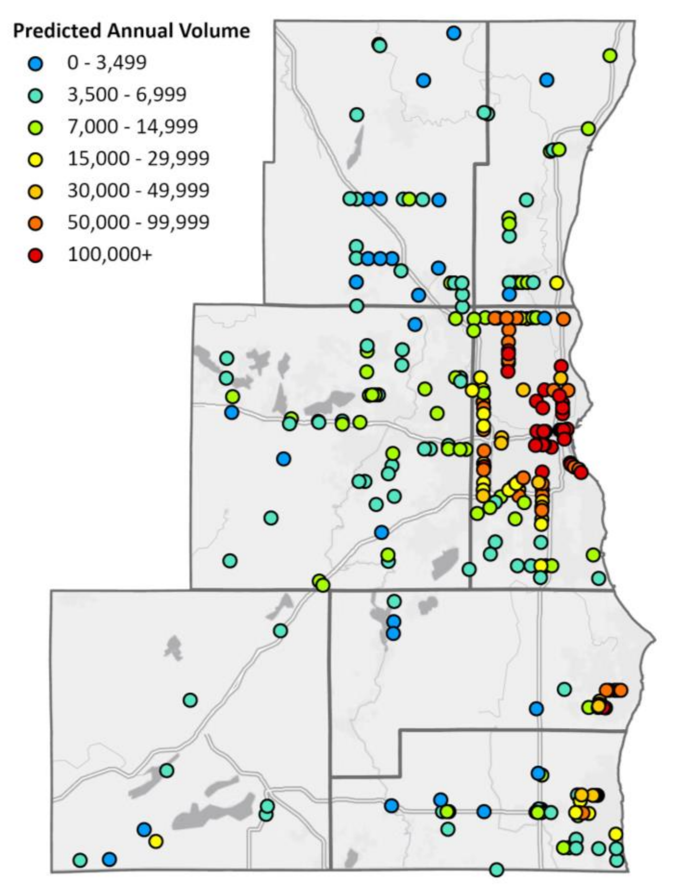
Exposure Data to Improve Pedestrian Safety: WisDOT SE Region Pilot Study



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October 2021

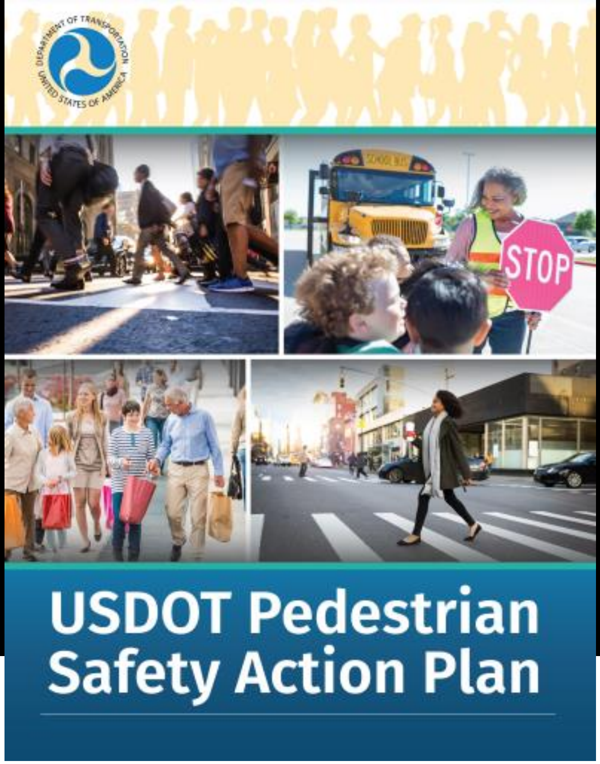
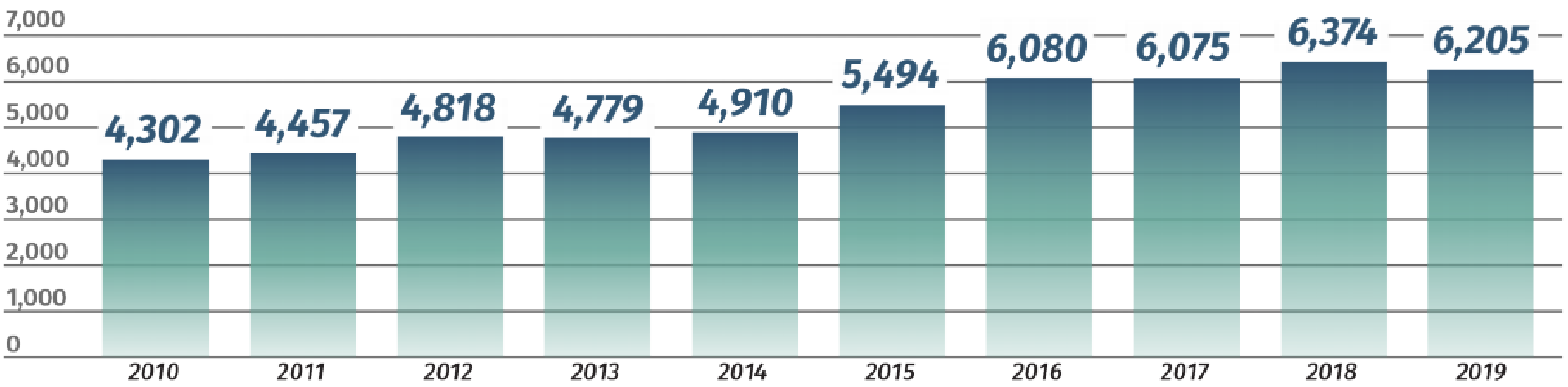


Figure 1. Pedestrian Fatalities, 2010-2019



Source: FARS 2010 to 2018 Final File, NHTSA's Preview of Motor Vehicle Traffic Fatalities in 2019

Source: USDOT Pedestrian Safety Action Plan, https://highways.dot.gov/sites/fhwa.dot.gov/files/2020-11/FHWA_PedSafety_ActionPlan_Nov2020.pdf, 2020.

ADDRESSING THE CHALLENGE

Some factors that are unique to pedestrian safety present challenges when it comes to solutions. Unlike vehicles, there is currently not a consistent way to measure exposure to risk as it relates to pedestrians. Exposure describes the frequency in which pedestrians are exposed to the risk of a crash with a vehicle. The number of person trips is generally not collected. There are some States and localities that are beginning to collect this information, but it is not widespread. In addition to not having a way to measure risk, there are other problems associated with pedestrian safety including urban sprawl which can make it difficult for pedestrians to get around; poor links to transit; problems caused by weather conditions; and a general lack of safe, complete networks for pedestrians to use when they go about their daily travels.

FHWA, NHTSA, and other USDOT agencies are addressing these and other challenges while moving forward with efforts to improve pedestrian safety. The USDOT Pedestrian Safety Action Plan includes actions that will be completed in the near term (December 2020) and those that will be completed by December 2021 and beyond. The plan also identifies those actions that fall under the safe system approach. The safe system approach promotes a more forgiving transportation system that takes human vulnerability into account. It caters to all the modes of transportation, including pedestrians and bicyclists.

Source: USDOT Pedestrian Safety Action Plan, https://highways.dot.gov/sites/fhwa.dot.gov/files/2020-11/FHWA_PedSafety_ActionPlan_Nov2020.pdf, 2020.

Why do we need pedestrian exposure data?

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- Count core users of our transport system
- Prioritize projects
- Inform facility design

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N. 27th Street
Rapid Implementation Project
(City of Milwaukee DPW)

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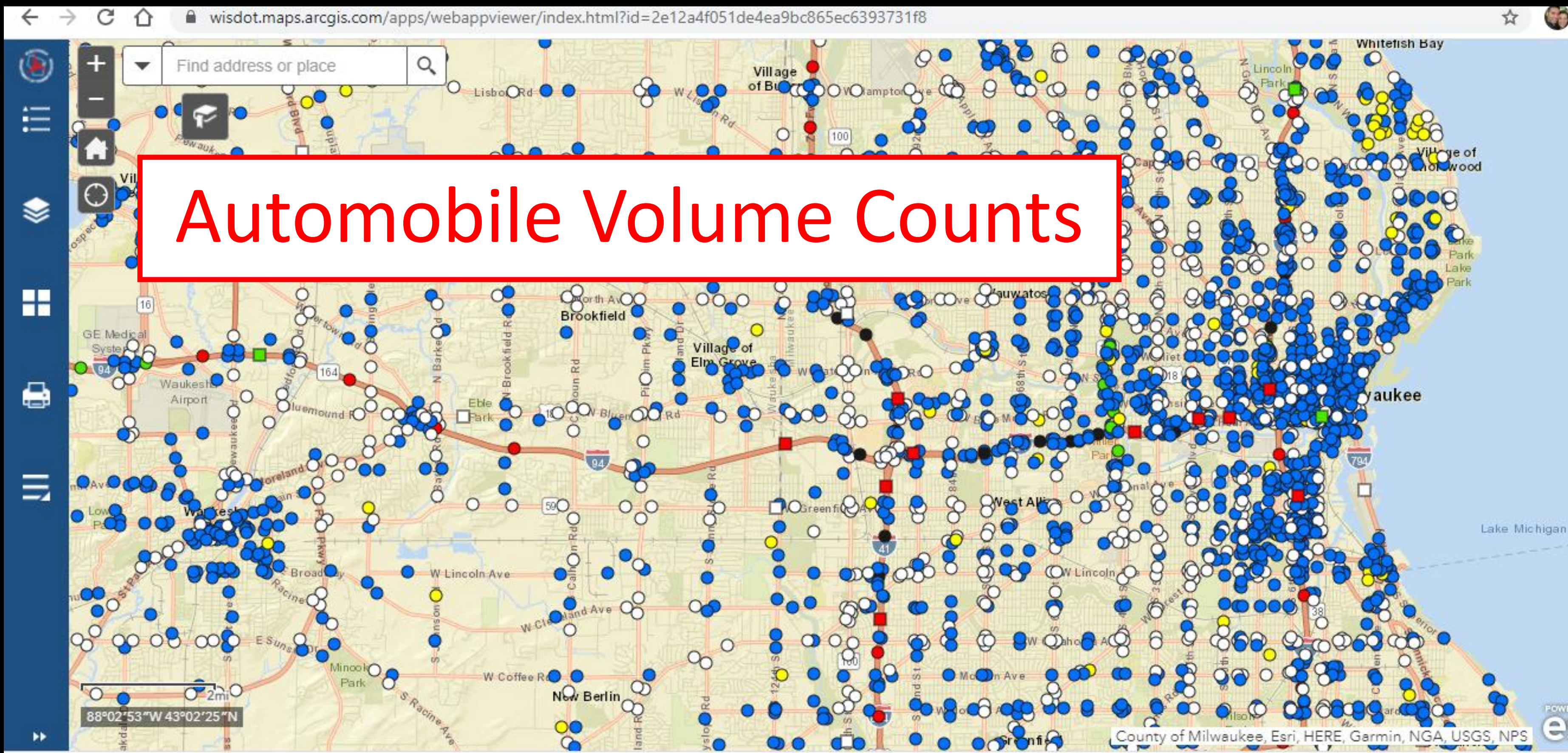
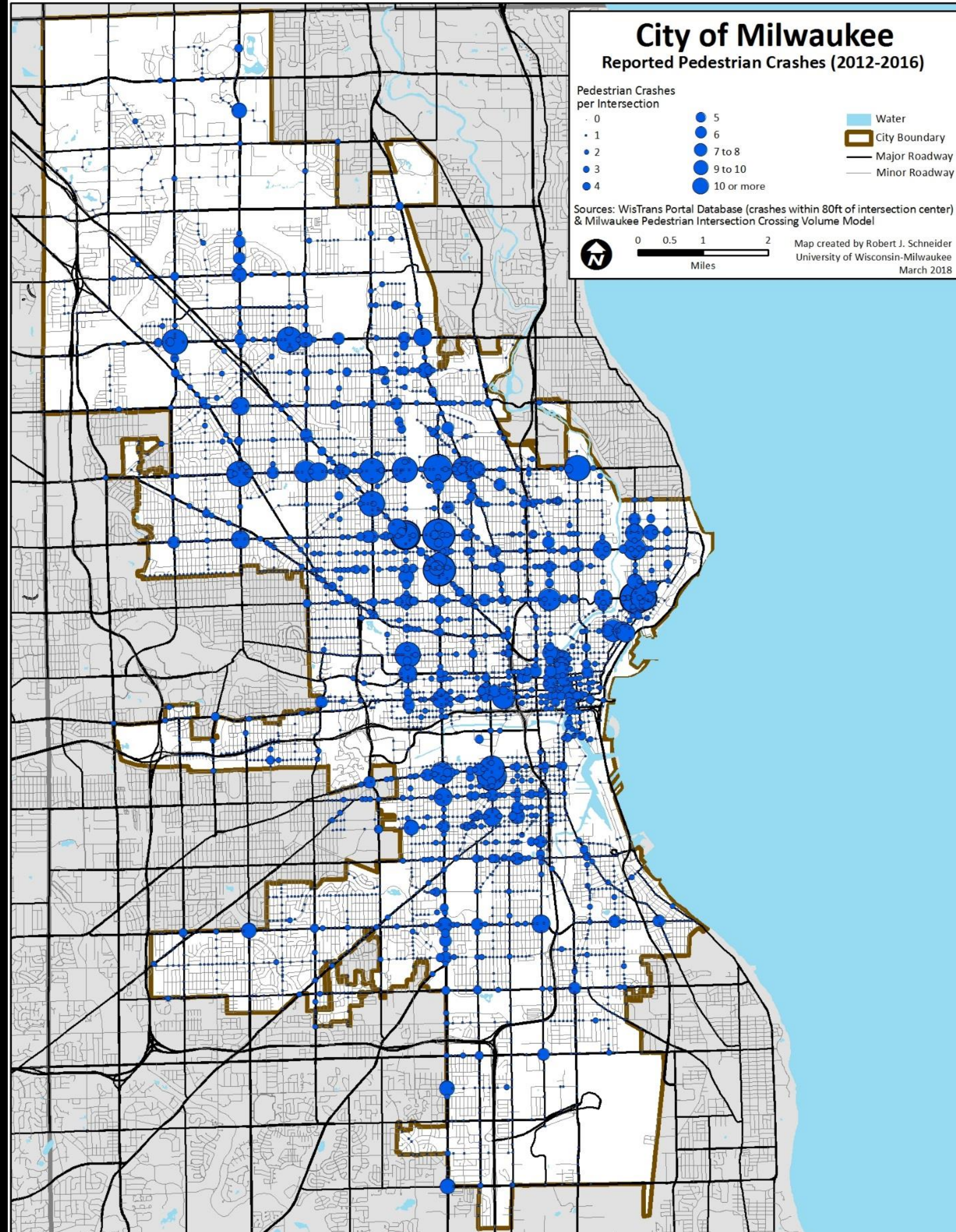


Automobile Volume Counts

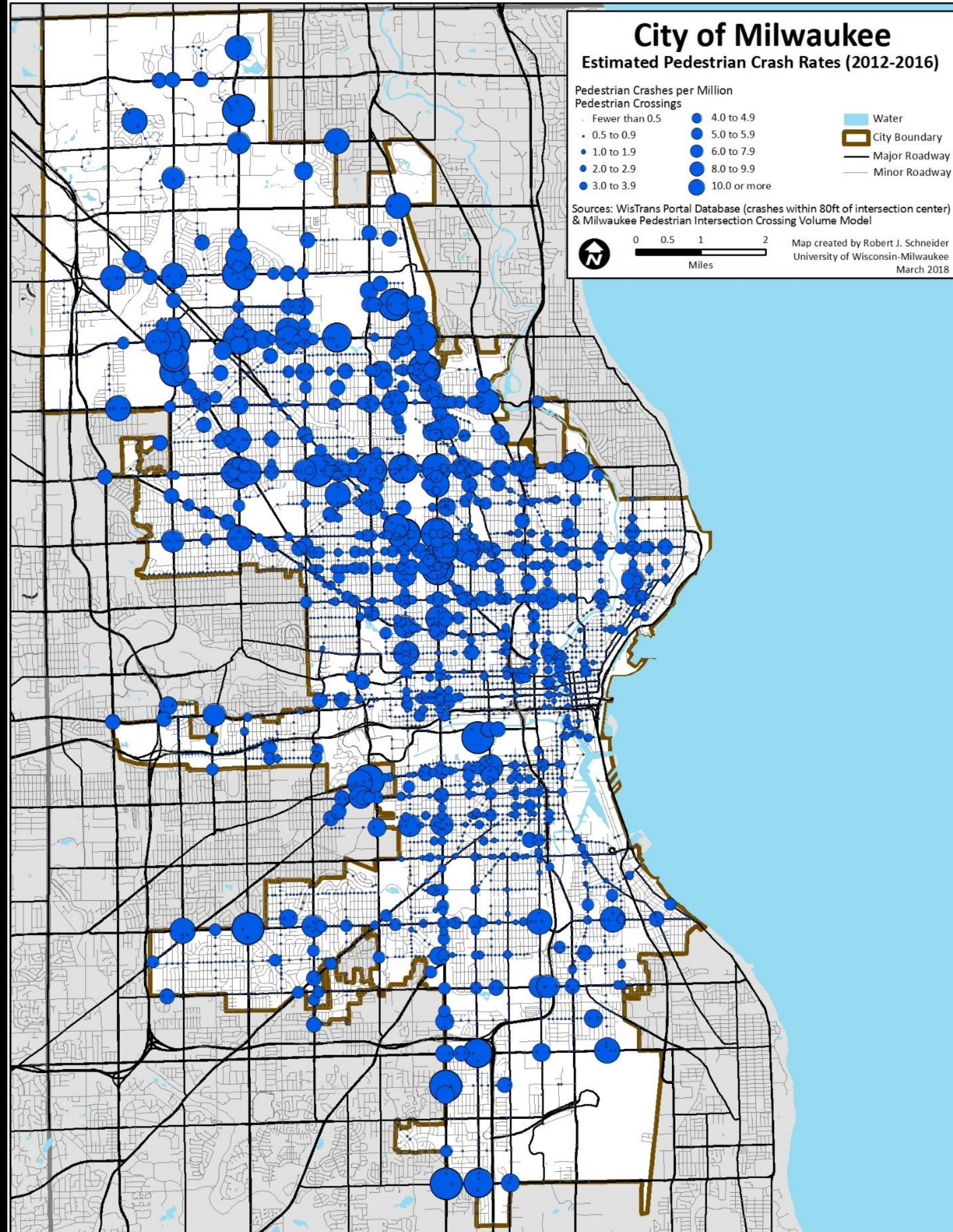
Source: Wisconsin Department of Transportation. TC Map (Traffic Count Map), https://wisconsindot.gov/Pages/projects/data-plan/traf-counts/default.aspx, 2021.

Safety Example: <u>Number</u> of Crashes



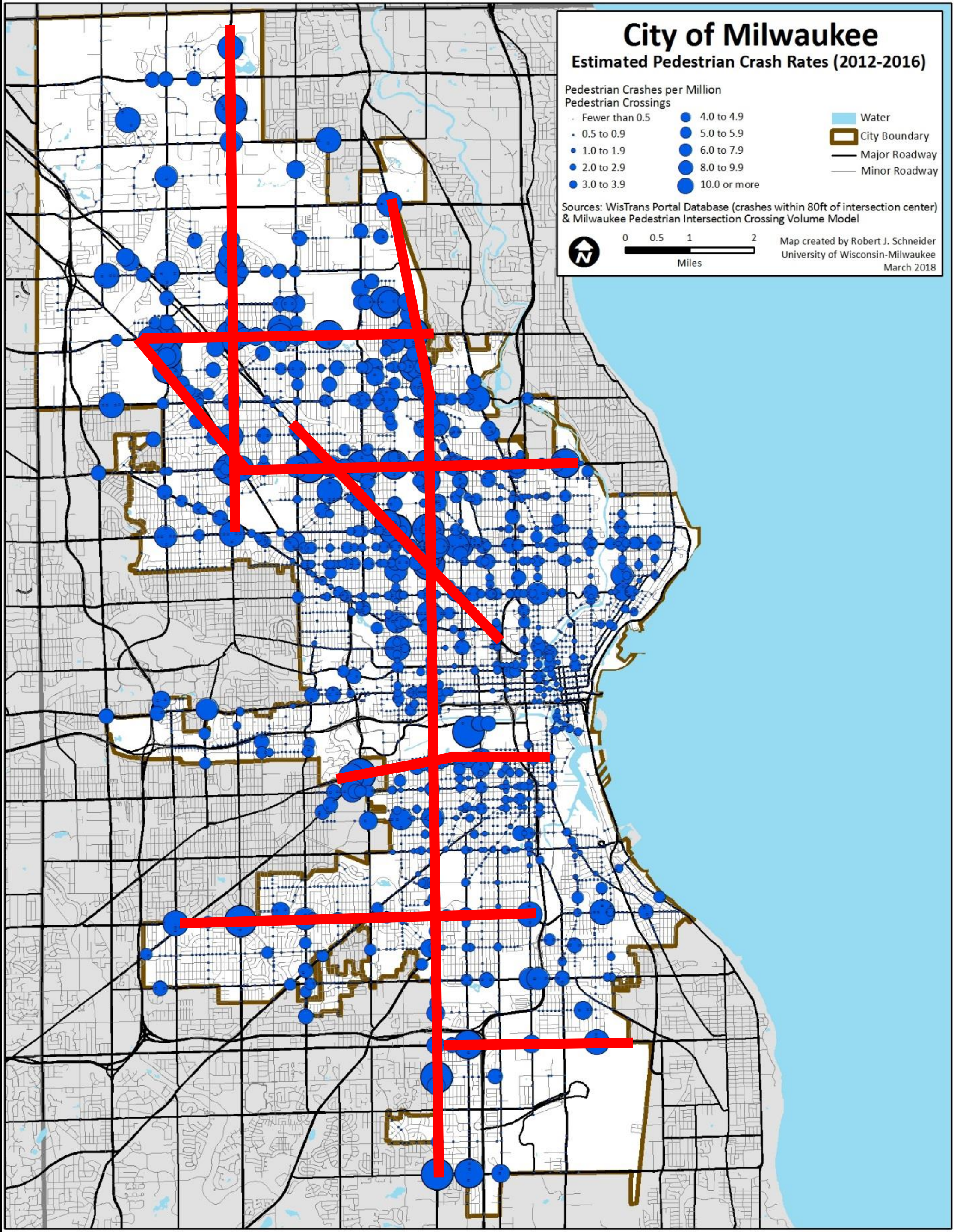
Source: City of Milwaukee,
Milwaukee Pedestrian Plan, 2019

Safety Example: Crash Risk



Source: City of Milwaukee, Milwaukee Pedestrian Plan, 2019

Safety Example: Crash Risk



Source: City of Milwaukee, Milwaukee Pedestrian Plan, 2019

1: Regional Pedestrian Volume Model

How many pedestrians cross an intersection with certain characteristics in a year?

Schneider, R.J., A. Schmitz, and X. Qin. "Development and Validation of a Seven-County Regional Pedestrian Volume Model," Transportation Research Record: Journal of the Transportation Research Board, https://doi.org/10.1177/0361198121992360, 2021.

Data: Manual Intersection Counts

- Turning counts along SHS & other intersections
- SE Region Office: 1,252 counts from 2013-2018

Intersection Traffic Volume Report

Count Basics	Version 2013.J4.1		Page 1 of 11
Start Date:	Monday, June 16, 2014	Weekday	Schools Not in Sessio
Total Number of Hours Counted: 13		Non-Holiday	No Special Events

Base Information, Observed (13) Hour and Estimated (24) Hour Volume Summaries

Intersection of: 39th Avenue and STH 158

Print

WISCONSIN DEPARTMENT OF TRANSPORTATION

Site Information

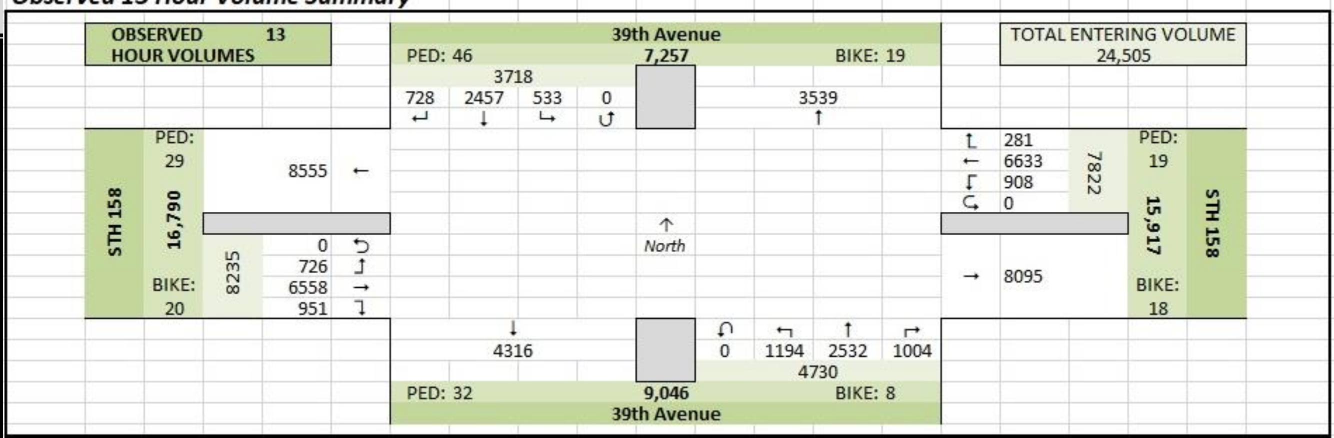
Municipality	Kenosha		
County	Kenosha	WisDOT Region	SE
Traffic Control	Traffic Signal		
Roadway Names		North Direction	↑
North Leg	39th Avenue		
East Leg	STH 158		
South Leg	39th Avenue		
West Leg	STH 158		
Special Considerations			
Schools	Not in Session		
Holidays	None		
Special Events	None		
Special Pedestrians Observed			
Pre-school children	A Few		
Elementry school age children	None		
Visually impaired (white cane/helper dog)	1 or 2		
Elderly/disabled (except wheelchairs)	1 or 2		
Wheelchairs/electric scooters	1 or 2		
Other (describe) None	None		

Count Information

Hrs Counted:	6:00 AM-7:00 PM		
1st Day of Count	Monday, June 16, 2014	Weather	
AM Peak Period	Tuesday, June 17, 2014	Cloudy& Dry	
Midday Peak Period	Tuesday, June 17, 2014	Cloudy & Dry	
PM Peak Period	Monday, June 16, 2014	Clear & Dry	
Calculated Peak Hours			
AM 9:00-10:00am	MD 1:00-2:00pm	PM 4:15-5:15pm	
Peak Hours Selected for Analysis			
AM 9:00-10:00am	MD 1:00-2:00pm	PM 4:15-5:15pm	
Daily/Seasonal Adjustment Group	(2) Urban Arterials & Collectors		
Count Expansion Group	(2) Urban Arterials & Collectors		
Daily/Seasonal Adjustment Factor	0.898	Count Expansion Factor	1.261
Company Name	TADi	Manual Adj.	1.000
Observers: AM Peak Period	Jack & Karlyn Bieberitz		
Midday Peak Period	Mike Weichmann		
PM Peak Period	Ron & Pat Andryk		

- Supplemented with 38 City of Milwaukee arterial counts

Observed 13 Hour Volume Summary



Source: WisDOT, SE Region

Potential Explanatory Variables

- Summarized 14 previous direct demand pedestrian volume models
- Tested variables from previous studies
  - **Built Environment** (Population & employment density, proximity to bus stops, retail, restaurants & bars, parks, schools, college campuses)
  - **Socioeconomic** (Age under 18 & over 64, median income, poverty, renters, zero-vehicle households, blue-collar & white-collar jobs)
  - **Roadway** (Maximum AADT & number of lanes on any approach, signal control)

Explanatory Variable Measurement

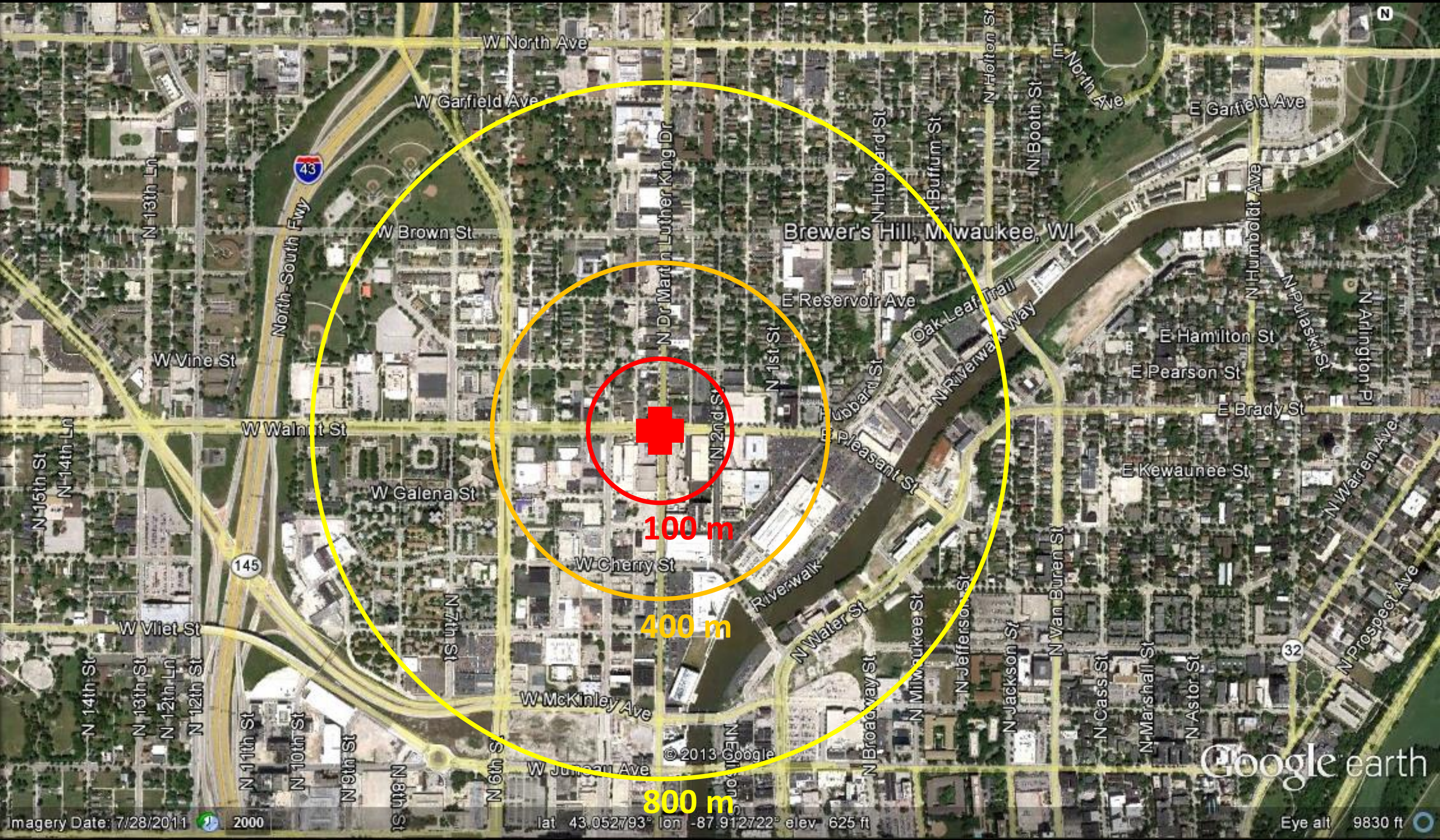


Image Source: Google Earth

Recommended Pedestrian Volume Model

$$Y_i = \exp(7.63 + 0.019X_{1i} + 0.0058X_{2i} + 0.43X_{3i} + 0.38X_{4i} + 0.21X_{5i} + 0.48X_{6i} + 4.18X_{7i})$$

where:

Y_i = estimated **annual pedestrian crossing volume** at intersection i

X_{1i} = square root of the population density within 400m of intersection i

X_{2i} = square root of the job density within 400m of intersection i

X_{3i} = square root of number of bus stops within 100m of intersection i

X_{4i} = square root of number of retail businesses within 100m of intersection i

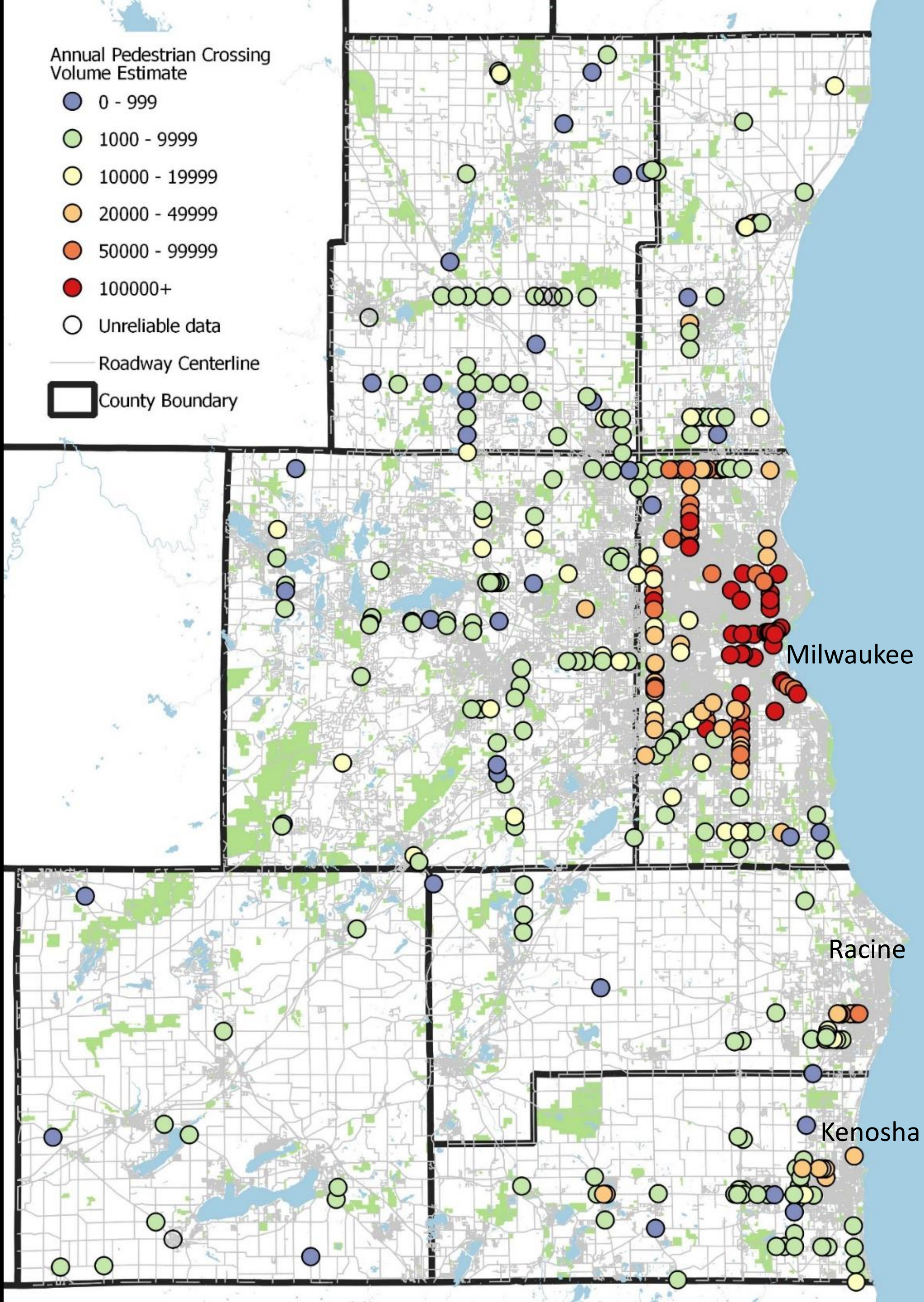
X_{5i} = square root of number of restaurant and bar businesses within 100m of intersection i

X_{6i} = 1 if intersection i is within 400m of a school (0 otherwise)

X_{7i} = Proportion of households without a motor vehicle within 400m of intersection i

Predicted Annual Pedestrian Crossing Volumes at SE Wisconsin Intersections

(Model B, "square root model")



Application: Pedestrian Risk

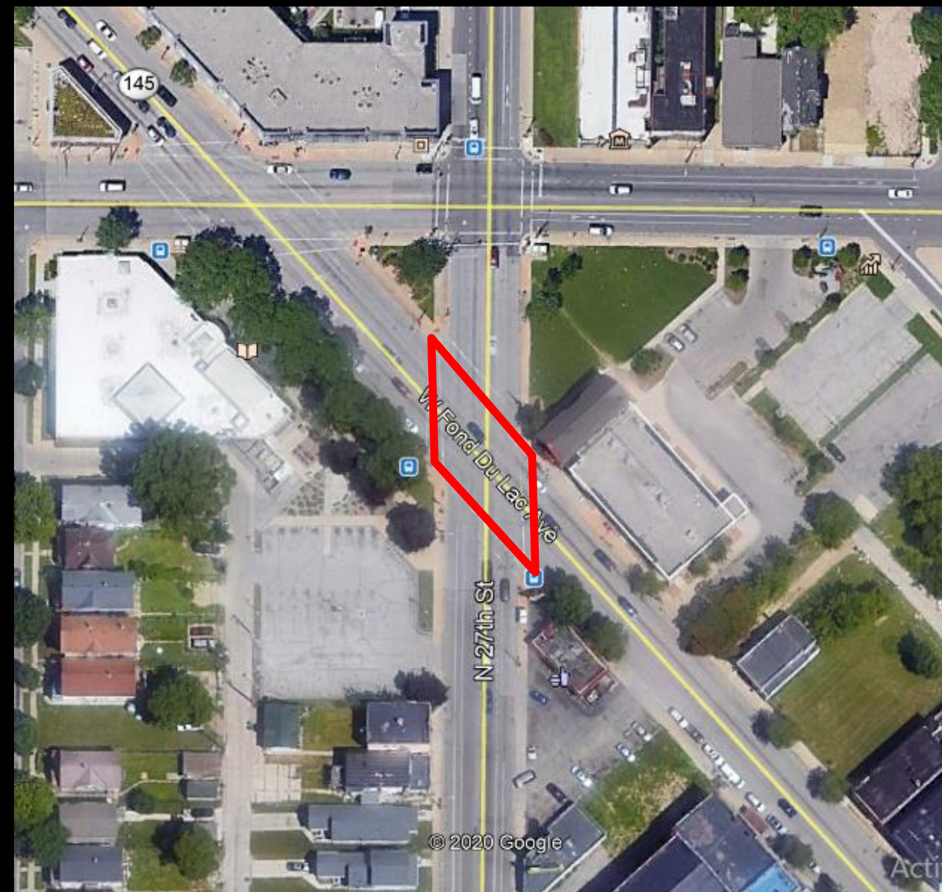
2 crashes in 5 years = 0.4 crash/yr
18,300 crossings/yr

9 crashes in 5 years = 1.8 crash/yr
786,000 crossings/yr

Identical scale (Source: Google Earth, 2018: image height = 1000 feet)

WI 190 & N 124th St, Brookfield

21.9 crashes/million crossings

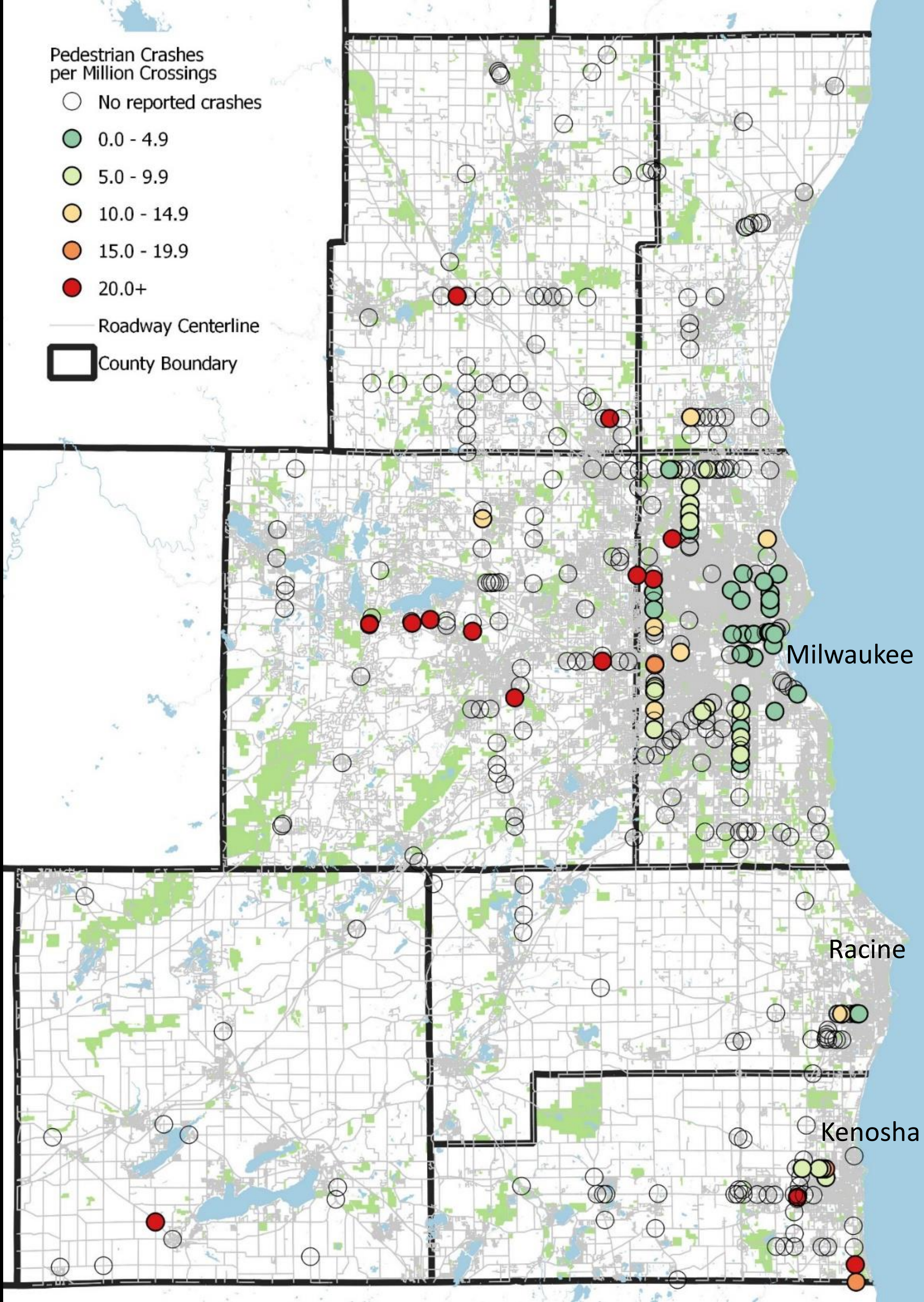


WI 145 & N 27th St, Milwaukee

2.3 crashes/million crossings

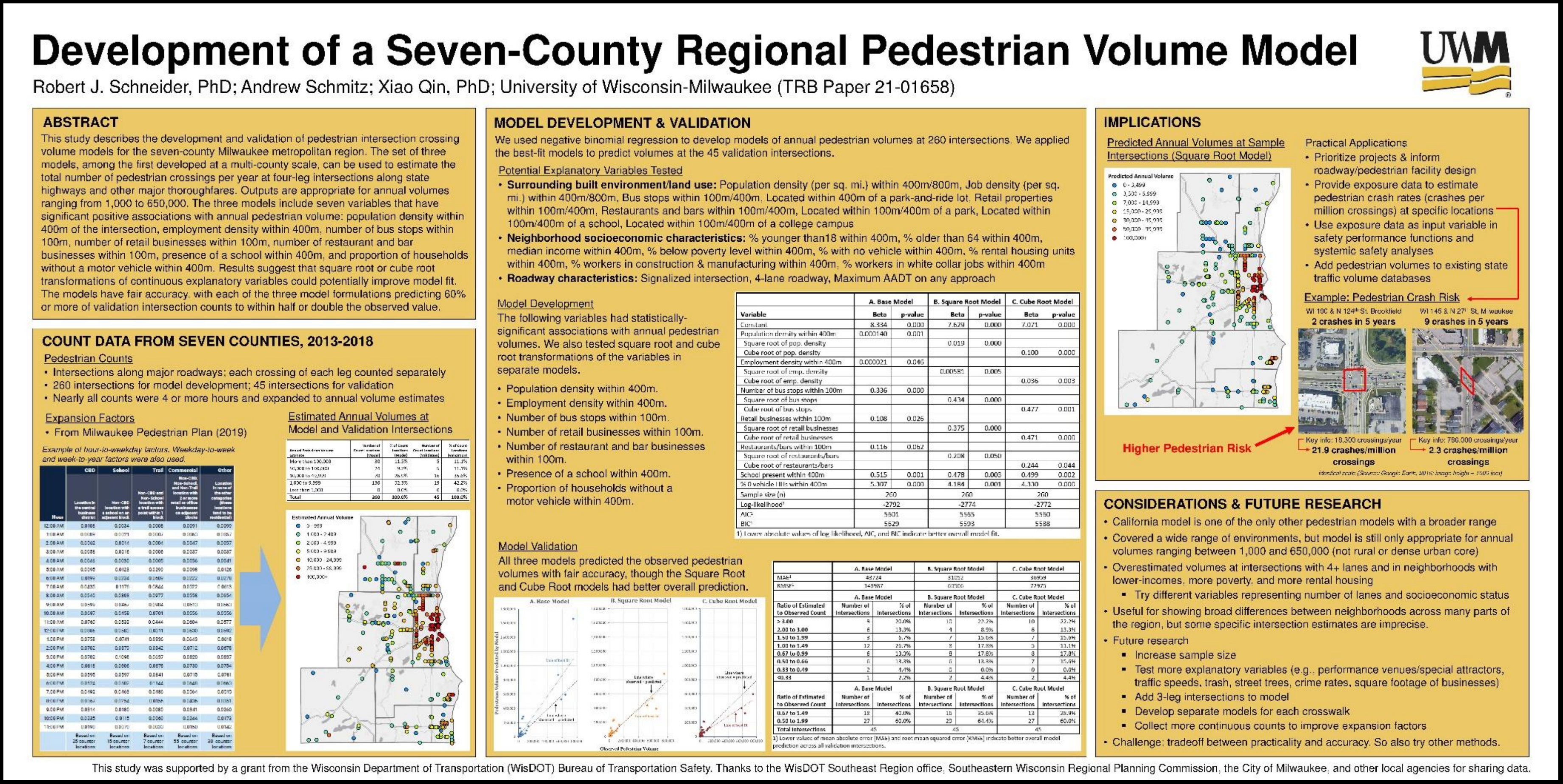
Estimated Pedestrian Crash Risk at SE Wisconsin Intersections

(Model B, "square root model")

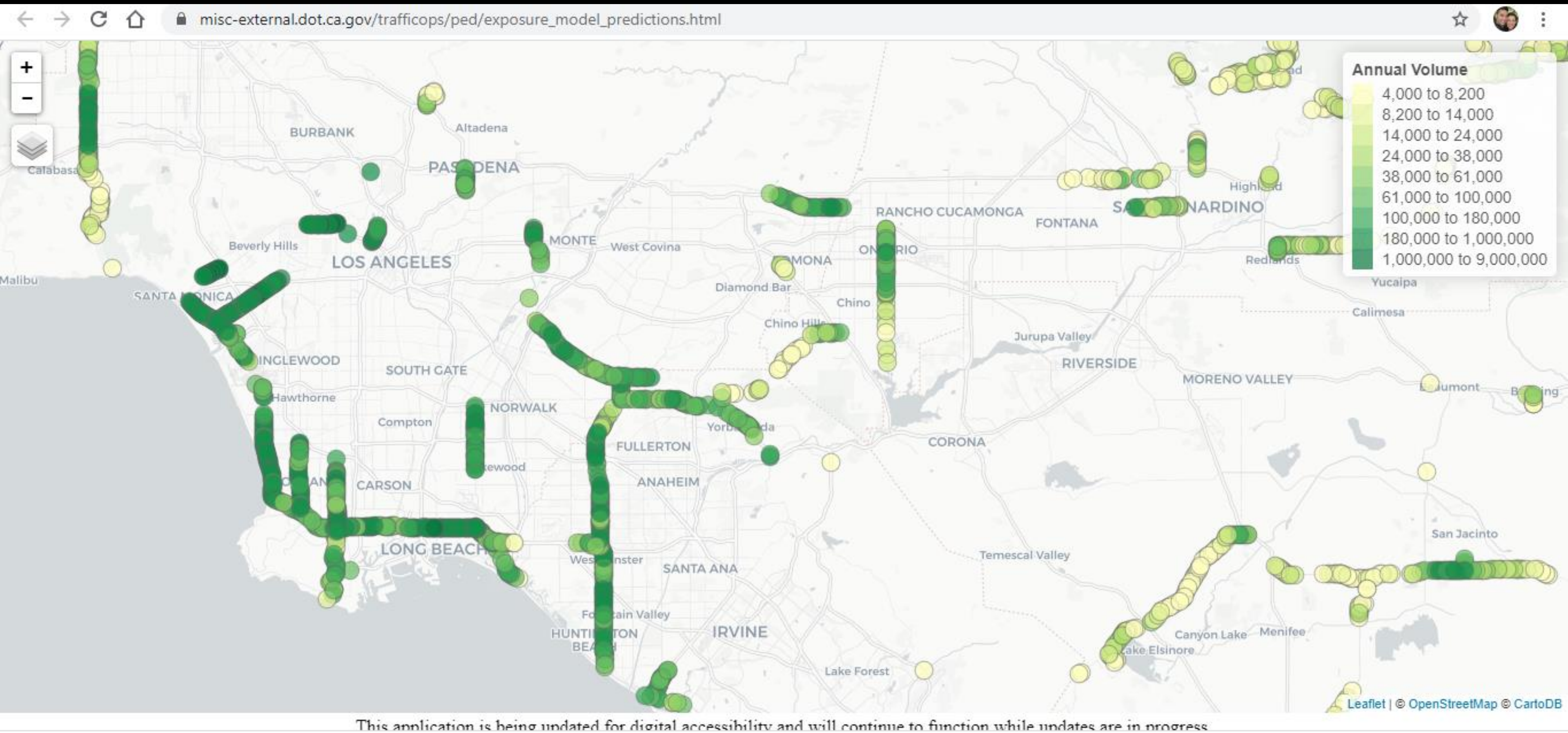


Putting Research Products to Use

- Interactive statewide pedestrian volume map
- HSIP and other safety analysis processes



Caltrans Pedestrian Volume Map



Source: California Department of Transportation. State Highway Pedestrian Exposure Estimates, https://dot.ca.gov/programs/safety-programs/ped-bike/exposure, 2021.