Split Speed Bump

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Introduction

Speed bumps have been found to be very effective at slowing traffic on residential streets throughout the City of Portland. City residents have embraced these devices as a means to slow traffic and enhance their livability.

The speed bump programs began in 1992 after several months of test and evaluation with two bump designs. The 14 foot speed bumps, only used on Local Service Streets (the lowest classification of streets in the City), slow passenger cars and light vans so that the 85th percentile speed along the street is between 24 and 28 mph. The 22 foot speed bumps allow an 85th percentile speed of 29 to 34 mph.

The Fire Bureau expressed concern that the 22' speed bumps are slowing their trucks and engines causing a negative impact on the Fire Bureau's 4 minute "fire response time"goal. In a series of several speed bumps on primary fire response routes, valuable time is lost, endangering public safety. We needed to develop a solution that would address both aspects of public safety, rapid response by Emergency Services and traffic calming for residential streets.

History / Problem

In 1991 the City of Portland Bureau of Traffic Management undertook a study of speed bumps (humps) in response to public demands for some respite from the excessive and continual increase of traffic speeds. As the result of two years of testing, speed bumps became a standard 'tool' for addressing the problem of speeding on Portland's residential streets. In Phase III of the original 1992 speed bump tests, the " Fire Bureau indicated a maximum comfortable speed of 20 mph for the 14'...speed bump and 25 mph for the 22'...speed bump"**.**

The 14' speed bump was adopted for local service streets that do not have transit or are not a primary fire response route. The 22' speed bump is designed for streets with high volumes of traffic, and those that are transit or primary fire response routes.
The Traffic Calming Program has been installing speed bumps since 1992, and in the fiscal year 1995-96, installed more than 100 new speed bumps. With so many bumps installed, and hundred's of streets on waiting lists, the Fire Bureau and the Bureau of Traffic Management became concerned about a "cumulative effect", or how several speed bump streets along any emergency route may impact the response time.

The goal of the Portland Bureau of Fire and Emergency Services is a response time of 4 minutes or less on 90% of emergency calls. A study was undertaken to quantify the effects of speed bumps on emergency vehicles. Measurements found that the amount of the time increase was dependent upon the type of vehicle and the type of traffic calming. Rescue vehicles were not slowed at all over the 22' bumps, while trucks and engines were slowed as much as 9 seconds per bump.

It was decided that an "emergency response route" street classifications would need to be developed, similar to the City's existing traffic street classifications[2], before any more traffic slowing devices could be placed on emergency response routes. This process of developing an emergency response route street classification and policies is a long and detailed task that can take several years to complete. All projects planned for streets currently used as primary routes by the Fire Bureau were put on hold until the classification process was completed.

In the meantime, excessive vehicle speeds continue to threaten public safety and neighborhood livability, and a great number of speeding problems are found on streets that also serve as primary response routes. The Traffic Calming Program needed a device that would both accommodate the Fire Bureau vehicles, and still slow speeding motorists.

Test and Test Plan

Since fire and emergency vehicles are allowed, by law, to use any portion of the street they need when on an emergency response run, we began with the concept of a chicane using two halves of a 22' speed bump separated by enough distance so that the emergency vehicle with the least amount of maneuverability could go through the chicane at approximately 20 mph.

Phase I

A Traffic Calming engineer and a Fire Bureau battalion chief used cones to build a simulation of the test device at the Fire Bureau Training Center. The vehicle selected by the Fire Bureau for testing was the vehicle with the least amount of maneuverability. The truck was 39 feet long, 8 feet, 4 inches wide, with a wheelbase of 18 feet, 6 inches. The street width used was 40'.

RESULTS OF PHASE I

In August of 1996, trial runs were conducted in the Fire Bureau Training Center lot, in a wide area of asphalt. A street segment and speed bump halves were outlined with cones, and runs were made through the split bump halves. After several runs, it was decided that the distance between the two lane bump halves needed to be at least 28 feet for the vehicle to maneuver through at or near 20 mph. Preliminary drawings of the new device were made and a field test was planned.

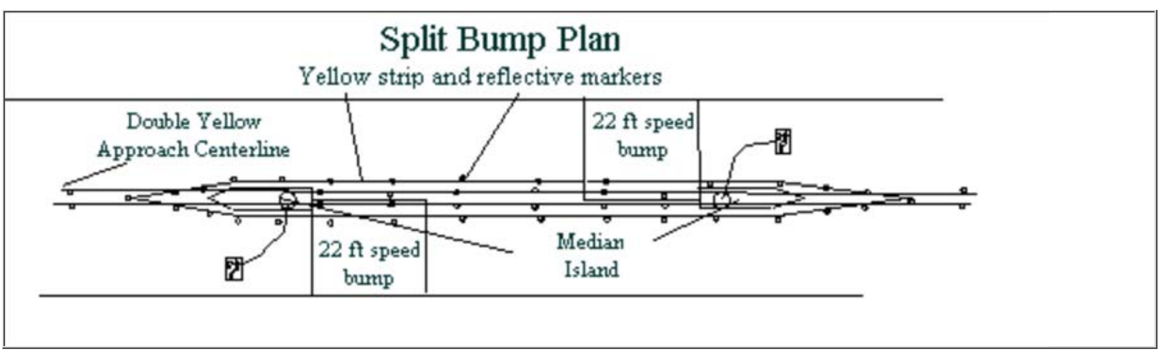
Phase II

Part 1 An actual street test location was selected that was part of an existing traffic calming project: SE Market Street between SE 117th and SE 112th Avenues. This street is 42 feet wide, has no horizontal curves, and the visibility along the street is excellent. This segment of SE Market is defined by a signal at SE 112th and an all-way stop at SE 117th.

Photos

The nearby fire station was notified and asked to make a few practice runs through the off-set speed bump and offer any suggestions they felt were appropriate.

The device was placed approximately 200 feet west of the all-way stop. The first part of the testing was for safety. Concerns of whether automobile drivers would violate the device and chicane between the bumps were raised. Twenty-four hour time lapse video equipment was placed to record driving patterns over the bump.



Part 2 This part of the initial testing was to determine if, and how fast fire vehicles were able to drive around the two bump halves. The largest Fire Bureau vehicles from from the nearby station was used for the short test.

Part 3 The final part of Phase II was to place another split speed bump device approximately 600 feet west of the original device to determine the effect on speeds the two devices have in combination.

Total slowing effect on fire vehicles was tested. This was a controlled test that matched the original test that determined the time lost by speed bumps on fire vehicle response times.

RESULTS OF PHASE II

The 24 hour time-lapse video showed that drivers did not swerve into the oncoming lane to avoid the speed bump half in their lane. The temporary concrete medians and signs placed in advance of each bump half seemed to keep drivers in their own lane and over the speed bump. Dense centerline striping and raised reflective pavement markings gave an illusion that a median continued the entire distance between the bump halves. Subsequent 24 hour time-lapse video showed no indication of confusion on the part of the drivers, nor any violations of drivers trying to avoid the device at any time.

The results of the Fire Bureau vehicle testing were favorable. The vehicles were able to travel through the "chicane" at 17 to 21 mph. They indicated that the speed was quite satisfactory, and that this maneuver is no different than weaving around cars.

Concern was raised that a car may stop in the middle of the gap between bumps while the emergency vehicle approaches. There was fear that this device might prevent drivers from pulling off to the right when the emergency vehicles are running. Parking removal would alleviate this problem by providing an available refuge for cars pulling off to the right. If a car does stop in the middle of the device and blocks the fire vehicle pathway, the Fire Bureau decided that they would just go over the 22' bump. An occasional 22' speed bump does not create serious delay problems for them.

It was determined that parking removal would be necessary for the Fire Bureau to perform the chicane maneuver. Parking was removed on both sides of Market Street opposite each bump half.

Since it was found that the general public is willing to stay to the right of the centerline, two adjustments were considered to the companion device to be installed approximately 600' from the first device.

- The first adjustment was to make the approach islands shorter. It appeared that the "Keep Right" sign was enough to win driver compliance, and that the 20' island could be made smaller, just enough to place the sign.
- The second adjustment was to widen the gap between the two bump halves. This was done to explore how far apart the two bump halves can be and still maintain driver compliance on a straight stretch of street.

With the second device in place (installed 4/11/97) the street was measured for overall slowing effect. The effect on the 85th percentile speed was impressive. While control locations along Market Street (106th, 110th, 122nd) had no change in their 85th percentile speeds, the 85th percentile speed at the location between the two off-set bumps (114th) dropped from 37 mph to 26 mph.

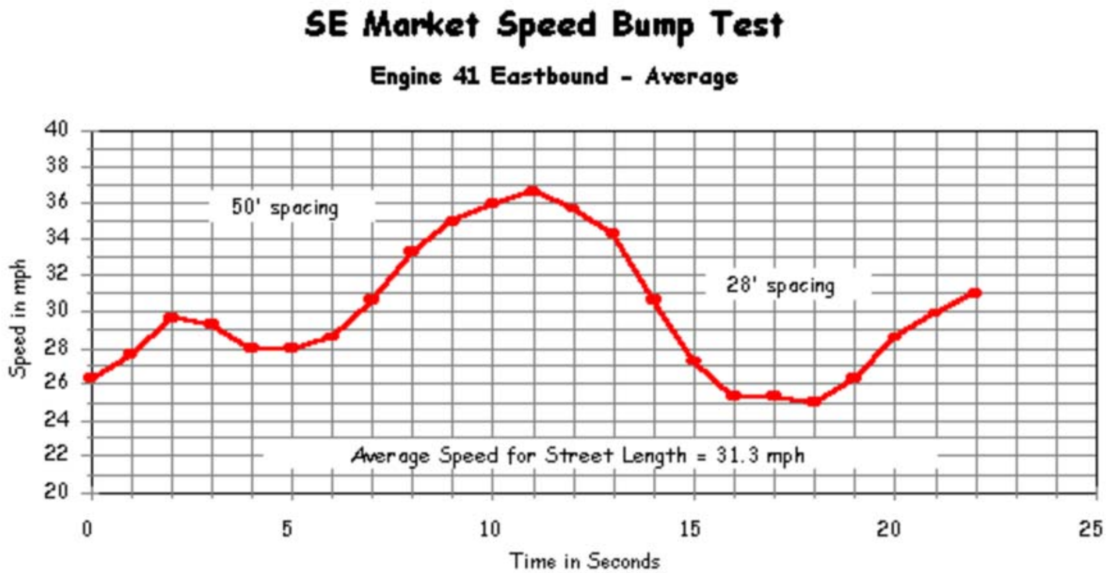
85th Percentile Speed Changes on SE Market Street

Market St. Location	**85th %ile Before Test (mph)**	**85th %ile with One Split Bump in Place**	**85th %ile with Two Split Bumps in Place**
East of 106th Ave	40	36	37
West of 114th Ave*	37	35	26
West of 122nd Ave	34	33	34

Table 1 * Between the two bump locations

Emergency vehicles ran timed tests through both of the new split bumps to determine the time lost by each vehicle. A truck and an engine were supplied for the test. These are the vehicles that had the greatest delay per device during the original testing of the other traffic calming devices.

Both vehicles were able to travel the length of the street at speeds between 29 and 31 mph. The vehicle speeds through the 50 foot off-set spacing were 26 mph to 30 mph. Between the 28 foot off-set spacing, speeds were 20 mph to 26 mph. It was found that the actual time lost was no more than 1 to 2 seconds for the largest of the vehicles.


SE Market Speed Bump Test
Engine 41 Eastbound - Average
50' spacing
28' spacing
Average Speed for Street Length = 31.3 mph
Speed in mph
Time in Seconds
40
38
36
34
32
30
28
26
24
22
20
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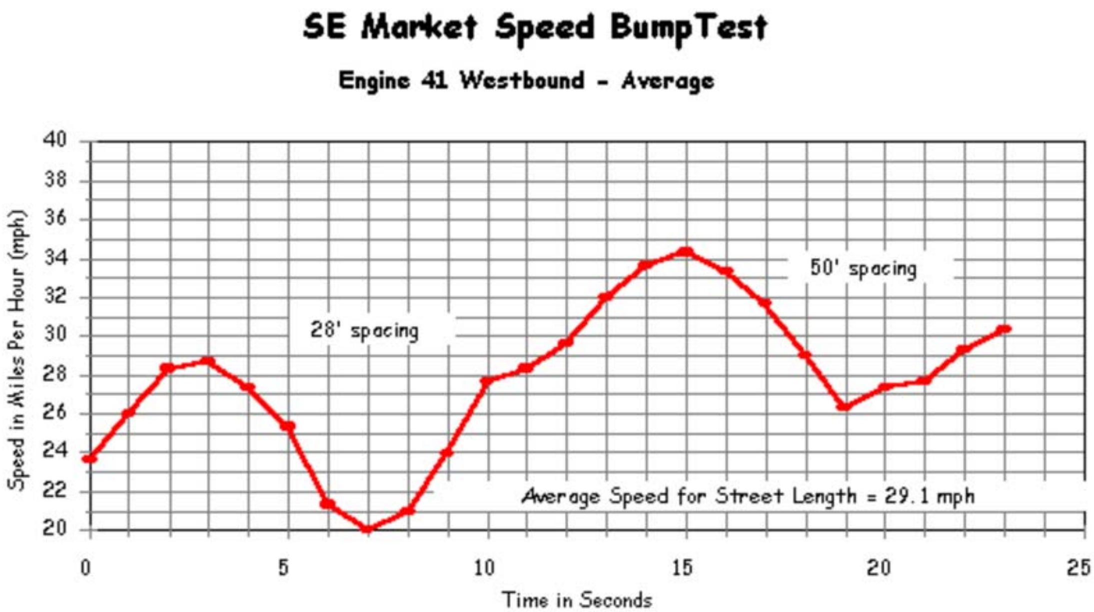
5
10
15
20
25


SE Market Speed BumpTest
Engine 41 Westbound - Average
28' spacing
50' spacing
Average Speed for Street Length = 29.1 mph
Speed in Miles Per Hour (mph)
Time in Seconds
40
38
36
34
32
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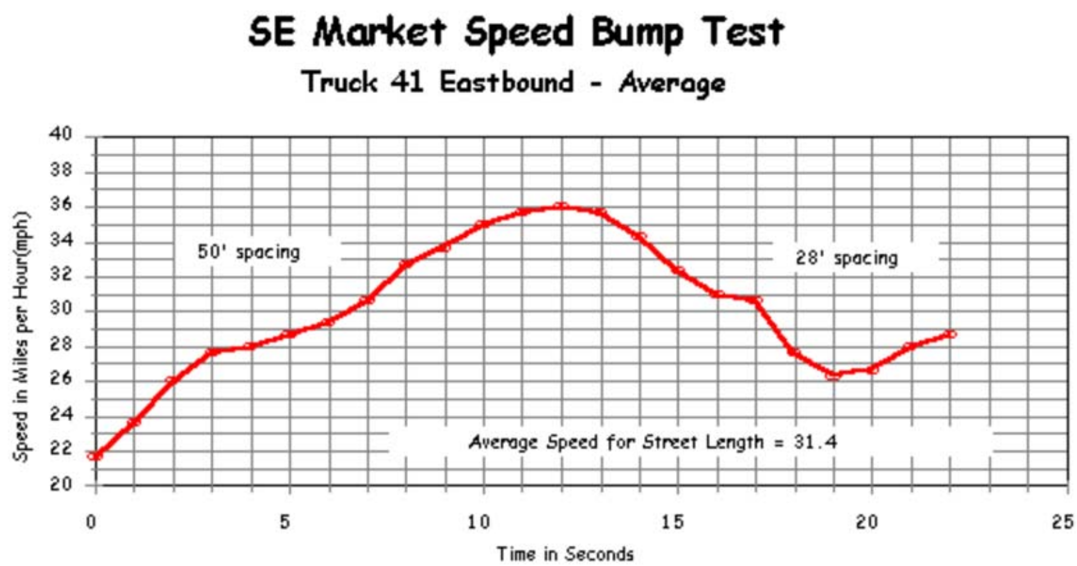
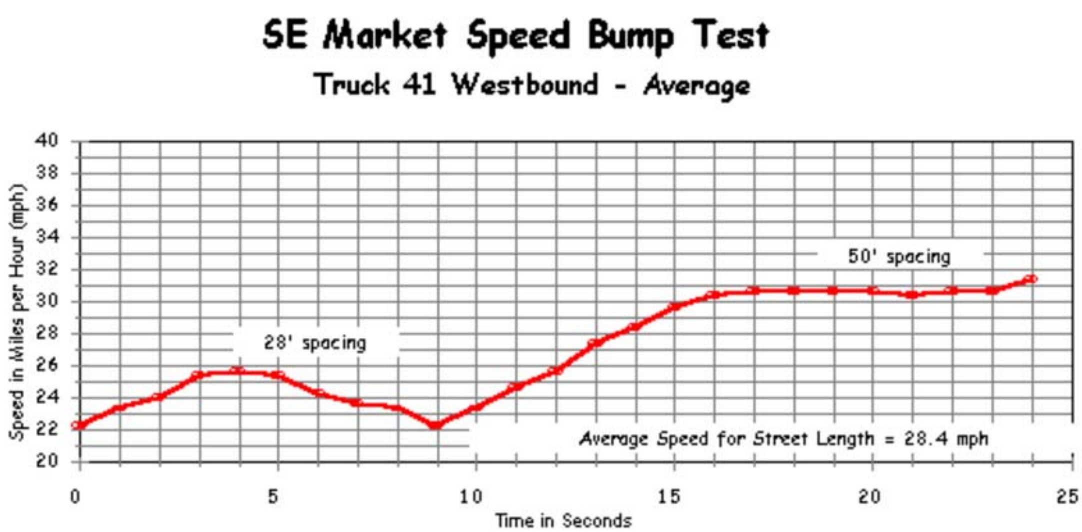




The Fire Bureau is satisfied with the results and have no objections to limited use of this device. They asked that the distance between bump halves be greater than the original 28 feet. 50 feet was set as the standard minimum distance between the bumps. The distance may be extended, however, driver compliance must be maintained. It is hoped that the bump halves will be able to function as individual devices.

In reviewing the data for the test, it was noted that the slowest speeds, and therefore the most time lost, were at the off-set speed bump with the 28' spacing The speed for the off-set speed bump with the 50' spacing never went below 25 mph.

Since the Fire Bureau believes that 25 mph is a reasonable speed for their vehicles on a Local Service street, it was concluded that the split bump, as it was designed with the 50' spacing, would meet their needs.

Based on the results of Phase I and II of the Off-Set Speed Bump Test, a third phase was initiated to determine some of the limitations of this new device.

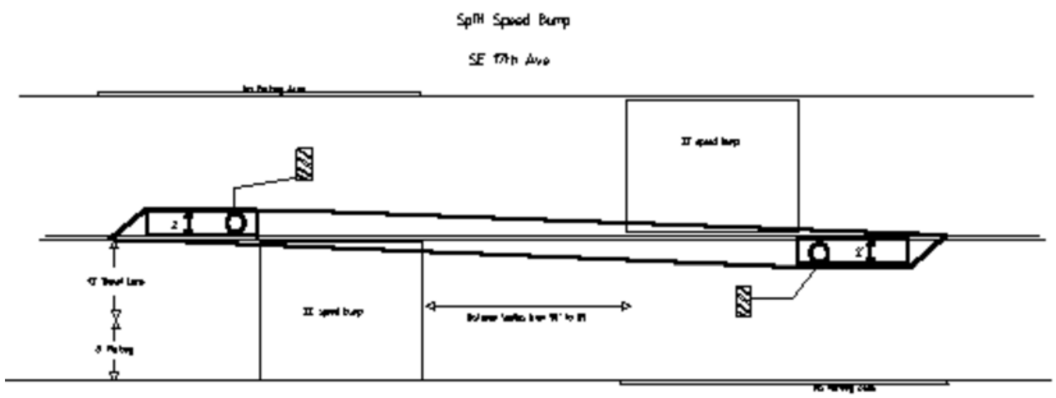
Phase III

The third phase of the testing included the split speed bump in combination with other traffic calming devices, and to test this combination on a street narrower than 42'. The most common street width in the City is 36'. SE 17th

Avenue between SE McLoughlin Blvd and SE Tacoma St. was chosen for this test. It is 36 feet wide, with parking allowed on both sides of the street. 85th percentile speeds along this 11/2 mile section measured from 37 mph to 39 mph. The speed limit is 25 mph.

A Traffic Committee consisting of area residents interested in solving the traffic problems on SE 17th established speed reduction as one of its primary goals. They circulated a petition for a test, and a majority of residents on SE 17th signed the petition.

The design on the split bumps for this narrower street required some lane adjustments to maintain a minimum 10' lane through the device. Because of the width restriction on SE 17th, parking was removed for 30' opposite each of the split bumps. This incorporated both the 22' length of the bump half, and 7 feet for the approach island. These islands were only 2 feet wide, and set in such a way as to maintain the 10' travel lane. The distances between the bumps ranged from 50' to 85'.



Two issues arose. The parking removal, necessary for the Fire Bureau vehicle moves and lane widths for the buses. While the bus system in Portland, Tri-Met, felt that their buses could operate satisfactorily on the 10' lane, the day following the device installations Tri-Met re-routed the bus line on SE 17th west 1 block to SE Milwaukie (a Neighborhood Collector). Tri-Met contended that the parking removal was insufficient for their needs. 10 to 30 feet of additional parking was removed to allow the buses the additional lane width they required.

Tri-Met had additional concerns about the street designs. Their concern was that if a larger vehicle were to park at the edge of the "no parking" areas, that they might not be able to get through the device. This "tight area" was at the concrete median in advance of the bumps.

Tri-Met concluded that a 10' travel lane is not enough for them to maneuver their buses down the City Streets. They require the option of crossing over the yellow centerline in cases where large vehicles were parked along the street. It was decided that the split speed bumps would be removed, and other methods of traffic slowing would be investigated.

Speed and volume data were collected on SE 17th as well as parallel streets (including SE Milwaukie). The results indicated that the 85th percentile speed had dropped 5 to 6 mph on SE 17 with the speed bumps. In addition, speeds were also reduced on SE Milwaukie, most likely due to the increase in volume.

85th Percentile Changes with Split Speed Bump in Place

Street	**Location**	**85th %ile Before**	**85th %ile After**	**Change**
Milwaukie	north end	37 mph	36 mph	-1 mph
	south end	34 mph	28 mph	-6 mph
SE 17th	north end	38 mph	32 mph	-6 mph
	south end	37 mph	32 mph	-5 mph
SE 18th	north end	20 mph	21 mph	1 mph

	south end	26 mph	27 mph	1 mph
SE 19th	north end	27 mph	25 mph	-2 mph
	south end	28 mph	27 mph	-1 mph
SE 20th	north end	22 mph	25 mph	3 mph
	south end	24 mph	24 mph	0
SE 21st	north end	25 mph	25 mph	0
	south end	25 mph	27 mph	2 mph
SE 22nd	north end	28 mph	27 mph	-1 mph
	south end	32 mph	31 mph	-1 mph

Table 2

No violations of the devices were observed. Drivers either slowed, or chose another route for their trips.

A comparison between the total area volumes before and after the split speed bumps were installed revealed an overall net loss of traffic volume at both the north end of the area and a greater volume reduction at the south end of the area. They also reduced the amount of large truck traffic that had used SE 17th as a cut-through to avoid the business areas of NE Milwaukie St.

Volume Change with Split Speed Bumps in Place

x-str	**Milwaukie**	**SE 17th**	**SE 18th**	**SE 19th**	**SE 20th**	**SE 21st**	**SE 22nd**	**Total**
Ellis	1184	-2094	0	18	52	26	62	-752
Rex	1568	-3136	18	-26	-36	-101	-55	-1768

Table 3 all numbers are in vehicles per day (vpd)

Since the split bumps have been removed, residents of SE 17th report that the speeds have increased and large trucks are again using their streets.

Conclusions and Recommendations

The split speed bump was found to effectively slow traffic speeds without delay to emergency vehicles. In both of the tests, speeds were reduced and Fire Bureau quick response time was maintained. The larger distances between each of the bump halves does not seem to influence driver behavior. Especially on high volume streets, drivers showed no tendency to cross over the center line to avoid the bump.

The test on SE 17th showed that the additional parking removal needed for bus operation conflicted with the neighborhoods need for on-street parking. Tri-met tells us that if more parking could have been removed for the bumps, transit buses would have had no difficulty negotiating them on this 36' wide street.

Since parking removal is necessary for these devices to operate well on the street widths tested, they should not be considered for streets where on street parking is important. The advantages of slower vehicle speeds needs to be weighed against the residents needs for on street parking with the final decision to be made by the residents.

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End Notes:

1. Speed Bump Evaluation Status Report, City of Portland, OR, Bureau of Traffic Management; June 1992.

2. Transportation Element of the Comprehensive Plan, City of Portland, OR Department of Transportation; June 1996.