Speed Reduction While Accommodating Emergency Vehicles with Small Inner Track Widths

Sharla Cote, Engineer-in-Training
City of Regina

Paper prepared for presentation

at the Roundabouts and Traffic Calming: Sustainable Infrastructure Assets Session

of the 2007 Annual Conference of the
Transportation Association of Canada
Saskatoon, Saskatchewan

ABSTRACT

The City of Regina implemented speed cushions, which are new to Regina, on Whelan Drive. The high speeds and proximity to an elementary school and two parks contributed to why Whelan Drive was selected to be the location of this pilot project.

Speed cushions were used instead of conventional speed humps due to the need to provide unimpeded access for emergency vehicles with small inner track widths while slowing down passenger vehicles. Regina Fire Department raised concerns regarding the time they lose driving over speed humps when responding to emergencies.

Conflict studies have been done to monitor the number of individuals that improperly use the speed cushions in order to determine if they are causing any additional problems. Speed studies have also been performed to measure the impact of the speed cushions on the 85th percentile, which is the speed which 85% of vehicles are travelling at or below. The studies were performed in the fall, winter and spring since installation in order to measure the ongoing success of the project.

Minor improvements can be made to make this design even more safe and desirable, such as additional signage, increased enforcement of crossing the centre line, and filling in one of the gaps.

With ongoing monitoring and implementation of some key suggestions, this pilot project could be a positive solution to speeding problems on residential and collector streets, yet still provide the fast and safe passage of emergency vehicles.

1.0 Introduction

1.1 Project History

The City of Regina has a Traffic Calming Program wherein locations that are deemed to have speeding or shortcutting problems are analysed based on a variety of criteria in order to assess which locations are the most critical.

As part of this program, the location of Whelan Drive between Reed Place and Radway St was determined to need some type of traffic calming installed in 2006 to reduce speeds and improve pedestrian safety.

The speed cushions needed to accommodate the small inner track width of City of Regina Fire Department pumper trucks and were designed accordingly. The resulting unique design is considered a pilot project in Regina and is being regularly monitored for its effectiveness and possible safety risks. If it is considered a success based on lowering the 85th percentile while not posing a new safety hazard, it may be implemented in other areas of the city.

1.2 Site Characteristics/Initial Conditions

1.2.1 Traffic Characteristics

Whelan Drive is a collector street which carries approximately 5,000 vehicles per day (vpd) (1). It is an important east-west connection for residents in the northwest area of Regina, providing access to major roads such as McCarthy Boulevard, Rochdale Boulevard and Courtney Street. Whelan Drive is not a bus route and the majority of vehicles using the road are passenger vehicles.

1.2.2 Surrounding Land Use

The surrounding land uses include an elementary school with approximately 300 students (2), single-family housing and access to Lakewood Park and Whelan/Radway Park. Lakewood Park is a large, well-used park containing walkways connecting many different neighbourhoods, multi-purpose gazebo, tennis courts and a large pond. Figure 1 shows the portion of Whelan Drive in discussion, including the surrounding land uses.

Figure 1 – Whelan Dr Project Boundaries and Surrounding Land Use

1.2.3 Geometric Characteristics

Whelan Drive is 11 m wide curb-to-curb with two driving lanes and two parking lanes. The grade of the road at Lakewood Drive is 3.14% and as it progresses eastward, it levels out to 0.5%. There were no drainage issues at this location. There are 1.5 m wide sidewalks on both sides of the street.

1.2.4 Signage and Pavement Markings

Like most residential collectors in Regina, the road did not have any pavement markings prior to traffic calming. The south parking lane in front of the school is signed as no stopping for most of the length of Whelan Drive in the study area. There is an all-way stop at Radway Street and Whelan Drive and stop controls on all side streets in the study area.

1.2.5 Speed Characteristics

This location has a 40 kilometres per hour (km/hr) posted speed limit due to the proximity to the elementary school. This speed limit is in effect between 8:00 a.m. and 10:00 p.m., every day of the year. Prior to traffic calming, a spring 2006 speed study found that the 85th percentile at this location was 50 km/hr, well above the posted speed limit.

1.2.6 Pedestrian Characteristics

Whelan Drive has a pedestrian corridor with overhead sign signs and flashing lights, as well as a painted crosswalk. This pedestrian corridor is located east of the main entrance to the school at the Lakewood Park entrance. A 2005 pedestrian count showed that over the noon-hour, over 100 pedestrians crossed at this location.

At the intersection of Whelan Drive and Lakewood Drive there are side-mounted pedestrian signs for east-west traffic on Whelan Drive.

1.2.7 Collision Data

The most recent collision data available is to the end of 2004. The most recent five-year collision history (2000-2004) showed a total of seven collisions along this corridor. One of these collisions involved a young pedestrian. There were no fatalities on this segment during the five-year period.

2.0 Traffic Calming Analysis

Based on the existing conditions and studies that had been performed, City of Regina Traffic Engineering staff determined that some form of traffic calming needed to be implemented at this site. The fundamental problem was a speeding/pedestrian crossing conflict. Since the pedestrian corridor, painted crosswalk and reduced speed limit were already in place, it was decided that vertical deflection was needed to physically slow the drivers down.

While Regina has implemented typical speed humps in other locations, Traffic Engineering staff had been made aware that the Fire Department was strongly opposed to them. They observed that the speed humps slowed down their fire trucks, which can be a critical amount of time in an emergency. For this reason, Traffic Engineering staff decided to explore different alternative forms of vertical deflection.

Ultimately, speed cushions were determined to be the next best option to slow down vehicles on Whelan Drive.

3.0 Speed Cushion Design

3.1 Speed Cushion Definition

A speed cushion is a raised area of a roadway, which deflects both the wheels and the frame of a traversing vehicle, similar to speed humps (3). Most vehicles will have to take the speed cushion with one side of the vehicle's wheels on the

cushion and one side on the road. The purpose of a speed cushion is to selectively reduce vehicle speeds of passenger cars (4).

3.2 Design Considerations

The main determinant of the design of these speed cushions involved the width of inner track width of the biggest pumper fire truck. Project participants were surprised to discover that the inner track width of the fire truck was 1.18 m, roughly the same width as many passenger vehicles. This similarity meant that whatever design that was chosen must allow for fire trucks to pass over unimpeded, but not allow other vehicles with the same inner track width to pass over them the same way and defeat the purpose of the speed cushions.

Other things taken into consideration were spacing of the speed cushions, height and width of the cushions, potential parking restrictions, maintenance, pavement markings and signage.

3.3 Final Speed Cushion Design

The final design of the speed cushions are shown in Figure 2, with a more detailed description described at the end of this section. The recommended layout of the three sets of speed cushions are shown in Figure 3.

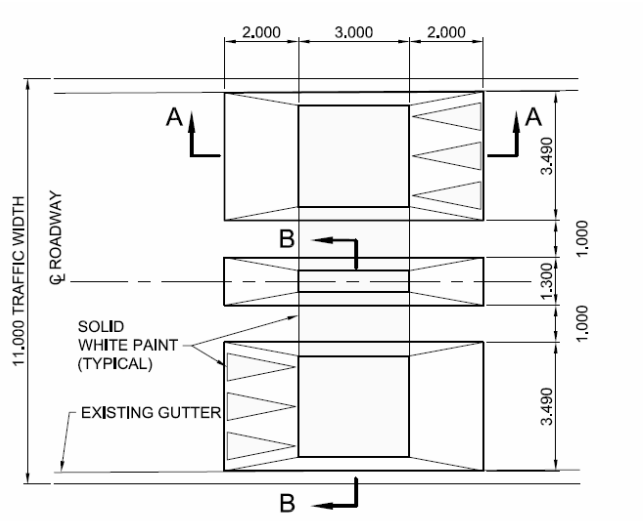

Figure 2 – Speed Cushion Design Details

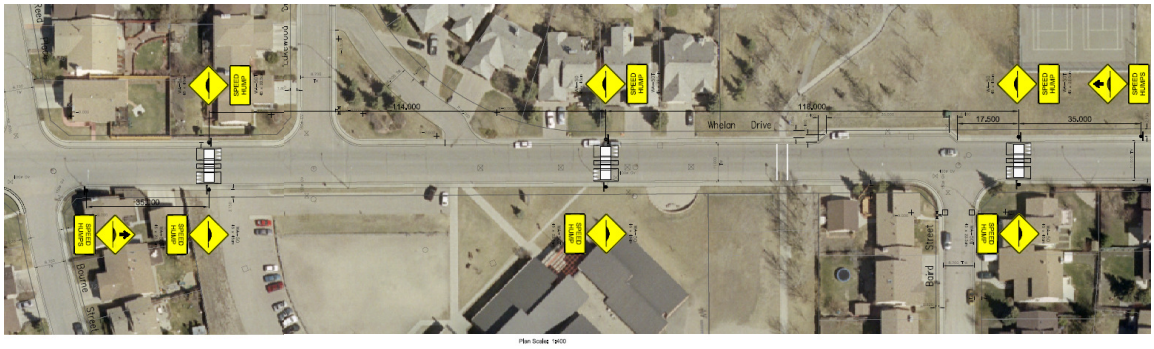

Figure 3 – Layout of Speed Cushions on Whelan Drive

As shown, there is a small cushion that straddles the centre line of the road. The goal of this design is to allow emergency vehicles to drive over the centre speed cushion unimpeded. All other vehicles should drive over the side cushions, either with all four wheels over the side cushion or with two wheels in the gap and two wheels on the side cushion. By painting a yellow centre line down the middle of the road, it would make it illegal for non-emergency vehicles to drive over the centre hump, according to City of Regina Traffic Bylaws. While it was acknowledged that there is physically nothing to prevent non-emergency vehicles from driving over the centre cushion, this was viewed to be a pilot project designed to attempt to provide both traffic calming and unimpeded emergency vehicle access at the same time.

The following list describes the features of the speed cushions and the rationale behind them.

- Height – 90 millimetres (mm)
    - TAC guidelines suggest a typical speed hump height of 80 mm (3). The 90 mm height selected for these speed cushions was in anticipation of the diminished effect that taking the speed cushions with two wheels on the flat road and two wheels on the speed cushion would have. It would also discourage people with low-riding cars from taking the centre cushion.
- Width
    - Centre Cushion – 1.30 m
        - The 1.3 m width would allow 1.18 m wide fire truck to pass over the centre cushion completely unimpeded
    - Side Cushion – 3.49 m
        - The two side cushions were made 3.49 m so they would span from the curb to the centre cushion, with 1.00 m in between the side cushions and the centre cushion. These 1.00 m gaps allow for enough extra space for the fire trucks to driver over the gaps without needing to slow down to precisely line up with them.
- Length – 7.00 m overall

    - As per TAC guidelines (3)
- Distance between sets of speed cushions – approximately 115 m
    - Placement of the three sets of cushions worked out well, spaced at least 30 m from intersections. The centre hump was spaced exactly between the front lawns of two houses so it was as far away from the driveways as possible.
- Signage – Speed hump WA-50 signs (Figure 4) installed in both directions at each set of speed cushions. “Speed hump ahead" signs (Figure 5) installed 35 m in advance of first set of speed cushions in both directions. The decision to use speed hump signs over speed cushion signs was based on not wanting to create unnecessary confusion over a new term. Since the speed cushions have a similar purpose and appearance to speed humps, it was decided that they would be referred to as speed humps.

Figure 4 – WA-50 Speed Hump Sign

Figure 5 – “Speed Hump Ahead” Sign

- White painted arrows – 3 on each side cushion, 1 on the centre cushion, both directions
    - To indicate the vertical deflection to drivers, as per TAC guidelines (3)
- Painted yellow centre line
    - This road previously did not have a painted yellow centre line, so installing one would make it illegal, according to City of Regina Traffic Bylaws, for any vehicles other than emergency vehicles to cross the centre line and drive over the centre cushion.
    - The line breaks approximately 60 centimetres in advance and after each cushion. This was done due to the complexity of painting the centre line over the narrow centre cushion.

4.0 Public Consultation

4.1 Emergency Services

The final speed cushion design was discussed with the Regina Fire Department, the Regina Police Service and Emergency Medical Services (EMS). All three organizations supported the new design and appreciated that their concerns were taken into consideration. The Fire Department was invited by Traffic

Engineering to bring their largest fire truck on site during construction to ensure that the new design would work for them. This was done on the first day of construction and was a complete success. Painted lines were drawn on the pavement to indicate where the cushions were to be built and the fire truck slowly drove through the painted gaps. This on site meeting was critical, as we discovered that the fire truck wheels needed approximately 30 cm more than had been originally designed. This additional gap space was needed so the fire trucks don't have to slow down in order to align themselves to the narrow gaps.

4.2 Neighbourhood Mail Drop

Regina's Traffic Calming Program requires the approval of at least two-thirds of residents that are directly impacted by the traffic calming i.e. those with frontage on the proposed street. For this reason, the City hand-delivered open house notices to the approximately 40 houses that would be directly impacted by having speed cushions in front of or adjacent to their home. These notices were different from all the others in that they gave more detailed information and had a survey on the back so those people who couldn't attend the open house could fill it out and mail it back. The City of Regina wanted to ensure that those people still had an opportunity to have their say in the project.

4.3 School Mail Drop

Since the students at the adjacent elementary school would be the most obvious beneficiaries of the speed cushions, Traffic Engineering staff provided enough open house notices to be sent home with every student. This way, parents that do not live in the area would be notified of the open house.

4.4 City-Wide Notice

An open house notice in Regina's main newspaper provided awareness for citizens throughout the city that there would be an opportunity for them to come and see the design and voice their opinions before the construction began.

4.5 Open House Results

The open house was held on July 20, 2006 at the affected elementary school on Whelan Drive. Though it was less-than-ideal that the open house was held during the summer when children were not in school, it was felt that sufficient numbers of people would still be interested in attending.

Ultimately, 17 individuals came to the open house, which is not out of the ordinary for Regina. Providing the survey on the back of the neighbourhood mail drop was beneficial, as 35 household surveys were returned. Most comments had to do with requesting traffic calming at additional locations and the occasional concern regarding snow building up in between the gaps in winter.

The final results indicated that 83% of those who returned surveys were in support of the speed cushions. Since this was well over the required two-thirds, the project was approved and sent out to tender. The speed cushions were constructed on September 25, 2006, just weeks after the start of a new school year. To date, there have only been two calls from the public specifically about the installed speed cushions. Both of these calls were made before winter and voiced concerns over snow piling up in the gaps and causing vehicles to lose control.

5.0 Analysis

5.1 Preliminary Speed Study

A speed study was conducted three weeks after construction of the speed cushions to evaluate the initial effect on drivers' speeds. The results of this preliminary speed study were very promising and are described in Table 1. The average 85th percentile was reduced by 11 km/hr to 39 km/hr.

Table 1 – Preliminary Speed Study Results

	Number of vehicles	Mean Speed (km/hr)	Speed Differential (km/hr)	85th Percentile (km/hr)
9:30 a.m. – 10:30 a.m.	99	35	12	40
3:15 p.m. – 4:15 p.m.	256	32	15	38
Average	178	34	13	39

5.2 Winter Conflict Study

With a long winter season in Regina, it is important that the speed cushions are monitored for their effectiveness in the presence of winter conditions. In March, 2007, a conflict study was conducted to see how drivers were adjusting to the speed cushions in the presence of snow.

The objectives of the conflict study were to count the number of vehicles that drove over the speed cushions as desired ("Proper") and the number that drove over any of the centre cushions ("Improper"). The study was conducted on a school day between 10:00 a.m. and 11:00 a.m. and again between 11:45 a.m. and 12:45 p.m. The results are summarized in Tables 2 and 3.

Table 2 – Winter Conflict Study Results – 10:00 a.m.–11:00 a.m.

Eastbound	
Proper	Improper
52	3
(95%)	(5%)

Westbound	
Proper	Improper
35	9
(80%)	(20%)

Average	
Proper	Improper
43	6
(87%)	(12%)

Table 3 – Winter Conflict Study Results – 11:45 a.m.-12:45 p.m.

Eastbound	
Proper	Improper
86	3
(97%)	(3%)

Westbound	
Proper	Improper
89	7
(93%)	(7%)

Average	
Proper	Improper
87	5
(95%)	(5%)

The results indicate that during times when drivers know children are in school (Table 2), there were higher percentages of people that drove over the centre cushion. Another observation is that westbound drivers tend to take the centre cushion more often than eastbound drivers. Overall, it was satisfying to see that only 5 – 12% of drivers drove over the centre cushions.

Analysis of the details of which centre cushion(s) drivers took shows that of the drivers that drove over a centre cushion, 86% of them took the centre cushion from the middle set, which is located directly in front of the school. A possible explanation for this is that most on-street parking happens in front of the school near the middle set of cushions, so drivers feel compelled to drive closer to the centre of the road to avoid potential conflict with parked cars.

The following are additional notes from this conflict study:

- There was no snow in the gaps of the speed cushions; it is naturally packed down by drivers
- The snow on top of the speed cushions was packed similar to the snow on the road
- The road had been graded, however there was snow in the parking lanes, which could make drivers prefer to drive more towards the centre of the road
- There were no conflicts or confusion between drivers and pedestrians
- There were no “close calls” involving a driver taking the centre cushion when another vehicle was approaching in the oncoming direction
- There was sufficient traffic in both directions to make people not want to take the centre cushion
- A large truck parks in front of one house every day at the middle set of speed cushions, likely making vehicles want to drive closer to the centre of the road

Figures 6 - 8 show images of what the speed cushions look like in the winter, and how drivers look while using the speed cushions properly and improperly.

Figure 6 – Speed Cushions During Winter

Figure 7 – Proper Use of Speed Cushion

Figure 8– Improper Use of Speed Cushion

5.3 Spring Conflict Study and Speed Study

A spring conflict study and speed study were conducted in April, 2007. The purpose of the spring conflict study was mostly to monitor the longer-term impacts of the speed cushions during ideal driving conditions. A speed study was performed simultaneously, which will provide data to compare against the preliminary speed study from Fall 2006. The results of this conflict study are shown in Table 4.

Table 4 – Spring Conflict Study – 11:45 a.m.-12:45 p.m.

Eastbound	
Proper	Improper
51	3
(95%)	(5%)

Westbound	
Proper	Improper
61	17
(78%)	(22%)

Average	
Proper	Improper
56	10
(87%)	(13%)

The results show that a higher number of people drive over the centre cushions during dry, ideal conditions than during winter conditions. However, the difference is surprisingly low. On average, only 13% of drivers use the centre cushion; just 1% higher than the upper range observed during the winter. These results are promising, in that 87% of drivers are using the speed cushions responsibly.

The following are additional notes made during this study:

- There were no conflicts or confusion between pedestrians and drivers
- There were no “close calls” involving a driver taking the centre cushion when another vehicle was approaching in the oncoming direction
- There was sufficient traffic in both directions to make people not want to take the centre cushion
- The same large truck as in the winter conflict study still parks in front of one house by the middle set of speed cushions. Drivers in the spring sometimes elected to drive over the side cushion with all four wheels, meaning they got very close to the parked truck.

Figures 9 - 12 show images of what the speed cushions look like in ideal, dry conditions and how drivers look while using the speed cushions properly and improperly.

Figure 9 – Speed Cushion During Dry Conditions

Figure 10 – Speed Cushion During Dry Conditions – Alternate View

Figure 11 – Improper Use of Speed Cushion – Dry Conditions

Figure 12 – Proper Use of Speed Cushion – Dry Conditions

The speed study data is shown in Table 5. The average 85th percentile is 42 km/hr for both directions. This is a 3 km/hr increase from the Fall 2006 speed study done immediately after installation. The most recent speed data shows that the majority of drivers are still using the speed cushions responsibly. An 85th percentile of 42 km/hr is a great improvement over the 50 km/hr it was prior to speed cushions.

Table 5 – Spring Speed Study Results – 11:45 a.m.-12:45 p.m.

	Number of vehicles	Mean Speed (km/hr)	Speed Differential (km/hr)	85th Percentile (km/hr)
Eastbound	64	34	11	40
Westbound	78	37	14	44
Average	71	35	13	42

5.4 Overall Results

A summary of the results for all the speed studies are shown in Table 6. The results show an overall decrease of 8 km/hr from prior to installation of the speed cushions. This is a decrease typically found with regular speed humps, so it is very promising that this kind of decrease has resulted from speed cushions.

Table 6 – Overall Speed Data

	Average 85th Percentile (km/hr)	Overall Change (km/hr)
2005 – Pre-construction	50	
2006 – Immediately post-construction	39	-11
2007 – Spring	42	-8

Table 7 shows the difference between how drivers behave during winter and spring road conditions, based on the averages from the conflict studies. The data shows that drivers use the centre cushion an average of 4% more during dry road conditions.

Table 7 – Comparison of Winter and Spring Conflict Studies

	Proper	Improper
Winter – 10:00 a.m. – 11:00 a.m.	87%	12%
Winter – 11:45 a.m. – 12:45 p.m.	95%	5%
Winter Average	91%	9%
Spring – 11:45 a.m. – 12:45 p.m.	87%	13%

6.0 Recommendations

There are some key improvements that could be made to the existing speed cushions to reduce the ability of drivers to use the centre cushion, and in turn, improve the safety of this location. The following recommendations are shown by increasing complexity:

- Extend yellow painted centre line – As mentioned previously, the painted centre line stops and starts approximately 60 centimetres away from the speed cushion. With a little additional time and expense, these gaps in the line could be filled so there is a continuous centre line, further compounding the fact that it is wrong to drive over the centre cushion.
- Install new signs – Create some new signs that indicate to drivers that it is illegal and punishable by $50 to cross the centre line (5).
- Increase police enforcement – By occasionally doing some enforcement of crossing the centre line, the number of drivers that cross the centre line may be reduced.
- Restrict parking near speed cushions – By restricting within 30 m on either side of each set of speed cushions, the number of people who use the centre cushion to leave space for the parked cars would likely be reduced since the parked cars would no longer be able to park there. This parking restriction would be in effect during school hours, but would allow for residents to park on street at night. This could be a sensitive issue as many people feel entitled to the parking lane directly in front of their home.
- Fill in the westbound gaps – The majority of improper driving over the centre cushions were done by westbound drivers. By filling in the gaps with additional asphalt in just the westbound direction, the majority of offenders would not be able to use the centre cushions, and fire trucks would be able to have one set of wheels in the other gap and one set of wheels on the side cushion. This would require negotiations with the fire department to determine whether or not they feel comfortable with that.

7.0 Conclusion

The speed cushion pilot project undertaken by the City of Regina has been a success in that it has reduced the 85th percentile to values that are considered acceptable. In addition, while the design is new to Regina residents and has potential for conflicts between drivers, there have been no significant problems created by the speed cushions. Overall, the project has done well, with a few minor improvements that can be made to make it even more successful. After any recommendations are implemented, the conditions will be reviewed to evaluate the impact of the improvement. The project will be reviewed once more in the fall at the one-year milestone to determine whether or not the design should be implemented at other locations.

8.0 References

(1) City of Regina, 2004 Traffic Flow Map.

(2) MacNeill Elementary School, http://macneill.rbe.sk.ca/ . Accessed on April 12, 2007.

(3) Transportation Association of Canada, Canadian Guide to Neighbourhood Traffic Calming. December, 1998.

(4) The Corporation of Delta, Neighbourhood Traffic Calming Policy and Procedures. Accessed April 12, 2007. http://www.corp.delta.bc.ca/assets/Engineering/PDF/roads_traffic_calming_policy.pdf

(5) City of Regina, Engineering and Works Department Traffic Bylaw #9900, Including Amendments to July 24, 2006.