic. When given the choice between a quick response time by emergency service providers or a reduction in the speed and volume of cars on their neighborhood streets, residents will invariably place a greater value on the latter. Regardless of whether the danger to children from speeding automobiles is really a greater risk than a slow emergency response time, residents' fears for their children's safety is greater than their fear of fire and medical emergencies, and that must be respected.

If firefighters understand that the community is willing to accept a slower emergency response time and that city officials won't blame them when traffic control devices cause their response times to drop, they'll more easily accept the operational changes that must be implemented to give the customers what they want.

To help citizens create the kind of communities they want to live in, emergency service providers may have to work with their public works departments to help design traffic management programs. To do this, fire and EMS departments can set up a committee that meets regularly with the planning or public works department to review and approve such projects. Committee members can be the first point of contact for the departments on transportation issues and can provide the public safety departments with a consistent review and approval process when implementing traffic management projects.

In areas where traffic management initiatives reduce response time, emergency service providers can implement mitigation strategies. They can create maps that clearly indicate the most efficient routes into and through neighborhoods, as well as the location of traffic management devices. They can practice getting through 911 gates quickly and plan routes that bypass gates. And they can buy hardware that permits emergency vehicles to pre-empt traffic signals so that they can clear intersections and stop cross-traffic.

Taking this advice to heart, the Austin Fire, EMS, and Public Works and Transportation Departments recently met to discuss how to move forward together with the city's speed hump program. As a result, speed humps won't be approved for all the Austin streets on which they're being requested. Current funding levels will limit the number of humps that can be installed to approximately 65 to 100 annually, depending on which design is used. And Austin's Public Works and Transportation Department recently revised the approval criteria to include only those streets where average vehicle speeds exceed the speed limit by five miles per hour.

In addition, the Austin Fire and EMS Departments will more clearly define what they consider to be emergency response routes and will approve speed humps requested on streets that don't fall into this category. The Public Works Department will seek additional funding for traffic management and explore the use of other devices. Most important, the departments have agreed to work together to find a balance between the neighborhoods' need for increased livability and the fire and EMS departments' need to provide effective and efficient response.

To implement a traffic management program that benefits both the community and those who provide emergency services successfully, cities must evaluate the different strategies and devices available and incorporate them into a comprehensive plan to deal with traffic problems. All affected parties, including the emergency service agencies, must participate in the planning process from the very beginning, and they must all make a commitment to work together, serving the interests of their community.

Anyone interested in receiving a copy of "The Impact of Traffic Management Programs on the Delivery of Fire Suppression and Emergency Medical Services," the complete report from which this article is taken, may write to McGinnis at the Austin Fire Department, 1621 Festival Beach Road, Austin, TX 78702. Please enclose a check or money order for $5 to cover copying and postage costs.

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January 1996

The Influence of Traffic Calming Devices on Fire Vehicle Travel Times

Traffic Calming Section
Bureau of Traffic Management
Portland Department of Transportation
City of Portland, Oregon

The Influence of Traffic Calming Devices upon Fire Vehicle Travel Times

January 1996

INTRODUCTION

Traffic calming devices are used on Portland's neighborhood streets when traffic conditions are out of character with their adjacent residential, institutional, and recreational land uses. Calming devices are used to slow vehicle speeds; to encourage the use of more appropriate streets for through trips; and to enhance pedestrian, bicycle, and transit safety. The devices have proven to be effective without significantly impacting convenience, mobility, and travel time for drivers. At the same time certain devices affect the speed of various fire vehicles and may increase overall response times.

During the Fall of 1995 the City's Fire Bureau and Bureau of Traffic Management conducted a thorough data collection effort to help quantify the relationship between three types of traffic calming devices and fire vehicle travel times. Different types of fire vehicles were driven on streets calmed with traffic circles, 22-foot speed bumps, and 14-foot speed bumps. Figures 1, 2, and 3 illustrate the three devices. Table 1 lists basic information about the types of fire vehicles used in this study.

PURPOSE

The purpose of this paper is to present how speed bumps and traffic circles affect fire vehicle travel times. This paper describes how the data was collected and analyzed, presents the findings, and goes on to recommend additional areas in need of research.

RESEARCH METHOD

The testing considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested are: the driver, the type of fire vehicle, the desirable vehicle speed, and the types of calming devices.

The data collection effort involved six fire vehicles of varying characteristics. Test runs were conducted on a total of six streets. Two streets had 22-foot speed bumps. Two streets had 14-foot speed bumps, and two had traffic circles. A total of 36 different drivers participated in the testing. The total number of test runs on each street was four per vehicle, or 24 runs per street.

Each test run was video taped. The camera recorded the vehicle speeds that were detected and displayed by a radar gun. The time of day, to the nearest second, was superimposed on the recording.

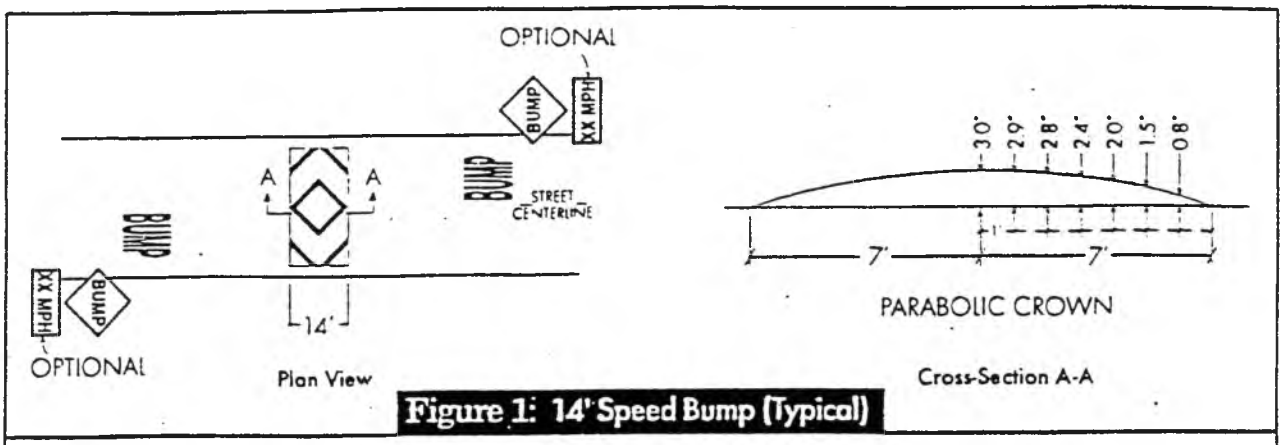

Figure 1: 14' Speed Bump (Typical)

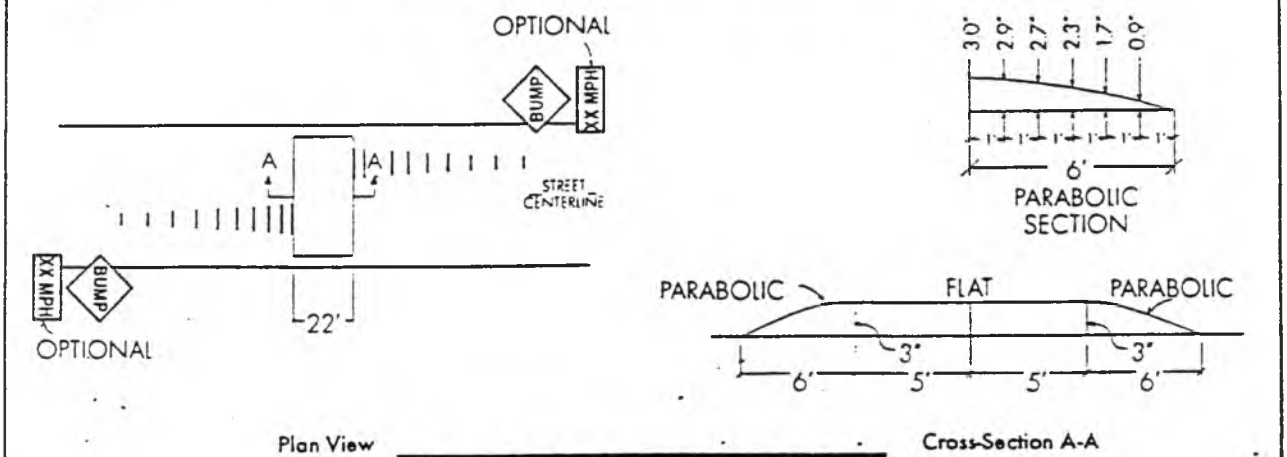

Figure 2: 22' Speed Bump (Typical)

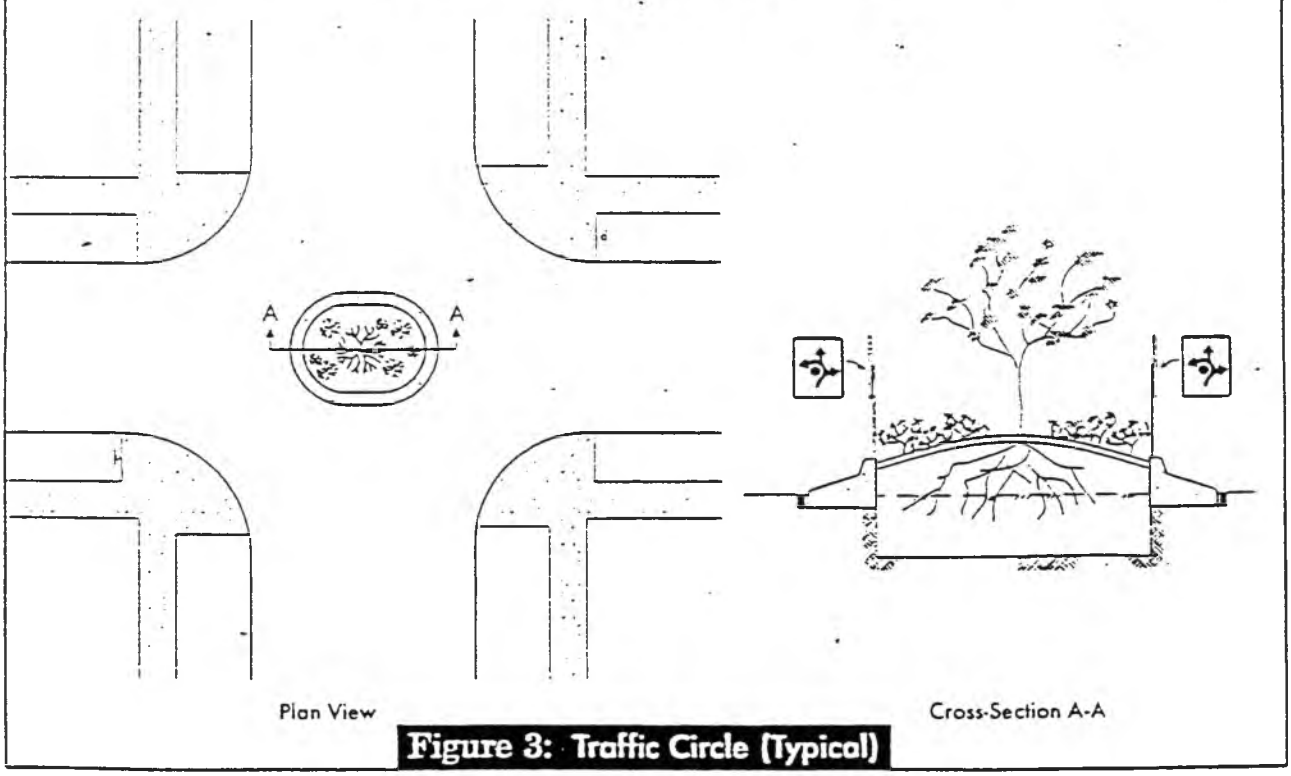

Figure 3: Traffic Circle (Typical)

Table 1.

Fire Vehicle Specifications

Vehicle	Overall Length	Wheelbase	Weight (lbs)	Horse-power (HP)	Wt./HP Ratio (lbs/HP)	0-40 mph Accel. Time (sec)
Engine 18	29' 10"	15' 5"	34,860	185	188	19
Rescue 41	21'	11' 6"	na	185	na	12
Squad 1	27'	14' 6"	23,170	275	84	17
Truck 1	48'	21' 0"	53,000	450	118	20
Truck 4	57'	13' 0"	53,960	450	120	22
Truck 41	37' 6"	16' 9"	42,100	350	120	27

The speed and time information for each test run was transcribed from the video tapes to a spreadsheet. The information for each run was used to calculate the distance traveled after each second as well as the vehicle's distance from the starting line after each second of the run.

For various combinations of the four variables, the time needed to travel a length of street that had no calming device was compared to the time needed to travel the same length with a calming device. The time and impact distance required to decelerate from a desirable response speed, negotiate the calming device, and accelerate back to the original speed was determined from the data. The time required to travel the same impact distance without a calming device to influence the desirable response speed was calculated. The difference between the two travel times equals the delay associated with the calming device. This delay-per-device was calculated for all six vehicles as they negotiated every calming device on the six test streets. Delays-per-device were calculated for desirable response speeds of 25, 30, 35, and 40 mph.

FINDINGS

The results of the City's research are presented in Tables 2, 3, and 4. Depending on the type of fire vehicle and the desirable response speed, the three devices were found to create a range of delays for each device as follows:

22-foot bumps:	0.0 to 9.2 seconds of delay per bump
14-foot bumps:	1.0 to 9.4 seconds of delay per bump
Traffic circles:	1.3 to 10.7 seconds of delay per circle

The drivers' performances did not appear to significantly influence the results. Their choices of deceleration and acceleration rates as well as their choices of minimum speeds near the devices were very consistent.

CONCLUSIONS

The purpose of this paper was to show how speed bumps and traffic circles used in Portland affect fire vehicle travel times. The results provide quantitative data that can be used in the determination of the impacts of one or more traffic calming devices on fire response times along a given emergency response route. Additional information is necessary in order to make a complete assessment of these impacts. This includes: 1) the types of fire vehicles responding to emergencies; 2) the desirable and appropriate speed of fire vehicles at each of the calming devices located along the response route; 3) the geographical area that will be affected by any increase in delay to response times; and 4) the use of this route by fire vehicles given the likely demand for emergency services and the availability of good alternative routes.

A full assessment of the impacts on response times for a given set of traffic calming devices needs to be balanced with the benefits of traffic calming on reducing speeding problems and enhancing public safety and livability along neighborhood streets. This paper provides the initial quantitative data that is necessary to begin to weigh the pros and cons of traffic calming.

RECOMMENDATIONS

The City needs to pursue full assessments of the impacts of specific traffic calming projects, either planned or existing projects, on emergency vehicle responses. This assessment needs to consider all the necessary information as summarized above. The results of this assessment then needs to be compared to the benefits of the traffic calming project, especially the benefits to public safety.

Due to the City's desire to provide both fast response for emergency services and slower overall traffic speeds on neighborhood streets, a public process should be undertaken to address the trade-offs between these two community values and to provide policy direction for implementing traffic calming on a city-wide basis. This should be done by revising the Transportation Element to include a classification for emergency response routes.

Factors that may need to be considered in addressing any trade-offs are options to mitigate impacts on fire vehicle response times. These options include the use of traffic signal preemption devices, the locating of new fire stations, fire vehicle modifications to minimize weight-to-horsepower ratios, securing and cushioning certain pieces of equipment, and improving vehicle suspensions.

Bureau of Traffic Management
Portland Office of Transportation
City of Portland, Oregon
January 1996

Typical Impacts of Traffic Circles on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	14	25	2.8	261
	14	30	4.3	489
	14	35	6.1	671
	14	40	8.5	814
Rescue 41	16	25	1.3	170
	16	30	2.3	301
	16	35	3.1	467
	16	40	5.1	612
Squad 1	17	25	1.2	172
	17	30	2.3	326
	17	35	3.7	501
	17	40	5.3	776
Truck 1	10	25	4.8	319
	10	30	6.4	524
	10	35	8.4	749
	10	40	10.7	1034
Truck 4	11	25	4.3	322
	11	30	6.2	549
	11	35	8.1	799
	11	40	10.3	1139
Truck 41	11	25	3.9	338
	11	30	5.2	555
	11	35	7.3	845
	11	40	9.2	1255

Lowest Speed: This is the lowest speed a vehicle travels when navigating around a traffic circle

Desirable Speed: This is the speed a driver might wish to travel if there were no traffic circles.

Travel Time Delay: This is the additional time required to travel to a destination due to a traffic circle's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the traffic circle's influence.

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Typical Impacts of 14-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	13	25	2.3	236
	13	30	3.7	399
	13	35	5.2	581
	13	40	7.7	814
Rescue 41	17	25	1.0	147
	17	30	1.7	269
	17	35	2.9	483
	17	40	4.9	628
Squad 1	12	25	2.7	244
	12	30	4.1	436
	12	35	5.9	611
	12	40	8.3	852
Truck 1	11	25	3.4	269
	11	30	4.9	455
	11	35	6.6	646
	11	40	9.4	931
Truck 4	12	25	3.4	315
	12	30	4.9	485
	12	35	6.8	732
	12	40	9.1	1053
Truck 41	12	25	3.5	327
	12	30	4.7	472
	12	35	6.6	762
	12	40	8.6	1152

Lowest Speed: This is the lowest speed a vehicle travels when crossing a 14-foot speed bump.

Desirable Speed: This is the speed a driver might wish to travel if there were no speed bumps.

Travel Time Delay: This is the additional time required to travel to a destination due to a 14-foot speed bump's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the speed bump's influence.

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Typical Impacts of 22-foot Speed Bumps on Emergency Vehicles

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	21	25	0.8	136
	21	30	1.7	323
	21	35	3.0	505
	21	40	5.0	752
Rescue 41	34	25	0.0	0
	34	30	0.0	0
	34	35	0.3	118
	34	40	1.5	263
Squad 1	24	25	0.4	80
	24	30	1.0	214
	24	35	2.1	433
	24	40	3.4	708
Truck 1	22	25	0.6	137
	22	30	1.4	320
	22	35	3.0	600
	22	40	4.9	885
Truck 4	16	25	1.8	254
	16	30	3.4	449
	16	35	5.9	674
	16	40	7.7	1039
Truck 41	14	25	3.0	316
	14	30	4.8	622
	14	35	7.2	912
	14	40	9.2	1322

Lowest Speed: This is the lowest speed a vehicle travels when crossing a 22-foot speed bump.

Desirable Speed: This is the speed a driver might wish to travel if there were no speed bumps.

Travel Time Delay: This is the additional time required to travel to a destination due to a 22-foot speed bump's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at a given desirable speed because of the speed bump's influence.