Vancouver Traffic Management Plan: Street Design to Serve Both Pedestrians and Drivers

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The Southeast Vancouver Neighborhood Traffic Management Report was initiated in 2001 (completed in 2002), and similar to many traffic calming exercises, it was intended to build a framework for enhanced livability in an area of Vancouver, Washington that had a tremendous range of street facilities. (The City of Vancouver is located 10 miles north of Portland, Oregon in Washington State.) In the southeast quadrant of Vancouver there are neighborhoods that are tailor-made for walking – combinations of narrow streets, traffic calming measures, trails and sidewalks with landscape strips – a design topology that encourages use of the street by residents. These enclaves of community-sensitive design are commonly surrounded by areas developed primarily in the 1970's to 1980's. In many of these older neighborhoods the street design appeared to be guided by a bigger is better perspective, where pedestrian facilities were not even contemplated. This range of street facilities provided a fertile test bed for research into how people perceived their streets and uses them. Click on **www.ci.vancouver.wa.us/transportation/ntmp/seindex.html** for a full copy of our Southeast Vancouver Neighborhood Traffic Management Report.

Summary

Analysis and surveys conducted in Vancouver provide insights as to the dichotomy of perspectives individuals have for their street – as a *traveler* (a driver's perception of a wide street as convenient or safe) and as a *resident* (a pedestrian's perception of higher vehicle speeds as unsafe and undesirable). Based upon analysis of responses to interview surveys, many residents that thought their street was safe for one purpose (driving), also did not conduct activities on their street which would validate its safety (cross the street, have kids play in the front yard, walk). While limited in the survey application, the five streets surveyed produced consistent relationships – as speed, volume and street width increased, factors that influence livability (such as walking) decreased.

In evaluating the relationship between street width and motor vehicle speed it was found that given a consistent set of street topology characteristics, as street width increases, vehicle speed increases. The relationship was linear and basically suggests that for every 1m [3 to 4 feet] of roadway width, vehicle speeds incrementally increase 1.6 kilometers per hour [1 mile per hour]. However, more significantly the number of vehicles traveling 8 and 16 kph [5 and 10 mph] or more over the posted speed increase geometrically with street width. These higher speed vehicles are commonly the vehicles that place pedestrians at significant risk of injury or death and are the general stimulus that generates calls to city staff with complaints about drivers speeding (an indicator of lower livability). Based upon these findings, the range of 24 to 32 feet width streets appear to produce the most desirable balance of safety, pedestrian access, and vehicle maneuverability. These width findings are consistent with

historical standards (1920's) and Appleyard's work. Had developers and jurisdictions used these guidelines, many of today's street livability problems could have been avoided.

While there are numerous traffic calming measures to manage driver behavior and vehicle speed in neighborhoods, there are fewer tools available to address vehicle volume. The same surveys of residents indicated that the greatest level of street activity (including walking) occurred with street volumes less than 1,000 vehicles per day. While vehicle activity can create a sense of security, too much of a good thing seems to have the opposite effect – reduced pedestrian and resident street activity. A second analysis approach was utilized in Vancouver to test the relationship between neighborhood traffic volumes and connectivity, on the assumption that connectivity could provide the basis for reduced street volumes by better distribution or dispersion of traffic. A detailed EMME/2 travel demand forecast model was used to test connectivity options and their influence on neighborhood livability. It was found that a dense grid-like street network was not necessarily needed to provide the benefit of connectivity – but linkages were needed about every 152 to 305 meters [500 to 1000 feet]. However, connectivity by itself was not a panacea. By combining both traffic calming and connectivity, desirable levels of motor vehicle traffic could be achieved and with less extensive neighborhood traffic management than traffic calming alone.

Simply narrowing streets and installing vertical or horizontal deflection traffic calming devices will not assure a livable pedestrian environment. The design of streets should consider street anatomy from a pedestrian perspective: the walls, the border area, and the crossing area. Key tools to establishing a livable walking environment in the pedestrian areas include providing adequate buffer areas, walking zones, driveway and curb ramps, and crossing treatments. These tools can be applied within standard residential street right-of-way widths (ranging from 48 feet to 56 feet) if street curb-to-curb widths are limited to the recommended 24 to 32 feet. Without these key characteristics, pedestrians can be obstructed and forced to travel in the roadway area.

Background

Good planning for traffic calming cannot begin without proper understanding of its beginning. While Donald Appleyard did not invent traffic calming, his book *Livable Streets* (1981) stands as one of the best assessments of local street design and analysis. There are very few calming measures that are utilized today that are not in part or whole described in his book. His delving into the perceptions of the street (livability and street use) beyond the engineering numbers of the street (speed, volume, width) provide a platform that many transportation planners pay homage to but do not follow. There are plenty of traffic calming resources available (www.ite.org/traffic/index.html) and nearly all reference Appleyard's work but many then fail to follow up on his lead in surveying the perceptions of residents. Appleyard notes:

> *"streets must be more than channels for car transportation; they must also accommodate people on foot, on bicycles; they must be a social place for people to meet face to face; and they must bring additional green space to communities"*

Surveying residents, beyond “do you approve of traffic calming or not”, is necessary to provide an understanding of how people perceive their street, use their street and how their street functions. In Vancouver, these issues were important because of the wide range of street designs in the southeastern quadrant of the city. Without better understanding of each of these issues, it would be difficult to generate a cogent and comprehensive management plan that would not just become a spot response to complaints of an individual or small group of neighbors. A balance of understanding that includes engineering data, perceptions, adaptive responses of collective street use *and* citizen input were viewed as necessary to successfully implement a plan to better accommodate livability concerns. This balance of understanding is critical to resolve the inevitable dichotomy of resident issues, best stated by Anne Moudon in *Public Streets for Public Use* (1987):

> *“the public must confront ambiguities and outright contradictions in its demands: the same person who wants ease and speed as a driver, but who objects to the lack of safety for the pedestrian (or their children), must examine their priorities.”*

Many analysis techniques are aimed at assessing vehicle speeds, vehicle volumes and resident perceptions of livability that directly relate to the pedestrian environment. Some engineers and planners question the significance of attention on local streets in attempting to improve pedestrian safety, claiming that the “real problems” are on arterial and collector streets. While there are real and apparent dangers associated with pedestrian travel on arterials and collectors (e.g. safe crossing locations), no one should mistake that local streets have significant “real” issues, particularly when the pedestrian environment is ignored. First, in 2001, there were 4,882 pedestrian fatalities in the United States - of which 25% occur on local streets (*US Department of Transportation Fatality Analysis Reporting System*). With 64 percent of the pedestrian fatalities occurring in urban areas, this represents nearly 800 deaths – over two per day on local streets. Second, there is a demonstrated relationship between vehicle speed and pedestrian fatalities – when a collision does occur with vehicle speeds over 48 kilometers per hour (kph) [30 miles per hour (mph)] the likelihood of death increases dramatically. This is documented in past research studies as noted below:

Table 1. Relationship of Vehicle Speed to Odds of Pedestrian Death in Collision

Vehicle Speed	**Odds of Pedestrian Death** Source 1	**Odds of Pedestrian Death** Source 2
32 kph / 20 mph	5%	5%
48 kph / 30 mph	45%	37%
64 kph / 40 mph	85%	83%

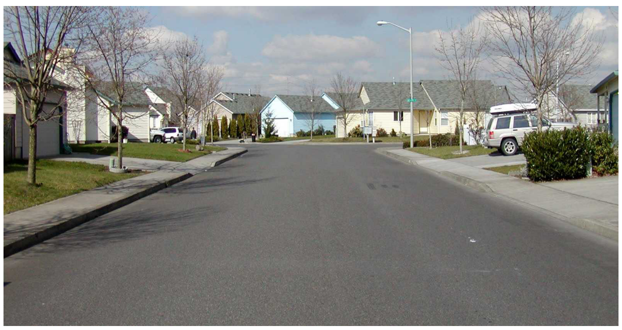
Source 1: *Killing Speed and Saving Lives*, UK Department of Transportation, London, England. See also Limpert, Rudolph. Motor Vehicle Accident Reconstruction and Cause Analysis. Fourth Edition. Charlottesville, VA. The Michie Company, 1994, p. 663.

Source 2: *Vehicle Speeds and the Incidence of Fatal Pedestrian Collisions* prepared by the Australian Federal Office of Road Safety, Report CR 146, October 1994, by McLean AJ, Anderson RW, Farmer MJB, Lee BH, Brooks CG.

If the higher end vehicle speeds can be reduced through enhanced local street design (either new streets or older streets retrofitted with traffic calming), the potential for these unfortunate events can be reduced substantially. These points to the need for quantifiable information about street performance and function when determining the appropriate design features that can be applied to enhance street topology.

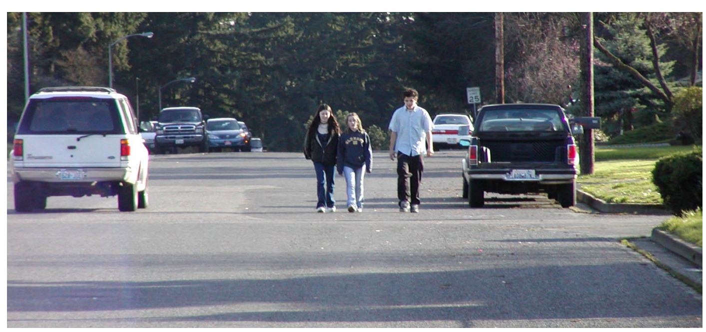
Introduction of Key Sections

The development of the neighborhood traffic management plan in southeast Vancouver sought to provide a program that would examine these issues and provide guidance on systematic traffic calming, beyond the complaint by complaint process, which benefits pedestrians, bicyclists and drivers. Information on local streets was obtained from the three sectors of the local street: the fronting users, the pedestrian zone and the vehicle zone. Data was obtained through surveys of residents in neighborhoods somewhat similar to those conducted by Appleyard to assess perceptions and realities of street functions. The vehicle zone was analyzed from two aspects – an engineering approach using street characteristic data (such as width of street, volume of traffic and vehicle speed) and the aspect of the vehicle users. Through traffic was assessed by utilizing detailed travel demand forecasting techniques to evaluate connectivity. Finally, the pedestrian zone was evaluated from a street topology standpoint and resident choice of behaviors conducted along a street.



Residential Street Surveys

Because many new streets are being built in southeast Vancouver, the greater the inventory of streets with characteristics that are conducive to driver speeding – the greater the potential to retrofit streets later when residents are concerned about livability. Following an approach set forth in Donald Appleyard's *Livable Streets,* surveys of several neighborhood streets were conducted to determine the public's view of livable street characteristics. Numerous questions were asked of residents and details of their streets were collected (volume, speed, width, etc.). The survey form is shown on the next page.



SE Vancouver Neighborhood Traffic Management Plan **Street Condition Survey**	CITY OF VANCOUVER

Street:

Address:

Date:

1. Describe the nature or character of your street in 3 words:

2. Do you think that the average speed (not posted speed) on your street is:

Very Slow	Fairly Slow	About Right	Somewhat Fast	Very Fast
1	2	3	4	5

If the speeds are very fast (5), what speed do you think vehicles are traveling on average (miles per hour)?

3. Do you think the traffic volume on your street is:

Very Light	Light	Average	Somewhat Heavy	Very Heavy
1	2	3	4	5

If very heavy traffic (5), how many vehicles do you think, on average, travel on the street in one hour (PM Peak Hour)?

4. Do you think that the width of this street is:

Very Narrow	Narrow	Just Right	Wide	Very Wide
1	2	3	4	5

5. Which of these activities have you done on your street in the last week (2 weeks if poor weather):

- ❑ Walk
- ❑ Jog
- ❑ Bike
- ❑ In-Line Skate/Skateboard/Rollerblade
- ❑ Garden
- ❑ Played games in your front yard
- ❑ Played games in street (basketball, etc.)
- ❑ Sat in your front yard
- ❑ Had trouble parking on your street
- ❑ Had trouble backing out of your driveway
- ❑ Walked across your street
- ❑ Other--

6. If you have children or grandchildren, which of these activities have you done in the last week (2 weeks if poor weather):

- ❑ Let your kids play in the front yard
- ❑ Let your kids cross the street
- ❑ Let your kids play in the street

7. How would you rate your street in terms of safety:

Very Safe	Safe	Comfortable	Uncomfortable	Very Unsafe
1	2	3	4	5

8. What 3 things would you do to improve your street:

1.

2.

3.

SOURCE: ***DKS** Associates* and the City of Vancouver

The survey (April 2002) was administered in a door to door interview format for five neighborhoods. This abbreviated survey format (as compared to Appleyard's lengthy format) was undertaken to minimize the time a resident needed to respond to questions, while at the same time providing key relationship information. The street's physical condition was surveyed independently – over 30 factors were noted ranging from functional classification to street width to pedestrian facility types. Appleyard would have classified these streets as either LIGHT (<2,000 ADT) or MEDIUM (2,000 – 10,000 ADT) streets and they were more suburban in nature to those originally surveyed by his team, though these streets are typical of the zone then under study by our staff. This information was obtained primarily to test two hypotheses:

1) Is the environmental capacity of a street different in SE Vancouver than that noted in Appleyard's *Livable Streets* (stated as about 2,000 vehicles per day (vpd) with a range of 1,500 to 4,000 vpd); and
2) What relationships exists between street livability and factors such as street width, volume and speed

Data Collection

Existing characteristics for each of the survey locations were collected to define the nature of the street. Data collected included street width, presence of sidewalks and/or bike lanes, presence of on-street parking, presence of landscaping, presence of curves, and presence of street lighting. In addition to the data collected by field review, each of the survey locations was counted over a 24-hour period to collect volume and speed data. Table 2 lists the general street characteristics for each of the survey locations.

Table 2. Survey Street Characteristics

Street	ADT	85th Percentile Speed	Posted Speed	%Over 56 kph 35 mph	Paved Width	Sidewalks	Bike Lanes	Curves
SE 24th St	800	43 kph 27 mph	40 kph 25 mph	<1%	9.7 m 32 ft	Yes	No	Yes
NE 9th St	1,200	48 kph 30 mph	40 kph 25 mph	2%	12.8 m 42 ft	No	No	Yes
NE 155th Ave	2,200	47 kph 29 mph	40 kph 25 mph	2%	12.8 m 42 ft	Yes	No	Yes
SE Talton	2,500	56 kph 35 mph	40 kph 25 mph	15%	19.5 m 64 ft	No	Yes	Yes
SE 98th Ave	4,200	58 kph 36 mph	40 kph 25 mph	18%	18.9 m 62 ft	No	No	No

Survey Results

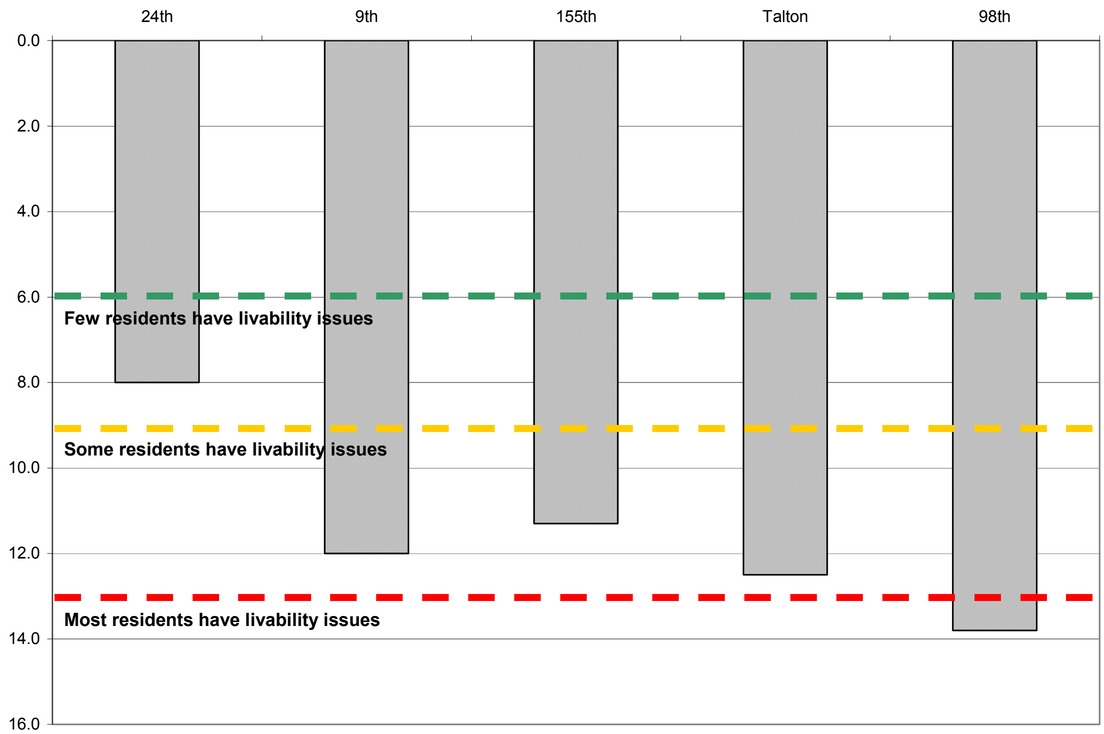
The surveys completed at each location were compiled to form an overall livability score for each street using a point system established for the responses to the street use/activity questions. The greater number of issues that effect livability (negatively) results in a higher score. Therefore, a lower score corresponds to a more livable street.

The street livability scores for the locations surveyed for this project ranged from 8 to 14 points per questionnaire, which indicated that the streets were on both sides of the livability continuum (see Figure 1).

Overall the scores clustered around these three ranges:

Livable: 6 to 9 points – average of 3 points per question – few concerned about traffic
Livability Threatened: 10 to 13 points – some voice concerns about traffic conditions
Livability Degraded: 14 or more points – most voice concern about traffic conditions

Figure 1. Livability Scoring Results



The surveys provided ample opportunity to discuss livability with residents in qualitative terms. Findings from the residential survey streets combined the resident perceptions with actual quantifiable street features (width, volume, and speed). Some of the comments and findings from the residents include the following:

- As volume goes up, livability perception goes down
- As speed goes up, livability perception goes down
- As width goes up, livability perception goes down
- While residents perceived livability impacts, many times they were not able to make the connection or nexus that street width was a factor in vehicle speed and ease of crossing
- Some residents liked their wide streets because they are easy to drive on
- Residents living near all-way stop intersection of residential streets had issues with the noise and safety (people not stopping)
- Most residents associated the average speed of the street with the top speed they have "observed" on the street
- Most residents that ranked the speed of their street as "very fast" indicated that they still allowed their children to cross the street

While the surveys and comments provide some conflicting views and facts they clearly point to the effects of vehicle speed and volume, along with street width, on livability. In general the findings from this limited sample of SE Vancouver neighbors match closely with the research conducted by Appleyard 25 years ago.

Survey Analysis

The data collected at each survey location were averaged and grouped for detailed analysis. The general findings indicate that as volume, speed, or width increase on a residential street, the perceived livability decreases. Figures 2, 3, and 4 show the data trends between each of the survey locations.

Figure 2 depicts street survey information comparing volume to livability factors. For SE Vancouver, the residential street environmental capacity appears to be in the range of 1,000 to 3,000 vpd. This indicates that streets with volumes less than 1,000 vpd would generally be considered a livable street to most residents and streets with volumes above 3,000 vpd would generally be considered to have livability issues to most residents.

Figure 3 suggests that as vehicle speed increases, street livability decreases. The survey size limits the accuracy of the plotted trend, but the data suggest that residential streets with 85th percentile speeds less than 45 kph [28 mph] would generally be considered to be livable to most residents and streets with 85th percentile speeds about 54 kph [34 mph] would not be considered livable by most citizens. While the speed data trends suggest livability effect similar to vehicle volume, it is interesting to note that speed is generally the first complaint from residents. This may imply that increased volumes at the residential street level (1,000 to 3,000 vpd) are acceptable with low vehicle speeds.

Figure 4 shows the effect of street width on neighborhood livability. As street width increases, the surveyed livability decreased. Streets with a width below 10.7 m [35 ft] appear to be rated as more livable. The trend line plotted on Figure 4 suggests that to design a neighborhood street with an 85th percentile speed of 40 kph [25 mph] would have a cross-section of about 8 m [26 to 28 feet].

Additional Findings

In additional to the volume and speed findings described above, the door-to-door surveys revealed several unique issues that warrant further description. The following bullet items discuss these issues:

- **Street Width:** The street width questions in the survey form were aimed at finding what width of street was felt to be appropriate for residential streets. The assumption leading into this survey was that streets that are too wide would be viewed as a negative characteristic. However, numerous residents presented with the width questions responded that, “Yes, my street is very wide. It is great and wide.” However, the livability scores tallied form the surveys indicate that the general impression of street livability decreases as width increases. This suggests that residents are not aware that increased width is an underlying factor to vehicle speed, ease of crossing, and overall residential street character.

Figure 2. Street Livability Versus Volume

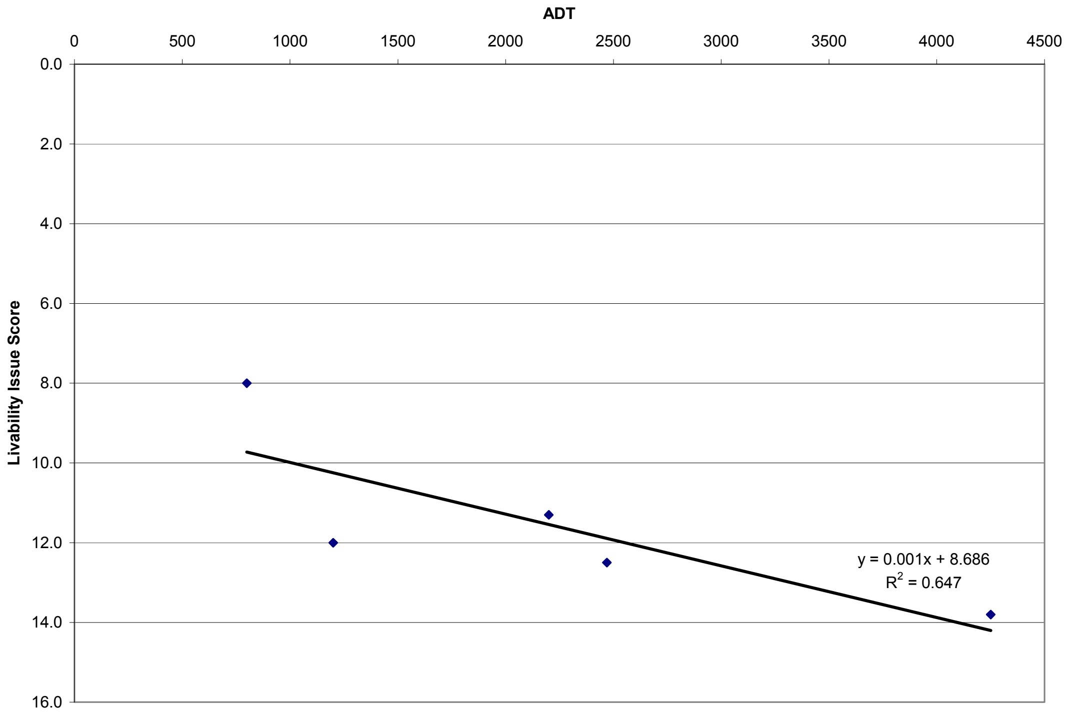


Figure 3. Street Livability Versus Speed

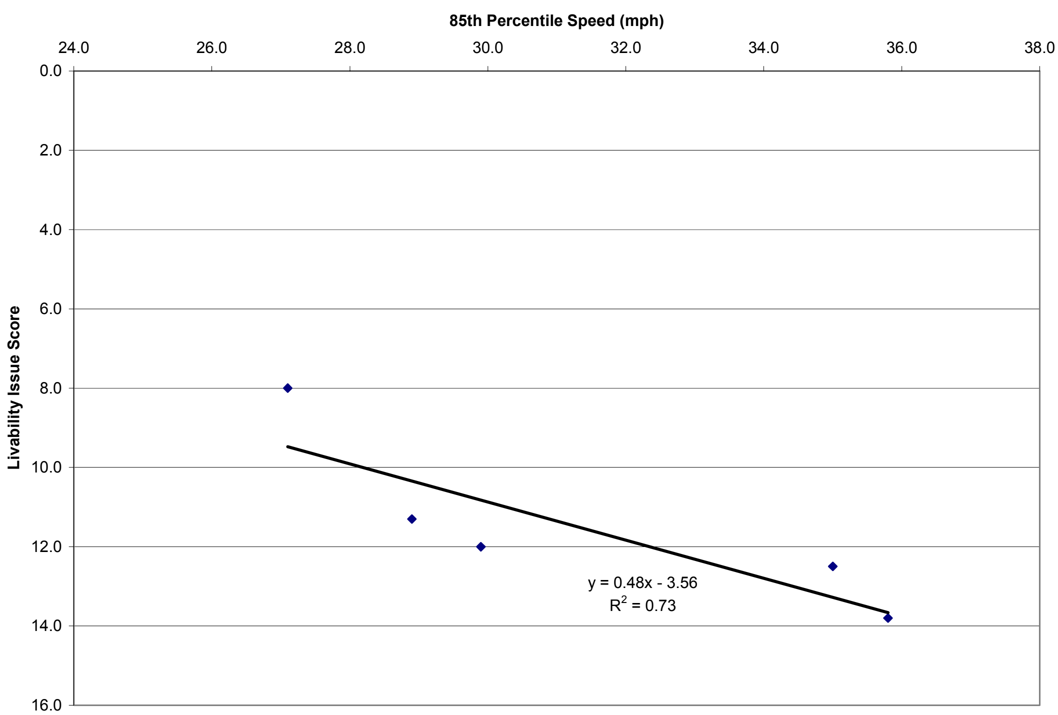
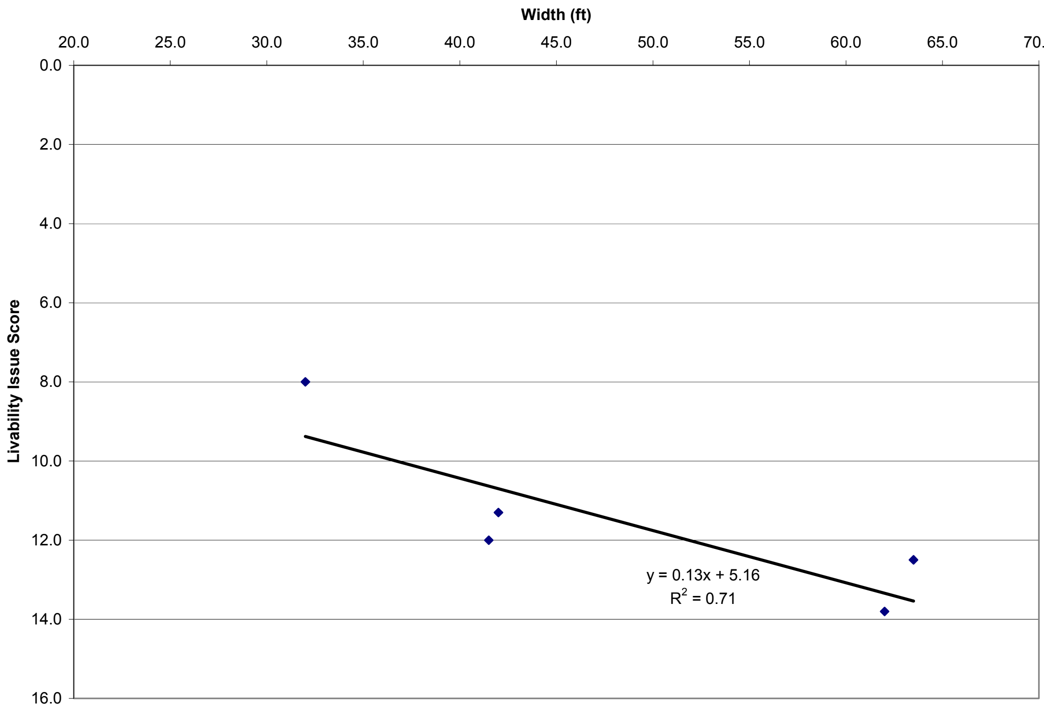


Figure 4. Street Livability Versus Width



- **Sidewalks:** Based on response to the street width question, residents were asked if they thought narrowing the street by adding sidewalks would improve the traffic issues on their street. The common response was that sidewalks would be nice, but a speed hump, stop sign, or speed limit sign is what will slow people down. Again, this points to an education program on the nature of traffic issues and street width.
- **Vehicle Speeds:** Residents who felt that vehicles were traveling too fast were asked to estimate the average speed of vehicles on their street. The results indicated that citizens view the average speed to be 8 to 16 kph [5 to 10 mph] above the measured 85^{th} percentile speed. This indicates that generally, the rare fast vehicle is viewed to be the average vehicle on a street.
- **Stop Signs:** As part of the livability survey, residents were asked what improvements could be made to resolve traffic issues on their street. For many residents, this discussion led to stop signs. However, there were two differing view points on this issue. Residents that lived mid-block thought that an additional stop sign at a nearby intersection would solve everything. Residents that lived at intersections with a stop sign strongly objected to the stop signs because most cars don't stop and those that do often "peel-out", which creates a safety and noise problem. In addition, these residents thought that the stop signs encouraged speeding from one intersection to the next. This suggests that there is general pressure to install stop signs as a traffic calming tool, however the stop signs can actually create a problem if they are installed at an un-warranted location.

The findings from these surveys clearly points to a relationship of vehicle speed and street width to the livability of street as it relates to volume on the street. If streets can be planned from the beginning with proper widths and anticipated flows (volume) the number of concerns about livability goes down. SE Vancouver had a wide range of neighborhood street widths and volumes that were surveyed. The findings indicated intuitive results – speeds go down with street width and people consider streets with volume below 1,000 vehicles per day very livable – with a transition in livability occurring between 1,000 and 3,000 vehicles per day. Because of the limited statistical data, additional research was conducted on the relationship between vehicle speed and street width.

Street Width and Vehicle Speed Research

Based upon the findings of the residential street surveys that street width and vehicle speed were related, a greater data set was desired to further understand this relationship. The objective was to identify streets with reasonably homogeneous characteristics such as residential frontage, which allowed parking (but without dense on-street parking activity), improved frontage (curb and gutter), 40 kph [25 mph] speed limit and street segments over 305 m [1,000 feet] in length. Nearly 30 street segments were identified in the Vancouver/Portland region where current detailed vehicle speed data was available. Evaluation of two vehicle speed characteristics was undertaken. First was the 85th percentile speed (that speed which 85 out of 100 drivers are driving at or below). Second was the percentage of vehicles driving 8 kph [5 mph] or more over the speed limit and the percentage driving 16 kph [10 mph] or more over the speed limit. These two percentages focus in on the vehicle speeds that are the greatest threat to pedestrians – if the percentage of vehicles in these two groups can be reduced – even if the 85th percentile remains above 40 kph [25 mph]; the risk of a significant incident for a pedestrian is substantially reduced. Figures 5, 6 and 7 provide the relationship between street width and these three speed characteristics.

Figure 5. Vehicle Speed Versus Street Width

Figure 6. Vehicles 5+ mph Over Speed Limit Versus Street Width

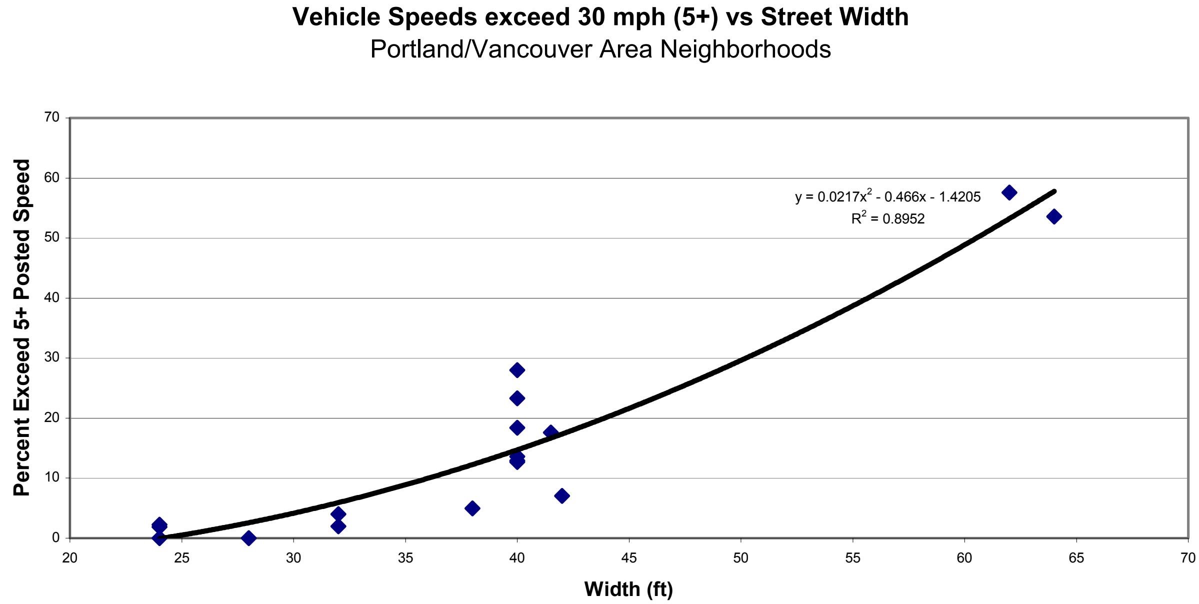
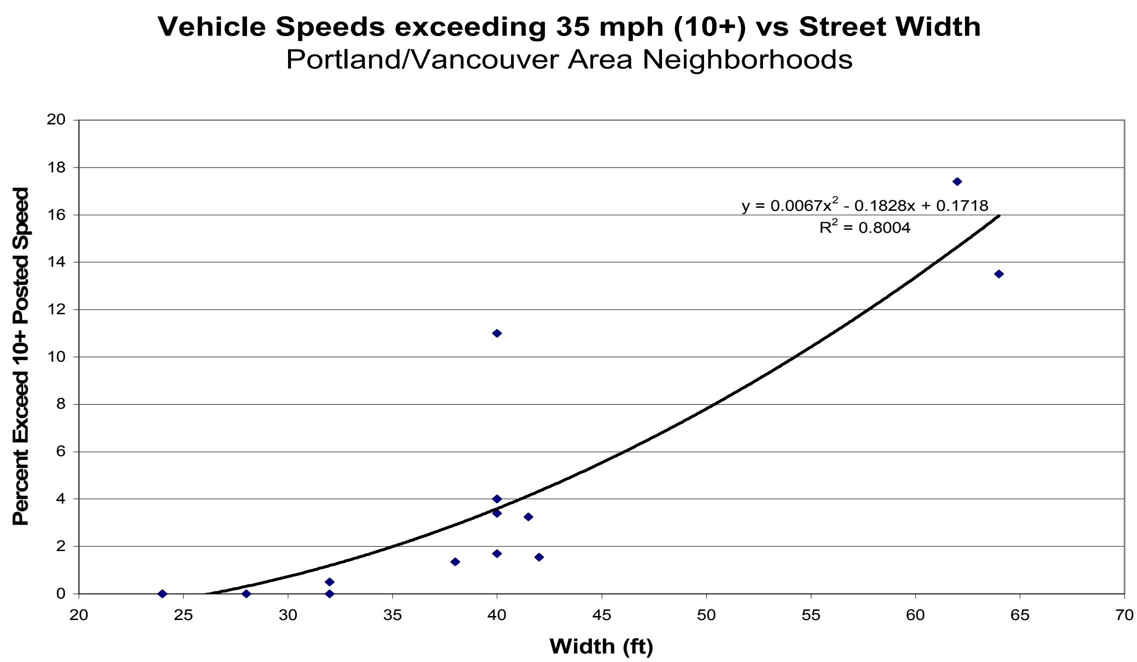


Figure 7. Vehicles 10+ mph Over Speed Limit Versus Street Width



These relationships provide two key results. First, that for every 1 m [three to four foot] increase in street width; vehicle speed (85th percentile) increases 1.6 kph [1 mph]. Second, as street width increases, the number of vehicles traveling 8 to 16 kph [5 or 10 mph] or more above the speed limit increases geometrically. These results point to the dichotomy of local street issues. Some technicians could interpret these data as saying in the choice between street widths, why not go wider since 1 m [3 to 4 feet] of width only effects 1.6 kph [1 mph] of 85th percentile speeds (while others would say keep reducing street width until the speed drops below 20 mph). Many people could see that streets between 7.3 m and 9.7 m [24 and 32 feet] in width have negligible numbers of 5+ and 10+ mph vehicles (as compared to streets above 9.7 m [32 feet]) and say why have any local street wider than this distance.

From a pedestrian perspective of the street, vehicle speeds above 48 kph [30 mph] has substantially more risk for pedestrians than below that level. Street widths that act to reduce or limit these higher vehicle speeds are clearly more desirable for pedestrians. Additionally, while the 1.6 kph [1 mph] of speed reduction for every 1 m [3 to 4 feet] of street width may not seem like much – because it is the 85th percentile speed – it is very significant. In reviewing Figure 5, the street width that yields a 40 mph [25 mph] 85th percentile speed would be about 7.3 m [24 feet]. Based upon prior assessment of neighborhood complaints, when 85th percentile speeds are about 43 kph [27 mph] or below – the likelihood of complaints is substantially reduced. The street width that corresponds to that range is 9.7 m [32 feet]. Reviewing other recent research corroborates this finding. Analysis conducted in Longmont, Colorado indicates that risk of motor vehicle injury collisions is lowest with street widths between 7.3 m to 9.7 m [24 to 32 feet] (refer to http://members.aol.com/Phswi/Swift-street.html). Findings from a 1997 analysis similar to that conducted in Vancouver shows the same convergence of street width and vehicle speed (refer to (http://www.fehrandpeers.com/fp-lib/public/residential_sts_quality.pdf). Based upon these findings, the range of 7.3 m to 9.7 m [24 to 32 feet] width streets would appear to produce the most desirable balance of safety, pedestrian access and vehicle maneuverability.

Connectivity Analysis

It should not be interpreted that due to the focus on street width in the prior sections, street width is the only factor that affects vehicle speeds on local streets. On the contrary, it is only one factor. History with neighborhoods in Vancouver indicates that cut-through traffic plays a significant role in determining vehicle speeds on local streets. Fewer complaints about traffic volume have historically been logged in Vancouver's oldest, most connected neighborhoods. One recent example of the role that cut-through traffic plays with vehicle speed was identified in research conducted by DKS Associates for the City of Beaverton on the Lombard Avenue Extension Project in 1998. It is a typical suburban neighborhood where only one street provides east-west connectivity and another street provides north-south connectivity, the through routes had 85th percentile speeds 6.4 to 11. 2 kph [4 to 7 mph] higher than adjacent streets in the same neighborhood that did not connect to another outlet.

While street width can be a factor to assist in calming local streets, width does not necessarily help in settings with a lack of connectivity where traffic concentrates on a limited number of through streets. In assessing ways to address this impact, the level of desirable connectivity was analyzed utilizing travel demand forecasting tools. The hypothesis was that if local street volumes could be limited to the range deemed more livable by residents (below the 1,000 to 3,000 vpd range) the potential to address vehicle speed by traffic calming measures or street width is possible.

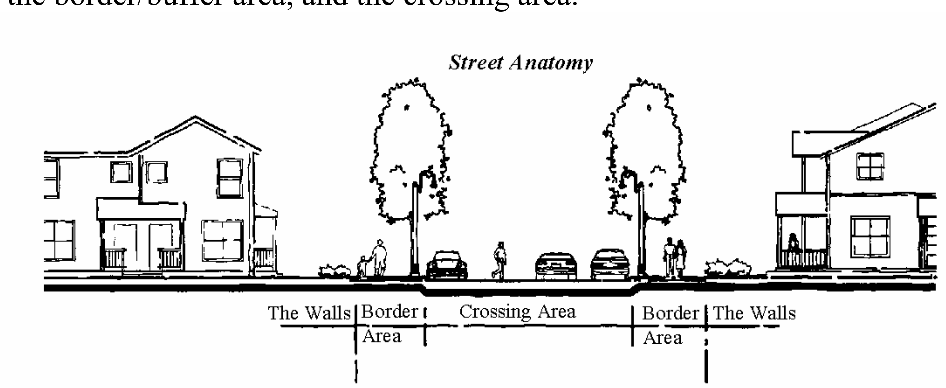
The Vancouver area EMME/2 travel demand model was utilized for this analysis. The test disaggregated the regional travel model in a select study area of SE Vancouver and found that lack of connectivity or single route connectivity (meaning just one arterial or collector route within a larger sub area) resulted in substantially more cut-through traffic than where neighborhood streets are linked together forming multiple routes of access. It was found that a dense, grid-like street network was not necessarily needed to provide the benefit of connectivity – but linkages about every 152 to 305 m [500 to 1000 feet]. Providing connectivity at this level distributed traffic more effectively, allowing local streets to remain in the 1,000 to 3,000 vpd range. However, connectivity by itself was not a panacea. By combining both traffic calming and connectivity, desirable levels of motor vehicle traffic could be achieved - with less extensive neighborhood traffic management than traffic calming alone.

Coordination with the emergency service providers further confirmed this conclusion. Based upon input from the fire department, a criterion was established that the use of vertical deflection (e.g. speed cushions) or horizontal deflection (e.g. diverters) was possible when multiple routes of access to a neighborhood area were provided. Where multiple access points could not be provided, limits on the use of these measures were established (spacing between measures). In a growing area such as Vancouver, this provided additional criteria for the development of network connectivity to avoid future livability concerns.

Besides providing adequate street connectivity, a key to assuring that local streets function for pedestrians, bicyclists and all street users is to make sure that the arterial and collector system meets its needs in providing capacity. The lack of system capacity routinely results in cut-through traffic which is harder to mitigate after the fact than if the system is designed with adequate connectivity and system capacity. When a lack of system capacity is combined with arterials and collector streets that are either turned into, designed as or have the characteristics of local streets, extensive connectivity is virtually the only solution to resolve effects of vehicle traffic on any nearby routes.

Street Topology for Pedestrians

The final area of the street that was analyzed as part of the SE Vancouver Neighborhood Traffic Management Plan was the space utilized by pedestrians. Working with Tom Litster from Otak, the basic anatomy of neighborhood streets was outlined: the walls (or private facilities, the border/buffer area, and the crossing area.



Simply narrowing streets will not make a better place for pedestrians. In fact, if design ignores pedestrians, narrower streets would produce an even worse environment for walking. Addressing pedestrian walkability (the equivalent to livability) requires working with the potential tools available within the realm of local streets to make the street an inviting "place" for pedestrians. These tools can be applied within standard residential street right-of-way widths (ranging from 48 feet to 56 feet) if street curb-to-curb widths are limited to the recommended 24 to 32 feet. The following tools were developed to address specific issues for local streets:

Local Street Pedestrian Tool Box

Buffer Area: This is the area between pedestrians and moving cars. This generally includes on-street parking and/or a furnishing zone. A bicycle lane can increase the buffer area. The lack of this space puts the pedestrian within the "physical impact zone" of the motor vehicle (wind gust and water splash of passing vehicles, little time to react to avert collisions between walking zone and roadway). Use of a furnishing zone in lieu of a curb tight sidewalk can enhance this area. All local street sidewalks have a furnishing zone (light poles, mail boxes, newspaper boxes, locations for garbage cans and utilities are some of the obstructions that are commonly within a furnishing zone**,** while landscaping, trees, pedestrian amenities and benches are pedestrian desirable elements of the zone). Many times the furnishing zone is located in the walking zone. This provides little buffer for pedestrians and many times results in pedestrians walking in the street where there is no buffer at all. Landscaping and "green street" elements can enhance the buffer area**,** creating a highly desirable local street for pedestrians.

Walking Zone: The key to walkability is being able to walk next to someone. Social walking by two pedestrians abreast requires six feet of space to comfortably accommodate this activity. The width of a common adult thorax is about 0.46 to 0.61 m [18 to 24 inches]. With one foot of shy distance from each edge of walk (to avoid falling off the curb and not hitting private landscaping), that consumes six feet. Six feet is not a luxury for pedestrians – it is the minimum necessary to create a livable environment. Walking single file may be adequate but it does not create more livable street. When street furnishings are placed in the walking zone, the ability to walk two abreast is not possible (pointing to the benefit of landscape streets or "green street" zones).

Driveways and Curb Ramps: The slope of the sidewalk at driveways and intersections is controlled by the Americans with Disabilities Act (ADA). ADA calls for a level walking zone for all driveway curb cuts – a pedestrian friendly driveway – providing another reason to consider landscaped furnishing zones (to allow the driveway to ramp up to the sidewalk grade). Curb ramps are required at all intersections that are not already raised crossings.

Additionally, ADA guidelines call for the use of tactile warning strips at curb ramps (truncated domes).

Crossing Treatments: Crossing the street at intersections of local streets can generally be accomplished with curb ramps. However, some locations on local streets call for greater attention to pedestrian design. Use of painted crosswalks has been discouraged in the past due to liability concerns about creating a false sense of security for the pedestrian. Recent research conducted by Zeeger (2001) indicates that for low volume, low speed, narrow streets, this concern is not necessarily the case. However, painted crossings should not be necessary unless something else about the street design is not functional. Curb extensions can be utilized where needed to improve sight lines between vehicles and pedestrians at key school or elderly crossing points on local streets (these are extremely valuable on collectors and arterial streets too). Probably one of the key pedestrian crossing design features is the use of median islands that provide refuge for pedestrians and break**s** crossing into two movements (again very valuable for collector and arterial streets). While curb extensions and medians are not commonly necessary for local street design to enhance the pedestrian environment, when planned in concert with key pedestrian routes to school, parks, transit stops, senior centers, community centers, retail or other activity centers they can greatly improve the livability of a street and the attractiveness of walking as a transportation mode.

Areas for Further Study

Based upon the findings from this study, additional data collection in the future would provide greater understanding of the local street design on pedestrian safety and livability. The following list provides areas for further research and data collection:

- Local street speed surveys obtaining daily traffic volume, 85th percentile speed, percentage 8 kph [5 mph] and percentage 16 kph [10 mph] over the posted speed;
- Analysis of streets with cut through traffic – including speed, crash and volume data;
- Additional residential interview surveys that explore the perceptions residents have of their street and how they utilize the street; and
- Greater understanding of local street accidents and injury collisions as they relate to controllable local street design characteristics.

About the Authors

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IMAGES OF STREETS SELECTED FOR SURVEY

SE 177th Avenue / SE 24th Street

NE 9th Street

NE 155th Avenue

SE Talton Avenue

SE 98th Avenue