

# **An Evaluation of Speed Cushions on Neighborhood Streets: Balancing Emergency Vehicle Mobility with Traffic Calming Needs**

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## **INTRODUCTION**

Local jurisdictions frequently respond to public concerns about speeding on neighborhood streets. When a speed study confirms that a significant percentage of vehicles are exceeding the posted speed limit, the traffic engineer carefully reviews roadway conditions to determine if additional safety measures need to be implemented. Preserving roadway safety for both the motorized and non-motorized public alike who share the roadway is essential.

Each jurisdiction is likely to employ a number of solutions from its traffic safety toolbox. Additional signing, use of mobile radar speed display units, neighborhood speed watch programs, and targeted police enforcement may discourage drivers from traveling at unacceptable speeds. Physical devices, such as traffic circles, speed humps, and speed tables can also be considered, but will likely impact emergency vehicles by increasing their response times.

To balance increased driver awareness of travel speeds with emergency vehicle accessibility, King County Department of Transportation installed a set of ten speed cushions along 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South between South 288<sup>th</sup> Street and South 298<sup>th</sup> Street as part of a pilot project. To evaluate the effectiveness of this traffic calming device, speed and volume studies were conducted before and after installation.

The information presented here serves as a companion document to the presentation that was given at the 2006 ITE Annual Meeting and Exhibit, in Milwaukee, Wisconsin.

## **BACKGROUND**

This pilot project was carried out on 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South, an urban, north-south, neighborhood collector (see Figure 1). The width of this roadway, 38 feet from vertical curb to vertical curb, provides adequate space for one travel lane in each direction and on-street parking on both sides. Pedestrians and other non-motorized users must share this space since neither sidewalks nor designated shoulder areas exist. There are no lane markings on this neighborhood roadway. (As a general guidance, the King County Department of Transportation does not place edgelines and / or centerlines on residential roads unless there are compelling reasons to do so. To maintain a "quiet, non-arterial appearance", pavement markings are usually reserved for roadways where speeds and volumes are higher.)

Prior to the installation of speed cushions, volumes on this neighborhood collector ranged from over 900 vehicles per day (both directions) on the north end to nearly 1,800 vehicles at the south end. Average vehicle speeds ranged from 24.2 miles per hour to 28.2 miles per hour on a roadway posted at 25 miles per hour.



FIGURE 1 : PHOTO OF 36<sup>th</sup> PLACE SOUTH / 39<sup>th</sup> AVENUE SOUTH / SOUTH 294<sup>th</sup> STREET / 45<sup>th</sup> PLACE SOUTH (BEFORE)

In response to long-standing neighborhood concerns regarding speeding, reckless driving, and side-swiping of on-street parked vehicles, staff from the King County Department of Transportation's Traffic Engineering Section held a series of public meetings and led public outreach efforts to discuss alternatives to improving traffic safety. For this neighborhood, there was strong consensus that the installation of preventative traffic calming devices be under consideration, although staff explained that existing speed and volume data indicated that roadway conditions were similar to those of comparable neighborhood collectors. Staff members recognized, however, that the candidate roadway, with long sight lines in places, manageable traffic volumes, and documented cases of reckless driving, could serve as a test location for the implementation of speed cushions. As a result, King County created a pilot project at this location.

## DESIGN DEVELOPMENT

To determine an appropriate speed cushion design, staff from the King County Department of Transportation conducted on-site investigations of similar devices in neighboring jurisdictions, discussed possible design features with local fire department personnel, and reviewed existing data and design standards. Special consideration was given to the different track and vehicle widths of passenger and emergency vehicles.

As a reference for practitioners, Tables 1 and 2 provide information on the different spacing of passenger and emergency vehicles that are commonly in use today on nationwide roadways.

TABLE 1 : TRACK WIDTH AND VEHICLE WIDTH OF MOST POPULAR VEHICLES IN THE U.S.

	<u>Vehicle</u>	<u># Sold</u>	<u>Track Width</u>	<u>Vehicle Width</u>
1	Ford F-Series	901,463	67.0"	78.9"
2	Chevrolet Silverado	705,891	65.0"-66.0"	78.5"
3	Toyota Camry	433,703	60.4"-60.8"	70.7"
4	Dodge Ram	400,543	67.9"-68.6"	79.5"
5	Honda Accord	369,293	61.1"-61.2"	71.3"
6	Honda Civic	308,415	59.0"-60.2"	68.9"
7	Nissan Altima	255,371	61.0"-61.2"	70.4"
8	Chevrolet Impala	246,481	61.5"-62.4"	72.9"
9	Chevrolet Malibu	245,861	59.3"-60.0"	69.9"
10	Chevrolet TrailBlazer	244,150	62.1"-63.1"	74.7"

SOURCE : J.D. POWER AND ASSOCIATES, AUTOMOTIVE NEWS DATA CENTER, 2005

TABLE 2 : TRACK WIDTH AND VEHICLE WIDTH OF SELECTED LIFE SAFETY VEHICLES

<u>Ambulance Manufacturer</u>	<u>Track Width</u>	<u>Vehicle Width</u>
Lifeline	72.0"-75.2"	92.8"-96.0"
Horton	n / a	94.3"-96.3"
Braun	n / a	96.0"
Road Rescue	n / a	90.0"-96.0"
Demers	74.5"-78.8"	94.0"
<u>Fire Engine Manufacturer</u>	<u>Track Width</u>	<u>Vehicle Width</u>
H & W	73.8"-82.8"	96"
Pierce Manufacturing	n / a	96"-101"

SOURCE : VARIOUS COMPANY WEB-SITES (SEE REFERENCE LIST FOR MORE INFORMATION)

Based on this review, the King County Department of Transportation created a design in which the center speed cushion was 84 inches wide. The adjacent cushions to the left and to the right of this center cushion were spaced 18 inches away. The intent of this design was to allow most emergency vehicles to straddle the center cushion and drive through each set of speed cushions without having to noticeably slow down, and to prevent most passenger cars and trucks from making the same maneuver. Each speed cushion, patterned after the shape of a traditional speed hump, was designed to be 3 inches in height and 14 feet in length. The final design and layout of the King County speed cushion is shown in Figures 2 and 3.

To prevent drivers from reaching undesirable speeds between each speed cushion, engineers conducted a careful field review to determine the best placement of each speed cushion along this roadway. Field engineers wanted to balance effectiveness without having to install an excess number of devices. Since 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South was nearly one mile in length, a total of ten speed cushions were installed, with the spacing between each set of cushions ranging from 366 feet to 761 feet. The placement of each cushion was dependent on field conditions, including, but not limited to, driveway locations, proximity to intersections, and sight distance concerns.

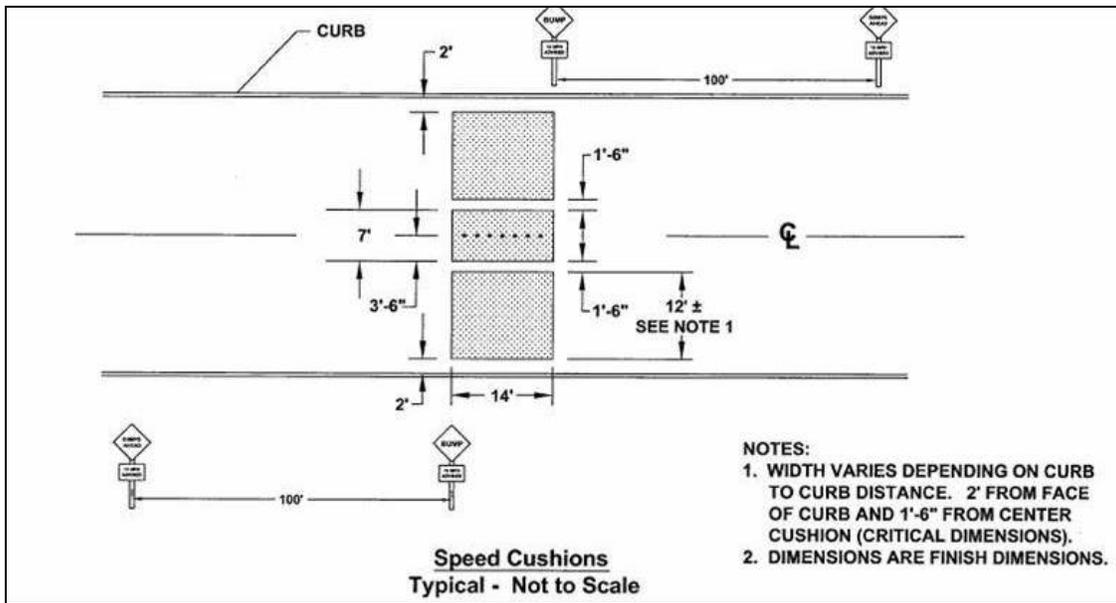


FIGURE 2 : SPEED CUSHION LAYOUT (PLAN VIEW)

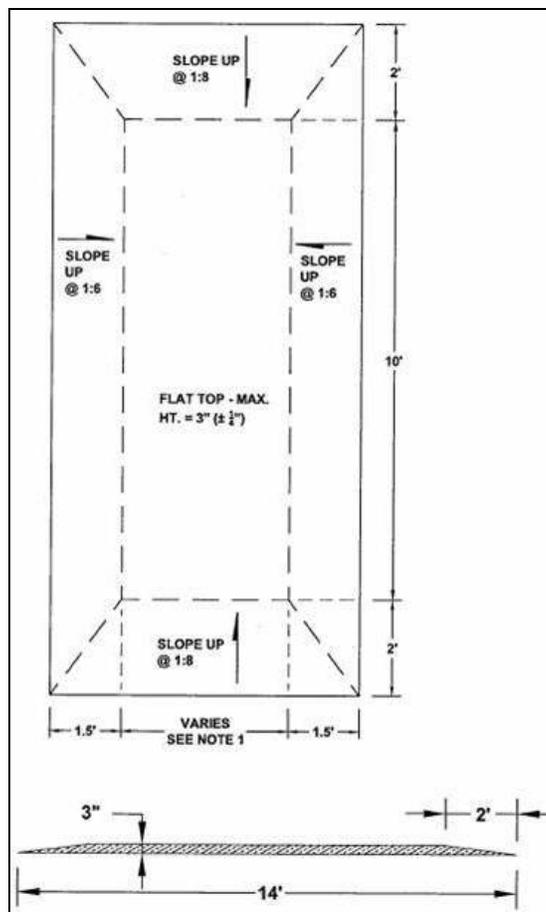


FIGURE 3 : SPEED CUSHION SPECIFICATIONS (PLAN VIEW)

## CONSTRUCTION SPECIFICATIONS

Each speed cushion was constructed using Class B, asphalt concrete pavement. The cushion was rolled and then hand-tamped using a plate compactor by King County Road Maintenance Division staff. The edges were subsequently crack-sealed to minimize deterioration over time.

To provide guidance to drivers, a white arrow was painted on the roadway surface in advance of the speed cushion. Raised pavement markers were installed on top of the center cushion to provide additional guidance. Appropriate warning signs were also installed at each location.

Figure 4 shows one of the speed cushion installations with signage and pavement markings after construction.



FIGURE 4 : PHOTO OF 36<sup>th</sup> PLACE SOUTH / 39<sup>th</sup> AVENUE SOUTH / SOUTH 294<sup>th</sup> STREET / 45<sup>th</sup> PLACE SOUTH (AFTER)

## RESULTS

To evaluate the effectiveness of these traffic calming devices, volume and speed counts were conducted at two different locations along this corridor before and after the installation of the speed cushions (see Figure 5). Traditional rubber hose technology was used to collect this data over a three-weekday period. For the after condition, special attention was given to place the counters at the midpoint location between two sets of speed cushions to minimize the influences of slowing by drivers either approaching or departing from a nearby device.

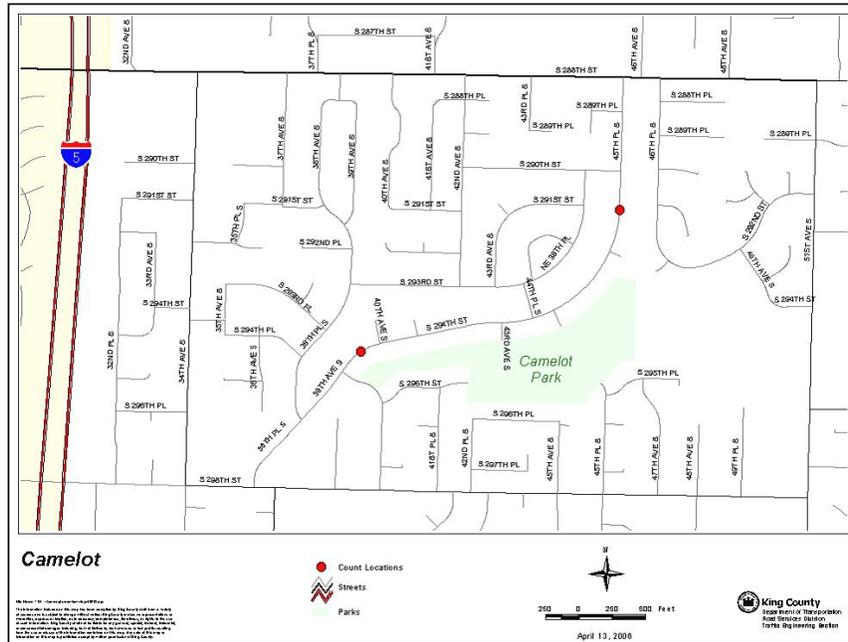


FIGURE 5 : LOCATIONS OF TRAFFIC SPEED AND VOLUME COUNTS

Traffic speed and volume counts were collected in September 2002, June 2003, and May 2004 prior to installation of the speed cushions. Count data were collected after installation in October 2004 and April 2005. The results indicate that, in general terms, average speeds and volumes at both locations decreased after installation of these traffic calming devices. A summary of the before and after data is shown in Table 3.

TABLE 3 : SPEED AND VOLUME DATA – (BEFORE AND AFTER)

	<b>39th Place South, south of South 294th Street</b>					
	northbound			Southbound		
	AVG	STDEV	VOL	AVG	STDEV	VOL
Jun-03	24.18	5.47	1382	26.14	5.73	1319
May-04	24.60	5.05	1497	25.92	5.30	1424
Oct-04	21.02	5.39	1026	22.53	5.88	1002
Apr-05	22.49	5.54	993	22.04	5.69	957

	<b>45th Place South, south of South 290th Street</b>					
	northbound			Southbound		
	AVG	STDEV	VOL	AVG	STDEV	VOL
Sep-02	27.70	6.81	1427	26.92	6.61	1422
Jun-03	27.72	5.95	1412	25.99	5.85	1359
May-04	28.20	5.80	1425	25.41	5.24	1386
Oct-04	20.65	5.64	1004	21.43	5.82	914
Apr-05	20.76	5.03	1028	21.68	5.15	1007

## CONCLUSIONS

Since installation of these speed cushion devices, staff at the King County Department of Transportation has received favorable feedback from both the residents who live along 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South and the local fire department personnel.

A number of specific findings, discussed below, may be beneficial to practitioners who have installed or are considering implementation of this device:

- The reduction in traffic volumes along 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South indicates that the installation of speed cushions has caused some dispersal of traffic to other neighborhood roadways (undesirable) and nearby arterial roadways (desirable). Some drivers likely used this roadway as a “cut-through” route before speed cushions were installed, and staff recognized that a redistribution of traffic onto adjacent neighborhood roadways was possible. To address this concern, homeowners who lived on these adjacent roadways were contacted prior to installation and informed of the potential repercussions. King County then required that at least 60% of all impacted homeowners within the impacted area – an area that included both the homeowners who lived along 36<sup>th</sup> Place South / 39<sup>th</sup> Avenue South / South 294<sup>th</sup> Street / 45<sup>th</sup> Place South as well as those who did not - sign a petition in which they acknowledged that they were aware of this project and agreed to the potential changes in neighborhood traffic circulation.
- While the local Fire Department prefers that roadways remain clear of traffic calming devices, the speed cushion design seems to have minimized the increase in response times that are typically experienced by emergency services personnel when traveling over or around traditional traffic calming devices. As a result, response from this area’s fire department personnel has been generally positive. It should also be pointed out that this route has not and does not function as a primary response route.
- King County is currently in the process of analyzing video footage to determine compliance levels of this device in terms of whether or not a driver stays in his or her travel lane. An initial review indicates that a majority of drivers are not intentionally deviating from their normal travel path and straddling the center speed cushion in an attempt to minimize the impacts of this physical device.
- Within the Puget Sound region, a number of local jurisdictions have begun experimenting with speed cushions. Since there is not a “standard” regarding the design and associated markings, there are presently many variations of the speed cushion in terms of shape, materials used, color, and pavement markings currently in use on local roadways. To minimize potential confusion for local drivers, development of a “regional standard” should be considered as more speed cushions are likely to be installed in the future.

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