

Engineering and Traffic Investigation Providing Justification for Lowering *Default* Arterial and Non-Arterial Speed Limits

August 2016

Overview

Seattle is committed to improving public health and safety through Vision Zero, the city's aspirational initiative to eliminate fatalities and serious injuries on Seattle's streets by 2030. At the core of this initiative is the belief that death and injury on city streets is preventable and acknowledging the importance of street design in mitigating the frequency and severity of collisions.

The city of Seattle is an increasingly dense urban environment with more than 1,000,000 daily motor vehicle trips, thousands of daily pedestrian and bike trips, and approximately 400,000 daily transit trips. More than 10,000 collisions occur on Seattle streets annually. Less than 10 percent of these crashes involve pedestrians, bicyclists or motorcycles yet these modes make up more than 50 percent of fatalities. Vehicular speed is often the critical factor for survival in collisions. The higher a driver's speed, the greater risk to vulnerable road users.

While we can engineer for safer streets, Vision Zero acknowledges that human beings are fallible. In just the last three years, collisions attributed to inattention increased 280 percent in Seattle and contributed to more than 3,000 crashes in 2014 alone. With each crash, speed makes the difference between no injury, minor injury, serious injury or death.

In an effort to improve safety for everyone that uses Seattle's transportation systems, the Seattle Department of Transportation (SDOT) proposes the following changes to the Seattle Municipal Code (SMC) regarding speed limits:

- Non-arterial speed limit reduction from 25 miles per hour (mph) to 20 mph (SMC 11.52.060)
- *Default* speed limit reduction for unsigned arterial streets from 30 mph to 25 mph (SMC 11.52.080)

These amendments to the SMC will be consistent with Washington State code and Federal Highway Administration (FHWA) recommendations.

Lower speed limits have been shown to be safer for our most vulnerable populations. According to a recent World Health Organization (WHO) report, legislation on road safety is a critical piece in reducing road traffic crashes, injuries and deaths¹.

The following report provides the engineering justification for lower non-arterial and default speed limits.

¹ WHO "Global Status Report on Road Safety 2015"

Background

The primary purpose of having a speed limit is to enhance road safety for everyone. Setting an appropriate speed limit:

- **Alerts drivers about the environment ahead** – speed limits generally reflect the geometric design of the street and adjacent land uses as well as the amount of on-street parking, driveways, and pedestrian and bicycle activity
- **Enhances safety for everyone** – Setting appropriate speed limits reduces the probability and severity of crashes under favorable roadway and environment conditions
- **Provides regulatory framework** – Speed limits allow law enforcement and the municipal court system the governing context for controlling speeds

As far back as 1927 (as far as is catalogued in the Municipal archives) the city established a maximum speed limit of 25 mph on all city streets.² For arterial highways Seattle deferred to the state of Washington, which set all arterial highway speed limits in Seattle. At this time streets and highways were just starting to develop into what we understand today – the first traffic signal in Seattle was installed in 1924 at 4th Ave S and S Jackson St.

Until 1934 speed limits on arterial highways in Seattle were relegated to the state. Beginning in 1934, the city began including a handful of arterials in the traffic code with 35mph limits³. These streets included important routes such as Empire Way (now MLK Jr Way), E Marginal Way, and Westlake Ave. Between 1934 and 1948 the traffic code added and removed individual streets to this 35mph list through a series of ordinances.

In 1948 Seattle updated the traffic code to reflect the current default speed limit regulations we know today – 30 mph *default* arterial speed limit and 25 mph on all other streets, unless otherwise marked⁴.

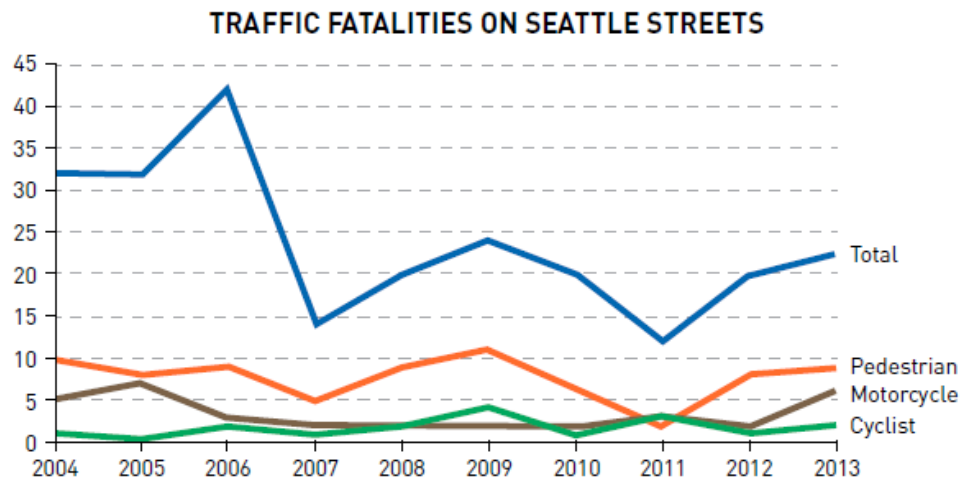
Seattle's Vision Zero Initiative, which launched in 2015, places emphasis on safety for bicyclists and pedestrians. Safety for vehicle drivers and passengers has improved substantially over the last decade but safety for vulnerable users has not experienced the same positive trend. Furthermore, the likelihood of injury is high for pedestrians or bicyclists involved in collisions. The injury rate for pedestrians involved in collisions is 77 percent and 83 percent for bicyclists involved in collisions.⁵

² Ordinance 53233

³ Ordinance 64692

⁴ Ordinance 77299

⁵ Seattle Department of Transportation 2015 Traffic Report, <http://www.seattle.gov/transportation/reports.htm>



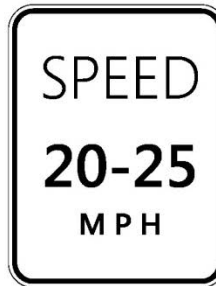
Seattle's transportation infrastructure serves an increasing amount of vulnerable users like pedestrians and bicyclists. Non-motorized and trips taken by transit continue to increase and rose 7 percent and 5 percent respectively between 2012 and 2014⁶ in the City Center. SDOT has also tracked increasing pedestrian and bicycle counts at most locations counted through the National Bicycle and Pedestrian Documentation project.⁷

While increasing non-motorized and transit trips improves the efficiency of our transportation network, studies demonstrate the negative effects of higher driving speeds. For instance, the cognitive abilities of drivers decline at higher speeds. Without factoring in behavioral issues like distracted driving, drivers becomes less aware of surroundings as speed increases and our ability to process information is limited by our field of view. An increase in travel speed increases the stopping distance of a vehicle, decreases the driver's field of vision and results in less time for the driver to react to a person or hazard in the roadway⁸.

⁶ "2014 Center City Commuter Mode Split Survey", Commute Seattle (2016)

⁷ "2015 Traffic Report", Seattle Department of Transportation,
<http://www.seattle.gov/transportation/docs/2014TrafficReport.pdf>

⁸ "Street Environment, Driving Speed and Field of Vision" by A. Bartmann, W. Spijker & M. Hess (1991)

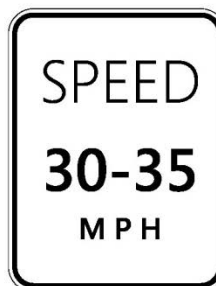


STOPPING
DISTANCE

40 feet

FATALITY RISK

5%



STOPPING
DISTANCE

75 feet

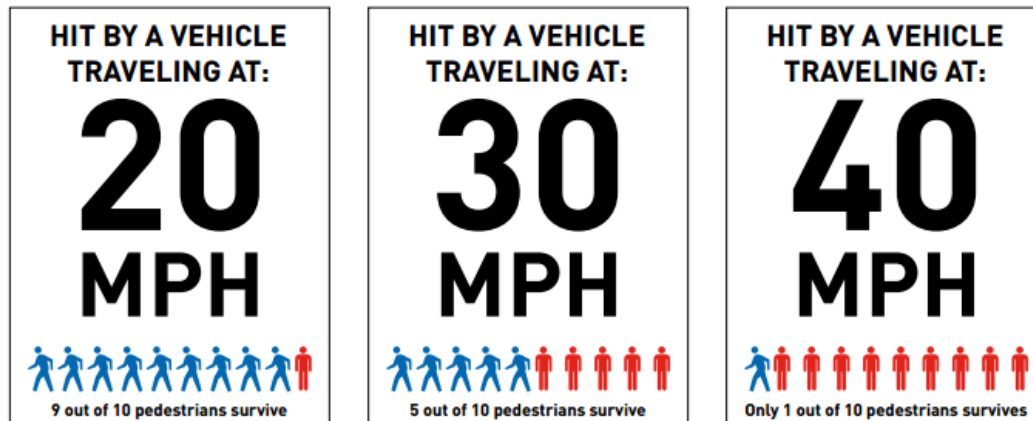
FATALITY RISK

45%

Injuries for vulnerable road users increase in severity as vehicle speeds increase. When a person is struck at a high rate of speed, a proportion of the vehicle's kinetic energy is transferred to the human body. Kinetic energy is determined by the square of the vehicle's speed⁹, rather than by speed alone. If a vehicle were traveling 20 percent faster along an arterial (e.g. from 25 mph to 30 mph), the kinetic energy increases by 44 percent, or more than doubling the risk of injury due to the greater amount of energy the vulnerable person in the roadway has to absorb. For reference, "the human tolerance for a pedestrian struck by a well-designed car will be exceeded if the vehicle is traveling at over approximately 20 mph."¹⁰

⁹ $E_K = \frac{1}{2}mv^2$, where E_K = Kinetic Energy, m = mass of object, and v = speed of object

¹⁰ Tingvall, C. and Haworth, N. (1999) Vision Zero - An ethical approach to safety and mobility, Paper presented to the 6th ITE International Conference Road Safety & Traffic Enforcement: Beyond 2000, Melbourne, 6-7 September 1999 (<http://www.monash.edu/miri/research/reports/papers/visionzero>)



Furthermore, behavioral issues like inattention increase the likelihood of collisions and data show an alarming trend in the number of collisions attributed to driver distraction. In Seattle, inattention-related collisions increased 280 percent between 2011 and 2014. Lower speed limits will minimize injuries when these mistakes like this occur and will help improve public safety in Seattle.

The benefits of this speed limit reduction proposal are consistent with city and SDOT policies.

- **Reduce collisions that result in injuries, serious injuries and fatalities** – through Vision Zero, the city is committed to a goal of ending all serious injuries and fatalities on city streets by 2030. Speed is a contributing cause of death and serious injury on Seattle streets.
- **Reduce collisions and provide a cost savings to society** – AAA¹¹ estimates that each serious collision costs taxpayers roughly \$6 million, based on the FHWA comprehensive costs for serious injuries and fatalities. These costs are based on 11 components which include: property damage; lost earnings; lost household production (non-market activities occurring in the home); medical costs; emergency services; travel delay; vocational rehabilitation; workplace costs; administrative costs; legal costs; and pain and lost quality of life.
- **A safer city encourages a healthier city** – Streets that feel safer may encourage more active forms of transportation, such as walking and biking. Reducing the speed limit for vehicles will make vulnerable users more comfortable with using our transportation infrastructure, and create more opportunities for physical activity. Additionally, lower vehicle speeds mean reduced noise pollution from the road and foster more vibrant communities, such as neighborhoods lined with small businesses.
- **Safer streets encourage more non-motorized travel** – Streets that feel safer may help the city achieve mode share goals and improve the efficiency of the transportation network. Seattle currently administers programs to promote transit use, ridesharing, bicycle trips, and walking and biking to school.

¹¹ “Crashes vs. Congestion – What’s the Cost to Society” (AAA, November 2011)

Speed Limit Proposal

Non-arterial Speed Limit Reduction Justification

Existing non-arterial speed limit: 25 mph

Proposed non-arterial speed limit: 20 mph

To enhance safety for vulnerable users on non-arterial streets, SDOT proposes to amend SMC 11.52.060 to reduce the speed limit on non-arterial streets from 25 mph to 20 mph. This change would affect all of Seattle's 2400 miles of non-arterial streets as shown in maps 1 and 2. Reducing the speed limit on non-arterials is consistent with Washington's Neighborhood Safe Streets Law (2013) which authorizes municipalities to lower limits to 20 mph.

Seattle's non-arterial streets (commonly referred to as 'residential' or 'local' streets) are designed for low speeds. The standard residential street in Seattle is 25 feet wide with 7-foot wide parking lanes on both sides of the street. This leaves one 11 foot-wide general purpose travel lane for vehicles. Two vehicles travelling in opposite directions on a standard non-arterial street must take turns navigating the street. The width of our non-arterials maintains low speeds on these roadways.

While the frequency of collisions on non-arterial streets is relatively low, nearly 3600 collisions occur on these roadways each year. Approximately 10 percent of annual serious injury and fatal collisions occur on these streets.

Annual Collisions on Non-arterial Streets (3 year average)			
Total Collisions	Injuries	Serious Injuries	Fatalities
3594	400	14	1.66

Speed limit signs are not posted on non-arterial streets unless the street passes through a special designation area such as a school zone or 20 mph zone. The non-arterial speed limit will be posted on signage at major entrances to the city as described later in this document.

Case Study – "Slow Zones"

Countries around Europe have started implementing "Slow Zones" which sets the speed limit at 20 mph to slow traffic down on non-arterial streets in neighborhoods. After implementing "Slow Zones", the following safety impacts were noticed¹²:

¹² NACTO "Neighborhood Slow Zones – A community-driven approach to reducing speeds to 20MPH" (http://nacto.org/wp-content/uploads/2012/10/ViolaRob_Neighborhood-Slow-Zones-NACTO-Conference-2012.pdf)

- **London** – 46% reduction in collisions. Average speeds also reduced by 9 mph. In another study¹³, there was a 41.9% reduction in fatalities and serious injuries where the reduction was greatest in younger children under 15 years old

New York City started implementing “Slow Zones” in 2011. Since then, their findings show promising trends¹⁴:

- 10-15% reductions in speeds
- 14% overall reduction in crashes with injuries
- 31% reduction in driver or passenger injuries

On September 8, 2015, SDOT formally announced the 20 mph zone program to improve neighborhood safety for all travelers near schools and playgrounds. This pilot program is consistent with our current city laws based on SMC 11.52.100. SDOT reduced non-arterial speed limits to 20 mph at six pilot locations in 2015 based on collision history, number of nearby pedestrian generators, geographical representation, and partnership opportunities. There are two phases to this neighborhood 20 mph zone program:

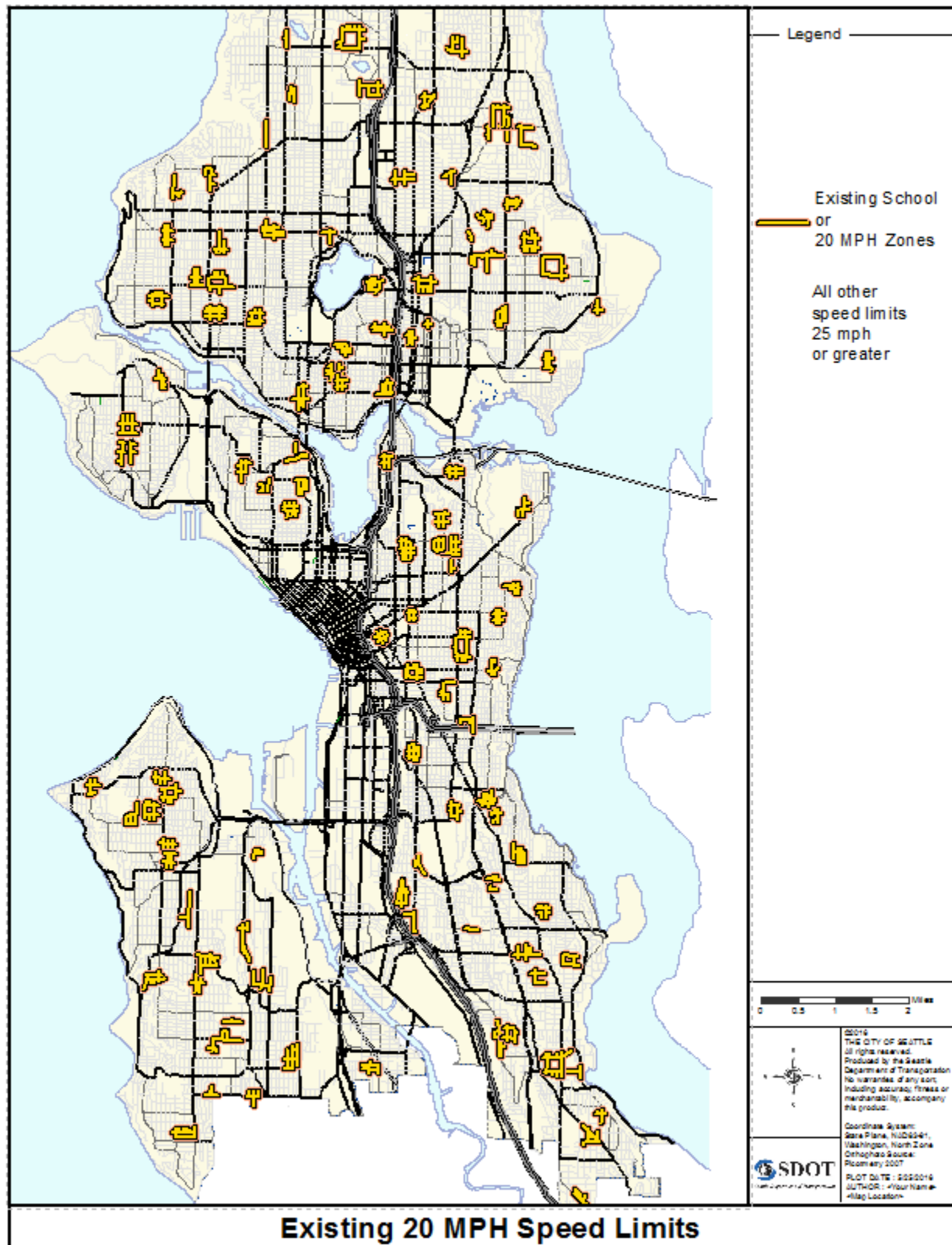
- Phase One – Install 20 MPH signs and 20 MPH markings on the street.
- Phase Two – If speeds are not reduced with signs, install other safety improvements such as curb bulbs, speed humps, and other appropriate traffic calming devices.

Speeds were reduced by a maximum of 1.6 mph and collisions dropped in five out of the six 20 MPH zones.

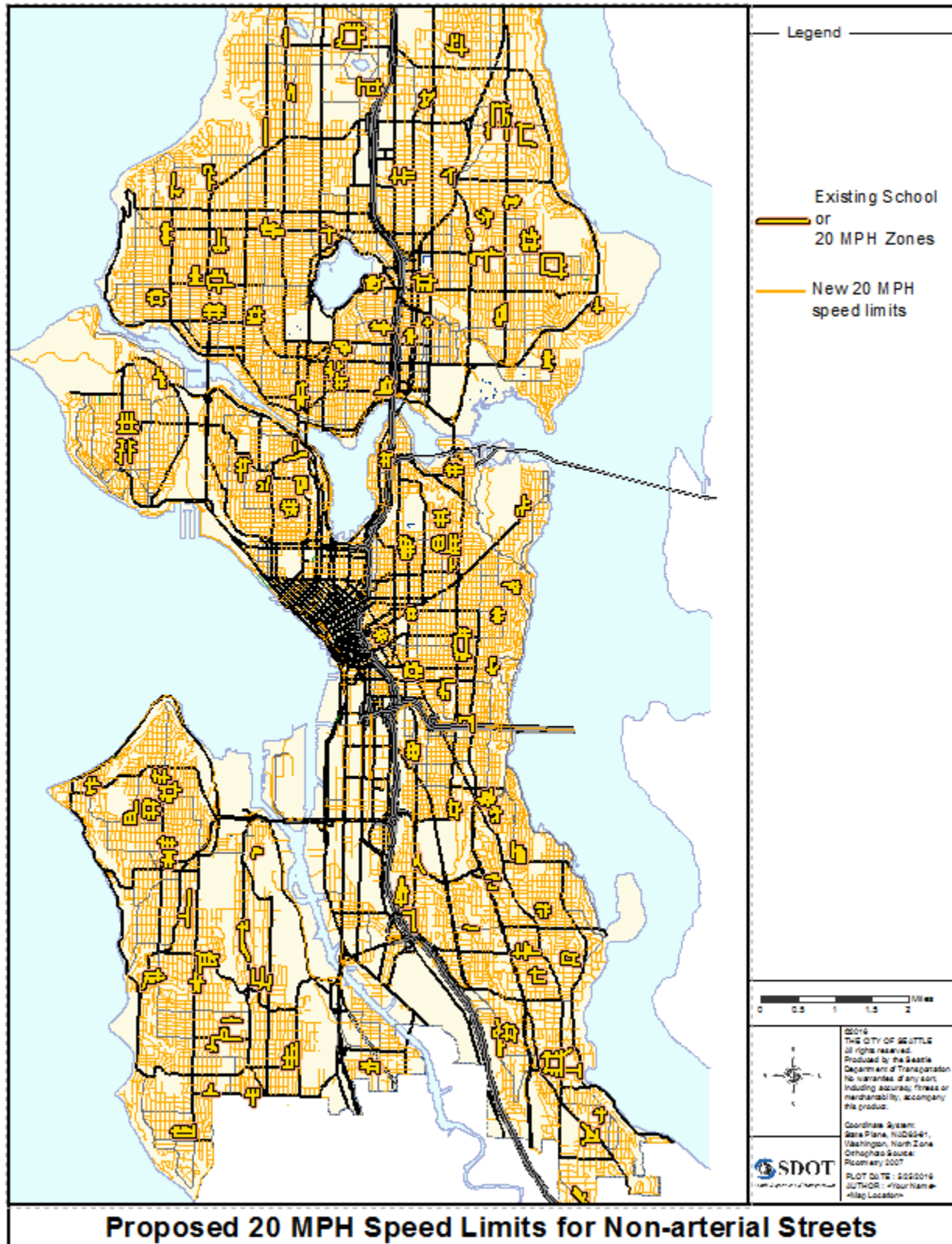
¹³ Effect of 20 mph traffic speed zones on road injuries in London, 1986-2006: controlled interrupted time series analysis (BMJ 2009;339:b4469)

¹⁴ <http://www.nyc.gov/html/dot/downloads/pdf/2015-02-hudson-heights-slowzone.pdf>

Map 1 – Existing non-arterial speed limits



Map 2 – Proposed Speed Limits for Non-arterial Streets



Default Arterial Speed Limit Reduction Justification

Existing *default* arterial speed limit: 30 mph

Proposed *default* arterial speed limit: 25 mph

SDOT proposes to amend SMC 11.52.080 to reduce the *default* arterial speed limit from 30 mph to 25 mph. Reducing the default arterial speed limit will make Seattle's speed limit consistent with the Washington state speed limit of 25 mph for city streets¹⁵. Of the 39 cities within King County, Seattle is the only city with a default speed limit higher than 25 mph. Other major cities that have a *default* arterial speed limit of 25 mph or lower include: London, Paris, Tokyo, New York City, Phoenix and Portland, Oregon. The city of Boston reduced their default speed limit to 20 mph.

The default speed limit is in effect on streets where the speed limit is not posted or where signs are missing or illegible. Streets where the *default* arterial speed limit is currently in effect include areas of the Central Business District, South Lake Union, Lower Queen Anne, the International District and portions of Capitol Hill and First Hill west of 23rd Avenue.

Current operating speeds for vehicular traffic in study area (85th percentile): 22 to 25 mph

Changing the default arterial speed limit to 25 mph would be compliant with Federal Highway Safety Administration¹⁶ guidance for setting speed limits.

Engineering improvements have been implemented to support existing vehicle speeds. In 2015 and 2016, SDOT retimed and coordinated more than 300 signals in the areas where the default speed limit is currently in effect. Vehicular traffic speeds were determined for arterial streets. Current operating speeds range from 22 to 25 mph – below the default speed limit of 30 mph. A 25 mph design speed was used for SDOT's signal timing and coordination project. This signal design has been in operation since January 2016. SDOT is prepared to install or replace nearly 500 signs to highlight the new speed limits upon passage of legislation. More information about signage changes can be found later in this report.

The proposed reduction to the default speed limit would become effective immediately upon acceptance of this proposal in central Seattle. The default speed limit reduction is intended to address an increase in crash severity in this area.

More than 9000 collisions occur on Seattle's arterial streets annually. These roadways are typically wide (40 feet wide or greater) and designed to accommodate transit, freight and higher traffic volumes. The majority of arterial streets have posted speed limits of 30 mph or higher. Given higher vehicular speeds and traffic volumes for all modes on these roadways, there is greater opportunity for conflicts.

¹⁵ RCW 46.61.400 "Basic rule and maximum limits"

¹⁶ "Methods and Practices for Setting Speed Limits: An Informational Report", FHWA, 2012

Average Annual Collisions on Arterial Streets (3 year average)			
Total Collisions	Injuries	Serious Injuries	Fatalities
9810	3111	144	17

90 percent of serious injuries and fatal collisions occur on our arterial street network and speed has become an increasingly significant contributing factor in central Seattle. Although a small land area, this area has concentrated a collision frequency 6 times of land area percent. Speed has been involved in a greater proportion of fatal collisions over the last decade. In general, speed contributed to 4 percent of annual collisions in downtown but 42 percent of fatal crashes in downtown Seattle from 2011-2013. Collision data show that the majority of the serious, speed-related collisions occur during the evening after the heavy traffic volumes subside. Lower volumes make attaining higher speeds possible.

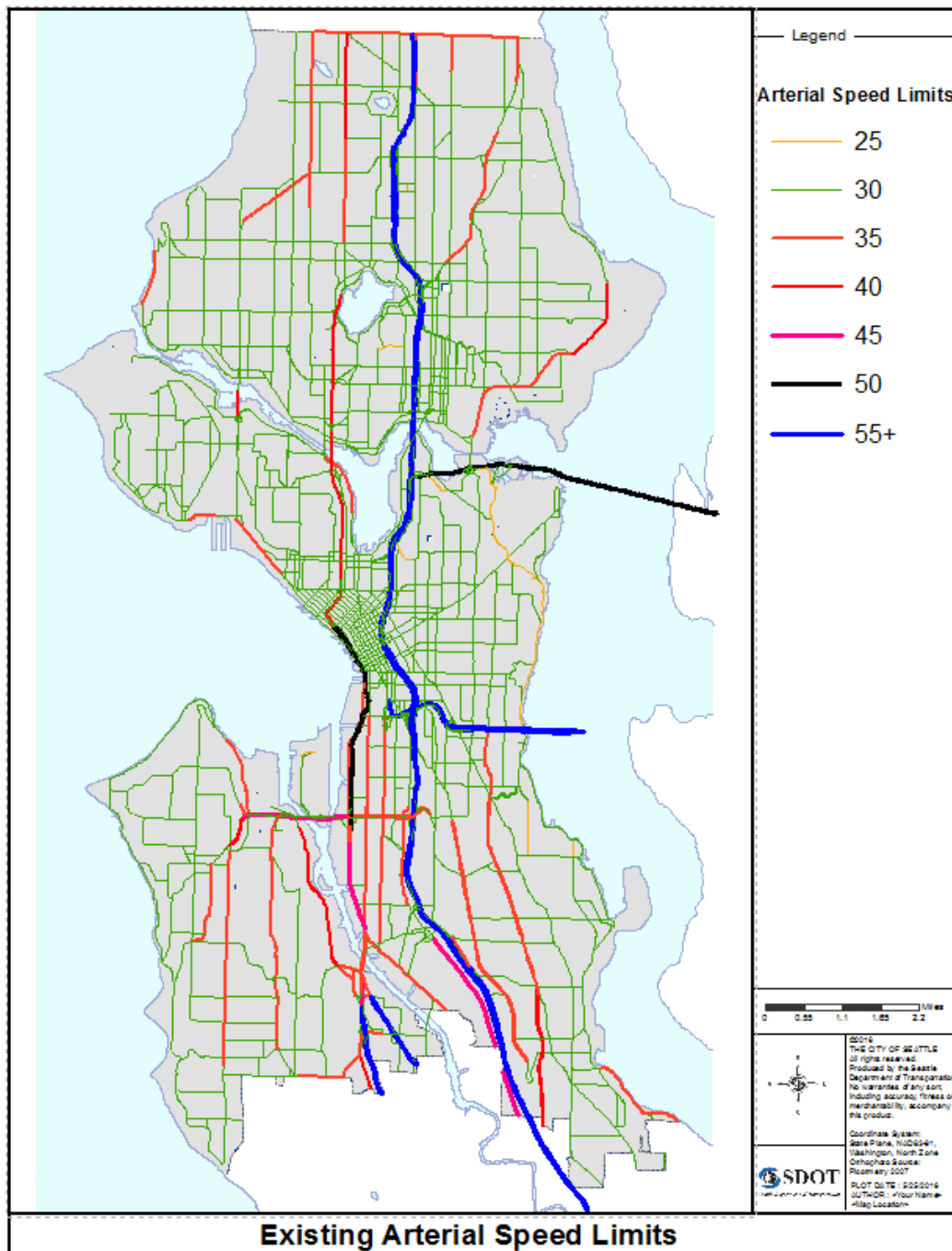
Please note that the data below relies on a relatively small sample size due to the fact that few traffic fatalities occur in Seattle. Because of its sample size, this data is only one of the factors supporting the City's decision.

Collisions and severity: Central Seattle and citywide

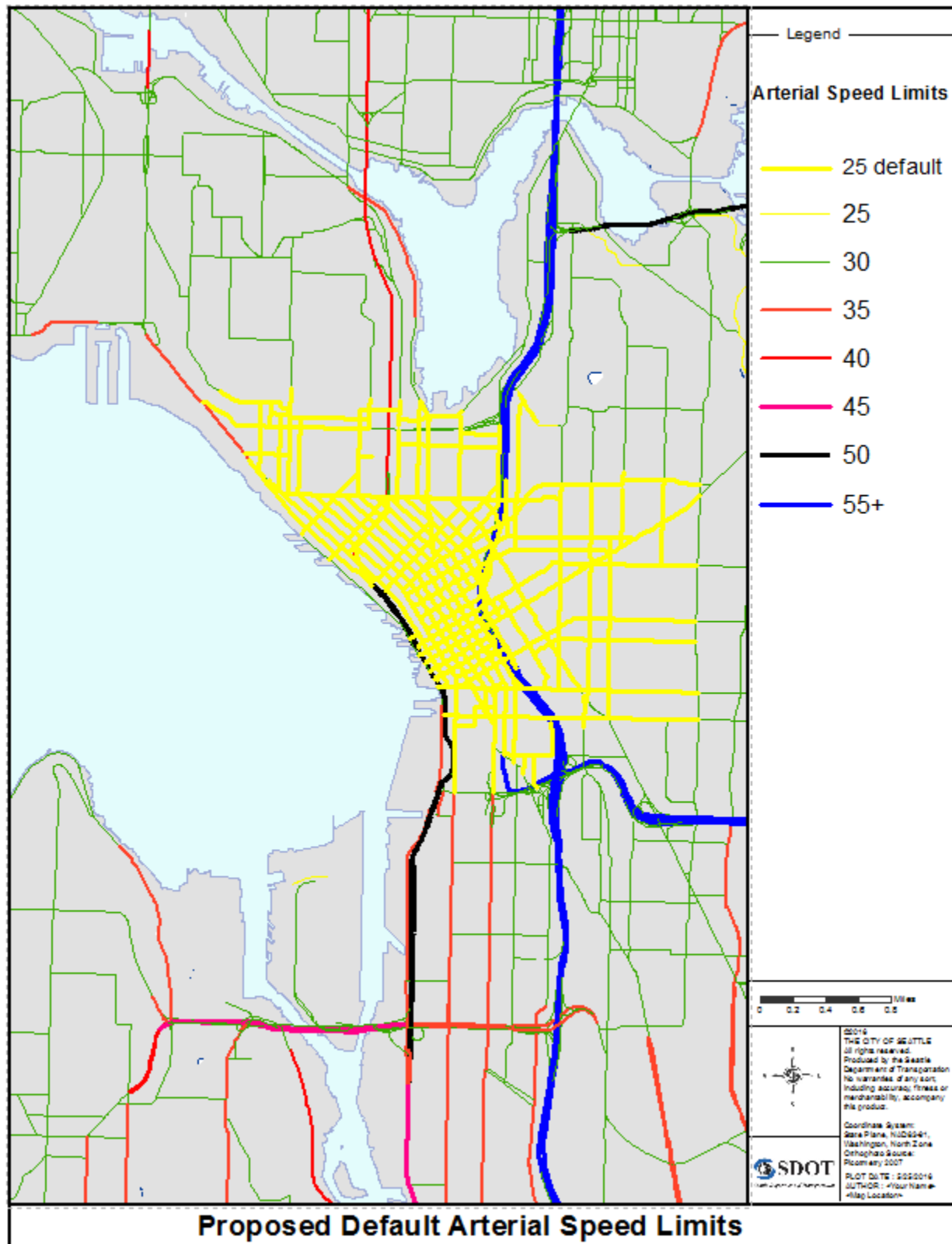
Time	Indicator	Downtown	City	% Downtown/City
	Area	2.13	83.54	2.55%
2004-2013	All collisions	21741	140086	15.52%
	Annual Average	2174.10	14008.60	
	Speeding	783	7114	11.01%
	% Speeding	3.60%	5.08%	70.92%
	Serious + Fatal	310	2228	13.91%
	Annual Average	31.00	222.80	
	% of all collisions	1.43%	1.59%	89.65%
	Speeding	29	327	8.87%
	% Speeding	9.35%	14.68%	63.74%
	Serious collisions	283	2009	14.09%
	% of all collisions	1.30%	1.43%	90.77%
	Speeding	23	262	8.78%
	% Speeding	8.13%	13.04%	62.32%
	Fatal collisions	27	219	12.33%
	% of all collisions	0.12%	0.16%	79.44%
	Speeding	6	65	9.23%
	% Speeding	22.22%	29.68%	74.87%
2011-2013	All collisions	5787	38227	15.14%
	Annual Average	1929.00	12742.33	
	Speeding	193	1501	12.86%
	% Speeding	3.34%	3.93%	84.94%
	Serious + Fatal	85	524	16.22%
	Annual Average	28.33	174.67	
	% of all collisions	1.47%	1.37%	107.15%
	Speeding	10	63	15.87%
	% Speeding	11.76%	12.02%	97.85%
	Serious collisions	78	472	16.53%
	% of all collisions	1.35%	1.23%	109.16%
	Speeding	7	48	14.58%
	% Speeding	8.97%	10.17%	88.25%
	Fatal collisions	7	52	13.46%
	% of all collisions	0.12%	0.14%	88.92%
	Speeding	3	15	20.00%
	% Speeding	42.86%	28.85%	148.57%

Changing the *default* arterial speed limit will impact the Central Business District, South Lake Union, Lower Queen Anne, the International District and portions of Capitol Hill and First Hill west of 23rd Avenue. See the maps below to view existing arterial speed limits and the specific areas where the default speed limit will take effect with this proposed change to the Seattle Municipal Code.

Map 3 – Existing Arterial Speed Limits

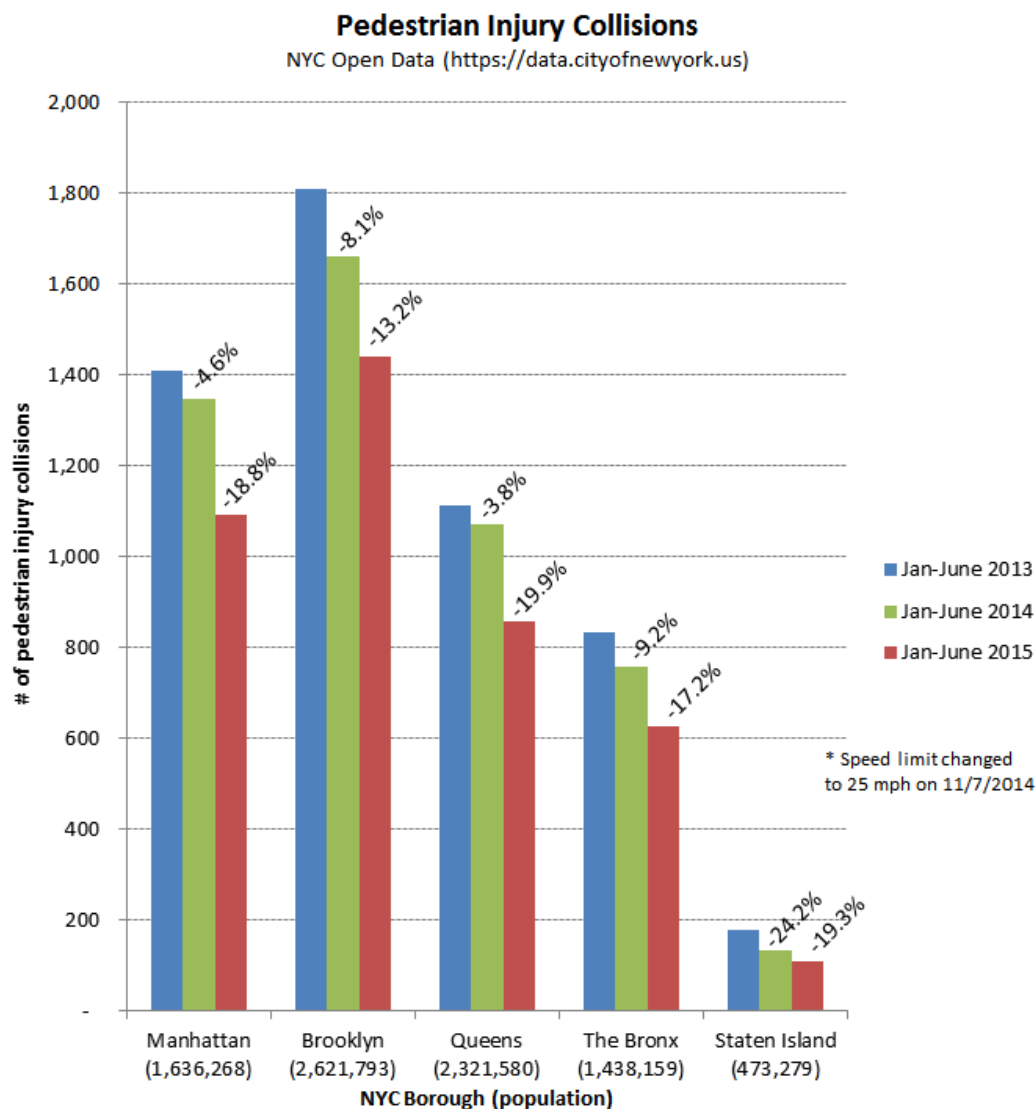


Map 4 – Proposed *Default* Arterial Speed Limit Changes



Case Study - New York City

Since 1965, New York City has had a speed limit of 30 mph¹⁷. On November 7, 2014, New York lowered their *default* speed limit from 30 mph to 25 mph in an effort to reduce serious injuries and fatalities¹⁸. The *default* arterial speed limit is in effect on 90 percent of arterial streets. The remaining 10 percent of arterials continue to have higher posted speed limits while the New York City Department of Transportation (NYCDOT) reviewed select arterials for speed limit reductions. While New York's speed limit changes have been in place for less than two years, collision data show that this change has contributed to promising safety trends. Most importantly, the total number of pedestrian injury collisions substantially dropped for four of the five boroughs following the speed limit reduction.



¹⁷ <http://nymag.com/daily/intelligencer/2014/11/things-to-know-about-nycs-new-speed-limit.html>

¹⁸ <http://www1.nyc.gov/office-of-the-mayor/news/494-14/transcript-mayor-de-blasio-signs-new-law-lowering-new-york-city-s-default-speed-limit-25-mph>

Arterial Speed Limits

This proposal does not suggest altering the process for adjusting speed limits on arterial streets where the speed limit signs are posted. Posted speed limits adjustments typically occur after geometric design changes are implemented and only after engineering studies validate adjustment in accordance with national guidelines for setting speed limits¹⁹. Adjustments to the posted speed limit require approval from the City Traffic Engineer.

The Seattle Department of Transportation currently maintains a multi-year program to review posted speed limits on arterial streets. Review of posted speed limit will occur as budget and other demands on the department will allow. Changes to posted speed limits will be recommended if the City's review, including engineering studies, support such changes.

Conclusion

The Seattle Department of Transportation and the City Traffic Engineer propose to amend the Seattle Municipal Code to reduce the speed limit on non-arterial streets from 25 mph to 20 mph. SDOT and the City Traffic Engineer also propose to reduce the default arterial speed limit from 30 mph to 25 mph given that:

- Existing vehicular speeds in the areas impacted by this change are within accepted guidance set by the FHWA for setting speed limits
- There has been an increase in speed-related fatal collisions in central Seattle
- Higher vehicular speeds increase collision severity
- Engineering improvements have been made in the areas impacted by this change to support the 25 mph speed limit
- Additional signage improvements will be installed to inform drivers of the speed limits
- Additional arterial speed limit adjustments will be considered through SDOT's annual programs and adjustments will be made in accordance with national guidelines for setting speed limits

Implementation methodology

Seattle's speed limits have not substantially changed in decades. SDOT will coordinate a multifaceted approach to help educate residents and visitors about lower the speed limits. Effectively lowering the speed limits will be accomplished through the following:

- **Education** – Installing new signs throughout the city to remind residents and visitors of the new default arterial speed limits
- **Engineering** –Signal adjustments will reinforce the new default arterial speed limits
- **Enforcement** – SDOT and the Seattle Police Department (SPD) coordinate on a monthly basis to deploy SPD to areas where we need to target driver behavior that puts those around them at risk

¹⁹ "Methods and Practices for Setting Speed Limits: An Informational Report", FHWA, 2012

- **Evaluation** – Seattle evaluates the health of their transportation system on an annual basis through the public facing Annual Traffic Report. We will continue to evaluate the effectiveness of our policies and approaches through this report

Engineering

Seattle’s arterial street network outside of the downtown core is lined with speed limit signs at regular intervals. Seattle currently posts speed limit signage at major and minor arterial entrances to the city. Variability in speed limit sign placement is due to site conditions along each roadway.

In order to educate people about the new speed limits, SDOT will install 75 to 100 new signs. “Gateway signs” will be placed at 40 locations citywide and provide the *default* arterial speed limit as well as the non-arterial speed limit. These new signs will be posted where people enter Seattle including near the city limits and near highway off-ramps where visitors may be visiting from outside of Seattle:



Existing gateway signs located near city limits

SEATTLE	
SPEED LIMITS	
ARTERIAL	25
NON-ARTERIAL	20
UNLESS OTHERWISE POSTED	

New gateway signs

Smaller signs with speed limits will be posted on minor arterial entries to Seattle. There are currently 38 existing signs posted citywide that SDOT will remove and replace.



Existing signs located near city limits on minor arterials



New signs

SDOT will continue to ensure that speed limit signs are posted regularly on arterials outside of downtown through annual maintenance programs.

Through the Seattle Department of Transportation's (SDOT) Neighborhood Traffic Program, more than 400 advisory 20 mph speed limit signs have been installed on non-arterial streets. With the lower non-arterial speed limit, the advisory speed limit signs will be removed to remain in compliance with the Manual on Uniform Traffic Control Devices (MUTCD).

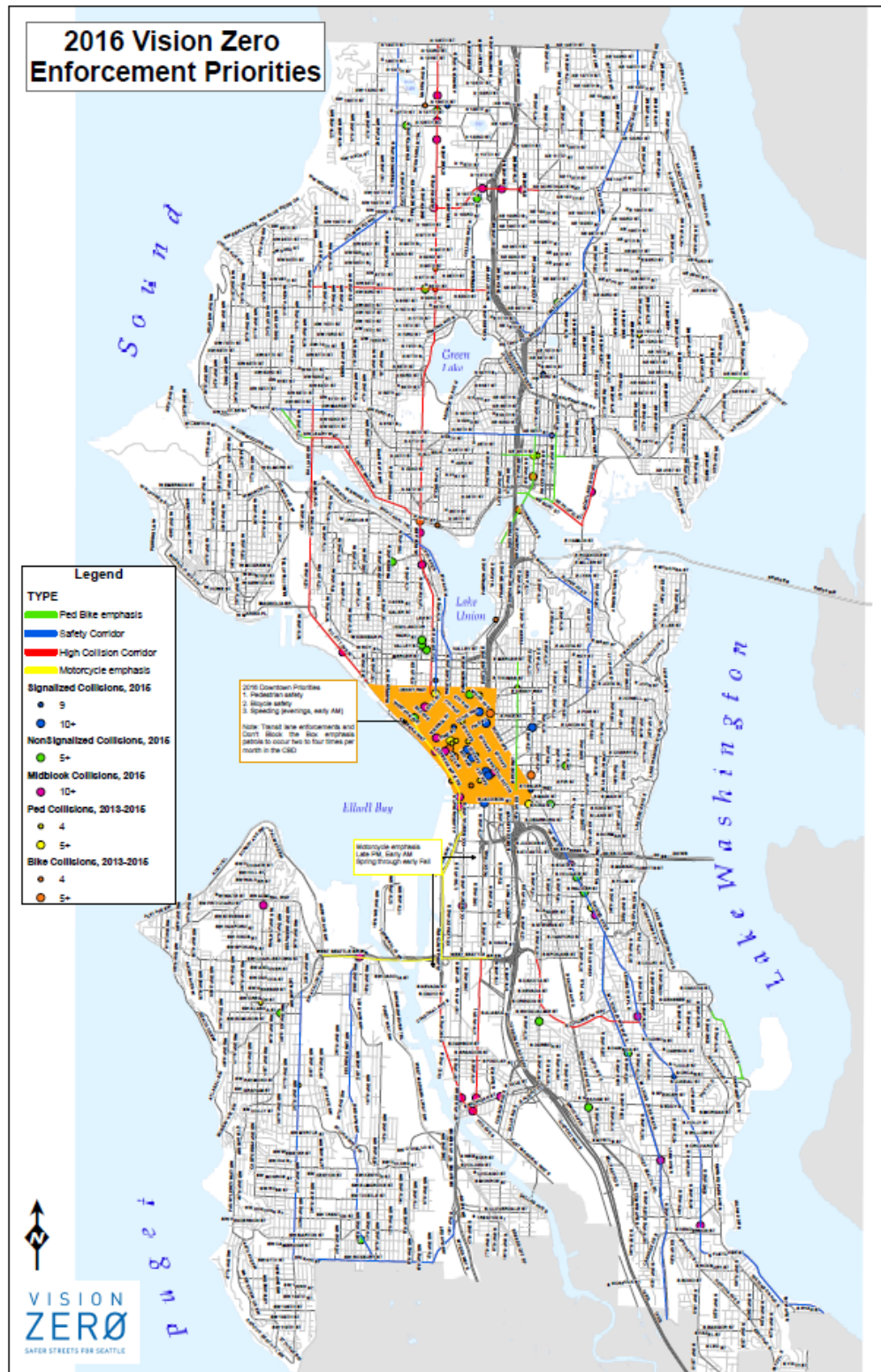


Existing 20 mph advisory speed limit signs will be removed

Enforcement

The Seattle Police Department (SPD) is committed to the city's Vision Zero goal. SDOT and SPD meet regularly to discuss trends and enforcement priorities. Speeding is a top citation issued by SPD annually and Seattle will continue to use enforcement to reinforce the posted speed limit.

Enforcement priorities are determined by speed and collision data. SDOT and SPD work to ensure that enforcements occur throughout the city but target the areas where speeding has contributed to collisions more often. Common locations for speed limit enforcements include arterial corridors, locations identified through SDOT's High Collision Evaluation Program and school zones. Priority enforcement locations for 2016 are shown in the map below:



Education

In addition to the new signage noted above, the city will conduct a comprehensive public outreach campaign to educate drivers about the speed limit changes. Outreach methods will include earned media, newspaper and radio ads, social media messages and online resources.

Implications

Lowering speed limits may foster a public perception of decreased mobility for increased safety on our arterial street network. However, the actual impact to vehicular travel times are minimal considering the safety benefits of lower speeds. The average trip by car is 3.5 miles. Reducing the speed limit from 30 mph to 25 mph would add 1.4 minutes to the average trip.

Speed (mph)	Time to Travel One Mile (mins)
25	2.4
30	2.0
35	1.71
40	1.5

There will be a transition period as more drivers within Seattle become accustomed to the lower speed limit; however, education campaign and targeted police enforcement to help change the driver behavior and reinforce the speed limits.

Safer neighborhoods results in benefits to the quality of life for everyone. Road safety improves the transportation system, which impacts people's reach for opportunities in jobs, education, and a better life. For businesses and communities, reducing speeds may reduce road noise which can promote public health and growth for economic centers. Seattle has also established the Housing Affordability and Livability Agenda (HALA) initiative to keep Seattle affordable and not displace families.