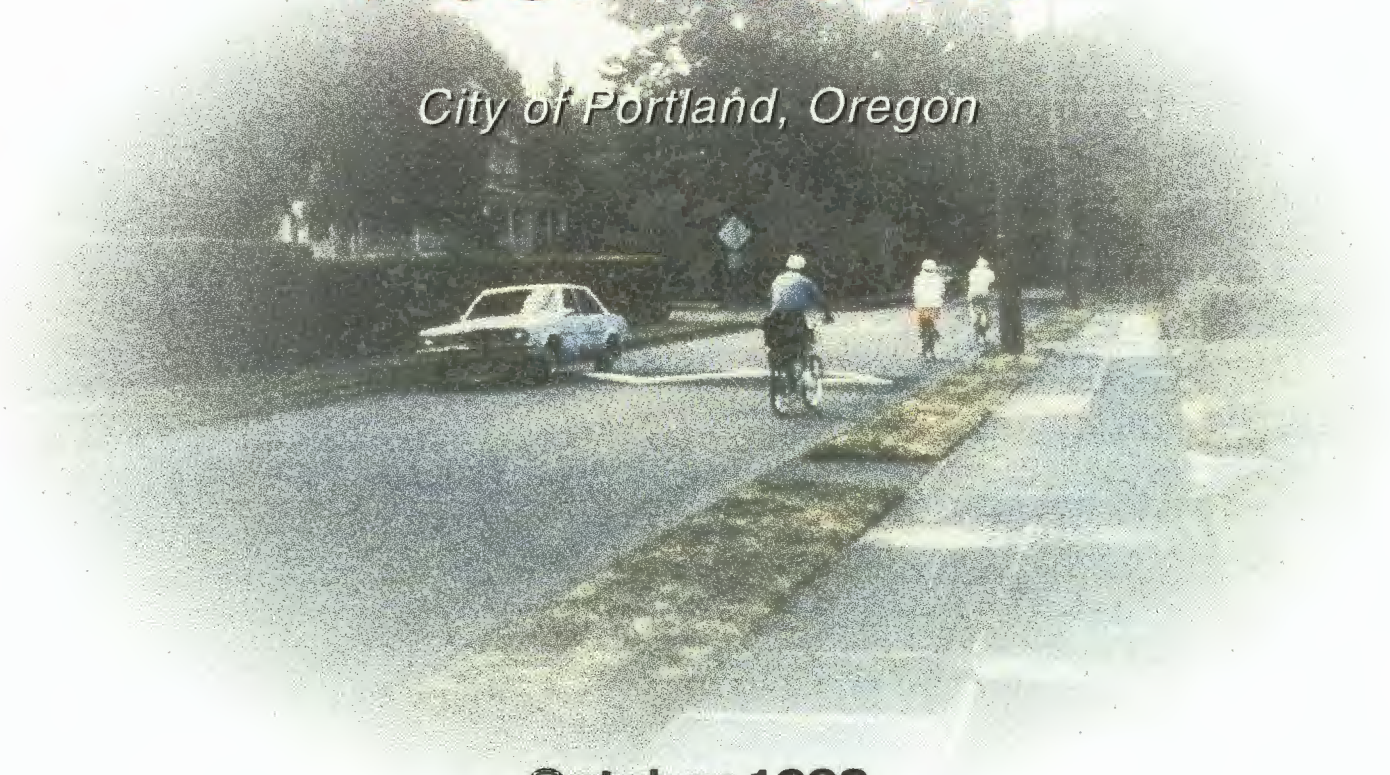
Transportation Engineering Report

City of Portland Speed Bump Peer Review



City of Portland, Oregon

October 1998

Kittelson & Associates, Inc.
Transportation Planning/Traffic Engineering

Transportation Engineering Report

City of Portland Speed Bump Peer Review

City of Portland, Oregon

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City of Portland Speed Bump Peer Review

Section 1

Executive Summary

Executive Summary

The City of Portland's Traffic Calming Program has installed over 500 speed bumps, more than 60 traffic circles, and many other traffic calming devices such as diverters, median islands, and curb extensions throughout the City. Each time the City installs a new series of speed bumps, the City of Portland TCP evaluates the impacts speed bumps have on traffic volumes and vehicle speeds on the treated street (speed bump street) 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. In this review, Kittelson & Associates evaluated changes in vehicle speeds, traffic volumes, crash statistics, crime statistics and emergency services after installation of both 14 foot and 22 foot speed bumps. The relationships between speed bumps and vehicle speeds, traffic volumes and crashes was also evaluated. In addition, a public opinion survey was conducted. The results of the peer review are summarized below by topic area for both 14 and 22 foot speed bumps.

VEHICLE SPEEDS

Speed bumps are an effective tool in reducing travel speeds to be consistent with posted speed limits. They are very effective in reducing the speeds of the fastest drivers. Speeds also decreased slightly (2 mph) on parallel untreated streets. More specifically:

- On average, 14-foot speed bumps reduced 85th percentile travel speeds by 6.9 mph to 25.8 mph after speed bumps were installed. This is approximately equal to a typical 25 mph speed limit on local streets.
- After the study streets were treated with 14-foot speed bumps, 20 percent of motorists on average were traveling at speeds greater than 25 mph (60% before). Further, only one percent of motorists were traveling more than 10 mph over the speed limit, as opposed to 14.5 percent before 14 foot bumps were installed.
- 22-foot speed bumps decreased 85th percentile travel speeds on average by 8.2 mph to 29.9 mph. This is slightly higher than a 25 mph hour speed limit on local streets, but on target with a 30 mph speed limit on neighborhood collector streets.
- After streets were treated with 22-foot speed bumps, 43 percent of motorists continued to travel at speeds over the speed limit (77% before); however, only 2.8 percent traveled at speeds more than 10 mph over the speed limit (22% before).

- The public perception survey revealed that 91 percent of residents of both speed bump and parallel untreated streets combined thought speeds were too high before speed bumps were installed. After installation, 69 percent of the treated streets residents perceived a reduction in speeds on their streets and only 6 percent perceived an increase in speeds. Parallel street residents were evenly split on the speed benefit, as 30 percent thought there was a decrease and 31 percent thought there was an increase on their own street.
- The survey revealed that the residents' perceptions about speed are consistent with the documented speed impacts. Overall, residents of speed bump streets see more of a speed benefit than parallel street residents, which corresponds to the actual speed data.

Figure 1 shows before and after 85th percentile travel speeds on streets treated with speed bumps (both 14-foot and 22-foot), parallel untreated streets and the combination of all study streets. Overall, with installation of speed bumps the average 85th percentile travel speed on the treated and parallel untreated study streets combined decreased 5.4 mph to 27.5 mph.

Figure 1
Effect of Speed Bumps on 85th Percentile Speeds

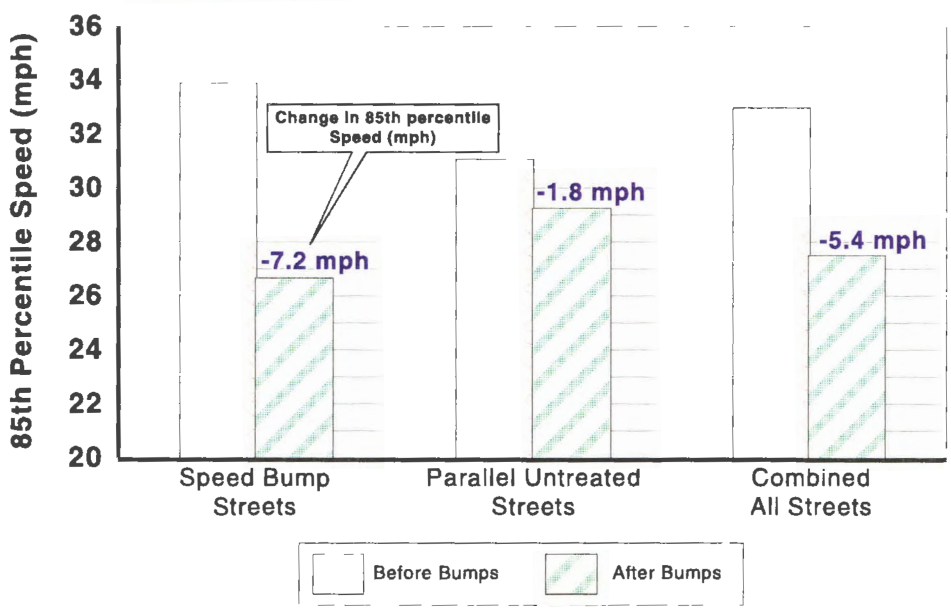
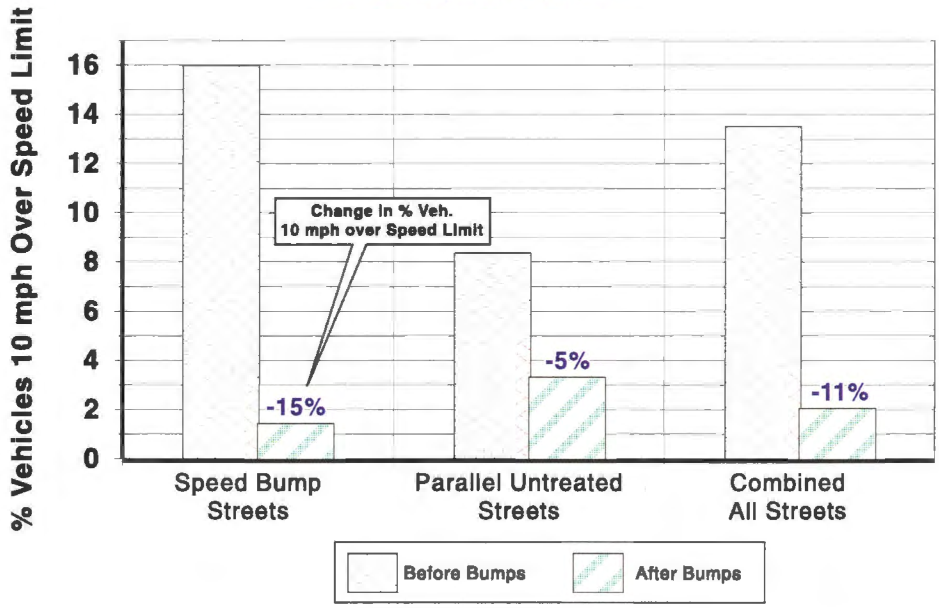


Figure 2 shows the effect of speed bumps on those motorists traveling more than 10 mph over the speed limit on streets treated with speed bumps, parallel untreated streets and all study streets combined. Overall, before speed bumps were installed approximately 13 percent of motorists traveled more than 10 mph over the speed limit. After installation of speed bumps, only two percent of motorists traveled more than 10 mph over the speed limit.

Figure 2
Effect of Speed Bumps on Percent of Vehicles 10 mph or More Over Speed Limit



TRAFFIC VOLUMES

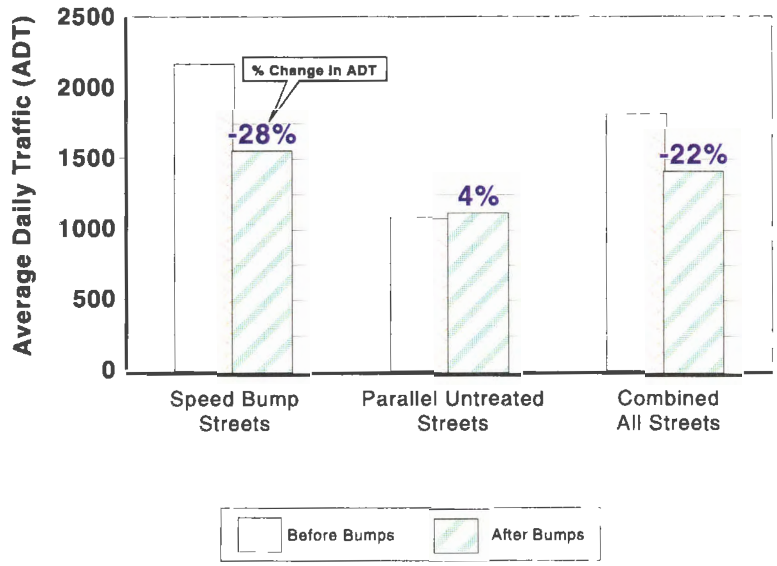
Traffic volumes tend to decrease on streets treated with speed bumps. The amount of volume reduction depends on the amount of speed reduction and availability of alternate routes. Some but not all of this volume diverts to the parallel untreated streets. Other findings regarding traffic volumes include:

- On streets treated with 14-foot speed bumps, the average traffic volume reduction was 33 percent, or 490 daily vehicles (ADT). Therefore the average after traffic volume on streets treated with 14-foot speed bumps was 980 ADT.
- After installing 22-foot speed bumps, traffic volumes decreased by an average of 21 percent, or 1,015 ADT. The resulting after traffic volume on streets treated with 22-foot speed bumps was an average of 3,720 ADT.
- The parallel untreated streets experienced an average increase in traffic volume of four percent, or 40 ADT. This change is not a statistically significant increase in traffic volume on parallel untreated streets as a result of installing speed bumps. A four percent increase complies with the City's traffic threshold curve.
- The results of the public opinion survey showed that 64 percent of the respondents who lived on streets treated with speed bumps perceived a reduction in traffic volumes. This perception matches the documented reduction in traffic volumes on treated streets. Alternately, 68 percent of residents living on parallel untreated streets perceived an increase in traffic volumes after installation of speed

bumps. The documented four percent increase in traffic volume does not support this perception.

Figure 3 shows the overall change in daily traffic volumes on streets treated with both 14- and 22-foot speed bumps. As a whole, after installation of speed bumps, the traffic volume on treated and parallel untreated streets combined decreased from 1,810 to 1,410 ADT. This is equivalent to a 22 percent decrease in traffic volume with only four percent being shifted from speed bump streets to the nearby parallel streets.

Figure 3
Effect of Speed Bumps on Traffic Volumes



VEHICLE CRASHES

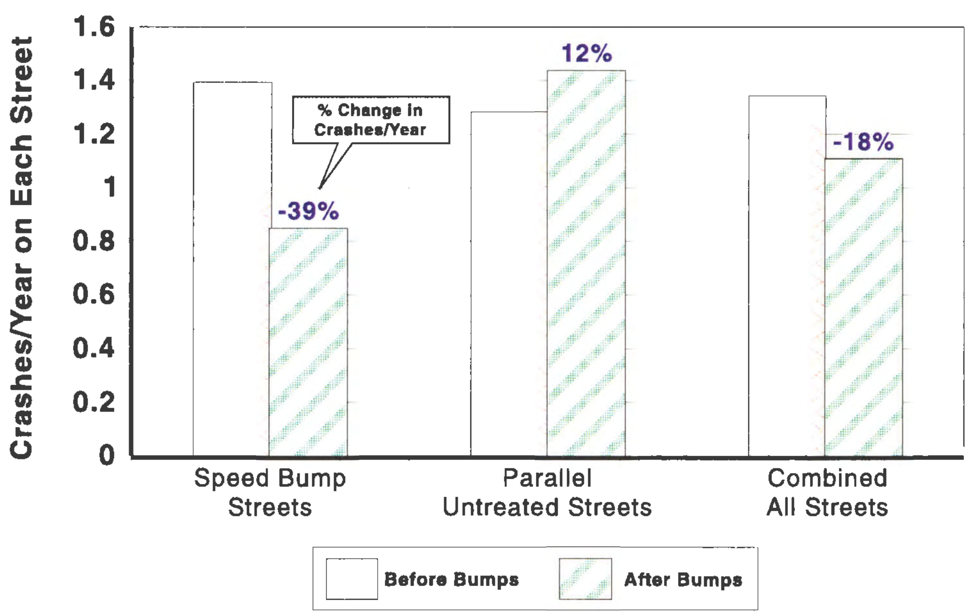
The crash analysis showed that the incidence of crashes (crash frequency) decreases with installation of speed bumps. The decrease in the incidence of crashes is strongly driven by the reduction in traffic volumes. More specific findings from the crash analysis include:

- With installation of speed bumps, the incidence of crashes on treated streets decreased on average 39 percent from 1.39 to 0.85 crashes per year. Separating the treated streets by bump type, the 14-foot bump streets experienced a 48 percent crash reduction and the 22-foot bump streets experienced a 32 percent reduction in crash frequency.
- The crash *rate* (annual crashes per ADT) decreased on treated streets an average of five percent after speed bumps were installed. The difference in the crash frequency and crash rate reductions show that the reduction in crash frequency is mainly due to the reduction in traffic volume on treated streets

- There was no measured change in crash type caused by the installation of speed bumps.
- The incidence of injury crashes on treated streets decreased by 46 percent, a statistically significant reduction, after speed bumps were installed.
- Crash frequency increased by 12 percent on parallel untreated streets after speed bumps were installed. This increase is not statistically significant, however, meaning the data cannot prove there is a correlation between speed bump installation and crash frequency on parallel untreated streets.
- Residents of streets treated with speed bumps do perceive an increase in safety overall. In contrast, and despite the fact that the data does not prove this, residents of parallel untreated streets perceive that safety worsened on their street after installation of the speed bumps.

Figure 4 shows that the crash frequency on both treated and parallel untreated streets combined decreased by 18 percent after speed bumps were installed. This decrease is not statistically significant.

Figure 4
Effect of Speed Bumps on Crash Frequency



CRIME AND EMERGENCY SERVICES

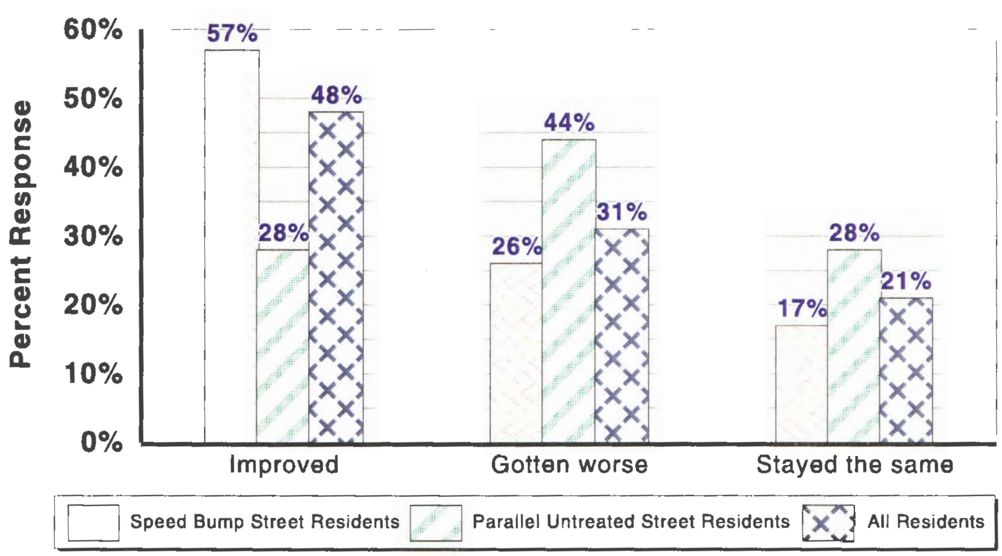
The results of the crime statistics and emergency services data analysis show that:

- There is no direct correlation between the installation of speed bumps and crime rates on the treated street or the parallel untreated street.
- Due to the small data set, a relationship between speed bump installation and emergency services calls could not be proven.
- Future research into the relationship between speed bumps and emergency service response time and emergency service calls should be further developed.

PUBLIC OPINION

A public opinion survey was distributed to approximately 1,200 residents living on or parallel to a speed bump street. In all, 400 people responded. Overall, more respondents thought speed bumps improved livability in their neighborhood (48%) than thought the livability got worse (39%). Of those living on streets treated with speed bumps, 57 percent of the respondents believed that speed bumps have improved livability on their street. Of those living on parallel untreated streets, 28 percent of respondents believed that speed bumps improved livability on their street and 44 percent thought that livability has gotten worse as a result of speed bumps. Figure 5 summarizes these results. More details of the survey responses are included in the individual chapters of this report.

Figure 5
Since speed bumps have been installed, overall neighborhood livability has ...



RELATIONSHIP BETWEEN SPEED BUMPS AND SPEED, VOLUME, AND CRASH REDUCTION

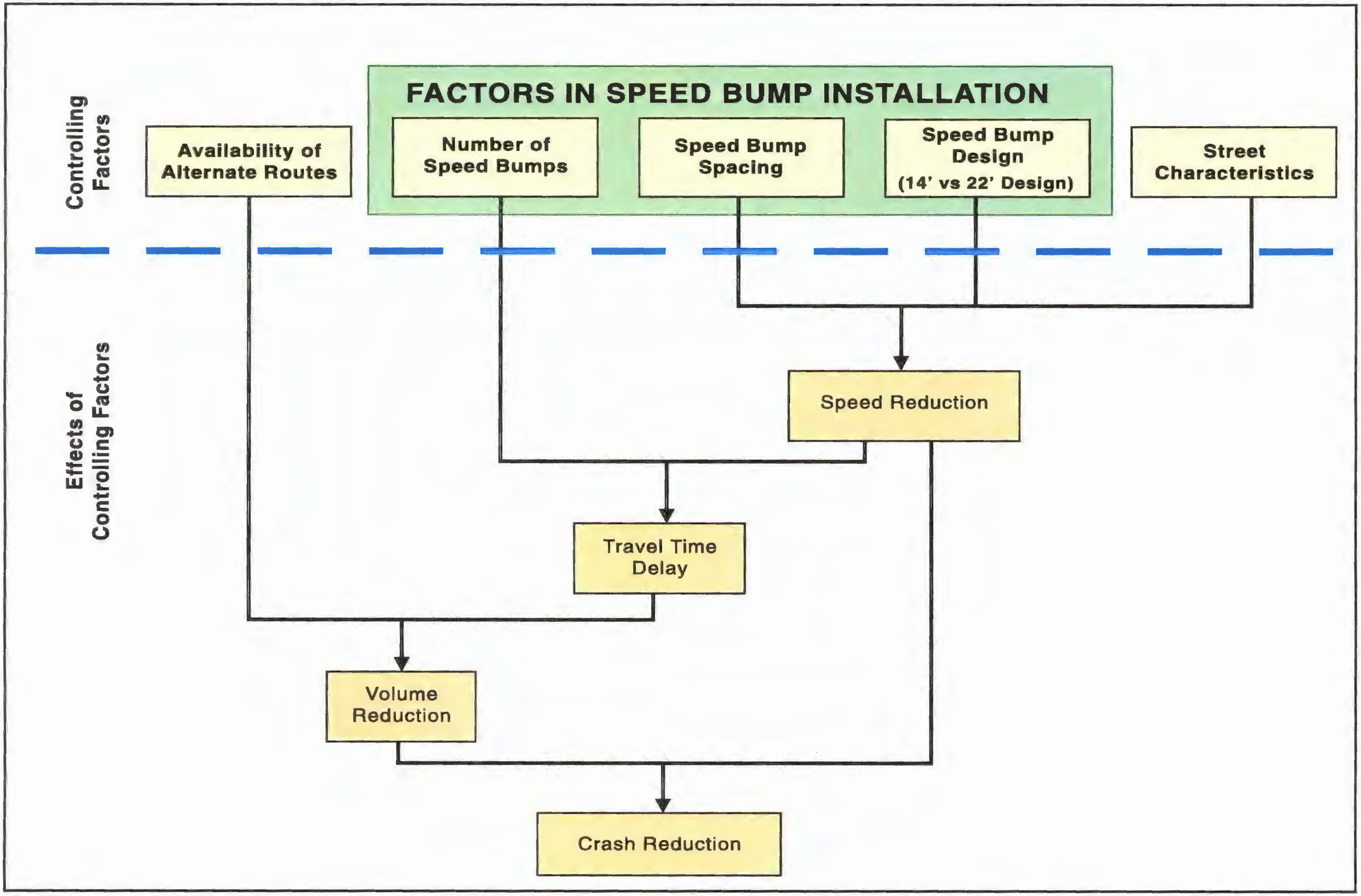
Another task of this peer review was to develop an understanding of how speed bumps reduce speed, volume, and crashes and how these criteria interrelate to each other. This task is useful in that an understanding of this relationship will help the City predict the effectiveness of speed bumps on a particular street before the bumps are installed. Figure 6 shows a schematic diagram of this relationship. The figure shows that five controlling factors were identified which collectively determine the effectiveness of speed bumps in reducing speeds, volumes, and crashes. Speed bumps have a direct effect on reducing speeds, which in turn has an effect of reducing volumes on treated streets. The reduction in volume is also strongly dependent on the availability of alternate routes. Reducing volumes on treated streets has the effect of reducing the number of crashes since fewer vehicles on the street will result in a lower probability of a crash. This relationship is described in more detail in the report.

RECOMMENDATIONS

Shortly after they are introduced, the currently designed 14 and 22 foot speed bumps effectively reduce travel speeds to be consistent with posted speed limits. They also effectively reduce the speeds of the fastest drivers. However, the City has limited data available about how speeds on treated streets change over time. Additional research into the effect of the duration of installation of speed bumps on travel speeds should be performed.

Traffic volumes decrease on streets treated with speed bumps. The amount of reduction depends on the speed reduction and the availability of alternate routes. The data available shows a four percent increase in traffic volumes on the identified parallel untreated streets. The assumption has been that traffic diverts to the nearby more appropriate collector or arterial street. Additional research should be performed to evaluate traffic diversion as a result of installing speed bumps. Further, the relationship between volume diversion and the availability of alternate routes should also be evaluated. Finally, the analysis showed the measured increase in traffic volume on untreated streets is consistent with City of Portland's traffic volume threshold curve. Additional research into the validity of this curve should be performed.

The incidence of crashes decrease with the installation of speed bumps. The decrease in crashes is strongly driven by the reduction in traffic volumes. Additional research into the change in crash types as a result of the volume reduction would be valuable.



RELATIONSHIP BETWEEN SPEED BUMPS AND SPEED, VOLUME, AND CRASH REDUCTION

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT

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FIGURE 6

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City of Portland Speed Bump Peer Review

Section 2

Introduction

Introduction

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

- Project Purpose
  - Investigate effects of speed bumps on:
    - vehicle speeds
    - traffic volumes
    - vehicle crashes
    - emergency services
    - crime

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

- Project Process
  - selected streets
  - conducted survey
  - analyzed and evaluated data

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.

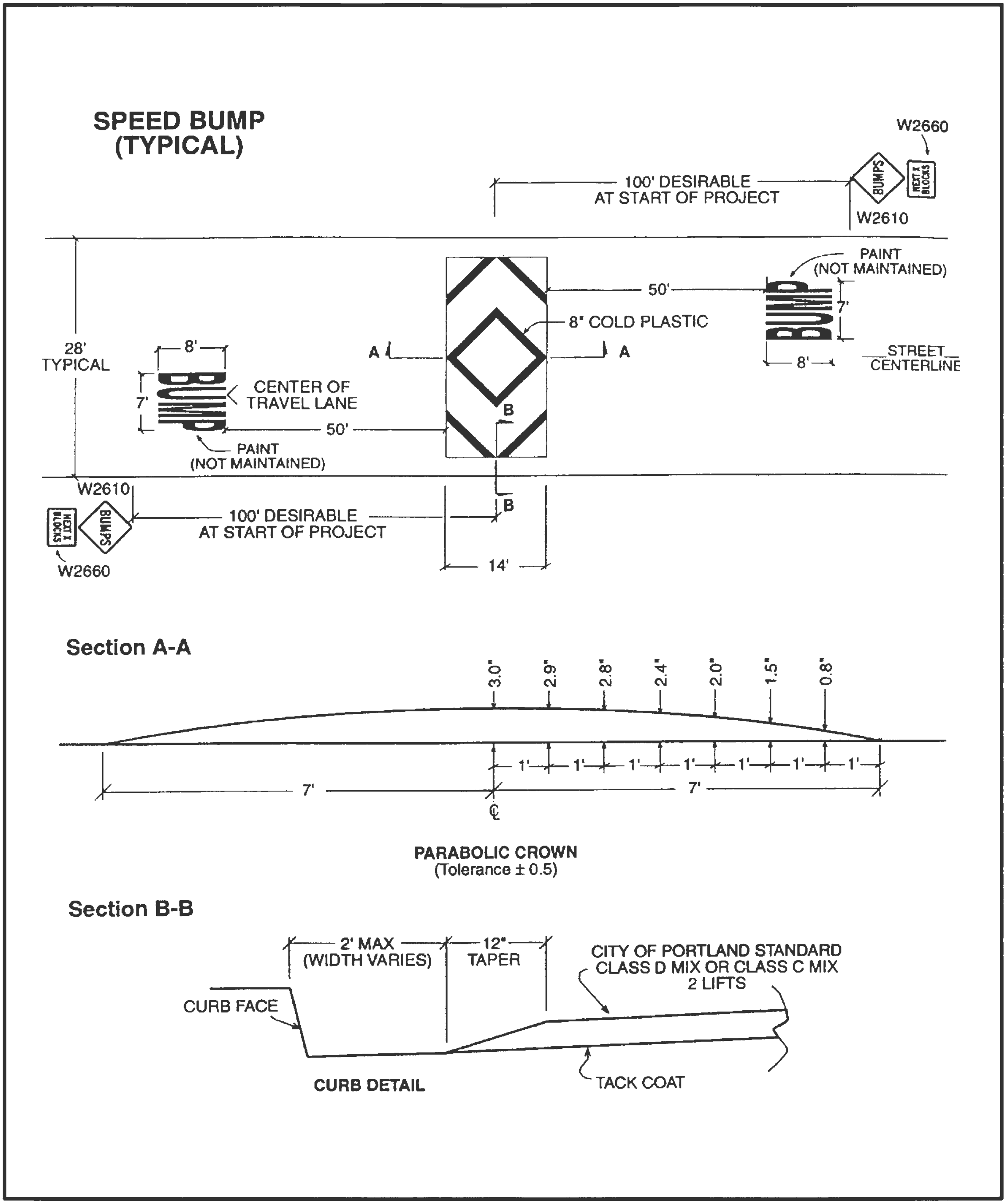
BACKGROUND, TERMS, AND METHODOLOGY

Speed Bump Design

- Two standard speed bumps in City:
  - 14 foot
  - 22 foot

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.

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



14' SPEED BUMP DETAIL

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT	FIGURE 7A
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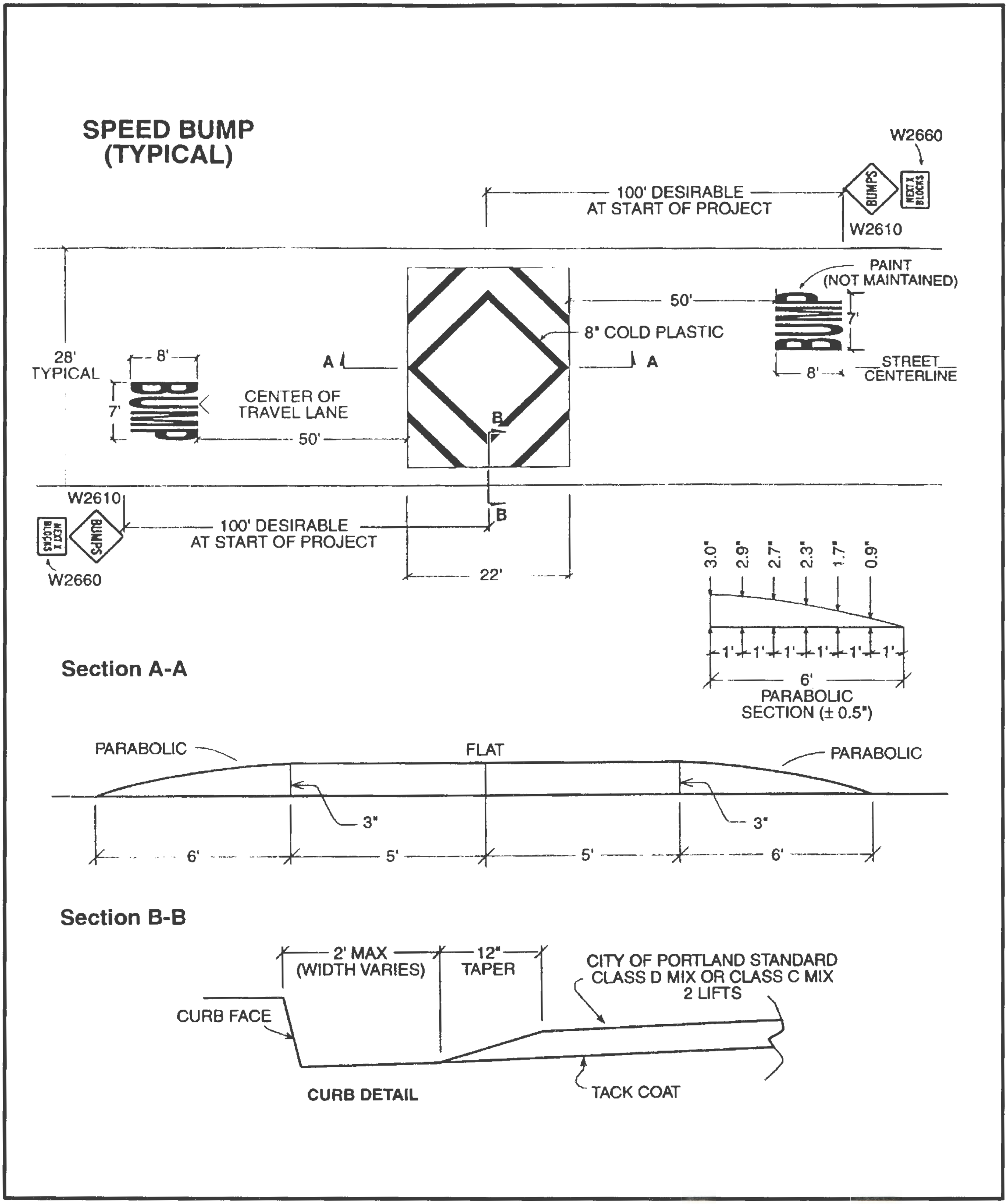

22' SPEED BUMP DETAIL

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

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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.

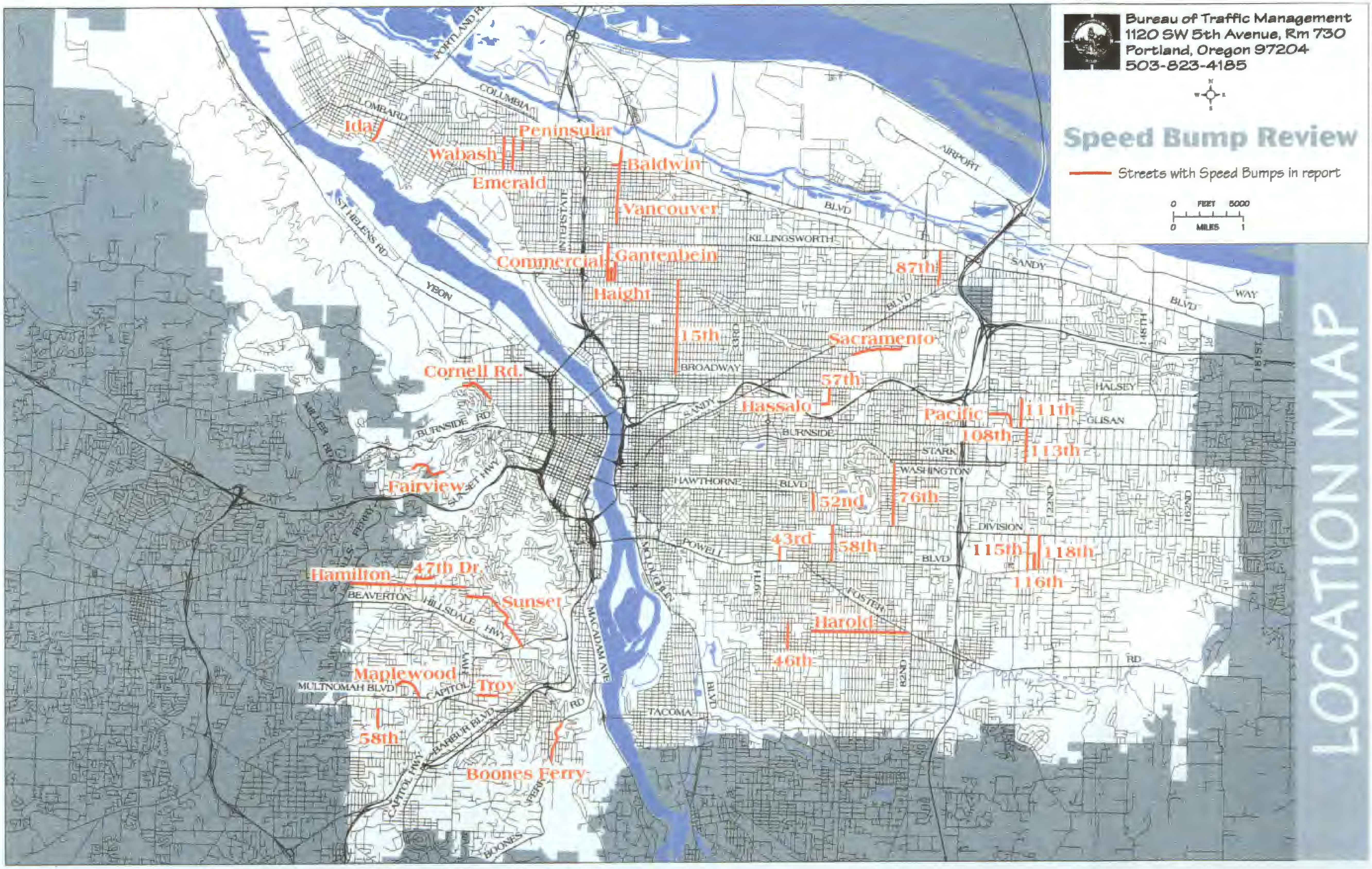
The spacing between speed bumps is determined on an individual street-by-street basis. The City typically places bumps between 300 and 600 feet apart, but spacing occasionally varies beyond this guideline.

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.

- 33 speed bump streets were studied (also referred to as treated streets).
- Streets studied match characteristics of all City speed bump streets.

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 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.



MAP OF TREATED STREETS ANALYZED FOR THIS PROJECT

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT	FIGURE 8
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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.

▪ 16 parallel untreated streets were studied.

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

- 1,200 residents were delivered surveys, and 33% filled out and returned their 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 re-

- Statistical significance: A real difference between before and after data, most likely due to speed bumps.

duction 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.

- A t-value greater than 2.0 means the data is statistically significant.

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. It 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.

City of Portland Speed Bump
Peer Review

Section 3

Effect of Speed Bumps on Vehicle Speed

Effect of Speed Bumps on Vehicle Speed

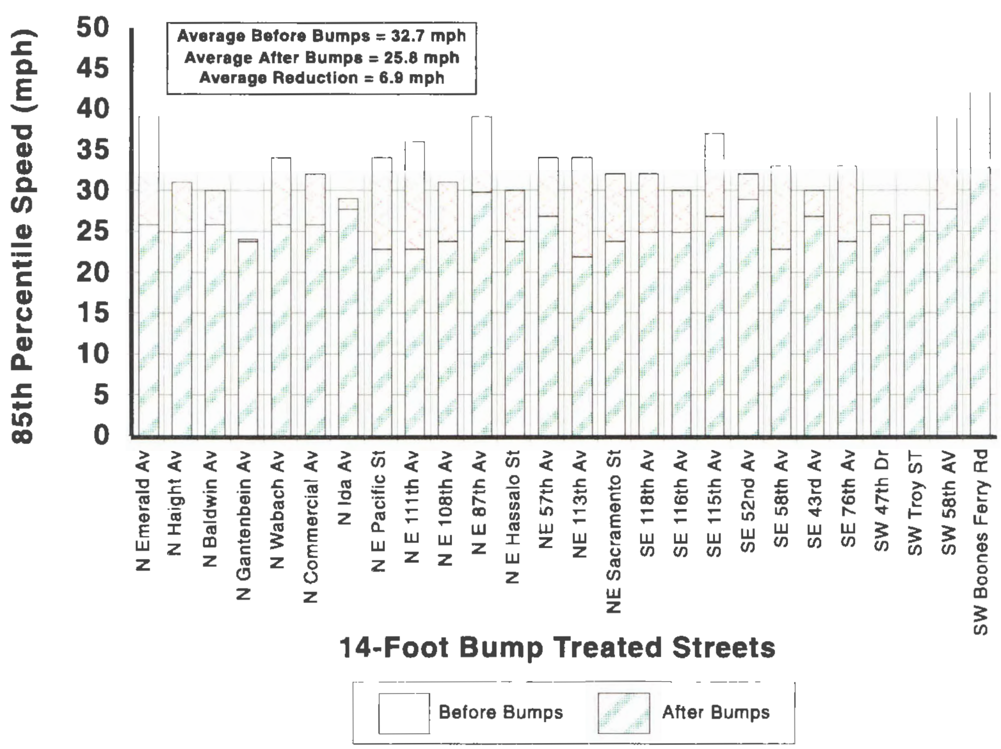
Three different measures of speed were analyzed for this project: 85th percentile speed, percent of vehicles traveling over the speed limit, and percent of vehicles traveling 10 mph or more over the speed limit. The first two measures are indicators of the overall vehicle speeds on a street, while the measure of percent traveling 10 mph or more over the speed limit measures the fastest vehicles on a street.

TREATED STREETS

85th Percentile Speeds

Figure 9 shows the effect of speed bumps on 85th percentile speed for each of the 26 study streets with 14-foot bumps. 14-foot speed bumps are typically installed on local streets with speed limits equal to 25 mph. As the figure shows, each street experienced a net reduction in 85th percentile speed, with the exception of one street, N Gantenbein Avenue. The 85th percentile speed on this street was less than 25 mph before speed bumps were installed. Alternately, three treated streets experienced reductions in

Figure 9
Effect of 14-foot Speed Bumps on 85th Percentile Speeds



85th percentile speeds more than 10 mph. These streets are N Emerald Street, NE Pacific Street, and NE 111th Avenue. Overall, the average reduction in 85th percentile speeds was 6.9 mph for 14-foot bump streets. This reduction is statistically significant (t-value = 9.2). As described previously, a t-value higher than 2.0 means the difference in the before and after data is statistically significant. With this 6.9 mph hour reduction in speed, the average 85th percentile travel speed on streets treated with 14-foot speed bumps was 25.8 miles per hour, which is essentially equal to the 25 mph speed limit on most local streets.

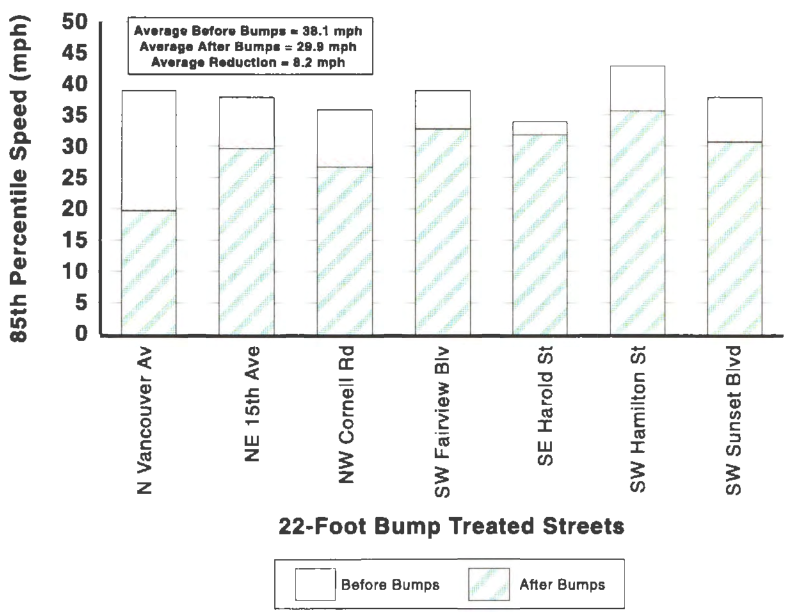
- 14 foot bumps reduce 85th percentile speeds to 25.8 mph, equal to the speed limit.

Figure 10 shows the effect of speed bumps on 85th percentile speeds for the study streets with 22-foot bumps. Typically, 22-foot speed bumps are installed on local and neighborhood collector streets with either 25 mph or 30 mile per hour speed limits. The seven study streets experienced an average reduction in 85th percentile speed of 8.3 mph. SE Harold Street experienced only a 2 mph reduction, while N Vancouver Avenue experienced a 19 mph reduction (39 mph to 20 mph). Even with the small sample size, the 8.3 mph reduction is large enough that the reduction is statistically significant (t = 4.2). Accounting for the 8.3 mph reduction in speed, the average 85th percentile travel speed on the 22-foot bump study streets was 29.9 mph. This is slightly faster than a 25 mph hour speed limit on local streets, but appropriate for streets with a 30 mph speed limit.

- 22 foot bumps reduce 85th percentile speeds to 29.9 mph.

Figure 10

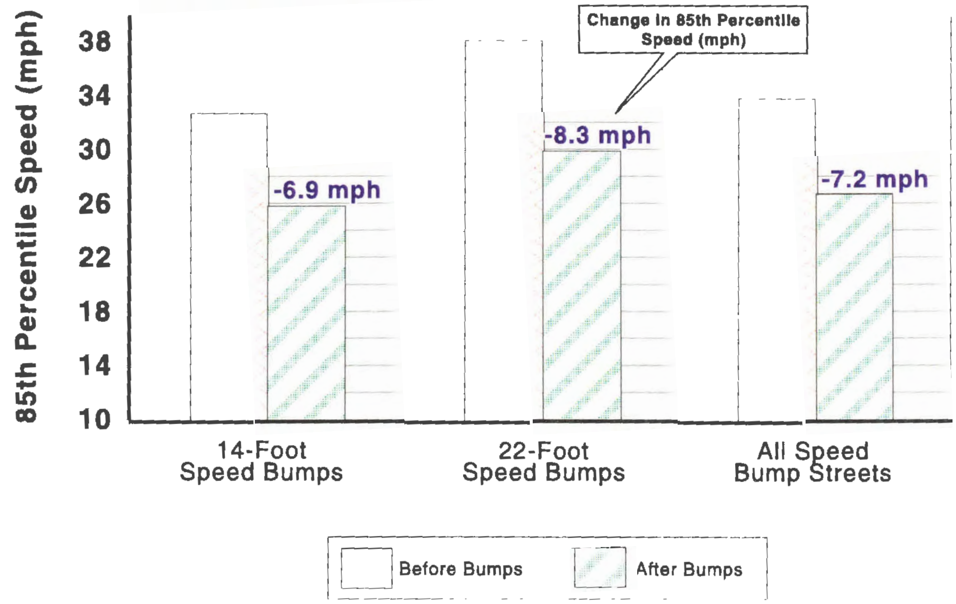
Effect of 22-foot Speed Bumps on 85th Percentile Speeds



When considering the effect of 85th percentile speeds on all speed bump streets combined, the average reduction is 7.2 mph (34.0 mph to 26.8 mph). Figure 11 graphically shows this finding, which is statistically significant (t = 10.1). This finding represents a 21 percent decrease in 85th percentile speeds after speed bumps are installed. On all streets combined

- The average 85th percentile speed on all bump streets is 26.8 mph, close to 25 mph and 30 mph speed limits.

Figure 11
Effect of Bump Type on 85th Percentile Speed



the 85th percentile travel speed of 26.8 mph hour is consistent with local street and neighborhood collector street speed limits of 25 to 30 mph.

Percent of Vehicles Traveling Over Speed Limit

- After 14 foot bumps, 20% of motorists travel over speed limit (60% before).

Figure 12 shows the effect of 14-foot speed bumps on the percent of vehicles traveling over the speed limit. The majority of 14-foot speed bumps are installed on local streets where the posted speed is 25 mph. As Figure 12 shows, 40 percent of the vehicles that traveled over the speed limit before bumps were installed now travel below the speed limit. This reduction is statistically significant (t = 9.8). Therefore, in addition to creating 85th percentile speeds consistent with the posted speed limit, only 20 percent of motorists on average will travel over the posted speed limit after 14-foot speed bumps are installed (as compared to 60% before speed bumps were installed).

- After 22 foot bumps, 43% of motorists travel over speed limit (77% before).

Figure 13 shows the effect of 22-foot speed bumps on the percent of vehicles traveling over the speed limit. As mentioned previously, 22-foot bumps are installed on higher-volume local streets and neighborhood collectors. The posted speed for 22-foot bump streets could be either 25 or 30 mph, but rarely higher than that. As Figure 13 shows, 34 percent of the vehicles stopped traveling over the speed limit after 22-foot bumps were installed, which is a statistically significant reduction (t = 5.1). However, as compared to 14-foot speed bumps, more motorists continue to travel at speeds greater than the posted speed limit on 22-foot bump streets (43%) as opposed to 14-foot bump streets (20%).

Figure 12
Effect of 14-foot Speed Bumps on Percent of Vehicles Over Speed Limit

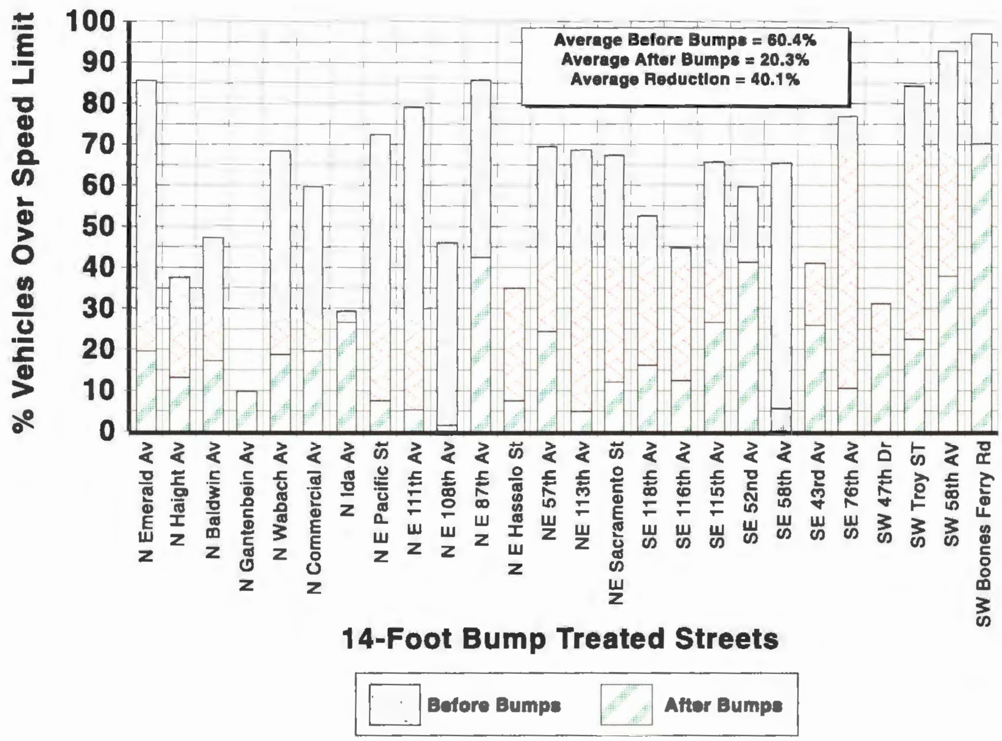
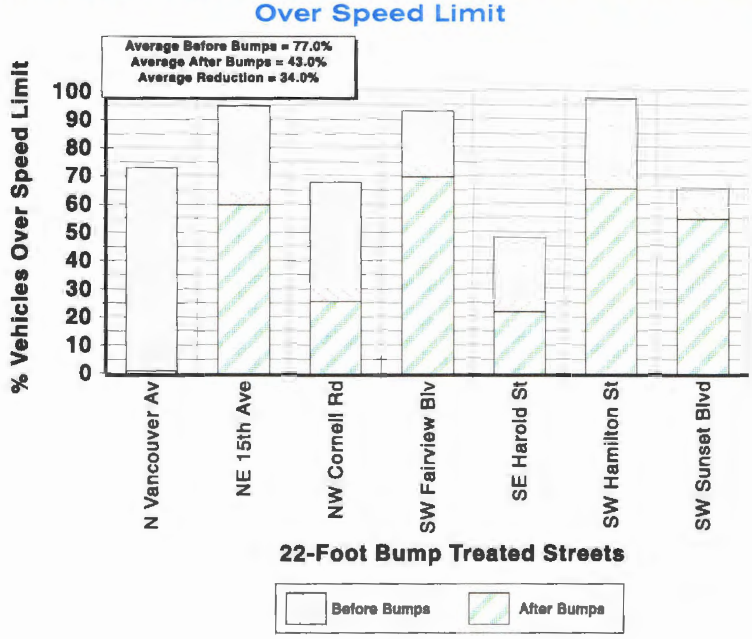


Figure 13
Effect of 22-foot Speed Bumps on Percent of Vehicles Over Speed Limit

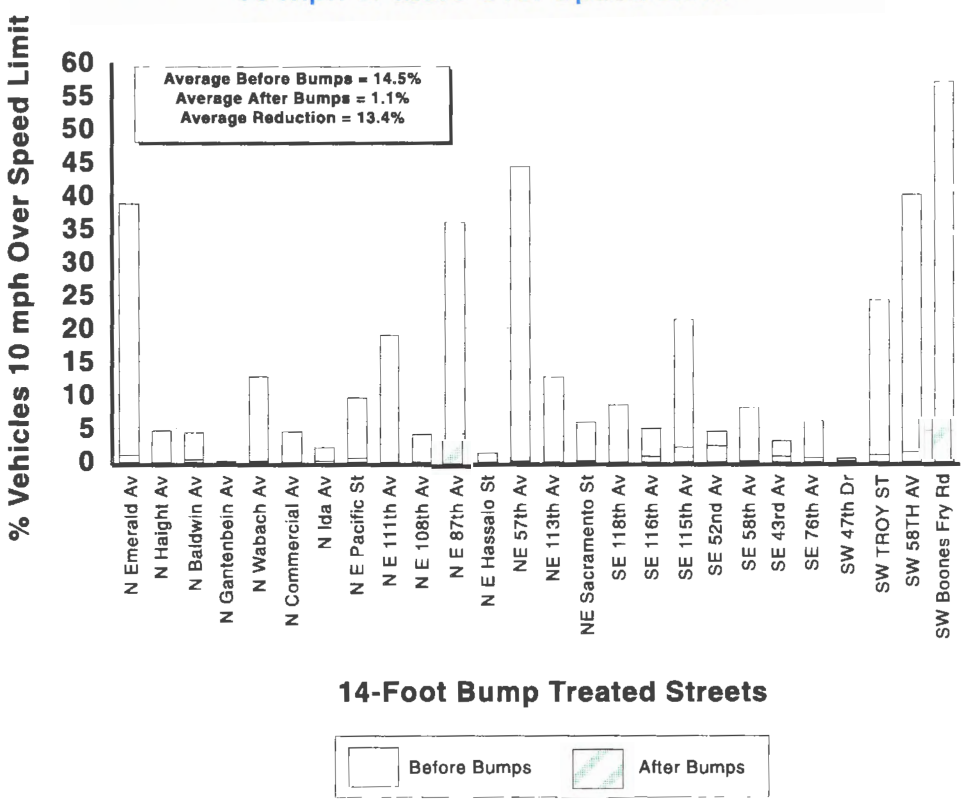


Percent of Vehicles Traveling 10 mph or More Over Speed Limit

- After 14 foot bumps, 1% of motorists travel 10 mph or more over speed limit (14.5% before).

This speed measure tracks the speeds of the fastest vehicles, which are often the vehicles most frustrating for residents. Figure 14 shows the effect of 14-foot bumps on the percent of vehicles traveling 10 mph or more over the posted speed. As Figure 14 shows, 14 percent of the vehicles traveled more than 10 mph over the speed limit before 14-foot bumps were installed, and only 1.1 percent of the vehicles traveled 10 mph or more over the speed limit after the bumps were installed. Thus, of the vehicles traveling 10 mph or more over the speed limit, 92 percent of them (13.4/14.5) slowed below this threshold after 14-foot speed bumps were installed. This reduction is statistically significant (t = 4.6). Installing 14-foot speed bumps essentially prevents motorists from traveling more than 10 mph over a 25 mph speed limit, assuming the bumps are properly spaced.

Figure 14
Effect of 14-foot Speed Bumps on Percent of Vehicles 10 mph or More Over Speed Limit

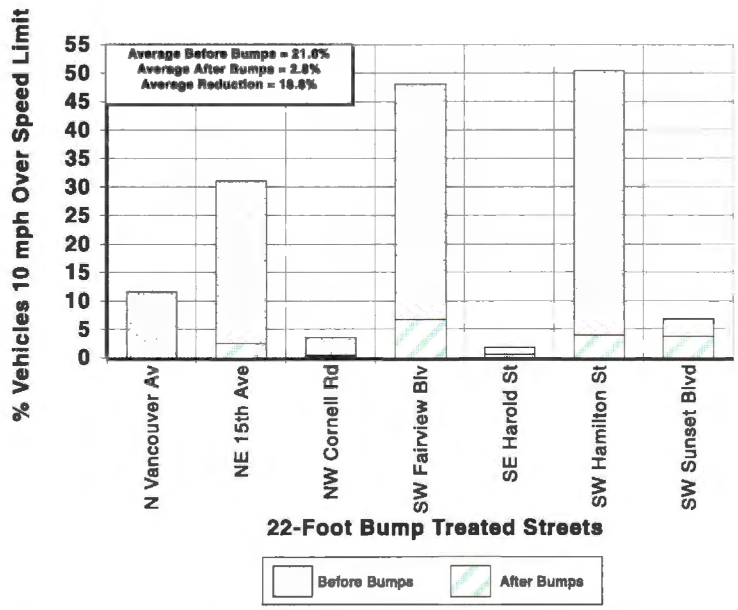


- After 22 foot bumps, 2.8% of motorists travel 10 mph or more over speed limit (21.6% before).

Figure 15 shows that 22-foot speed bumps are nearly as effective as 14-foot bumps in reducing the fastest speeds of motorists. The 18.8 percent reduction shown in Figure 15 is statistically significant (t = 2.6), leaving only 2.8 percent of the motorists traveling more than 10 mph over the posted speed limit. Thus, of the vehicles traveling 10 mph or more over the speed limit, 87 percent of them slowed below this threshold after 22-foot speed bumps were installed. Installing 22 foot speed bumps on local or neighborhood collector streets essentially prevents motorists from travel-

Figure 15

Effect of 22-foot Speed Bumps on Percent of Vehicles 10 mph or More Over Speed Limit



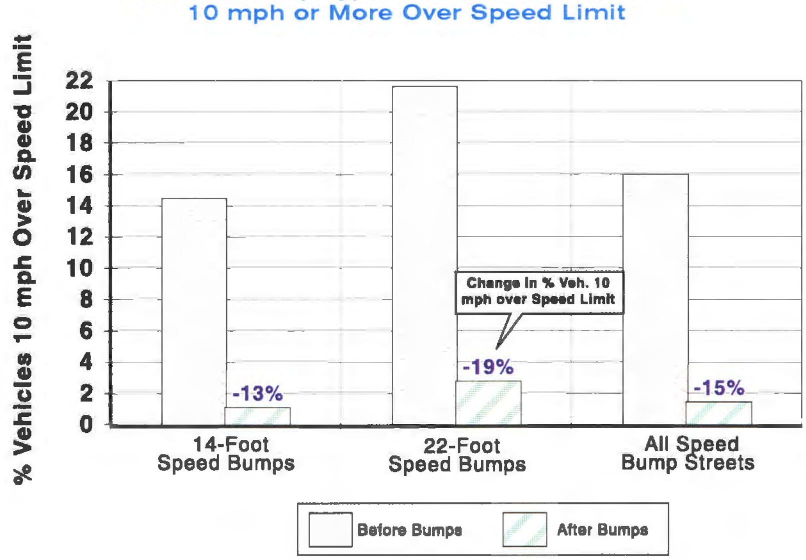
ing more than 10 mph over the posted speed limit, assuming the bumps are properly spaced.

When considering all speed bumps combined, Figure 16 shows that overall a 15 percent reduction is experienced, a statistically significant reduction ($t = 5.3$), leaving less than two percent of all motorists on speed bump treated streets traveling faster than the posted speed limit. This makes speed bumps very effective in reducing the number of motorists traveling at excessive speeds.

- Speed bumps are very effective in reducing speeds of fastest drivers.

Figure 16

Effect of Bump Type on Percent of Vehicles 10 mph or More Over Speed Limit



PARALLEL UNTREATED STREETS

Figures 17, 18, and 19 show the change in travel speeds on treated, parallel untreated, and combined all streets. The figures represent the parallel streets to both 14-foot and 22-foot treated streets. The speed differences between streets parallel to 14-foot bumps and streets parallel to 22-foot bumps are minimal and not statistically significant. Thus, the results of all parallel treated streets combined are shown in this report. As the figures show, the *parallel untreated streets* experienced the following vehicle speed changes:

- average decrease in 85th percentile speed of 1.8 mph, from 31 mph to 29 mph (t= 2.1) (Figure 17),

Figure 17

Effect of Speed Bumps on 85th Percentile Speeds

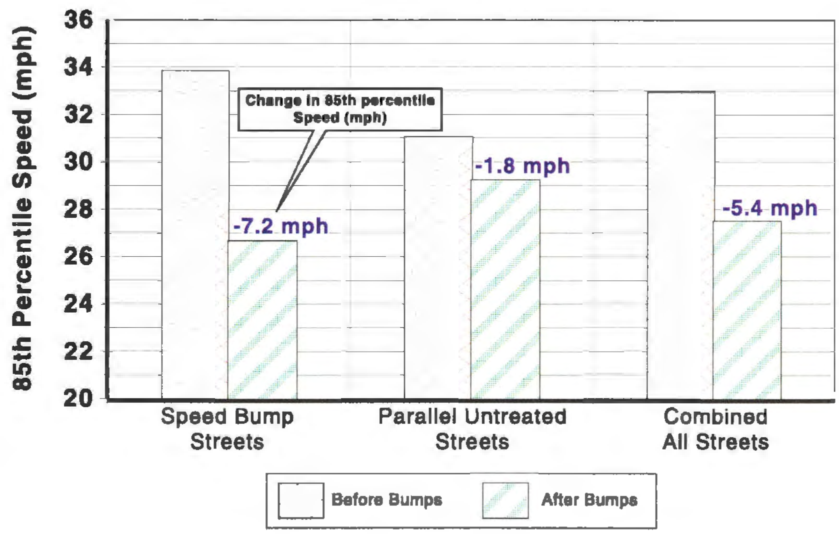


Figure 18

Effect of Speed Bumps on Percent of Vehicles Traveling Over Speed Limit

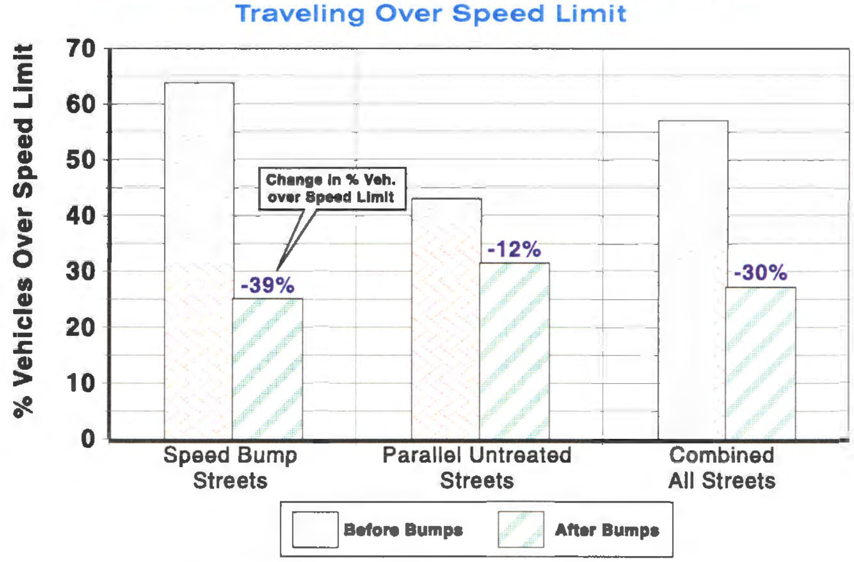
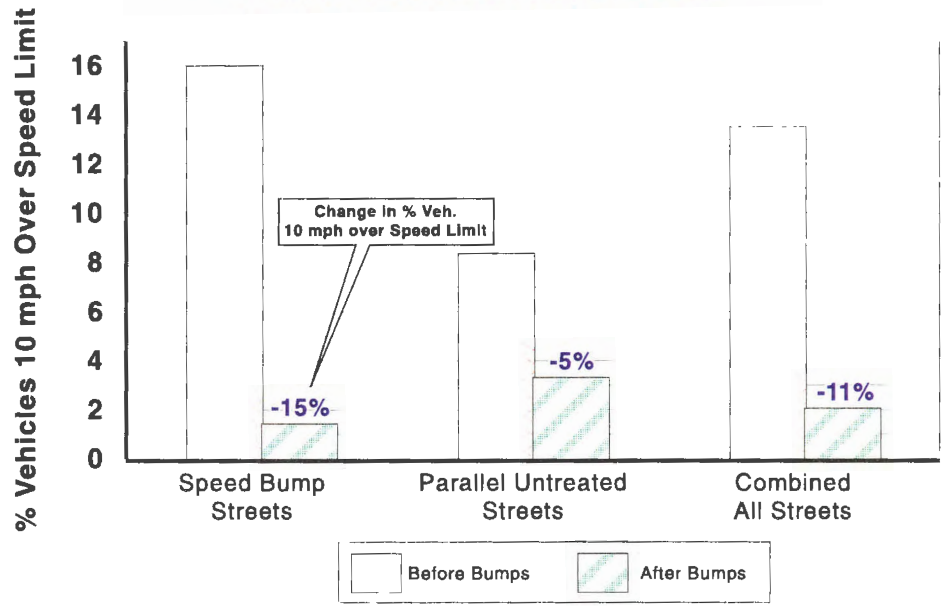


Figure 19
Effect of Speed Bumps on Percent of Vehicles 10 mph or More Over Speed Limit



- average decrease in percent traveling over speed limit of 12 percent, from 43 to 31 percent (t= 2.8) (Figure 18), and
- average decrease in percent traveling 10 mph or more over speed limit of 5 percent, from 8 to 3 percent, (t= 1.4) (Figure 19).

The implications of this is that although there are greater benefits of speed bumps in speed reduction to the treated streets as compared to the untreated streets, there are speed reduction benefits also achieved on parallel untreated streets in the immediate area. This can be seen in the combined column on Figures 17, 18, and 19

The speeds on the parallel untreated streets decreased slightly after speed bumps were installed. The reductions in 85th percentile speeds and percent traveling over the speed limit are statistically significant, but just barely (t value of 2.1 for 85th percentile speed is just higher than the 2.0 threshold). The percent traveling 10 mph or more over speed limit measure is not statistically significant.

■ Effect on the treated and parallel untreated streets combined:

- 85th percentile speed reduced to 28 mph (33 mph before).
- motorists traveling over the speed limit reduced to 27% (57% before).
- motorists traveling 10 mph or more over speed limit reduced to 2% (13% before).

The effect of speed bumps on the *treated and parallel untreated streets combined* was then evaluated to determine the overall effect on the immediate area of speed bumps. The last column of the graphs in Figures 17, 18, and 19 ("Combined All Streets") show that speed bumps have the effect of decreasing speeds on the treated and nearby untreated streets combined. These speed reductions are each statistically significant. Specifically, the *treated and parallel treated streets combined* experienced the following speed changes as a result of speed bump installation:

- average decrease in 85th percentile speed of 5 mph, from 33 mph to 28 mph (t= 5.0) (Figure 17),

- average decrease in percent traveling over speed limit of 30 percent, from 57 to 27 percent (t= 5.7) (Figure 18),
- average decrease in percent traveling 10 mph or more over speed limit of 11 percent, from 13 to 2 percent (t= 3.6) (Figure 19).

While there are greater speed reduction benefits to the streets treated with speed bumps, this data shows that there are also speed reduction benefits on the combined treated and parallel untreated streets.

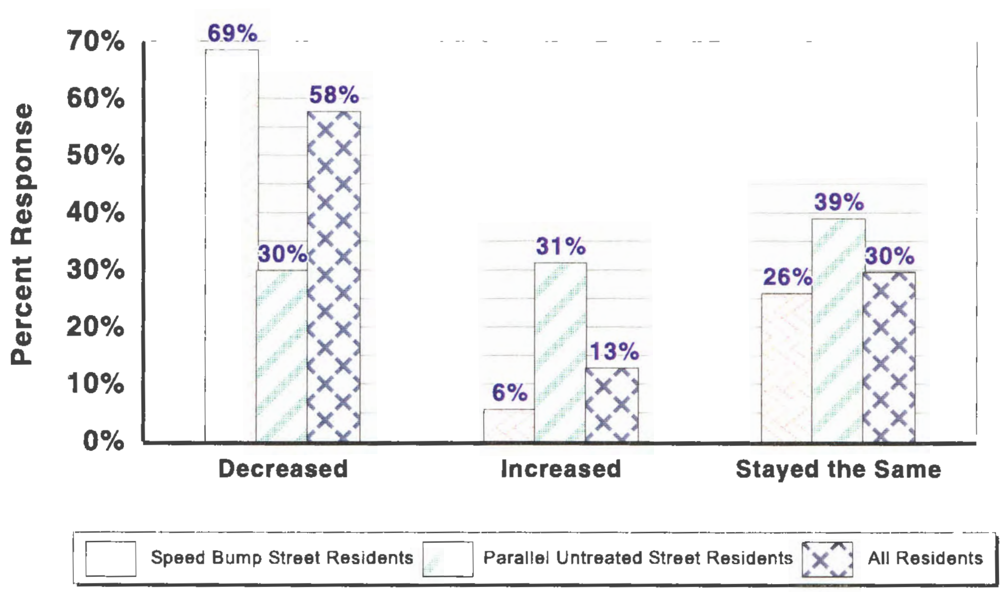
PUBLIC PERCEPTION OF VEHICLE SPEED

As previously described a public perception survey was conducted on eight different treated and their respective parallel untreated streets. Approximately 1,200 surveys were distributed and 400 were returned. *A copy of the survey and results are shown in Appendix B.*

- Majority (58%) of treated street residents thought speeds decreased after bumps.

The survey results showed that before speed bumps were installed, 91 percent of the residents of both speed bump streets and parallel streets combined thought speeds of the fastest drivers were too high. Figure 20 shows the results of one of the speed questions in the survey. As Figure 20 shows, after installing the speed bumps, more residents thought speeds had decreased (58%) than those who thought speeds had increased (13%). Comparing treated and untreated streets, more people living on speed bump streets perceived a reduction in speeds (69%) than those living on parallel untreated streets (30%).

Figure 20
Since speed bumps have been installed, vehicle speeds have...



- Parallel untreated street residents were evenly split on whether speeds decreased or increased on their street.

As discussed previously, the data results showed a 2 mph reduction in 85th percentile travel speeds on parallel untreated streets and a combined (14 and 22 foot) 7 mph reduction in 85th percentile travel speeds on treated streets. The public perception of the speed benefit is consistent with the observed reduction. The parallel street residents were evenly split on whether they perceived a decrease or increase in speeds. The treated street residents see more of a positive speed benefit than do parallel street residents.

- The perceived speed benefit of speed bumps decreases over time.

As part of the distribution, surveys were distributed to streets where bumps have been installed for less than nine months and on streets where the bumps have been installed for more than two years. The results show the perception of the speed benefit of speed bumps seems to be dependent on the duration the bumps have been in place. Residents living on streets with bumps in place over two years did not perceive as much speed reduction as residents living on streets with bumps in place less than nine months. This indicates that either residents forget the speeds of vehicles on their streets before the speed bumps were installed, so the new "post-bump" environment is improved but over time the improvements are perceived to decrease. Or speeds increase over time as motorists become accustomed to the bumps. Alternately, some combination of the two possibilities could occur.

SUMMARY

The following are key conclusions from the speed review:

- Speed bumps are an effective tool in reducing travel speeds to be consistent with posted speed limits. They are also very effective in reducing the speeds of the fastest drivers.
- On average, 14-foot speed bumps reduced 85th percentile travel speeds by 6.9 mph to 25.8 mph after speed bumps were installed. This is approximately equal to a typical 25 mph speed limit on local streets.
- After the study streets were treated with 14-foot speed bumps, 20 percent of motorists on average were traveling at speeds greater than 25 mph (60% before). Further, only one percent of motorists were traveling more than 10 mph over the speed limit, as opposed to 14.5 percent before 14 foot bumps were installed.
- 22-foot speed bumps decreased 85th percentile travel speeds on average by 8.2 mph to 29.9 mph. This is slightly higher than a 25 mph hour speed limit on local streets, but on target with a 30 mph speed limit on neighborhood collector streets.
- After streets were treated with 22-foot speed bumps, 43 percent of motorists continued to travel at speeds over the speed limit (77%

before); however, only 2.8 percent traveled at speeds more than 10 mph over the speed limit (22% before).

- The public perception survey revealed that 91 percent of residents of both speed bump and parallel streets combined thought speeds were too high before speed bumps were installed. After installation, 69 percent of the treated streets residents perceived a reduction in speeds on their streets and only 6 percent perceived an increase in speeds. Parallel street residents were evenly split on the speed benefit, as 30 percent thought there was a decrease and 31 percent thought there was an increase.

- The survey revealed that the residents perceptions about speed are consistent with the documented speed impacts. Overall, residents of speed bump streets see more of a speed benefit than parallel street residents, which corresponds to the actual speed data.

The analysis also revealed areas where additional study would be valuable. These areas include:

- Additional data should be collected to evaluate how speeds change over time on streets treated with speed bumps.

- On parallel untreated streets, the average percent of motorists traveling more than 10 mph over the speed limit decreased but this was not a statistically significant result. More detailed data should be collected to further evaluate this change in speed.

City of Portland Speed Bump
Peer Review

Section 4

Effect of Speed Bumps on Traffic Volumes

Effect of Speed Bumps on Traffic Volumes

There are typically two different types of motorists who travel on residential streets. The majority are local residential motorists, who live in the area and travel on a particular residential street to get to or from their home. Traveling on these residential streets is a necessity for these motorists. The other type of motorists traveling on residential streets are sometimes referred to as "cut-through" motorists. These motorists are using the residential streets as a short-cut to by-pass nearby collector or arterial streets which may be congested or out-of-direction to their destination. Cut-through motorists do not have a trip end in the vicinity of the residential street in which they are traveling.

Speed bumps are not installed for the purpose of reducing traffic volumes on residential streets. However, since speed bumps slow traffic down, this can result in some traffic diversion from the speed bump street. This diversion in traffic volume most likely comes from the cut-through motorists who decide the street with speed bumps is no longer the fastest or most convenient route, and they divert to alternate routes. Some traffic diversion can also result from local residential motorists who live in the vicinity and have an alternative street to travel on to get home which is nearly as convenient as the speed bump street.

TREATED STREETS

14-Foot Speed Bumps

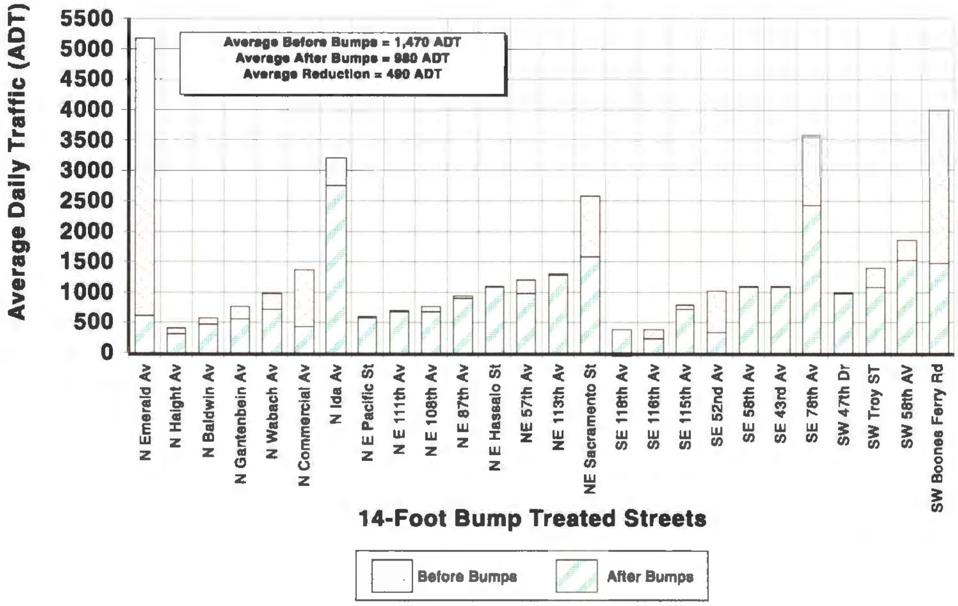
- Traffic volumes reduced by 33% to 980 ADT after installing 14 foot bumps.

Figure 21 shows the effect of 14-foot speed bumps on traffic volumes for treated streets. As the figure shows, volumes decreased on 14-foot speed bump streets by an average of 490 vehicles daily, or a reduction of 33 percent to on average 980 vehicles per day. This reduction is statistically significant ($t = 2.5$). Some treated streets experienced no reduction in traffic volume, namely NE Pacific Street, SE 58th Avenue, and NE 113th Avenue. These streets either do not have clear alternate parallel routes or are not cut-through routes and are used solely by neighborhood traffic that cannot divert. Other streets experienced significant reductions in traffic volume, including N Emerald Avenue, SW Boones Ferry Road, and SE 76th Avenue. These streets were most likely cut-through routes before speed bumps were installed. After bumps were installed, motorists diverted to other nearby routes.

22-Foot Speed Bumps

Figure 22 shows the effect of 22-foot speed bumps on traffic volumes for treated streets. For the seven 22-foot bump study streets, an average re-

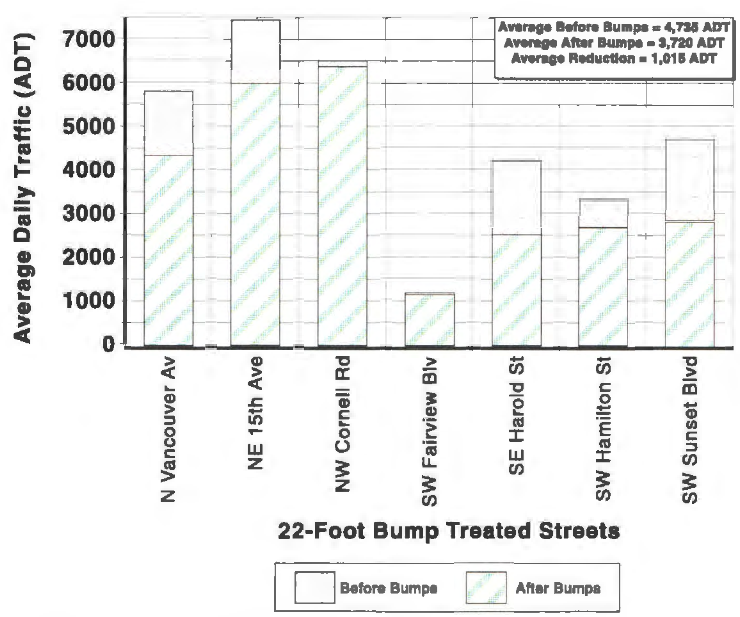
Figure 21
Effect of 14-foot Speed Bumps on Traffic Volume



■ Traffic volumes reduced by 21% to 3,720 ADT after installing 22 foot bumps.

duction of 1,015 ADT was measured. The average daily traffic volume on these streets after speed bumps were installed was 3,720 vehicles per day. This translates to a 21 percent reduction in ADT. As shown in Figure 22, Fairview Boulevard experienced only a slight reduction (30 ADT), while Sunset Boulevard experienced the most significant volume reduction (1,825 ADT). The average reduction of 1,015 ADT is statistically significant (t = 3.6).

Figure 22
Effect of 22-foot Speed Bumps on Traffic Volume

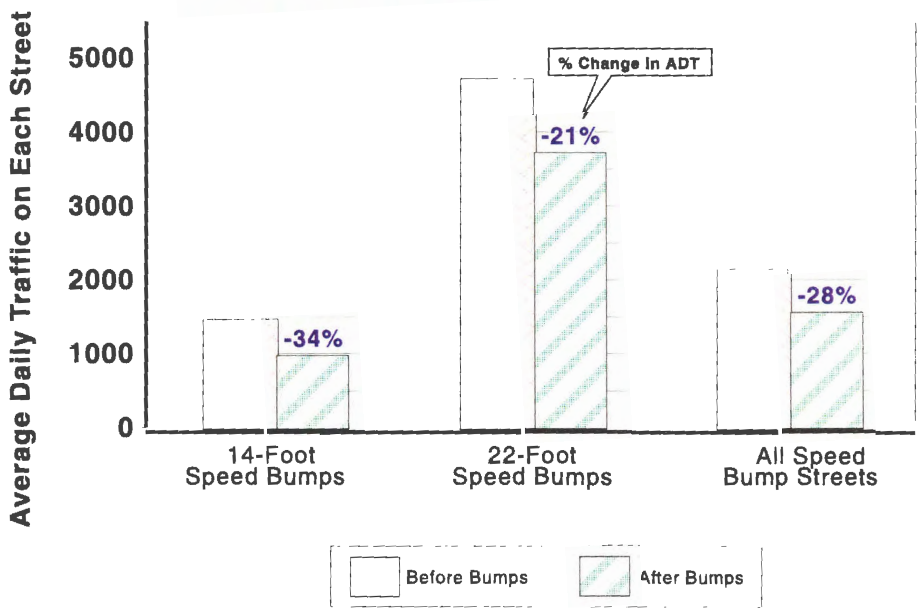


All Treated Streets Combined

■ Traffic volumes reduced by 28% to 1,500 ADT on all treated streets combined.

Figure 23 displays the combined traffic volume effect of speed bumps on all treated streets combined. As shown in Figure 23, the 33 speed bump streets evaluated for this project experienced an average reduction of 605 ADT, or 28 percent, after speed bumps were installed. After installation of the speed bumps the study streets had an ADT of approximately 1,500. This reduction is statistically significant (t = 3.6).

Figure 23
Effect of Bump Type on Traffic Volume



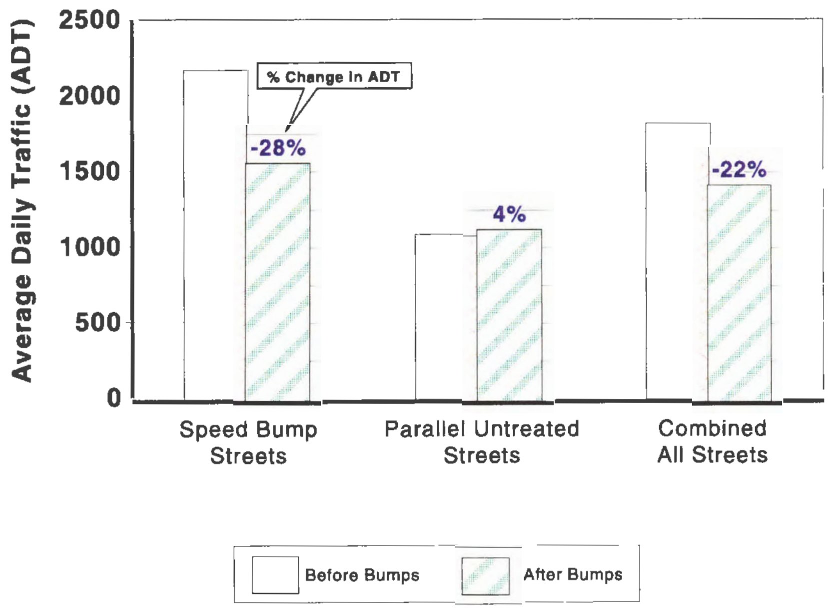
Of the 33 speed bump streets studied, 14 had identified parallel untreated streets with before and after data available. Of the 14 treated streets with identified parallel routes, the volumes decreased by an average of 32 percent after speed bumps were installed. On the other hand, the treated streets without identified parallel routes experienced a volume reduction of 24 percent. This data suggests that volumes are reduced more on treated streets if a parallel untreated route is located in the vicinity.

PARALLEL UNTREATED STREETS

■ Traffic volumes increased by 4% on parallel untreated streets. This is *not* statistically significant.

As shown in the previous section, approximately 28 percent of the traffic on speed bump streets were shifted to other routes. It is important to understand where this volume is shifted. Are the vehicles moved to the next adjacent parallel street, or are they shifted out of the neighborhood to the appropriate collector and arterial streets? To answer this question, an evaluation was performed on the effect of speed bumps on the parallel untreated streets. As mentioned earlier, only 16 of the 24 identified parallel untreated streets were studied since the remaining streets did not have before and after data collected. Thus, this study could not evaluate specifically whether the volumes were shifted to the parallel untreated streets, other local streets in the area, or nearby collectors and arterials. Rather, it could give a general sense of how much of the shifted volume went to the identified parallel untreated streets. Figure 24 shows the effect of speed bump installation on the speed bump streets, parallel untreated streets, and both treated and untreated streets combined.

Figure 24
Effect of Speed Bumps on Traffic Volumes



As shown in Figure 24, the volume on the untreated streets directly parallel to the speed bump streets increased by an average of four percent, or 40 ADT, which is *not* a statistically significant increase (t = 0.30). Given that traffic volumes vary as much as 10 percent from day-to-day, a four percent increase would be virtually undetectable. Separating this four percent increase by bump type, the streets parallel to 14-foot bump streets increased volume by approximately two percent (t = 0.2), while the streets parallel to the 22-foot bump streets experienced a volume increase of approximately 15 percent (t = 2.3). Since the t value for the streets parallel to 22-foot bump streets is higher than 2.0, this difference is statistically significant, although it just barely meets the criteria. This data suggests that the streets parallel to 22-foot bumps are installed on higher volume streets with more non-local motorists than the streets parallel to 14-foot bumps. This may be due to the fact that 22-foot bump streets are installed on higher volume streets with more non-local motorists than 14-foot bump streets.

- Traffic volumes reduced by 22% to 1,400 ADT on all treated streets combined.

When considering the effect of treated and untreated streets combined, the average daily traffic decreased by an average of 22 percent, or 395 ADT, as shown in Figure 24. This decrease is statistically significant (t = 3.1). Although it cannot be proved directly with this study, it is reasonable to estimate that the majority of the 22 percent diversion away from the treated and parallel untreated streets was returned to the more appropriate nearby collector or arterial streets.

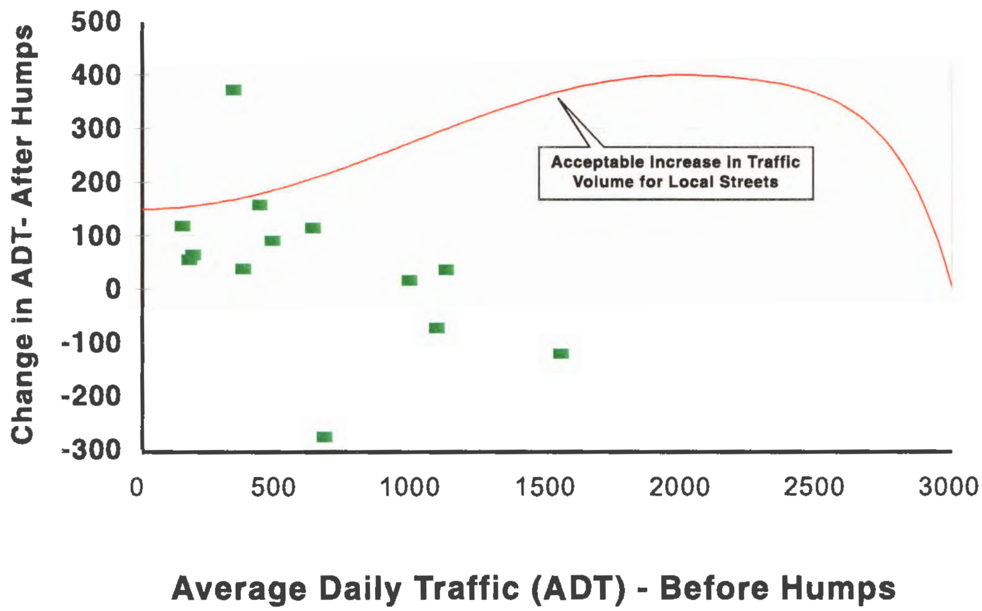
Traffic Threshold Curve

- Traffic volume diversion to local parallel streets complies with City's traffic threshold curve.

The City of Portland has developed a traffic threshold curve which determines the allowable increase in traffic volumes on local parallel streets. This threshold curve was developed as part of a project evaluating the City of Portland's Neighborhood Traffic Management Program (NTMP) in 1992 (Reference 1). The City developed the traffic threshold curve based on the following key parameters: an increase of 150 Average Daily Traffic (ADT) should be allowed and tolerable on any street, the maximum acceptable increase should be 400 ADT, and the maximum total volume on an untreated parallel street should not exceed 3,000 ADT.

The parallel streets analyzed for this study were plotted on the traffic threshold curve and are shown in Figure 25.

Figure 25
Traffic Threshold Curve for Parallel Streets



As Figure 25 shows, the local parallel streets for this study all experience an acceptable increase in traffic volumes (many of them decrease in traffic volume), with the exception of SE 54th Avenue which is a parallel street to SE 52nd Avenue. This street experienced a 100 percent increase in traffic volumes after speed bumps were installed on SE 52nd Avenue. This increase is due to the fact that SE 54th Avenue is a convenient alternate route to SE 52nd Avenue. Overall, the local parallel streets comply with the traffic threshold curve developed by the City. Studying the validity of the City's traffic threshold was not part of this project.

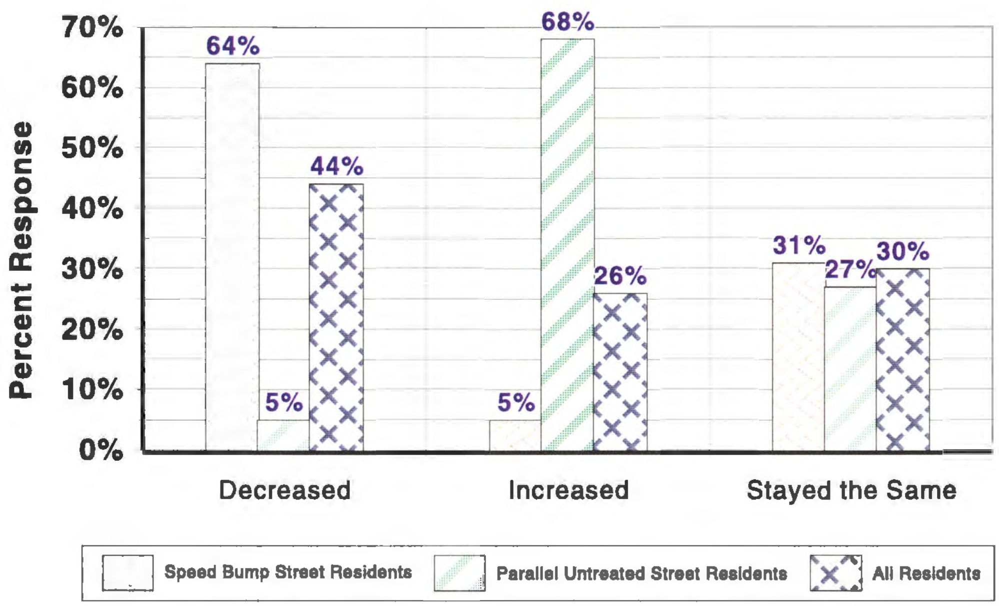
PUBLIC PERCEPTION OF VOLUME CHANGE

■ The majority of speed bump street residents (64%) perceived a decrease in traffic volumes.

The results of the public perception survey relating to traffic volume show that the majority (53%) of residents living on speed bump and parallel untreated streets did not think traffic volumes were too high before bumps were installed. Figure 26 shows the result of one of the volume-related questions on the survey. After the bumps were installed, 64 percent of the speed bump street residents perceived a decrease in traffic volumes, while only 5 percent perceived an increase in volume. This perception matches the documented 28 percent decrease in traffic volume on speed bump streets.

Figure 26

Since speed bumps have been installed, traffic volumes have...



■ The majority of parallel street residents (68%) perceived an increase in traffic volumes. This is not consistent with measured data.

The perception of those living on speed bump streets and those living on parallel untreated streets were quite different regarding traffic volume. The majority (68%) of the parallel untreated street residents perceived an increase in traffic volumes, while Figure 24 documents only a four percent increase in traffic volume. The parallel street residents have the perception that many more vehicles are using their street as a cut-through route now as a result of the speed bumps, when it has been documented that this does not occur. The survey results also indicate that the perception of traffic volume does not change with the duration the bumps have been in place.

SUMMARY

Traffic volumes decrease on streets treated with speed bumps. The amount of volume reduction depends on the amount of speed reduction and availability of alternate routes. Some but not all of this volume shifts to the parallel untreated streets. Other findings regarding traffic volumes include:

- On streets treated with 14-foot speed bumps, the average traffic volume reduction was 33 percent, or 490 daily vehicles (ADT). Therefore the average after traffic volume on streets treated with 14-foot speed bumps was 980 ADT. The reduction in traffic volumes complies with the City's traffic threshold curve.
- After installing 22-foot speed bumps, traffic volumes decreased by an average of 21 percent, or 1,015 ADT. The resulting after traffic volume on streets treated with 22-foot speed bumps was an average of 3,720 ADT. This reduction complies with the City's traffic threshold curve.
- The parallel untreated streets experienced an average increase in traffic volume of four percent, or 40 ADT. This change is not a statistically significant increase in traffic volume on parallel untreated streets as a result of installing speed bumps.
- The results of the public opinion survey showed that 64 percent of the respondents who lived on streets treated with speed bumps perceived a reduction in traffic volumes. This perception matches the documented reduction in traffic volumes on treated streets. Alternately, 68 percent of residents living on parallel untreated streets perceived an increase in traffic volumes after installation of speed bumps. The documented four percent increase in traffic volume does not support this perception.

Additional research is also required relating to traffic volume changes as a result of speed bump installation. These future research areas include:

- Evaluation and further development, if necessary, of the adopted traffic threshold curve. Specifically as it relates to the upper bound of this curve. There is little data available for the higher volume streets (more than 1,500 vpd) to test the reasonableness and applicability of the upper bound of the threshold curve. However, it seems that the upper bound of the curve should continue to increase, rather than decreasing as it currently does. The parameter of a maximum allowable volume of 3,000 ADT could possibly be replaced by another parameter such as a given street should not experience an increase in traffic more than 15 to 20 percent of the pre-bump traffic.
- A reasonable assumption based on this data is that traffic shifts to the nearby appropriate collector or arterial street after speed bumps are installed. To verify and quantify this finding, additional research should be performed to evaluate traffic diversion as a result of the installation of speed bumps. Further, the relationship between volume diversion and the availability of alternate routes should be investigated.

Section 5

Effect of Speed Bumps on Traffic Accidents

Effect of Speed Bumps on Traffic Crashes

EFFECT OF SPEED BUMPS ON TRAFFIC CRASHES

In evaluating the effect of speed bumps on traffic crashes, three different measures of crash rates were considered: annual crashes (labeled as crash frequency), annual crashes per average daily traffic (ADT), and annual crashes per million-vehicle-miles (MVM). Transportation studies most commonly use the crashes per MVM measure, which takes into account the traffic volume (ADT) and length of the street segment. For this study, however, the crashes per MVM rate was not used since the majority of the study streets are fairly short segments (1,000 to 3,000 feet) and have low traffic volume. With short segments and low volumes, each crash on the street has a substantial effect on the crash rate when expressed in crashes per MVM. Thus, with such a low number of crashes and short street segments, a change in one or two crashes causes the crash rate to vary significantly, thereby skewing the results if expressed in crashes per MVM. Therefore, it was decided that leaving the length of the street segment out of the crash rate gave a more accurate depiction in evaluating the effect of speed bumps on crashes. The other two crash measures, annual crashes (crash frequency) and annual crashes per ADT (crash rate) were analyzed and are described in the remainder of this section.

EFFECT ON CRASH FREQUENCY/RATE

- Crash frequency decreased by 39% after installation of bumps (14 and 22 foot bumps combined).

Figure 27 shows the effect of speed bump installation on crash frequency (crashes per year). The figures shows the effect on treated streets, parallel untreated streets, and the combined effect for both treated and parallel untreated streets. Overall, the treated streets experienced a 39 percent decrease in crashes per year after speed bumps are installed. The 39 percent decrease on speed bump streets is a statistically significant difference ($t = 2.8$) from 1.39 to 0.85 crashes/year, meaning crashes most likely do decrease on speed bump streets due to bump installation.

- On 14 foot bump streets, crash frequency decreased by 48% to 0.39 crashes/year.
- On 22 foot bump streets, crash frequency decreased by 32% to 2.55 crashes/year.

The crash frequency differs slightly on streets treated with 14-foot and 22-foot speed bumps. Figure 28 shows the effect of bump type on crash frequency. As Figure 28 shows, the crash rate decreased 48 percent on 14-foot bump streets, from 0.76 to 0.39 crashes/year. On 22-foot bump streets, the crash rate decreased 32 percent, from 3.76 to 2.55 crashes/year. The 22-foot bump streets have higher crash frequencies because they have higher traffic volumes and longer street sections.

As will be discussed later in this report, both volume reduction and speed reduction play a role in determining the amount of crash frequency reduction on treated streets. As shown previously, more speed reduction and volume reduction on a percent basis is experienced on 14-foot speed bump

Figure 27

Effect of Speed Bumps on Crash Frequency

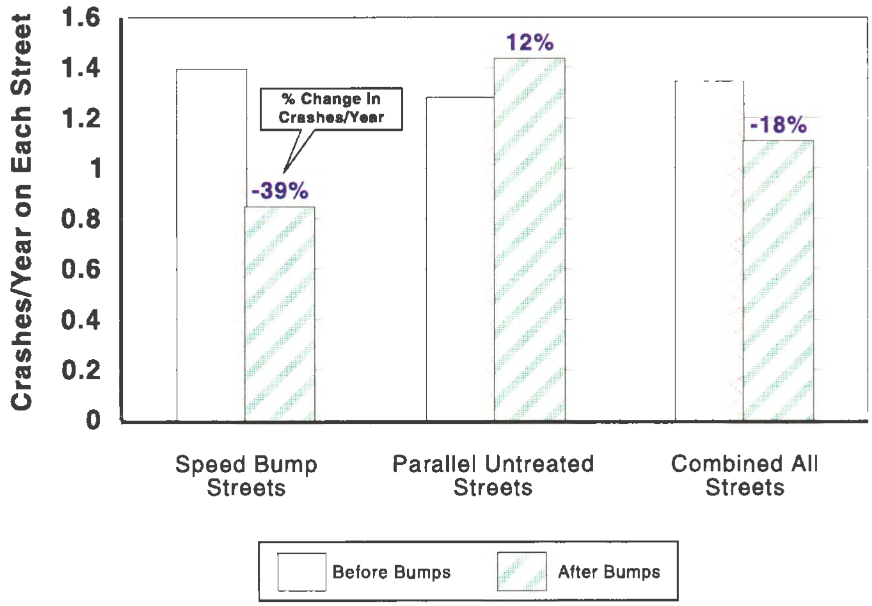
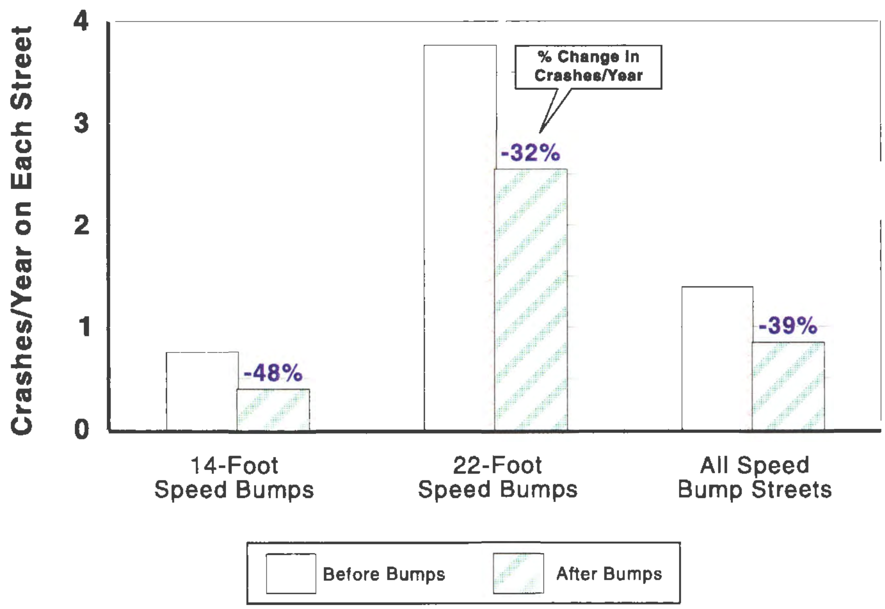


Figure 28

Effect of Bump Type on Crash Frequency



- On parallel untreated streets, accident frequency increased by 12% to 1.44 crashes/year. This is *not* statistically significant.

treated streets than 22-foot treated streets. Thus, it is logical that 14-foot bumps would result in a more dramatic crash reduction on a percent basis than 22-foot bumps. In other words, due to the higher propensity for vehicle diversion and speed reduction resulting from 14-foot bumps, 14-foot bumps may accordingly result in a higher reduction in crashes than will 22-foot bumps.

The parallel untreated streets experienced a 12 percent increase (from 1.28 to 1.44 crashes/year) in crash frequency, which is not a statistically significant change (t = 0.85). The treated and parallel untreated streets combined experienced an 18 percent decrease (from 1.34 to 1.11 crashes/year) in crash frequency, which is also not a statistically significant change (t = 1.68).

This data shows that on average the incidence of crashes on streets treated with speed bumps decreases after bumps are installed. However, from this data, the speed bumps have no proven effect on crash frequency on immediately adjacent parallel streets. The incidence of crashes is relatively low, before and after installation of speed bumps.

- No provable change in *crash rates* on treated streets was found as a result of speed bumps.

- Reduction in *crash frequency* on treated streets is due to volume diversion from treated streets to other streets.

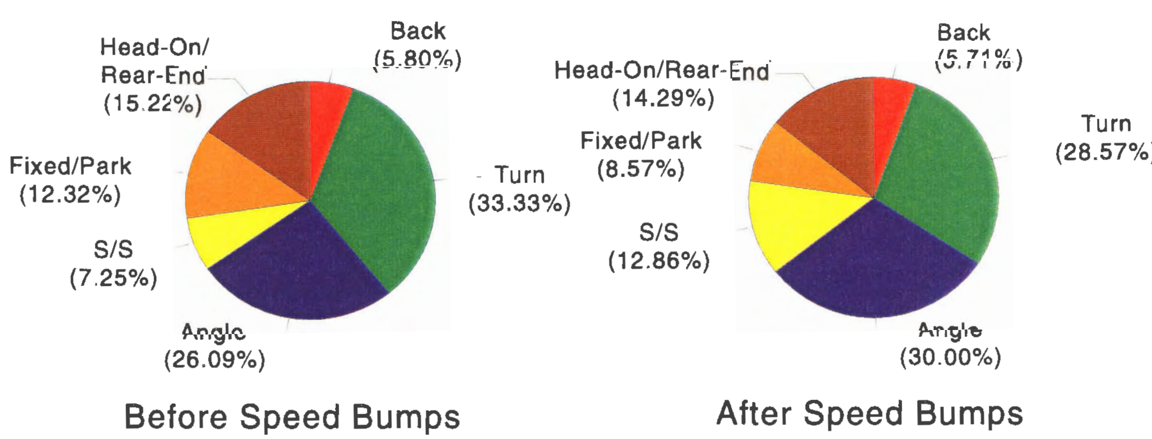
The change in *crash rate* was next calculated for the treated streets. Based on the data provided, it was found that there is a five percent reduction in crashes per ADT after speed bumps were installed. This change is not statistically significant (t= 0.22). This is different than the 39 percent reduction in crash frequency shown in Figure 27. The only difference between the crash frequency and crash rate is that the crash rate takes into account that volumes on the treated streets decrease after speed bumps are installed. Thus, of the 39 percent reduction in crash frequency on treated streets, the reduction in traffic volumes is the main factor in the reduction of crashes on treated streets. Fewer cars mean less potential for crashes. This issue is discussed in more detail in the *Factors in Crash Reduction* section of the report.

EFFECT ON CRASH TYPE

- No change in *crash type* as a result of speed bumps.

Figure 29 shows the type of crashes before and after speed bumps were installed. As shown in the figure, the results of the crash analysis show that speed bumps do not cause any type of crash to occur statistically more or less frequently than it did before the speed bumps were installed. The

Figure 29
Effect of Speed Bumps on Crash Type



change in crash types shown in Figure 29 is a result of normal variance in the occurrence of crashes.

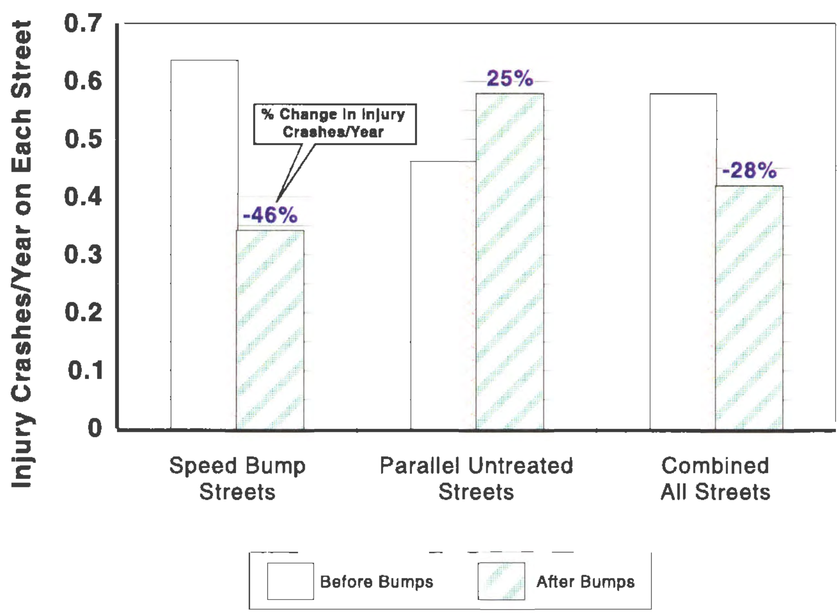
EFFECT ON CRASH SEVERITY

- The incidence of injury crashes decreases with installation of speed bumps.

The number of injury crashes (crash severity) was investigated before and after speed bump installation to determine the effect on the severity of crashes. Figure 30 shows the change in the number of injury crashes per year, which can be summarized as follows:

- injury crashes reduced by 46 percent on speed bump streets (t = 2.06),
- injury crashes increased by 25 percent on parallel untreated streets (t = 1.17), and
- injury crashes reduced by 28 percent on combined all streets (t = 1.67).

Figure 30
Effect of Speed Bumps on Injury Crash Rate



- Decrease in injury crashes is largely due to reduction of traffic after installation of speed bumps.

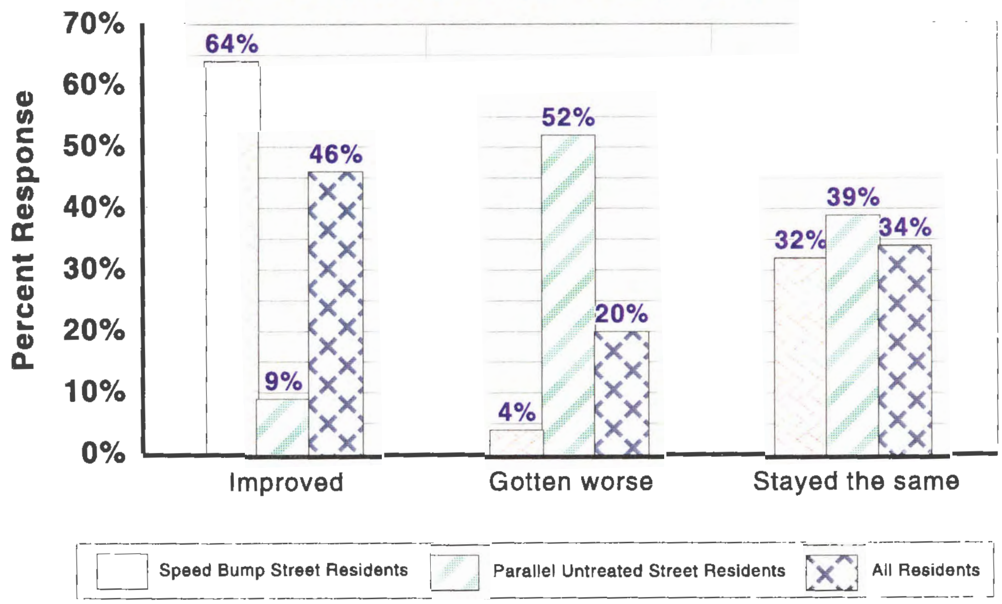
The 46 percent reduction in injury crashes is primarily due to the 39 percent reduction in total crashes (caused by the decrease in traffic volumes on treated streets), since a decrease in the total crashes will naturally lead to a decrease in the number of injury crashes. The change in crash severity on speed bump streets is statistically significant (t = 2.06), but the changes on parallel untreated and combined all streets are *not* statistically significant (t = 1.17 and 1.67, respectively).

PUBLIC PERCEPTION OF CRASH CHANGE

- The majority (64%) of treated street respondents perceived a safety benefit of bumps.
- The majority (52%) of parallel street respondents perceived a decrease in safety due to bumps.

Although the resident survey did not directly ask about the safety of motorists, it did ask about the safety of pedestrians and bicyclists. Figure 31 shows the results of a survey question regarding safety. With installation of speed bumps, more survey respondents perceived an improvement in safety for pedestrians and bicyclists (46%) than perceiving a reduction in safety (20%). Those living on speed bump streets perceived more of a safety benefit (64%) than those living on parallel untreated streets (4%). The perception of increased safety for those living on treated streets matches fairly well with the reality of the statistically significant 39 percent reduction in crash frequency. Approximately 52 percent of those living on parallel untreated streets perceived a decrease in safety, while the parallel streets actually experienced only a 12 percent increase in crashes, which was *not* statistically significant. There does not seem to be a change in the perception of safety as the duration the bumps have been in place increases.

Figure 31
Since speed bumps have been installed, pedestrian and bicycle safety has...



SUMMARY

The crash analysis showed that the incidence of crashes (crash frequency) decreases with installation of speed bumps. The decrease in the incidence of crashes is strongly driven by the change in traffic volumes More specific findings from the crash analysis include:

- With installation of speed bumps, the incidence of crashes on treated streets decreased on average 39 percent from 1 39 to 0.85 crashes per year. Separating the treated streets by bump type, the 14-foot bump streets experienced a 48 percent crash reduction and the 22-foot bump streets experienced a 32 percent reduction in crash frequency.

- The crash *rate* (annual crashes per ADT) decreased on treated streets an average of five percent after speed bumps were installed. The difference in the crash frequency and crash rate reductions show that the reduction in crash frequency is mainly due to the reduction in traffic volume on treated streets.
- There was no measured change in crash type caused by the installation of speed bumps.
- The incidence of injury crashes on treated streets decreased by 46 percent, a statistically significant reduction, after speed bumps were installed.
- Crash frequency increased by 12 percent on parallel untreated streets after speed bumps were installed. This increase is not statistically significant, however, meaning the data cannot prove there is a correlation between speed bump installation and crash frequency on parallel untreated streets.
- Residents of streets treated with speed bumps do perceive an increase in safety overall. In contrast, and despite the fact that the data does not prove this, residents of parallel untreated streets perceive that safety worsened on their street after installation of the speed bumps.
- Additional research into a change in crash type as a result of the installation of speed bumps would be valuable.

City of Portland Speed Bump
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Section 6

Relationship Between Speed Bumps and Speeds, Volumes, and Accidents

Relationships Between Speed Bumps and Speeds, Volumes, and Crashes

OVERVIEW

- Five factors affecting benefits of speed bumps:
  - availability of alternate routes
  - number of speed bumps
  - spacing of speed bumps
  - design of speed bumps (14 or 22 foot)
  - street characteristics

Figure 32 shows a flow chart representing the relationship between speed bump installation and the effect speed bumps have on vehicle speeds, traffic volumes, and vehicle crashes. As shown at the top of Figure 32, five controlling factors were identified which together determine the quantifiable change in speeds, volumes, and crashes:

- Availability of alternate routes - Are there alternate routes available which are easy to find and do not cause much travel time loss as compared to traveling to the same destination on the speed bump street?
- Number of speed bumps - How many speed bumps are installed on a street?
- Speed bump spacing - What is the distance between the speed bumps?
- Speed bump design - What are the dimensions (length, height, grade) of the speed bump? In the City of Portland, is the bump a 14-foot or 22-foot bump?
- Street characteristics - What are the physical characteristics of the street, such as horizontal or vertical curves, pavement width, nearby traffic control devices, and surrounding land uses?

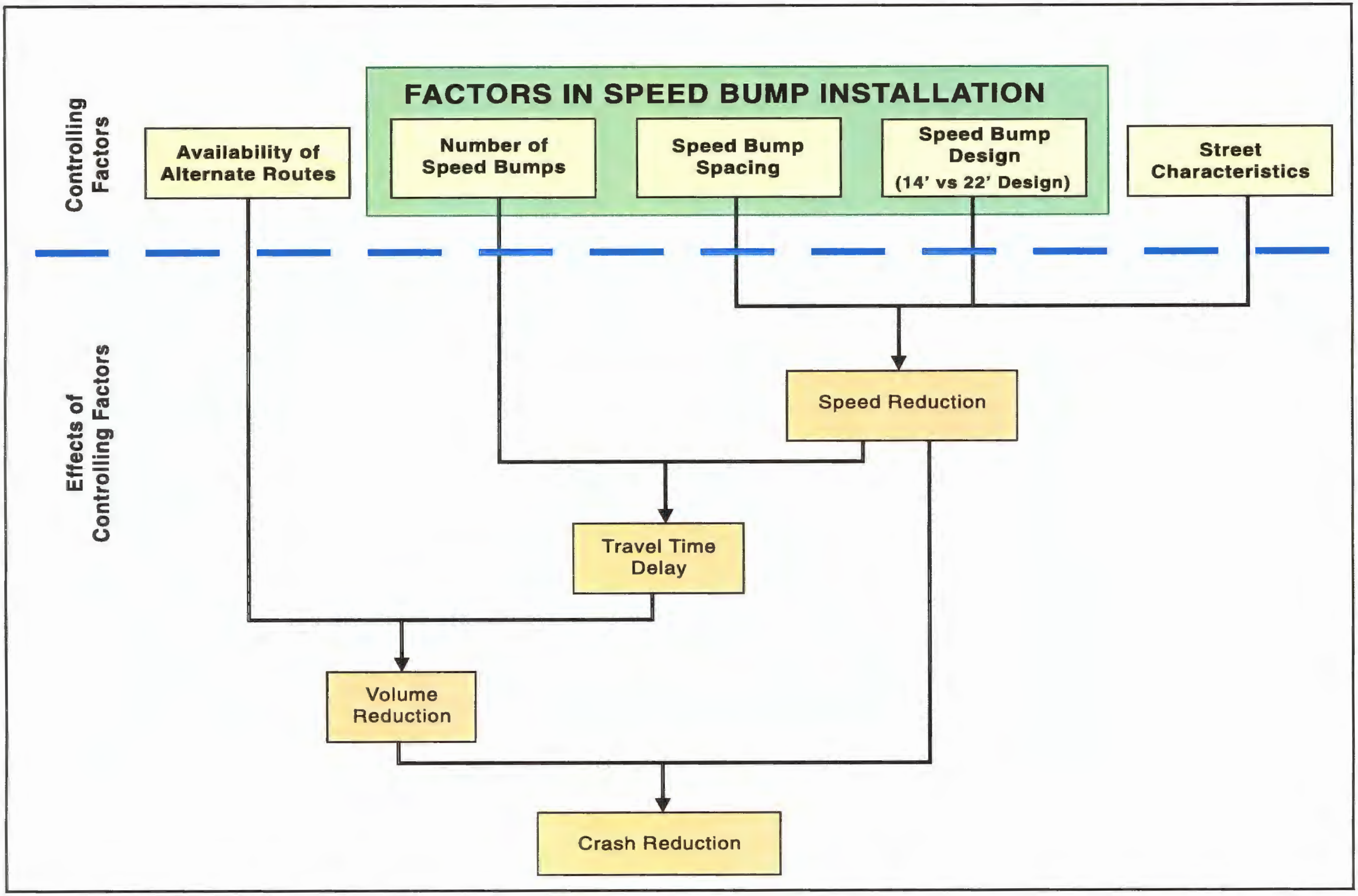
These factors collectively determine how effectively speed bumps function in reducing speeds, volumes, and crashes. Of these factors, only three are controlled by speed bump installation: number of speed bumps, speed bump spacing, and speed bump design. The other two factors, availability of alternate routes and street characteristics, cannot be changed since they are a function of the existing roadway network. The following section describes the relationship between these factors.

FACTORS IN SPEED REDUCTION

- Factors affecting speed reduction:
  - spacing of bumps
  - design of bumps (14 or 22 foot)
  - street characteristics

The analysis shows that the cause of speed reduction on speed bump streets is a function of primarily the following factors:

- *Speed bump spacing:* The spacing of the speed bumps determines how much distance is available for vehicles to accelerate and decelerate between bumps. Generally, a shorter speed bump spacing results in lower speeds along the treated street section, since vehicles have a shorter time to accelerate and decelerate between the bumps.



RELATIONSHIP BETWEEN SPEED BUMPS AND SPEED, VOLUME, AND CRASH REDUCTION

CITY OF PORTLAND SPEED BUMP PEER REVIEW PROJECT

OCTOBER 1998

FIGURE 32

- *Speed bump design (14-foot vs. 22-foot)*: The design of the speed bumps determines how severe the vertical acceleration is on vehicles as they travel over the bumps. A bump design producing a severe vertical acceleration on the vehicle will result in the driver traveling slower over the bump to minimize driver discomfort.

- *Street characteristics:* The physical characteristics of the street such as vertical and horizontal curves, number, parking utilization, and type of traffic control devices (stop signs, traffic lights, etc.), and pavement width affect how much speed reduction will result after speed bumps are installed. For example, a street with a narrow pavement width and sharp horizontal curves will most likely have slower speeds relative to other streets before speed bumps are installed. So, by installing speed bumps on this street, a small speed reduction will probably be realized. On the other hand, a straight street with a wide pavement width will most likely have relatively higher speeds relative to other streets before bump installation and will thus realize a fairly high speed reduction after bumps are installed. These physical street characteristics vary from street-to-street, making it difficult to forecast the amount of speed reduction a street will experience before bumps are installed.

Evaluation of Speed Reduction Factors

As described above, the speed bump spacing and speed bump design have a direct impact on the amount of speed reduction realized when speed bumps are installed. The physical characteristics of the street also have an impact on speed reduction, but cannot be quantified since each street has uniquely different characteristics.

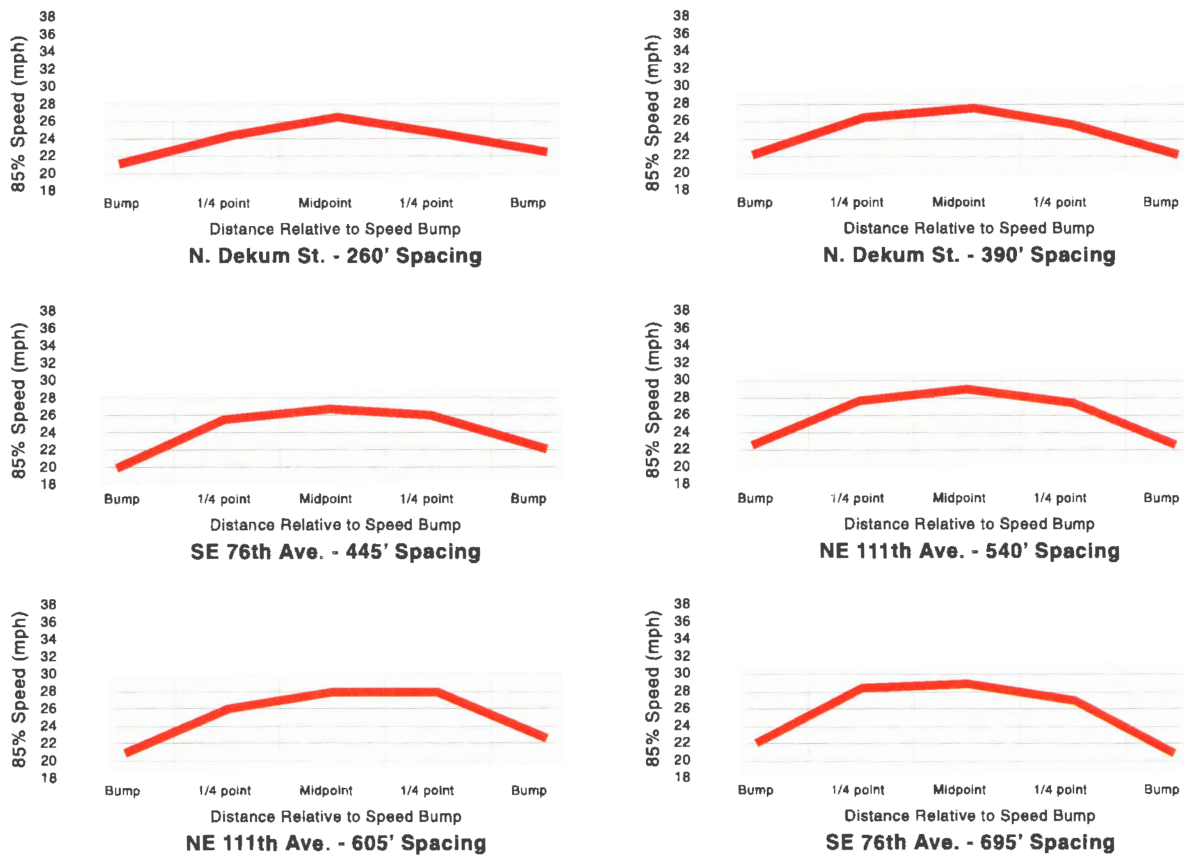
Figure 33 displays the speed profile between 14-foot speed bumps on six different street segments, each with different speed bump spacing. Figure 34 shows similar speed profile data with 22-foot speed bumps. Using the data shown in Figure 33 and 34, Figure 35 shows the average speed profile for speed bumps spaced between 400 and 600 feet apart. A number of observations regarding the effect of speed bump spacing and design on speed reduction can be made associated with Figures 33, 34, and 35:

■ 14 foot bumps result in overall lower speeds than 22 foot bumps.

- Directly over the bumps, the 14-foot speed bumps experience 85th percentile speeds between approximately 20 and 22 mph (Figure 33), while the 22-foot bumps experience 85th percentile speeds over the bumps approximately between 26 and 30 mph (Figure 34). The more abrupt 14-foot design results in higher vertical acceleration and thus more driver discomfort at higher speeds than is experienced over the more gradual 22-foot design.

- Drivers decelerate and accelerate more abruptly between 14-foot bumps than they do between 22-foot bumps, as their speed at the

Figure 33
Speed Profile for 14-foot Speed Bumps



- Speeds directly over bump versus speeds at bump mid-point can vary by 5 mph on 14 foot bump streets.
- More even speeds are maintained on 22 foot bump streets.

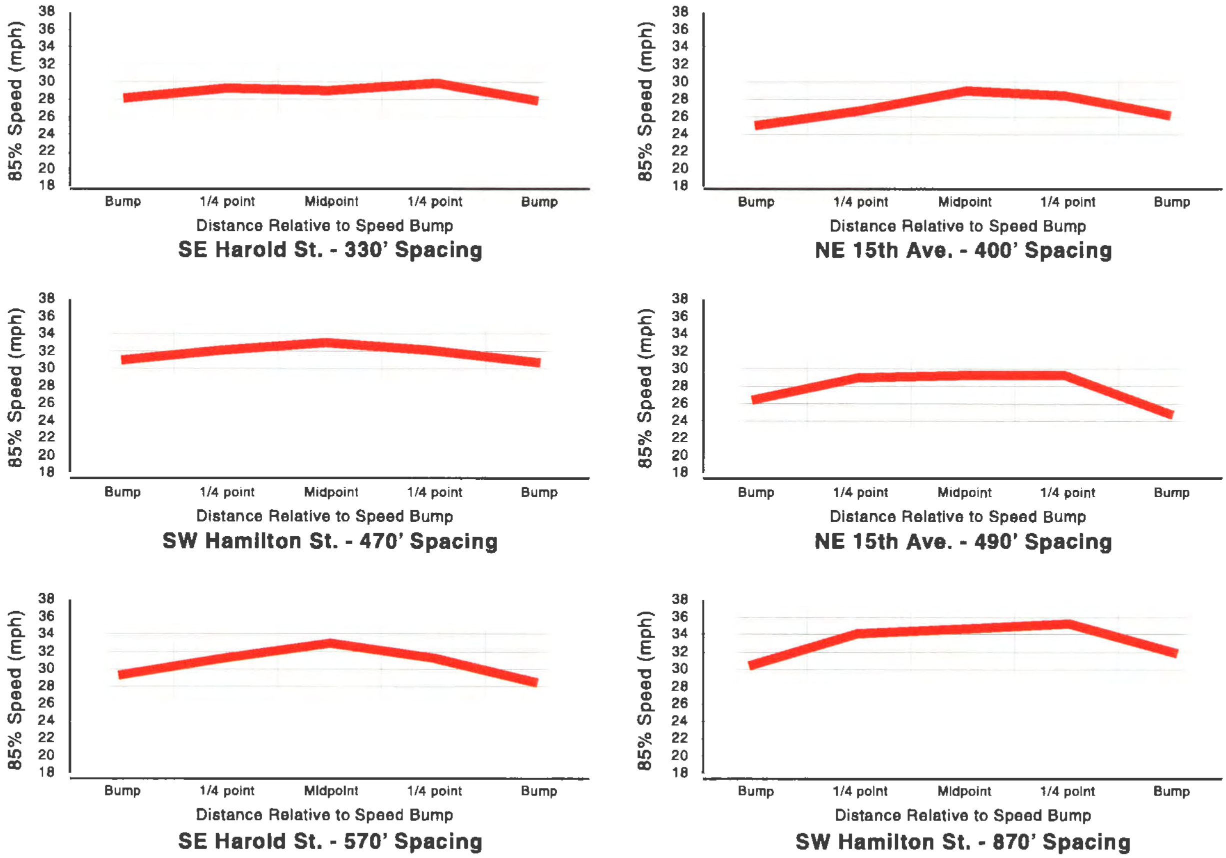
midpoint of the bumps increases by approximately 5 to 6 mph (Figure 35). This is presumably to make up for the lost time associated with decelerating to speeds drivers perceive as too low over the 14-foot bumps (20 to 22 mph). Drivers maintain a more even speed between 22-foot bumps, with drivers increasing speeds between the bumps by approximately 3 mph (Figure 35). This speed increase between the bumps depend on the bump spacing; however, given the same spacing, 14-foot bumps will result in a more spiked speed profile than 22-foot bumps.

As mentioned previously, speeds may gradually increase as bumps become "older" and drivers become more accustomed to the vertical acceleration. The data shown in Figures 33, 34, and 35 was collected on treated streets with bumps installed for more than two years. Thus, the speeds reported in these figures were most likely slightly lower immediately after the bumps were installed than they are shown in Figures 33, 34, and 35 (see Figure 11).

Figure 36 shows the relationship between speed bump spacing and speeds mid-way between bumps. As the figure shows, speeds between bumps

Figure 34

Speed Profile for 22-foot Speed Bumps



generally increase as bumps are spaced further apart. This is due to the fact that drivers have more time to accelerate and decelerate between bumps as the bumps are spaced farther apart in an effort to make up lost time incurred by slowing down over the bumps. Also, the speeds between bumps are lower in a series of 14-foot bumps than they are in a series of 22-foot bumps, as indicated by the two shaded areas in Figure 36.

- Speeds between bumps increase as speed bump spacing increases.

Figure 36 is helpful in determining the optimum speed bump spacing. For example, if a series of 14-foot bumps are to be installed on a local street where the desired 85th percentile speed is 25 mph, then Figure 36 indicates that the 14-foot bumps should be installed at 275- to 350-foot spacing.

FACTORS IN VOLUME REDUCTION

As shown previously in Figure 32, there are two factors which determine the amount of volume reduction on a treated street: availability of alternate routes and travel time delay. Drivers will shift to alternate routes if they determine another route is faster or more convenient than the speed bump route. Regarding the travel time delay factor, there are two primary

■ Factors affecting volume diversion:

- availability of alternate routes
- travel time delay

Figure 35

Speed Profile Over Speed Bumps at 400-600 foot Spacing

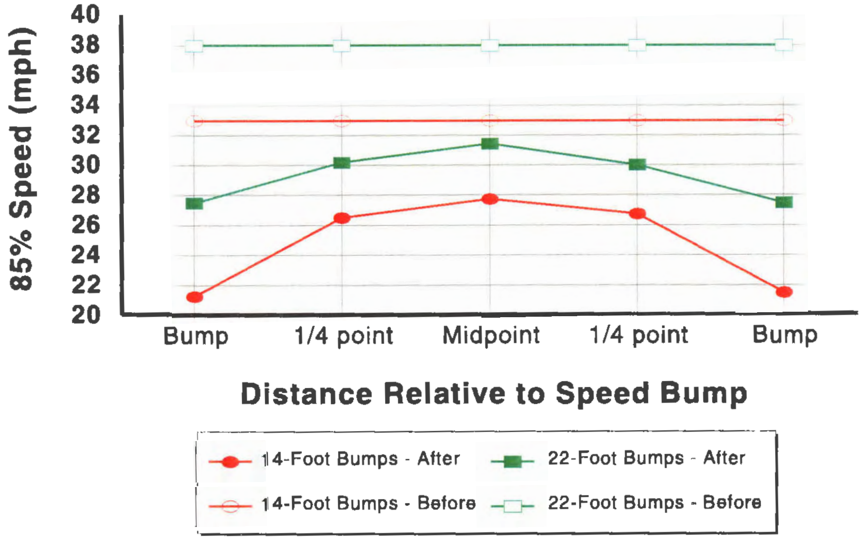
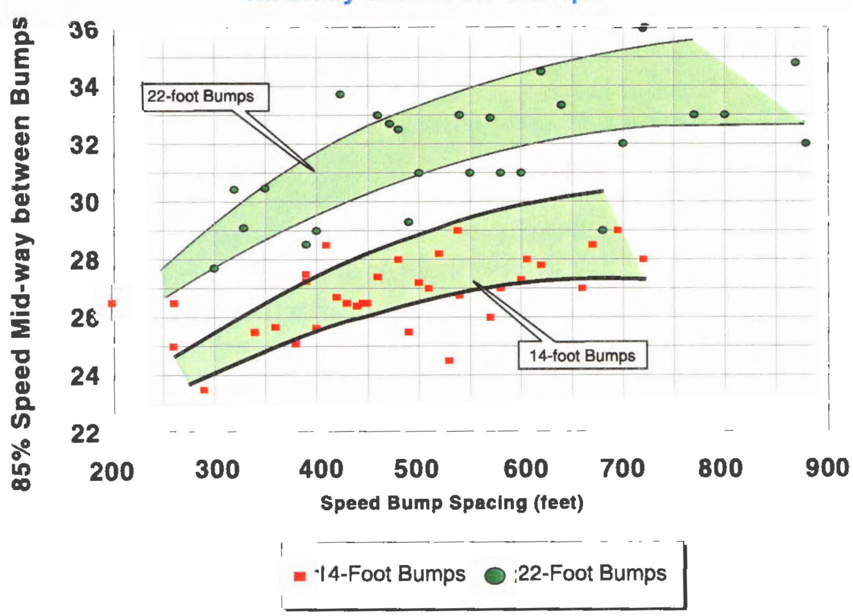


Figure 36

Effect of Speed Bump Spacing on 85th Percentile Speed Midway Between Bumps



factors which determine if another route will be faster and, thus, controls the amount of volume reduction: the number of speed bumps and speed reduction between bumps.

Availability of Alternate Routes

If a convenient street parallel to a treated street is available and it will provide a quicker or less disruptive (i.e. fewer traffic signals or stop signs) route than the treated street, vehicles may divert to the parallel street to avoid the slower speeds on the treated street. A good example of this is on SW Maplewood Drive in Portland, where 14-foot bumps diverted vehicles to the nearby SW 51st Avenue. But when the bumps were spaced further apart and were replaced with 22-foot bumps, not nearly as many vehicles diverted to SW 51st Avenue. The experience with SW Maplewood Drive showed that drivers are aware of alternate routes and the amount of volume diversion is dependent both on the availability of alternate routes and the amount of travel time delay incurred by the speed bumps.

Travel Time Delay

- Travel time delay is affected by:
  - number of speed bumps
  - speed reduction through the bumps

The amount of travel time delay on a treated street section is defined as the difference between a vehicle's travel time through the treated section before and after speed bumps are installed. A motorist is more likely to seek out alternate routes as the travel time delay incurred by speed bumps increases. The amount of travel time delay is dependent on:

- *Speed reduction in the speed bump section* - The speed reduction, as described previously, is a function of the speed bump spacing, speed bump design, and street characteristics. The speed reduction in the speed bump section affects the amount of travel time delay for motorists traveling on a treated street, which in turn affects the amount of volume diversion. It can be seen through this relationship that motorists do not divert to other routes based on the speed bump spacing or design, but these factors indirectly do affect the volume diversion since they determine the amount of speed reduction.

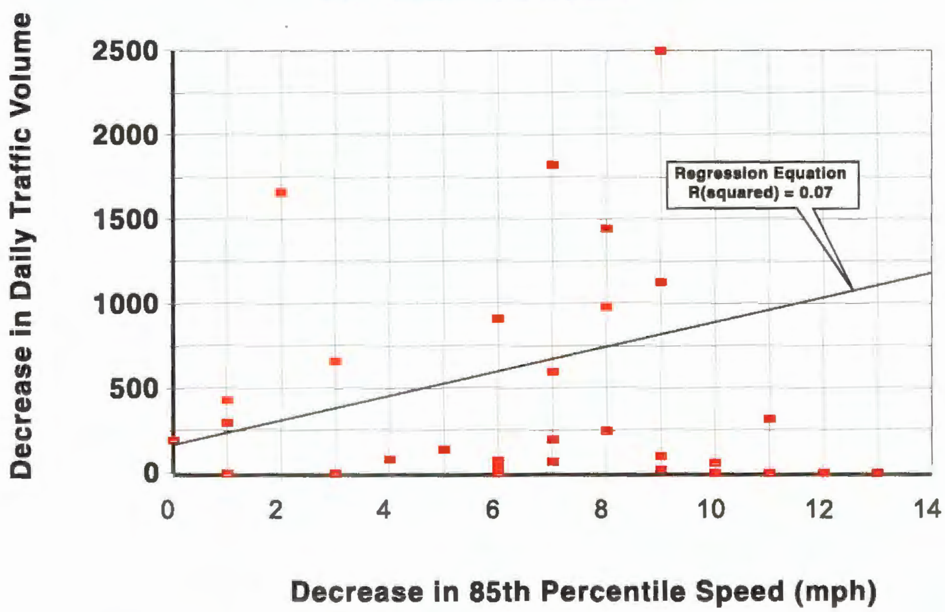
- *Number of speed bumps* - A street with five speed bumps will result in a slower travel time through a treated street section than if the same street had only two bumps. The number of bumps does not affect the speed reduction at a given point in the treated street section; rather, it defines the duration vehicles must travel at the reduced speed. The speed reduction applied over the duration of the treated street section defines the total travel time delay on a treated street section.

Evaluation of Volume Reduction Factors

To quantify the relationship between volume diversion and the factors discussed above, an evaluation was performed of the relationships between volume diversion and speed reduction, and between volume diversion and the number of speed bumps. The other relationship discussed above, volume diversion and availability of alternate routes, cannot directly be measured since each speed bump is located in a unique location with varying degrees of alternate routes. Although the influence of alternate routes on volume diversion cannot be specifically measured, it is an important factor in volume diversion and, thus, should be considered for future research.

Figure 37 shows the relationship between the reduction in 85th percentile speed and traffic volume reduction. Figure 38 shows the relationship between the number of speed bumps and reduction in traffic volume. Figure 37 shows that a higher reduction in speeds results in a higher reduction in traffic volumes on speed bump streets. Similarly, Figure 38 shows that more speed bumps on a given street results in a higher reduction in traffic volumes. Based on the analysis, it appears that the number of bumps criteria more directly influences the volume reduction than does the speed reduction criteria. Note that the regression analyses revealed a low correlation between the variables (R^2 value ranges from 0 to 1, with 0 being low correlation and 1 being high correlation). This low correlation does not necessarily mean there is no correlation between the variables,

Figure 37
Relationship Between 85th percentile Speed Decrease and Volume Decrease



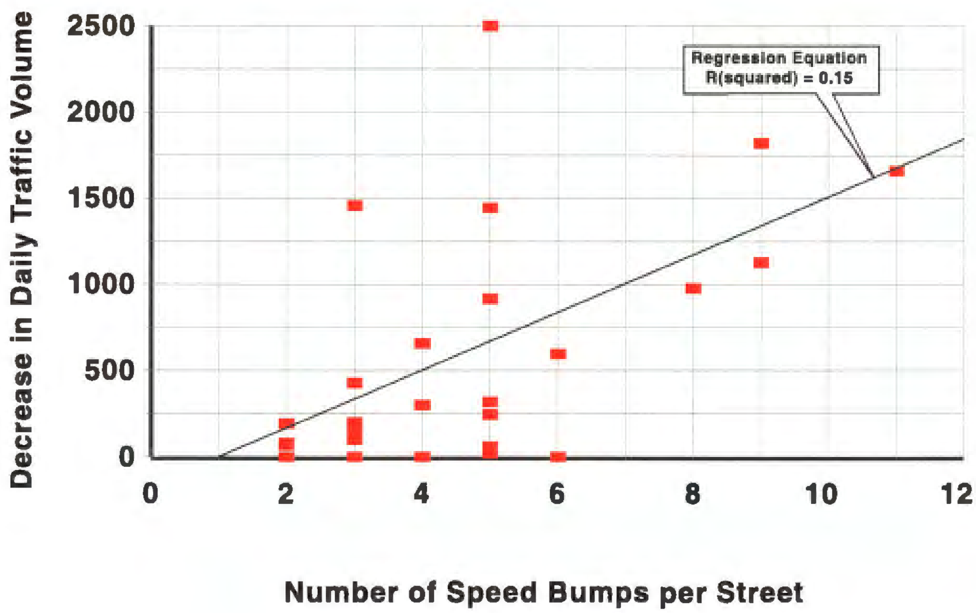
but that there are other variables also affecting the reduction in traffic volumes, such as the availability of alternate routes.

FACTORS IN CRASH REDUCTION

As shown in Figure 32, the amount of crash reduction experienced on a speed bump street, if any, is dependent on both the amount of volume reduction and speed reduction. A volume reduction will most likely mean a crash reduction simply because there will be fewer vehicles on a roadway, decreasing the opportunity for a crash. Speed reduction could also mean a reduction in crash frequency or severity since drivers are more aware of the surroundings and have a shorter stopping distance to avoid collisions.

Figure 38

Relationship Between Number of Bumps and Volume Decrease



As Figure 32 shows, the design, spacing, and number of speed bumps indirectly affects the change in crashes through their affect on speed reduction and volume reduction. Based on data evaluated for this project, it is thought that a direct analysis of the relationship between speed bump design or spacing and crash reduction is not valid.

Effect of Volume Reduction

- Crash reduction due to speed bumps is largely driven by traffic diversion from the local street.

To determine the relationship between traffic volume reduction and crash frequency, the crash rate was normalized for traffic volumes or, in other words, expressed in annual crashes per ADT (average daily traffic). Expressing the crash rate in this form allows the amount of crash reduction attributable to volume reduction to be determined. Table 2 shows the difference in crash rates with and without taking into account traffic volumes.

Table 2

Change in Crash Rates After Speed Bumps are Installed

Street Type	Crashes/Year	Crashes/Year/ADT
Speed Bump Streets	- 39% (Stat. Signif.)	- 5% (Not Stat. Signif.)

As shown in Table 2, once traffic volumes are taken into account in the crash rate, the change in crash rate is minimal and not statistically significant, meaning there is likely no change in the crash rate. Thus, of the 39 percent reduction in annual crashes on speed bump streets, the reduction in traffic volumes is most likely the only reason for the reduction in the number of crashes on speed bump streets (crash frequency). Stated differently, the reduction in crash frequency on speed bump streets is directly proportional to the amount of vehicle diversion.

Effect of Speed Reduction

Even though the reduction in crash frequency was shown to be primarily due to a reduction in traffic volume, the role of speed reduction in reducing crash frequency and severity was also investigated. To evaluate the relationship between speed reduction and crash reduction, a regression analysis was performed on the 33 speed bumps studied for this project. The purpose of the regression analysis was to find: 1) whether any relationship between speed reduction and crash frequency existed, 2) whether any relationship between speed reduction and a crash severity existed, and 3) whether a stronger relationship existed between speed reduction of all vehicles (indicated by the 85th percentile speed and percent traveling over the speed limit measures) or just the reduction in the fastest vehicles (indicated by the percent traveling 10 mph or more over the speed limit measure). Specifically, the regression analysis was performed for the following variables:

- 85th percentile speed vs. total crashes per year,
- percent traveling over speed limit vs. total crashes per year,
- percent traveling 10 mph or more over speed limit vs. total crashes per year, and
- percent traveling 10 mph or more over speed limit vs. injury crashes per year.

Table 3 shows the results of the regression analysis.

Table 3
Regression Analysis - Speed Reduction vs. Crash Reduction

Relationship Tested	Result	R2 value
85% Speed vs. Total crashes per Year	No or minimal relationship	0.01
Percent Traveling Over Speed Limit vs. Total crashes per Year	No or minimal relationship	0.01
Percent Traveling 10 mph or more over Speed Limit vs. Total crashes per Year	Higher Speed Reduction means Higher Crash Reduction - **Possible relationship**	0.05
Percent Traveling 10 mph or more over Speed Limit vs. Injury crashes per Year	No or minimal relationship	0.02

Note: R^2 value shows the strength of the relationship between the two factors. R^2 ranges from 0 to 1, with 0 being no relationship and 1 being a very strong relationship.

As shown in Table 3, no or a minimal relationship seems to exist between the speed reduction and reduction in crash frequency. Of the three speed measures tested in the regression analysis, the percent traveling 10 mph or more over the speed limit measure shows the strongest relationship to the crash reduction. However, this relationship is not very strong as evidenced by the low R^2 value. However, as stated previously, a low R^2 value does not necessarily prove that there is not a relationship, but that there may be other factors affecting the reduction in crashes. Overall, this regression analysis supports the earlier finding that the crash frequency reduction is due primarily to the reduction in traffic volumes and not a reduction in vehicle speed.

As shown previously in Figure 30, the severity of injury crashes decreases on speed bump streets and increases on parallel untreated streets. Even though it cannot be proved statistically, it is a logical presumption that a seven mph decrease in 85th percentile vehicle speeds will lead to a partial decrease in the severity of crashes. Another hypothesis for the slight decrease in crash severity is that the presence of speed bumps causes an overall increased awareness on the speed bump street, resulting in better driver attentiveness.

City of Portland Speed Bump Peer Review

Section 7

Effect of Speed Bumps on Crime and Emergency Services

Effect of Speed Bumps on Crime and Emergency Services

As part of this project, the effect of speed bumps on crime frequency and emergency services was also evaluated. The methodology and results of this analysis are presented in the remainder of this section.

EFFECT OF SPEED BUMPS ON CRIME

The effect of speed bumps on crime frequency was investigated through an evaluation of the crime rates before and after speed bumps were installed. The crime data was supplied by the City of Portland Police Bureau. Table 4 shows the results of the analysis.

Table 4
Effect of Speed Bumps on Crime Frequency

Description	Crimes per Month on Each Street		Percent Change	Statistically Significant Difference?
	Before Bumps	After Bumps		
Speed Bump Street	1.17	1.23	+5%	No
Parallel Untreated Streets	1.03	1.35	+30%	No
Combined All Streets	1.12	1.27	+13%	No

■ No direct relationship found between speed bumps and crime.

As shown in Table 4, both speed bump streets and parallel streets experienced an increase in crime frequency after speed bumps were installed. In comparison, data from the City of Portland Police Bureau indicates the crime rate for the entire City has increased by an average of 5.3 percent per year between 1990 and 1996 (Reference 2). Thus, the increase on speed bump streets has been consistent with the city-wide increase in crime rates. However, the crime rates on parallel streets have increased at a higher rate than the city-wide increase. The increase in crime rates on speed bump and parallel streets are not statistically significant, meaning the data cannot prove that the crime rate changes as a result of installing speed bumps.

EFFECT OF SPEED BUMPS ON EMERGENCY SERVICES

The City of Portland Bureau of Fire and Emergency Services has stated that their target for providing emergency response to any area of the City is four minutes or less for 95 percent of emergency calls. The Fire Bureau developed a map that shows all areas in Portland which have response times in excess of four minutes. According to the Fire Bureau's map, there are approximately 12 "areas" of differing sizes in the City that have response times greater than four minutes. There are a number of variables which could cause the areas to have deficient response times, such as accessibility and topography of the area (this problem is evident in the West Hills), distance to the nearest fire station, traffic volumes and congestion, and possibly the presence of traffic calming devices (i.e. traffic circles, diverters, speed bumps).

The delay speed bumps can cause emergency service vehicles depends on a number of factors. Some factors that affect the delay experienced on speed bump streets are as follows:

- Delay caused by speed bumps to emergency service vehicles not quantified, but affected by:
  - vehicle type
  - driver characteristics
  - speed bump type
  - speed bump spacing
  - number of speed bumps

- *Vehicle type* - Larger emergency service vehicles generally must slow down more over the bumps than smaller vehicles.
- *Driver characteristics* - Each driver is slightly different in their driving aggressiveness and acceptance of discomfort over the bumps; thus, the more aggressive drivers tend to produce less delay per bump than more conservative drivers.
- *Speed bump type (14' or 22' bump)* - Vehicles will experience more delay on 14-foot bumps than 22-foot bumps due to the more severe design of the 14-foot bumps.
- *Speed bump spacing* - If two bumps are located on a street, the amount of delay experienced on the street due to the bumps is a function of the bump spacing. If the bumps are spaced far enough apart that the vehicle reaches its optimum speed between the bumps, then the maximum possible delay per bump is fully realized. However, if the bumps are placed closely together, then the delay will effectively be the delay over one bump due to the close spacing. Thus, the delay *per bump* is a function of the spacing and increases as the speed bump spacing increases.
- *Number of speed bumps* - More speed bumps on a street will result in more overall delay for emergency service vehicles. The speed bump spacing, as described above, determines the vehicle speeds and corresponding delay through the speed bump section, while the number of speed bumps determines the distance vehicles are delayed through a treated street section.

- No relationship proven between speed bumps and frequency of emergency service calls.

Another task identified for this project was to determine the effect of speed bumps on the number of emergency calls. It was believed that since speed bumps have been shown to decrease the number of traffic crashes, fewer emergency calls would be made. Due to changes in their computer systems, the Fire Bureau only has emergency call data available from 1996 and 1997. Thus, "before" data could only be summarized for those speed bumps constructed in 1996 or 1997. For speed bumps constructed in this time period, it was determined that the emergency call frequency decreased slightly on the speed bump streets and increased slightly on the parallel untreated streets. Due to the small sample size of this data, these slight changes cannot be proven statistically significant. However, this trend does match the decreased crash frequency found on speed bump streets and increased frequency on parallel untreated streets.

- Majority of survey respondents (53%) do not think speed bumps cause problems for emergency service vehicles.

The public opinion survey showed that approximately half of the residents (53 percent) think speed bumps do not cause a problem for fire trucks or ambulances. Also, emergency service vehicles were perceived to have more of a problem with the delay caused by speed bumps than other large vehicles, such as buses, trucks, or garbage trucks.

SUMMARY

The results of the crime statistics and emergency services data analysis show that:

- Based on this analysis, there is no direct correlation between the installation of speed bumps and crime rates on the treated street or the parallel untreated street.
- Insufficient data was available from the City of Portland Fire Bureau to evaluate a relationship between emergency service response time and speed bumps.
- Due to the small data set, a relationship between speed bump installation and emergency services calls could not be proven.

Future research into the relationship between speed bumps and emergency service response time and emergency service calls should be performed.

City of Portland Speed Bump Peer Review

Section 8

Findings and Conclusions

Findings and Conclusions

Through this project, it is shown that speed bumps are an effective tool in reducing vehicle speeds in the City of Portland, particularly the speeds of the fastest drivers, on treated streets. Also, speed bumps do not cause an increase in speeds on the parallel untreated streets, and in fact reduce speeds on many parallel untreated streets. With this reduction in speed, speed bumps frequently divert traffic off the treated streets. It appears that this volume reduction often diverts vehicles to the appropriate nearby collectors and arterial streets and a net reduction in volumes is realized on a neighborhood-level as a result. Crash rates are also reduced on the treated and untreated streets combined after speed bumps are installed, which is mainly due to the reduction in traffic volumes. The specific findings and conclusions of this peer review can be summarized as follows:

VEHICLE SPEEDS

Speed bumps are an effective tool in reducing travel speeds to be consistent with posted speed limits. They are very effective in reducing the speeds of the fastest drivers. Speeds also decreased slightly (2 mph) on parallel untreated streets. More specifically:

- On average, 14-foot speed bumps reduced 85th percentile travel speeds by 6.9 mph to 25.8 mph after speed bumps were installed. This is approximately equal to a typical 25 mph speed limit on local streets.
- After the study streets were treated with 14-foot speed bumps, 20 percent of motorists on average were traveling at speeds greater than 25 mph (60% before). Further, only one percent of motorists were traveling more than 10 mph over the speed limit, as opposed to 14.5 percent before 14 foot bumps were installed
- 22-foot speed bumps decreased 85th percentile travel speeds on average by 8.2 mph to 29.9 mph. This is slightly higher than a 25 mph hour speed limit on local streets, but on target with a 30 mph speed limit on neighborhood collector streets.
- After streets were treated with 22-foot speed bumps, 43 percent of motorists continued to travel at speeds over the speed limit (77% before); however, only 2.8 percent traveled at speeds more than 10 mph over the speed limit (22% before).
- The public perception survey revealed that 91 percent of residents of both speed bump and parallel untreated streets combined thought speeds were too high before speed bumps were installed. After installation, 69 percent of the treated streets residents perceived a reduction in speeds on their streets and only 6 percent perceived an increase in speeds. Parallel street residents were evenly

split on the speed benefit, as 30 percent thought there was a decrease and 31 percent thought there was an increase on their own street.

- The survey revealed that the residents' perceptions about speed are consistent with the documented speed impacts. Overall, residents of speed bump streets see more of a speed benefit than parallel street residents, which corresponds to the actual speed data.

Figure 1 shows before and after 85th percentile travel speeds on streets treated with speed bumps (both 14-foot and 22-foot), parallel untreated streets and the combination of all study streets. Overall, with installation of speed bumps the average 85th percentile travel speed on the treated and parallel untreated study streets combined decreased 5.4 mph to 27.5 mph.

Figure 2 shows the effect of speed bumps on those motorists traveling more than 10 mph over the speed limit on streets treated with speed bumps, parallel untreated streets and all study streets combined. Overall, before speed bumps were installed approximately 13 percent of motorists traveled more than 10 mph over the speed limit. After installation of speed bumps, only two percent of motorists traveled more than 10 mph over the speed limit.

TRAFFIC VOLUMES

Traffic volumes decrease on streets treated with speed bumps. The amount of volume reduction depends on the amount of speed reduction and availability of alternate routes. Some but not all of this volume diverts to the parallel untreated streets. Other findings regarding traffic volumes include:

- On streets treated with 14-foot speed bumps, the average traffic volume reduction was 33 percent, or 490 daily vehicles (ADT). Therefore the average after traffic volume on streets treated with 14-foot speed bumps was 980 ADT. The reduction in traffic volumes complies with the City's traffic threshold curve.
- After installing 22-foot speed bumps, traffic volumes decreased by an average of 21 percent, or 1,015 ADT. The resulting after traffic volume on streets treated with 22-foot speed bumps was an average of 3,720 ADT. This reduction complies with the City's traffic threshold curve.
- The parallel untreated streets experienced an average increase in traffic volume of four percent, or 40 ADT. This change is not a statistically significant increase in traffic volume on parallel untreated streets as a result of installing speed bumps.
- The results of the public opinion survey showed that 64 percent of the respondents who lived on streets treated with speed bumps perceived a reduction in traffic volumes. This perception matches the

documented reduction in traffic volumes on treated streets. Alternately, 68 percent of residents living on parallel untreated streets perceived an increase in traffic volumes after installation of speed bumps. The documented four percent increase in traffic volume does not support this perception.

Figure 3 shows the overall change in daily traffic volumes on streets treated with both 14- and 22-foot speed bumps. As a whole, after installation of speed bumps, the traffic volume on treated and parallel untreated streets decreased from 1,810 to 1,410 ADT. This is equivalent to a 22 percent decrease in traffic volume with only four percent being added to the nearby parallel streets.

VEHICLE CRASHES

The crash analysis showed that the incidence of crashes (crash frequency) decreases with installation of speed bumps. The decrease in the incidence of crashes is strongly driven by the diversion in traffic volumes. More specific findings from the crash analysis include:

- With installation of speed bumps, the incidence of crashes on treated streets decreased on average 39 percent from 1.39 to 0.85 crashes per year. Separating the treated streets by bump type, the 14-foot bump streets experienced a 48 percent crash reduction and the 22-foot bump streets experienced a 32 percent reduction in crash frequency.
- The crash *rate* (annual crashes per ADT) decreased on treated streets an average of five percent after speed bumps were installed. The difference in the crash frequency and crash rate reductions show that the reduction in crash frequency is mainly due to the reduction in traffic volume on treated streets.
- There was no measured change in crash type caused by the installation of speed bumps.
- The incidence of injury crashes on treated streets decreased by 46 percent, a statistically significant reduction, after speed bumps were installed.
- Crash frequency increased by 12 percent on parallel untreated streets after speed bumps were installed. This increase is not statistically significant, however, meaning the data cannot prove there is a correlation between speed bump installation and crash frequency on parallel untreated streets.
- Residents of streets treated with speed bumps do perceive an increase in safety overall. In contrast, and despite the fact that the data does not prove this, residents of parallel untreated streets perceive that safety worsened on their street after installation of the speed bumps.

Figure 4 shows that the crash frequency on both treated and parallel untreated streets combined decreased by 18 percent after speed bumps were installed. This decrease is not statistically significant.

CRIME AND EMERGENCY SERVICES

The results of the crime statistics and emergency services data analysis show that:

- There is no direct correlation between the installation of speed bumps and crime rates on the treated street or the parallel untreated street.
- Due to the small data set, a relationship between speed bump installation and emergency services calls could not be proven.
- Future research into the relationship between speed bumps and emergency service response time and emergency service calls should be further developed.

PUBLIC OPINION

A public opinion survey was distributed to approximately 1,200 residents living on or parallel to a speed bump street. In all 400 people responded. Overall, more respondents thought speed bumps improved livability in their neighborhood (48%) than thought the livability got worse (39%). Of those living on streets treated with speed bumps, 57 percent of the respondents believed that speed bumps have improved livability on their street. Of those living on parallel untreated streets, 28 percent of respondents believed that speed bumps improved livability on their street and 44 percent thought that livability has gotten worse as a result of speed bumps. Figure 5 summarizes these results. More details of the survey responses are included in the individual chapters of this report.

RELATIONSHIP BETWEEN SPEED BUMPS AND SPEED, VOLUME, AND CRASH REDUCTION

Another task of this peer review was to develop an understanding of how speed bumps reduce speed, volume, and crashes and how these criteria interrelate to each other. This task is useful in that an understanding of this relationship will help the City predict the effectiveness of speed bumps on a particular street before the bumps are installed. Figure 6 shows a schematic diagram of this relationship. The figure shows that five controlling factors were identified which collectively determine the effectiveness of speed bumps in reducing speeds, volumes, and crashes. Speed bumps have a direct effect on reducing speeds, which in turn has an effect of reducing volumes on treated streets. The reduction in volume is also strongly dependent on the availability of alternate routes. Reducing volumes on treated streets has the effect of reducing the number of crashes since fewer vehicles on the street will result in a lower probability of a crash. This relationship is described in more detail in the report.

RECOMMENDATIONS

Shortly after they are introduced, the currently designed 14 and 22 foot speed bumps effectively reduce travel speeds to be consistent with posted speed limits. They also effectively reduce the speeds of the fastest drivers. However, the City has limited data available about how speeds on treated streets change over time. Additional research into the effect of the duration of installation of speed bumps on travel speeds should be performed.

Traffic volumes decrease on streets treated with speed bumps. The amount of reduction depends on the speed reduction and the availability of alternate routes. The data available shows a four percent increase in traffic volumes on the identified parallel untreated streets. The assumption has been that traffic diverts to the nearby more appropriate collector or arterial street. Additional research should be performed to evaluate traffic diversion as a result of installing speed bumps. Further, the relationship between volume diversion and the availability of alternate routes should also be evaluated. Finally, the analysis showed the measured increase in traffic volume on untreated streets is consistent with City of Portland's traffic volume threshold curve. Additional research into the validity of this curve should be performed.

The incidence of crashes decrease with the installation of speed bumps. The decrease in crashes is strongly driven by the reduction in traffic volumes. Additional research into the change in crash types as a result of the volume reduction would be valuable.

City of Portland Speed Bump Peer Review

Appendix A

Speed, Volume, Accident, and Crime Data

Speed Bump Street Data

					ADT Volume				# Total Accidents			# Total Acc./year				# Total Acc./year/1000 ADT				# Total Acc./MVM (mill. veh. mi.)			
Area	Type	Street	Length (ft)	Classification	Before	After	% Change	Change	Before	After	After-month	Before	After	Change	% Change	Before	After	Change	% Change	Before	After	Change	% Change
N	14 Ft Bump	Emerald Ave	2400	Local	5174	636	-87.7%	-4538	9	0	4	3.00	0.00	-3.00	-100.0%	0.58	0.00	-0.58	-100.0%	3.49	0.00	-3.49	-100.0%
N	14 Ft Bump	Haight Ave	760	Local	409	333	-18.6%	-76	1	0	21	0.33	0.00	-0.33	-100.0%	0.81	0.00	-0.81	-100.0%	15.51	0.00	-15.51	-100.0%
N	14 Ft Bump	Baldwin	600	Local	578	497	-14.0%	-81	0	0	15	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
N	14 Ft Bump	Gatenbein Ave	1540	Local	768	573	-25.4%	-195	1	0	21	0.33	0.00	-0.33	-100.0%	0.43	0.00	-0.43	-100.0%	4.08	0.00	-4.08	-100.0%
N	14 Ft Bump	Wabash Ave	2400	Local	980	730	-25.5%	-250	2	0	18	0.67	0.00	-0.67	-100.0%	0.68	0.00	-0.68	-100.0%	4.10	0.00	-4.10	-100.0%
N	14 Ft Bump	Commercial Ave	1540	Local	1369	452	-67.0%	-917	1	2	21	0.33	1.14	0.81	242.9%	0.24	2.53	2.28	938.4%	2.29	23.75	21.46	938.4%
N	14 Ft Bump	Ida Ave	3000	Local	3210	2780	-13.4%	-430	0	0	18	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	Pacific St	1440	Local	600	600	0.0%	0	0	0	32	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	111th Ave	2280	Coll.	700	700	0.0%	0	2	1	21	0.67	0.57	-0.10	-14.3%	0.95	0.82	-0.14	-14.3%	6.04	5.18	-0.86	-14.3%
NE	14 Ft Bump	108TH AV	625	Local	770	700	-9.1%	-70	0	1	32	0.00	0.38	0.38	0.0%	0.00	0.54	0.54	0.0%	0.00	12.40	12.40	0.0%
NE	14 Ft Bump	87th Ave	2610	Local	940	920	-2.1%	-20	1	0	21	0.33	0.00	-0.33	-100.0%	0.35	0.00	-0.35	-100.0%	1.97	0.00	-1.97	-100.0%
NE	14 Ft Bump	Hassalo St	720	Local	1100	1100	0.0%	0	0	0	18	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	57th Ave	1200	Local	1200	1000	-16.7%	-200	0	1	18	0.00	0.67	0.67	0.0%	0.00	0.67	0.67	0.0%	0.00	8.04	8.04	0.0%
NE	14 Ft Bump	113th Ave	2640	Local	1300	1300	0.0%	0	1	1	21	0.33	0.57	0.24	71.4%	0.26	0.44	0.18	71.4%	1.40	2.41	1.00	71.4%
NE	14 Ft Bump	Sacramento St	3380	Local	2580	1600	-38.0%	-980	1	5	50	0.33	1.20	0.87	260.0%	0.13	0.75	0.62	480.5%	0.55	3.21	2.66	480.5%
SE	14 Ft Bump	118th Ave	2640	Local	350	380	8.6%	30	2	0	26	0.67	0.00	-0.67	-100.0%	1.90	0.00	-1.90	-100.0%	10.44	0.00	-10.44	-100.0%
SE	14 Ft Bump	116th Ave	1200	Local	388	247	-36.3%	-141	1	1	26	0.33	0.46	0.13	38.5%	0.86	1.87	1.01	117.5%	10.36	22.53	12.17	117.5%
SE	14 Ft Bump	115th Ave	2640	Local	790	730	-7.6%	-60	0	0	26	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SE	14 Ft Bump	52nd Ave	2400	Local	1020	360	-64.7%	-660	6	2	20	2.00	1.20	-0.80	-40.0%	1.96	3.33	1.37	70.0%	11.82	20.09	8.27	70.0%
SE	14 Ft Bump	58th Ave	2785	Local	1100	1100	0.0%	0	2	0	18	0.67	0.00	-0.67	-100.0%	0.61	0.00	-0.61	-100.0%	3.15	0.00	-3.15	-100.0%
SE	14 Ft Bump	43rd Ave	1370	Local	1100	1100	0.0%	0	1	0	26	0.33	0.00	-0.33	-100.0%	0.30	0.00	-0.30	-100.0%	3.20	0.00	-3.20	-100.0%
SE	14 Ft Bump	76th Ave	4800	Local	3570	2440	-31.7%	-1130	21	5	16	7.00	3.75	-3.25	-46.4%	1.96	1.54	-0.42	-21.6%	5.91	4.63	-1.28	-21.6%
SW	14 Ft Bump	47th Dr	960	Local	1000	1000	0.0%	0	0	0	20	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SW	14 Ft Bump	TROY ST	2400	Local	1400	1100	-21.4%	-300	1	0	21	0.33	0.00	-0.33	-100.0%	0.24	0.00	-0.24	-100.0%	1.44	0.00	-1.44	-100.0%
SW	14 Ft Bump	58TH AV	2800	Local	1860	1540	-17.2%	-320	2	0	37	0.67	0.00	-0.67	-100.0%	0.36	0.00	-0.36	-100.0%	1.85	0.00	-1.85	-100.0%
SW	14 Ft Bump	Boones Fry Rd	3000	Local	4000	1500	-62.5%	-2500	4	1	52	1.33	0.23	-1.10	-82.7%	0.33	0.15	-0.18	-53.8%	1.61	0.74	-0.87	-53.8%
N	22 Ft Bump	Vancouver Ave	2040	Coll.	5804	4346	-25.1%	-1458	4	4	16	1.33	3.00	1.67	125.0%	0.23	0.69	0.46	200.5%	1.63	4.89	3.27	200.5%
NE	22 Ft Bump	15th Ave	2300	Coll.	7447	6000	-19.4%	-1447	9	4	28	3.00	1.71	-1.29	-42.9%	0.40	0.29	-0.12	-29.1%	2.53	1.80	-0.74	-29.1%
NW	22 Ft Bump	Cornell Rd	3200	Coll.	6500	6400	-1.5%	-100	7	2	27	2.33	0.89	-1.44	-61.9%	0.36	0.14	-0.22	-61.3%	1.62	0.63	-0.99	-61.3%
SE	22 Ft Bump	Fairview Blvd	8800	Local	1190	1160	-2.5%	-30	3	0	14	1.00	0.00	-1.00	-100.0%	0.84	0.00	-0.84	-100.0%	1.38	0.00	-1.38	-100.0%
SE	22 Ft Bump	Harold St	7200	Local	4210	2550	-39.4%	-1660	40	35	40	13.33	10.50	-2.83	-21.3%	3.17	4.12	0.95	30.0%	6.36	8.27	1.91	30.0%
SW	22 Ft Bump	Hamilton St	4800	Coll.	3300	2700	-18.2%	-600	11	4	37	3.67	1.30	-2.37	-64.6%	1.11	0.48	-0.63	-56.8%	3.35	1.45	-1.90	-56.8%
SW	22 Ft Bump	Sunset Blvd	5500	Coll.	4700	2876	-38.8%	-1824	5	1	28	1.67	0.43	-1.24	-74.3%	0.35	0.15	-0.21	-58.0%	0.93	0.39	-0.54	-58.0%
Average					**2163.85**	**1559.09**	**-27.95%**	**-604.76**				**1.39**	**0.85**	**-0.55**	**-39.13%**	**0.59**	**0.56**	**-0.03**	**-4.85%**	**3.24**	**3.65**	**0.41**	**12.52%**

Speed Bump Street Data

			# Injury Accidents		# Inj. Acc/year				# Inj. Acc./year/million ADT			# Inj. Acc./MVM (mill. veh. mi.)			
Area	Type	Street	Before	After	Before	After	Reduction	% Change	Before	After	% Change	Before	After	Change	% Change
N	14 Ft Bump	Emerald Ave	3	0	1.00	0.00	1.00	-100.0%	193.27	0.00	-100.0%	1.16	0.00	-1.16	-100.0%
N	14 Ft Bump	Haight Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
N	14 Ft Bump	Baldwin	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
N	14 Ft Bump	Gatenbein Ave	1	0	0.33	0.00	0.33	-100.0%	434.03	0.00	-100.0%	4.08	0.00	-4.08	-100.0%
N	14 Ft Bump	Wabash Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
N	14 Ft Bump	Commercial Av	0	1	0.00	0.57	-0.57	0.0%	0.00	1264.22	0.0%	0.00	11.88	11.88	0.0%
N	14 Ft Bump	Ida Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	Pacific St	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	111th Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	108TH AV	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	87th Ave	1	0	0.33	0.00	0.33	-100.0%	354.61	0.00	-100.0%	1.97	0.00	-1.97	-100.0%
NE	14 Ft Bump	Hassalo St	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	57th Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
NE	14 Ft Bump	113th Ave	1	1	0.33	0.57	-0.24	71.4%	256.41	439.56	71.4%	1.40	2.41	1.00	71.4%
NE	14 Ft Bump	Sacramento St	1	3	0.33	0.72	-0.39	116.0%	129.20	450.00	248.3%	0.55	1.93	1.37	248.3%
SE	14 Ft Bump	118th Ave	1	0	0.33	0.00	0.33	-100.0%	952.38	0.00	-100.0%	5.22	0.00	-5.22	-100.0%
SE	14 Ft Bump	116th Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SE	14 Ft Bump	115th Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SE	14 Ft Bump	52nd Ave	1	2	0.33	1.20	-0.87	260.0%	326.80	3333.33	920.0%	1.97	20.09	18.12	920.0%
SE	14 Ft Bump	58th Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SE	14 Ft Bump	43rd Ave	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SE	14 Ft Bump	76th Ave	8	1	2.67	0.75	1.92	-71.9%	746.97	307.38	-58.8%	2.25	0.93	-1.32	-58.8%
SW	14 Ft Bump	47th Dr	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SW	14 Ft Bump	TROY ST	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SW	14 Ft Bump	58TH AV	0	0	0.00	0.00	0.00	0.0%	0.00	0.00	0.0%	0.00	0.00	0.00	0.0%
SW	14 Ft Bump	Boones Fry Rd	1	0	0.33	0.00	0.33	-100.0%	83.33	0.00	-100.0%	0.40	0.00	-0.40	-100.0%
N	22 Ft Bump	Vancouver Ave	1	2	0.33	1.50	-1.17	350.0%	57.43	345.14	501.0%	0.41	2.45	2.04	501.0%
NE	22 Ft Bump	15th Ave	7	2	2.33	0.86	1.48	-63.3%	313.33	142.86	-54.4%	1.97	0.90	-1.07	-54.4%
NW	22 Ft Bump	Cornell Rd	3	0	1.00	0.00	1.00	-100.0%	153.85	0.00	-100.0%	0.70	0.00	-0.70	-100.0%
SE	22 Ft Bump	Fairview Blvd	3	0	1.00	0.00	1.00	-100.0%	840.34	0.00	-100.0%	1.38	0.00	-1.38	-100.0%
SE	22 Ft Bump	Harold St	24	16	8.00	4.80	3.20	-40.0%	1900.24	1882.35	-0.9%	3.82	3.78	-0.04	-0.9%
SW	22 Ft Bump	Hamilton St	5	1	1.67	0.32	1.34	-80.5%	505.05	120.12	-76.2%	1.52	0.36	-1.16	-76.2%
SW	22 Ft Bump	Sunset Blvd	2	0	0.67	0.00	0.67	-100.0%	141.84	0.00	-100.0%	0.37	0.00	-0.37	-100.0%
Average			**1.91**	**0.88**	**0.64**	**0.34**	**0.29**	**-46.2%**	**223.91**	**251.06**	**12.12%**	**0.88**	**1.36**	**0.47**	**53.28%**

Speed Bump Streets

Survey #	Area	Street	Device	# Bumps	Volume (ADT) Before	Volume (ADT) After	85% Speed Before	85% Speed After	85% Speed % Change	85% Speed mph Change	% over speed lim. Before	% over speed lim. After	% over speed lim. % Change	% 10 mph over speed lim. Before	% 10 mph over speed lim. After	% 10 mph over speed lim. % Chang
ERR	N	Emerald Ave	14 Ft Bump	5	5174	636	39	26	-33.3%	-13	85.6	19.7	-65.90	38.7	1.2	-37.50
8	N	Haight Ave	14 Ft Bump	2	409	333	31	25	-19.4%	-6	37.5	13.4	-24.10	4.6	0	-4.60
9	N	Baldwin	14 Ft Bump	2	578	497	30	26	-13.3%	-4	47.2	17.6	-29.60	4.3	0.5	-3.80
11	N	Gatenbein A	14 Ft Bump	2	768	573	24	24	0.0%	0	7.7	9.7	2.00	0	0	0.00
13	N	Wabash Ave	14 Ft Bump	5	980	730	34	26	-23.5%	-8	68.4	19	-49.40	12.7	0.2	-12.50
15	N	Commercial	14 Ft Bump	5	1369	452	32	26	-18.8%	-6	59.8	19.9	-39.90	4.5	0	-4.50
16	N	Ida Ave	14 Ft Bump	3	3210	2780	29	28	-3.4%	-1	29.3	27.2	-2.10	2	2.1	0.10
28	NE	Pacific St	14 Ft Bump	4	600	600	34	23	-32.4%	-11	72.4	8	-64.40	9.5	0.7	-8.80
30	NE	111th Ave	14 Ft Bump	4	700	700	36	23	-36.1%	-13	79.1	5.5	-73.60	18.9	0	-18.90
31	NE	108TH AV	14 Ft Bump	2	770	700	31	24	-22.6%	-7	46	2	-44.00	4	0	-4.00
32	NE	87th Ave	14 Ft Bump	5	940	920	39	30	-23.1%	-9	85.7	42.8	-42.90	35.9	4.3	-31.60
34	NE	Hassalo St	14 Ft Bump	2	1100	1100	30	24	-20.0%	-6	34.9	8.1	-26.80	1.2	0	-1.20
35	NE	57th Ave	14 Ft Bump	3	1200	1000	34	27	-20.6%	-7	69.5	24.8	-44.70	44.3	0.3	-44.00
36	NE	113th Ave	14 Ft Bump	6	1300	1300	34	22	-35.3%	-12	68.7	5.3	-63.40	12.6	0	-12.60
37	NE	Sacramento	14 Ft Bump	8	2580	1600	32	24	-25.0%	-8	67.4	12.4	-55.00	5.8	0.2	-5.60
48	SE	118th Ave	14 Ft Bump	6	350	380	32	25	-21.9%	-7	52.6	16.7	-35.90	8.4	0	-8.40
49	SE	116th Ave	14 Ft Bump	3	388	247	30	25	-16.7%	-5	44.8	12.9	-31.90	4.9	0.9	-4.00
56	SE	115th Ave	14 Ft Bump	5	790	730	37	27	-27.0%	-10	65.7	27.2	-38.50	21.3	2.2	-19.10
58	SE	52nd Ave	14 Ft Bump	4	1020	360	32	29	-9.4%	-3	59.7	41.7	-18.00	4.5	2.5	-2.00
59	SE	58th Ave	14 Ft Bump	6	1100	1100	33	23	-30.3%	-10	65.5	6	-59.50	8	0.3	-7.70
60	SE	43rd Ave	14 Ft Bump	2	1100	1100	30	27	-10.0%	-3	41	26.4	-14.60	3	0.9	-2.10
65	SE	76th Ave	14 Ft Bump	9	3570	2440	33	24	-27.3%	-9	76.9	11	-65.90	6	0.8	-5.20
71	SW	47th Dr	14 Ft Bump	3	1000	1000	27	26	-3.7%	-1	31.2	19.1	-12.10	0.4	0.2	-0.20
72	SW	TROY ST	14 Ft Bump	4	1400	1100	27	26	-3.7%	-1	84.2	22.8	-61.40	24.2	1.2	-23.00
73	SW	58TH AV	14 Ft Bump	5	1860	1540	39	28	-28.2%	-11	92.8	38.4	-54.40	40	1.6	-38.40
74	SW	Boones Fry	14 Ft Bump	5	4000	1500	42	33	-21.4%	-9	97	70.6	-26.40	57	8	-49.00
78	N	Vancouver A	22 Ft Bump	3	5804	4346	39	20	-48.7%	-19	72.9	1.3	-71.60	11.6	0	-11.60
84	NE	15th Ave	22 Ft Bump	5	7447	6000	38	30	-21.1%	-8	95	60.2	-34.80	31	2.7	-28.30
85	NW	Cornell Rd	22 Ft Bump	3	6500	6400	36	27	-25.0%	-9	67.9	26	-41.90	2.9	0.1	-2.80
89	SE	Fairview Blvd	22 Ft Bump	5	1190	1160	39	33	-15.4%	-6	93	70	-23.00	48	7	-41.00
91	SE	Harold St	22 Ft Bump	11	4210	2550	34	32	-5.9%	-2	48	22.6	-25.40	0.7	1.3	0.60
96	SW	Hamilton St	22 Ft Bump	6	3300	2700	43	36	-16.3%	-7	97	66	-31.00	50.4	4.2	-46.20
98	SW	Sunset Blvd	22 Ft Bump	9	4700	2876	38	31	-18.4%	-7	65	55.2	-9.80	6.8	4	-2.80
Average							**33.88**	**26.67**	**-21.3%**	**-7.21**	**63.92**	**25.14**	**-38.78**	**16.00**	**1.44**	**-14.57**

Parallel Street Data

Speed Bump Street	Bump Type	Constructio Date	Parallel Routes	Between	Length (ft	Volume (ADT)				85% Speed				% over speed lim.			% 10 mph over speed lim.		
						Before	*After*	*Change*	*% Change*	*Before*	*After*	*% Change*	*mph Chn*	*Before*	*After*	*% Change*	*Before*	*After*	*% Change*
N Haight Av.	14 foot	03/25/95	-																
N Baldwin	14 foot	09/08/95	-																
N Gantenbein	14 foot	03/25/95	-																
N Wabash	14 foot	06/19/95	***N Washburne***	Lombard-Willis	2400	633	748	115	18.2%	33	34	3.0%	1	54.6	61	6.4	7.2	10	2.8
N Commercial	14 foot	03/25/95	***N Kerby***	Skidmore-Alberta	1440	482	573	91	18.9%	31	24	-22.6%	-7	49	9.7	-39.3	4	0	-4
N Ida Av.	14 foot	06/30/95	***N Alma***	Willamette-Lomb.	1800	673	398	-275	-40.9%	29	29	0.0%	0	37.5	35.5	-2	2.2	2.3	0.1
			N Burr	Willamette-Lomb.	1490	788	466	-322	-40.9%	25	25	0.0%	0	11.2	11.6	0.4	0	0	0
			N Buchanan	Willamette-Lomb.	1440	2003	819	-1184	-59.1%	31	25	-19.4%	-6	51.2	14.9	-36.3	3.7	0.4	-3.3
NE Pacific St.	14 foot	04/27/94	***NE Oregon St.***	102nd-108th															
NE 111th Av.	14 foot	03/25/95	***NE 114th Av.***	Glisan-Halsey	2640	1120	1157	37	3.3%	35	33	-5.7%	-2	76	69.6	-6.4	15	10	-5
NE 108th	14 foot	04/28/94	-	-															
NE 87th Av.	14 foot	03/25/95	***NE 82nd***	Prescott-Killing.															
			NE 89th	Prescott-Killing.	5280														
NE Hassalo	14 foot	06/24/95	-																
NE 57th Av.	14 foot	06/26/95	-																
NE 113th Av.	14 foot	03/25/95	-																
NE Sacrament	14 foot	10/26/92	***NE Alameda***	64th-70th															
			NE Tillamook	62nd-82nd															
SE 118th Av.	14 foot	10/19/94	***SE 119th Av.(b***	Division-Powell	2400														
SE 116th Av.	14 foot	10/14/94	-																
SE 115th Av.	14 foot	10/18/94	***SE 112th Av.***	Division-Powell	2690	6292	7838	1546	24.6%	45	38	-15.6%	-7	48.8	31	-17.8	59.5	1.2	-58.3
SE 52nd Av.	14 foot	04/02/95	***SE 51st Av.***	Lincoln-Hawthorne	1440	437	595	158	36.2%	34	32	-5.9%	-2	61.8	53.3	-8.5	9.9	9.4	-0.5
			SE 54th Av.	Lincoln-Hawthorne	1440	339	712	373	110.0%	32	27	-15.6%	-5	58.7	28.3	-30.4	5.2	1.3	-3.9
SE 58th Av.	14 foot	06/16/95	***SE 52nd Av.***	Division-Powell															
			SE 62nd Av.	Division-Powell	2760	1550	1430	-120	-7.7%	24	29	20.8%	5	8.4	4.3	-4.1	0	2.1	2.1
SE 43rd Av.	14 foot	10/12/94	-																
SE 76th Av.	14 foot	08/12/95	***SE 72nd Av.***	Taylor-Division	3600	1091	1019	-72	-6.6%	35	34	-2.9%	-1	65.6	61.3	-4.3	16.3	11.5	-4.8
			SE 80th Av.	Washing.-SE 77th															
SW 47th Av.	14 foot	04/02/95	-																
SW Troy	14 foot	03/25/95	***SW Custer***	Cap.Hwy-25th															
SW 58th Av.	14 foot	11/01/93	-																
Boones Ferrry	14 foot	08/23/92	***SW 2nd Ave.***	Terwill-Palatine Hil															
N Vancouver	22 foot	08/19/95	-																
NE 15th Av.	22 foot	08/17/94	***NE 14th***	Prescott-Fremont	2400	368	407	39	10.6%	29	26	-10.3%	-3	31.8	16.9	-14.9	1.2	0	-1.2
			NE 16th	Prescott-Fremont	2400	189	254	65	34.4%	24	26	8.3%	2	8.4	17	8.6	0	0	0
			NE 17th	Prescott-Fremont	2400														
NW Cornell	22 foot	09/16/94	***NW Westover***	Cornell-Burnside	5280	990	1007	17	1.7%	33	32	-3.0%	-1	70.8	63.1	-7.7	7.8	4.3	-3.5
SW Fairview	22 foot	10/07/95	-																
SE Harold	22 foot	08/30/93	***SE Reedway***	SE 52nd-SE 72nd	5040	176	232	56	31.8%	29	28	-3.4%	-1	29.1	6.5	-22.6	1.1	0.3	-0.8
			SE Ramona	SE 52nd-SE 72nd	5040	149	268	119	79.9%	28	26	-7.1%	-2	26.9	19.8	-7.1	0.8	0.25	-0.55
SW Hamilton	22 foot	11/05/93	-																
SW Sunset	22 foot	08/14/94	***SW 19th Ave.***	18th-Seymour															
Average						**1080**	**1120.188**	**40.19**	**3.7%**	**31.06**	**29.25**	**-5.8%**	**-1.81**	**43.11**	**31.49**	**-11.62**	**8.37**	**3.32**	**-5.05**

Parallel Street Data

Speed Bump Street	Bump Type	Constructi Date	Parallel Routes	# Total Accidents Before	After	After-months	# Total Acc./year Before	After	Change	% Change	# Total Acc./year/1000 ADT Before	After	% Change	# Total Acc/MVM (mill. veh. mi.) Before	After	Change	% Chang
N Haight Av.	14 foot	03/25/95	-														
N Baldwin	14 foot	09/08/95	-														
N Gantenbein	14 foot	03/25/95	-														
N Wabash	14 foot	06/19/95	***N Washburne***	5	1	18	1.67	0.67	-1.00	-60.00%	2.632965	0.891266	-66.1%	15.86992433	5.37201182	-10.497913	-66.1%
N Commercial	14 foot	03/25/95	***N Kerby***	0	2	21	0.00	1.14	1.14	100.00%	0	1.994515	100.0%	0	20.0362246	20.0362246	100.0%
N Ida Av.	14 foot	06/30/95	***N Alma***	5	3	18	1.67	2.00	0.33	20.00%	2.476474	5.025126	102.9%	19.9022528	40.3845713	20.4823185	102.9%
			N Burr	2	1	18	0.67	0.67	0.00	0.00%	0.846024	1.430615	69.1%	8.213671189	13.8892122	5.67554104	69.1%
			N Buchanan	3	0	18	1.00	0.00	-1.00	-100.00%	0.499251	0	-100.0%	5.015308088	0	-5.0153081	-100.0%
NE Pacific St.	14 foot	04/27/94	***NE Oregon S***	1	0	32	0.33	0.00	-0.33	-100.00%							
NE 111th Av.	14 foot	03/25/95	***NE 114th Av.***	0	1	21	0.00	0.57	0.57	100.00%	0	0.493888	100.0%	0	2.70623635	2.70623635	100.0%
NE 108th	14 foot	04/28/94	-														
NE 87th Av.	14 foot	03/25/95	***NE 82nd***														
			NE 89th	1	2	21	0.33	1.14	0.81	242.86%							
NE Hassalo	14 foot	06/24/95	-														
NE 57th Av.	14 foot	06/26/95	-														
NE 113th Av.	14 foot	03/25/95	-														
NE Sacrament	14 foot	10/26/92	***NE Alameda***	2	2	50	0.67	0.48	-0.19	-28.00%							
			NE Tillamook	14	10	50	4.67	2.40	-2.27	-48.57%							
SE 118th Av.	14 foot	10/19/94	***SE 119th Av.(***														
SE 116th Av.	14 foot	10/14/94	-														
SE 115th Av.	14 foot	10/18/94	***SE 112th Av.***	6	7	26	2.00	3.23	1.23	61.54%	0.317864	0.412193	29.7%	1.709346314	2.21661086	0.50726455	29.7%
SE 52nd Av.	14 foot	04/02/95	***SE 51st Av.***	1	0	20	0.33	0.00	-0.33	-100.00%	0.762777	0	-100.0%	7.662595042	0	-7.662595	-100.0%
			SE 54th Av.	0	0	20	0.00	0.00	0.00	0.00%	0	0	0.0%	0	0	0	0.0%
SE 58th Av.	14 foot	06/16/95	***SE 52nd Av.***	17	11	18	5.67	7.33	1.67	29.41%							
			SE 62nd Av.	6	2	18	2.00	1.33	-0.67	-33.33%	1.290323	0.932401	-27.7%	6.762858076	4.88691376	-1.8759443	-27.7%
SE 43rd Av.	14 foot	10/12/94	-														
SE 76th Av.	14 foot	08/12/95	***SE 72nd Av.***	7	6	16	2.33	4.50	2.17	92.86%	2.138711	4.416094	106.5%	8.59390586	17.7450361	9.15113023	106.5%
			SE 80th Av.	4	2	16	1.33	1.50	0.17	12.50%							
SW 47th Av.	14 foot	04/02/95	-														
SW Troy	14 foot	03/25/95	***SW Custer***	0	1	21	0.00	0.57	0.57	100.00%							
SW 58th Av.	14 foot	11/01/93	-														
Boones Ferrry	14 foot	08/23/92	***SW 2nd Ave.***	0	0	52	0.00	0.00	0.00	0.00%							
N Vancouver	22 foot	08/19/95	-														
NE 15th Av.	22 foot	08/17/94	***NE 14th***	1	3	28	0.33	1.29	0.95	285.71%	0.905797	3.159003	248.8%	5.459598968	19.040567	13.580968	248.8%
			NE 16th	0	2	28	0.00	0.86	0.86	100.00%	0	3.374578	100.0%	0	20.3399233	20.3399233	100.0%
			NE 17th	3	3	28	1.00	1.29	0.29	28.57%							
NW Cornell	22 foot	09/16/94	***NW Westover***	8	6	27	2.67	2.67	0.00	0.00%	2.693603	2.64813	-1.7%	7.379733407	7.25515002	-0.1245834	-1.7%
SW Fairview	22 foot	10/07/95	-														
SE Harold	22 foot	08/30/93	***SE Reedway***	10	8	40	3.33	2.40	-0.93	-28.00%	18.93939	10.34483	-45.4%	54.3596434	29.6916121	-24.668031	-45.4%
			SE Ramona	3	3	40	1.00	0.90	-0.10	-10.00%	6.711409	3.358209	-50.0%	19.26301457	9.63869498	-9.6243196	-50.0%
SW Hamilton	22 foot	11/05/93	-														
SW Sunset	22 foot	08/14/94	***SW 19th Ave.***	1	1	28	0.33	0.43	0.10	28.57%							
				3.85	**2.96**	**26.65**	**1.28**	**1.44**	**0.15**	**12.09%**	**2.51**	**2.41**	**-4.3%**	**10.01**	**12.08**	**2.06**	**20.6%**

Parallel Street Data

Speed Bump Street	Bump Type	Construc Date	Parallel Routes	# Injury Accidents Before	# Injury Accidents After	# Inj. Acc/year Before	# Inj. Acc/year After	# Inj. Acc/year Change	# Inj. Acc/year % Change	# Inj. Acc./year/million ADT Before	# Inj. Acc./year/million ADT After	# Inj. Acc./year/million ADT % Change	# Inj. Acc/MVM (mill. veh. mi.) Before	# Inj. Acc/MVM After	# Inj. Acc/MVM Change	# Inj. Acc/MVM % Change
N Haight Av.	14 foot	03/25/95	-													
N Baldwin	14 foot	09/08/95	-													
N Gantenbein	14 foot	03/25/95	-													
N Wabash	14 foot	06/19/95	***N Washburne***	1	1	0.33	0.67	0.33	100.00%	526.59294	891.2656	69.25%	3.1739848659	5.37201182	2.19802695	69.3%
N Commercial	14 foot	03/25/95	***N Kerby***	0	1	0.00	0.57	0.57	100.00%	0	997.25754	100.00%	0	10.0181123	10.0181123	100.0%
N Ida Av.	14 foot	06/30/95	***N Alma***	1	1	0.33	0.67	0.33	100.00%	495.2947	1675.0419	238.19%	3.9804505599	13.4615238	9.48107319	238.2%
			N Burr	1	0	0.33	0.00	-0.33	-100.00%	423.01184	0	-100.00%	4.1068355945	0	-4.1068356	-100.0%
			N Buchanan	0	0	0.00	0.00	0.00	0.00%	0	0	0.00%	0	0	0	0.0%
NE Pacific St.	14 foot	04/27/94	***NE Oregon St***	0	0	0.00	0.00	0.00	0.00%							
NE 111th Av.	14 foot	03/25/95	***NE 114th Av.***	0	0	0.00	0.00	0.00	0	0	0	0.00%	0	0	0	0.0%
NE 108th	14 foot	04/28/94	-													
NE 87th Av.	14 foot	03/25/95	***NE 82nd***													
			NE 89th	1	2	0.33	1.14	0.81	242.86%							
NE Hassalo	14 foot	06/24/95	-													
NE 57th Av.	14 foot	06/26/95	-													
NE 113th Av.	14 foot	03/25/95	-													
NE Sacramento	14 foot	10/26/92	***NE Alameda***	0	1	0.00	0.24	0.24	ERR							
			NE Tillamook	3	6	1.00	1.44	0.44	44.00%							
SE 118th Av.	14 foot	10/19/94	***SE 119th Av.(***													
SE 116th Av.	14 foot	10/14/94	-													
SE 115th Av.	14 foot	10/18/94	***SE 112th Av.***	1	3	0.33	1.38	1.05	315.38%	52.977326	176.65417	233.45%	0.2848910523	0.94997608	0.66508503	233.5%
SE 52nd Av.	14 foot	04/02/95	***SE 51st Av.***	1	0	0.33	0.00	-0.33	-100.00%	762.77651	0	-100.00%	7.6625950423	0	-7.662595	-100.0%
			SE 54th Av.	0	0	0.00	0.00	0.00	0.00%	0	0	0.00%	0	0	0	0.0%
SE 58th Av.	14 foot	06/16/95	***SE 52nd Av.***	7	4	2.33	2.67	0.33	14.29%							
			SE 62nd Av.	1	0	0.33	0.00	-0.33	-100.00%	215.05376	0	-100.00%	1.1271430127	0	-1.127143	-100.0%
SE 43rd Av.	14 foot	10/12/94	-													
SE 76th Av.	14 foot	08/12/95	***SE 72nd Av.***	1	1	0.33	0.75	0.42	125.00%	305.53009	736.0157	140.90%	1.2277008372	2.95750602	1.72980518	140.9%
			SE 80th Av.	1	0	0.33	0.00	-0.33	-100.00%							
SW 47th Av.	14 foot	04/02/95	-													
SW Troy	14 foot	03/25/95	***SW Custer***	0	1	0.00	0.57	0.57	ERR							
SW 58th Av.	14 foot	11/01/93	-													
Boones Ferrry	14 foot	08/23/92	***SW 2nd Ave.***	0	0	0.00	0.00	0.00	ERR							
N Vancouver	22 foot	08/19/95	-													
NE 15th Av.	22 foot	08/17/94	***NE 14th***	1	2	0.33	0.86	0.52	157.14%	905.7971	2106.0021	132.50%	5.4595989676	12.6937113	7.23411236	132.5%
			NE 16th	0	2	0.00	0.86	0.86	100.00%	0	3374.5782	100.00%	0	20.3399233	20.3399233	100.0%
			NE 17th	3	3	1.00	1.29	0.29	28.57%							
NW Cornell	22 foot	09/16/94	***NW Westover***	3	1	1.00	0.44	-0.56	-55.56%	1010.101	441.35496	-56.31%	2.7674000277	1.20919167	-1.5582084	-56.3%
SW Fairview	22 foot	10/07/95	-													
SE Harold	22 foot	08/30/93	***SE Reedway***	7	3	2.33	0.90	-1.43	-61.43%	13257.576	3879.3103	-70.74%	38.051750381	11.1343545	-26.917396	-70.7%
			SE Ramona	3	2	1.00	0.60	-0.40	-40.00%	6711.4094	2238.806	-66.64%	19.263014574	6.42579665	-12.837218	-66.6%
SW Hamilton	22 foot	11/05/93	-													
SW Sunset	22 foot	08/14/94	***SW 19th Ave.***	0	0	0.00	0.00	0.00	ERR							
				36	**34**	**0.46**	**0.58**	**0.12**	**25.37%**	**1541.63**	**1032.27**	**-33.04%**	**5.44**	**5.29**	**-0.16**	**-2.9%**

Speed Bump Streets

	street	date	before speed bumps crimes	months	crime/mo	after speed bumps crimes	months	crime/mo	% Change
North	Baldwin	09/08/95	24	68	0.35	24	25	0.96	172%
	Commercia	03/25/95	299	63	4.75	107	30	3.57	-25%
	Emerald	08/10/96	192	80	2.40	20	13	1.54	-36%
	Gantenbein	03/25/95	309	63	4.90	109	30	3.63	-26%
	Haight	03/25/95	169	63	2.68	57	30	1.90	-29%
	Ida	06/30/95	10	66	0.15	13	27	0.48	218%
	Peninsular	04/27/97	24	88	0.27	6	5	1.20	340%
	Vancouver	09/19/95	17	68	0.25	3	25	0.12	-52%
	Wabash	06/19/95	134	66	2.03	32	27	1.19	-42%
Northeast	Hassalo	06/24/95	29	66	0.44	11	27	0.41	-7%
	Pacific	04/27/94	13	52	0.25	22	41	0.54	115%
	Sacramento	10/26/92	11	35	0.31	23	58	0.40	26%
	15th	08/17/94	109	56	1.95	72	37	1.95	-0%
	57th	06/26/95	42	66	0.64	22	27	0.81	28%
	87th	03/25/95	47	63	0.75	28	30	0.93	25%
	108th	04/28/94	12	52	0.23	11	41	0.27	16%
	111th	03/25/95	29	63	0.46	8	30	0.27	-42%
	113rd	03/25/95	38	63	0.60	15	30	0.50	-17%
Southeast	Harold	08/30/93	209	44	4.75	289	49	5.90	24%
	43rd	10/12/94	57	54	1.06	36	39	0.92	-13%
	46th	05/10/97	45	88	0.51	0	5	0.00	-100%
	52nd	04/02/95	33	63	0.52	17	30	0.57	8%
	58th	06/16/95	98	65	1.51	31	28	1.11	-27%
	76th	08/12/95	129	67	1.93	56	26	2.15	12%
	115th	10/15/95	100	69	1.45	68	24	2.83	96%
	116th	10/15/95	34	69	0.49	27	24	1.13	128%
	118th	10/15/95	66	69	0.96	46	24	1.92	100%
Southwest	SW Boones	08/23/92	21	32	0.66	31	61	0.51	-23%
	NW Cornell	09/16/94	66	56.5	1.17	31	36.5	0.85	-27%
	SW Hamilto	11/05/93	26	46	0.57	20	47	0.43	-25%
	SW Fairvie	10/07/95	50	69	0.72	17	24	0.71	-2%
	SW Maplew	10/07/96	24	81	0.30	4	12	0.33	13%
	SW Sunset	08/14/94	94	55.5	1.69	72	37.5	1.92	13%
	SW Troy	03/25/95	0	63	0.00	0	30	0.00	
	SW 47th Dr	04/02/95	25	63	0.40	17	30	0.57	43%
	SW 58th Av	11/01/93	42	46	0.91	21	47	0.45	-51%

Parallel Untreated Streets

	street	date	before speed bumps crimes	before speed bumps months	before speed bumps crime/mo	after speed bumps crimes	after speed bumps months	after speed bumps crime/mo	% Change
North	Alma	06/30/95	32	66	0.48	8	27	0.30	**-39%**
	Burr	06/30/95	11	66	0.17	2	27	0.07	**-56%**
	Burrage	08/10/96	12	79	0.15	4	14	0.29	**88%**
	Delaware	04/26/97	21	88	0.24	4	5	0.80	**235%**
	Kerby	03/25/95	371	63	5.89	166	30	5.53	**-6%**
	Washburne	06/19/95	78	66	1.18	41	27	1.52	**28%**
Northeast	Alameda	10/26/92	20	35	0.57	37	58	0.64	12%
	Oregon	04/27/94	76	52	1.46	91	41	2.22	52%
	Tillamook	10/26/92	9	35	0.26	32	58	0.55	115%
	14th	08/17/94	69	56	1.23	26	37	0.70	-43%
	16th	08/17/94	57	56	1.02	49	37	1.32	30%
	17th	08/19/94	50	56	0.89	49	37	1.32	48%
	82nd	03/25/95	47	63	0.75	21	30	0.70	-6%
	89th	03/25/95	51	63	0.81	34	30	1.13	40%
	114th	03/25/95	0	63	0.00	0	30	0.00	
Southeast	Ramona	08/30/93	115	44	2.61	141	49	2.88	10%
	Reedway	08/30/93	74	44	1.68	72	49	1.47	-13%
	41st	05/10/97	56	88	0.64	1	5	0.20	-69%
	45th	05/10/97	53	88	0.60	5	5	1.00	66%
	51st	04/02/95	60	63	0.95	13	30	0.43	-55%
	52nd	06/16/95	112	65	1.72	68	28	2.43	41%
	54th	04/02/95	71	63	1.13	17	30	0.57	-50%
	62nd	06/16/95	54	65	0.83	19	28	0.68	-18%
	72nd	08/12/95	44	67	0.66	13	26	0.50	-24%
	80th	08/12/95	137	67	2.04	49	26	1.88	-8%
	112th	10/15/95	153	69	2.22	105	24	4.38	97%
Southwest	SW Custer	03/25/95	0	63	0.00	0	30	0.00	
	NW Westov	09/16/94	110	56.5	1.95	147	36.5	4.03	107%
	SW 2nd Av	08/23/92	11	32	0.34	18	61	0.30	-14%
	SW 19th Av	08/14/94	10	55.5	0.18	10	37.5	0.27	48%
	SW 51st Av	10/07/96	11	79	0.14	3	14	0.21	54%

City of Portland Speed Bump Peer Review

Appendix B

Public Opinion Survey Comments and Results

Streets Surveyed

Street	Limits	Information	Surveys Distributed	Surveys Returned	Return Rate
Speed Bump Streets					
NE Ainsworth St.	NE 42nd Ave. - NE Lombard St.	14-ft. Bumps (12) 6-9 months old	109	49	45.0%
NE Fargo St.	NE 103rd Ave. - NE 122nd Ave.	14-ft. Bumps (10) 6-9 months old	108	46	42.6%
NE Dekum St.	NE Vancouver Ave. - MLK Blvd.	14-ft. Bumps (5) 6-9 months old	27	3	11.1%
SE 76th Ave.	SE Division St. - SE Washington St.	14-ft. Bumps (9) > 2 yrs. old	89	37	41.6%
SE 52nd Ave.	SE Hawthorne St. - SE Lincoln St.	14-ft. Bumps (4) > 2 yrs. old	53	20	37.7%
NE 87th Ave.	NE Killingsworth St. - NE Prescott St.	14-ft. Bumps (5) > 2 yrs. old	32	12	37.5%
SW Sunset Blvd.	SW Capitol Hwy. - SW Dosch Rd.	22-ft. Bumps (9) > 2 yrs. old	78	37	47.4%
SE Harold St.	SE 52nd Ave. - SE Foster Rd.	22-ft. Bumps (11) > 2 yrs. old	170	47	27.6%
Parallel Streets					
NE Simpson St.	NE 42nd Ave. - NE Lombard St.	Parallel to NE Ainsworth St.	127	30	23.6%
NE Morris St.	NE 103rd Ave. - NE 117th Ave.	Parallel to NE Fargo St.	80	15	18.8%
NE Siskiyou St.	NE 117th Ave. - NE 122nd Ave.	Parallel to NE Fargo St.	36	9	25.0%
NE Bryant St.	NE Vancouver Ave. - MLK Blvd.	Parallel to NE Dekum St.	27	5	18.5%
SE 72nd Ave.	SE Taylor St. - SE Division St.	Parallel to SE 76th Ave.	75	25	33.3%
SE 51st Ave.	SE Hawthorne St. - SE Lincoln St.	Parallel to SE 52nd Ave.	47	10	21.3%
NE 89th Ave.	NE Killingsworth St. - NE Prescott St.	Parallel to NE 87th Ave.	29	3	10.3%
SW 19th Ave.	SW 18th Ave. - SW Seymour St.	Parallel to SW Sunset Blvd.	38	13	34.2%
SE Reedway St.	SE 52nd Ave. - SE 72nd Ave.	Parallel to SE Harold St.	96	28	29.2%
Total			1,221	401	32.8%

1. Overall effect of speed bumps on my street (all residents)

Answer	Before Speed Bumps		After Speed Bumps			
	Was a Problem	Was Not a Problem	Worse than Before	Same as Before	A Little Better	A Lot Better
Speeding traffic all day	71.1%	28.9%	5.6%	25.9%	20.3%	48.2%
High speeds by a few drivers	91.3%	8.7%	11.3%	30.9%	26.8%	30.9%
Speeding during rush hours only	42.3%	57.7%	8.4%	50.7%	16.3%	24.6%
Street is dangerous for pedestrians	59.4%	40.6%	10.4%	39.2%	25.0%	25.4%
Street is dangerous for bicyclists	57.5%	42.5%	10.9%	44.0%	21.4%	23.8%
Traffic laws not enforced	73.3%	26.7%	9.1%	67.5%	12.8%	10.7%
Too many cars all day	47.5%	52.5%	12.3%	46.2%	18.6%	22.9%
Too many cars during rush hour	45.1%	54.9%	10.5%	50.2%	19.8%	19.4%
Too much traffic at night	35.0%	65.0%	10.0%	54.6%	17.9%	17.5%

2. Since the bumps were installed, the fastest drivers on my street...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Drive faster than before	4.7%	3.0%	9.8%
Still travel any speed they wish	38.6%	32.5%	56.1%
Have slowed somewhat	38.3%	44.9%	19.5%
Are not much faster than the rest of the drivers	15.5%	16.7%	12.2%
I have not noticed	2.8%	3.0%	2.4%

3. With speed bumps, the safety of pedestrians and bicyclists on my street has...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Gotten worse	18.9%	3.8%	48.3%
Stayed the same	31.8%	29.8%	35.8%
Improved a little	22.0%	31.1%	4.2%
Improved a lot	21.1%	30.2%	3.3%
I have not noticed	6.2%	5.1%	8.3%

4. With speed bumps, the number of vehicles on my street has...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Increased	24.8%	4.3%	65.0%
Stayed the same	27.9%	29.4%	25.0%
Reduced a little	22.8%	32.8%	3.3%
Reduced a lot	19.4%	28.9%	0.8%
I have not noticed	5.1%	4.7%	5.8%

5. With speed bumps, traffic using my street as a cut-through route has...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Increased	27.5%	5.8%	68.9%
Stayed the same	23.8%	25.2%	21.0%
Decreased a little	13.3%	19.5%	1.7%
Decreased a lot	27.2%	40.3%	2.5%
I have not noticed	8.1%	9.3%	5.9%

6. I believe the bumps on the speed bump street are...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Too high for driving comfort at 25 mph	31.7%	28.2%	39.0%
About right for 25 mph	45.2%	43.3%	49.2%
A little too low, most drivers can go faster than 25 mph	18.3%	24.4%	5.9%
Far too low, has no slowing effect	2.5%	3.8%	0.0%
I have not noticed	2.2%	0.4%	5.9%

7. The noise of traffic going over the bumps is...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
An annoyance	17.8%	17.8%	N/A
Annoying but worth the slowing effect	13.4%	13.4%	N/A
Not a problem for me	58.9%	58.9%	N/A
I have not noticed	9.9%	9.9%	N/A

Notes: N/A = Parallel street residents not asked this question.

8. The warning signs and speed bump markings are...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Not enough to warn drivers of their presence	8.1%	8.9%	6.6%
About right to let drivers know the bumps are there	78.6%	81.4%	73.0%
More than is really needed to warn drivers	7.6%	7.7%	7.4%
I have not noticed	5.7%	2.0%	13.1%

9. Given the choice, I would...

Answer	Lives on Bump Street/Parallel Street	
	Bump Street	Parallel Street
Get rid of the speed bumps	20.4%	41.6%
Keep the bumps as they are	53.8%	17.7%
Add more bumps	14.2%	N/A
Add other traffic calming devices	8.8%	N/A
Have speed bumps put on my street too	N/A	35.4%
Have the speed bumps removed from the neighboring street and put on mine	N/A	0.9%
No opinion	2.9%	4.4%

Notes: N/A = Not asked this question.

10. The speed bumps are spaced at a distance that...

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
Drivers speed between the bumps	36.0%	40.7%	27.0%
Drivers stay at lower speed between the bumps	43.2%	43.9%	41.7%
Drivers have too many bumps to go over	12.8%	9.0%	20.0%
I have not noticed	8.1%	6.4%	11.3%

11. Since the bumps have been installed, there is less speeding in the area.

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
1 - Strongly Disagree	16.8%	10.7%	30.5%
2	8.3%	8.1%	8.6%
3	6.2%	4.3%	10.5%
4	4.4%	3.4%	6.7%
5	12.7%	11.5%	15.2%
6	4.1%	4.3%	3.8%
7	6.2%	7.3%	3.8%
8	15.6%	18.8%	8.6%
9	5.0%	6.0%	2.9%
10 - Strongly Agree	20.6%	25.6%	9.5%
Disagree (1 - 3)	31.3%	23.1%	49.6%
Neutral (4 - 6)	21.2%	19.2%	25.7%
Agree (7 - 10)	47.4%	57.7%	24.8%

12. Overall, the bumps have improved livability in the area.

Answer	Overall	Lives on Bump Street/Parallel Street	
		Bump Street	Parallel Street
1 - Strongly Disagree	20.2%	13.6%	34.9%
2	7.0%	7.2%	6.6%
3	4.1%	4.7%	2.8%
4	4.1%	2.5%	7.5%
5	11.7%	10.6%	14.2%
6	4.7%	4.2%	5.7%
7	6.4%	7.2%	4.7%
8	15.5%	17.8%	10.4%
9	7.0%	8.9%	2.8%
10 - Strongly Agree	19.3%	23.3%	10.4%
Disagree (1 - 3)	31.3%	25.5%	44.3%
Neutral (4 - 6)	20.5%	17.3%	27.4%
Agree (7 - 10)	48.2%	57.2%	28.3%

13 Speed bumps have not caused problems for these vehicles (all residents):

Answer	Trucks	Buses	Fire Trucks	Ambulances	Garbage Trucks
1 - Strongly Disagree	21.0%	19.7%	29.3%	29.1%	17.0%
2	3.1%	3.2%	3.9%	4.3%	4.2%
3	5.0%	5.2%	6.6%	5.9%	3.9%
4	5.0%	5.2%	4.3%	3.9%	3.9%
5	11.8%	11.2%	7.8%	7.9%	10.8%
6	2.3%	2.4%	3.5%	2.0%	1.5%
7	4.2%	4.4%	5.1%	5.5%	6.9%
8	12.2%	12.0%	11.3%	11.8%	11.6%
9	10.3%	11.2%	8.6%	9.1%	10.8%
10 - Strongly Agree	25.2%	25.3%	19.5%	20.5%	29.3%
Disagree (1 - 3)	29.1%	28.1%	39.8%	39.3%	25.1%
Neutral (4 - 6)	19.1%	18.8%	15.6%	13.8%	16.2%
Agree (7 - 10)	51.9%	52.9%	44.5%	46.9%	58.6%

Survey Number	Survey Comments
359	After seeing Ainsworth, I'd love to have them on Simpson -- at least between Portland Hiway and 60th. It is a cut-through street for a lot of traffic.
355	I never drive on streets with speed bumps. I don't like them at all!
353	Speed bumps are one street over from my home. Now all the traffic uses my street to avoid bumps. This increase in traffic is a danger to my kids playing outside also more noise congestion.
347	Bicycle lanes are a waste of tax money. They do no good. The worst traffic problem in my neighborhood is bicyclists on the side walks. They don't even use the bike lanes provided.
337	Bumps are just another unnecessary expenditure. Rather than solve a perceived problem (speeding) they create actual problems, such as erratic speeds, too fast, too slow almost a stop and go situation as people encounter bumps and are jolted and made afraid becoming over cautious. and damage and increased wear and tear on all vehicles. and bumps slow emergency vehicles making longer response times.
336	I don't have a clue what effect speed bumps have on service vehicles. However, I'd like to see speed bumps on my street. I think speed bumps have the potential to slow down POV speeds.
335	Speed bumps are hard on shocks of front and of car
334	Have noticed the cross streets to the bumps -- people are running the stop signs -- so thank God other traffic is slowed down so as to decrease collisions.
333	There are no speed bumps on our street or on the neighborin streets that I use.
326	I do not approve of my tax money being spent on this survey
321	Speed bumps only move the problem not fix it -- I worry about our fire protection -- the flower pots on Lincoln changed the direction for fire and police -- ticket speeders might help the problem --
320	I have only lived here since speed bumps were installed on neighboring street. I would really like speed bumps on our street (72nd) because my new car was hit by a speeder and we have 4 kids and a cat. People fly down 72nd off of the hill toward Division and they scare me.
316	The speed bumps are ineffective -- installed in front of a 30 mph speed sign -- too many produce stress and anger -- too high in some areas produce loss of control of the cars steering (particularly for the elderly)
313	I hate the speed bumps in my neighborhood and don't want them on my street. I would like to see them removed from my neighborhood. I think speed bumps are the worst form of traffic control.
310	We need bumps on our street. Between 111 - 119.
312	I think speed bumps should be declared unconstitutional
307	Too many fast bycle riders. Put bumpss on south-side sidewalks between SE 62 and Se 67th also put bumps on the street of Reedway Se 62 and SE 67th Im a Senior of 89 Most traffic from Harold comes over here now! at least 50% of people are going over 50 +
306	We have so many water holds and sauch bad water in most streets a please spend the money on that instead of (bumps) Please thank you.
304	Our street is to narrow for any kind of bumps and they are a waste of city and county money. There are no street signs on our street. Large signs should be installed but never bumps.
302	We don't have speed bumps and hope we don't get them, it just send the speeders to another street without bumps. putting all that roundabout and speed bumps is a waste of dollars.

301 I do not like the speed bumps at all. They create problems for fire - police - safety vehicles. I wish they were removed.

300 Need more public service announcements about courtesy and driving safety. All ads on cars are about speed and power.

295 The only good thing ab't. speed bumps is if they're on your st. If they're not, it's hell since everyone comes down my st. instead and since it has a more secluded feel to it, go even faster!

292 Speed bumps and blocking lanes are not the solution for speeding. These items belong in parking lots and perks, not public thoroughfares. We need more traffic police to uphold these types of traffic infraction.

362 The speed bumps on mthe neighboring street are a slight bother to me personally and I have to admit they are better than some I've had the misfortune of encountering.

361 This survey is a good idea.

360 Traffic has just moved over one block to avoid speed bumps. Speeders speed between stop signs and rarely stop at intersections with stop signs; our narrow streets create a more dangerous situation than is realized on Harold. Add more stop signs, not speed bumps, and monitor compliance.

358 We are all for speed bumps! But they should be properly marked. Our car happens to be very low slung, and we need the warning!!!

357 You must has a lot of money to waste (Our money)

356 If the transportation department took the time to analyze overalll traffic patterns and road conditions and synchronize stop lights and develop expeditious corridors for traffic flow speed bumps would not be necessary. Traffic calming is based upon creating solutions. Therefore with people who need to get from point "A" to point "B" in a reasonable amount of time there is the greater possibility for accidents. Remove obstacles and create smooth flowing traffic corridors which will eliminate traffic from areas with speed bumps. Coordinate stop lights.

354 I want the information needed to get speed bumps on installed on my street. I feel very strong about this.

352 I helped with the speed bump program on Harold St. People now use side streets more to avoid bumps. Traffic is slower on Harold.

351 Our neighborhood was not actually given time to arm ourselves against this action on Harold as someone at "Cith Hall" forgot to mail out letters of info. A lady came around door to door warning us the nite before the final meeting to tell us about it. Only 3 of us were able to attend. We are still furious.

350 Need more 25 mph signs on 72nd Ave. More enforcing 75 per traffic 35 to 50 mph.

349 Everyone to drive in the middle of the street. Many of the streets in this area have been paved but only a small stretch of Simpson was paved. We feel speed bumps are a large waste of money as are circles in intersections. They are an infringement on people who obey the laws. Money could be better spent on improving streets. There must be better methods of stopping speeders.

348 P.S. speed bumps w/o approach arrows to hint for 20-25 mph reconstruct or remove, please. Thx-- Distribution of surveys seems ineffective some in doors. I got this from my neighbor who had 2. Some in mail boxes. My mail is in a USPS locked gang box and none fo us had any surveys. (Besides - it's illegal to stuff in mail boxes -- and some in newspaper boxes - thta went unnoticed. Please revise distribution method. Thx!

346 I would like speed bumps put on SE 72nd!

345 I avoid driving on SE 76th and use sections of the named streets in my neighborhood which I rarely used before. The greatest threat to pedestrians is the lack of SIDEWALKS.

344 We don't want speed bumps on our street period.

Drivers are of freeway at 102nd exit turning up Fargo to 108 st turning right and going up to 108
and Morris and turning left to continue to 122nd avoide the rest of the speed bumps on Fargo --
343 Put the speed bumps on Morris St.

342 Speed bumps would be welcome on Morris St. to slow down traffic (including busses)

NE Simpson street si about 5 blocks long stop sign, at each end, no speed signs, at each end, all
cars going on this street, are speeding, these driver dont know what the speed limit is, a big
341 jocke, you are taking you life away, around here and for kids

Thank you - thank you for the speed bumps. The obnoxious motorcycle riders at midnight and 2
am, etc. no longer go back & forth. Traffic is truly calmed and safer for vehicles and pedestrians.
340 The Hillside Neighborhood Assn. supports speed bumps. Recording Sec. 246-3967

I like having the speed bumps! Lincoln has some devices to slow traffic (Roundabouts) but they
339 are not enough. Some sp. bumps on Lincoln would do wonders for my neighborhood!

I would be in favor of speed bumps on 72nd Ave. The first could go ideally right in front of my
338 house!

The street of Simpson between 60th & Killingsworth is used as a short cut for many drivers who
332 drive at excess speeds coming of Killingsworth, and is well overdue for speed bumps.

Only speed bumps in area are on Fargo St from 103rd east. Too far from Morris St to have nay
331 effect that I can say.

329 I believe that speed bumps cause undo wear on undercarriage of automobiles

I am glad they, the bumps, are not on SE 51st Ave. but the traffic problems are less the because
328 they are on SE 52nd Ave.

We don't have any yet BUT many of our close streets do. We were elated when we heard we
327 were going to get them - But where are thery????

The questionaire is not well formulated. Many questions are unanswerable. I have no idea of the
effects of speed bumps on a street I can not see. I only know the cars travel much slower and on
my street where there are no speed bumps, cars fly down the hill at breakneck speed and try to
gather speed going up the hill. The speed limit sign (one) is almost invisible to drivers. Many
327 more cars use my street to avoid the speed bumps. My streets needs one.

Emergency Vehciles 1. If they damage their equipment on speed bumps does this mean that
they do not respond to those areas on unimproved roads, some on primary response routes, with
much worse road conditions? If this is the case their equipment desperately needs updating. 2.
The speed limit on this street (SE 72nd Avenue, North of Dividion) is 25MPH, this means that
emergency vehicles could legally precede at 27.5 MPH (25 + 10%). Surely the speed over these
325 bumps does not significantly affect response time.

Perhaps if fines were higher on licenses cancelled after so many tickets. The bumps would not
342 be needed.

Also, we support placing numerous "Children Playing" signs in neighborhoods with high density
323 of families with children.

This has been a real problem I was wondering when our city would start paying attention to this.
We have children in our neighborhood. And elderly too. And these people that speed don't care
322 about anyone but there selves and there needs. Thank you for taking the time to care.

I would object to speed bumps on my street as it would be an annoyance to those of us who
drive conscientously in order to contol those few who do not. Many of these questions are hard to
answer as there are no speed bumps on my street but rather on the next street over. #12 - I have
no idea as I do not drive any of these vehicles. Although at first I objected to speed bumps on the
neighboring street I no longer mind them. However, I have noted a bit of an increase in traffic on
319 our street, I assume due to people avoiding speed bumps.

318 Thanks for doing this survey. Speed bumps are needed on SW Dosch.

The traffic on my street is heavy and dangerous. I have witnessed a car accident in th past 2
months. There are childeren, pets, and walkers/joggers on the street daily. Cars go fast as 65
mph - all hours. The street accesses Mt. Tabor Park, accounting for more pedestrians than other
317 neighboring streets.

315 This street is a cut off from the highway, to a main street, with alot of traffic.

314 I am unable to complete this survey since I have only resided in this neighborhood for 2 months.

The city engineer says that speed bump costs $5000! Would a stop sign cost less? Which of the
above would the fire, ambulance and police like? If the police could ticket the speeders, this
could produce revenue for this city, instead of spending more of our money on speed bumps
311 $5000 per bump is incredible!

Although I do have children, I am fond of a number of the young children who are my neighbors
and who are at risk from the increased traffic on our street since speed bumps were installed on
an adjacent street. My neighbors and I believe speed bumps on 51st would not only reduce
309 traffic but also reduce the speed of the traffic that remains.

308 If you cant help, can you give me a name and phone number of who can?

Unfortunately we have 1925 streets with 1998 traffic - The main thoroughfares are insufficient to
move the traffic - Bicylce lanes should not be allowed on main artares - street parking should be
limited to one side at narrow roads - Bumps are not pleasant but are effective - Architectural
outcropping with landscaping is ludicrous - If anything is needed its the removal of parking strips
305 and create wider streets.

303 Will be glad to have them on 89th.

The good thing about the "bumps" is that it did slow traffic down in the school zone. It certainly
299 didn't help traffic on the surrounding streets!

Since the speed bumps were put on 76th between Stark & Division more cars use 72nd as a
through street. I got hit trying to get out of my car after I was already parked and the driver almost
didn't stop and she was going well over 25 miles an hour. I've also had 2 cats killed by drivers
298 and the neighbors dog was killed and their child was amost hit by speeding drivers.

Speed bumps on Vancouver Ave. and Dekum St. were installed without formal written notice.
Too many bumps on both streets (on Vancouver Ave. one bump each of 3 blocks between
Ainsworth and Portland Blvd). curb extensions at Vanc. & Ptl. Blvd are a traffic hazard. I do not
297 speed.

The problem with speed bumps is where do you stop? Every street has occasional speeders -
are we going to inconvenience everyone because of a few speeders? Thats what we have traffic
296 tickets for. Get rid of them!

This survey is a waste of taxpayers money. We dont have speed bumps on NE 89th Ave.
294 Everyone on this block was given a form . Most peolple threw them away.

Any white Xerox forms returning to you are from/had #9 on them - was not going to double side
the sheets - not everyone on Simpson St. received these - wish it could have been a door to door
293 service. Over 30 copies were hand delivered to those not received. I quit at that #.

I would perefer speed bumps on our street. A few midway on the hill would probably be enough.
Traffic speed was bad before, but is worse now that bumps were put on the neighboring street.
Even the "City of Portland" trucks speed through when coming down off Mt.Tabor. Being close to
the park, there are a lot of people jogging, walking, bike riding, walkding dogs or out with
childeren. Due to speeding cars, there has been car accidents and squirrels and houehold pets
291 run over.

I am a strong supporter of traffic calming, and also of photo-radar speed enforcement. We must
get through traffic off 52nd north of Division, and moving the buss off Lincoln (and down to
290 Division) would be very nice!

220 SE 76th between Division and Washington is residential but most of the traffic is not.

SW Sunset Blvd. is a neighborhood feeder street that also serves Tri-Met and as access for
emergency services. It should never have had speed bumps installed. I've seen an ambulance
with lights flashing and siren going...doing DEAD-SLOW over the bumps! What we need is even
enforcement of all traffic laws, not fads and hi-teck doodads. Real cops in real patrol cars, a
219 presence on the streets.

Overall I'm sure the speed bumps keep speeds down and improve the liveability of our street -
keep them. By the way, this survey was found in the mud along the street - don't know where it
211 was supposed to be.

Less fear of walking, backing out of driveway, fewer (none that I have seen) accidents, fewer
dogs run over (none since bumps)...the street (Sunset Blvd.) is liveable again. I would like to see
fewer cars, and less speed between and over bumps, but the improvement from "pre-bump"
times has been significant an much appreciated. The opinions of those who do not live on the
205 street affected should not carry any weight in decisions regarding need for bumps.

PLEASE - Driving fast is fun, but....Remove bumps * keep signage. For #1. safty and #2. livability
204 #3. I'd rather drive the speed limit and still have a smooth ride.

192 The speed pumps have greatly inproved our neighborhood.

It can be annoying going over bumps even at 25 mph. We're stuck if they're all up and down our
own street. There are people who just go to another street! I see so many streets getting speed
bumps. It makes me wonder what a huge sum of money is spent on labor and materials on
speed bumps, to the neglect of our streets that need repairing. There's only so much money
available for road repairs - Taxes ahre high. Schools are suffering! Just a thought - please pass
191 comments on to whomever should know.

Our society has become one of defiant to laws and as a result measures such as speed bumps
190 have become needed to contorl speeders. I wish we would not have to do them.

You have to slow down because the bumbs if you care about you're car but if they were lower
183 people would speed. We love the bumbs. Thank you.

180 I think they work.

While this is a residential steet, near schools there are no sidewalks and shoulders in some
areas. Traffic is very heavy and has been for years. Speed has always been excessive and very
dangerous to get out of a drive away or enter the street, our mail boxes are run over on a regular
177 basis. The street is posted 25 mph and the speed bumps help this.

Because we don't have sidewalks on our street, the speedbumbs have greatly improved safety of
pedestrians and property. Regardless of sidewalks, the bumps helped in the speeding problems
176 we used to have.

174 The speed bumps have increased safety in our neighborhood, and are a great asset!!! Thanks.

172 Keep the speed bumps!

170 Problem is most drive too fast and a lot don't dirve by rule's. All in a hurry.

In our opnion, these are not adequate bumps. They need to be closer together and higher to be effective. We have been on other streets with higher bumps and they are more effective. Some
163 vehicles are not affected by the present ones and don't slow down at all. We live on NE 87th --

I live on the corner of 52nd and Harold - I see a lot of people squealing off 52nd onto Harold - the
162 median doesn't slow them much. The problem is way worse in the summer.

We would really like to restrict speeding both on Sunset and Boundary! We live at the intersection of the two and people speed in both directions. We recently had a cat killed by a speeding driver. We are strongly in favor of electronic ticketing devices as a deterant to
160 speeding.

153 Why cant we spend our money on fixing potholes, repaving, or sidewalks instead of speedbumps

Before speed bumps, at least once a month, my mailbox and paperbox would be taken out at nite by speeders or cars would end up in my ditch. Since speed bumps, this hasn't happened. Please back them up. When my children were small, I would have appereicated the speed bumps a lot! I
151 live on SW Sunset Blvd.

I feel that the bumps are not high enough. People drive into other peoples yards to get away from
131 bumps. They speed and don't care how fast they go...

I like the effect of the speed bumps but feel we could still do something else. Maybe circle
218 islands.

217 Speed bumps are not the answer - Stop signs - stop traffic -

Although the speed bump was placed a few feet from the entrance to my dirveway (narrow) it is
216 still difficult to go over the speed bump and turn directly into the driveway.

Speed bumps hinder emergency vehicles speed bumps only moves speeders to adjoining
215 streets strict law enforcement can cure the problem.

Sunset Blvd was designated as a major arterial. The real estate agents are trying to make it a side street, traffic flow is hampered, bicycle commuting (I do use this mode) is far more
214 dangerous due to cars vearing and the oil slick on the leading edge of the bumps.

213 The bumps are too tall and not long enough.

Before the bumps were installed, living on Sunset Blvd was noisy, dangerous. It was difficult to back out of driveway. There is still to much traffic and noise caused by cut-through traffic. But safety has improved dramatically. Since the bumps, we have had no cars in our roadside ditch, no flattened mail box, no high speed wrecks in front of our house. All had occured before the bumps. and we can now back out of our drive way without fear of causing an accident. We who
212 live on Sunset Need The Bumps.

Speed bumps definitely improve the livability of our street. I am still dismayed by the number of
210 people who speed on our street.

The speed bumps are really hard on vehicles shocks and some mufflers, even when not
209 speeding.

I have called different city agencies with the concern of excessive speed on our street. the attitude is the speed bumps will cure the problem. It hasn't yet. People think this street is the
208 Freeway.

I think speed bumps are one deterent for speeding. The problem is these bumps wear down
207 overtime. I would like to see the severity of the bumps increased to slow traffic even more.

Before the speed bumps - a car came around a curve - the driver saw a pedestrian in the school cross walk, tried to stop, the car went out of control and hit the pedestrian who still has to use a
206 support for walking.

203 Basically we would rather be without the bumps.

I wish that the bumps were higher. Many vehicles especially 4 wheel drives, vans and pickups
202 barely notice them.

I was among the group that got bumps extended, curbs and the meridan. I am pretty pleased we
have had no deaths or major accidents people will speed no matter how high the bumps there
are times a cop car would help. I do want the bumps to stay and will do what I need to make this
201 happen.

200 Thank you for helping our traffic problem on our street.

I had an old second car, the bumps ruined the suspensions and front end of the car. Front
wheels wouldn't stay in alignment. When the petition went around I thought the bumps would be
a good idea, they really don't control a thing. Individual who started petition for bumps doesn't
199 use the street anymore he has through street next to his house

We try not to drive down our own street since the speed bumps were installed because of wear
and tear on our vehicles. Sine the school next door to us has become a high school. There is lots
of speeding going on during lunch and after school. The students are not at all affected by the
198 speed bumps.

Some cars used to travel upwards of 70 mph. Not anymore. Something you haven't thought of is
this: you don't see peoples pets ran over in the street anymore because the cars are now going
slow enough to allow the animals to get out of the way. Thanks! P.S. I think speed bumps have
197 actually made my property value rise.

196 The best thing that has happeneed on this street now we need a path for pedestrians.

I did nto allow my children on the street prior to the speed bumps due to teenage drivers and
195 local businesses high speed short cut traffic, now I do. Thanks for your time.

Thank you for the speed bumps. No more cars or motorcycles using this street as a qtr. mile
194 drag strip!

Bumps are so large that driving at 25 beats the hell out of any vehicle. Speeding was not a
problem before, the city has over reacted with an excessive number of large bumps. This is the
longest stretch. (11 blocks) of speed bumps I have ever seen. Either this is a sick experiment or
the city has drastically over reacted to someone inflating a small problem way out of proportion.
Speeding by a few was and always will be a small problem. Small problems don't call for drastic
193 soltuions. Tear out the bumps.

I believe the speed bumps would have been a good thing when we had the elementary school
open 1-6 grades (Summer) But since its closing small children do not walk along side (in) the
189 street and I don't feel the bumps are necessary. I don't drive fast and I don't like the bumps.

A lot of teens and younger people drive my street. It helps to have the bumps as it slows them
188 down a little. I did not live here before the bumps so can not answer all questions.

187 Thanks!! The speed bumps are a great, my children can now go out front.

The fact that Sunset Blvd. does not have curbs/sidewalks is an issue that affects the safety of
cyclists and pedestrians before and after speed bumps were put in. I hope their affect is singled
out when reviewing the affect speed bumps has on this street. I see the bumps as have helped
towards safety and sidewalks/curbe the ultimate safety feature for this street. I also would like to
see the city enforcing homeowners with brush, trees, etc. that "hang" into the right of way of the
city's pedestrian path causing peds and cyclists to be in road and on speed bumps when traffic
186 passes.

Speed bumps are harmful to our vehicles and are an embarrasment when visitors are annoyed
by them. We didn't ask for them. They were forced on us!! Please help us get rid of them.
185 Speeding was never that much of a problem.

184 The speed bumps are helping - of course because I live on the street I am always looking for ways to improve conditions. I appreciate the city taking the time and money to invest in my neighborhood. Thank you.

182 I often see some people keeping up what seems faster than 25 and cut close to the curb to lessen the bumb. I am out 2 times a day to walk my dog but do avoid walking very far on 76th because of gas fumes.

181 I think the "no trucks" sign should be at both ends of the street - they now come from 122 and 111th and travel up and down the street. Sign is located at Fargo and Morris Ct.

179A Best thing that ever happened to Ainsworth between 60th and 42nd.

179B The speed bumps are doing a purty good job.

175 One of the speed bumps is directly in front of my home, these are streets without side walks. Drivers go around the speed bumps into my property and have been making big ruts. Any ideas how to correct this problem.

172 Noisy trucks (work vehicles) clang when go over speed bumps early in morning. People honk when they go over in protest. (still!) We have had several vehicles drive up onto our property (around the speed bumps), over the flexible reflectors and over newly planted trees... We have several children that walk to and from school (high school, elementary and middle school) on our street and they aren't safe from motorists. Speed bumps are ineffective without curbs.

171 If I could vote on speed bumps again, I would vote "No" because it has had so little impact on decreasing the amount of traffic and its overall speed, and increasing the noise considerably.

169 More police visibility may help with those that run stop signs at high speeds. Also children at play signs may help. But probably not. Speed sign at corner of 111th and Fargo is loose and keeps turning.

167 Not all speed bumps are equal - some are more difficult to cross than others. Many drivers use our front asphalt instead of driving over the speed bump.

166A Speed bumps are a costly bunch of political jive. Get rid of them NOW! If Katz supports speed bumps, I will never vote for a democrat mayor again!

166B The speed bumps are a joke

165 The bumps are a waiste of Taxes Payers money.

164 They seem to be appropriate and effective

161 This survey should have come out a year ago because the "before" situation would be clearer in our minds. Also, Sunset Blvd. still needs sidewalks for pedestrian safety.

159 Extremely dangerous in ice - even at very low speeds.

158 The "bumps" are the best method available for reducing speeding traffic

157 Smoother consistent bumps may be more effective on NE Ainsworth (Between 42nd and 60th) It seems as though speeding up to 35 mph in effect smooths the ride as opposed to going 25 mph (the posted speed) on some bumps than others

156 A mistake on Sunset Blvd!

155 We have a hearing impared child. Buying our house on this street with speed bumps was a very strong factor. Remember with a helment and the wind my son can not hear the cars. The speed bumps slow them down and he can ride a little safer here, because the cars see him. 70th should have speed bumps too. They race down while our children are playing.

154 Parked cars shouldn't restrict moving traffic.

152 I think the bumps is one of the best things that has happened to our street. Before the bumps you could sit and think you were on a freeway on ramp. Would like to see sidewalks next!

The only problems with bumps is a person who travels the street late at night around 3:00 to 4:00
AM. This person honks their horn as they go over each bump waking everyone up. They do it on
52nd and 55th SE. I wish someone would give that person a nice expensive ticket. Other than
150 this person, I love the bumps. I've lost too many pets to this street.

I don't like the appearance of the bumps. or driving over them myself. The volume of traffic is less
now making the area more residential like. I never found speed so much a problem before, but
149 volume of traffic was.

There is a need for consideration of a traffic light at 52nd and Hawthorne, along with more if not
148 better street lamps on 52nd Between Hawthorne and Lincoln Street to improve visibility!

As one who took my turn clocking drivers with a radar gun, I am glad our efforts to get speed
bumps paid off. It has been a very effective way of reducing speed and traffic on our street
147 without using police resources.

They can't fix potholes but they can sure waste the pothole money to ruin the road with speed
bumps and other stupid ideas. They can't even keep their traffic lights in sync. Also the money
146 wasted on this survey would fix many more potholes.

The speed laws need to be better enforced. I realize that with traffic as it is today we need a
"cop" pit every corner. Tell Kathy speed bumps help a little. Some drivers "pass" when people
145 slow down!

Anyone who does not appreciate the speed bumps 1) is renting and doesn't know what it was
like 5 yrs ago 2) Recently moved onto Harold St. 3) Doesn't "live" on Harold St. and opinions
should be counted as such. I've lived in the neighborhood for 30 years. They may be a pain at
144 times, but well worth it!

The bumps were installed before I bought the house but the neighbors said that it was terrible
before and a lot better now. I would not have bought this house if it were not for the speed
143 bumps. People still drive too fast, but it would be worse with out them.

The speed bumps cause undue wear and tear on our vehicles. Traffic enforcement is a much
better option and also is a revnue enhancer for the city. I am concerned about the decrease in
142 property value. I am selling my house and most people who look at it dislike the speed bumps.

It would be nice if the crews which install the speed bumps were more consitant with each other.
Some crews will use their template for the proper slope and height of speed bumps, others are
141 not to particular.

We believe that a traffic circle on 52nd and Lincoln would encourage traffic to use the traffic
signal on 50th and Lincoln, discouraging traffic flow through all 'neighborhood' streets, including
140 SE 51st and 52nd.

Please, please get rid of the speed bumps! The only way for a change of people is a change of heart! Force for many does not work! Some do not want to go by speed laws and others not enforced, make it harer for those who do abide by the law! The speed laws are for everyone! Safety, but some don't understand that, so they get angry and do as they please! That kind of driving is unsafe for all! It is ridiculous! Only one man seemed to want it and talked others into it! He was unhappy and didn't want it! Huge waste of taxpayer money! Drivers definitely speed between bumps! Our family dislikes the bumps! we have to go 10-15 miles per hour over them. One member of our family avoids our street, when can drive on one of the streets nearby. Annoyance is terrible, some slow down and then speed up immediately and if they hit the bumps at regular speed, the noise is also terrible. Far worse than before the speed bumps.

139

A few speed bumps at either end of Ainsworth would be sufficient as there are no city maintained
138 roads between those streets - 42nd & 60th.

Don't remove the speed bumps. Its safer for the kids, I know with speed bumps its going to save some childrens life, and thats what its all about. Saving one childs life is worth all the speed
137 bumps in the world. Thank you.

136 The best thing that ever happened to this street. I have lived on it since Feb. 1932.

The noise is terrible - especially when people brake for the bump - then speed to the next bump. Also people still pass the car in front of them over bumps or not. It would be alot better and safer
134B to enforce speed limit by ticketing.

134A I am happy to have the speed bumps on my street, they have helped.

I no longer drive on Harold Street between 52nd Ave. and 72nd Ave. as the speed bumps are too annoying and distracting. I've had to find other routes. Traffic laws are enforced a lot better due to photo radar not necessarily the speed bumps and more cooperation with the Police Dept. &
133 patrols.

Some drivers honk over every bump. This is a tremendous noise nuisance. What can be done
132 about this?

Those speed bumps are painful and harmful to the spine of everyone and particularly to those with neck and back problems. They are a very primitive solution and they punish everyone, you should team up with Intel Tektronix etc to develop non manual ways of catching violators. Hear
130 me!! I abhor bumps and I also hate speeders!

Please do not quote me - Thanks. They are a nuisance! Get rid of them! The big problems are 1) still speeders - they go fast trying to "overcome" the bumps 2) People who stop at every (9) bumps and go over them slowly. When you are in some cars and go over them it sounds/feels like the car is falling apart. 3) The noise of cars scraping the bottom of their cars or trucks
129 "shifting" what they are carrying. How safe is this for the cars???

128 In order to prevent hitting bottom, I have to drive at 15 mph. I'd really like to see them removed.

For about a year (after installing Speed bumps), we were ecstatic over the reduction in cars. - After the storm last year (which caused traffic to be diverted from Scholls Ferry Rd.) we noticed an increase in traffic using Sunset Blvd. However, we are 100% in favor of the bumps. Don't ever
127 remove them!!!!

29 Thanks for asking us! We don't like driving over them.

In the last 2 years the bumps have flattened but they are still all right, the warnings do a lot for reducing the traffic that used to use this street as a short cut, speccially to avoid the traffic on
383 Sunset Highway.

As usual the few causing problems prior to the bumps find other ways to continue their behavior. While the law abiding majority bears the inconvenience. P.S. I also occaisionally alter my route to
380 avoid the bumps.

I think that the bumps are a detractor in the neighborhood. I have had complaints from people visiting me. I find it disgusting that the city installed the bumps on a weekend at a high expense.
387 This whole escapade is a waste of taxpayers money.

The speed bumps have changed the character of the street from a road where drivers go to make up for lost time to a place where traffic goes slowly. If warning signs were placed where drivers of big trucks (semis - 18 wheelers) saw the before they turned on the street that might
386 help.

Please note that I cannot answer all of the questions because I moved in after the speed bumps
385 had been installed.

The bump directly in front of my house (51 NE Dekum) seems lower and traversed at higher
384 speeds than any of the other on the street.

We would very much like to have speed bumps installed on NE Simpson. I believe the speed problems on Ainsworth have decreased since they have gotten them. When we bought our home 2 years ago, our only complaint was that drivers drive way too fast for a residential street without
397 sidewalks.

The bumps have done much to improve liveability--but they are 1) too widely spaced - cars gun their motors to speed up between bumps; 2) too low - passenger cars still cruise over them at 30-40 mph & pick-ups, minivans etc don't even feel the bump (try driving over a street of bumps
399 in a pick-up, you'll see what I mean).