Analysis Procedure Manual
2020 Change Sheets

January 2020

APM Version 2

Chapter 12, Subsection 12.3.3

Deleted:

- Vistro version 6 or higher is able to automatically re-sort TWSC movements in order to perform this type of workaround analysis as well.

Technical Tools Webpage

Added:

Unsignalized Intersection Pedestrian Crossing Calculator: This spreadsheet tool implements NCHRP Report 562 Improving Pedestrian Safety at Unsignalized Crossings. It can be used as a guide to select or screen potential pedestrian crossing treatments for plans and projects. These treatments can range from signs and markings to full mid-block traffic signals. For more information see Chapter 14 of APM Version 2.

Updated:

Updated version of Pedestrian and Bicycle Signalized Intersection MMLOS Calculator.

Updated:

Updated version of Planner Traffic Count Request Template under Volume Development Tools.

February 2020

APM Version 1

Chapter 11
Note: APM Version 2 Chapter 16 is currently in progress. Contact TPAU if guidance on air and noise traffic data is needed in the interim.

Chapter 11, Section 11.3.1 Basic Freeway and Multilane Highway Segments

From:
See Appendix 11C for Oregon-specific default values. The FFS can be estimated using the “roadway characteristics” method described as part of the detailed analysis method below, or as the speed limit plus 5 mph. Unlike the detailed method (described next), no FFS adjustment is made for differential truck speed limits or for mountainous terrain.

To:
See Appendix 11C for Oregon-specific default values. The FFS can be estimated using the “roadway characteristics” method described as part of the detailed analysis method below, or as the speed limit plus 5 mph. See Appendix 11A for adjusting the FFS for differential truck speed limits or for mountainous terrain.

Chapter 11, Example 11-2 Freeway Analysis (Screening Method)

From:
Step 2. Adjust Volumes. The peak-15-minute demand flow rate is determined by dividing the peak hour volume by the peak hour factor. The PHF is unknown; therefore, the default value of 0.95 for freeways is used (see Appendix 11C or HCM 6). The resulting demand flow rate is $6,820 / 0.95 = 7,179$ veh/h.

The $v/c$ ratio is then $7,179 / 5,799 = 1.24$.

To:
**Step 2. Adjust Volumes.** The peak-15-minute demand flow rate is determined by dividing the peak hour volume by the peak hour factor. The PHF is unknown; therefore, the default value of 0.94 for freeways is used (see Appendix 11C or HCM 6). The resulting demand flow rate is $6,820 / 0.94 = 7,255$ veh/h.

The $v/c$ ratio is then $7,255 / 5,799 = 1.25$.

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**Chapter 11, Example 11-15 Freeway Reliability Analysis (Screening Method)**

Corrected example using PHF of 0.94 and adjusting FFS for differential in truck and auto posted speeds.

**Chapter 16, Appendix 16A**

**Deleted:**

Noise, Air and Energy Traffic Requirements Checklist

**Added:**

Example Air and Noise Traffic Data Request Forms

_March 2020_

_APM Version 1_

APM version 1 deleted after moving remaining chapters to APM version 2

_APM Version 2_

Incorporated remaining chapters from APM version 1

- v1 Chapter 7 now v2 Chapter 15
- v1 Chapter 11 now v2 Chapter 19

**Chapter 13, Section 13.4.4**
From:

Critical movements may be identified using either CMA analysis (for protected phasing only) or, if using Synchro, from the Synchro HCM 2000 report.

To:

Critical movements may be identified using either CMA analysis (for protected phasing only) or from the Synchro HCM 2000 report or the SIDRA output. However, in some cases the critical movements identified in the Synchro HCM 2000 report or the SIDRA output are not correct for the purpose of calculating Xc, and need to be modified. The critical movements need to be based on the following considerations:

- Identify the critical pair from the possible left-through combinations for each direction
- Split timing is assumed to be equivalent to exclusive phases, so the controlling flow ratio in both directions needs to be accounted for.
- Approaches with exclusive right turn lanes should have a flow ratio calculated for the right turn lane group and compared with the other lane group flow ratios for that approach. It is possible to have the right turn control.
- Use lane group capacities and related volumes instead of movement capacities.
- Use permitted saturation flow rates for permitted movements and protected saturation flow rates for protected movements.

If elements of both (NB/SB or EB/WB) non-split-timed critical pairs are flagged as critical movements in the Synchro HCM2000 or SIDRA report, the analyst needs to determine the highest critical pair to use (e.g. EBL + WBT) of the two and only use the highest in the Xc calculation. Otherwise the calculated Xc value will be too high.
The full HCM MMLOS is most applicable to urban roadways with uniform segments broken up by signalized intersections. The MMLOS only evaluates segments bracketed by signalized intersections but the qualitative assessment can be done at all types of traffic control (e.g. roundabouts). Many communities do not have any signals or have too few signals to make the full HCM MMLOS method usable. In addition, this methodology allows for a multimodal look at a reasonable cost without requiring intensive data gathering. For most planning efforts, design details are not generally available until later, within phases such as refinement plans or project development, so it can be difficult to properly create the MMLOS inputs. All of the elements below should be considered for each mode. However, not all of the elements below will be contextually applicable in every community (i.e. volumes not sufficient for traffic signals or all-way stop control) so deviations should occur as necessary but need to be documented.

At intersections, the following factors are considered:

- **Traffic control**: Intersections with a traffic signal or all-way stop control with marked crosswalks are rated better than locations with only two-way stop control or locations without marked crosswalks.

- **Crossing width**: Fewer turn or through travel lanes to be crossed is rated better than more turn/through lanes because the exposure to traffic and potential conflicts are less.

- **Median islands**: The presence of a median island is rated better than no islands as two-stage crossings significantly improve the associated safety and ease when using a crossing, are possible at unsignalized crossings.
Chapter 14, Section 14.3.2

On segments, the following factors are considered:

- **Preferred Bicycle facility type:** Bicycle facilities with greater separation from vehicles rate higher than shared or lesser separated facilities. Wider bicycle facilities will rate better than narrower or non-existent ones. Ideally, arterials (7000+ AADT) have separated facilities (i.e. separated bicycle lanes, buffered bike lanes, and shared-use_ eye_ tracks_ bike_ paths); low-speed collectors (1500-7000 AADT) have buffered or standard bike lanes; and local streets have shared facilities. This will vary by location, context, and size of the community. For more information, please refer to the Bicycle Facility Selection Process of the ODOT Blueprint for Urban Design document (Pages 3-13 through 3-18), Separation Matrix of the ODOT Bicycle and Pedestrian Design Guide (Chapter I, Page 3).

- **Outside travel lane width:** Wider travel lanes are rated better than narrower travel lanes on higher volume/speed roadways (i.e. arterials) because of the larger buffer space between vehicles and bicyclists. On lower volume/and-speed urban streets/roadways, narrower lanes are better than wider lanes for better shared lane utilization when (i.e. sharrow markings are used, so the bicyclist takes the center of the lane rather than potentially being squeezed to the side marked roadways).
14.4.1 Additional Rider Factors

The Bicycle Level of Stress does not include other factors that may be important to bicycle riders that should be taken into consideration when applying this methodology. These can include presence of steep or long climbs, poor pavement condition, heavy vehicle use, narrow travel lanes, neighborhood crime, noise, absence of lighting, high driveway density, skewed railroad crossings, in-pavement streetcar/railroad tracks, drainage grates, and curbside conditions (snow removal or litter/gravel in the roadway). Congested conditions can also be considered if they add difficulty to getting gaps in traffic to get into a right or left turn lane for instance. Roadway locations with either a documented (reported total bike crashes including any injury or fatal ones) or a perceived (near misses, known unreported crashes) crash history should be flagged for reference.

Roadways where biking is prohibited, such as along certain segment of urban freeways designated in OAR 734-020-0045, should also be noted.¹

Some of these can be significant determinants to the comfort of potential cyclists and may, at times, degrade a segment by one or even two levels rendering a route unacceptable. If a number of these considerations exist, the stress levels should be optionally adjusted to account for them or they can be placed on a stress map or in a separate graphic to flag them as concerns. These can also come into play when determining alternate paths to high-stress routes.

Sometimes, systematic deviations are required to properly capture the overall context of a community or are relevant to a particular project area. For example, there have been cases, where the LTS ends up being the same on all facilities as all roadways are 25 mph and two lanes, but there are noticeable differences between the subject roadways. New tables and LTS adjustments can be created, however, as some of these can be subjective, adequate documentation needs to be provided outlining the reasons for the deviations. Where possible, these deviations should be explained in the methodology and assumptions memorandum before analysis begins, but may require a separate memorandum if issues come up during the analysis. Roadways where biking is prohibited, such as certain urban freeways, should also be noted.

¹ Shoulders should be available for pedestrians to access the nearest exit during mechanical incidents or after collisions, but it is not preferred to accommodate bicycle or pedestrian travel on shoulders on urban limited access facilities. Instead, pedestrian and bicycle travel should be accommodated on a parallel multi-use path, separated bikeway, or parallel streets. Limited access highway shoulders should only be used as a primary pedestrian and bicycle accommodation in low volume rural areas and/or where physical constraints and sparse surrounding network make a parallel route infeasible.
Chapter 14, Section 14.4.4

14.4.4 LTS Segment Criteria

The LTS segment criteria are broken into three classes: physically separated paths and lanes, standard bike lanes, and without bike lanes (mixed traffic). The physically separated paths include bike paths and separated bike lanes/cycle tracks which may be separated from motor vehicles by landscaped buffers, curbs, bollards, bioswales, or on-street parking, or other vertical delineators, (for cycle tracks). Physically-separated bike paths and lanes (assuming full bike standards) are generally classified as LTS 1.

Poor pavement conditions in the bike-traveled portion of the roadway should have the LTS increased by one level. Poor pavement is defined as having potholes, large cracks, heavy raveling with loose aggregate, broken/faulted/lifted concrete slabs, or spalling. Poor pavement will take more attention by the bicyclist to maintain their position and speed and will create more discomfort if they have to frequently move laterally into more direct conflict with motor vehicles. Frequent drainage grates requiring the same movement into the travel lanes may also increase the LTS a level.

Mixed traffic conditions are roadways without any bike markings (including widened shoulders not marked as bike lanes). Designated bike boulevards or when “sharrow” markings are present also fall under mixed traffic conditions. Markings and signs give bicyclists more perceived safety and warn drivers about potential bicycles being in the roadway which tends to lower overall speeds. Mixed traffic segment criteria for urban/suburban sections are based on the speed limit or the prevailing speed if different, and the number of lanes by direction, and the two-way average daily traffic (ADT) or functional class if ADT is not available as shown in Exhibit 14-5 and 14-6. This exhibit was reformatted into “lanes per direction” from the original methodology, for consistency with the other segment criteria exhibits and to fix the with/without bike lane issue previously mentioned.

Designated bike boulevards or marked shared low-speed “sharrow” routes also are considered as mixed traffic conditions, but depending on judgment and area context, may have LTS levels reduced by one. Markings and signs give bicyclists more perceived safety and warn drivers about potential bicycles being in the roadway which tends to lower overall speeds.
## Exhibit 14.5 Urban/Suburban Mixed Traffic Criteria – 30 mph or less

<table>
<thead>
<tr>
<th>Number of Lanes</th>
<th>ADT (vph) (^1)</th>
<th>Function Class</th>
<th>Posted or Prevailing Speed or Speed Limit (mph)</th>
<th>Unmarked Centerline</th>
<th>1-lane per direction</th>
<th>2-lanes per direction</th>
<th>3+ lanes per direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unmarked Centerline</td>
<td>&lt;750</td>
<td>Local</td>
<td>LTS 1</td>
<td>LT</td>
<td>LT S 1</td>
<td>LTS 2</td>
<td></td>
</tr>
<tr>
<td>750 -</td>
<td>Local</td>
<td>LTS</td>
<td>LT</td>
<td>LTS 24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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\(^*\)ADT is both directions for two-way streets. For one-way streets use \(^1\)*ADT.
**Chapter 14, Section 14.4.5**

14.4.5 LTS Intersection Approach Criteria

Intersection approach criteria are based on the presence and type of right or left turn (vehicular) lanes. If there are no turn lanes on an approach, then this portion of the methodology is skipped.

ODOT Bicycle & Pedestrian Design Guide standards have the right turn lane to the right of the bike lane so the bike lane continues straight and requires vehicles to turn and yield to bicyclists across a marked dashed bike lane (see Exhibit 14-67a). Locations where the through travel lane becomes a right turn lane (lane drop) may have a more stressful design where the bike lane shifts to the left while the travel lane continues straight (Exhibit 14-67b or c). Exhibit 14-7b shows an older marking style while Exhibit 14-7c is the current version. In this case, the bike lane cannot be to the right of a right-turn lane unless controlled by a separate bicycle signal (see Exhibit 14-67d), as the through bike lane would directly conflict with the right turn lane with the potential for many “right-hook” type crashes. Other intersection designs may have the bike lane end where the right turn lane begins (i.e. T-intersections, roundabouts) and re-appear on the other side of the intersection (Exhibit 14-67e).
The right turn criteria are based on whether the bike lane stays straight or shifts to the left, turn lane length and turning speed. The longer the turn lane, the longer a bicyclist will have traffic on both sides in close proximity if continuing straight, or mixing with traffic if turning right. When the bike lane stays straight, turn lanes of 150’ or less (100’ is typical for most urban applications) and low turning speed (15 mph is a common for most residential and commercial areas) will have a LTS 2 as seen in Exhibit 14-78. Longer turn lanes, higher turning speeds or at skewed intersections will result in a LTS 3 rating. Turn lanes in excess of 300’ can create a “sandwich” effect on the bicyclist especially under higher volume and speed conditions resulting in LTS 4. Dual shared or exclusive right turn lanes are typically in very high volume locations which add additional stress and are LTS 4.

A roadway with no marked bike lanes and a right turn lane will be a high stress location unless the right turn lane is short and rarely used. This condition will also occur if a bike lane is dropped ahead of an intersection. If the turn lane is short (less than 100’ including taper) then there is no impact on the LTS. If speeds are 20 mph or less and sharrow markings are present in the shared turn lane then the LTS can be reduced by one level. Approaches with bike signals (as would be the case as shown in Exhibit 14-7d) can be considered to be LTS 1 unless there is excessive delay, high motorist or bicyclist non-compliance, or other circumstances present.

If a separated bike lane uses a protected intersection design where the bike lane is separated by the same distance or bends out further away from the travel lane, then this is considered to be LTS 1. Approaches that “bend-in” the bike lane to be adjacent to the travel lane have more vehicle proximity stress and are LTS 2. Approaches that require the separated bike lane to have a leftward lateral shift in which vehicles also cross are similar to Exhibit 14-7b and ones that terminate the bike lane into a shared “mixing zone” with right turning traffic are similar to Exhibit 14-7e.
<table>
<thead>
<tr>
<th>Right-turn lane configuration</th>
<th>Right-turn lane length (ft)</th>
<th>Bike Lane Approach Alignment</th>
<th>Vehicle Turning Speed (mph)</th>
<th>LTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibit 14-7a Single</td>
<td>≤ 150</td>
<td>Straight</td>
<td>≤ 15</td>
<td>2</td>
</tr>
<tr>
<td>Exhibit 14-7a Single</td>
<td>&gt;150 to 500' maximum</td>
<td>Straight</td>
<td>≤ 20</td>
<td>3</td>
</tr>
<tr>
<td>Exhibit 14-7b or c Single</td>
<td>&lt;150Any</td>
<td>Shift to Left</td>
<td>≤ 15</td>
<td>3</td>
</tr>
<tr>
<td>Exhibit 14-7c Single or Dual</td>
<td>≤ 75Any</td>
<td>StraightAny</td>
<td>≤ 15Any</td>
<td>24</td>
</tr>
<tr>
<td>Exhibit 14-7c</td>
<td>&gt;75' to 150' maximum</td>
<td>Straight</td>
<td>≤ 15</td>
<td>3</td>
</tr>
</tbody>
</table>

1 Use LTS 4 for any lengths, speeds, or configurations (e.g. dual right turns or Exhibit 14-7d) not shown in the table.
2 For the purposes of this methodology, the Any other single right turn lane length include the length of the taper, configuration not shown above.
3 This is vehicle speed at the corner, not the speed crossing the bike lane. Corner radius can also be used as a proxy for turning speeds.

Shared through-left lanes where a bike lane is present can act similar to mixed traffic conditions as the rider only has to move into the adjacent lane from the bike lane. Similarly, roadways with no bicycle lanes also act like mixed traffic conditions as the rider may already be in the shared left-through lane or just needs to move laterally into a left turn lane. Low-speed intersections that are set up for bicyclists to make two-stage left turns like with a bike box can be LTS 1. Please note that the only currently allowable bike box application is a two-stage left turn box at a 'T' intersection. All other intersection types and other bike box applications are considered experimental and require FHWA approval. See FHWA’s Bicycle Facilities Design Guidance web page for up-to-date information. Separate left turn lanes require the rider to occupy a through lane for some distance (to allow for signaling intentions to following vehicles). Dual left turn lanes (either shared or exclusive) indicate high-volume locations which add additional stress above and beyond the speed and necessary lateral movements and should be a typically LTS 4.
If bicyclists typically use a lower stress two-stage left turn maneuver using the crosswalks or facilitated with special bike box or left turn queue box markings, then the LTS is controlled by the appropriate intersection crossing criteria in Exhibits 14-10 & 11 for each of the crossed roadways instead of the left turn criteria shown in Exhibit 14-9. Low-speed signalized intersections that are set up for bicyclists to make two-stage left turns with regular and left-turn queue bike boxes can be LTS 1.

For rating routes, only include the effect of the left turn lane if the route requires a left turn and typically uses the vehicle lane versus a two-stage movement. For through and right turn movements, include the effect of the right turn criteria.

For rating routes, only include the effect of the left turn lane if the route requires a left turn. For through and right turn movements, include the effect of the right-turn criteria.

<table>
<thead>
<tr>
<th>Exhibit 14.10-9 Unsignalized Intersection Crossing Without a Median Refuge Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prevailing Speed or Speed Limit (mph)</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Functional Class/ADT (vpd)</strong></td>
</tr>
<tr>
<td>≤ 1,200</td>
</tr>
<tr>
<td>≤ 25</td>
</tr>
<tr>
<td>30</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>≥ 40</td>
</tr>
</tbody>
</table>

1For street being crossed.

2For one-way streets use Exhibit 14-7/Exhibit 14-10.
Exhibit 14-1110 has the maximum number of lanes a bicyclist encounters on each side of a median refuge. The presence of a median refuge generally implies an roadway with a substantial amount of traffic volume, so specific ADT values are not included in the exhibit. Adding a median refuge of at least six feet in width (10 feet for LTS 1 eligibility) will decrease the LTS versus when a refuge is not present. The presence of turn lanes are also accounted for as they add conflict points and vehicle paths to the awareness needs.

### Exhibit 14-1110 Unsignalized Intersection Crossing With a Median Refuge Criteria

<table>
<thead>
<tr>
<th>Prevailing Speed or Speed Limit (mph)</th>
<th>Maximum Through/Turn Lanes Crossed per Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Lane</td>
</tr>
<tr>
<td>≤ 25</td>
<td>LTS 1&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>30</td>
<td>LTS 1&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>35</td>
<td>LTS 2</td>
</tr>
<tr>
<td>≥ 40</td>
<td>LTS 3</td>
</tr>
</tbody>
</table>

<sup>1</sup>For street being crossed.<br><sup>2</sup>Refuge should be at least 10 feet to accommodate a wide range of bicyclists (i.e. bicycle with a trailer) for LTS 1, otherwise LTS=2 for refuges 6 to <10 feet.

Shared through-left lanes where a bike lane is present can act similar to mixed traffic conditions as the rider only has to move into the adjacent lane from the bike lane. Similarly, roadways with no bicycle lanes also act like mixed traffic conditions as the rider may already be in the shared left-through lane or just needs to move laterally into a left turn lane. Low-speed intersections that are set up for bicyclists to make two-stage left turns like with a bike box can be LTS 1. Please note that the only currently allowable bike box application is a two-stage left turn box at a “T”-intersection. All other intersection types and other bike box applications are considered experimental and require FHWA approval. See FHWA’s Bicycle Facilities Design Guidance web page for up to date information. Separate left turn lanes require the rider to occupy a through lane for some distance (to allow for signaling intentions to following vehicles). Dual left turn lanes (either shared or exclusive) indicate high-volume locations which add additional stress above and beyond the speed and necessary lateral movements and should be LTS typically LTS 4.
If bicyclists typically use a lower stress two-stage left turn maneuver using the crosswalks or facilitated with special bike box or left turn queue box markings, then the LTS is controlled by the appropriate intersection crossing criteria in Exhibits 14-10 & 11 for each of the crossed roadways instead of the left turn criteria shown in Exhibit 14-9. Low-speed signalized intersections that are set up for bicyclists to make two-stage left turns with regular and left-turn queue bike boxes can be LTS 1.

For rating routes, only include the effect of the left turn lane if the route requires a left turn and typically uses the vehicle lane versus a two-stage movement. For through and right turn movements, include the effect of the right turn criteria.

For rating routes, only include the effect of the left turn lane if the route requires a left turn. For through and right turn movements, include the effect of the right turn criteria.

Exhibit 14-9-8 Left Turn Lane Criteria

<table>
<thead>
<tr>
<th>Prevailing Speed or Speed Limit (mph)</th>
<th>No lane crossed</th>
<th>1 lane crossed</th>
<th>2+ lanes crossed</th>
<th>Dual-shared or exclusive left-turn lane</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤25</td>
<td>LTS 2</td>
<td>LTS 2</td>
<td>LTS 3</td>
<td>LTS 4</td>
</tr>
<tr>
<td>30</td>
<td>LTS-2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥35</td>
<td>LTS-3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1Use LTS 4 for any shared/exclusive dual left turn lane configuration.
2For shared through left lanes or where mixed traffic conditions occur (no bike lanes present)
Unsignalized intersection crossings can act as a barrier to bicyclists, especially with a high number of lanes or higher speeds. The crossing can be an impediment to travel if the bicyclist has to cross six or more lanes at any speed or has to cross a 35 mph (or greater) four-lane street. The criteria for unsignalized intersection crossings includes consideration of the presence of a median of sufficient width to provide for a two-stage crossing. Pedestrian/bicycle over/underpasses would be considered as separate facilities and are LTS 1.

Signalized crossings usually do not create a barrier as the signal provides a protected way across and are not considered in the methodology. Signalized intersections do pose risks for right-turn “hook” crashes, however, especially where right turn lanes are not present. Bicyclists may have also difficulty triggering the signal detection (vs. walking the bike across the street as a pedestrian). There may be areas where engineering judgment is required in assigning stress levels higher than LTS 1 at signalized intersections for these reasons. The presence of bike signals may be a mitigating factor in higher-risk areas thus keeping the LTS at 1.

Roundabouts were not included in the original research, but a single-lane roundabout assuming mixed traffic conditions (Exhibit 14-5) where the bicyclist takes the lane with the typical sub-25 mph speeds should be LTS 2. Dual-lane roundabouts should also use the mixed traffic conditions for two lanes (LTS 3). Dual-lane roundabouts may require bicyclists to cross a through lane to turn left which would have a similar application to Exhibit 14-8; however the mixed traffic conditions will likely still control. Right-turn bypass lanes within the roundabout would be considered as right turn lanes as shown in Exhibit 14-7.

Where there is no median refuge, the LTS depends with two-way crossings of up to three lanes, the LTS ranges from 1 to 3 depending on the speed and two-way average daily traffic (or functional class if ADT is not available) as seen in Exhibit 14-109. For crossings of four to five lanes, the LTS ranges from 2 to 4.
### Exhibit 14-10-9 Unsignalized Intersection Crossing Without a Median Refuge Criteria

<table>
<thead>
<tr>
<th>Prevailing Speed or Speed Limit (mph)</th>
<th>Total Through/Turn Lanes Crossed (Both Directions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤ 3 Lanes</td>
</tr>
<tr>
<td>Functional Class/ADT (vpd)</td>
<td></td>
</tr>
<tr>
<td>Local</td>
<td>Collector</td>
</tr>
<tr>
<td>≤ 1,200</td>
<td>≥ 3,000</td>
</tr>
<tr>
<td>≥ 25 (LTS 1)</td>
<td>LTS 1</td>
</tr>
<tr>
<td></td>
<td>1,200 - 3,000</td>
</tr>
<tr>
<td>30 (LTS 1)</td>
<td>LTS 1</td>
</tr>
<tr>
<td></td>
<td>32</td>
</tr>
<tr>
<td>≥ 40 (LTS 1)</td>
<td>LTS 3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
</tbody>
</table>

1For street being crossed.
2For one-way streets use Exhibit 14-7/Exhibit 14-10.

Exhibit 14-11-10 has the maximum number of lanes a bicyclist encounters on each side of a median refuge. The presence of a median refuge generally implies an roadway with a substantial amount of traffic volume, so specific ADT values are not included in the exhibit. Adding a median refuge of at least six feet in width (10 feet for LTS 1 eligibility) will decrease the LTS versus when a refuge is not present. The presence of turn lanes are also accounted for as they add conflict points and vehicle paths to the awareness needs.

### Exhibit 14-11-10 Unsignalized Intersection Crossing With a Median Refuge Criteria

<table>
<thead>
<tr>
<th>Predominate Speed or Speed Limit (mph)</th>
<th>Maximum Through/Turn Lanes Crossed per Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 Lane</td>
</tr>
<tr>
<td>≤ 25 (LTS 1)</td>
<td>LTS 1</td>
</tr>
<tr>
<td>30 (LTS 1)</td>
<td>LTS 1</td>
</tr>
<tr>
<td>35 (LTS 2)</td>
<td>LTS 2</td>
</tr>
<tr>
<td>≥ 40 (LTS 3)</td>
<td>LTS 3</td>
</tr>
</tbody>
</table>

1For street being crossed.
2Refuge should be at least 10 feet to accommodate a wide range of bicyclists (i.e. bicycle with a trailer) for LTS 1, otherwise LTS=2 for refuges 6 to <10 feet.
Roundabouts

Calculation of the traffic stress at roundabouts will determine if bicyclists can use a shared sidewalk that surrounds it or if they will ride in the vehicular lanes under mixed traffic conditions. For a sidewalk to serve as a potential bicycling path, all of the following criteria must be met. If both routes are possible, evaluate both options and use the lower stress option as the controlling LTS.

- **Minimum** six foot clear width (allows slow-speed passing assuming no obstructions that would prevent a cyclist from riding close to the edge of the walkway).
- **Offset** from edge of circulating roadway to path crossing should be no more than 30’ to minimize out-of-direction travel.
- **Path geometry** should have no turns greater than 90 degrees and allow a cyclist to see (without looking behind them) if it is safe to cross within 10’ from the crossing (allows for minimum 5 mph travel speed).
- **Separate bike ramps** need to be provided to transition riders between the sidewalk and street (or bike lane) on entry and exit legs in a reasonably direct manner and provide a safe re-entry. If a single ramp is intended to provide both bicycle and pedestrian traffic then it needs to be wider than the standard (8'-10') pedestrian curb ramp.

A separate 8’+ path or sidewalk surrounding a roundabout will be normally LTS 1 for the segments between the leg crossings. Narrower 6’ sidewalks are LTS 2 as it more difficult to overtake pedestrians or bicyclists traveling in the same direction or allow opposing traffic to pass. Each of the roundabout leg crossings will need to be evaluated as that will be the source of traffic stress for bicyclists using the sidewalk crossing as shown in Exhibit 14-13. All of the individual leg crossing LTS’s are compared and the highest one used to represent the roundabout LTS.

The overall roundabout leg crossing LTS should also be checked against the mixed traffic LTS criteria in Exhibit 14-5. Leg crossings will generally control over the mixed traffic condition except in cases where tangential legs are used or higher volumes are present. (See Exhibit 14-12b or c). Tangential legs occur when the approach centerline does not go through the roundabout center. These have little deflection in the vehicle path and results in much higher speeds through the pedestrian crossing. Most roundabouts should have non-tangential approaches as shown in Exhibit 14-12a. The highest LTS from Exhibit 14-13 or 14-15 will be used in this case.

---

3 *Furth, P. Level of Traffic Stress (LTS) Criteria for Roundabouts, Northeastern University, March 2014.*
Exhibit 14-12 Roundabout Approach Geometry


<table>
<thead>
<tr>
<th>Entry/Exit Type</th>
<th>Non-Tangential(^1)</th>
<th>Tangential(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single entry lane</td>
<td>LTS 1</td>
<td>LTS 2</td>
</tr>
<tr>
<td>Single exit lane</td>
<td>LTS 1</td>
<td>LTS 3</td>
</tr>
<tr>
<td>Dual entry lane</td>
<td>LTS 1</td>
<td>LTS 3</td>
</tr>
<tr>
<td>Dual exit lane</td>
<td>LTS 3</td>
<td>LTS 4</td>
</tr>
</tbody>
</table>

\(^1\) An exit/entry lane is tangential if a driver does not have to turn to the right when entering or exiting. This is a non-standard design.

If there is no adequate alternative path or sidewalk to use, then the bicyclist will need to use the vehicle lane under mixed traffic conditions through the roundabout. The LTS is computed for these cases in Exhibit 14-5. Dual-lane roundabouts will always be LTS 4 as these always have at least one multilane exit which sets up a potentially hazardous conflict between circulating bicyclists and exiting traffic from the inside lane. Partial two-lane roundabouts are considered to have two circulating lanes for the purposes of this methodology as stress level is controlled by the worst condition.

Right-turn bypass lanes outside of the roundabout (Exhibit 14-14a) should be considered as mixed traffic conditions as in Exhibit 14-5 or possibly 14-6 for higher speed movements. Right-turn bypass lanes within the roundabout (Exhibit 14-14b) would be considered as right turn lanes as shown in Exhibit 14-8.
**Exhibit 14-15 Roundabout Circulating LTS**

<table>
<thead>
<tr>
<th>Number of circulating lanes</th>
<th>Total Entry Leg ADT (vpd)</th>
<th>LTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤ 4,000</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>4,000 - ≤ 6,000</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>&gt; 6,000</td>
<td>3</td>
</tr>
<tr>
<td>2+ (Partial or full)</td>
<td>Any</td>
<td>4</td>
</tr>
</tbody>
</table>

**Signalized Intersections**

Signalized crossings usually do not create a barrier as the signal provides a protected way across and are not considered in the methodology as LTS 1 is assumed for the crossing movements. Signalized intersections do pose risks for right-turn “hook” crashes, however, especially where right turn lanes are not present.

At certain locations, bicyclists may have difficulty triggering the signal detection or an intersection may not have the proper striping, ramps, and push button accommodations for bicyclists. These crossing locations force the bicyclist to use the crosswalk like a pedestrian instead and should be LTS 2. There may be other areas where engineering judgment is required in assigning stress levels higher than LTS 1 at signalized intersections. The presence of bike signals or regular and left-turn bike boxes may be a mitigating factor in higher-risk areas thus keeping the LTS at 1.
Chapter 14, Section 14.4.8

14.4.8 Route Connectivity using LTS

The LTS designations should be mapped on the system network. This can be facilitated with GIS or with a travel demand model if available. The objective of mapping is to identify locations with LTS values exceeding a desired level that may then be targeted for improvements. Ideally, the displayed LTS should be directional as it may differ on each side of a street. This will require some work with link offsets and layers to get this to show properly in GIS mapping software. Exhibit 14-1843 shows an example of using LTS showing the different stress levels. The high stress routes can easily be contrasted against the lower stress ones.

Chapter 14, Section 14.4.9

According to the original research report, riders can typically tolerate up to 25% extra distance since the vast majority of trips are within 25% of the shortest-path available. However, most bicyclists choose trip paths that are only 10% longer than the shorter higher-stress routes, so 10% is a good target value. A 10% target represents a half-mile of extra travel on a five mile trip. Short trips should not have detours of longer than approximately ¼ mile, which represents about one and a half minutes of travel time at 10 mph. In addition, the 25% maximum threshold for connectivity can also be used to predict route selection, to plan way-finding routes, or even analyze detour routes around a construction zone.

Routes can be assessed for acceptable out-of-direction travel if either of the following relationships is true:

\[ \frac{L_4}{L_4} \leq 1.25; \text{ OR} \]
\[ L_k - L_4 \leq 1,430,760 \text{ feet} (0.2733 \text{ mile}) \]

---

5 Understanding and Measuring Bicycle Behavior: a Focus on Travel Time and Route Choice, Dill & Gildea, Portland State University, December 2008.
Example 14-2 Alternate Route Out-of-Direction Travel

This example illustrates the impact of out-of-direction travel on alternate routing. Two routes, one short and one long, are shown bypassing a signalized intersection with high-stress approaches in the figure below. These are only two routes of the many that are available to use.

City of Burns US20 LTS Example

For the (exaggerated) short route, the normal high-stress route through the intersection is 700 feet. Adding in the two extra blocks of travel (600’ total) to cross on a lower-stress path creates a 1300 foot route. While the total length of extra travel distance is acceptable as 600 feet is less than 1,430 feet, the overall extra trip distance as a proportion of the total is not, as 1300 feet/700 feet = 1.86 or 86% extra distance. For this route, bicyclists
Solutions to Decrease LTS Level

There are a number of ways to lower stress levels and to achieve a desired LTS level on a segment, approach, or crossing. For more detail on these solutions, please refer to the Oregon Bicycle and Pedestrian Design Guide, the ODOT Traffic Manual, and the ODOT Highway Design Manual including the Blueprint for Urban Design. A few examples (not exhaustive):

- Creating conventional bike lanes, buffered bike lanes, raised bike lanes, and bike boulevards.
- Creating segregated bike facilities such as separated bicycle lanes/cycle tracks or bike paths.
- Safety measures in design, such as couplets, medians, or pedestrian refuges. If four lanes of vehicular capacity is still needed then investigating a couplet may also achieve stress reductions.
- Increase width of outside lanes on roadways too narrow for striped bike lanes to create more buffer space and room for bicyclists.
- Paving/widening shoulders or removing parking.
- Reducing the number of lanes through a road diet.
- Install road markings (such as sharrows) and way-finding signs.
- Addition of flashing pedestrian activated beacons (PABs) or mid-block pedestrian hybrid beacons (PHBs) can improve higher-volume crossing locations.
- Removing or improving barriers, such as providing a safe grade-separated crossing over highways or railroads.
- Improving the pavement conditions on the shoulders of roadways.

Adding two-stage left-turn bike boxes (see Section 14.4.5 LTS Intersection Approach Criteria for limitations);
- Adding bike signals to clarify bike movements.
- Reducing speeds, enforcement of speeds limit or education about speed.

Segment LTS:
Most roadway sections are two lanes and 25 mph except for US20 west of the OR78 junction which has four lanes. No bike lanes are in the example area so all roadways are considered mixed traffic. The, which will be LTS is LTS 32 for the two-lane major roadways (US20 and OR78) based on the average daily traffic (3,300 for US20 and 2,600 for OR78), LTS 3 for the four-lane section of US20, and LTS 1 for the local streets (no marked centerlines).
Chapter 14, Section 14.5.4

*Vertical:* A vertical buffer (i.e., retaining wall) elevates the pedestrian facility higher than the roadway surface. This typically contains an additional fence or pedestrian buffer facility.

*Prevailing or Posted Speed:* The prevailing (or average) speed is the recommended speed to be used in the methodology. Private probe speed data is a good source for prevailing speeds (See Chapter 3). If prevailing
Chapter 14, Section 14.5.5

Sidewalk Criteria

The condition and geometry of the sidewalk is the first criterion in the PLTS methodology. The criterion splits sidewalks into greater than five feet and less than five feet in width. The five foot condition is based on federal and state design codes and recommendations. The federal standard for a sidewalk is five feet. In Oregon, the Oregon Bicycle and Pedestrian Design Guide (OBPDG) states that the standard pedestrian zone is six feet and those five feet may be acceptable in some areas (local and residential streets). Short (<200’) sections can have widths as narrow as four feet. While sidewalks along a state highway may need to be wider, sidewalks in central business districts of heavy used pedestrian areas may also need to be wider. The Blueprint for Urban DesignGuides such as the OBPDG and the Highway Design Manual (HDM) should be referenced for more information.

Exhibit 14-2146 uses the overall condition and the effective (useable) width of the sidewalk. The purpose is to rate which groups of users can safely and comfortably utilize a facility. A narrow (from obstructions or actual width) or low quality sidewalk will not be passable for all user groups. The actual sidewalk width, especially if it is less than five feet, will impact the use by disabled people while effective width rates the comfort and flow of pedestrians along a sidewalk. A sidewalk needs to have at least six feet of space with no obstructions, like signs and poles, to be eligible for the effective width. The effective width is the simple average clear width of a sidewalk segment rather than following the more-detailed Highway Capacity Manual procedure.

Use the actual sidewalk width first in Exhibit 14-2116 to see if the minimum actual width is present, then check the effective width if the sidewalk is at least six feet wide to determine the appropriate PLTS. For example, a seven foot sidewalk in fair condition would be eligible for a PLTS 2 as the actual width is greater than five feet, but if the effective (or clear) width was judged to be at least six feet then PLTS 1 would be used. If the effective width is less than five feet use the corresponding actual width rows as obstructions will still cause impediments to disabled users. A PLTS 1 sidewalk must be accessible to all users, have six effective feet or wider path, and in good or fair condition.

However, in-sidewalk obstructions will impede disabled users if the clear width is less than five feet, so use the corresponding actual width rows to determine the PLTS. Given the same seven-foot fair condition sidewalk above, if the effective (clear) width was only three feet because of a building column then PLTS 4 would be used.
### Exhibit 14-2146 Sidewalk Condition

<table>
<thead>
<tr>
<th>Actual/Effective Sidewalk Width (ft)</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
<th>No Sidewalk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;4</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
</tr>
<tr>
<td>≥4 to &lt;5</td>
<td>PLTS 3</td>
<td>PLTS 3</td>
<td>PLTS 3</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
</tr>
<tr>
<td>≥5</td>
<td>PLTS 2</td>
<td>PLTS 2</td>
<td>PLTS 3</td>
<td>PLTS 4</td>
<td>PLTS 4</td>
</tr>
<tr>
<td>Effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥5†††</td>
<td>PLTS 1</td>
<td>PLTS 1</td>
<td>PLTS 2</td>
<td>PLTS 3</td>
<td>PLTS 4</td>
</tr>
</tbody>
</table>

1Can include other facilities such as walkways and shared-use paths
2Effective width is the available/useable area for the pedestrian clear of obstructions. Does not include areas occupied by store fronts or curb side features.
3Consider increasing the PLTS one level (Max PLTS 4) for segments that do not have illumination. Darkness requires more awareness especially if sidewalk is in fair or worse condition.
4Effective width should be proportional to volume as higher volume sidewalks should be wider than the base six feet. Use a minimum PLTS 2 for higher volume sidewalks that are not proportional (include documentation).

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### Chapter 14, Section 14.5.8

14.5.8 General Land Use Criteria

The general land use can create an overall positive effect on walkability and use of certain facilities if destinations are frequent and convenient. Higher pedestrian use leads to a greater driver expectation and driving behaviors typically reflect such (i.e. more likely to yield). Conversely, land use can create a dampening effect to the point that it will not matter how well the facilities are laid out or constructed, the desire to walk on a segment is diminished if the facility goes through a perceived unattractive/unsecure/noisy/too-busy area. Areas that are more auto-oriented have lower driver expectations for pedestrians so yielding behaviors are much less likely. Exhibit 14-2449 groups typical land use types and the land use contexts used in the ODOT Blueprint for Urban Design document by PLTS level with more pedestrian-friendly walkable areas getting better/lower PLTS levels.
### Exhibit 14 24-19 General Land Use

<table>
<thead>
<tr>
<th>PLTS</th>
<th>Overall Land Use</th>
<th>Blueprint for Urban Design Land Use Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Residential, central business districts (CBD), neighborhood commercial, parks and other public facilities, governmental buildings/plazas, offices/office parks</td>
<td>Traditional Downtown/CBD Urban Mix Residential Corridor</td>
</tr>
<tr>
<td>2</td>
<td>Low density development, rural subdivisions, un-incorporated communities, strip commercial, mixed employment</td>
<td>Suburban Fringe Rural Community</td>
</tr>
<tr>
<td>3</td>
<td>Light industrial, big-box/auto-oriented commercial</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Heavy industrial, intermodal facilities, freeway interchanges</td>
<td>Commercial Corridor</td>
</tr>
</tbody>
</table>

### Chapter 14, Section 14.5.9

#### Exhibit 14 2722 Adjustments for Arterial Crosswalk Enhancements

<table>
<thead>
<tr>
<th>Treatment 2</th>
<th>Treatment 2</th>
<th>Adjustment/Deletion</th>
<th>Treatment 2</th>
<th>Adjustment/Deletion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markings</td>
<td>Markings</td>
<td>-0.5</td>
<td>In-street signs</td>
<td>-1.0</td>
</tr>
<tr>
<td>Roadside signage</td>
<td>Roadside signage</td>
<td>-0.5</td>
<td>Curb extensions</td>
<td>-0.5</td>
</tr>
<tr>
<td>Illumination/Lighting</td>
<td>Illumination/Lighting</td>
<td>-0.5</td>
<td>Raised crosswalk</td>
<td>-1.0</td>
</tr>
<tr>
<td>PAB (e.g. RRFB)</td>
<td>PAB (e.g. RRFB)</td>
<td>-1.0</td>
<td>Standard 12” flashing beacon</td>
<td>-0.5</td>
</tr>
</tbody>
</table>

2 Maximum reduction on PLTS 2.
3 Pedestrian hybrid beacons (PHB) are considered to be equivalent to signalized crossings.
4 Note: Not applicable for roadways with pedestrian median refuges as crosswalk markings and roadside signage assumed as part of the basic installation.
Chapter 14, Section 14.5.10

14.5.10 Results

Mapping the PLTS for a community is a typical result from the analysis and can be readily easily done using GIS. Ideally, the displayed PLTS should be directional as it may differ on each side of a street. This will require some work with link offsets and layers to get this to show properly in GIS mapping software. The map shows the gaps and barriers in the system which can be used to inform stakeholders when creating a list of prioritized projects. The maps can also be included in planning documents and used to help inventory the pedestrian facilities.

Chapter 14, Section 14.5.11

14.5.11 Solutions to Decrease PLTS Level

There are several ways to reduce PLTS and reach the chosen target for a roadway. Several publications including the Oregon Bicycle and Pedestrian Design Guide, the ODOT Traffic Manual, and the ODOT Highway Design Manual (Blueprint for Urban Design), includes design considerations for pedestrian facilities. A few examples of actions that can reduce PLTS:

- Installing pedestrian facilities, or expanding facilities where pedestrian routes exist
- Create paved surfaces where there are trails or worn paths are evident
- Improving the condition of the sidewalk, including limiting vertical change and smoothing the surface
- Upgrading sidewalk ramps to current standards
- Infilling gaps in sidewalk to create connectivity
- Redesigning roadway to include wider or buffered sidewalks
- Creating a multi-use path on high speed roadway
- Significantly changing the roadway character and reducing speed limit

- Installing additional crossing enhancements at unsignalized crossings (e.g., beacons, lighting, curb extensions, etc.),
- Removing barriers to connectivity
- Redesigning buffer to include trees, large vegetation, and/or street furniture
- Land use changes over time to encourage more pedestrian-scale developments
Example 14-4 Pedestrian Level of Traffic Stress

The following section shows examples of corridor sections for each PLTS. All of the examples are pedestrian facilities within the Salem city limits. The purpose of the example is to illustrate different PLTSs.

Center Street at High Street

<table>
<thead>
<tr>
<th>Street Name</th>
<th>Center St at High St</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidewalk</td>
<td></td>
</tr>
<tr>
<td>Condition</td>
<td>Fair</td>
</tr>
<tr>
<td>Width (ft)</td>
<td>6+12</td>
</tr>
<tr>
<td>Buffer</td>
<td></td>
</tr>
<tr>
<td>Width (ft)</td>
<td>60</td>
</tr>
<tr>
<td>Buffer Type</td>
<td>Solid Surface; street trees present</td>
</tr>
<tr>
<td>Bike Lane</td>
<td></td>
</tr>
<tr>
<td>Width (ft)</td>
<td>0</td>
</tr>
<tr>
<td>Parking</td>
<td></td>
</tr>
<tr>
<td>Width (ft)</td>
<td>8</td>
</tr>
<tr>
<td>Roadway</td>
<td></td>
</tr>
<tr>
<td>Number of Lanes</td>
<td>4</td>
</tr>
<tr>
<td>Posted Speed (mph)</td>
<td>30</td>
</tr>
<tr>
<td>Land Use</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td>Central business district</td>
</tr>
<tr>
<td>Total Buffering Width (ft)</td>
<td>16</td>
</tr>
</tbody>
</table>

If the adjacent intersection at 12th and Chemeketa were added to the segment, as would be done if a route was being investigated, the segment's PLTS would not change. Control over the segment's PLTS 2. This signalized intersection has permissive left turns, but is free of complex elements, so the PLTS is 2, which is equal to the final segment PLTS.
Chapter 14, Section 14.6.5

14.6.5 Separated Bicycle Lanes/Bikeways

The separated bike lane methodology augments the re-estimated HCM bike lane methodology of the previous section by adding new facility types. Low-stress tolerant users desire a greater degree of separation between them and the adjacent traffic stream. The standard bike lane or even a buffered bike lane does not offer the amount of separation needed especially for roadways with higher volume and/or speeds. Separated bicycle lanes/bikeways (also known as cycle tracks or protected bike lanes) offer additional comfort (lower stress) to the bicyclist by creating a vertical delineation between the bicycle lane and the vehicle lanes and are a step up from a buffered bicycle lane. Vertical delineation can be simple as a line of posts (candlesticks), bollards, or large planters, to physically separating the bikeway with the vehicle parking strip. Exhibit 14-3126 illustrates the differences in separation for the typical bicycle facilities from least to most.

The LOS is relatively poor for sections of standard bike lanes on higher speed and/or volume urban roadways, so adding a separated bike lane will allow for a better LOS. If a previously conducted Bicycle Level of Traffic Stress analysis indicated system needs, adding a separated bike lane on major routes can further enhance or help establish a low-stress network. For separated bicycle lanes/bikeways to have the greatest benefit, they need to intersect other lower-stress bicycle facilities such as bike boulevards, streets with standard bike or buffered lanes, or even low-speed routes with sharrows rather than being an isolated facility. Routes with established substantial bicycle volumes or more direct routes that have limited use because of high-stress elements may be good candidates for separated bicycle lanes/bikeways. Separated bicycle lanes/bikeways appeal to the largest segment of current and potential bicyclists, so having them in certain high-connectivity corridors should help to increase the overall mode share along a route and increase the total amount of users.

The context of the corridor should be considered on whether a separated bike lane is the appropriate treatment. Not all roadways are suitable for separated bicycle lanes/bikeways. Separated bicycle lanes/bikeways have the greatest benefit on roadways with no or limited driveways and wider spaced intersections to maximize bicycle flow and minimize potential conflicts. Every intersection and driveway is a point of conflict and can introduce safety and operational issues especially when paired with adjacent parking. Parking between the travel lane and the separated bike lane can create sight distance issues. If sight distance is not maintained sufficiently (by prohibiting parking close to the intersection/driveway) then this may encourage vehicles to creep out and block the bike lane while waiting to turn. Higher volume and/or many driveways can substantially impede operations of bikes and increase the risk of collisions. The parking can also create visibility issues for drivers to see oncoming bicyclists (could be in both directions for a two-way bike lane) as they turn into a driveway and across the bike lane. If access management solutions to consolidate/minimize driveways are not possible, then a buffered bike lane may be more appropriate in a parking and/or driveway dense location.
A constrained right-of-way, and/or existing features (e.g., number of driveways or parking needs) may pose design challenges. This analysis should not be done in isolation as safety shall be evaluated whether the features associated with the separated bike lanebikeway treatment may affect bike users or another transportation mode's safety. For example, more substantial separators such as bollards or large planters could create a fixed-object hazard for vehicles as they are close to the lane edge especially with higher speeds. The analyst needs to discuss the applicability of separated bicycle lanesbikeways with Region, Traffic-Roadway Section, or local jurisdiction roadway/bicycle-pedestrian staff (as appropriate) before pursuing a specific separated bike lanebikeway treatment.

Methodology Summary

This methodology is based on the paper, A Level-of-Service Model for Protected Bike Lanes by Foster, Monsere, Dill and Clifton, Portland State University, 2014. The research was based on recent video-clip data obtained in a similar manner as previous HCM research efforts. The methodology uses the same cumulative logistic model form as the re-estimated bike lane method (Section 14.5) so results will be consistent between the two. The methodology is limited to segments only. Intersection crossings will be covered in future sections.

The methodology does not cover roadways that have a substantial amount of driveways and/or higher volume driveways as most of the research was based in central business districts or residential areas where high numbers of driveways or high-volume driveways or were uncommon. The most significant variables for estimating the performance of separated bicycle lanesbikeways are buffer type, direction of travel, and adjacent vehicle speed and daily volume. The resulting LOS scores are based on user perceptions of each video clip and are graded from best (LOS A) to worst (LOS F). The methodology results represent the probability that a user (or the population of users) will pick a given LOS (or a range of LOS). Better conditions will result in better LOS scores. An Excel-based calculator is available on ODOT's Planning Section webpage.

Data Needs and Definitions

The methodology uses the following four variables to estimate the separated bike lanebikeway LOS. The analysis is intended to be applied on road segments on a per direction basis like most HCM-based methods. Segments with two-way separated bicycle lanesbikeways only need to be evaluated in one direction. The variables and their category values are shown below:

- Buffer type (posts, planters, parking strip, raised/parking)
- Direction of (bikeway) travel (one-way or two-way)
- Adjacent vehicle speed (25 – 35 mph)
- Average daily volume in both directions (9,000 – 30,000) vehicles per day
Chapter 14, Section 14.6.6

14.6.6 Buffered Bike Lanes

Buffered bike lanes offer additional comfort to the bicyclist by providing separation from the vehicle lanes using a striped and/or hatched buffer. Buffered bike lanes should be used when speeds exceed 25 mph or when volumes are in excess of 21,500 ADT and should be used up to when speeds of 35 mph and/or 57,500 ADT. Beyond these values, separated facilities should be used. This type of bike lane will allow a more acceptable LOS grade than a standard bike lane for higher volume and speed facilities, such as most urban state highways. Buffered bike lanes may also be a good compromise in areas with a substantial amount of driveways that would make operations of a separated bikeway difficult or create a number of safety issue locations because of visibility/sight distance.

Methodology Summary

The methodology for the estimation of a buffered bike lane LOS is based on an extension of Exhibit 14-3328. In the exhibit, the “n” is the observation sample size, and “PBL” is a protected (separated) bike lane. The LOS of a buffered bike lane falls in the LOS B-C range which is approximately halfway between the LOS of a standard bike lane at LOS C-D and a separated bike lane (one-way) bikeway at LOS A-B. The estimated buffered bike lane LOS is obtained from averaging the LOS scores of both the bike lane and separated bikeway since both methods use the same cumulative logistic regression model form. This procedure is considered an interim method until better facility-specific methodologies are available. An Excel-based calculator is available on ODOT’s Planning Section webpage which combines both methodologies for a quick but separate (i.e. the presence of unsignalized conflicts only applies to the standard bike lane methodology) comparison.

This estimated method is best applicable within the ranges of the separated bike lane methodology (speeds 25-35 mph & 9,000-30,000 AADT). Higher volumes and speeds (vice versa for low speeds/volumes) will tend to make the separated bike lane better while the bike lane LOS becomes worse which will generally make the differences balance out between them.

LOS Criteria

The applicable LOS criteria and descriptions for shared-use paths come from HCM Exhibits 23-4 and 23-5 which are combined into Exhibit 14-3429 and Exhibit 14-3530 below. The LOS criteria is mainly based on recreational users which considers the influence of child bicyclists, runners, skaters and walkers in addition to the bicyclist mode. More user conflicts (passings and meetings) will result in lower LOS grades. A poor LOS indicates less user satisfaction and could increase the probability versus a chance of a potential route shift. Since a shared path will generally offer the lowest stress route, route shifting is unlikely unless there are nearby adjacent routes with no more than 10% extra without out-of-direction travel distance and the path carries high amount of high-stress tolerant (commuter) bicyclists that could travel comfortably on an on-street bike facility. Poor LOS grades generally indicate that the path is too narrow for the amount of existing or projected users.
14.6.9 Selecting Pedestrian Crossing Treatments

Before deciding on specific treatments, project existing conditions and alternatives should be evaluated for adequate spacing of pedestrian crossings. Especially in urban areas, roadway geometry, volumes, and available pedestrian facilities may hinder access to the nearest improved crossing. Pedestrians generally will not walk more than about 10% to go out of their way to and back to use the nearest signalized crossing, but instead may not do a particular trip or risk crossing the roadway mid-block. Table 3-9 in the ODOT Blueprint for Urban Design document contains target crossing spacing ranges for the different urban contexts. Land use density and nearby pedestrian generators should be considered when deciding on a specific spacing. When possible, these target ranges should be met.

14.6.9 NCHRP 562 Application

One of the main products of the National Cooperative Highway Research Program (NCHRP) Report 562 was a spreadsheet tool that can be used as a guide to select or screen potential pedestrian crossing treatments for plans and projects. These treatments can range from signs and markings to full mid-block traffic signals. This tool uses relatively little data (i.e., speeds, volumes, widths) which is generally available to the typical TSP planning level all the way to the project development and TIA-level efforts. Selected treatments can also be analyzed with FLTS and MMLOS methods described earlier in this chapter.

Any crossing treatment should be reviewed by Region Traffic and/or the Traffic-Roadway Section for its appropriateness for the given location and plan/project type. These treatments may have additional requirements listed in the Highway Design Manual, the Bicycle Pedestrian Design Guide, the Manual of Uniform Traffic Control Devices, or the Traffic Manual.

The need for a crossing treatment should not be based solely on the results of the NCHRP 562 methodology. Other factors such as the distance to the nearest improved crossing, number of vulnerable users, and crash history should also be considered.
Treatment Categories

There are five main categories used in the tool as explained below. Most of these have additional information shown in the solutions section of Chapter 10. For planning level analysis, improvements should be identified using general categories rather than as specific treatments, in order to allow for flexibility in design.

- **No Treatment** – Occurs when the volumes of pedestrians are low-insufficient (<20 pedestrians per hour at 35 mph or less or <14 pedestrians per hour at greater than 35 mph). Many locations in Oregon will fall into this category. When the tool indicates “no treatment” this means that no traffic control treatments such as signs, markings, or active pedestrian devices such as beacons are traffic control devices are not recommended. Traffic calming or pedestrian visibility-type measures can still be considered such as illumination, curb extensions, medians, and/or median refuge islands as appropriate. At certain locations such as transit stops and school crossings, however, it may be unlikely that these would be appropriate to provide done without additionally marking a traffic control treatment even where there are few users in any given hour due to known continuous use throughout the day and presence of particularly vulnerable users. Crosswalk. The analyst will need to review these results with Region Traffic to determine if the category should remain as “No Treatment” or be upgraded to the “Crosswalk” category.

- **Crosswalk** – Includes typical signing and crosswalk markings. This mainly applies to cases with sufficient pedestrian volume but low traffic volume.

- **Enhanced/Active** – Includes constant presence of enhanced and active treatments. Examples of enhanced treatments are in-street signs, raised crosswalks, and curb extensions all of which are known to result in significantly increased stopping compliance. Active treatment examples are rapid-flashing and traditional flashing beacons that are pedestrian activated features such as illumination, signing, markings, and pedestrian-activated beacons (PAB). This mainly applies to areas with sufficient pedestrians but higher traffic volumes or areas with high pedestrian volumes (>100 pedestrians per hour) and lower traffic volumes.
Input Data

- Posted speed limit, 85th percentile speed, or statutory speed (i.e. 25 mph residential or 20 mph downtown)
- Population category of surrounding area (less or greater than 10,000)

> The NCHRP 562 method does not include an allowance for just “marked crosswalks” when the population in less than 10,000. Treatment options are limited to no treatment, active/enhanced, red indication, and signal, so the method may overestimate the need for active/enhanced options. Adequate illumination, signs and continental crosswalk markings may be the expected outcome especially when volumes, speeds, or crossing distances are low/small.

- Bi-directional roadway vehicles per hour during the pedestrian peak hour. This can be either an existing condition or future projected volume. If a median/pedestrian refuge island of at least six feet wide is present then each direction needs to be analyzed separately. When an island is present two spreadsheets will need to be worked up, one for each direction. Vehicle volume in Line 3a will always be the total of both directions, while the volume in Line 4e, will be each approach direction when an island is present or the total when an island is not present. The pedestrian peak hour is typically not the same hour as the vehicular peak hour. Typically it can occur around the lunchtime period (i.e. 12-1 PM) which will likely require longer duration traffic counts at higher pedestrian volume locations in a plan or project.

> It can be helpful to analyze both the pedestrian peak hour and the vehicle peak hour especially when projecting future conditions. Treatments could be triggered with lower pedestrian volumes and higher vehicle volumes and vice versa.
Pedestrian volume in the pedestrian peak hour — Sum existing condition or future projected pedestrian crossings from both directions at a mid-block location. If the analysis site is an intersection, sum both directions on both approaches (i.e. both east-west crosswalks north and south of the intersecting roadway). If separate pedestrian counts are done versus standard intersection classification counts, these should be at least 16-hours to capture multiple potential peaks (e.g. morning, noon, school, afternoon) and taken in good weather (spring/summer/fall) when pedestrians are mostly likely to be at the location. The choice of a weekday or weekend counts should be based on the surrounding land use and pedestrian destinations surrounding the crossing location. Future population growth rates should be considered to estimate future background pedestrian growth. It may be necessary to consider a larger area (approximately a ½ mile radius) surrounding the crossing to help quantify or qualitatively explain the potential for induced growth above and beyond the background growth. Pedestrian warrant threshold reduction percentage — This parameter is used as part of the analysis for a full traffic signal. If the location experiences high pedestrian volumes (i.e. more than 100 peds/hr), then some consideration of the number of vulnerable pedestrians should be made. Otherwise, this parameter has no effect on the results and the default “no” can be retained.

Pedestrian warrant threshold reduction percentage — This value is not used by ODOT and can be ignored. Entering yes or no in Line 3d of the spreadsheet will have no effect on the results.
Example 14-10 Pedestrian Crossing Treatment Selection

A state highway in an urban area a small city splits the commercial zone area from the residential parts of the city. Residents report that it can be difficult to cross the roadway and it is too far out of direction to reach the nearest traffic signal. The roadway speed is 30 mph. A count was done and the pedestrian peak hour was determined to be from 12-1 PM and about 40 pedestrians per hour cross at this location. The bi-directional roadway volume was determined to be 450 vph during this time at this location. The assumed pedestrian walking speed is 3.5 ft/s, with a 30 ft curb-to-curb distance. Pedestrian yielding rates remain low at this location regardless of the current pedestrians yielding law which may be due to relatively low visibility of the crossing. The data is entered into the tool and a recommendation of a marked crosswalk an enhanced or active crossing is generated.

Improvements for this location are at least crosswalk signing, continental markings marking (if not already marked), and advance stop bars, illumination.

---

**Analyst and Site Information**

<table>
<thead>
<tr>
<th>Analyst</th>
<th>E. N. Green</th>
<th>Major Street</th>
<th>Main Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis Date</td>
<td>March 29, 2018</td>
<td>Minor Street</td>
<td>Elm Street</td>
</tr>
<tr>
<td>Data Collection Date</td>
<td>March 14, 2018</td>
<td>Peak Hour</td>
<td>12-1 PM</td>
</tr>
</tbody>
</table>

**Step 1: Select worksheet:**

- Pedestrian speed limit or 85th percentile speed on the major street (mph)
- Yes NO

**Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?**

- Peak-hour pedestrian volume (ped/h), \( V_p \)
- Yes NO

**Result:** Go to step 3.

**Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?**

- Major road volume, total of both approaches during peak hour (veh/h), \( V_{peak} \)
- Yes NO

**Result:** The signal warrant is not met. Go to step 4.

**Step 4: Estimate pedestrian delay.**

- Pedestrian crossing distance, curb to curb (ft), \( L \)
- Pedestrian walking speed (ft/s), \( S_p \) (suggested speed = 3.5 ft/s)
- Pedestrian start-up time and end clearance time (s), \( t_s \) (suggested start-up time = 3 sec)
- Critical gap required for crossing pedestrian (s), \( t_c \)

**Result:**

- Major road volume, total of both approaches during peak hour (veh/h), \( V_{peak} \)
- 450

**Step 5: Select treatment based on total pedestrian delay and expected motorist compliance.**

- Expected motorist compliance at pedestrian crossings in region: Enter HIGH for High Compliance or LOW for Low Compliance

**Treatment Category:** CROSSWALK

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Pedestrian Crossing Safety

The need for a median refuge island, or curb extensions. A pedestrian crossing treatment-activated beacon (PAB) is rooted on safety so that also possible if requirements in the safest crossing can be provided. The NCHRP 562 methods, explained previously, ODOT Traffic Manual and other applicable manuals are generally based on volumes of pedestrians or vehiclesnet and the crossing geometry. There can be many locations that fall into the “No Treatment” category but they have a noted crash history, have potential crash risks, or are near vulnerable populations (e.g. schools). Locations should also be screened for safety which can either confirm the NCHRP 562 treatments or suggest other possibilities. The publication, “FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations” contains a countermeasure methodology reproduced in Exhibits 14-35 through 14-36. Exhibit 14-35 is a table of pedestrian crash countermeasures by geometry, speed and AADT. Not all of the treatments indicated in a particular cell in Exhibit 14-35 should be considered at a single location, necessary approvals obtained.
### Exhibit 14-35 Pedestrian Crash Countermeasures

<table>
<thead>
<tr>
<th>Roadway Configuration</th>
<th>Posted Speed Limit and AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vehicle AADT &lt;9,000</td>
</tr>
<tr>
<td></td>
<td>≤30 mph</td>
</tr>
<tr>
<td>2 lanes (1 lane in each direction)</td>
<td>1 2 3</td>
</tr>
<tr>
<td>3 lanes with raised median (1 lane in each direction)</td>
<td>1 2 3</td>
</tr>
<tr>
<td>3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)</td>
<td>1 2 3</td>
</tr>
<tr>
<td>4+ lanes with raised median (2 or more lanes in each direction)</td>
<td>1 2 3</td>
</tr>
<tr>
<td>4+ lanes w/o raised median (2 or more lanes in each direction)</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>

Given the set of conditions in a cell:
- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- • Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

*Refer to chapter 4, table 4.1 and table 2.1 for more information about using multiple countermeasures.

**It should be noted that the PHB and RRFB are not both installed at the same crossing location.

If a location has an identified crash history or has had recent crash analyses done for a plan or project this may indicate a safety issue. However, most pedestrian crashes are random and a crash pattern may not be evident. There are a number of pedestrian crash risk factors that are associated with collisions and potential severe injuries:
- Excessive vehicle speed
- Inadequate visibility
- Failing to yield to pedestrians in crosswalks
- Insufficient separation from traffic

Exhibit 14.36 shows these safety risks and the associated countermeasures that address them. These are the same countermeasures shown in Exhibit 14.35 above. The crash reduction factors (CRF) from the original and supplemental ARTS CRF lists should be used as all but the parking restriction countermeasure are available. Appendix B of the FHWA guide does have a 30% CRF applied to a pedestrian crash basis for the parking countermeasure.

**Exhibit 14.36 Safety Issues and Related Countermeasures**

<table>
<thead>
<tr>
<th>Pedestrian Crash Countermeasure for Uncontrolled Crossings</th>
<th>Conflicts at crossing locations</th>
<th>Excessive vehicle speed</th>
<th>Inadequate conspicuity/visibility</th>
<th>Drivers not yielding to pedestrians in crosswalks</th>
<th>Insufficient separation from traffic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crosswalk visibility enhancement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-visibility crosswalk markings*</td>
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<td></td>
<td></td>
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<tr>
<td>Parking restriction on crosswalk approach*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved nighttime lighting*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Street Pedestrian Crossing sign*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Curb extension*</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raised crosswalk</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Pedestrian refuge island</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Pedestrian Hybrid Beacon</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Road Diet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectangular Rapid-Flashing Beacon</td>
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</tbody>
</table>

*These countermeasures make up the STEP countermeasure “crosswalk visibility enhancements.” Multiple countermeasures may be implemented at a location as part of crosswalk visibility enhancements.
Example 14-11 Pedestrian Crossing Safety Countermeasures

This example uses the same basic data as in Example 14-10. This roadway has two lanes, 30 mph speed and has 450 vph (4500 vpd). This data is used in Exhibit 14-35 to determine the potential safety countermeasures. High visibility crosswalk markings, lighting, parking restrictions and warning signs are indicated as the top countermeasure to be considered. This is consistent with the NCHRP 562 results in the previous example. Exhibit 14-35 also indicates that in-street pedestrian crossing signs, curb extensions, and a refuge island also can be considered. Raised crosswalks were also in the exhibit, but these are not installed on state highway mainlines and would be dropped from consideration.
**Chapter 14, Section 14.7.2**

*Passenger Load Factor (a):* For this simplified methodology, this factor is assumed to be 1.0, which represents that, on the average of all transit vehicles using that segment in the desired time period, they are 80% or less full (0.8 passengers per seat). On congested segments where passenger per seat ratios are higher than 80% and up to 100%, use passenger load factors in Exhibit 14-66. If overcrowding exists on the average where the numbers of passengers exceed the number of seats (presence of standees), please refer to the 3rd case of HCM Equation 18-59 for computing the appropriate passenger loading factor.

or the 2nd case of HCM Equation 18-59. If overcrowding exists on the average where the numbers of passengers exceed the number of seats (presence of standees), please refer to the 3rd case of HCM Equation 18-59 for computing the appropriate passenger loading factor.

Exhibit 14-60 or the 2nd case of HCM Equation 18-59. If overcrowding exists on the average where the numbers of passengers exceed the number of seats (presence of standees), please refer to the 3rd case of HCM Equation 18-59 for computing the appropriate passenger loading factor.

**July 2020**

**APM Version 2**

**Chapter 3, Subsection 3.4**

Added:

Disruptive events such as the 2020 COVID-19 pandemic can cause major changes in traffic patterns for extended periods of time. Under these conditions taking new traffic counts for the project will often not be advised and state and local traffic count programs will likely have been suspended. Refer to *Appendix 3E* for guidance on traffic counts in planning and project development when disruptive conditions are present.
Added:

Disruptive events such as the 2020 COVID-19 pandemic can cause major changes in traffic patterns for extended periods of time. Under these conditions taking new traffic counts for the project will often not be advised and state and local traffic count programs will likely have been suspended. Refer to Appendix 3E for guidance on volume development in planning and project development when disruptive conditions are present.

Appendix 3E

Added:
New Appendix 3E, Traffic Volume Development During Disruptive Events

October 2020

APM Version 2

Chapter 14, Subsection 14.4.4

Added:

While not a main focus of this method, biking is allowed on Interstate highways and freeways in certain urban areas. However, even with wider shoulders, due to high vehicle and heavy truck volumes as well as high-speed conflicts at ramps, the level of traffic stress should be coded as BLTSLTS 4 for these sections. Certain freeway sections in Portland and Medford prohibit bicycles as shown in Oregon Administrative Rule OAR 734-020-0045, so these sections should show the BLTSLTS as not applicable (“N/A”).

Chapter 14, Subsection 14.4.7
The rural roadway environment is substantially different from the urban. High speeds are assumed and vehicular operation is unpredictable as drivers are not expecting bicycles in or near the travel lanes. Paved shoulders when provided can narrow in guardrail sections and through bridges and tunnels creating higher potential conflict areas especially where volumes are higher. Gravel, cinders, and other debris is common in the shoulders which may limit their use and force the bicyclist to use the travel lanes. Given the geometric and operational differences, the rural bicyclist must be more aware and is likely higher stress tolerant than their urban counterpart. The BLTS rural nomenclature uses a “R” prefix to help set off the environmental difference, as an urban BLTS 2 is not the same experience as a rural BLTS R2 for the reasons above.

**Rural <45 mph**

While the original methodology was designed only for urban applications, it can be used also for rural roadways that have posted or operating speeds less than 45 mph. Rural roadways with speeds less than 45 mph tend to be one or two-lane local, undeveloped roadways that:

1. Connect rural communities,
2. Exist in parks or other recreational areas or
3. Provide a connection to a tourist destination.

These are typically low volume and have no or little paved shoulder width. Sight distances are likely to be lower (especially on horizontal curves) because of the lower road design standards used. Use the regular BLTS methodology for Exhibit 14-5 and Exhibit 14-6 for these roadways and Exhibit 14-10 through Exhibit 14-15 for intersections. Approach criteria will probably not be applicable because low volume roadways generally do not have turning lanes. Add the “R” suffix to designate a rural roadway to the BLTS values in the tables.

**Rural >45 mph**

Application of the BLTS methodology to the typical higher-speed rural environment requires considering paved shoulder widths and volumes. Daily bi-directional (combined) volumes are necessary for this method. This can be AADT for initial scoping-level assessments, but most analyses should take seasonal adjustment into account especially for coastal and summer recreational routes as the majority of bike travel occurs in the summer months. The normal BLTS methodology tops out at 40 mph, while most typical state and county rural roadways are posted at 45 - 55 mph; some eastern Oregon state highways have higher speed limits.

Interstate highways are a special case and while they typically have shoulders of 10' or more, the posted speed limits can be up to 70 mph, and high traffic and truck volumes are a normal occurrence making the overall environment not very inviting to cyclists. Rural Interstate highways are coded as BLTS R4. Where no parallel routes exist, (e.g. certain sections of I5 in southern Oregon and 184 in eastern Oregon) there is a need to create separated facilities instead of attempting to widen shoulders as that would likely have limited likelihood to increase use.

A large portion of bicycle-vehicle crashes occur when a vehicle attempts to overtake a bicyclist on a roadway with no or little available paved shoulder width. The wider the shoulder the less likely a bicyclist will be in the same path as vehicles. The occurrence of bike crashes is highest on higher volume rural facilities with little or no paved shoulders, poorly placed rumble strips, or deteriorated shoulder pavement conditions.
Narrow or no shoulders and higher volumes (increased overtaking conflicts) will increase the stress level at any speed. Paved shoulders less than four feet in width are not considered rideable (even when clear of debris or obstacles) because there is effectively no opportunity to move out of the travel lane while riding on these segments. This is a high stress environment to ride in unless volumes are very low (<400 vehicles per day). Even with low volumes, a bicyclist is generally unable to move into the shoulder or could encourage unsafe/illegal close passing behavior.

Shoulders between four and six feet in width do allow riding in the shoulder continuously when clear of debris. The clear riding space may be constrained by debris or obstacles, but there is some space to navigate around occasional obstacles without leaving the shoulder. Where there is continuous debris, it is probably still physically possible to move out of the travel lane when vehicles approach. The shoulder may also pinch down for short segments (e.g., bridges), but there should generally be a wide enough shoulder approaching these pinch points that a bicyclist could wait in the shoulder for a gap in traffic before proceeding.

Shoulder width greater than six feet should generally provide room to ride and navigate around debris without leaving the shoulder, although it might require the bicyclist to get in closer proximity to the vehicular traffic. Shoulders greater than six feet can accommodate ODOT’s common placement of rumble strips adjacent to the fog line, while still providing at least four feet of shoulder on the outside of the rumble strips. While rumble strips encroach on the clear rideable space, they also discourage cars from encroaching into the shoulder, which can improve bicyclist comfort.

Long-term debris in the shoulder (like leftover cinder from winter maintenance), limiting or preventing shoulder use, should be coded as no shoulder. However, the true shoulder width (and resulting BLTS) should also be retained for documentation. Unless an adjacent separated multi-use path/bike lane is provided (BLTS 4R1), most rural roadways do not have bike lanes and bicyclists will depend on paved shoulders. Exhibit 14-16 shows the BLTS for typical rural conditions for higher speed rural roadways.

Rural intersection crossing stress levels will be typically based on approach volumes and number of lanes (Exhibit 14-17). Since the rural environment is more unpredictable (higher speeds and motorists are less likely to be aware of or anticipate bicyclists) than the urban environment, the minimum BLTS is 2.
Added:

OTSDE, the Oregon Transportation Safety Data Explorer, is a publicly accessible, web-based GIS tool that supports ODOT safety and multi modal work, helping users see connections to leverage efforts across programs. OTSDE uses ESRI Web AppBuilder functionality to provide a user interface that does not require ArcGIS skills to view and filter crash data, crash screening data, and active transportation data. Main capabilities of OTSDE:

1) Visualize Corridors
2) View Active Transportation Data
3) Filter Crash Data