UMTRI TRANSPORTATION RESEARCH INSTITUTE UNIVERSITY OF MICHIGAN

ATLAS CENTER *Advancing Transportation Leadership and Safety*

The Pedestrian and Bicyclist Safety Risk Assessment Tool: User's Manual

Name

Project ID:

Prepared for:

MDOT

THE TEAM

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WE BUILD

A WEB TOOL

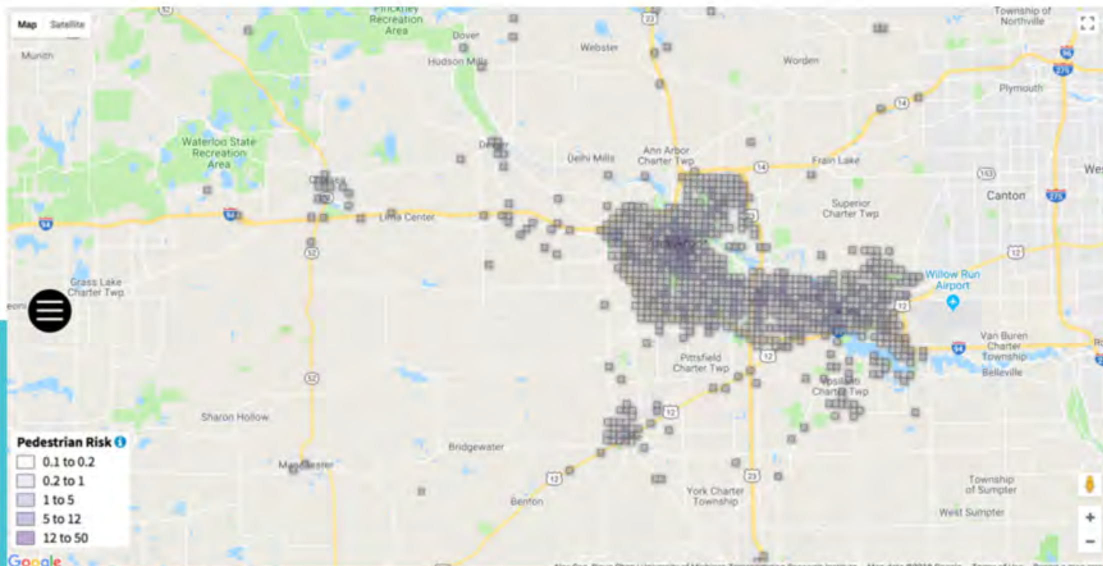
This web tool is an easy to use intuitive interface that uses Google Maps to display and organize the results. This manual provides you with a basic understanding of htow to navigate the tool. Additionally, we provide a case study of a possible use of the tool. For a more detailed description of the methodology underlying this tool, please see

https://github.com/caocscar/pedbikeriskexposure/blob/master/draft.md

1 TOOL INTERFACE

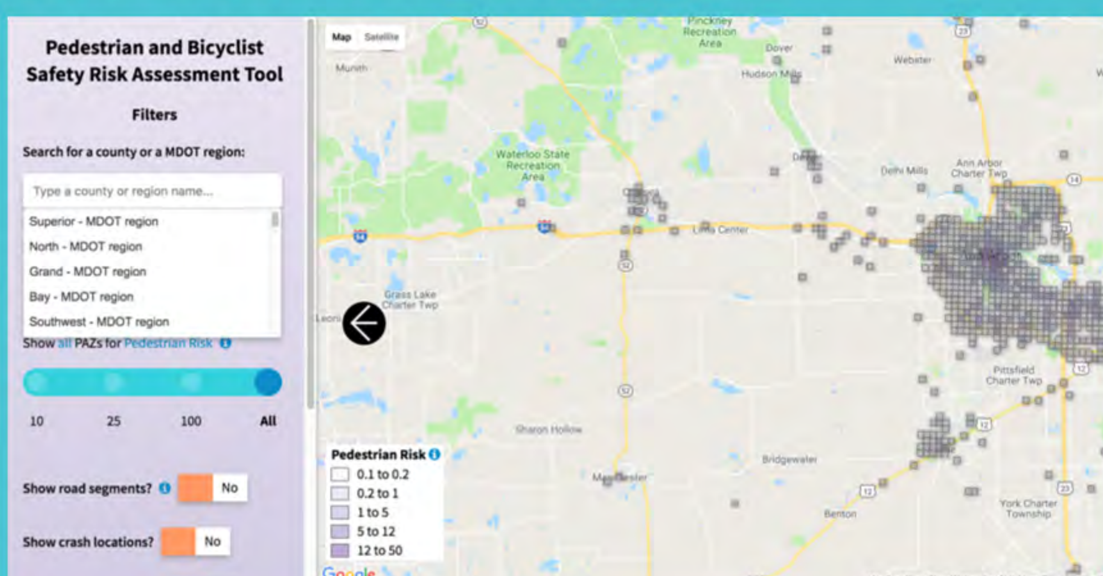
- ## Main Menu

  Click the menu bottom on the left side of the screen



- ## Select Geographic Region of Interest

  Type the name of the region into the dialog box



Select Unit of Analysis

You may select more that one of the following units of analysis:

Show PAZ?

> Displays the 400 x 400m grid of Pedestrian Analysis Zones (PAZ)

Show road segments?

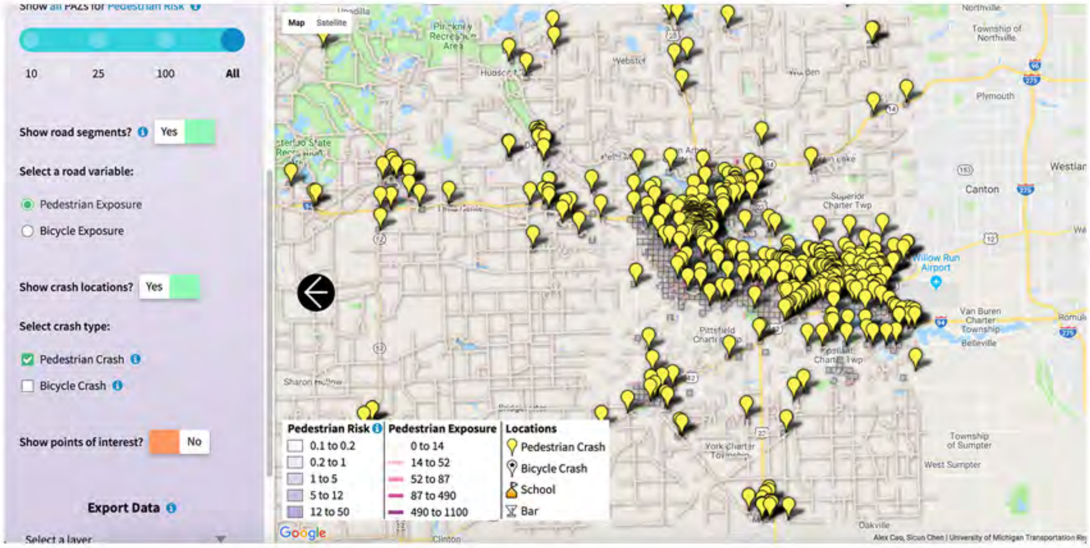
> Displays underlying road network
(only available for exposure measures)

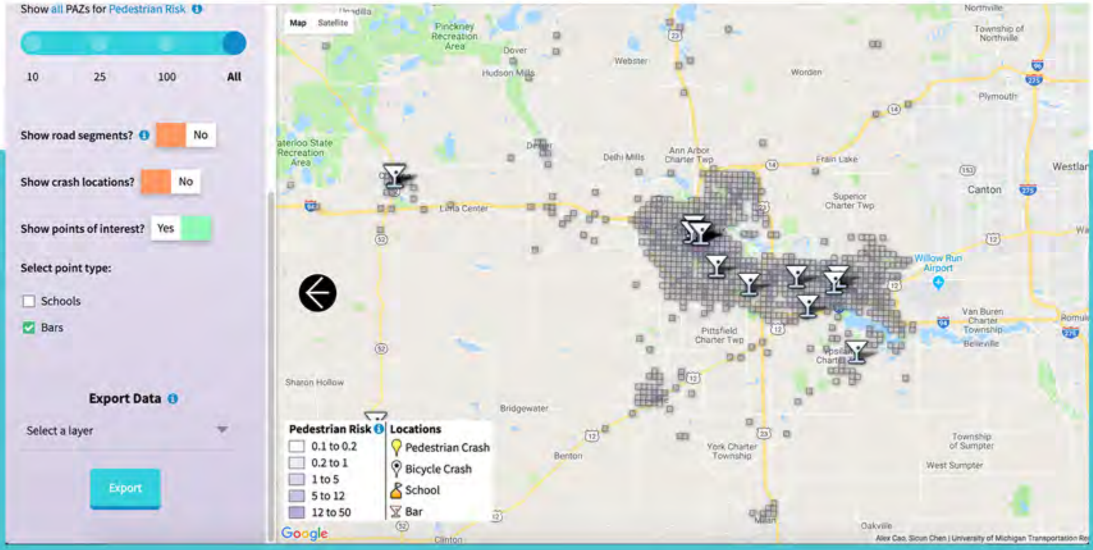
Show crash locations?

> Displays the location of all pedestrian and/or bicycle crashes from 2005-2015

Show points of interest?

> Displays the locations of schools and bars.





Select Analysis Variable

When you select PAZ, select one of the following analysis variables.

Pedestrian Risk
This is the expected number of pedestrians involved crashes in the next 11 years. This number is based on crash data, roadway, exposure, built environment and household characteristics.

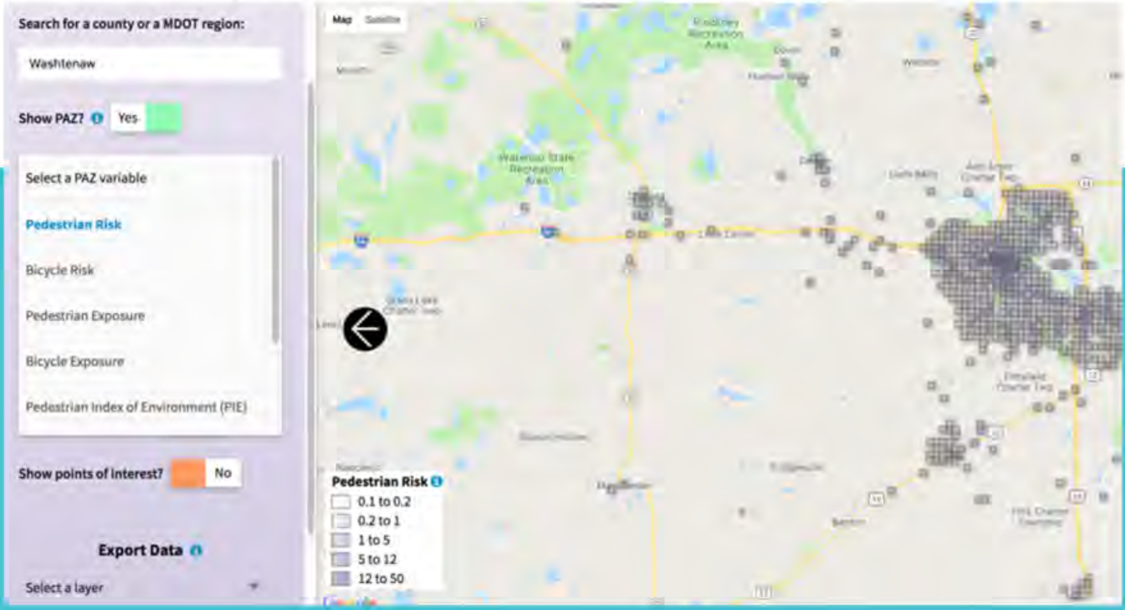
Bicycle Risk
This is the expected number of bicycles involved crashes in the next 11 years. This number is based include crash data, roadway, exposure, built environment and household characteristics.

Pedestrian Exposure
(1) estimated number of pedestrian trips per day that begin or end in the PAZ.
(2) estimated number of pedestrian trips per day that traverse a given road segment. These estimates are based on roadway, exposure, built environment and household characteristics.

Bicycle Exposure
(1) estimated number of bicycle trips per day that begin or end in the PAZ.
(2) estimated number of bicycle trips per day that traverse a given road segment. These estimates are based on roadway, exposure, built environment and household characteristics.

Pedestrian Index of Environment (PIE)
This is a measure of how suitable the build environment is for walking. The value ranges from 0 to 100.

Bicycle Index of Environment (BIE)
This is a measure of how suitable the build environment is riding a bicycle. The value ranges from 0 to 100.



WE DID

A CASE STUDY

We illustrate the usage of the tool with a fictitious case study:
Pedestrian Risk Assessment in Wayne County.

This case example focuses on pedestrian risk assessment to identify corridors in Detroit Michigan in need of countermeasures. Often the characteristics that make walking safe (or unsafe) persist over space. For example, along busy roads, land use features like business districts or the lack of lighting are often consistent over space. Due to this spatial continuity, transportation engineers often would like to improve the facilities in an entire corridor, not just one location.

2 CASE STUDY

In order to accomplish this task, a typical approach is to follow the 8 steps below.

- **Step 1: Determine Use(s) of Risk Values: Network Screening, Area Based**

  The MDOT engineers were interested in estimating pedestrian risks to identify corridors in need of countermeasures.

- **Step 2: Select Geographic Scale: Areawide -> Network -> Corridor**

  MDOT project team was interested analyzing risk at the corridor level.

- **Step 3: Select Risk Definition: Expected Crashes**

  The definition of risk combined various risk indicators to estimate the expected number of pedestrian-vehicle crashes.

- **Step 4: Select Exposure Measure: Trips Made**

  The project measured exposure in trips per day in a Pedestrian Analysis Zone (PAZ), which is a 400m x 400m unit of analysis. These units are aggregated up to the level of the corridor.

- **Step 5: Select Analytic Method to Estimate Exposure:**

  Demand estimation -> pedestrian trip generation and flow mode.
  The analytic method used a statewide travel survey, land-use data, and household characteristics to generate pedestrian trips at the PAZ level (see next page, Figure 3.1).

- **Step 6: Use Analytic Method to Estimate Selected Exposure Measure**

  The project team used the Michigan household travel survey (MTC III) to fit our trip production and destination choice models. We divided trips into five categories, namely home-based other (HBOther), home-based shopping (HBShopping), home-based school (HBSchool) and non-home-based other (NHBO) and non-home-based work (NHBW) and run the regression separately. We highlight the results for home based other (HBO) trips. For home-based trips, we estimate the number of trips per day at the household level using a negative binomial regression of the of the form, (see next page)

Number of HB Walking Trips =
f (Number of Households + Household Characteristics + Built Environment)

Below are representative regression results for the “home-based other” trip purpose (Figure 2.2). After completing all of the steps in the methodology, we obtained pedestrian exposure estimates. For more detailed information about the methodology, see (Cai et. al., 2018).
The figure on the following page (Figure 2.3) shows the results for Wayne county Michigan where Detroit is located.

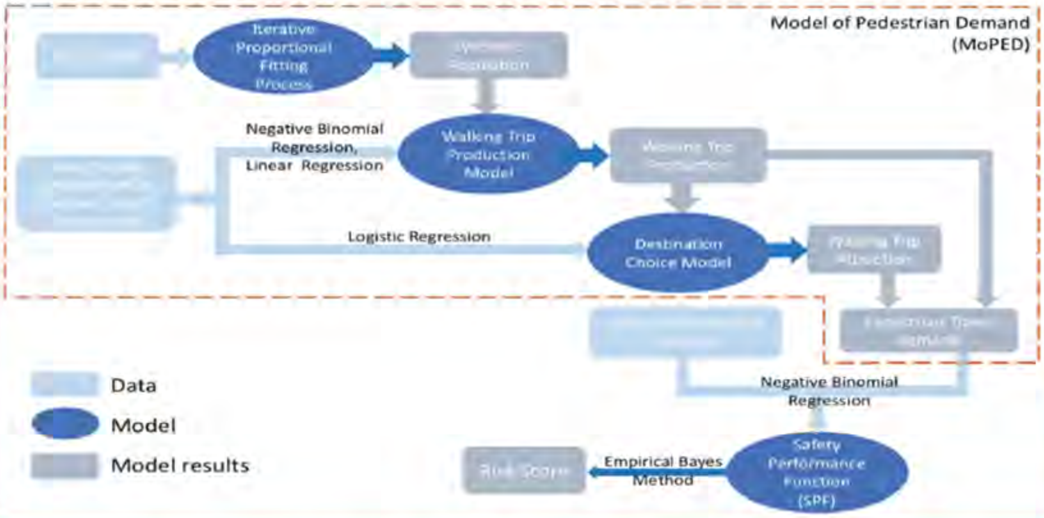


Figure 2.1 Step 5 Demand Estimation Using Pedestrian Trip Generation and Flow Models

Variable	Coef	Std err	P > |z|	[95.0% Conf. Int.]	
Constant	-0.7348	0.034	0.000	-0.801	-0.669
HHSIZE_1	-0.6565	0.071	0.000	-0.795	-0.518
HHSIZE_2	-0.1999	0.051	0.000	-0.299	-0.101
HHSIZE_3_or_more	-0.1217	0.073	0.0094	-0.021	0.264
HHVEH_0	0.8794	0.095	0.000	0.693	1.065
HHVEH_1	-0.2959	0.055	0.000	-0.404	-0.188
HHVEH_2	-0.5610	0.053	0.000	-0.664	-0.458
HHVEH_3_or_more	-0.7573	0.067	0.000	-0.888	-0.626
HHCHILD_0	-0.4110	0.051	0.000	-0.512	-0.310
HHCHILD_1_or_more	-0.3238	0.059	0.000	-0.439	-0.208
HHWORKER_0	-0.2714	0.040	0.000	-0.349	-0.194
HHWORKER_1_or_more	-0.4635	0.039	0.000	-0.540	-0.387
PIE	0.0272	0.002	0.000	0.022	0.032
Sample size	12062				
Log-Likelihood	-7457.5				

Figure 2.2 Pedestrian Trip Generation Model Results for Home-Based Other Trips

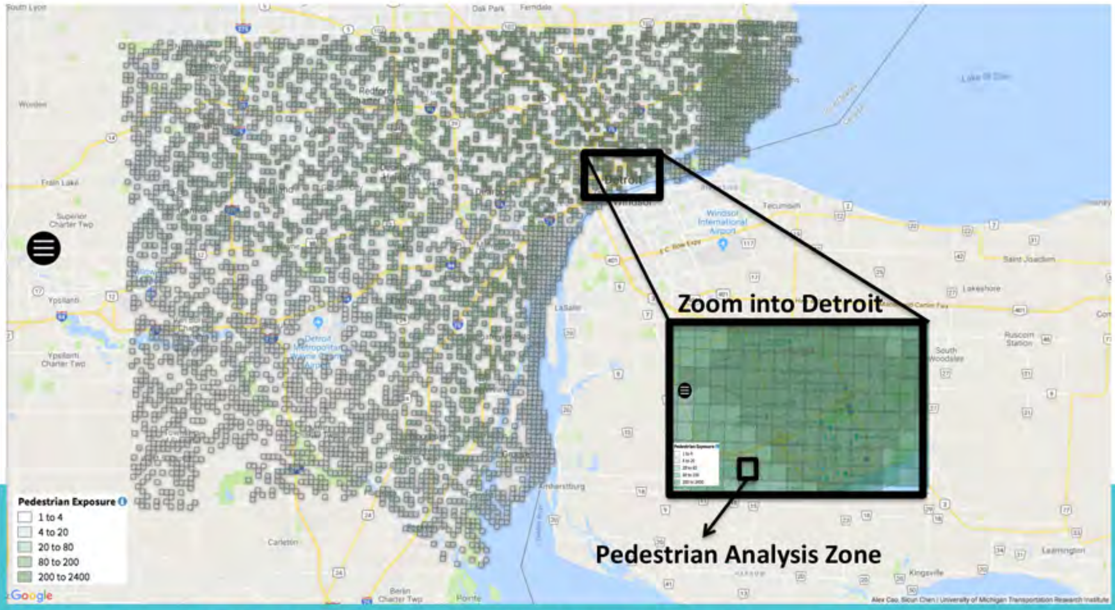


Figure 2.3 Daily Pedestrian Trips Made per PAZ for Wayne County, Michigan

- ## Step 7: Compile Other Required Data

  The approach required many other data sources to calculate the risk values. The schematic below (Figure 2.4) shows the various data sources used in the risk model.

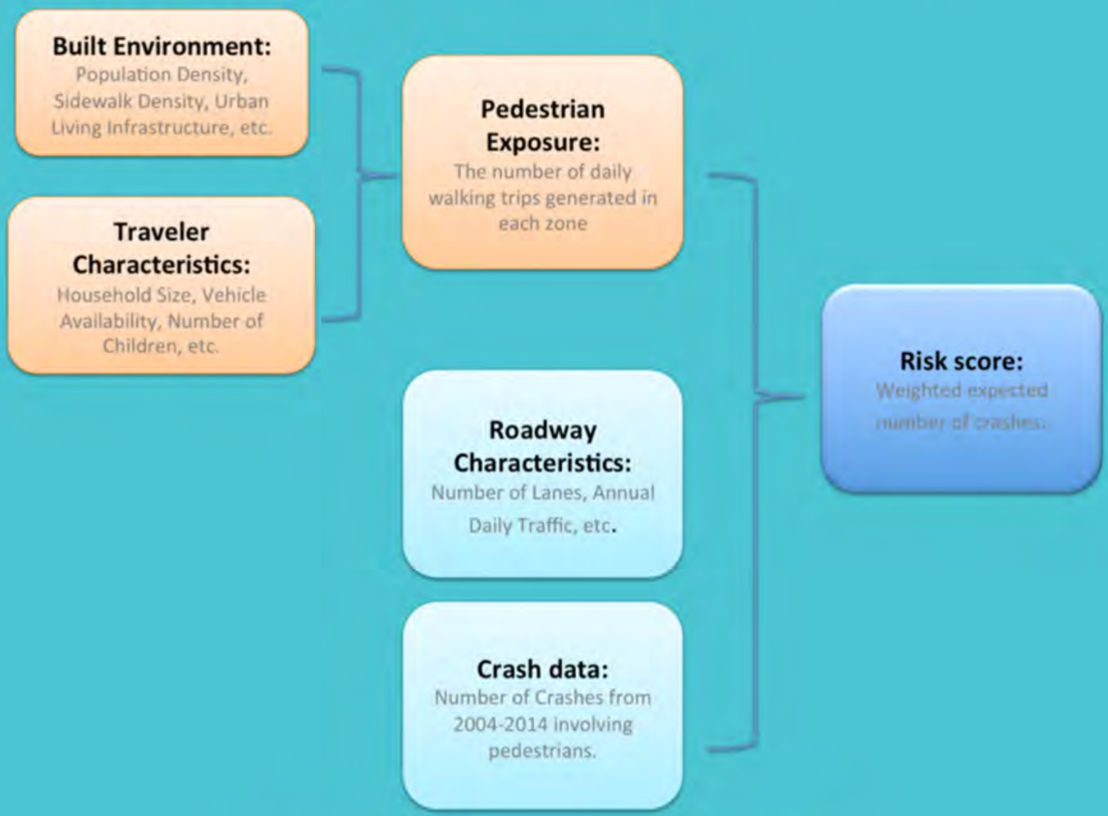


Figure 2.4 Step 7: Compile Other Required Data

Step 8: Calculate Risk Values

We used the Empirical Bayes framework from the HSM to create customized safety performance functions (SPFs) for both bicyclist and pedestrians (Figure 2.5).

The MDOT engineers also wanted to analyze corridors. Thus we applied the Level-of-Service-of-Safety (LOSS) metric from the highway safety manual. LOSS divides the risk-scores of candidate areas into 4 categories based on its standard deviation from the average risk. The areas in the highest quantile are the most dangerous for pedestrians. Figure 2.6 shows that LOSS map for pedestrian risk. In order to calculate the risk values of the corridors, we add together the risk score of each PAZ in the Gratiot corridor to arrive at a cumulative risk score of 50. The corresponding cumulative risk fir the Woodward corridor was 91.

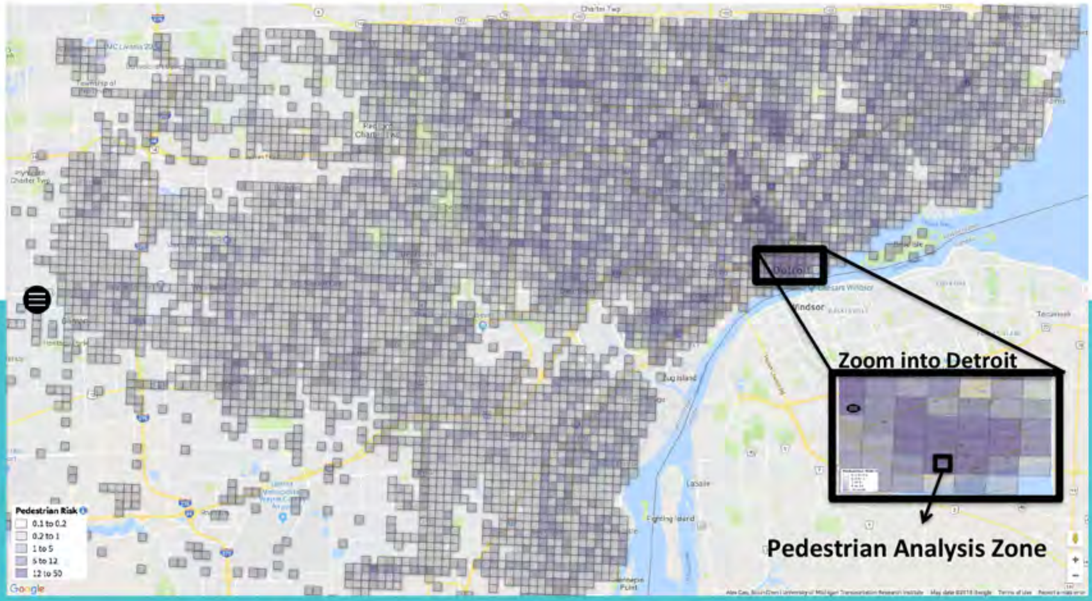


Figure 2.5 Risk Measured as the Expected Number of Crashes per PAZ

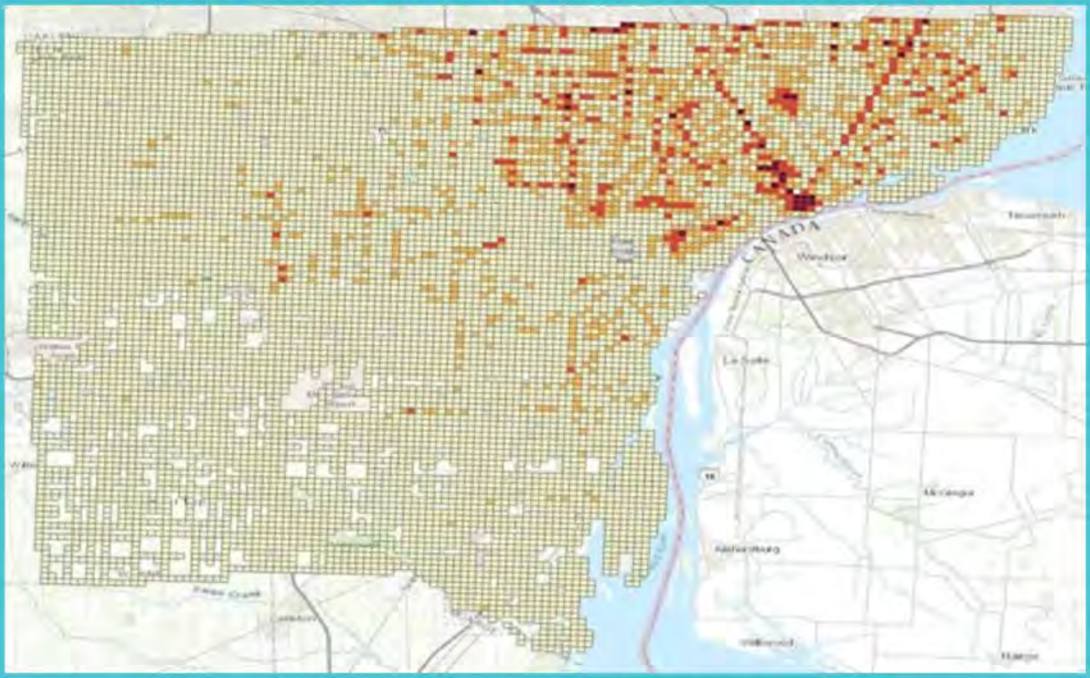


Figure 2.6 Level-of-Service-of-Safety (LOSS) Map Derived From the Risk Values

[1] The LOSS analysis requires access to the underlying GIS shape files. The LOSS analysis was conducted by Dean Kanitz of MDOT.

THANK YOU