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MEMORANDUM

August 1, 2023 (originally submitted August 18, 2022)

To: Yixuan Lin
Organization: Monroe County Department of Planning & Development
From: Theja Putta and Michael Blau
Project: Monroe County Countywide Active Transportation Plan

Re: Task 3.3 Bicycle and Pedestrian Crash Analysis – FINAL

Introduction

This memo summarizes the results of a crash analysis conducted for Monroe County as part of the Countywide Active Transportation Plan (CATP). The aim of this analysis is to understand the patterns of bicycle and pedestrian crashes in the County. The data analysis only includes high-level information, which does not show crash details or causes. The findings include roads under different jurisdictions, so it would be useful to coordinate the findings with all the involved agencies. The analysis has three main components – data consolidation, descriptive statistics, and corridor identification using the Safer Streets Priority Finder tool developed by Toole Design.

Data Consolidation

Crash Data

Geocoded crash data is essential to understand and perform safety analysis. Detailed geocoded crash data for the State of New York can be obtained from New York State Department of Transportation (NYSDOT) Query, Reporting and Analysis application (QRA). The data for this analysis is provided by Genesee Transportation Council (GTC). The data contained all crashes involving a bicyclist or pedestrian that occurred in Monroe County from 2012 through 2021. It must be noted that data of this type, derived from police crash data, is known to have problems with underreporting.[1] Also, please note that these crashes were not vetted to eliminate crashes that occurred in parking lots, potentially resulting in roadway segments being incorrectly identified as having a pedestrian or bicyclist crash history.

[1] Doggett, S., Ragland, D. R, & Felschundneff, G. (2018). Evaluating Research on Data Linkage to Assess Underreporting of Pedestrian and Bicyclist Injury in Police Crash Data. UC Berkeley: Safe Transportation Research & Education Center.

The crash data contained columns that identified the transportation mode (pedestrian or bicyclist) and the severity of injuries in the crash. Pedestrian crashes are those that are coded with “ACCD_TYP” as “COLLISION WITH PEDESTRIAN,” or “COLLISION WITH OTHER PEDESTRIAN.” Bicyclist crashes are those coded with “ACCD_TYP” as “COLLISION WITH BICYCLIST'.” The most severe injury for each crash is categorized into one of the following categories.

- Fatality (K)
- Incapacitating Injury (A)
- Non-Incapacitating Injury (B)
- Possible Injury (C)
- Property Damage Only (O)

There are 16 crashes that did not have enough information to identify the injury severity. These are excluded from the analysis.

Land Use Context

The County is divided into urban, suburban, and rural land use contexts to better understand the crash trends in the region. The City of Rochester is classified as urban while its suburbs of Greece, Gates, Chili, Brighton, Henrietta, Pittsford, Perinton, Penfield, Webster, East Rochester, Fairport, and Irondequoit are classified as suburban. Everything else is classified as rural. The land use context information is then joined to crash data based on the geocoded location of each crash.

Descriptive Statistics

This section provides summaries of crashes involving a bicyclist or a pedestrian by injury severity, land use context, and temporal trends. There are a total of 5,477 crashes in the County between 2012 and 2021 for which injury severity information is available. Crash data is divided into two primary categories based on injury severity:

1. Killed or Seriously Injured (KSI) consisting of K and A crashes
2. Non-KSI crashes consisting of B, C, and O crashes

Pedestrian Crashes

Pedestrian crashes formed 58 percent of the total crashes in the dataset. Figure 1 shows a map of all pedestrian crashes in Monroe County within the last ten years.

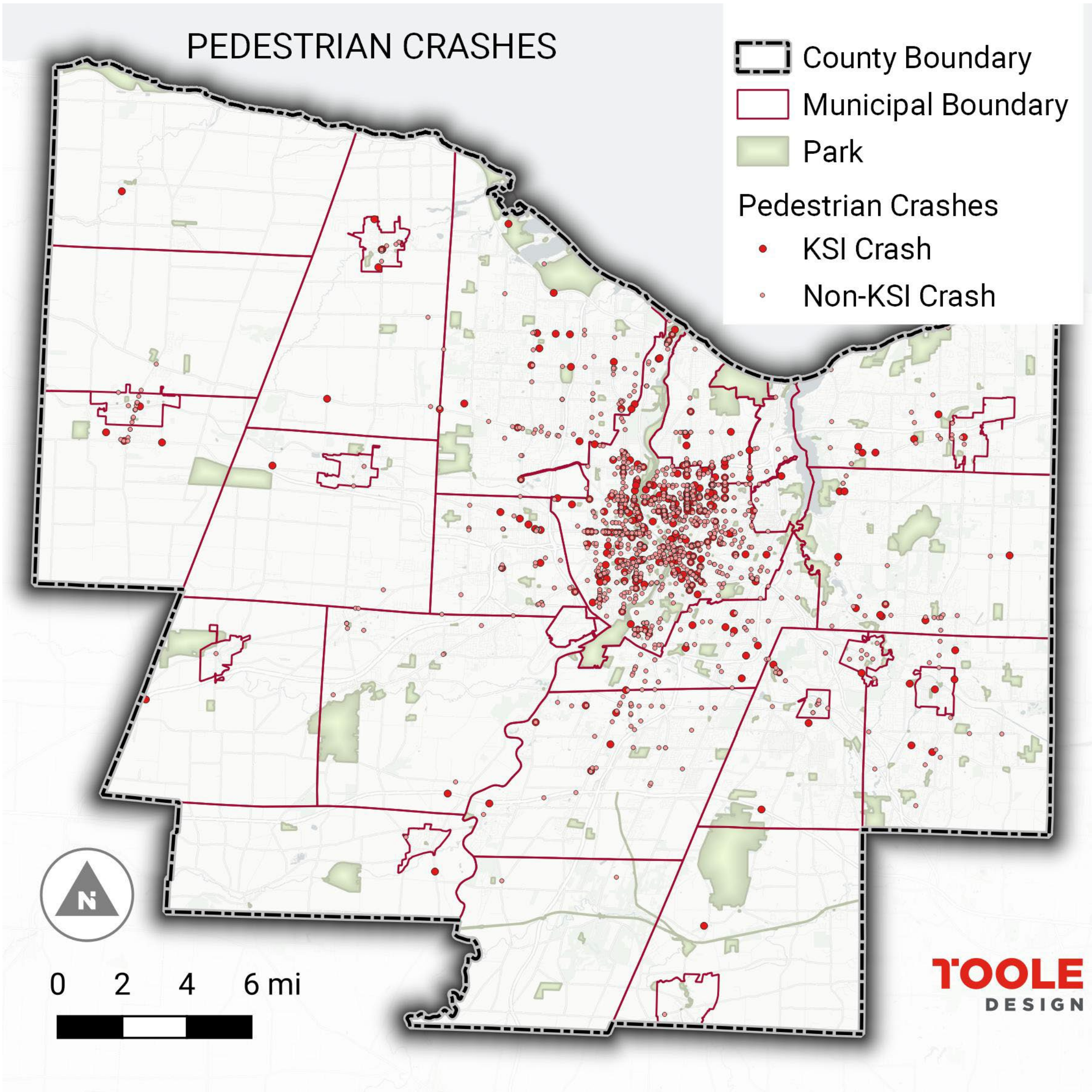

Figure 1: Pedestrian Crashes in Monroe County

The share of KSI crashes ranged from 15 to 27 percent of all crashes with an average of 19 percent for the 10-year period. This share is highest at 22 percent and 27 percent in 2020 and 2021 respectively. The total number of crashes in 2020 and 2021 were lower than any of the previous eight years, while the total KSI crashes remained at the same level of the previous years. The total KSI crashes reached a 10-year high in 2021 comprising 27 percent of all pedestrian crashes for the year. The variation of pedestrian crashes over time is shown in Figure 2.

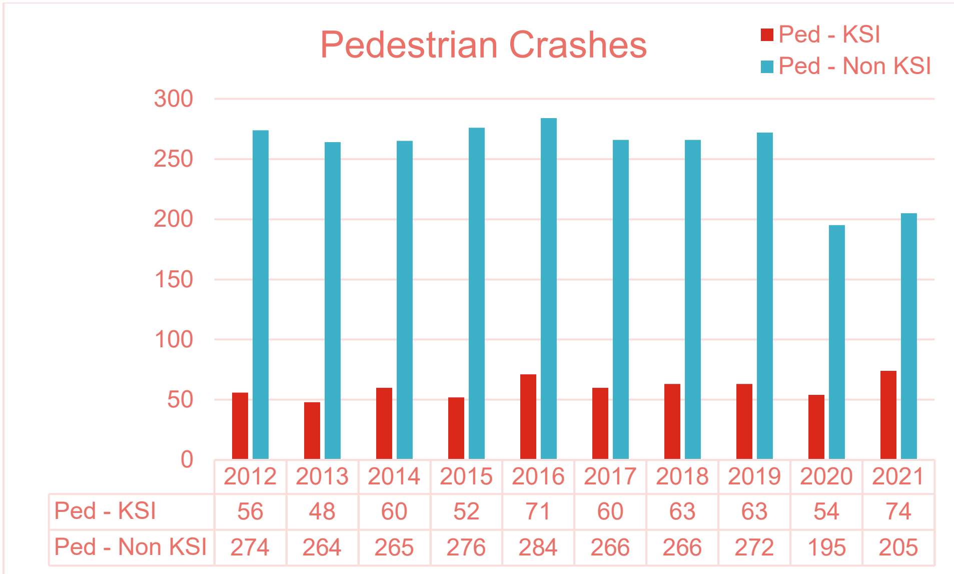

Figure 2: Pedestrian Crashes Over Time

The Rochester area has a disproportionately high number of crashes compared to the county overall.[2] This trend holds for the share of KSI crashes as well. Urban areas generally tend to have more people walking compared to suburban and rural areas, which could lead to a higher-level exposure to crash risk. The proportion of crashes that occurred in different types of land use and their corresponding population percentage is shown in Table 1.

Table 1: Share of Pedestrian Crashes in Different Land use Contexts

	All Crashes	Percent	KSI Crashes	KSI Percent	Population percent
Urban	2,170	68.5%	408	67.9%	27.0%
Suburban	878	27.7%	160	26.6%	58.6%
Rural	120	3.8%	33	5.5%	14.5%

Crashes in rural parts of Monroe County have a higher likelihood of resulting in a severe injury, at 27 percent compared to 18 percent in suburban areas and 19 percent in urban areas. This finding could indicate that higher speeds in rural areas cause more severe injuries, as studies have shown,[3] suggesting that although a higher proportion of crashes occur in urban areas, a crash is more likely to be severe in rural areas. These crashes should be reviewed further to determine if there is a correlation between higher speeds and more severe crashes. The share of crashes by injury severity for different land use contexts is shown in Figure 3.

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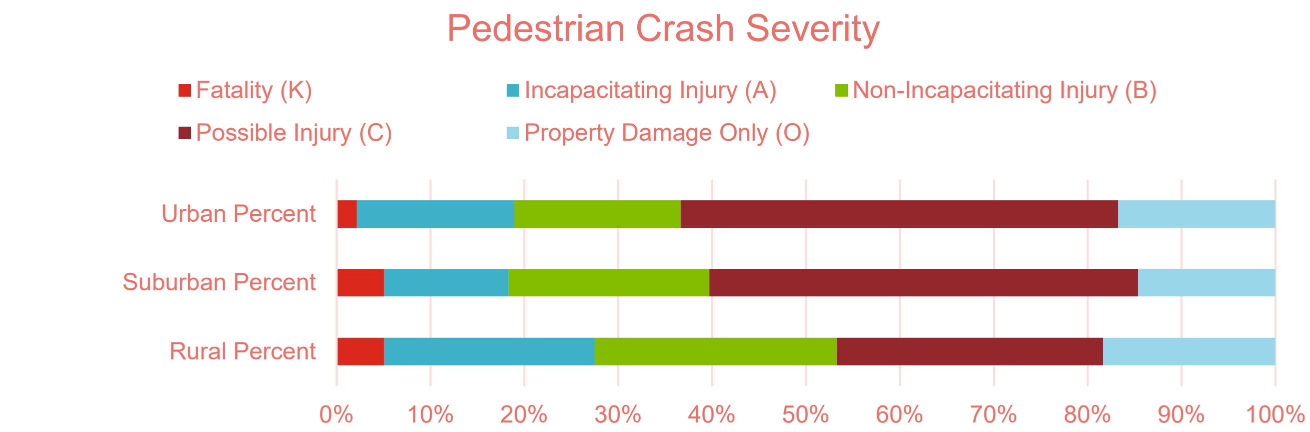
[2] Population calculated is for the year 2010 obtained from https://www.monroecounty.gov/gis-Data

[3] Tefft B. C. (2013). Impact speed and a pedestrian's risk of severe injury or death. Accident; analysis and prevention, 50, 871–878. https://doi.org/10.1016/j.aap.2012.07.022



	Rural Percent	Suburban Percent	Urban Percent
Fatality (K)	5.05%	5.06%	2.15%
Incapacitating Injury (A)	22.47%	13.27%	16.75%
Non-Incapacitating Injury (B)	25.78%	21.36%	17.74%
Possible Injury (C)	28.35%	45.67%	46.59%
Property Damage Only (O)	18.36%	14.64%	16.77%

Figure 3: Pedestrian Crashes by Severity and Land Use

Bicyclist Crashes

Bicyclist crashes formed 42 percent of the total crashes. Figure 4 shows a map of all bicyclist crashes in Monroe County within the last ten years.

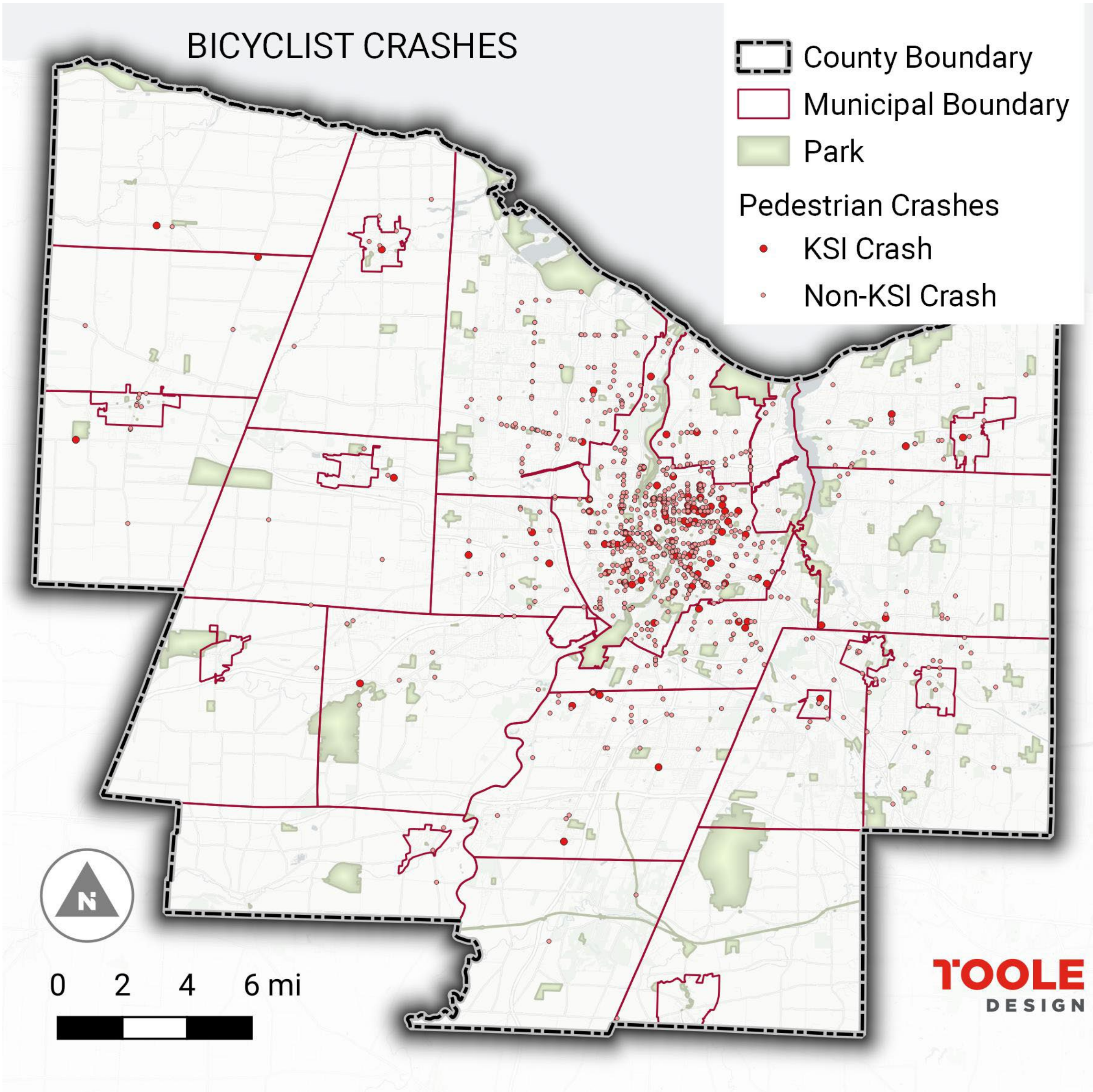


Figure 4: Bicyclist Crashes in Monroe County

The total number of overall crashes seems to be on a downward trend in the last ten years. The share of KSI crashes ranged from five percent to 15 percent of all crashes with an average of nine percent for the ten-year period. This share is about half as much as that of pedestrian crashes. Like pedestrian crashes, bicyclist crashes had the highest percent of KSI crashes in 2021 at 15 percent, even as the total number of crashes is lower in number than the previous years. The variation of pedestrian crashes over time is shown in Figure 5.

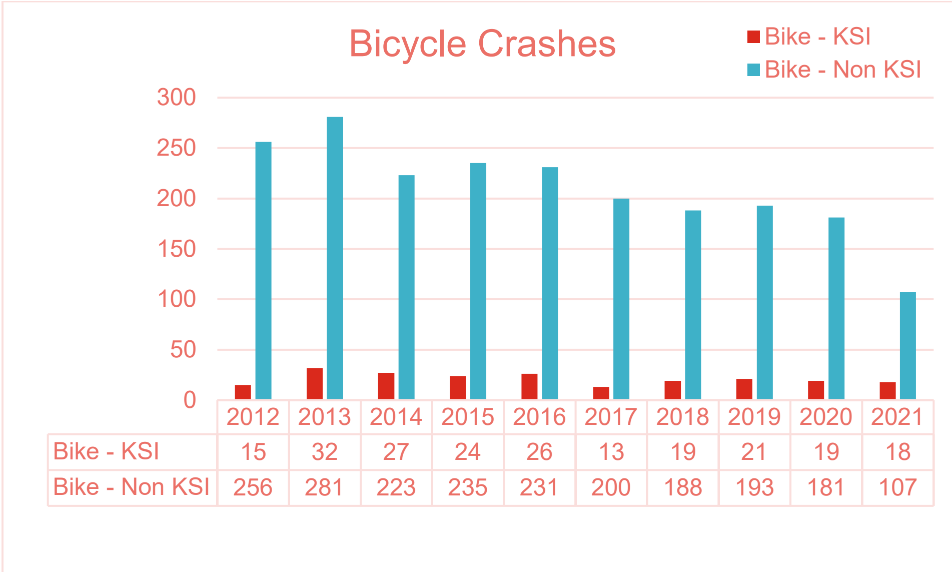


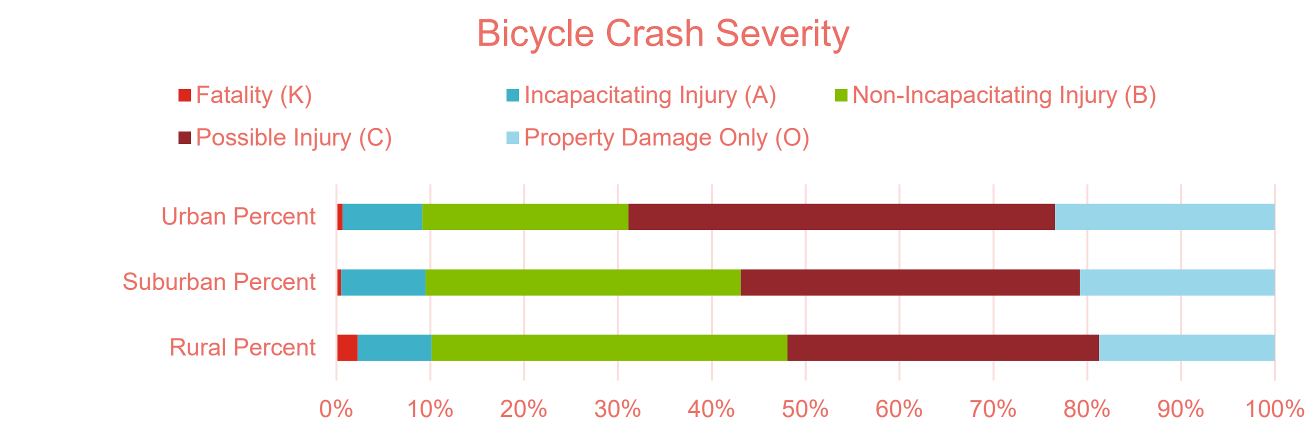
Figure 5: Bicyclist Crashes Over Time

Bicyclist crashes follow a similar trend as pedestrian crashes, with urban areas seeing a disproportionately high number of crashes. However, suburban areas seem to have a higher share of bicyclist crashes than pedestrian crashes. The proportion of crashes that occurred in different types of land use and their corresponding population percentage is shown in Table 2.

Table 2: Share of Bicyclist Crashes in Different Land use Contexts

	All Crashes	Percent	KSI Crashes	KSI Percent	Population percent
Urban	1400	60.6%	127	59.3%	27.0%
Suburban	819	35.5%	78	36.4%	58.6%
Rural	90	3.9%	9	4.2%	14.5%

There is no noticeable difference in the likelihood of a crash being severe across different land uses. However, fatal bicyclist crashes seem to form 2.3 percent of all crashes in rural areas, which is almost four times that of suburban and urban areas. It must be noted that the fatal crashes are infrequent, have a small sample size, and this difference may not be statistically significant. The share of crashes by injury severity for different land use contexts is shown in Figure 6.



	Rural Percent	Suburban Percent	Urban Percent
Fatality (K)	2.27%	0.48%	0.65%
Incapacitating Injury (A)	7.86%	9.00%	8.50%
Non-Incapacitating Injury (B)	37.91%	33.60%	21.95%
Possible Injury (C)	33.21%	36.13%	45.46%
Property Damage Only (O)	18.74%	20.78%	23.44%

Figure 6: Bicyclist Crashes by Severity and Land Use

Safer Streets Priority Finder (SSPF) Tool

SSPF Background

Toole Design, in collaboration with the City of New Orleans, University of New Orleans Transportation Institute, and New Orleans Regional Transit Authority, developed the Safer Streets Priority Finder Tool[4] (i.e., SSPF Tool). The SSPF Tool is a free, interactive, open-source resource available at the national scale that can help transportation practitioners identify a street network that is similar to a High Injury Network[5] for bicyclists and pedestrians. The network goes further than a typical High Injury Network by not only taking into consideration areas where a disproportionate share of fatal and serious injury crashes have already occurred, but also areas that have factors present that are likely to contribute to future risk.

The SSPF Tool is an expansion of a prior effort—the Pedestrian Fatality Risk Pilot[6] beta tool (i.e., Pilot Tool), developed by the USDOT. The Pilot Tool is based on a tract-level statistical model of pedestrian fatalities for the entire United States. As described in Mansfield, et al. (2018)[7], this model considers various factors to predict pedestrian fatalities, including VMT density by functional classification, intersection density, employment density, residential population density, activity mix index, and sociodemographics.

[4] https://www.saferstreetspriorityfinder.com/

[5] https://visionzeronetwork.org/hin-for-the-win/

[6] See "Pedestrian Fatalities Pilot" section: https://www.transportation.gov/SafetyDataInitiative/Pilots
An interactive map of the Pedestrian Fatalities Pilot can be viewed here: https://maps.dot.gov/BTS/PedestrianFatalityModel/

[7] Technical report for the Pedestrian Fatalities Pilot can be viewed here: https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/328686/effects-roadway-and-built-environment-characteristics-pedestrian-fatality-risk-mansfield-et-al.pdf

The SSPF Tool produces two main outputs:

1. Crash Density Analysis (also called a Sliding Windows Analysis, typically how High Injury Networks are defined)
2. Safer Street Model: Estimated Future Societal Costs

The following sections provide high-level summaries for each analytical methodology and the results from each analysis. SSPF uses crash data for a year period. 2017 to 2021 data are used for the analysis in this section. For more detailed information on the methodologies for each analysis, please see, SSPF Technical Report.[8]

Crash Density Analysis

Crash Density Analysis generalizes counting crashes along corridors that tend to share similar characteristics (in this case name and functional class). A specified length (0.5 mi) of roadway section (window segment) is moved along the roadway alignment in increments of smaller steps (0.1 mi). Crashes occurring within 15 meters of these window segments are then counted and summarized by mode and severity. This method allows calculating crash density along a street corridor without being impacted by how the network is split at intersections and other locations.

Segments with higher scores (represented by thicker and darker lines) represent portions of the roadway network that have a higher concentration of overall crashes and KSI crashes. Figure 7 and Figure 9 show the results of the crash scores from the Crash Density analysis. Figure 8 and Figure 10 show the same information zoomed in to the Rochester area.

[8] https://www.saferstreetspriorityfinder.com/tool/final_report

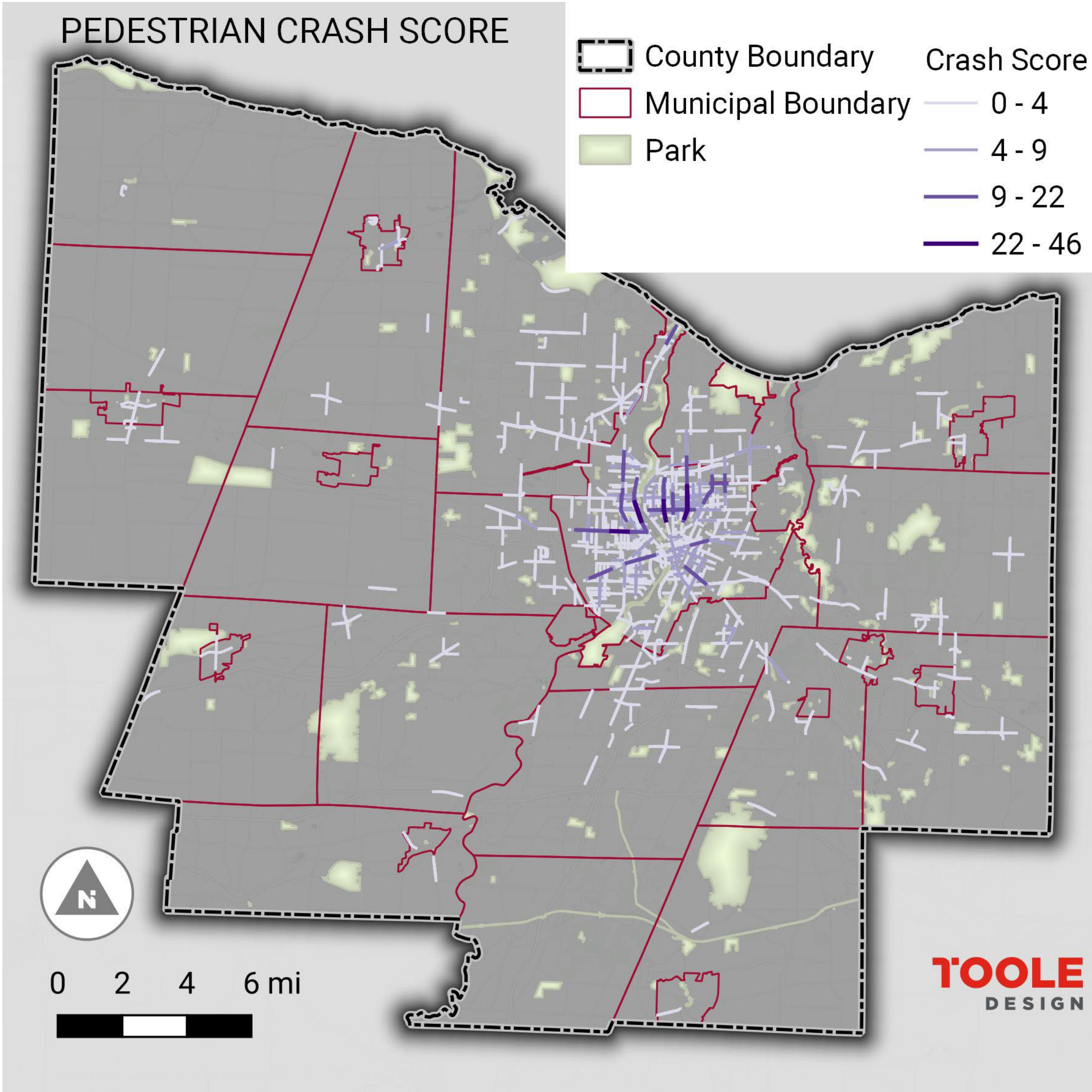


Figure 7: Pedestrian Crash Density Analysis Output

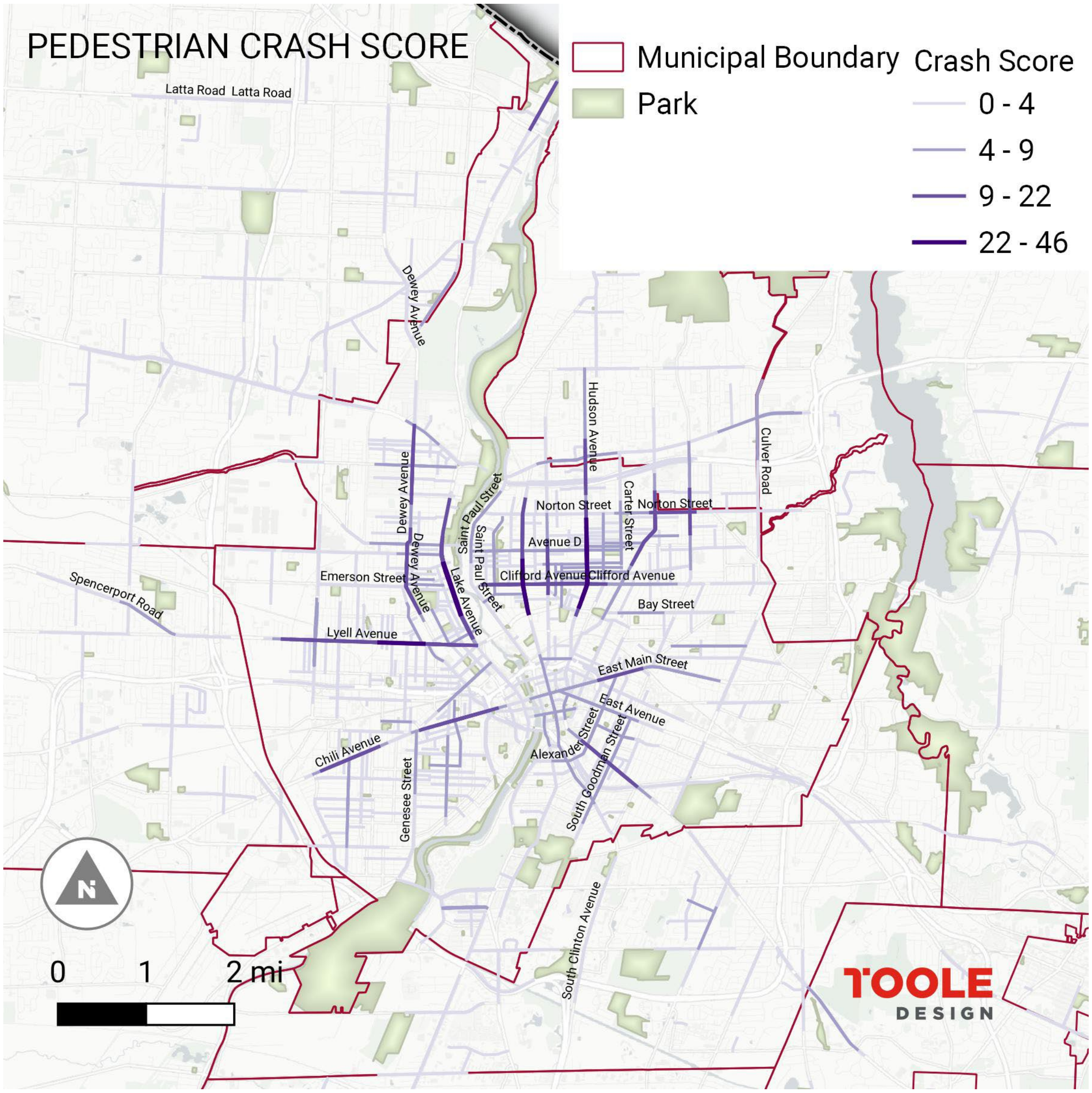


Figure 8: Pedestrian Crash Density Analysis Output for Rochester

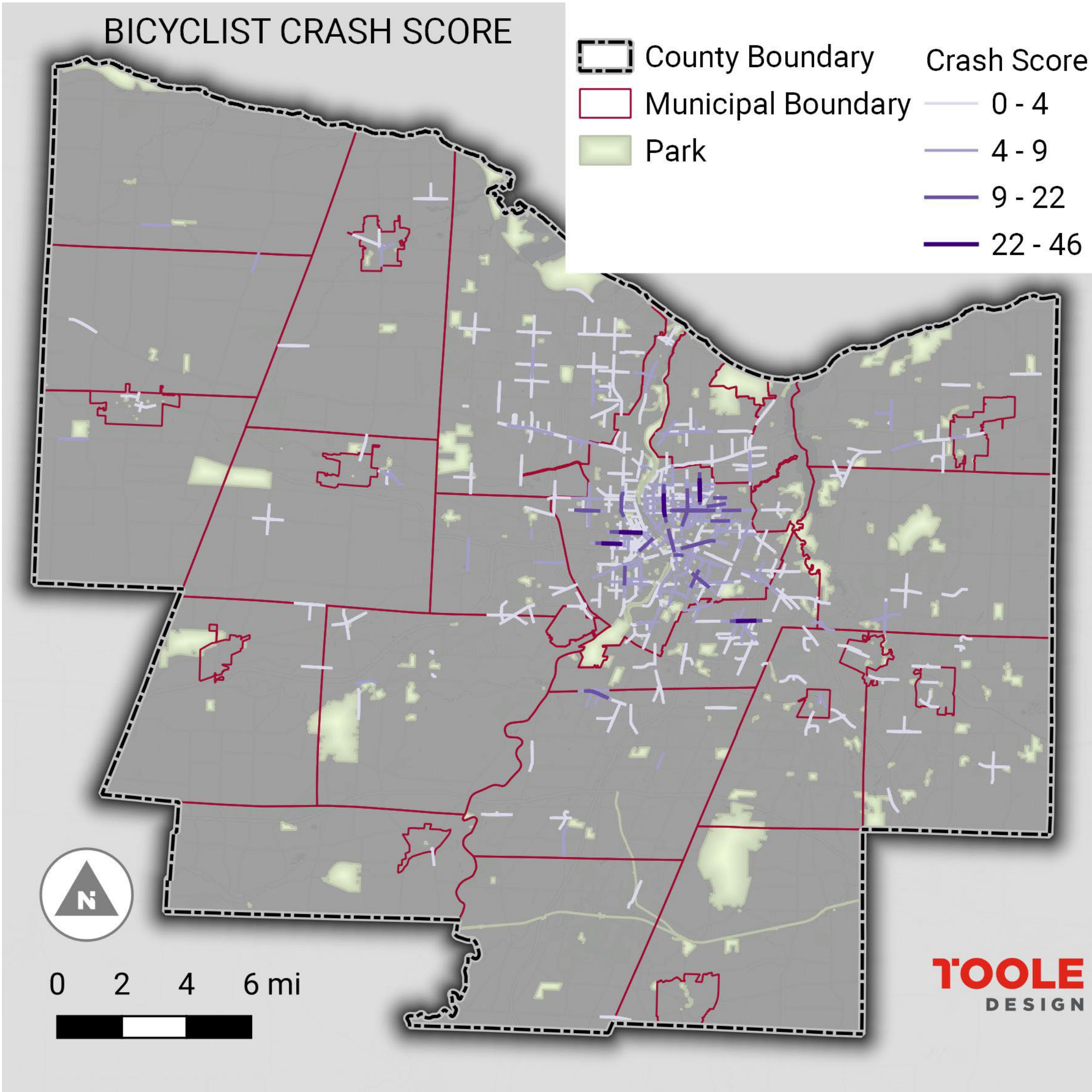


Figure 9: Bicycle Crash Density Analysis Output

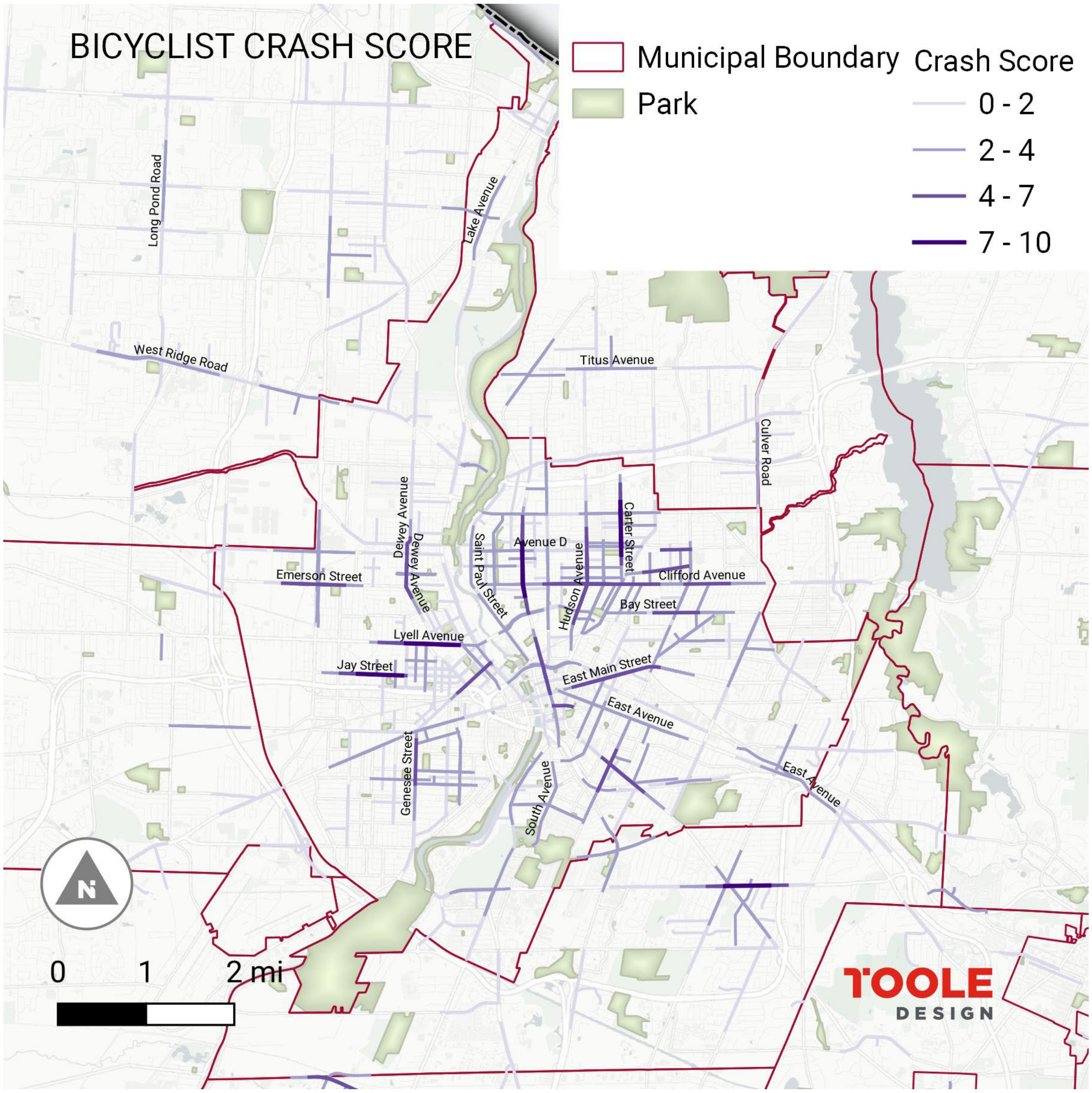


Figure 10: Bicycle Crash Density Analysis Output for Rochester

The Crash Density Analysis shows that the high crash score corridors for people walking and biking are concentrated in Rochester. Greece, Irondequoit, and Brighton also experience higher crash densities than the rest of the county, although not as severe as Rochester. The Rochester Active Transportation Plan includes a separate crash analysis that offers more detailed findings and recommendations for improving pedestrian and bicyclist safety in city limits.

The top 10 corridors with the highest crash score for each of the urban, suburban, and rural areas are given in Table 3 and Table 4. For each of the corridors given in the tables below, the municipalities that the corridor is located in are also provided.

Table 3: Top Ten Pedestrian Score Segments for Each Land Use Type

Street Name	Functional Class	Land Use	Crash Score	Municipality	Jurisdiction
Hudson Avenue	Minor Arterial	Urban	46	Rochester	Local
North Clinton Avenue	Major Collector	Urban	26	Rochester	Local

Street Name	Functional Class	Land Use	Crash Score	Municipality	Jurisdiction
Lyell Avenue	Minor Arterial	Urban	25	Rochester	Local
Lake Avenue	Major Arterial	Urban	24	Rochester	State
Clifford Avenue	Minor Arterial	Urban	18	Rochester	Local
Dewey Avenue	Major Collector	Urban	18	Rochester	Local
Portland Avenue	Major Arterial	Urban	17	Rochester	Local
Monroe Avenue	Major Arterial	Urban	15	Rochester	Local
West Main Street	Major Arterial	Urban	15	Rochester	Local
East Main Street	Major Arterial	Urban	12	Rochester	Local
Hudson Avenue	Minor Arterial	Suburban	10	Irondequoit	County
Monroe Avenue	Major Arterial	Suburban	8	Pittsford	State
East Ridge Road	Minor Arterial	Suburban	7	Irondequoit	County
North Goodman Street	Minor Arterial	Suburban	7	Irondequoit	County
Bennington Drive	Major Collector	Suburban	6	Greece	Local
Newton Drive	Local Road	Suburban	6	Brighton	Local
Spencerport Road	Minor Arterial	Suburban	6	Gates	State
South Winton Road	Minor Arterial	Suburban	5	Brighton	County
Baker Avenue	Local Road	Suburban	4	Irondequoit	Local
Brighton-Henrietta Town Line Road	Major Collector	Suburban	4	Brighton, Henrietta	County
East Avenue	Minor Arterial	Rural	6	Hilton	County
State Street	Major Collector	Rural	4	Brockport	Local
Bankside Drive	Local Road	Rural	3	Hamlin	Local
Brockport-Spencerport Road	Major Arterial	Rural	3	Sweden	State
Fourth Section Road	Major Arterial	Rural	3	Sweden	State
Gursslin Lane	Local Road	Rural	3	Hilton	Local
Hovey Street	Local Road	Rural	3	Hilton	Local
Klafehn Drive	Local Road	Rural	3	Hilton	Local
Main Street	Minor Arterial	Rural	3	Hilton	State
Manitou Road	Major Collector	Rural	3	Parma	State

Table 4: Top Ten Bicyclist Score Segments for Each Land Use Type

Street Name	Functional Class	Land Use	Crash Score	Municipality	Jurisdiction
Carter Street	Minor Arterial	Urban	10	Rochester	Local
Jay Street	Major Collector	Urban	9	Rochester	Local
Lyell Avenue	Minor Arterial	Urban	9	Rochester	Local
North Clinton Avenue	Major Collector	Urban	8	Rochester	Local
Clifford Avenue	Minor Arterial	Urban	7	Rochester	Local
Dewey Avenue	Major Collector	Urban	7	Rochester	Local
Hudson Avenue	Minor Arterial	Urban	7	Rochester	Local

Street Name	Functional Class	Land Use	Crash Score	Municipality	Jurisdiction
East Main Street	Major Arterial	Urban	6	Rochester	Local
Fernwood Avenue	Major Collector	Urban	6	Rochester	Local
Genesee Street	Major Arterial	Urban	6	Rochester	Local
Elmwood Avenue	Major Arterial	Suburban	8	Brighton	County
Jefferson Road	Major Arterial	Suburban	6	Brighton, Henrietta	State
Five Mile Line Road	Minor Arterial	Suburban	4	Penfield	County
Five Mile Line Road	Major Collector	Suburban	4	Webster	County
Gardham Road	Local Road	Suburban	4	Irondequoit	Local
Monroe Avenue	Major Arterial	Suburban	4	Brighton	State
South Winton Road	Minor Arterial	Suburban	4	Brighton	County
Titus Avenue	Minor Arterial	Suburban	4	Irondequoit	County
West Ridge Road	Major Arterial	Suburban	4	Greece	State
Amerige Park	Local Road	Suburban	3	Irondequoit	Local
Spencerport Road	Major Collector	Rural	4	Ogden	State
East Avenue	Minor Arterial	Rural	3	Hilton	County
Fourth Section Road	Minor Arterial	Rural	3	Sweden	State
Hovey Street	Local Road	Rural	3	Hilton	Local
Main Street	Minor Arterial	Rural	3	Hilton	State
Roosevelt Highway	Minor Arterial	Rural	3	Hamlin	State
South Avenue	Minor Arterial	Rural	3	Hilton	State
Sweden-Walker Road	Minor Arterial	Rural	3	Clarkson, Hamlin	State
Winter Ridge	Local Road	Rural	3	Ogden	Local
Old Hojack Lane	Local Road	Rural	2	Hilton	Local

Safer Streets Model

The Safer Streets Model brings the segmented road network window segments (produced in the Crash Density Analysis) into a Bayesian statistical framework to estimate crash risk throughout the system. This framework incorporates observed crash history, functional class of the segment, and tract-level fatality risk from the Pilot Tool in estimating the crash risk by severity. The model estimates crash risk rates per mile for each road segment and each crash mode (pedestrian and bicyclist only) and severity. These values are then converted to crash cost estimates based on the costs assigned to each crash severity. For this analysis, the crash costs used are the default costs built into the tool which are calculated based on based on FHWA's Crash Costs for Highway Safety Analysis[9]. The comprehensive crash costs based on injury severity are given in Table 5. Figure 11 and Figure 13 show the annual societal cost due to crashes on roadways in Monroe County. Figure 12 and Figure 14 show the same information zoomed in to the Rochester area. The cost is divided by segment mileage to eliminate the effect of longer segments being highlighted on the map.

[9] https://safety.fhwa.dot.gov/hsip/docs/fhwasa17071.pdf

Table 5: Cost Associated With Crashes Based on Injury Severity

Injury Severity	Comprehensive Crash Cost
Fatality (K)	$ 11,326,039
Incapacitating Injury (A)	$ 651,305
Non-Incapacitating Injury (B)	$ 201,223
Possible Injury (C)	$ 120,563
Property Damage Only (O)	$ 11,096

While the Crash Density analysis shows high-risk street corridors based only on the historic crash data, the output of the safer streets model incorporates other factors like functional class, socio-economic characteristics, and other factors by incorporating the outputs from the Pilot tool. The results of this model can be overlaid with the Crash Density output to identify locations that might have a relatively high crash risk even if they have not had a crash history. An example of one such street would be Lake Road in Clarkson which has no crashes recorded between 2017 and 2021, but the model estimated that there is a crash risk with an estimated cost of $100,000 per mile per year.

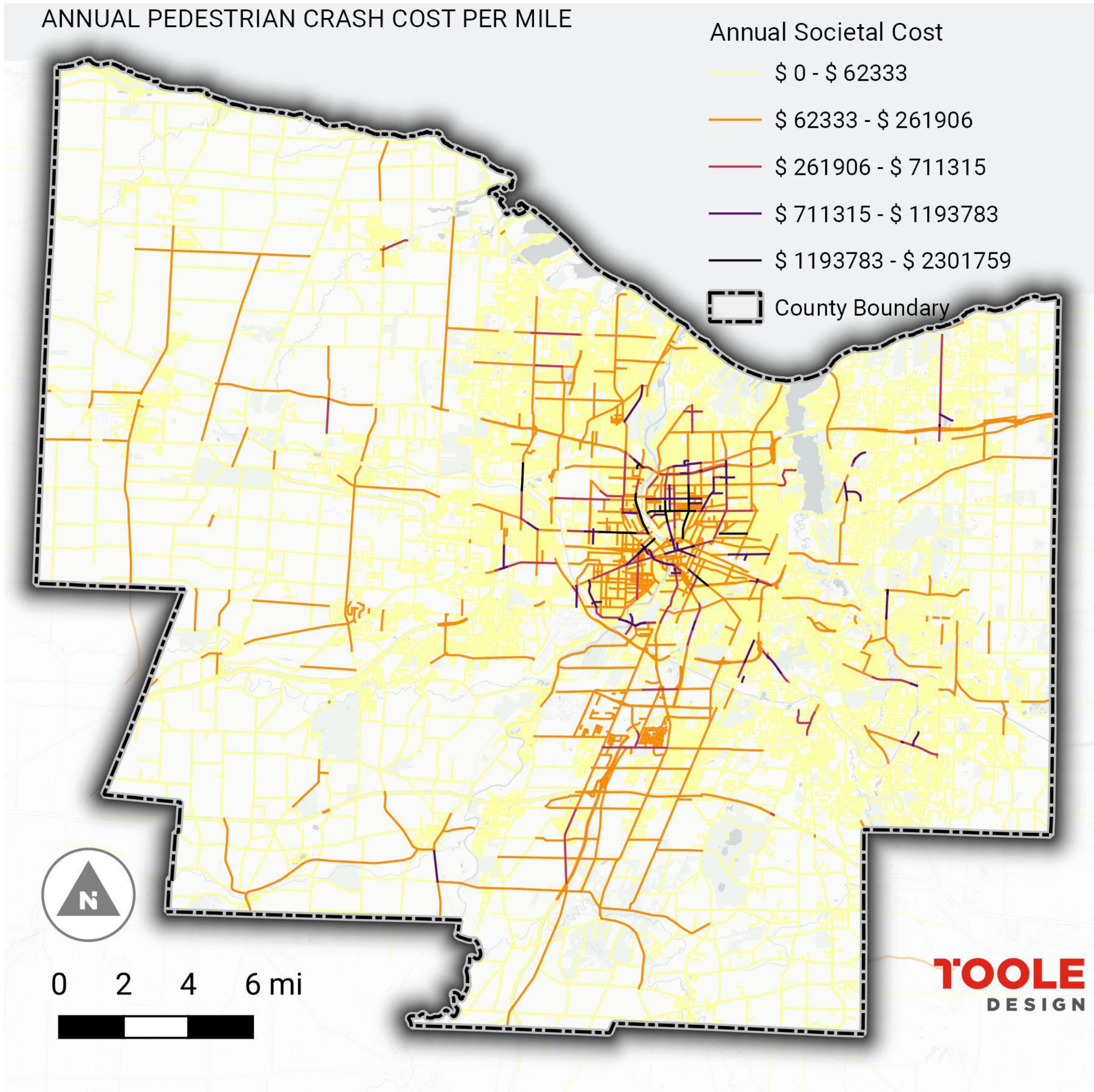


Figure 11: Annual Societal Cost Due to Pedestrian Crashes

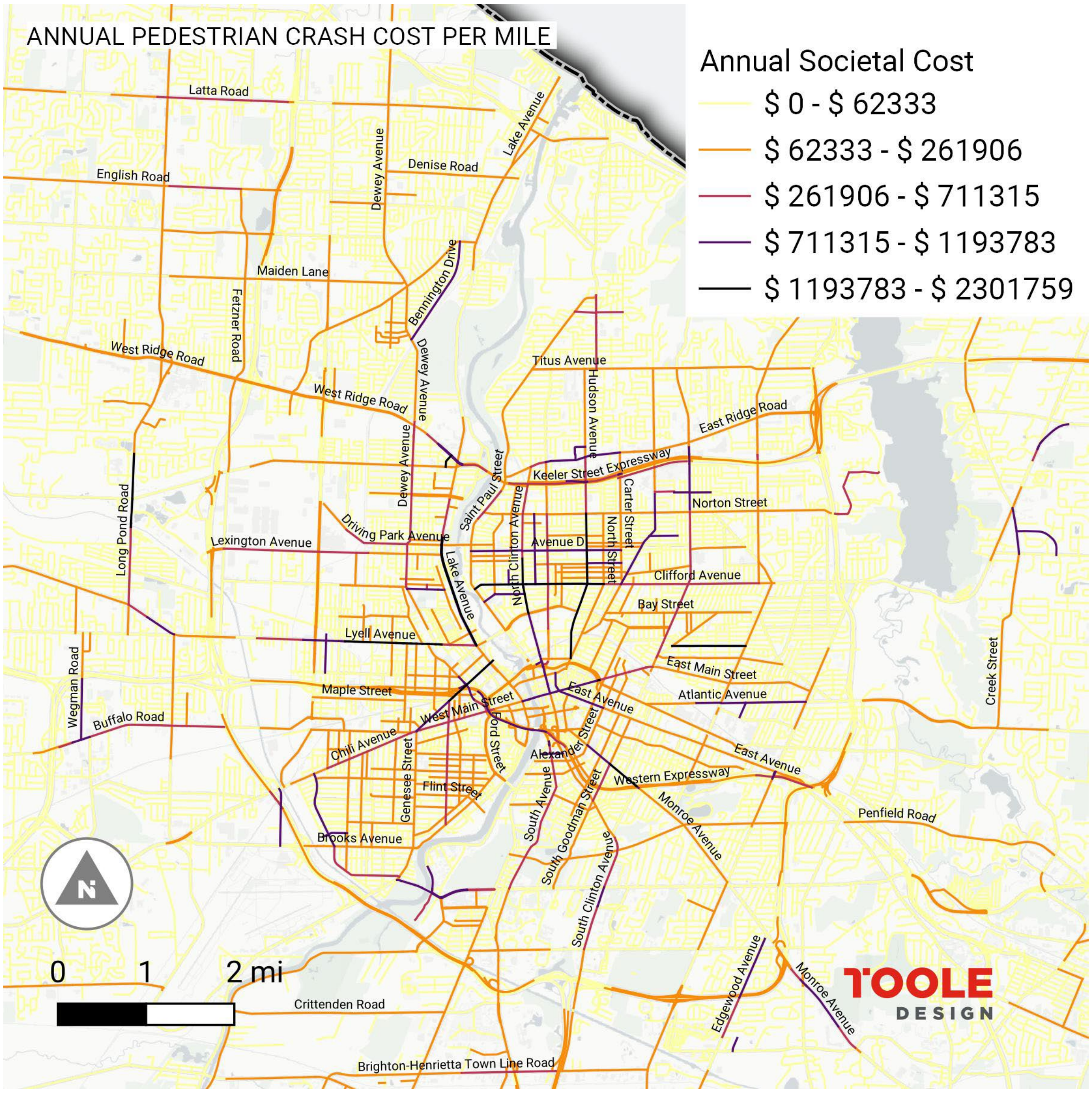


Figure 12: Annual Societal Cost Due to Pedestrian Crashes - Rochester Area

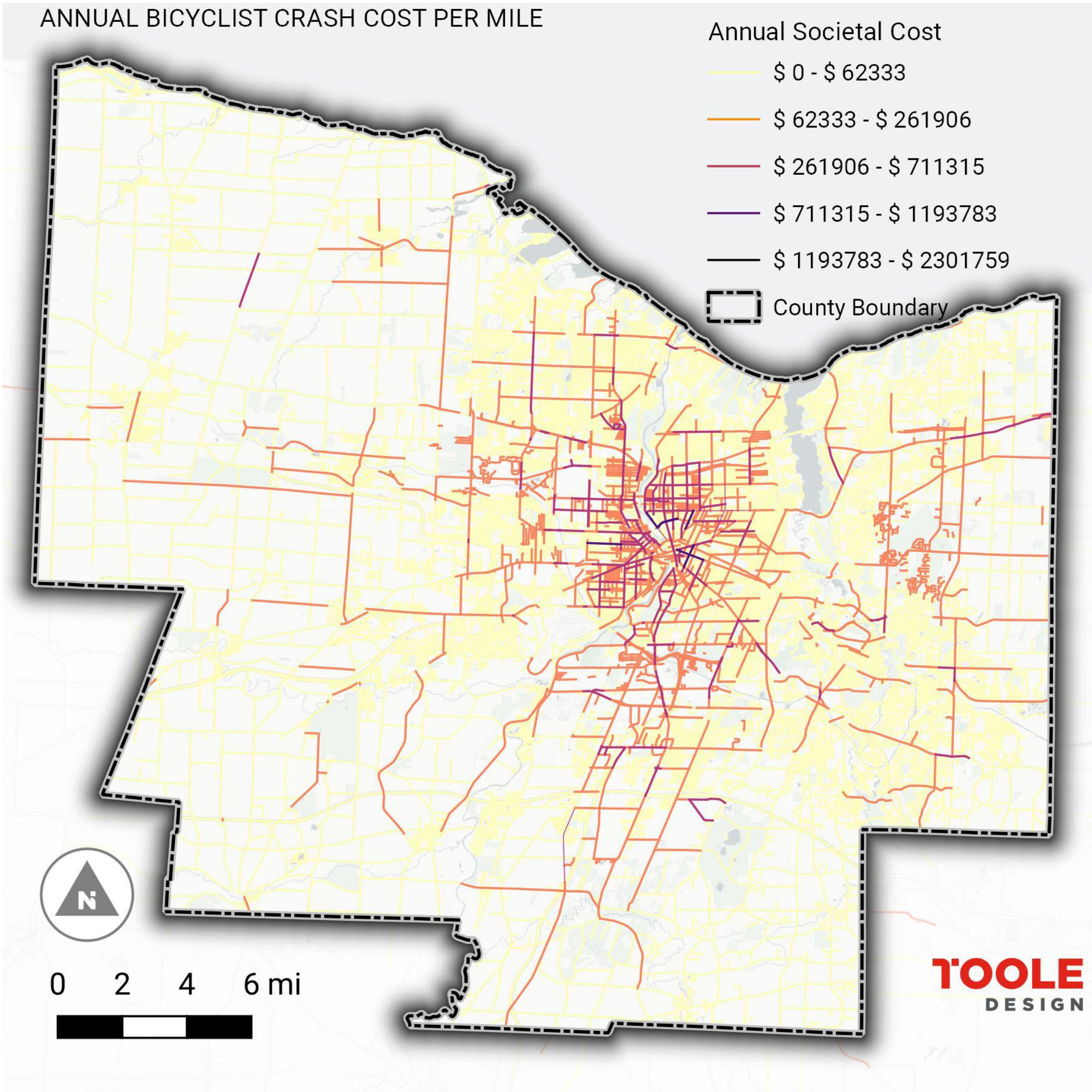


Figure 13: Annual Societal Cost Due to Bicyclist Crashes

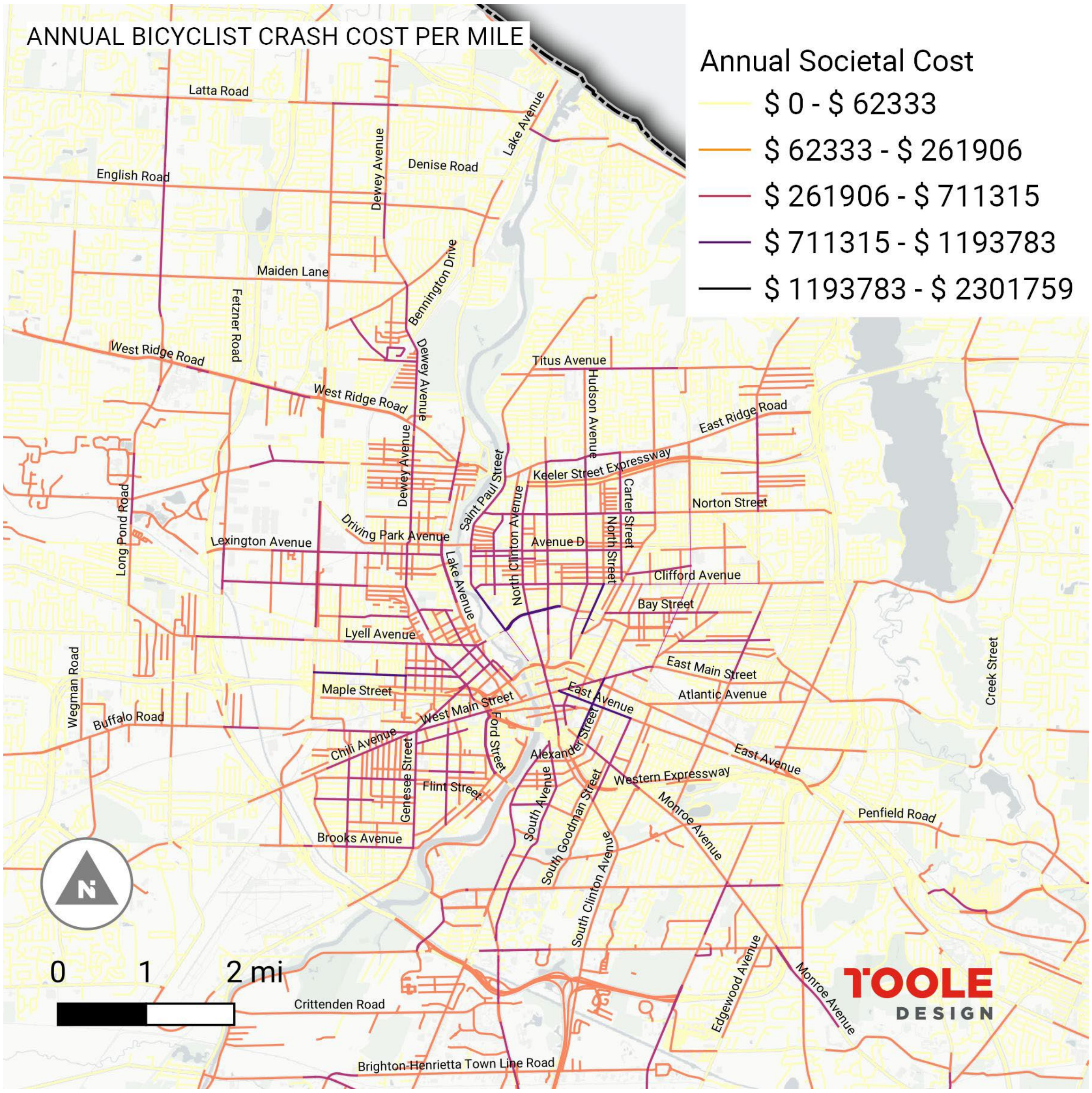


Figure 14: Annual Societal Cost Due to Bicyclist Crashes - Rochester Area