

EXHIBIT NO. 1

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4-21-01

City of Alexandria, Virginia

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~~3-27-01~~

MEMORANDUM

DATE: MARCH 22, 2001

TO: THE HONORABLE MAYOR AND MEMBERS OF CITY COUNCIL

FROM: PHILIP SUNDERLAND, CITY MANAGER ^{PS}

SUBJECT: COMPREHENSIVE TRANSPORTATION POLICY AND PROGRAM FOR THE CITY

ISSUE: City Council consideration of the development of a comprehensive transportation policy and program for the City.

RECOMMENDATION: That City Council:

1. Receive this memorandum, and schedule for public hearing on Saturday, April 21, the question whether the City should develop a comprehensive transportation policy and program, as proposed below in this memorandum; and
2. At the conclusion of the public hearing, endorse the concept of, and authorize staff to proceed with the development of, a comprehensive transportation policy and program for the City, as proposed below.

BACKGROUND: Over the years, the City has conducted numerous transportation studies and undertaken a variety of transportation-related activities. However, most of these efforts have involved specific projects directed at a specific area of the City, rather than being a part of and consistent with an overall transportation policy and plan. Clearly, the area of transportation -- whether expressed, for instance, in terms of vehicular traffic, public transit, air and noise pollution, pedestrian safety or, generally, the City's quality of life -- presents numerous problems that need solutions. It is staff's view that these problems are best addressed within the framework of a comprehensive Citywide transportation policy and program. Below is a discussion of why we believe it is important for the City to proceed with the development of a comprehensive approach to transportation, followed by a series of recommendations regarding a multi-phased planning process that will result in a well defined transportation policy for the City and a set of program initiatives that implement that policy.

DISCUSSION: Alexandria is currently one of the most densely populated cities in the country, with very little vacant land left for development, and a street system that is essentially in place with little room to expand. The City's population continues to grow (the 2000 Census shows a

15.4% increase in Alexandria's population between 1990 and 2000 from 111,183 to 128,283 residents), the number of visitors continues to increase and the number of jobs in the City is at an all time high of over 90,000. As a result, more people than ever are traveling within the City. At the same time, the population and employment in the region continue to grow, and more people are traveling through Alexandria each day to get to a destination outside the City. Traffic studies for the Woodrow Wilson Bridge replacement project estimated that over 60% of rush hour traffic on City arterial roads is through-traffic. These factors put tremendous pressure on the City's existing constrained transportation network.

To address current and future transportation issues, we need to establish (i) an overall transportation policy that clearly defines the City's goals in a variety of transportation areas (e.g., traffic, transit, parking, pedestrian safety), and (ii) a program of specific transportation projects and activities to implement the policy objectives. In developing this policy and program, it is essential that we take into account a variety of transportation-related factors, such as land use, the environment, economic development, streetscape design, pedestrian safety, aesthetics, and the overall quality of life in the City. In addition, we must engage all components of the community in developing this policy and program.

The City is now undertaking a number of measures designed to address various transportation-related issues. For example, we are engaged in: the Gridlock Reduction Intervention Program; traffic calming measures in neighborhoods; the photo red light camera program; many specific projects in response to the 1999 Citywide traffic survey; a range of measures designed to make our roadways more pedestrian friendly (e.g. installing pedestrian-activated countdown signals, widening sidewalks, planting trees and greenery in medians and along sidewalks); working with the school system to make it safer for children to access schools; acquiring land to support a future expansion of the DASH bus system; designing a straightened Monroe Avenue bridge; studying a possible road connection between Eisenhower Avenue and Duke Street; and performing a variety of transportation-related activities in connection with the Woodrow Wilson Bridge replacement project.

These and other actions are focused on addressing some of the City's significant transportation problems, but not necessarily from a Citywide perspective. It is staff's view that we need to begin approaching these issues in a comprehensive and coordinated way, so that, rather than attempting to respond individually to every problem that happens to be identified, we look at all our major transportation issues at the same time, prioritize them based in part on adopted Citywide policies, and proceed to address them in a coordinated fashion that is consistent with those policies. This is what the transportation policy and program is intended to do.

Through the gathering of information and discussions with the community, we intend to determine how best to approach the range of transportation issues that face Alexandria, many of which arise from our location and the volume of traffic that passes through each day. One of our major goals is to control the impacts of that traffic. The challenge is to develop a transportation

program that protects the City's neighborhoods from undue traffic, while at the same time allowing Alexandria to continue to grow and prosper economically.

It is anticipated that the central policy goals of a comprehensive transportation policy and program would include the following:

1. Protecting the quality of life in residential neighborhoods by keeping through-traffic on City arterials and primary collectors and off local streets;
2. Defining the primary function of the City's major roadways as carriers of vehicles traveling through the City or as carriers of local traffic, and then developing measures that support the defined function; and
3. Reducing the number of vehicles on City roadways by means of public transportation, car pooling and other forms of non-vehicle transportation.

Attachment 1 shows the City's street system-- arterials, primary collectors, local collectors and local streets. Arterials are defined as roads which are designed to move through-traffic at efficient speeds and high volumes. Primary collectors are designed for both local and through-traffic, and provide connections between arterials. Local collectors and local streets are primarily used for local traffic.

The anticipated focus of the transportation policy and program will be on the linchpin of the City's road network, our arterials and primary collectors; an anticipated major goal of the policy and program will be to keep vehicles traveling through the City on these roadways and out of residential neighborhoods. This goal will work in tandem with our traffic calming program (see Attachments 2 and 3), which is intended to control the speed and volume of through-traffic that does enter residential areas.

The development of a comprehensive transportation policy and program for the City will require a multi-phase, multi-year study of our transportation network. This study will be divided into four phases, each of which is summarized below.

Phase I: This phase would involve the collection of data to assess the condition of the arterials and primary collectors in the City (see Attachment 1). Examples of data to be collected include morning and evening peak-hour volumes, turning movements at key intersections, prevailing speeds, availability of on-street parking, transit data and pedestrian counts. Once collected, these data would be analyzed to determine the condition of each major roadway, including current road capacity, level of service, corridor and system performance constraints, and the need for auxiliary lanes.

A consultant would be retained in Phase I to collect and analyze data, and also to assist in the development of a set of comprehensive transportation policy goals for the City. The results of

the data collection and analysis efforts, along with a proposed policy, would be presented to Council for its preliminary review, would then be taken to the community for review and comment, and, following revisions to reflect community input, would be taken again to Council for approval. At the conclusion of Phase I, staff would seek authority and funding to continue with subsequent phases of this work. Phase I is estimated to cost approximately \$200,000, and to take approximately nine to 12 months to complete.

Phase II: In this phase, the results of the Phase I data collection and analysis efforts would be used to prioritize the order in which the City's arterials and primary collectors would be addressed in the comprehensive transportation program. Phase II also would identify a range of actions that could be taken in order to resolve some of the traffic, pedestrian, safety and other problems associated with these arterials and collectors.

The work of Phase II would be largely accomplished through a series of charettes involving the public, staff from the Department of Transportation and Environmental Services, and consultants (a charrette is an extensive planning exercise involving the community that is designed to solve problems with consensus). The charettes would look at effective transportation measures from other cities similar to Alexandria, and compare and contrast needs and solutions. Examples of such measures include: redesigning intersections and roadways; increasing roadway capacity; revising signal coordination; changing HOV, on-street parking and lane usage restrictions; increasing transit usage (e.g., DASH and Metro); and employing "Intelligent Transportation Systems" which involve the use of technology (such as dynamic message boards) to inform motorists of incidents on the roadway and computer system software to adjust signal operations based on traffic demand. In Phase II, a consultant would act as a facilitator for the citizen charettes, and would assist in identifying alternative solutions to the problems associated with the prioritized arterials and primary collectors.

Phase III: The focus of Phase III would be to review the various solutions identified in Phase II and to undertake a cost/benefit analysis for each -- i.e., to compare the cost to implement the solution with the public benefit it produces. A Council-appointed committee of 15 to 20 persons representative of civic associations, the business community and traffic experts would participate in Phase III, along with T&ES staff and a consultant. The committee would review the alternative solutions identified in Phase II against a set of criteria which would include desired levels of service and the costs/benefits associated with the solutions. The recommendations from this committee would be presented to Council, and then addressed in a series of community meetings leading to a public hearing before Council, following which Council would act on the recommendations. The product of Phase III would be a program of cost efficient projects and other activities designed to address the major transportation problems found on the prioritized arterials and primary collectors.

Phase IV: In this final phase, a plan for implementing the transportation program approved by Council in Phase III would be prepared. The plan would consist of a scope of work and schedule for the various projects and other activities in the approved program. This plan would be

developed by T&ES staff and then brought to Council for public hearing and consideration. The implementation of any plan approved by Council would occur in a number of phases over many years. Each phase would be brought forward to Council during the annual budget process, where once again there would be review by the public and Council. Each year, projects and other activities in the transportation program would have to compete for funding with other City needs. Of course, alternative non-City funding sources for these transportation activities would constantly be explored and identified.

In addition to the above, a steering committee composed of City staff representing the departments of Planning and Zoning, Police, Office of Management and Budget, and T&ES (as the lead agency) would monitor and generally oversee the development of the transportation policy and program.

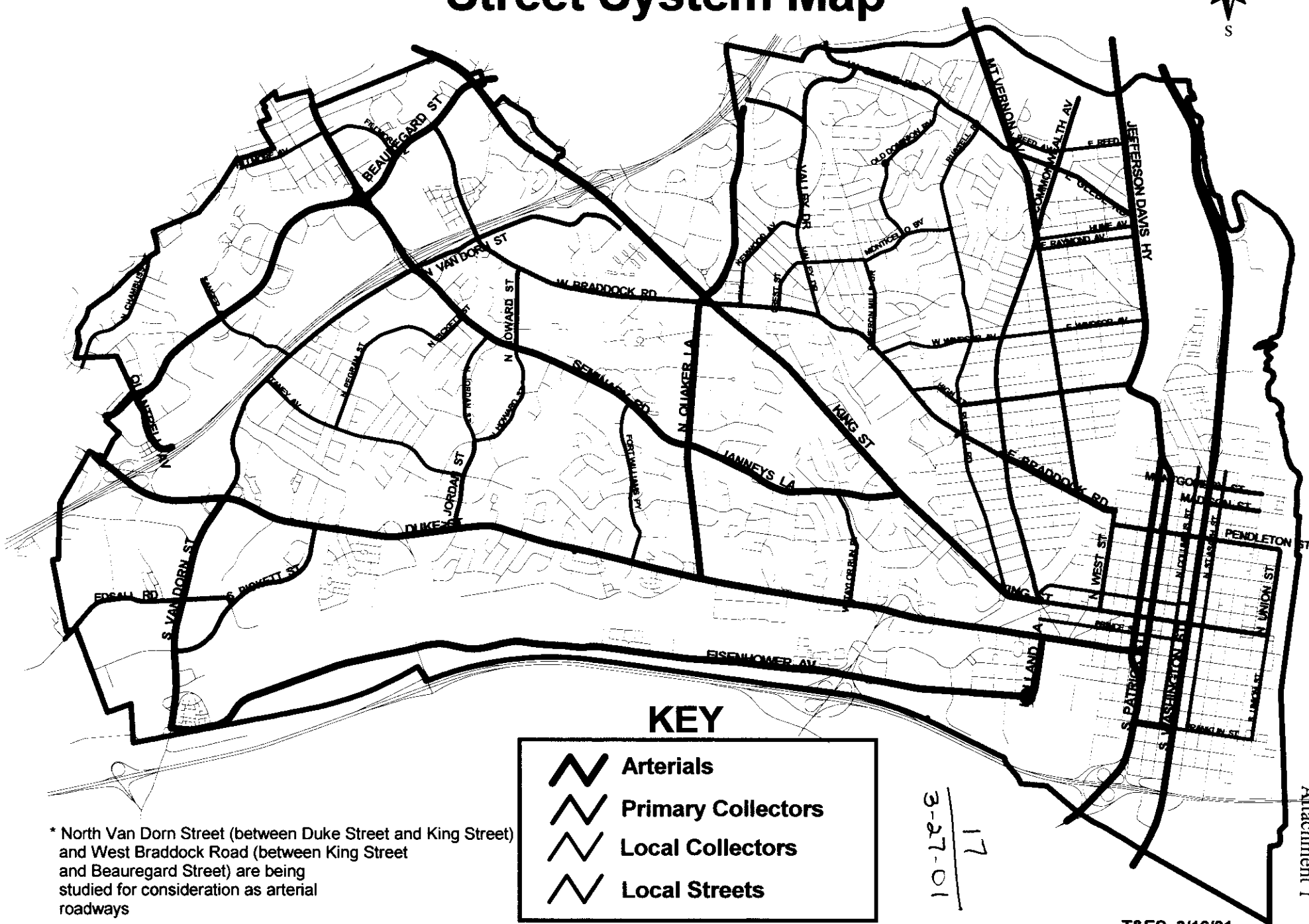
In summary, this docket item is the first step in a multi-year process that will lead to the approval of a comprehensive transportation policy and program for the entire City and, we believe, a vastly improved approach to dealing with the City's major traffic and other transportation-related problems. We anticipate that Phases I through IV of this program will take approximately 30 months, with completion of Phase IV by January 1, 2004, and implementation of the transportation plan starting in FY 2005.

FISCAL IMPACT: Phase I is estimated to cost \$200,000. The funds will come from a previously approved appropriation by City Council of General Fund fund balance earlier designated for this purpose. Staff will return to Council at the conclusion of each phase to report on the results. Funding for post-Phase I phases (estimated at \$250,000 to \$300,000) will primarily be handled as part of each year's budget process (likely starting in FY 2003).

ATTACHMENT:

1. Map showing the City's street system
2. City of Alexandria Neighborhood Traffic Program
3. Rosemont Traffic Calming Plan

STAFF: Richard J. Baier, P.E., Director, Transportation and Environmental Services



* North Van Dorn Street (between Duke Street and King Street) and West Braddock Road (between King Street and Beauregard Street) are being studied for consideration as arterial roadways

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Attachment 1

T&ES 3/16/01

*City of Alexandria*

Neighborhood Traffic Program

Department of Transportation and Environmental Services



The City of Alexandria's "Neighborhood Traffic Program" (NTP) incorporates *Education*, *Enforcement* and *Engineered* street design to protect the quality of life enjoyed in City neighborhoods. The City has developed the NTP to provide residents a forum to raise neighborhood traffic concerns and a means to participate in the selection of strategies that promote safe and pleasant conditions for residents, pedestrians, bicyclists and motorists in City neighborhoods.

This handbook has been developed to advance the goals of the NTP by:

1. Introducing the concepts of neighborhood traffic management;
2. Outlining a comprehensive strategy to guide the use of City resources on neighborhood traffic management projects;
3. Defining an on-going process for neighborhood traffic projects; and
4. Providing descriptions of the measures available for neighborhood traffic projects.

Background

The City of Alexandria is fortunate to have a number of premier travel destinations for shopping, entertainment, recreation, tourism and employment. These activity centers are linked by the City's transportation network which includes local streets, collectors, arterials, and bicycle and pedestrian facilities. As the pace of development has risen in the City and the level of mobility desired by residents has increased, the capacity of many of the City's collector and arterial streets has been strained. These capacity constraints have led to increasing incidents of use of local neighborhood streets for "cut-thru" traffic as motorists seek ways of by-passing congested arterials and use neighborhoods as a shortcut to their destination.

The use of neighborhood streets by "cut-thru" traffic has serious implications for neighborhood cohesion, livability and quality of life. The prospect of increased daily traffic and increased vehicle speed poses hazards for residents, increases noise levels, places pedestrians and bicyclists at greater risk, and creates barriers to quality neighborhood interaction.

In recognition of these traffic issues, the City has initiated the NTP to partner with City residents and neighborhoods in identifying, evaluating and solving traffic conditions related impacts that compromise neighborhood livability. The NTP is a neighborhood based planning program that is intended to provide residents an opportunity to participate meaningfully in transportation planning decisions and assist with the task of balancing community-wide mobility needs with neighborhood preservation objectives.

Neighborhood Traffic Program Goals

1. To provide protection to the City residential neighborhoods from the following types of traffic:
 - a. through-traffic using a residential local or collector street as a shortcut or detour;
 - b. an excessive volume of traffic on a residential local or collector street;
 - c. traffic operating at excessive speeds; or
2. To increase access, safety, comfort and convenience for alternative transportation users on neighborhood streets.
3. To encourage effective citizen engagement and input in evaluating neighborhood traffic problems and selecting improvement strategies and mitigation measures.
4. To appropriately channel public resources by establishing procedures to evaluate and prioritize traffic mitigation measures.
5. To effectively address the dual and frequently competing public safety interests of mobility and livability.

Neighborhood Traffic Program Policies

The following policies provide the framework for the Neighborhood Traffic Program:

1. City streets are classified based on clear functions, and classifications includes arterial, collector and local streets.
2. Any two-lane residential or connector streets may be considered for traffic mitigation in the NTP.
3. Arterials are the most desirable facilities for through traffic and all feasible opportunities for re-routing traffic to a higher classification street will be explored.
4. Traffic may be re-routed from one street to another of equal classification as a result of neighborhood traffic measures only if the end result is a more equal distribution of the traffic burden.
5. Re-routing of traffic onto a lower classification street from a higher classification street as a result of neighborhood traffic measures is unacceptable. Any increase in traffic on local streets of more than 10% is caused by a mitigation measures and will require a reevaluation of the project.
6. Neighborhood livability should be given precedence over marginal motor vehicle efficiencies.
7. Reasonable emergency vehicle access must be maintained.
8. Implementation of neighborhood traffic measures shall conform to the procedures set forth in this document and to nationally accepted traffic engineering standards.
9. The NTP is not designed to address dangerous intersections, provide noise mitigation from major arterials or cause a modal shift.
10. The City will employ traffic control devices in such a way that traffic is encouraged to use arterial streets, including the expansion of the computerized synchronization of signals, proper spacing of signals, controls of access to arterials, and posting realistic speed limits on arterials, etc.

Neighborhood Traffic Program Guidelines

1. A residential local or collector street is a local or connector street whose abutting land use is at least 85% residential when considered in segments of one-quarter mile.
2. Traffic on residential local or collector streets (total both directions) generally should not exceed:

<u>Street Function/Housing Density</u>	<u>Vehicles Per Day</u>	<u>Vehicles Per Hour</u>
Residential Local/Low Density (single family)	1,000	100
High Density (multifamily)	2,000	200
Residential Collector	8,000	800

3. Vehicle speeds (for at least 85% of vehicles established by radar or equivalent) should not exceed posted speeds.
4. Level of Service "D" or better should be provided at neighborhood intersections. Level D occurs when all vehicles waiting at the start of green are able to clear the intersection by the end of that green cycle for at least 90% of the signal cycles during peak traffic hours.
- e. Residents along a residential local or collector street may seek to have the NTP address a traffic condition existing on their block or at an intersection at the end of their block. The request must describe the condition to be addressed and its location. The request also must be accompanied by the signatures of at least 65% of the neighbors who reside on the street of the location of the describe conditions. In the case of blocks falling within the boundaries of an established civic associations, the request must be endorsed by the association, in lieu of the signatures of neighbors. In addition, an established civic association may request that the NTP address a traffic condition existing within its boundaries, so long as the request is accompanied by the signatures of at least 65% of the neighbors who reside on the street of the location of the condition.
- f. In order for a traffic mitigation measure to be implemented through the NTP, at least 65% of the neighbors who reside on properties on the street of the location of the measure must demonstrate their support. In the case of blocks falling within the boundaries of and established civic association, the measure must also be endorsed by the association. In the case of a mitigation measure that lacks a specific "location," the measure must be endorsed by the association, in lieu of the signatures of the neighbors.
- g. Priority should be given to mitigation measures that are designed to a moderate a street condition with a history of pedestrian, bicycle and/or vehicle accidents.
- h. Priority should be given to mitigation measures that are in close proximity to schools, hospitals and parks.

Neighborhood Traffic Program Procedures

1. *Neighborhood Notification* - The City will promote participation in the NTP through correspondence with neighborhood homeowner associations. Applications for consideration may be submitted at any time and will be considered on a first-come, first-serve basis.
2. *Neighborhood Response* - Neighborhood associations submit an application that indicates the areas of concern and provides initial suggestions generated by neighborhood residents. If the application is not generated by the neighborhood association, it must include the signatures of at least 20% of the affected resident population (which includes those properties within one block of intersection projects, all properties fronting mid-block projects, and roads that have their sole access through the study area, i.e. dead end street). This requirement is to ensure that the problem is perceived as a neighborhood problem, not solely an individual homeowner problem.
3. *Staff Review* - City Transportation Division staff process the request and schedule the necessary data collection required to quantify the problem. These preliminary measures will include pre-study meetings with the neighborhood association traffic committee, executive board, or other applicants to better understand the nature of the perceived problem.

Traffic calming projects will be selected based on need as identified in a ranking system that evaluates levels of speeding, traffic volumes, proximity to schools and other pedestrian generators, and location along bicycle and transit routes. Other considerations include the project size and complexity, compatibility with other transportation projects and budget availability.

4. *Design Solution Options* - City Transportation Division staff will develop preliminary design options for review by the neighborhood association. These designs will be presented to the traffic committee or executive board of the neighborhood association for their comment and review. Based upon this input, staff will further develop the designs and prepare final engineering schematics and drawings for final approval by the neighborhood association. Input of any schools or businesses in affected by the prospective improvements will also be solicited.

5. *Public Notification* - A joint public/neighborhood association meeting will be scheduled for the proposed traffic mitigation measures. The meeting will be held at a location within the neighborhood and will allow property owners to comment on the proposed measures. The City Transportation Division will post temporary signs announcing the upcoming meeting but it will also rely on the neighborhood association to distribute meeting information to its membership. Automated telephone messaging may also be used. At the meeting, property owners will receive a project description narrative, drawings and a ballot. Residents will have 60 days after the meeting to return their completed ballot. All ballots must be signed and must indicate support or opposition to the proposed project.

6. *Decision for Improvement* - Before the results of the ballot are considered sufficient to proceed with the project, there must be at least a 50% response rate of affected residents (which includes those properties within one block of intersection projects, all properties fronting mid-block projects, and roads that have their sole access through the study area, i.e. dead end street). At least 65% of the respondents must support the proposed improvement. If this level of support is not achieved, the project will not move forward.

Projects will be selected and prioritized based on five criteria:

1. Neighborhood Preference / Neighborhood Benefit
2. Maintenance Needs
3. Cost of Construction
4. Technical Feasibility
 - space constraints
 - drainage requirements
 - landscaping needs
 - emergency services access
5. Impact on Mobility Citywide

7. *Design and Construction* - If the project is approved by the neighborhood and City staff, the City will proceed with engineering design. Depending upon the extent of the project design may require 3-9 months, with construction following shortly thereafter.

8. *Evaluation* - Transportation Division staff will monitor the impacts of the mitigation projects to ensure that they achieve desired results. The overall program will be evaluated for performance annually.

Understanding Streets and Traffic

City streets are designed and constructed according to a hierarchy of function that is referred to as street classification. The street hierarchy is linked together in what is typically called the street network. The street network is designed to provide the most efficient and effective routes from trip origins to destinations.

Street Classifications

Arterial Streets - Arterial streets, such as Duke Street, King Street, Glebe Road, Van Dorn Street, Quaker Lane, Route 1, George Washington Parkway, Eisenhower Avenue, etc., form the backbone of the City street network. These high capacity roadways serve as direct links between different areas of the City. There are approximately 20 miles of major arterial streets in the City. These streets are typically 4 lanes and carry between 15,000 to 40,000 vehicles daily with posted speeds of 35 mph.

Collectors - Collector streets, such as Cameron Mills Road, Taney Avenue, Commonwealth Avenue, Jordan Street, Howard Street, Monroe Street, etc, feed into the arterial streets allowing motorists quick and easy access to the major roadways while also enabling pedestrians and bicyclists to conveniently move through the City. These streets serve as “through” streets between major roadways. There are approximately 40 miles of collector streets in the City. Collector streets are usually 2 lanes and carry between 4,000 to 10,000 vehicles daily with posted speeds of 25 mph.

Residential/Locals - The residential and local streets, such as Windsor Avenue, Glendale Avenue, Darmouth Road, Beverly Drive, Green Street, Pelham Street, Vermont Avenue, Echols Avenue, comprise the majority of typical City neighborhood streets. These streets often operate in grid patterns to effectively allow movements within and through adjoining neighborhoods. There are approximately 150 miles of residential streets in the City. Residential streets are 2 lane facilities that carry between 500 to 3,000 cars per day with posted speeds of 25 mph.

Traffic Patterns

One of the principle objectives of the NTP is to better educate people about alternative modes of transportation (public transit, walking, bicycling) and the benefits that they provide. Increased transit use will directly reduce the amount of vehicles traveling on City streets, whereas traffic calming efforts often just shifts traffic volumes from one street to another.

Arterial and collector streets are intended to serve the majority of traffic moving within and through the City street network. These streets are typically designed with wider right of way to better allow for the effective movement of the maximum amount of traffic. However, as traffic volumes approach the capacity of these streets, especially during morning and evening rush hours, portions of the motoring public will seek to avoid congestion delays by diverting to residential collector and local streets to cut-through to their destination.

A small number of traffic calming projects intentionally seek to divert traffic from residential streets back to the collector and arterial streets. Physical devices can be used to divert traffic away from the project street but these measures are used cautiously to avoid merely moving cut-through traffic to an adjacent residential street.

Most traffic calming projects seek to reduce traffic volumes through non-diversionary techniques, such as speed tables, curb extensions, narrowed streets, etc. For example, drivers who have been using a residential street as a through street (rather than just for local access) may prefer not to use it after traffic calming measures have been installed.

Neighborhood Collector Streets

Neighborhood collector streets, such as Taney Avenue, Fillmore Avenue, and Cameron Mills Road are intended to distribute traffic between more principle traffic routes and local streets within the neighborhood. These routes typically also serve as emergency response routes, transit routes and bicycle routes. Because these streets serve multiple purposes, their use must strike a balance between efficiently moving traffic and preserving neighborhood livability.

The most common problems on residential collector streets is high vehicle speeds. Speeding tends to also lead to related problems with increased traffic noise, accidents and difficulties for pedestrians and bicyclists. Since neighborhood collector streets are meant to serve as through-streets, traffic calming projects on these streets are not designed to decrease traffic volumes.

The City employs three approaches to solving speeding problems on neighborhood collectors:

Education - informing people of the opportunities available to reduce traffic congestion and promoting transit, bicycling and pedestrian travel modes.

Enforcement - enlists the assistance of the Police Department to focus enforcement efforts on project target areas and increase community awareness of speeding problems.

Engineering - uses a range of tools designed to physically alter travel paths in order to reduce speeds and improve safety.

Neighborhood Traffic Program “Tools”

The following is a list of traffic calming devices that have been successfully employed to protect neighborhoods from unwanted traffic. Each device is designed to respond to particular problems and there is a matrix that identifies the likely improvements.

TOOL BOX

Chapter		Volume Reduction	Speed Reduction	Safety Improvement	Pollution Reduction	Access Restriction	Emergency Access	Maintenance Problems	Level of Violation	Community Acceptance	Cost
1	Truck Restrictions	○	○	○	◁	●	○	○	○	●	○
2	Increased Enforcement	○	●	◐	○	○	○	○	n/a	●	◐
3	Speed Watch	○	●	◐	○	○	○	○	n/a	●	○
4	Variable Speed Display	○	●	◐	○	○	○	○	n/a	●	○
5	Watch for Children	○	○	○	○	○	○	○	n/a	●	○
6	Pavement Markings	○	○	○	○	○	○	○	n/a	●	○
7	Street Narrowing	○	◐	◐	○	○	○	○	n/a	○	◐
8	Turn Restrictions	●	◐	◐	◁	●	○	○	○	○	○
9	Private Streets	◐	◐	◐	●	◐	●	○	n/a	○	●
10	Basket Weave Stop Signs	○	◐	●	○	○	○	○	○	●	○
11	Yield Signs	○	◐	○	○	○	○	○	◐	●	○
12	Do Not Enter	◐	○	◐	◁	●	○	○	◐	○	○
13	Speed Limit Changes	○	○	○	○	○	○	○	●	●	○
14	Parking Restrictions	○	○	●	○	○	○	○	○	○	○
15	All Way Stop	○	◐	◐	○	○	○	○	◐	●	○
16	One Way Streets	◐	○	◐	○	●	○	○	○	○	○
17	Stop Sign Removal	○	○	◐	●	○	○	○	n/a	●	○
18	Chokers	◐	○	◐	○	○	○	○	n/a	●	●
19	Partial Diverters	◐	◐	◐	◁	●	●	○	○	○	●
20	Street Closure	◐	●	◐	●	●	●	●	n/a	○	●
21	Full Diverters	◐	◐	◐	◁	●	●	●	n/a	○	●
22	Traffic Circles	○	◐	◐	○	○	●	◐	n/a	○	●
23	Median Barriers	●	○	●	◁	●	●	○	n/a	○	◐
24	Speed Bumps/Humps	○	●	○	○	○	●	◐	n/a	○	◐
25	Curvilinear Reconstruction	◐	◐	◐	○	○	○	○	n/a	○	●

KEY

○ LOW, UNLIKELY, NO

◐ MID, MODERATE, POSSIBLE

● HIGH, LIKELY, YES

◁ SHIFT

TRUCK RESTRICTIONS

CHAPTER

1

Truck route ordinances, or weight restrictions are placed on streets and roadways for various reasons. Among these are noise, excessive traffic volumes and speeds, and safety concerns. Residents often feel that their concerns can be alleviated or eliminated by restricting or eliminating truck traffic. This is normally accomplished by posting the roadway with specific load limit requirements or by establishment of a specific ordinance, with positive signing of truck routes.

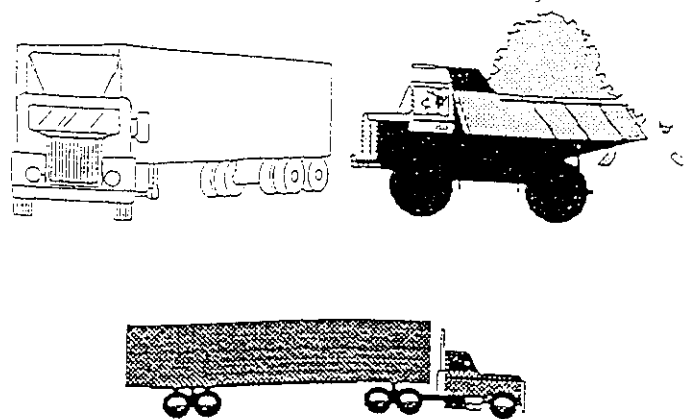
Effects

Based upon surveys from other communities, the reactions from the establishment of such restrictions are generally very positive from the residents. Generally, it is felt that noise, complaints, and volumes are reduced. The restrictions are viewed in a positive manner by the neighborhoods and often times by political bodies as well. However, there are sometimes negative consequences as well. Some general results and experiences are as follows:

Volumes. Positive effect - volumes are often reduced (Heavy Commercial).

Traffic Noise, Air Quality and Energy Consumption. Positive effect - Noise is often reduced.

Complaints. Mainly reduced, although restriction and reduced accessibility for businesses can cause other complaints.



Accidents. Little or no effect.

Enforcement. Negative effect in that additional manpower is required to enforce the regulations.

Accessibility. Negative for businesses that have used the restricted street. Other accessibility options for those businesses may be few or none. In addition, other heavy vehicles that serve the neighborhood residents (school buses, garbage trucks, delivery vehicles, etc.) may be restricted as well.

Community Reaction. Generally positive, although negative consequences and complaints can result. Many times, the "undesired" traffic is simply shifted to a different street where the same complaints and concerns are again repeated. Businesses that generate the heavier traffic will sometimes complain of hardships and inconveniences caused by the restrictions.

Additional Considerations

1. Load Capacity of Street - In many cases, heavier traffic may be using a street that was not designed for heavy volumes. Establishment of weight limits not only pleases the neighboring residences, but also preserves the structural integrity and life of a street that rapidly deteriorates from the heavier loads and volumes.

2. Legal and Other - In some instances, designated collector streets designed to carry heavier vehicles traverse through local residential areas. Residents seeking to ban trucks from such streets may find that restrictions are not realistic or even possible in establishing for legal and practical reasons.

Case Study

No specific case study is provided in this report. The information provided is a result of the experiences of many different communities. Most experiences in this report deal with actual posting limitations of individual streets, rather than citywide ordinances.

In establishing a Truck Route Ordinance, or Citywide Plan for controlling truck movements, cities will often designate certain streets as truck routes as part of their Comprehensive Plan. This Ordinance of Plan restricts truck travel to established truck routes.

The establishment of truck and heavy vehicle restrictions on streets can be a very sensitive and complicated issue. Many stakeholders in the community, including residents and businesses, may be significantly impacted by such restrictions. Politicians, residents, businesses, and technical staff must thoroughly weigh the impacts and effects on the community as a whole when considering such restrictions.

Additional Considerations

1. Load Capacity of Street - In many cases, heavier traffic may be using a street that was not designed for heavy volumes. Establishment of weight limits not only pleases the neighboring residences, but also preserves the structural integrity and life of a street that rapidly deteriorates from the heavier loads and volumes.
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Case Study

No specific case study is provided in this report. The information provided is a result of the experiences of many different communities. Most experiences in this report deal with actual posting limitations of individual streets, rather than citywide ordinances.

In establishing a Truck Route Ordinance, or Citywide Plan for controlling truck movements, cities will often designate certain streets as truck routes as part of their Comprehensive Plan. This Ordinance of Plan restricts truck travel to established truck routes.

The establishment of truck and heavy vehicle restrictions on streets can be a very sensitive and complicated issue. Many stakeholders in the community, including residents and businesses, may be significantly impacted by such restrictions. Politicians, residents, businesses, and technical staff must thoroughly weigh the impacts and effects on the community as a whole when considering such restrictions.

Increased enforcement involves the effective use of public safety/police personnel to encourage reduced speeds in residential areas. The enforcement procedure usually involves the use of radar to identify speeders and subsequent ticketing of speed violators.

Effects

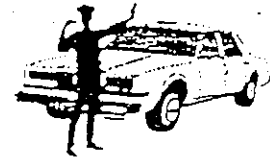
Volumes. Little or no effect. On higher volume streets used as "bypasses," there may be a slight reduction.

Speed. Studies have shown that enforcement operations result in appreciable speed reductions. However, speeds are usually reduced only as long as the enforcement is maintained.

Traffic Noise, Air Quality and Energy Consumption. Little effect in most cases. However, in areas with higher volumes, especially larger percentages of heavy commercial and truck traffic, there may be some reductions.

Traffic Safety. The number of accidents is generally reduced and overall safety is improved while speeds are reduced. May have significant impact if sustained enforcement is present.

Community Reaction. Residents support and encourage enforcement on "their" street. There is often a negative reaction if enforcement results in citation to local residents. This results in reduced police interest in enforcement. Neighbors should be encouraged to view enforcement as a system wide procedure.



Additional Considerations

1. Impacts of enforcement can have a longer lasting effect when enforcement is repetitive on a non-routine basis and this is communicated to the neighborhood and the driving public through signing and/or brochures.
2. Budget and manpower constraints. Use of personnel for speed enforcement is typically not a high priority for police departments. Manpower time and wages can be costly for this type of speed reduction technique.
3. "Photo-Radar" has been implemented in some cities. This can be more cost-effective and safer method of enforcement on higher volume streets.

Case Study

No specific case study is provided for this report. However, surveys have shown that police enforcement for speed reduction is a widely accepted and effective method nationwide. It is also accepted positively by the general public. However, as previously stated, the negative aspects of this method are the following: priority and expense concerns of law enforcement agencies, and enforcement must be administered continuously for long term to be effective.

Studies have generally shown that people speeding in neighborhoods tend to be local residents.

The Neighborhood Speed Watch Program, which borrows some of the Neighborhood Crime Watch concepts, relies on neighborhood participation to create awareness and thus help control speeds in neighborhoods. A personal letter may be sent to local residents asking for their cooperation and personal visits by neighborhood committee members may include an appeal for cooperation if a self contained subdivision is involved. Signs may be erected. Radar observations by transportation personnel or neighborhood residents trained in the use of a radar unit are then made. One runs the unit and one records vehicle and speed information. Speeders are sent letters by the Traffic or Police Department pointing out the inconsistent speeds relative to standards adopted by their friends and neighbors. In many cases, the speeders turn out to be local residents. When neighborhood residents run the unit, they learn first hand about the problem or lack thereof. This technique could be a part of a low cost initial phase attempt to slow speeders. Later phases could involve physical design or other changes if this technique fails to produce lasting speed reductions.

Effects

Volumes. Essentially no change since traffic is local.

Speed. According to a February, 1990 *ITE Journal* article, "Neighborhood Speed Watch: Another Weapon in the Residential Street Control Arsenal," in two Georgia sub-



divisions, 85th percentile speeds were reduced from 45 to 35 mph and the total number of vehicles exceeding 50 mph was reduced from 56 to 13 vehicles daily. In others, the speed reductions were evidently not significant. Speeds typically go down during the watch, but may not remain down later. Data is needed.

Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. Possibility of improved safety through reduced speed.

Community Reaction. This program has been perceived positively by the neighborhoods, even in areas where significant speed reductions were not measurable. Residential speed complaints virtually ceased in the Georgia case referenced earlier. In many cases, the neighborhood residents may find that no significant problem exists.

Cost

This technique can typically be fairly low in cost requiring a radar gun and some data processing and training (staff time).

Additional Considerations

This is a rather new technique. This synopsis was taken from a single county in Georgia as documented in the ITE Journal and from information about the Bellevue, Washington and Portland, Oregon programs.

The county program cited is managed by a single technician.

Possible concerns with causing conflict between citizens involved -- "vigilantism".

Case Study

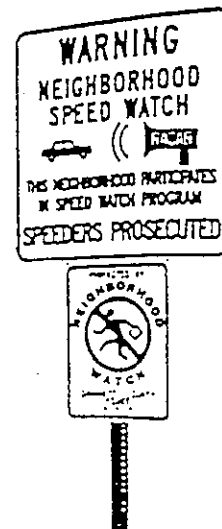
There is no local case study to cite. However, the Gwinnett County, Georgia article, referenced earlier, is essentially a case study.

References

Feb. 1990 ITE Journal Article
Gwinnett County, Georgia

Portland Neighborhood Speed Watch Program
Portland Office of Transportation
1220 SW 5th Street, Room 730
Portland, Oregon 97204-1969

City of Bellevue
Department of Public Works
P.O. Box 90012
Bellevue, Washington 98009-9012



A portable speed display board wired to a radar unit is aimed at passing motorists. It may be mounted on a trailer or be designed to stand alone. It displays the driver's travel speed as well as the speed limit. The intent is to alert motorists of their speed compared to the speed limit, and thereby improve compliance. An educational campaign should accompany the use of the display board. Neighborhood residents may be asked to "run" the board themselves, or it may be run by police or traffic departments. It can be used to target times of the day when enforcement is needed as well as to educate the public as to whether there is or is not a speeding problem.

Effects

Volumes. Little or no effect.

Speed. Lower observed speeds when device is present. Can be used to target police enforcement times if a problem is evident.

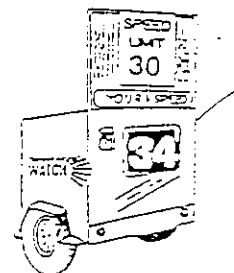
Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. There is the potential for sudden braking by some motorists.

Community Reaction. The display board reception has been positive in the short term both to the neighborhoods and to local elected officials.

Cost

About \$2,000 - \$11,500 equipment per unit (depending on sophistication and whether a traffic counting computer unit is included) plus volunteer time to "run" the board.



Additional Considerations

This is a relatively low cost approach which requires police, traffic engineers, and neighborhoods working together to reduce speeds on residential streets. Data on effectiveness is needed.

Possible concerns with causing conflict between citizens involved -- "vigilantism".

Use of this device may challenge a certain group of drivers to speed if not monitored.

Case Study

The City of Brooklyn Center has a speed display board which counts traffic as well as displays motorists' speeds relative to the speed limit. They use this both as an educational device (to let motorists know their speeds and to let residents know if a speeding problem exists) as well as an enforcement aid. They can target when to have police enforcement if data shows speeds are excessive at a certain time. They are quite pleased with the results. The unit cost is \$8,500 without a computer for traffic data and \$11,500 with a computer (which they have). They use it both on residential and arterial streets. They make the unit, which is manufactured by Custom Signal Company, available to other communities for a rental fee which was \$20 a day at this writing.

References

Madison, Wisconsin
Bellevue, Washington



A variety of signs exist to try and warn of the presence of children, "Watch for Children," "Slow, Children at Play," etc. The request for these signs generally stem from parents' concern for their children's safety in the streets near their home. Unfortunately, the request for this type of signage is based on a widespread but false belief that traffic signs provide protection.

Effects

Volumes. No effect

Speed. Little or no effect.

Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. Little or no effect.

Cost

Minimal for one installation. May become significant if installed at a large number of locations.

Additional Considerations

There is no indication that signs of this type achieve the desired safety benefits. Since children live in virtually every neighborhood, signs would have to be posted in all blocks, or drivers might assume that no children live where the signs are not posted.

Signs of this type might indicate that the street is an acceptable place to play.

There is no evidence or documentation that this type of signing has any legal consequence.



This low cost use of painted lane markings is a very simple attempt to change the pattern of driver behavior on any roadway, but particularly on collector or minor arterials. This concept utilizes the painted lane line to develop a parking reservoir and, in turn, creates the impression of a narrowed roadway, even if parked vehicles are not present. It is generally used where the roadway width is greater than one lane, parking is allowed, and no lane is present.

Effects

Volumes. It is very unlikely that any reduction in volume would be realized because, in reality, the capacity is not reached.

Speed. The impression of a reduced roadway width does appear to affect drivers in a manner that tends to slow them down. The reduction may not be dramatic, but it is a noticeable improvement.

Traffic Noise, Air Quality and Energy Consumption. As the level of speeding and potential hazardous driving is reduced, an accompanying reduction in noise is possible. However, there should not be high expectations for major reductions in noise levels. Air quality or energy consumption improvements are not expected.

Traffic Safety. The use of the painted line to delineate the parking area not only creates the impression of a narrowed roadway reducing speed, but also discourages vehicles from driving in or along the parking lane (especial-

ly when parked vehicles are not present). This, in turn, reduces the frequency of attempts to pass on the right, use of the parking lane as a thru lane, and other hazardous action by irresponsible drivers. The net result is fewer lane conflicts, more defined driving patterns, and reduced potential for accidents of the pedestrian, passing on right, sideswipe, and parked vehicle variety.

Community Reaction. Generally speaking, the reactions have been very positive. This application is low cost, easy to do, involves no construction and does not have negative impacts on the adjacent property owners. Neighborhoods have indicated that driving patterns have improved and speeds are reduced. Only complaints (from drivers) have been that traffic moves slower thru the area.

Additional Considerations

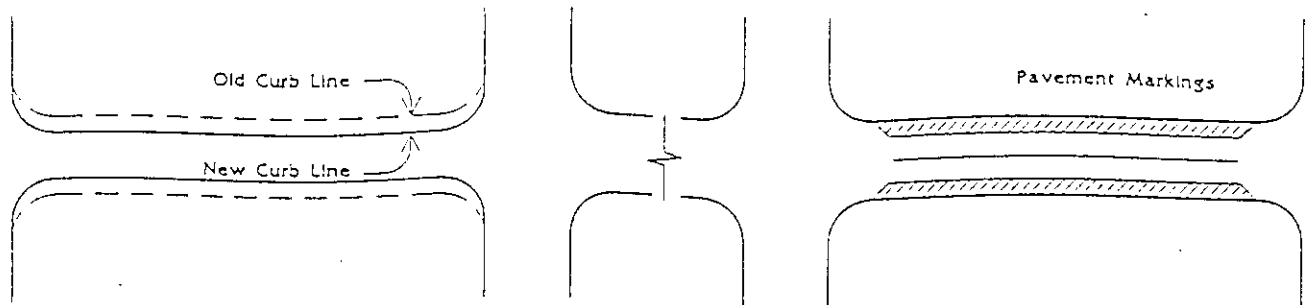
The use of pavement markings may denote a major street.

Case Study

The City of Minneapolis has used this application on two collector roadways in residential areas (Portland Avenue South and Sunset Blvd.) with the result being a better channelized vehicle flow and reduced speeds. There has not been adequate time to evaluate impact on accidents.

Reference

Improving the Residential Street Environment, May 1981, FHWA



Street narrowing involves the reduction of the typical pavement width along a roadway. The narrowing can be achieved physically by removing part of the pavement surface or psychologically by using pavement markings that indicate narrow travel lanes.

Effects

Volumes. Little or no effect.

Speed. Minimal changes. Most studies have shown actual speed changes in the range of one to two mph, both positive and negative.

Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. Minimal effect on overall accident experience. There is the possibility of improved pedestrian safety due to shorter street crossing times, but there is also the possibility of reduced pedestrian safety if there are many parked cars which obscure the vision of drivers. Bicycle safety may be compromised by physically removing part of the pavement surface.

It should be noted that the studies did not involve any pavement widths narrower than 22 feet nor any travel lanes narrower than nine

feet wide. Narrowing roadways to less than 22 feet wide and narrowing travel lane widths to less than nine feet may have adverse traffic safety impacts.

Community Reaction. Mixed. Most residents feel safer due to the narrower street. Loss of pavement width has resulted in on-street parking being prohibited and the loss of on-street parking has caused some hardship and inconvenience for residents.

Cost

Costs can vary considerably. Physically narrowing the street may be very expensive (\$50.00 per lineal foot) if concrete curb and gutter must be replaced and extensive landscaping is involved. Narrowing the street by the use of pavement markings is relatively inexpensive (\$0.20 per lineal foot).

Additional Considerations

Typically, physical narrowing of the street is accompanied by street beautification programs which provide landscaping, wider sidewalks, or other amenities along the street. These amenities are generally perceived as having a positive effect on the neighborhood.

Case Studies

A. In San Francisco, California, six locations on three different streets were physically narrowed in connection with a street beautification program. Street width reduction ranged from 8 to 18 feet, but still left two lanes of substantial width (the narrowest, 11 feet wide). Before and after studies showed that there was no consistent or material reduction in the speed of traffic after street narrowing. The table below shows the results of the before and after speed studies:

B. In Brooklyn Park, Minnesota, four collector streets in residential neighborhoods were narrowed through the use of pavement markings. On France Avenue, 74th Avenue, and Xerxes Avenue, the 44-foot width of the roadway was narrowed by marking a five-foot wide bike lane on both sides of the road. On Brookdale Drive, the 44-foot width of the roadway was narrowed by marking 8-foot

wide parking lanes on both sides of the street. Before and after studies indicated no change in the speed of traffic, volume of traffic or accident rate on any of these streets due to the street narrowing. On-street parking was prohibited along with providing bike lanes, and these parking regulations have resulted in several complaints from the neighborhood. Comments on the parking lane lines have been somewhat mixed, but the majority have been positive.

References

- William Marconi, "Speed Control Measures in Residential Areas," *Traffic Engineering*, ITE, March 1977.
- Harry S. Lum, "The Use of Road Markings to Narrow Lanes for Controlling Speed in Residential Areas," *ITE Journal*, ITE, June 1984.
- D. T. Smith, Jr., and D. Appleyard, "Improving the Residential Street Environment," Report No. FHWA/RD-81/031, Federal Highway Administration, Washington, D.C., May 1981.

Before and After Speed Studies at Locations Where Streets Were Narrowed in San Francisco, California

Location	95th Percentile Speed		Net Change (mph)
	Before (mph)	After (mph)	
Bryant at 21st Street	34	33	-1
Bryant Street, 22nd to 23rd St	28	25	-3
Bryant at 23rd Street	26	27	+1
Harrison at 23rd Street	35	30	-5
Harrison St, 23rd to 24th St	32	30	-2
Sanchez, 14th to Duboce St.	27	28	+1

TURN RESTRICTIONS

CHAPTER 8

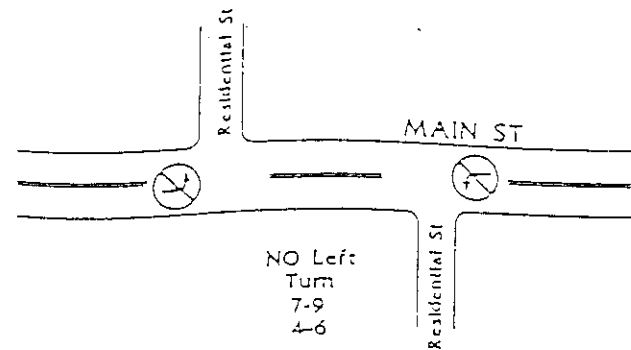
Turn restrictions are a passive traffic control technique involving the use of regulatory signing which prohibits certain traffic movements generally where an arterial and local street meet. It can be used in neighborhoods where "cut through" traffic is a problem. Turn prohibitions involve the use of standard "No Right Turn" or "No Left Turn" sign with or without time (rush hour) limitations. They are most effective when used during rush hours only if that is the time when "cut through" traffic occurs, thereby reducing neighborhood inconvenience. They should be used at the periphery of neighborhoods rather than within them. Where a turn prohibition sign is installed and no reasonable alternative exists in the driver's eyes, violations are likely. Without regular enforcement or where frequent flaunting of regulations occurs, they will not work well.

Effects

Volumes. Where turning movements onto local residential streets are reduced, volumes on those streets are lessened. However, volumes on other streets where traffic diverts to will go up.

Speed. To the extent that traffic cutting through is diverted, speeds on the local residential streets will be reduced.

Traffic Noise, Air Quality and Energy Consumption. Noise and air quality on residential streets is generally improved with impacts transferred to other streets. Energy use may be



the same or higher depending on alternate route directness of travel.

Traffic Safety. Safety should be improved on the restricted volume street, but effects on alternate routes need to be evaluated.

Community Reaction. Generally positive if a reasonable alternate route(s) exists. The neighborhood residents need to be aware of the potential inconvenience. Complaints may rise on routes traffic is diverted to.

Cost

Very low in cost and construction effort.

Additional Consideration

Where arterial street constraints are the cause of cut-through traffic, consideration should be given to eliminating or reducing these constraints.

Case Study

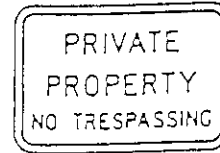
Various streets around the Twin Cities including the Kenwood, East Isles, and Lowry Hill neighborhoods of Minneapolis use turn restrictions with some success. St. Paul has used this technique at Juliet and Lexington. It reduced traffic volume from about 250 to 50 during a peak period.

Streets can become private either through the platting process or through the vacating of a public street. Both of these concepts will be discussed. The concept of a private street is to restore more use of the right-of-way to the adjacent property owner while still maintaining vehicle access to the adjacent property via the private street. The concept works best when the private street has only one entrance, thus, through traffic is eliminated. The entrance needs to be designated so as to look private, thus a driveway works better than a street opening. For a vacated street, a supplemental sign may be needed to advise previous users that the street is now private. Fencing may be required.

The benefits for the adjacent land owners are many. The street can be built to narrow widths, tight curves, etc. to force traffic to a slow speed. Portions of the right-of-way can be used for parking, landscaping, and other uses. The area of the right-of-way can be used in the calculations for floor area ratios, thus allowing higher density development. The benefits to the road agency are also many. The land is returned to the tax rolls, often as a high tax rate. The agency is relieved of maintenance duties, lighting, snow removal and other responsibilities of public roads.

Effects

Volumes. The through traffic volume is drastically reduced. The volume is reduced to that generated by the adjacent property. Adjacent



streets need to be studied for the impact of displaced traffic, if any.

Speed. The reduction of speed is also drastic as the private street is reconstructed to a narrow standard, or modified as a parking lot.

Traffic Noise, Air Quality and Energy Consumption. There is a reduction in noise on the private street due to the decrease in volume. This is accompanied by an improvement in air quality, especially if more trees and grass are introduced. This may be a good requirement to be placed upon the property owner.

Traffic Safety. There will be substantial increase in traffic safety on the private street.

Community Reaction. Reactions from people who live on the street is usually positive, since they have control of eliminating outside traffic. Minnesota state law requires Public Hearings in the platting of property and vacating of public streets so public input is obtained from the start.

Case Study

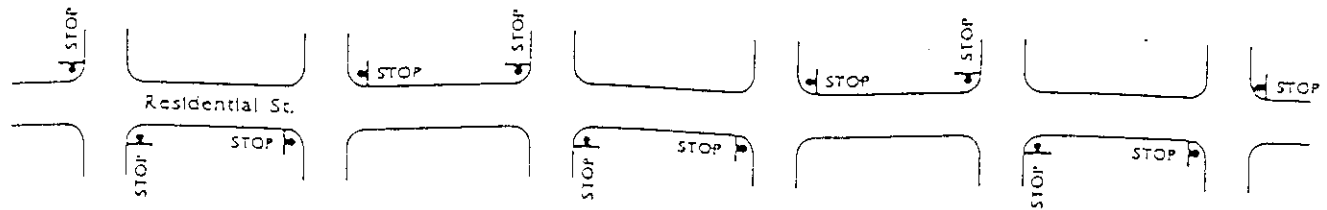
The City of Rochester, Minnesota has 26 private streets that were developed through the platting process. These streets are marked in a dashed code on the city's street map. A majority have been constructed to look like a private driveway. The owner is now responsible for all maintenance which previously was a city responsibility including snow plowing, signing, lighting.

During the platting process a document is filed with the Zoning Administrator outlining who is the responsible person or persons.

A recent example is Baihly Estates Lane located with a plat called Baihly Estates 1st. This street is a private street serving 18 single family homes.

Additional Considerations

Public utilities such as sewer mains, water mains, hydrants, electric conduits will need easements.



The use of alternating two-way stop control within an area of local residential streets can reduce accidents. The stop control is alternated every other block creating a "basket-weave" effect of traffic control. Traffic can proceed through one intersection, but must then stop at the next.

Effects

Volumes. The impact on the traffic volume is minimal. Some vehicles may be diverted to adjacent collector or arterial streets to avoid the stop signs.

Speed. For those portions of roadway which do not have the right-of-way, speed is reduced within 200 feet of the intersection. On the portions of roadway which have the right-of-way, there is a potential increase in speed, especially when fairly long stretches of uninterrupted roadway are on either side of the intersection. The increase in speed frequently leads to requests for all-way stop control.

Traffic Noise, Air Quality and Energy Consumption. There is an increase in noise and energy consumption from starting and stopping of vehicles. Air quality is negatively affected as well.

Traffic Safety. Depending on the accident patterns without control, a significant positive change in accidents could occur. If there are a number of right angle accidents, a significant reduction will possibly occur. This is the result of a more clear definition of who has the right-of-way. If there are few right angle accidents, there will probably be a less significant effect on accidents.

Community Reaction. The reaction is primarily positive, especially by those citizens who live in or near the area of control. Some drivers express concern of over-control; but in areas they drive, not where they reside.

Additional Considerations

In a northern climate, the approaches to the intersection become icy more easily because of the additional starting and stopping with the use of stop signs. In the case of hilly terrain, there will be difficulties in stopping and starting at intersections in snowy or icy conditions.

Cost

The cost of area wide control can be significant. While the cost of stop signs at one intersection is affordable, an area wide or city wide program can be a serious fiscal commitment.

Additional tree trimming will probably be necessary to maintain sign visibility.

Drivers that are in an area of basketweave stop signs are not surprised by unexpected control. They either have the right of way or have to yield to the other street.

In areas where there is a need for parking, the supply will shrink because of parking distances required by State law in advance of stop signs.

There is some possibility of creating a disrespect for all stop signs and traffic control in general because the drivers frequently do not encounter another vehicle, view the control as unnecessary, and "run" the stop sign.

Case Study

In 1980, Thomas Ave., a collector in St. Paul, Minnesota, had its second fatal accident involving young pedestrians in two years. The City was asked to install yet another all-way stop. It was decided that Thomas Ave. was a low enough volume collector that all-way stops

could be used at one-quarter mile spacing. In the residential areas adjacent to this collector, there was no control at the intersections.

It was determined that rather than piecemeal reacting to each accident, it would be better to have a traffic plan. This plan included: 1) all-way stop control at one-quarter mile spacing on Thomas Ave. for its entire 3 mile length; 2) improve the adjacent arterial street to accommodate any traffic that might be diverted off of Thomas; 3) basketweaving the area of local intersections so that the local residential streets would not become more attractive to drivers than the Thomas. This plan was implemented late in 1981. The area included 108 local intersections which were basketweaved. In the year before the installation, there were 49 right angle accidents; in the year after the basketweaving, there was one right angle accident. The overall number of accidents at these intersections was down 68% (171 to 55). For other intersections in the area that already had control, the number of accidents was down 3% (404 to 392).

As a follow-up, the City reviewed the right angle accidents at the basketweaved intersections in 1990. There were 5 right angle accidents at the 108 intersections.

YIELD signs are a passive traffic control technique which assigns right-of-way at an intersection. This technique can be used to address right angle type accidents at uncontrolled intersections.

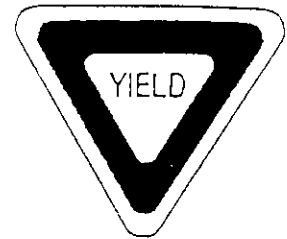
Effects

Volumes. The impact on the traffic volume is minimal. Some vehicles may be diverted to adjacent collector or arterial streets to avoid the yield signs.

Speed. On the portions of roadway which have the right-of-way, there is a potential increase in speed, especially when fairly long stretches of uninterrupted roadway are on either side of the intersection. For those portions of roadway which do not have the right-of-way, speed is reduced within about 50 feet of the intersection.

Traffic Noise, Air Quality and Energy Consumption. There is an increase in noise and energy consumption from the accelerating and decelerating of vehicles. Air quality is negatively affected as well.

Traffic Safety. Results are mixed. A study in June 1981 for the FHWA indicates that yield signs reduce accidents on low volume streets and do not cause unnecessary stops. A study conducted by the City of St. Paul in February of 1983 indicates that the YIELD signs at the intersection of low volume local streets actually increased the accident rate.



The City no longer uses Yields to control low volume intersections. A close engineering analysis is recommended before using Yield signs, and evaluation of the results of the installation should be conducted if they are used.

Community Reaction. Generally positive, but frequently followed by requests for stop sign control after accidents or near misses.

Additional Considerations

The cost of area wide control can be significant. While the cost of yield signs at one intersection is affordable, an area wide or city wide program can be a serious fiscal commitment.

Additional tree trimming will probably be necessary to maintain sign visibility.

DO NOT ENTER signs are a passive traffic control technique which prohibits vehicles from entering a roadway. This technique can be used when "cut through" traffic is or might be a problem.

Effects

Volumes. The impact on the traffic volume can be dramatic. Many vehicles may be diverted to adjacent streets.

Speed. To the extent that traffic cutting through is diverted, speeds on the local residential streets will be reduced.

Traffic Noise, Air Quality and Energy Consumption. Noise and air quality on residential streets is generally improved with impacts transferred to other streets. Energy may be the same or higher depending on the alternate routes directness and the congestion on that route.

Traffic Safety. Safety should be improved on the restricted street, but effects on alternate routes need to be evaluated.

Community Reaction. Generally positive if a reasonable alternate route exists. The amount of inconvenience to the neighbors and the degree of the amount of cutting through that is occurring determine the extent of the reaction. The residents of the streets that have diverted traffic could object, especially if the traffic increase is large either in volume or in the percentage of increase.



Additional Considerations

If there is a significant degree of congestion on the alternative routes, the signs will be ignored and a significant enforcement effort will be required.

This control works best when implemented at the same time as an arterial improvement eases congestion on alternative routes.

The cost is very low.

This control is more restrictive than turn restrictions, but less so than one-way streets.

This control can prohibit traffic through an area and at the same time, allow emergency vehicle access.

Case Study

A Target store was constructed on Pacific St. in St. Paul, Minnesota. An adjacent neighborhood did not want any commercial traffic cutting through their neighborhood, yet blocking the street would have seriously increased the response time of fire vehicles. The DO NOT ENTER signs were installed for both approaches to a very short segment of street (20 feet).

During the break in period, there were many violations, but with enforcement and time, the neighborhood had it's emergency protection and peace and quiet from excessive commercial traffic.

Speed limits should be determined by an Engineering and Traffic Study of the street section involved. Of consideration in reviewing a speed limit change should be the 85th percentile speed (at which 85% of the traffic is traveling slower than this speed), the location of sidewalks, driveways, obstructions, the horizontal and vertical alignment of the street, the use of the street by pedestrians and the existence of hazards which are not easy to detect by drivers.

Effects

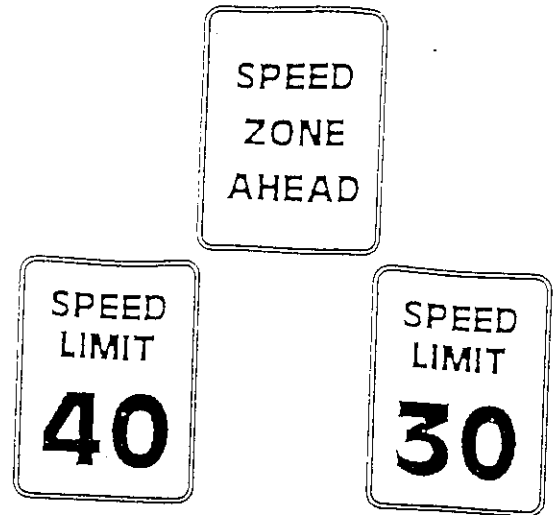
Volumes. Little or no effect.

Speed. Drivers generally ignore posted speed limits, and travel at speeds which the drivers consider reasonable, comfortable, convenient and safe under existing conditions. Drivers appear not to operate by the speedometer, but by the conditions they meet. A speed limit change accompanied by enforcement may see a speed reduction (see Chapter 2 on enforcement).

Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. Effects of speed limit changes on traffic safety on local residential streets have not been reported.

Community Reaction. If speed limit signs posted are significantly lower than prevailing



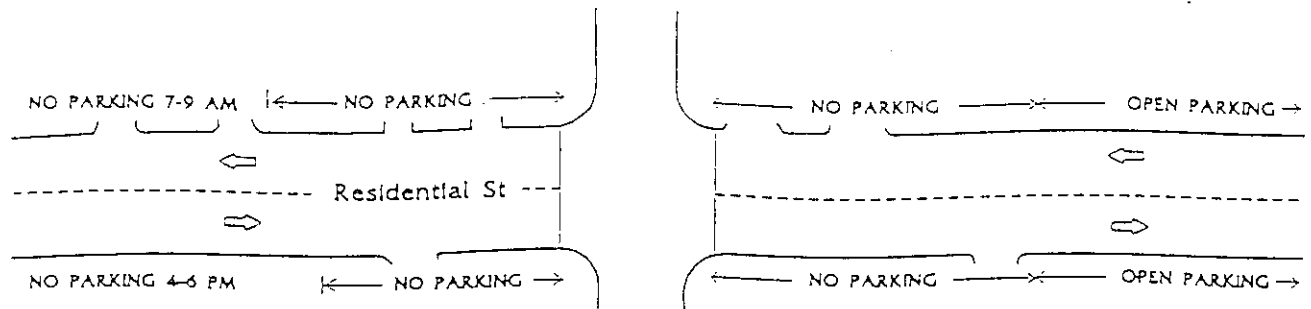
traffic speed, residents normally place some hope in them, or in subsequent enforcement. However, if the posted limits are within a few miles per hour of the previously prevailing traffic speed, they really don't address the residents' problem. Since residents may feel that speeds of 25 to 35 m.p.h. are too fast (limits which are enforced on roughly 80% of the residential streets in the United States), the basic issue is not whether the signs are effective, but the way in which the speed limits themselves are set for local streets in the United States.

Cost

Minimal for a section of street.

Reference

Institute of Transportation Engineers, Residential Street Design and Traffic Control



Parking restrictions can improve residential street safety in two ways:

1. Clearance No Parking Zones to improve sight lines at intersections and crosswalks.
2. Extended No Parking zones to improve visibility of and for pedestrians along the length of the block.

Effects

Volumes. No effect on traffic volumes.

Speeds. Clearance No Parking Zones have minimal effects on speed. Extended No Parking Zones create potential for increased speeds dependent on street width.

Safety. Clearance and extended No Parking Zones improve safety. Clearance No Parking Zones which increase sight line distances reduce right angle conflict between vehicles at intersections, alley and driveways. Clearance No Parking Zones improve visibility of and

for pedestrians in a crosswalk. States and municipalities often set a standard mandatory clearance for School Crossings and sidewalks for this purpose. Extended No Parking Zones eliminate parked vehicles which obstruct visibility of your pedestrians along the block.

Traffic Noise Air Quality, Energy Consumption. Parking restrictions will have insignificant effects in these areas.

Community Reaction. Community acceptance and feasibility of parking restrictions varies with the demand for on-street parking. In areas on-street parking is at capacity and there is no alternative off-street parking, additional parking restrictions, including short clearance zones, can be controversial. The potential for increased speeds can also create opposition from residents. It can be difficult to convince residents that the safety advantages of parking removal are real and justify the inconvenience from the restrictions.

Additional Considerations

Removal of parking does reduce other types of accidents. On many streets, late evening hit and run parked vehicle accidents are the major accident type and these accidents are reduced by the extended parking restrictions. Accident types related to parking maneuvers are reduced by parking restrictions. Extended No Parking Zones can prove an effective deterrent to some crime and social problems which can equal traffic safety in importance to residents.

Case Study

Library search found no case studies involving clearance or extended parking zones for the improvement of residential street safety. Extensive research exists on the importance of sight distance to intersection safety and these define the value of corner clearance No Parking Zones.

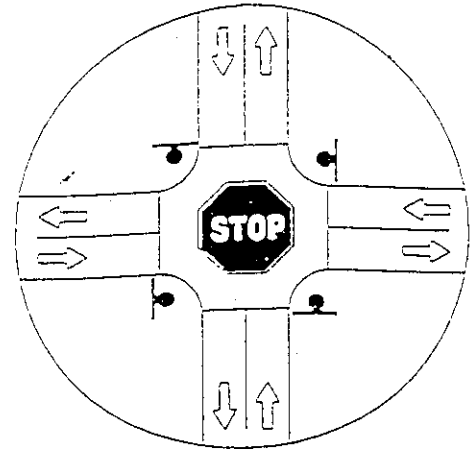
The City of Minneapolis has conducted a ten year study of all pedestrian accidents involving pedestrians between 5 and 15 years of age. This study found the major accident type was a mid-block accident involving a child darting out from behind a parked vehicle leaving motorists inadequate time to respond. This study found that pedestrian accidents at intersections rated third behind mid-block and alley accidents and that high speed and negligent driving were not the attributable cause of the accident. (Studies of all age pedestrian accidents show a similar pattern only less pronounced than for younger pedestrians). What is relevant to this report is that the one factor in young pedestrian safety over which the traffic engineer has the most potential control is the presence of the parked vehicle visibility obstruction.



The Manual on Uniform Traffic Control Devices (MUTCD) and Traffic Engineers Handbook (TEH) have established specific warrants for installation of 4 way or all way stops. These warrants were developed to assist in determining whether or not 4 way stop signs could help assign right of way at higher volume intersections reduce an accident problem, or fill in as an interim measure until traffic signals could be installed. Considerations outside established warrants are restricted intersection sight distances, and school crossings. Studies have shown that 4 way stop signs are not an effective technique for controlling speeds and should not be used to reduce traffic volumes, or simply to satisfy citizen demands. It should be remembered that stop signs constitute one of the most significant means of separating and controlling traffic movements and should be carefully considered.

Effects

Volumes. Four-way stop signs produce no net reduction of traffic volumes if traffic is primarily local in make-up. Where there is existing shortcutting thru traffic, stop signs may reduce volumes; however, the effectiveness of the 4-way stop as a deterrent to thru traffic is dependent on stop sign saturation, heavy enforcement and the availability of useful alternative routes. Often the alternative route is another adjacent residential street, and problem traffic is merely displaced, not eliminated.



Speeds. Studies have typically shown 4-way stops do not have a significant impact on vehicular speeds. Overall area speeds have shown minimal reductions near the intersection. In midblock areas, where most accidents involving young pedestrians occur, speed increases are frequently the result.

Safety. It is not clear whether 4-way stop signs will improve safety when they do not meet established warrants. In some cases accidents actually increase, possibly due to the stop signs being unexpected or deemed unnecessary thereby encouraging rolling stops, or by instilling a false sense of security in crossing motorists and pedestrians. Studies have shown that stop signs that do not meet warrants are basically ignored by many drivers. Also as mentioned before, speeds tend to increase in the mid block areas where most young pedestrian accidents occur. However, if warrants are met or where sight distances are poor - an all way stop may increase safety.

Traffic Noise, Air Quality, Energy Consumption. Noise is increased near the intersection due to the increased activity of acceleration (many drivers speed up to make up for time lost at the stop sign) and added braking. Adjacent residents may complain about the additional noise.

Air quality is worsened and fuel consumption is increased due to added deceleration, acceleration and idling. Unnecessary stops reduce the efficient movement of traffic flow, by increasing travel time on the route.

Community Reaction. Mixed. Some residents would feel "anything is better than nothing" or are misinformed about the potential impacts. Some view this measure as a safety improvement. Others view this measure as an unnecessary impediment to reasonable movement thru the area and an encouragement to "blow the stop signs" in the area. Many residents in the immediate vicinity of all-way stop signs view them in a positive manner. It is up to traffic engineers or other governing agents to responsibly determine the best traffic control under the specific circumstances based on reasonable guidelines.

Additional Considerations

Installation of all-way stop signs is often used by a governing body as an immediate, tangible and inexpensive response to a neighborhood's concern about safety on a local residential street. The use of stop signs creates a solution which is one of perception rather than effective improvement. This misuse of stop signs should be resisted by the local traffic engineer and governing body. Some studies have shown that the warrants for stop signs can be expanded to include other considerations such as presence of

designated school crossings and sight distance problems. The failure to follow the established warrants, to install stop signs without specific justification, may have legal implications to the local government agency.

Warrants for All-Way Stops (Section 2B-6 MUTCD)

- 1) Where traffic signals are warranted and urgently needed, the multiway stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for signal installation.
- 2) An accident problem, as indicated by five or more reported accidents of a type susceptible of correction by a multiway stop installation in a 12 month period. Such accidents include right and left turn collisions, as well as right angle collisions.
- 3) Minimum traffic volumes:
 - a) The total vehicular volumes entering the intersection from all approaches must average at least 500 vehicles per hour for any eight hours of an average day and
 - b) The combined vehicular and pedestrian volumes from the minor street or highway must average at least 200 units per hour for the same eight hours, with an average delay to minor street vehicular traffic of at least 30 seconds per vehicle during the maximum hour, but
 - c) When the 85 percentile approach speed of the major street exceeds 40 mph, the minimum vehicular volume warrant is 70 percent of the above requirements.

Reference

Manual on Uniform Traffic Control Devices

Conversion of two-way streets to one-way operation for purposes of residential street traffic control takes three forms:

1. Divergent and convergent one-way residential streets to reduce direct through routes impacting the neighborhood.
2. Alternating one-way streets throughout a portion of a grid system to gain safety advantages of one-way operation.
3. Creating a one-way couplet by pairing a residential street with a nearby thru street to create a corridor for thru traffic which will draw traffic away from adjacent residential streets.

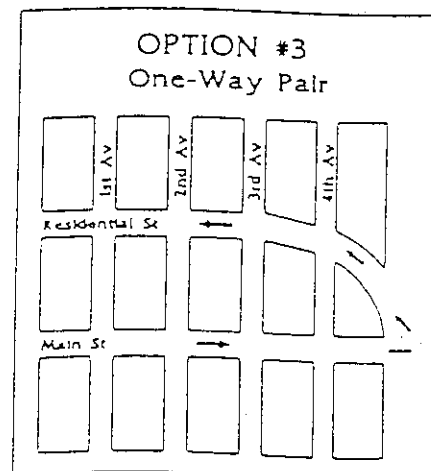
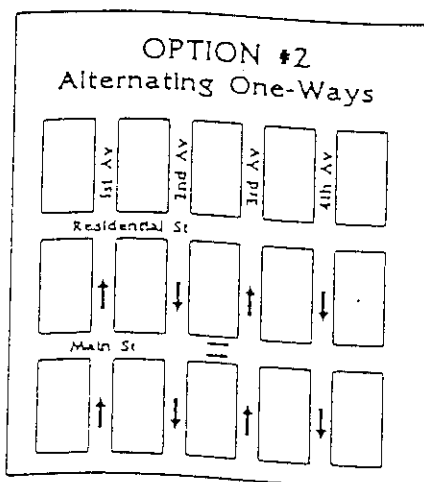
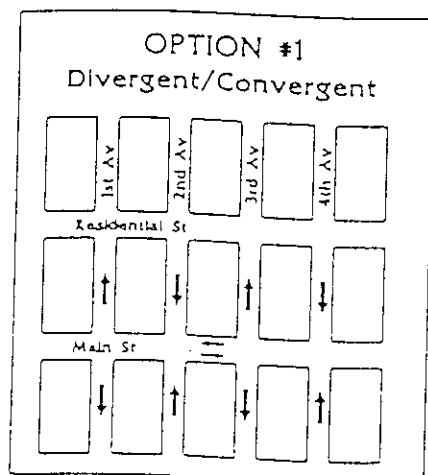
Effects

Volume. Divergent/Convergent one-way (#1) effectively reduces traffic volumes where thru traffic is a problem. Alternating one-way

(#2) has no significant effect on traffic volumes. One-way pairing (#3) increases traffic volumes on one street and reduces volumes on adjacent streets. Traffic volume change is determined by level of shortcutting thru traffic and effectiveness of one-way couplet.

Speed. Conversion to one-way often results in increased speeds. One-way streets improve comfort level for motorists at higher speeds.

Safety. One-way streets improve safety, despite higher speeds. They result in fewer potential conflicting movements. Studies show safety improvement greater midblock than at intersections. One-way streets which reduce traffic volumes (#1, #3) on residential streets improve safety on these streets by means of traffic reduction.



Traffic noise, air quality, energy consumption. One-way generally creates minimal effect in these areas. One exception is under convergent/divergent one-way streets (#1) which create longer, circuitous routes for local traffic.

Community reaction. Community reaction to one-way streets is heavily mixed. Studies show opposite reactions by residents on the same one-way converted street. The higher speeds are perceived by residents to increase accident hazards, however accident analysis often proves that this increased speed does not equate to a higher accident rate. Upgrading of a residential street to create a one-way couplet for thru traffic (#3) has a negative impact on livability and property value on that street. Residents may object to reduced access created by one-way streets (#1 & #2).

Additional Considerations

One-way streets create a secondary, or primary benefit, of increasing parking on residential streets where parking is limited by street width. One-way streets are relatively inexpensive to implement. One-way streets have a high compliance/low violation rate due to the fact that deliberate violation results in prolonged exposure to detection by residents and police. One-way streets are less of

an obstacle to emergency vehicles than are physical barriers. One-ways work effectively in combination with other measures to combat increased speeds. One-way streets can require additional signing measures to accommodate two-way bicycle traffic.

Case Study

Most case studies of one-way streets are related to improving capacity and operation of arterial and collector thru streets. Most of the studies done on one-way streets to resolve residential traffic problems were conducted in foreign countries, including Netherlands, Israel, Germany, Canada and Australia. Traffic, roadway, neighborhood conditions and study conclusions differ greatly limiting usefulness of these case studies.

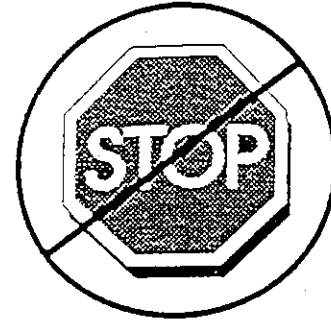
The City of Minneapolis has used all three types of one-way street applications. However, experience in each is not extensive, and the city does not have conclusive before/after studies. On this basis we comment that one-way streets have been well enough received and effective for the purpose installed that it has not been necessary to remove any one-way application and we continue to offer and use this measure to resolve residential traffic issues.

In many communities, stop signs are often installed in locations where they are not warranted. The MUTCD (Manual on Uniform Traffic Control Devices) has established specific warrants for such installations. However, due to political or other reasons, unwarranted stop signs are still installed. The signs are often installed with the perception that speed and traffic volume will be reduced, safety will be enhanced, etc. After installation, it is often found that the unwarranted signs are not solving the problems, and in some cases, have created new problems. The questions of then removing the unwarranted stop sign(s) becomes a new issue.

Removal of a stop sign can often be as sensitive an issue as installing a new stop sign, sometimes even more so. Different perceptions and objectives often exist between individuals who reside by the street and the motorists from outside the neighborhood who drive the street on a regular basis. When considering the removal of a stop sign, careful consideration of MUTCD warrants, accident histories, and traffic counts and speeds must be studied carefully. In addition, the general public and decision makers must be educated as thoroughly as possible.

Effects

Volumes. Little impact.



Speed. Speed at or near intersections may increase. However, mid-block areas will experience little impact.

Traffic Noise, Air Quality and Energy Consumption. Usually improves.

Traffic Safety. Not clearly defined as to whether or not safety will improve or worsen. Each situation is unique. Typically, safety improves in the long run when unwarranted signs are removed.

Community Reaction. Mixed. Differing view points are often expressed between citizens residing adjacent to the roadway and motorists traveling on the roadway daily. Removal of inplace stop signs is often very difficult to accept for residents used to having them there, even when the signs are unwarranted. It is imperative that traffic engineers and other decision makers determine the best traffic control measures under specific circumstances based on reasonable guidelines.

A choker is a narrowing of the street, either at an intersection or at midblock, to constrain the width of the traveled way. Chokers may consist of curb bulbs or median islands.

Effects

Volumes. Little or no effect if the same number of travel lanes are retained for both the before and after situation. Significant reductions may occur if narrowing limits use of section to one direction at a time or reduces capacity of an already congested street.

Speed. Little or no effect.

Traffic Noise, Air Quality and Energy Consumption. Little or no effect.

Traffic Safety. Possibility of improved pedestrian safety due to improved visibility of crossing point and to shorter street crossing time. Possibility of improved vehicular safety at intersections due to physical parking limitations.

Community Reaction. Generally positive. Residents feel safer crossing the street at the choker and feel the choker provides some "protection" for vehicles parked on-street.

Cost

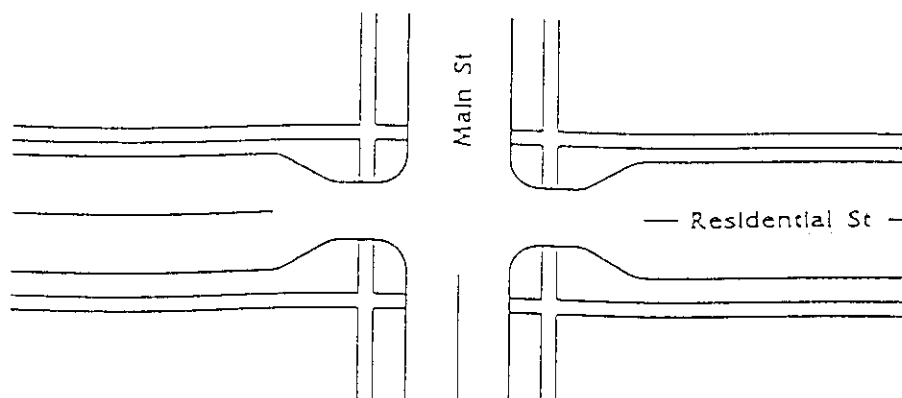
Cost per installation for typical street with concrete curb and gutter is approximately \$5,000.00. Cost can vary significantly depending upon the need for adjustments to drainage facilities, the type of sidewalk/boulevard material used, and the amount and type of landscaping/pedestrian amenities provided.

Additional Considerations

The chokers can provide landscaping opportunities and definition of neighborhood entry which help enhance the aesthetics of the neighborhood.

Reference

D. T. Smith, Jr., and D. Appleyard, "Improving the Residential Street Environment," Report No. FHWA/RD-81/031, Federal Highway Administration, Washington, D.C., May 1981.



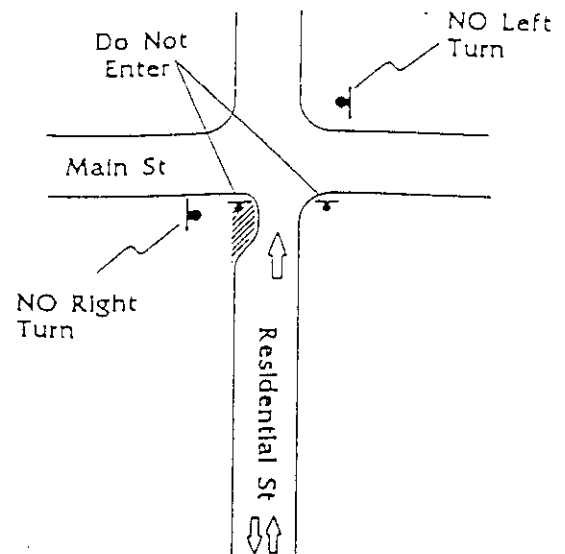
The Partial-Diverter is the narrowing of a two-way street in order to eliminate one direction of travel. The concept is effective only when used at an intersection. Traffic attempting to use the protected street is rerouted onto other roadways. Only one direction of traffic is affected, thus the term "partial-diverter" is used.

The concept of a partial-diverter as a residential traffic management device is well documented in Federal Highway Administration Research Documents. Reference is made to "Residential Street Design & Traffic Control" published by Prentice Hall (1989).

The partial-diverter is shown as shaded in the above diagram. The partial-diverter is made as large as possible for visibility and landscaping. It leaves a simple exit lane and stops short of the closest driveway. It physically prohibits mainline left and right turns onto the side street. A partial-diverter may also be designed to eliminate the exit lane.

Effects

Volumes. The impact on traffic volume is drastic. The volume in the closed direction at the partial-diverter is zero. Beyond the partial-diverter, the volume in the closed direction is reduced to that generated by the land use on the adjacent properties. Some reduction in volumes may also occur in the opposite directions as drivers learn what alternates are available. Traffic volumes on the alternate routes will increase.



Speed. Traffic speed will be changed. The traffic in the closed direction will be only those residents who are leaving their residences and this type of traffic is usually slow, although some speeding may occur. Traffic speed in the unaffected direction most likely will not be affected.

Traffic Noise, Air Quality and Energy Consumption. There is a reduction in noise on the protected street, accompanied by an improvement in air quality; both attributed to the decrease in volume. There is no change in energy consumption since trips are not eliminated, merely diverted.

Traffic Safety. There will likely be a substantial increase in traffic safety on the protected street. This can be expected to change in traffic volume and speed. Before and after studies are needed to measure these effects. Accident data should also be compared.

Additional Considerations

This technique in neighborhood traffic control must be limited in use to those streets designed as local streets on the area's thoroughfare plan. They should not be local streets that are serving as access to portions of the community that are part of the neighborhood, such uses include schools, churches, parks, etc.

The residents need to be involved from the beginning in the decision process. They need to show their support via petitions, attitudes, surveys, meetings and public hearings. A two-thirds majority in favor of the partial-diverter installation is recommended. Some education on its use is needed since it is not a common traffic device. A six to twelve month trial period is recommended before permanent construction work is done. Expected costs can vary depending upon if curb and gutter is used, the amount of landscaping, if any, if catch basins are involved, etc.

Additional Consideration

Enforcement may be necessary to keep traffic from entering the prohibited street.

Case Studies

16th Ave. N.W. (1700 & 1800 Blocks)

This is a residential avenue in N.W. Rochester in close proximity to a diamond interchange of T.H. 52 and 19th St. N.W. Due to traffic congestion at this interchange, this avenue had traffic volumes exceeding 3800 ADT. It had geometric constraints consisting of narrow pavement, narrow right-of-way, tight

horizontal curves and vertical crest sight restrictions. A "partial-diverter" was installed in November, 1985 based upon a strong majority petition. A six month trial basis was conducted resulting in a 58% reduction in traffic in the six peak hours. An after survey indicated the majority in favor had increased. The permanent installation cost was \$8,000.00.

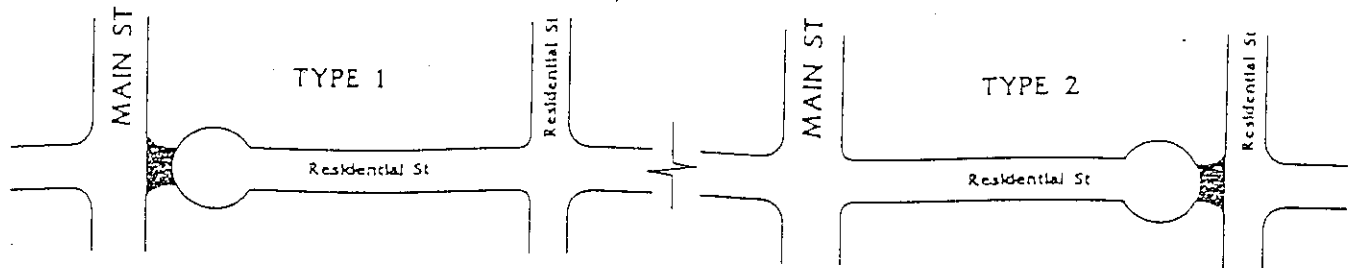
Pre-accident studies showed an average of six accidents per year over a three year period. Typical accidents include side swipes at the crest of the hill and at two tight horizontal curves, hits on parked cars; hits on vehicles backing out of driveways. Post accident studies showed several years where no accidents occurred on the street. The accident average per year dropped to below 1.0.

37th Street N.W. Frontage Road (1800 Block)

This is a residential street in N.W. Rochester, in close proximity to a signalized intersection at 18th Ave. & 37th St. N.W. The frontage road intersects 18th Ave. too close to the signal. It was recently reconstructed with a "partial-diverter" to eliminate traffic from entering the intersection from the frontage road. A pre-survey of the residents indicated a majority of travel occurred at the opposite end, but an entrance from 18th Ave. was desired for larger vehicles; such as garbage trucks, snow plows, delivery trucks.

Reference

Residential Street Design & Traffic Control, Prentice-Hall, 1989



A street closure, for the purpose of the Residential Neighborhood Traffic Control Tool Box, is defined as closing a street either at one end or the other, or at a mid-block location. The purpose is to eliminate unwanted through traffic.

Street closing is a fairly common traffic control technique. It is well documented in the "Residential Street Design & Traffic Control" published by Prentice Hall (1989). There are two basic types of closure to consider. Type 1 is defined as being near to the main street. The closed street can no longer gain access to or from the main street. Type 2 is defined as being a far closure. The closed street can only gain access to the main street. Type 1 is most effective at reducing through traffic volumes.

Effects

Volumes. The impact on traffic volume is drastic, reducing traffic volume to that which is generated by the land use on the abutting properties. To be most effective, the closure must be visible to the drivers, so that the driver does not run onto the street and then finds it to be a dead-end. A "dead-end" sign may be needed. Sufficient capacity on the alternative route is also needed.

Speed. Again, the impact is drastic, reducing the speed to that normally associated with short dead-end residential streets.

Traffic Noise, Air Quality and Energy Consumption. There should be a dramatic reduction in noise directly related to the reduction in traffic volumes. This is also accomplished with an increase in air quality.

Energy Consumption. No change in energy consumption is expected since vehicle trips are not eliminated, but merely rerouted to main streets.

Traffic Safety. There is a substantial increase in traffic safety. The neighborhood abutting the closed street has less traffic and the traffic that remains is all local, usually well known amongst themselves. There is also a safety improvement to the main street. Traffic entering or exiting the main street is eliminated at the closed street and relocated at adjacent intersection with better traffic control. This portion of traffic safety has been the driving force in the majority of street closures described in the case study section.

Community Reaction. Reaction from people who live on the street is usually very positive. It is important to have all the residents in-

involved in the decision process from the start. There is some inconvenience to these residents since they are restricted to access only from the open end. A negative reaction can be expected from the traveling public until they understand the nature of problems associated with through traffic in a neighborhood.

Capacity on the main routes should be available for the relocated traffic.

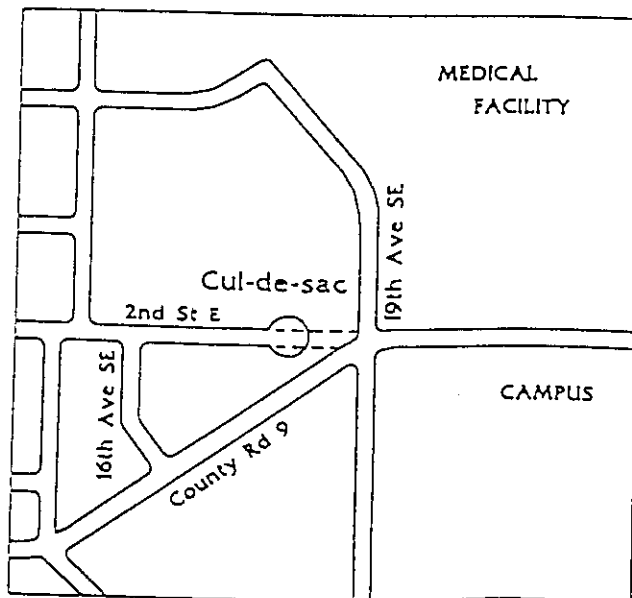
Additional Considerations

The reduced access to the closed street should be reviewed prior to the actual closing, especially for emergency services such as police, fire and ambulance. A proper turn around area is needed at dead-end for vehicle turn around and snow storage. Cost can vary from \$5,000 to \$10,000 depending upon size of the cul-de-sac and drainage facilities.

Case Studies

2nd Street S.E. (16th Ave. to 19th Ave.)

This is a residential street in S.E. Rochester. The east end of the street was the 5th leg in an unusual intersection. During preliminary studies on the intersection for a possible traffic signal, the undesired 5th leg was recom-



mended for a street closure. The issue was pursued by using a survey of abutting residents. A strong majority were immediately in favor.

The street was closed following a public hearing and approved by the Common Council. Since the closure, only one objection from the public has been received. The closure reduced the traffic volume on 2nd Street S.E. from 1200 ADT down to less than 100.

Other Locations:

This technique has been used in Rochester for many years. The following is a list of streets that were cut off from main streets:

- N.E. 32nd St. N. E. @ Broadway
- S.E. 2nd St. S.E. @ C.R. #9
- 13th Ave. S.E. @ 6th Street
- S.W. 7th Ave. S.W. @ T.H. 14
- N.W. 2nd Ave. N.W. @ Civic Center Drive
- 3rd Ave. N.W. @ Civic Center Drive
- 5th Ave. N.W. @ Civic Center Drive
- 4th St. N.W. @ Civic Center Drive
- 12th St. N.W. @ 4th Ave.
- 19th St. N.W. @ 4th Ave.
- 3rd Ave. N.W. @ West River Road
- 21st Ave. N.W. @ 37th St. N.W.

The full diverter is defined as a raised barrier placed diagonally across an intersection that physically divides the intersection and forces all traffic to make a sharp turn. In some localities, it is called a "diagonal diverter."

The full diverter is a technique which can be used in older well established neighborhoods, that are experiencing substantial outside cut through traffic. Both intersecting streets must be minor local streets and there needs to be good visibility approaching the full diverter. Drivers need sufficient reaction time to see the diverter, slow down and make the turn.

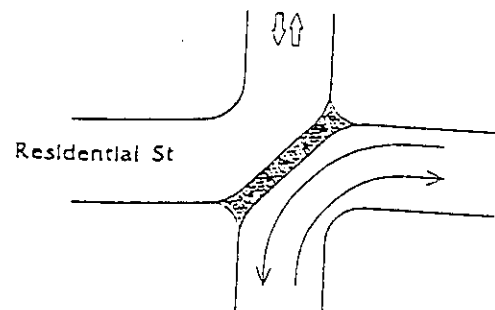
Effects

Volumes. Through traffic volumes reduced due to diversion to other streets. The intent is to divert the traffic to arterial and collector streets.

Speed. It is reduced due to the obstruction in the roadway and forcing the driver to make a tight turn. Minimal reduction in speed at mid-block is experienced.

Traffic Noise, Air Quality and Energy Consumption. No realistic impact on noise is experienced. Minor increase in energy consumption is caused by the circular routes, thus air quality is also.

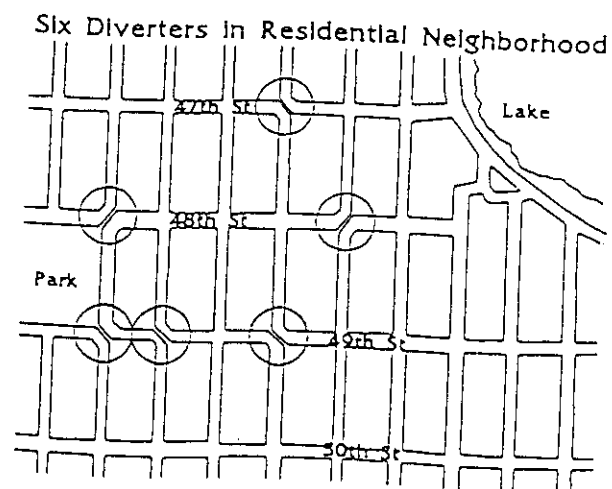
Traffic Safety. Increase in safety due to diversion of through traffic. Intersection safety is increased as all the conflicting moves are eliminated.



Community Reaction. Community reaction is very controversial. The amount of confusion for visitors and delivery vehicles is considerable. Residents tend to be either strongly in favor or opposed. A strong petition from the neighborhood should be acquired. Some residents perceive a loss of neighborhood cohesion.

Additional Considerations

Drainage needs to be considered in the design of the diverter. Bicycle traffic can be accommodated through the diverter if desired. Diverters generally need to be put in as a group or cluster to route traffic to collector roadways. Above all, emergency access for police, fire ambulance needs to be preserved. Costs can be reasonable if done as part of a paving project, but can be expensive as a retrofit only.



A traffic circle is a raised geometric control island, frequently circular, in the center of an intersection of local streets. A typical traffic circle would be about 20 feet in diameter. Traffic traveling through the intersection must avoid the island. This affects the path and speed of the traffic. Traffic circles can be used with or without stop sign control of the intersection. The approach roadway widths should be 30 feet wide or wider. Frequently, the island is landscaped with low growing shrubs and a tree.

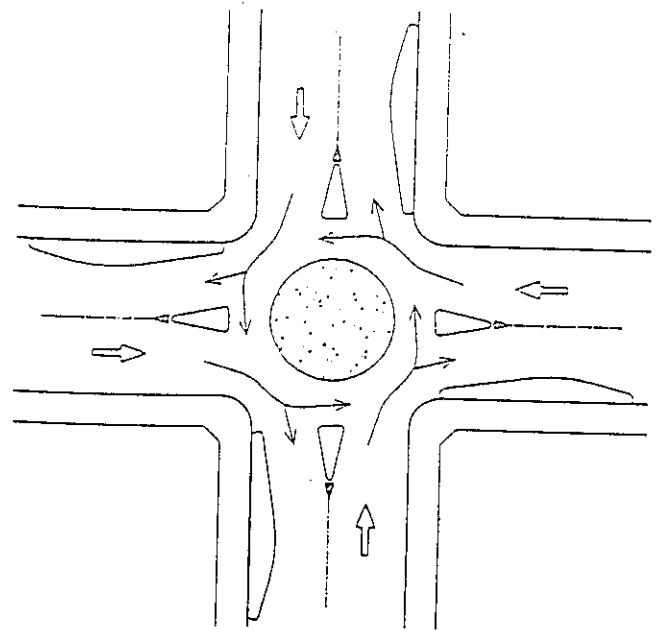
Effects

Volumes. The impact on the traffic volume is minimal. Some vehicles may be diverted to adjacent collector or arterial streets to avoid the islands.

Speed. Speeds near the intersection are reduced so that the vehicles can avoid the traffic circle. This is especially true of left turning vehicles. Speed in the middle of the block may increase as some drivers try to make up for lost time.

Traffic Noise, Air Quality and Energy Consumption. There is an increase in noise and energy consumption from the deceleration and acceleration of vehicles. Air quality is negatively affected as well.

Traffic Safety. Depending on the accident patterns, a positive change in accidents could occur. If there are a number of right angle accidents, a significant reduction will possibly occur. This is the result of a slowing of traffic at the point of conflict. If there are few right



angle accident or there is stop control at the intersection already, there will probably be little effect on accidents.

Community Reaction. The reaction is mixed. Some drivers express concern about an unnecessary obstruction and potential hazard. There are a few complaints regarding noise, air quality, or energy consumption. Depending on the kind of construction and landscaping, the traffic circle can receive varying opinions on their aesthetic value. Loss of parking in areas of heavy parking can cause complaints. The ability to maneuver around the traffic circle before the streets are cleared of snow can also cause complaints.

Cost

The cost of a typical traffic circle with concrete curb and gutter and landscaping can approach \$5,000.

Additional Considerations

In areas where there is a need for parking, the supply will shrink because of parking distances required by State law in advance of crosswalks and stop sign will need to be enforced and probably signed.

Some confusion over the correct way to make a left turn can occur. Both methods, in advance of the circle and around the circle, are acceptable.

The questions of whether to landscape and who will care for it must be addressed.

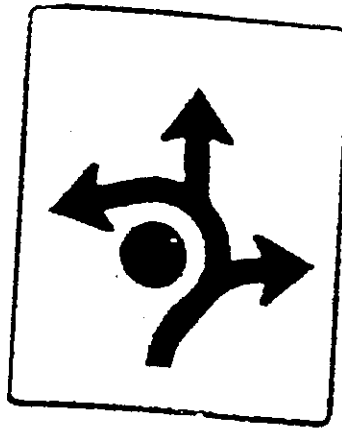
Snow plowing is slowed by the fact that the plows must adjust for the traffic circle in the street.

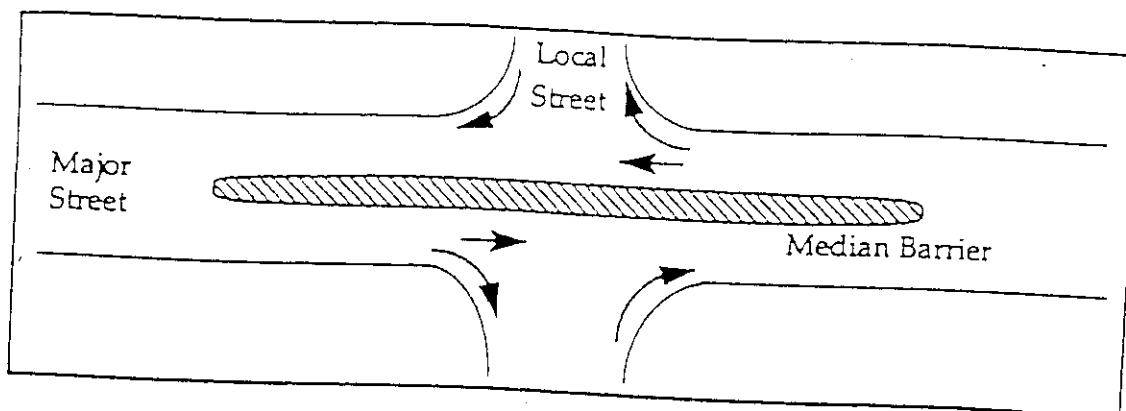
Case Study

Traffic circles are widely used in Portland, Oregon and Seattle, Washington. Seattle has over 300 local intersections with traffic circles. There is a waiting list of over 300 more intersections.

The City of St. Paul has two intersections with experimental traffic circles. They were installed in the fall of 1992. An evaluation of the effects is currently underway.

Snow plowing worked well through one winter. The largest snowfall that St. Paul had was 12 inches and the experimental intersections appeared to be in better condition than the adjacent "normal" intersections.





The use of median barriers for neighborhood traffic control is a physical means for preventing left turning traffic on a major street from accessing a local street and through traffic from continuing on that local street. In using this technique as with other traffic diversion techniques, the impact of the diverted traffic should be assessed. Alternate routes for the diverted traffic should be analyzed with regard to traffic carrying capability and desirability.

Effects

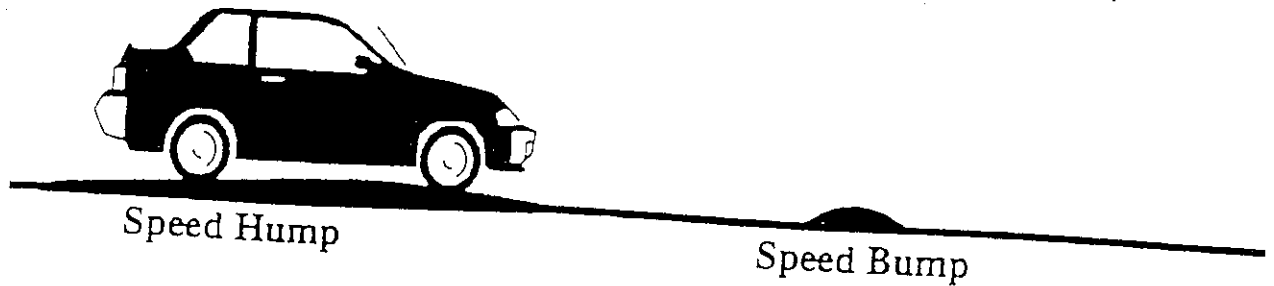
Volumes. The degree to which traffic volumes will be reduced on the minor street will vary dependent upon the proportion of traffic that is prohibited by the median barrier. If left turns onto and off of the local street are a significant part of the traffic volume, there will be a significant volume reduction. If through traffic on the minor street is significant, there will also be a significant volume reduction.

Speed. A median barrier is usually used to prohibit through traffic in a residential neighborhood. When the through traffic is

reduced or eliminated, there will more than likely be an accompanying reduction in vehicle speeds.

Traffic Noise, Air Quality and Energy Consumption. Reduced traffic volumes on the street closed to through traffic by the median barrier, will result in reduced noise and improved air quality. However, the noise and air quality may worsen in the surrounding area which is handling the diverted traffic. Energy consumption could improve through more controlled flow of the major street traffic at controlled intersections or it could worsen if the diverted traffic volumes exceed nearby intersection capacities. Energy consumption could also increase by eliminating what may have been a shortcut for through traffic.

Traffic Safety. It is anticipated that a reduction in traffic volumes created by the median barrier will also bring with it an associated reduction in accidents. A benefit to pedestrians may result by providing a safety island to help in crossing the major street.



Speed bumps and speed humps are design features which rise above the roadway surface and extend across the roadway perpendicular to the traffic flow. Speed bumps are 3 to 6 inches high and 1 to 3 feet long (shorter than the wheel base of an automobile). They are typically used in low speed parking lots and alley situations. Speed humps, on the other hand, are 3 to 4 inches high and 12 feet long (longer than the wheel base of an automobile).

Effects

Volumes. Speed bumps and speed humps will often reduce traffic volumes on the streets where they are installed. The degree of traffic reduction is dependent upon the number and the spacing of the bumps/humps, the amount of cut through traffic, and the availability of alternate routes. Speed bumps/humps have been used to deter trucks and larger vehicles from using a street.

Speed. Speed bumps are effective in slowing vehicles traveling at typical residential speeds to approximately 5 mph when cross-

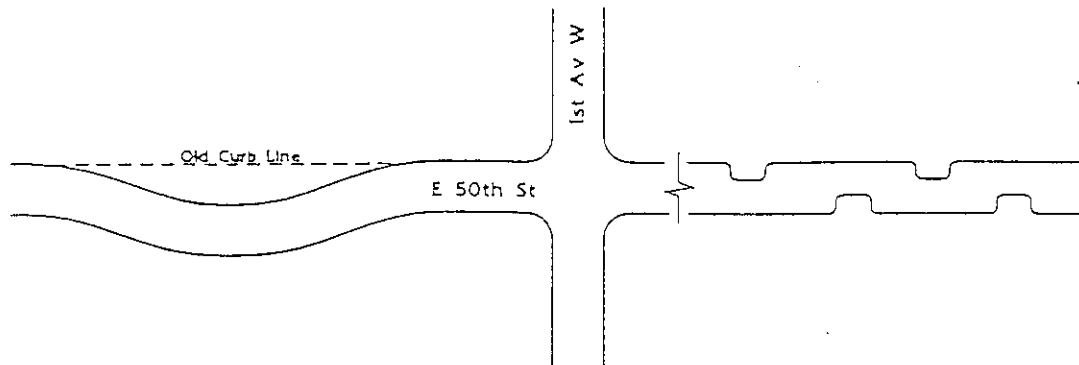
ing the bump. At higher speeds, the bumps have less impact to the vehicle.

Speed humps generally slow vehicles traveling at typical residential speeds to approximately 15 mph. At higher speeds the vehicle experiences severe jolting with the hump acting as a bump.

Speed bumps or speed humps should only be installed on streets where the prevailing speed limit is 30 mph or less.

These features generally have a continuous effect on vehicle speeds if spaced 250 feet to 800 feet apart. If spacing exceeds 800 feet, the effect on speed is only at the bump/hump.

Traffic Noise, Air Quality and Energy Consumption. Traffic noise is generally reduced slightly between the bumps/humps on low volume local streets. At the speed bumps/humps, experience has shown anywhere from a slight reduction in noise level to an increase in noise level. The noise level at the bumps/humps is dependent upon the speed at which the vehicles traverse them.



Curvilinear reconstruction involves the introduction of curvatures on previously straight alignment. The introduction of curvature into straight streets may take two different forms:

1. Reconstruct the street with a curved centerline alignment and a uniform roadway width.
2. Introduce chokers or other types of barriers on alternate sides of the street to create a serpentine travel path.

Effects

Volumes. Little or no effect if the same number of travel lanes are retained for both the before and after situation. Significant reductions may occur for alternating barrier type of construction if barriers limit use of section to one direction at a time or reduce capacity of an already congested street.

Speed. Little or no effect for curved alignment, uniform width construction. Some reduction in vicinity of barriers for alternating barrier construction; the closer the spacing of the barriers the greater the likelihood of speed reductions.

Traffic Noise, Air Quality and Energy Consumption. Minimal effect.

Traffic Safety. Mixed results. One study indicated accident reduction for alternating barrier construction. Some concern that curvilinear alignment and associated landscaping creates a more hazardous situation, especially for pedestrians, by limiting visibility.

Community Reaction. Mixed. Some studies indicate favorable community reaction, while other studies indicate residents are concerned about traffic safety due to poor visibility conditions.

Cost

Can vary considerably. Street reconstruction is very expensive (\$250 per lineal foot). Alternating barriers cost approximately \$5,000 per barrier.

Additional Consideration

The curvilinear reconstruction provides landscaping opportunities.

References

- Edwin Von Borstel, "Controlling Neighborhood Traffic," APWA Reporter, APWA, November 1985.
- P. H. Bowers, J. C. Thomson, and L. Baher, "Shared Space and Child Safety," Traffic Engineering & Control, November 1984.
- Institute of Transportation Engineers, Traffic Engineering Handbook, 4th Edition, Prentice Hall, Englewood Cliffs, NJ, 1992.

COMMUNITY OF ROSEMONT TRAFFIC CALMING PLAN



Traffic calming is a combination of measures that reduce the impact of motor vehicles by altering driver behavior that results in a better quality of life for the community. The City of Alexandria and the Department of Transportation and Environmental Services are working to protect residential neighborhoods and encourage thru vehicles to use arterial and collector roadways.

This traffic calming plan for Rosemont has been developed with the Rosemont Citizens Association. This is a pilot project that may expand to other neighborhoods depending on available funding.

The primary goal of this plan is speed reduction. Traffic calming features will be concentrated along Commonwealth Avenue and Russell Road. (See Traffic Calming Diagram). This plan aims to reduce average travel speeds along these two collector roadways by approximately 5 mph.

Since most of the traffic calming elements are on Russell Road and Commonwealth Avenue, this plan will be implemented when sixty five percent (65%) of the residents on these two streets approve the plan.

Traffic Calming Features

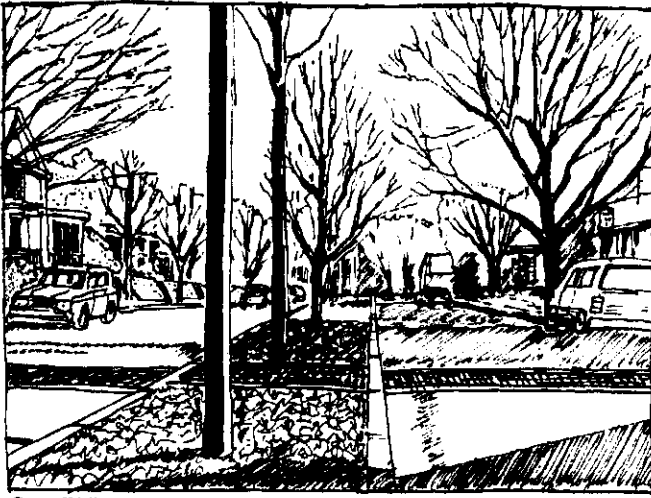
In addition to typical vehicular traffic, **traffic calming** features are designed to accommodate busses, emergency vehicles, bicyclists and pedestrians. All features allow positive drainage and are ADA (Americans with Disabilities Act) compliant.

The following is a brief discussion and schematics showing the traffic calming features that are being proposed:

Speed Tables are trapezoidal raised areas with a textured surface that are placed at certain intervals along the road. A speed table is generally 3 inches high and 20 feet long. Speed Tables are typically long enough for the entire wheelbase of a passenger car to rest on top.



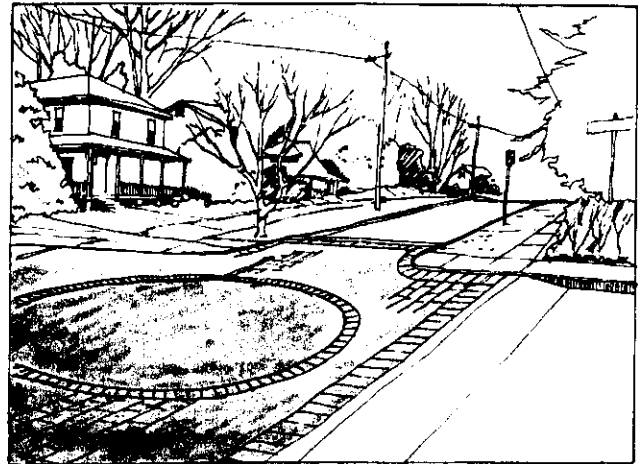
Speed Table



Raised Crosswalk

Raised Crosswalks are similar to speed tables but they are constructed at grade. Raised crosswalks are placed at intersections and are finished with textured material to visibly define the crosswalk.

Raised Intersections are raised areas that cover an entire intersection. They are constructed of pavers or other textured materials. Raised intersections may also include the crosswalks.



Raised Intersection

Gateway Treatments are placed at key entrances to a neighborhood to alert motorists that they are entering a residential area. Gateways can include landscaping, street furniture and other "hardscape" features. Raised or textured crosswalks can also be integrated into gateways. Gateways help to accommodate pedestrians at intersections.

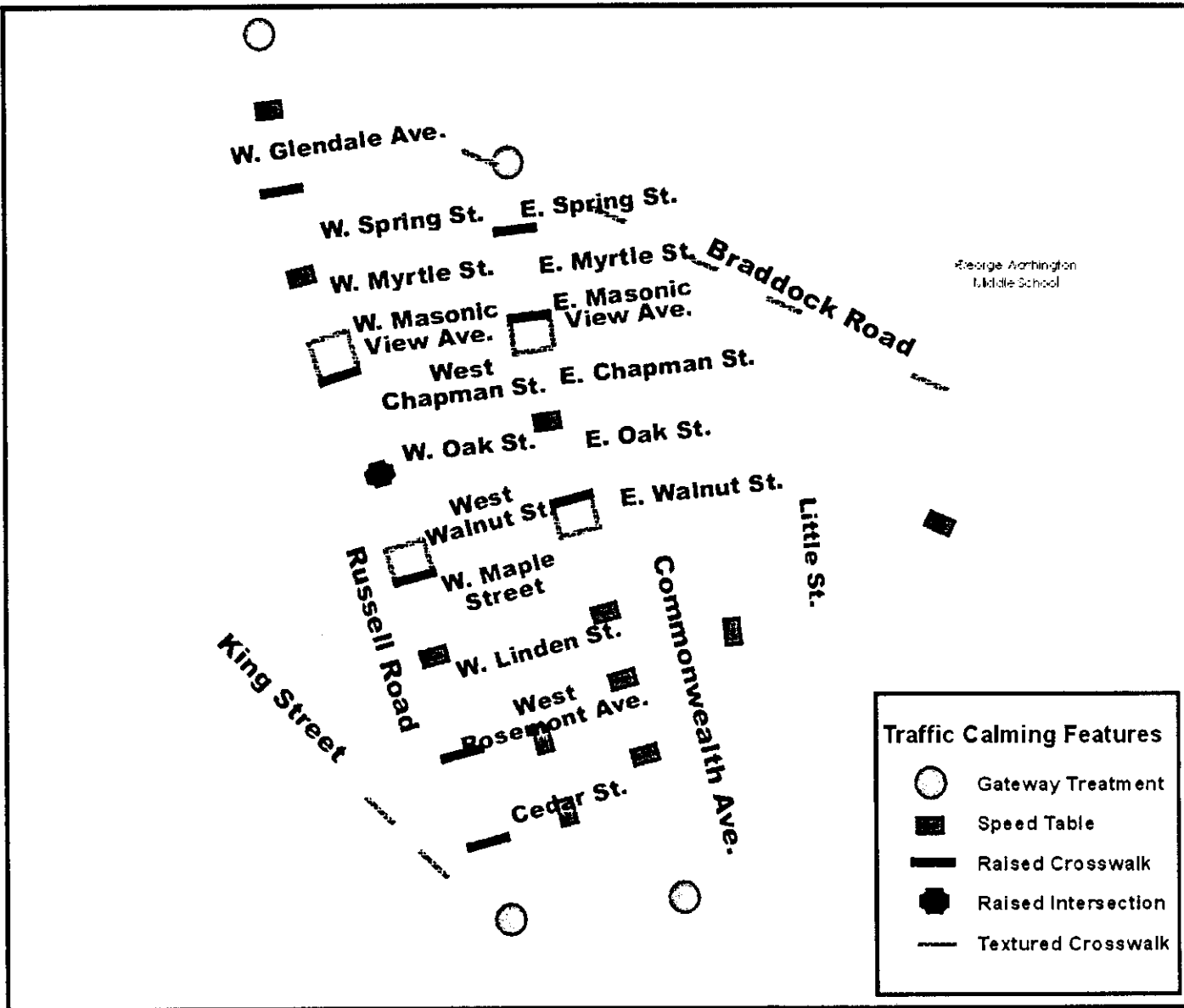


Entry

Multiple **Traffic Calming** elements will be combined at a number of locations along both Russell Road and Commonwealth Avenue, to maximize effectiveness.

Frequently Asked Questions

- ***How will this traffic calming plan affect traffic volumes in my neighborhood?*** We do not anticipate a significant reduction in traffic volumes. Traffic calming features will be included on both Russell Road and Commonwealth Avenue so there should not be any diversion from one road to the other.
- ***Will signs be included in the plan? How many?*** Signs will be placed at the entrances to the neighborhood on Russell Road and Commonwealth Avenue to alert motorists of the traffic calming devices. Although additional signs may be included, signs are not required for each individual traffic calming device.
- ***Will this plan reduce the travel speed of vehicles in Rosemont?*** Yes. The goal of this plan is to reduce the speeds by approximately 5 mph.
- ***Will this plan affect noise levels in this community?*** Surveys in other communities indicate that the lower speeds lead to lower overall noise levels
- ***Will the plan affect emergency vehicle response times?*** The traffic calming devices will slow emergency vehicles. However, the overall effect on response times in the community will be very slight.
- ***How will the traffic calming elements affect snow removal?*** The traffic calming features should not affect snow removal.
- ***Will parking be impacted by the plan?*** Parking will not be impacted by the plan.
- ***Will roadway drainage be impacted by the plan?*** The traffic calming features are designed to allow normal roadway drainage.
- ***Can additional landscaping be included in the plan?*** Landscaping may be included in the neighborhood gateways. No additional landscaping is planned for the neighborhood although landscaping could be provided by the civic association or as part of a neighborhood improvement plan.
- ***How much would it cost to implement the plan? Are funds available?*** The current plan will cost about \$200,000 to implement. Funds are available after July 1, 2001.
- ***If this plan proceeds, what is the schedule for completing and implementing the plan?*** If this plan is approved, construction would begin in the Fall of 2001 and completed in a few months.
- ***What is the process for obtaining the required 65% approval for this plan.*** Representatives from the citizens association will meet with residents on Russell Road and Commonwealth Avenue to review the traffic calming plan. Residents supporting the plan will sign petitions. When the 65% threshold is reached the petitions will be presented to the Department of Transportation and Environmental Services.



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