RUTGERS
Edward J. Bloustein School
of Planning and Public Policy

2011 PEDESTRIAN SAFETY TRACKING REPORT

SUBMITTED TO:

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Introduction

This report is intended to extend and update the information provided in the 2010 Pedestrian Safety Tracking Report. Data presented in this report were collected from a variety of sources, but focus on the Plan4Safety database of reported crashes in the State of New Jersey. This database is maintained by the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, The State University of New Jersey. The data in the Plan4Safety database are compiled from police records and verified by New Jersey Department of Transportation. This report updates the 2010 report with data from 2009 and 2010, while also increasing the accuracy of previously reported data through a more robust data extraction.

The primary purpose of this report is to continue to track crashes involving pedestrians. This report refines the previous work done, and provides more detailed analysis of the patterns of pedestrian fatalities and injuries on New Jersey's highways and roads. We have specifically expanded this year's analysis to include some new spatial information on counties and municipalities. It is our expectation that this spatial data and more sophisticated visual representations of existing data will be incorporated into future updates to make the presentation of this material more accessible and useful for policy makers.

Another ongoing goal of this research is to collect and compile information on safety improvements and investments. These efforts are underway, reflected in a separate three-corridor analysis report entitled *Pedestrian Safe Corridors: Memorandum*. We expect to improve this effort in subsequent years as we are able to collect more data on specific improvements and combine those data with the Plan4Safety data.

The primary findings of this report show a continuation of the highly variable number of pedestrian fatalities on New Jersey streets, even while the overall numbers of crashes involving pedestrians have modestly declined in the most recent years. Demographic analysis shows a higher risk for men and older adults, especially over the age of seventy-five. New analysis techniques have also uncovered a significant outlier in terms of overall pedestrian safety: Atlantic County. Home to popular tourist destinations that attract many pedestrians to the region, Atlantic County has a much higher rate of crashes involving pedestrians than any other New Jersey county when population density is controlled. One explanation is that most of the county is tourist-oriented, which inflates the number of pedestrians compared to the native population during certain times of year. Nevertheless, Atlantic County (and to a lesser extent Ocean County) is more fatally dangerous than other areas of the State.

The data extracted from the Plan4Safety database limited the type of crashes under investigation. Like the previous year's study, the 2011 Pedestrian Safety Tracking Report only examined crashes involving pedestrians, which were also reported to result in injury or fatality. We omitted crashes that only resulted in property damage. Data were merged from both the pedestrian reports and the crash reports to create a

single dataset containing all pedestrian (individual) and crash site variables. When possible, pedestrian-level data were used to calculate injury and fatality counts. In some cases, crash counts were used in place of pedestrian level data for analysis.

The rest of this report provides detailed sections analyzing trends in pedestrian safety. The report aims to inform decision makers and therefore does not explicitly engage in policy discussions or make recommendations. The concluding section does discuss some implications of the findings, but does not suggest any strategies for addressing pedestrian safety. The concluding section also summarizes the methodological challenges in analyzing pedestrian safety data.

Total Pedestrian Fatalities and Injuries

During the eight-year study period, 2003-2010, a total of 1003 pedestrian fatalities occurred due to vehicle-pedestrian crashes, or an average of 125 per year. During the same eight-year period, a total of 40,150 pedestrian injuries occurred due to such crashes at an annual rate of 5,019 injuries. Fatalities have stayed nearly constant over the period, but injuries show a large drop between 2005 and 2006 and then again between 2008 and 2010. During the latter period, vehicle-miles-traveled have also fallen, which may be one explanation for the decline in pedestrian injuries.

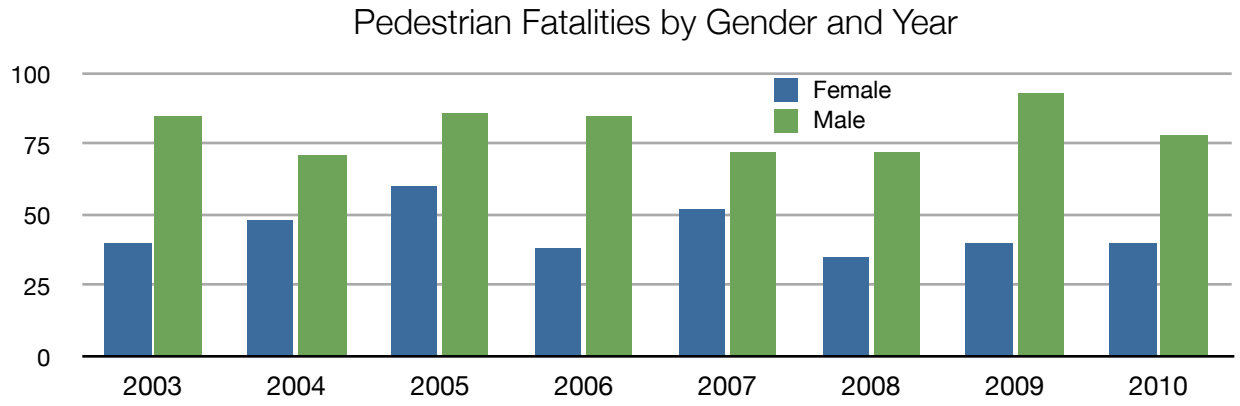
Annual Pedestrian Fatalities and Injuries in New Jersey, 2003-2010

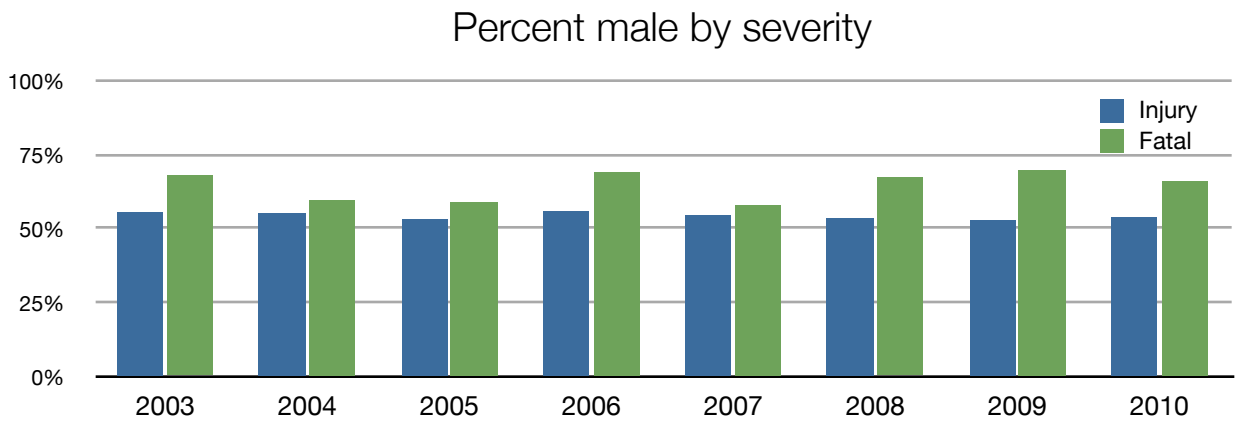
	Injury	Fatal	Daily Vehicle Miles Traveled	Pedestrian Fatalities per 1 million Daily VMT	Pedestrian Injuries per 1 million Daily VMT
2003	5,817	126	195,237,000	0.6	29.8
2004	5,785	120	199,119,000	0.6	29.1
2005	5,658	147	203,076,000	0.7	27.9
2006	4,805	124	207,131,000	0.6	23.2
2007	4,721	125	208,419,000	0.6	22.7
2008	4,704	108	200,051,000	0.5	23.5
2009	4,549	133	199,586,000	0.7	22.8
2010	4,111	120	N/A	N/A	N/A
Total	40,150	1003			

Gender

One of the more striking details about these data is the differences in injuries and fatalities among men and women. Though men are very slightly overrepresented in injurious crashes, fatal crashes show a troubling difference. Men represent 65 percent of the pedestrian fatalities in New Jersey crashes. One reason may be that men walk more frequently at night when more fatal crashes occur. Men's proportion of nighttime fatalities is 67 percent; that proportion drops to 59 percent during daylight hours. Because most fatal crashes occur in nighttime hours, the overall percentage is skewed heavily toward the nighttime percentage.

Pedestrian fatalities have varied over the last eight years. Between 2008-2010, a higher proportion of men have been killed than in three of the previous five years. This increase corresponds to a general decline in pedestrian fatalities over this same period. The proportion of injuries occurring to males has remained nearly constant throughout the entire study period.



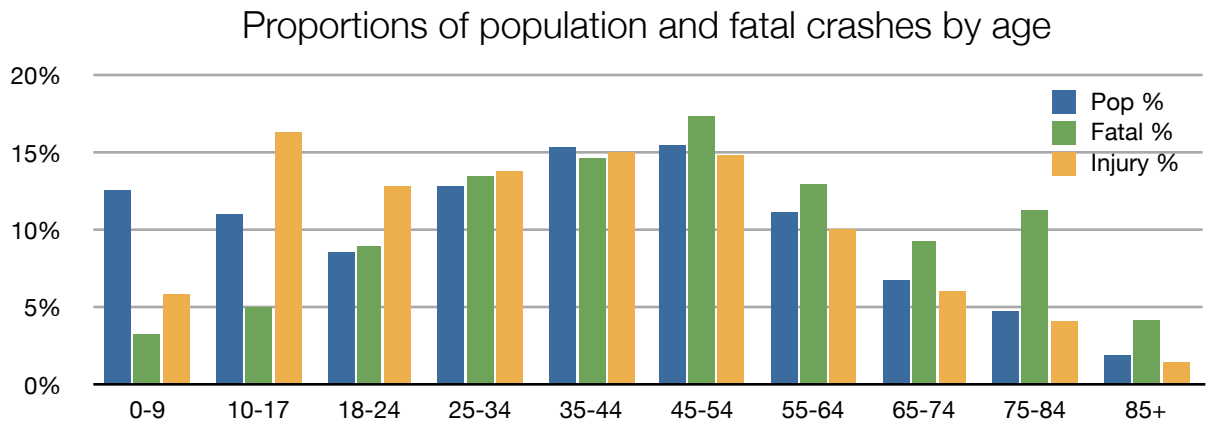


Age

Data for 2003-2010 show age as an interesting indicator in crash occurrences. In this analysis we compared both injuries and fatalities to the overall population shares in ten different age categories. For pedestrian injuries, the 10-17 and 18-24 year-old categories are significantly over-represented. This likely reflects both the propensity of younger people to walk and their risk-taking behavior when walking. The 0-9 year-old category is the only category underrepresented, likely due to their dependence on adults. All other age categories track closely to the overall population share for pedestrian injuries.

Pedestrian fatalities tell a slightly different story, though. First, pedestrian under 18 years old are significantly underrepresented compared to their population share. This contrasts the injury data and is difficult to explain; some hidden explanatory factor must be omitted from our data. One explanation may be that younger people are in better physical condition and can survive major injuries more often than

older adults. Pedestrians over the age of 44 become more likely to be involved in a fatal pedestrian crash and that propensity increases with each age category. The older one gets, the more likely it seems pedestrian crashes will be fatal.



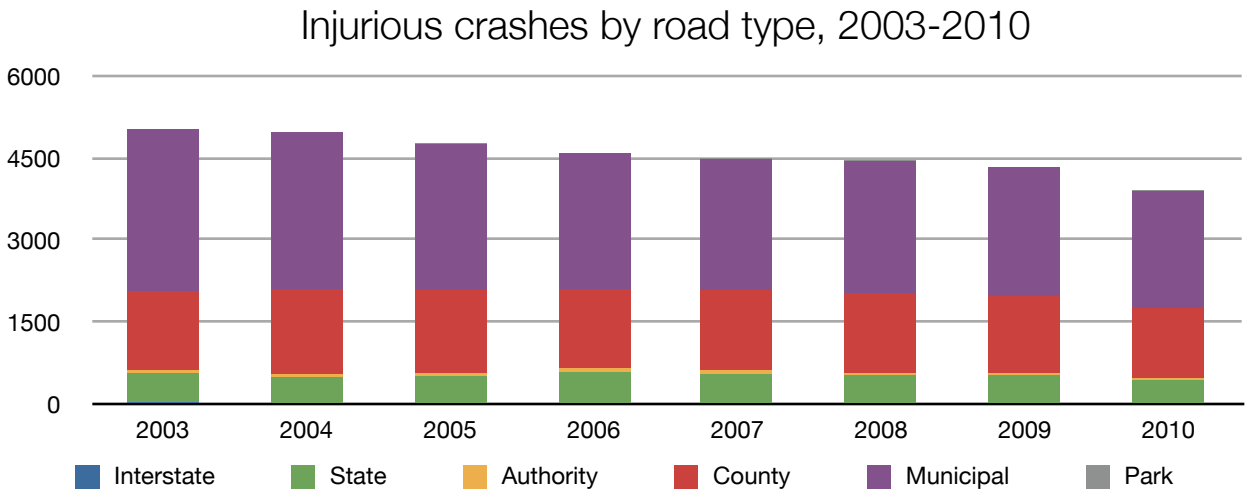
Pedestrian Crashes by Road Type

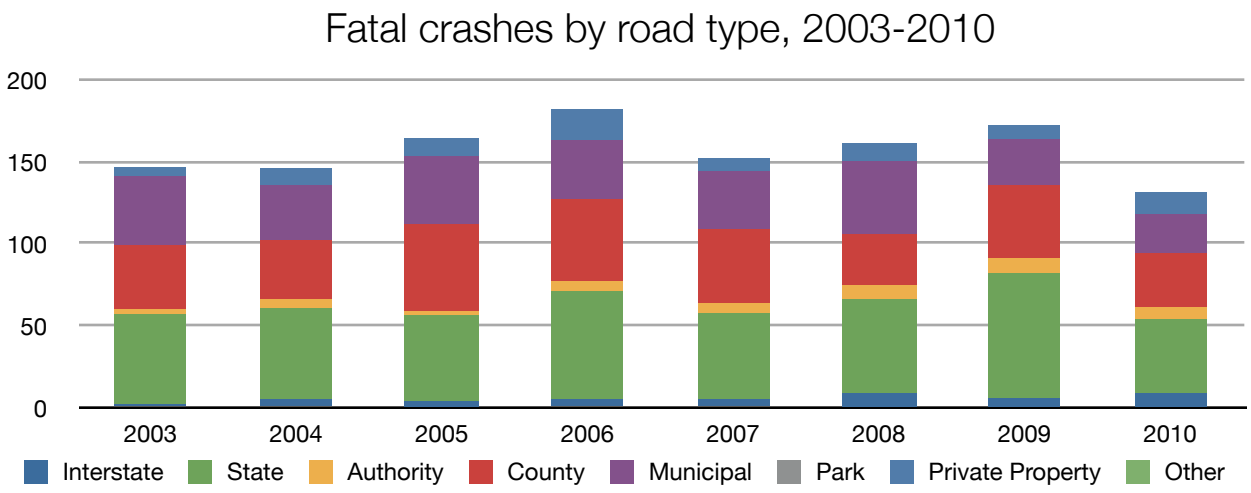
During the years 2003-2010, the largest number of pedestrian fatalities occurred on state highways (380), followed by county roads (268), and municipal roads (220), respectively. However, when normalized by miles of roadways in each class, fatalities are far less frequent on county and municipal roads (52 and 10 per 1,000 miles, respectively) than state highways (198 per 1,000 miles). A moderate increase in pedestrian fatalities on Interstate highways from 2008-2010 (19 per year versus 10 per year in 2003-2007) has pushed the normalized average fatalities for Interstate highways (104) into the same range as other high-speed roadways like state highways (198) and toll roads (119).

These data indirectly indicate that speed is an important factor in pedestrian fatalities. This is highlighted by the county road injury data. County roads have the highest normalized injury rate (1,797 per 1,000 road miles), yet as previously mentioned, do not result in nearly as many fatalities as the higher speed highways.

Although municipal roads account for only a modest number of pedestrian fatalities compared to state highways, half of the pedestrian injuries occur on these roads. These roads, however, account for 70 percent of the total road miles in the state.

Pedestrian fatalities for each road type have remained fairly constant over the eight year study period. Injurious crashes have also remained nearly constant, except for at the municipal level. Municipal roadways have seen a steady decline in reported injuries during the entire study period (2,956 injuries in 2003 to 2,153 in 2010).


Injurious crashes by road type, 2003-2010
6000
4500
3000
1500
0
2003
2004
2005
2006
2007
2008
2009
2010
Interstate
State
Authority
County
Municipal
Park


Fatal crashes by road type, 2003-2010
200
150
100
50
0
2003
2004
2005
2006
2007
2008
2009
2010
Interstate
State
Authority
County
Municipal
Park
Private Property
Other

Pedestrian Crashes by Time of Day

Combined data for the eight-year study period show that most pedestrian fatalities (65 percent) occur at night. This statistic illustrates the importance of visibility in pedestrian safety. In contrast, however, most pedestrian injuries (64 percent) occur during daylight hours. The relatively high proportion of injuries during the daytime is due to greater pedestrian presence. Most pedestrian activities occur during the day, thus putting more pedestrian on the streets at risk of traffic crashes.

Crashes by light condition

	Dark	Dawn	Daylight	Dusk	Total
Fatalities	635	13	314	21	983
%	65%	1%	32%	2%	
Injuries	11705	392	23398	1030	36525
%	32%	1%	64%	3%	

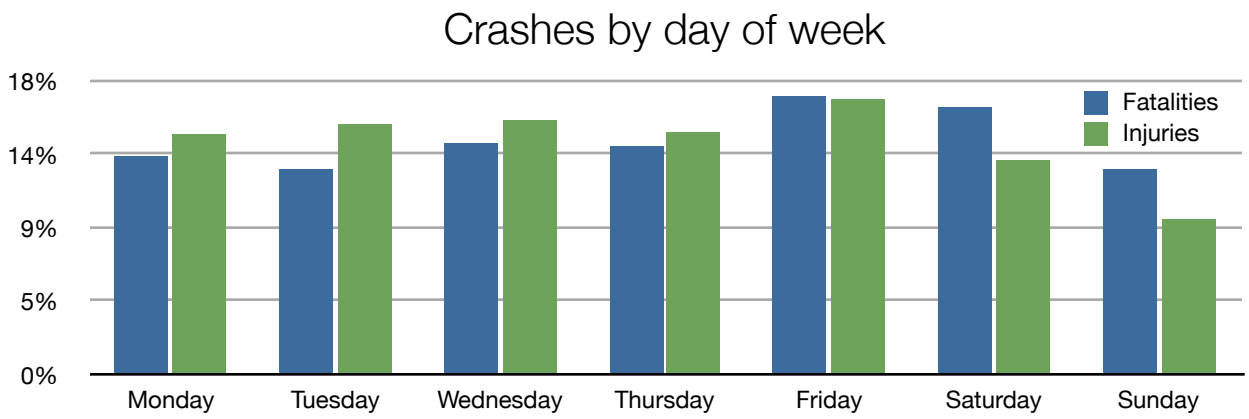
One potential explanation of higher rates of pedestrian fatalities at night might be the increased use of alcohol in those types of crashes. At night, 23 percent of fatal crashes involved alcohol compared to 6 percent during daylight hours. It seems there is evidence among these data of alcohol as a contributing factor in more pedestrian fatalities at night.

Although darkness is often attributed to crashes, when the pedestrian injuries and fatalities are classified by availability of streetlights, it appears only a small proportion (7 percent) of nighttime injuries occur in areas with no streetlights. Fatalities, however, far outpace the proportion of injuries in unlit areas at 20 percent of all nighttime pedestrian deaths. To understand the true impact of streetlights on pedestrian crashes, a more detailed research approach would be needed.

Hourly data of the eight-year period show that pedestrian injuries predominately occur in the afternoon/evening period. This can be directly related to activities and road usage by individuals.

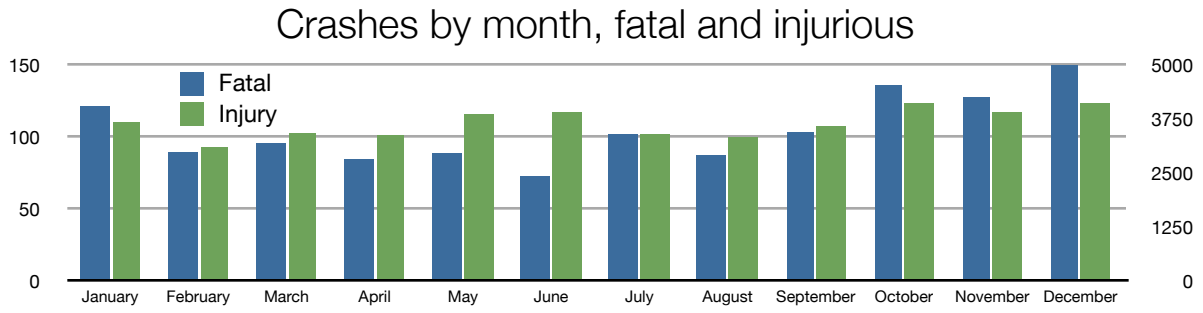
Pedestrian Crashes by Day of the Week

Aggregate data for the 2003-2010 period show that pedestrian fatalities and injuries vary only modestly between the days of the week. Both fatalities and injuries are highest on Fridays. The higher frequency of crashes on Fridays may be due to a combination of various factors, including greater traffic volumes, greater traffic and pedestrian volumes after dark, and alcohol consumption. Despite lower traffic volumes on weekends, Saturdays have the second most fatalities. Sundays also have a large fatality-to-injury discrepancy. Lower injury rates and higher fatality rates on weekends suggests that higher speeds due to lower traffic volume may be a contributing factor to these higher weekend fatality rates.



Pedestrian Crashes by Month

The largest number of pedestrian crashes occurs during the October-December period. Aggregate data from the 2003-2010 period show that both fatalities and injuries peak in the month of December. The reason for a large number of crashes in December may be a combination of weather, high volumes of holiday traffic, alcohol consumption, and unfamiliarity with driving in winter weather conditions. It is worth noting that a large number of injuries occur in May and June, which may be due to higher pedestrian volumes and academic breaks.

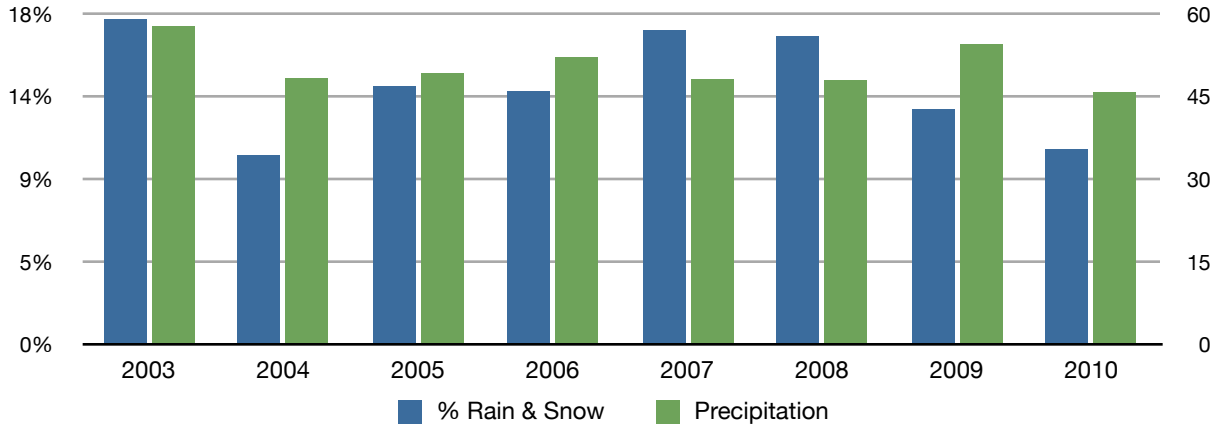


Pedestrian Crashes by Weather Condition

During the eight-year study period, 66 percent of pedestrian fatalities occurred during clear conditions, while 12 percent occurred during rain or snow. Seventy percent of pedestrian injuries occurred during clear conditions; twelve percent of injuries occurred during rain or snow. Most pedestrian crashes occur during clear conditions because pedestrians tend to avoid activity during inclement weather. Taking into account weather conditions is a difficult procedure due to the variety of ways one could measure

weather-related impacts. One way to control for variation in weather with easily accessible data is to use total annual precipitation. Normalizing for this factor on an annual basis reveals that 2007 and 2008 seemed to have an unusually high number of pedestrian fatalities in rain or snow conditions compared to the annual precipitation figures. In 2004, 2009, and 2010, rain/snow fatalities were much lower when compared with annual rainfall. These anomalies are difficult to explain, but may be worth future research to detect these differences more accurately.

Percent rain/snow conditions by year versus annual statewide preciptation



Pedestrian Crashes and Alcohol Consumption

It is widely acknowledged by researchers that alcohol consumption by motorists and pedestrians is often a contributing factor in crashes. Between 2003 and 2010, alcohol was involved in 17 percent of total pedestrian fatalities. Alcohol is a much smaller factor in pedestrian injuries; only 6 percent of pedestrian injuries reported during the period involved alcohol. This relationship is highly correlated with the daytime/nighttime crash statistics reported earlier. More fatal crashes occur at night, when alcohol is also more likely to be involved, than during the day. These data do not infer, however, who was under the influence of alcohol and pedestrian alcohol consumption is likely to be underreported because it is not necessarily illegal to walk when under the influence of alcohol.

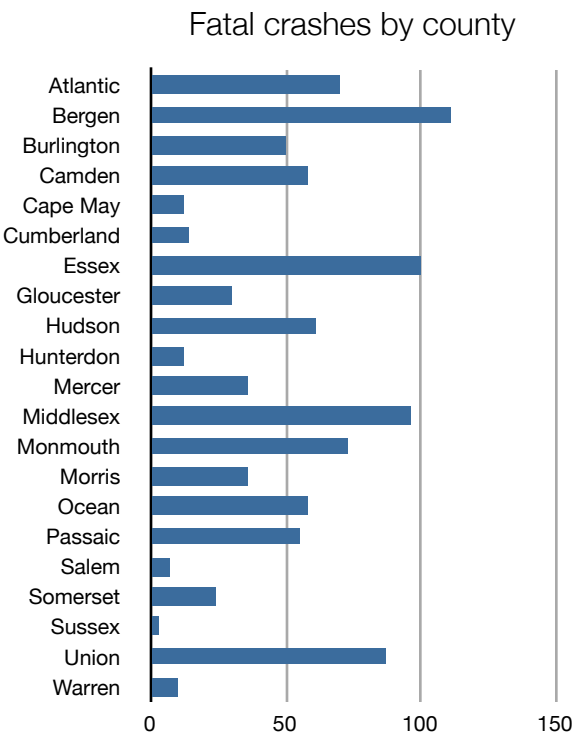
Crashes involving alcohol

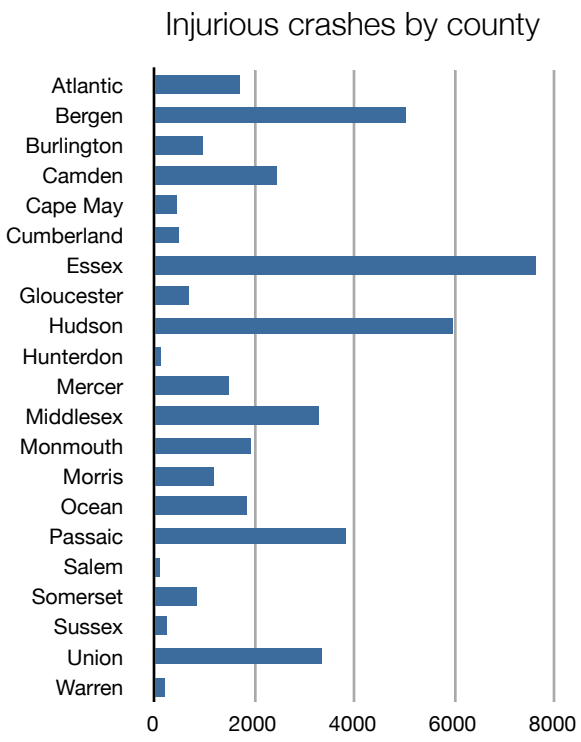
		2003	2004	2005	2006	2007	2008	2009	2010
Fatal	Alcohol	31	24	28	37	20	20	38	20
	No alcohol	116	122	136	145	132	141	134	112
	% alcohol	21%	16%	17%	20%	13%	12%	22%	15%
Injury	Alcohol	386	377	341	326	305	305	299	272
	No alcohol	5575	5586	5429	5121	5128	5090	4990	4481
	% alcohol	6%	6%	6%	6%	6%	6%	6%	6%

Pedestrian Crashes by County

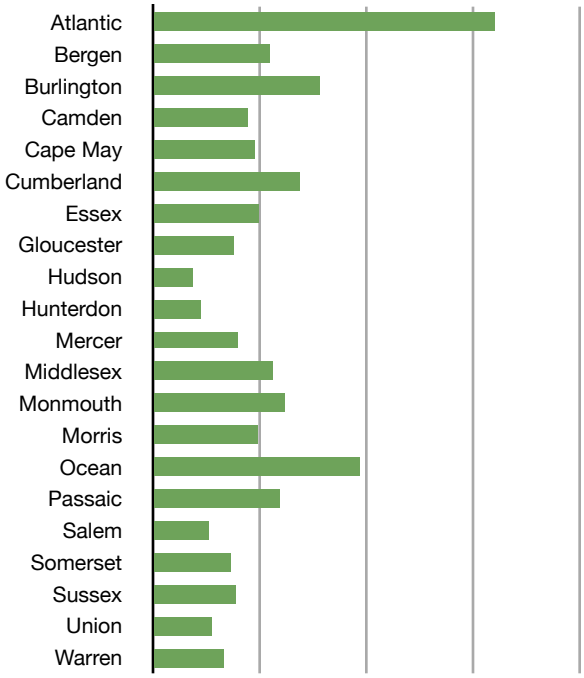
The data reported to the Plan4Safety database allow a certain degree of spatial analysis. In this section we briefly highlight some of the county-level variation in crash statistics during the eight year study period. In general, urban and northern counties have lower rates of pedestrian crashes when controlling for population density than suburban and southern counties. Three significant outliers are present in the population density analysis: Atlantic, Ocean, and Burlington Counties. Both Atlantic and Ocean Counties are shore counties with large tourism economies. They tend to attract visitors who are likely to walk more often than other places, and who are unfamiliar with the areas. The visitors to these places are also likely to consume alcohol and walk at night. Burlington County, on the other hand, is a large suburban county on the Delaware River. Detecting reasons why Burlington has a high fatality rate normalized by population density is difficult.

Controlling for population only (omitting land area) yields slightly different results. Smaller, northern counties (Essex, Hudson, Passaic, and Union) have much higher total crash rates when only population is controlled. Atlantic also remains high. Burlington drops to near the bottom, suggesting that it's large land area might be a larger factor in the density analysis above. In terms of fatal crashes, Atlantic remains an outlier in fatal crashes when only population is controlled. Both Ocean and Burlington drop back to the rest of the counties in the fatal crash analysis. Union is the only other outlier and is difficult to explain with the available data.

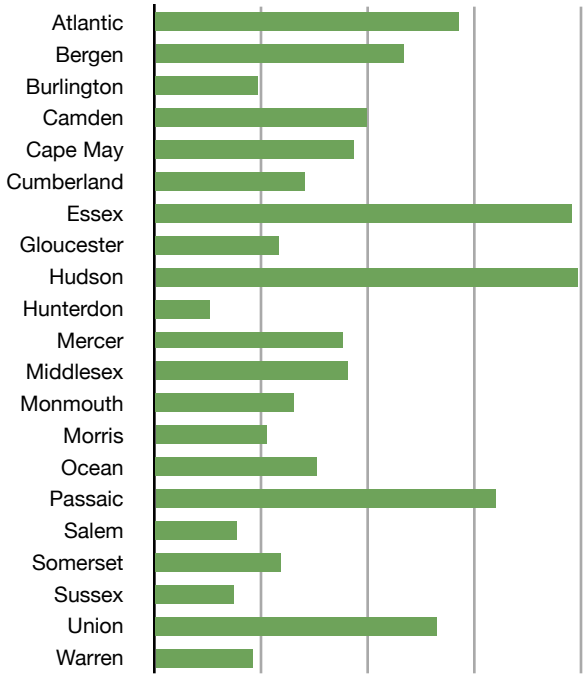




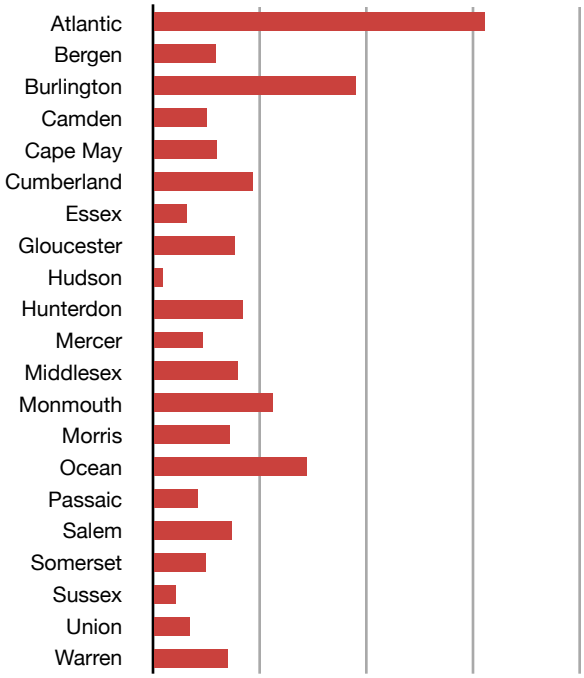
All crashes controlling for pop density, by county



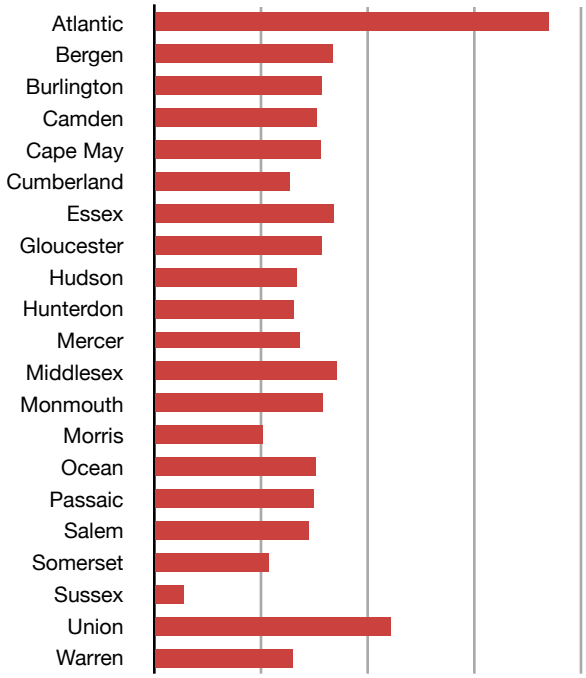
All crashes per 100,000 people by county



Fatal crashes controlling for population density, by county



Fatal crashes per 100,000 people by county



Pedestrian Crashes for 10 Largest New Jersey Municipalities

As a supplement to the county-level analysis, we visualized the crash data for New Jersey's ten largest municipalities. Each of the maps in **Appendix A** shows a visual representation of crash data over the entire eight-year study period. Crash locations are aggregated based on proximity to each other, and larger dots represent clusters of frequent crashes. The maps show a spatial pattern of crashes along major transportation corridors. These are typically the highest traffic locations with the most retail and service businesses to attract high volumes of both automobiles and pedestrians. Relatively suburban municipalities like Toms River and Hamilton clearly show clustering along corridors and at major intersections of multiple corridors. Denser urban municipalities like Jersey City and Newark show much more distributed (but high density) crash locations. This reflects the high pedestrian volumes in these cities.

Pedestrian Danger Index — 10 Largest New Jersey Municipalities

	Average Annual Pedestrian Deaths per 100,000 (2003-2010)	Average Annual Pedestrian Crashes per 100,000 (2003-2010)	Percent of Workers Walking to Work (ACS 2005-2009)	Pedestrian Danger Index - Fatalities	Pedestrian Danger Index - Crashes
Jersey City	1.0	96.9	8.2%	12	12
Paterson	0.9	90.4	5.9%	16	15
Lakewood	2.2	51.6	9.8%	22	5
Elizabeth	1.6	66.5	6.5%	25	10
Newark	2.1	100.7	7.5%	28	13
Trenton	1.9	87.7	5.3%	36	16
Edison	2.0	30.4	2.0%	101	15
Woodbridge	2.6	31.4	2.5%	104	12
Toms River	2.5	32.9	1.1%	215	29
Hamilton	1.3	25.6	N/A	N/A	N/A

Note: American Community Survey data for Hamilton Township not available.

Another measure of pedestrian safety at the municipal level is the Pedestrian Danger Index (PDI). This index uses the percent of workers walking to work (as reported to in the American Community Survey) as a rough estimate of pedestrian exposure within municipalities.[1] This measure was developed by the Surface Transportation Policy Partnership in the 1990s and has been applied by a number of research groups as a best available practice to estimating pedestrian exposure. We have adapted the data for our use by adding PDI measures associated with both fatal crashes and total crashes. The data from New Jersey's ten largest municipalities show a pattern of high pedestrian danger in suburban locations like Edison, Woodbridge, and Toms River. These three municipalities have a much lower rate of pedestrian exposure (measured by workers walking to work). Among the other municipalities, Jersey City and

[1] PDI is computed by dividing the average annual fatalities (or crashes) by the percent of workers walking to work. For convenience, the PDI - Crashes measure is divided by 100. PDI - Fatalities and PDI - Crashes are not comparable.

Paterson are safest, while Trenton and Newark are less safe. These results show little correlation among pedestrian deaths and pedestrian exposure among this small sample of cities. Comparison with PDI - Total Crashes shows some similarities and differences. Toms River is still an outlier when taking into account total crashes; it seems much more dangerous than the other municipalities listed by both measures. Toms River has the lowest pedestrian walking rate of all the municipalities listed, so that may be influencing the results. When taking into account all crashes, suburban Edison and Woodbridge fall roughly into the same category as the other municipalities listed. Elizabeth and Lakewood both seem significantly safer than other municipalities when measuring based on total pedestrian crashes. In future work, we plan to expand this analysis to include all available municipalities in New Jersey.

Conclusions and Implications

The analyses in this report provide some useful information on pedestrian crashes in New Jersey by focusing on fatalities and injuries from 2003-2010. New Jersey is a state characterized by predominately urban and suburban land use patterns, along with a ubiquitous network of Interstate highways, tollways, and state highways. It's relatively small land area also means that it has the highest population density among all states. The combination of high overall population density and automobile-oriented land use patterns contributes to a high degree of exposure to unsafe automobile traffic for pedestrians. Although overall traffic fatalities in New Jersey are modest in comparison to many other states, the state ranks fairly high in the northeastern region. This should be a concern for all transportation planners and policy makers in the state.

The analyses in this report provide some key information on pedestrian crashes in the state:

- *First*, far more men become casualties of pedestrian crashes than women. This is presumably because of exposure since men walk more frequently and take more risks than women (in darkness and in unsafe conditions).
- *Second*, age is an important indicator. Young people seem to take more risks resulting in higher injury rates, but older people are more prone to be killed in crashes compared to their respective shares of the population.
- *Third*, most pedestrian injuries occur in the daytime when pedestrian activity is higher, but pedestrian fatalities are skewed heavily toward darkness hours. To understand this relationship more fully, a comprehensive pedestrian study should be conducted.
- *Fourth*, most pedestrian crashes occur on municipal roads, but these also tend to be less fatal. State highways, county roads, and Interstates have higher proportions of traffic fatalities because speed kills.

- *Fifth*, pedestrian crashes follow temporal patterns. More crashes tend to occur in the late Autumn, with a second spike during the early Summer. Factors contributing to these increases could be academic cycles and changing climate conditions (including shorter daytime hours), which take time to adjust to each year.

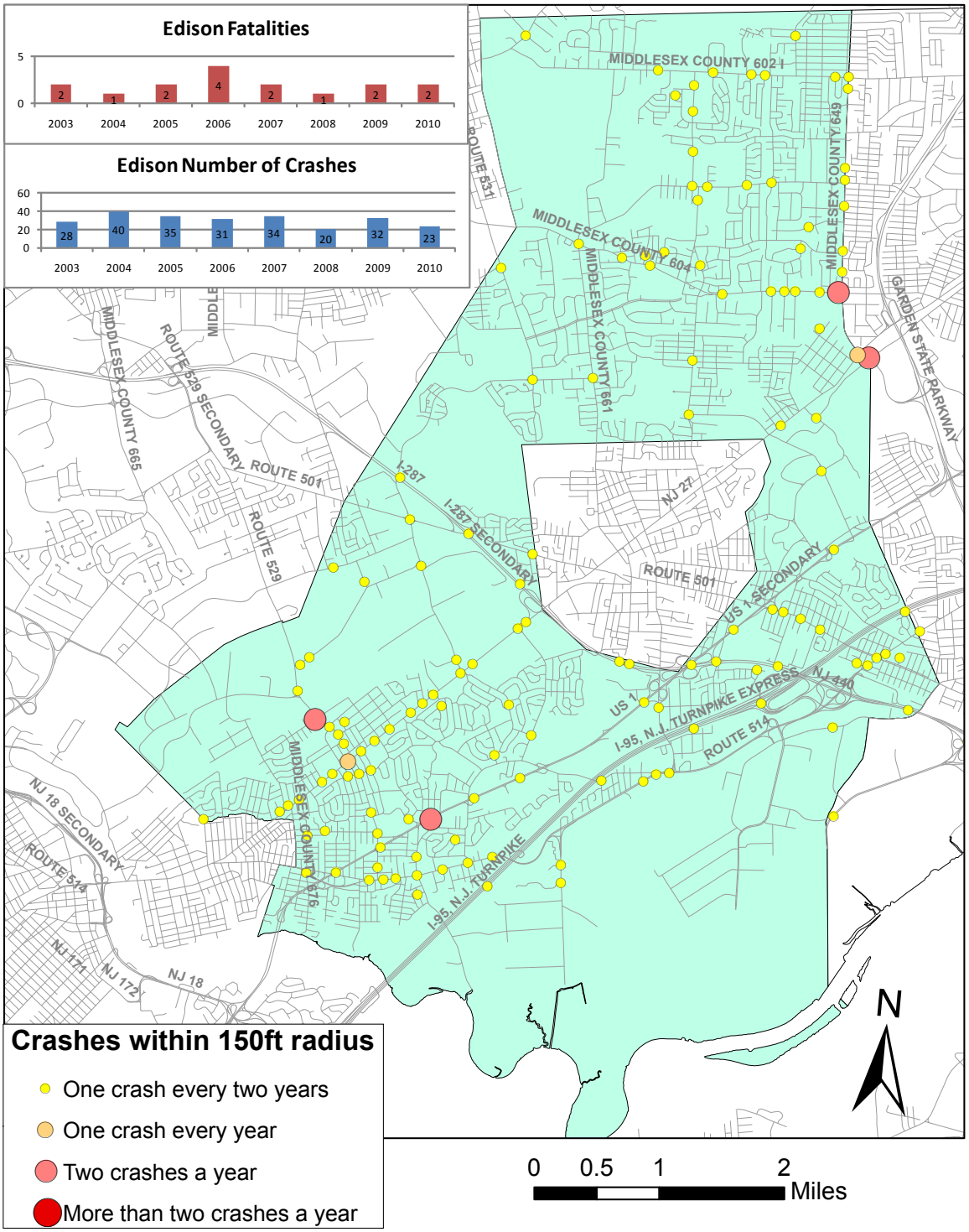
- *Sixth*, alcohol use continues to be a factor in pedestrian crashes. Nighttime crashes—where the results are more often fatal—are more often correlated with alcohol involvement than daytime crashes, a very troubling relationship.

In order to make policy recommendations regarding pedestrian safety issues, cause-and-effect explanations are important. Identifying the causes of crashes in a scientific manner using the limited data collected by CAIT in the Plan4Safety database is limited. The Plan4Safety database has no measure for pedestrian volumes or exposure, so controlling for volumes of pedestrian activity is not possible. Pedestrian volume counts are costly to collect and are generally not readily available except in very small geographic samples and for very limited durations. The Plan4Safety data are also devoid of any information on land uses in the areas where crashes occur. We can only infer characteristics of land use by looking at the types of roads (state highways, county roads, municipal arterials, etc). In the absence of adequate information on pedestrians' exposure and micro-area land use characteristics, it is difficult to identify specific strategies to address pedestrian crashes.

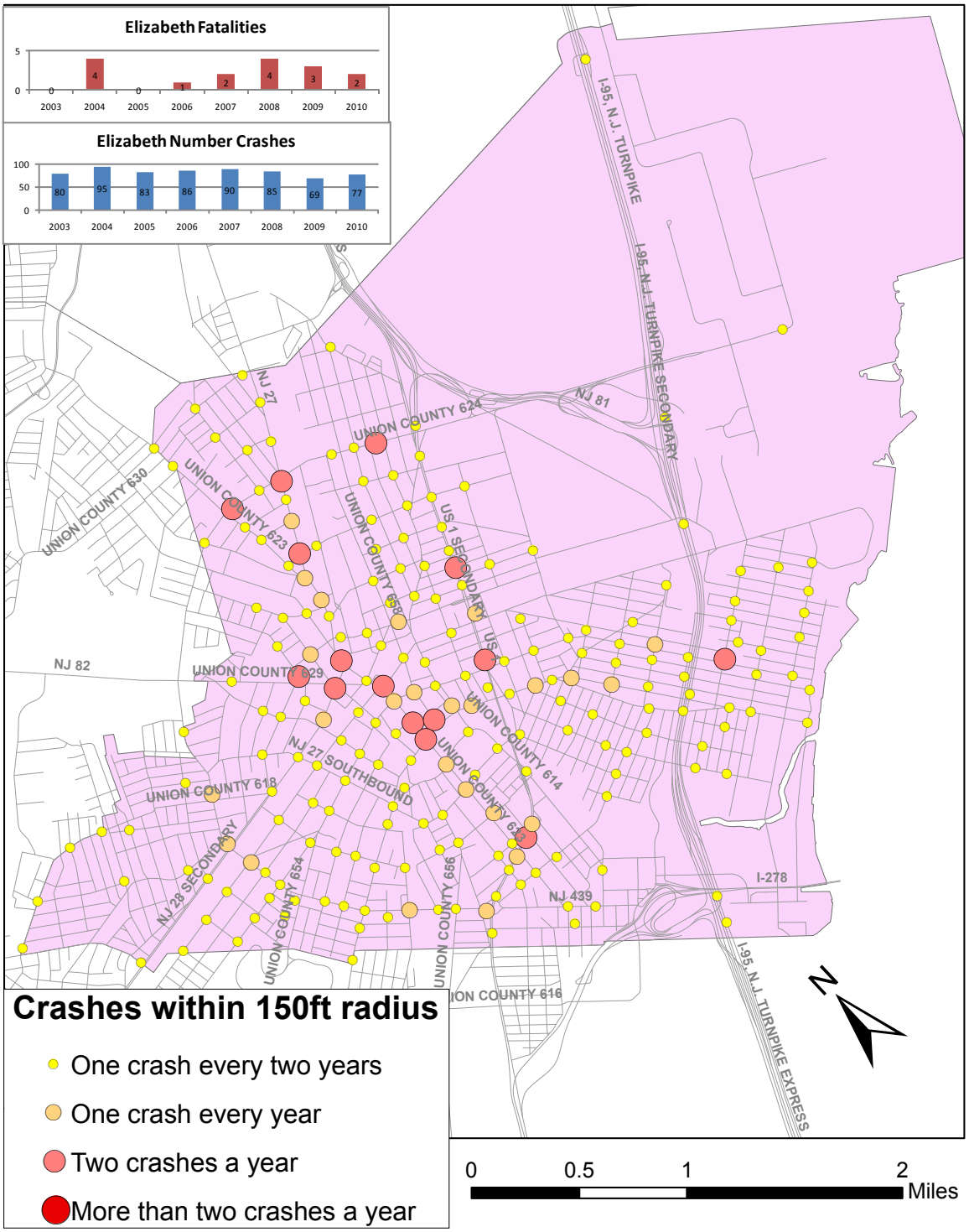
We have begun the process of examining the Plan4Safety data on a spatial scale. We hope to expand this effort in future updates to this report and other work. We will continue to seek more sources of data to include alongside the Plan4Safety data in these analyses to help establish new understandings of the patterns of pedestrian crashes in the State of New Jersey.

Appendix A – Pedestrian Crashes in New Jersey's Ten Largest Municipalities

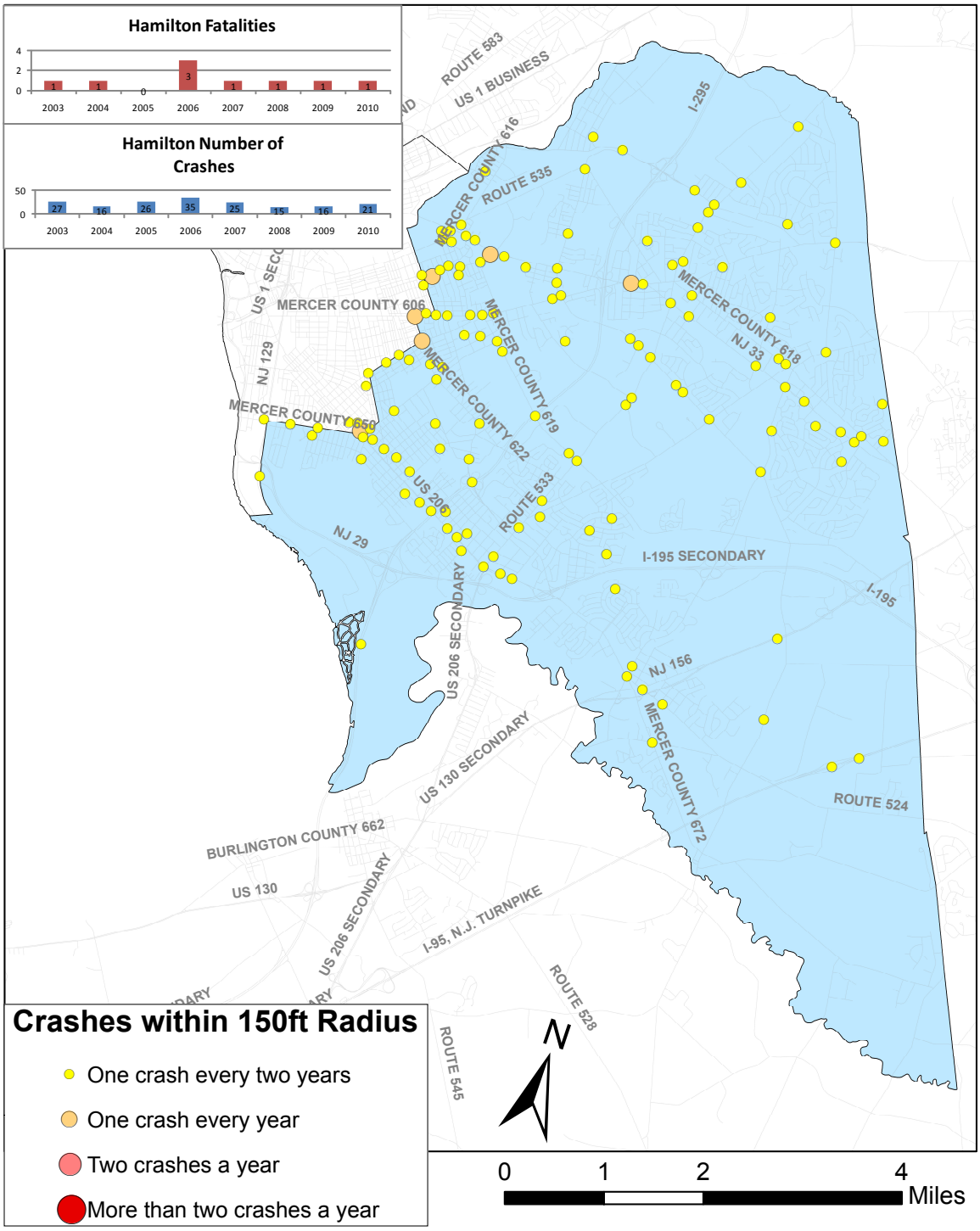
Pedestrian Vehicle crashes 2003 - 2010
Edison



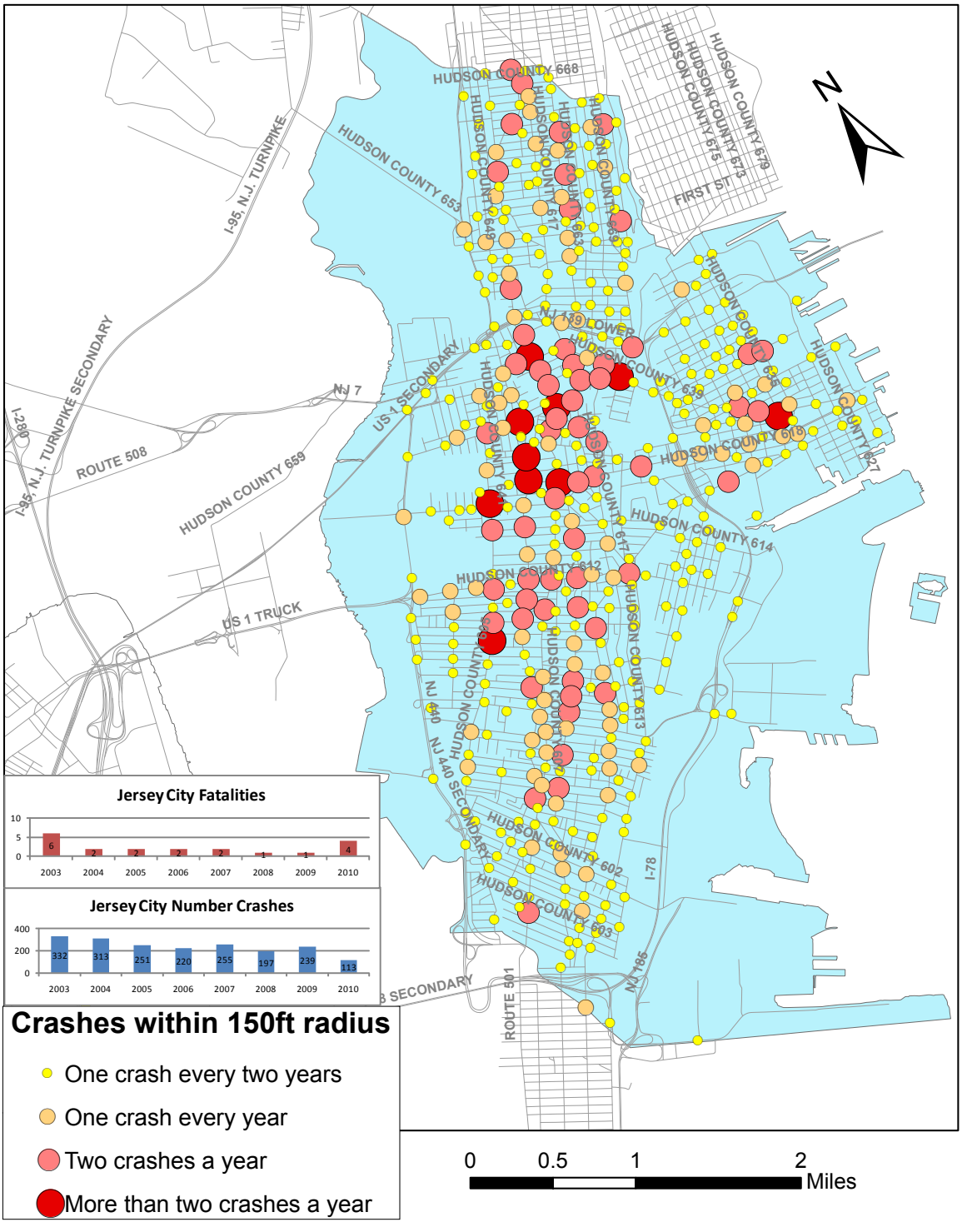
Pedestrian Vehicle crashes 2003 - 2010
Elizabeth



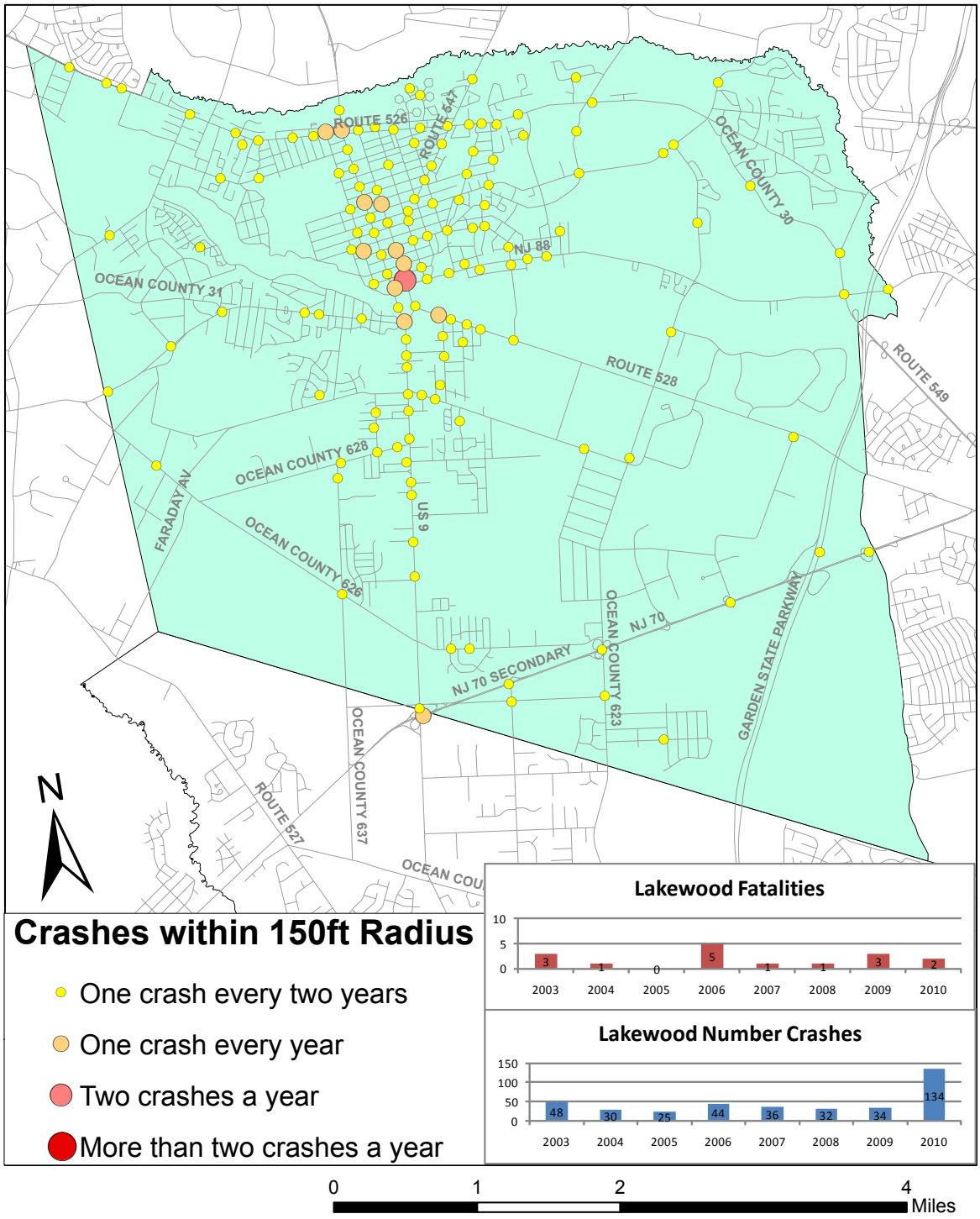
Pedestrian Vehicle crashes 2003 - 2010
Hamilton



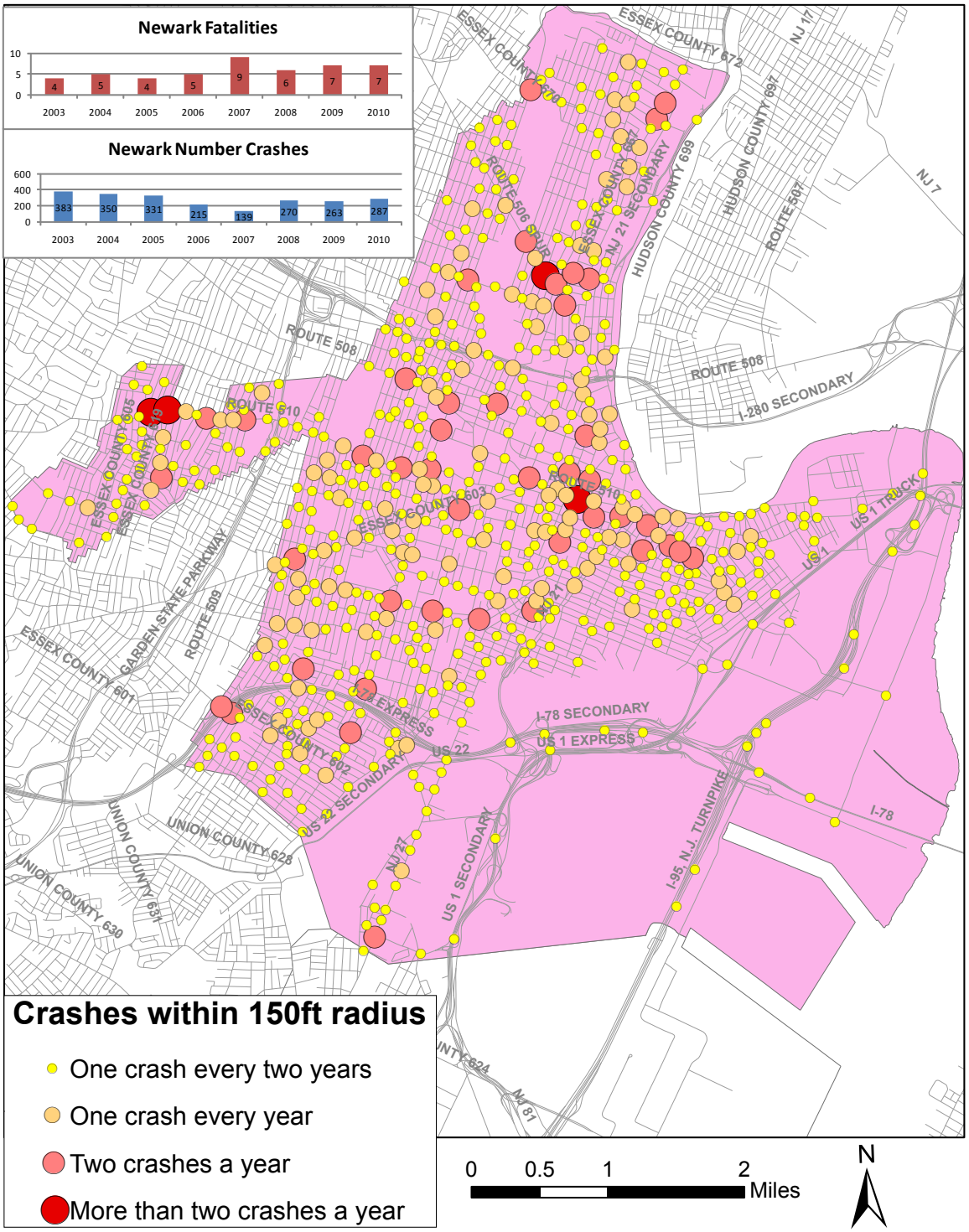
Pedestrian Vehicle crashes 2003 - 2010
Jersey City



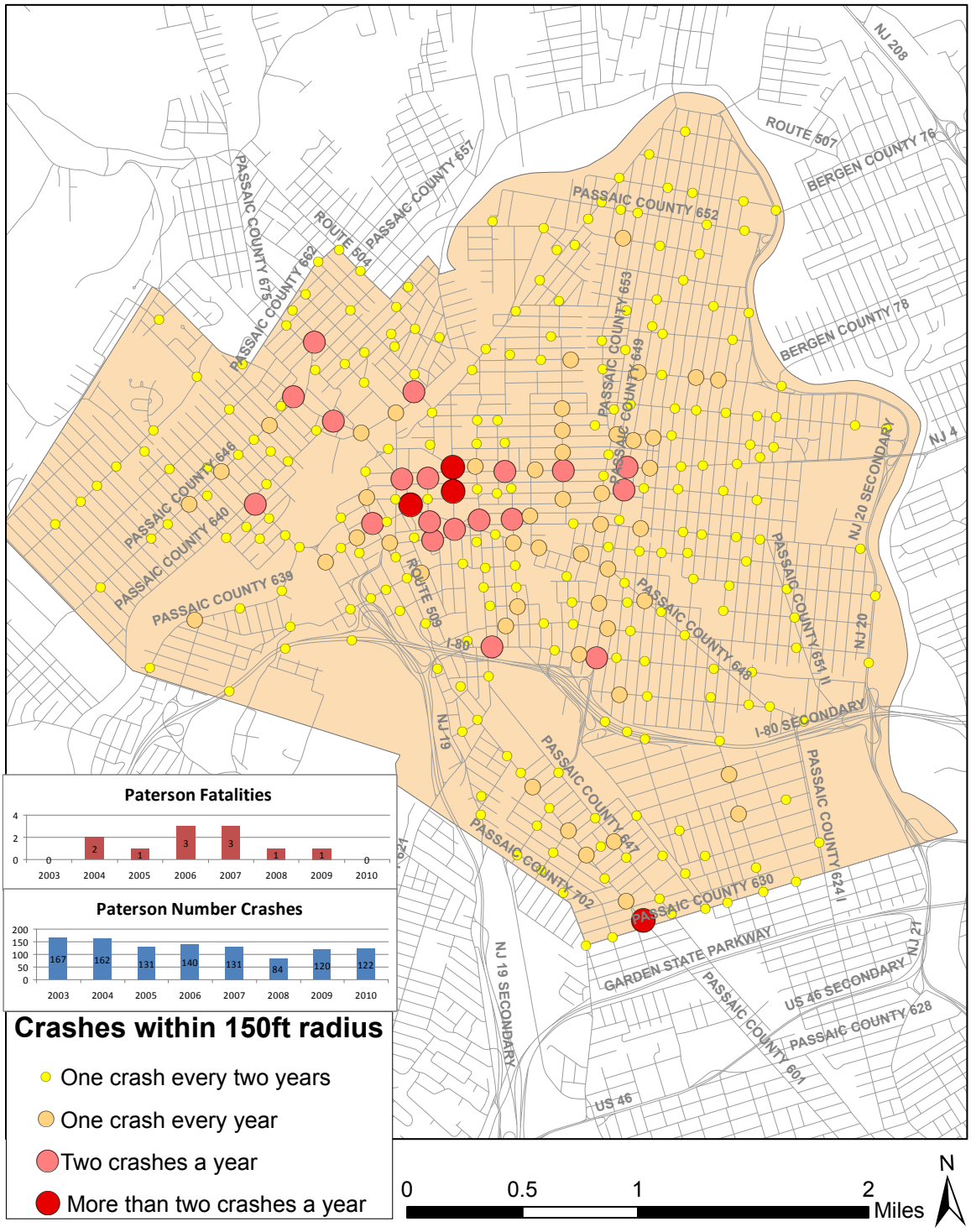
Pedestrian Vehicle crashes 2003 - 2010
Lakewood



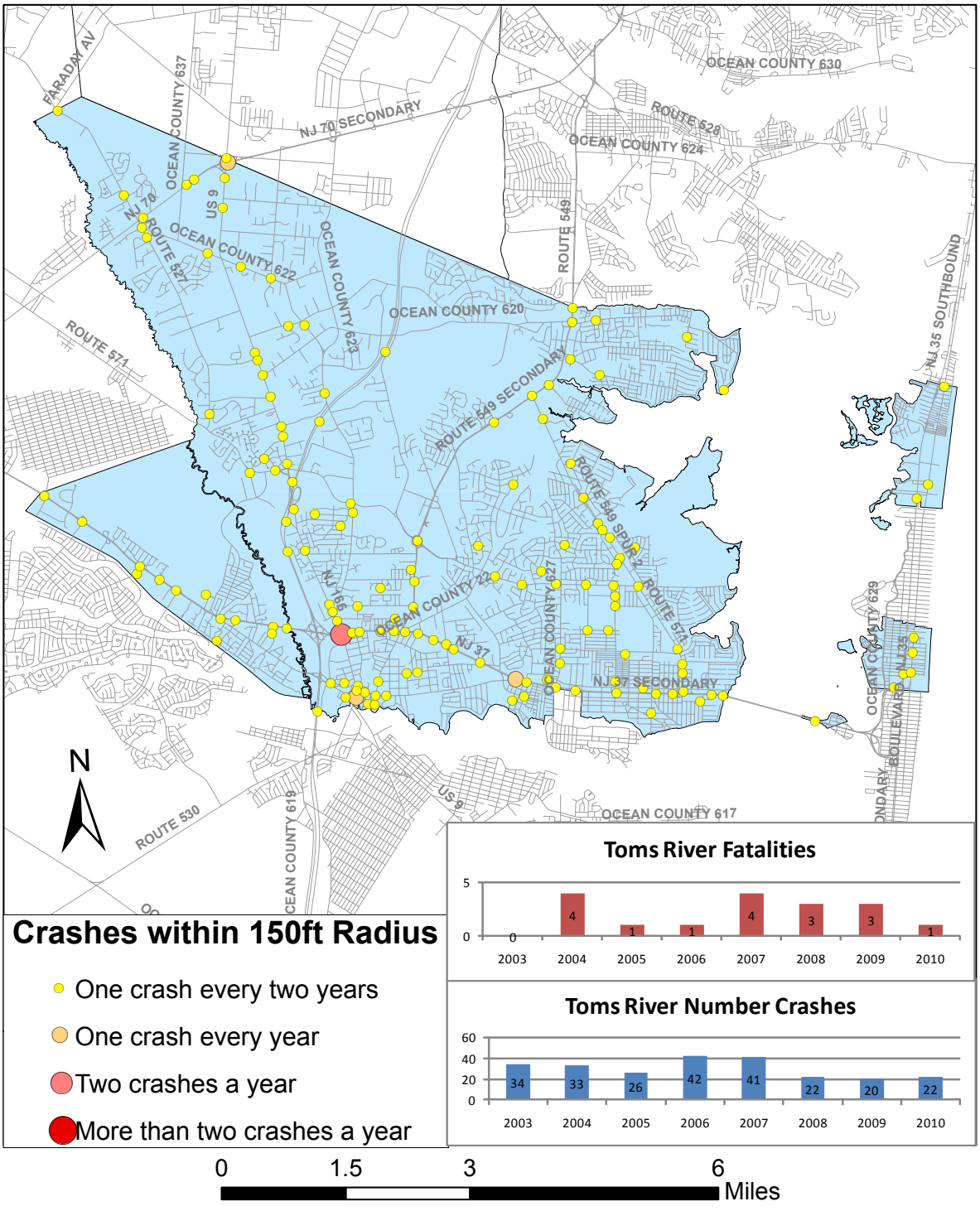
Pedestrian Vehicle crashes 2003 - 2010
Newark



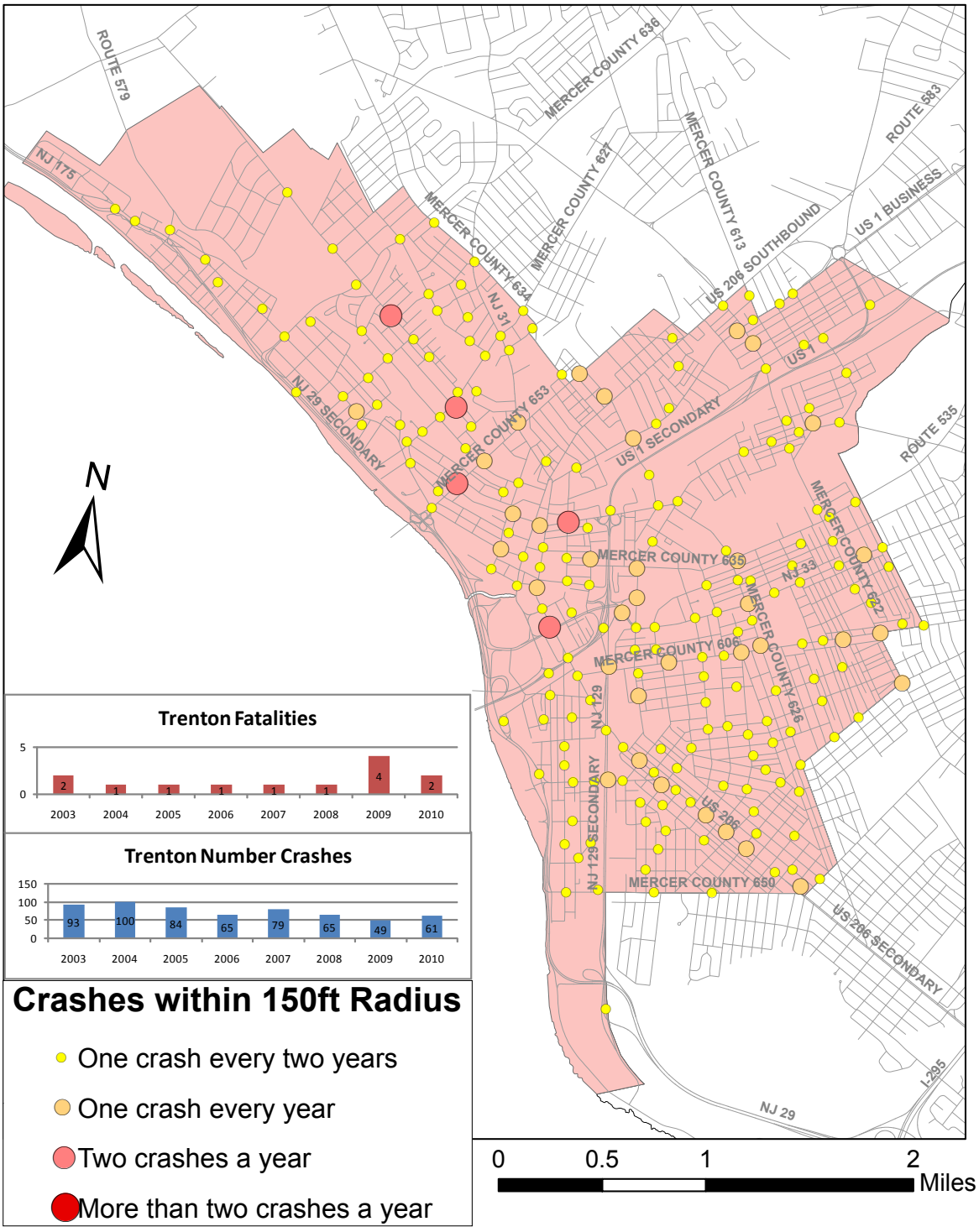
Pedestrian Vehicle crashes 2003 - 2010
Paterson



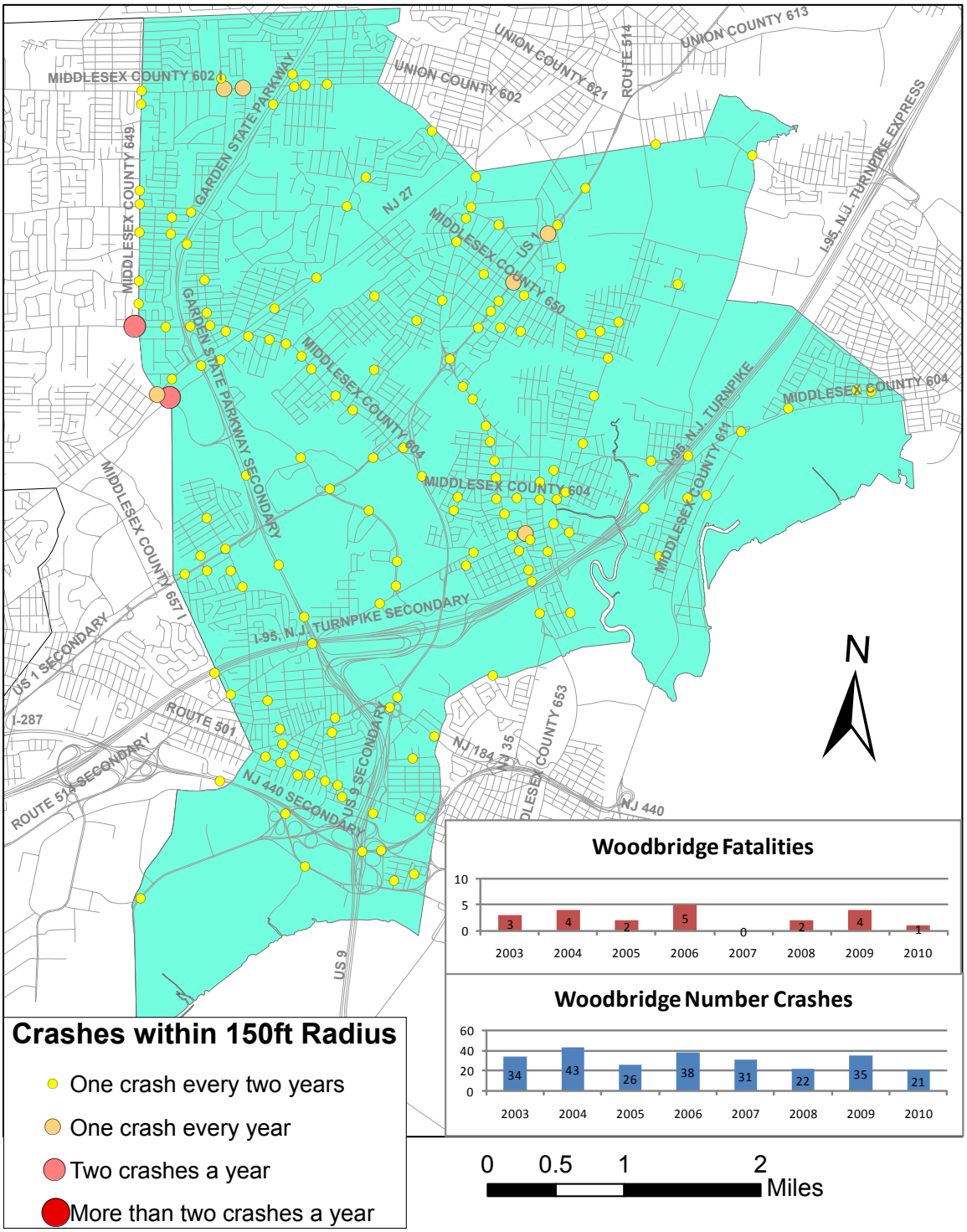
Pedestrian Vehicle crashes 2003 - 2010
Toms River



Pedestrian Vehicle crashes 2003 - 2010
Trenton



Pedestrian Vehicle crashes 2003 - 2010
Woodbridge



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