2017 CITY OF MINNEAPOLIS

PEDESTRIAN CRASH STUDY

COMPLETED FOR:

Minneapolis
City of Lakes

COMPLETED BY:

Kimley»Horn

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EXECUTIVE SUMMARY

The Minneapolis Pedestrian Crash Study assessed trends, contributing factors, and characteristics of pedestrian crashes in the City of Minneapolis over the past 10 years to better understand where, how, and why pedestrian crashes are occurring in Minneapolis. The statistics shown in this summary provide a glimpse of trends across the city. For complete crash analysis, see **Chapter 5** and **Appendix B.**

Minneapolis is a Good City for Walking

- **MINNEAPOLIS IS UNIQUE.** The alarming national trends of increasing numbers of pedestrian crashes over the past several years does not hold true in Minneapolis.
- **THERE IS STRENGTH IN NUMBERS.** Over the decade, while pedestrian counts have risen, pedestrian crash numbers have held steady.
- **SLOWING DOWN YIELDS LESS SEVERE CRASHES.** Pedestrian crashes are less likely to be severe on lower-speed streets. While the vast majority of pedestrian crashes occur on streets with a 30 MPH speed limit, **pedestrian crashes increase in severity when they occur along higher speed streets.**

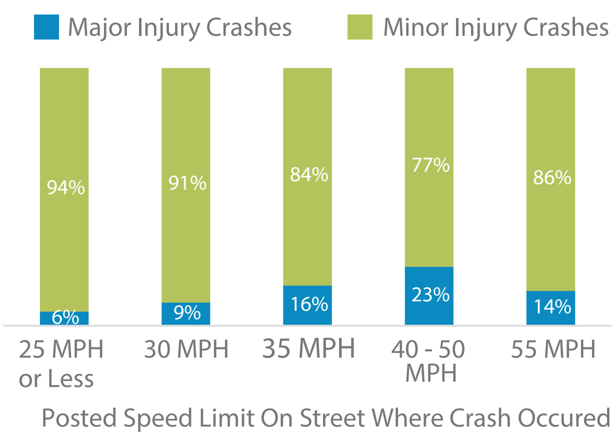


Figure ES-1. Pedestrian Crash Severity by Posted Speed Limit

Source for Pedestrian Crash Data: 10-Year Dataset

- **FEWER LANES ARE BETTER FOR PEDESTRIANS.** Streets with fewer lanes have fewer pedestiran crashes per mile.
- **CRASHES ARE CONCENTRATED TO A SMALL NUMBER OF STREETS.** Eighty percent of all pedestrian crashes occurred on 10 percent of the streets in the city, and seventy-five percent of fatal and serious injury pedestrian crashes occurred on 5 percent of streets in the city. Focusing improvements on these streets will yield the greatest benefits in pedestrian safety.

Minneapolis Pedestrian Crash Trends

While the rate of major pedestrian crashes is lower in Minneapolis than other cities and states (as described in **Appendix A**), these crashes are still occurring and are preventable.

- **THE MAJORITY OF PEDESTRIAN CRASHES HAPPEN AT INTERSECTIONS.** Over two-thirds of pedestrian crashes occur at traffic signals, and the most common location for a pedestrian crash is in a crosswalk area.
- **CRASHES ARE PREVENTABLE.** Vehicle drivers were found to be most at fault in 62 percent of pedestrian crashes and drivers are more likely than pedestrians to have at least one contributing factor in the crash. The most common contributing factor by a vehicle is failing to yield to the pedestrian right of way.

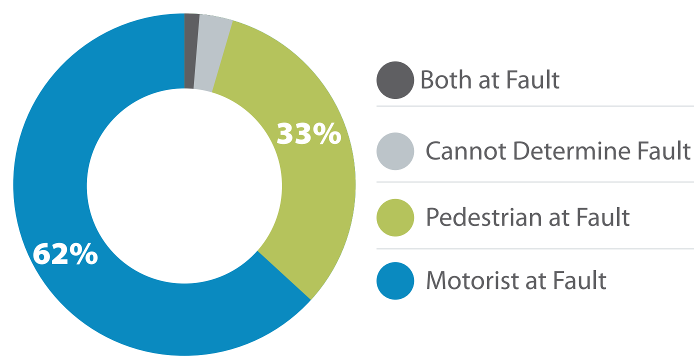
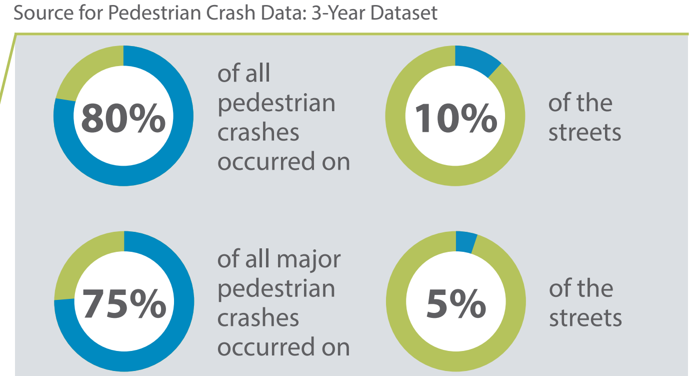


Figure ES-2. Pedestrian Crash Fault

Source for Pedestrian Crash Data: 3-Year Dataset



- **LEFT TURNING VEHICLES POSE A UNIQUE THREAT TO PEDESTRIANS.** Just under half of pedestrian crashes involved a turning vehicle, and nearly three-quarters of those crashes involve a left-turn parallel path movement.

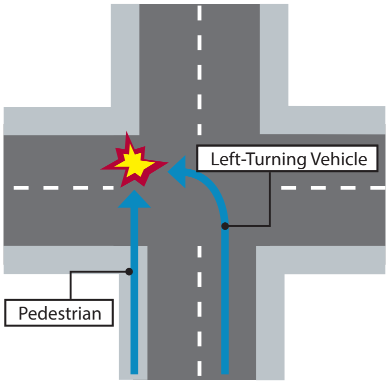


Figure ES-3. Left-Turn Pedestrian Crashes

A motorist left-turn parallel path crash occurs when the motorist and pedestrian are initially traveling on the same street in the same direction before the vehicle crosses the path of the pedestrian with a left turn.

- **SOME POPULATIONS ARE OVER-REPRESENTED IN PEDESTRIAN CRASHES.** Areas of the city with majority non-white populations and lower income experience more pedestrian crashes per capita than other areas of the city.

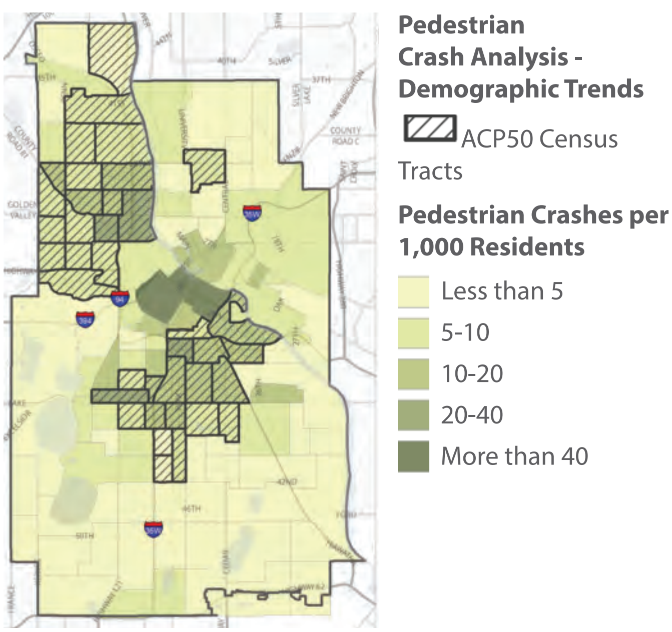


Figure ES-4. Crashes per Resident and ACP50 Census Tracts

Source for Pedestrian Crash Data: 10-Year Dataset

- **PEDESTRIAN AGE MAKES A DIFFERENCE IN CRASH SEVERITY.** Pedestrians over the age of 45 are over-represented in major crashes, and when fatal crashes are considered alone, pedestrians over the age of 65 are significantly over-represented.

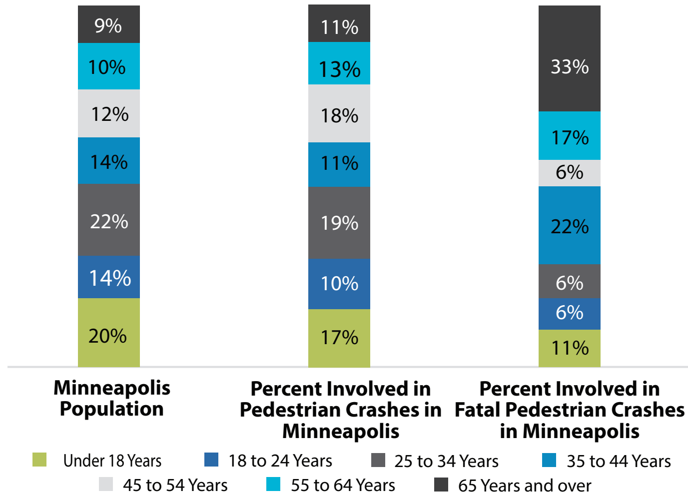


Figure ES-5. Pedestrian Crashes by Age

Safety Improvement Strategies

Efforts to improve pedestrian safety should involve all 6 E's - engineering, education, enforcement, encouragement, evaluation, and equity.

- **ENGINEERING** strategies such as improving crosswalk visibility, creating pedestrian refuge islands, minimizing corner radii, extending curbs at intersections, reducing speed limits, and adding protected left-turn lanes and/or phases can improve safety.
- **EDUCATION** campaigns should be tailored to underrepresented populations, and at-risk age groups, eliminating distracted driving, highlighting safe travel practices near transit.
- **ENFORCEMENT** at priority intersections, especially during peak crash periods, could bring awareness of safety issues.
- **ENCOURAGEMENT** through supporting neighborhood events, enhancing pedestrian realms, and implementing pedestrian-friendly land use policies to reinforce safety in numbers.
- **EVALUATION** should occur both before and after implementation of any of these safety measures to determine their effectiveness.
- **EQUITY** should remain a priority in project selection and implementation.

1. INTRODUCTION

The City of Minneapolis has demonstrated a commitment to safe and comfortable travel throughout the city for all users. Several policies, plans, and studies highlight this commitment for pedestrians in particular:

- The **Complete Streets Policy** passed in 2016 prioritizes public right-of-way use for walking above biking, transit, and motor vehicles.
- The **Pedestrian Master Plan** of 2009 (a part of Access Minneapolis) sets several goals and objectives to improve pedestrian safety and reduce pedestrian crashes.
- The **Minneapolis Public Works Safe Routes** program initiated in 2006 prioritizes pedestrian safety enhancements around schools and encourages walking through formalized route identification like **Walking Routes for Youth**.
- The additional funding available through the 2016 **Neighborhood Parks and Streets Ordinance** and the project weighting of the **20 Year Streets Funding Plan** were reflective of the Complete Streets modal priority and included pedestrians as a unique consideration.

The Minneapolis Pedestrian Crash Study assesses trends, contributing factors, and characteristics of pedestrian crashes in the City of Minneapolis over the past 10 years.

> *"Walking is an essential mode of transportation for everyone in Minneapolis, and it contributes to the success of public transit, vibrant business districts, healthy citizens, and safe neighborhoods."*
>
> **- City of Minneapolis Pedestrian Master Plan (2009)**

Purpose

Recognizing that pedestrians are the most vulnerable users, and that all trips begin and end as a pedestrian, improving pedestrian safety must be the highest priority because they are the most at risk users.

Crashes for all modes in Minnesota (which are dominated by vehicle-vehicle crashes and pedestrian crashes statewide) have been on the rise since 2012. However, pedestrian crashes in the City of Minneapolis have remained relatively constant over the study period. This study was initiated to better understand where, how, and why these pedestrian crashes are occurring in Minneapolis.

This data-driven approach will be valuable in future planning and programming of projects to improve pedestrian safety. The results of this analysis are intended to be used in both reactive and proactive ways – to reduce crashes that are happening and identify areas where crashes could happen in the future.

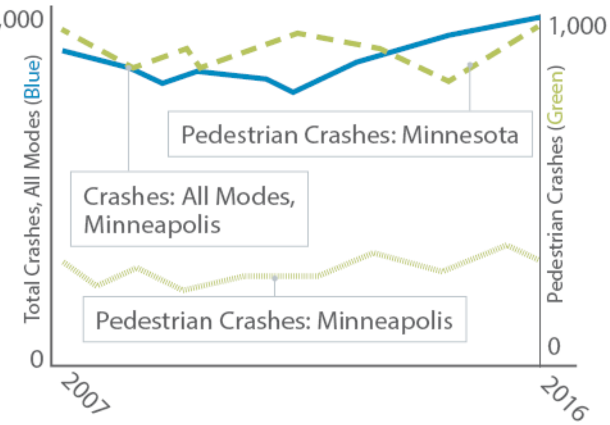


Figure 1-1. Crashes Over Time

While crashes involving all modes and pedestrian crashes statewide have increased, pedestrian crashes in Minneapolis have remained constant over the decade.

Sources:
Source for Crashes, All Modes, Minnesota: MnCMAT
Source for Pedestrian Crash Data in Minneapolis: 10-Year Dataset
Source for Pedestrian Crash Data in Minnesota: Minnesota Motor Vehicle Crash Facts (2015)

Using This Report

This study is an informational document that looks at pedestrian crash trends city-wide. The information is intended to be used to identify locations for future studies and develop strategies for capital improvement programs.

There is a growing trend across the United States to focus on systemic safety improvements to improve safety at locations that may not have had a crash yet. The results of this analysis can be used by Minneapolis departments and committees, as well as other agencies with infrastructure in Minneapolis, to implement design, policy, and other countermeasures to reduce pedestrian crashes.

Report Structure

This report begins with an overview of national trends in pedestrians crashes in Chapter 2. Chapter 3 discusses crash and other data available in Minneapolis. Chapter 4 discusses the approach and methodology used for the pedestrian crash analysis. Chapter 5 presents the results of the analysis. These results include details on when crashes are occurring and how those crashes correlate with street characteristics, intersections, demographics, and other factors.

Additional information can be found in **Appendices A, B, C, and D** of this report, including an in-depth national review on crashes (**Appendix A**), supplemental crash data and findings (**Appendix B**), and detailed intersection information (**Appendix C**).

2. PEDESTRIAN SAFETY IN CONTEXT

Before examining pedestrian crashes in Minneapolis, several pedestrian crash studies in other cities and several nationwide studies were reviewed. Key findings of these studies are provided here for background and context for the Minneapolis pedestrian crash analysis. More detailed descriptions of these studies are provided in **Appendix A**.

Pedestrian crashes in Minneapolis have been considered in the context of several national studies, including Dangerous by Design 2016, authored by Smart Growth America and the National Complete Streets Coalition.

Fatality Trends

National Fatality Trends Over Time

The national steady downward trend of fatalities for all modes through the 1990s and early 2000s has reversed. Mirroring the recent upward trend in motorized fatalities, pedestrian and bicycle fatalities have gone up every year since 2009.

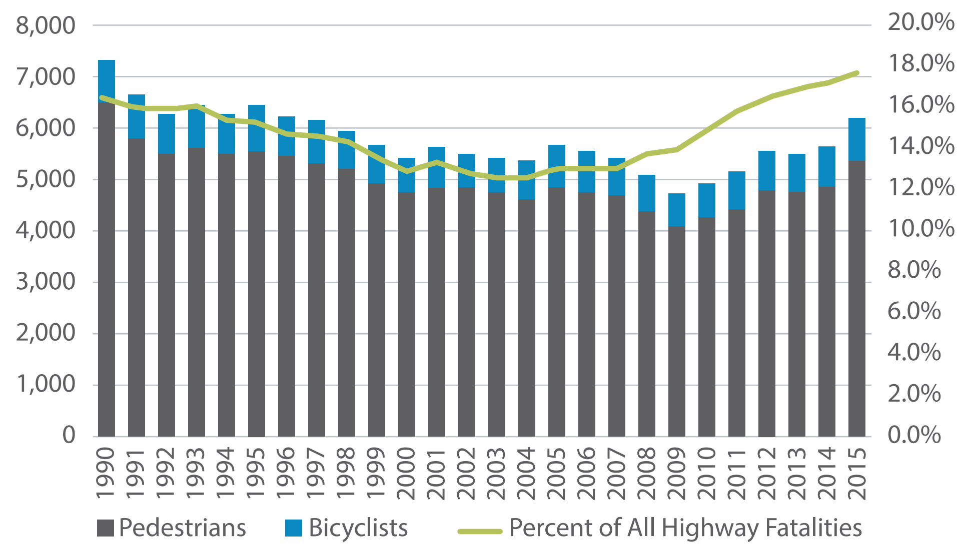


Figure 2-1. U.S. Pedestrian and Bicycle Fatalities, 1990-2015

Source: Strategic Agenda for Pedestrian and Bicycle Transportation (FHWA) using NHTSA data.

A study from the Governors Highway Safety Commission corroborates these findings. Its study found that nationally pedestrian fatalities increased by 25 percent from 2010 to 2015 and account for a steadily increasing percentage of total traffic fatalities. It estimates that fatalities in 2016 increased 11 percent over 2015.

Compared to other states, Minnesota's pedestrian, vehicle, and bicycle fatality rates are low. The Governors Highway Safety Commission report found that at 0.75 pedestrian fatalities per 100,000 population in 2015, Minnesota had the fourth lowest fatality rate in the country. However, pedestrian fatalities in Minnesota in the first six months of 2016 increased 64 percent compared to the first six months of 2015, from 14 to 23 deaths.

Although the statewide pedestrian fatality rate is low, that percent is on the rise in Minneapolis specifically. Since 2013, the percent of all traffic fatalities that involve pedestrians have been on the rise **(Figure 2-2).**

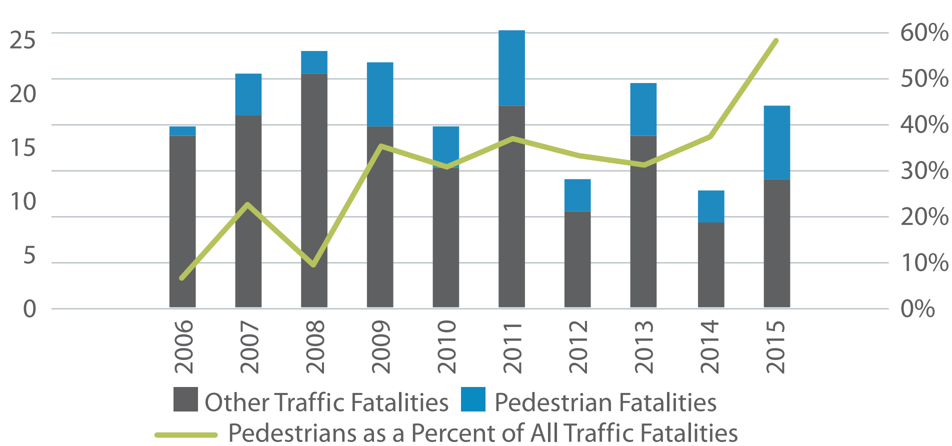


Figure 2-2. Traffic Fatalities in Minneapolis

Source: MnCMAT. These fatality numbers include crashes on freeways in the City of Minneapolis. The dataset presented in Chapter 4 and 5 excluded pedestrian crashes on freeways from the analysis.

National Demographic Trends in Fatal Pedestrian Crashes

Several studies indicated that pedestrian fatalities are not distributed equally among population groups. In particular, seniors, people of color, and low-income populations are disproportionately represented among pedestrian fatalities as compared to their portion of the population. One specific example of this uneven representation by age comes from a 2016 New York City study that found that seniors have a disproportionately higher risk of being killed by a left-turning vehicles than other age groups. While victims of all other fatal crash types have a median age of 50, left-turning vehicle crash victims have a median age of 67.

Race and ethnicity are also factors in pedestrian crashes. A Smart Growth of America study found that while only one-third of of the United States population identified as non-white or Hispanic, these groups accounted for almost half of all pedestrian deaths between 2005 and 2014.

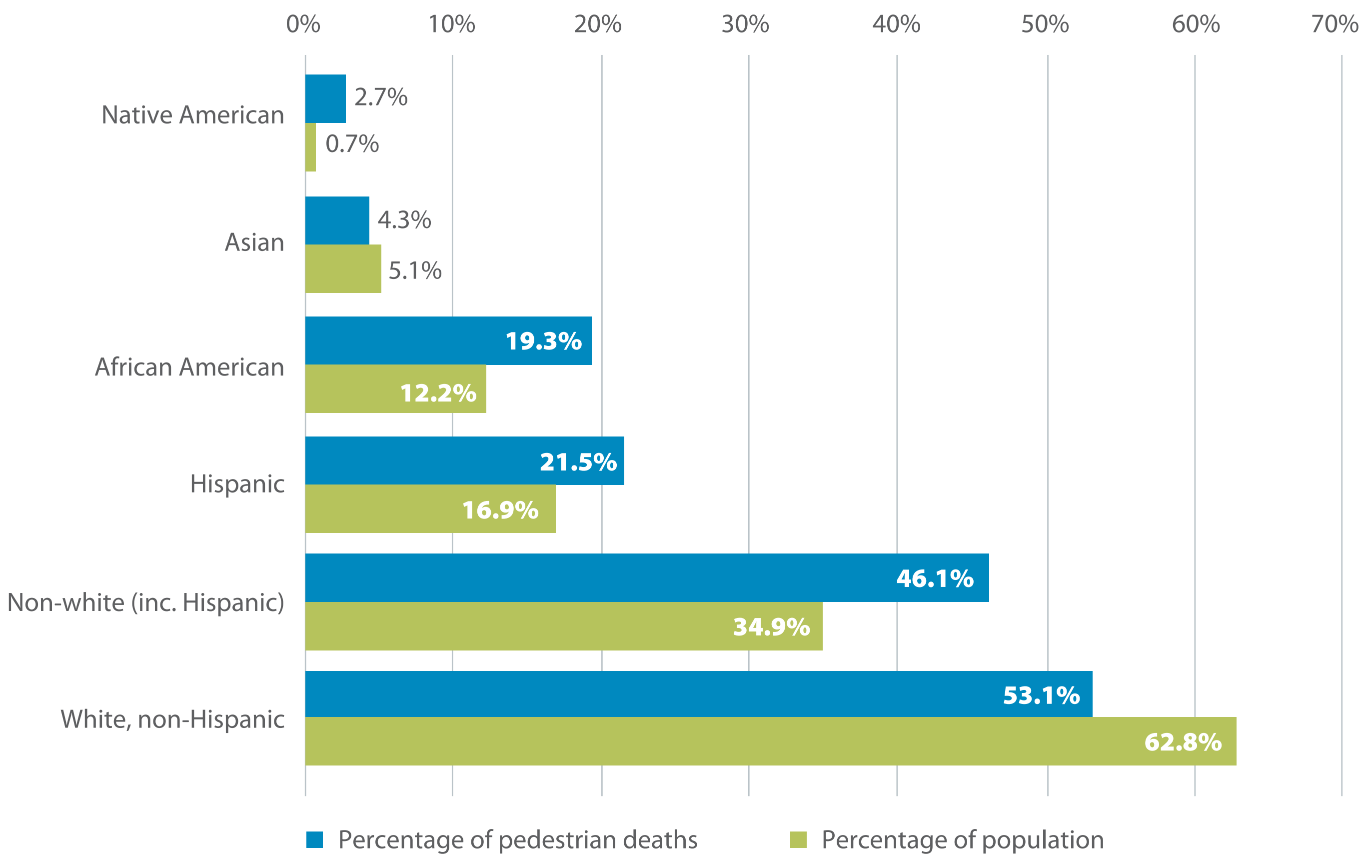


Figure 2-3. Pedestrian Deaths by Race/Ethnicity Relative to U.S. Population, 2005-2014
Nationally, minority groups are overrepresented in pedestrian deaths.
Source: Smart Growth America

Crash Locations

In urban settings, pedestrian crashes occur most frequently at intersections. In rural or suburban settings, pedestrian crashes tend to occur at non-intersection locations. Pedestrian crashes happen most often on arterial streets and on streets with more vehicular travel lanes.

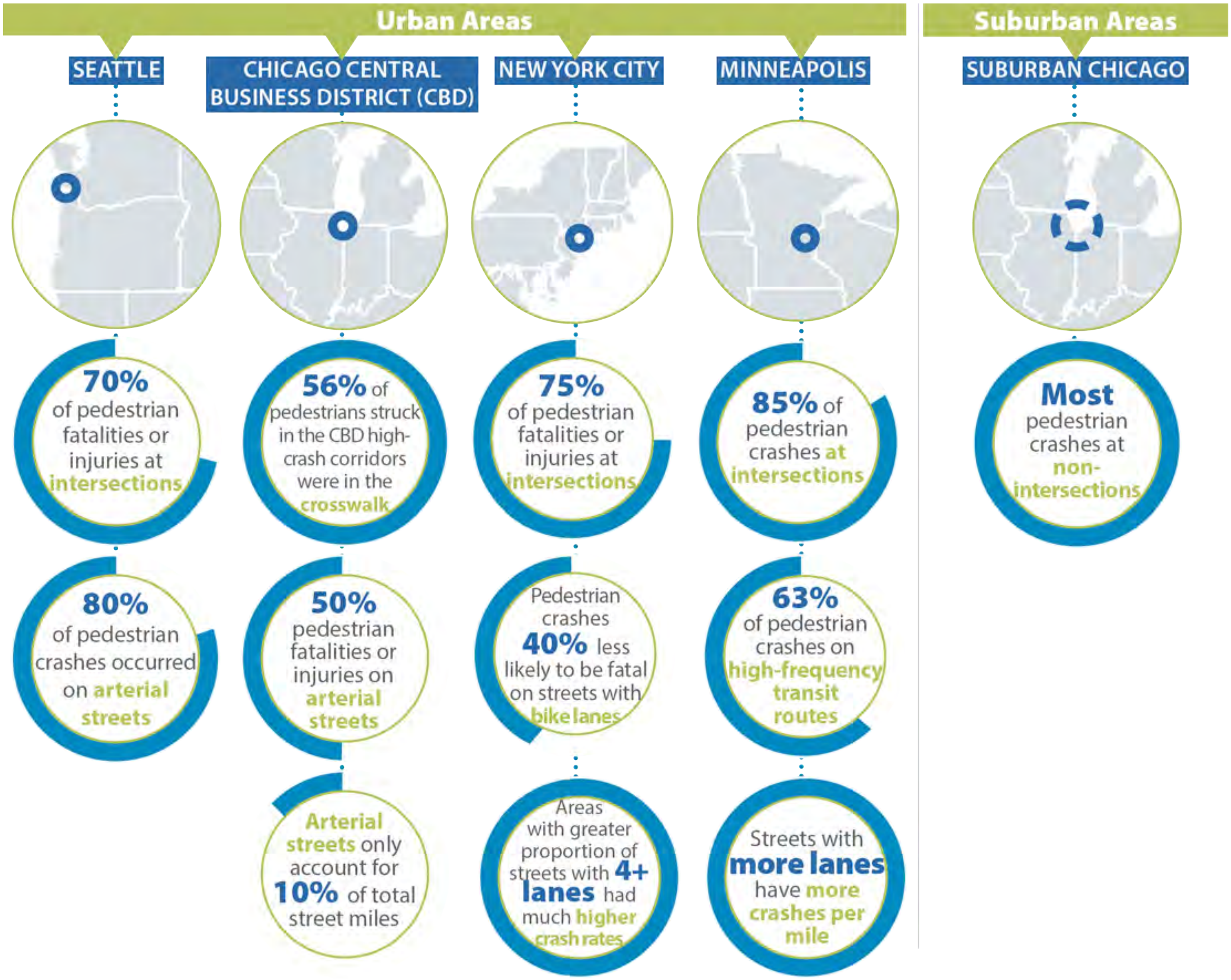


Figure 2-4. National Trends in Crash Locations

Sources: New York statistics on this page are from the New York City Pedestrian Safety Study & Action Plan (2010), Seattle statistics on this page are from the City of Seattle Bicycle and Pedestrian Safety Analysis (2016), and Chicago statistics on this page are from the City of Chicago Pedestrian Crash Analysis Summary Report (2011). Minneapolis statistics on this page were compiled as a part of this Pedestrian Crash Study.

Common Features

Driver Inattention and Failure to Yield

Multiple cities and studies found that inattention and driver failing to yield are the most common contributing factors in pedestrian crashes.

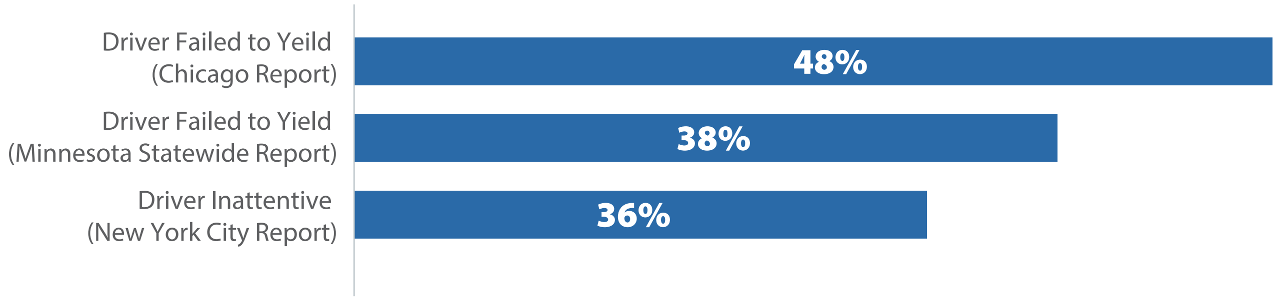


Figure 2-5. Driver Inattention and Failure to Yield

Additionally, a 2017 report from the Governors Highway Safety Association suggests that the growing use of smartphones by all road users could be a significant source of distraction.

Turning Vehicles

Several studies found that turning vehicles are most commonly involved in pedestrian crashes and that left-turning vehicles are more often involved than right-turning vehicles.

Turning-vehicle related crashes are a much smaller percentage of all pedestrian crashes in statewide Minnesota than in urban studies. The different street network characteristics of these geographies (with low intersection density in statewide Minnesota and higher intersection density in Chicago and Seattle) likely contribute to this difference in turning-related crashes. However, all three studies show that left-turning vehicles are involved in crashes more than right-turning vehicles.

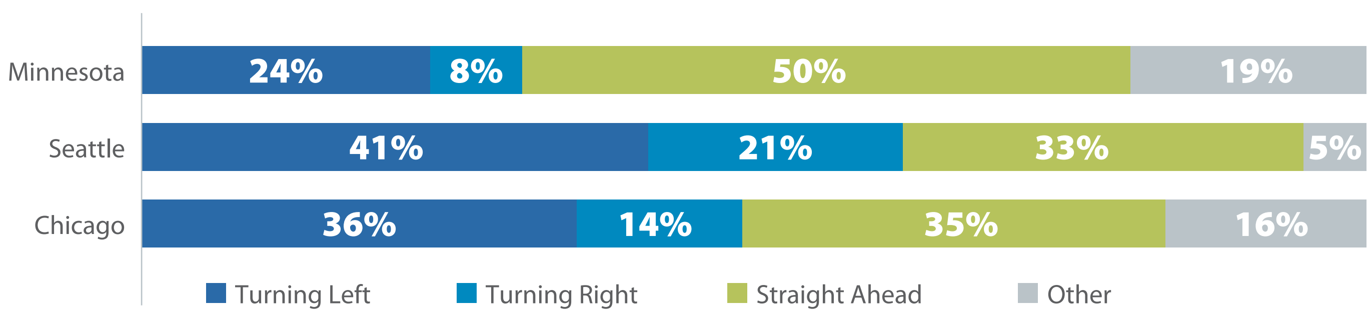


Figure 2-6. Vehicle Movements Prior to Crash

Source: Adapted from Minnesota Motor Vehicle Crash Facts (2015), the City of Chicago Pedestrian Crash Analysis Summary Report (2011), and the City of Seattle Pedestrian Safety Analysis (2016)

A 2016 New York City study found that over two-thirds of all intersections (70 percent) where a left-turn pedestrian or bicyclist injury crash occurred involved a one-way street. These crashes were most likely to happen at intersections where:

- The approach street is a minor street.
- The receiving street is 60' or wider.
- The vehicle is turning onto a two-way street.
- The vehicle is turning from a one-way onto a one-way.

The same study showed that all left-turn pedestrian and bicycle injury and fatal crashes occurred at about 18 percent of New York City's intersections. Left-turn restrictions and left-turn phasing had the greatest benefits in reducing pedestrian and bicycle injuries resulting from left-turn crashes.

3. UNDERSTANDING THE CRASH DATA

Where the Data Comes From

This study used pedestrian crash data supplied by City of Minneapolis Public Works, which consists of reported crashes from the Minneapolis Police Department. Data was also provided by University of Minnesota Police Department and Metro Transit. To create a complete dataset of all pedestrian crashes that occurred in Minneapolis, additional data was sourced from the Minnesota Department of Transportation (MnDOT) via the Crash Mapping and Analysis Tool (CMAT). This data was needed to capture crashes that were reported by Minnesota State Patrol, Hennepin County sheriff, or other law enforcement agencies not noted above.

This process of acquiring and compiling crash data is challenging. The Minneapolis Traffic and Parking Services Division receives reports from the Minneapolis Police Department (MPD) but does not have direct access to the crash reporting system. Some MPD reports are not transmitted to the Minneapolis Traffic and Parking Services Division due to ongoing investigations or other reporting delays. In addition, the Minneapolis Traffic and Parking Services Division does not have any access to crash reports filed by other agencies such as the Minnesota State Patrol or Metro Transit Police.

While acquiring all the pedestrian crash reports and data from every reporting agency is a large effort, it is a vital task to produce a complete picture of crashes occurring in Minneapolis. **The more comprehensive the dataset, the more robust and accurate the analysis will be.**

However, a crash is not simply a line item in a database. It is the representation of complex and unique events which are experienced differently by all parties involved, including the victims, witnesses, responding police officers, and staff who input the data. Emotions, adrenaline, and personal perceptions are only some of the intangibles that are directly tied to this data. The results of this analysis must be interpreted with these limitations in mind.

When a crash occurs, there is a process by which the numerous details and factors of the event are documented, organized, and recorded.

- According to Minnesota statute 169.09, an individual involved in a traffic crash that immediately results in property damage or bodily injury is required to remain at the scene of the crash until contact information is exchanged with all parties involved. The involved parties then have up to 72 hours to notify the police.
- If the police are notified at the time of the crash, a police officer joins the involved parties at the scene of the crash, gathers all necessary details of the crash and completes a Minnesota Department of Public Safety (DPS) motor vehicle crash report. Attributes such as location, time, personal information, weather, and road surface conditions are recorded using a standardized coding system. A crash narrative and diagram are also included in the report.
- The Minneapolis Police Department sends copies of their DPS crash reports to Minneapolis Traffic and Parking Services Division (Public Works). The Traffic Division enters the crash data into an internal database tool, which is then used to monitor safety trends, identify locations for further study or improvements, and inform the design of capital improvement projects.
- The Minnesota DPS is the centralized reporting agency for all crashes that occur in Minnesota. Law enforcement officers are required to submit reports on crashes they investigate within 10 days. DPS also collects citizen crash reports. The crash data from all law enforcement agencies and citizens are then aggregated and imported into the MnCMAT system, which is maintained by the Minnesota Department of Transportation. MnCMAT makes the crash data available to engineers and planners for study and analysis.

Limitations of the Data

The process and procedure of reporting and documenting crashes described above provides the best available source of crash data and information. However, the process has its limitations which arise from conflicting witness accounts, crash victim mental state or motive, innate challenges of reducing complex events to limited codes, and the crash interpretation by law enforcement and engineering staff. However, despite these limitations, the crash reports remain a valuable source of information on crash patterns and locations of crashes occurring over the last 10 years.

Some of the crash attributes that may be subject to the most inconsistency include:

- **Pedestrian position within intersection prior to the crash** – This data is largely dependent on the reporting officer's depiction of how far the pedestrian was from the curb, and some police reports are more robust than others in their description. While most reports give a comprehensive report of crash location, the data is subject to a certain amount of missing location information due to incomplete police reports.
- **Driveway, alley, and mid-block crashes** – Crashes occurring at driveway entrances, alleys or mid-block locations are included in the 10-Year dataset, however the location information is known only as an estimate of distance from the center of the nearest intersection and may not reflect the precise location of the crash.
- **Contributing factors** – Factors that require the person at fault to admit wrong-doing are likely to go underreported. Distracted driving in particular is challenging to prove and report without evidence.
- **Traffic control status** – Because the exact signal phase or operational status of the traffic control device at the time of the crash is not directly observed by those compiling the reports, the report is only reflective of the status of the signal as reported by witnesses and those involved in the crash.

Unreported Crashes

In addition to data limitations of reported crashes, some number of vehicle crashes go unreported. Crashes involving pedestrians may have a higher rate of going unreported. The reasons for not reporting a crash may be that property damage or injury was marginal or that the parties involved were not aware that they are required to report the incident.

One method to understand the general magnitude of unreported pedestrian crashes injuries is to compare hospital records with reported crash numbers. **Figure 3-1** shows a trend of under-reported pedestrian crash injuries, which could have been either an unreported crash or a reported crash where the pedestrian didn't realize they were injured until later (after the report was filed).

In addition, by only considering hospital visits, the exact level of underreporting of injuries is still uncertain for two reasons:

- Not all pedestrian crashes with injuries warrant a visit to the hospital
- A crash victim treated at a hospital within Minneapolis may have been involved in a crash that occurred outside of the city (and vice versa).

Nevertheless, total pedestrian crash numbers presented and analyzed are likely lower than the true number that occurred.

Near misses, which can be tracked and analyzed at an intersection-level, are nearly impossible to capture city-wide. Therefore, these instances are also not included in the datasets of this study.

Figure 3-1. Pedestrian Crashes Per Year Compared to Hospital Visits in Minneapolis

Source for Police Report: 10-Year Dataset
Source for Hospital Report: Minnesota Injury Data Access System

4. METHODOLOGY

Approach and Methods to Analyzing Crash Data

Table 4-1 on the following page summarizes the approach and assumptions used in the Pedestrian Crash Study. While crashes are difficult to predict, this study compiled two distinct datasets to attempt to find trends related to crashes through the city. This study used a similar approach as the Minneapolis bicycle crash study[4-A] for consistency. The two datasets on the next page were used to generate the crash trends in **Chapter 5**. The 10-Year database provides a large dataset for analyzing location and crash type trends. The 3-Year database allows for more detailed analysis of the contributing factors and actions of drivers and pedestrians.

The 10-Year dataset and the 3-Year dataset were used to generate the crash trends presented in Chapter 5.

4-A *Understanding Bicyclist-Motorist Crashes in Minneapolis, City of Minneapolis Public Works Department Bicycle and Pedestrian Section, 2013.*

Table 4-1. Crash Dataset Summary

<table>
<tr><th>Dataset</th><th>10-Year Data</th><th>3-Year Data</th></tr>
<tr><td>Description</td><td>The existing Minneapolis crash database was supplemented with crashes from Metro Transit, University of Minnesota, and MnCMAT to create a comprehensive dataset of pedestrian crashes in the city over 10 years.</td><td>The original police reports for each pedestrian crash within the City of Minneapolis were reviewed, geolocated, and contributing factors coded in order to glean a higher level of detail related to the circumstances of pedestrian crashes.</td></tr>
<tr><td>Sample Size</td><td>3,016 pedestrian crashes, comprised of:
› 39 Fatal (K)
› 256 Incapacitating (A)
› 929 Non-Incapacitating (B)
› 1,562 Possible (C)
› 77 No Apparent Injury (N)
› 153 Unknown (U)</td><td>878 pedestrian crashes, comprised of:
› 13 Fatal (K)
› 88 Incapacitating (A)
› 290 Non-Incapacitating (B)
› 416 Possible (C)
› 65 No Apparent Injury (N)
› 6 Unknown (U)</td></tr>
<tr><td>Years of Crash Data</td><td>10 Years: 2007-2016</td><td>3 Years: 2014-2016</td></tr>
<tr><td>Reasons for Use</td><td>› Large sample size from which to analyze spatial relationships on a city-wide scale and trends over time
› Before/after analysis</td><td>› Higher level of confidence in accuracy of pedestrian location and actions
› Better determines fault and contributing factors in crashes
› Includes some demographic information</td></tr>
<tr><td>Limitations</td><td>› Multiple sources inherently produce inconsistency in coding of data
› Pedestrian location is aggregated to within or outside an intersection based on distance from the center of the intersection; cannot be used for fine-grained location analysis at intersections</td><td>› Smaller sample size
› All relevant data may not be provided in the police report</td></tr>
<tr><td>Source Specifics</td><td>Several agencies provided line items for the 10-Year database:
› City of Minneapolis: 2007 - 2016.
› Metro Transit: 2007 - 2016. Only light rail crashes were obtained from Metro Transit. Other pedestrian crashes with transit vehicles are captured in the City of Minneapolis dataset or the MnCMAT dataset.
› University of Minnesota: 2007 - 2016.
› MnCMAT: 2007 - 2015. Crashes from 2016 were unavailable from this source at the time of study.</td><td>Police Reports were compiled from several agencies to generate the 3-Year database:
› City of Minneapolis Police Department: 2014 -2016.
› Metro Transit Police: 2014 - 2016. Only light rail crashes were obtained from Metro Transit. Other pedestrian crashes with with transit vehicles are captured in the City of Minneapolis reports or the Department of Public Safety reports.
› University of Minnesota Police Department: 2014 - 2016.
› Minnesota Department of Public Safety: 2014 - 2016.</td></tr>
</table>

Crash Exclusions

Some crash instances are excluded from this study either because they are outside the public or city right-of-way or because they are not related to public infrastructure or policy:

- Crashes occurring on private property (this accounted for less than one percent of the reports reviewed)
- Crashes occurring in a parking lot (this accounted for two percent of the reports reviewed)
- Crashes on freeways or other right-of-way where pedestrians are prohibited (this accounted for less than two percent of the reports reviewed)
- Homicides or intentional injury crashes (this accounted for five percent of the reports reviewed)

Combined, these types of crashes represented 10 percent of the reports reviewed.

Accuracy of City-Wide Datasets

The types of crash trends and factors analyzed were selected based on findings from other national studies and from Minneapolis needs and priorities. The types of analyses that could be conducted were also limited by what data was readily available and how often the data is updated.

As such, unless otherwise noted, this study assumed that the most current data available is applicable for the entire study period, which may cause an over-representation of features that were updated or changed within the study period. Thus, a pedestrian crash that occurred at an intersection that has a feature today many not have had the feature when the crash occurred.

Volume Data

This analysis looked at one or two factors at a time and - outside of entering automobile volumes at intersections - did not account for volumes of pedestrians, bicyclists, or motorists city-wide. While pedestrian counts are taken every year by the City of Minneapolis, they are not taken on every street nor are they taken on the same streets every year. Thus, although crash rates are typically used in crash studies to identify locations where high numbers of crashes occur relative to total users, this study was unable to use pedestrian exposure as a criterion due to the lack of consistent and comprehensive pedestrian volume data city-wide.

Data for Comparisons and Trends

Figure 4-1 shows the wide variety of street, infrastructure, and other data sources that were part of the pedestrian crash analysis.

Figure 4-1. Data for Comparisons and Trends

5. FINDINGS IN MINNEAPOLIS PEDESTRIAN CRASHES

When do crashes occur?

Crashes for all modes of transportation in Minneapolis peak in the winter, while pedestrian crashes peak in October. The rise in pedestrian crashes may be related to sustained higher pedestrian levels, similar to those in summer, while the hours of daylight are comparatively much less. In addition, during fall months the evening commute (the time of day with the most pedestrian crashes) occurs during sunset and dusk when visibility can be limited. There were 35 crashers in October on average. The month in the 10-year period with the most crashes was October 2009 with 44 crashes.

A 10-Year dataset and a 3-Year dataset are sourced for pedestrian crash data in this chapter. These datasets are a compilation of pedestrian crashes throughout Minneapolis. A full description of the inputs and methodology used to compile these datasets is available in **Chapter 4.**

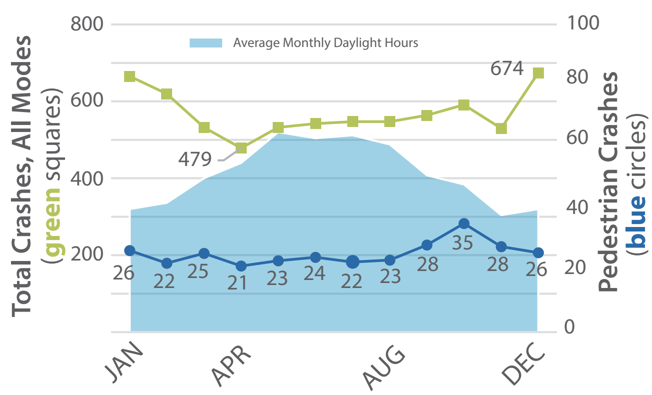


Figure 5-1. Average Crashes per Year by Month

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Total Crashes (All Modes, All Severities): MnCMAT

Crashes for all modes and for pedestrians peak on Fridays. Pedestrian crashes hover around five percent of the total crashes in the city. This percent remains consistent across every day of the week.

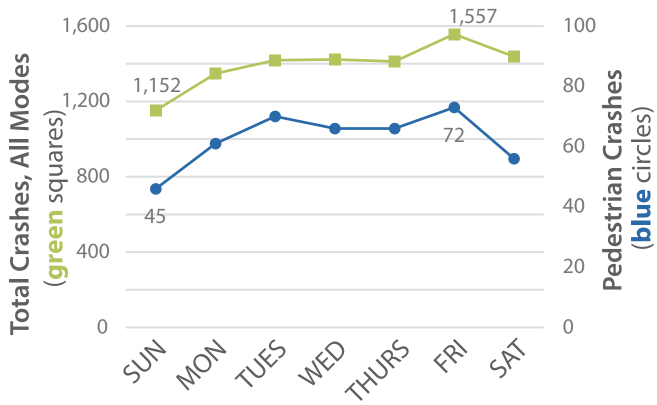


Figure 5-2. Average Crashes per Year by Day of Week
Source for Pedestrian Crash Data : 10-Year Dataset
Source for Crashes (All Modes): MnCMAT

During the week, crashes for all modes of transportation and for pedestrians peak during the evening commute (3PM-6PM). However, pedestrian *weekend* crashes peak later in the evening and overnight.

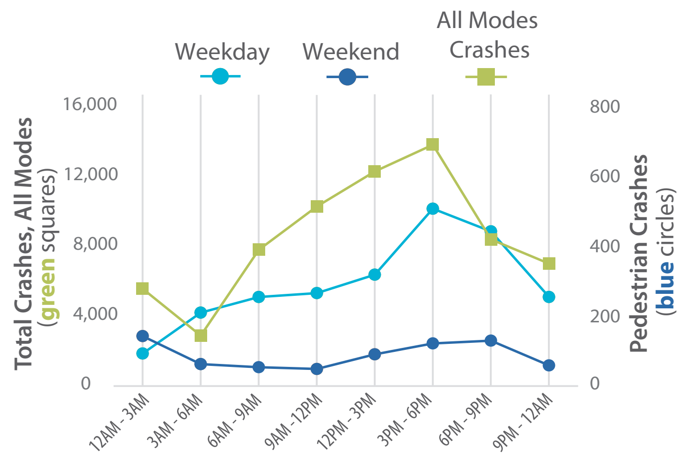


Figure 5-3. Average Crashes per Year by Time of Day
Source for Pedestrian Crash Data : 10-Year Dataset
Source for Crashes (All Modes): MnCMAT

How Severe are the Crashes?

This study grouped fatal crashes (Type K) and incapacitating crashes (Type A) together because these two types of crashes both represent a life-altering crash. This is standard practice in statistical crash analysis because these types of crashes typically have similar characteristics and the factors that result in a fatality rather than a serious injury can be minor or random. For instance, if the pedestrian location had been different by a matter of feet, or if the automobile had been traveling one or two miles per hour more or less, the outcome of the crash may have been different. Additionally, the grouping also creates a larger sample size for analysis, which is more useful for identifying trends and patterns. Fatal and incapacitating crashes are grouped together and referred to as Major Crashes in this study.

Minor Crashes in this study are defined as non-incapacitating (Type B), possible injury (Type C), no injury (Type N/PDO), and unknown.

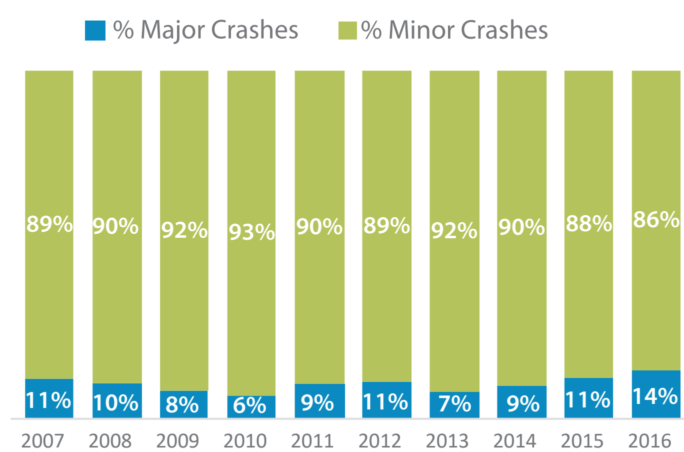


Figure 5-4. Percentage of Major Crashes
There are on average 4 fatal pedestrian crashes per year. Approximately 10 percent of the major crashes each year result in a fatality. See Table B-1 for additional details.
Source for Pedestrian Crash Data: 10-Year Dataset

Major Crash Intersections

Thirteen Minneapolis intersections had two or more major crashes in the 10 year study period. At three of these intersections, half of the crashes (or more) were major:

- Vineland Place & Lyndale Avenue
- 27th Street & Cedar Avenue
- 3rd Street N & 2nd Avenue South

Major crashes in this study are defined as fatal crashes (Type K) and incapacitating crashes (Type A) because these two types of crashes both represent a life-altering crash.

Figure 5-5. Crash Severity Trends
Percent of Crashes that are Major

- 25% or less
- 26-49%
- 50% or more
- Major Crashes
- High Injury Network

Source for Pedestrian Crash Data: 10-Year Dataset

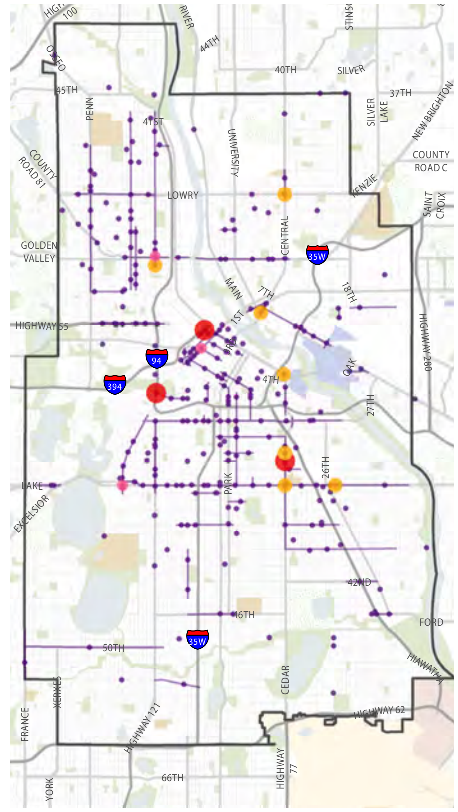


Table 5-1. Intersections with Two or More Major Crashes between 2007 and 2016

Intersection		Intersection Type	Total Pedestrian Crashes	Major Pedestrian Crashes	Percent Major Crashes
Lake St W	Hennepin Ave S	Arterial-Arterial	20	4	20%
27th St E	Cedar Ave S	Local-Arterial	6	3	50%
Lake St E	28th Ave S	Arterial-Arterial	8	3	38%
Lake St E	Cedar Ave S	Arterial-Arterial	9	3	33%
Lowry Ave NE	Central Ave NE	Arterial-Arterial	11	3	27%
6th St N	Hennepin Ave S	Arterial-Arterial	14	3	21%
Vineland Place W	Lyndale Ave S	Arterial-Arterial	3	2	67%
3rd St N	2nd Ave N	Arterial-Arterial	4	2	50%
18th Ave N	Lyndale Ave N	Local-Arterial	5	2	40%
26th St E	Cedar Ave S	Arterial-Arterial	5	2	40%
University Ave SE	Central Ave SE	Arterial-Arterial	6	2	33%
Washington Ave S	Cedar Ave S	Arterial-Arterial	7	2	29%
West Broadway Ave N	Lyndale Ave N	Arterial-Arterial	23	2	9%

Source for Pedestrian Crash Data: 10-Year Dataset

Street Characteristics

Crash Concentration

Although crashes have occurred throughout the city over the past 10 years, the majority of crashes are concentrated to a small number of streets. In fact, 80 percent of all pedestrian crashes occurred on 10 percent of the streets in the city. These 10 percent of streets, in this study called the "Pedestrian Crash Concentration Corridors" are highlighted in light purple in **Figure 5-6**. Because pedestrian crashes in Minneapolis are most common at intersections, there is no minimum or maximum length of corridor for selection. As such, the shorter corridors are largely due to one or two adjacent intersections with a history of crashes.

Major Crashes are also concentrated. Nearly three-quarters (74 percent) of all major crashes occurred on less than five percent of the streets in the city. These streets are shown in dark purple and labeled as the "High Injury Network" on **Figure 5-6**.

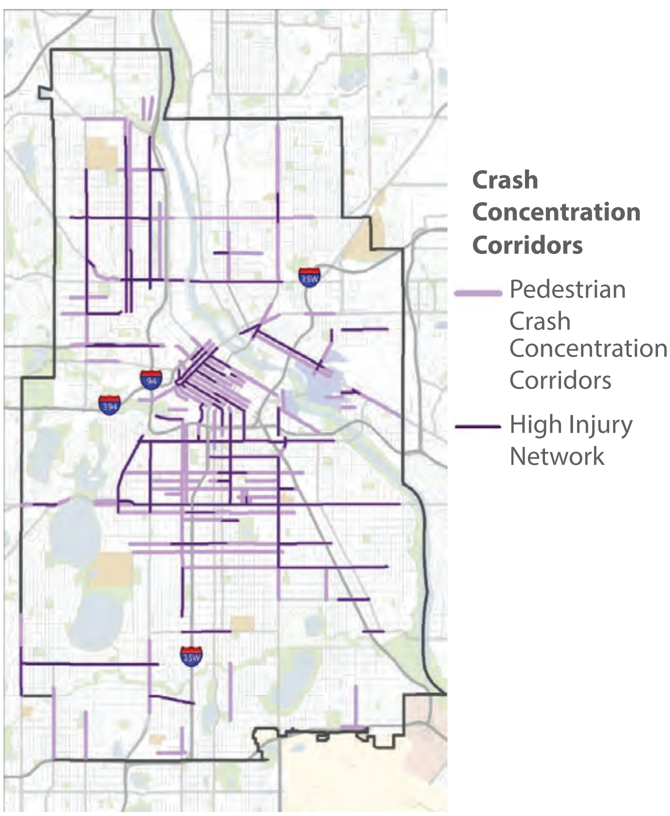


Figure 5-6. Pedestrian Crash Concentration Corridors

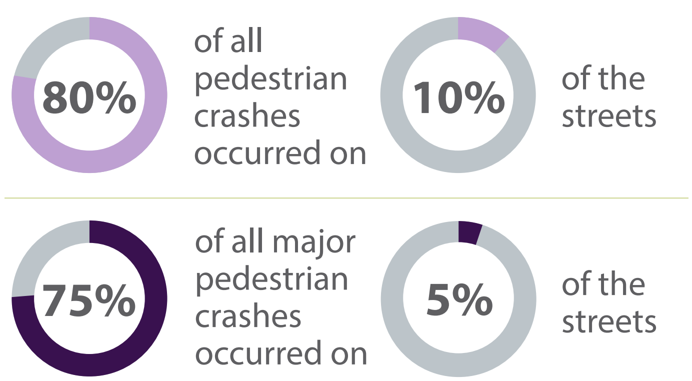
Source for Pedestrian Crash Data: 10-Year Dataset

JURISDICTION OF PEDESTRIAN CRASH CONCENTRATION CORRIDORS

Most of miles of streets in the city are under City of Minneapolis jurisdiction, but 20 percent of the miles of streets in the city are owned and maintained by other agencies. The Pedestrian Crash Concentration Corridors and the High Injury Network occur both on City of Minneapolis streets and on streets under the jurisdiction of other agencies. Of the 110 miles of Pedestrian Crash Concentration Corridors:

- 63 miles are owned and operated by the City of Minneapolis. This represents seven percent of the streets under city jurisdiction.
- 38 miles are owned and operated by Hennepin County. This represents 41 percent of the streets under the county's jurisdiction in the city.
- 9 miles are owned and operated by MnDOT. This represents 14 percent of the streets under the state's jurisdiction in the city.

Eighty percent of all pedestrian crashes occurred on 10 percent of the streets in the city.



CRASH DENSITY

The crash density map in **Figure 5-7** provides a relative sense of the geographic distribution of crashes and is used as a background to the other infrastructure and street characteristics maps that follow. However, looking at hot spots alone only tells part of the story because the corridors and locations with more pedestrian crashes also have high volumes of users. Lake Street, Franklin Avenue, University Avenue SE/4th Street SE, and Penn Avenue N all have high numbers of cars, buses, bikes, and pedestrians, and all have high pedestrian crash numbers along their corridors.

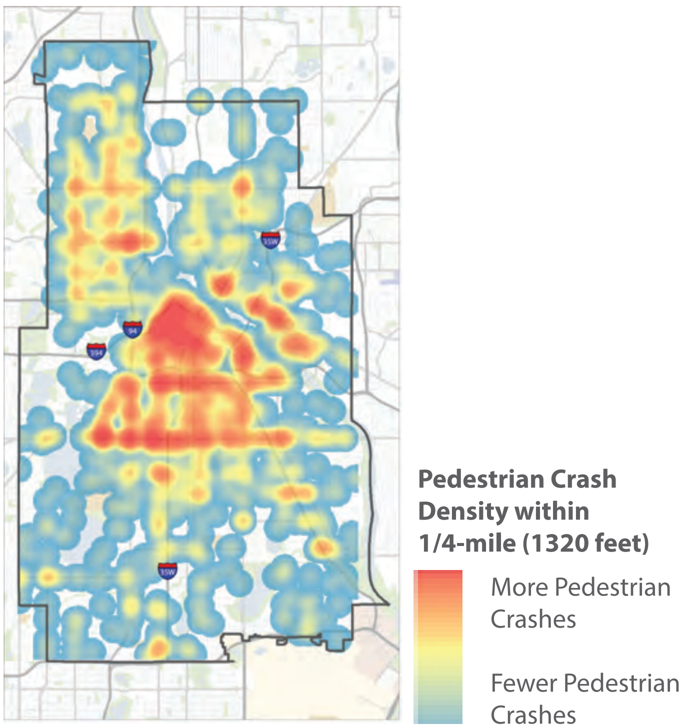


Figure 5-7. Pedestrian Crash Density

Source for Pedestrian Crash Data: 10-Year Dataset

Additionally, areas with tight intersection spacing – such as downtown Minneapolis – inherently will have more crashes per quarter mile, as multiple intersections and streets will fall within the density radius. A smaller density radius is useful to understand more intersection and block-specific trends and comparisons.

For additional insight on pedestrian crash density, a brief comparison of pedestrian, bicycle, and vehicle crash densities in Minneapolis was also conducted. Crash density maps provided by the City of Minneapolis show that the relative densities of crashes involving pedestrians, bicyclists, and vehicles alone have locational similarities. Most crashes among all three crash types occur in the urban core of the city where streets, intersections, and people are more densely situated. However, while pedestrian and vehicle-alone crashes are more widely distributed throughout the city, bicycle crashes are more concentrated around the urban core. Bicycle, pedestrian, and vehicle crash density heat maps are provided in **Appendix D**.

Approach to Identifying Crash Over- and Under-Representation

Pedestrian crashes occur on different types of streets throughout the city. A systematic safety approach is used to analyze the frequency or severity of crashes compared to the frequency of specific street or intersection characteristics. This approach is used to identify street and intersection features that are significantly over-represented in pedestrian crashes and therefore may be a contributing factor in pedestrian crashes. The systematic analysis has the benefit of identifying improvements that can address locations with a history of pedestrian crashes, as well as locations that have similar characteristics where pedestrian crashes have not yet occurred.

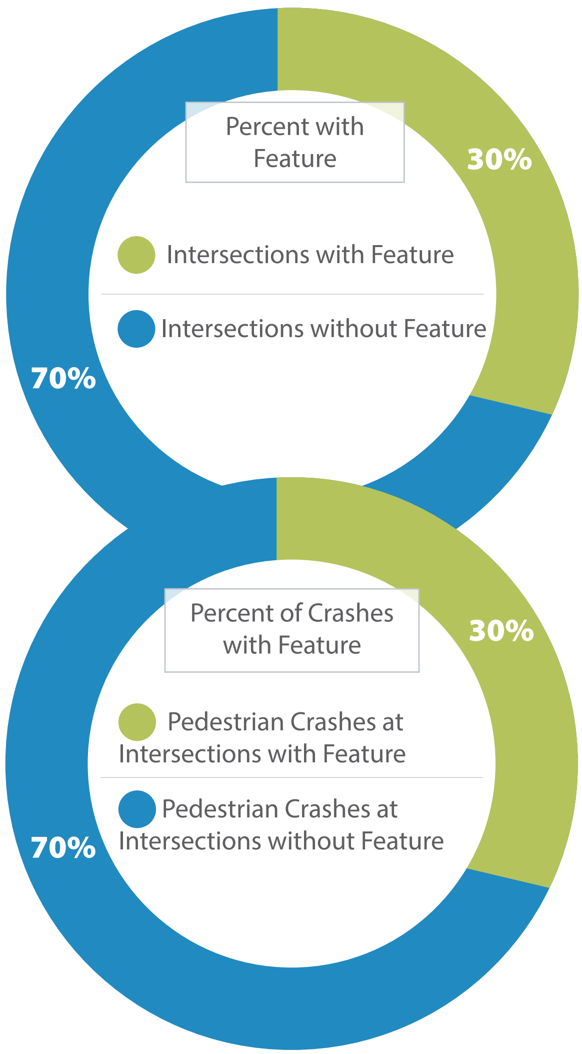


Figure 5-8. Example of Feature that is Not Over-Represented in Pedestrian Crashes

The example feature is equally represented in infrastructure prevalence and pedestrian crashes. This indicates that this feature is likely not a contributing factor to pedestrian crashes and therefore would not be a focus area for improvements.

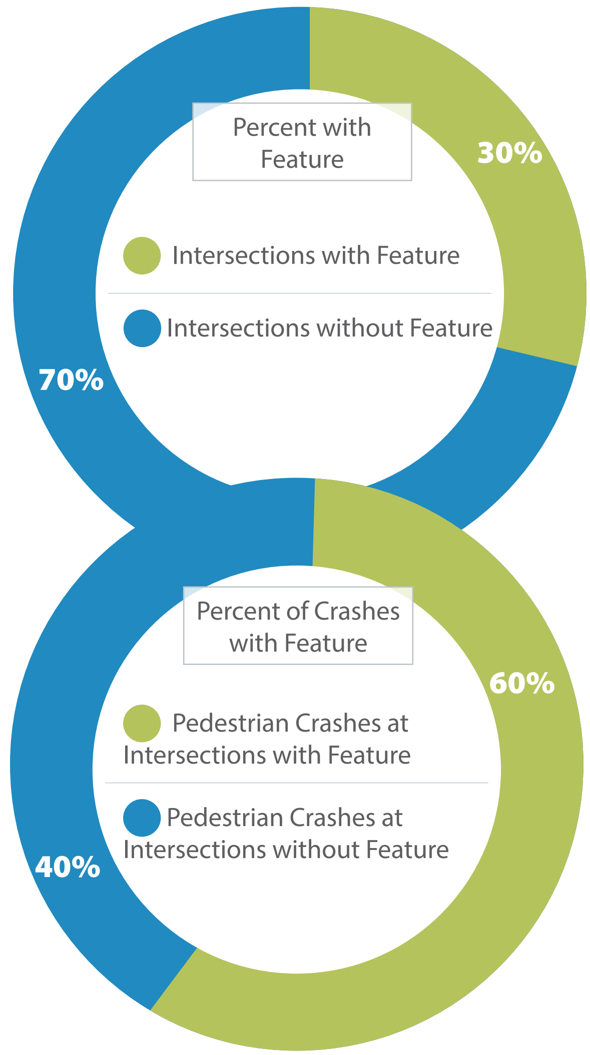


Figure 5-9. Example of Feature that is Over-Represented in Pedestrian Crashes

The example feature is over-represented in pedestrian crashes compared with infrastructure prevalence. This suggests that this feature is potentially a contributing factor to pedestrian crashes and would be a focus area for improvements, even at locations where pedestrian crashes have not occurred.

Bicycle Lanes

While one study from the national review indicated that streets with bicycle lanes were less likely to have fatal pedestrian crashes, Minneapolis crash trends did not show a similar result. Nine percent of the pedestrian crashes on streets with bicycle lanes were major injury crashes, which is only two percentage points lower than streets without bicycle lanes. This finding is likely not statistically significant.

However, several miles of bicycle lanes have been created over the course of the 10-Year study period. This means that a pedestrian crash that occurred along a street that has a bicycle lane today may not have had a bicycle lane at the time of the crash.

For more information, a comparison of bicycle, pedestrian, and vehicle crash densities is provided in **Appendix D.**

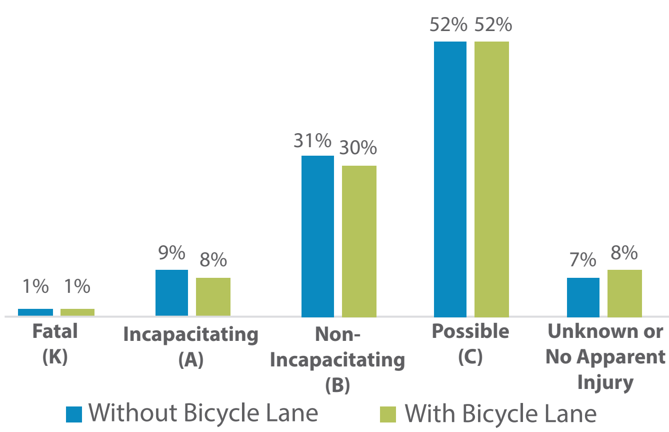


Figure 5-10. Injury Crashes with and without Bicycle Lanes

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Bicycle Lane Data: City of Minneapolis

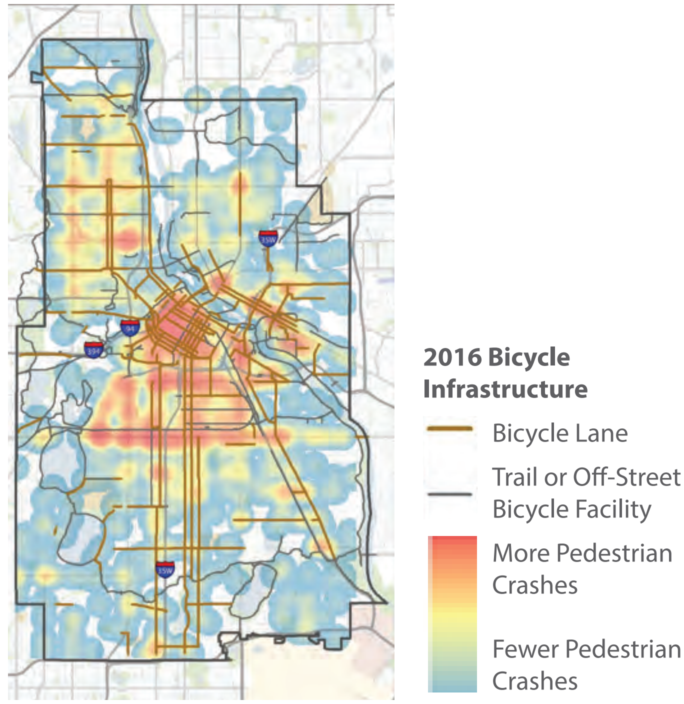


Figure 5-11. Existing Bicycle Lanes

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Bicycle Lane Data: City of Minneapolis

Speed Limit

Streets with 30 and 35 mile-per-hour (mph) posted speed limits are over-represented in pedestrian crashes compared to their share of miles in the city. Streets with a 25 mph posted speed limit are notably under-represented in pedestrian crashes compared to their share of miles in the city. All of the 25 mph streets are parkways, which have very high pedestrian activity, and most of the 55 mph streets are freeway entrance or exit ramps, which have low pedestrian activity.

A larger percentage of pedestrian crashes on streets with 40, 45, or 50 mile-per-hour speed limits are major crashes, demonstrating that greater injury severity occurs on higher-speed streets.

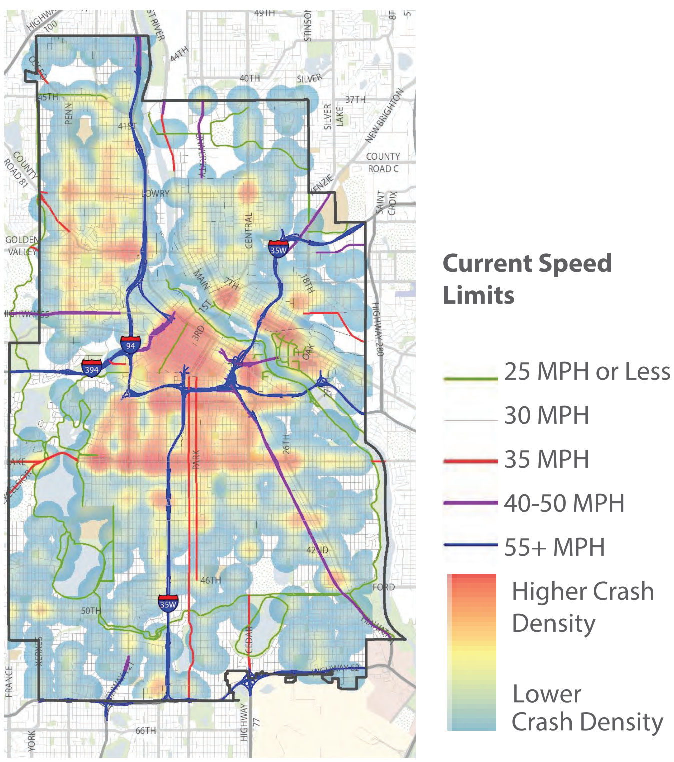


Figure 5-12. Pedestrian Crash Trends by Speed Limit

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Speed Limit Data: City of Minneapolis

Although interstates are shown in Figure 5-12, the miles of and the crashes on the mainline were excluded from analysis.

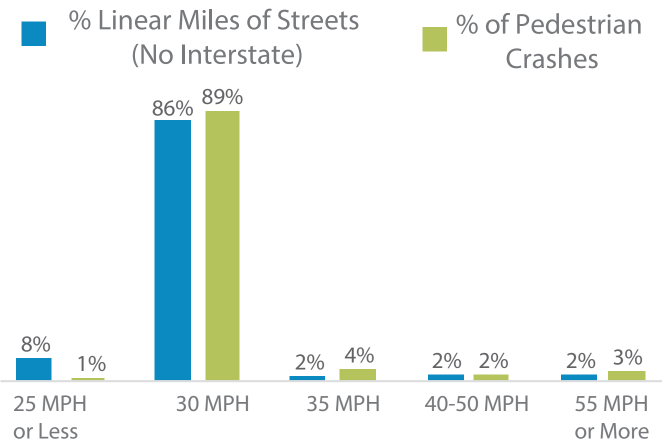


Figure 5-13. Pedestrian Crashes by Posted Speed Limit

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Speed Limit Data: City of Minneapolis

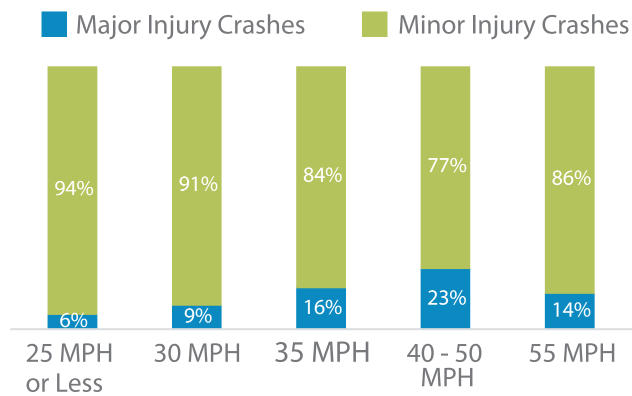


Figure 5-14. Pedestrian Crash Severity by Posted Speed Limit

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Speed Limit Data: City of Minneapolis

Sidewalk Gaps

Eight percent of the linear miles of city streets are considered to have a sidewalk gap because they do not have sidewalks on one or both sides of the street. However, only four percent of the pedestrian crashes happened on streets that have sidewalk gaps. This underrepresentation of pedestrian crashes on streets with sidewalk gaps is not surprising; areas without sidewalks are primarily in industrial areas that do not have significant pedestrian activity.

However, there are six sidewalk gap segments that had three or more pedestrian crashes on or near the segment over the 10 years analyzed. These streets and intersections do have significant pedestrian or vehicular activity and likely warrant further consideration for pedestrian infrastructure:

- Seven intersection pedestrian crashes have occurred at the I-35W frontage road and University Ave SE or 4th Street SE*
- Six pedestrian crashes - five intersection related and one midblock - have occurred along the Willow Street sidewalk gap at Loring Park
- Five intersection pedestrian crashes have occurred at Huron Boulevard and Fulton Street
- Four intersection pedestrian crashes have occurred at University Avenue NE and 37th Avenue NE
- Four pedestrian crashes - one midblock and three intersection related - have occurred along Butler Place near Riverside Avenue
- Three pedestrian crashes have occurred at the northbound entrance ramp to Hiawatha Avenue from Lake Street**

*This intersection and area present a unique challenge of accommodating high volumes of turning vehicles to and from the freeway ramps alongside high numbers of students walking through and living in the area. While many of the crashes at these intersections may not be directly related to the sidewalk gap itself, missing sidewalk connectivity through this busy area is worth noting.

**Two of the three crashes at this interchange involved vehicles making right turns onto Hiawatha Avenue. This suggests that the issue is likely the free-right movement, not the lack of a sidewalk on the entrance ramp.

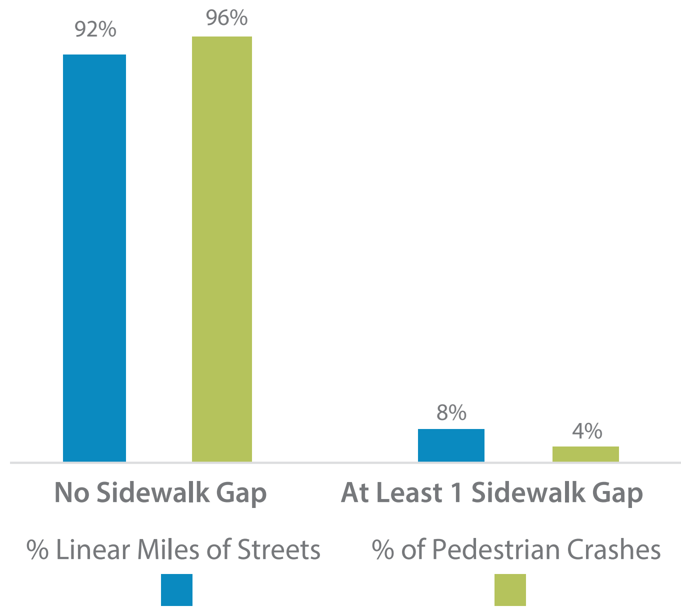


Figure 5-15. Pedestrian Crashes and Sidewalk Gaps

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Sidewalk Gap Data: Pedestrian Master Plan (2009)

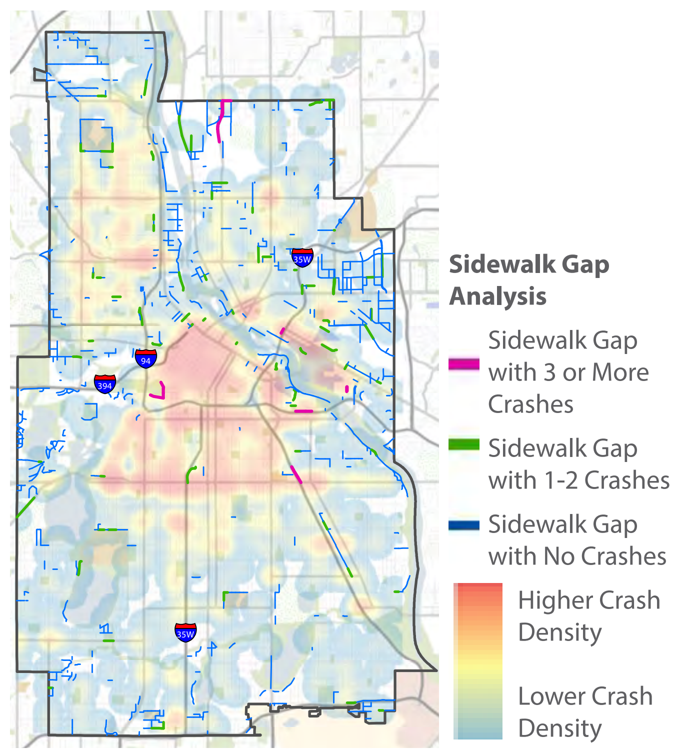


Figure 5-16. Pedestrian Crash Trends by Sidewalk Gaps

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Sidewalk Gap Data: Pedestrian Master Plan (2009)

Number of Travel Lanes

The number of vehicular travel lanes on a roadway or street can be a proxy for the length of the pedestrian crossing or the conflicts and exposure a pedestrian experiences while crossing the street. One-way streets with one, two, and three travel lanes and two-way streets with two and four travel lanes make up the majority of the street network in Minneapolis. This study found that both one-way and two-way streets with fewer vehicle lanes result in fewer pedestrian crashes per mile.

Although two-way streets with three, five, and six lanes were considered in this analysis, these lane configurations make up a very small percentage of total mileage and therefore the sample size was too small to be conclusive.

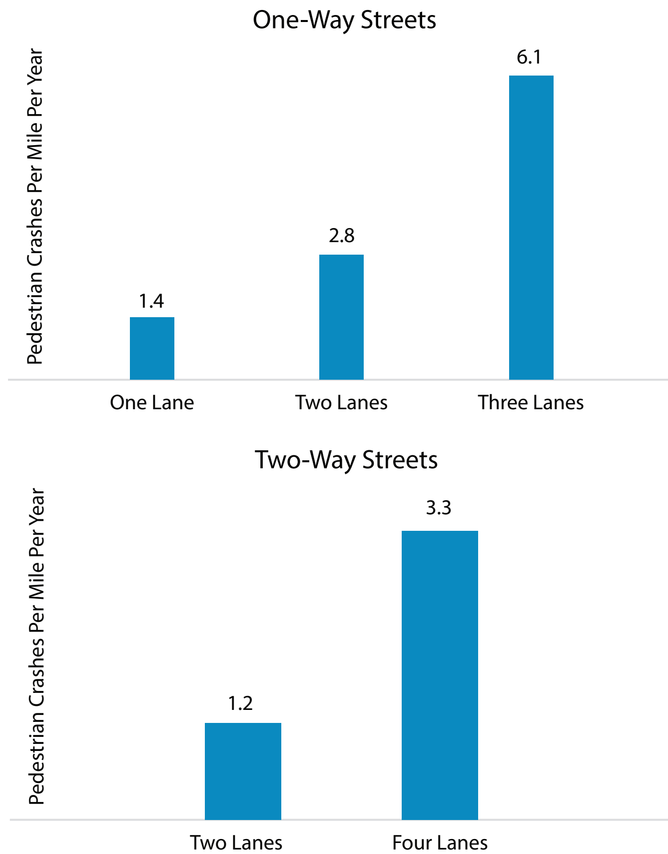


Figure 5-17. Pedestrian Crashes Per Mile Per Year by Number of Lanes

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Lane Data: City of Minneapolis

Streets with Transit

There is an overrepresentation of pedestrian crashes along streets with high-frequency transit routes. While the streets with high-frequency transit routes make up only eight percent of the street mileage in the city, they encompass 63 percent of the pedestrian crashes.

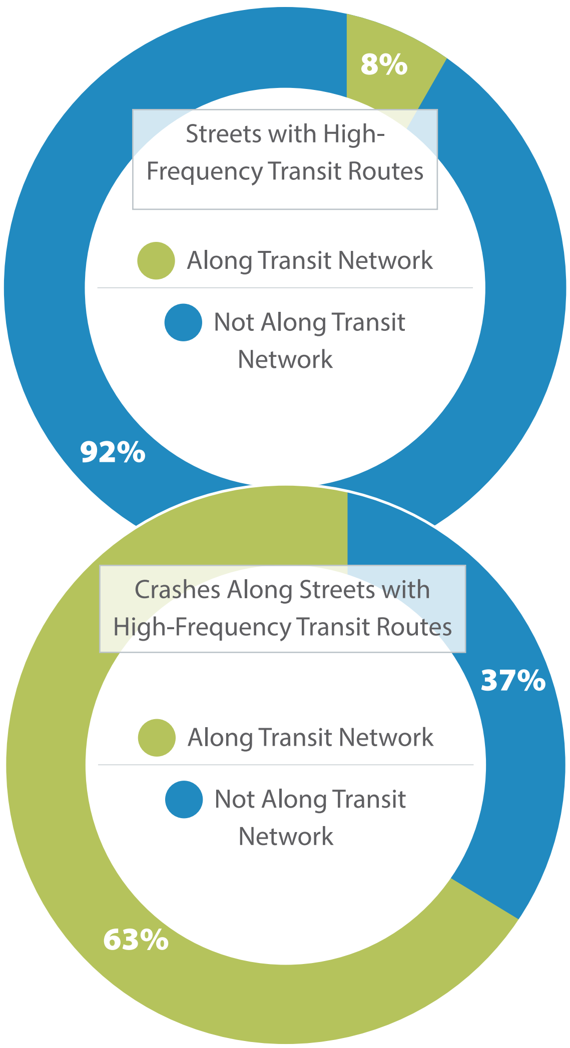


Figure 5-18. Streets with High-Frequency Transit Routes and Pedestrian Crashes

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Transit Data: MetroGIS Geospatial Commons and Access Minneapolis

Bus Stops

More than half of pedestrian crashes occurred within 100 feet of a bus stop.

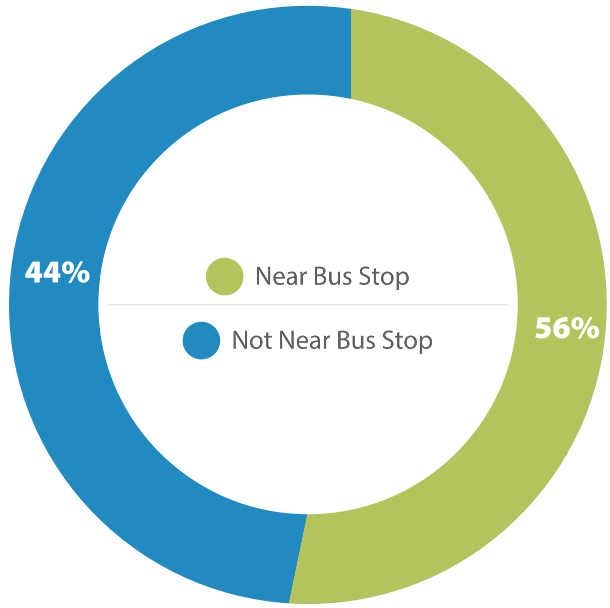


Figure 5-19. Pedestrian Crashes Near Bus Stops

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Transit Data: MetroGIS Geospatial Commons and Access Minneapolis

Because every transit user is a pedestrian at some point during their trip, high frequency transit routes (Metro Transit's High Frequency Network and the city's primary transit network (PTN)) are likely to have higher pedestrian activity. It is not surprising then that pedestrian crashes are more likely near high frequency transit routes and near bus stops.

Walking Routes for Youth

The identification and mapping of the Walking Routes for Youth is a collaboration between Minneapolis Public Works and Minneapolis Public Schools that helps students and families navigate their neighborhoods on foot. The streets that encompass the Walking Routes for Youth are a connected walking grid of the city, and the maps of these routes show the location of traffic signals, pedestrian short cuts, and other infrastructure that help users – and in particular children-- cross barriers and get to their destination. Thirteen percent of streets in Minneapolis are identified as a Walking Route For Youth.

Busy Walking Routes are over-represented in pedestrian crashes, while Neighborhood Walking Routes are under-represented in pedestrian crashes.

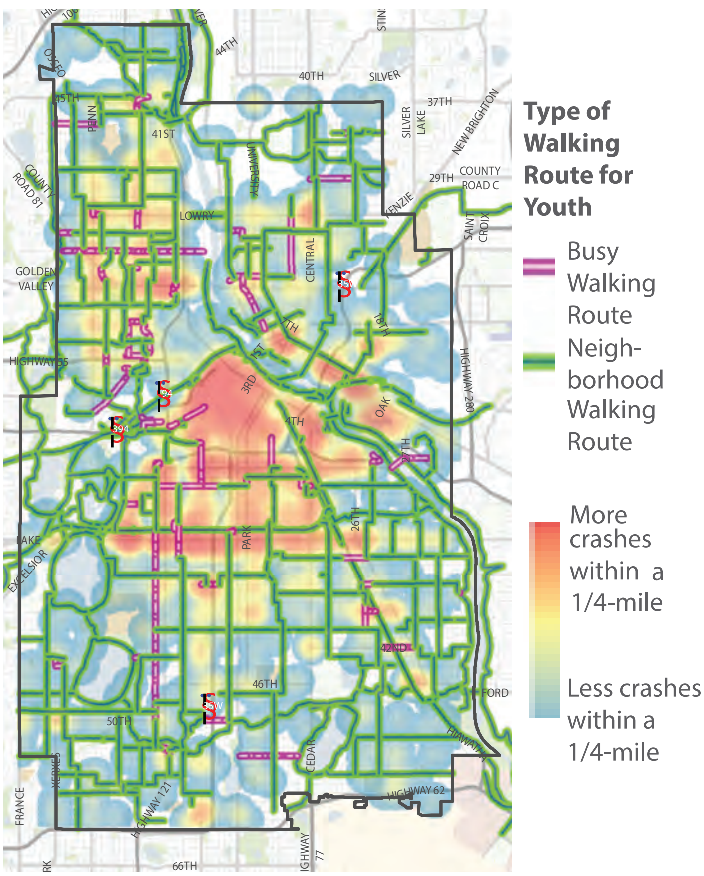


Figure 5-20. Existing Infrastructure - Walking Routes for Youth

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Walking Routes for Youth Data: City of Minneapolis

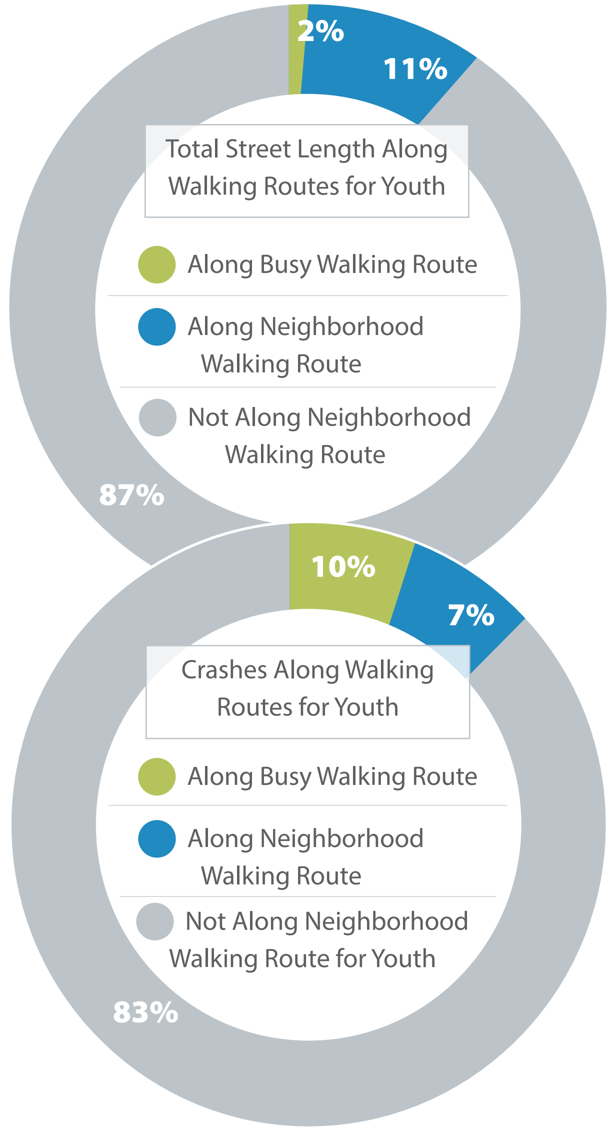


Figure 5-21. Walking Routes for Youth and Pedestrian Crashes

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Walking Routes for Youth Data: City of Minneapolis

Pedestrian Generators

Pedestrian generators are defined in the Pedestrian Master Plan as places that attract many pedestrians and include parks, hospitals, recreation centers, schools, theaters, museums, and libraries. Approximately one-quarter of pedestrian crashes occurred near at least one of these pedestrian generators. Pedestrian crashes were most common near parks, schools, and theaters. Very few recreation centers, hospitals, senior facilities, or museums have pedestrian crashes recorded in proximity to them.

The study defined a crash near a pedestrian generator if it occurred within 300 feet of the center of the pedestrian generator. This distance was used to capture the variability in site size and facility access that is inherent in this wide variety of destinations.

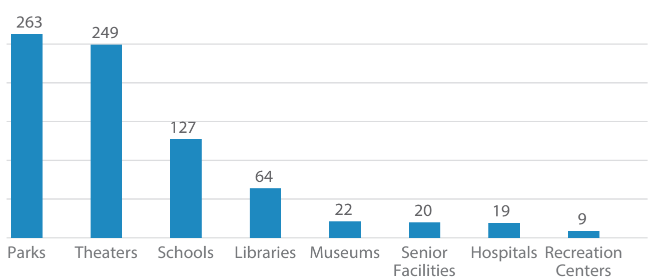


Figure 5-22. Pedestrian Crashes within 300 Feet of a Pedestrian Generator

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Generator Data: Minneapolis Pedestrian Master Plan (2009)
Source for Senior Center Locations: Minnesota Seniors Online

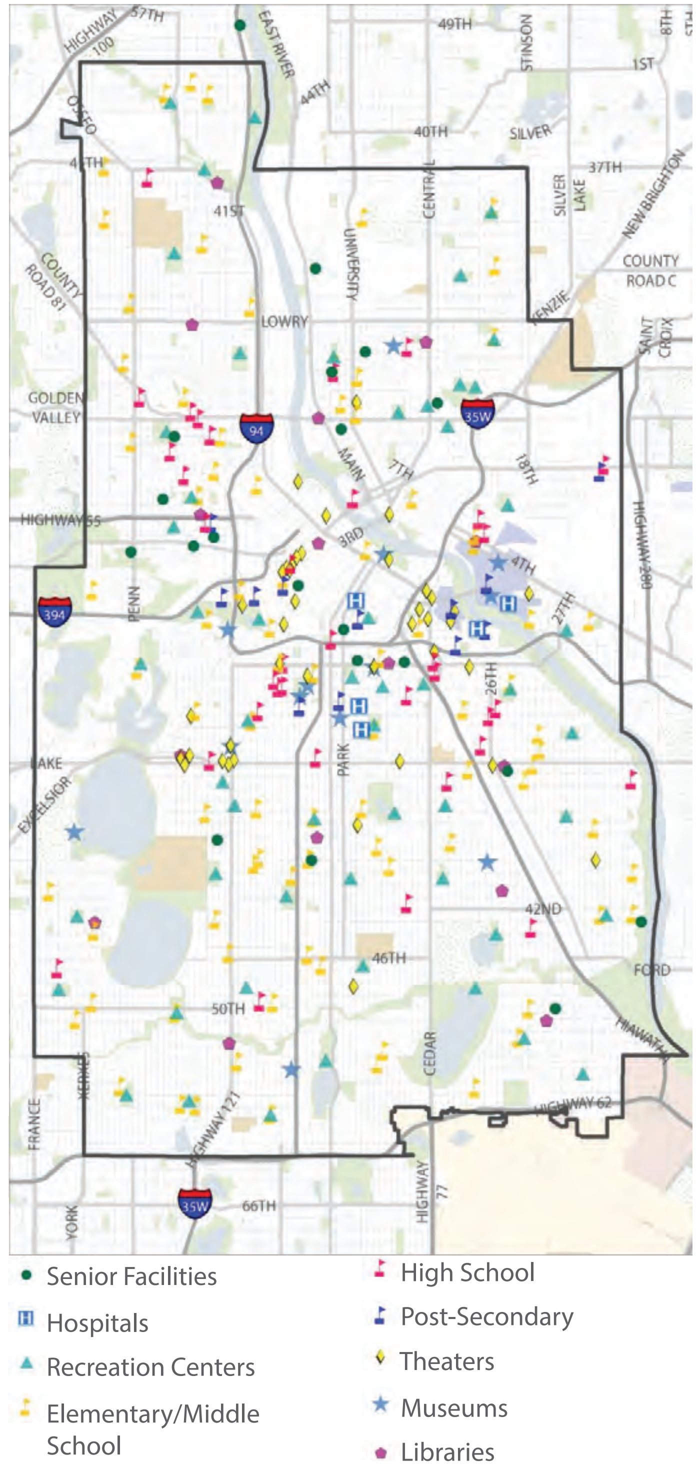


Figure 5-23. Pedestrian Master Plan Data - Pedestrian Generators

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Generator Data: Minneapolis Pedestrian Master Plan (2009)
Source for Senior Center Locations: Minnesota Seniors Online

Intersection Characteristics

Intersections have the highest potential for conflicts - they have more users interacting near them and more movements and modes sharing space. Minneapolis in particular has a grid street network that creates high intersection density and more opportunities for pedestrian/vehicle conflicts at intersections. Only 15 percent of crashes occurred at midblock locations in Minneapolis. Statewide, where intersection density is lower, non-intersection locations make up 39 percent of crashes.

The majority of pedestrian crashes in Minneapolis happen at intersections.

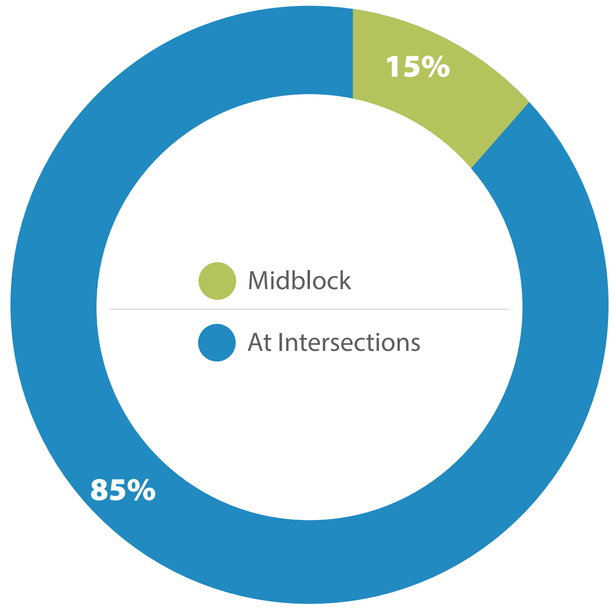


Figure 5-24. Locations of Pedestrian Crashes

Source for Pedestrian Crash Data: 10-Year Dataset

Intersection Overview

Only 12 percent of intersections are controlled by signals, but 68 percent of intersection pedestrian crashes in Minneapolis happened at signalized intersections. Stop signs are highly underrepresented in crashes; only 30 percent of pedestrian crashes at intersections happened at stop signs. More than half of the traffic signals in the city have experienced a pedestrian crash, while only one in 10 stop-controlled intersections in the city have experienced a pedestrian crash. The 16 percent of intersections with no control or unknown control represent a very small percentage of pedestrian crashes.

Statewide pedestrian crashes are more dispersed among intersection control types, compared to Minneapolis. Signalized intersections remain the most common intersection crash location, with over half of the pedestrian crashes, and stop controlled intersections have around a quarter of pedestrian crashes. Pedestrian crashes at intersections with no or unknown stop control make up a much larger percentage statewide than in Minneapolis.

A majority of pedestrian crashes at intersections occur at traffic signals.

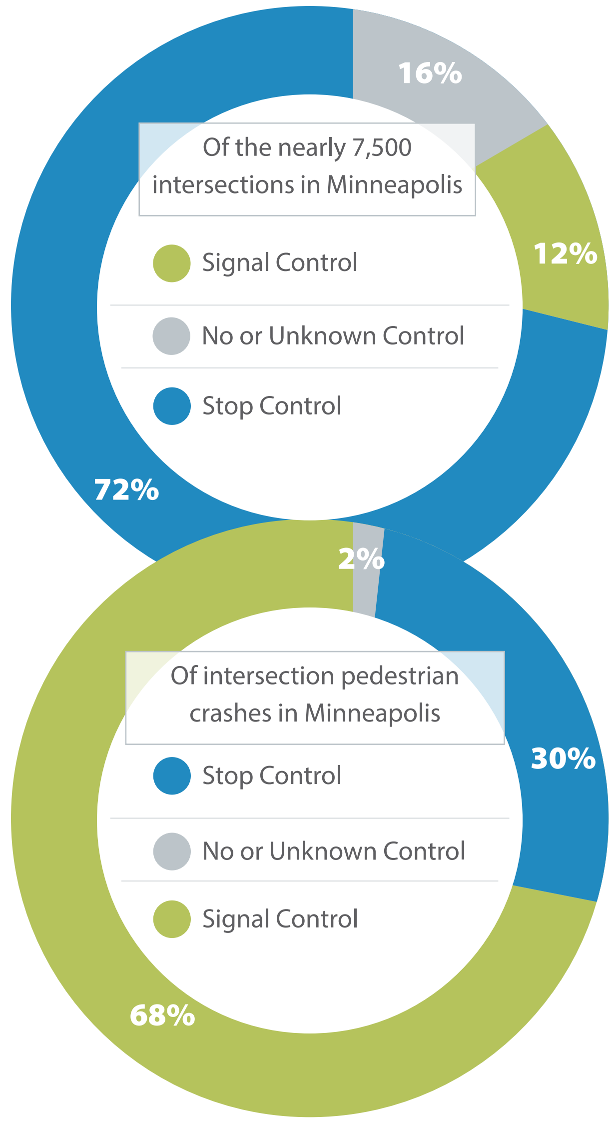


Figure 5-25. Pedestrian Crashes and Intersection Control Type
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis

Priority Intersections

Because intersections make up a large majority of pedestrian crashes, intersections and features at intersections were a focus of this study.

The number of crashes at intersections tends to be a function of exposure – the volume of traffic traveling through the intersection. To factor in the exposure, the crash rate is calculated as the number of crashes per million entering vehicles (MEV). Note that the number of crashes per million entering vehicles and pedestrians would be a better measure of exposure, however daily pedestrian volumes are not available for most streets.

An intersection with either a high total number of pedestrian crashes or a high vehicle-pedestrian crash rate, accounting for the volume of traffic, should be considered for further study. A high number of crashes offers the largest opportunity to reduce the number of pedestrian crashes. Crash rates allow comparison of streets with different traffic volumes and provides the ability to identify potential safety issues at lower volume intersections.

The following tables show the top intersections by total pedestrian crashes and by pedestrian crash rates.

High numbers of pedestrian crashes and high pedestrian crash rates both can indicate a safety concern.

INTERSECTIONS WITH THE MOST CRASHES

The intersections with the most crashes over 10 years city-wide are shown in **Table 5-2**. The top 25 intersections all had signalized control.

Table 5-2. Intersections with Highest Total Pedestrian Crashes

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per million Entering Vehicles per Year	Entering Volume	Intersection Control
1	Lake St W	Lyndale Av S	24	0.17	37,950	Signalized
2	West Broadway Av N	Lyndale Av N	23	0.23	28,000	Signalized
3	Franklin Av W	Nicollet Av S	21	0.18	31,600	Signalized
4	Lake St W	Hennepin Av S	20	0.21	26,300	Signalized
5	Lake St W	Pillsbury Av S	17	0.18	25,400	Signalized
6	Lake St W	Blaisdell Av S	17	0.18	26,500	Signalized
7	4th St S	Cedar Av S	16	0.22	19,650	Signalized
8	Franklin Av E	Chicago Av S	16	0.17	25,150	Signalized
9	Franklin Av E	Portland Av S	16	0.14	30,350	Signalized
10	26th St W	Lyndale Av S	15	0.14	29,700	Signalized
11	4th St SE	Central Av SE	14	0.13	28,700	Signalized
12	6th St N	Hennepin Av S	14	0.13	30,200	Signalized
13	4th St N	1st Av N	13	0.15	23,200	Signalized
14	Lake St E	Bloomington Av S	13	0.12	30,500	Signalized
15	9th St N	Hennepin Av S	13	0.10	34,100	Signalized
16	7th St N	Hennepin Av S	13	0.09	38,500	Signalized
17	4th St N	Hennepin Av S	13	0.09	38,800	Signalized
18	Franklin Av W	Hennepin Av S	12	0.14	24,325	Signalized
19	Lowry Av NE	Central Av NE	11	0.11	26,500	Signalized
20	Lake St E	1st Av S	11	0.12	24,900	Signalized
21	Franklin Av E	3rd Av S	11	0.12	25,675	Signalized
22	Lagoon Av W	Hennepin Av S	11	0.11	27,600	Signalized
23	Franklin Av W	Lyndale Av S	11	0.08	37,100	Signalized
24	Grant St W	Nicollet Mall S	10	0.31	8,800	Signalized
25	2nd St S	3rd Av S	10	0.17	15,675	Signalized

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis
Source for Traffic Volume Data: City of Minneapolis

INTERSECTIONS WITH THE HIGHEST CRASH RATE

The intersections with the highest pedestrian crash rate over 10 years city-wide – or the highest number of pedestrian crashes per vehicles that travel through the intersection – are shown in **Table 5-3**.

Table 5-3. Intersections with the Highest Total Pedestrian Crash Rate

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Volume	Intersection Control
1	Grant St W	Nicollet Mall S	10	0.31	8,800	Signalized
2	West Broadway Av N	Lyndale Av N	23	0.23	28,000	Signalized
3	4th St S	Cedar Av S	16	0.22	19,650	Signalized
4	Lake St W	Hennepin Av S	20	0.21	26,300	Signalized
5	Currie Av W	10th St N	5	0.19	7,100	Signalized
6	Franklin Av E	Mid-Block Driveway between 13th Av S and 14th Av S	6	0.19	8,550	Signalized
7	29th St W	Pillsbury Av S	4	0.19	5,700	Stop Sign
8	Cedar Av S	Mid-Block Driveway between 24th St E and EM Stately St	6	0.19	8,700	Signalized
9	Lake St W	Pillsbury Av S	17	0.18	25,400	Signalized
10	Franklin Av W	Nicollet Av S	21	0.18	31,600	Signalized
11	Hennepin Av S	Mid-Block Driveway between 28th St W and Lagoon Av	6	0.18	9,150	Signalized
12	18th Av N	Lyndale Av N	5	0.18	7,700	Signalized
13	Lake St W	Blaisdell Av S	17	0.18	26,500	Signalized
14	2nd St S	3rd Av S	10	0.17	15,675	Signalized
15	Franklin Av E	Chicago Av S	16	0.17	25,150	Signalized
16	33rd St E	Chicago Av S	4	0.17	6,300	Signalized
17	Lake St W	Lyndale Av S	24	0.17	37,950	Signalized
18	27th Av N	Emerson Av N	3	0.17	4,750	Stop Sign
19	25th Av N	Emerson Av N	3	0.17	4,750	Stop Sign
20	Grant St W	LaSalle Av S	6	0.17	9,550	Signalized
21	5th St N	1st Av N	9	0.16	15,100	Signalized
22	9th St S	Nicollet Mall S	6	0.16	10,100	Signalized
23	4th St S	Nicollet Mall S	10	0.16	17,500	Signalized
24	31st St W	Blaisdell Av S	8	0.16	14,100	Signalized
25	4th St N	1st Av N	13	0.15	23,200	Signalized

Intersections with fewer than 3 crashes over 10 years are excluded from this highest crash rate list.
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis
Source for Traffic Volume Data: City of Minneapolis

PRIORITY INTERSECTIONS BASED ON TOTAL CRASHES AND CRASH RATE

The priority intersections shown in **Table 5-4 and 5-5** are those that fall in both lists for signalized intersections and stop-controlled intersections, respectively. **Appendix C** includes the top intersections by total number of crashes and street type such that the City and other agencies can assess priorities for infrastructure improvements based on the performance of intersections within their jurisdiction.

Table 5-4. Signalized Priority Intersections Based on Total Crashes and Crash Rate

Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year
Lake St W	Lyndale Av S	24	0.17
West Broadway Av N	Lyndale Av N	23	0.23
Franklin Av W	Nicollet Av S	21	0.18
Lake St W	Hennepin Av S	20	0.21
Lake St W	Pillsbury Av S	17	0.18
Lake St W	Blaisdell Av S	17	0.18
4th St S	Cedar Av S	16	0.22
Franklin Av E	Chicago Av S	16	0.17
Grant St W	Nicollet Mall S	10	0.31
2nd St S	3rd Av S	10	0.17

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis

Table 5-5. Stop-Controlled Priority Intersections Based on Total Crashes and Crash Rate

Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year
27th St E	Cedar Av S	6	0.12
Lake St E	Clinton Av S	6	0.08
Franklin Av E	21st Av S	5	0.10
27th St W	Lyndale Av S	5	0.07
West Broadway Av N	Bryant Av N	5	0.07
29th St W	Pillsbury Av S	4	0.19
Como Av SE	19th Av SE	4	0.13
15th St E	Chicago Av S	4	0.09
Lagoon Av W	Irving Av S	4	0.07
Franklin Av E	Stevens Av S	4	0.05
27th Av N	Emerson Av N	3	0.17
25th Av N	Emerson Av N	3	0.17

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis

Crosswalks

AT SIGNALIZED INTERSECTIONS

- Approximately **60 percent of pedestrian crashes**
- The pedestrian was in the crosswalk most of the time in crashes at signalized intersections.
- If the pedestrian was not in the crosswalk area at the time of the crash, the pedestrian was most commonly in the travel lane just outside the crosswalk.

Pedestrians involved in a crash are most commonly in the crosswalk area.

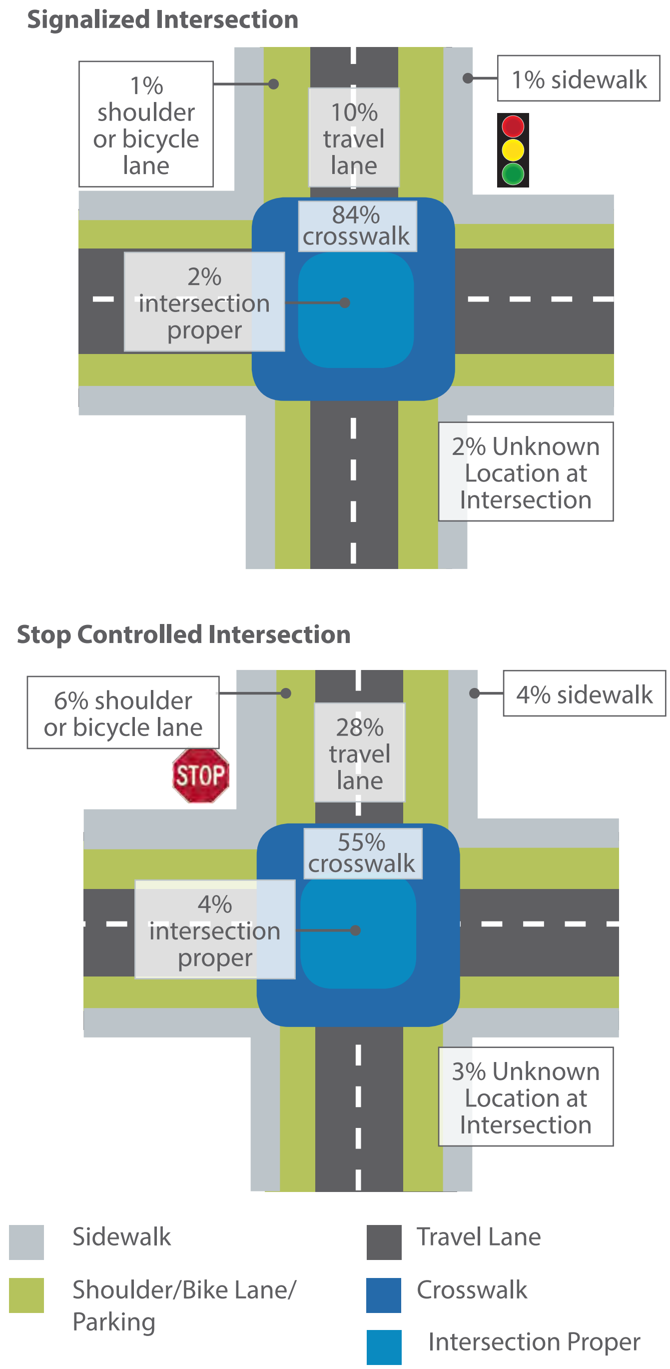


Figure 5-26. Pedestrian Crash Locations within Intersections

Source for Pedestrian Crash Data: 3-Year Dataset

AT STOP SIGN CONTROLLED INTERSECTIONS

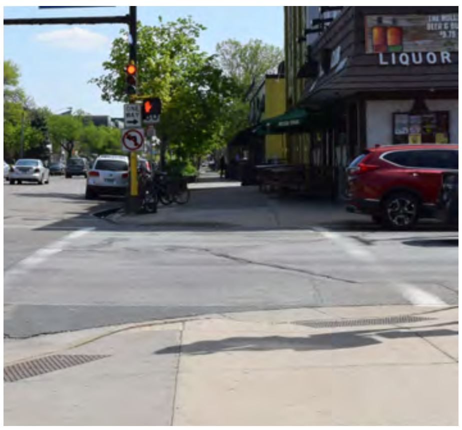
- Approximately **25 percent of pedestrian crashes**
- The pedestrian was in the crosswalk area in just over half of these crashes and in the travel lane in about a quarter of the crashes. The other pedestrian pre-crash locations each represent less than six percent of the crashes.

AT MID-BLOCK

- Approximately **15 percent of pedestrian crashes**
- The pedestrian was in the travel lane nearly three-quarters of the time in mid-block crashes.

CROSSWALK TYPES

Unmarked 83 percent of intersections



Parallel Line 13 percent of Intersections

Continental (Zebra) 4 percent of intersections

Assuming there is no prohibiting signage, pedestrians have the right-of-way to cross at any intersection in the State of Minnesota, whether or not the intersection has a marked crosswalk. The majority of intersections in Minneapolis have unmarked crosswalks because they are unsignalized. Of intersections with marked crosswalks, parallel line crosswalks are most common (around 80 percent of marked crosswalks) and continental (zebra) crosswalks make up the remaining marked crosswalks. The City plans to change all marked crosswalks to zebra style starting in 2017.

Despite the small percentage of marked crosswalks city-wide, most pedestrian crashes occur at intersections that have marked crosswalks. This correlates to the fact that marked crosswalks are found predominantly at traffic signals. Around one-fifth of pedestrian crashes at intersections occurred at a zebra style crosswalk and over half occurred at a parallel line crosswalk. These percentages are fairly consistent with the percentages of the two crosswalk types.

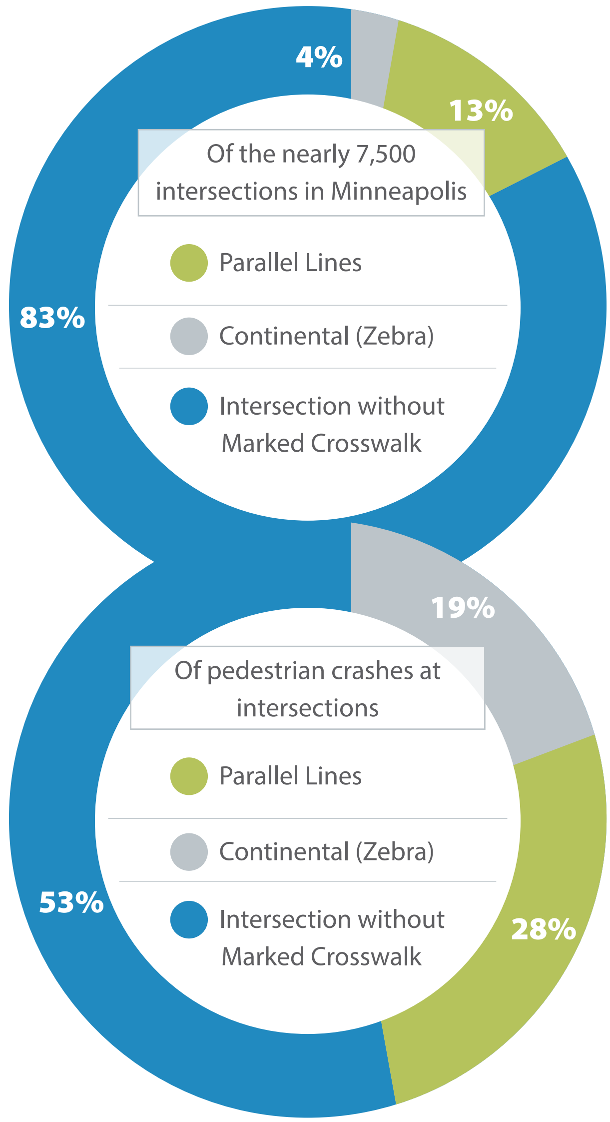


Figure 5-27. Pedestrian Crashes and Crosswalk Type

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Crosswalk Type: City of Minneapolis

Signal Features

Understanding how the features of signalized intersections influence pedestrian crashes was one key area of analysis in this study. **Table 5-6** summarizes these findings for signal features, and **Appendix B** has more details and discussion on each signal feature.

Table 5-6. Signal Features and Pedestrian Crashes

Signal Feature	% of Intersections with this Feature	% of Pedestrian Crashes at Intersections with this Feature	Over, Under, Or Equally Represented in Pedestrian Crashes?
No Turn On Red Sign	20%	29%	Slightly Over
Left Turn Phasing	33%	46%	Over
Countdown Timer	30%	35%	Slightly Over
Overhead Indications	74%	85%	Over
Pedestrian Flashers	5%	1%	Under
Leading Pedestrian Interval (LPI)	0.5% (9 intersections city-wide)	3%	Slightly Over

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Signal Features: City of Minneapolis

There are two main reasons that pedestrian crashes are overrepresented at many of the signal features studied in this analysis:

- Intersections that include these features have them for a reason, typically higher volumes for vehicles and/or pedestrians. This results in higher exposure and conflict, which leads to higher potential for crashes.
- A number of these features were updated or modified during the course of the 10-Year study period. This means that a pedestrian crash that occurred at an intersection that has this feature today may not have had the signal feature when the crash occurred.

Overall, signal design does not appear to be strongly correlated with pedestrian crashes. However, it is one aspect that should be considered in the overall intersection design to minimize vehicle-pedestrian conflicts.

NO TURN ON RED

One signal feature considered in this analysis is whether the presence of a No Turn On Red (NTOR) restriction corresponded to any trends in pedestrian crash frequency or crash type.

The analysis showed that intersections with NTOR Signs are overrepresented in pedestrian crashes compared to their share of intersections citywide. Additionally, pedestrian crashes at these intersections were more likely to involve a vehicle turning right on green compared to intersections without the NTOR restriction. The percentage of pedestrian crashes involving a vehicle turning right on red was the same for intersections with and without the NTOR restriction. These findings suggest that No Turn on Red restrictions do not reduce pedestrian crashes; NTOR restrictions should be considered where there are significant turning conflicts or sight line issues.

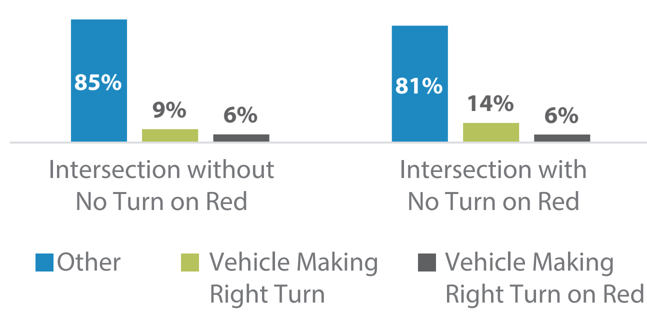


Figure 5-28. Pedestrian Crashes and No Turn on Red Restrictions

Source for Pedestrian Crash Data: 10-Year Dataset
Source for NTOR Data: City of Minneapolis

Demographics

Several national studies have shown that pedestrian crashes correlate with demographics. While the 10-Year database does not include age and gender for all crashes, the police reports used for the detailed three-year analysis include this information for both the pedestrian and driver. Self-identified demographic information such as race and income are not captured on crash reports, but census block data has been used to review these factors relative to crash trends.

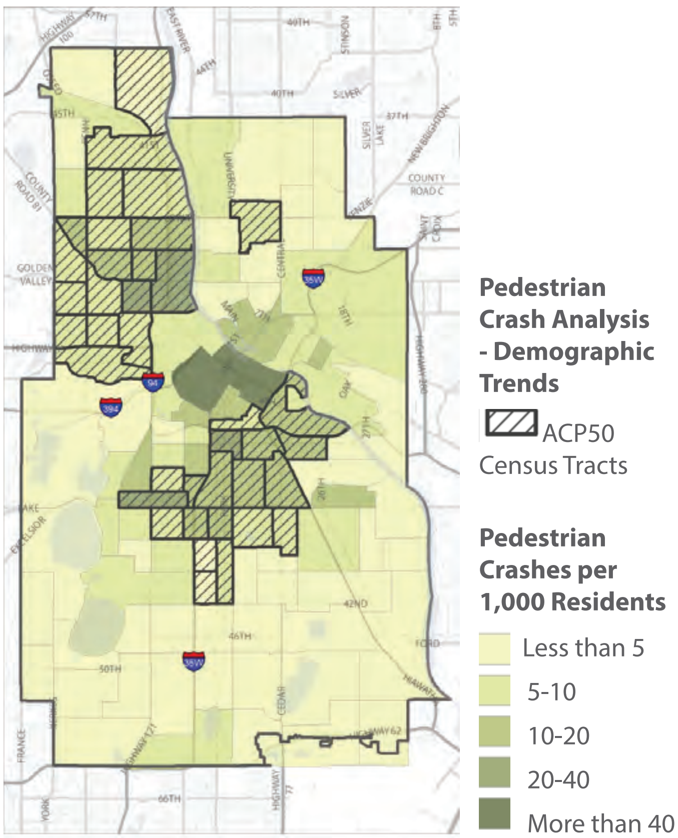


Figure 5-29. Crashes per Resident and ACP50 Census Tracts

ACP50 areas represent 31 percent of the population but experienced 42 percent of the pedestrian crashes over 10 years.

Race and Poverty

The high crashes per capita in downtown are likely due to its relatively low number of residents compared to the daily pedestrian activity the area experiences. Outside of downtown, there are two concentrations of non-white majority, poverty, and high pedestrian crash rate. Both of these areas fall within "ACP50s". An "ACP50" area is one in which 50 percent or more of the residents are people of color and 40 percent or more of the residents have family incomes that are less than 185 percent of the federal poverty threshold. The data evaluated does not define equity but was a starting point to evaluate this issue based on data that is readily available. The study found that pedestrian crashes are more likely to occur in ACP50 areas - **ACP50 areas represent 31 percent of the population but experienced 42 percent of the pedestrian crashes over 10 years.**

This finding – that there is an overrepresentation of crashes in non-white and/or impoverished areas – is consistent with national trends in pedestrian crashes.

Although pedestrian crashes are over-represented in ACP50 areas, vehicle availability had a stronger connection with pedestrian crash rates per capita than income or race, based on linear regression. This analysis found that high vehicle availability correlates to lower pedestrian crash rates per capita. This relationship could be a product of fewer pedestrians in general in these areas (and as such, fewer opportunities for pedestrian crashes) rather than an indication of more favorable conditions for pedestrians.

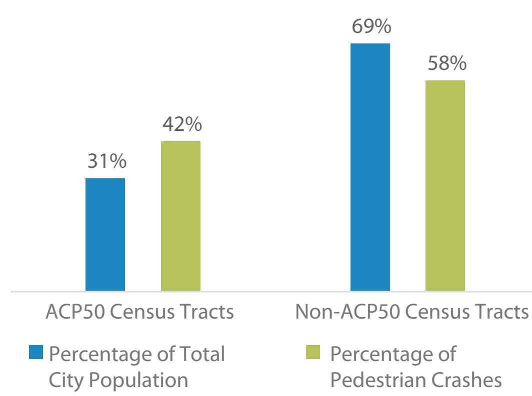


Figure 5-30. Pedestrian Crashes and Population

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Demographic Data: 2015 American Community Survey 5-Year Estimates

Age

In Minneapolis, pedestrians aged 45–64 were sligtly over-represented in crashes. This is different from national trends, which typically have found an over-representation of pedestrians over 65 and under 18. While pedestrians over the age of 45 make up 31 percent of the population, they are victims in 42 percent of the major pedestrian crashes. **Fatal pedestrian crashes in Minneapolis are over-represented in pedestrians age 55 and older, and are significantly over-represented in pedestrians 65 and older.**

Statewide trends mirror national trends, with pedestrians between the ages of 15 and 25 and those older than 65 being involved in 38 percent of serious injury crashes[5-A].

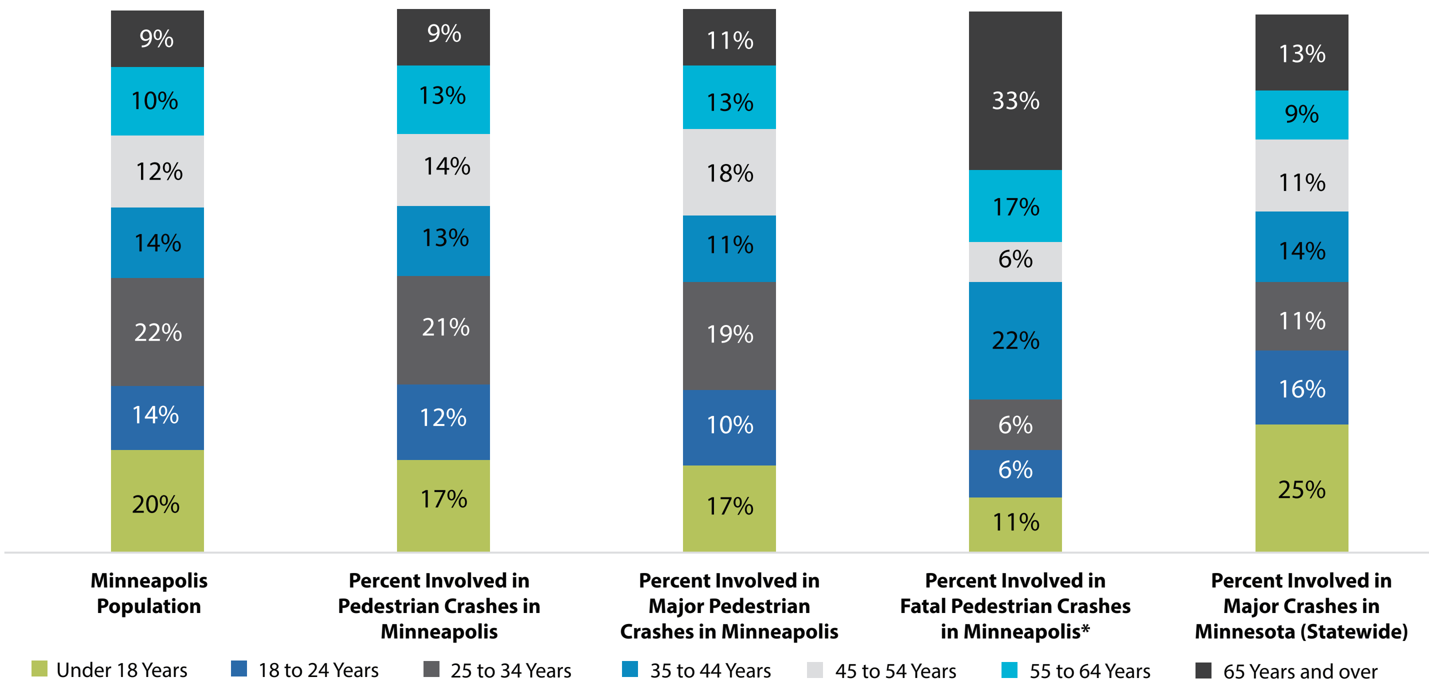


Figure 5-31. Age Distribution of the Population and Pedestrian Crashes in Minneapolis

Source for Pedestrian Crash Data: 3-Year Dataset
Source for Demographic Data: 2015 American Community Survey 5-Year Estimates
Source for Minnesota Statewide Major Crashes: Minnesota Motor Vehicle Crash Facts (2015)

**Minneapolis fatal crashes were supplemented with 10-Year data in order to provide an adequate sample size. All other Minneapolis categories use 3-Year data only.*

Thirty-three percent of fatal pedestrian crashes in Minneapolis involved pedestrians aged 65 and older.

5-A Statewide trends pulled from the Minnesota Motor Vehicle Crash Facts (2015)

Crash Causes

Contributing Factors

Motorists had at least one contributing factor more often than pedestrians.

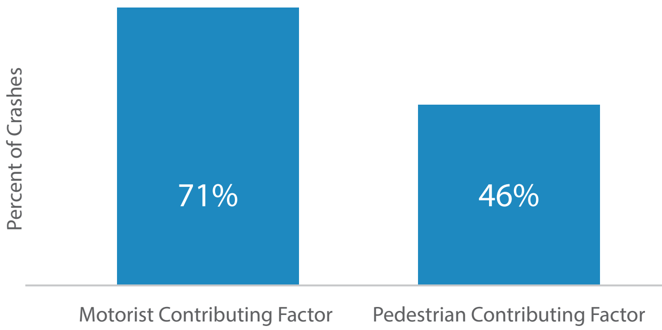


Figure 5-32. Pedestrian Crash Contributing Factors
Source for Pedestrian Crash Data: 3-Year Dataset

The percentages total more than 100 percent because some crashes have both a vehicle and pedestrian contributing factor.

Example motorist contributing factors:

- Failing to yield to pedestrian right of way
- Motorist inattentive or distracted
- Obstructed Vision

Example pedestrian contributing factors:

- Failing to yield to vehicular right of way
- Alcohol or drug influence

Fault

Assigning fault in a crash is inexact, and typically this is not explicitly stated on a crash report. For the purposes of this study, fault was evaluated based on detailed review of every pedestrian crash report within the past three years. In reviewing each crash report, the actions and contributing factors of the driver and the pedestrian were both considered to assess whose actions most directly contributed to the crash. The driver was at fault in two-thirds of pedestrian crashes and the pedestrian was at fault in about one-third of crashes.

Example of pedestrian at fault: A pedestrian walks into the street unexpectedly, leaving the driver with no time to correct or stop their vehicle before striking the pedestrian (this type of crash is called a "Dart Out" crash).

Example of motorist at fault: A vehicle attempts to make a left turn during a gap in automobile traffic but does not see the pedestrian in the crosswalk and the vehicle strikes the pedestrian.

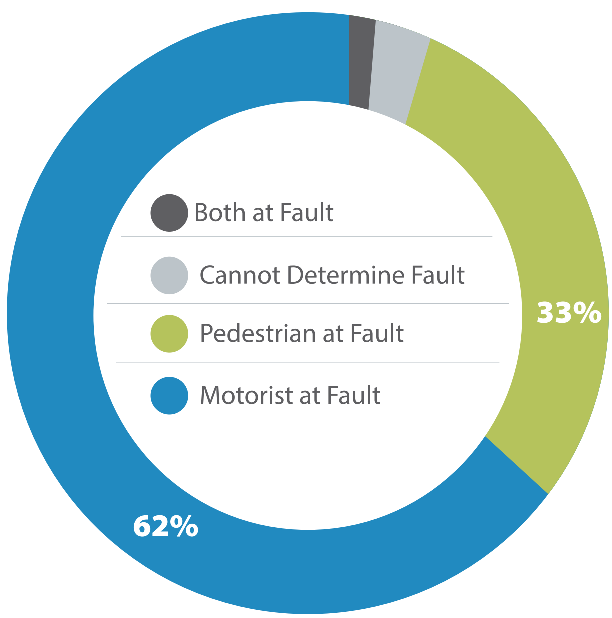


Figure 5-33. Pedestrian Crash Fault
Source for Pedestrian Crash Data: 3-Year Dataset

Drug and Alcohol Influence

The focus of this study is to consider pedestrian crashes as they relate to infrastructure, such that projects and efforts to improve infrastructure can be made with prevention of future pedestrian crashes in mind. While it is important to understand the trends of crashes that involve individuals under the influence, there are likely factors at play in these crashes that infrastructure alone cannot solve. Prevention of these crashes will likely need more study and consideration.

Nine percent of all pedestrian crashes involve pedestrians under the influence; the trends of these crashes are detailed in this section. Only one percent of pedestrian crashes involve a driver under the influence, and there were not any clear trends given the small sample size.

- Crashes that involved a pedestrian under the influence of alcohol or drugs were twice as likely to result in a fatality or incapacitating injury as compared to crashes where the pedestrian was not under the influence
- The fatal or incapacitating injury crashes (major crashes) that involve a pedestrian under the influence most commonly occur in the evening (between 6PM and 9PM)
- Between midnight and 3AM, over one-third of the pedestrian crashes involved a pedestrian under the influence

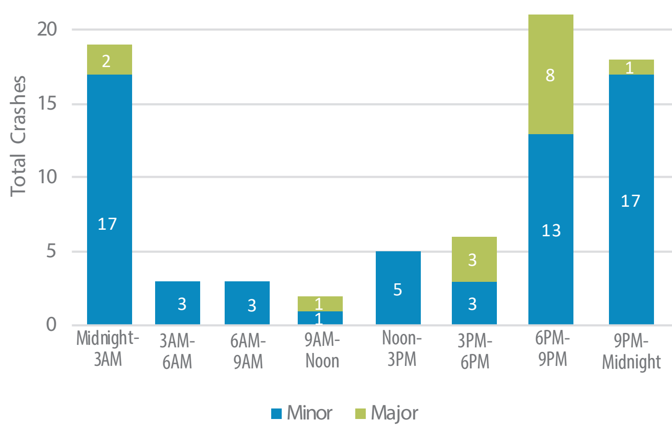


Figure 5-34. Crashes with Pedestrians Under the Influence by Time of Day

Source for Pedestrian Crash Data: 3-Year Dataset

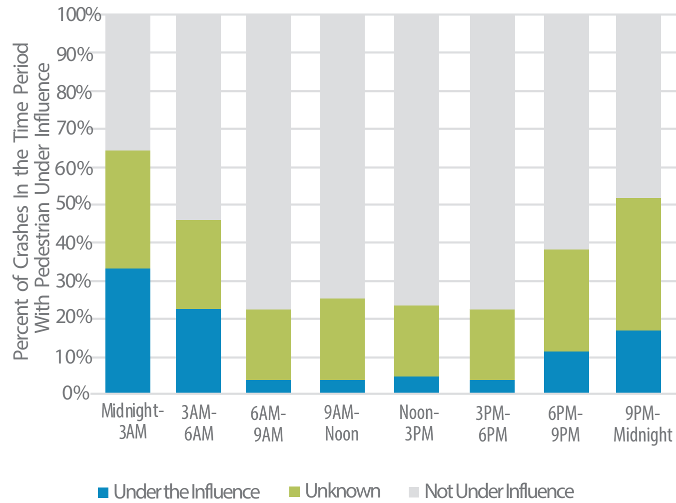


Figure 5-35. Percent of All Pedestrian Crashes with Pedestrians Under the Influence by Time of Day

Source for Pedestrian Crash Data: 3-Year Dataset

Vehicle Pre-Crash Maneuver

Vehicle pre-crash maneuvers describe what the vehicle was doing prior to the crash. These maneuvers do not necessarily indicate fault, explain why the crash occurred, or correlate directly to a crash group. The maneuvers simply give a snapshot into pre-crash locations and movements of the parties involved in the crash.

In Minneapolis, consistent with national trends, pedestrian crashes where the vehicle is making a left-turn are much more common than pedestrian crashes where the vehicle was making a right-turn.

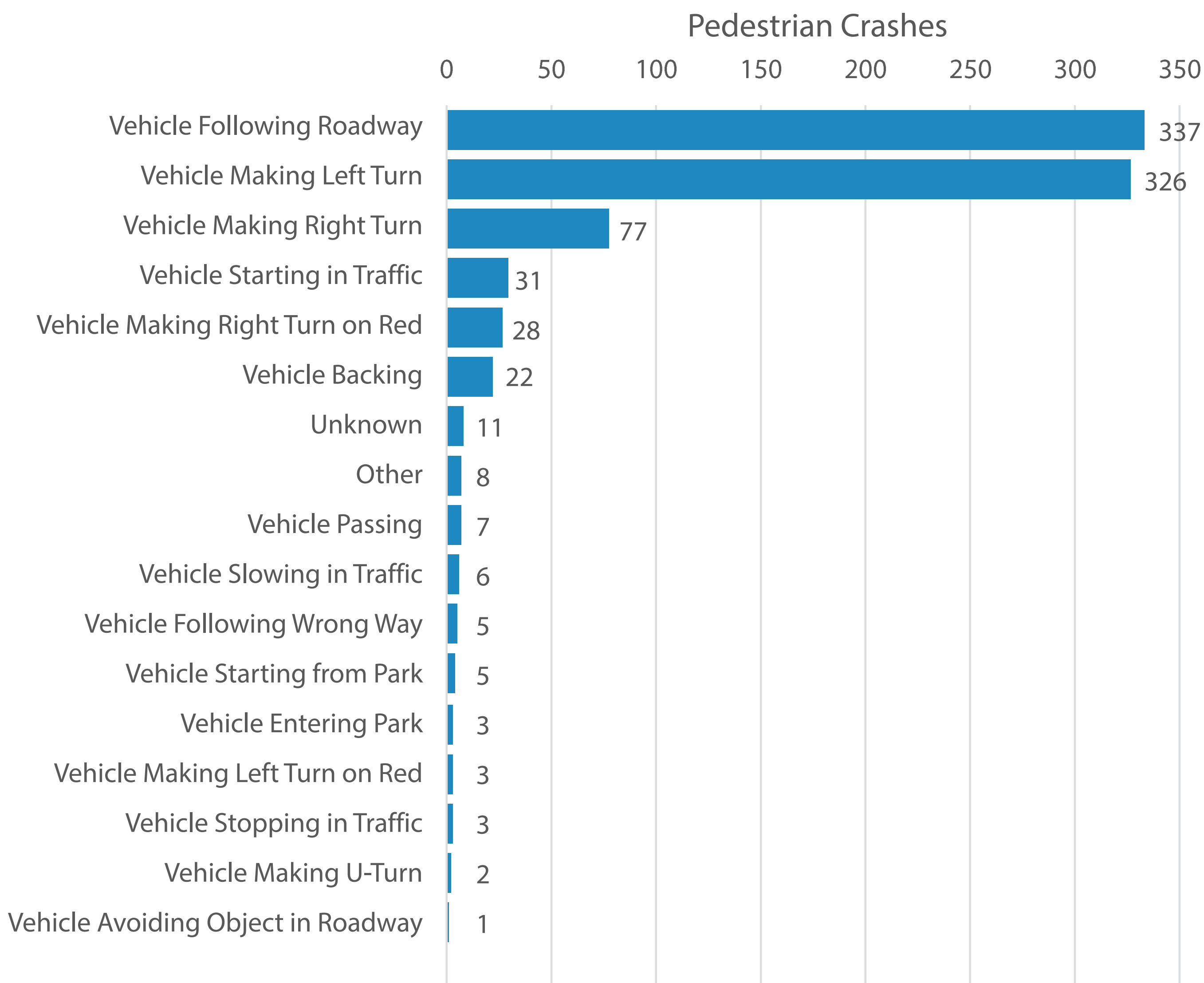


Figure 5-36. Vehicle Movements in Pedestrian Crashes

Source for Pedestrian Crash Data: 3-Year Dataset

Pedestrian Pre-Crash Maneuver

Pedestrian pre-crash maneuvers describe what the pedestrian was doing prior to the crash. These maneuvers do not necessarily indicate fault, explain why the crash occurred, or correlate directly to a crash group. The maneuvers simply give a snapshot into pre-crash locations and movements of the parties involved in the crash.

In Minneapolis, consistent with national trends, pedestrians crossing with a traffic signal and pedestrians darting into traffic are the most common pre-crash maneuvers.

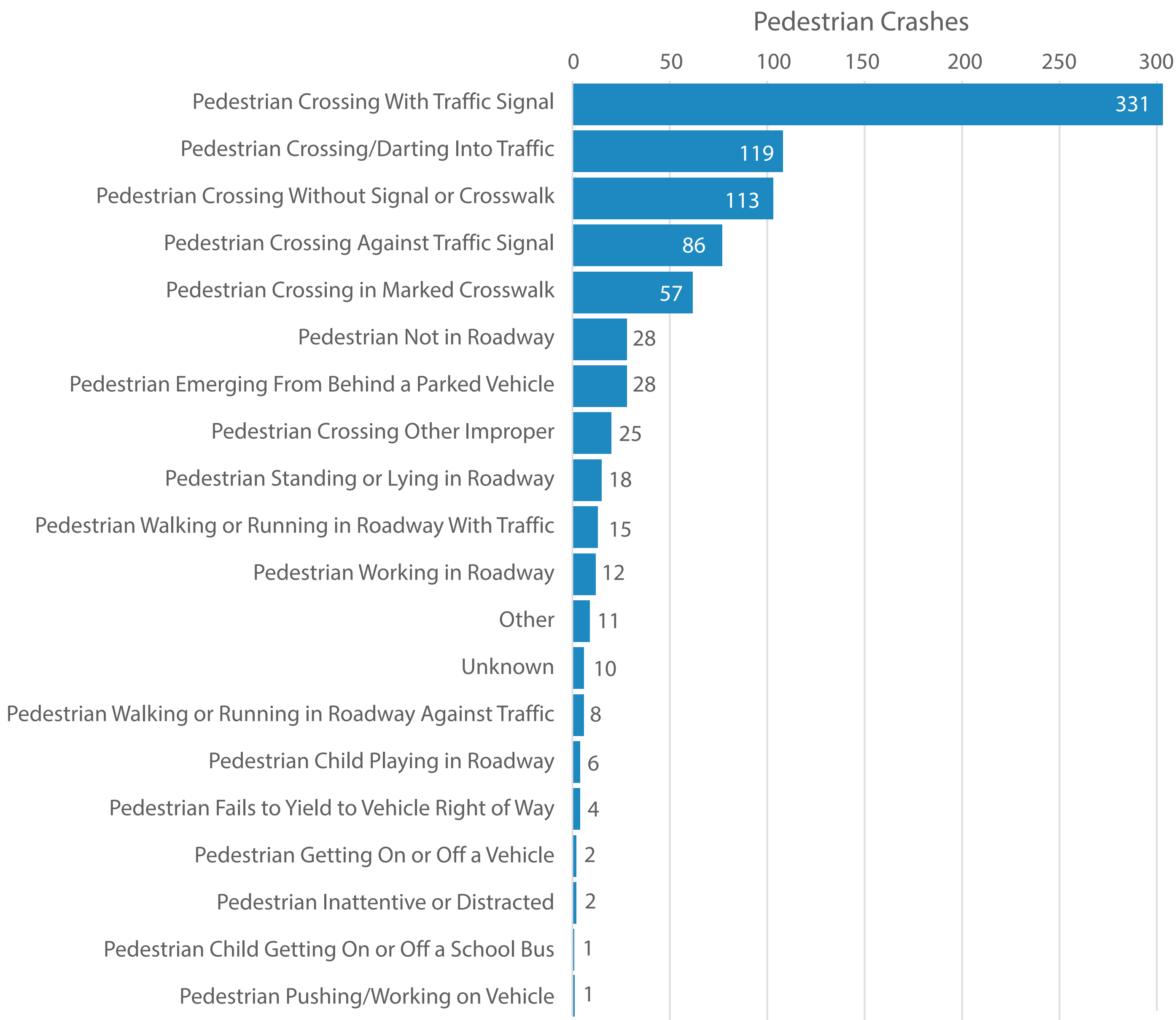


Figure 5-37. Pedestrian Movements in Pedestrian Crashes

Source for Pedestrian Crash Data: 3-Year Dataset

Common Crash Groups

All pedestrian crashes were sorted in crash groups based on the unique combination of contributing factor(s), fault, pre-crash maneuvers, and other circumstances described in its police report. Although each crash is unique, these crash group trends provide a snapshot of types of crashes that are occurring.

Nearly half (47 percent) of pedestrian crashes are due to a turning vehicle. The next two most common crash groups included a vehicle following the roadway (proceeding straight through an intersection or block), and a pedestrian darting into the street.

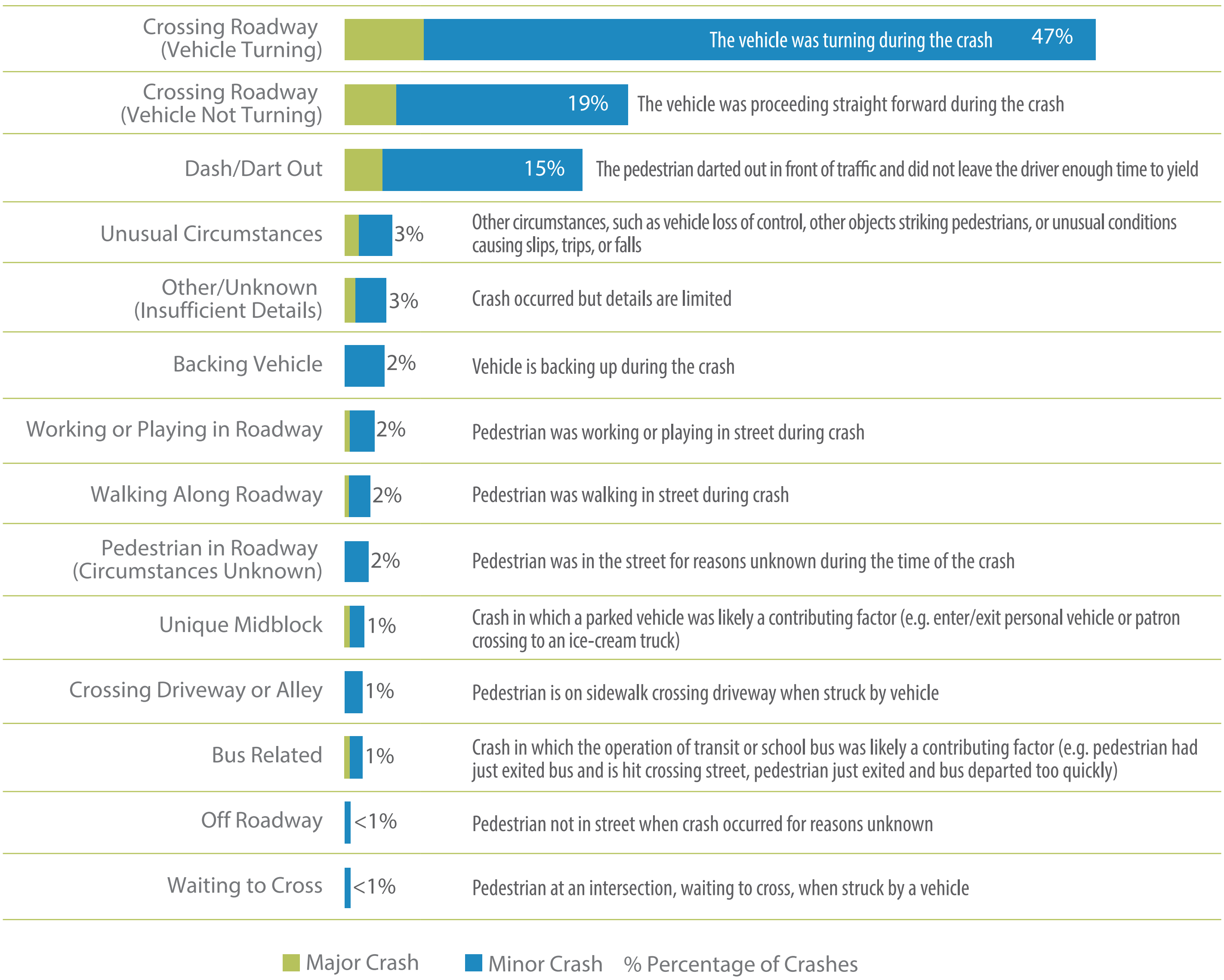


Figure 5-38. Crash Groups for All Pedestrian Crashes

Source for Pedestrian Crash Data: 3-Year Dataset

Serious Injury Crash Groups

Serious injury crashes have the same general trend of crash groups as all pedestrian crashes: turning related crashes are the most common, followed by crashes where the vehicle was following the roadway. However, some crash groups have slightly higher percentages of serious injury crashes. Crashes where the vehicle was crossing the roadway, dash/dart outs, and unusual circumstance crashes have a greater share of the serious injury crashes than they do in all pedestrian crashes.

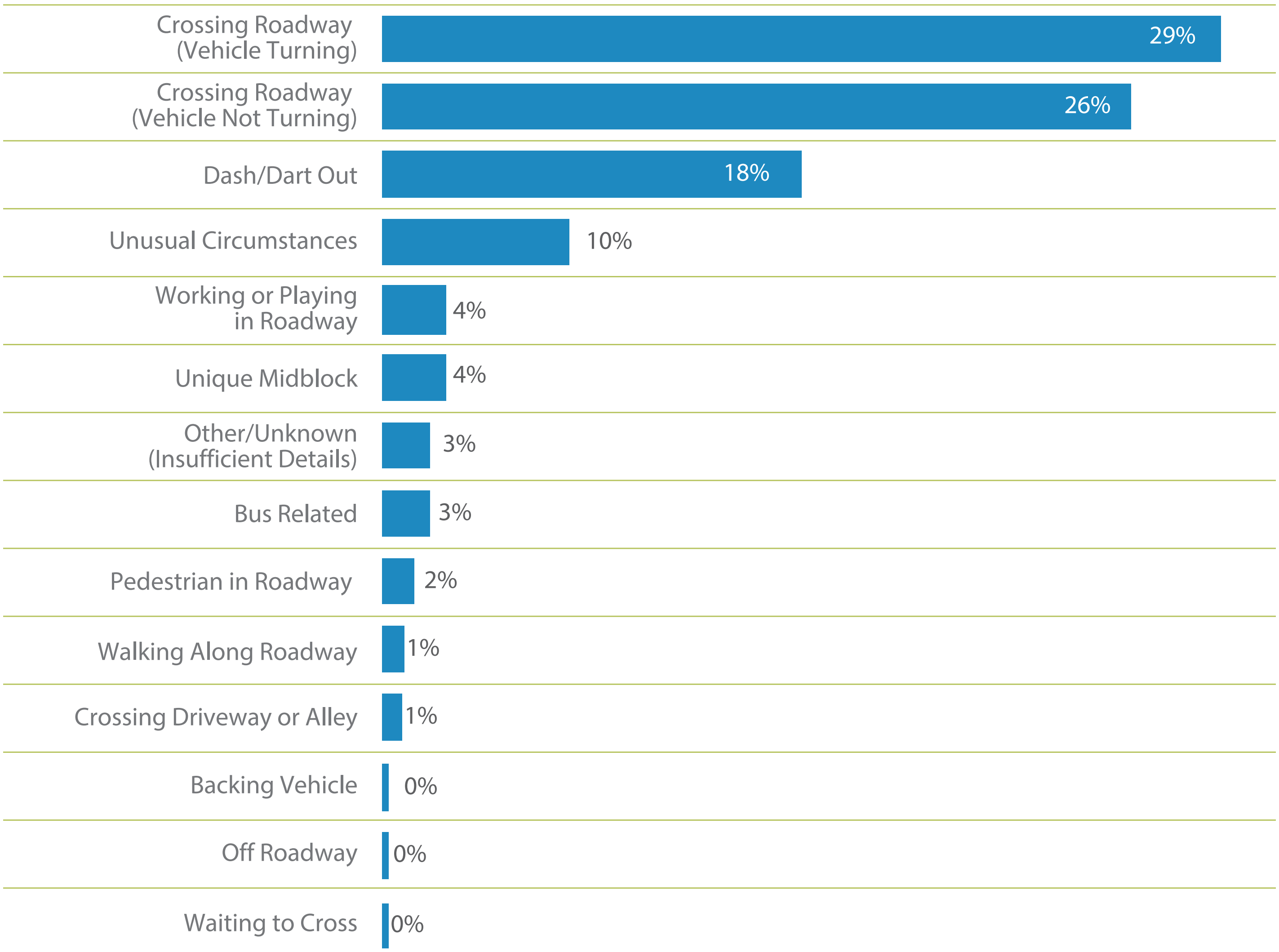
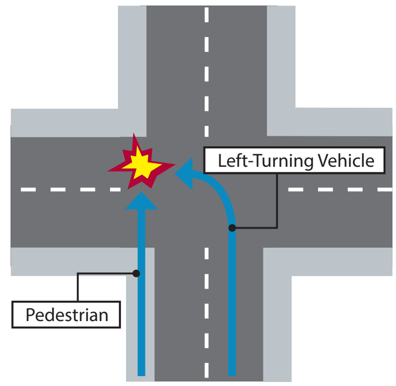


Figure 5-39. Crash Groups for Major Crashes

Source for Pedestrian Crash Data: 3-Year Dataset

Turning Vehicle Crash Types

There is a clear pattern when turning crashes are considered by themselves. Nearly three-quarters of turning movement crashes involve a left-turn parallel path movement. This type of crash occurs when the motorist and pedestrian are initially traveling on the same street (in either opposite or same directions) before the vehicle crosses the path of the pedestrian by making a left turn.



A motorist left-turn parallel path crash occurs when the motorist and pedestrian are initially traveling on the same street in the same direction before the vehicle crosses the path of the pedestrian with a left turn.

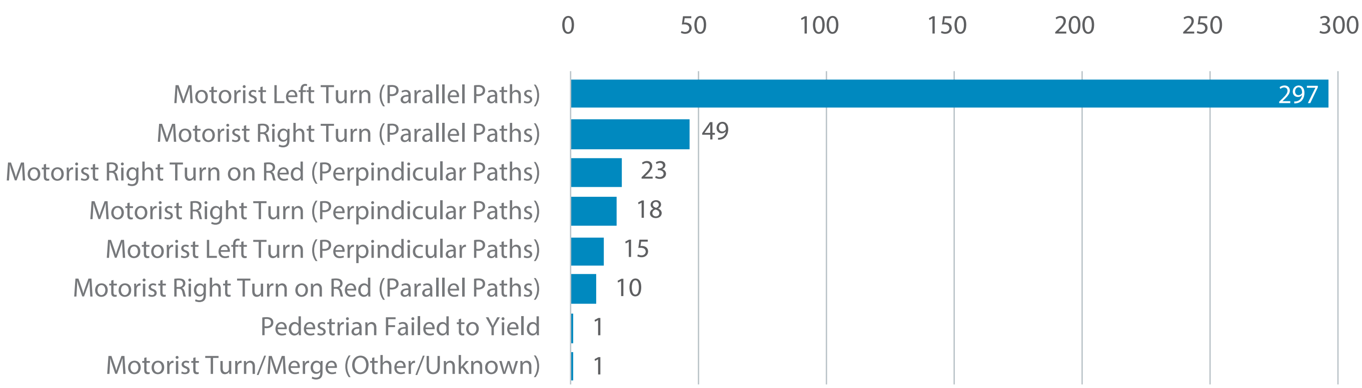


Figure 5-40. Pedestrian Crashes and Turning Vehicle Movements

Source for Pedestrian Crash Data: 3-Year Dataset

Corridor Analysis

This study analyzed four corridors with high numbers of pedestrian crashes. The corridors were evaluated to identify trends as well as areas for potential future study or improvements.

West Broadway Avenue

OVERVIEW

- Estimated Pedestrian Daily Traffic: 1,770 (at Emerson Avenue & West Broadway)
- Automobile Average Daily Traffic: 20,000
- Corridor Length: 0.89 miles
- Crash Rate: 0.8 crashes per million vehicle miles

DESCRIPTION

West Broadway Avenue (West Broadway) between Fremont Avenue and the Mississippi River is a four- to five-lane corridor north of downtown Minneapolis. It is primarily a commercial corridor.

PEDESTRIAN CHALLENGES

West Broadway is a wide corridor with on-street parking and left-turn lanes. High pedestrian volumes combined with high vehicle volumes generate many conflicts. In addition, large turn radii at the interchange of I-94 are particularly unwelcoming for pedestrians. The intersection at Lyndale North and West Broadway should be a priority for further study, as it represented nearly half of the pedestrian crashes in the corridor.

TRENDS

Vehicle movements prior to crashes in the corridor were more varied than city-wide trends. One-third of the crashes involved a left-turning vehicle (compared to half city-wide), and just under one-third involved a through movement.

Table 5-7. West Broadway Pedestrian Crash Types

Vehicle Movement	Crashes	Percentage
Vehicle Making Left Turn	17	33%
Vehicle Making Right Turn	10	19%
Vehicle Following Roadway	15	29%
Other Vehicle Movement	8	15%
Unknown or Other	2	4%
Grand Total	**52**	**100%**

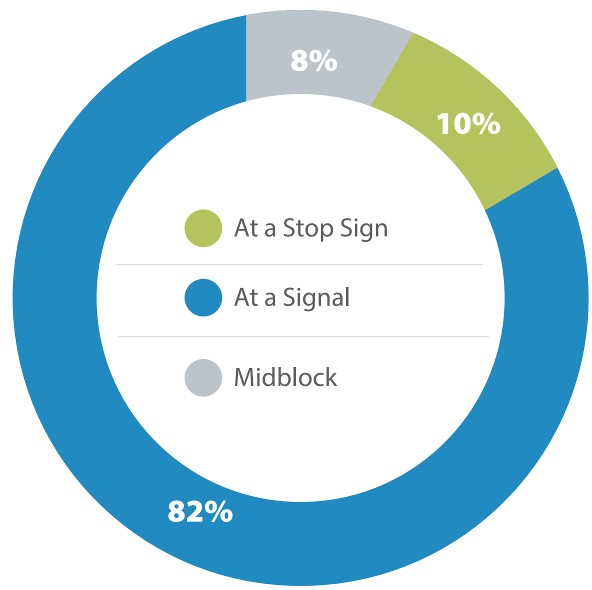


Figure 5-41. West Broadway Pedestrian Crashes by Intersection Control

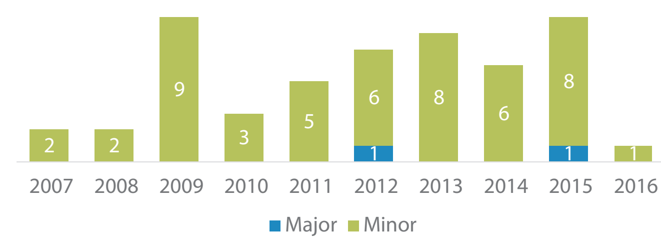


Figure 5-42. West Broadway Pedestrian Crashes by Year

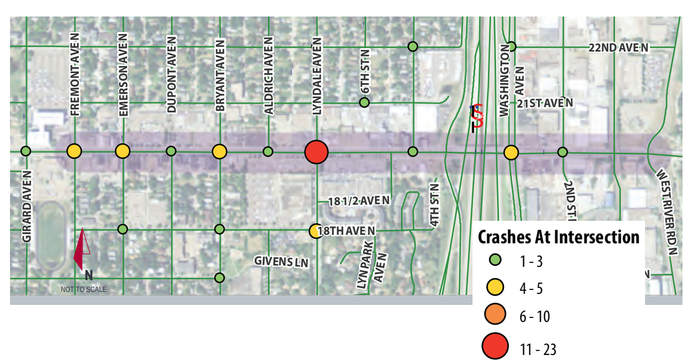


Figure 5-43. West Broadway Pedestrian Crash Locations

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts (2016 Update)
Source for Vehicle Volume Data: City of Minneapolis (2015 AADT)

Franklin Avenue

OVERVIEW

- Estimated Pedestrian Daily Traffic: 1,090
- Automobile Average Daily Traffic: 19,800
- Corridor Length: 0.75 miles
- Crash Rate: 1.8 crashes per million vehicle miles

DESCRIPTION

Franklin Avenue between Nicollet Avenue and Chicago Avenue is a four-lane corridor just south of downtown Minneapolis. It is a well travelled corridor by pedestrians, with many commercial businesses, medium-density housing, and a crossing over Interstate 35W.

PEDESTRIAN CHALLENGES

Many sections of the corridor do not have any buffer between pedestrians and traffic, such as a boulevard or on-street parking. The sidewalks through the corridor are generally narrow and have frequent obstructions such as fire hydrants.

TRENDS

The high intersection density and low number of mid-block crashes indicates that pedestrians are crossing at intersections. Almost every intersection in this corridor has experienced at least one pedestrian crash over 10 years, with signalized intersections having the vast majority of the pedestrian crashes. Similar to city-wide trends, just under half of the crashes in the corridor involve a left-turning vehicle.

Table 5-8. Franklin Avenue Pedestrian Crash Types

Vehicle Movement	Crashes	Percentage
Vehicle Making Left Turn	43	44%
Vehicle Following Roadway	35	36%
Vehicle Making Right Turn	11	12%
Other Vehicle Movement	4	4%
Unknown or Other	4	4%
Grand Total	**97**	**100%**

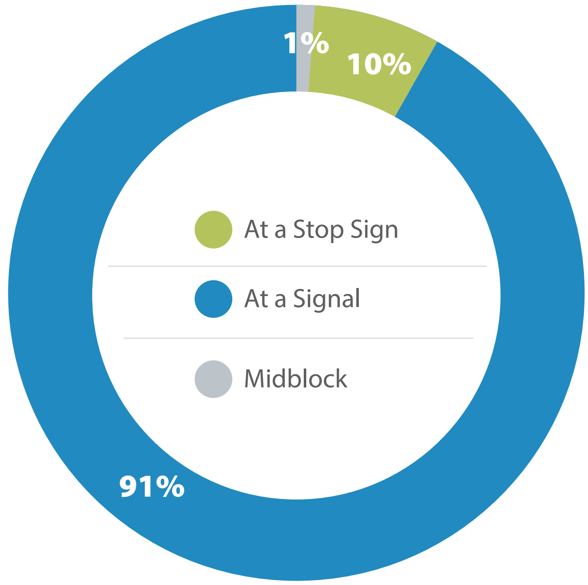


Figure 5-44. Franklin Avenue Pedestrian Crashes by Intersection Control

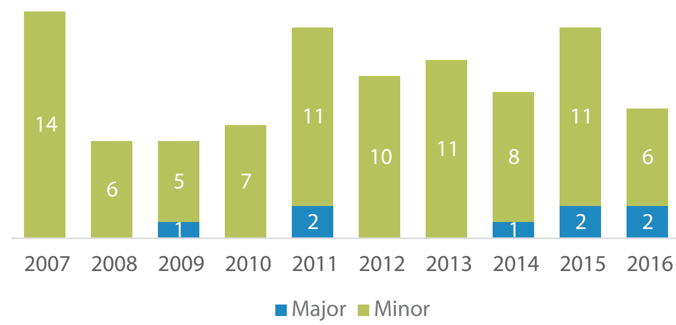


Figure 5-45. Franklin Avenue Pedestrian Crashes by Year

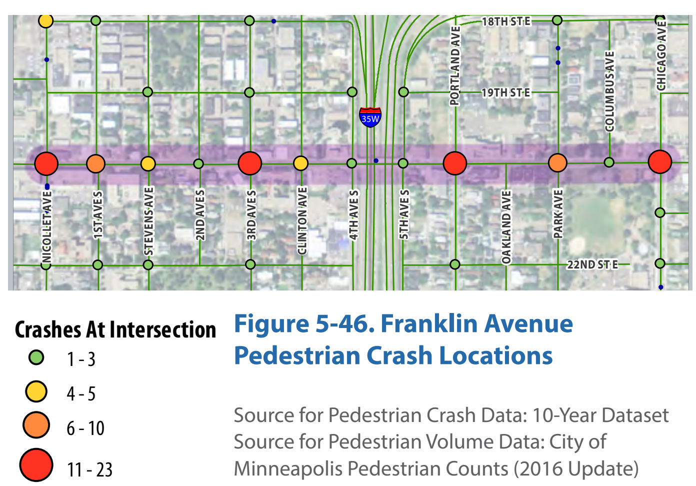


Figure 5-46. Franklin Avenue Pedestrian Crash Locations

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts (2016 Update)
Source for Vehicle Volume Data: City of Minneapolis (2015 AADT)

Cedar Avenue

OVERVIEW

- Estimated pedestrian daily traffic: 500
- Automobile average daily traffic: 17,400
- Corridor length: 0.75 miles
- Crash rate: 0.78 crashes per million vehicle miles

DESCRIPTION

Cedar Avenue between 24th Street East and East Lake Street is a four-lane corridor in the Little Earth area of Minneapolis. The corridor passes several parks, the Midtown Greenway, and many single- and multi-family homes.

PEDESTRIAN CHALLENGES

The long blocks along Cedar Avenue lead to a higher percentage of crossings and crashes at unsignalized locations. Despite the traffic signal and the pedestrian bridge, several crashes have occurred at the mid-block crossing near Cedar Field Park and 25th Street East. The high vehicular volumes also impact the pedestrian experience and safety of those that move along the corridor.

TRENDS

The types of crashes in the Cedar Avenue corridor differ from the trends city-wide. Crashes appear to be more severe on average; this corridor has experienced a major crash most years. Over half of the crashes in the corridor are from through moving vehicles and left-turning crashes are only 30 percent of the crashes, compared to nearly half of crashes city-wide.

Table 5-9. Cedar Avenue Pedestrian Crash Types

Vehicle Movement	Crashes	Percentage
Vehicle Making Left Turn	20	54%
Vehicle Following Roadway	11	30%
Other Vehicle Movement	3	8%
Vehicle Making Right Turn	2	5%
Unknown or Other	1	3%
Grand Total	**37**	**100%**

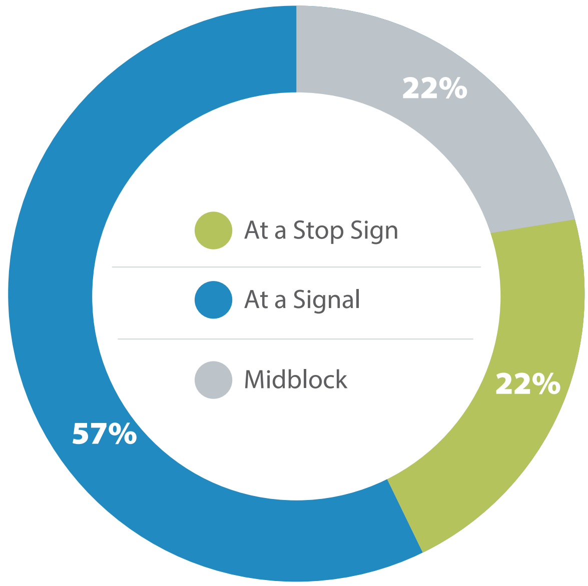


Figure 5-47. Cedar Avenue Pedestrian Crashes by Intersection Control

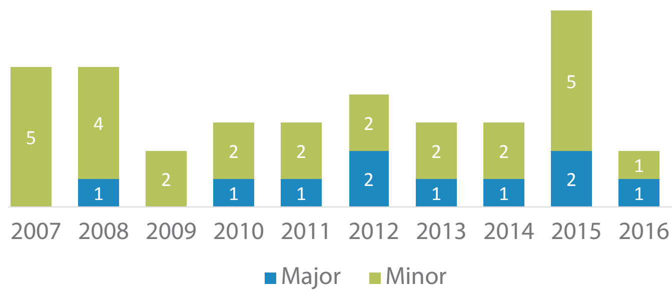
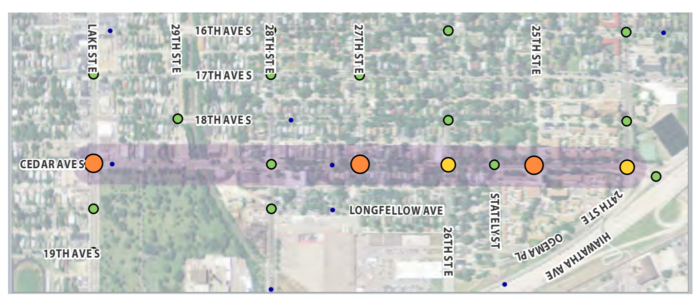


Figure 5-48. Cedar Avenue Pedestrian Crashes by Year



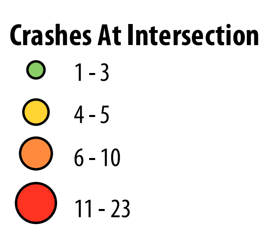


Figure 5-49. Cedar Avenue Pedestrian Crash Locations

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts (2016 Update)
Source for Vehicle Volume Data: City of Minneapolis (2015 AADT)

Lyndale Avenue

OVERVIEW

- Estimated Pedestrian Daily Traffic: 820
- Automobile Average Daily Traffic: 24,000
- Corridor Length: 0.87 miles
- Crash Rate: 0.77 crashes per million vehicle miles

DESCRIPTION

Lyndale Avenue between Franklin Avenue and 29th Street is a four-lane corridor with parking on both sides of the street in the Uptown area of Minneapolis. It is a well traveled corridor by pedestrians, with businesses all along the corridor and medium-density housing.

PEDESTRIAN CHALLENGES

The corridor has high vehicular traffic volumes and signalized crossings are spaced about ¼ mile apart. There are no traffic signals at 25th, 27th and 29th Streets.

TRENDS

Left-turning vehicles were involved in 47 percent of the crashes in this corridor, and most of those crashes involved a parallel path movement between the pedestrian and the vehicle. With high volumes of both pedestrians and vehicles travelling along Lyndale, extra consideration could be given to reducing conflicts between left-tuning vehicles and pedestrians.

Table 5-10. Lyndale Avenue Pedestrian Crash Types

Vehicle Movement	Crashes	Percentage
Vehicle Making Left Turn	28	47%
Vehicle Following Roadway	17	29%
Vehicle Making Right Turn	8	14%
Other Vehicle Movement	3	5%
Unknown or Other	3	5%
Grand Total	**59**	**100%**

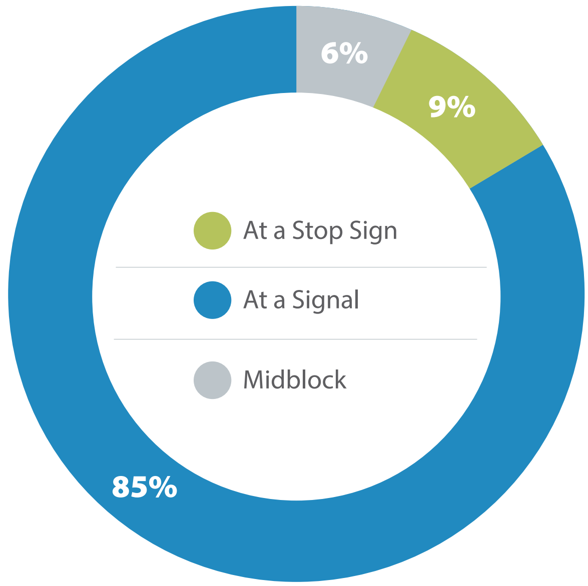


Figure 5-50. Lyndale Avenue Pedestrian Crashes by Intersection Control

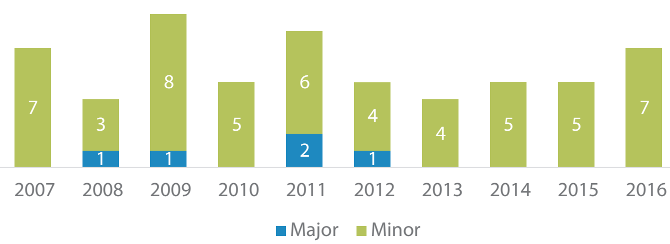
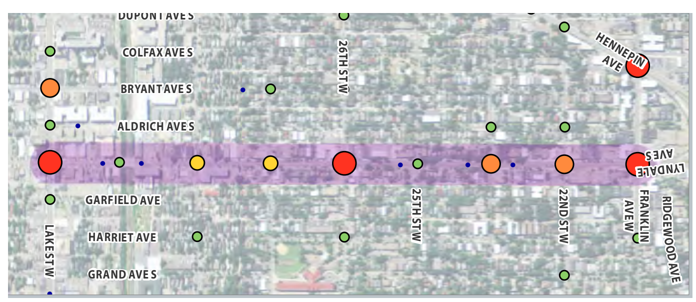


Figure 5-51. Lyndale Avenue Pedestrian Crashes by Year



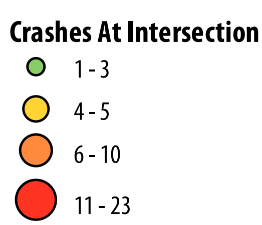


Figure 5-52. Lyndale Avenue Pedestrian Crash Locations

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts (2016 Update)
Source for Vehicle Volume Data: City of Minneapolis (2015 AADT)

6. SAFETY IMPROVEMENT STRATEGIES

The Six E's of Safety

The Six E's of safety - **Engineering, Education, Enforcement, Encouragement, Evaluation, and Equity** are the components of effort to improve pedestrian safety. Based on national, state, and Minneapolis-specific data, pedestrians tend to be at higher risk of injury and death when:

- Crossing at intersections
- Traveling on arterial streets and streets with higher speed limits
- Major left-turning movements conflict with pedestrian routes
- Traffic volumes are highest, specifically during the afternoon rush-hour
- Natural light levels are low, such as at dawn and dusk and in the fall

The following sections summarize some of the key strategies for each one of the E's. These strategies are based on findings from Minneapolis crashes and from trends documented in national studies.

Engineering

Street and intersection design is one of the tools that the city and other agencies will need to employ to reduce pedestrian crashes. Good design improves the comfort of the pedestrian realm and reduces conflicts between pedestrians and other modes. This section suggests several strategies to be considered relative to street design and operation.

Engineering strategies that can help improve pedestrian safety include:

- **Visibility of Crosswalks and Crossings** - While Minnesota State Statute establishes pedestrians' right to cross at any intersection regardless of the presence of a marked crosswalk, marked crosswalks serve as a guide for pedestrians and as a way to communicate pedestrian right-of-way to motorists. Unsignalized marked crosswalks should be considered for additional treatments such as flashers or median refuge.
- **Pedestrian Refuges** - Refuge islands reduce the distance and time that pedestrians are exposed to vehicle traffic. They are best applied where vehicle volumes or number of lanes make crossing difficult.
- **Intersection Radii** - Minimizing corner radii serves to reduce vehicle turning speeds and shorten pedestrian crossings at the intersection.
- **Curb Extensions** – Bumping curbs out at intersections improves the visibility of pedestrians, as well as reducing crossing distance. Where curb extensions are not feasible, parking clearance of 20 to 25 feet from the crosswalk can still be used to make sure drivers and pedestrians can see each other.
- **Road Narrowing** - Fewer lanes and conflict points will help reduce pedestrian crashes. Reduce crossing distances by eliminating lanes when feasible.
- **Leading Pedestrian Interval (LPI)** – A LPI is a signal design feature that gives the walk signal to pedestrians prior to a green light for automobiles. This strategy has the most benefit where there are significant conflicts or crashes with turning vehicles, especially left-turning vehicles.
- **Reducing Speed Limits** – Higher vehicle speeds result in greater chance of a pedestrian crash resulting in a fatality or serious injury.
- **Left Turn Treatments** - When a fully protected left turn phase is not feasible, a Flashing Yellow Arrow can include a protected only phase only when the push button is pressed.
- **Appropriate Design Speeds** - Advocate for lower design speeds to reduce required width and number of lanes and ultimately increase pedestrian comfort.

Narrowing lanes, shortening crossing distances, reducing conflicts with turning vehicles, reducing vehicle speeds, and other traffic calming measures decrease pedestrian fatality and serious injury rates.

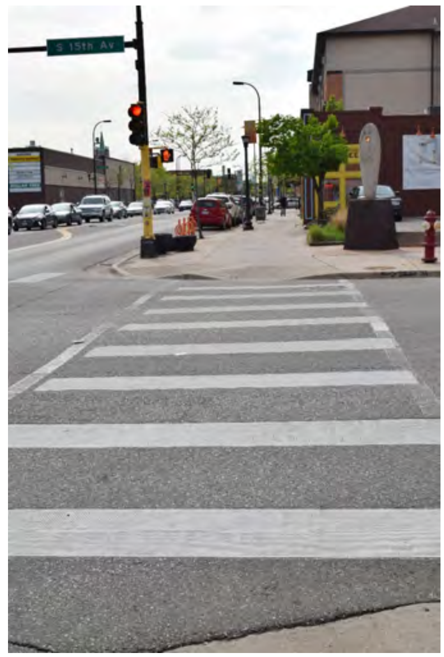


Figure 6-1. Example of Zebra Crosswalk
The intersection of 15th Avenue South and Franklin Avenue has visible, zebra-style crossings that reinforce pedestrian presence.

Desirable | Undesirable

Desirable	Undesirable
Wide pedestrian zone	Narrow pedestrian zone
Small corner radius	Large corner radius
Ample corner space	Little corner space
Straight path of travel	Indirect path of travel

Figure 6-2. Access Minneapolis Design Guidelines for Streets and Sidewalks
The design guidelines in Access Minneapolis note that small corners and straight pedestrian travel paths are preferred over large radii and indirect pedestrian paths.

LEFT TURN LANES PROTECT PEDESTRIANS

Recommendations from the "Left Turn Pedestrian & Bicyclist Crash Study" completed by the New York City Department of Transportation in August 2016

Both Minneapolis and national crash trends showed that drivers turning left are much more likely to be involved in a pedestrian crash than those turning right. The New York City Department of Transportation studied left-turn pedestrian crashes in detail and determined that protected left turn lanes and phases reduce crashes by simplifying the left-turning maneuver and decision-making for drivers. A protected left turn phase eliminates the possibility that a driver will misjudge the gaps in road and sidewalk traffic; the driver simply turns when there is a green arrow. Additionally, left turn lanes reduce the "back pressure" that results when a driver waits to turn left while other drivers who want to move through the intersection are forced to wait behind the turning vehicle.

Education

- **Vulnerable Populations** - Education campaigns should take age into consideration. Seniors are more likely to be involved in a crash during the day time, while younger people are more likely to be involved in a crash at night.
- **Distracted Driving** - Education campaigns should address driver inattention and failure to yield, which are frequent contributing factors to pedestrian crashes.
- **Pedestrians Under the Influence** - Because pedestrians under the influence are at a higher risk for a major crash, education campaigns could highlight actions that pedestrians can take to increase their own safety.
- **Safe Routes to School** - Programs like Safe Routes to School can be used to teach children lifelong safe walking practices.

Enforcement

- **Failure to Yield** - This was the primary cause of pedestrian crashes in Minneapolis. Targeted enforcement at high-crash intersections can help draw attention to the issue, especially in spring when the number of pedestrians increases, and in fall when there are fewer daylight hours.
- **Speeding** - Yielding to pedestrians is more challenging when drivers speed and crash severity increases at higher vehicle speeds. Enforcing safe travel speeds may reduce the number and severity of pedestrian crashes.
- **Tougher Prosecution and Sentencing** - Prosecution of drivers at fault in pedestrian crashes and tougher sentences on drivers may result in more awareness of the issue and more cautious driving.

Encouragement

- **Neighborhood Events** - Ongoing support of Open Streets, neighborhood events, and temporary installations such as parklets encourage people to walk in their neighborhoods.
- **Pedestrian Realm** - Creation of inviting spaces in public right-of-way or by adjacent property owners enhances the pedestrian experience and can create a buffer from traffic.
- **Land Use and Zoning** - Walking is encouraged by pedestrian-friendly land use policies such as mixed-use zoning, minimal setbacks, and lower parking requirements.

Evaluation

- **Before/After** - Follow-up studies after implementation of safety measures are key to identify the most effective treatments.
- **Monitoring** - Tracking pedestrian volume and crash data over time will allow the city to identify and address evolving trends and needs.

Equity

- **ACP50s** - Prioritize improvements in ACP50s and in areas that have disproportionate numbers of crashes to the population that lives there.
- **High Pedestrian Activity Areas** - Prioritize engineering improvements in the areas with the most pedestrians in order to have the largest impact on the pedestrian mode.

APPENDIX A. NATIONAL PEDESTRIAN STUDY REVIEW

This chapter is a review of pedestrian crash trends in Minnesota and across the United States. This review relies primarily on information from published federal, state, and local crash and safety studies. Crash trends, current research, and best practices are gleaned from these reports and applied as applicable to the Minneapolis Pedestrian Crash Study.

Studies Considered

Nine studies were reviewed to inform the Minneapolis Pedestrian Crash Study. These studies vary in date, data used, purpose, and audience. Four of the reports provide national trends and/or compare pedestrian crashes between geographic areas. Four of the reports provide an in-depth look at pedestrian crash trends within a large city. One of the reports provides a review of pedestrian crashes across Minnesota. This section provides an overview of each report in terms of purpose and methodology. The results and findings of the reports are synthesized together in the Findings section. The reports reviewed are summarized in **Table A-1**.

Table A-1. Reports Reviewed for the Minneapolis Pedestrian Crash Study

Report Title	Year	Author/Agency	Geographic Scope
Strategic Agenda for Pedestrian and Bicycle Transportation	2016	Federal Highway Administration	National
Dangerous by Design 2016	2016	Smart Growth America	National
Bicycling & Walking in the United States Benchmarking Report	2016	Alliance for Biking and Walking	National
Pedestrian Traffic Fatalities by State	2017	Governors Highway Safety Association	National
Minnesota Motor Vehicle Crash Facts	2015	Minnesota Department of Public Safety	Statewide
City of Chicago Pedestrian Crash Analysis Summary Report	2011	Chicago Department of Transportation	City
New York City Pedestrian Safety Study & Action Plan	2010	New York City Department of Transportation	City
Don't Cut Corners: Left Turn Pedestrian & Bicycle Crash Study	2016	New York City Department of Transportation	City
Seattle 2015 Traffic Report	2015	Seattle Department of Transportation	City
City of Seattle Bicycle and Pedestrian Safety Analysis	2016	Seattle Department of Transportation	City

Strategic Agenda for Pedestrian and Bicycle Transportation

- Author: U.S. Department of Transportation Federal Highway Administration
- Year Published: 2016

The United States Department of Transportation (USDOT) Federal Highway Administration's (FHWA) Strategic Agenda for Pedestrian and Bicycle Transportation (The Agenda) is a policy and investment framework for pedestrian and bicycle initiatives through 2021. The Agenda articulates goals and supporting actions to promote safe, accessible, comfortable, and connected bicycle and pedestrian networks; ensure the safety of nonmotorized travelers; ensure equitable access for everyone to jobs, schools, and essential services; and to expand transportation options and choices for all. The Agenda establishes two national goals:

- Achieve an 80 percent reduction in pedestrian and bicycle fatalities and serious injuries in 15 years and zero pedestrian and bicycle fatalities and serious injuries in the next 20 to 30 years.
- Increase the percentage of short trips represented by bicycling and walking to 30 percent by the year 2025. Short trips are defined as trips five miles or less for bicyclists and one mile or less for pedestrians.

The majority of the document outlines the actions the FHWA will take to achieve those two goals.

Dangerous by Design 2016

- Author: Smart Growth America
- Year Published: 2017

Smart Growth America's Dangerous by Design is a report that ranks the 104 largest metro areas in the country (which includes the Minneapolis-Saint Paul-Bloomington region) by a "Pedestrian Danger Index," or PDI. PDI is a calculation based on the share of local commuters who walk to work and the most recent data on pedestrian deaths. First developed in the 1990s by the Surface Transportation Policy Partnership and used more recently by Smart Growth America's Transportation for America program, PDI is the rate of pedestrian deaths relative to the number of people who walk to work in the region. The 2016 report is the fourth edition of this study. Measuring danger as a rate, and not an absolute count, corrects for cities that may have higher numbers of deaths simply as a function of higher numbers of people on foot overall. For the first time, the 2016 update to this study includes a racial and income-based examination of pedestrian fatalities through the use of Fatality Analysis Reporting System (FARS) and American Community Survey (ACS) data.

Bicycling & Walking in the United States Benchmarking Report

- Author: Alliance for Biking & Walking
- Year Published: 2016

The Alliance for Biking & Walking has been tracking biking and walking data across the U.S. through the Benchmarking Project since 2003. Every two years, the project team releases an updated report with the most recent data available. This report collects and compares data between states and between the 50 most populous cities – including Minneapolis. The data used includes national sources managed by public agencies and state and city surveys.

Pedestrian Traffic Fatalities by State

- Author: Governors Highway Safety Association
- Year Published: 2017

The Governors Highway Safety Association releases an annual Pedestrian Traffic Fatalities by State report. The most recent report estimated the number of nationwide pedestrian fatalities in 2016 by applying historical seasonal trends to preliminary data from the State Highway Safety Offices for the first six months of 2016. The report analyzes and compares state-level data on fatalities and details actions taken by selected states to improve pedestrian safety.

Minnesota Motor Vehicle Crash Facts

- Author: Minnesota Department of Public Safety
- Year Published: 2016

The Minnesota Motor Vehicle Crash Facts summarizes the crashes, deaths, and injuries that occurred on Minnesota roadways during 2015 (the most recent full-year data available). The report details historical information on crashes statewide, factors contributing to crashes, and details many of these crash trends by mode. This summary only considers the information presented for the pedestrian crashes.

New York City Pedestrian Safety Study & Action Plan

- Author: New York City Department of Transportation
- Year Published: 2010

The New York City Pedestrian Safety Study and Action Plan reports the results of an analysis of over 7,000 pedestrian crashes and recommends actions to improve pedestrian safety. The study modeled crash frequency to understand factors impacting high-frequency crash locations using mapping software and statistical analysis tools. The study also modeled crash severity to understand why some crashes resulted in fatalities while others resulted in severe injuries.

The primary dataset used in the study included all New York City fatal and serious injury pedestrian/vehicle crashes from 2002 to 2006. The researchers relied heavily on crash data from the New York State Department of Transportation (NYSDOT), which was derived from police officer reports. Severe injuries were classified according to NYSDOT criteria.

Don't Cut Corners: Left Turn Pedestrian & Bicycle Crash Study

- Author: New York City Department of Transportation
- Year Published: 2016

New York City Department of Transportation (DOT) developed the Left Turn Pedestrian and Bicycle Crash Study to advance New York City's Vision Zero Initiative to eliminate traffic deaths and serious injuries.

In line with the Vision Zero Pedestrian Safety Action Plans, this study utilizes a data-driven approach to examine crashes. DOT took an exhaustive look at the problem of left turn pedestrian and bicyclist injuries (including fatalities) in New York City, querying five years of citywide crash data, manually reviewing 1,105 crash reports drawn from the most problematic locations citywide, and analyzing 478 intersections where treatments were installed. The study relies on these findings to provide recommendations for additional engineering, planning, and education efforts to prevent and mitigate left turn failure to yield pedestrian and bicyclist injuries.

City of Chicago Pedestrian Crash Analysis Summary Report

- Author: Chicago Department of Transportation
- Year Published: 2011

The Chicago Department of Transportation (CDOT) used data from the Illinois Department of Transportation to analyze all crashes in Chicago from 2005 to 2009 involving a pedestrian and a motor vehicle, where the first point of contact for the vehicle was a pedestrian. The analysis included information on all pedestrians involved in the crash, not just the pedestrian first hit. The results of the analysis helped to inform the development of Chicago's Pedestrian Plan and public awareness campaign.

City of Seattle Traffic Report

- Author: Seattle Department of Transportation
- Year Published: 2015

The City of Seattle releases an annual report on traffic trends in the city every year. This comprehensive report has information on all modes. The report summarizes volumes, speeds, collisions, and other data such as contributing factors when possible.

City of Seattle Bicycle and Pedestrian Safety Analysis

- Author: Seattle Department of Transportation
- Year Published: 2016

City of Seattle Bicycle and Pedestrian Safety Analysis analyzed bicycle and pedestrian crashes that occurred from 2007 to 2014 to identify problems to address through street design and traffic operations. Information such as crash type, actions of people walking, biking, or driving, and roadway configuration were considered to understand the relationship between where, how, and to the extent possible, why crashes happen. The analysis explored factors contributing to all pedestrian and bicycle crashes across the city and the most common factors associated with higher rates of severe crashes (i.e., fatal or serious injury).

Findings

Pedestrian Fatalities

NATIONAL TRENDS

The Bicycling & Walking in the U.S. 2016 Benchmarking Report noted that while the national pedestrian fatality rate has declined greatly since the 1980, there has been a recent upward trend post-2009 (**Figure A-1**).

The Strategic Agenda concurred that the steady downward trend of non-motorized fatalities through the 1990s and early 2000s has reversed and that incidents of nonmotorized traveler fatalities have gone up every year since 2009 (**Figure A-3**).

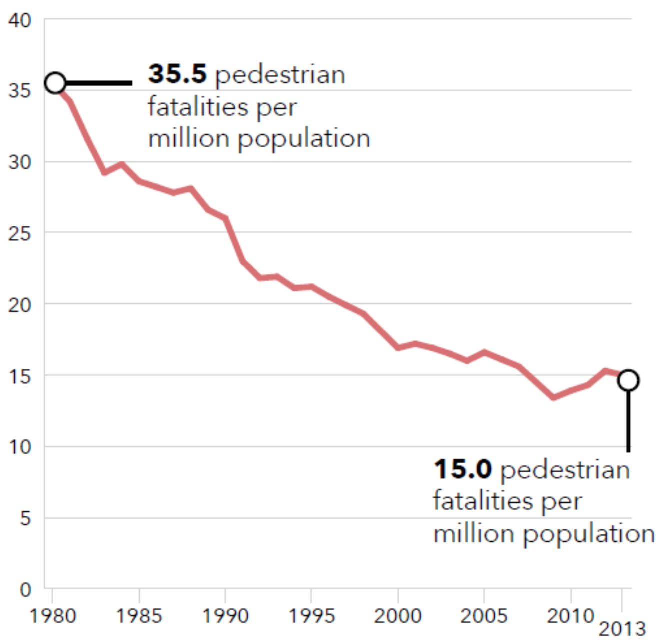


Figure A-1. Pedestrian Fatality Rate 1980 - 2013

Data Source: FARS, ACS, 1980 - 2013; Originally pulled from Bicycling & Walking in the U.S. 2016 Benchmarking Report

The Pedestrian Traffic Fatalities by State report found that pedestrian fatalities increased by 25 percent from 2010 to 2015 and account for a steadily increasing percentage of total traffic fatalities. It estimates that fatalities in 2016 increased 11 percent over 2015. Thirty-four states saw increases in fatalities and fifteen states had decreases.

The percentage of trips taken by a non-motorized mode is also increasing. According to the National Household Travel Survey (NHTS), in 2009 there were 41 billion pedestrian trips and 4.1 billion bicycle trips. Combined, this represented 11.5 percent of all trips. This is an increase from 36.5 billion trips (9.5 percent of all trips) in 2001 and 23.7 billion trips (6.25 percent of all trips) in 1995. The two studies together suggest that fatalities are increasing at a greater rate than growth in walking/biking.

STATE TRENDS

The Bicycling & Walking in the United States 2016 Benchmarking Report noted that, when analyzed in three-year periods, pedestrian fatalities across Minnesota have marginally declined over the last decade. There were 115 statewide pedestrian fatalities from 2005–2007. That number dropped to 102 in 2008–2010, but then rose to 109 in 2011–2013.

Compared to other states, Minnesota's pedestrian fatality rate is low. The Pedestrian Traffic Fatalities by State report found that at 0.75 pedestrian fatalities per 100,000 population in 2015, Minnesota had the fourth lowest fatality rate in the country. However, pedestrian fatalities in Minnesota in the first six months of 2016 increased 64 percent over the first six months of 2015, from 14 to 23 deaths.

The Minnesota Motor Vehicle Crash Facts noted the significant rise in pedestrian crashes between 2014 and 2015. As stated in that report, there were 911 crashes that involved at least one pedestrian in Minnesota in 2015. This is an 11 percent increase from 2014 and is the highest level since 2007. Pedestrian fatalities statewide also increased between 2014 and 2015 (**Figure A-2**). Crash Facts also noted the injury severity discrepancy between pedestrian crashes and other traffic crashes. In 2015, nearly five percent of all pedestrian crashes resulted in a death; one-half of one percent of all traffic crashes resulted in a death in that same year.

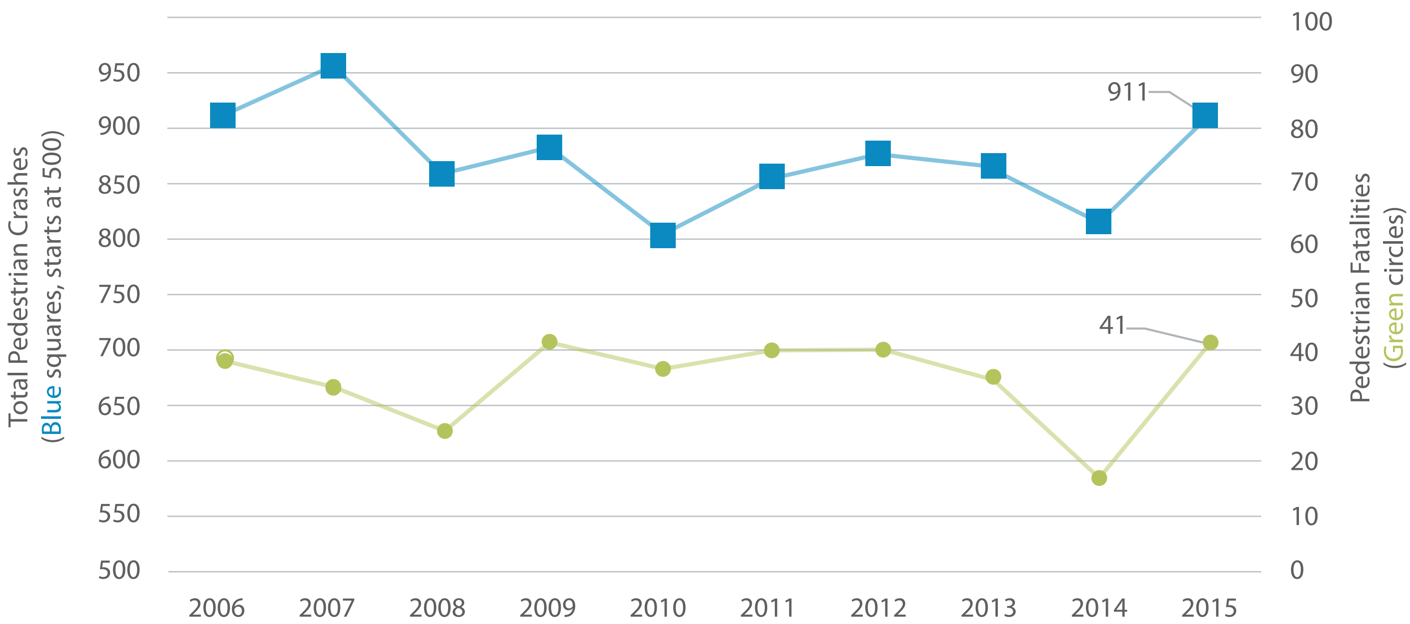


Figure A-2. Pedestrian Crashes and Fatalities in Minnesota, 2006–2015

Figure adapted from Minnesota Motor Vehicle Crash Facts (2015) data

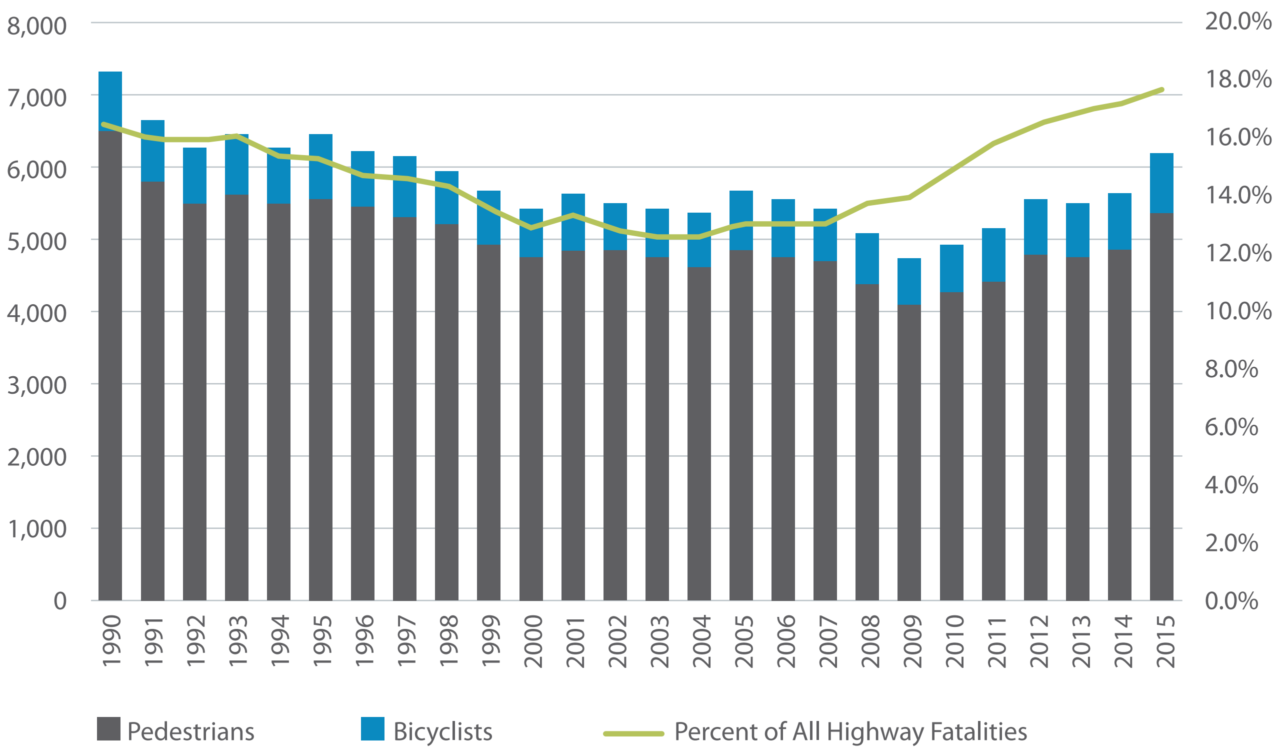


Figure A-3. United States Pedestrian and Bicycle Fatalities, 1990–2015

Figure originally from the Strategic Agenda, data from the National Highway Traffic Safety Administration

CITY TRENDS

NEW YORK CITY

As stated in the New York City Pedestrian Safety Study & Action Plan, New York City has seen a 63 percent decrease in all traffic fatalities between 1990 and 2009, and pedestrian fatality and injury rates dropped about 40 percent from the 1990s to the 2000s. While significant progress has been made, the New York City Department of Transportation aims to further reduce traffic fatalities by 50 percent by 2030.

In 2009, New York City's pedestrian fatality rate was 1.8 per 100,000 residents. 52 percent of those killed in crashes from 2005–2009 were pedestrians. When involved in a crash, pedestrians were 10 times more likely to be killed than those traveling in cars.

CHICAGO

As stated in the City of Chicago 2011 Pedestrian Crash Analysis Summary Report, the absolute number and rate of pedestrian crashes and fatalities fell between 2005 and 2009. In 2005, there were 121 pedestrian crashes per 100,000 residents. In 2009, that number fell to 110 crashes per 100,000 residents.

SEATTLE

Pedestrian crashes in Seattle have been generally decreasing since 2006. Data from the 2014 Traffic report data shows that 2009 was the worst year for Seattle pedestrians in the recent past with 11 fatalities.

MINNEAPOLIS

In addition to analyzing statewide trends, The Bicycle & Walking in the U.S. 2016 Benchmarking Report also compared trends in large cities. The report's data indicated that pedestrian fatalities have been marginally increasing relative to its population growth in Minneapolis over the last decade.

In addition to analyzing trends over time, The Bicycle & Walking in the U.S. 2016 Benchmarking Report also compared trends between the largest U.S. cities. Minneapolis tied for the fifth lowest pedestrian fatality rate for walking commuters of the 51 largest cities between 2005 and 2013 (**Figure A-4**). Data for the 52 cities studied in this report indicate an inverse relationship between walking levels in a city and pedestrian fatality rates. In other words, cities with the highest rates of pedestrian fatalities are among those with the lowest levels of walking.

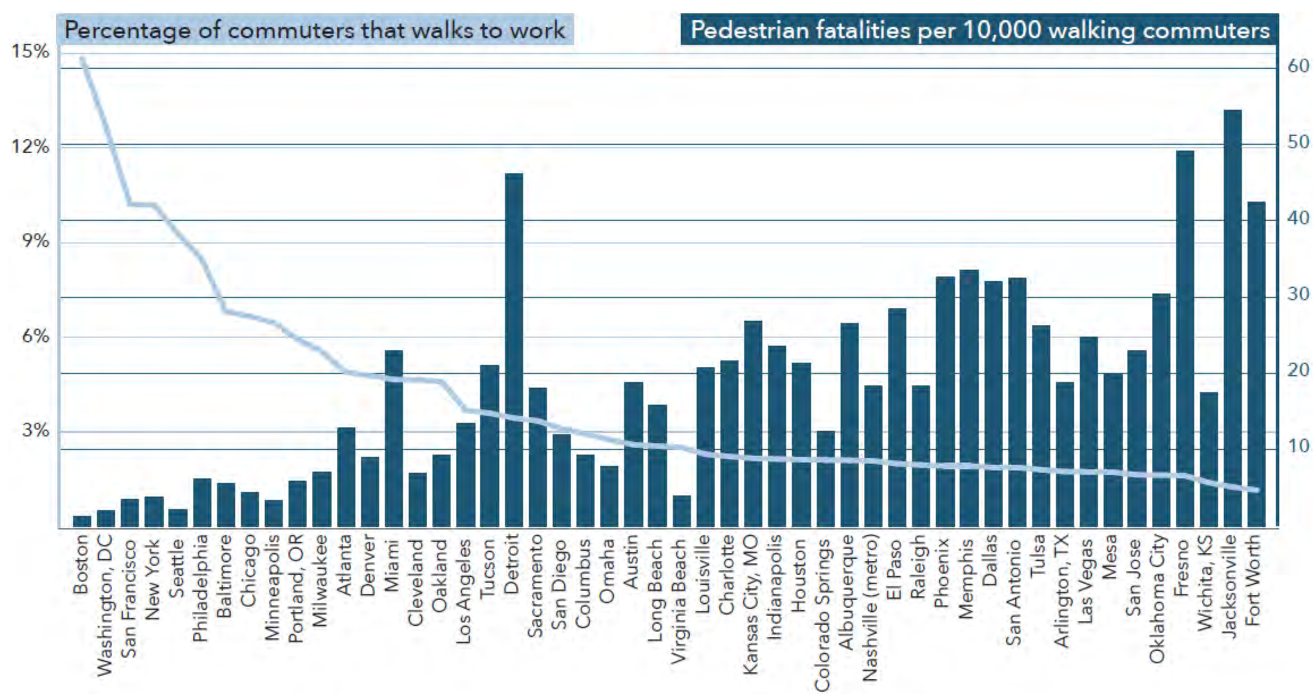


Figure A-4. City Walking and Pedestrian Fatality Rates

An inverse relationship exists between walking levels in a city and pedestrian fatality rates.

Data from FARS, ACS. Source: Bicycling and Walking in the United States 2016 Benchmarking Report

A possible explanation is that in places where more bicyclists and pedestrians are present, motorists are accustomed to sharing the roadways with bicyclists and are more aware of pedestrians at crossings. However, the infrastructure, such as signed routes, bike lanes, and sidewalks that contribute to increased bicycling and walking also likely contribute to increased safety.

The Dangerous by Design report concurs that the Minneapolis metro area is relatively safe for pedestrians when compared to other large cities. The weighted average PDI for all 104 metro areas included in the analysis is 64.1. The Minneapolis metro area had a PDI of 28.7 and ranked 91st of the largest 104 metro areas on PDI. Because higher PDI numbers correspond to higher rates of pedestrian deaths, being low on the list indicates a safer city for pedestrians.

The Dangerous by Design report noted that most metro areas' PDIs have improved since 2014. Thirty out of 51 metro areas had lower PDIs in 2016 compared to 2014. The Minneapolis-Saint Paul metro area was consistent with that trend; the region's PDI decreased four percentage points between 2014 and 2016 (**Table A-2**).

Table A-2. 2011–2016 Minneapolis Area PDI

Metro Area (MSA)	2011 PDI	2014 PDI	2016 PDI	Change in PDI since 2014
Minneapolis-St. Paul-Bloomington, MN-WI	35.1	32.2	28.7	-4.0

Source: Adapted from Dangerous by Design (2016)

Demographics

Seniors, people of color, and low-income populations are disproportionally represented among pedestrians in crashes compared to their representation of the population. Even after controlling for the relative amounts of walking among these populations, as was done in the Dangerous by Design report, the risks continue to be higher for people of color and older adults—indicating that these people most likely face disproportionately unfavorable conditions for walking.

AGE

YOUTH

- The Bicycling & Walking in the U.S. 2016 Benchmarking Report notes that people under the age of 18 made up 21 percent of the population of the state of Minnesota between 2005 and 2013, but comprised 10 percent of pedestrian fatalities.

SENIORS

- The Bicycling & Walking in the U.S. 2016 Benchmarking Report notes that seniors made up 14 percent of the population of Minnesota between 2005 and 2013 but comprised 24 percent of the pedestrian fatalities.
- The Dangerous by Design report notes that adults 65 years and older are at higher risk of being struck and killed by a car while walking than people in other age groups.
- Seniors were disproportionately impacted by crashes in the New York City Pedestrian Safety Study, accounting for 38 percent of pedestrian fatalities and 28 percent of severe injuries but only 12 percent of the population.
- The Chicago Pedestrian Crash Analysis report noted that seniors had a low overall crash rate but were overrepresented in fatal and serious injury crashes.

GENDER

Men are more likely to be both drivers and pedestrians in pedestrian crashes. While this holds true statewide and nationwide, the trend is even more pronounced in New York: the majority of pedestrian crash victims in every age category were male, with the greatest gender disparity for males under age 13.

- As stated in Minnesota Motor Vehicle Crash Facts 2015, males accounted for 68 percent of all pedestrian fatalities and 53 percent of pedestrian injuries in Minnesota.
- In the New York City Pedestrian Safety Study, 80 percent of crashes involved male drivers, with the likelihood of crashes peaking for men from age 40-49 and spiking again over age 80.
- In the Chicago Pedestrian Crash Analysis report, nearly 65 percent of drivers were male (in crashes where the driver's gender was known).
- Male pedestrians in Chicago were overrepresented in crashes but not to the same extent as males nationwide (52 percent of crashes in Chicago versus 69 percent nationwide). The greatest gender disparity in crashes was in the 0 to 4 and 5 to 14 age groups, where male pedestrian crash rates greatly exceeded female crash rates.

PEOPLE OF COLOR

- The Bicycling & Walking in the U.S. 2016 Benchmarking Report notes that people of color or of Hispanic/Latino origin made up 18 percent of the population between 2005 and 2013 but comprised of 21 percent of the pedestrian fatalities.
- The Dangerous by Design report notes that people of color, particularly Native Americans and African Americans, are at higher risk of being struck and killed by a car while walking than people in other demographics (**Figure A-5**).
- The New York City Pedestrian Safety Study found that neighborhoods with higher percentages of Black and Hispanic residents experienced higher crash rates, but Black and Hispanic pedestrians were not involved in more fatal pedestrian crashes than average. The study notes that this suggests that the problem stems from dangerous environmental conditions and driver behavior in certain localities, rather than the actions of Black and Hispanic pedestrians. Foreign-born residents account for 36 percent of residents but 51 percent of fatalities.
- The breakdown of pedestrian fatalities by race aligned closely with the racial makeup of Chicago's population as stated in the Chicago Pedestrian Crash Analysis report. Black pedestrians were slightly overrepresented (34 percent of the overall population but 36 percent of fatal crashes.)

INCOME

- The Bicycling & Walking in the U.S. 2016 Benchmarking Report found that census tracts with higher poverty rates had four times as many pedestrian crashes as census tracts with lower poverty rates.
- The analysis done by Smart Growth America in the Dangerous by Design report showed that the lower a metro area's median household income, the more likely it is that its residents will be killed by cars while walking.

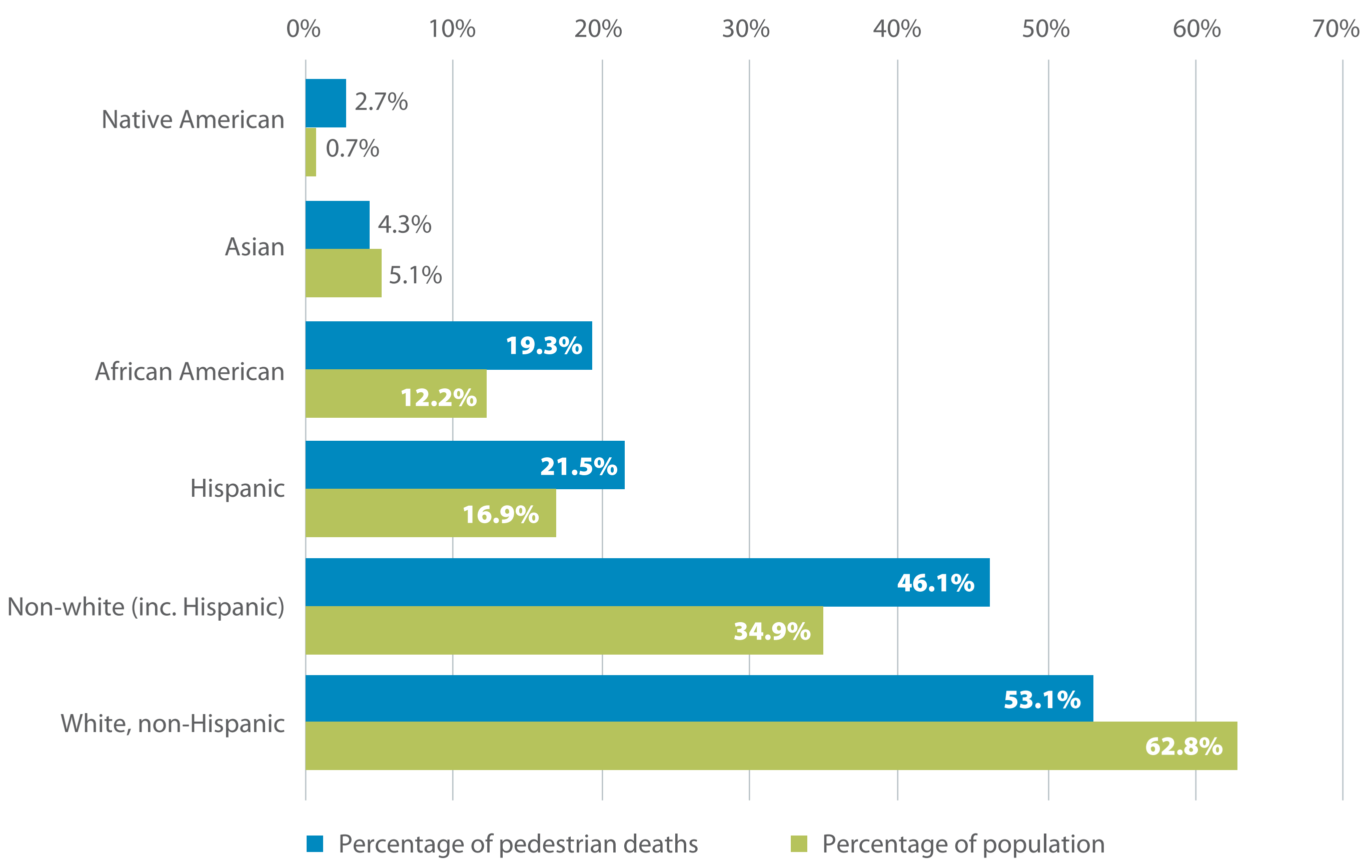


Figure A-5. Pedestrian Deaths by Race/Ethnicity Relative to U.S. Population, 2005–2014

Source: Dangerous by Design (2016)

COMMENTARY ON REASONS FOR DEMOGRAPHIC FINDINGS

The Dangerous by Design report provided some reasons for these demographics trends.

- *"Some of these outcomes are due to the fact that low income communities and communities of color have more people who walk and they tend to walk more. The risk of being hit as a pedestrian goes up the more often one is a pedestrian. And for many, walking is a necessity, not a choice, and individuals are forced to increase their exposure to these risks. "*
- *"In other cases, it is not just a matter of increased risk from increased exposure. Instead, after controlling for the amount of walking, risks continue to be higher—indicating disproportionately unsafe conditions for pedestrians."*

Pedestrian Crash Characteristics

LOCATION

According to Minnesota Motor Vehicle Crash Facts 2015, just over half (51 percent) of pedestrian crashes in 2015 occurred in urbanized regions populated with more than 250,000 people. Studies in Seattle, Chicago, and New York City also suggest that urbanized areas have a higher likelihood of pedestrian crashes.

INTERSECTIONS

In more urban settings, pedestrian crashes occur more frequently at intersections. In more rural or suburban settings, pedestrian crashes occur at non-intersection locations.

The City of Chicago 2011 Pedestrian Crash Analysis Summary Report found that Chicago has a higher proportion of intersection crashes than is typical nationally, with four in five fatal and serious injury crashes occurring within 125 feet of the midpoint of an intersection. Seattle had similar findings, with nearly three out of four (73 percent) of pedestrian crashes occurring at an intersection.

In 2015 in Minnesota, nearly one-third (32 percent) of pedestrians killed and one-quarter (26 percent) of pedestrians injured were trying to cross a road at a location without a crosswalk or signal. Thirteen percent of pedestrians injured were crossing the road at a signalized intersection and were crossing with the signal. In urban New York City, nearly three in four crashes where pedestrians were killed or seriously injured occurred at intersections. According to New York's study, the rest of the U.S. follows a pattern more similar to statewide Minnesota where three in four such crashes occur at non-intersection locations. The New York study attributes this difference to high intersection density, which encourages crossing at intersections rather than mid-block, and sidewalks on nearly all streets, which reduces crashes from walking along the roadway.

The findings from Chicago's 2011 Pedestrian Crash Analysis further highlight the difference in pedestrian crash locations in urban verses rural/suburban locations. Inside Chicago's central business district (CBD), pedestrians were most commonly in the crosswalk at the time of a crash. Outside the CBD, pedestrians were most commonly in the roadway. Children under age 14 were more likely to be struck on local streets, mid-block, and not in a crosswalk than other age groups. Senior pedestrians were more likely to be hit when walking in a crosswalk than other age groups.

SIGNALS

In New York City, more pedestrians were hit while crossing an intersection with the signal than were hit when crossing against the signal. However, crashes were more deadly when the pedestrian was crossing against the signal, especially for children.

ARTERIAL STREETS

In both Chicago and New York City, arterial streets accounted for a disproportionate number of pedestrian fatalities. Chicago's arterial streets accounted for 50 percent of fatality and serious injury crashes, despite representing only 10 percent of total street miles. The top twelve neighborhood high-crash corridors in Chicago were all arterials, and eight of those were four-lane roadways. Crashes on New York City's arterial streets were two-thirds more likely to be deadly than crashes on non-arterial streets. In New York City, roads with four or more travel lanes had more pedestrian crashes than roads less than 30 feet wide.

BIKE LANES

The New York City study found that the presence of bike lanes on a street improved pedestrian safety, even when controlling for other factors. Crashes on streets with bike lanes were about 40 percent less likely to be fatal.

TIMING OF PEDESTRIAN CRASHES

TIME OF YEAR

In Minnesota, Chicago, and New York City, pedestrian crashes peak in the late fall months of October through December. The time-of-year pedestrian crash and fatality trends for Minnesota are shown in **Figure A-6**.

The New York City Pedestrian Safety Study and Action Plan found that more crashes took place in November and December than in other months, possibly due to increased shopping, alcohol use, and traffic volumes associated with the holidays, as well as poor road conditions and decreased daylight.

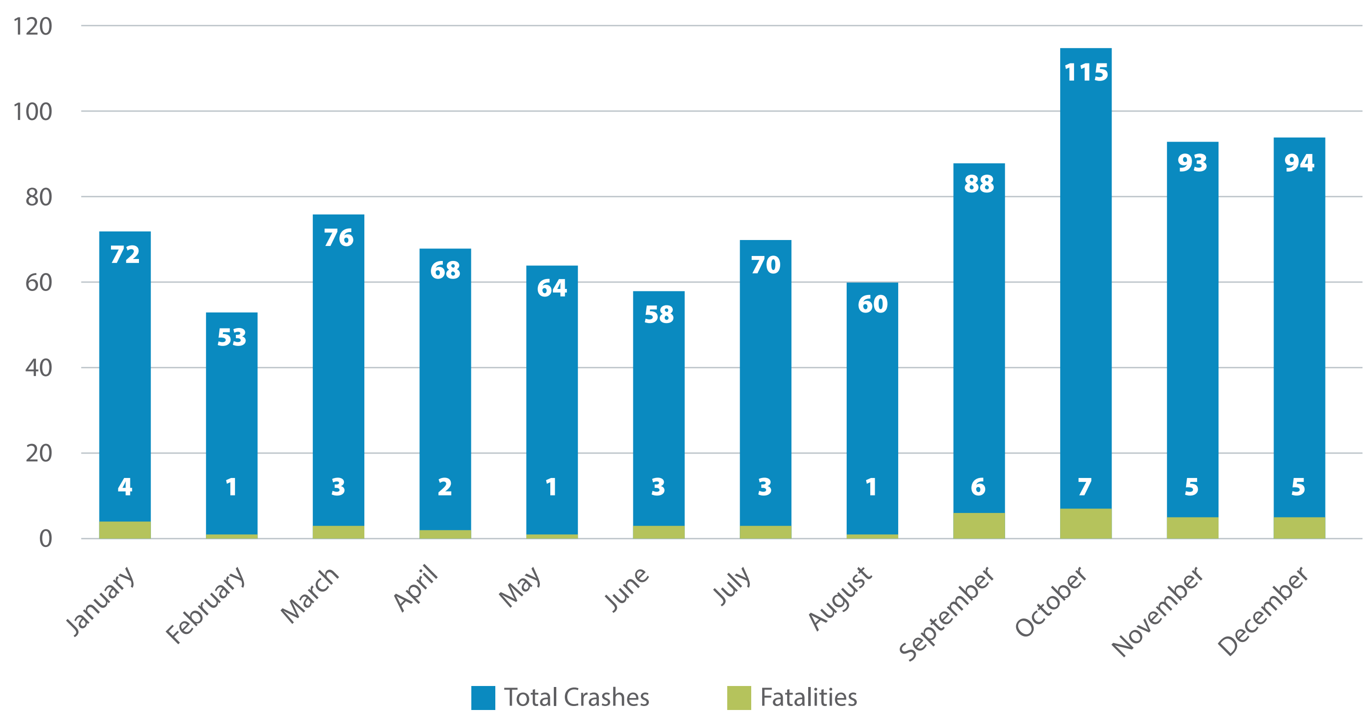


Figure A-6. 2015 Pedestrian Crashes and Fatalities by Month in Minnesota

Source: Adapted from Minnesota Motor Vehicle Crash Facts (2015)

TIME OF DAY

Nationwide, 74 percent of 2015 pedestrian fatalities occurred after dark, according to the Pedestrian Traffic Fatalities by State report.

Mirroring national trends, in Minnesota, Chicago, and New York City, pedestrian crashes peak in the afternoon and are most deadly in the late-night hours.

According to Minnesota Motor Vehicle Crash Facts 2015, about one-third (33 percent) of pedestrian crashes occurred during the weekday rush period (6am-9am or 3pm-6pm). One out of four (24 percent) fatal pedestrian crashes occurred during the late-night hours (9pm to 3am).

The New York City Pedestrian Safety Study and Action Plan found that 40 percent of crashes occurred in the late afternoon and early evening (3pm to 9pm). Crashes from 3am to 6am were twice as deadly as those occurring in other time periods, likely due to decreased traffic volumes that allow for higher vehicle speeds.

Per the City of Chicago 2011 Pedestrian Crash Analysis Summary Report, crashes were more likely to occur on Thursdays and in the afternoon and evening (3pm to 9pm). Crash rates throughout the day varied by age: senior pedestrians were the only age group most likely to be hit midday, and crashes late at night were more likely to involve 19 to 29-year-olds.

CRASH CAUSES

DRIVER BEHAVIOR

In Minnesota, Chicago, and New York City, driver inattention and failure to yield were top factors in pedestrian crashes.

According to Minnesota Motor Vehicle Crash Facts 2015, driver failure to yield was a contributing factor for 38 percent of all pedestrian crashes in 2015. 21 percent of crashes cited driver inattention or distraction as a contributing factor.

The New York City Pedestrian Safety Study and Action Plan found that in cases where pedestrians were seriously injured or killed, 36 percent of crashes involved driver inattention and 27 percent of crashes involved driver failure to yield.

The City of Chicago 2011 Pedestrian Crash Analysis Summary Report found that failure to yield was the most common motorist action at the time of a pedestrian crash, representing the primary factor in 48 percent of crashes where motorist action was known.

The Pedestrian Traffic Fatalities by State report suggests that the growing use of smartphones by all road users could be a significant source of distraction. Annual multimedia messages increased by 45 percent from 2014 to 2015 and data usage more than doubled.

TURNING MOVEMENTS

In Minnesota, Chicago, and Seattle, left turning crashes were much more common than right turning crashes. In Minnesota, one-third (31 percent) of vehicles involved in pedestrian crashes were making a turn, with left turns more common in crashes than right turns (**Figure A-7**).

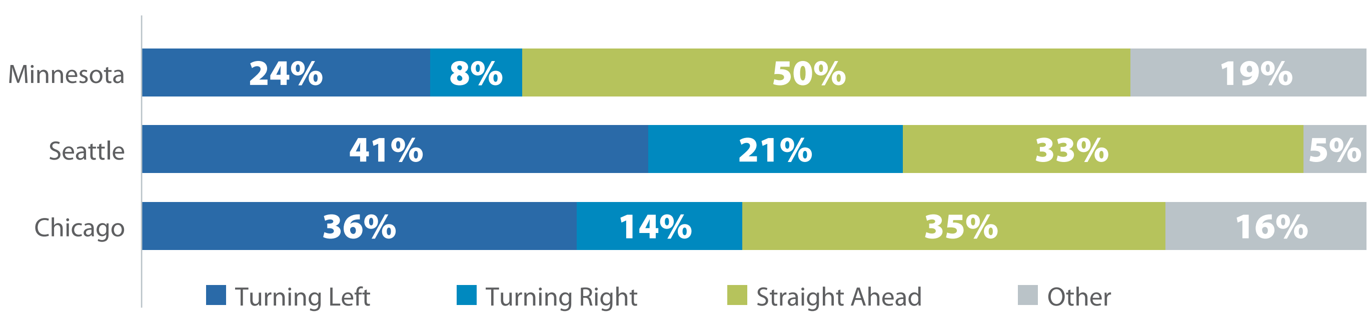


Figure A-7. Vehicle Movement Prior to Pedestrian Crash

Source: Adapted from Minnesota Motor Vehicle Crash Facts (2015), the City of Chicago Pedestrian Crash Analysis Summary Report (2011), and the City of Seattle Pedestrian Safety Analysis (2016)

The City of Chicago 2011 Pedestrian Crash Analysis Summary Report found that 52 percent of crashes at signalized intersections involved a driver making a turning movement, and 70 percent of those crashes involved a left turn. Crashes in the CBD were more likely to involve turning movements and left turns than those outside the CBD.

The City of Seattle Traffic Report found that there were twice as many crashes involving a left-turn than involving a right turn.

However, according to Minnesota Motor Vehicle Crash Facts 2015, nearly half (48 percent) of the vehicles involved in pedestrian injury crashes in 2015 (and nearly four in five involved in fatal pedestrian crashes) were moving straight ahead in the roadway prior to the crash. However, this is likely due to the statewide (rather than urban) nature of this dataset.

ADDITIONAL FACTORS

According to Minnesota Motor Vehicle Crash Facts 2015, obscured driver vision was a factor for nine percent of all pedestrian crashes.

The New York City Pedestrian Safety Study and Action Plan found several additional factors that contributed to the frequency and severity of pedestrian crashes. These factors include:

- **Lane Changing** Lane changing increased the deadliness of crashes.
- **Unsafe Speeds** Serious crashes where drivers were traveling at excessively high speeds were twice as deadly as those where drivers were traveling at safe speeds.
- **Influence of Alcohol** Eight percent of fatal crashes involved a driver who was under the influence of alcohol.

The City of Chicago 2011 Pedestrian Crash Analysis Summary Report discovered that 40 percent of fatal crashes were hit-and-runs, and about two hit-and-run crashes per day occurred that resulted in a pedestrian injury or fatality. Additionally, taxis were involved in crashes at a higher rate within the CBD than in the city as a whole.

The Pedestrian Traffic Fatalities by State report found that alcohol was involved in half of nationwide pedestrian fatalities in 2015, with 34 percent of crashes involving a pedestrian under the influence of alcohol (blood alcohol concentration of 0.08 grams per deciliter or higher) and 15 percent of crashes involving a driver under the influence of alcohol.

Summary of Factors

The studies reviewed as part of the Minneapolis Pedestrian Crash Study have suggested that these factors may influence pedestrian safety:

- **Poor infrastructure conditions -** Lack of or inadequate facilities, uneven or unmaintained surfaces, blocked paths, connectivity issues, difficult street crossings, and poor lighting.
- **Unsafe driver behavior or traffic characteristics -** Habits displayed by drivers, such as operating vehicles aggressively, negligently, while impaired or distracted, as well as traffic patterns associated with higher crashes such as congestion.
- **Unsafe pedestrian or bicyclist behaviors -** Failure to exhibit safe walking and bicycling behaviors, such as ignoring traffic signs or texting while walking or biking.

DESIGN RECOMMENDATIONS

The New York City Safety Study recommended installing countdown pedestrian signals at 1,500 intersections, re-engineering 60 miles of streets and 20 major intersections, and launching pilot programs to test the safety of neighborhood 20 mph zones and improve visibility at left turns.

Other studies provided a more general set of tools that planners, engineers, and policymakers could use as appropriate, such as:

- Wide sidewalks
- Curb extensions
- Refuge islands
- Pedestrian countdown signals
- Leading pedestrian interval signal timing
- Midblock crossings (especially at transit stops)
- Pedestrian hybrid beacons
- Planting street trees
- Restricted right turns on red at signals
- Compact intersections
- Back-in angled parking and smaller curb radii
- Pedestrian overpasses/underpasses
- New traffic signals where warranted
- Provision of ample crossing time
- Improved street lighting
- High visibility crosswalks
- Roundabouts in place of stop signs and signals
- Restricted and protected left turns

Some general design considerations recommended by the national studies include:

- Improving the visibility of pedestrians and reducing the speed of vehicles (using many of the tools listed)
- Enforcing the traffic laws and speeds of automobiles, supplementing traditional enforcement with automated enforcement
- Educating the public on the necessity of progress

Public awareness campaigns around drunk or distracted driving, speed limit enforcement, and reminding pedestrians to cross streets safely are all important to improving pedestrian safety.

Other common recommendations were to reduce the number of lanes or narrow travel lanes as well as designate space for every mode on the street and clarify where each user should travel.

POLICY RECOMMENDATIONS

Minnesota already has many of the plans and policies in place to increase pedestrian safety, as noted in the Bicycling & Walking in the United States 2016 Benchmarking Report. This report and others did note several plans/policies that Minnesota is missing that other states or cities have implemented:

- **Incentives -** Governments or employers can use incentives to encourage bicycling or walking to work to further create safety in numbers for pedestrians. Examples of these incentives include offering a place to shower, lockers, or secured bike parking, allowing flexible schedules or casual dress, and providing gift certificates or bonuses.
- **Vulnerable Road User Law -** Vulnerable road user laws vary state-by-state and are intended to increase protection for pedestrians, bicyclists, and other non-car road users. They often increase penalties for violating existing laws that impact vulnerable road users and prohibit certain actions being taken towards them such as throwing an object or harassment.
- **Trip Reduction Law -** As a way to manage traffic congestion and alleviate air pollution, trip reduction laws can require local, regional, or state governments or employers to encourage the use of alternative forms of transportation and develop programs that reduce drive-alone trips.
- **Safe Streets Policy -** At a city or agency level, set a vision/goal for safer streets to allow transportation agency staff to find appropriate design solutions, regardless of prevailing speed. Having a policy foundation encourages the design and redesign of streets to include features that encourage safer – and slower – driving speeds. Setting this goal enables design professionals to employ tools to provide pedestrians with safe options.

APPENDIX B. ADDITIONAL CRASH SUMMARY TABLES AND FIGURES

How Severe are the Crashes?

Major Crashes in this study are Fatal crashes (Type K) and Incapacitating crashes (Type A). These two crash severity levels are grouped together because they both represent a life-altering crash. For statistical crash analysis, it is standard practice to combine these categories because these types of crashes typically have similar characteristics and the factors that result in a fatality rather than a serious injury can be minor or random. For instance, if the pedestrian location had been different by a matter of feet, or if the automobile had been traveling one or two miles per hour more or less, the outcome of the crash may have been different. The grouping also creates a larger sample size for analysis, which is more useful for identifying trends and patterns.

Minor Crashes in this study are defined as Non-Incapacitating (Type B), Possible Injury (Type C), No Injury (Type N/PDO), and Unknown.

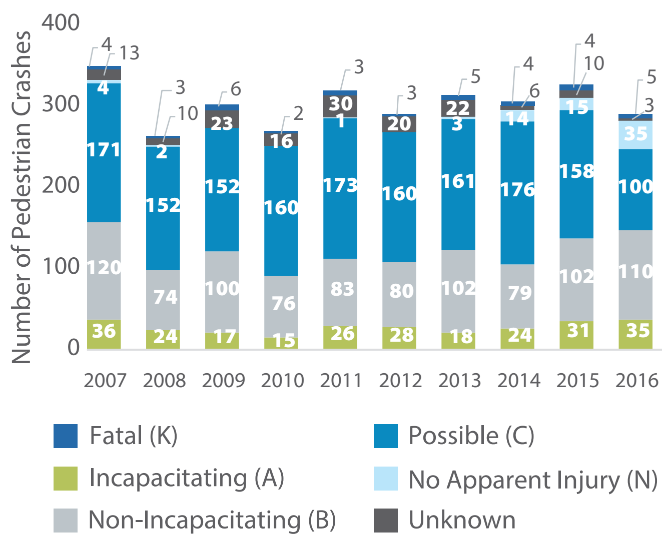


Figure B-1. Pedestrian Crash Severity

Source for Pedestrian Crash Data: 10-Year Dataset

Table B-1. Pedestrian Crash Severity by Year

Year	Fatal (K)*	Incapacitating (A)*	Non-Incapacitating (B)	Possible (C)	Unknown	No Apparent Injury (N)	Total Minneapolis Pedestrian Crashes
2007	4	36	120	171	13	4	348
2008	3	24	73	152	10	2	264
2009	6	17	100	152	23	0	298
2010	2	15	76	160	16	0	269
2011	3	26	83	172	30	1	315
2012	3	28	78	159	20	0	288
2013	5	18	103	160	22	3	311
2014	4	24	79	177	6	14	304
2015	4	30	102	158	10	14	318
2016	5	38	115	101	3	39	301
Grand Total	**39**	**256**	**929**	**1562**	**153**	**77**	**3,016**
Percent Total	**1%**	**8%**	**31%**	**52%**	**5%**	**3%**	

**These crashes are defined as major crashes in this study.*

Crash Data Source: 10-Year Dataset.

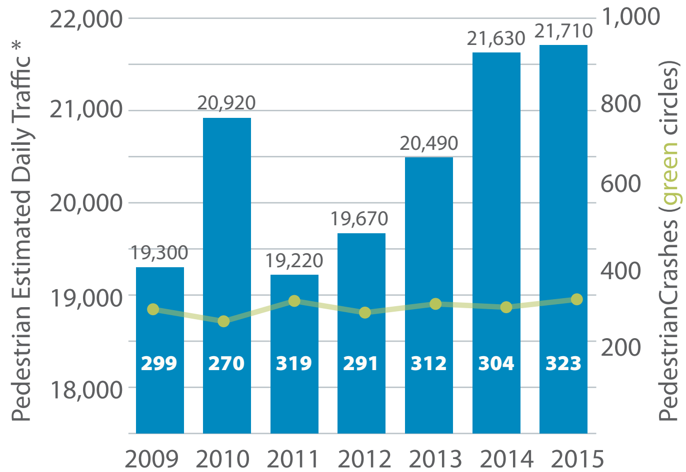
Trends over Time

Minneapolis annual pedestrian counts have increased since 2011 while the rate of pedestrian crashes has hovered around 300 annually.

While the number of people walking to work has increased 15 percent since 2011, pedestrian crashes have remained consistent.

Years where there was a noticeable increase in walkers (2012, 2014), the crash rate per walker slightly declined. This may suggest that there are strengths in numbers: as more people decide to walk, the pedestrian mode becomes more visible to automobiles, and drivers are more aware of and watching for pedestrians.

American Community Survey walk-to-work data not available before 2009. Total 2016 crashes and walk-to-work data was not available at the time of the survey.



*at 23 Benchmark Locations

Figure B-4. Crashes and Pedestrian Counts per Year

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts

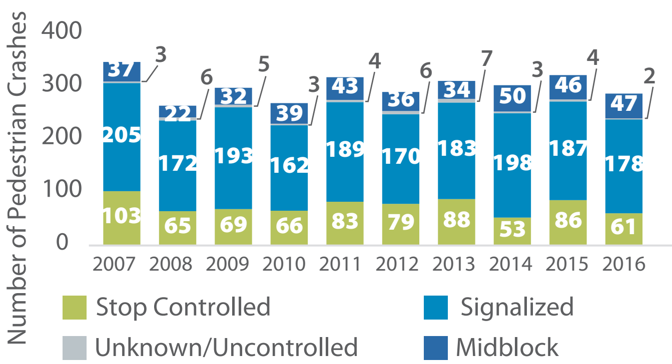


Figure B-2. Pedestrian Crash Location by Year

Source for Pedestrian Crash Data: 10-Year Dataset

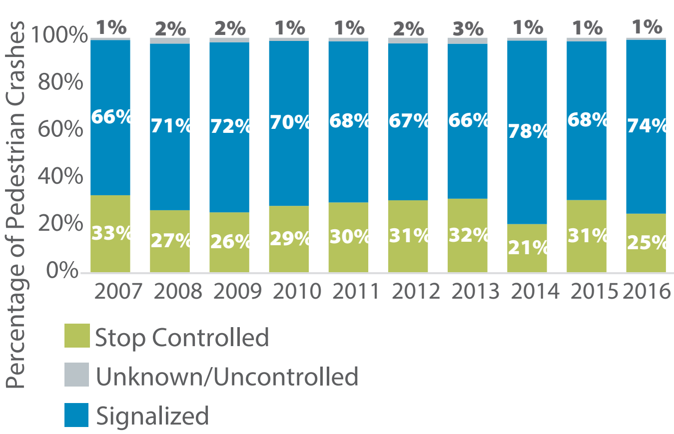


Figure B-3. Pedestrian Intersection Crashes by Year

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Intersection Control Data: City of Minneapolis

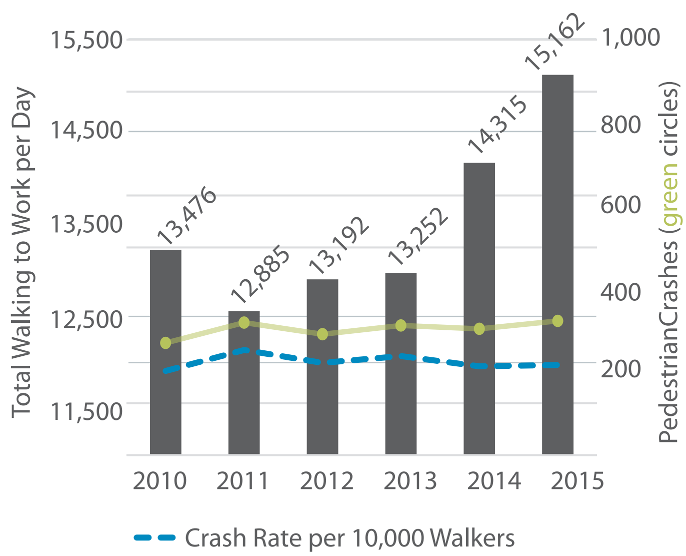


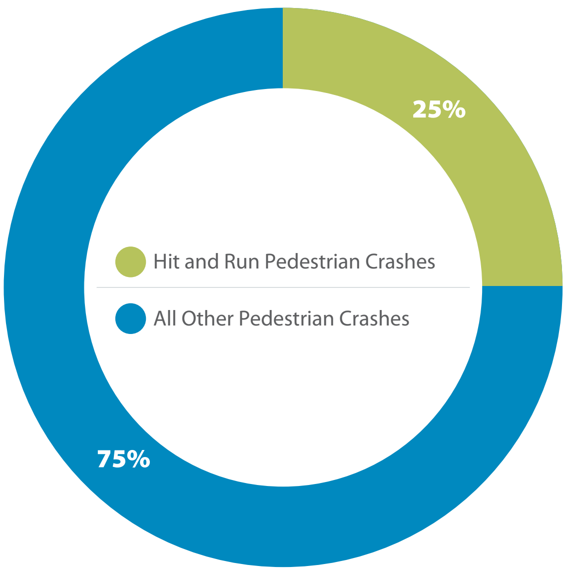
Figure B-5. Pedestrian Crashes per Year and Walking Mode to Work

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Pedestrian Volume Data: City of Minneapolis Pedestrian Counts (2016 Update)

Other Factors

Hit-and-Run

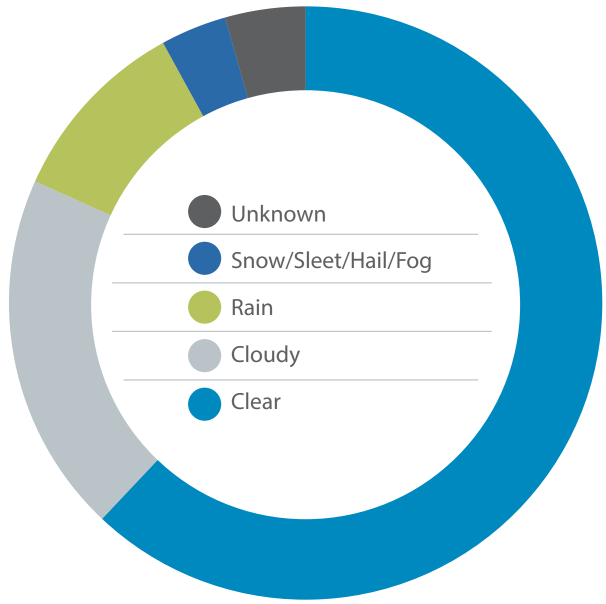
Hit-and-runs make up around 25 percent of pedestrian crashes. However, in 18 percent of crashes hit-and-run status was not available from the police report.



Figures B-6. Hit and Run Pedestrian Crashes
Source for Pedestrian Crash Data: 3-Year Dataset

Weather

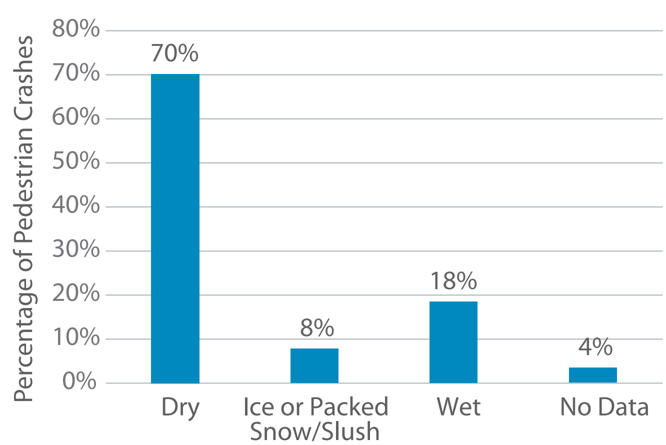
Crashes happen in all weather conditions, but primarily when it was clear or cloudy (no precipitation).



Figures B-7. Pedestrian Crashes by Weather Conditions
Source for Pedestrian Crash Data: 3-Year Dataset

Road Conditions

The majority of pedestrian crashes occur when roads are dry.



Figures B-8. Pedestrian Crashes by Road Conditions
Source for Pedestrian Crash Data: 3-Year Dataset

Signal Characteristics

No Turn On Red

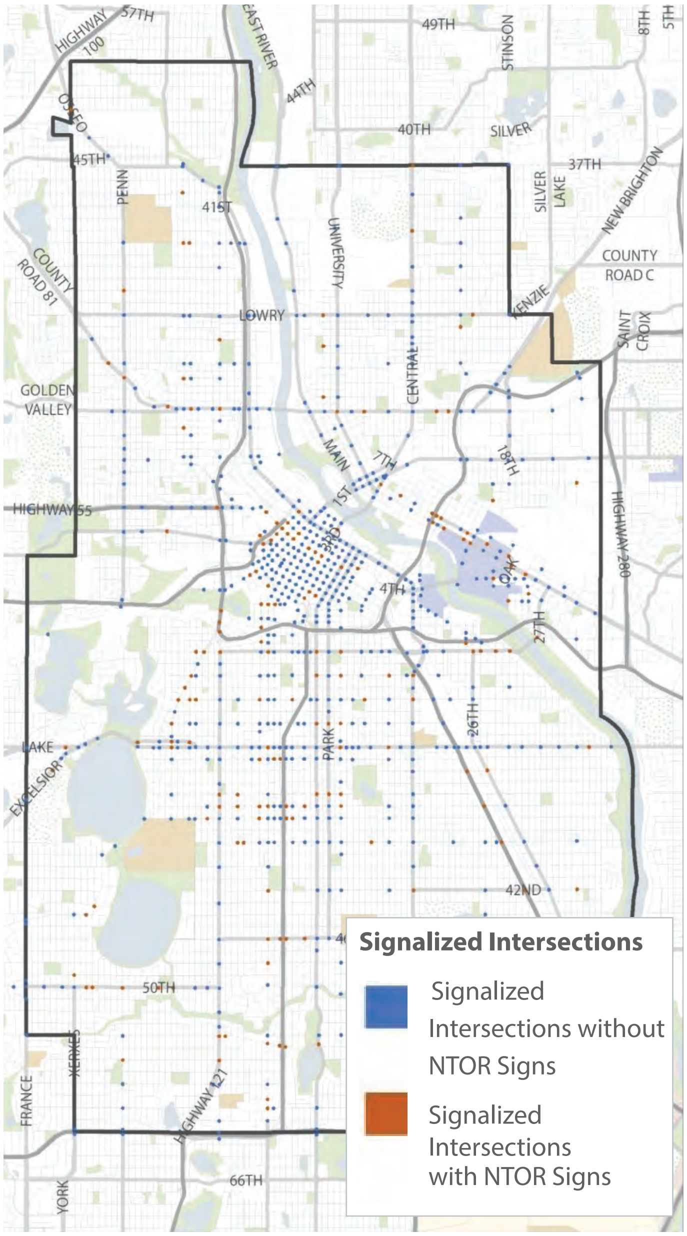


Figure B-9. Existing Infrastructure - No Turn On Red (NTOR) Restrictions
Source for NTOR Data: City of Minneapolis

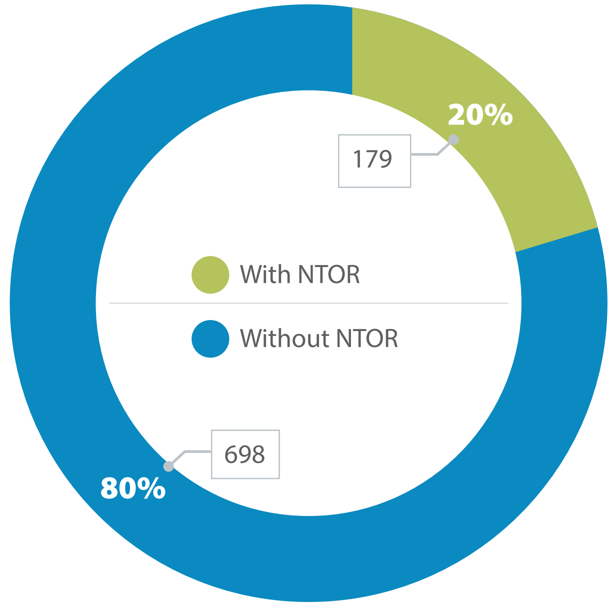


Figure B-10. Signals with NTOR
Source for NTOR Data: City of Minneapolis

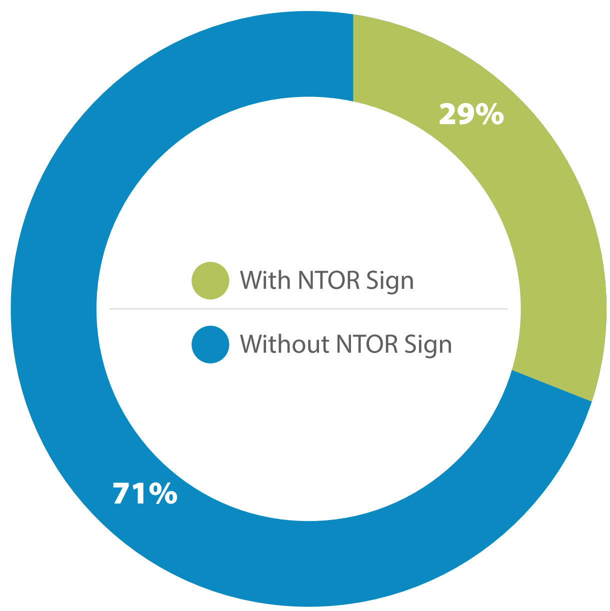


Figure B-11. Pedestrian Crashes at Signalized Intersections by NTOR Restrictions
Source for Pedestrian Crash Data: 10-Year Dataset
Source for NTOR Data: City of Minneapolis

Leading Pedestrian Interval (LPI)

Leading pedestrian intervals (LPIs) are installed to give pedestrians a WALK indication prior to the parallel green indication. It is intended to make pedestrians more visible by allowing them to enter the crosswalk prior to vehicles starting to move.

The before/after analysis of LPIs installed in Minneapolis shows they are most effective at reducing pedestrian crashes where there is a pattern of crashes between turning vehicles and pedestrians in the before conditions, for example at Lake Street W and Hennepin Avenue.

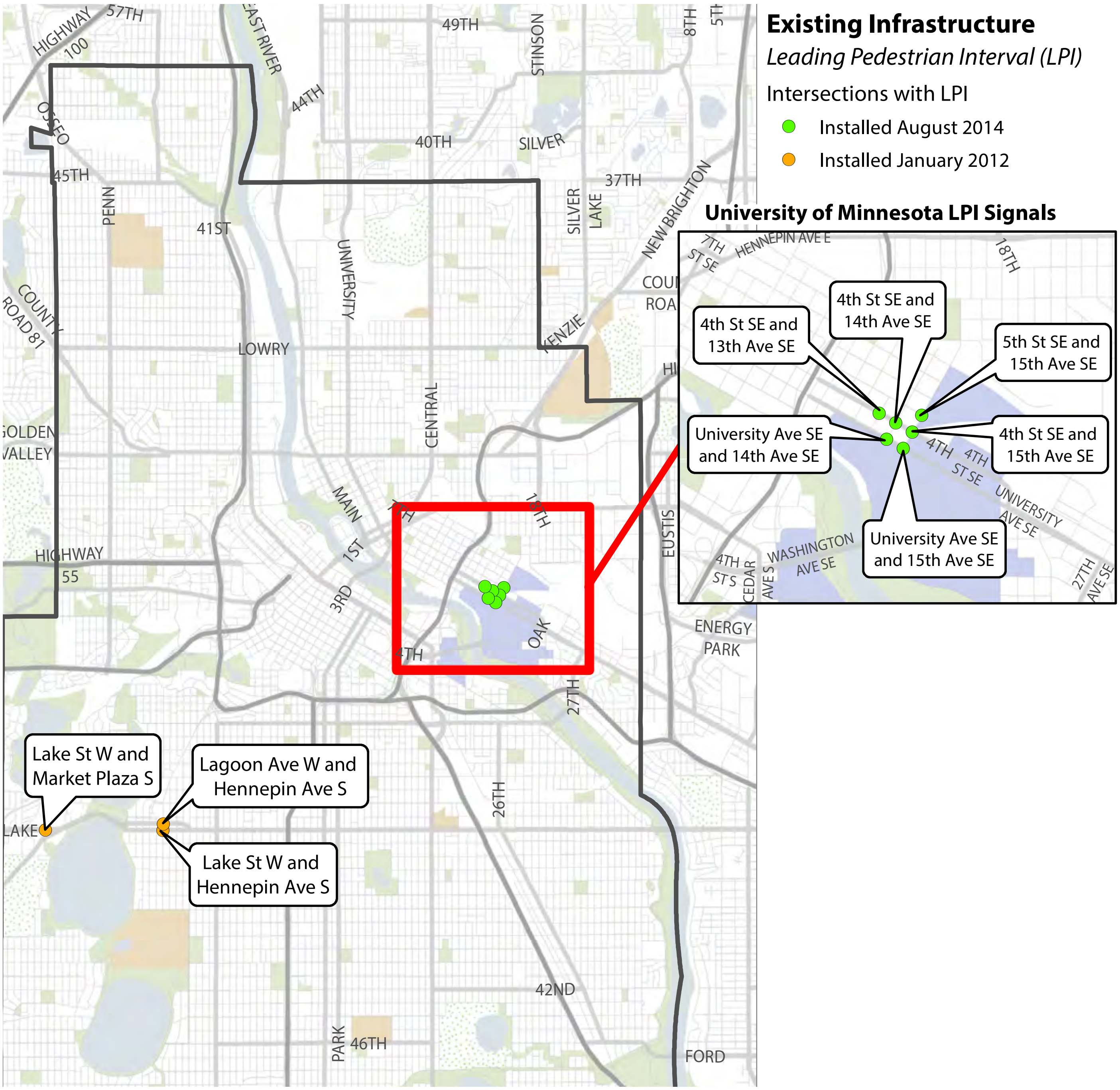


Figure B-12. Existing Infrastructure - Leading Pedestrian Interval Locations

Source for LPI Data: City of Minneapolis

CRASH DETAILS AT LEADING PEDESTRIAN INTERVAL INTERSECTIONS

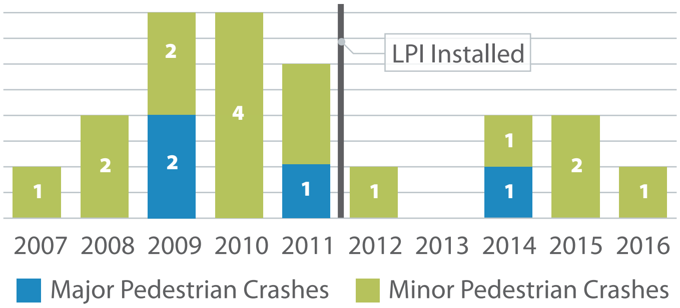


Figure B-13. Before and After LPI Crash Analysis at Lake St W and Hennepin Ave

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

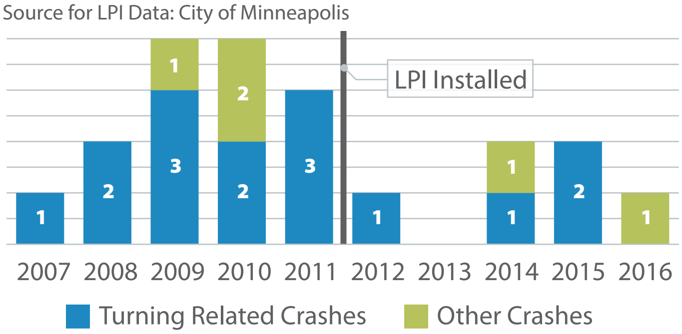


Figure B-14. Turning Related Crash Analysis at Lake St W and Hennepin Ave

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

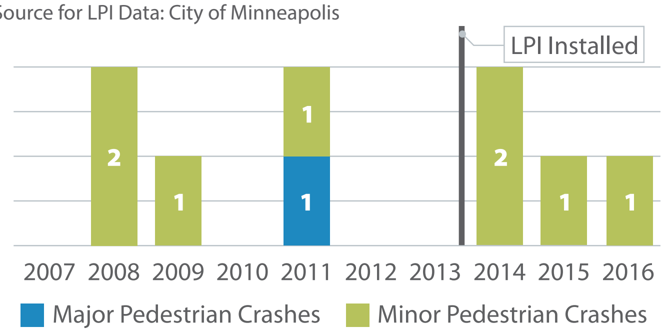


Figure B-15. Before and After LPI Crash Analysis at 4th St SE and 15th Ave SE

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

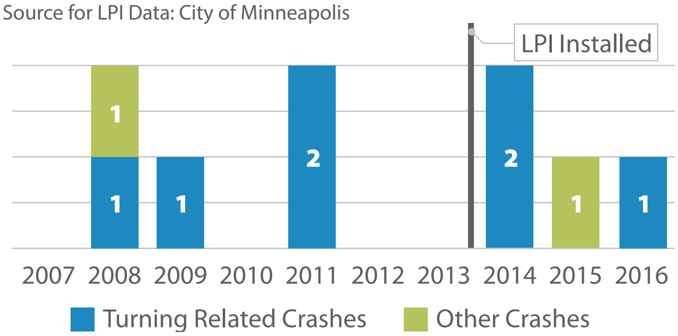


Figure B-16. Turning Related Crash Analysis at 4th St SE and 15th Ave SE

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

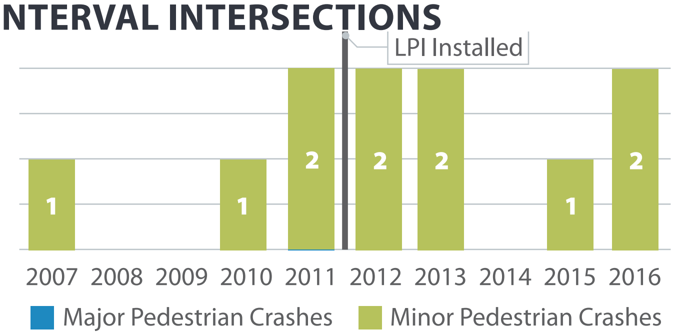


Figure B-17. Before and After LPI Crash Analysis at Lagoon Ave W and Hennepin Ave

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

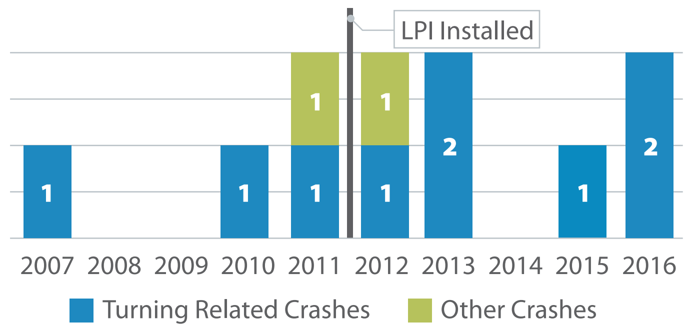


Figure B-18. Turning Related Crash Analysis at Lagoon Ave W and Hennepin Ave

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

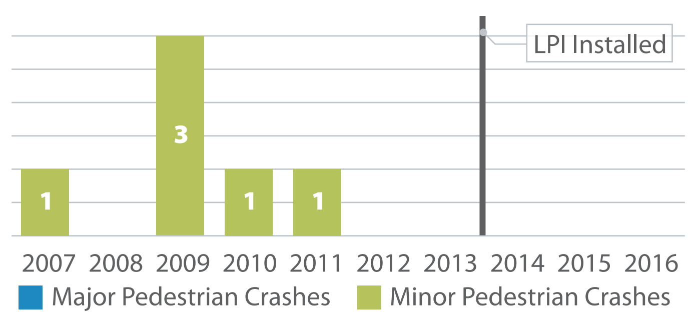


Figure B-19. Before and After LPI Crash Analysis at 4th St SE and 14th Ave SE

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

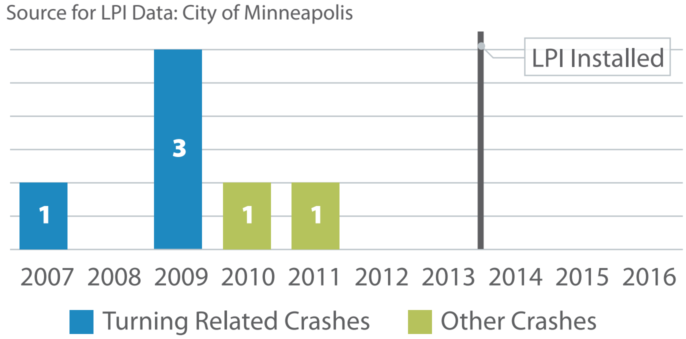


Figure B-20. Turning Related Crash Analysis at 4th St SE and 14th Ave SE

Source for Pedestrian Crash Data: 10-Year Dataset
Source for LPI Data: City of Minneapolis

Left-Turn Phasing

Pedestrian crashes are over-represented at intersections with protected-permissive left turn signal phases: 42 percent of pedestrian crashes occurred at the 31 percent of intersections that have this type of left-turn phasing. Pedestrian crashes are slightly under-represented at intersections with protected left turns: three percent of the pedestrian crashes occurred at the four percent of intersections that have protected phases.

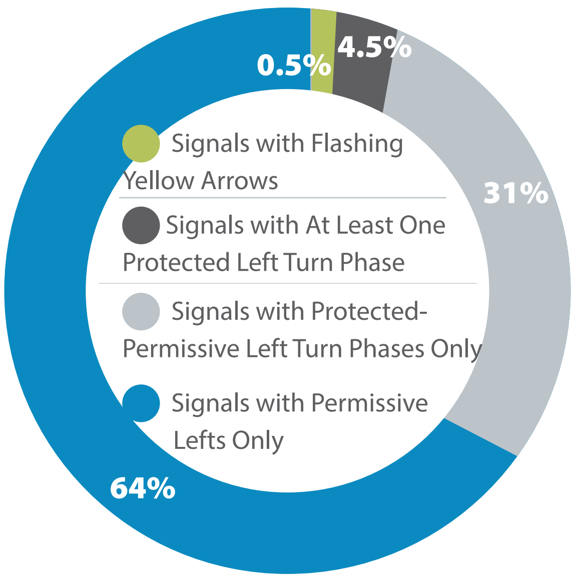


Figure B-21. Signals with Left-turn Phasing

Source for Left-Turn Phasing Data: City of Minneapolis

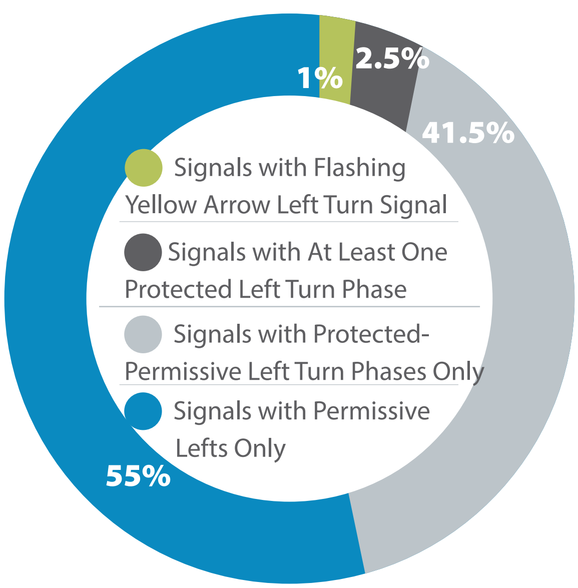
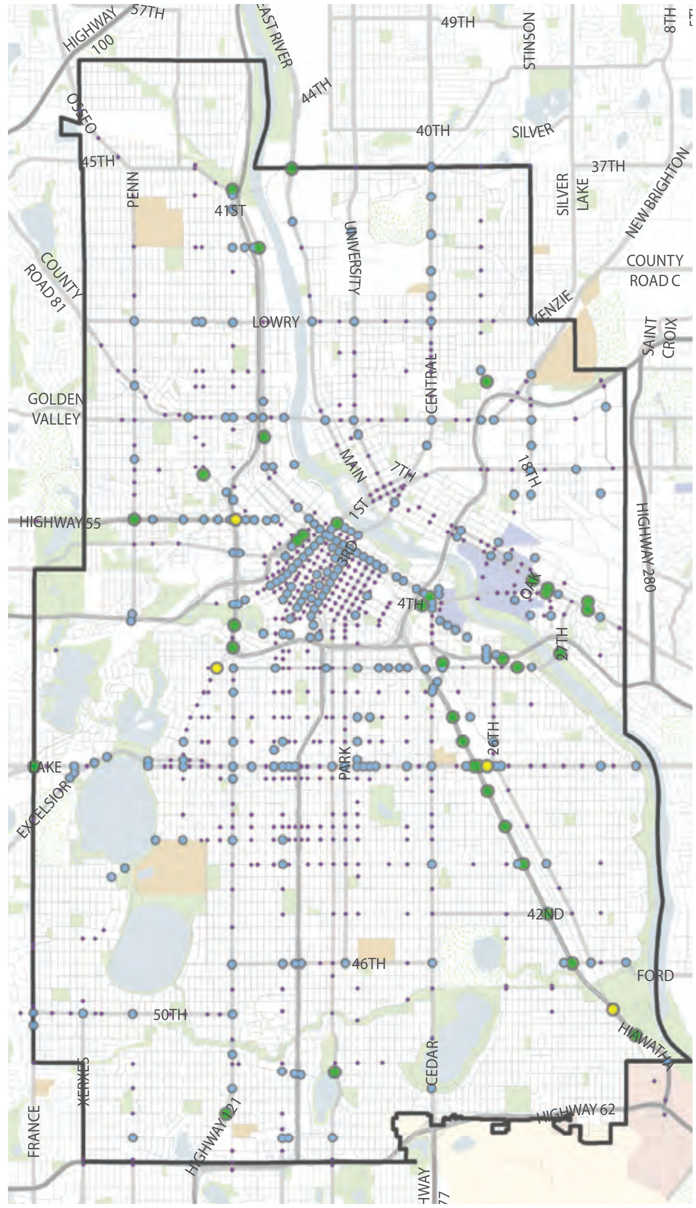


Figure B-22. Pedestrian Crashes at Signalized Intersections When Vehicle was Making a Left Turn

Source for Pedestrian Crash Data: 10-Year Dataset

Source for Left-Turn Phasing Data: City of Minneapolis



Left-Turn Phasing

- At Least One Protected Phase
- Only Protected-Permissive Phasing
- At Least One Flashing Yellow Arrow Left Turn Signal
- Permissive Lefts Only

Figure B-23. Existing Infrastructure - Left-Turn Signal Phasing Locations

Source for Left-Turn Phasing Data: City of Minneapolis

Overhead Indications

Overhead signal indications have been shown to result in reduced crash frequency at signalized intersections in Minneapolis. However, this analysis did not find a positive relationship between the presence of overhead signal indications and a prevention of pedestrian crashes.

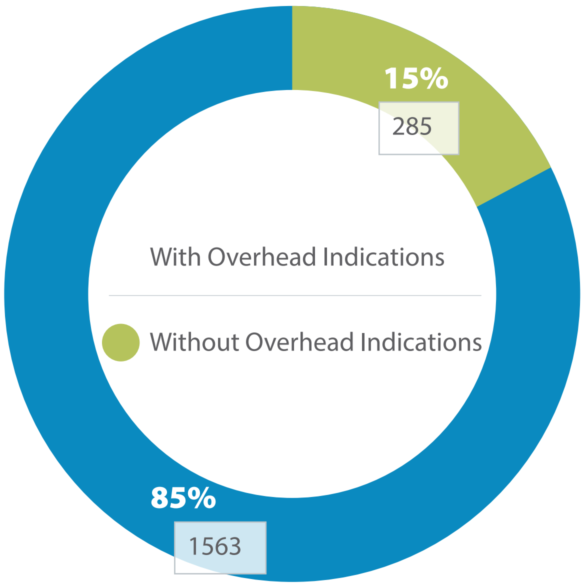


Figure B-24. Pedestrian Crashes by Overhead Signal Presence

Source for Pedestrian Crash Data: 10-Year Dataset
Source for Overhead Signal Data: City of Minneapolis

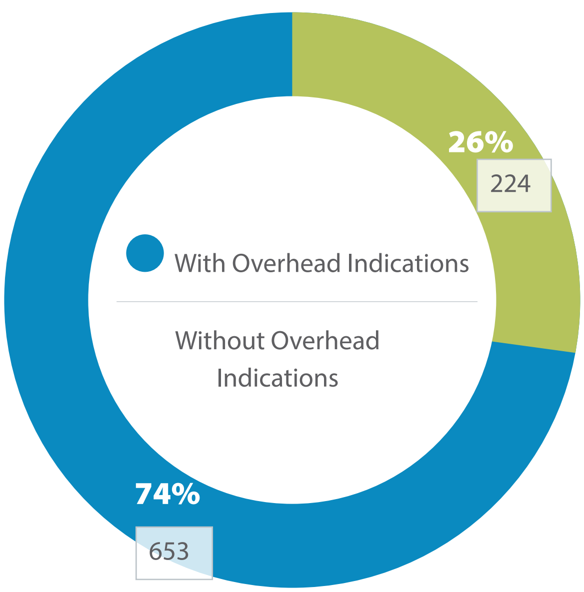
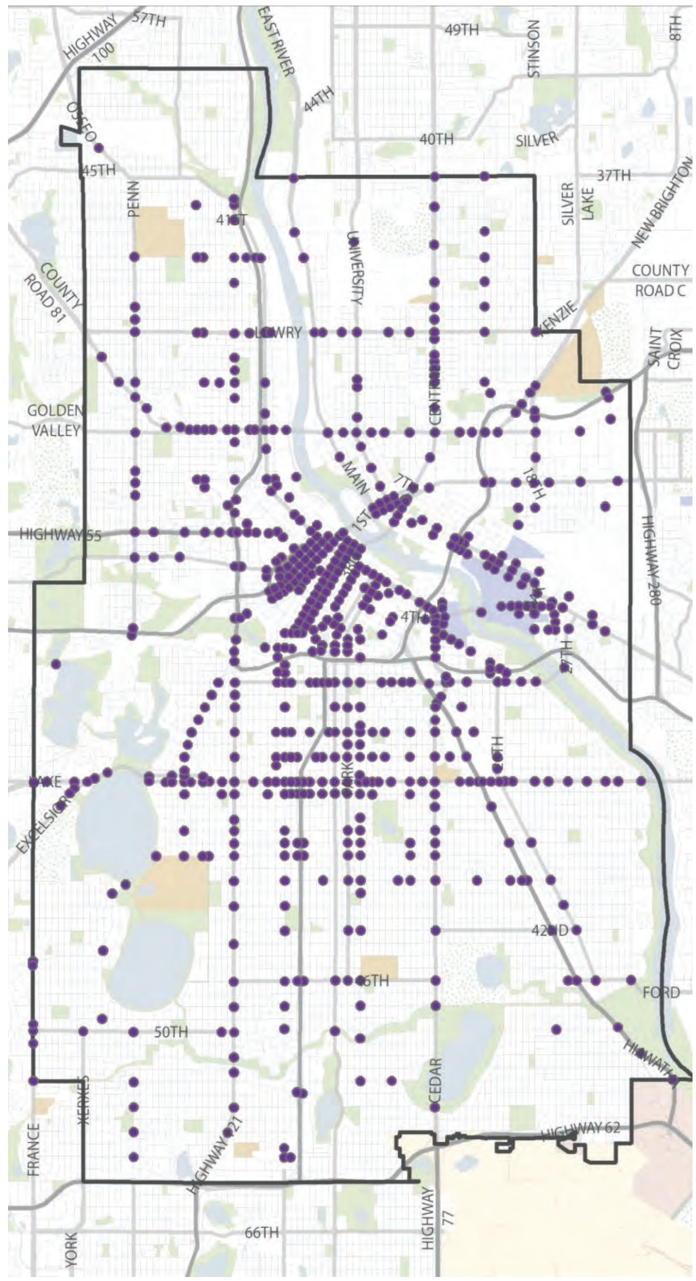


Figure B-25. Signalized Intersection with Overhead Signal Indications

Source for Overhead Signal Data: City of Minneapolis



Overhead Indicators

Intersections with Overhead Indicators

Figure B-26. Existing Infrastructure - Overhead Signal Locations

Source for Overhead Signal Data: City of Minneapolis

Countdown Timers

Countdown timers give pedestrians additional information about the signal time remaining to complete their crossing. The City of Minneapolis has been working to install countdown timers at all signals in the city. This means that a pedestrian crash that occurred at an intersection that has a countdown timer today may not have had the countdown timer when the crash occurred.

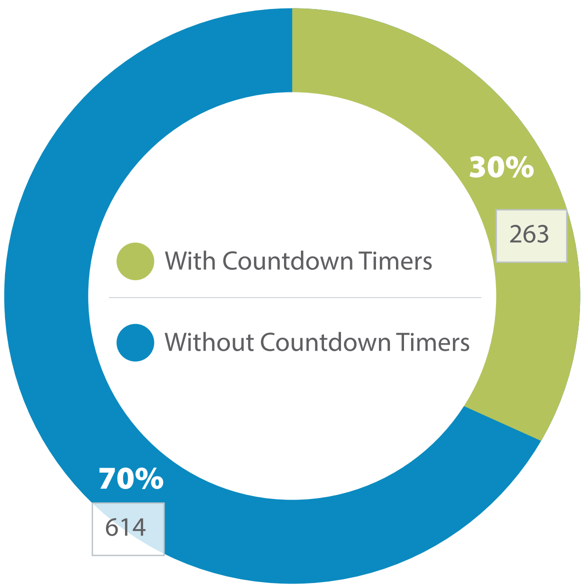
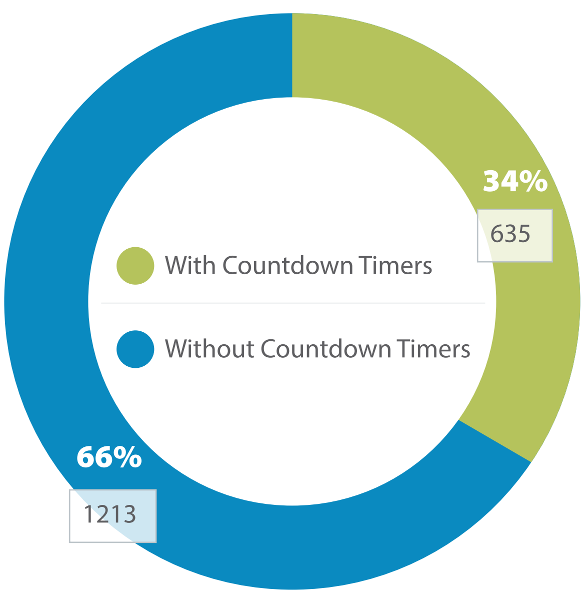


Figure B-27. Signalized Intersections with Pedestrian Countdown Timers

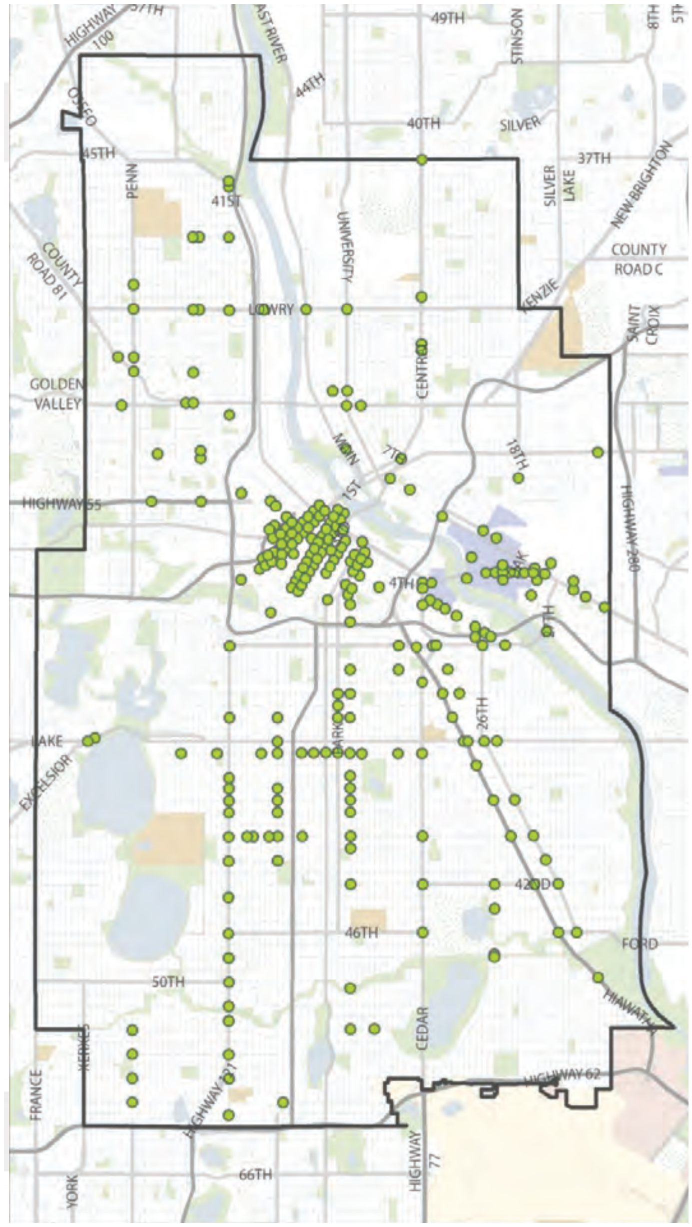
Source for Countdown Timer Data: City of Minneapolis



Figures B-28. Pedestrian Crashes by Presence of Countdown Timer

Source for Pedestrian Crash Data: 10-Year Dataset

Source for Countdown Timer Data: City of Minneapolis



Countdown Timers

Signalized Intersections with Countdown Timers

Figure B-29. Existing Infrastructure - Countdown Timer Locations

Source for Countdown Timer Data: City of Minneapolis

DETAILED BEFORE AND AFTER ANALYSIS OF COUNTDOWN TIMERS

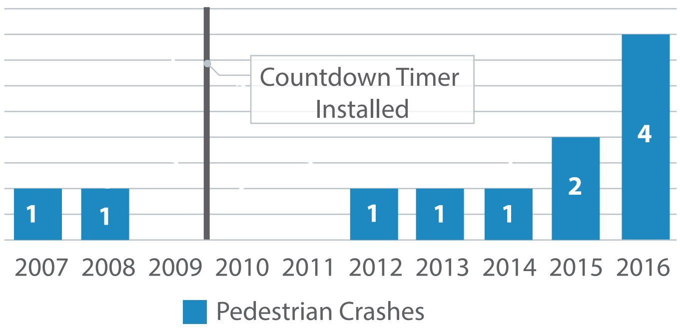


Figure B-30. Before and After Countdown Timers at Hennepin Ave and 8th St S
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

Figure B-33. Before and After Countdown Timers at Lyndale Ave and Lake St
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

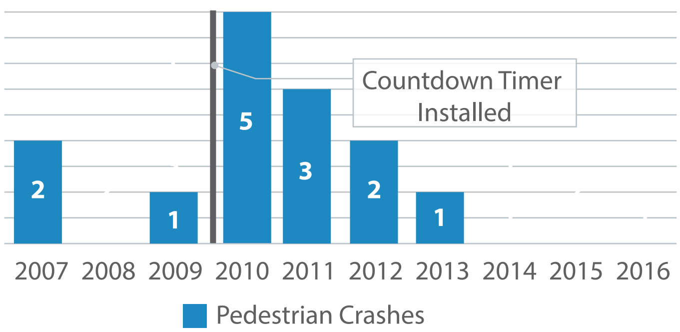


Figure B-31. Before and After Countdown Timers at 1st Ave N and N 4th St
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

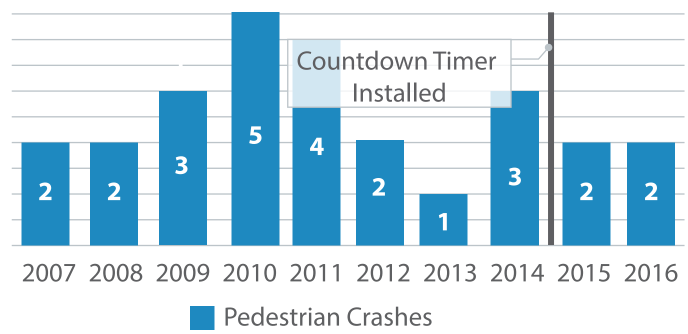


Figure B-34. Before and After Countdown Timers at Franklin Ave and Nicollet Ave
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

Figure B-32. Before and After Countdown Timers at Hennepin Ave and 7th St S
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

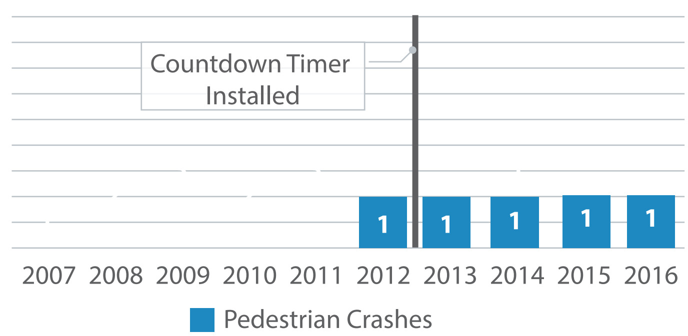


Figure B-35. Before and After Countdown Timers at E Hennepin Ave and 4th St SE
Source for Pedestrian Crash Data: 10-Year Dataset
Source for Countdown Timer Data: City of Minneapolis

Street Reconstruction

Based on the four recently reconstructed corridors in Minneapolis, street reconstruction alone does not appear to correlate to a reduction in pedestrian crashes. While the small number of crashes in each of these corridors is positive, the small sample size makes drawing conclusions challenging.

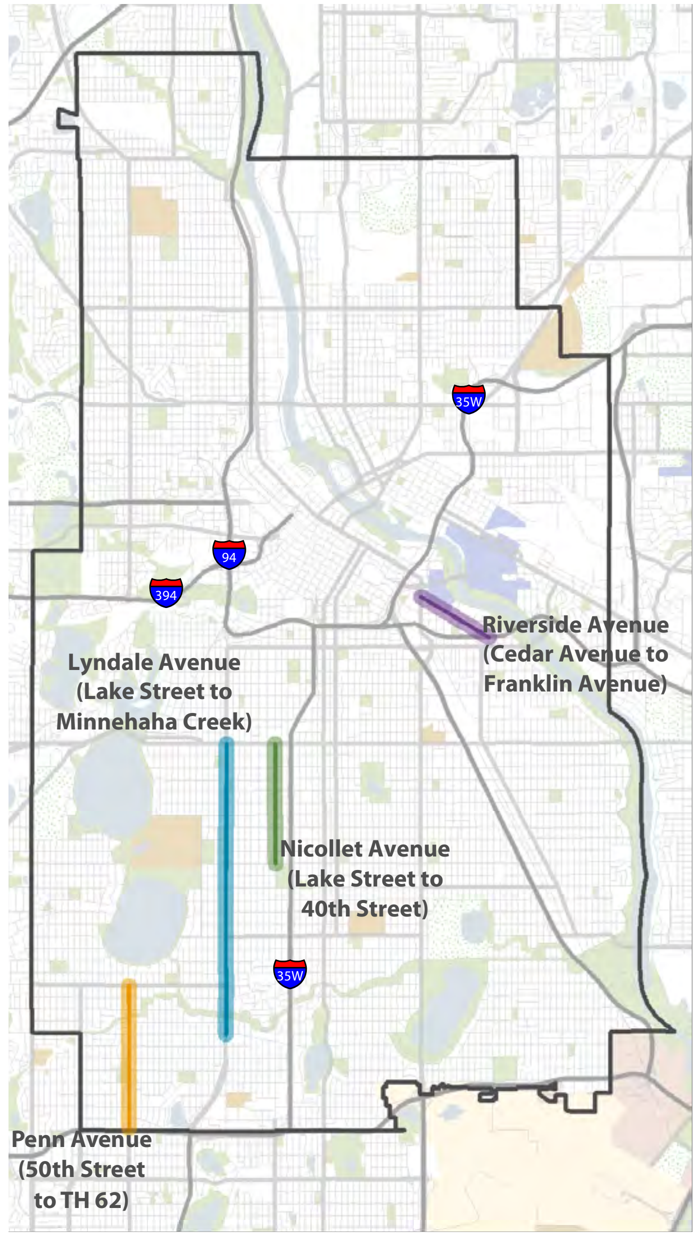


Figure B-36. Minneapolis Street Reconstruction Corridors

Source for Reconstruction Data: City of Minneapolis, Hennepin County

Lyndale Avenue

Lyndale Avenue between Lake Street and Minnehaha Creek was reconstructed during 2008 and 2009. Geometric changes included reducing the street from four lanes to two lanes and adding a median between 31st Street and 38th Street.

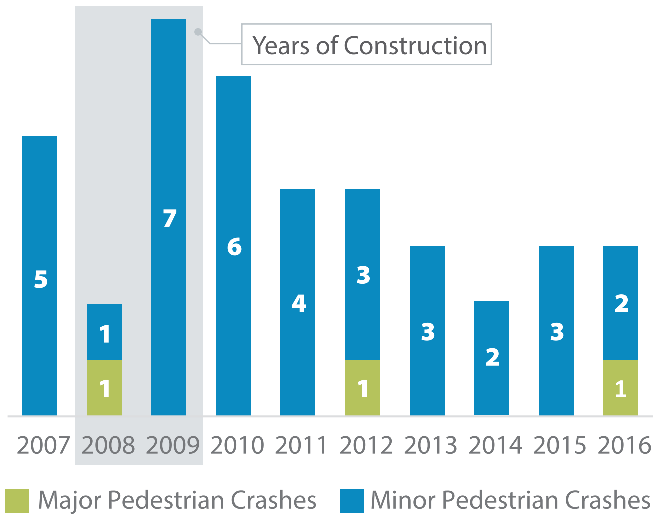


Figure B-37. Pedestrian Crashes on Lyndale Avenue

Source for Pedestrian Crash Data: 10-Year Database
Source for Reconstruction Data: City of Minneapolis, Hennepin County

Nicollet Avenue

Nicollet Avenue between Lake Street and 40th Street was reconstructed during 2012 and 2013. The street was narrowed through reconstruction, but the number of travel lanes was not modified.

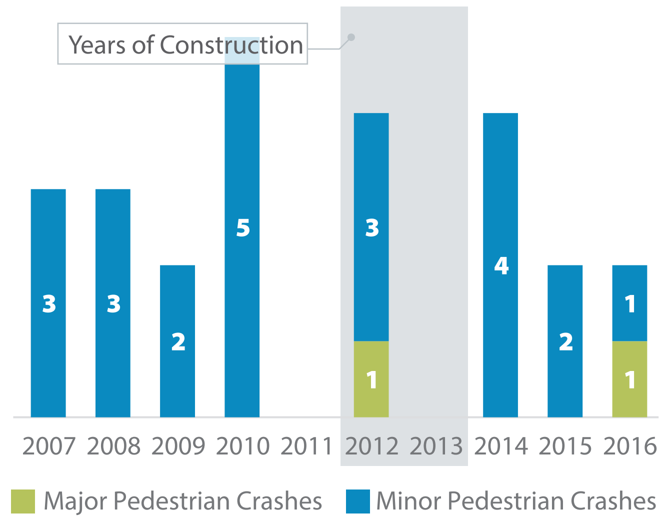


Figure B-39. Pedestrian Crashes on Nicollet Avenue

Source for Pedestrian Crash Data: 10-Year Database
Source for Reconstruction Data: City of Minneapolis, Hennepin County

Riverside Avenue

Riverside Avenue between Cedar Avenue and Franklin Avenue was reconstructed during 2011 and 2012. Geometric changes included reducing the street from four lanes to three lanes, adding a shared left turn lane, and adding bicycle lanes.

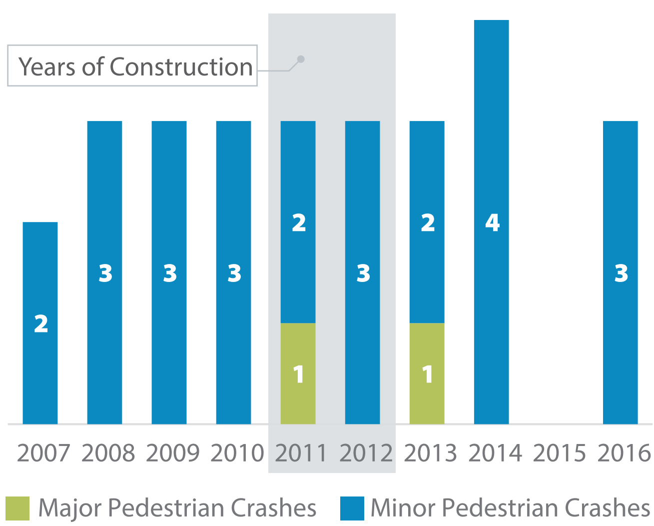


Figure B-38. Pedestrian Crashes on Riverside Avenue

Source for Pedestrian Crash Data: 10-Year Database
Source for Reconstruction Data: City of Minneapolis, Hennepin County

Penn Avenue S

Penn Avenue between 50th Street and Trunk Highway 62 was reconstructed during 2013 and 2014. The street was narrowed through reconstruction, but the number of travel lanes was not modified.

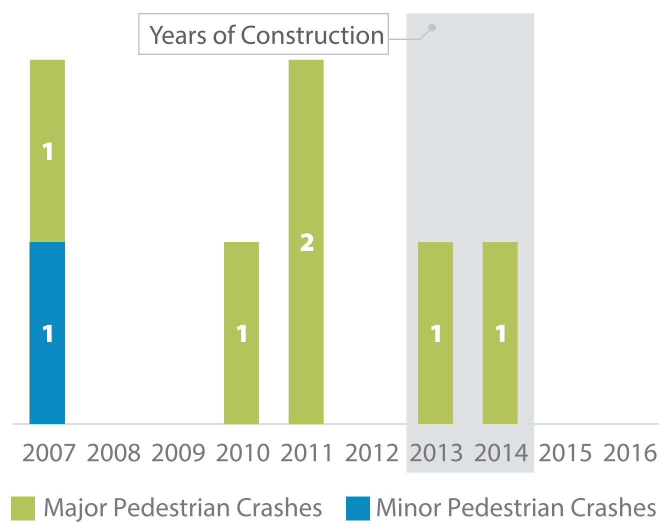
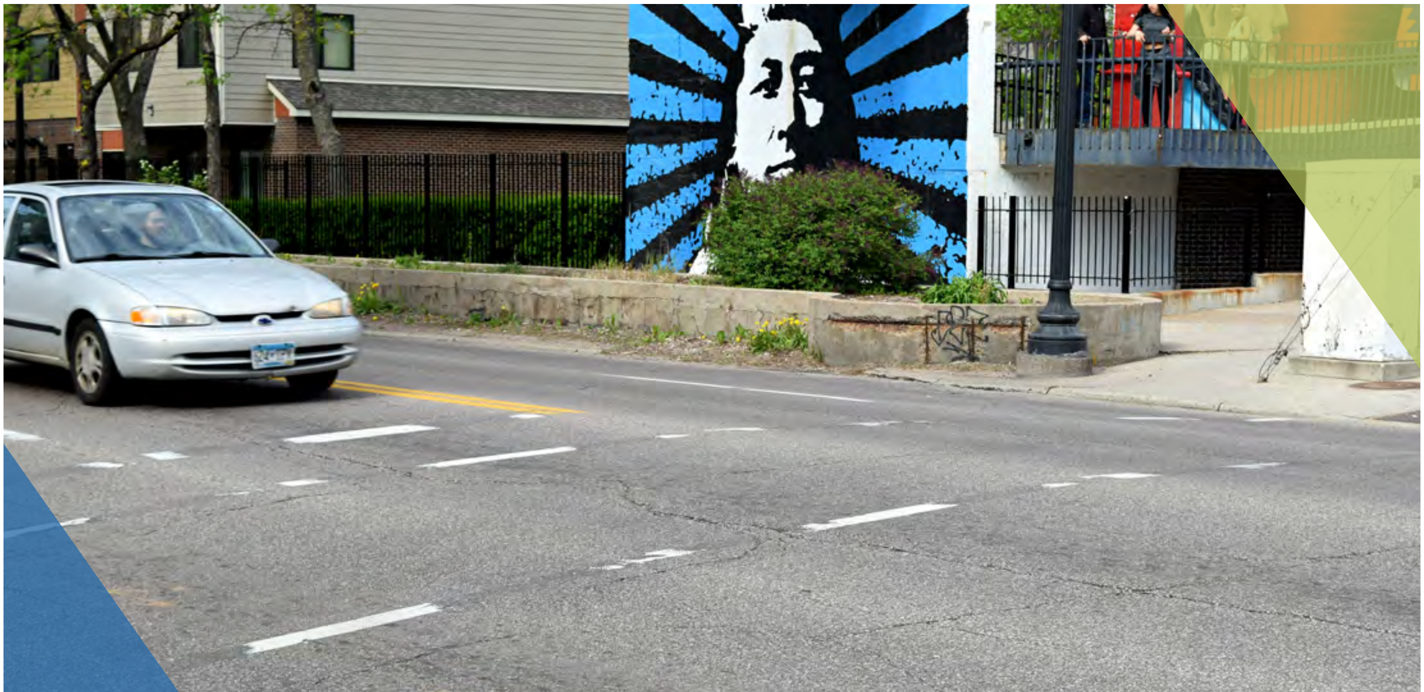


Figure B-40. Pedestrian Crashes on Penn Avenue S

Source for Pedestrian Crash Data: 10-Year Database
Source for Reconstruction Data: City of Minneapolis, Hennepin County



APPENDIX C. HIGH PEDESTRIAN CRASH INTERSECTIONS BY JURISDICTION

Intersections and streets in this study were considered city-wide. However, not every street is owned and operated by the same entity. This appendix lists intersections with high pedestrian crash numbers and rates by jurisdiction so that each entity can prioritize locations within their own agency. Each list consists of intersections on that agency's streets, regardless of the jurisdiction of the intersecting street. For instance, an intersection between a residential (city) street and a county street would appear on both lists. However, an intersection of a county street and a county street would only appear on the county street list.

Crashes at Parkway Intersections

Parkways are owned and operated by the City of Minneapolis Park and Recreation Board. These streets typically have a posted 25 mph speed limit, but may still carry relatively high vehicle volumes and have high numbers of pedestrians and bicyclists. Examples of City of Minneapolis Park and Recreation Board streets are East River Road and Saint Anthony Parkway. The City of Minneapolis Park and Recreation Board street intersections with the most crashes are shown in **Table C-1** and intersections with the highest crash rates are shown in **Table C-2**. All of these intersections have low total numbers of pedestrian crashes compared to other intersections in the city.

Table C-1. Parkway Intersections with Highest Pedestrian Crash Totals

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (vehicles/day)
1	Lake St W	Dean Pkwy S	3	0.02	46,000
2	40th St W	King's Hwy S	2	0.55	1,000
3	Kenwood Pkwy W	Vineland Place W	2	0.17	3,200
4	East River Pkwy SE	Fulton St SE	2	0.16	3,450
5	The Mall Pkwy W	The Mall turnaround south of the Midtown Greenway & west of Hennepin Ave	1	0.55	500
6	29th Ave N	Theodore Wirth Pkwy	1	0.37	750
7	22nd St W	East Lake of the Isles Pkwy	1	0.37	750
8	44th St W	West Lake Harriet Pkwy S	1	0.27	1,000
9	43rd St W	King's Hwy S	1	0.15	1,800
10	Arlington St SE	East River Pkwy SE	1	0.15	1,850
11	The Mall Pkwy W	Humboldt Ave S	1	0.11	2,500
12	Linden Hills Blvd S	William Berry Pkwy S	1	0.11	2,600
13	Victory Memorial Pkwy N	Knox Ave N	1	0.09	3,200
14	Victory Memorial Pkwy N	Logan Ave N	1	0.08	3,450
15	42nd St W	West Lake Harriet Pkwy S	1	0.07	4,050
16	Saint Anthony Pkwy NE	Hayes St NE	1	0.07	4,150
17	West Lake Calhoun Pkwy S	Upton Ave S	1	0.06	4,250
18	Cedar Lake Pkwy S	Depot St S	1	0.05	5,050
19	King's Hwy	East Lake Harriet Pkwy S	1	0.05	5,450
20	36th St E	West River Pkwy S	1	0.05	6,150
21	Saint Anthony Pkwy NE	Columbia Ave NE	1	0.04	6,400
22	Minnehaha Pkwy W	Nicollet Ave S	1	0.03	8,200
23	Victory Memorial Pkwy N	45th Av N	1	0.03	8,475
24	Plymouth Ave N	West River Pkwy N	1	0.02	11,425
25	Minnehaha Pkwy E	Bloomington Ave S	1	0.02	11,950

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Table C-2. Parkway Intersections with Highest Pedestrian Crash Rates

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	40th St W	King's Hwy S	2	0.55	1,000
2	The Mall Pkwy W	The Mall turnaround south of the Midtown Greenway & west of Hennepin Ave	1	0.55	500
3	29th Ave N	Theodore Wirth Pkwy	1	0.37	750
4	22nd St W	East Lake of the Isles Pkwy	1	0.37	750
5	44th St W	West Lake Harriet Pkwy S	1	0.27	1,000
6	Kenwood Pkwy W	Vineland Place W	2	0.17	3,200
7	East River Pkwy SE	Fulton St SE	2	0.16	3,450
8	43rd St W	King's Hwy S	1	0.15	1,800
9	Arlington St SE	East River Pkwy SE	1	0.15	1,850
10	The Mall Pkwy W	Humboldt Ave S	1	0.11	2,500
11	Linden Hills Blvd S	William Berry Pkwy S	1	0.11	2,600
12	Victory Memorial Pkwy N	Knox Ave N	1	0.09	3,200
13	Victory Memorial Pkwy N	Logan Ave N	1	0.08	3,450
14	42nd St W	West Lake Harriet Pkwy S	1	0.07	4,050
15	Saint Anthony Pkwy NE	Hayes St NE	1	0.07	4,150
16	West Lake Calhoun Pkwy S	Upton Ave S	1	0.06	4,250
17	Cedar Lake Pkwy S	Depot St S	1	0.05	5,050
18	King's Hwy	East Lake Harriet Pkwy S	1	0.05	5,450
19	36th St E	West River Pkwy S	1	0.05	6,150
20	Saint Anthony Pkwy NE	Columbia Ave NE	1	0.04	6,400
21	Minnehaha Pkwy W	Nicollet Ave S	1	0.03	8,200
22	Victory Memorial Pkwy N	45th Ave N	1	0.03	8,475
23	Plymouth Ave N	West River Pkwy N	1	0.02	11,425
24	Minnehaha Pkwy E	Bloomington Ave S	1	0.02	11,950
25	Minnehaha Pkwy W	Lyndale Ave S	1	0.02	12,450

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Crashes at City of Minneapolis Street Intersections

The City of Minneapolis owns, operates, and maintains Residential Streets, Local Streets, and Municipal State Aid (MSA) Streets. Municipal State Aid (MSA) streets typically have higher volumes of users and connect city destinations. Examples of MSA streets are Lyndale Avenue N and 38th Street E. The city street intersections with the most crashes are shown in **Table C-3** and intersections with the highest crash rates are shown in **Table C-4**.

Table C-3. City Intersections with Highest Pedestrian Crash Totals

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million entering vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	West Broadway Ave N	Lyndale Ave N	23	0.23	28,000
2	Franklin Ave W	Nicollet Ave S	21	0.18	31,600
3	Lake St W	Hennepin Ave S	20	0.21	26,300
4	Lake St W	Pillsbury Ave S	17	0.18	25,400
5	Lake St W	Blaisdell Ave S	17	0.18	26,500
6	4th St S	Cedar Ave S	16	0.22	19,650
7	Franklin Ave E	Chicago Ave S	16	0.17	25,150
8	26th St W	Lyndale Ave S	15	0.14	29,700
9	4th St SE	Central Ave SE	14	0.13	28,700
10	6th St N	Hennepin Ave S	14	0.13	30,200
11	4th St N	1st Ave N	13	0.15	23,200
12	Lake St E	Bloomington Ave S	13	0.12	30,500
13	9th St N	Hennepin Ave S	13	0.10	34,100
14	7th St N	Hennepin Ave S	13	0.09	38,500
15	4th St N	Hennepin Ave S	13	0.09	38,800
16	Franklin Ave W	Hennepin Ave S	12	0.14	24,325
17	Lake St E	1st Ave S	11	0.12	24,900
18	Franklin Ave E	3rd Ave S	11	0.12	25,675
19	Lagoon Ave W	Hennepin Ave S	11	0.11	27,600
20	Franklin Ave W	Lyndale Av S	11	0.08	37,100
21	Grant St W	Nicollet Mall S	10	0.31	8,800
22	2nd St S	3rd Ave S	10	0.17	15,675
23	4th St S	Nicollet Mall S	10	0.16	17,500
24	35th St W	Nicollet Ave S	10	0.14	19,200
25	4th St N	2nd Ave N	10	0.13	21,380

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Table C-4. City Intersections with Highest Pedestrian Crash Rates

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicales/Day)
1	Grant St W	Nicollet Mall S	10	0.31	8,800
2	West Broadway Ave N	Lyndale Ave N	23	0.23	28,000
3	4th St S	Cedar Ave S	16	0.22	19,650
4	Lake St W	Hennepin Ave S	20	0.21	26,300
5	Currie Ave W	10th St N	5	0.19	7,100
6	29th St W	Pillsbury Ave S	4	0.19	5,700
7	Lake St W	Pillsbury Ave S	17	0.18	25,400
8	Franklin Ave W	Nicollet Ave S	21	0.18	31,600
9	Hennepin Ave S	Mid-Block Driveway between 28th St W and Lagoon Ave	6	0.18	9,150
10	18th Ave N	Lyndale Ave N	5	0.18	7,700
11	Lake St W	Blaisdell Ave S	17	0.18	26,500
12	2nd St S	3rd Ave S	10	0.17	15,675
13	Franklin Ave E	Chicago Ave S	16	0.17	25,150
14	33rd St E	Chicago Ave S	4	0.17	6,300
15	27th Ave N	Emerson Ave N	3	0.17	4,750
16	25th Ave N	Emerson Ave N	3	0.17	4,750
17	Grant St W	LaSalle Ave S	6	0.17	9,550
18	5th St N	1st Ave N	9	0.16	15,100
19	9th St S	Nicollet Mall S	6	0.16	10,100
20	4th St S	Nicollet Mall S	10	0.16	17,500
21	31st St W	Blaisdell Ave S	8	0.16	14,100
22	4th St N	1st Ave N	13	0.15	23,200
23	8th St S	Nicollet Mall S	4	0.15	7,400
24	Lake St E	28th Ave S	8	0.14	15,150
25	22nd St E	Bloomington Ave S	3	0.14	5,700

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Crashes at County Road Intersections

Hennepin County owns and maintains a number of arterials through the City of Minneapolis, such as Lake Street (County Road 3) and Penn Avenue (County Road 2). These streets connect destinations within and outside the City of Minneapolis, and as such are some of the highest volume arterial streets in the City of Minneapolis for both pedestrians and other modes. The intersections on county roads with the most pedestrian crashes are shown in **Table C-5** and intersections with the highest crash rates are shown in **Table C-6**.

Table C-5. County Intersections with Highest Pedestrian Crash Totals

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	Lake St W	Lyndale Ave S	24	0.17	37,950
2	West Broadway Ave N	Lyndale Ave N	23	0.23	28,000
3	Franklin Ave W	Nicollet Ave S	21	0.18	31,600
4	Lake St W	Hennepin Ave S	20	0.21	26,300
5	Lake St W	Pillsbury Ave S	17	0.18	25,400
6	Lake St W	Blaisdell Ave S	17	0.18	26,500
7	4th St S	Cedar Ave S	16	0.22	19,650
8	Franklin Ave E	Chicago Ave S	16	0.17	25,150
9	Franklin Ave E	Portland Ave S	16	0.14	30,350
10	26th St W	Lyndale Ave S	15	0.14	29,700
11	Lake St E	Bloomington Ave S	13	0.12	30,500
12	Lake St E	1st Ave S	11	0.12	24,900
13	Franklin Ave E	3rd Ave S	11	0.12	25,675
14	Lowry Ave NE	Central Ave NE	11	0.11	26,500
15	Lagoon Ave W	Hennepin Ave S	11	0.11	27,600
16	Franklin Ave W	Lyndale Ave S	11	0.08	37,100
17	Lake St E	Chicago Ave S	10	0.09	32,200
18	Lowry Ave N	Penn Ave N	9	0.11	21,750
19	4th St SE	15th Ave SE	9	0.10	24,800
20	24th St W	Lyndale Ave S	9	0.09	27,825
21	Franklin Ave E	Park Ave S	9	0.09	29,000
22	Lake St E	Cedar Ave S	9	0.07	37,000
23	Lake St E	28th Ave S	8	0.15	15,150
24	Lake St W	Bryant Ave S	8	0.09	25,200
25	38th St E	Minnehaha Ave S	8	0.14	15,825

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Table C-6. County Intersections with Highest Pedestrian Crash Rates

Rank	Street On	Cross Street	Total Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	West Broadway Ave N	Lyndale Ave N	23	0.23	28,000
2	4th St S	Cedar Ave S	16	0.22	19,650
3	Lake St W	Hennepin Ave S	20	0.21	26,300
4	Franklin Ave E	Mid-Block Driveway between 13th Ave S and 14th Ave S	6	0.19	8,550
5	Cedar Ave S	Mid-Block Driveway between 24th St E and EM Stately St	6	0.19	8,700
6	Lake St W	Pillsbury Ave S	17	0.18	25,400
7	Franklin Ave W	Nicollet Ave S	21	0.18	31,600
8	Lake St W	Blaisdell Ave S	17	0.18	26,500
9	Franklin Ave E	Chicago Ave S	16	0.17	25,150
10	Lake St W	Lyndale Ave S	24	0.17	37,950
11	Lake St E	28th Ave S	8	0.15	15,150
12	Franklin Ave E	Portland Ave S	16	0.14	30,350
13	38th St E	Minnehaha Ave S	8	0.14	15,825
14	26th St W	Lyndale Ave S	15	0.14	29,700
15	Cedar Ave S	Mid-Block Crossing between Riverside Ave and 6th St S	3	0.12	6,700
16	Lake St E	1st Ave S	11	0.12	24,900
17	27th St E	Cedar Ave S	6	0.12	14,000
18	Franklin Ave E	3rd Ave S	11	0.12	25,675
19	Lake St E	Bloomington Ave S	13	0.12	30,500
20	Lowry Ave NE	Central Ave NE	11	0.11	26,500
21	Lowry Ave N	Penn Ave N	9	0.11	21,750
22	Lagoon Ave W	Hennepin Ave S	11	0.11	27,600
23	9th St S	Park Ave S	4	0.11	10,200
24	6th St S	Cedar Ave S	6	0.11	15,350
25	15th St E	Portland Ave S	5	0.10	13,400

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Crashes at State Highway Intersections

The Minnesota Department of Transportation (MnDOT) owns and maintains several trunk highways through the City of Minneapolis. These are typically some of the highest volume streets in the City of Minneapolis. Some examples include Hiawatha Avenue and Olson Memorial Highway (TH 55) and freeway on- and off-ramps to I-35W, I-94, and I-394. The intersections with the most pedestrian crashes on state roads are shown in **Table C-7** and intersections with the highest crash rates are shown in **Table C-8**.

Table C-7. State Intersections with Highest Pedestrian Crash Totals

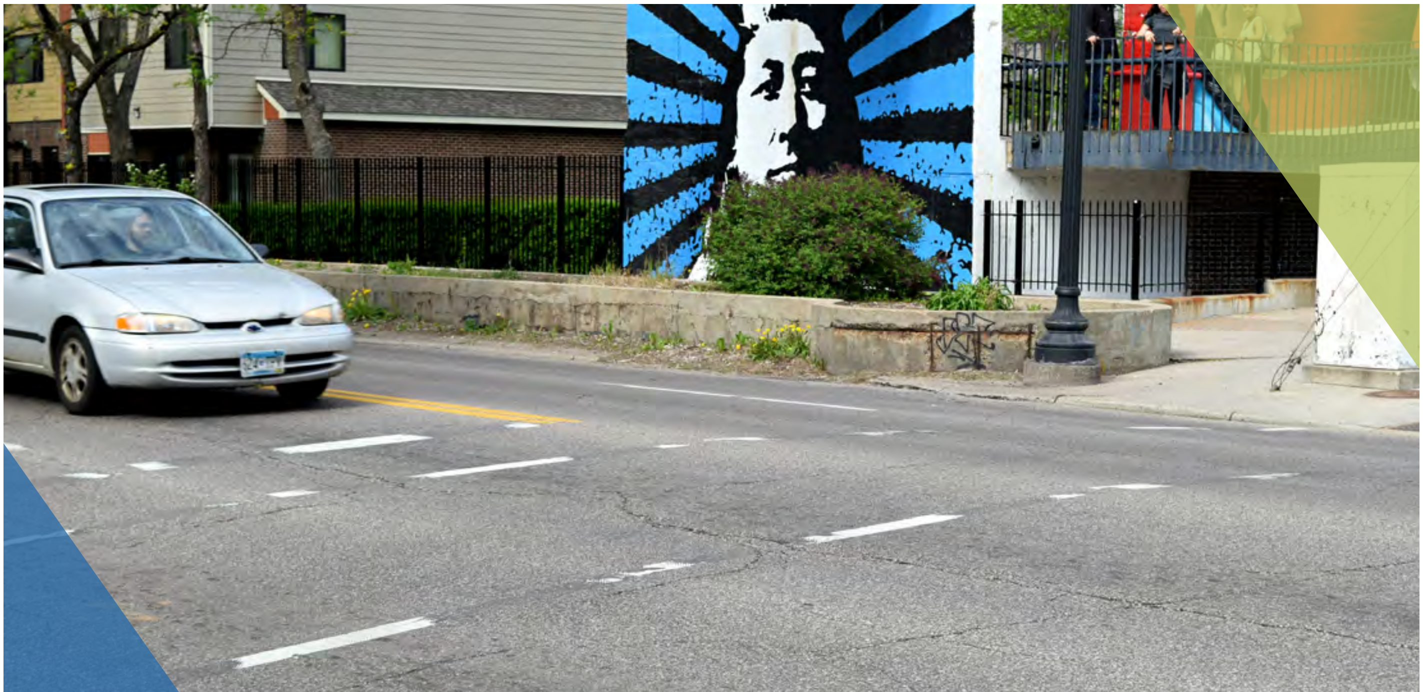
Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	4th St SE	Central Ave SE	14	0.13	28,700
2	Lowry Ave NE	Central Ave NE	11	0.11	26,500
3	2nd St S	3rd Ave S	10	0.18	15,675
4	4th St N	2nd Ave N	10	0.13	21,380
5	Washington Ave S	3rd Ave S	8	0.07	33,550
6	University Ave SE	Central Ave SE	6	0.07	23,350
7	Washington Ave S	I-35W SB Ramp	6	0.05	34,090
8	University Ave SE	I-35W NB Ramp	5	0.06	24,650
9	Fulton St SE	Huron Blvd SE	5	0.05	30,558
10	37th Ave NE	University Ave NE	4	0.05	20,850
11	10th St S	5th Ave S	4	0.04	25,600
12	Hennepin Ave E	University Ave NE	4	0.04	28,450
13	3rd St N	2nd Ave N	4	0.04	29,000
14	Lake St E	Hiawatha Ave S SB Ramp	4	0.04	30,160
15	42nd St E	Hiawatha Ave S	4	0.03	32,050
16	38th St E	Hiawatha Ave S	4	0.03	35,150
17	3rd Ave NE	University Ave NE	3	0.05	15,215
18	26th Ave NE	Central Ave NE	3	0.05	15,900
19	24th Ave NE	Central Ave NE	3	0.05	16,200

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis

Table C-8. State Intersections with Highest Pedestrian Crash Rates

Rank	Street On	Cross Street	Total Pedestrian Crashes	Crash Rate Crashes per Million Entering Vehicles per Year	Entering Vehicle Volume (Vehicles/Day)
1	2nd St S	3rd Ave S	10	0.18	15,675
2	36th St E	Stevens Ave S	4	0.14	8,100
3	4th St SE	Central Ave SE	14	0.13	28,700
4	4th St N	2nd Ave N	10	0.13	21,380
5	Lowry Ave NE	Central Ave NE	11	0.11	26,500
6	University Ave SE	Central Ave SE	6	0.07	23,350
7	Washington Ave S	3rd Ave S	8	0.07	33,550
8	University Ave SE	I-35W NB Ramp	5	0.06	24,650
9	3rd Ave NE	University Ave NE	3	0.05	15,215
10	37th Ave NE	University Ave NE	4	0.05	20,850
11	26th Ave NE	Central Ave NE	3	0.05	15,900
12	24th Ave NE	Central Ave NE	3	0.05	16,200
13	Washington Ave S	I-35W SB Ramp	6	0.05	34,090
14	Fulton St SE	Huron Blvd SE	5	0.05	30,558
15	10th St S	5th Ave S	4	0.04	25,600
16	Hennepin Ave E	University Ave NE	4	0.04	28,450
17	3rd St N	2nd Ave N	4	0.04	29,000
18	Lake St E	Hiawatha Ave S SB Ramp	4	0.04	30,160

Source for Pedestrian Crash Data: 10-Year Database
Source for Vehicle Volume Data: City of Minneapolis



APPENDIX D. PEDESTRIAN, BICYCLE, AND VEHICLE CRASH DENSITY MAPS

This appendix shows the densities of pedestrian, bicycle, and vehicle crashes in Minneapolis. The maps were provided by the City of Minneapolis.

For additional insight on pedestrian crash hotspots, a brief comparison of pedestrian, bicycle, and vehicle crash densities in Minneapolis was also conducted. The crash density maps provided by the City of Minneapolis in this appendix show that the relative densities of crashes involving pedestrians, bicyclists, and vehicles alone have locational similarities. Most crashes among all three crash types occur in the urban core of the City where streets, intersections, and people are more densely situated. However, while pedestrian and vehicle alone crashes are more widely distributed throughout the city, bicycle crashes are more concentrated around the urban core.

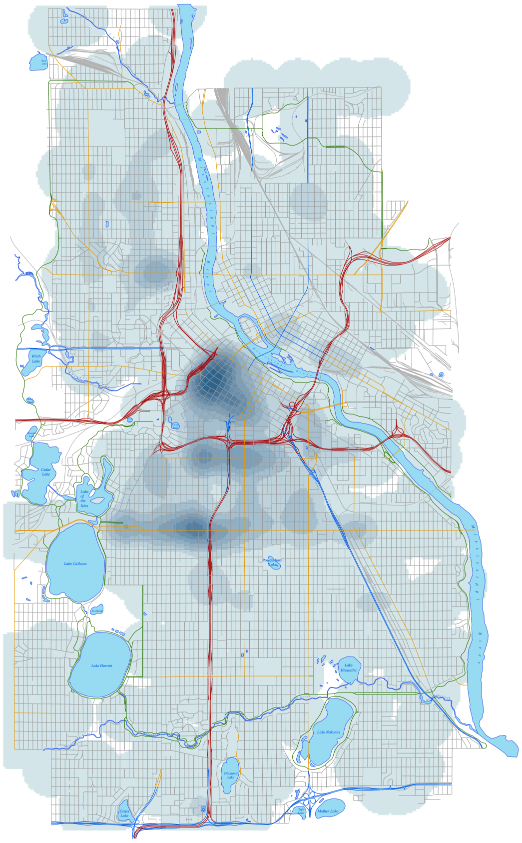


Figure D-1. Pedestrian Crash Density Map

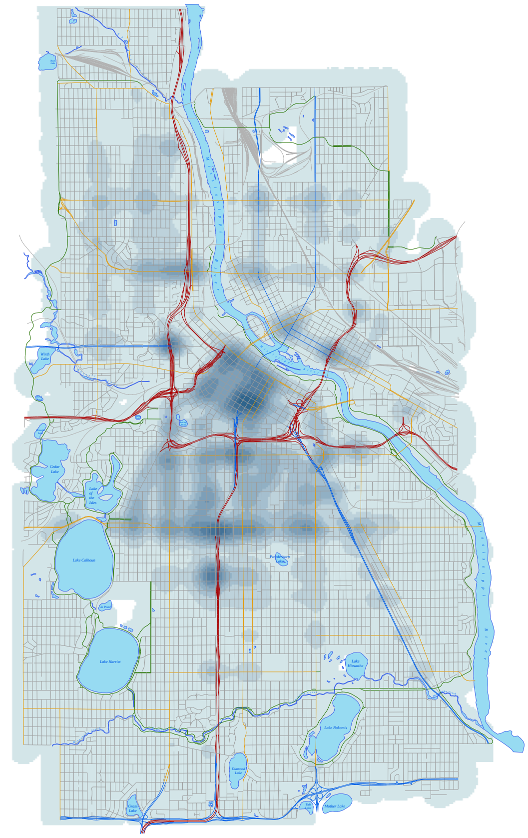


Figure D-3. Vehicle Crash Density Map

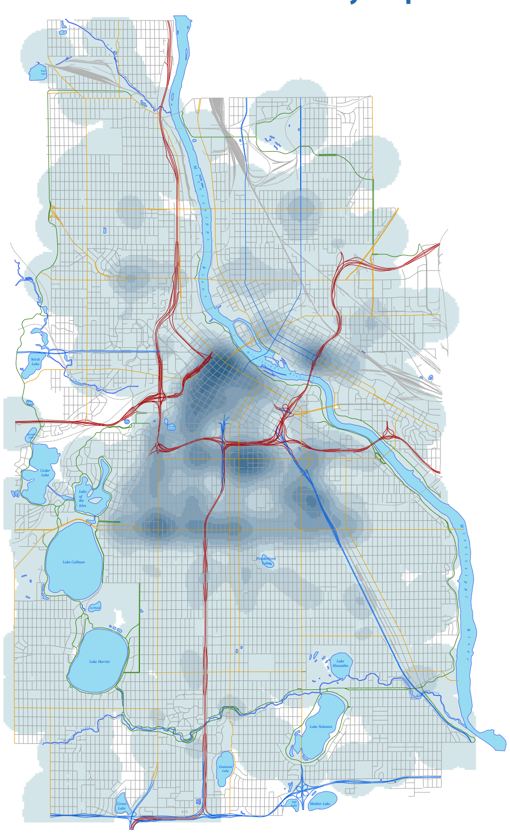


Figure D-2. Bicycle Crash Density Map