

Appendix E

LTS Inputs

Bicycle Level of Traffic Stress (LTS) Scoring Criteria

LTS classifies the street network according to the estimated level of stress it causes cyclists, taking into consideration a cyclist’s physical separation from vehicular traffic, vehicular traffic speeds along a roadway segment, number of travel lanes, and factors related to intersection approaches with right-turn lanes and unsignalized crossings. LTS scores range from 1 (lowest stress) to 4 (highest stress), and correspond to roadway conditions that different cycling demographics would find suitable for riding on the basis of stress tolerance.

LTS is determined for roadway segments and intersection approaches using a series of look-up tables. Look-up tables for bicycle LTS along roadway segments are categorized as follows:

- Mixed traffic, no bike lanes (Table 1)
- Roadway with bike lane and on-street parking (Table 2)
- Roadway with bike lane and no on-street parking (Table 3)

Look-up tables for bicycle LTS at intersection approaches are categorized as follows:

- Intersection approaches with no bicycle facility and a right-turn lane (Table 4)
- Intersection approaches with bike pocket lane to the left of a right-turn lane (Table 5)
- Unsignalized crossing location without a median refuge (Table 6)
- Unsignalized crossing location with a median refuge (at least 6 feet wide) (Table 7)

LTS Scoring Criteria for Roadway Segments

As shown in **Tables 1** through **3**, speed and roadway width (or number of travel lanes) are major factors considered in the LTS score. Bike lane width and the frequency of bike lane obstructions are also considered for developing LTS scores along roadways with bike lanes. Separate scoring methods are used for roadway segments with and without bike lanes.

Table 1 shows the LTS segment criteria for cyclists traveling along roadways with no bike facility. Table 2 shows the LTS segment criteria for cyclists traveling along roadways with bike lanes and on-street parking. Table 3 shows the LTS segment criteria for cyclists traveling along roadways with bike lanes and no on-street parking. The analyst would refer to the relevant table (1 through 3) based upon the roadway environment being assessed.

Table 1: LTS Criteria for Roadway Segment with No Bicycle Facility^b

		Street Width		
		2-3 Lanes	4-5 Lanes	6+ Lanes
Speed Limit	≤25 mph	LTS 1 ^a or 2 ^a	LTS 3	LTS 4
	30 mph	LTS 2 ^a or 3 ^a	LTS 4	LTS 4
	≥35 mph	LTS 4	LTS 4	LTS 4

Source: Mekuria et al. (2012)

Note:

^a Use lower value for streets without marked centerlines or classified as residential and with fewer than 3 lanes; use higher value otherwise.

^b Bicycle routes or Class III facilities are treated as “no bicycle facility”.

Table 2: LTS Criteria for Roadway Segment with Bike Lane and On-Street Parking

Level of Stress (LTS)	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS ≥ 4
Street width (through lanes per direction)	1	1	2 or more	2 or more
Sum of bike lane and parking lane width (includes marked buffer and paved gutter)	15 ft. or more	14 or 14.5 ft ^a	13.5 ft. or less	13.5 ft. or less
Speed limit or prevailing speed	25 mph or less	30 mph	35 mph	40 mph or more
Bike lane blockage (typically applies in commercial areas)	Rare	Rare	Frequent	Frequent

Source: Mekuria et al. (2012)

Note:

^a If speed limit < 25 mph or Class = residential, then any width is acceptable for LTS 2.

Table 3: LTS Criteria for Roadway Segment with Bike Lane and No On-Street Parking

Criteria	LTS ≥ 1	LTS ≥ 2	LTS ≥ 3	LTS ≥ 4
Street width (through lanes per direction)	1	2, if directions are separated by a raised median	More than 2, or 2 without a separating median	More than 2, or 2 without a separating median
Bike lane width (includes marked buffer and paved gutter)	6 ft. or more	5.5 ft. or less	5.5 ft. or less	5.5 ft. or less
Speed limit or prevailing speed	30 mph or less	30 mph or less	35 mph	40 mph or more
Bike lane blockage (typically applies in commercial areas)	Rare	Rare	Frequent	Frequent

Source: Mekuria et al. (2012)

The LTS link or segment score is defined by the lowest scoring factor along the segment. Mekuria et al. (2012) call this the “weakest link” principle, implying that a cyclist’s overall stress along a route is derived from the *worst* aspect of that route, not from an *averaging* of all route characteristics. A roadway segment with low stress conditions can have its overall LTS score degraded if it also has high-stress intersection approaches with right-turn lanes. LTS scoring criteria for each of the elements is described in the following section.

Table 3 for example would be interpreted as follows, using the weakest link principle: if a roadway segment has one travel lane in each direction and a 6-foot bike lane (LTS 1), but also has a speed limit of 40 mph or more (LTS 4), then the prevailing level of traffic stress score for the segment is LTS 4, the weakest link.

LTS Scoring Criteria for Intersection Approaches with Right-Turn Lanes

Intersection approaches are only factored into the overall LTS score when there is a right-turn lane requiring a through-moving cyclist to merge across the right-turn lane. Separate scoring methods are used for intersection approaches with right-turn lanes depending on whether the cyclist is in mixed traffic or has a bike lane.

Table 4 shows the LTS criteria for cyclist traveling along a roadway with no bicycle facility and arriving at an intersection with a right-turn lane, while **Table 5** shows the LTS for bicyclists arriving at an intersection with a pocket bike lane (ie., where a bike lane is provided to the left of a right-turn lane).

Table 4: LTS Criteria for Intersection Approach – No Bicycle Facility and Presence of a Right-turn Lane

Criteria	LTS Score
Single right-turn lane with length ≤ 75 ft. and intersection angle and curb radius limit turning speed to 15 mph.	(no effect on LTS)
Single right-turn lane with length between 75 and 150 ft., and intersection angle and curb radius limit turning speed to 15 mph.	LTS ≥ 3
Otherwise	LTS = 4

Source: Mekuria et al. (2012)

Table 5: LTS Criteria for Intersection Approach – Pocket Bike Lane with Right-Turn Lane

Criteria	LTS Score
Single right-turn lane up to 150 ft. long, starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 15 mph.	LTS ≥ 2
Single right-turn lane longer than 150 ft. starting abruptly while the bike lane continues straight, and having an intersection angle and curb radius such that turning speed is ≤ 20 mph.	LTS ≥ 3
Single right-turn lane in which the bike lane shifts to the left but the intersection angle and curb radius are such that turning speed is ≤ 15 mph.	LTS ≥ 3
Single right-turn lane with any other configuration; dual right-turn lane along with an option (through-right) lane.	LTS = 4

Source: Mekuria et al. (2012)

LTS Scoring Criteria for Unsignalized Crossings

Separate scoring methods are used for unsignalized crossings depending on the presence of a median refuge of at least six feet. **Table 6** shows the LTS for cyclists traveling across a roadway at an unsignalized crossing without a median refuge, while **Table 7** shows LTS for cyclists traveling across a roadway at an unsignalized crossing with a median refuge of at least six feet.

Table 6: LTS Criteria for Unsignalized Crossing – Without Median Refuge

		Width of Street Being Crossed		
		Up to 3 lanes	4-5 Lanes	6+ Lanes
Speed Limit	≤25 mph	LTS 1	LTS 2	LTS 4
	30 mph	LTS 1	LTS 2	LTS 4
	35 mph	LTS 2	LTS 3	LTS 4
	≥40 mph	LTS 3	LTS 4	LTS 4

Source: Mekuria et al. (2012)

Table 7: LTS Criteria for Unsignalized Crossing – With Median Refuge of at Least Six Feet

		Width of Street Being Crossed		
		Up to 3 lanes	4-5 Lanes	6+ Lanes
Speed Limit	≤25 mph	LTS 1	LTS 1	LTS 2
	30 mph	LTS 1	LTS 2	LTS 3
	35 mph	LTS 2	LTS 3	LTS 4
	≥40 mph	LTS 3	LTS 4	LTS 4

Source: Mekuria et al. (2012)