SPEED LIMIT SETTING METHODS AND STEP-BY-STEP PROCEDURES

CITY OF BELLEVUE

FEBRUARY 2023

PREPARED FOR THE CITY OF BELLEVUE

DKS

719 SECOND AVENUE, SUITE 1250, SEATTLE, WA 98104 • 206.382.9800 • DKSASSOCIATES.COM

ACKNOWLEDGEMENTS

Chris Long, PM

Chris Iverson

Franz Loewenherz

Kurt Latt

John Murphy

Vanessa Humphreys

Robbie Cunningham Adams

Brian Chandler, PM

Lacy Brown

Veronica Sullivan

Ilana Burstein

Charles Smith

Billy McKeever

TABLE OF CONTENTS

INTRODUCTION

This *Speed Limit Setting Methods and Step-by-Step Procedures* document will be used as a supplement to the *Speed Limit Standard Operating Procedure* (SOP). It provides the actions required to determine the following speed limit-related values:

1. **Suggested Speed Limit** per the City of Bellevue Speed Limit Setting Tool that is based on a customized process (based on NCHRP Report 966) as described herein.
2. **Recommended Speed Limit** that incorporates the Suggested Posted Speed Limit, engineering judgement, coordination with law enforcement, and considers other factors such as citywide consistency, bicycle "Level of Traffic Stress[1]" and coordination with adjacent jurisdictions.
3. **Approved Speed Limit** per the approach described in the SOP that includes recommending a posted speed limit to City Council for ordinance modification.

The City will take the following approach to identifying the most appropriate speed limit for each facility (see Figure 3) by incorporating collision history, road system design, pedestrian and bicyclist activities and facilities, and surrounding context. Understanding the road setting and urban context can help determine the most appropriate speed limit and lead to additional design treatments to improve safety for all users.

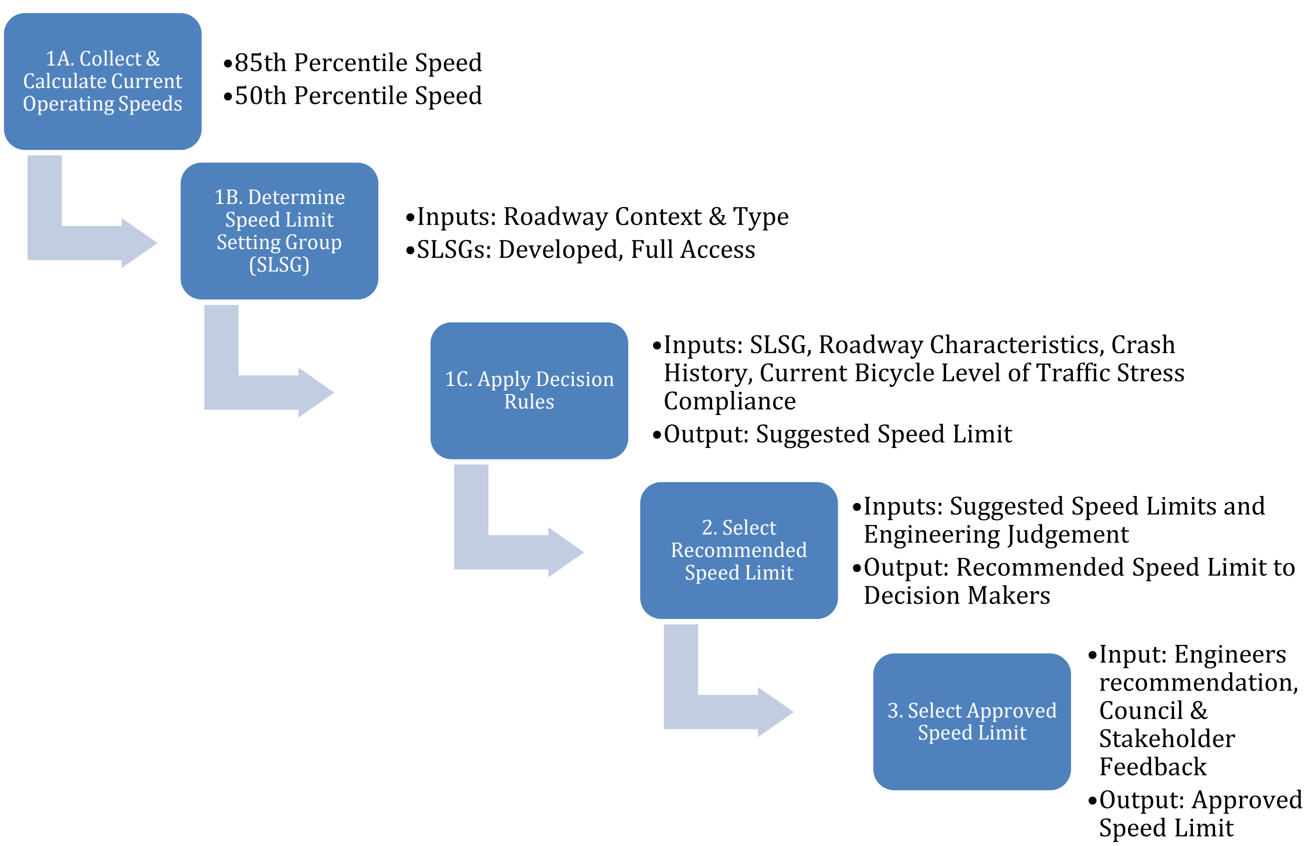

Figure 1: Overview of the Expert System Approach to a Speed Limit Setting Procedure (adapted from NCHRP Report 966)

[1] "Bicycle level of traffic stress (LTS) is defined in Figure 11 of the *Mobility Implementation Plan*.

STEP 1. SUGGESTED SPEED LIMIT

The following steps will lead to a suggested regulator speed limit.

STEP 1A: COLLECT CURRENT OPERATING SPEEDS

Traffic studies are typically collected by the City for a variety of reasons including as part of ongoing roadway monitoring and reporting, associated with project implementation and evaluation, and in response to community traffic concerns. Traffic studies are conducted by an on-call consultant who deploys pneumatic tube counts to collect operating speeds, traffic volumes, vehicle classification, and other attributes. Reports—typically for periods of 7-days—are then provided to the City that include variables that such as average, 50^{th} percentile, 85^{th} percentile, and 95^{th} percentile speeds, 10 mph pace, and percent in pace; along with providing a breakdown of speed and volume data in day, hour, and speed bins. The following criteria should be used when collecting new speed data:

1. New speed counts should be taken at the same location as previous counts for data comparison purposes unless there is concern that the old location may no longer provide accurate free flow speed data.
2. Tubes should be placed mid-block away from driveways, intersection, crosswalks and traffic signals to obtain the best free flow speeds.
3. Tubes should be placed away from traffic calming measures such as speed bumps, speed cushions and radar speed feedback signs.

STEP 1B: DETERMINE SPEED LIMIT SETTING GROUP (SLSG)

The next step in determining a posted speed limit is to select a Speed Limit Setting Group (SLSG) based on roadway segment context and type. These factors help City staff determine the most appropriate design criteria and elements to understand road user needs along a given segment.

ROADWAY CONTEXT

Each of the three types of land use in the city requires different geometric design practices in terms of desired operating speeds, mobility/access demands, and user groups. Each is described and illustrated in Table 1.

Table 1: Roadway Contexts

Roadway Context		Density	Land use / structures	Setback from roadway
Suburban		Medium (single and multifamily buildings and multistory commercial)	Residential, commercial, mixed	Varied setbacks with some sidewalks and mostly off-street parking
Urban		High (multistory, low-rise buildings with off-street parking)	Mixed residential and commercial uses with some institutional and industrial uses	On-street parking and sidewalks with mixed setbacks
Urban Core		Highest (multistory and high-rise buildings)	Mixed commercial, residential, and institutional uses	Small setbacks with sidewalks

The City recently defined Performance Management Areas (PMAs) as part of the *Mobility Implementation Plan* (MIP) development. The following table and figure provide a connection between the Roadway Context and Performance Management Areas.

Table 2. Roadway Context and Performance Management Areas

Roadway Context	Performance Management Area	Color
Suburban	Residential, low density	Green (PMA 1)
Urban	Mixed-Use/Commercial, moderate density	Yellow (PMA 2)
Urban Core	Mixed-Use, high density, high growth	Orange (PMA 3)

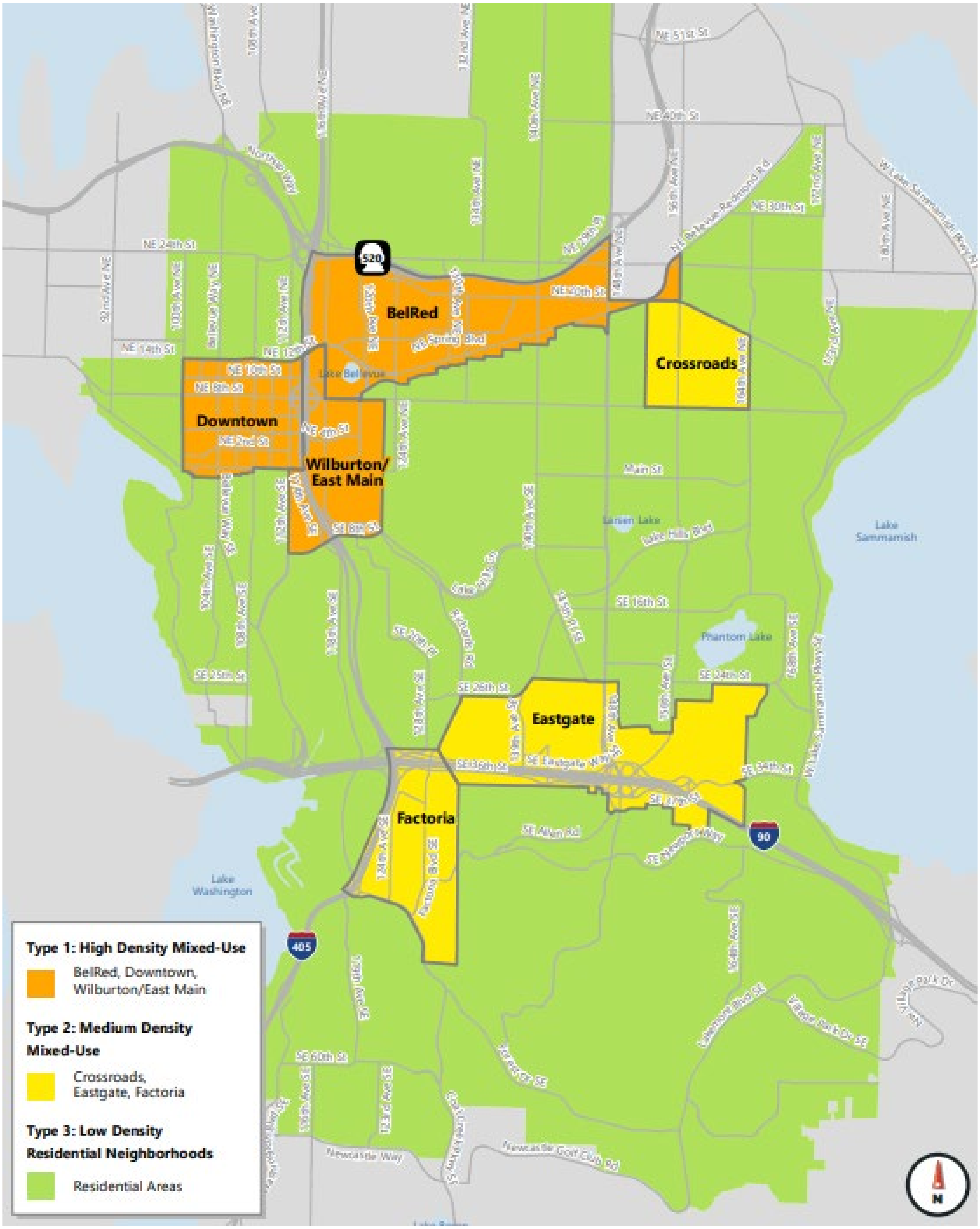

Figure 2. Performance Management Areas (Bellevue Mobility Implementation Plan)

ROADWAY TYPE

To determine roadway type, use City of Bellevue Comprehensive Plan Transportation Element Functional Class as described below.

- **Highway / Major Arterial.** "A street that provides efficient direct routes for long-distance auto travel within the region. Streets connecting freeway interchanges to major concentrations of commercial activities are classified as major arterials. Traffic on major arterials is given preference at intersections, and some access control may be exercised in order to maintain the capacity to carry high volumes of traffic." Connects large centers of activity over long distances or connects large centers of activity.
- **Minor Arterial.** "A street that provides connections between major arterials and concentrations of residential and commercial activities. The amount of through traffic is less, and there is more service to abutting land uses. Traffic flow is given preference over lesser streets." Connects centers of activity.
- **Collector Arterial.** "A street that is two or three-lanes that collects (or distributes) traffic within a neighborhood and provides connections to minor or major arterials. Collectors service neighborhood traffic and also provide access to abutting land uses. They do not carry much through traffic and are designated to be compatible with residential neighborhoods and local commercial areas." Provides connections between arterials and local roads.
- **Local Street.** "A street designed primarily to provide access to abutting land uses and carry local traffic to collector arterials. This classification includes both local and neighborhood collector streets as described in the city's Development Standards." Circulation and access only.

SPEED LIMIT SETTING GROUP

A Speed Limit Setting Group (SLSG) is a list of combined roadway contexts and types where a similar speed limit setting decision process will produce a suggested speed limit. The SLSGs are Developed and Full Access as shown in Table 3.

Table 3: Speed Limit Setting Groups (Adapted from NCHRP 966)

Context and Type	Suburban	Urban	Urban Core
Major Arterial	Developed	Developed	Full Access
Minor Arterial	Developed	Full Access	Full Access
Collector Arterial	Developed	Full Access	Full Access
Local Street	Full Access	Full Access	Full Access

STEP 1C: APPLY DECISION RULES FOR SUGGESTED SPEED LIMIT

SPEED LIMIT SETTING OPTIONS

Speed limit options include the following values based on collected operating speeds and basic statistical calculations.

- The 85th percentile speed rounded to the closest 5-mph increment (C85).
  - This is the typical/legacy method for setting all posted speed limits in most jurisdictions in the U.S.
- The 85th percentile speed rounded down to the nearest 5-mph increment (RD85).
- The 50th percentile speed rounded to the closest 5-mph increment (C50).
- The 50th percentile speed rounded down to the nearest 5-mph increment (RD50).

The operating speeds used in this process will typically be the lowest of both directions on two-way facilities. Where multiple traffic studies exist on the same corridor, the lowest speeds of all the counts should be used assuming the engineer has determined that all studies are valid and were performed in a location that captured free flow speeds. Engineering judgement should be used in cases where these two traffic study locations or the two directions of travel are dramatically different.

REQUIRED DATA ELEMENTS AND PROCEDURE TO DETERMINE SAFETY RISK

Choosing the appropriate SLSGs leads to the decision process in the following tables to determine the suggested speed limit.

DEVELOPED GROUP

Start with the Closest 85th Percentile Speed (C85) and then check each of the items in Table 4 to determine if the posted speed limit should be set lower. Any single item in the Closest 50th (C50) column determines that value as the suggested speed limit. If no variables are in the C50 column, then any single item in the Rounded Down 85th (RD85) column determines that value as the suggested speed limit.

For example, if C85 is selected for the first four rows below (Access Points, Lanes/Median/AADT, Lane Width, and Shoulder Width), but Bicyclist Activity is High, then the suggested speed limit is the Closest 50th Percentile Speed (C50).

Table 4: Speed limit decision rules for developed group

Variable	Closest 50th (C50)	Rounded Down 85th (RD85)	Closest 85th (C85)
Signal density (Includes signals at start and end of corridor)	> 4 signals/mile	> 3 signals/mile	≤ 3 signals/mile
Access density	> 60 driveways (residential & commercial) and unsignalized intersections per mile	> 40 and ≤ 60 driveways/ unsignalized intersections per mile	≤ 40 driveways/ unsignalized intersections per mile
Number of lanes/ median type (undivided, two-way left-turn lane [TWLTL], or divided)	-	Four or more lanes with undivided median	Four or more lanes with divided or TWLTL median Fewer than four lanes with any median type
Bicyclist activity – in motor vehicle lane, shoulder, or non-separated bike lane	High (any arterial with striped bike lane, buffered bike lane, sharrows, or wayfinding directing cyclist to corridor)	-	Low/None
Bicyclist activity – in separated bike lane	-	Present (i.e., any corridor with a separated bike lane or multi-purpose path)	None
Pedestrian Activity and Sidewalk Presence/Width, and Sidewalk Buffer	High Ped Activity: Urban Core and Urban Roadway Context areas, or near schools or parks Sidewalk: None or Narrow (6 ft wide or less and without buffer)	High Ped Activity: Urban Core and Urban Roadway Context areas, or near schools or parks Sidewalk: Adequate (greater than 6 ft wide or 6 ft or less with a continuous buffer)	Low Ped Activity: By engineering judgment Sidewalk: n/a
On-street parking activity	High (Urban Roadway Context areas with time limited parking or other active curb space)	-	Low/None (all other parking)
Collision History	Portion of corridor on High Injury Network	-	Not on High Injury Network

> Greater than *≥ Greater than or equal to* *< Less than* *≤ Less than or equal to*

FULL ACCESS GROUP

Start with the Closest 50th Percentile Speed (C50) and then check each of the items in Table 5 to determine if the posted speed limit should be set lower. Any single item in the Rounded Down 50th (RD50) column determines that as the suggested speed limit.

For example, if C50 is selected for the first seven rows below, but Crash Rate is High or Medium, then the suggested speed limit is the Rounded Down 50th Percentile Speed (RD50).

Table 5: Speed limit decision rules for full access group

Variable	**Rounded Down 50th (RD50)**	**Closest 50th (C50)**
Signal density (Includes signals at start and end of corridor)	> 8 signals/mile	≤ 8 signals/mile
Access density	> 60 driveways/unsignalized intersections per mile	≤ 60 driveways/unsignalized intersections per mile
Bicyclist activity – in motor vehicle lane, shoulder, or non-separated bike lane	High (any arterial with striped bike lane, buffered bike lane, sharrows, or wayfinding directing cyclist to corridor)	Low/None
Bicyclist activity – in separated bike lane	Present (i.e., any corridor with a separated bike lane or multi-purpose path)	None
Pedestrian Activity and Sidewalk Presence/Width, and Sidewalk Buffer	High Ped Activity: Urban Core and Urban Roadway Context areas, or near schools or parks Sidewalk: None or Narrow (6 ft wide or less and without buffer)	Low Ped Activity: By engineering judgment Sidewalk: All other sidewalk conditions
On-street parking activity	High (Urban Core or Urban Roadway Context areas with time limited parking or other active curb space)	Low/None (all other areas)
Collision History	Portion of corridor on High Injury Network	Not on High Injury Network

> Greater than ≥ Greater than or equal to < Less than ≤ Less than or equal to

STEP 2. RECOMMENDED SPEED LIMIT

After completing the procedure to determine the appropriate **suggested** speed limit based on decisions rules, conduct the following checks to confirm the most appropriate recommended speed limit for the section.

TARGET OPERATING SPEED

NCHRP Report 966 has identified suggested target vehicle operating speed for different combinations of roadway context and roadway type, as shown in Table 6.

Table 6: Suggested target operating speed (mph) by roadway context and type[2]

	Suburban	Urban	Urban Core
MAJOR ARTERIAL	30+	≤45	≤25
MINOR ARTERIAL	30-45	≤45	≤25
COLLECTOR ARTERIAL	30-45	≤25	≤25
LOCAL STREET	≤25	≤25	≤25

The engineer should review the suggested speed limit in Step 1C and compare it to the Target Speeds table. If the suggested speed limit does not fit the suggested target speed, confirm calculations, and then identify potential reasons for the difference.

The engineer should identify any unique characteristics along the segment and consult traffic safety and operations resources related to speed limit setting (e.g., NCHRP 17-76, USLIMITS2, FHWA Office of Safety publications, established industry experts), to determine the recommended posted speed limit.

SEGMENTATION AND SIGN FREQUENCY

Speed Limit Segment Length. Speed limits should be assigned to roadway segments that are reasonably uniform in roadway characteristics, context, and type; and when a change to one of these variables occurs, a new segment should be defined. For example, changes to the number of lanes or roadway context (urban, rural, suburban, rural town) necessitates a new segment.

It is important to keep segment lengths reasonable for driver expectation and maintenance feasibility. For example, changing speed limits too often can be confusing for road users and onerous for City staff to keep records of every change.[3]

---

[2] NCHRP Report 966 (adapted from NCHRP 855)

[3] FHWA, USLIMITS 2, Table 2, pg 34 (44). Transportation Research Board. 2006. Expert System for Recommending Speed Limits in Speed Zones: NCHRP 03-67.

If a roadway segment has an isolated speed-related concern, such as a horizontal curve, it should be addressed with standard warning treatments (e.g., a posted advisory speed), not by reducing the regulatory speed limit for the segment. For each case, an engineering study may determine a change to the segment length.

Speed Limit Sign Frequency. Speed limit signs should be placed in the following locations:

1. They are required at each point of change from one speed limit to another. Care should be taken to place the sign as close to where the speed limit ordinance identifies the change in speed.
2. Beyond major intersections and at other locations where it is necessary to remind road users of the speed limit that is applicable.
3. Downstream from where traffic may turn from an arterial corridor that has a different posted speed limit.
4. As needed to remind road users of the current speed limit. Engineering judgment should dictate the placement, balancing the competing values of reducing sign clutter and providing adequate information to road users.

COORDINATION WITH ADJACENT JURISDICTIONS

Speed limit studies near jurisdictional boundaries should be coordinated with the neighboring jurisdiction. The city engineer or city traffic engineer for the neighboring jurisdiction should initially be contacted to notify them of the study and to see when their section of the same road was last studied. If the speed limit and characteristics of the roadway in the neighboring jurisdiction are the same, they may want to consider collecting speed data at the same time as Bellevue's study. The results of Bellevue's study should be shared with the neighboring jurisdiction before finalizing the study to see if the neighboring jurisdiction is also interested in making a change. An attempt should be made to coordinate the deployment of the new speed limit if the neighboring jurisdiction is going to make the same change.

If the speed limit and/or characteristics of the roadway in the neighboring jurisdiction are not the same, the study should document these difference and factor them into the decision to change Bellevue's speed limit.

ENGINEERING JUDGMENT

The final posted speed limit recommendation should be based on the established procedure and the application of engineering judgment. At a given location, factors outside the data elements used in this procedure may be appropriate to include, and those elements may help establish the most appropriate posted speed limit.

One factor to consider in selection of the recommended speed limit is the desired "Bicycle Level of Traffic Stress (LTS)" as defined in Figure 11 of the "Performance Metrics" chapter of the *Mobility Implementation Plan* (MIP). The MIP uses the priority bicycle corridors identified in Figure 8 of the MIP and the MIP Performance Management Areas to determine a target LTS for every bicycle network corridor. The targets are shown in Figure 12 of the MIP. Table 3 of the MIP uses a bicycle facility type, speed limit and arterial traffic volume to determine the LTS level for a corridor. A citywide assessment of LTS for every bicycle network corridor was performed in development of the MIP. The result of this analysis is displayed in Figure 17 of the MIP. Any change made to speed limits should consider the impacts to bicycle LTS. The engineer may find that a reduction in speed will help a corridor meet the desired LTS target.

If the Speed Limit Setting Tool produces a suggested speed limit that is higher than what the engineer believes should be applied, further study should be performed to determine if arterial traffic calming techniques may help change the characteristics of the road and naturally reduce speeds to the desired speed limit.

STEP 3. APPROVED SPEED LIMIT

Speed limits are approved through an ordinance approval process with the Bellevue City Council. Typically, this involves working with the City Attorney's office to update the ordinance associated with the new speed limit, and then submitting this ordinance to Council for approval through the consent process. An agenda memo is required along with the ordinance change to explain why the speed limit is being changed.

A Council Study Session could be used if a particular speed limit change requires more discussion to explain the justification for the change or to provide more visibility for the change with the community. The ordinance would still be submitted through the consent process, assuming Council is in favor of the change.