I. Introduction

Since the enforcement of local, county and state laws and ordinances is the primary mission of a police department, it would be logical to expect that the most prevalent type of complaint received by the police would involve crime. However, contrary to this rationale, traditional criminal activity represents a comparatively small portion of the overall number of complaints received by the police department. By a considerable margin, traffic issues generate the greatest number of calls, letters and emails to the stationhouse.

Within the general category of traffic, anxiety over speeding vehicles is by far the most common type of complaint received followed closely by concern over excessive volume. These issues are by-products of our contemporary society and adversely affect virtually all of Greenburgh’s neighborhoods in varying degrees. Residential streets that provide alternate access around busy thoroughfares are especially impacted because they often present a more expeditious route to a transportation facility, shopping area, workplace, school or other location that generates comparatively large traffic volumes for at least part of the day. In suburban communities, such as the Town of Greenburgh, traffic concerns may well rival crime as the issue having the most significant impact on residents’ quality of life.

Citizen concern over traffic issues has prompted calls for lowering speed limits; the installation of all varieties of warning signs and signals; requests to turn streets into dead ends and one-way thoroughfares; prohibiting through traffic and for the implementation of other legal impediments that, if put into operation, would serve to discourage all but residents from using the affected street. Although the motives behind such requests are understandable, often their realization is either prohibited by existing rules; tend to create more serious problems than those they were intended to address or are outright illegal.

Until now, the most effective police response to these problems has been increased enforcement of the Vehicle and Traffic laws within the areas affected. Ideally, this is undertaken by personnel assigned to patrol the neighborhoods involved as part of their routine duties. Unfortunately, in Greenburgh, because officers often spend the majority of their shift disposing of the record number of calls for service received by the department, little time remains for proactive patrol or traffic enforcement duties. This is particularly true during the second (8:00 a.m. to 4:00 p.m.) and third (4:00 p.m. to midnight) platoons when the enforcement of traffic laws is most needed.

In response to this, several years ago, the department assigned two officers to the exclusive enforcement of Vehicle and Traffic laws. It was hoped that the efforts of these individuals together with that of regular patrol personnel would help ensure that traffic complaints received adequate attention. On a daily basis, these officers are assigned to those areas from which complaints are received to address the reported offenses. While the majority of complaints involve speeding, stop sign violations, passing stopped school buses, and sign and lane usage infractions are also frequent sources of concern.

Because, however, of the significant number of individual locations within town requiring this special attention, it quickly became evident that this strategy would not be sufficient to satisfactorily address the ever-growing enforcement dilemma faced by the department. Therefore, to further mitigate this concern, additional personnel are periodically detailed to selective enforcement duties on an overtime basis. Assigning officers in this fashion assures their availability to exclusively focus on traffic issues. Although this action has resulted in thousands of tickets being issued (5,454 in 1999 and 6,437 in 2000), residents
often express dissatisfaction with the efforts of the police because officers cannot always be at their specific location when the problems are most prevalent and also because the situation appears to quickly recur when the officers are not present. Since it is not possible for the police to maintain a full time presence at any single location, never mind the numerous ones from which substantiated complaints are received, it became imperative that other, more permanent and comparatively less expensive types of traffic calming strategies needed to be found.

One means explored and implemented involved the purchase of a traffic sled. This device, which contains a built-in radar unit, is placed on a street where a confirmed problem with speeding exists to act as a deterrent against the violation. A sign announcing the area speed limit is mounted on the sled and the unit measures and displays the speed of each vehicle passing through the radar cone thereby advising a driver of the actual speed at which their vehicle is traveling. Limited success in slowing vehicles has been achieved when the device is deployed by itself. Increased effectiveness is achieved when selective enforcement is utilized in conjunction with the traffic sled, such as on alternating days.

In its attempt at traffic calming, the department has also employed unoccupied, marked police cars. Vehicles utilized in this fashion are parked in conspicuous locations on streets where speeding is prevalent to help deter offenders.

Although some success has been achieved utilizing each of these approaches, up to now, none has been more successful than the police officer with a radar gun and ticket book. For only when an offending motorist believes that a significant potential exists for their driving indiscretions to be punished, do they tend to be more fastidious in complying with traffic regulations.

While the enforcement of speed limits by police officers is an effective means of addressing concerns over speeding vehicles, limited resources do not allow such enforcement on a permanent basis. Additionally, such enforcement does not generally result in a reduction in traffic volume. Research has shown, however, that correctly installed Speed Humps are an effective approach to slowing traffic on residential streets and may also serve to divert traffic from the street on which they are installed.

II. Conclusion

Extensive research in the use of Speed Humps (pavement undulations) performed in Great Britain, Australia, the United States and other countries prior to our own analysis, indicates that the placement of a “properly designed and engineered” Speed Hump system can be an effective traffic calming device. Previous studies show that such systems reduce traffic speed, traffic volume and accidents. They are, however, not a panacea for all residential street traffic problems and if improperly engineered and/or installed will not only be ineffective but can create worse problems than they were intended to address. All research sources also agree that Speed Humps, “should not be considered an option to good residential planning and subdivision street design, nor should they be used to convert streets to playgrounds or otherwise to encourage pedestrian activity in public streets.”

More and more frequently we receive calls from the public that their children, “cannot even play in the street in front of their homes because of traffic.” Streets are not playgrounds and the temptation to make them such or condone this use of them must be vigorously resisted.
Furthermore, notwithstanding the fact that the installation of Speed Humps might be an appropriate traffic calming option on a particular street, it should be noted that not all people who live on such a street will be in favor of them. To ensure that a majority of residents are in favor of such an installation, an appropriate application process must be part of any Speed Hump installation program.

A brief analysis of the study on Columbia Avenue revealed the following. A traffic survey of the street performed between October and November of 1993 revealed an average of 3,019 vehicles per day using the road. In response to citizen concerns, in August of 1995, the speed limit on Columbia Avenue was reduced from 30 mph to 25 mph. This reduction was accompanied by a significant amount of strict selective enforcement. Subsequent to this between October and November of 1996, a second study was conducted that revealed an average of 2,728 vehicles per day were utilizing the street. The average speed of these vehicles was 29 mph with a median speed of 28 mph. The 85th percentile speed\textsuperscript{1} was 34 mph. In August of 1999, a series of Speed Humps were installed on a portion of the street and a subsequent traffic study was undertaken in June 2001 to access their effectiveness. This study revealed that an average of 2,322 vehicles per day were utilizing the street, about 23% fewer vehicles than the daily average in 1993 and nearly 15% less than the findings of the 1996 study.

The average speed of vehicles was 20 mph, down 31% from the '96 study; median speed was reduced by 10 mph to 18 mph, a reduction of 36% while there was an 11 mph reduction in the 85th percentile speed from 34 mph to 23 mph or about 32%. This study clearly indicates that the Speed Humps installed on Columbia Avenue have reduced vehicle speed and volume. The Columbia Avenue study shall be more fully examined later in this report.

III. Speed Humps

What is a Speed Hump? Originally developed in the early 1970s in Great Britain, a Speed Hump or pavement undulation is a raised area in the roadway surface that extends transversely across the pavement width. Speed Humps can be constructed of a number of materials including asphalt, concrete, brick and recycled rubber. Generally, Speed Humps installed on residential streets are 12 feet long with a maximum height of 3 to 4 inches and are placed at intervals of between 200 and 600 feet. Although often confused with them, a Speed Hump is not the same as a Speed Bump. Speed Bumps are also raised areas in the pavement surface but are much more abrupt. They are generally 3 to 6 inches in height and have varying lengths of between 1 and 3 feet. Obviously, the effect on a vehicle crossing each of these devices at a given speed is quite different.

A properly engineered and installed Speed Hump will cause the occupants of a car crossing it at speeds of up to about 30 mph, to experience a gentle rocking motion. This generally results in vehicles slowing to between 15 and 20 mph when traversing the device. Crossing a Speed Hump at higher speeds can produce significant driver discomfort, jolting the vehicle’s suspension and its occupants and cargo. This is similar to what is experienced when a Speed Bump is traversed at anything but very slow speeds. Speed Humps are designed to slow vehicular traffic to reasonable speeds while Speed Bumps are intended to bring vehicles to a near stop when crossing them. While Speed Bumps may be appropriate for installation in public and private parking lots, because of their undesirable impact on

\textsuperscript{1} The 85th percentile is often used to measure the maximum reasonable speed for traffic.
traffic and the increased potential for liability associated with them, they are unsuitable for placement on public roadways.

![Image of traffic and speed humps]

**FIGURE 1**

**IV. Considerations of Installation**

Speed Hump installation should conform to the practices set forth in the “Guidelines for the Design and Application of Speed Humps” published by the Institute of Transportation Engineers (ITE) and Federal Highway Administration’s (FHA) recently revised Manual on Uniform Traffic Control Devices (MUTCD 2000). Excerpts from the ITE practices are included as a part of this report so as to provide the reader with a brief understanding of the limitations and conditions affecting the use of Speed Humps. It should be noted that there are a number of additional considerations not mentioned here that might impact on a decision to install these devices. These are available through various agencies such as the Institute of Traffic Engineers, the Federal Highway Authority and the New York State Department of Transportation.

**General considerations**

Government and police department officials are beginning to receive numerous calls from citizens requesting that Speed Humps be installed on their streets. These requests are obviously the result of a belief, real or perceived, that a problem with speeding cars or excessive traffic volume exists in their immediate neighborhood. Public officials must resist the temptation to appease the concerns of these individuals by indicating that they will support such requests. Although the installation of Speed Humps might well be an appropriate response to some of these concerns, this cannot be determined with certainty without first conducting appropriate traffic and engineering studies of the problem. Oftentimes, the problem is one of perception or, if genuine, can be addressed more efficiently and economically utilizing alternative traffic control measures. Moreover, even after it has been determined that the installation of Speed Humps might sufficiently address citizen concerns on a particular street, because they may divert traffic, they could serve to actually create equal or greater traffic problems on other nearby residential streets. Obviously, in these cases they should not be installed unless the issues on the other roads that could be affected are also addressed in the installation plan.

Residential Streets – The installation of Speed Humps should be limited to those roadways fitting the definition of a “residential street” as defined by the American Association of State Highway and Transportation Officials (AASHTO) having no more than two (2) travel lanes or where the pavement width is no more than forty (40) feet and has a good surface and
drainage qualities. Street widths greater than 40 feet “may” be considered for Speed Humps if they maintain only 2 travel lanes.

Street Grades - ITE guidelines indicate that under normal circumstances, Speed Hump installation should be limited to streets with grades of eight percent (8%) or less. Downgrades in excess of this limit increase the potential for accidents when ice or snow is present or when vehicles traverse the devices at excessive speeds. Drainage also becomes an issue where steeper grades are involved.

Traffic Speeds – Speed Hump installation should be limited to streets where the posted speed limited is 30 mph or less. The 85th percentile must also be considered when deciding whether placement of these devices is appropriate.

Vehicle Types – Speed Humps should not be considered for streets that are considered transit or truck routes or that are utilized as primary access routes for emergency vehicles.

Limitation on location – Speed Humps should not be installed within 200 feet of an intersection and each should be visible for a distance of at least two hundred (200) feet. Additionally Speed Humps should not be installed so that they infringe on a driveway access or adjacent to a fire hydrant. Speed Humps should not be located so that utility maintenance access holes are contained within them.

Drainage – The effects on drainage must also be considered when the installation of Speed Humps is being contemplated. Ideally, Speed Humps should be installed across the entire width of a road whether the road has curbing or not. When this type of installation will adversely affect drainage, the edge of the device may be tapered to improve water runoff. It should be noted, however, that doing so may encourage drivers wishing to reduce the effect of the hump to drive with one wheel in the gutter created by the taper. It should also be noted that Speed Humps could serve to defer rainwater that normally would flow down a grade into yards and driveways causing flooding conditions in private homes.

On-Street Parking and Street Lighting – Both these must be considered when planning for the installation of Speed Humps. As described below, warning signs and pavement markings must be placed on each approach to a Speed Hump. If not taken into consideration at the time the project is planned, the effectiveness of these signs and markings can be adversely affected by vehicles parked on the street. It is also desirable to place these devices in proximity to street lights. This improves the nighttime visibility of the Speed Hump, which is especially helpful when they must be placed in locations where sight distance is marginal.

Signs and Pavement Markings – Standard Warning signs (W4-1C) should ideally be located at a distance of 100 feet from the centerline of the Speed Hump on each approach to it. Many types of pavement markings have been suggested to further alert motorists to the actual location of the device. Care must be taken, however, not to utilize markings that could be misinterpreted by motorists as being pedestrian crosswalks. Pavement markings should also be placed on both approaches to the device. The town has opted to place white bars beginning at about 80 feet from the start of the undulation that gradually increase in width as the motorist approaches the Speed Hump. Whatever design is selected, it must conform to guidelines found in the Manual on Uniform Traffic Control Devices.
Construction and Maintenance – Speed Humps may be constructed of a number of materials including asphalt, concrete, pavers made of brick or concrete, and recycled rubber. Although we have not as yet experienced problems, studies on the use of these devices have shown that the softer substances are those most likely to result in deformations of the hump that could, if not corrected, diminish the device’s ability to effect speed control or unfavorably impact traffic safety thereby increasing liability. Since a deformity of as little as 1/2 inch could impact the effectiveness of the device, a program of routine inspection and maintenance of Speed Hump installations must be part of any program utilizing these devices. Funds must be appropriated for this purpose and to correct any noted deficiencies. As previously indicated, this possibility is reduced when the Speed Hump is constructed of a harder material.

Snow Removal – Generally, Speed Humps do not seem to be negatively affected by snow plowing operations. Our own experience seems to bear this out. It is generally felt that snowplow operators should exercise caution by slowing down when crossing the device. Some communities have noted a lifting of the Speed Hump by the plow blade. This possibility has been minimized through staking the hump to the road surface rather than just laying it atop the existing pavement and ensuring the edges of the device are properly maintained.

Community Support – Notwithstanding the traffic concerns that may be shared by all residents of a particular street, not all will be in favor of installing Speed Humps to address these issues. Moreover, some of those who may initially be in favor will change their mind once installation is complete. Our own experience with this phenomenon is more completely dealt with later in this report when the actual Columbia Avenue study is addressed.

There are a number of reasons why residents may not be in favor of placing Speed Humps on their streets or would ask for their removal after installation. Among these are.
- Aesthetics of the humps and their associated warning signs and markings
- Increased noise levels associated with vehicles crossing the device and acceleration/deceleration
- Concerns that emergency vehicle response times will be affected

In an effort to reduce calls for the removal of these devices, we are recommending that Community Support for their installation be obtained prior to any placement being performed. We suggest this be done by petition containing the signatures of at least 2/3 of the households adjacent to the street. A letter of support from the existing neighborhood association should also be requested and in the event that no such association exists, the town may wish to consider obtaining a petition from the residents of the nearby streets that may be affected by the placement of the devices. Of course, information describing the pros and cons of Speed Hump usage should be distributed prior to the circulation of a petition in order that citizens may be able to make an informed decision. The department would be happy to design both the petition and informational pamphlet should the board agree with this strategy.

Should the project receive the requisite community support and after a determination is made by the appropriate departments that the installation of Speed Humps is a suitable

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2 This can be minimized through utilization of a properly designed, installed and maintained Speed Hump.
traffic calming measure for the area, a Town Board Resolution authorizing the installation should be adopted.

It is further recommended that prior to directing the removal of any Speed Hump the Town Board hold a public hearing with notice of said hearing going to all persons who originally requested placement of the devices to afford them the opportunity to comment on the proposed removal. Speed Humps should not be removed unless they have been found to be ineffective or removal is supported by a majority of the directly affected residents.

Cost – The cost of Speed Hump installation varies widely depending upon the type of material used in their construction. For example, the actual cost of installing each of the Speed Humps placed on Columbia Avenue was approximately $1,000 each. This covers the cost of asphalt, labor, signs and pavement markings but does not consider any costs associated with the traffic and engineering studies that will be required.

As an alternative to manufacturing their own devices, municipalities have the option of purchasing Speed Humps from several private sources. These devices have the advantage of being portable so they can be employed in pilot studies as well as in permanent installations. Made from recycled tire rubber and modular in design, they are easily installed under virtually any type of weather condition. In addition to being portable, because they are constructed of recycled rubber they tend to be less susceptible to the deformation encountered when using softer materials such as asphalt. The cost of these devices is appreciably higher than an asphalt installation. Depending on the number purchased, costs per device can be as high as $3,000 to as low as $2,300. If quantities in excess of twenty are purchased, further discounts are available. These costs are for the material only and do not take into consideration expenditures for traffic and engineering studies, signage and pavement markings or installation.

V. Columbia Avenue Pilot Study

Overview - The conditions on Columbia Avenue typify the traffic concerns of a number of Greenburgh neighborhoods. Columbia Avenue is a narrow, two-lane, residential street devoid of sidewalks and just under ½ mile in length that parallels Central Avenue, a major north/south thoroughfare. With access from three intersecting streets, the road is utilized as an alternate for train station commuters and others seeking to avoid the congestion encountered at the busy Central/Hartsdale Avenue intersection. Residents of the street have long complained about excessive traffic volume, speeding vehicles and cars running Stop signs. A traffic study on the street conducted between October and November of 1993 revealed an average of 3,019 vehicles used the road each day.

To help dispel public concern, significant enforcement resources were assigned to the street and in January of 1994, an ordinance prohibiting the use of the street by commercial vehicles was adopted.

A subsequent traffic study conducted in December of 1994 showed an average of 2,507 vehicles per day using the road. The average speed of these vehicles was 25 mph with the median at 24 mph and the 85th percentile at 31 mph. It should be noted that during the

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3 The 85th percentile is often used to measure the maximum reasonable speed for traffic.
period these statistics were taken, enforcement action on the street was occurring on a regular basis.

In August of 1995, as a further traffic calming measure, the speed limit on Columbia Avenue and a number of other adjoining streets was reduced to 25 mph.

The results of yet another traffic analysis performed in late October through early November of 1996, revealed the daily average to be 2,728. Average speed of vehicles was 29 mph; the median 28 mph and the 85th percentile speed was 34 mph, 9 miles above the posted speed limit. During the period this study was undertaken, no special enforcement measures were performed so as not to skew the statistics. Notwithstanding the previous measures taken, it became evident from this survey that without an almost fulltime enforcement presence, motorists were not going to appreciably alter their driving habits. It is this analysis that prompted the town to experiment with the placement of Speed Humps on Columbia Avenue. It should be noted that numerous residents of the street supported this trial and forwarded petitions to the town supervisor urging the town to move ahead with the program.

Speed Hump Analysis - In August of 1999, three (3) Speed Humps were placed on Columbia Avenue by the town’s Department of Public Works’ personnel. The humps were made of asphalt, twelve feet in width and four inches above the existing road surface at their center point. The first was installed 450’ from Columbia Avenue’s intersection with East Hartsdale Avenue; the second 177’ feet further north and the third 242’ north of hump number two. All of the devices were located on Columbia Avenue within the 3/10-mile distance between its intersection with East Hartsdale Avenue and Lawton Avenue, the first intersecting street off Columbia.

![Figure 2](image)

**Figure 2**
Street Layout (Not to Scale)

Traffic surveys were conducted on Columbia Avenue on two occasions subsequent to the placement of the devices. The first of these studies was performed in April of 2000. This review showed a daily average of 2,170 vehicles per day proceeding at an average speed of 18 mph, with the median at 17 mph. The 85th percentile speed was 22 mph.

The final study was completed in June of 2001. The average daily use in this study was 2,322 vehicles per day traveling at an average speed of 20 mph. The median was 18 mph and the 85th percentile speed was 23 mph.
In both these studies the registration tubes for the traffic counters were located between Speed Humps. As part of the June 2001 analysis, a second counter was also placed on Columbia Avenue near Lakeview Avenue to evaluate traffic speeds and volumes further north of the area where the devices were located. Unfortunately a tube failure resulted in dated being collected on only 1,896 vehicles. Although the sample was somewhat limited, the vehicles tallied did display speeds comparable to those noted between the Speed Humps. The average speed was 23 mph; the median 22 mph and the 85th percentile speed 28 mph.

Citizen Response – On June 21st, 2000, about ten months after the Speed Humps had been placed, a questionnaire was distributed to the eighty-six (86) households who lived adjacent to Columbia Avenue. Forty-one (41) or about 48% of the surveys were returned. Respondents were asked to answer nine questions by checking off the box that most appropriately described their feelings about the devices. A place for comments was also included on the form. The results of the survey were as follows. Percentages are rounded off to the nearest whole number.

Question 1. Do you believe the speed humps on Columbia Avenue have slowed the speed of traffic using the road? (if no, skip to question 3)
Response: YES 29 (71%) NO 12 (29%)

Question 2. If you believe traffic has been slowed, please check the appropriate box that best depicts how much.
Response: CONSIDERABLY 11 (38%) A LITTLE 17 (59%) CANNOT ESTIMATE 1 (3%)

Question 3. Do you believe the speed humps on Columbia Avenue have reduced the number of vehicles using the road? (if no, skip to question 5)
Response: YES 8 (20%) NO 33 (80%)

Question 4. If you believe that traffic has been reduced, please check the appropriate box that best depicts by how much.
Response: CONSIDERABLY 5 (63%) A LITTLE 2 (25%) NO ANSWER 1 (13%)

Question 5. Do you feel safer with these devices installed on your street? (if no, skip to question 7)
Response: YES 24 (59%) NO 15 (37%) NO ANSWER 2 (5%)

Question 6. If you feel safer, please check the appropriate box that best depicts how much.
Response: CONSIDERABLY 8 (33%) SOMEWHAT 9 (38%) A LITTLE 5 (21%) CANNOT ESTIMATE 1 (4%) NO ANSWER 1 (4%)

Question 7. State and federal regulations require that warning signs and road markings be placed on the approaches to a speed hump. The department has received some complaints that these signs and markings are unsightly and adversely affect the aesthetic value of the resident’s property. Do you agree?
Response: YES 19 (46%) NO 22 (54%)
Question 8. In general, do you believe the installation of speed humps on Columbia Avenue has improved or detracted from your quality of life?

Response: IMPROVED 25 (61%) DETRACTED 12 (29%) NO ANSWER 4 (10%)

Question 9. After nearly ten months of having speed humps on Columbia Avenue, do you believe they should be retained or removed?

Response: RETAINED 29 (71%) REMOVED 10 (24%) NO ANSWER 2 (5%)

Noted below are some of the typical anecdotal comments received about the Speed Hump project. These were collected from the questionnaires and personal conversations with citizens.

“Parking is more uncomfortable on the bump.”

“This stupid, wasteful project should be ended by the removal of the humps. I believe this inane project was instituted because one hump who lives on Columbia Avenue and who does not reflect the views of most residents has pushed this project due to his traffic pattern fetish.”

“Please thank the individuals responsible for the installation of the speed humps.”

“These humps do nothing to slow down SUVs.”

“I think it would be a mistake to remove them.”

“Now cars speed – I feel they will lose control and hit a pedestrian in the street.”

“Trucks, landscapers, contractors and their cargo bounces over bumps at any rate of speed – very noisy.”

“Much safer for our children and walkers. Great idea, put more on Columbia.”

“The signs are most definitely unsightly and the quantity is uncalled for.”

“The street outside my house now resembles a runway at the Westchester County airport.”

Notwithstanding the fact that residents believed by a margin of nearly 3 to 1 that the Speed Humps should be retained on Columbia Avenue, it is obvious from these comments that passions against the devices and even the people who advocate their use, can be considerable. It is because of this that we have recommended that community input be sought prior to assigning serious consideration to any Speed Hump project.

VI. Closing Comments

This and numerous other studies have confirmed that Speed Humps have a place as a traffic-calming device. Speed Humps are self-enforcing, which over the long-term offsets what could be fairly significant installation costs and continuing maintenance expenditures. However, to be effective and to minimize liability they must be properly designed, installed and maintained. Speed Humps are not a universal remedy for traffic ills. Often, street use, topography or public opinion will render them an unsuitable alternative. Moreover, they
should never be employed as a substitute for proper transportation planning, subdivision layout and residential street design. Within these constraints, the Police Department finds that the Town of Greenburgh could derive considerable benefit through the implementation of a Speed Hump installation program.