Council Meeting Date: January 4, 2021 **Agenda Item:** 8(b)

CITY COUNCIL AGENDA ITEM

CITY OF SHORELINE, WASHINGTON

AGENDA TITLE:	Discussion of the Arterial Speed Limit Study
DEPARTMENT:	Public Works
PRESENTED BY:	Kendra Dedinsky, City Traffic Engineer
ACTION:	____ Ordinance ____ Resolution ____ Motion __X_ Discussion ____ Public Hearing

PROBLEM/ISSUE STATEMENT:

Fatal and serious injury collisions are on the rise in Shoreline. A significant proportion (39%) of these fatal and serious injury collisions involved pedestrians for collisions that occurred between 2017 and 2019. The most significant factor in pedestrian collision outcomes is driver speed. Target Zero, Washington State's plan to achieve zero fatal and serious injury collisions, identifies context sensitive speed limit setting as a recommended strategy for reducing fatal and serious injury collisions.

Industry standards have historically used vehicle operating speeds as the primary factor in speed limit setting, largely ignoring the experience of the road's most vulnerable users. Recent shifts in research and practices urge local governments to utilize new speed limit setting methods that consider pedestrians, bicyclists, collision history and land use as significant and relevant factors.

Based on this research and shift in practices, six key arterial corridors have been analyzed for possible speed limit changes by the City's traffic engineering consultant, DKS. DKS used the most recent research for this analysis - National Cooperative Highway Research Program (NCHRP) 17-76: *Guidance for the Setting of Speed Limits.* This analysis resulted in a recommendation for speed limit reduction of five (5) miles per hour (MPH), from 35 MPH to 30 MPH, for five of the six corridors detailed in Attachment A. Tonight, staff is looking for direction from Council regarding DKS' recommendation and whether Council is interested in bringing an Ordinance back to Council for consideration that would reduce speed limits as presented in Attachment A.

RESOURCE/FINANCIAL IMPACT:

There are no direct financial or resource impacts as a result of this proposed change. This item is discussion only. If an ordinance to reduce speeds is approved, staff anticipates the work to change signs can be accommodated within the existing Traffic Safety budget.

RECOMMENDATION

No action is required; this item is for discussion purposes only. Staff is looking for direction from Council on bringing an Ordinance back for Council consideration to reduce speed limits as presented in this report.

Approved By: City Manager ***DT*** City Attorney ***MK***

BACKGROUND

The City of Shoreline strives to reduce serious and fatal injury collisions, consistent with the State's Target Zero Plan. A significant portion of the City's fatal and serious injury collisions are pedestrian collisions. Pedestrian collisions accounting for 39% of the fatal and serious injury collisions in the 2017-2019 collision data. In addition, the vast majority of pedestrian collisions occur on arterial streets (96% for 2015-2019 data) which make up only 27% of the City's street network centerline miles. Focusing on arterial streets for reducing pedestrian collisions represents a great opportunity for targeted and efficient safety strategies.

One of the most important factors in pedestrian injury outcomes is vehicle speed. The State's Target Zero Plan highlights the recommended practice of setting speed limits appropriate for the roadway context, including consideration of pedestrians, bicyclists, adjacent land use, and collision history. As such, the 2018 Annual Traffic Report recommended a speed limit study which was supported by Council during their June 24, 2019 Council discussion. The staff report for the 2018 Annual Traffic Report is available at the following link: June 24, 2019 staff report on Discussion of the 2018 Annual Traffic Report.

Throughout 2020, staff worked on this study with traffic engineering consultant DKS, a leader and expert in these evolving speed limit setting practices. The study relied on research and the tool developed under the National Cooperative Highway Research Program (NCHRP) Project 17-76 to evaluate the following six corridors:

- N 175th Street, from Aurora Avenue N to 15th Avenue NE
- 15th Avenue NE, from NE 145th Street to NE 175th Street
- Greenwood Avenue N, from N 145th Street to N 160th Street
- Meridian Avenue N, from N 145th Street to NE 205th Street
- NW Richmond Beach Road, from Fremont Avenue N to 3rd Avenue NW
- 15th Avenue NE, from NE 180th Street to NE 196th Street

These corridors were selected for study based on multiple factors including existing speed limit, collision history, or recent changes to roadway cross section or adjacent land use as discussed in Attachment A, Appendix A. The last speed limit study the City conducted was completed in 2007, and is available at the following link: September 17, 2007 staff report on Speed Limit Findings.

State law (RCW 46.61.415) establishes the authority for local authorities to change speed limits based on study. Current speed limits are established in Shoreline Municipal Code Section 10.20.

DISCUSSION

In transportation engineering, vehicle speed relates to two main performance measures: mobility and safety. Mobility in this context is primarily linked to travel time, which can increase with lower speeds. Conversely, increased safety is strongly tied to lower speeds. The determination of an appropriate speed limit is an exercise in prioritizing

safety while balancing motorists' behavior and the mobility needs of all users. Two main ways lower speeds influence the prevention and severity of collisions are by increasing reaction time and a driver's cone of vision and by reducing the force of impact in a collision, which significantly reduces injury severity. For example, as illustrated in Figure 1 below, most pedestrians can survive a collision with a vehicle traveling at 20 MPH, but most are killed if the vehicle is traveling at 40 MPH.

Figure 1. Pedestrian collision outcomes based on driver speed

Historically, speed setting practices have relied heavily on 85th percentile speeds, which is the speed at which 85% of traffic is traveling at or below. This car-centric practice was based on the idea that most drivers will generally travel at the speed comfortable for them, not necessarily at the posted speed limit, and as a result, this "comfortable" driving speed is what should largely guide speed limit setting. The main goal in this context was to minimize speed differential between vehicles, as significant variations in vehicle speeds has been linked to increases in collisions. This principle has some relevant application to multilane highway and freeway settings in rural areas. However, it should not be the primary consideration in a city street environment, and the research was not intended for urban applications.

In more urban city street settings, where stopping and slowing is commonplace, and where in many cases the prudent driver sets the travel speed on what are often one lane or two lane per direction roadways, the context is much different and deserving of a new approach. Additionally, while older speed limit setting methods have considered some other factors like roadway geometry, number of access points and collision history, they have generally excluded the pedestrian and bicyclists experience, which is integral to a thriving urban environment and should be a top consideration.

With Federal efforts supporting a zero-fatality goal and with the State Target Zero goal of reducing serious and fatal collisions, policy makers and local agencies have been taking a fresh look at injury minimization through more appropriate speed limit setting. Newer guidelines, as outlined and discussed in Attachment A, better address the urban

context. For example, the National Association of City Transportation Officials (NACTO) has developed new policies around speed limit setting, shifting the focus away from 85th percentile speeds by considering two main factors: conflict density and activity level. The Washington State Department of Transportation (WSDOT) has also recently created a draft Injury Minimization and Speed Management Policy, encouraging all owners of public roads in Washington State to use the recommended policy that urges establishment of injury minimization target speeds sensitive to the types of roadway users. Notably the policy recommends posting the speed rounded down to the nearest 5 MPH increment and recognizes that this may result in posting the target speed even more than 5 MPH below the operating speed.

With the recent development of the NCHRP 17-76 Speed Limit Setting Tool, the goals around injury minimization and context sensitivity come together in a useful format for transportation professionals. This tool considers the following inputs for the speed limit recommendation:

- 85th percentile speed
- 50th percentile speed
- Segment length
- Number of lanes
- Median presence
- Number of traffic signals
- Number of access points
- Bicyclist activity/bike lane type
- Sidewalk presence/width
- Sidewalk buffer presence
- Pedestrian activity
- On-street parking activity
- Parallel parking permitted
- Adverse alignment
- Average daily traffic
- Collision history
- Serious and fatal collision history

Based on these inputs, speed limit changes are recommended on five of the six study corridors as shown in Table 1 below. A detailed overview of assumptions for each corridor is provided in Attachment A. All corridors currently have a posted speed of 35 MPH.

Table 1. Speed Limit Setting Tool Analysis Results

Corridor	Length (mi)	Roadway Context	AWDT* (veh/day)	Number of Crashes (2010-2019)	Suggested Posted Speed (MPH) **
N 175th St, from Aurora Ave N to 15th Ave NE (Principal Arterial)	1.5	Urban	19,988 (2018)	477	30
15th Ave NE, from NE 145th St to NE 175th St (Principal Arterial)	1.5	Urban	18,306 (2019)	288	30
Greenwood Ave N, from N 145th St to N 160th St	0.8	Suburban	8,552 (2018)	36	30
Meridian Ave N, from N 145th St to NE 205th St	3.0	Urban	5,050 (2019)	361	30
NW Richmond Beach Rd, from Fremont Ave N to 3rd Ave NW	0.5	Suburban	16,706 (2019)	130	30
15th Ave NE, from NE 180th St to NE 196th St	0.8	Urban	13,740	102	35 (no change)

** AWDT: Average Weekday Traffic*
*** All segments have a current posted speed limit of 35 MPH*

In terms of the impact to vehicle travel time, the longest segment in this study is Meridian Avenue N from N 145th Street to N 205th Street. For the three-mile trip from N 145th Street to N 205th Street, the increased delay due to a five (5) MPH speed limit reduction would be just over 50 seconds; however, delay on city streets primarily occurs at intersections.

Next Steps

If Council is supportive of further considering these proposed speed limit changes, staff will draft a proposed Ordinance based on the recommended speed limit changes for Council consideration in the first quarter of 2021. If approved, staff will work on public information materials to disseminate before and after the speed limit sign changes. Staff would also collect before and after speed data to present in the 2022 Annual Traffic Report. While increased Police enforcement measures would not be anticipated at this time, the City would rotate available speed feedback carts on these corridors for the first year of implementation. For additional context, the City of Seattle has had success in reducing speed limits without increasing enforcement, as described in their report online at: Speed Limit Case Studies Report.

RESOURCE/FINANCIAL IMPACT

There are no direct financial or resource impacts as a result of this proposed change. This item is discussion only. If an ordinance to reduce speeds is approved, staff

anticipates the work to change signs can be accommodated within the existing Traffic Safety budget.

RECOMMENDATION

No action is required; this item is for discussion purposes only. Staff is looking for direction from Council on bringing an Ordinance back for Council consideration to reduce speed limits as presented in this report.

ATTACHMENTS

Attachment A – Arterial Speed Limit Study

CITY OF SHORELINE: ARTERIAL SPEED LIMIT POLICY

DATE: December 16, 2020

TO: Kendra Dedinsky - City of Shoreline

FROM: Brian Chandler, Veronica Sullivan, and Wintana Miller - DKS Associates

SUBJECT: Suggested Posted Speed Limits for Key Arterials with Appendices Project #19165-000-100

DKS was tasked with assisting the City of Shoreline as they refine their speed limit policy on six arterial segments. The approach, corridor profiles and assumptions used for the corridor selection process can be found in the previous Speed Limit Key Corridors memo (see Appendix A). The objective of this memo is to summarize the results of our speed limit analysis on the six study corridors and provide suggested speed limits based on the most recent research.

TABLE OF CONTENTS

DKS

OVERVIEW OF STUDY CORRIDORS

Based on each study corridor's Average Weekday Traffic (AWDT), functional class, operating speed, collision history,[1] and recent/upcoming changes to cross section and land use, the study team selected the following six corridors to determine suggested posted speed limits:

1. **Greenwood Ave N, from N 145th St to N 160th St.** Selected by the City.
2. **Meridian Ave N, from N 145th St to NE 205th St.** Selected by the City.
3. **NW Richmond Beach Rd, from Fremont Ave N to 3rd Ave NW.** Selected by the City.
4. **15th Ave NE, from NE 180th St to NE 196th St.** Selected by the City.
5. **N 175th St, from Aurora Ave N to 15th Ave NE.** Highest crash rate of all corridors studied. The upcoming capital project could be a good opportunity to readdress the posted speed limit.
6. **15th Ave NE, from NE 145th St to NE 175th St.** High collision frequency and crash rate. Planned rezoning provides an opportunity to reassess the posted speed limit.

Figure 1 illustrates the location of the six study corridors.

[1] Crash data were provided by the City of Shoreline from 2010 to 2019, which included a total of 4,834 crashes.

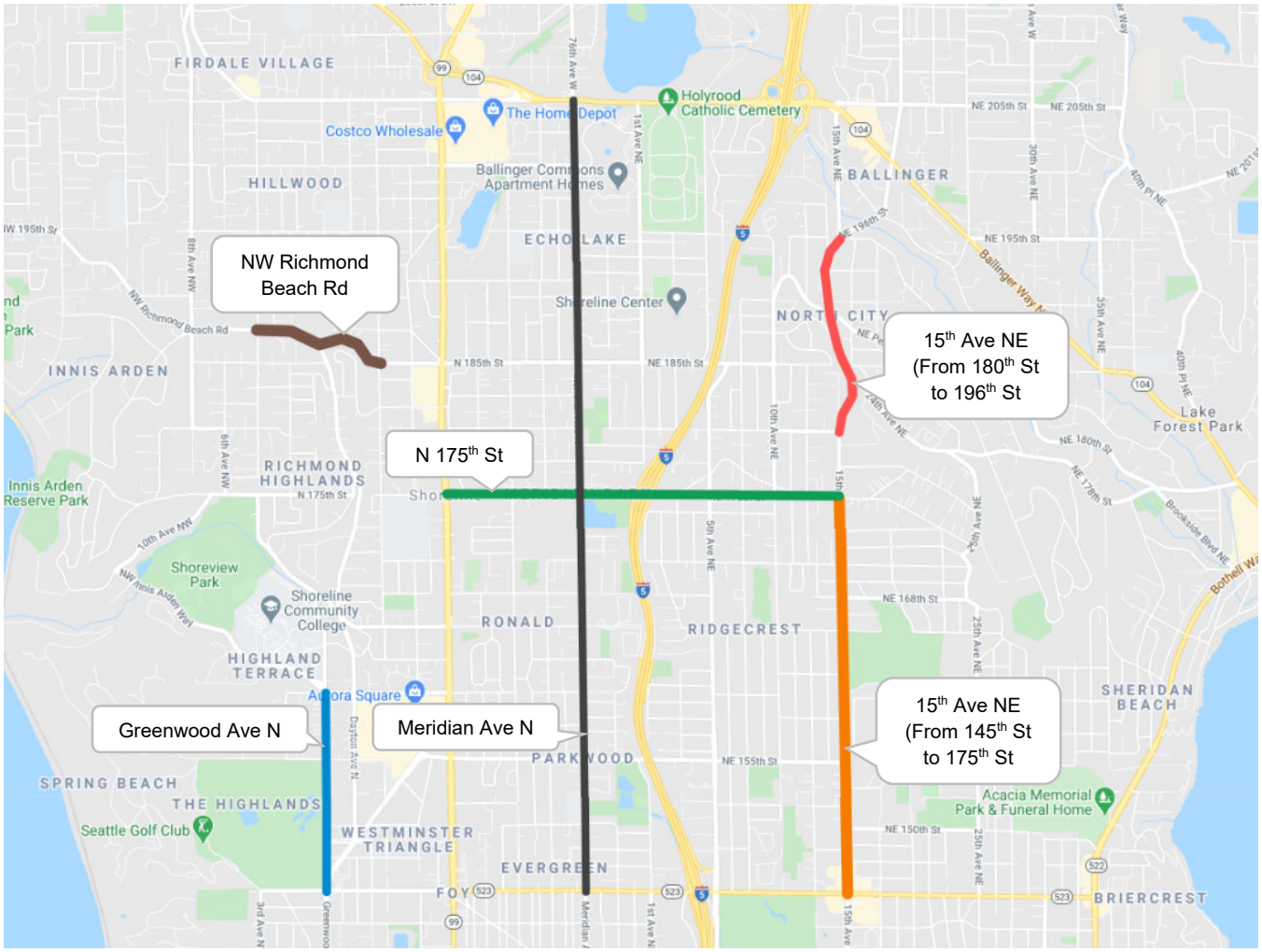


Figure 1. Shoreline Arterial Speed Limit Study Corridors

DKS

Resources Used

In addition to the literature review conducted and documented in the previous Speed Limit Approach Review Memo (see Appendix B), the DKS team found additional recent resources that became available during late-Summer 2020. The following section will outline the resources used to determine the speed limits along the study corridors.

Washington State Injury Minimization and Speed Management Policy Elements and Recommendations (Draft, October 2020, See Appendix D)

A multidisciplinary workgroup of transportation stakeholders has developed a draft set of policy elements and recommendations to reduce the effects of vehicle speed on traffic-related injuries in Washington State. The group focused on modifications to the existing geometric design speed approach and operating speed approach for setting speed limits, with the express purpose of minimizing injuries statewide. The draft document encourages for all road owners in Washington to create, adopt, and implement their own Injury Minimization and Speed Management Policies through applicable changes to their practices and procedures. The document includes the following assertions and additional details:

- The link between speed and injury severity in crashes is consistent, direct, and especially critical for pedestrians, bicyclists, and users of mobility assistive devices.
- In urban areas, using a target speed approach to reduce posted speed limits resulted in a reduction in speed, speed variance, and [improved] road safety for all road users. Targets speeds including the following examples:
    - 20 mph target for residential and business districts.
    - 25 mph or less target for arterials and state highways that are not limited access (or other arterials that act in a similar way) in urban, suburban and rural town centers where origins and destinations are within a walking (1 mile) or biking (3 mile) distance.
    - 30-45 mph on rural roads where there are no median barriers and head-on collisions are possible.

The document includes an "Injury Minimization Speed Setting Approach" as follows (these steps are detailed in the full recommendations):

- Establish target speeds.
- Use default/category target speeds.
- Where the operating speed is within 5mph of the target speed, adopt the target speed
- Where the operating speed exceeds the target speed by 5mph, use an engineering study to determine iterative speed limits and implement speed management.
- Make incremental adjustments of 5mph or more, as motorist response to speed management, until the target speed is achieved.

ITE Presentation: Speed Limit Case Studies (2020)

ITE provided two examples of cities that have reduced operating speeds and crashes by reducing posted speed limits. Figure 2 below illustrated these short-term studies.

- Toronto reduced posted speed limits from 40 kph to 30 kph, and a study showed reductions in pedestrian-vehicle collisions, fatalities, and serious injuries.
- In Seattle, officials reduced posted speed limits from 30 mph to 25 mph. Operating speeds and crashes both reduced after this change.

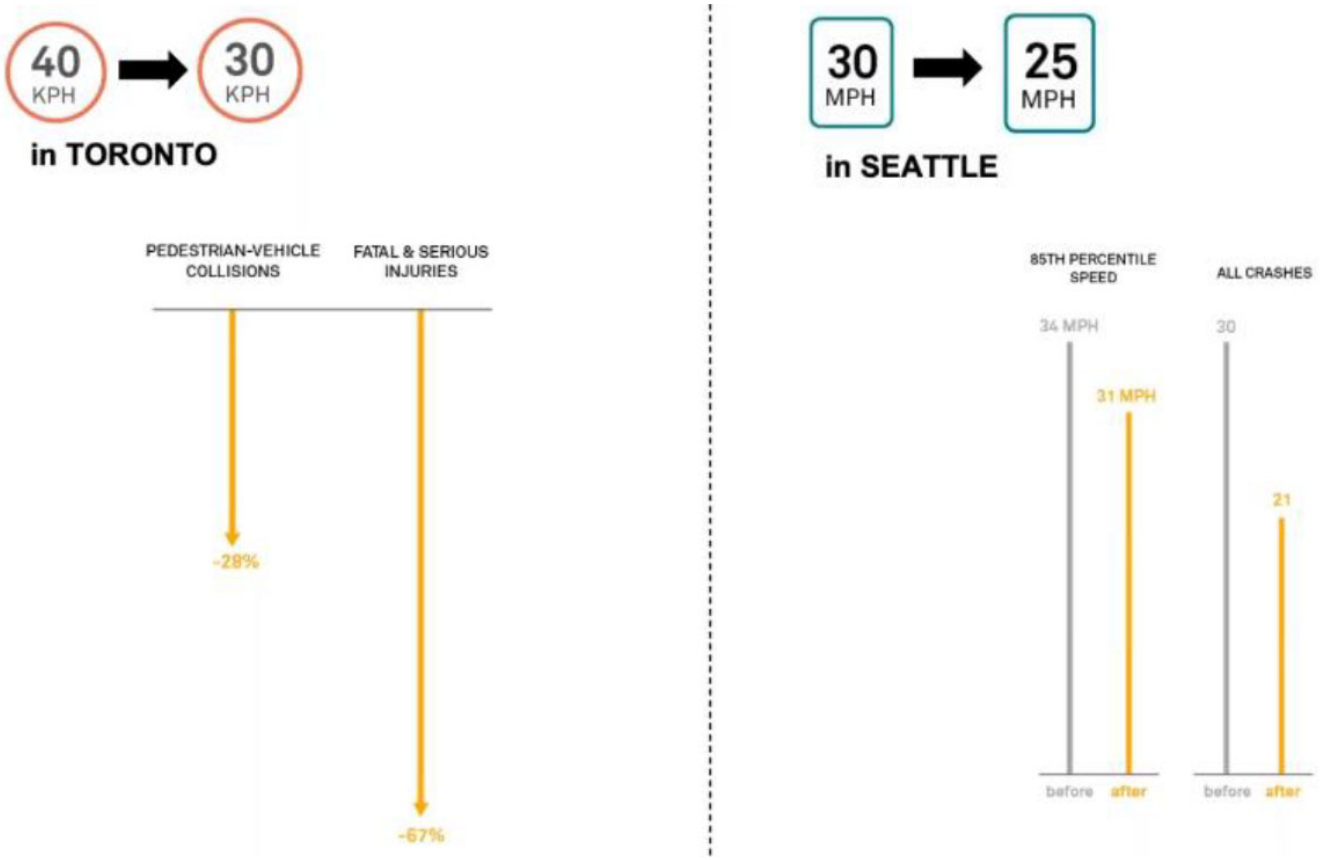


Figure 2. ITE Case Studies, Speed Limit Modifications

NACTO City Limits: Setting Safe Speeds Limits on Urban Streets (2020)

In summer 2020, the National Association of City Transportation Officials (NACTO) published *City Limits* that documents guidance on how to strategically set speed limits on urban streets, using a Safe Systems approach.[2] The Safe Systems approach is a technique that focuses on changing the policies and engineering decisions that create unsafe conditions, rather than focusing on individual behavior. The main goal of the Safe Systems approach is to reduce traffic deaths and severe injuries by considering safety for all road users. This holistic approach involves engineers determining the speed that is safest for all people to use the street and then build infrastructure to support that speed. The *City Limits* document provides three key tools for setting speed limits:

1. Setting **Default Speed Limits** on many streets at once.
    a. For example, in October 2016, the Seattle City Council passed an ordinance to lower the default speed limit from 25 to 20 mph on 1,250 miles of neighborhood streets and the default speed limit from 30 to 25 mph on arterials. When Seattle DOT replaced existing 30mph signs spaced one mile apart with 25mphs signs place ¼ mile apart on Greenwood Ave / Phinney Ave, they saw reductions in 85th and 50th percentile speeds, and reduction of all crashes and injury crashes.
2. Designating **Slow Zones** in sensitive areas.
    a. For example, in 2011, New York City designated neighborhood slow zones in small (1/4 square mile) residential areas with low traffic volumes and minimal through traffic, with 20 mph on-street markings, signs, speed humps and other traffic calming treatments. This program eventually expanded to over two dozen neighborhoods, demonstrating the large demand for safer streets in the city.
3. Setting **Corridor Speed Limits** on high priority major streets using a Safe Speed Study.
    a. When determining a safe speed limit for a major street, there are two key considerations:
        i. Conflict density: How frequently potential conflicts arise on a given street. For urban areas, this is usually a factor of how separated modes are, and what the crossing demand is.
        ii. Activity level: How active a street currently is or is expected to be. Streets with a larger number of potentially serious conflicts and a higher level of activity should have lower speed limits.

Figure 3 illustrates the risk matrix that summarizes a method for determining maximum safe speed limits based on density of conflict points and level of activity on a major street.

[2] https://nacto.org/wp-content/uploads/2020/07/NACTO_CityLimits_Spreads.pdf

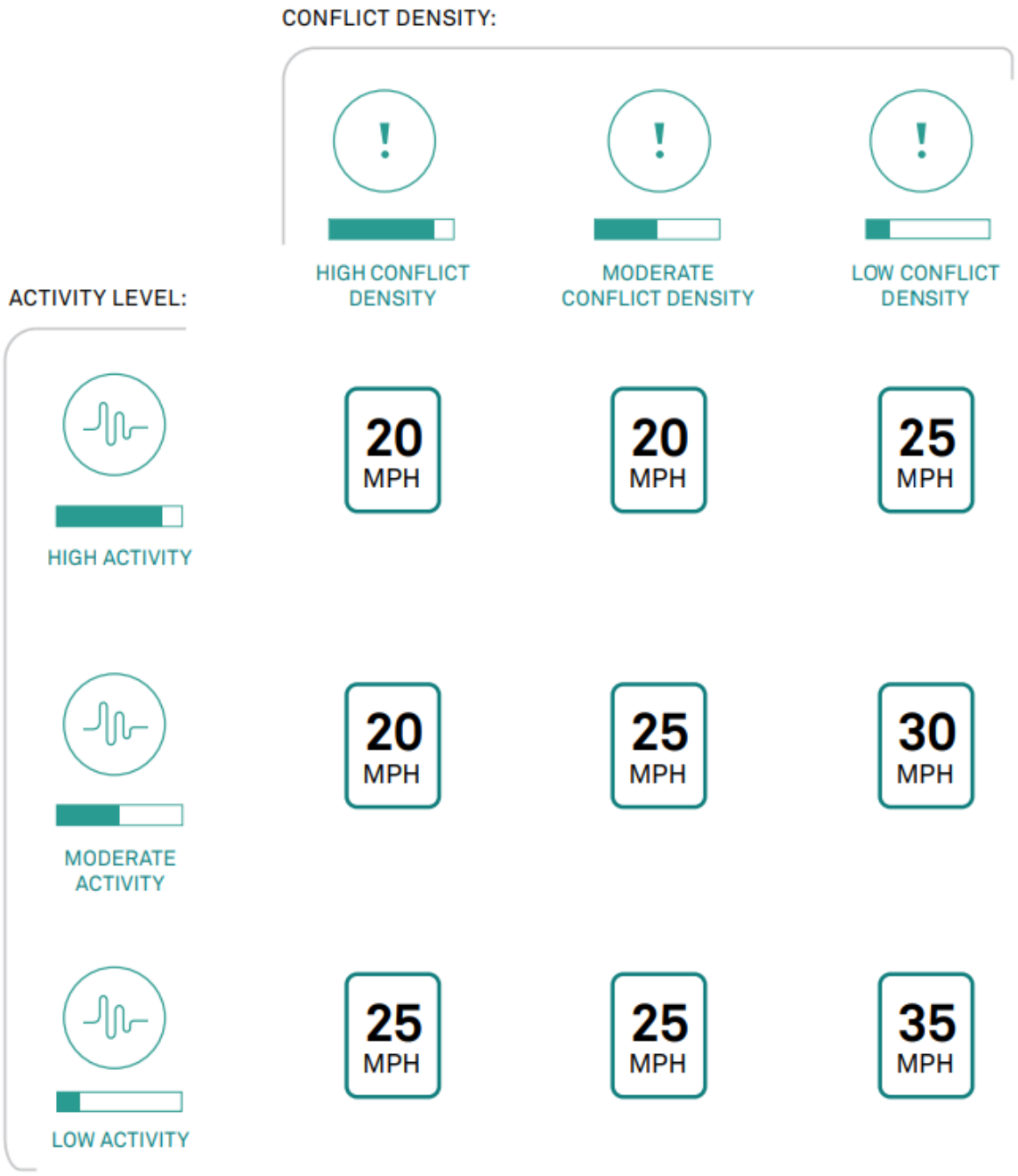


Figure 3. Suggested Corridor Posted Speed Limits Based on Activity and Conflict Densities (NACTO, 2020)

NCHRP Project 17-76: Guidance for the Setting of Speed Limits (Anticipated Winter 2020-21)

Current research promotes identification of a Target Speed for each corridor based on the roadway's context and type, and then applying drivers' operating speeds, roadway characteristics, and collision risk and rate to further refine the most appropriate speed limit for each segment. The National Cooperative Highway Research Program (NCHRP) investigated factors that influence operating speed and safety. Through their research and knowledge, NCHRP was able to develop guidance through a multi-step decision-making procedure with collecting and calculating operating speeds, based on a variety of inputs, as illustrated in Figure 4.

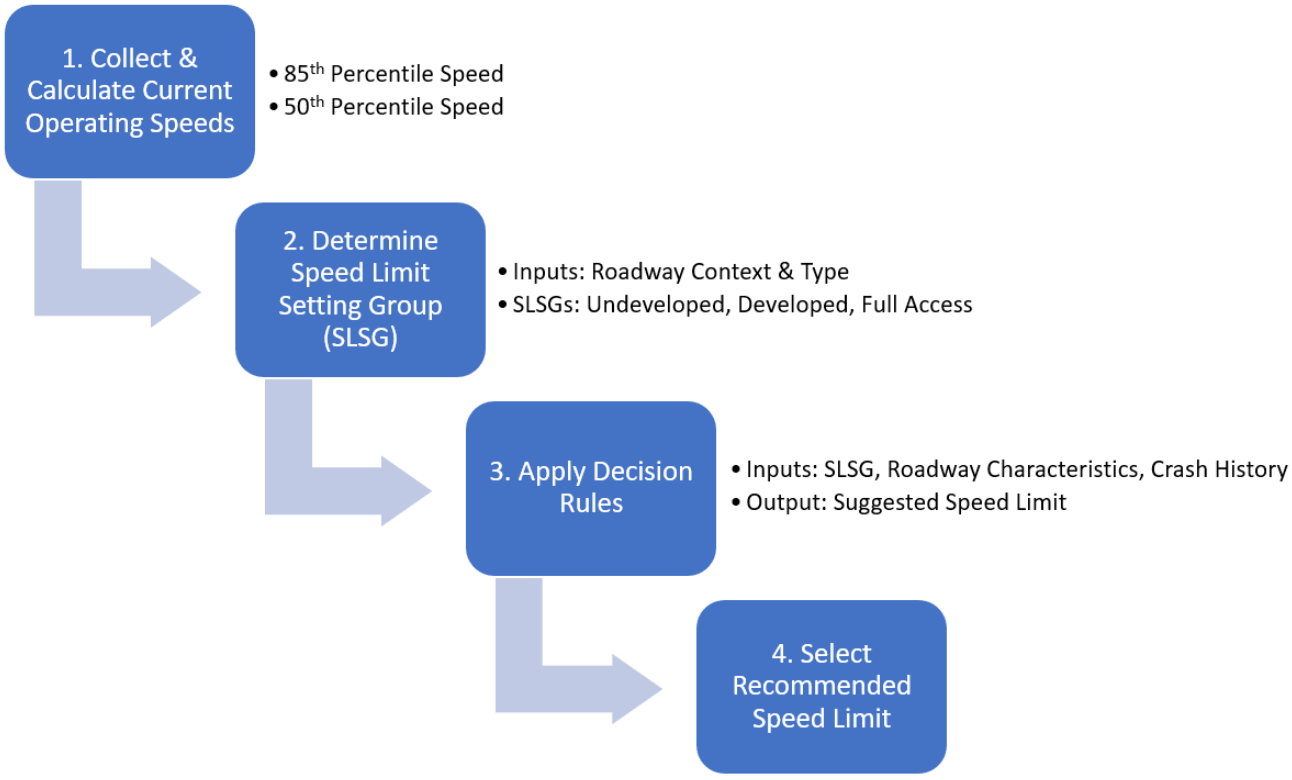


Figure 4. NCHRP 17-76 Decision-making Procedure (Draft)

Based on their research, the NCHRP 17-76 research team developed a draft speed limit setting tool (SLS-Tool) that allows engineers to make informed decisions about setting appropriate speed limits. The DKS team used the draft SLS-Tool to determine suggested posted speed limits for the study corridors. Detailed summary tables are reported in Appendix C. The SLS-tool based the suggested speed limit on the following attributes for developed areas:

- Roadway context
- Roadway type
- 85th-percentile speed
- 50th-percentile speed
- Segment length
- Number of lanes

- Number of traffic signals
- Number of access points (not including single-detached driveways)
- Bicyclist activity /bike lane type
- Sidewalk presence
- Sidewalk buffer presence
- Pedestrian activity
- On-street parking activity
- Parallel parking activity
- Angle-parking activity
- Adverse alignment present
- Crash data
- Average AADT (Due to data availability, recent average weekday daily total was used as a conservative measure of vehicles/day)

The DKS team applied the general concepts and made initial calculations using a draft version of the NCHRP 17-76 project's *User Guide for Posted Speed Limit Setting Procedure and Tool*. The team recommends that the City of Shoreline checks the methodology, calculations, and results with the final published version of this document and tool (expected in Winter 2020-21).

Suggested Posted Speed Limit Results

The DKS team used the draft NCHRP 17-76 SLS-Tool to determine a suggested posted speed limit based on existing operating speeds, site characteristics, and crash data. Table 1 summarizes the results of the tool's outputs. The complete list of inputs for each study corridor can be found in Appendix C.

Table 1: Shoreline Study Corridors Comparison

Corridor	Length (mi)	Roadway Context	AWDT* (vpd)	Number of Crashes (2010-19)	Suggested Posted Speed Limit (mph) **
N 175th St, from Aurora Ave N to 15th Ave NE (Principal Arterial)	1.5	Urban	19,988 (2018)	477	30
15th Ave NE, from NE 145th St to NE 175th St (Principal Arterial)	1.5	Urban	18,306 (2019)	288	30
Greenwood Ave N, from N 145th St to N 160th St	0.8	Suburban	8,552 (2018)	36	30
Meridian Ave N, from N 145th St to NE 205th St	3.0	Urban	5,050 (2019)	361	30
NW Richmond Beach Rd, from Fremont Ave N to 3rd Ave NW	0.5	Suburban	16,706 (2019)	130	30
15th Ave NE, from NE 180th St to NE 196th St.	0.8	Urban	13,740 (2017)	102	35

** AWDT: Average Weekday Traffic*

*** All segments have a current posted speed limit of 35 mph*

POTENTIAL NEXT STEPS

The next steps of this study could involve revising the citywide speed limit setting policy. With the recent publications of NACTO's *City Limits: Setting Safe Speed Limits on Urban Streets,* NCHRP 17-76, and the upcoming *Washington State Injury Minimization and Speed Management Policy Elements and Recommendations*, there is sufficient research to consider a citywide speed limit policy that encourages safe and consistent posted speed limits on all streets in the City of Shoreline.

DKS

APPENDIX A: SHORELINE SPEED LIMIT KEY CORRIDORS (JULY 2020)

DKS was tasked with assisting the City of Shoreline as they refine their speed limit policy on arterial streets. The main objective of this memo is to review existing posted speed limits on arterials corridors to recommend up to five key corridors that should be analyzed in more detail.

Overview of Study Corridors

During a meeting conducted April 23, 2020, and follow-up correspondence, the City of Shoreline and DKS identified the following locations to review under this task.

- The City identified three arterials to be selected for detailed analysis.
    1. Greenwood Ave N, from N 145th St to N 160th St
    2. Meridian Ave N, from N 145th St to NE 205th St
    3. NW Richmond Beach Rd, from Fremont Ave N to 3rd Ave NW
- The study team reviewed the remaining four corridors in this memo.
    4. 15th Ave NE, from NE 145th St to NE 175th St
    5. 15th Ave NE, from NE 180th St to NE 196th St
    6. N 175th St, from Aurora Ave N to 15th Ave NE
    7. Dayton Ave N, from Westminster Way N to Carlyle Hall Rd N
- *The City listed these corridors to hold off on further study for now, due to current and upcoming projects.*
    8. *1st Ave NE, from NE 195th St to NE 205th St: Existing sidewalk, cemetery on one side, green space buffer.*
    9. *Westminster Way N, from N 145th St to Aurora Ave N: Upcoming developer project at N 155th St/Westminster Way N will change roadway cross section and traffic patterns.*
    10. *N 160th St, from Dayton Ave N to Aurora Ave N: Upcoming redevelopment of the Sears property will include a road diet on N 160th St and potential speed limit changes.*

Figure 1 illustrates the seven corridors mentioned above: three identified by the City for further study (Greenwood Ave N, Meridian Ave N, and NW Richmond Beach Rd) and four to be reviewed in this memo (N 175th St, Dayton Ave N, and two sections of 15th Ave NE).

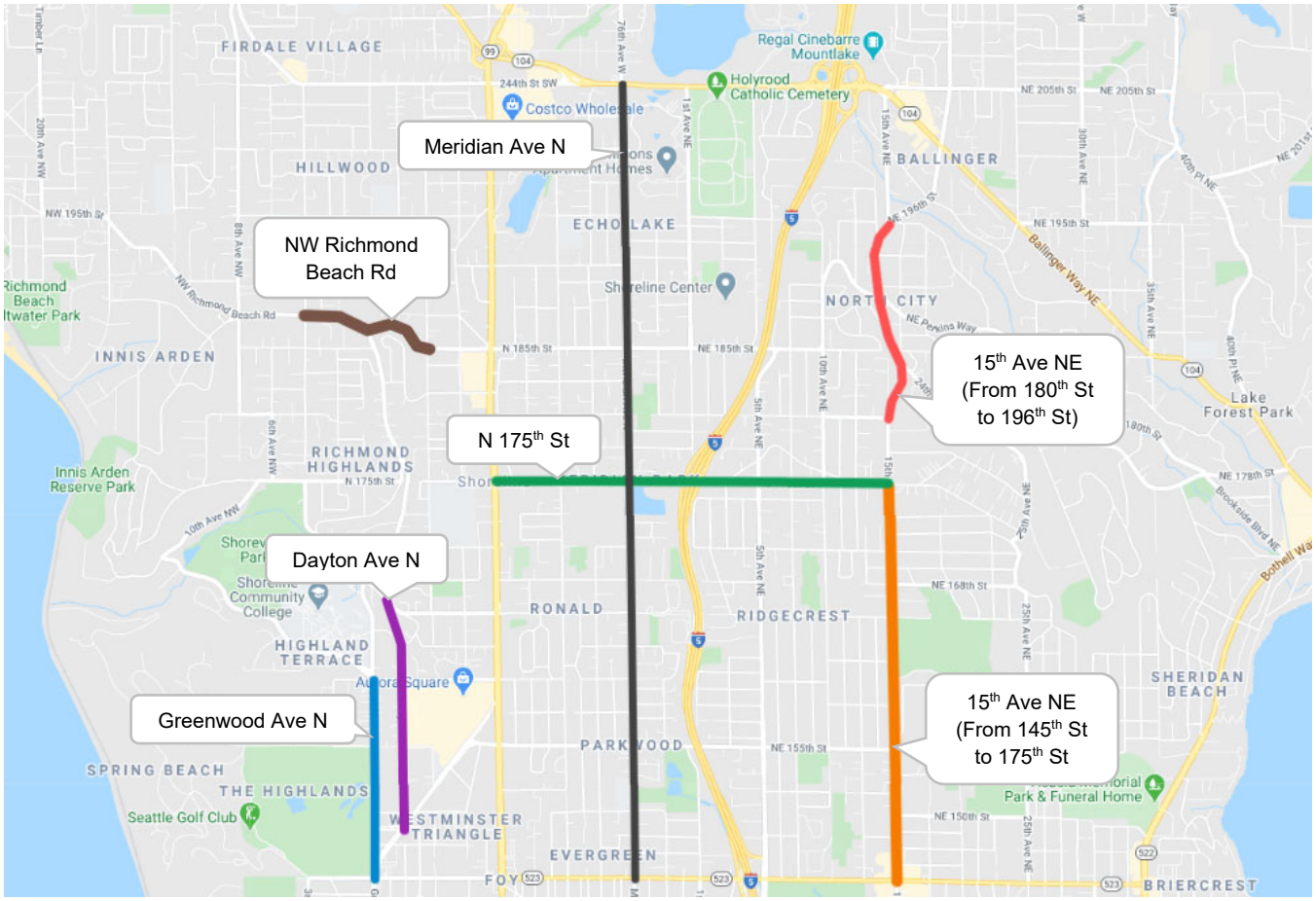


Figure 5. Shoreline Arterial Speed Limit Study Corridors

Approach for Selection

Focusing on the remaining four segments, the study team used the following data elements to identify segments for further study:

- Functional classification
- Current roadway cross section
- Other roadway attributes
- Nearby destinations
- Average Weekday Daily Traffic
- Operating (85th percentile) speed
- Collision history
- Recent changes to roadway cross section, land use, or other pertinent elements

Crash data were provided by the City of Shoreline from 2010 to 2019, which included a total of 4,834 crashes.

Corridor Profiles

Following is an overview of findings from each of the four study corridors.

15th Ave NE, from NE 145th St to NE 175th St. This 1.5-mile segment of 15th Ave NE is classified by WSDOT as a Principal Arterial.[3] It serves Hamlin Park and shopping districts on either end (Goodwill and QFC at NE 145th St; Safeway at NE 175th St) as a 3-lane and 5-lane arterial. This segment of 15th Ave NE has approximately 18,300 vehicles on an average weekday with a prevailing speed of 43 mph. The corridor averages approximately 28 collisions each year.

Based on the Sept 2016 Comprehensive Plan Future Land Use Map, most of this segment is planned for Mixed Use Residential (MUR-45 and MUR-70).[4]

15th Ave NE, from NE 180th St to NE 196th St. This 1.26-mile segment of 15th Ave NE is classified by WSDOT as a Principal Arterial. It serves a shopping district on the south side and primary residential to the north as a 4-lane undivided roadway. The corridor includes roadway curvature and several skewed and otherwise "non-standard" intersections.

This segment of 15th Ave NE matches the other section to the south with approximately 18,300 vehicles on an average weekday, and the same prevailing speed of 43 mph. However, this part of the corridor averages approximately 10 collisions annually.

N 175th St, from Aurora Ave N to 15th Ave NE. This 1.5-mile corridor is classified by WSDOT as a Principal Arterial. Its cross section is a 4-lane undivided roadway with sidewalks, and the corridor averages approximately 48 collisions each year. It serves schools and churches, and it is bisected by the Interstate, resulting in two interchange ramp intersections to serve I-5 and two segments with different average weekday traffic volumes.

- West of I-5, approximately 20,000 vehicles travel along N 175th St at a prevailing speed of 38 mph.
- East of I-5, approximately 12,600 vehicles travel along N 175th St at a prevailing speed of 40 mph. This section was recently repaved, and there is a capital project design underway..

Dayton Ave N, from Westminster Way N to Carlyle Hall Rd N. This Minor Arterial runs 0.9 miles on the west side of the city, serving Aurora Square shopping district, WSDOT facilities, and residential areas. It is a 2-lane roadway with bicycle lanes on both sides, which were added in 2017. More than 17,000 vehicles travel along Dayton Ave N on an average weekday at a prevailing speed of 44 mph. The corridor averages approximately 6 collisions each year.

[3] https://www.wsdot.wa.gov/data/tools/geoportal/?config=FunctionalClass
[4] http://www.shorelinewa.gov/home/showdocument?id=31241. The rezone spans 145th to 158th.

Corridor Comparison

Based on the information provided above, the team compared the four study corridors to identify which might be the most appropriate to consider for a speed limit modification. Table 1 below shows this information and is sorted by corridor crash rate.

Table 1: Study Corridors Comparison

Corridor	Length (mi)	AWDT* (vpd)	85th % Speed (mph)	Number of Crashes (2010-19)	Crash Rate**
N 175th St, from Aurora Ave N to 15th Ave NE (Principal Arterial)	1.5	9,726	35.6	477	895.8
15th Ave NE, from NE 145th St to NE 175th St (Principal Arterial)	1.5	18,300	43	288	287.4
15th Ave NE, from NE 180th St to NE 196th St (Principal Arterial)	1.26	18,306	43.3	102	121.2
Dayton Ave N, from Westminster Way N to Carlyle Hall Rd N (Minor Arterial)	0.9	17,587	43.9	64	110.8

*AWDT refers to Average Weekday Daily Total

**Crash Rate is based on collisions per 100 million VMT

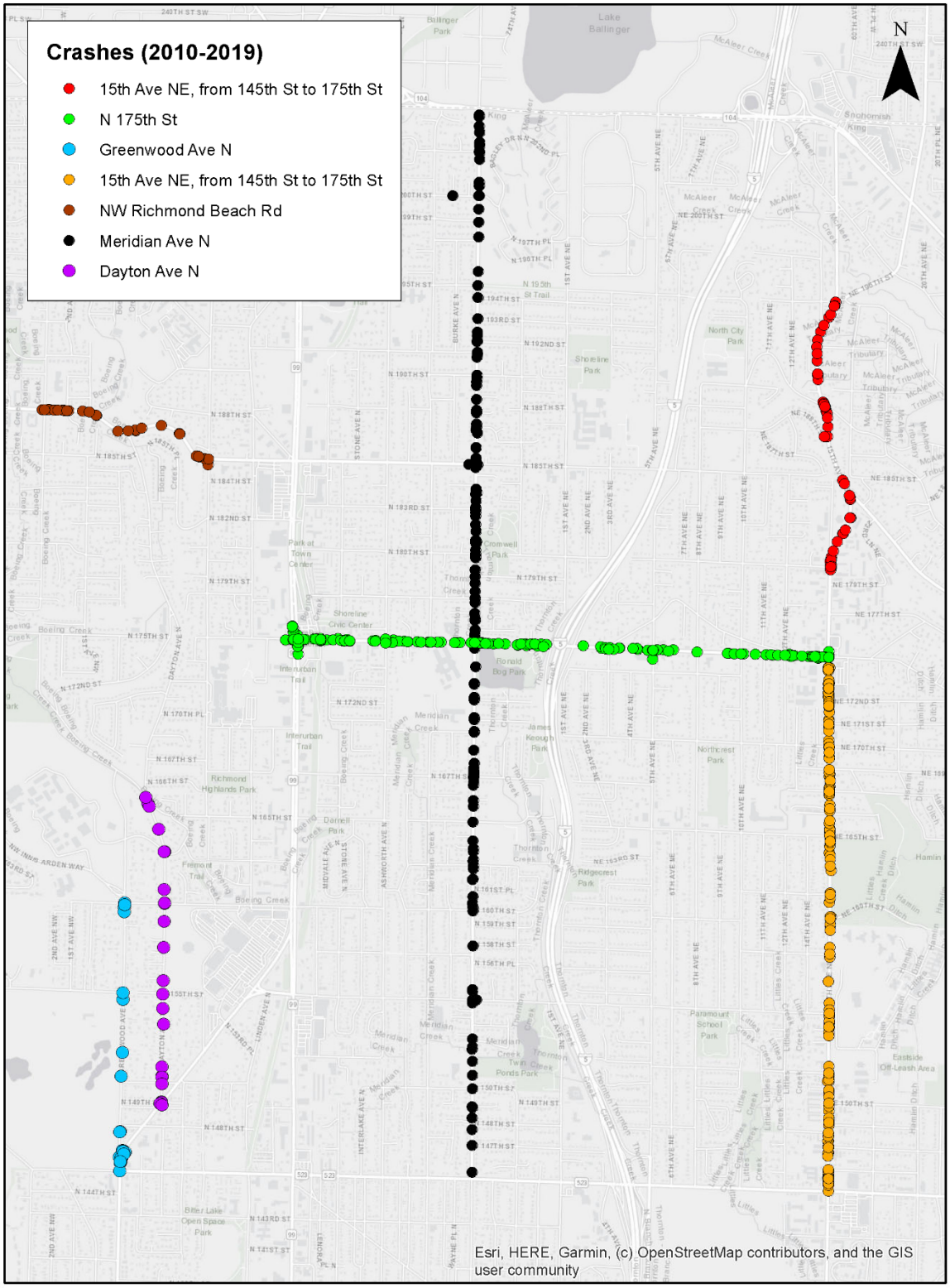
Recommendation

Based on each study corridor's AWDT, operating speed, crash history, and recent/upcoming changes to cross section and land use, the study team recommends these five corridors for further study and suggested speed limit recommendations:

- **Greenwood Ave N, from N 145th St to N 160th St.** Selected by the City.
- **Meridian Ave N, from N 145th St to NE 205th St.** Selected by the City.
- **NW Richmond Beach Rd, from Fremont Ave N to 3rd Ave NW.** Selected by the City.
- **N 175th St, from Aurora Ave N to 15th Ave NE.** Highest crash rate of all seven corridors. The upcoming capital project could be a good opportunity to readdress the posted speed limit.
- **15th Ave NE, from NE 145th St to NE 175th St.** High collision frequency and crash rate. Planned rezoning provides an opportunity to reassess the posted speed limit.

DKS

Shoreline Collision Frequency on Reviewed Segments, 2010-2019



DKS

APPENDIX B: SPEED LIMIT APPROACH REVIEW MEMO (APRIL 2020)

DKS was tasked with assisting the City of Shoreline as they refine their speed limit policy on arterial streets. The main objective of this Speed Limit Approach Review Memo is twofold:

1. **Literature Review:** Review current approaches, guidelines, and tools related to speed limit setting.
2. **Approach Recommendation:** Recommend an approach moving forward for the City to revise arterial corridor speed limits.

Overall, the purpose of this task is to incorporate the current state of practice and research to shape a holistic speed limit policy approach to improve the safety on arterial streets in Shoreline.

Literature Review: Arterial Speed Limit Study

This section summarizes a literature review that includes the following:

1. Washington State Legislature RCW 46.61.400 and 46.61.415
2. Setting Speed Limits from the Institute of Transportation Engineers (ITE)
3. Design Factors to Control Speed from ITE
4. Urban Street Design Guide by the National Association of City Transportation Officials
5. Speed as a Safety Problem from ITE
6. Vision Zero Success Depends on Managing Speed for Safety by Vision Zero Network
7. Safety Issues: Speed Limits and Data-Driven Speed Enforcement by Ivan Cheung
8. Urban Bikeway Design Guide by National Association of City Transportation Officials (NACTO)
9. Board Meeting: Reducing Speeding-Related Crashes Involving Passenger Vehicles
10. Landmark National Study Urges Safety Over Speed by Kathleen Ferrier
11. USLIMITS 2 by Federal Highway Administration
12. Blueprint for Urban Design by Oregon Department of Transportation
13. NCHRP Project 17-76: Guidance for the Setting of Posted Speed Limits
14. Washington State Strategic Highway Safety Plan: Target Zero 2019

1. Washington State Legislature

Sources:

Basic Rule: RCW 46.61.400 https://app.leg.wa.gov/rcw/default.aspx?cite=46.61.400

Local Authority: RCW 46.61.415 https://app.leg.wa.gov/RCW/default.aspx?cite=46.61.415

The following is directly quoted from Washington State Legislature:

- **RCW 46.61.400 –** Basic rule and maximum limits outlined
    1. No person shall drive a vehicle on a highway at a speed greater than is reasonable and prudent under the conditions and having regard to the actual and potential hazards then existing. In every event speed shall be so controlled as may be necessary to avoid colliding with any person, vehicle or other conveyance on or

entering the highway in compliance with legal requirements and the duty of all persons to use due care.

2. Except when a special hazard exists that requires lower speed for compliance with subsection (1) of this section, the limits specified in this section or established as hereinafter authorized shall be maximum lawful speeds, and no person shall drive a vehicle on a highway at a speed in excess of such maximum limits"
    a) Twenty-five miles per hour on city and town streets;
    b) Fifty miles per hour on county roads;
    c) Sixty miles per hour on state highways. The maximum speed limits set forth in this section may be altered as authorized in RCW 46.61.405, 46.61.410, and 46.61.415.
3. The driver of every vehicle shall… drive at an appropriate reduced speed when approaching and crossing an intersection or railway grade crossing, when approaching and going around a curve, when approaching a hill crest, when traveling upon any narrow or winding roadway, and when special hazard exists with respect to pedestrians or other traffic or by reason of weather or highway conditions.

- **RCW 46.61.415 –** When local authorities may establish or alter maximum limits
    1. Whenever local authorities in their respective jurisdictions determine on the basis of an engineering and traffic investigation that the maximum speed permitted under RCW 46.61.400 or 46.61.440 is greater or less than is reasonable and safe under the conditions found to exist upon a highway or part of a highway, the local authority may determine and declare a reasonable and safe maximum limit thereon which
        a) Decreases the limit at intersections; or
        b) Increases the limit but not to more than sixty miles per hour; or
        c) Decreases the limit but not to less than twenty miles per hour.
    2. Local authorities… shall determine by an engineering and traffic investigation the proper maximum speed for all arterial streets and shall declare a reasonable and safe maximum limit thereon which may be greater or less than the maximum speed permitted under RCW 46.61.400(2) but shall not exceed sixty miles per hour.
    3. A) Cities and towns in their respective jurisdictions may establish a maximum speed limit of twenty miles per hour on a nonarterial highway, or part of a nonarterial highway, that is within a residence district or business district.
    B) A speed limit established under this subsection by a city or town does not need to be determined based on an engineering and traffic investigation if the city or town has developed procedures regarding establishing a maximum speed limit under this subsection. Any speed limit established under this subsection may be canceled within one year of its establishment, and the previous speed limit reestablished, without an engineering and traffic investigation. This subsection does not otherwise affect the requirement that cities and towns conduct an engineering and traffic investigation to determine whether to increase speed limits.
    4. The secretary of transportation is authorized to establish speed limits on county roads and city and town streets as shall be necessary to conform with any federal requirements which are a prescribed condition for the allocation of federal funds to the state.
    5. Any altered limit established as hereinbefore authorized shall be effective when appropriate signs giving notice thereof are erected. Such maximum speed limit may be declared to be effective at all times or at such times as are indicated upon such signs; and differing limits may be established for different times of day, different

types of vehicles, varying weather conditions, and other factors bearing on safe speeds, which shall be effective when posted upon appropriate fixed or variable signs.

6. Any alteration of maximum limits on state highways within incorporated cities or towns by local authorities shall not be effective until such alteration has been approved by the secretary of transportation.

2. ITE: Setting Speed Limits

Source: Institute of Transportation Engineers: https://www.ite.org/technical-resources/topics/speed-management-for-safety/setting-speed-limits/

Notes:

- **Design speed**- determines minimum values for road design including road curves and sight distance. The selected speed determines the geometric design features of the roadway
    1. Other features like lane widths, roadway shoulders, cross sections, curbs, etc. are determined on the road function and safety
    2. "Ideally, the speed a motorist feels is safe is the same as the designs speed selected."
- Operating speed-observed vehicle speed traveling on a roadway
    1. Vehicles do not all travel at the same speed, so a speed distribution is made and usually the 85th percentile speed is chosen to be the operating speed and can influence the posted speed limit
    2. "Ideally, the operating speed should be close to the speed limit"
- Speed limits should be lowered if there are other users, bicyclists and pedestrian that also need to feel safe while on the road
    1. The MUTCD does not recognize updating speeds based on pedestrian activity, parking practices, or alignments
- "**The Vision Zero** approach encourages setting speeds to also take into consideration other factors such as surrounding land use, the history of traffic crashes, injuries and fatalities, and existence of other permissible travel modes such as bicycling, walking, or riding transit"
- "The concept of target speed is outlined as the highest speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a safe environment for pedestrians, bicyclists, and public transit users"
- Variable speed limit systems are useful for weather conditions, intersections, transition zones, work zones, school zones, bicycle and slow lanes, and safe truck speeds
- "The selection of the speed limit for any particular section of a road type is an exercise in weighing the objectives of safety and operational efficiency. The operational efficiency is measured by travel time and the safety level, measured by the incidence of crashes and resulting injuries and fatalities with consideration of the road function."
- There are three approaches to setting speed limits:
    1. **Engineering Approach** - A base speed limit it set based on the 85th percentile speed / design speed of the road and this speed is adjusted on conditions like roadways and pedestrians
    2. **Expert System Approach** – USLIMITS2 is an expert system where the speed limits are suggested by a computer program based on inputs from the user
        a) Inputs include surrounding development; access points; road function; road characteristics (e.g., divided or undivided, number of lanes, annual average daily traffic (AADT), roadside hazards, and section length) or freeway characteristics (e.g., number of interchanges, section length, and AADT); existing vehicle operating speeds (50th and 85th percentile); pedestrian activity; crash history; and special conditions (e.g., adverse alignment, transition zones, and parking)

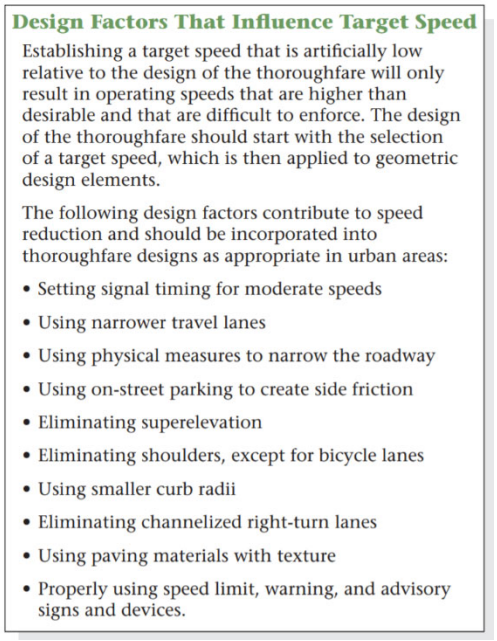
3. **Safe System Approach** – Human error is always likely to occur and that should not result in a fatality or serious injury. Speed limits are chosen according to crash types likely to occur. The most import factor is the safety of all road users.

3. ITE: Design Factors to Control Speed

Source: Institue of Transportation Engineers: https://www.ite.org/pub/?id=e1cfaec4-2354-d714-51ee-02d880c363a5

Notes:

- It's important to "design urban streets that are compatible with and supportive of the surrounding context and community" and a broad range of design controls to accomplish this
- Design Control: physical and operational characteristics that guide the selection of criteria for designing thoroughfares. Some design controls are fixed (terrain, climate), but some can be influenced through design such as vehicle speed.
- Speed
    1. Replace design speed with target speed
    2. "**Target speed** is the highest speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multimodal activity generated by adjacent land uses, to provide both mobility for motor vehicles and a safe environment for pedestrians, bicyclists, and public transit users."



Design Factors That Influence Target Speed

Establishing a target speed that is artificially low relative to the design of the thoroughfare will only result in operating speeds that are higher than desirable and that are difficult to enforce. The design of the thoroughfare should start with the selection of a target speed, which is then applied to geometric design elements.

The following design factors contribute to speed reduction and should be incorporated into thoroughfare designs as appropriate in urban areas:

- Setting signal timing for moderate speeds
- Using narrower travel lanes
- Using physical measures to narrow the roadway
- Using on-street parking to create side friction
- Eliminating superelevation
- Eliminating shoulders, except for bicycle lanes
- Using smaller curb radii
- Eliminating channelized right-turn lanes
- Using paving materials with texture
- Properly using speed limit, warning, and advisory signs and devices.

- Location
    1. Rural, suburban and urban roadways.
    2. Land uses varying from residential to commercial.
- Design Vehicle
    1. A design vehicle is the largest vehicle that uses a street and determines lane widths and curb radii
    2. "In walkable urban areas, it is not desirable to choose the largest vehicle that occasionally uses the facility."
        a) Designing for large vehicles is not safe for pedestrians and designing for small vehicles causes operational and safety problems
    3. The largest design vehicle should that regularly uses the area should be accommodated but a vehicle that infrequently uses the area can encroach into opposing traffic lanes, multiple-point turns, or encroachment into the side street
- Functional Classification
    1. "**Functional class** is used to determine features such as the thoroughfare's continuity through an area and the types of places it connects, the purpose and length of the trips it accommodates, its level of access to adjacent land development, the type of freight service, and the types of public transit that need to be accommodated."
    2. Identifying the functional classification for each roadway helps determine the appropriate design controls
- Pedestrian and Bicyclist Requirements as a Design Control
    1. Pedestrian and bicyclist activity require facilities that affect the design elements
- Capacity and Vehicular Level of Service
    1. Traffic projections and levels of service of all users
- Design Factors That Influence Target Speed

1. Setting signal timing for moderate speeds; using narrower travel lanes; using physical measures to narrow the roadway; using on-street parking to create side friction; eliminating super elevation; eliminating shoulders, except for bicycle lanes; using smaller curb radii, eliminating channelized right-turn lanes; using paving materials with texture; properly using speed limit, warning, and advisory signs and devices

4. NACTO Urban Street Design Guide

Source: National Association of City Transportation Officials: https://nacto.org/publication/urban-street-design-guide/design-controls/design-speed/

Notes:

- "In 2011, 4,432 pedestrians were killed and 69,000 injured in motor vehicle crashes" in USA
  - 73% of the fatalities occur in urban areas
- To reduce this number, cities should lower speeds by adding design elements to the road
  - This "may be the single most consequential intervention in reducing pedestrian injury and fatality."
- There is a correlation between speeds, crash risk, and injury severity

SPEED (MPH)	STOPPING DISTANCE (FT)*	CRASH RISK (%)†	FATALITY RISK (%)†
10–15	25	5	2
20–25	40	15	5
30–35	75	55	45
40+	118	90	85

* Stopping Distance includes perception, reaction, and braking times.

† Source: Traditional Neighborhood Development: Street Design Guidelines (1999), ITE Transportation Planning Council Committee 5P-8.

- **Target speed** is the speed you intend for drivers to go
- **Operating speed** is the 85th percentile of the speed drivers travel in free-flow conditions
  - This should be between 10-30 mph on urban streets
- A **design speed** should be selected in cities to influence the roadway geometric characteristics
- "Higher design speeds often mandate larger curb radii, wider travel lane widths, on-street parking restrictions, guardrails, and clear zones."
- "Lower design speeds reduce observed speeding behavior, providing a safer place for people to walk, park, and drive."
- The existing speed limit method is the operating speed should equal the design speed which should equal the posted speed
- Urban streets speed limits should be designed so the target speed equals the design speed which equals the posted speed
- Urban streets can have higher target speeds up to 35 mph only if they are outside of areas with heavy pedestrian and bicyclist usage
- "The maximum target speed for urban collector or local streets is 30 mph."
- Neighborhoods should have 20 mph zones for a safe interaction of children playing
- You can lower the design speed to match the target speed by:
  - Narrowing lane widths, adding roadside landscaping, adding speed humps, and adding curb extensions
  - Use short cycle lengths and slow signal progression
- The operating speed can be up to 10 mph lower than the posted speed limit in areas with high pedestrian and bicyclist volumes
- Enforcement cameras are helpful in reducing driving speeds and speed limit compliance

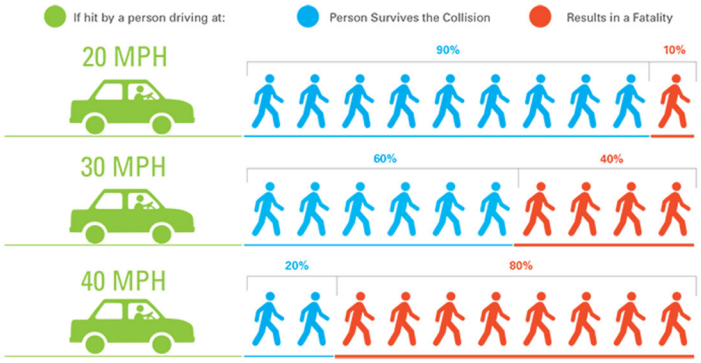
DKS

5. ITE Speed as a Safety Problem

Source: Institute of Transportation Engineers: https://www.ite.org/technical-resources/topics/speed-management-for-safety/speed-as-a-safety-problem/

Notes:

- "To achieve the goal of Vision Zero, transportation professionals must design roads to provide safety for all functions and users, set safe speed limits for the context, and work collectively on proper enforcement and data collection measures to ensure desired speeds are achieved once a road is constructed and a speed limit is set"
- "The fatality rates on interstates/freeways were 8.5% higher for each 5 mph increase in the maximum speed limits"
- "The motorist must take into consideration vehicle capability, roadway features, environmental conditions, surrounding context, presence of other road users, and most importantly, the speed limit"
- Speed measures mobility and safety of the road
    - "Mobility is a factor of travel time, which may be minimized with higher speeds"
    - "Safety is associated with the reduction, if not complete absence, of crashes and fatalities"
- "Design complexities, such as right-of-way limits, land use context, presence of other road users, intersections, sight distances, etc., typically requires lower speeds for the safety of all road users"



- Speeding is a factor in most crashes
- "The percentage of speed-related fatalities is highest on local road types compared to all other road types."

6. Vision Zero Success Depends on Managing Speed for Safety

Source: The Vision Zero Network: https://visionzeronetwork.org/resources/safety-over-speed/

Notes:

- Vision Zero has a **safe systems** approach-design the road knowing humans will make mistakes. Do not expect perfect behavior to stop collisions altogether.
- To allow safe travel for all roadway users there must be safe streets, speeds, vehicles, and people
- Effective solutions to **slow speeds** are
    1) Safe street design
    2) Automated speed enforcement
    3) Safe speed limits
- Safe street design
    - Consider installing roundabouts, speed humps, medians or road diets
- Automated Speed Enforcement
    - Installing safety cameras
        - Research show cameras reduce crashes by 8-49%
    - They are only allowed in 14 states, so states should amend laws to install and use them
- Safe Speed Limits

    - Today's standards for setting speed limits are outdated and ineffective
        - Most states rely on the 85th percentile standard assuming most drivers operate at reasonable speeds according to weather conditions, traffic, road geometry and other factors. This means drivers set the speed limit rather than what could be a safe operating speed.
- This study recommends setting speed limits to balance with the safe systems approach to incorporate other critical factors, such as crash history and the safety of walkers and bike riders
- Speed limits are controlled by the state, some cities are currently trying to change state legislation

Summary:

Safe street design, automated speed enforcement, and safe speed limits are important to slow speeds to make the roadway safe for all users.

7. NTSB Safety Issues: Speed Limits and Data-Driven Speed Enforcement

Source: Ivan Cheung, National Transportation Safety Board: https://www.ntsb.gov/news/events/Documents/2017-DCA15SS002-BMG-pres-3.pdf

Notes:

- Statutory speed limits - Change by road type and location, but same per jurisdiction
- Posted speed limits - governments establish speed zones, and they don't change by traffic conditions
- There are three types of speeds:
    - Design phase - design speed based on road geometric design features
    - Setting the speed - statutory and posted speed limits
    - Operating speeds - Vehicle's driving speeds
- Three methods of setting speed limits in speed zones:
    - Choosing a speed limit based on an engineering study and an analysis of the current speed distribution of free-flowing traffic
    - Choosing a speed limit within 5 mph of the 85th percentile speed
    - Choosing a speed limit from surrounding factors including pedestrian activity and reported crashes
- By setting speed limits on the 85th percentile free-flowing speeds, we are assuming that most drivers and reasonable and that only a small number of drivers are responsible for crashes
    - This method came from research on rural roads-which does not apply to all road types
    - This results in the further increase in speed limits
- Recommended method for setting speed limits:
    - A computer system that chooses a speed based on crash data, 85th percentile speed, 50th percentile speed, section length, statutory limit, adverse alignment, transition zone, AADT, roadway type, and number of interchanges
    - This approach is beneficial on urban roads and for pedestrian safety
- High-visibility enforcement is conducted by law enforcement and is helpful at high crash risk locations to reduce speeding-related crashes

Summary:

- The 85th percentile is no longer the best practice for choosing speed limits, especially on urban roads with pedestrian activity
- Incorporate the safe system approach with balancing operating speed and crash experience when setting speed limits

DKS

8. NACTO Urban Bikeway Design Guide

Source: National Association of City Transportation Officials: https://nacto.org/publication/urban-bikeway-design-guide/bicycle-boulevards/speed-management/

Notes:

- "Reducing speeds along the bicycle boulevard improves the bicycling environment by reducing overtaking events, enhancing drivers' ability to see and react, and diminishing the severity of crashes if they occur."
- Bicycle boulevards should have 85th percentile speeds of 25 mph or less, but 20 mph is preferred
    - These speeds can be achieved with traffic calming measures
- There are a few vertical deflection speed control measures:
    - Speed humps commonly referred to as bumps
    - Speed cushions/ speed lumps so large and emergency vehicles are not impeded
    - Speed tables and split speed tables
        - This includes a raised crosswalk that is a speed table marked for pedestrians
- Horizontal deflection measures are important for bicyclists because they allow them to feel comfortable riding in the lane and "overtaking cars do not encroach on bicyclists"
- There are a few horizontal deflection speed control measures:
    - Curb extensions and bulb-outs
        - They visually narrow the roadway, act as a minor street crossing reducing pedestrian crossing distance, increase available space for street furniture and trees, and help with stormwater management
        - This includes edge islands which help improve drainage
    - Neighborhood traffic circles
        - They "reduce vehicle speeds by narrowing turning radii, narrowing the travel lane, and, if planted, obscure the visual corridor along the roadway"
        - Bicyclists do not feel they're effective as motorists overtake them while in the traffic circle
    - Chicanes
        - Drivers must slow down to navigate the shifted roadway lines
    - Pinch point or choker narrowing
        - Narrowing the street so two drivers cannot pass through simultaneously with a cut through passage for bicyclists
        - This includes "neckdowns" which are pinch points at intersections
    - A center island in the median providing some deflection
    - Skinny streets
        - Narrow residential streets for bi-directional travel so drivers must yield to each other
    - These treatments are best in these types of situations:
        - Bicycle boulevards with high vehicle speeds
        - Neighborhood streets where residents feel the speeds are too high
        - Streets where improving the minor street to help bicycles traveling along the bicycle boulevard will allow for high vehicle travel speeds
        - Locations with high pedestrian volumes
        - Locations where green infrastructure and sewer improvements are desired

9. NTSB Board Meeting: Reducing Speeding-Related Crashes Involving Passenger Vehicles

Source: National Transportation Safety Board: https://www.ntsb.gov/news/events/Pages/2017-DCA15SS002.aspx

Notes:

- Speeding is the cause for about 10,000 highway crashes per year in the US
- Vehicles driving at higher speeds have a greater change of injuries and fatalities in a collision
- "The public is less aware of the risks of speeding compared with other risky driving behaviors. There is also less social stigma surrounding speeding"
- Reductions in speeding related injuries can be achieved with a greater understanding of the impacts of speeding

10. Landmark National Study Urges Safety Over Speed

Source: Kathleen Ferrier, Vision Zero Network: https://visionzeronetwork.org/safety-over-speed/

Notes:

- Speeding is an under addressed problem and one of the greatest threats to public safety, so vision zero has recommendations to save 10,000 lives annually
    - The number of speeding related fatalities is similar to the number of drunk driving fatalities
- **Vision zero** wants "modernization of speed practices, including a multi-modal approach to set speed limits and use of proven technologies such as automated speed enforcement"
- The majority of fatal, speed related crashes occur on local road, but local governments do not have the ability to update the speeds
- Vision zero recommends:
    - Use of automated speed enforcement
    - Replace the 85th percentile approach speed with the **safe systems approach**
        - The safe systems approach factors in multi modal activity and crash history
    - Encourage local groups, the state government, and the federal government to get more involved in making speeding a safety priority
    - Apply the safe systems approach in urban areas for all road users
- The article lists case studies in 6 cities with a large decrease in fatalities after the city decreased speeds by 5-10 mph and/or installed a speed camera
- "Speed increases the likelihood of serious and fatal crash involvement"
- Speeding related fatalities are higher on local roads than highways
- Automated speed enforcement technology has reduced crashes 8-49% in 28 studies
- The current 85th percentile approach to speed limit setting encourages higher speeds, because it bases speeds on drivers' habits

11. FHWA USLIMITS2 Tool

Source: Federal Highway Administration: https://safety.fhwa.dot.gov/uslimits/

Notes:

- "A tool to aid practitioners in determining appropriate speed limit recommendations"
- The USLIMITS2 is a tool to identify safe speeds along all different types of roadways
    - This tool does not work in specific zones like construction and school zones
- This is a great designed for communities that do not have access to or do not have funding to hire engineers to conduct a speed study
- It can also help engineers determine a recommended speed in addition to their speed study
- To use this tool, a user enters defining characteristics of the roadway and area including 50th percentile speed, 85th percentile speed, and crash history

- You can also use this tool on new projects without existing speeds, and use the statutory speed and then update the speeds after collecting reliable data

USLIMITS2 Sample output

USLIMITS2 Speed Zoning Report

Project Name: Main Street

Analyst: Jane Smith

Date: 07-16-2019

Basic Project Information
Route Name: Main St
From: 1st St
To: 48th Ave
State: Washington
County: Hazzard
City: Smallville
Route Type: Road Section in Developed Area
Route Status: Existing

Crash Data Information
Crash Data Years: 9.00
Crash AADT: 9618 veh/day
Total Number of Crashes: 45
Total Number of Injury Crashes: 5
Section Crash Rate: 120 per 100 MVM
Section Injury Crash Rate: 13 per 100 MVM
Crash Rate Average for Similar Roads: 235
Injury Rate Average for Similar Roads: 70

Roadway Information
Section Length: 1.19 mile(s)
Statutory Speed Limit: 35 mph
Existing Speed Limit: 35 mph
Adverse Alignment: No
One-Way Street: No
Divided/Undivided: Undivided
Number of Through Lanes: 2
Area Type: Residential-Collector/Arterial
Number of Driveways: 10
Number of Signals: 1

Traffic Information
85th Percentile Speed: 37 mph
50th Percentile Speed: 34 mph
AADT: 9618 veh/day
On Street Parking and Usage: Not High
Pedestrian / Bicyclist Activity: Not High

Recommended Speed Limit:

Disclaimer: The U.S. Government assumes no liability for the use of the information contained in this report. This report does not constitute a standard, specification, or regulation.

[5] USLIMITS2 User Guide. https://safety.fhwa.dot.gov/uslimits/documents/appendix-l-user-guide.pdf

DKS

Equations Used in Crash Data Calculations

Exposure (M)
M = (Section AADT * 365 * Section Length * Duration of Crash Data) / (100000000)
M = (9618 * 365 * 1.19 * 9.00) / (100000000)
M = 0.3760

Crash Rate (Rc)
Rc = (Section Crash Average * 100000000) / (Section AADT * 365 * Section Length)
Rc = (5.00 * 100000000) / (9618 * 365 * 1.19)
Rc = 119.69 crashes per 100 MVM

Injury Rate (Ri)
Ri = (Section Injury Crash Average * 100000000) / (Section AADT * 365 * Section Length)
Ri = (0.56 * 100000000) / (9618 * 365 * 1.19)
Ri = 13.30 injuries per 100 MVM

Critical Crash Rate (Cc)
Cc = Crash Average of Similar Sections + 1.645 * (Crash Average of Similar Sections / Exposure) ^ (1/2) + (1 / (2 * Exposure))
Cc = 234.74 + 1.645 * (234.74 / 0.3760) ^ (1/2) + (1 / (2 * 0.3760))

Cc = 277.18 crashes per 100 MVM

Critical Injury Rate (Ic)
Ic = Injury Crash Average of Similar Sections + 1.645 * (Injury Crash Average of Similar Sections / Exposure) ^ (1/2) + (1 / (2 * Exposure))
Ic = 69.91 + 1.645 * (69.91 / 0.3760) ^ (1/2) + (1 / (2 * 0.3760))
Ic = 93.67 injuries per 100 MVM

12. Oregon Department of Transportation: Blueprint for Urban Design

Source: Oregon Department of Transportation
https://www.oregon.gov/odot/Engineering/Documents_RoadwayEng/Blueprint-for-Urban-Design_v1.pdf

Notes:

- "When determining the context of a roadway section, roadway federal functional classification, state classification, adjacent land use, roadside context, roadway segment designation, and to some extent, traffic volume and number of lanes is considered. Traffic volume, speed, and lane configuration along with classification are indicators of how a roadway section is being used and sets expectations for road users, as well as expectations for adjacent businesses – both existing and future."
- Creating greater differentiation in contexts based on more specific parameters along a section of roadway that affect its use can provide flexibility. It also helps prioritize design elements to better address user and community needs, rather than a "one-size-fits-all" approach. This is the basis for performance-based design, which focuses on the outcomes of the design decisions as the primary measure of design effectiveness.
- It's important to understand the types of users and intensities on every roadway
    - In downtown contexts, a higher number of pedestrians, bicyclists, and transit users are expected so slower speeds, shorter signal spacing, shorter crossing distances, and other design elements such as bicycle facilities, on-street parking, and wide sidewalks should be considered as strategies to improve safety and comfort
- "In Suburban Fringe, designers should expect a predominance of vehicles and freight; however, bicyclists and pedestrians are also likely to be present and enhanced facilities should be considered for safety and comfort. A roadway in Suburban Fringe would typically have higher speeds, and lower levels of traffic delay, but the design elements for the facility will change as it transitions into different urban contexts."

Land Use Context	Motorist	Freight	Transit	Bicyclist	Pedestrian
Traditional Downtown/CBD	Low	Low	High	High	High
Urban Mix	Medium	Low	High	High	High
Commercial Corridor	High	High	High	Medium	Medium
Residential Corridor	Medium	Medium	Low	Medium	Medium
Suburban Fringe	High	High	Varies	Low	Low
Rural Community	Medium	Medium	Varies	High	High

Additional guidance:

- Traditional downtown areas should have maximum speeds of 25 mph to serve all users
- Urban mix areas should have speeds between 25-30 mph. Bicyclists should have a wide area for their lower speeds, but if this is not available, they should have a buffer separating them from the roadway
- Commercial corridor areas should have speeds between 30-35 mph, bicycle and pedestrian facilities should be separated from travel lanes with a buffer
- Residential corridors should have speeds between 30-35 mph
- Suburban fringe areas should have speeds between 35 - 40 mph. Bicycle and pedestrian facilities should have a buffer, and speeds should be lowered going through urban areas
- Rural community areas should have speeds between 25-35 mph and other design elements should reflect the needs of the community

13. NCHRP Project 17-76: Guidance for Setting Speed Limits

Source: National Cooperative Highway Research Program, Texas A&M Transportation Institute. https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4052

Notes:

- Texas A&M presented this ongoing research at the AASHTO Meeting, June 18, 2019
- NACTO 2017 policy included the following statement: "State rules or laws that set speed limits at the 85th percentile speed should be repealed"
- NTSB's publication recommended removing the MUTCD's guidance that speed limits should be within 5 mph of the 85th percentile speed
- National Committee on Uniform Traffic Control Devices (NCUTCD) Task Force on Speed Limits identified key directions / suggested changes to the MUTCD:
- Keep MUTCD general. Save detailed procedures for guides.
- Emphasize that other factors (beyond the 85th percentile speed) have a role in setting speed limits; reorganize this list of factors.

- Retain a reference to the 85th for freeways, expressways, and rural areas.
- Current state of practice found through survey
- All/most states use 85th percentile speed and crash history
- Over half of states responding use roadside development, land use, traffic condition/volume, max/min speeds allowed in the state, and sight distance.
- About one-third include parking, shoulder, pavement conditions, access as factors
- Less than one-third of (but at least 3) states use functional class, pedestrians, urban streets, alignment, cross section, and traffic control devices.

Suggested starting points from the ongoing research:

Suggested Speed Limit Starting Point…

Speed Limit Setting Groups	Method, Engineering • Percentile speed selected based on roadway characteristics & crashes • Statutory speed when applicable	Basis
• Limited access • Undeveloped • Developed	• Closest 85th • Rounded down from 85th • Closest 50th	• Connection to driver's response while still reflecting roadway / roadside characteristics and crashes • USLimits2
• Full Access (< 30 mph typically)	• Closest 50th • Rounded down from 50th	• Above • Greater sensitivity to context (active transportation)

DKS

14. Washington State Strategic Highway Safety Plan: Target Zero 2019

Source: Washington Traffic Safety Commission – 2019 Target Zero Plan Update:

http://wtsc.wa.gov/wp-content/uploads/dlm_uploads/2019/10/TargetZero2019_Lo-Res-1.pdf

Notes:

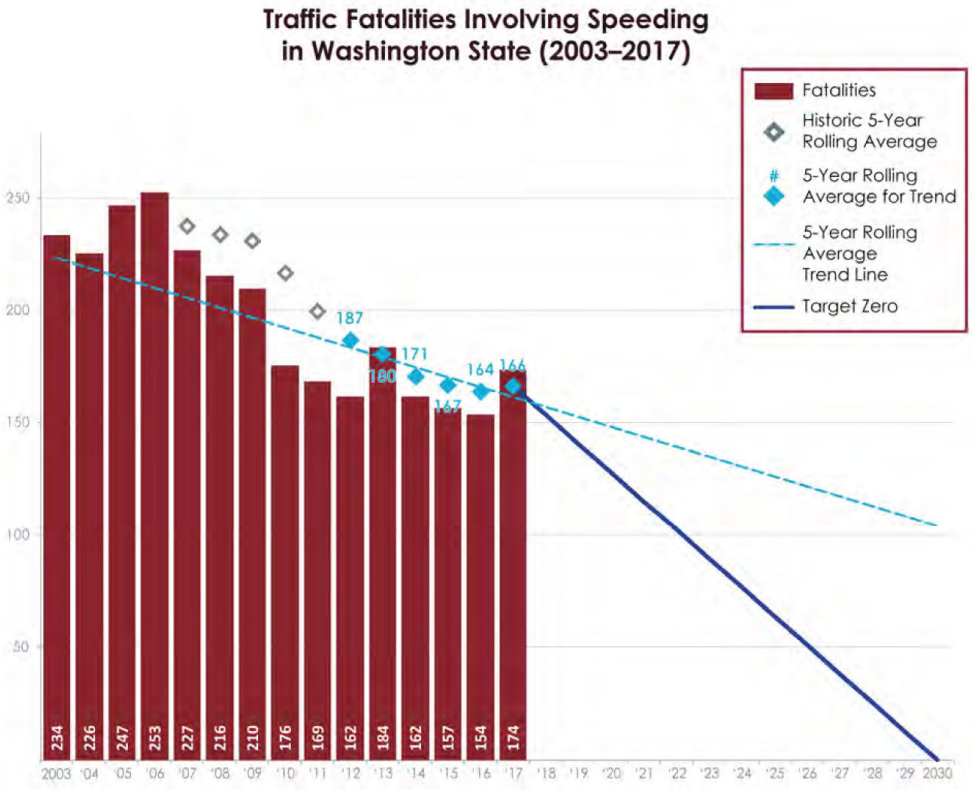
- The Target Zero plan represents the vision towards zero deaths and serious injuries on Washington's roadways by 2030.
- The 2015-2017 data used in the plan shows that traffic fatalities increased 23% and serious injuries 7% compared with the prior three-year period (2012-2014).

	2012-2014	2015-2017	Three Year % Change
Number of All Fatalities			
Speeding	508	485	-4.5%
Pedestrian and Bicyclist	233	329	+41.2%
Impairment	759	958	+26.2%
Number All Serious Injuries			
Speeding	1,622	1,579	-2.7%
Pedestrian and Bicyclist	1,165	1,333	+11.1%
Impairment	1,365	1,215	-11%

- From 2015-2017, one in every three fatal crashes involved speeding as a contributing factor. 64% of speeding driving involved in fatal crashes were exceeding reasonable speed – they were traveling too fast for conditions.
- Aggressive driving: an individual committing a combination of moving traffic offenses so as to endanger other persons or property. Speeding is the most common aggressive behavior.
- Countermeasures for speeding include: driver education and campaigns, enforcement and engineering and road design.

DKS

Strategies for Reducing Speeding (SPE) Fatalities and Serious Injuries		
Objective	Strategies	Implementation Areas
SPE.1. Reduce motorist speed through enforcement activities.	SPE.1.1 Increase use of automated speed enforcement. (P, CTW)	Enforcement
	SPE.1.2 Conduct High Visibility Enforcement efforts at locations where speeding-related crashes are more prevalent. (P, NCHRP)	Education, Enforcement
	SPE.1.3 Increase penalties for repeat and excessive speeding offenders. (R, CTW)	Leadership
	SPE.1.4 Equip law enforcement officers with appropriate equipment for speeding enforcement. (R, WSP)	Enforcement
	SPE.1.5 Increase use of aerial speed enforcement. (U)	Enforcement
SPE.2. Use engineering measures to lower motorist speed.	SPE.2.1 Set speed limits which account for roadway design, traffic, and environment. (R, NCHRP)	Engineering
	SPE.2.2 Implement traffic calming strategies at road sections and intersections along the types of streets for which they are intended, primarily low-volume residential and, occasionally, collector and arterial streets. (R, NCHRP)	Engineering
	SPE.2.3 Place speed limit signs so they are visible and installed at appropriate intervals. (R, NCHRP)	Engineering
	SPE.2.4 Use electronic variable speed limit signs that change according to conditions such as weather and congestion. (R, NCHRP)	Engineering
	SPE.2.5 Support the limited use of speed feedback signs to warn motorists that they are exceeding the speed limit; continue to research the most effective locations for these signs. (R, NCHRP)	Engineering
	SPE.2.6 Implement timed and coordinated traffic signals to improve traffic flow, reduce red-light running, and manage speeds. (R, NCHRP)	Engineering
P: Proven R: Recommended U: Unknown		



Recommended Speed Limit Policy Approach

Based on a review of the literature, including recent researching findings in 2019 and 2020, the DKS team recommends the City of Shoreline take the following three-step approach to identifying the most appropriate posted speed limit for each of the city's arterials. Overall, the team recommends incorporating a safe systems approach that does not focus entirely on the 85th percentile speed, but rather incorporates the crash history, road system design, traffic volume and surrounding context of the road functionality. Understanding the road setting and urban context can help determine the appropriate speed limit and additional design treatments to improve safety for all users.

STEP 1: Identify Target Speed by Urban Context

For each arterial, use the urban context to identify a Target Speed per the 2020 ODOT Blueprint for Urban Design,[6] using this as a baseline for a desired speed limit along each roadway.

Table 3-10: Recommended ODOT Target Speed and Design Treatments for Urban Contexts

Urban Context	Target Speed (MPH)	Design Treatments
Traditional Downtown/CBD	20-25	Roundabouts, lane narrowing, speed feedback signs, on-street parking[1], street trees[2], median islands, curb extensions, chicanes[3], textured surface, coordinated signal timing, speed tables[3], road diets
Urban Mix	25-30	Roundabouts, lane narrowing, speed feedback signs, on-street parking[1], street trees[2], median islands, curb extensions, chicanes[3], textured surface, coordinated signal timing, road diets
Commercial Corridor	30-35	Roundabout, lane narrowing, speed feedback signs, landscaped median Islands, coordinated signal timing, road diets
Residential Corridor	30-35	Roundabout, lane narrowing, speed feedback signs, landscaped median Islands, coordinated signal timing, road diets
Suburban Fringe*	35-40	Roundabouts, transverse pavement markings, lane narrowing, speed feedback signs, road diets, entry treatments
Rural Community	25-35	Roundabouts, lane narrowing, speed feedback signs, on-street parking[1], street trees[2], median islands, curb extensions, chicanes[3], speed tables[3], road diets, entry treatment

* The suburban fringe context is typically suburban adjacent to rural areas at the edge of urban development, but often is in the process of developing. For projects in the suburban fringe context zone, practitioners should consider likely future development and consider applying designs for residential corridor, commercial corridor, or urban mix contexts if this type of development is likely to occur.

[1] If on-street parking is not well utilized, the additional pavement width may increase operating speeds.

[2] When used along roadways, street trees may not reduce speeds in a specific urban context to a point where it is appropriate to have a vertical element adjacent to the roadway.

[3] Speed tables and chicanes may not be appropriate on most state roadways but may be considered in special cases.

[6] *Oregon DOT Blueprint for Urban Design, Volume 1*, p. 3-22. Salem, Oregon, January 2020.

STEP 2: Calculate USLIMITS2-based Recommendation

Start with USLIMITS2 as an initial analysis using a nationally-recognized standard tool. Use already-available input data that include the following:

- Recorded operating speeds to calculate 50th and 85th percentile
- Frequency and severity of collisions
- Corridor AADT
- Segment length
- Roadway cross-section (number of lanes, divided/undivided)
- Number of driveways
- Number of signalized intersections
- On-street parking usage (Low, Medium, High)
- Pedestrian/bicycle activity (Low, Medium, High)

STEP 3: Incorporate NCHRP 17-76 Guidance

Supplement USLIMITS2 results by applying the framework introduced in NCHRP Project 17-76 (full report not yet available). In the near-term, incorporate draft guidance for the suggested speed limit starting point.

Speed Limit Setting Groups	**Method, Engineering:** **Percentile speed based on roadway characteristics, crashes.** **Statutory speed where applicable.**	**Basis**
Limited Access	Closest 85th percentile	Connection to driver's response while still reflecting roadway characteristics and crash history. USLIMITS2
Undeveloped	Rounded down from 85th percentile	
Developed	Closest 50th percentile	
Full access (typically less than 30 mph)	Closest 50th percentile or rounded down from 50th percentile	Items above, AND Greater sensitivity to context (e.g., active transportation)

DKS

APPENDIX C: INPUTS FOR NCHRP 17-76 TOOL

Site Description Data		
Urban	Roadway context	Clear all data
Principal arterial	Roadway type	
Yes	Are crash data available?	
DKS	Analyst	Enter default data
10/15/2020	Date	
N 175th St	Roadway name	
Aurora to 15th Ave NE	Description	Test macros
35	Current speed limit (mph)	
	Notes	

Analysis Results		
	Speed limit setting group	Developed
	Suggested speed limit (mph)	**30**

Speed Data	
60	Maximum speed limit (mph)
38.3	85th-percentile speed (mph)
32.4	50th-percentile speed (mph)

Site Characteristics	
1.5	Segment length (mi)
4	Number of lanes (two-way total)
Undivided	Median type
6	Number of traffic signals
48	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Not present	Sidewalk buffer
Some	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
19,988	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
477	All (KABCO) crashes for crash data period	
165	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	587.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	171.6
	Critical KABCO crash rate (crashes / 100 MVMT)	486.2
	Critical KABC crash rate (crashes / 100 MVMT)	150.5

DKS

Site Description Data		
Urban	Roadway context	Clear all data
Principal arterial	Roadway type	
Yes	Are crash data available?	
DKS	Analyst	Enter default data
10/15/2020	Date	
15th Ave N	Roadway name	
NE 145th St to 175th St	Description	Test macros
35	Current speed limit (mph)	
	Notes	

Analysis Results	
Speed limit setting group	Developed
Suggested speed limit (mph)	**30**

Speed Data	
60	Maximum speed limit (mph)
43.3	85th-percentile speed (mph)
32.3	50th-percentile speed (mph)

Site Characteristics	
1.5	Segment length (mi)
2	Number of lanes (two-way total)
TWLTL	Median type
6	Number of traffic signals
57	Number of access points (total of both directions)
High / Not separated	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Not present	Sidewalk buffer
Some	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
18,306	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
288	All (KABCO) crashes for crash data period	
114	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	329.2
	1.3 x average KABC crash rate (crashes / 100 MVMT)	101.6
	Critical KABCO crash rate (crashes / 100 MVMT)	279.9
	Critical KABC crash rate (crashes / 100 MVMT)	93.2

DKS

Site Description Data	
Suburban	Roadway context
Minor arterial	Roadway type
Yes	Are crash data available?
DKS	Analyst
10/15/2020	Date
N Richmond Beach Rd	Roadway name
From Fremont Ave N to 3rd Ave NW	Description
35	Current speed limit (mph)
	Notes

Clear all data

Enter default data

Test macros

Analysis Results	
Speed limit setting group	Developed
Suggested speed limit (mph)	**30**

Speed Data	
60	Maximum speed limit (mph)
34.4	85th-percentile speed (mph)
29.3	50th-percentile speed (mph)

Site Characteristics	
0.5	Segment length (mi)
4	Number of lanes (two-way total)
Undivided	Median type
3	Number of traffic signals
4	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Not present	Sidewalk buffer
Some	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
Yes	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
16,706	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
130	All (KABCO) crashes for crash data period	
63	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	587.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	171.6
	Critical KABCO crash rate (crashes / 100 MVMT)	517.3
	Critical KABC crash rate (crashes / 100 MVMT)	167.8

DKS

Site Description Data		
Suburban	Roadway context	Clear all data
Collector	Roadway type	
Yes	Are crash data available?	
DKS	Analyst	Enter default data
10/15/2020	Date	
Greenwood Ave N	Roadway name	
from N 145th St to N 160th St	Description	Test macros
35	Current speed limit (mph)	
	Notes	

Analysis Results		
	Speed limit setting group	Developed
	Suggested speed limit (mph)	**30**

Speed Data	
60	Maximum speed limit (mph)
41	85th-percentile speed (mph)
29.4	50th-percentile speed (mph)

Site Characteristics	
0.8	Segment length (mi)
2	Number of lanes (two-way total)
Undivided	Median type
0	Number of traffic signals
24	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
None	Sidewalk presence / width
None	Sidewalk buffer
Some	Pedestrian activity
Not high	On-street parking activity
Yes	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
8,552	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
35	All (KABCO) crashes for crash data period	
12	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	298.4
	1.3 x average KABC crash rate (crashes / 100 MVMT)	91.3
	Critical KABCO crash rate (crashes / 100 MVMT)	281.4
	Critical KABC crash rate (crashes / 100 MVMT)	99.9

DKS

Site Description Data		
Urban	Roadway context	Clear all data
Minor arterial	Roadway type	
Yes	Are crash data available?	Enter default data
DKS	Analyst	
10/15/2020	Date	Test macros
Meridian Ave N	Roadway name	
NE 145th St to 205th St	Description	
35	Current speed limit (mph)	
	Notes	

Analysis Results	
Speed limit setting group	Developed
Suggested speed limit (mph)	**30**

Speed Data	
60	Maximum speed limit (mph)
35.7	85th-percentile speed (mph)
31.3	50th-percentile speed (mph)

Site Characteristics	
3	Segment length (mi)
2	Number of lanes (two-way total)
Undivided	Median type
6	Number of traffic signals
77	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Adequate	Sidewalk presence / width
Present	Sidewalk buffer
Some	Pedestrian activity
Not high	On-street parking activity
Yes	Parallel parking permitted?
No	Angle parking present?
No	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
5,050	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
361	All (KABCO) crashes for crash data period	
131	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	267.0
	1.3 x average KABC crash rate (crashes / 100 MVMT)	82.9
	Critical KABCO crash rate (crashes / 100 MVMT)	238.0
	Critical KABC crash rate (crashes / 100 MVMT)	82.3

DKS

Site Description Data		
Urban	Roadway context	Clear all data
Principal Arterial	Roadway type	
Yes	Are crash data available?	
DKS	Analyst	Enter default data
10/15/2020	Date	
15th Ave NE	Roadway name	
From NE 180th St to NE 196th St	Description	Test macros
35	Current speed limit (mph)	
	Notes	

Analysis Results	
Speed limit setting group	Developed
Suggested speed limit (mph)	**35**

Speed Data	
60	Maximum speed limit (mph)
39	85th-percentile speed (mph)
34.9	50th-percentile speed (mph)

Site Characteristics	
0.81	Segment length (mi)
4	Number of lanes (two-way total)
Undivided	Median type
4	Number of traffic signals
23	Number of access points (total of both directions)
Not high / Any type	Bicyclist activity / bike lane type
Narrow	Sidewalk presence / width
Not present	Sidewalk buffer
Negligible	Pedestrian activity
Not high	On-street parking activity
No	Parallel parking permitted?
No	Angle parking present?
Yes	Adverse alignment present?

Crash Data		
10	Number of years of crash data	
13,740	Average AADT for crash data period (veh/d)	
No	Is the segment a one-way street?	
102	All (KABCO) crashes for crash data period	
35	Fatal & injury (KABC) crashes for crash data period	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	587.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	171.6
	Critical KABCO crash rate (crashes / 100 MVMT)	508.4
	Critical KABC crash rate (crashes / 100 MVMT)	162.9

APPENDIX D: DRAFT WASHINGTON STATE INJURY MINIMIZATION AND SPEED MANAGEMENT POLICY ELEMENTS AND IMPLEMENTATION RECOMMENDATIONS

The October 2020 draft of the Washington State Injury Minimization and Speed Management Policy Elements and Implementation Recommendations was prepared and reviewed by the Washington Injury Minimization and Speed Management Policy and Guidelines Workgroup. This group consists of several federal, Tribal, state, and local agency staff.

Washington State Injury Minimization and Speed Management Policy Elements and Implementation Recommendations

Prepared and Reviewed by:

Washington Injury Minimization and Speed Management Policy and Guidelines Workgroup

Members

Andrew Beagle, P.E. City of Olympia
Charlotte Claybrooke, WSDOT, Active Transportation Division (Facilitator)
Scott Davis, P.E. WSDOT, Headquarters (HQ) Traffic Operations, Formally with Thurston County
Josh Diekmann, P.E. PTOE City of Tacoma (Active Transportation Safety Council Member)
John Deskins, P.E. City of Richland
Dongho Chang, P.E. Traffic Engineer, City of Seattle (Active Transportation Safety Council Member)
Mike Dornfeld, P.E. WSDOT, HQ Traffic Operations
Peter Eun, Transportation Safety Engineer, Federal Highway Administration, Resource Center, Safety and Design Team, Pedestrian Safety
Matthew Enders, P.E. WSDOT, HQ Local Programs
Will Hitchcock, Washington State Department of Health
Colleen Jollie, Retired WSDOT Tribal Liaison
Scott Langer, P.E. WSDOT Southwest Region, Assistant Region Traffic Engineer
Katherine Miller, P.E. City of Spokane
John Milton, Ph.D, P.E., RSP2I, PTOE, WSDOT, HQ Transportation Safety & Systems Analysis, State Safety Engineer
Gabe Philips, AICP WSDOT, HQ Multimodal Planning
Chris Schroedel, WSDOT, HQ Design Office & Lead for WSDOT Multimodal Technical Forum
Jeff Shea, P.E. Kitsap County
Ida Van Schalkwyk, Safety Engineer, WSDOT, HQ Design Office
Kirk Vinish, AICP Lummi Tribe
Scott Waller, Washington Traffic Safety Commission
Ravyn Whitewolf, City of Blaine (WA City Design Standards Committee Member)
Chris Workman, P.E. Washington Transportation Improvement Board

Octoberr 2020 DRAFT

DISCLAIMER
The contents of this document reflect the views of the Injury Minimization and Speed Management Workgroup members. The contents do not necessarily reflect the official views or policies of the agencies that they represent. This document does not constitute a standard, specification, or regulation.

Introduction

The numbers of fatal and serious injury traffic crashes in Washington State (2791 in 2019) present a basis for making bold changes to stop them. Motorist driving speeds and vehicle size create physical forces that are greater than the human body can tolerate during a crash. This leads to the outcome of crashes for all users of the roadways and especially those who walk or bike susceptible far too often to fatal and serious injuries. Washington's Strategic Highway Safety Plan "Target Zero," and many local agency "Vision Zero" plans recognize that speed setting through the notion of injury minimization would result in a significant reduction in fatal and serious injuries for all road users. The Injury Minimization and Speed Management Workgroup has studied the findings of multiple reports, scientific papers, legislative statutes, manuals, and recommendation documents to understand the issues. This work reflects other national and state efforts to address speed and injury severity such as the National Association of City Transportation Officials City Limits, the Oregon Speed Zone Standards and the Institute of Transportation Engineers Speed Management for Safety.

The information reviewed show a direct link between driver speed and more severe outcomes for those involved in a traffic crash. The facts provide robust justification for an injury minimization and speed management policy and recommendations. In recognition of the findings and as a step towards accomplishing the Washington State Strategic Highway Safety Plan goal of zero deaths and zero serious injuries by 2030, the Injury Minimization and Speed Management Workgroup has prepared this document.

Facts

Speed management for injury minimization is a recommended strategy in the 2019 Washington State Strategic Highway Safety Plan.

Washington State public agencies actively promote safe roads through planning, design, operation, maintenance, education, and enforcement for users of all ages and abilities.

All users of the transportation system regardless of mode are equally deserving of safe facilities to accommodate their travel.

Research finds that:

- As the operating speed of a road increases the likelihood of crashes increases[i];
- The link between speed and injury severity in crashes is consistent, direct and especially critical for pedestrians,[ii] bicyclists, and users of mobility assistive devices;
- Reducing speed limits has resulted in reduced driver speeds in urban environments;[iii]
- Speed management design treatments such as roundabouts and road diets have been effective in lowering operating speed [iv];
- In urban areas, using a target speed approach to reduce posted speed limits resulted in a reduction in speed, speed variance, and road safety for all road users;[v]

- Past transportation decisions and investments often resulted in disparities in the distribution of benefits and burdens, including higher-speed roads, less pedestrian infrastructure, and fewer controlled crossing opportunities in neighborhoods subjected to redlining and other discriminatory practices[vi][vii];
- Depending on the initial absolute speed, each one mile per hour reduction in the average operating speed results in a reduction in fatal crashes of between 7 and 22 percent;[viii]
- Roads with speed limits at or above 45mph show about 4 times more bicyclist deaths and 32-54 percent more bicyclist serious injuries than roads with speed limits less than 30 mph;[ix]
- The ranges below represent the threshold speeds from the research where they found a 10% risk of a fatality (Table 1) and of a serious injury (Table 2) for the different crash types:

Table 1 Fatality Probability and Vehicle Impact Speed[x] [xi] [xii] [xiii] .

Crash Type	Driver Speed (10% Fatal Injury Risk)
Pedestrian or Bicyclist/vehicle crash	20[xiv] – 25[xv] MPH
Side impact crash vehicle/vehicle (typically at intersections)	30 MPH
Head-on vehicle/vehicle (typically no median barriers)	30[xvi] - 45[xvii] MPH
Rear-end vehicle/vehicle	35[xviii] – 70[xix] MPH

Notes: Speed limits from kilometers per hour have been converted to miles per hour. Speed limits are rounded to the nearest US speed limit. Ranges vary due to the different research study results.

Table 2 Severe Injury Probability and Vehicle Impact Speed[xx].[xxi]

Crash Type	Driver Speed (10% Severe Injury Risk)
Pedestrian/vehicle crash	10 – 20 MPH
Side impact crash vehicle/vehicle (typically at intersections)	20 MPH
Head-on vehicle/vehicle (typically no median barriers)	20 MPH
Rear-end vehicle/vehicle	35 MPH

Notes: Speed limits from kilometers per hour have been converted to miles per hour. Speed limits are rounded to the nearest US speed limit. Ranges vary due to the different research study results.

Conclusion

Year after year thousands of people die or become seriously injured while using Washington State roads. Driver speed is directly linked to the likelihood of a crash and to crash severity. The current system is not bringing about the desired goals of reducing injuries and eliminating traffic deaths. Taken together the information and research reviewed by the work group presents a strong basis for the need to change the operating speeds on many segments of Washington's streets and roads.

Key changes needed to lower operating speeds include modifications to the existing geometric design speed approach and typical approach to setting speed limits. The Injury Minimization and Speed Management Workgroup encourages agencies in Washington to adopt an injury minimization and speed management policy and/or other changes, as outlined in the recommended policy elements below. These are followed by implementation recommendations that can be used with or without a policy to shift towards lowering driver speeds and eliminating transportation-related deaths and serious injuries.

All owners of public roads, streets, and highways in Washington State are encouraged to use the recommended *Injury Minimization and Speed Management Policy Elements* below to create, adopt and implement Injury Minimization and Speed Management Policies and/or other changes applicable for their agencies.

Recommended Elements of an Injury Minimization and Speed Management Policy

Adopt and implement an injury minimization speed setting approach to achieve speed limits that will minimize injury severity should a crash occur to eliminate traffic fatalities and serious injuries.

Adopt a broader Safe Systems Approach **to identify locations to prioritize** for injury minimization and speed management improvements. This includes locations that present a higher possibility of serious injury or fatal crashes occurring based on land use context, observed crash data, crash potential, and/or roadway characteristics that are likely to increase exposure.

Consider injury minimization and speed management in all transportation investments and project phases regardless of funding source, including but not limited to, planning, programming, design, right-of-way acquisition, subdivision and land development, updating geometric and street section standards, new construction, construction engineering, reconstruction, operation, traffic control selection, system management, repair, maintenance and funding identification.

Injury Minimization Speed Setting Approach

- Establish target speeds;
- Use default/category target speeds;
- Where the operating speed is within 5mph of the target speed adopt the target speed;
- Where the operating speed exceeds the target speed by 5mph, use an engineering study to determine iterative speed limits and implement speed management;
- Make incremental adjustments of 5mph or more, as motorist response to speed management until the target speed is achieved.

More details are in the speed setting recommendations below.

Collaborate with neighboring jurisdictions regarding injury minimization and speed management implementation and the use of the recommendations below, working together to develop and improve the transportation network to achieve the state Target Zero goal.

Require training on injury minimization and speed management techniques. Training should extend to everyone working on transportation projects including designers, planners, and consultants. See the Professional Development and Training recommendations below.

Adopt access control, access management policies, and land use development policies/ordinances and practices that consider target speeds rather than just the existing speeds to support injury minimization and speed management treatments and system management.

Adopt a Washington State "Target Zero" or "Vision Zero" safety goal of eliminating fatal and serious injuries and plan for safety. (Example: Seattle Vision Zero or Thurston County Comprehensive Plan)

If an exception is made to an adopted policy element, document the reason for the exception and make information about the decision available publicly.

The policy purpose is to eliminate fatal and serious injury crashes by aligning injury minimization speeds, travel (operating) speeds, posted speed limits, design speed, operations, land use function and road purpose. The results of changes will not be immediate. WSDOT, large cities, small cities, and counties will face different issues regarding injury minimization and speed management across different road types, characteristics of existing roads, and context. These efforts contribute to a continuum of change.

Recommendations to Achieve Target Speeds

The following recommendations are for practitioners including those who set speed limits, design engineers and planners. Recommendations for law enforcement, transportation data management professionals, policy makers and advocacy groups are included in Appendix A. All are needed to shift the culture of speed and reduce transportation-related deaths and serious injuries.

Speed Setting Recommendations

- Use an injury minimization speed setting approach:
  - Establish injury minimization target speeds for all roads based on the road and land use context, potential for different crash types, the impact forces that result, and the human body's tolerance to withstand those forces (consider the data tables on page 3). The goal is to minimize injury severity should a crash occur in order to eliminate traffic fatalities and serious injuries. **Examples*** – set:
    - 20 mph target for residential and business districts;
    - 25 mph or less target for arterials and state highways that are not limited access (or other arterials that act in a similar way) in urban, suburban and rural town centers where origins and destinations are within a walking (1 mile) or biking (3 mile) distance;
    - 30-45 mph on rural roads where there are no median barriers and head-on collisions are possible.

    The target speed may be a speed that will require a phased approach to bring operating speeds down over time.

Other good resource information about identifying target speeds and setting speed limits for minimize injury can be found in the NACTO City Limits Guide, the Oregon Department of Transportation Speed Zone Standards and the Institute of Transportation Engineers Setting Speed Limits website.

* Examples refer to the research documented on page 2 above.

- Use default and/or category injury minimization target speed limits in all areas that have the same context, density, and/or road characteristics. Examples of this include adopting one speed for all rural roads with the same driveway/access density or all roads with horizontal curves that limit visibility. In population centers this could include adopting one speed for all of the roads that go through or are adjacent to residential and business districts.
- Where the operating speed is within 5mph of the target speed adopt the target speed and post the target speed. Use speed management techniques as needed to reach compliance.
- Where the operating speed exceeds the target speed by more than 5mph, use an engineering study to determine a starting posted speed limit that will be adjusted down over time until the target speed can be obtained. Post the speed rounded down to the nearest 5 mph increment. This may result in posting the target speed even if it is more than 5mph below the operating speed. Implement speed management techniques to change the look of

the road to obtain lower speeds. Make incremental adjustments to the posted speed limits of 5mph or more, keeping them consistent with motorist response to speed management so they remain credible and elicit compliance. Where a significant difference exists between the operating speed and the injury minimization target speed, this may require an iterative process to step operating speed down over a longer period of time. Note: This approach requires more time and is more expensive than a more complete shift to the target speed with speed management all at once.

- Keep in mind that engineering speed study approaches such as the 50th percentile, 85th percentile and 10 MPH pace speed evaluate speeds based on motorist perceptions and that such studies can bias results towards higher speeds. Drivers will be responding to design cues and the behaviors of other drivers. The results of these studies do not equate to the speed with the lowest crash involvement rate for all road types or to the desired target speed.[xxii] Such studies are to be used to identify the degree of change needed and may serve as evaluation tools for progress toward the target speed.
- Information sources that help identify where speed management treatments are needed most may include:
  - Speed survey data including 50th percentile or 10 MPH pace;
  - Crash history, particularly serious injury and fatal crashes. Apply a safe systems approach when using crash history to determine road characteristics and speeds that are associated with fatal/serious injury crashes across the road network and make system-wide changes to prevent crashes proactively in all similar locations.
  - Numbers of speeding tickets issued and variance from posted speed; speeds well in excess of current posted speed indicate higher crash potential and more severe consequences in a crash.
  - Refine the steps and data sources for injury minimization and speed setting engineering studies and provide direction for how to use an injury minimization speed setting approach.
- Where operating speeds change throughout the day because of traffic volumes, use speed management techniques to achieve the target speed for the road during the low peak times to prevent increases in operating speeds that may become evident as vehicle volumes decrease. This maintains the purpose of the injury minimization target speed in addressing the safety needs of all road users.
- Use a multimodal approach to level of service (LOS), to provide LOS performance measurement information for users of all modes appropriate to the injury minimization context and goals.
- Update the WSDOT traffic manual or local agency operational guidance to provide direction on how to use an injury minimization and speed management approach while operating within the speed setting flexibility provided in:
  - The Washington modifications to the MUTCD,
  - The functional and context classification of the roadway,
  - The statutory range for posted and unposted speeds.

When updating guidance, include information on consideration for land use, the function of the roadway, and the number of approaches per mile.

- Develop criteria for when an engineering study would result in the decision to post a 10 or 15 mph speed limit for shared streets (woonerfs, mall/market streets, etc.).
- Provide guidance that addresses tort barriers related to setting injury minimization speed limits.
- Encourage agencies to use RCW 46.61.415 (3)(a) - to establish maximum speed limits of twenty miles per hour on non-arterial highways, or part of a non-arterial highway, that are within a residential district or business district.
- Convene a workgroup to consider changes to the Washington Administrative Code (WAC) 468-95-045 to allow for speed setting based on injury minimization target speeds without a requirement to reevaluate existing speed limits.

Design and Geometric Recommendations

- Where the operating speed exceeds the injury minimization target speed, identify, and install design speed management countermeasures to create vertical deflection, horizontal deflection, vertical delineation, gateway treatments, roundabouts, and access control. FHWA Engineering Speed Management Countermeasures website is a resource for this information.
- Proactively implement roadway reallocation (road diets) where traffic volumes allow, using bike, transit or parking lane conversions where possible reducing the number of travel lanes. This will lower speeds and help to prevent aggressive driving/passing or severe speed differentials, where some drivers obey a lower posted speed limit and others do not. This may include roads with a bus lane during peak hours and switching to a parking lane for off peak hours.
- Narrow lane widths at intersections and along corridors between intersections. This is especially important for the curb or outside lane of multi-lane roads.
- At intersections consider converting turn lanes to curb extensions or median islands.
- Change or implement policies needed to allow for the use of design elements to achieve target speeds.
- Strengthen all agency's, including WSDOT's, Design and Traffic Manuals and Design and Operational guidance, criteria and standards and any locally adopted design and operational guidance or standards for roadway construction, operations and maintenance to:
  - Add more flexibility for multimodal design and operation, such as detail regarding the use of a separated path versus a wider shoulder;
  - Embed the injury minimization and speed management concepts and countermeasures;
  - Discourage overbuilding for estimated future motor vehicle capacity where such design would encourage higher operating speeds that yield higher speed limit postings and which are at the expense of safety performance for all users;
  - Include design and operational guidance that considers the change in crash and severity exposure of vulnerable users, especially where there is need to accommodate variable speeds (such as urban – rural transition areas);
  - Update design guidance with speed minimization options for locations where land use and/ or the presence of destinations suggests current or latent demand for walking and bicycling;
  - Include guidance on road geometrics, roadside design and system operation that get people to drive slower and potentially provide multimodal options before roadside development is fully built out;
  - Create speed management guidance for different road types, modal priorities and land use conditions, residential streets, urban core, collectors/arterials.
  - Update guidance on setting clear zones for all road context and local agency size. Allow for clear zone guidance/standards that consider the character of the surrounding area and avoid blanket guidance for large clear zones (allow for 4’ versus 10’ in small town business districts, for example).
  - Allow for the use of street trees, street furniture, bike parking, etc. for traffic calming.

  - Update design guidance to match the MUTCD allowance of a ½ taper length on new construction and roadway modifications when the taper is being used for a lane shift versus a lane merge. Where the taper is being used for a lane merge consider separate formulas for urban and/or suburban facilities across all ranges of speed.
- Facilitate collaboration of design, traffic, and transportation safety engineers to implement injury minimization and speed management approaches consistent with local jurisdiction safety goals.
- Adopt policies that would require developers to include injury minimization and speed management treatments in new street design and the operational characteristics of streets that they build.
- Work with local law enforcement, firefighting and other emergency response professionals to identify issues to address and generate support for injury minimization and speed management goals and implementation. Consult design resources to address potential issues, which may include:[xxiii]
  - Enforcement preference for multiple lanes so they have a lane to work in;
  - Grid versus cul-de-sac issues;
  - Lane and shoulder width;
  - On-street parking value as friction for speed management vs space for emergency vehicles;
  - Emergency vehicle size;
  - Preference for 20’ road width on each side of a traffic-calming median.
- Determine if/where WA code exempts local agencies from adopting the International Fire Code (IFC), and identify what portion of the IFC needs to be exempted from adoption in local code to allow a 28-foot street with parking on both sides. Where it prevents injury minimization target speeds from being achieved coordinate with fire department staff to consider adoption of an amended version of section D103.6 of the International Fire Code (IFC) such that required placement of Fire Lane signs is consistent with Traffic Engineer Authority as granted under WAC 308-330-265(11).
- Keep an injury minimization target speed in mind when setting minimum requirements for access management and design/operational treatments. Consider using future land use and access spacing when following RCW 47.50 and WAC 468-52 regarding managed access class warrants for posted speed.
- Develop injury minimization design guidance for on and off ramps where they intersect with other roads.
- Consider reclassification of roadways where the existing functional classification or context classification designations prevent changes to achieve injury minimization speeds, especially where roads within the same community have different designs and/or contexts but the same classification. Lowering the functional classification of a road will sometimes be necessary to allow an injury minimization target speed to be achieved. Recognize that in some locations functional classification may need to be changed to better serve the needs of all road users.

Traffic Operations Recommendations

- Where the operating speed exceeds the injury minimization target speed, identify and install the appropriate traffic control countermeasures found in the FHWA Engineering Speed Management Countermeasures website such as signing, pavement markings, and dynamic signage.
- Use automated traffic safety and speed enforcement cameras in school zones, at traffic signals, and at other locations that may be approved under statute to help maintain speed limit and traffic signal compliance.
- Consider traffic signal timing and operations to manage for target speeds. This may be more effective where there is heavy traffic, in urban areas, dense pedestrian traffic and/or on one-way corridors. This treatment may be particularly challenging where there is more travel lane capacity than needed. As needed use traffic safety cameras to improve traffic signal compliance should it become an issue.
- Prioritize roundabouts when considering traffic control changes or updates at intersections due to their effectiveness at lowering operating speeds.
- Consider additional crossing times for pedestrians and bicyclists based on contextual needs of the location.
- Use radar feedback signs with messaging to help the public understand the importance of driving at injury minimization speeds ("safety over speed" messaging), and a reminder that the speed limit is the upper limit.

Issues Specific to Rural Roads

- Motorist expectation is for higher speeds on rural roads and therefore speed management may be more challenging due to:
  - History of higher posted speeds in rural areas
  - Longer segments between intersections
  - Motorists traveling longer distances between destinations
  - Wide clear areas with less natural visual friction for the motorists

  Examples of common rural road fatal or serious injury crash types where operating speed is an issue are where the vehicle hit a fixed object or run off the road collisions
- Speed management treatments that have been effective on rural roads:
  - Round-abouts
  - Speed feedback signs
  - School zone flashing beacons
  - Decreasing the number of travel lanes (road reconfigurations)
- Speed management treatments that may need further engineering judgement before being used on rural roads and are dependent on land use context:
  - Speed humps/bumps
  - Pinch points
  - Narrowing travel lane width

Professional Development and Training Recommendations

- Provide educational opportunities for traffic and transportation safety professionals to learn about the injury minimization speed management approach, the importance of driving speeds in determining crash likelihood and injury severity, and design and operational techniques to achieve lower operating speeds through self-enforcing streets.
- Encourage attendance at conferences, classes, seminars, webinars and workshops regarding safe systems, injury minimization, and speed management issues when available.
- Provide training about the relationship between the 85th percentile operating speed in different locations and the effect of increasing speed limits on fatal and serious injury crashes versus less severe crashes.
- Share case studies of policies/process where local fire departments support exemptions of the International Fire Code section from adoption in local code to allow for injury minimization treatments, such as streets that are 28 feet or less in width.
- Provide training about how to use an injury minimization speed setting approach for future changes to speed limits and decisions about new road speed limits, including information about land use context and the potential mix of transportation modes that will be using the facilities.
- Include information about the relationship between injury minimization speed management and land use/zoning/development decisions in educational opportunities for planners.
- Provide educational opportunities about how to determine which streets need traffic calming techniques and which traffic calming techniques are best for different street types (residential, business district, etc.).
- Provide human factors training to improve the understanding of how road users interact, understand, see, and make choices on road systems.

Recommendations about Funding

- Inventory and provide information about all current and potential future sources of funding for injury minimization roadway improvements.
- Encourage competitive grant programs (such as the WSDOT City/County Safety Program, Safe Routes to School and the Pedestrian and Bicycle Safety Program, TIB grant programs, and other sources) to make injury minimization and speed management practices eligible for funding and add injury minimization consideration in the selection criteria;
- Identify and pursue opportunities to incorporate speed management treatments with other projects and programs (such as roadway reallocation as part of preservation projects).

Site Design and Land Use Planning Recommendations

- Design buildings to be closer to the road.
- Avoid putting large parking lots between the road and the building.
- Encourage Metropolitan Planning Organizations and Regional Transportation Planning Organizations to support land use density as well as setting direction for roadway context and use that supports an injury minimization and speed management approach.

Glossary

10 MPH Pace Speeds - the range in which the highest percentage of drivers are going or the 10 MPH range containing the most vehicles.

50th Percentile Speed – the median speed.

Category Speed Limits – Where speed limits are assigned to specific categories of streets. Major streets in a jurisdiction would have a given speed limit and so would minor streets. The categories and speed limits would be set once for all streets in that category within the jurisdiction. They would not require an engineering traffic study to be enforceable.

Default Speed Limits – A speed limit that is applicable for all roads within a given jurisdiction. Minimal posted speed limit signs are needed. They do not require an engineering traffic study to be enforceable.

Operating Speed – The speeds at which motorists are observed driving their vehicles. This may be determined by road studies such as the 10mph Pace, or 50th percentile methodology depending on the agencies policy.

Posted Speed – the maximum lawful speed for a particular location as displayed on a regulatory sign.

Limited Access Arterials – where direct admission to or from adjacent lands/property is restricted, and interchanges are used rather than at grade intersections.

Speed Management – The use of engineering, traffic control and road design to induce drivers to travel at target speeds. This often includes treatments to lower motorist speeds along linear road segments or during turning movements at intersections.

Safe Systems Approach - The Safe Systems Approach begins by examining the contributing factors and road characteristics associated with serious injuries and deaths. It focuses on addressing these factors directly in ways that improve outcomes for all users regardless of their mode, actions, or human conditions. The Safe Systems approach recognize that the human body has a limited tolerance for the forces during a crash, that humans make mistakes, and that all stakeholders (users, designers and managers of infrastructure, vehicle manufacturers, etc.) have a responsibility to reduce deaths and serious injuries. More information is available at ITE Safe Systems.

Target Speed – the highest operating speed at which vehicles should ideally operate on a roadway in a specific context.

Additional References

NCHRP Report 737: Design Guidance for High-Speed to Low-Speed Transitions Zones for Rural Highways
NCHRP 535 Pedestrian Safety Relative to Traffic-Speed Management:
NACTO City Limits
NACTO Urban Street Design Guide - Design Speed
FHWA Engineering Speed Management Countermeasures
FHWA Methods and Practices for Setting Speed Limit
CalSTA – Zero Traffic Fatalities Task Force Report of Findings
Analysis of SHRP2 Speeding Data
A New Approach to a Safe and Sustainable Road Structure and Street Design for Urban Areas. Research Synthesis for the California Zero Fatalities Task Force
ITE and FHWA - Noteworthy Speed Management Practices

[i] R. Elvik, P. Christensen, and A. Amundsen. Speed and Road Accidents: An Evaluation of the Power Model." (2004). The Institute of Transport Economics (TOI), TOI Report 740/2004 (December).
[ii] National Transportation Safety Board. (2017). Reducing Speeding-Related Crashes Involving Passenger Vehicles. Safety Study NTSB/SS-17/01. Washington DC. http://www.trb.org/SafetyHumanFactors/Blurbs/176455.aspx
[iii] https://www.seattle.gov/Documents/Departments/SDOT/VisionZero/SpeedLimit_CaseStudies_Report.pdf
[iv] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. https://www.sciencedirect.com/science/article/pii/S2352146516304021
[v] Md. Tazul Islam, Karim El-Basyouny, and Shewkar E. Ibrahim. (2014). The impact of lowered residential speed limits on vehicle speed behavior. Safety Science, 62, February, 483-494. https://www.sciencedirect.com/science/article/pii/S0925753513002312;
[vi] A. Karner, D. Rowangould, and J. London. (2016). We Can Get There From Here: New Perspectives on Transportation Equity. USDOT, National Center for Sustainable Transportation. https://escholarship.org/uc/item/1z28n542;
[vii] P. Morency, L. Gauvin, C. Plante, M. Fournier and C. Morency. (2012). Neighborhood Social Inequalities in Road Traffic Injuries: The Influence of Traffic Volume and Road Design. American Journal of Public Health, 102:6, 1112-1119. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3483951/;
[viii] Elvik, R., Vadeby, A., Hels, T., van Schagen, I., 2019. Updated estimates of the relationship between speed and road safety at the aggregate and individual levels. Accid. Anal. Prev. 123, 114-122. https://doi.org/10.1016/j.aap.2018.11.014
[ix] Grembek, Offer, PhDChen, KatherineTaylor, Brian D., PhDHwang, Yu HongFitch, Dillon, PhDAnthoine, SoniaChen, BingchuGrover, Salvador, 2020. Research Synthesis for the California Zero Traffic Fatalities Task Force. University of California Institute of Transportation Studies. https://doi.org/10.7922/G2KP80DW
[x] Hussain, Q., Feng, H., Grzebieta, R., Brijs, T., Olivier, J., 2019. The relationship between impact speed and the probability of pedestrian fatality during a vehicle-pedestrian crash: A systematic review and meta-analysis. Accid. Anal. Prev. 129, 241–249. https://doi.org/10.1016/j.aap.2019.05.033
[xi] Sam D. Doecke, Craig N. Kloeden, Jeffrey K. Dutschke and Matthew R. J. Baldock (2018). Safe speed limits for a safe system: The relationship between speed limit and fatal crash rate for different crash types. Traffic Injury Prevention, 19:4, 404-408, DOI: 10.1080/15389588.2017.1422601. https://www.tandfonline.com/doi/abs/10.1080/15389588.2017.1422601;
[xii] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. https://www.sciencedirect.com/science/article/pii/S2352146516304021;
[xiii] Ryosuke Watanabe, Hiroshi Miyazaki, Yuichi Kitagawa, and Tsuyoshi Yasuki. (2011). Research of Collision Speed Dependency of Pedestrian Head and Chest Injuries Using Human FE Model (THUMS Version 4), 22nd International Technical Conference on the Enhanced Safety of Vehicles (ESV). https://www-esv.nhtsa.dot.gov/Proceedings/22/files/22ESV-000043.pdf;
[xiv] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. https://www.sciencedirect.com/science/article/pii/S2352146516304021;
[xv] Sam D. Doecke, Craig N. Kloeden, Jeffrey K. Dutschke and Matthew R. J. Baldock (2018). Safe speed limits for a safe system: The relationship between speed limit and fatal crash rate for different crash types. Traffic Injury Prevention, 19:4, 404-408, DOI: 10.1080/15389588.2017.1422601. https://www.tandfonline.com/doi/abs/10.1080/15389588.2017.1422601;
[xvi] Sam D. Doecke, Craig N. Kloeden, Jeffrey K. Dutschke and Matthew R. J. Baldock (2018). Safe speed limits for a safe system: The relationship between speed limit and fatal crash rate for different crash types. Traffic Injury Prevention, 19:4, 404-408, DOI: 10.1080/15389588.2017.1422601. https://www.tandfonline.com/doi/abs/10.1080/15389588.2017.1422601;

[xvii] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. https://www.sciencedirect.com/science/article/pii/S2352146516304021;
[xviii] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2015). Proposed vehicle impact speed - severe injury probability relationships for selected crash types. https://www.sciencedirect.com/science/article/pii/S2352146516304021;
[xix] Sam D. Doecke, Craig N. Kloeden, Jeffrey K. Dutschke and Matthew R. J. Baldock (2018). Safe speed limits for a safe system: The relationship between speed limit and fatal crash rate for different crash types. Traffic Injury Prevention, 19:4, 404-408, DOI: 10.1080/15389588.2017.1422601. https://www.tandfonline.com/doi/abs/10.1080/15389588.2017.1422601;
[xx] Chris Jurewicz, Amir Sobhani, Jeremy Woolley, Jeffrey Dutschke, and Bruce Corben. (2016). Exploration of Vehicle Impact Speed – Injury Severity Relationships for Application in Safer Road Design. https://www.sciencedirect.com/science/article/pii/S2352146516304021;
[xxi] Tefft BC. Impact speed and a pedestrian's risk of severe injury or death. Accid Anal Prev. 2013;50:871-878. doi:10.1016/j.aap.2012.07.022. https://pubmed.ncbi.nlm.nih.gov/22935347/
[xxii] NTSB. (2017). Reducing Speeding-Related Crashes Involving Passenger Vehicles. https://www.ntsb.gov/safety/safety-studies/Documents/SS1701.pdf.
[xxiii] Los Angeles County Department of Public Health. (2013). Best Practices: Emergency Access in Healthy Streets. https://nacto.org/wp-content/uploads/2015/04/Best-Practices-Emergency-Access-in-Healthy-Streets.pdf. NACTO. (2018). Webinar – Fire Trucks and Vision Zero. https://nacto.org/event/fire-trucks-and-vision-zero/. USDOT. (2018). Optimizing Large Vehicles for Urban Environments. https://nacto.org/wp-content/uploads/2018/12/2018USDOTVolpe_Downsizing_FINAL_updated12-21-18.pdf

Appendix A

Washington State Injury Minimization and Speed Management Guidance

The following recommendations are for practitioners including transportation data management professionals, law enforcement, policy makers and advocacy groups. All are needed to shift the culture of speed and reduce transportation-related deaths and serious injuries.

Data Development, System Analysis and Evaluation Recommendations

- Complete and adopt a road safety plan (RSP) that will provide a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads.
- Use an inventory of existing roads, speed limits and land use context to determine where changes are needed (where operating speed and/or posted speed are not consistent with established injury minimization speed goals).
- Review equity analysis data to identify locations/communities to prioritize.
- Create an injury minimization and speed management performance measure (will link to the WSDOT Active Transportation Plan Injury Minimization Speed Limits performance measure as an example when available) and develop a process of data collection to assess how well the roadway system supports it.
- Obtain operating speed data using spot speed surveys, pneumatic tubes, law enforcement LIDAR, etc.
- Maintain operating speed data in a searchable system so that it can be analyzed and integrated with other system data without extensive effort.
- Use transportation geo-data to ensure the accuracy of crash data provided in Police Traffic Collision Reports.

Recommendations about Educating the Public and Elected Officials

Public support is central to implementation success. It needs to include communication and education to inform the public about the extent to which driving speeds affect the likelihood of crashes and crash severity as well as the importance of this work as part of public safety. The goal is to shift the public's expectations, to serve all of the traveling public, and prevent the road rage response (horns honking and dangerous passing) when traveling speeds are lowered.

- Develop messages to:
    - Encourage proper road use behavior by all road users;
    - Explain how and why the injury minimization speed limit methodology is used so that when new lower speed limits are set the public and elected officials can be informed about the purpose and goals of the approach used and, if needed, why the 85th percentile or other speed setting methods were not used.
    - Obtain public understanding and support for injury minimization speed limits framed in a way to prevent/reduce road rage and support a positive traffic safety culture in communities;

    - Increase public understanding of the benefits to traffic operations of reducing the rates and severity of crashes;
    - Inform the general public about the importance of using appropriate lower speed limits to save lives and achieve Target Zero.
- Encourage public health and traffic safety partners to educate the public and elected officials about the importance of speed management and injury minimization.
- Create a one-page message about injury minimization and speed management that is easy to read and understandable for decision makers (one for cities and one for counties).
- Apply principles of multicultural communication identified in the Target Zero 2019 update to prepare and share traffic safety educational materials that are meaningful, understandable, and suitable for everyone in diverse communities.
- Provide elected officials with information about adopting an injury minimization and speed management policy and how this policy guidance replicates steps used to encourage the adoption of Complete Streets Policies.
- Create a one-page concise page that shows how injury minimization efforts support Complete Streets principles for staff and elected officials to use in response to public concerns.
- Encourage the integration of injury minimization and speed management into Complete Streets policies.
- Educate drivers by using advertising, updates to school curriculum, and driver's education.
- Involve the Insurance Commissioner's office and insurance companies in communicating the importance of driver compliance with speed management for injury minimization.

Recommendations for Advocates and Elected Officials Regarding Potential Changes to Laws and Regulations

- Encourage a change to the Revised Code of Washington (RCW) to:
    - Allow for a lower speed threshold of 15 mph (for shared streets [woonerfs, bike boulevards, festival streets, or other special conditions) with an appropriate process;
    - Allow for lower speeds on rural county roads and state routes where there are not design feature such as median barriers and roundabouts to reduce/prevent head on and side impact type crashes.
    - Support injury minimization speed setting without requiring an engineering study, similar to the 20 mph code language (RCW 46.61.415). This may include qualifying criteria language to indicate where these changes will be most effective at reducing fatal and serious injury crashes. Expand the RCW to expand this option to counties.
- Work to develop posted speed range guidelines for functional classification that includes context and multimodal consideration.
- Encourage a change to RCW 46.63.170 – To expand the use of automated traffic safety cameras for speed enforcement, allow cities the ability to authorize their use within their jurisdiction, and conduct a rural pilot. This is especially important in rural areas where resources for speed enforcement are limited. Automated speed enforcement is widely acknowledged as an effective countermeasure to reduce speed-related crashes, deaths and injuries.
- Where automated traffic safety cameras are used, designate the revenue from the automated enforcement for the sole purpose of funding measures to reduce crash potential for all road users.
- Encourage changes in statute that will limit liability and allow design elements to be implemented before target speeds are achieved.

Enforcement Recommendations

- The purpose of this policy is to develop "self-enforcing" streets that should reduce the need for law enforcement. Emphasis should be on design, operations, and automated enforcement.
- Conduct an equity analysis to identify land use, demographic, and enforcement patterns that may give rise to concerns that will need to be addressed considering implementation of enforcement activities related to speed management. (For example, if higher-speed roadways are concentrated in low-income neighborhoods, speeding tickets in those areas create a disproportionate financial burden on residents.)
- Before undertaking any enforcement emphasis campaigns, provide training on equity issues for law enforcement, conduct culturally appropriate community education and outreach, and stipulate that law enforcement work with cultural ambassadors in diverse communities to increase understanding of the need for speed management.
- In locations where injury minimization speed limits are set, enforcement efforts should focus on addressing the top 10% of aggressive speeders. Put less emphasis on enforcement of people driving at lower speeds even where five or more vehicles are in line behind them and more emphasizes on enforcement of aggressive drivers.
- Expand the use of automated speed enforcement in school zones and streets where pedestrian and bicycle use is higher.
- Support better documentation of posted and impact speeds in Police Traffic Collision Reports.