



Section 2 - Introduction

City of Portland Speed Bump Peer Review

In the past, the effect of automobile travel on residential streets was not considered a critical factor in the overall quality of life in a residential area. In fact, transportation planners and engineers were not necessarily responsible for considering how roadway traffic volumes and travel speeds would affect the perceived quality of life in a specific area. More recently however, these measures have become important to neighborhood groups, and traffic engineers and transportation planners have become responsible for responding to neighborhood concerns over traffic volumes and vehicle speeds. One of the most effective ways to reduce traffic volumes and vehicle speeds on residential streets is to install traffic calming devices. These devices can include traffic circles, traffic diverters, median islands, curb extensions, and speed bumps.

The City of Portland's Traffic Calming Program (TCP) has been installing traffic calming devices since 1984 and is considered a leader in North America in traffic calming installation and design. To date, the City of Portland has installed over 500 speed bumps, more than 60 traffic circles, and many other traffic calming devices such as diverters, median islands, curb extensions, and slow points to the street system. The work has been viewed as a success partially because of the technical approach taken. Data is collected and analyzed both before and after each traffic calming project to determine project results and neighborhood livability impacts. Further, the City periodically performs a peer review of a specific traffic calming device, such as this review of speed bumps.

Project Description

The purpose of this project is to evaluate the impact speed bumps have on City of Portland streets. Each time the City installs a new series of speed bumps, the City of Portland TCP evaluates the impacts the speed bumps have on traffic volumes and vehicle speeds on the treated street (street with speed bumps installed) and nearby parallel streets. Thus, the City has a good understanding of how the speed bumps affect each individual street, but does not know collectively the advantages and disadvantages of speed bumps on a City-wide level. For this purpose, the City of Portland retained Kittelson & Associates, Inc. to conduct a peer review of the effectiveness of speed bumps in the City of Portland. The peer review investigated the effect of speed bumps on treated streets (speed bump streets) and nearby untreated streets (parallel streets) by evaluating the following performance measures:

Vehicle speeds: What is the impact on the overall speed of vehicles and the speed of the fastest vehicles?

Traffic volumes: What is the impact on the daily traffic volumes?

Vehicle crashes: What is the impact on the frequency, type, and severity of vehicle crashes?

Crime: What is the impact on crime statistics?

Emergency services: What impact do speed bumps have on fire response times and the number of emergency call responses?

Public opinion: What is the perception of speed bump effectiveness by residents living on or near the speed bump streets?

Three separate steps were taken in addressing these performance measures: 1) quantify the impact of speed bumps on the above issues separately, 2) evaluate the difference between the effectiveness of speed bumps and how the public perceives their effectiveness, and 3) determine the factors which control the effectiveness of speed bumps (referred to as "controlling factors" for this report) and understand the interrelationships between the above issues.

The first step can be thought of as answering the question, "How much...?" For example, quantifying the impact on vehicle speeds can be evaluated by answering the question: how much speed reduction is experienced as a result of installing speed bumps? Or, how much do speed bumps reduce traffic volumes? The answers to these questions will result in a quantitative result such as, traffic volumes on treated streets decreased by 150 vehicles (for example) as a result of installing speed bumps.

The second step evaluates the public perception of speed bumps in terms of the public's general opinion of speed bumps and how that public perception relates to the measured effectiveness of speed bumps (i.e. reducing speeds, volumes, and crashes).

The third step attempts to explain the reason for the quantitative impacts addressed in step one. The purpose of the third step can be thought of as answering the question, "Why...?". For example, why was there a reduction in traffic speeds and volumes? This answer will identify the factors controlling the traffic speeds, volume and crash reduction and their interrelationship, and provide a basis for recommendations for future speed bump installations.

Overall, this three-step process will lead to a comprehensive evaluation of the advantages and disadvantages of speed bumps on City of Portland streets. The remainder of the report presents the methodology and results of the peer review.

Project Process

This project was completed over a 14-month process, beginning in July 1997 and ending in September 1998. The project was completed in the following steps:

Select streets for study: Determine an adequate sample size of treated and nearby untreated streets for analysis. Ensure the study streets are as representative of all speed bump streets as possible.

Collect data for study streets: Collect vehicle speed, traffic volume, vehicle crash, crime frequency, and emergency response frequency data before and after speed bump installation on the study streets.

Conduct a public opinion survey: Develop, implement, and summarize the results of a public opinion survey distributed to residents living on or nearby a speed bump street.

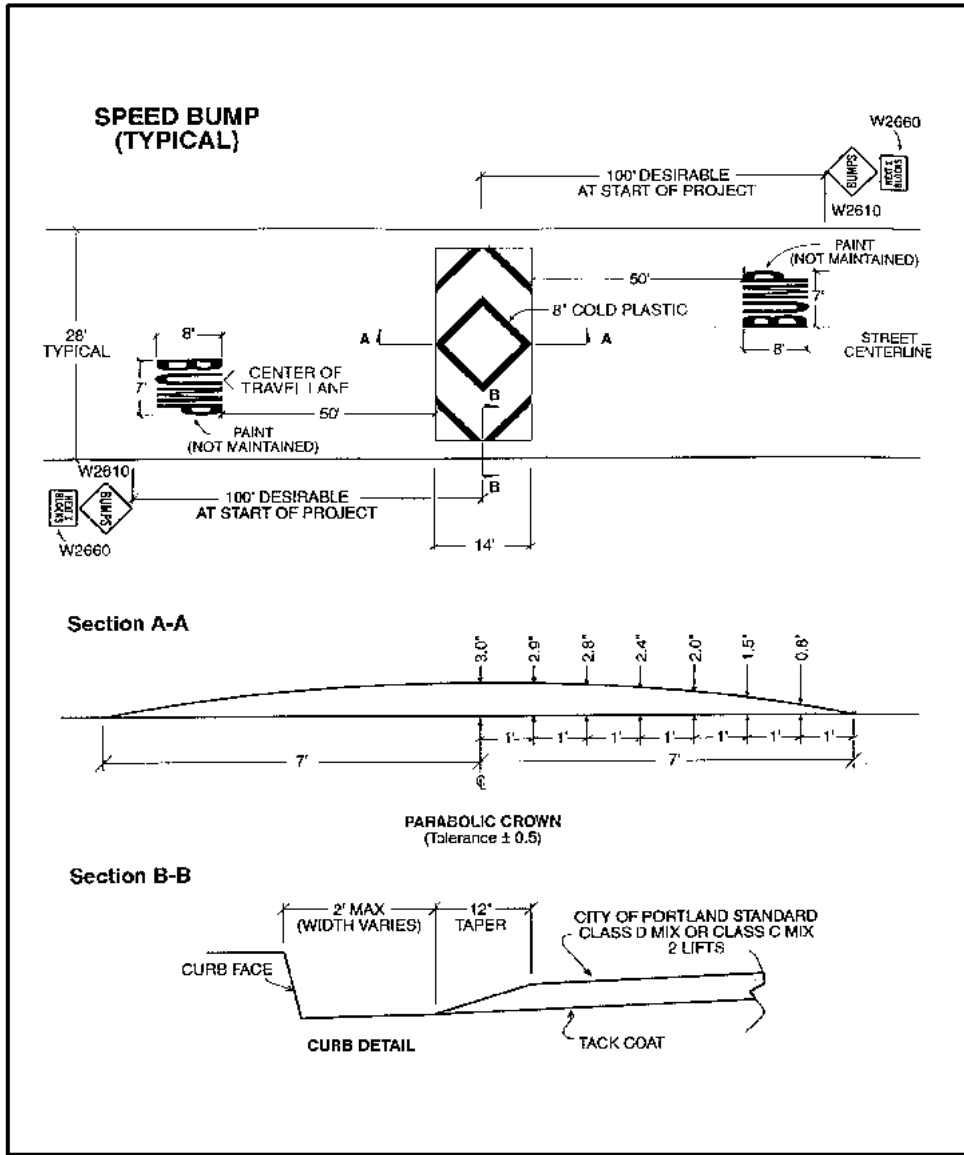
Analyze data: Analyze the data with the three-step process described previously: 1) quantify the impact of speed bumps on the above issues separately, 2) understand the perception of speed bumps by residents and how their perception matches performance, and 3) develop an understanding of the interrelationship between speeds, volumes, and crashes and the factors controlling these issues.

This report presents the results of each of these tasks and the recommendations made as a product of the information determined from these tasks.

Background, Terms, and Methodology

Speed Bump Design

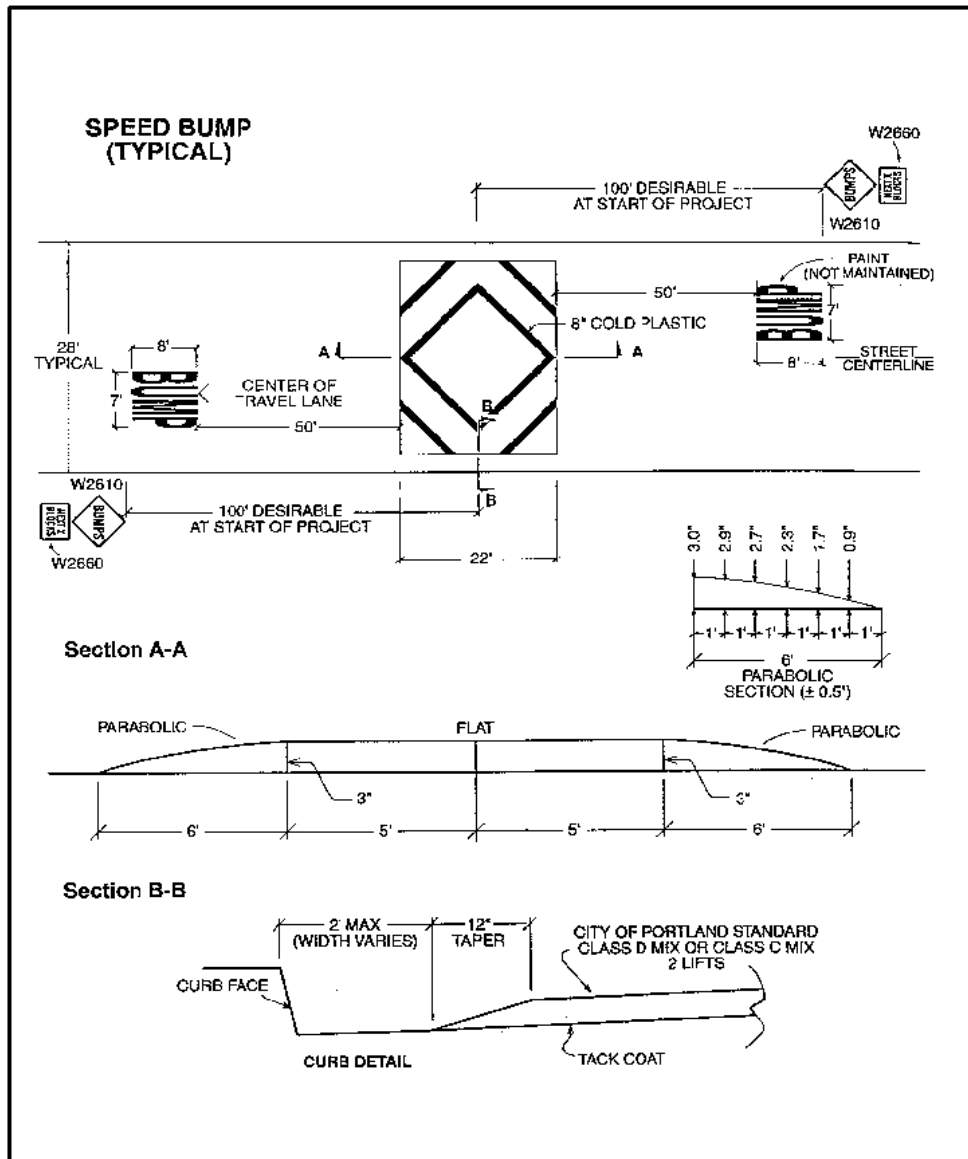
The City of Portland currently uses two different speed bump designs: the 14-foot speed bump and 22-foot speed bump. The 14-foot speed bump is 14 feet in length, three inches in height at the apex, and has a parabolic shape. The 14-foot speed bump is similar to the 12-foot bump developed by the Transport and Road Research Laboratory (TRRL) in Great Britain, which is widely used in other parts of the country. The 22-foot speed bump is 22 feet in length, three inches at the apex, and has a parabolic shape at the ends and flat top in the middle. The 14 foot and 22 foot designs are technically defined as speed *humps*. However, they are referred to as speed *bumps* in this report as this is the official term used by the City of Portland. Figures 7a and 7b show the design parameters of typical 14-foot and 22-foot speed bump designs.



14' SPEED BUMP DETAIL

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT OCTOBER 1998			FIGURE
			7A

18-27-DWG-5242-PORT-30P



22' SPEED BUMP DETAIL

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT OCTOBER 1998			FIGURE 7B
--	--	--	---------------------

1842-0003-2427-1-3 CDR

The City typically installs 14-foot speed bumps on low-volume local streets and 22-foot speed bumps on local streets that are transit routes and neighborhood collectors. The City has installed 12-foot bumps on three local streets in the past as part of the original speed bump testing, but does not install 12-foot bumps any longer. Of the 33 speed bump streets evaluated for this project, 26 streets have 14-foot speed bumps and the remaining seven streets have 22-foot speed bumps.

The spacing between speed bumps is determined on an individual street-by-street basis. The City typically places bumps between 300 and 600 feet apart, but spacing occasionally varies beyond this guideline.

Streets Studied

During the street selection phase of this project (October-November 1997) there were 99 streets with speed bumps. Studying all 99 streets for this project was not feasible due to the amount of data collection and analysis that would be required. Thus, the number of streets studied needed to be sufficient to perform adequate statistical analyses, yet not so large that the amount of data would require work greater than the scope and budget of the project. With these factors in mind, 30 to 40 streets were determined to be an adequate number for the analysis.

In deciding which streets to study, it was determined that the streets studied should be proportional to all speed bump streets in the City of Portland. For example, 74 percent of the 99 speed bump streets have 14-foot speed bumps; therefore, roughly 74 percent of the speed bump streets chosen in the sample size should have 14-foot speed bumps. The streets studied also needed to be representative of a number of other factors that characterize speed bump streets such as geographic location in the City, grid vs. non-grid street location (a grid location refers to streets spaced parallel to one another such as north/south and east/west streets on Portland's East side) street classification, and traffic volumes. Given this criteria, a total of 33 speed bump streets were selected and evaluated for this project. Figure 8 (not yet available here) shows a map of the 33 speed bump streets selected. Table 1 shows how closely the 33 study streets match the characteristics of all 99 City speed bump streets.

Table 1**Comparison of Study Speed Bump Streets and All Speed Bump Streets**

Characteristic	City of Portland Speed Bump Streets	
	33 Study Streets	99 Total Streets
Speed Bump Type		
14-foot	79%	74% ¹
22-foot	21%	23% ¹
Geographic Location		
N/NW	27%	20%
SW	15%	18%
NE	31%	27%
SE	27%	35%
Grid vs. Non-Grid		
Grid	79%	88%
Non-Grid	21%	12%
Street Classification		
Local Street	85%	86%
Neighborhood Collector	15%	14%
Average Daily Traffic (ADT)		
<1,000	34%	41% ²
1,000 - 2,500	33%	28% ²
>2,500	33%	31% ²
Fire Response Route		
Yes	24%	22%

Notes: 1. The remaining three percent have 12-foot speed bumps.

2. Based on data available for 64 speed bump streets.

To evaluate the effect of speed bumps on nearby streets, "parallel untreated" streets were also identified and studied. Parallel untreated streets are those streets which are nearby the speed bump street, have the potential for vehicle diversion, and are of equal or lower street classification than the speed bump street. Of the 33 speed bump streets studied, a total of 24 parallel untreated streets were identified for this project. However, before and after data was only available for 16 of the 24 parallel untreated streets. *Appendix A shows the 33 speed bump streets and 16 parallel streets studied for this project.*

An additional set of streets which are neither treated or parallel untreated streets could have been selected for the analysis in determining a

“control base” for the treated and parallel untreated streets. The purpose of a “control base” data set is to evaluate any underlying changes in speed, volume, or crashes which cannot be attributable to speed bumps. Example underlying changes could be a change in the police enforcement, a change in the general mentality of motorists to travel at a slower speed or wear their seat belts, an increase in safety of newer vehicles in comparison to older vehicles, or a general increase in traffic growth. Due to the short time period between collecting the before and after speed bump data, it was assumed that the effects of these “control” factors would be minimal on the data collected for this study. Thus, a finding that vehicle speeds reduced after speed bump installation may largely but not entirely be attributable to the installation of speed bumps.

Data Collection

Data collection was the most important component in developing findings and recommendations on the effectiveness of speed bumps. Due to the vast amount of data to be collected, it was the project component which necessitated the most time and effort. The following section describes which data was collected, how it was collected, and why it was collected.

Vehicle Speeds

Vehicle speeds were provided by the City of Portland Traffic Calming Program (TCP). The TCP recorded speed measurements before and after speed bumps were installed on each street. Speed measurements were taken between three and six months after the bumps had been installed and were recorded at approximately the midpoint between speed bumps. Three different measures of speed were collected by the City and analyzed for this project:

85th percentile speed - 85 percent of the vehicles travel at or slower than this speed (and 15 percent travel faster than this speed),

Percent traveling over speed limit - the percent of vehicles traveling faster than the speed limit. The speed limit is typically 25 mph on local streets and 25-30 mph on neighborhood collector streets.

Percent traveling 10 mph or more over speed limit - the percent of vehicles traveling 10 mph or more over the speed limit.

The first two measures are indicators of the overall vehicle speeds on a street, while the measure of percent traveling 10 mph or more over the speed limit measures the fastest vehicles on a street.

In addition to speeds midway between the bumps, data was collected to establish a “speed profile” for the following streets: NE 15th Avenue, SE Harold Street, N Dekum Street, SW Hamilton Street, SE 76th Avenue, and NE 111th Avenue. Speed data for these streets was collected directly on the bumps and at three points between the bumps. This gave a profile of the speed of vehicles over and between the speed bumps.

Traffic Volumes

Traffic volume data was provided by the City of Portland, which measured the average daily traffic (ADT) volumes on a mid-week day before and after speed bumps were installed on each street. The “after” data was collected between three and six months after installation of the bumps.

Vehicle Crashes

The City of Portland provided vehicle crash data from the Oregon Department of Motor Vehicles (DMV) on all treated and parallel untreated streets from three years prior to speed bump installation through the end of 1996. The DMV has not, as yet, compiled statistics from 1997. The DMV accident database only includes crashes reported to the DMV, so crashes that are not reported to the DMV are not included in this analysis. Each crash is categorized by date, time of day, location, type, severity, vehicle types involved, direction of travel prior to crash, and likely cause of the crash.

Crime Statistics

The City of Portland Police Bureau provided all reported crimes on the treated and parallel untreated streets from January 1990 to October 1997. Each crime is categorized by location, time of day, and type of offense.

Emergency Services

Emergency call records were provided by the City of Portland Bureau of Fire and Emergency Services on both the treated and parallel untreated streets in 1996 and 1997. This information is categorized by location, nature of the request, and date.

Public Opinion Survey

The survey was developed by the project team and distributed to residents living on a speed bump street or a neighboring parallel street. Approximately 1,200 surveys were distributed to eight different treated streets and their respective parallel untreated streets. *A copy of the survey and list of the streets surveyed is included in Appendix B. A disk containing the survey responses input into a QuattroPro spreadsheet has been provided to the City of Portland. The spreadsheet can be queried in numerous ways to further evaluate the results of the survey.* Overall, 400 of the 1,200 surveys distributed were completed and returned, translating to a return rate of 33 percent. The survey focused on the resident's perception of the effectiveness of the bumps in reducing speeds, volumes, and improving the safety and livability of the neighborhood.

Statistical Testing

This project used statistical testing on the before and after data to determine the impact of speed bumps on speeds, volumes and safety. For example, averaging all the 85th percentile speeds before and after bumps are installed, an average reduction of 7 mph is experienced (described in detail in the *Effect of Speed Bumps on Vehicle Speed* section of this report). Statistical testing was then performed to determine whether the 7 mph reduction is 'statistically significant'. If the 7 mph reduction is statistically significant, then it can be proven that there most likely is an actual reduction in speed due to speed bumps and it is not merely due to variability of the before and after data. Whether a difference in means (averages) is statistically significant is dependent on the variability of the individual means and sample size. As previously described, it was determined that at least 30 streets needed to be studied to make the statistical analyses valid.

For this project, a Paired t-Test was performed for all data sets (i.e. speed data, volume data, crash data) to determine whether there is a statistically significant difference in the means (averages) of the before and after data. In a Paired t-Test, a t-value is calculated as a function of the variance of the difference between means and the sample size. This t-value is then compared to the 95th percentile confidence level on a t distribution, which is approximately a value of 2.0. Thus, if the t-value is higher than 2.0, the difference in means is statistically significant. If the t-value is less than 2.0, the difference in means cannot be proven statistically significant at a 95th percentile confidence level. Overall, a higher t-value translates to a larger difference in means and thus better chance for statistical significance.

[PREVIOUS] Section 2 - Introduction [NEXT]
