



Intersection Level of Traffic Stress: How Much Do Intersections Affect Low-Stress Bike Accessibility?

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High-stress crossings can be a barrier

The east-west segments are low-stress, but a high stress crossing is a barrier.



RESEARCH NEED #1: Traffic Stress Criteria for Intersection Crossings (xLTS)

xLTS 1: Suitable for children
xLTS 2: Acceptable to most adults
xLTS 3: Acceptable to most bike enthusiasts

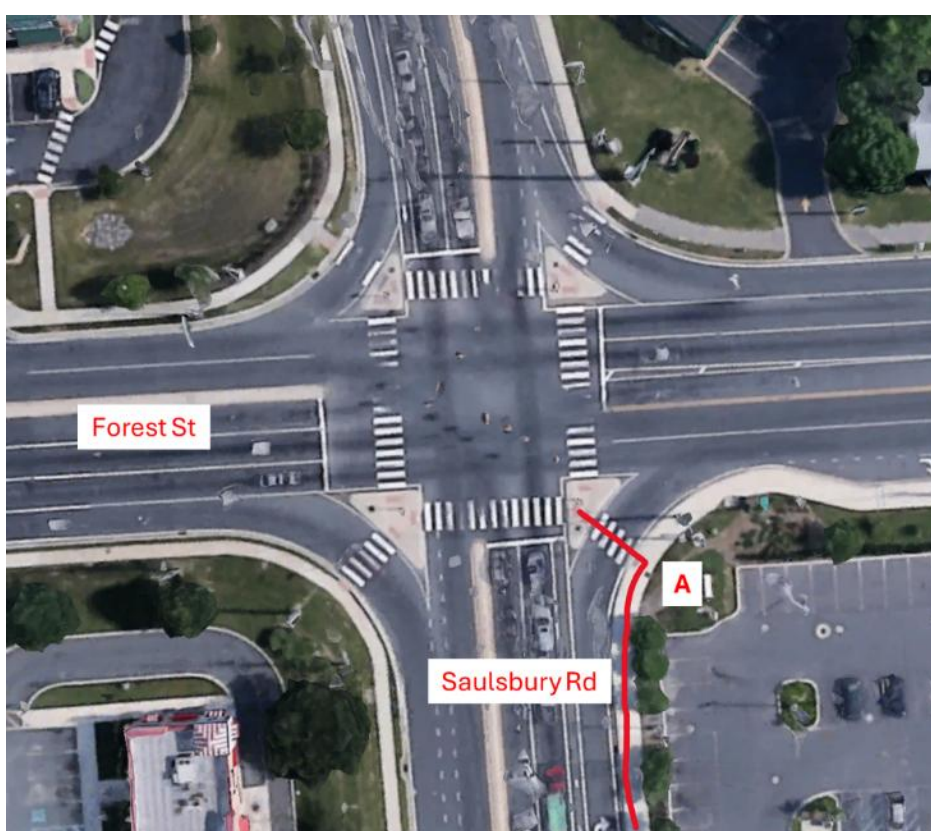
Criteria are not based on original data, but reflect known stress factors using a framework that promotes consistency.

Unsignalized crossings

ADT	Speed (85-p) < 62 km/h				Speed (85-p) > 62 km/h				ADT
	With Crossing Island	Without Crossing Island	Crossing 1-3 Lanes	Crossing 4+ Lanes	With Crossing Island	Without Crossing Island	Crossing 1-3 Lanes	Crossing 4+ Lanes	
24,000	3	3			3	3			
19,000	2	2	3	4	2	2	3	4	18,000
17,000									17,000
12,000			2	3			2	3	14,000
9,000		1	1	2		1	1	2	10,000
6,000									8,000
0									6,000

Other high stress triggers

- Freeway ramp entry and exit:
xLTS could be 2 or 3 depending on arterial speed
- Blind entry (see photo – cyclist entering at A has to look behind to see conflicting vehicles):
xLTS = 2

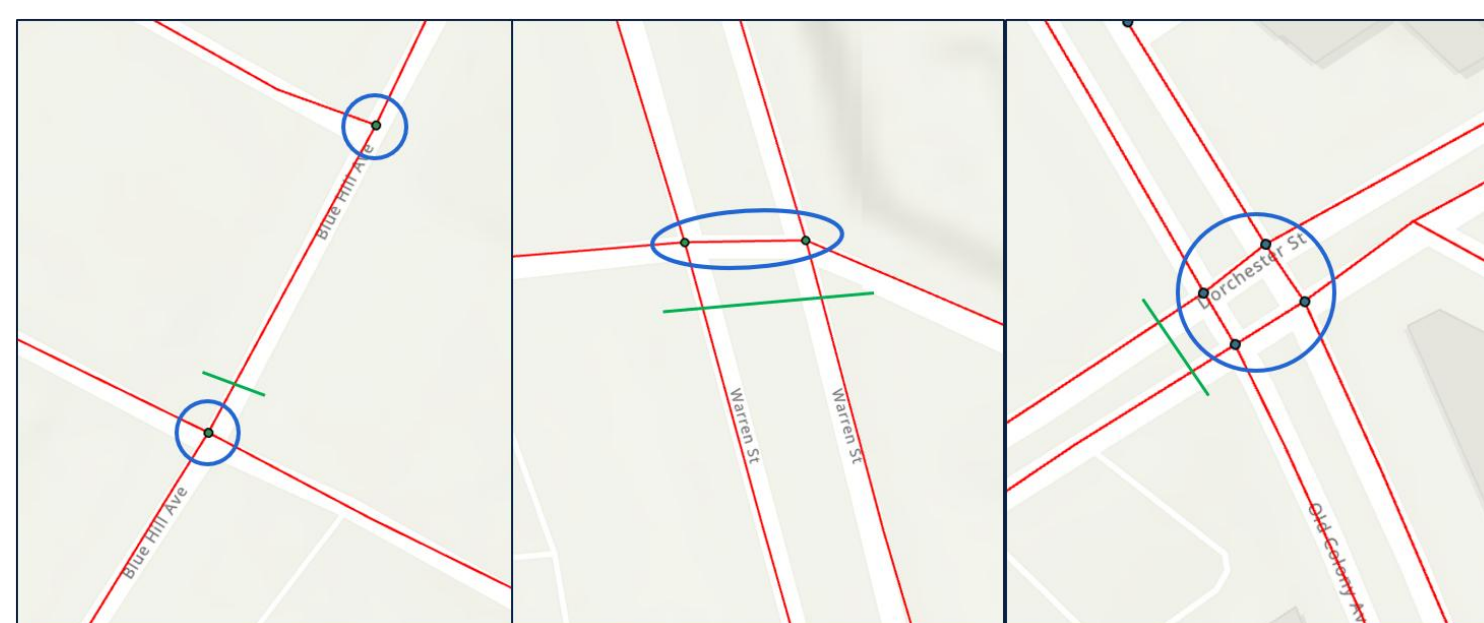


Signalized crossings

- xLTS 1 by default, but there are high-stress triggers:
- Crossing distance > 30 m (100 ft)
 - Conflicting right turn volume > 3.5 per cycle (5.5 w/ leading interval)
 - Conflicting left turn volume > 1.5 per cycle
 - Conflicting right turn speed > 24 km/h (15 mph)
 - Multistage crossing with island depth < 30 m (100 ft)

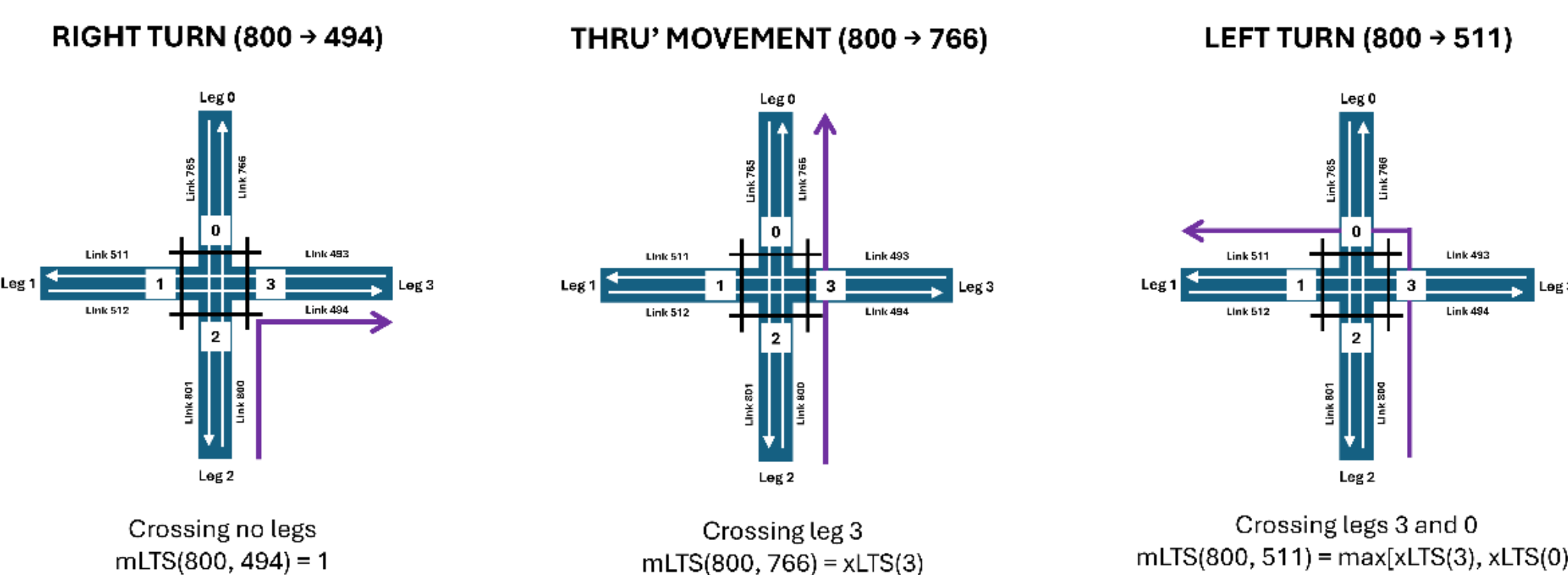
RESEARCH NEED #2: Modeling crossings in a network

New Data Structures: intersection, leg, crossing.
xLTS is an attribute of a crossing.



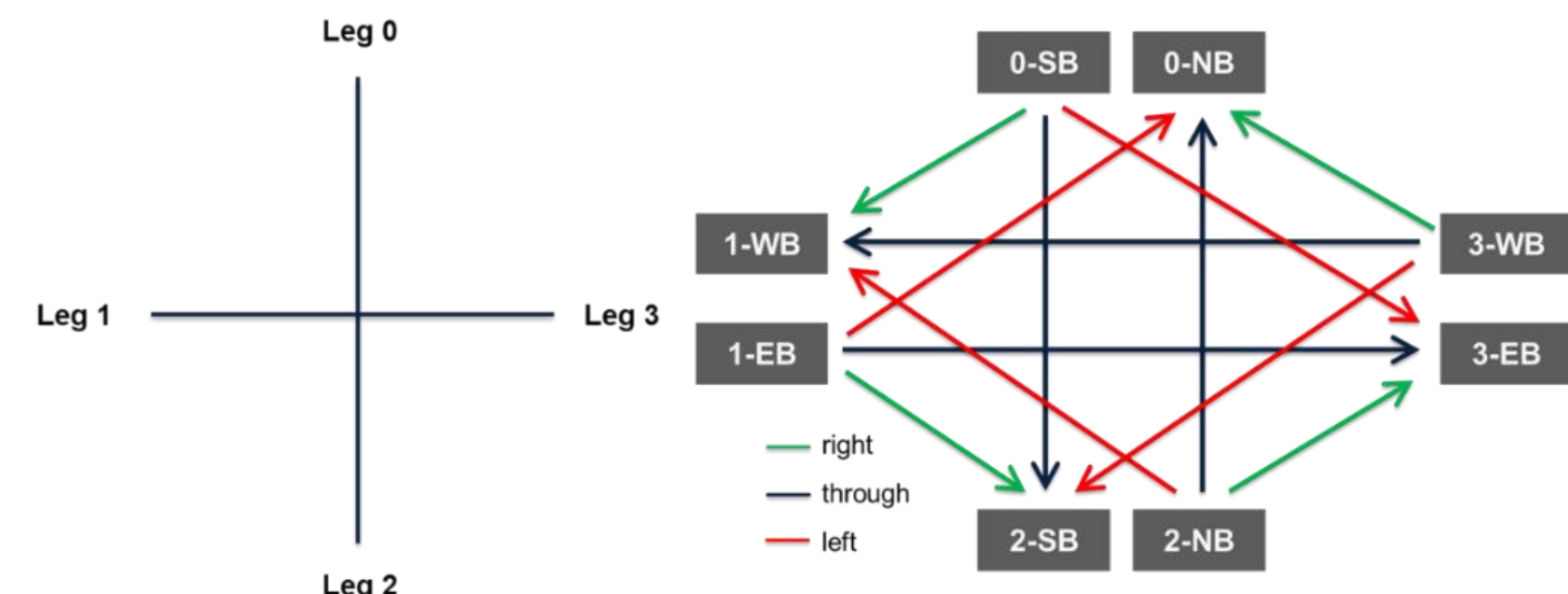
Crossings are a **relation** between 2 segments, and are **features** for visualization only

Movement LTS is derived from crossing LTS



Right: 0 crossings Through: 1 Left: 2
Movement stress = its most stressful crossing

Routing on a dual graph



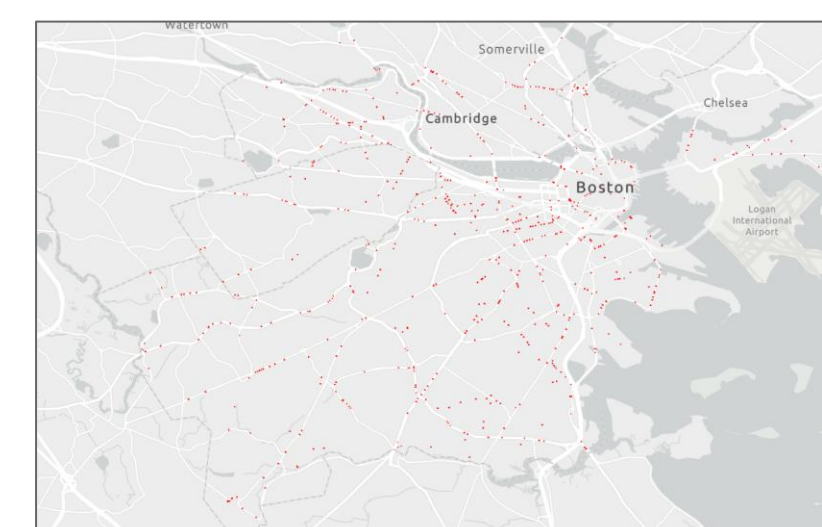
Dual node = far end of a street segment (one per direction)
Dual edge = an intersection movement and the segment following, carrying the movement stress and the distance and stress of the receiving segment

Critical crossings

Crossing stress is greater than the approach and departure leg stress.



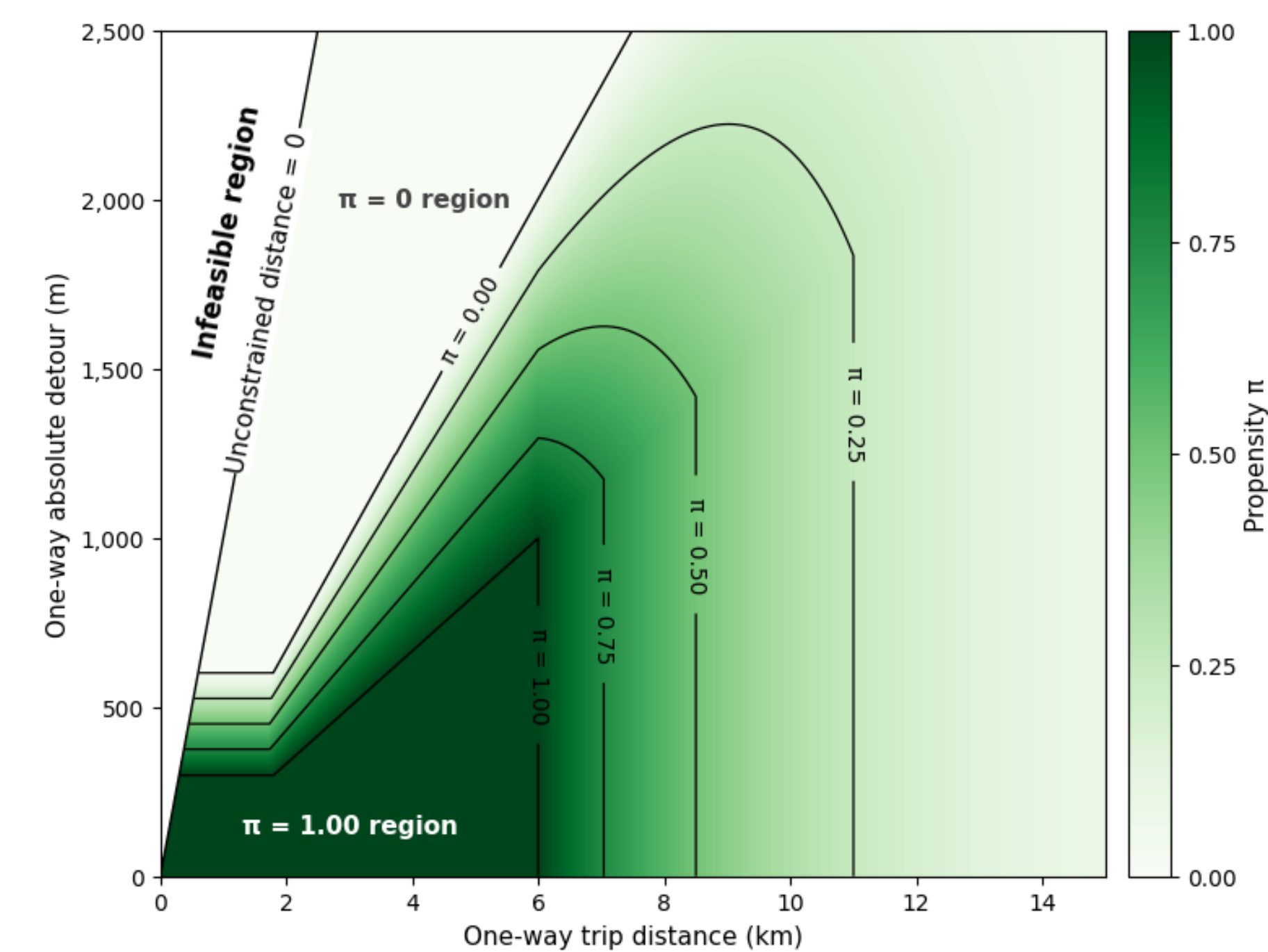
Montreal: 814 critical crossings



Boston: 1,199 critical crossings

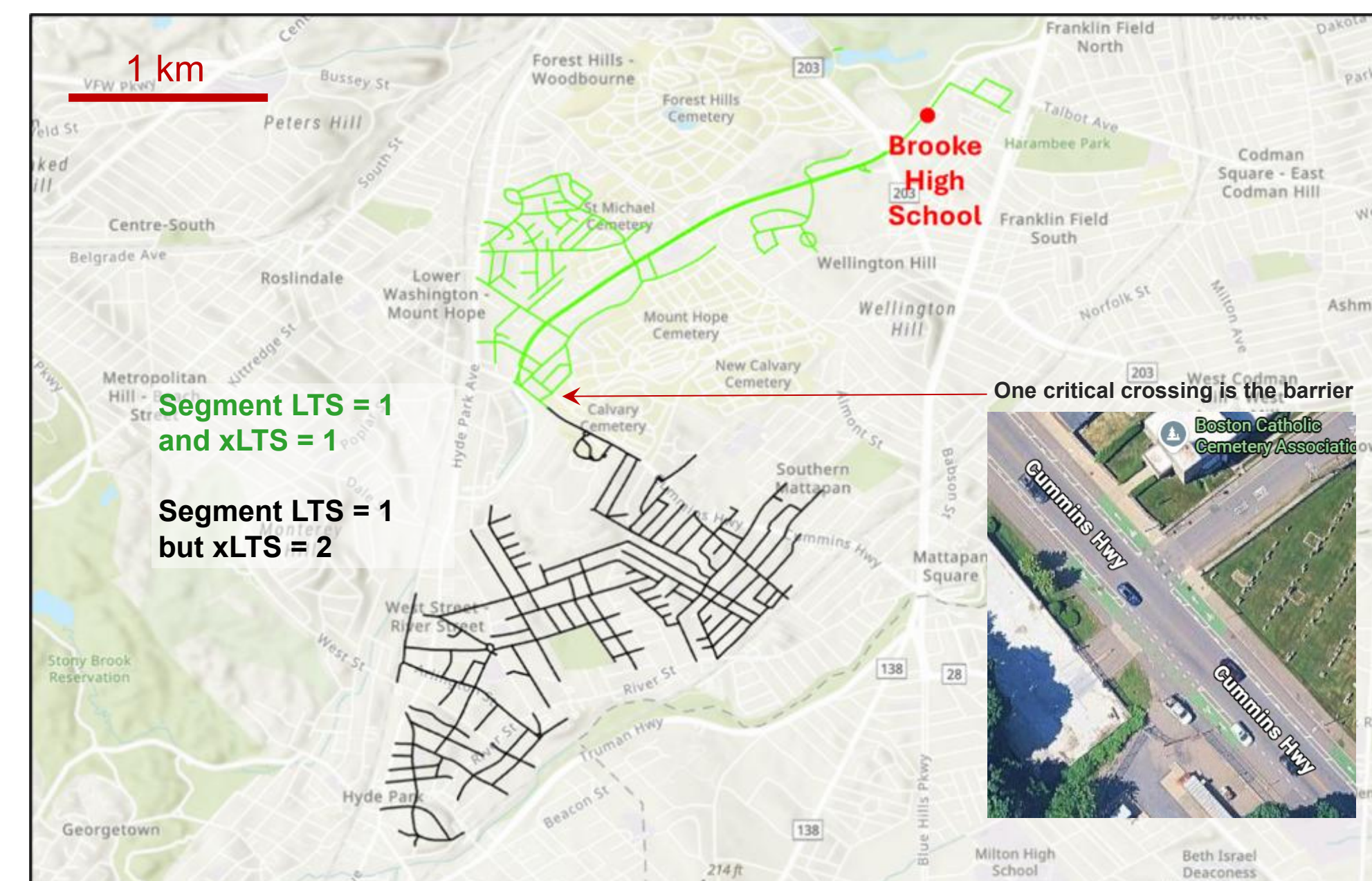
ACCESSIBILITY CASE STUDIES:

Propensity falls after 6 km (3.75 mi) of distance and detour factor of 1.2

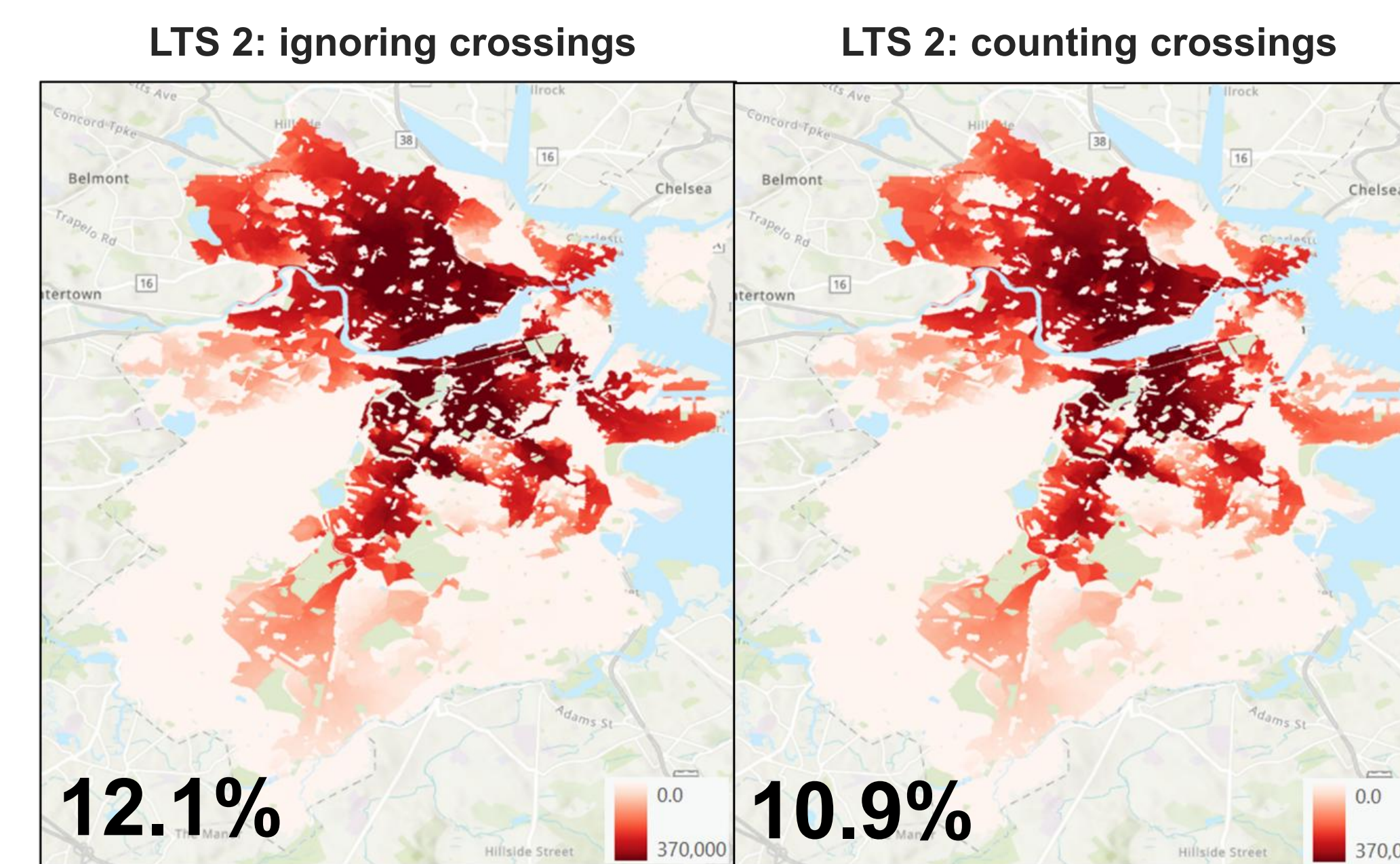
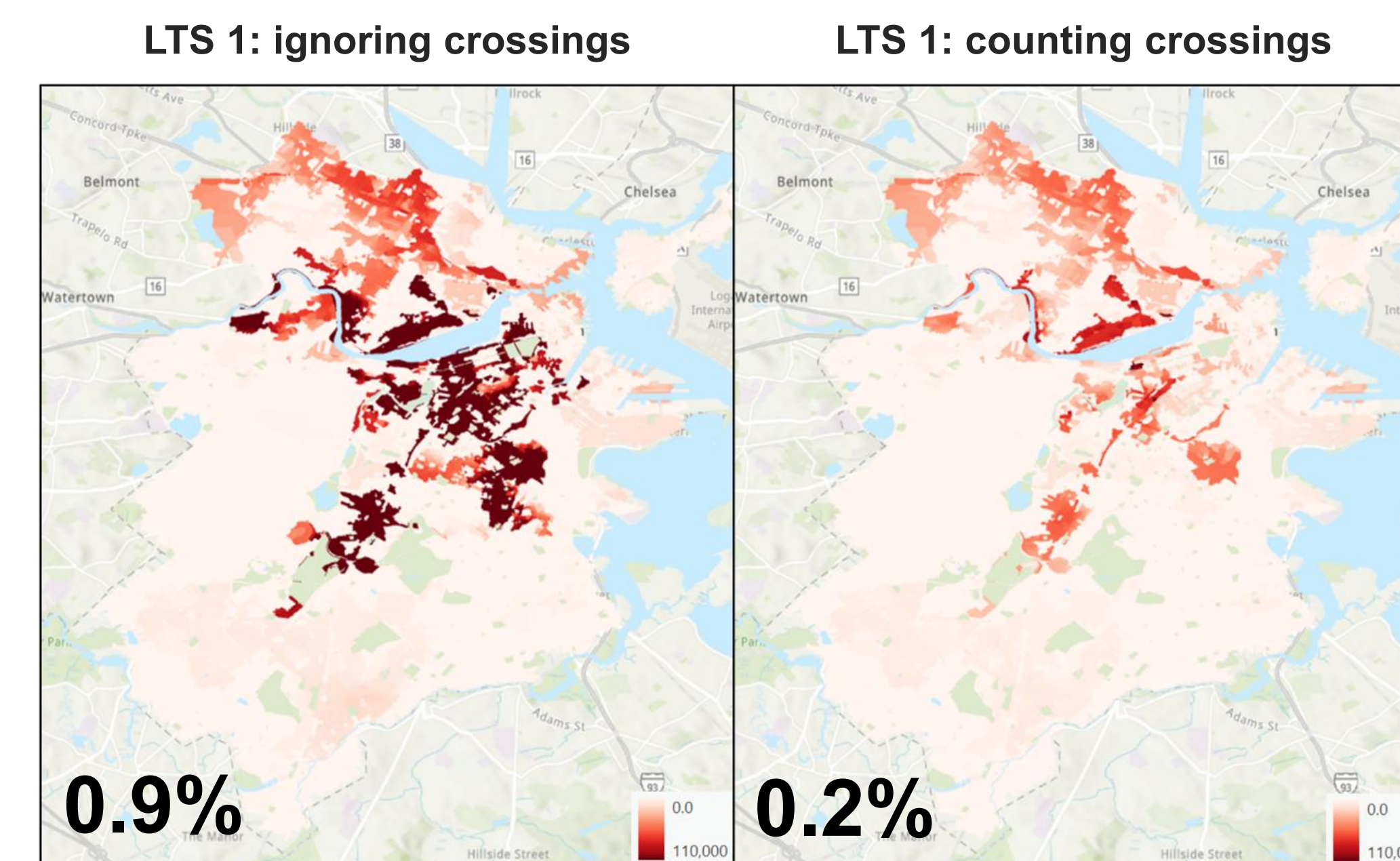


How much does intersection crossing stress create an additional barrier beyond segment LTS?

Bikeshed of a high school in Boston: accounting for crossing stress shrinks the bikeshed by ~50%



Share of Boston jobs reachable on a low-stress route



Conclusions

- With xLTS as well as segment-level LTS, all the traffic stress of getting from here to there can be accounted for.
- Intersection crossing stress can be modeled on a standard road network that lacks crossing features.
- From the Boston case study, intersection crossing stress appears to be a substantial barrier at LTS 1; at LTS 2, it is still an incremental barrier, but less so.
 - In US cities that are less pedestrian-friendly than Boston, intersection crossings may be more of a barrier.