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Highlights

Overall Trends in Wisconsin Pedestrian and Bicycle Safety

• Higher levels of walking and bicycling were associated with greater pedestrian and bicyclist safety: between 2006 and 2013, the number of people walking and bicycling to work increased and the risk of pedestrian and bicyclist fatalities and injuries (per commuter) decreased.
• Of fatal traffic crashes reported between 2011 and 2013, approximately 10% involved pedestrians and 2% involved bicyclists. Approximately 9% of total trips were made by pedestrians and 1% were made by bicyclists, so these travel modes were overrepresented in fatal crashes.
• The highest concentrations ("hot spots") of fatal and severe-injury pedestrian and bicycle crashes tend to be along signalized, multilane, arterial roadway corridors in urban and suburban areas with moderate to high levels of pedestrian or bicycle activity. Without controlling for pedestrian and bicycle volumes (or other measures of exposure), it is not possible to determine if these locations experienced more crashes simply because they had more activity or because their conditions were inherently more dangerous. Regardless, these types of locations warrant attention due to high numbers of crashes.

Fatal Pedestrian and Bicycle Crashes
The following points highlight common characteristics of fatal pedestrian and bicycle crashes reported in Wisconsin between 2011 and 2013. Note that these results do not control for exposure: some characteristics may have high percentages of crashes because they are associated with higher levels of pedestrian or bicycle activity.

Fatal Pedestrian Crashes: Location
• 83% were at locations with no traffic signal or stop sign facing the driver (some of these locations had crosswalks, which require motorists to yield the right-of-way to pedestrians).
• 74% were on arterial or collector roadways.
• 55% occurred on roadways between intersections (i.e., >50 feet from the nearest intersection).
• 46% were on roadways with speed limits of 35 mph or higher.
• 36% were on rural roadways.
• 20% were at night on roadways with no lights.

Fatal Pedestrian Crashes: Behavior
• 77% involved a motor vehicle traveling straight.
• 31% involved alcohol (either the driver or the pedestrian had been drinking alcohol).
• 28% involved a driver not yielding to a pedestrian in a crosswalk.
• 65% of fatalities at intersections involved driver error (59% failed to yield to a pedestrian in a crosswalk and 6% violated a traffic signal) while 12% involved pedestrian error (violated a traffic signal).

Fatal Pedestrian Crashes: Other
• 52% occurred between 3 p.m. and midnight. The peak 3-hour period was 3 to 6 p.m. (24%).
• 31% involved pedestrians aged 65 or older.

Fatal Bicycle Crashes: Location
• 76% were on arterial or collector roadways.
• 70% were on roadways with speed limits of 35 mph or higher.
- 67% were at locations with no traffic control for the driver (i.e., no traffic signal or stop sign).
- 64% were on roadways between intersections.
- 33% were on rural roadways.

**Fatal Bicycle Crashes: Behavior**
- 79% involved a motor vehicle traveling straight.
- 39% involved a motor vehicle striking a bicyclist from behind on a roadway. Of these rear-end fatalities, 62% were on rural highways and 31% occurred during darkness.
- 27% involved alcohol (either the driver or the bicyclist had been drinking alcohol).

**Fatal Bicycle Crashes: Other**
- Crashes involving bicyclists younger than age 20 decreased from 62% of all bicycle crashes in 2003 to 33% of all bicycle crashes between 2011 and 2013 (includes all injury severity levels).

**Strategies to Improve Pedestrian and Bicycle Safety**
This report recommends a multi-faceted approach to reduce pedestrian and bicycle crash risk, including engineering, education, enforcement, and evaluation strategies.

**Engineering**
- Reduce roadway design speeds (e.g., reduce the number of lanes, narrow roadway lanes).
- Reduce roadway crossing distances.
- Provide pedestrian and bicycle facilities (e.g., sidewalks, paved shoulders, and bicycle lanes).
- Improve roadway lighting.

**Education**
- Increase driver awareness of laws requiring them to yield to pedestrians in crosswalks and provide at least three feet of space when passing bicyclists (even when a bike lane exists).
- Increase driver awareness of the danger they pose to their neighbors who are walking and bicycling when they speed, are intoxicated, or are distracted (e.g., texting while driving, eating).
- Increase driver awareness of their responsibility to travel at a prudent speed (potentially lower than the speed limit) in order to be able to react safely to pedestrians and bicyclists at night.
- Increase bicyclist awareness of the risk of riding in the opposite direction of adjacent traffic, disobeying traffic control, and bicycling at night without lights and bright clothing.
- Increase pedestrian awareness of the risk of walking while intoxicated and disobeying traffic control. Emphasize the importance of pedestrian nighttime visibility to aid driver detection.

**Enforcement**
- Enforce laws to reduce drunk driving, speeding, failure to yield to pedestrians, and passing too close to bicyclists.
- Enforce laws to reduce bicycling at night without lights and pedestrian and bicyclist traffic signal violations.

**Evaluation**
- Improve police pedestrian and bicycle crash reporting practices to record details such as alcohol involvement by person/individual, crash type, helmet use, use of lights, and relevant maintenance problems.
- Collect pedestrian and bicycle counts and surveys to account for exposure.
- Quantify the impacts of specific intersection and roadway characteristics, education, and enforcement efforts on pedestrian and bicycle crash risk to inform future recommendations.
Executive Summary

Between 2011 and 2013, Wisconsin averaged more than 1,600 reported pedestrian crashes and more
than 1,100 reported bicycle crashes per year1. Pedestrians and bicyclists are particularly vulnerable to
serious injuries when they are involved in a crash with a motor vehicle: 19% of these pedestrian crashes
and 10% of these bicycle crashes resulted in fatal ("K"-level) or severe ("A"-level) injuries2. Of all 1,568
fatal crashes reported in Wisconsin between 2011 and 2013, 152 (9.7%) involved pedestrians and 33
(2.1%) involved bicyclists. Of all 8,737 severe-injury crashes during this period, 774 (8.9%) involved
pedestrians and 307 (3.5%) involved bicyclists. See the grey box below for information about crash data
used in this report.

Crash Data Used in this Report

The crash numbers cited throughout this report are based on all police-reported crashes in the
WisTransPortal Database (Wisconsin TOPS Laboratory 2014a) except deer-related crashes. Crashes on
private property (parking lots and driveways) are included. Private-property crashes account for
approximately 22% of pedestrian crashes (12% of fatal, 19% of severe, and 24% of non-severe
pedestrian crashes) and 6.4% of bicycle crashes (0.0% of fatal, 5.2% of severe, and 6.5% of non-severe
bicycle crashes). Note that the official crash statistics provided by the Wisconsin Department of Motor
Vehicles (DMV) exclude private-property crashes. Since crashes on private property are less likely to
involve turning vehicles, less likely to occur at high speeds, and less likely to result in fatal and severe
injuries than crashes on public roadways, the percentages of crashes with these characteristics
presented in this report are slightly different than percentages calculated from DMV records.

DMV statistics (for public roadways only) show: Wisconsin averaged more than 1,250 reported
pedestrian crashes and more than 1,050 reported bicycle crashes per year between 2011 and 2013.
21% of pedestrian crashes and 10% of bicycle crashes resulted in fatal or severe injuries. Of all 1,541
fatal crashes reported in Wisconsin between 2011 and 2013, 136 (8.8%) involved pedestrians and 33
(2.1%) involved bicyclists. Of all 8,449 severe-injury crashes during this period, 647 (7.7%) involved
pedestrians and 291 (3.4%) involved bicyclists.

Recognizing the importance of pedestrian and bicycle safety, the Wisconsin Department of
Transportation (WisDOT) Strategic Highway Safety Plan (SHSP) for 2014-2016 includes “Provide Safe
Pedestrian and Bicycle Travel” as one of the state’s “Highest Priority Issue Areas” (WisDOT 2014a).
Further, the WisDOT SHSP sets goals to reduce the number of pedestrian and bicycle fatal and serious-
injury crashes by 5% by 2016, reduce the number of pedestrian and bicycle injury crashes by 5% by
2015, and reduce the total number of pedestrian and bicycle crashes by 5% by 2016 (WisDOT 2014a).

This study explores the characteristics of pedestrian and bicycle crashes reported between 2011 and
2013, focusing especially on serious crashes (crashes resulting in fatal and severe injuries). The results
help Wisconsin DOT identify education, enforcement, and engineering treatments to help achieve its
goals to improve pedestrian and bicycle safety.

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1 Following convention, this report often uses the term “bicycle crash” to refer to the vehicle in crashes involving
people on bicycles (i.e., bicyclists). The term “bicyclist” is used where the sentence refers to a person.
2 This report classifies crash injury severity according to the KABCO scale. The definitions of each code are K =
“Killed”; A = “Incapacitating”; B = “Non-incapacitating”; C = “Possible”; and Blank = Unreported. These codes are
simplified in the text to K = “Fatal”; A = “Severe”; and B, C, or O = “Non-severe”.

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Summary of Previous Research

According to previous studies, pedestrian crashes are associated with roadway design characteristics such as higher automobile speeds, more lanes, and more automobile traffic. Pedestrian crashes are also more likely on roads without sidewalks and crossings without median islands. Behaviors associated with pedestrian crashes include driver and pedestrian intoxication, drivers failing to yield to pedestrians in crosswalks, and pedestrians stepping into the road between cars. Children and male adults tend to be overrepresented in pedestrian crashes compared to their proportion of the population.

Bicycle crashes also tend to be associated with higher-speed roadways, more lanes, and more automobile traffic. In addition, bicycle crashes are more common on roadways without designated bicycle facilities. Many bicycle crashes involve children and male adults, but fewer involve females and seniors. Common causes of bicycle crashes include driver and bicyclist failure to yield and bicyclists riding in the opposite direction of adjacent traffic (contra-flow riding in a location without designated contra-flow facilities).

Some of the common crash characteristics listed above are found simply because pedestrian and bicycle crashes tend to be more common in locations and during time periods with more pedestrian and bicycle activity. After controlling for exposure, the risk of being involved in a crash tends to be lower for each individual when there are more people walking and bicycling. Both pedestrians and bicyclists experience more fatal and severe injuries in crashes on higher-speed roads.
Summary of Analysis Approach
The analysis approach used in this study advances our understanding of pedestrian and bicycle safety in Wisconsin in six important ways. This study:

1) Provides a detailed understanding of pedestrian, bicyclist, and driver movements that preceded a crash. This is done by reviewing the narrative descriptions in police crash reports and applying a location-movement classification method (LMCM) to expand on the National Highway Traffic Safety Administration (NHTSA) crash typology used in the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) (Harkey et al. 2006).

2) Summarizes detailed roadway characteristics at pedestrian and bicycle crash sites. This is done by reviewing aerial and street-level imagery and recording characteristics such as local street versus collector or arterial roadway; number of lanes; and presence of bicycle lanes, sidewalks, marked crosswalks, curb extensions, and median islands.

3) Analyzes the characteristics of pedestrian and bicycle crashes that result in different levels of injury severity (fatal, severe, and non-severe).

4) Creates a list of the top 20 pedestrian and top 20 bicycle crash “hot spots”. These lists include locations in all five Wisconsin DOT districts that have high concentrations of fatal and severe pedestrian and bicycle crashes. This is done by analyzing the density of crash locations in GIS. Common characteristics of these locations are noted.

5) Explores the characteristics of crashes involving young pedestrians and young bicyclists. Pedestrians and bicyclists were considered to be young if they were below age 20. Age 20 was chosen for consistency with the analysis of Wisconsin bicycle crashes in 2003 (Amsden and Huber 2006). Future studies should use age 16 to divide age categories so that it is possible to examine the differences between crashes involving pedestrians and bicyclists at ages younger and older than the legal driving age.

6) Identifies whether the motorist, pedestrian, or bicyclist (or more than one party) was primarily responsible for the crash. Since “fault” is not assigned for crashes in Wisconsin, primary responsibility was determined by reviewing citations and the police description of the crash.

Pedestrian and bicycle crashes were analyzed separately, since they tended to involve different groups of people, different behaviors, and different roadway characteristics. The unit of analysis was crashes (rather than number of individual pedestrians or bicyclists injured). It is important to recognize several important limitations of the available data. These included unreported crashes, injury severity levels assessed by police, and lack of data on pedestrian and bicyclist exposure.

Available data from crashes reported to police between January 1, 2011 and December 31, 2013 were used for many analyses. This dataset included 4,857 pedestrian and 3,365 bicycle crashes on public roadways and on private property (only deer crashes were excluded). However, the existing crash data do not include information about some important behaviors and roadway characteristics, so additional data were collected for a sample of 296 pedestrian and 229 bicycle crashes. This made it possible to conduct several other detailed analyses.

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3 The pedestrian and bicycle crash typologies were originally developed by the National Highway Traffic Safety Administration (NHTSA) (Snyder and Knoblauch 1971; Cross and Fisher 1977) and refined for the Federal Highway Administration (FHWA) PBCAT in the 1990s (Harkey et al. 1999).
Summary of Findings

Overall, pedestrian and bicycle crashes have declined in Wisconsin over the last 15 years (Amsden and Huber 2006; WisDOT 2011; Wisconsin TOPS Laboratory 2014a). The tables below show the total number of reported pedestrian and bicycle crashes by severity level over the last decade (Table 1 and Table 2). Note that these tables include all police-reported crashes on public roadways and private property (parking lots and driveways) except deer crashes.

Table 1. Wisconsin Pedestrian Crashes by Severity Level, 2004 to 2013

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>55</td>
<td>43</td>
<td>58</td>
<td>57</td>
<td>59</td>
<td>40</td>
<td>56</td>
<td>62</td>
<td>48</td>
<td>42</td>
<td>520</td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>327</td>
<td>348</td>
<td>330</td>
<td>297</td>
<td>304</td>
<td>275</td>
<td>268</td>
<td>258</td>
<td>262</td>
<td>254</td>
<td>2,923</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>1,382</td>
<td>1,421</td>
<td>1,475</td>
<td>1,434</td>
<td>1,300</td>
<td>1,236</td>
<td>1,287</td>
<td>1,259</td>
<td>1,324</td>
<td>1,348</td>
<td>13,466</td>
</tr>
<tr>
<td>Total</td>
<td>1,764</td>
<td>1,812</td>
<td>1,863</td>
<td>1,788</td>
<td>1,663</td>
<td>1,551</td>
<td>1,611</td>
<td>1,579</td>
<td>1,634</td>
<td>1,644</td>
<td>16,909</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Table 2. Wisconsin Bicycle Crashes by Severity Level, 2004 to 2013

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>14</td>
<td>14</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>104</td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>145</td>
<td>144</td>
<td>132</td>
<td>136</td>
<td>119</td>
<td>118</td>
<td>109</td>
<td>105</td>
<td>115</td>
<td>87</td>
<td>1,210</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>1,091</td>
<td>1,064</td>
<td>1,034</td>
<td>1,093</td>
<td>1,005</td>
<td>990</td>
<td>1,055</td>
<td>1,003</td>
<td>1,098</td>
<td>924</td>
<td>10,357</td>
</tr>
<tr>
<td>Total</td>
<td>1,250</td>
<td>1,222</td>
<td>1,174</td>
<td>1,239</td>
<td>1,133</td>
<td>1,115</td>
<td>1,173</td>
<td>1,120</td>
<td>1,224</td>
<td>1,021</td>
<td>11,671</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Crashes may decrease over time for several reasons. One possibility is that roadway designs and pedestrian, bicyclist, and driver behaviors are safer. Another possibility is that overall levels of walking, bicycling, or driving have varied. To control changes in population and activity levels, Table 3 and Figure 1 provide several different measures of exposure and calculations of pedestrian crash rates over the last decade. Table 4 and Figure 2 provide similar calculations for bicycle crash rates.

4 Similar statistics are also available from DMV records for public roadways only. See http://wisconsindot.gov/Pages/about-wisdot/newsroom/statistics/final.aspx.
### Table 3. Wisconsin Pedestrian Crash Rates, 2004 to 2013

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Population (in 100,000s)</td>
<td>55.14</td>
<td>55.46</td>
<td>55.78</td>
<td>56.11</td>
<td>56.41</td>
<td>56.69</td>
<td>56.89</td>
<td>57.09</td>
<td>57.25</td>
<td>57.43</td>
</tr>
<tr>
<td>Pedestrian Crashes per 100,000 People</td>
<td>32</td>
<td>33</td>
<td>33</td>
<td>32</td>
<td>29</td>
<td>27</td>
<td>28</td>
<td>28</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Ped. K &amp; A Crashes per 100,000 People</td>
<td>6.9</td>
<td>7.0</td>
<td>7.0</td>
<td>6.3</td>
<td>6.4</td>
<td>5.6</td>
<td>5.7</td>
<td>5.6</td>
<td>5.4</td>
<td>5.2</td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT) (in Millions)</td>
<td>60,398</td>
<td>60,018</td>
<td>59,401</td>
<td>59,493</td>
<td>57,462</td>
<td>58,157</td>
<td>59,420</td>
<td>58,554</td>
<td>59,087</td>
<td>59,484</td>
</tr>
<tr>
<td>Pedestrian Crashes per Million VMT</td>
<td>0.029</td>
<td>0.030</td>
<td>0.031</td>
<td>0.030</td>
<td>0.029</td>
<td>0.027</td>
<td>0.027</td>
<td>0.027</td>
<td>0.028</td>
<td>0.028</td>
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<tr>
<td>Walk Commuters (in 1,000s)</td>
<td>99.41</td>
<td>93.82</td>
<td>97.39</td>
<td>94.87</td>
<td>94.87</td>
<td>94.87</td>
<td>94.27</td>
<td>91.65</td>
<td>99.93</td>
<td></td>
</tr>
<tr>
<td>Ped. Crashes per 1,000 Walk Commuters</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>19</td>
<td>17</td>
<td>18</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ped. K &amp; A Crashes per 1,000 Walk Commuters</td>
<td>3.9</td>
<td>3.8</td>
<td>3.7</td>
<td>3.3</td>
<td>3.7</td>
<td>3.4</td>
<td>3.4</td>
<td>3.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).

### Table 4. Wisconsin Bicycle Crash Rates, 2004 to 2013

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Population (in 100,000s)</td>
<td>55.14</td>
<td>55.46</td>
<td>55.78</td>
<td>56.11</td>
<td>56.41</td>
<td>56.69</td>
<td>56.89</td>
<td>57.09</td>
<td>57.25</td>
<td>57.43</td>
</tr>
<tr>
<td>Bicycle Crashes per 100,000 People</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>21</td>
<td>20</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Bicycle K &amp; A Crashes per 100,000 People</td>
<td>2.9</td>
<td>2.8</td>
<td>2.5</td>
<td>2.6</td>
<td>2.3</td>
<td>2.2</td>
<td>2.1</td>
<td>2.0</td>
<td>2.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT) (in Millions)</td>
<td>60,398</td>
<td>60,018</td>
<td>59,401</td>
<td>59,493</td>
<td>57,462</td>
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<td>6.1</td>
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Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).
Figure 1. Wisconsin Fatal & Severe Pedestrian Crash Rates, 2004 to 2013

Figure 2. Wisconsin Fatal & Severe Bicycle Crash Rates, 2004 to 2013
Pedestrian crash rates decreased between 2004 and 2013 by nearly all measures in Table 3. One exception was pedestrian crashes per million vehicles traveled, which remained relatively stable. Bicycle crash rates decreased over the 10-year period by all measures in Table 4. This suggests that there were real improvements in safety for pedestrians and bicyclists in Wisconsin between 2004 and 2013. These data also show that higher levels of walking and bicycling were associated with greater pedestrian and bicyclist safety: between 2006 and 2013, the number of people walking and bicycling to work increased and the risk of pedestrian and bicyclist fatalities and injuries (per commuter) decreased.

Several other measures can be used to assess Wisconsin pedestrian and bicycle crash trends. The National Household Travel Survey (NHTS) is the best available source of total pedestrian and bicycle activity in Wisconsin (including all types of walking and bicycling trips, not just commuting to work), but was only conducted in 2001 and 2009. This source shows that pedestrian crashes per million Wisconsin pedestrian trips decreased from 3.6 to 2.4 between 2001 and 2009. Bicycle crashes per million Wisconsin bicycle trips increased from 14.1 to 15.1 between 2001 and 2009 (Federal Highway Administration 2001 and 2009).

In 2004, 7.7% of all fatal crashes in Wisconsin involved pedestrians. This number increased to 8.5% in 2013 (and reached a high of 12.0% in 2011). The proportion of fatal crashes that involved bicyclists was 2.0% in 2004 and 2013 (Wisconsin TOPS Laboratory 2014a). From 2011 to 2013, 9.7% of fatal crashes involved pedestrians and 2.1% involved bicyclists. Based on 2009 NHTS data, approximately 9% of total trips in Wisconsin were made by pedestrians and 1% were made by bicyclists, so these travel modes were overrepresented in fatal crashes during the 2011 to 2013 period.

Pedestrian and bicycle fatalities are prominent in urban areas, as these communities tend to have more walking and bicycling activity. In the City of Milwaukee, 30% of all fatal traffic crashes reported between 2011 and 2013 involved pedestrians and 2.9% involved bicyclists. In the City of Madison, 28% of fatal crashes involved pedestrians and 10% involved bicyclists.

Pedestrian Crash Characteristics by Severity Level
There were 152 fatal (“K”-level) injury crashes, 774 severe (“A”-level) injury crashes, and 3,931 non-severe (“B”, “C”, or “O”-level) crashes involving pedestrians between 2011 and 2013. Detailed analysis of these pedestrian crashes showed:

- **83%** of fatal crashes were at locations where there was no traffic signal or stop sign facing the driver. These locations included roadways between intersections, parking lots/ driveways, and intersections of major roadways with minor streets. Most intersections of major roadways with minor streets had stop signs for the minor street but no stop sign or signal for the major roadway. However, most of these intersections had crosswalks across the major roadway, meaning that the driver was legally required to yield the right-of-way to the pedestrian. Only 66% of non-severe crashes had no traffic signal or stop sign facing the driver.

- **74%** of fatal crashes were on arterial and/or collector roadways. These thoroughfares were associated with more serious pedestrian injuries, as only 45% of non-severe crashes occurred on arterial or collector roadways. Arterial and collector roadways tend to have higher automobile speeds and volumes and more travel lanes.

- **55%** of fatal crashes occurred on a roadway between intersections.

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5 These variables are not included in the WisTransPortal database. Therefore, the results for these characteristics were based on a detailed analysis of a sample of 80 fatal pedestrian crashes.
• 46% of fatal crashes were on roadways with speed limits of 35 miles per hour or higher. Higher-speed roadways were associated with more serious pedestrian injuries, as only 16% of non-severe crashes occurred on roadways with speed limits of 35 miles per hour or higher. These roadways also tend to have higher volumes and more travel lanes.

• 47% of fatal crashes were on roadways with 4 or more lanes. Interestingly, 46% of the non-severe crashes took place on roadways with 4 or more lanes. Fatal crashes were initially expected to be much higher on multilane roadways because multilane roadways are often arterial and collector roadways in urban areas. These main roadways often have higher speeds than two-lane neighborhood streets. However, the narrow difference that exists between fatal and non-severe crashes on multilane roadways may be due to the strong connection between fatal crashes and rural locations. Rural roads often have two lanes and allow for higher speeds, which are associated with more severe injuries.

• 36% of fatal crashes were on rural roadways. Rural roadways were associated with more serious pedestrian injuries, as only 15% of non-severe crashes occurred on rural roadways.

• 20% of fatal crashes were at night on roads with no lights. Dark, unlit roads were associated with more serious pedestrian injuries as only 4.8% of all non-severe crashes were at night on roads without lighting. Of the fatalities that occurred on dark, unlit roads, 67% were in rural areas.

• Only 17% of fatal crashes had some form of traffic control present (other than a crosswalk). In contrast, 34% of all non-severe crashes had traffic control present.

• 48% of fatal crashes had some form of pedestrian crossing facility present (e.g., marked crosswalk, median refuge, or curb extensions; sidewalks are not a crossing facility; unmarked crosswalks are not considered to be a facility in this analysis), which was slightly higher than non-severe, which only had pedestrian facilities present in 42% of crashes. Of the fatal crashes that had pedestrian facilities present, 68% had a marked crosswalk and 50% had a median present. Without controlling for exposure (people are likely to walk more in locations with pedestrian facilities), it is not possible to determine a relationship between pedestrian facilities and pedestrian crash risk.

• 77% of fatal crashes involved a vehicle going straight. Vehicles were going straight in only 49% of non-severe crashes.

• 31% of fatal crashes involved alcohol (either the driver or pedestrian was intoxicated). Alcohol involvement was less prominent in severe (12%) and non-severe (6.9%) crashes.

• 28% of fatal crashes involved drivers not yielding to pedestrians in crosswalks. Of these failure-to-yield fatalities, 68% were at intersections where the driver was going straight and no signal or stop sign was present, 18% were at intersections where the driver struck the pedestrian while turning left (none involved right turns), and 14% involved the driver disobeying a signal or stop sign. Most of these failure-to-yield crashes were at marked crosswalks (with painted lines), but some were at unmarked crosswalks.

• Most pedestrian fatalities at intersections involved driver error. Considering the sample of 34 intersection pedestrian fatalities examined in detail, 65% were due to driver error (59% involved a driver not yielding to a pedestrian in a crosswalk and 6% involved a driver disobeying a traffic signal). Only 12% involved a driver with a green light striking a pedestrian who violated a red signal.

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6 Crashes were counted as being on a roadway with 4 or more lanes if they occurred at an intersection that had at least one approach with 4 or more lanes. Percentages are taken out of all intersection and non-intersection crashes (crashes that have an identified number of lanes), not parking lot or private property crashes.
• Fatalities at intersections were most common when pedestrians were in the far crosswalk (crosswalk negotiated by the driver when exiting the intersection) rather than the near crosswalk (crosswalk negotiated by the driver when entering the intersection).\(^5\)
• Fatalities were more likely when pedestrians were approaching from the driver’s left side.\(^5\) Non-severe crashes were more likely when pedestrians were approaching from the driver’s right side.
• 13% of fatal crashes involved a motorist striking a pedestrian who entered the roadway from the driver’s left on the far side of an intersection.\(^5\) Six of these crashes (60%) had no traffic control present on the motorist’s roadway and 3 crashes (30%) had operating traffic signals.
• The common categories of movements preceding a crash were different for non-severe-injury crashes.\(^5\) These less severe crashes were more likely to be at intersections and involve motorists turning left and right. In contrast, more severe crashes involved motorists traveling straight.
• 19% of all pedestrian crashes involved hit-and-run drivers. This rate was similar for all injury severity levels. However, police were much more likely to conduct follow-up investigations and find the hit-and-run drivers when the pedestrian was killed.
• Four pedestrian fatalities involved a pedestrian near a disabled vehicle. Three of these were at the side of freeways.
• One fatal crash was reported to involve a driver being distracted by a cell phone.\(^5\) Other fatalities may have involved distraction, but it was not noted in the crash narrative.
• 52% of fatal crashes occurred between 3 p.m. and midnight. 24% of fatal crashes occurred between 3 p.m. and 6 p.m.
• 31% of fatal crashes involved a pedestrian age 65 or older.

Bicycle Crash Characteristics by Severity Level
There were 33 fatal (“K” injury) crashes, 307 severe injury (“A” injury) crashes, and 3,025 non-severe (“B”, “C”, or “O” injury) crashes involving bicyclists between 2011 and 2013. Detailed analysis of these bicycle crashes showed:
• 76% of fatal crashes were on arterial and/or collector roadways.\(^7\) These thoroughfares were associated with more severe bicycle injuries, as only 61% of all non-severe crashes occurred on arterial or collector roadways. These roadways tend to have higher automobile speeds and volumes and more travel lanes. Of these fatal crashes on major roadways, 80% were at a location without a bicycle lane or paved shoulder.
• 70% of fatal crashes were on roadways with speed limits of 35 miles per hour or higher. Higher-speed roadways were associated with more severe bicycle injuries, as only 19% of all non-severe crashes occurred on roadways with speed limits of 35 miles per hour or higher. These roadways also tend to have higher volumes and more travel lanes.
• 67% of fatal crashes were at locations where there was no traffic control for the driver (e.g., traffic signal, stop sign).
• 64% of fatal crashes occurred on a roadway between intersections.\(^7\)
• 36% of fatal crashes were on roadways with 4 or more lanes. 41% of non-severe crashes were on roadways with 4 or more lanes.\(^7\) The proportion of fatalities on multi-lane roads may be smaller because a relatively high proportion of fatalities are on high-speed, two-lane, rural roads.

\(^7\) These variables are not included in the WisTransPortal database. Therefore, the results for these characteristics were based on a detailed analysis of all 33 fatal bicycle crashes.
33% of fatal crashes were on rural roadways. Rural roadways were associated with more severe bicyclist injuries, as only 14% of non-severe crashes occurred on rural roadways.

9.1% of fatal crashes were at night on roads with no lights. Dark, unlit roads were associated with more severe bicyclist injuries, as only 1.7% of all non-severe crashes occurred at night on roads with no lights.

33% of fatal crashes had a bicycle facility present (e.g., bicycle lane, paved shoulder, or sidepath; signed bike routes were not considered to be bicycle facilities). 15% of all non-severe crashes have a bicycle facility present. Without controlling for exposure (people are likely to bicycle more in locations with bicycle facilities), it is not possible to determine a relationship between bicycle facilities and bicycle crash risk. However, the higher percentage of fatal crashes with bike facilities present may reflect that many of the fatalities were on rural roadways with paved shoulders.

79% of fatal crashes involved a vehicle going straight.

39% of fatal crashes involved a motorist striking a bicyclist from behind on the roadway. All of these crashes were identified in the WisTransPortal database as occurring at non-intersection locations. 62% of these crashes occurred on rural roadways. 31% of these crashes occurred during darkness, meaning that 69% occurred in daylight. 31% of these crashes occurred with bicycle facilities present.

9.1% of fatal crashes were head-on, in which the vehicle crossed the center line and struck a bicyclist in the opposite lane of traffic. These circumstance was much less common for less severe crashes, as none of the non-severe injury crashes studied involved this situation.

27% of fatal crashes involved alcohol (either the driver or bicyclist was intoxicated). Alcohol involvement was less prominent in severe crashes (3.6%) and non-severe crashes (2.5%).

When classified by contributing circumstances, 12% of fatal crashes involved a motorist striking a bicyclist who was approaching from the left on the near side of the intersection. 6.1% of fatal crashes involved a motorist striking a bicyclist approaching from the right (in the opposite direction of adjacent traffic) on the near side of the intersection. This contributing circumstance was much more common in less severe bicycle crashes, as 23% of non-severe-injury crashes involved a bicyclist riding contra-flow without a contra-flow bicycle facility.

One bicycle fatality involved a driver being distracted by a cell phone. Other fatalities may have involved distraction by cell phone or other means, but it was not noted in the crash narrative.

Many of the bicycle fatalities were middle-aged men. 16 (48%) of the bicyclists killed were between 46 and 65 years old. 88% of bicycle fatalities were men. Only one of the bicyclists killed was younger than 18 (age 15), and only three were younger than 22.

Overall, bicycle crashes among young bicyclists (younger than age 20) decreased dramatically over the last decade. These young bicyclists accounted for nearly 62% (657 of 1,065) of bicycle crashes in 2003, but they accounted for only 33% (1,103 of 3,323) between 2011 and 2013. This change may reflect improvements in young bicyclist education and behavior, reductions in bicycling by this age group, or increases in bicycling by other age groups.

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8 Two of the 13 crashes were within 50 feet of an intersection, so our definition classified these as intersection crashes.
Location-Movement Classification Method (LMCM) Crash Types
To analyze and better understand the events leading up to each pedestrian and bicycle crash, we developed a location-movement classification method (LMCM). The LMCM classifies each crash according to 1) the location of the crash relative to an intersection or roadway segment and 2) the direction of movement of the pedestrian or bicyclist relative to the movement of the motor vehicle. The LMCM includes 57 distinct pedestrian crash types and 57 distinct bicycle crash types within four main categories: 1) roadway non-intersection (segment between intersections), 2) roadway intersection, 3) parking lot/private property, and 4) other. The LMCM complements existing NHTSA pedestrian and bicycle crash types used in the PBCAT and is intended to classify pedestrian and bicycle crashes in a useful way to identify problems and suggest safety measures.

It was necessary to review the narrative crash report description to determine the LMCM crash type for each crash. Therefore, the LMCM was applied to the sample of 296 pedestrian and 229 bicycle crashes. This sample included 80 pedestrian fatalities (53% of total pedestrian fatalities) and 33 bicycle fatalities (100% of total bicycle fatalities). The LMCM crash types were supplemented with additional information about roadway (e.g., traffic control, number of lanes, speed limit), behavior (e.g., distraction, intoxication, contra-flow riding), and other characteristics (e.g., age, gender, lighting, time of day). Many crashes within the top four fatal pedestrian crash types involved darkness and alcohol; many occurred at multi-lane roadway intersections or between intersections along high-speed, two-lane roadways (Figure 3). Many crashes within the top four fatal bicycle occurred during darkness, on two-lane roadways, and on roadways with high speed limits (Figure 4).
Figure 3. Top Four Fatal LMCM Pedestrian Crash Types

**#1 Fatal Pedestrian Crash Type**

**N_RRD_X**: Non-intersection; straight-traveling motorist strikes pedestrian in roadway; pedestrian not approaching from left or right (19 crashes).

- **Crash Scenario 1: 8 Crashes**
  - Pedestrian walking in roadway, with or against traffic, struck by vehicle in roadway lane.
  - **Night Crashes**: 3 crashes (38%) occurred between midnight and 6 a.m.
  - 4 crashes (50%) involved dark, dull conditions.
  - **Alcohol Involvement**: 3 crashes (38%) were flagged for alcohol involvement.

- **Speed**: 4 crashes (50%) were on roads with speed limits of 45 mph or higher.

**Other Crashes: 4 Crashes**

- 2 crashes involved a pedestrian who was dealing with a disabled vehicle at the time of crash.
- 2 crashes involved a pedestrian whose action in the roadway could not be determined.

**#2 Fatal Pedestrian Crash Type**

**I_FS_ST_L**: Intersection; straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (10 crashes).

- **Crash Scenario 1: 6 Crashes**
  - No traffic control on vehicle driver’s roadway, but a crosswalk was present.
  - **Peak Period and Night Crashes**: 3 crashes (50%) occurred between 5 p.m. and 9 p.m.
  - 2 crashes (33%) occurred between 9 p.m. and midnight.
  - **Urban Roadways**: 5 crashes (83%) occurred on an urban roadway.
  - 6 crashes (100%) occurred on roadways with speed limits of 25-30 mph.
  - **Lighting Condition**: 9 crashes (81%) occurred during darkness, but there were street lights.

**Other Crashes: 3 Crashes**

- 1 crash involved a pedestrian crossing at a non-crosswalk location with no traffic control on the driver’s roadway.

**Other Characteristics**: 6 crashes (60%) involved pedestrians who were 80+ years old.

**#3 Fatal Pedestrian Crash Type**

**N_RRD_R**: Non-intersection; straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the right (9 crashes).

- **Crash Scenario 1: 5 Crashes**
  - Straight-traveling motorist strikes pedestrian approaching from right with no noted obstructions.
  - **Daytime Crashes**: 5 crashes (100%) occurred between 9 a.m. and 6 p.m.
  - **Higher-Speed Urban Roadways**: 7 crashes (88%) occurred on urban roadways.
  - 5 crashes (63%) occurred on roadways that were 30 mph or higher.

**Other Crashes: 1 Crash**

- 1 crash involved a pedestrian who had entered the roadway from between two parked vehicles.

**Other Characteristics**: None of the crashes in this crash type involved a marked or unmarked crosswalk.

**#4 Fatal Pedestrian Crash Type**

**N_RRD_L**: Non-intersection; straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the left (9 crashes).

- **Crash Scenario 1: 9 Crashes**
  - Straight-traveling motorist strikes pedestrian approaching from the left with no noted obstructions.
  - **Evening Crashes**: 6 crashes (67%) occurred between 6 p.m. and midnight.
  - **Higher Speed, Rural Roadways**: 5 crashes (56%) occurred on rural roadways.
  - 5 crashes (56%) occurred on roadways that were 35 mph or higher.
  - 5 crashes (56%) occurred on 2-lane roadways.
  - **Alcohol Involvement**: 4 crashes (44%) were flagged for alcohol involvement.

**Other Characteristics**: All crashes involved pedestrians who were 40+ years old.
Figure 4. Top Four Fatal LMCM Bicycle Crash Types

#1 Fatal Bicyclist Crash Type

**N_RRD_S** - Non-Intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related) (10 crashes)

Crash Scenario 1: 5 Crashes
- Vehicle driver rode straight into the bicyclist, with no suggestion of the bicyclist swerving into the vehicle’s path of travel

Night Crashes
- 2 crashes (22%) occurred between 6 pm and 9 pm
- 2 crashes (22%) occurred between midnight and 3 am

High Speed, 2 Lane Roadways
- 8 crashes (80%) occurred on roadways that were 35+ mph
- 7 crashes (70%) occurred on 2 lane roadways

Limited Visibility
- 4 crashes (40%) noted that the driver did not see the bicyclist

Other Crashes: 1 Crash
- 1 crash involved a bicyclist who swerved into the passing vehicle

Additional Crash Characteristics:
- Bike lanes were not present in any of the crashes
- 3 crash reports (30%) noted alcohol as a potential contributing factor to the crash

#2 Fatal Bicyclist Crash Type

**I_NS_ST_L** - Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (5 crashes)

Crash Scenario 1: 2 Crashes
- Vehicle driver had a stop sign
- Limited Bike Facilities
  - 2 crashes (40%) had no bike facility

Urban Roadways
- 3 crashes (60%) occurred on urban roadways

Limited Visibility
- 2 crashes (40%) noted that the driver did not see the bicyclist

Other Crashes: 2 Crashes
- 1 crash occurred at an intersection controlled by a traffic light and involved a bicyclist who disobeyed traffic control
- 1 crash occurred at an intersection with a commercial parking lot driveway

#3 Fatal Bicyclist Crash Type

**I_FS_ST_R** - Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection (5 crashes)

Crash Scenario 1: 3 Crashes
- Bicyclist disregarded traffic control in each crash
- No bike lanes present

Multi-lane, Urban Roadways
- 2 crashes (67%) occurred on urban roadways
- 3 crashes (100%) occurred on multi-lane roadways

Limited Visibility
- 2 crashes (67%) noted that the driver did not see the bicyclist

Alcohol Involvement
- 2 crashes (67%) noted that alcohol potentially played a role in the crash

#4 Fatal Bicyclist Crash Type

**N_RSH_S** - Non-Intersection: Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction (3 crashes)

Crash Scenario 1: 3 Crashes
- Vehicle driver noted at fault; bicyclist was in the bike lane or on the shoulder in each crash

Rural, High Speed Roadways
- 3 crashes (100%) occurred on rural roadways
- 3 crashes (100%) occurred on 2 lane roadways
- 3 crashes (100%) had a posted speed limit of 55 mph

No Visibility Obstructions
- 3 crashes (100%) involved daylight conditions
- 3 crashes (100%) noted no obstructions

No Citations Given
- Driver deemed at fault in each crash, but no citations given
Comparison of LMCM and NHTSA Crash Typologies
The LMCM and NHTSA typologies were applied to identify characteristics of the most serious pedestrian and bicycle crashes reported in Wisconsin between 2011 and 2013. Both LMCM and NHTSA crash types were assigned to the sample of 296 pedestrian and 229 bicycle crashes used for detailed analysis. First, the top crash types for each severity level were identified separately using each method (e.g., Figure 3 and Figure 4). Next, the LMCM and NHTSA crash types were compared directly for all 231 pedestrian and 155 bicycle crashes in the sample with fatal and severe injuries. The examples below show how the LMCM can be used to supplement the information provided by the top NHTSA pedestrian crash type and top NHTSA bicycle crash type.

- **Top NHTSA Pedestrian Crash Type**: Pedestrian entered the roadway at a location where the motorist’s view was not obstructed (741). The LMCM shows that the majority (63%) of fatal and severe pedestrian crashes of this type occurred at non-intersection locations. Further, nearly three-quarters of these non-intersection crashes involved pedestrians approaching from the right (N_RRD_R) rather than the left (N_RRD_L). Therefore, countermeasures should emphasize protecting pedestrians approaching from the right along roadway segments. In addition, 48% of these crashes and 44% of those that involved a pedestrian entering the roadway from the right (N_RRD_R) occurred with non-daylit conditions. This may suggest that roadway lighting should be improved and that automated vehicle pedestrian detection systems should be designed to work in darkness and low-light conditions. Further, 56% of N_RRD_R crashes occurred with multilane roadways, so roadway designers should look for opportunities to reduce roadway lanes and to install pedestrian crossing facilities appropriate for multilane roads (e.g., median islands, pedestrian hybrid beacons).

- **Top NHTSA Bicycle Crash Type**: Motorist failed to detect the bicyclist and struck the bicyclist from behind (231). While the NHTSA crash type indicates the direction of the motorist and bicyclist, it does not provide detailed information about the location of the crash on the roadway. The LMCM shows that 72% of these fatal and severe bicycle crashes occurred in the travel lane and 28% occurred on paved shoulders or bicycle lanes. Further, 61% of crashes occurred in non-daylight conditions and 56% occurred on a rural roadway. Improving roadway lighting and adding roadway space for bicyclists (e.g., paved shoulders, bicycle lanes, separated bicycle lanes) may help prevent bicyclists from being struck from behind in travel lanes.

Fatal and Severe Crash Hot Spot Characteristics
The top 20 pedestrian crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings, bus stops, and mixed land uses. These characteristics are associated with higher levels of pedestrian activity as well as a more complex environment for drivers to negotiate. However, a review of the crash narratives at each hot spot also showed that driver and pedestrian behavior as well as randomness also contributed to the occurrence of crashes.

The top 20 bicycle crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings and mixed land uses. These characteristics are associated with higher levels of
bicycle activity as well as a more complex environment for drivers to negotiate. Notably, most of the hot spots did not have bicycle facilities. Like crashes at pedestrian crash hot spots, the crash narratives showed that driver and bicyclist behavior as well as randomness contributed to the occurrence of crashes.

**Young Pedestrian Crashes**

Pedestrians younger than age 20 accounted for approximately 28% (1,343 of 4,751) of all pedestrian crashes (with pedestrian age information) reported between 2011 and 2013. Approximately 20% (59 of 289) of the 2011 to 2013 pedestrian crashes analyzed in detail (with pedestrian age information) involved pedestrians younger than age 20.

The three most common young pedestrian crash types involved motorists driving straight.

- **Non-intersection:** Straight-traveling motorist strikes pedestrian approaching from right (N_RRD_R) (16 crashes).
- **Intersection:** Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection (I_NS_ST_L) (8 crashes).
- **Intersection:** Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (I_FS_ST_L) (6 crashes).

**Young Bicyclist Crashes**

The study of Wisconsin bicycle crashes reported in 2003 (Amsden and Huber 2006) looked closely at crashes involving young bicyclists, so this report includes a similar analysis. Overall, crashes involving bicyclists under age 20 decreased dramatically over the last decade. These young bicyclists accounted for 62% (657 of 1,065) of bicycle crashes in 2003, but they accounted for only 33% (1,103 of 3,323) between 2011 and 2013. This change may reflect improvements in young bicyclist education and behavior, reductions in bicycling by this age group, or increases in bicycling by other age groups.

The three most common types of crashes for young bicyclists involved motorists striking bicyclists on the near side of an intersection.

- **Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (I_NS_ST_L) (9 crashes).**
- **Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_ST_R) (8 crashes).**
- **Right-turning motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_RT_R) (8 crashes).**

**Summary of Recommendations**

The following engineering, education, and enforcement strategies are recommended to prevent the most common types of fatal and severe pedestrian and bicycle crashes identified by this study. These recommendations complement the pedestrian and bicycle recommendations already included in the WisDOT Strategic Highway Safety Plan (SHSP). The study recommendations are listed below. More detailed discussions of pedestrian and bicycle safety treatments, as well as key considerations about appropriate situations to apply each treatment, are provided in other references such as the WisDOT Wisconsin Guide to Pedestrian Best Practices (2010) and Wisconsin Bicycle Facility Design Handbook (2009) and the FHWA PEDSAFE (2013) and BIKESAFE (2014) countermeasure selection systems.
**Engineering: Treatments to Improve Pedestrian Safety**

- Construct sidewalks on both sides of roadways in urban and suburban areas and construct paved shoulders along major roadways in rural areas.
- Reduce the design speed and posted speed limit on arterial and collector roadways.
- Reduce the number of travel lanes on arterial and collector roadways.
- Provide marked crosswalks at key pedestrian crossing locations. These marked crosswalks should be installed according to FHWA crosswalk guidelines (i.e., marked crosswalks across multi-lane, high-speed, high-volume roadways should be supplemented by median islands, pedestrian crossing beacons, or other treatments) (FHWA 2005).
- Provide a dedicated left-turn phase at signalized intersections.
- Construct curb extensions to reduce crossing distances and increase pedestrian visibility at mid-block and intersection locations.
- Construct medians and median refuge islands along arterial and collector roadways.
- Install pedestrian crossing beacons at uncontrolled crosswalks, where warranted (rectangular rapid flashing beacons or pedestrian hybrid beacons).
- Prohibit right-turn-on-red at signalized intersections.
- Reduce turning radii at the corners of intersections.
- Eliminate dedicated right-turn lanes at intersections.
- Improve roadway lighting, especially at the sides of the roadway near crosswalks.
- Remove roadside visibility obstructions, including parked cars near crosswalks.

**Engineering: Treatments to Improve Bicyclist Safety**

- Add bicycle facilities along arterial and collector roadways in urban and suburban areas. These facilities include standard, striped bicycle lanes as well as other facilities that are more comfortable for bicyclists, including buffered bicycle lanes and separated bike lanes.
- Construct paved shoulders (at least four feet wide; wider if rumble strips are used) along major roadways in rural areas.
- Improve roadway lighting, especially in urban and suburban areas where bicyclists are common.
- Prohibit right-turn-on-red at signalized intersections.
- Reduce the number of roadway lanes on arterial and collector roadways.
- Provide a dedicated left-turn phase at signalized intersections.

**Education: Safety Messages for Motorists**

- You must yield the right-of-way to a pedestrian in a crosswalk. In other words, you must allow a pedestrian who has stepped off the curb into the crosswalk to cross in front of you before you proceed.
- You must yield the right-of-way to a pedestrian in a crosswalk when turning left or right at an intersection.
- You must yield the right-of-way to a pedestrian in a crosswalk when you are traveling straight, even if you are on a main roadway with no stop sign or traffic light and there is a stop sign for automobiles on the side street.
- Always be ready to yield to pedestrians when traveling straight, including people crossing from either the right or the left. This means that you need to be traveling slow enough to come to a stop before you reach any crosswalk, in case a pedestrian enters it.
- Always look in both directions for vehicles, bicyclists, and pedestrians at a stop sign. In particular, look for pedestrians and bicyclists approaching from the sidewalk on your right.
before turning right at an intersection. This includes looking to the right before turning right on red and before turning right onto a major street.

- Look for pedestrians in the crosswalk on the left side of the intersection before turning left.
- Reduce speed and watch closely for pedestrians near disabled vehicles in the roadway or at the side of the roadway.
- Look for bicyclists traveling through the intersection on the roadway or in the crosswalk on the left side of the intersection before turning before turning left.
- Travel at a prudent speed at night (potentially lower than the speed limit) in order to have the ability react safely to pedestrians and bicyclists.

**Education: Safety Messages for Pedestrians**

- Cross the street within crosswalks. Motorists are required to yield the right-of-way to you (stop so that you can cross) if you set foot into a crosswalk.
- Since motorists may not always be aware that you are trying to cross the street in a crosswalk, point your arm in the direction that you intend to cross before setting foot into the crosswalk.
- Do not cross from between parked cars. This is especially important for children.
- Watch for left-turning cars, especially when crossing driveways and minor streets along busy streets.
- Be aware that motorists may not see you if they are turning right and you are approaching on their right side (especially if they are turning onto a busy street).
- Be aware that motorists may have a difficult time seeing you at night, especially if you are not wearing bright/retroreflective clothing.
- If you stop your vehicle on the side of a high-speed roadway, do not get out before the police arrive.

**Education: Safety Messages for Bicyclists**

- Obey all traffic control, including stop signs and traffic signals.
- Ride in the street in the same direction as traffic. This is particularly important for keeping safe when you cross driveways and intersections.
- Assume that motorists will not see you if you approach from the right side of their vehicle at an intersection (especially from the sidewalk).
- Watch for left-turning cars at intersections on busy streets, even when you have the right-of-way.
- If you ride when it is dark, have a white light on the front of your bike and a red reflector or light on the back of your bike. Go beyond these minimum legal requirements and wear bright/retroreflective clothing.
- Be aware that motorists may have a difficult time seeing you at night, especially if you do not have lights and are not wearing bright/retroreflective clothing.

**Enforcement: Motorist, Pedestrian, and Bicyclist Behaviors to Target**

- Motorists speeding, especially on streets in locations with high levels of pedestrian and bicycle activity.
- Motorists not yielding to pedestrians in crosswalks when traveling straight through uncontrolled intersections.
- Motorists not yielding to pedestrians in crosswalks when turning at intersections.
- Motorists driving while intoxicated.
- Motorists passing within less than three feet of a bicyclist.
• Pedestrians disobeying traffic signals.
• Bicyclists disobeying traffic signals.
• Bicyclists riding without lights at night.

Evaluation
• Improve police pedestrian and bicycle crash reporting practices.
  o Identify alcohol involvement by person/individual.
  o Record the bicyclist person/individual in a consistent location on the crash report.
  o Record the LMCM crash type code on the crash report.
  o Record bicyclist helmet use consistently in the safety equipment field on the crash report. While helmet use is not required by law, more data can be useful for exploring the relationship between safety equipment and injuries.
  o Record bicyclist use of lights in a standard field on the crash report.
  o Record environmental context characteristics that may contribute to the crash (e.g., record if landscaping or parked vehicles were blocking the motorist’s view of a pedestrian before he or she stepped into the crosswalk; record if a bicycle lane had a pothole or debris that made a bicyclist swerve into traffic).
• Collect pedestrian and bicycle counts and surveys to account for exposure.
• Quantify the pedestrian and bicycle crash risk associated with specific intersection and roadway characteristics.
• Analyze crashes using WisTransPortal and emergency room data.
• Supplement standard police reports with detailed reconstruction data for fatal crashes.
• Analyze all pedestrian and bicycle crashes in detail.
Part 1. Pedestrian and Bicycle Safety Overview

Between 2011 and 2013, there were 378,436 traffic crashes reported in the State of Wisconsin. Of all reported crashes during this three-year period, 4,857 (1.3%) involved pedestrians, and 3,365 (0.89%) involved bicyclists. While these percentages are relatively small, pedestrians and bicyclists are particularly vulnerable to serious injuries when they are involved in a crash: 19% of these pedestrian crashes and 10% of these bicycle crashes resulted in fatal (“K”-level) or severe (“A”-level) injuries. Of all 1,568 fatal crashes reported in Wisconsin between 2011 and 2013, 152 (9.7%) involved pedestrians and 33 (2.1%) involved bicyclists. Of all 8,737 severe-injury crashes during this period, 774 (8.9%) involved pedestrians and 307 (3.5%) involved bicyclists. Therefore, this study has a special focus on pedestrian and bicycle crashes that resulted in fatal and serious injuries. See the grey box below for information about crash data used in this report.

**Crash Data Used in this Report**

The crash numbers cited throughout this report represent all police-reported crashes in the WisTransPortal Database (Wisconsin TOPS Laboratory 2014a) except deer-related crashes. Crashes on private property (parking lots and driveways) are included. These crashes account for approximately 22% of pedestrian crashes (12% of fatal, 19% of severe, and 24% of non-severe pedestrian crashes) and 6.4% of bicycle crashes (0.0% of fatal, 5.2% of severe, and 6.5% of non-severe bicycle crashes). Note that the official crash statistics provided by the Wisconsin Department of Motor Vehicles (DMV) exclude private-property crashes. Since crashes on private property are less likely to involve turning vehicles, less likely to occur at high speeds, and less likely to result in fatal and severe injuries than crashes on public roadways, the percentages of crashes with these characteristics presented in this report are slightly different than percentages calculated from DMV records.

DMV statistics (for public roadways only) show: Wisconsin averaged more than 1,250 reported pedestrian crashes and more than 1,050 reported bicycle crashes between 2011 and 2013. 21% of pedestrian crashes and 10% of bicycle crashes resulted in fatal or severe injuries. Of all 1,541 fatal crashes reported in Wisconsin between 2011 and 2013, 136 (8.8%) involved pedestrians and 33 (2.1%) involved bicyclists. Of all 8,449 severe-injury crashes during this period, 647 (7.7%) involved pedestrians and 291 (3.4%) involved bicyclists.

Recognizing the importance of pedestrian and bicycle safety, the Wisconsin Department of Transportation (WisDOT) Strategic Highway Safety Plan (SHSP) for 2014-2016 includes “Provide Safe Pedestrian and Bicycle Travel” as one of the state’s “Highest Priority Issue Areas” (WisDOT 2014a). Further, the WisDOT SHSP sets goals to reduce the number of pedestrian and bicycle fatal and serious-injury crashes by 5% by 2016, reduce the number of pedestrian and bicycle injury crashes by 5% by 2015, and reduce the total number of pedestrian and bicycle crashes by 5% by 2016 (WisDOT 2014a).

The purpose of this document is to summarize police-reported crashes that have involved pedestrians and bicyclists. Ultimately this information can inform engineering, enforcement, and education countermeasures to reduce pedestrian and bicyclist injuries and fatalities. In addition, it will help guide further research on the causes of pedestrian and bicyclist crashes. This document includes an in-depth analysis of crashes that were reported to police between 2011 and 2013 and included in the Wisconsin Department of Transportation WisTransPortal crash database (Wisconsin TOPS Laboratory 2014a). It includes information about injury severity, crash locations, roadway characteristics, and other potential factors that contribute to crashes involving pedestrians or bicyclists. All data are summarized at the
crash report level. This means that crash events involving more than one pedestrian are treated as a single pedestrian crash, even if the crash results in injuries to more than one pedestrian.

Note that pedestrian and bicycle crashes are more common at times and locations with higher levels of pedestrian and bicyclist activity. Since there is little data on pedestrian and bicycle volumes in the State of Wisconsin, it is not possible to assess which particular characteristics may be associated with higher and lower risk (e.g., crashes per pedestrian trip; crashes per pedestrian crossing; crashes per pedestrian mile traveled). The data summarized in this document should be viewed with this caveat in mind.

1.1. Summary of Previous Research

Agencies, research centers, and universities have conducted many pedestrian and bicycle safety studies over the last three decades. Much of this research has focused on how roadway design; land use; pedestrian and bicycle activity; and pedestrian, bicyclist, and driver socioeconomic characteristics are associated with pedestrian and bicycle crashes. The sections below summarize some of the main findings from this earlier research.

Note that this study and many of the studies discussed below include three important limitations:

- **Unreported crashes.** According to a study of pedestrian and bicyclist injuries treated in emergency rooms, only 56% of the pedestrians and 48% of the bicyclists were successfully linked to cases reported on their respective state motor vehicle crash files (Stutts and Hunter 1998). Since crashes involving emergency-room treatment tend to have the most severe injuries, it is likely that rates of underreporting are even higher for less severe pedestrian and bicycle crashes. Therefore, studies based on police crash databases do not include all crashes.

- **Lack of exposure data.** In general, pedestrian and bicycle crashes are more common at times and locations with higher levels of pedestrian and bicyclist activity. Exposure can be represented by measures such as pedestrian or bicycle roadway crossings, pedestrian or bicycle trips, and total time spent walking and bicycling. Since good estimates of pedestrian and bicycle exposure have been rare, very few studies account for this key influence on total pedestrian and bicycle crashes. Results of studies that examine total crashes (e.g., total pedestrian crashes at each intersection) often provide a very different perspective than studies that analyze crash rates (e.g., number of crashes at per pedestrian crossing at each intersection). For example, maps often show high concentrations of total crashes in central business districts (since they have high levels of walking activity) but show high levels of pedestrian risk along high-speed, multilane roadway corridors.

- **Injury severity levels recorded by law enforcement officers.** When compared to injury assessments done by medical practitioners, police tend to overestimate the severity of traffic crash injuries (Wisconsin TOPS Laboratory 2014). This issue may affect studies that report differences in crash characteristics by injury severity level.

1.1.1. Pedestrian Crash Studies

Many studies have investigated roadway design characteristics associated with pedestrian crashes. In general, they suggest that the following factors may increase pedestrian crash risk:

- **Higher speed limits** (Zegeer et al. 2006). In addition, high vehicle speeds increase the risk of severe pedestrian injuries (Jensen 1998; Davis 2001; Rosén, Stigson, and Sander 2011; Jermakian and Zuby 2011). Drivers approaching at higher speeds are less likely to yield to pedestrians in crosswalks (Gårder 2004).

- **Longer crossing distances and more motor vehicle lanes** (Harwood et al. 2006; Baltes and Chu 2002; Petritsch et al. 2005; Zegeer et al. 2005; Zegeer et al. 2006; Schneider et al. 2010).
• Arterial roadways (Dumbaugh and Lee 2010).
• Four-leg intersections (compared to three-leg intersections) (Dumbaugh and Lee 2010).
• Dedicated right-turn lanes for motor vehicles at intersections (Schneider et al. 2010).
• Permitted right-turn-on red at intersections (Petritsch et al. 2005; AASHTO 2010).
• Longer traffic signal phases and pedestrian wait times (Petritsch et al. 2005; Tiwari et al. 2007).
• Street segments without sidewalks (McMahon et al. 1999; Berhanu 2004).
• Crossings without median islands (Baltes and Chu 2002; Zegeer et al. 2005; Turner et al. 2006; Harwood et al. 2006; Schneider et al. 2010) or treatments such as in-roadway pedestrian crossing signs (Fitzpatrick et al. 2006), pedestrian hybrid beacons (Fitzpatrick et al. 2011), or rectangular rapid flashing beacons (Shurbutt and Van Houten 2010).
• Darkness or low lighting is associated with fatal pedestrian crashes (Jermakian and Zuby 2011).

Studies of land use characteristics have found more pedestrian crashes in the following locations:
• In urban areas (Hunter et al. 1996; Jensen 1998; Zegeer et al. 2006).
• In commercial retail areas (Schneider et al. 2010).
• Near strip commercial land uses and big box stores, but not near “pedestrian-scaled” retail uses (Dumbaugh and Lee 2010).
• Close to alcohol sales establishments, and bus stops (Harwood et al. 2006).
• Close to schools, parks, and malls (Wedagama, Bird, and Metcalfe 2006; Clifton and Kreamer-Fults 2007).

With the exception of Schneider et al. (2010), most of these studies do not account for differences in pedestrian volumes associated with certain land use characteristics, so the higher number of crashes in these types of locations may simply reflect more pedestrian activity in these locations.

Many studies have shown that higher motor vehicle and pedestrian volumes are associated with more pedestrian crashes. For example, higher traffic volumes are associated with more pedestrian crashes at intersections and at uncontrolled crossings of arterial and collector roadways (Zegeer et al. 2005; Harwood et al. 2006). While the total number of pedestrian crashes during a time period or at a location tends to increase as pedestrian volume increases, several studies suggest that this increase tends to be non-linear. All else equal, a location with 100 percent more pedestrians may only have 30 to 60 percent more (rather than 100 percent more) reported crashes or injuries (Jacobsen 2003; Harwood et al. 2006; Geyer et al. 2006; Schneider et al. 2010). This relationship is referred to as “safety in numbers.” While this relationship may exist, it is important to recognize that simply increasing pedestrian volumes may not have a direct positive impact on pedestrian safety. Other types of engineering, education, and enforcement safety treatments should accompany efforts to increase pedestrian activity (Bhatia and Wier 2010).

Driver and pedestrian socioeconomic characteristics may also be associated with pedestrian crashes (Preusser et al. 2002; Campbell et al. 2004). For example:
• Males tend to be involved in more pedestrian crashes than females (Hunter et al. 1996; Campbell et al. 2004).
• Children are more likely to be involved in crashes after darting into the street (Campbell et al. 2004).
• Neighborhoods with a greater percentage of children under age 18 (Schneider et al. 2010) and median annual neighborhood incomes of less than $25,000 (Harwood et al. 2006).
• Older pedestrians tend to experience more serious and fatal injury crashes when struck by motor vehicles (Hunter et al. 1996; Campbell et al. 2004).

Researchers have also classified types of crashes according to the movements that precede a collision (Hunter et al. 1996; Jermakian and Zuby 2011; MacAlister and Zuby 2015). This is often done by reading the written description and crash diagram included in police crash reports. According to a Federal Highway Administration study of crashes that occurred in six states in the early 1990s (Hunter et al. 1996), common types of pedestrian crashes include:

  • Intersection-related crashes
    o Vehicle turning at an intersection (10%).
    o Intersection dash (pedestrian entering the roadway suddenly) (7%).
    o Driver violation at an intersection (5%).
    o Other intersection crash type (e.g., multiple-threat, standing in roadway) (10%).

  • Midblock-related crashes
    o Midblock dart or dash (pedestrian entering the roadway suddenly) (13%).
    o Other midblock (e.g., multiple-threat, walking in roadway) (13%).

Relatively few studies have explored how driver and pedestrian behaviors are related to pedestrian safety. Much of this literature emphasizes driver and pedestrian impairment (i.e., being under the influence of alcohol or drugs) as a factor in many pedestrian crashes (10% of pedestrians; 3.1% of drivers), especially crashes producing severe and fatal injuries (Hunter et al. 1996). Other common pedestrian contributing factors include running into the roadway, failing to yield, and stepping into the road from between parked vehicles (Hunter et al. 1996). Other common driver contributing factors include hit-and-run and failure to yield (Hunter et al. 1996). The most common movements leading to pedestrian fatalities are a pedestrian crossing the roadway and a vehicle going straight (Jermakian and Zuby 2011). Research also suggests that driver distraction may lead to pedestrian crashes (Stimpson, Wilson, and Muelleman 2013). Relating behavior to pedestrian risk is complicated, especially since many drivers and pedestrians appear to behave in ways that account for the inherent danger present at a location (e.g., pedestrians cross against the signal more when there are large gaps in motor vehicle traffic; drivers tend stop less often when turning right on red if there are few pedestrians around) (Cooper et al. 2012).

Several resources have summarized the pedestrian safety literature (Campbell et al. 2004; Harwood et al. 2006; Schneider et al. 2010). Additional information is also available from the Federal Highway Administration Crash Modification Factors Clearinghouse (see http://www.cmfclearinghouse.org/) (2014). Note that the Federal Highway Administration developed a method to classify pedestrian crashes, and it can be applied using the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) (Harkey et al. 2006).

1.1.2. Bicycle Crash Studies

Roadway and bicycle facility design have been the main focus of many recent bicycle safety studies. These studies suggest that arterial roadways may be more likely to have bicycle crashes than other types of roads (Dumbaugh and Lee 2010). Higher-speed roadways also have a higher risk of fatal bicycle crashes (MacAlister and Zuby 2015). Compared to roadways with no designated bicycle facilities, roadways with bicycle lanes have lower bicycle crash risk (Reynolds et al. 2009; Teschke et al. 2012). Roadways with cycle tracks (i.e., “separated bicycle lanes,” “protected bicycle lanes”) may also have lower bicycle crash risk than other roadways (Lusk et al. 2011), but studies also emphasize possible increased risk at intersections (Jensen, Rosenkilde, and Jensen 2007) and that good facility design (e.g.,
providing sufficient sight distance at intersections and mitigating turning conflicts) is critical for realizing safety benefits (Federal Highway Administration, Forthcoming).

Studies of land use characteristics have found more bicycle crashes in the following locations:
- In urban areas (Hunter et al. 1996).
- Near strip commercial land uses and big box stores (Dumbaugh and Lee 2010).

Like studies of pedestrian crashes, most of these studies do not account for differences in bicycle volumes associated with certain land use characteristics, so the higher number of bicycle crashes in these types of locations may simply reflect more bicycling in these locations. The “safety in numbers” concept also applies to bicycle crash risk (Jacobsen 2003). Interestingly, communities with higher levels of bicycling tend to be associated with lower rates of fatal bicycle crashes as well as fatal pedestrian and motor vehicle crashes. This may be a result of communities with better bicycling conditions tending to have streets with lower traffic speeds (Marshall and Garrick 2011).

Driver and pedestrian socioeconomic characteristics may also be associated with bicycle crashes. For example:
- Males tend to be involved in more bicycle crashes than females (Hunter et al. 1996).
- Children younger than age 15 are overrepresented in bicycle crashes relative to their share of the population, although adults over age 44 are overrepresented in severe and fatal injury bicycle crashes (Hunter et al. 1996).

Bicycle crash types have also been identified (Hunter et al. 1996). Common types of bicycle crashes include:
- Bicyclist and motorist on crossing (perpendicular) paths
  - Motorist failed to yield (21%).
  - Bicyclist failed to yield at intersection (17%).
  - Bicyclist failed to yield at midblock location (12%).
- Bicyclist and motorist on parallel paths
  - Motorist merged or turned into path of bicyclist (12%).
  - Motorist overtaking bicyclist (9%).
  - Bicyclist merged into path of motorist (7%).

Relatively few studies have explored how driver and bicyclist behaviors are related to bicycle safety. Driver and bicyclist impairment was a contributing factor in some bicycle crashes (3.8% of bicyclists; 1.5% of drivers), but it was noted much less frequently than in pedestrian crashes (Hunter et al. 1996). More common bicyclist contributing factors include failure to yield, riding against traffic, and violating a stop sign (Hunter et al. 1996). More common driver contributing factors include failure to yield, hit-and-run, and “didn’t see cyclist” (Hunter et al. 1996).

The most common movements leading to bicycle fatalities are 1) a motor vehicle traveling straight and striking a bicyclist from behind and 2) a motor vehicle traveling straight and a bicyclist crossing the motorist’s path (MacAlister and Zuby 2015). The League of American Bicyclists found similar results after reviewing media accounts describing 628 bicyclist fatalities that occurred between February 2011 and February 2013 (McLeod and Murphy 2014). The following crash types were the most common causes of bicyclist fatalities:
- Rear end (driver striking bicyclist from behind) (40%).
• T-hit (driver striking bicyclist from the side) (10%).
• Head-on (8%).

Several resources have summarized the bicycle safety literature (Reynolds et al. 2009; Sanders 2013). Additional information is also available from the Federal Highway Administration Crash Modification Factors Clearinghouse (see http://www.cmfclearinghouse.org/) (2014). Note that the Federal Highway Administration developed a method to classify bicycle crashes, and it can be applied using the Pedestrian and Bicycle Crash Analysis Tool (PBCAT) (Harkey et al. 2006).

1.2. Previous Wisconsin Bicycle Crash Analysis
The Wisconsin Department of Transportation examined bicycle crashes throughout the state in the early 2000s (Amsden and Huber 2006). This included a detailed analysis of all bicycle crashes that occurred during 2003. The researchers used the PBCAT tool to identify the NHTSA crash type for each crash.

During 2003, Wisconsin bicycle crashes were most common during summer months (versus other times of year), on weekdays (versus weekends), and during the late afternoon (versus other times of day). These time periods are also likely to have more bicycle activity than other times.

The 2001 National Household Travel Survey (NHTS) showed that males accounted for 68% of all miles bicycled in Wisconsin, males were involved in 74% of the bicycle crashes in 2003, so men had a higher level of bicycling risk than women. Nearly half (50%) of all bicycle crashes involved bicyclists 10 to 19 years old, though no data were available to determine how much this age group bicycled.

As expected, Milwaukee and Dane county experienced the most bicycle crashes. Bicycle crashes were distributed similarly to population throughout the state.

Approximately 66% of bicycle crashes in 2003 occurred at intersections. More than 12% of crashes occurred where a bicyclist was going up or down a hill. Approximately 84% of crashes occurred during daylight, and most of the crashes that occurred from dusk until dawn were in locations with some street lighting.

The study of bicycle crashes in also examined differences between crashes that occurred in urban settings in 2003 and rural settings between 2002 and 2004. Nearly 70% of urban crashes occurred on arterial or collector roadways (30% occurred on local streets, and less than 1% occurred on expressways). Only 59% of rural crashes occurred on arterial and collector roadways. Most urban crashes occurred on roadways with more than 2000 vehicles per day, but most rural crashes were on roadways with fewer than 1000 vehicles per day. Urban crashes were much more likely to be on streets with posted speed limits of 25 or 30 mph, but nearly 80% of rural crashes were on roadways with speed limits of 55 mph. Compared to urban crashes, rural crashes were more likely to be in locations with hills and occur in darkness with no street lights.

The total urban and rural crash numbers for 2003 were compared with the total miles bicycled from the 2001 NHTS. The urban crash rate (8.1 crashes per million miles bicycled) was higher than the rural crash rate (1.45 crashes per million miles bicycled). Overall, the statewide bicycle crash rate was 6.26 crashes per million miles bicycled. When analyzed by county, the highest bicycle crash rates were in Portage County (14.09), Milwaukee County (10.79), and Eau Claire County (9.79). The lowest bicycle crash rates were in Dane County (3.8), Wood County (4.19), and Brown County (5.34).
The most common types of urban bicycle crashes included:

- Motorist drive-out (disobeying sign control) (14.6%)
- Bicyclist ride-through (disobeying sign control) (7.4%)
- Motorist left-turn (from opposite direction as bicyclist) (6.2%)
- Motorist drive-out (right turn on red) (5.7%)
- Motorist drive-out (from commercial driveway or alley) (5.4%)

A more in-depth analysis of the motorist drive-out crashes showed that many of the bicyclists in these crashes were approaching from the sidewalk or a sidepath. The report did not explore which direction (left or right) bicyclists came from.

Rural crashes had very different characteristics than urban crashes. Motorist overtaking crashes (striking a bicyclist from behind) were the most common type of crash in rural areas, accounting for more than 31% of all rural bicycle crashes (compared to fewer than 4% of all urban crashes).

Note that the NHTSA crash types often illustrate the type of movement being made by one party (either the motorist or the bicyclist), but they do not provide a complete understanding of how both parties were moving prior to the crash. In addition, the specific location of the motorist and bicyclist in relation to each intersection leg or pedestrian and bicycle facilities on each side of the roadway is not indicated clearly. This research project attempts to address these limitations.
Part 2. Pedestrian and Bicycle Crash Analysis Method

To understand factors associated with recent pedestrian and bicycle crashes in Wisconsin, the analysis explored the characteristics of pedestrian and bicycle crashes reported between 2011 and 2013 in the WisTransPortal database (Wisconsin TOPS Laboratory 2014a). All crashes considered in the study involved a motor vehicle (i.e., pedestrian or bicyclist falls and collisions with other objects were not included). The data included crashes that occurred on private property and in parking lots but excluded deer-related crashes. The unit of analysis was crashes (rather than number of individual pedestrians or bicyclists injured).

This 2011 to 2013 period included the most recent, available crash data. Three years of data were used (rather than a single year) to provide a larger sample of crashes for analysis and be less impacted by single-year anomalies. Older crashes were not used because they have a greater chance of occurring under conditions that no longer exist (i.e., road safety improvements may have been made since the crashes occurred).

2.1. Analysis Approach

The analysis involved two main steps. First, all 4,857 pedestrian and 3,365 bicycle crashes reported between 2011 and 2013 were summarized using variables available in the WisTransPortal database. These variables are derived from specific coded sections of the MV4000 crash form. Statistics were compiled from all valid, completed data items. Items left blank on the police crash reporting form were not considered. Some data fields apply specifically to each party involved in the crash (e.g., one party is an automobile driver, and the other party is a pedestrian). In many cases, the driver is listed as Party 1 and pedestrian or bicyclist is listed as Party 2. However, pedestrians and bicyclists are sometimes listed as Party 1. In these situations, the data fields were reorganized by hand so that pedestrian, bicyclist, and driver characteristics could be identified correctly.

Second, a sample of crashes was analyzed in detail. This included reviewing the written narrative sections of the MV4000 forms for each crash and documenting the characteristics of each crash site using aerial imagery (Google Earth) and street-level imagery (Google Street View). The police accounts of the crash were not coded in the WisTransPortal database, so they provided valuable insights into the circumstances related to each crash. Example data fields collected from the police crash narratives included:

- Driver distraction
- Driver stating that he or she did not see the pedestrian or bicyclist
- Bicyclist riding on the sidewalk
- Bicyclist riding in the opposite direction as adjacent traffic
- Analyst assessment of who the police officer suggested was primarily responsible for the crash: driver, pedestrian, or bicyclist (responsibility could be attributed to more than one party)

Example data fields collected from aerial and street-level imagery included:

- Local street versus collector or arterial roadway
- Number of roadway lanes
- Presence of bicycle lanes, sidewalks, crosswalks, curb extensions, and median islands

All data fields used in the analysis are listed in Appendix A.
The sample selected for detailed analysis included 296 pedestrian and 229 bicycle crashes. Since this study focuses on understanding factors associated with the most serious pedestrian and bicycle crashes, fatal (“K”-level) and severe injury (“A”-level) crashes were oversampled (Table 2.1). For example, police crash narratives were reviewed for 80 (53%) of the 152 fatal pedestrian crashes and all 33 (100%) of the fatal bicycle crashes but only about two percent of crashes with non-severe injuries.

This sample of crashes was selected systematically. All fatal bicycle crashes over the three-year study period were selected. Resources were not available to review every fatal pedestrian crash, so these crashes were sorted by date and time, and every other crash was chosen. The subset of serious injury (“A”-level) and non-severe (“B”, “C”, or “O”-level) pedestrian and bicycle crashes were selected to include approximately the same number of crashes each month of the year. This was done by selecting the first one or more crashes from the beginning of each month and the last one or more crashes from the end of each month. Finally, the top 20 “hot spots” (dense concentrations) of “K”- and “A”-level pedestrian crashes and top 20 “hot spots” of “K”- and “A”-level bicycle crashes in the state were identified (the hot spot identification process is described in Section 3.4). All crashes that occurred within these hot spots were added to the sample. Some of the hot-spot crashes had already been selected, so this final step added 71 severe-injury pedestrian crashes and 35 severe-injury bicycle crashes (24% of the pedestrian crash sample and 15% of the bicycle crash sample).

Because the additional hot spot crashes were included, crashes that are concentrated in particular areas are slightly overrepresented. These areas tended to be more urban, since urban areas generally have higher exposure levels. Compared with the full sample of 296 pedestrian crashes, the 71 severe-injury pedestrian crashes that were taken from “hot spots” were less likely to occur in daylit conditions (39% vs. 49%), but were more likely to be lit by streetlights when at night (56% vs. 42%). These crashes were also more likely to occur at an intersection (51% vs. 41%), involve a straight-traveling motorist (82% vs. 66%), occur on the weekend (60% vs. 47%), and suggest the pedestrian was primarily responsible for the crash (44% vs. 38%). Compared with the full sample of 229 bicycle crashes, the 35 severe-injury bicycle crashes were more likely to occur in daylit conditions (77% vs. 75%), at intersections (86% vs. 64%), at locations with lower speed limits (25 mph or less) (88% vs. 48%), and were slightly more likely to suggest that the bicyclist was at fault for the crash (51% vs. 42%). These comparisons indicate the direction of bias introduced by including the hot spot crashes. However, the additional hot spot crashes represented a relatively small share of the whole sample.

Table 2.1. Injury Severity of Sample of Pedestrian and Bicycle Crashes Reviewed in Detail

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>Pedestrian Crash Sample</th>
<th>Total Pedestrian Crashes</th>
<th>Bicycle Crash Sample</th>
<th>Total Bicycle Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>80 (52.6%)</td>
<td>152</td>
<td>33 (100%)</td>
<td>33</td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>154 (19.9%)</td>
<td>774</td>
<td>122 (39.7%)</td>
<td>307</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>62 (1.6%)</td>
<td>3,931</td>
<td>74 (2.4%)</td>
<td>3,025</td>
</tr>
<tr>
<td>Total</td>
<td>296 (6.1%)</td>
<td>4,857</td>
<td>229 (6.8%)</td>
<td>3,365</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)
2.2. Pedestrian and Bicycle Crash Classification Method

To analyze and better understand the events leading up to each pedestrian and bicycle crash, we developed a location-movement classification method (LMCM). The LMCM for pedestrian and bicycle crash typing builds on previous crash typing research to classify each crash according to 1) the location of the crash relative to an intersection or roadway segment and 2) the direction of movement of the pedestrian or bicyclist relative to the movement of the motor vehicle. The LMCM includes 57 distinct pedestrian crash types and 57 distinct bicycle crash types (Appendix B). This framework is intended to classify pedestrian and bicycle crashes in a useful way to identify problems and suggest safety measures. We supplemented the LMCM crash types with additional information about roadway (e.g., traffic control, number of lanes, speed limit), behavior (e.g., distraction, intoxication, contra-flow riding), and other characteristics (e.g., age, gender, lighting, time of day).

The LMCM is used to complement the existing NHTSA pedestrian and bicycle crash typology. The NHTSA pedestrian and bicycle crash types were originally developed in the 1970s (Snyder and Knoblauch 1971; Cross and Fisher 1977), and they were updated by the Federal Highway Administration for the PBCAT in the late 1990s (Harkey et al. 1999). This NHTSA method was applied to Wisconsin bicycle crashes reported in 2003 (Amsden and Huber 2006). This study applies the most recent version of the NHTSA crash typology (56 pedestrian crash types and 79 bicycle crash types), as described in the FHWA PBCAT manual (Harkey et al. 2006). These crash types are based on combinations of the following factors: pedestrian, bicyclist, and motor vehicle direction of travel; traffic control type; relative location (e.g., with respect to intersection, driveway, sidewalk, roadway); and circumstances (e.g., driverless vehicle, playing in road, multiple threat, dash versus dart out, failure to yield).

Note that other crash typing studies have classified crashes using attributes such as pedestrian and bicycle movement (in-line with vehicle traffic or crossing vehicle traffic), vehicle movement (straight or turning), pedestrian location (in crosswalk, at intersection but not in crosswalk, and non-intersection) (Jermakian and Zuby 2011; MacAlister and Zuby 2015). However, these methods are less common than the NHTSA typology, so they are not applied in this study.

2.3. Important Definitions

The definitions of variables are important to understand in order to interpret the results of this analysis correctly. Several of these definitions are listed below.

- **Intersection Crash.** A crash that occurs at the intersection of two paths of travel. Most often this intersection involves two or more roadways, but special instances were identified involving the intersection of roadways and driveways. Intersection crashes are defined as crashes that occur at the intersection or within 50 feet of the crosswalk on any side.
- **“From” Crosswalk.** The crosswalk that is located on the roadway on which the involved vehicle driver is driving from. In this situation, the crash would essentially be occurring before the intersection, but would be consistent with the concerns of an intersection crash.
- **“To” Crosswalk.** The crosswalk that is located on the roadway on which the involved vehicle driver is driving to. If the vehicle driver is turning from one roadway to another, this crosswalk occurs on the latter roadway, and if the vehicle is driving straight, this crosswalk is on the far end of the intersection from where the vehicle is coming.
- **Fatal Injury.** An injury recorded in the police report as a fatality (severity level “K” = Killed). The death may have occurred at the scene of the crash or within 30 days of the crash due to injuries from the crash.
• **Severe Injury.** An injury recorded in the police report as a severe injury (severity level “A” = Incapacitating). This is based on the officer’s assessment of the injury at the scene, and often includes crashes that require emergency room treatment.

• **Non-severe injury.** An injury recorded in the police report as a minor injury, possible injury, or no injury (severity level “B” = Non-Incapacitating, “C” = Possible, or none). This is based on the officer’s assessment of the injury at the scene.

• **Relevant citation.** A citation having to do with the circumstances that led directly to the crash (e.g., speeding, failure to yield, alcohol involvement) rather than other circumstances (e.g., suspended license, no insurance). Note that police may not write a citation in certain fatal crashes until after a more detailed investigation is completed, so a small number of citations may not be captured in the WisTransPortal database.

### 2.4. Considerations

Several data limitations identified in the literature review should be considered when interpreting the results of this study. These include unreported crashes, injury severity levels assessed by police, and lack of data on pedestrian and bicyclist exposure.

#### 2.4.1. Unreported Crashes

Many pedestrian and bicycle crashes are not reported to police. Underreporting is likely to be a more serious problem for less severe crashes (compared to fatalities or severe-injury crashes), since these crashes may not produce injuries that require medical treatment. This data limitation impacts the results of this analysis because the total reported number of pedestrian and bicycle crashes is likely to be lower than the actual number of incidents that occurred on Wisconsin roadways. Analyzing crashes by severity level helps overcome the tendency for results to reflect characteristics of more serious crashes. However, the category of non-severe crashes is likely to be biased towards more serious crashes since many minor crashes will not be included in the database.

#### 2.4.2. Injury Severity Levels Assessed by Law Enforcement Officers

Law enforcement officers record the injury severity level of each party involved in a crash. This is based on their experience and the definitions provided on the MV4000 crash form. However, when compared to injury assessments done by medical practitioners, police tend to overestimate the severity of traffic crash injuries (Wisconsin TOPS Laboratory 2014b). This analysis was not done specifically for pedestrian and bicycle crashes, but the finding may suggest that the crashes analyzed in this study include more severe-injury (“A”-level) crashes than would be considered by medical professionals.

#### 2.4.3. Pedestrian and Bicyclist Exposure

In general, pedestrian and bicycle crashes are more common at times and locations with higher levels of pedestrian and bicyclist activity. Since there is little data on pedestrian and bicycle volumes in Wisconsin, it was not possible to assess which particular times, locations, or contributing circumstances may be associated with higher and lower risk (e.g., crashes per pedestrian trip; crashes per pedestrian crossing; crashes per pedestrian mile traveled). In addition, it was not possible to identify whether risk is increasing or decreasing from year to year. The results presented below should be viewed with this very important caveat in mind. Note that the assessment of injury severity is based on crashes that have been reported, so it is possible to determine whether or not pedestrian and bicyclist crashes are more severe at particular times and locations (e.g., percentage of reported crashes that are fatal).
Part 3. Results
The results of the Wisconsin pedestrian and bicycle crash analysis are presented in several sections. The first section summarizes statewide trends in crashes and crash risk between 2004 and 2013. The remaining sections summarize the analysis of pedestrian and bicycle crashes reported between 2011 and 2013. These results are summarized by injury severity level, crash type, hot spot location, age (younger than 20 versus 20 or older), primary responsibility, and crash report accuracy.

3.1. Overall Trends in Pedestrian and Bicycle Crashes and Risk
Overall, pedestrian and bicycle crashes have declined in Wisconsin over the last 15 years (Amsden and Huber 2006; WisDOT 2011; Wisconsin TOPS Laboratory 2014a). The tables below show the total number of reported pedestrian and bicycle crashes by severity level over the last decade (Table 3.1 and Table 3.2). Note that these tables include all police-reported crashes on public roadways and private property (parking lots and driveways) except deer crashes.

Table 3.1. Wisconsin Pedestrian Crashes by Severity Level, 2004 to 2013

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>55</td>
<td>43</td>
<td>58</td>
<td>57</td>
<td>59</td>
<td>40</td>
<td>56</td>
<td>48</td>
<td>42</td>
<td>520</td>
<td></td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>327</td>
<td>348</td>
<td>330</td>
<td>297</td>
<td>304</td>
<td>275</td>
<td>268</td>
<td>258</td>
<td>262</td>
<td>254</td>
<td>2,923</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>1,382</td>
<td>1,421</td>
<td>1,475</td>
<td>1,434</td>
<td>1,300</td>
<td>1,236</td>
<td>1,287</td>
<td>1,259</td>
<td>1,324</td>
<td>1,348</td>
<td>13,466</td>
</tr>
<tr>
<td>Total</td>
<td>1,764</td>
<td>1,812</td>
<td>1,863</td>
<td>1,788</td>
<td>1,663</td>
<td>1,551</td>
<td>1,611</td>
<td>1,579</td>
<td>1,634</td>
<td>1,644</td>
<td>16,909</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Table 3.2. Wisconsin Bicycle Crashes by Severity Level, 2004 to 2013

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>14</td>
<td>14</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>9</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>104</td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>145</td>
<td>144</td>
<td>132</td>
<td>136</td>
<td>119</td>
<td>118</td>
<td>109</td>
<td>105</td>
<td>115</td>
<td>87</td>
<td>1,210</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>1,091</td>
<td>1,064</td>
<td>1,034</td>
<td>1,093</td>
<td>1,005</td>
<td>990</td>
<td>1,055</td>
<td>1,003</td>
<td>1,098</td>
<td>924</td>
<td>10,357</td>
</tr>
<tr>
<td>Total</td>
<td>1,250</td>
<td>1,222</td>
<td>1,174</td>
<td>1,239</td>
<td>1,133</td>
<td>1,115</td>
<td>1,173</td>
<td>1,120</td>
<td>1,224</td>
<td>1,021</td>
<td>11,671</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Annual total and annual fatal pedestrian crashes decreased between 2004 and 2013, but both increased between 2009 and 2013. Comparing 5-year periods, the average annual number of fatal pedestrian crashes from 2009-2013 (49.6) was not statistically different than the average annual number of fatal pedestrian crashes from 2004-2008 (54.4) (95% confidence level). The average annual number of total pedestrian crashes from 2009-2013 (1,604) was significantly lower than the average annual number of total pedestrian crashes from 2004-2008 (1,778) (95% confidence level).

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

Note that these tables include all police-reported crashes on public roadways and private property (parking lots and driveways) except deer crashes.

1 Similar statistics are also available from DMV records for public roadways only. See http://wisconsindot.gov/Pages/about-wisdot/newsroom/statistics/final.aspx.
Annual total and annual fatal bicycle crashes decreased between 2004 and 2013, but annual fatal bicycle crashes increased between 2009 and 2013. Comparing 5-year periods, the average annual number of fatal bicyclist crashes from 2009-2013 (9.8) was not statistically different than the average annual number of fatal bicyclist crashes from 2004-2008 (11.0) (95% confidence level). The average annual number of total bicyclist crashes from 2009-2013 (1,131) was not statistically different than the average annual number of total bicyclist crashes from 2004-2008 (1,204) (95% confidence level).

Crashes may decrease over time for several reasons. One possibility is that roadway designs and pedestrian, bicyclist, and driver behaviors are safer. Another possibility is that overall levels of walking, bicycling, or driving have varied. Therefore, Table 3 and Table 4 provide several different measures of exposure and calculations of pedestrian and bicycle crash rates over the last decade.
### Table 3.3. Wisconsin Pedestrian Crash Rates, 2004 to 2013

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in 100,000s)</td>
<td>55.14</td>
<td>55.46</td>
<td>55.78</td>
<td>56.11</td>
<td>56.41</td>
<td>56.69</td>
<td>56.89</td>
<td>57.09</td>
<td>57.25</td>
<td>57.43</td>
</tr>
<tr>
<td>Pedestrian Crashes per 100,000 People</td>
<td>32</td>
<td>33</td>
<td>33</td>
<td>32</td>
<td>29</td>
<td>27</td>
<td>28</td>
<td>28</td>
<td>29</td>
<td>29</td>
</tr>
<tr>
<td>Pedestrian K &amp; A Crashes per 100,000 People</td>
<td>6.9</td>
<td>7.0</td>
<td>7.0</td>
<td>6.3</td>
<td>6.4</td>
<td>5.6</td>
<td>5.7</td>
<td>5.6</td>
<td>5.4</td>
<td>5.2</td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT) (in Millions)</td>
<td>60,398</td>
<td>60,018</td>
<td>59,401</td>
<td>59,493</td>
<td>57,462</td>
<td>58,157</td>
<td>59,420</td>
<td>58,554</td>
<td>59,087</td>
<td>59,484</td>
</tr>
<tr>
<td>Pedestrian Crashes per Million VMT</td>
<td>0.029</td>
<td>0.030</td>
<td>0.031</td>
<td>0.030</td>
<td>0.029</td>
<td>0.027</td>
<td>0.027</td>
<td>0.027</td>
<td>0.028</td>
<td>0.028</td>
</tr>
<tr>
<td>Walk Commuters (in 1,000s)</td>
<td>99.41</td>
<td>93.82</td>
<td>97.39</td>
<td>94.87</td>
<td>86.73</td>
<td>94.27</td>
<td>91.65</td>
<td>99.93</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ped. Crashes per 1,000 Walk Commuters</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>19</td>
<td>17</td>
<td>18</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).

### Table 3.4. Wisconsin Bicycle Crash Rates, 2004 to 2013

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (in 100,000s)</td>
<td>55.14</td>
<td>55.46</td>
<td>55.78</td>
<td>56.11</td>
<td>56.41</td>
<td>56.69</td>
<td>56.89</td>
<td>57.09</td>
<td>57.25</td>
<td>57.43</td>
</tr>
<tr>
<td>Bicycle Crashes per 100,000 People</td>
<td>23</td>
<td>22</td>
<td>21</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>21</td>
<td>20</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>Bicycle K &amp; A Crashes per 100,000 People</td>
<td>2.9</td>
<td>2.8</td>
<td>2.5</td>
<td>2.6</td>
<td>2.3</td>
<td>2.2</td>
<td>2.1</td>
<td>2.0</td>
<td>2.2</td>
<td>1.7</td>
</tr>
<tr>
<td>Vehicle Miles Traveled (VMT) (in Millions)</td>
<td>60,398</td>
<td>60,018</td>
<td>59,401</td>
<td>59,493</td>
<td>57,462</td>
<td>58,157</td>
<td>59,420</td>
<td>58,554</td>
<td>59,087</td>
<td>59,484</td>
</tr>
<tr>
<td>Bicycle Crashes per Million VMT</td>
<td>0.021</td>
<td>0.020</td>
<td>0.020</td>
<td>0.021</td>
<td>0.020</td>
<td>0.019</td>
<td>0.020</td>
<td>0.019</td>
<td>0.021</td>
<td>0.017</td>
</tr>
<tr>
<td>Bike Commuters (in 1,000s)</td>
<td>20.07</td>
<td>19.06</td>
<td>21.47</td>
<td>20.01</td>
<td>20.75</td>
<td>19.08</td>
<td>24.46</td>
<td>23.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycle Crashes per 1,000 Bike Commuters</td>
<td>59</td>
<td>65</td>
<td>53</td>
<td>56</td>
<td>57</td>
<td>59</td>
<td>50</td>
<td>43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: US Census Bureau State Intercensal Estimates (US Department of Commerce 2014a); US Census Bureau Annual Estimates of the Resident Population (US Department of Commerce 2014b); Road Mileage and Annual VMT in Wisconsin (WisDOT 2014b); US Census Bureau American Community Survey (US Department of Commerce 2014c); WisTransPortal Database (Wisconsin TOPS Laboratory 2014a).
Figure 3.1. Wisconsin Fatal & Severe Pedestrian Crash Rates, 2004 to 2013

Figure 3.2. Wisconsin Fatal & Severe Bicycle Crash Rates, 2004 to 2013
Pedestrian crash rates decreased between 2004 and 2013 by nearly all measures in Table 3.3. One exception was pedestrian crashes per million vehicles traveled, which remained steady. Bicycle crash rates decreased over the 10-year period by all measures in Table 3.4. This suggests that there were real improvements in safety for pedestrians and bicyclists in Wisconsin between 2004 and 2013. These data also show that higher levels of walking and bicycling were associated with greater pedestrian and bicyclist safety: between 2006 and 2013, the number of people walking and bicycling to work increased and the risk of pedestrian and bicyclist fatalities and injuries (per commuter) decreased.

Several other measures can be used to assess Wisconsin pedestrian and bicycle crash trends. The National Household Travel Survey (NHTS) is the best available source of total pedestrian and bicycle activity (including all types of walking and bicycling trips, not just commuting to work), but was only conducted in 2001 and 2009. The NHTS shows that pedestrian crashes per million pedestrian trips decreased from 3.6 to 2.4 between 2001 and 2009. Bicycle crashes per million bicycle trips increased from 14.1 to 15.1 between 2001 and 2009 (Federal Highway Administration 2001 and 2009).

In 2004, 7.7% of all fatal crashes in Wisconsin involved pedestrians. This number increased to 8.5% in 2013. The proportion of fatal crashes that involved bicyclists was 2.0% in 2004 and 2013 (Wisconsin TOPS Laboratory 2014a). From 2011 to 2013, 9.7% of fatal crashes involved pedestrians and 2.1% involved bicyclists. Based on 2009 NHTS data, approximately 9% of total trips in Wisconsin were made by pedestrians and 1% were made by bicyclists, so these travel modes were overrepresented in fatal crashes during the 2011 to 2013 period.

Pedestrian and bicycle fatalities are prominent in urban areas, as these communities tend to have more walking and bicycling activity. In the City of Milwaukee, 30% of all fatal traffic crashes reported between 2011 and 2013 involved pedestrians and 2.9% involved bicyclists. In the City of Madison, 28% of fatal crashes involved pedestrians and 10% involved bicyclists.

### 3.2. General Results by Injury Severity Level

This section contains the results of the pedestrian and bicycle crash analyses based on injury severity level. The first two sections summarize fatal pedestrian crash characteristics and fatal bicycle crash characteristics. The next two sections describe severe pedestrian and severe bicycle crashes. The final two sections summarize other non-severe pedestrian and other non-severe bicycle crashes. Each section first presents results based on variables available in the WisTransPortal database and then includes results from the detailed analysis of police crash narratives, aerial imagery, and street-level imagery. This detailed analysis was conducted on a sample of crashes in each severity category, so the characteristics of these samples of crashes are summarized in Appendix C.

#### 3.2.1. Fatal Pedestrian Crashes

**General Crash Characteristics**

Of the 152 fatal pedestrian crashes recorded between January 2011 and December 2013:

- 62 crashes (41%) occurred in 2011, 48 crashes (32%) occurred in 2012, and 42 crashes (28%) occurred in 2013.
  - On average, there has been a 20% decline in fatal pedestrian crashes, annually during the years of 2011, 2012, and 2013. This may be the result of safer conditions (e.g., improved roadways, driver behaviors, or pedestrian behaviors), but it may also be due to fewer people walking in Wisconsin. While it is unlikely that walking declined by 20%
per year, there are no reliable sources of statewide pedestrian activity levels to draw a clear conclusion.

- 66 (43%) crashes occurred in the southeast region, 32 (21%) in the southwest region, and 27 (18%) in the northeast region.

- 37 (24%) crashes occurred in Milwaukee County, 13 (8.6%) in Dane County, 8 (5.3%) in Waukesha County and 8 (5.3%) in Kenosha County. Since Milwaukee County contains 17% of the state’s population, pedestrian fatalities are overrepresented in this community. This may be due to higher rates of walking in Milwaukee County or to more dangerous roadways or riskier pedestrian and driver behaviors.

- 31 (20%) crashes occurred in the City of Milwaukee, 8 (5.3%) in the City of Madison, and 5 (3.3%) in the City of La Crosse. (Figure 3.3)

- 83 crashes (55%) occurred at a non-intersection location, 51 (34%) occurred at an intersection, 13 crashes (8.6%) in a parking lot, and 5 crashes (3.3%) on private property. These classifications were identified by the police officer recording the crash. (Figure 3.4)
- 98 crashes (65%) occurred on an urban roadway.
- 54 crashes (36%) occurred on a state highway.
  - 32 crashes (59%) occurred on an urban state highway
- 73 crashes (48%) occurred on a Friday, Saturday or Sunday. (Figure 3.5)

- 62 crashes (46%) occurred on a roadway that had a posted speed limit of at least 35 mph or higher. 36 crashes (27%) occurred on a 30 mph roadway, and 33 crashes (25%) occurred on a 25 mph roadway. (Figure 3.6)
- 98 crashes (65%) involved male vehicle drivers and 85 crashes (56%) involved male pedestrians. Note that in our focused study of 80 fatal pedestrian crashes, 56 crashes (70%) involved a male vehicle driver and 41 crashes (51%) involved a female pedestrian. Therefore, our randomly-selected sample had a somewhat different gender breakdown than the full set of fatal pedestrian crashes.

- 29 crashes (19%) were deemed a hit-and-run.

- 97 crashes (64%) occurred on a roadway that wasn’t divided and 22 crashes (15%) occurred on a divided highway without a traffic barrier.

- 36 crashes (24%) occurred between 3 PM and 6 PM, 24 crashes (16%) between 6 PM and 9 PM, and 19 crashes (13%) between 9 pm and 12 AM. (Figure 3.7)
- 21 crashes (14%) involved pedestrians who were under 21 years old.
  
  o 9 (43%) of these crashes involved pedestrians who were 9 years old or younger and 9 crashes (43%) involved pedestrians who were between 18 and 21 years old.

- 47 crashes (31%) involved pedestrians who were 65 years old or older.

- 26 crashes (17%) involved a vehicle driver who was 65 years old or older, 12 crashes (7.9%) involved a vehicle driver who was 18 to 21 years old, and 11 crashes (7.2%) involved a vehicle driver who was 21 to 24 years old.

**Contributing Crash Factors**

Of the 152 fatal pedestrian crashes:

- 112 crash reports (74%) identified no inclement roadway conditions, but 29 (19%) identified the roadway as wet and 7 (4.6%) identified it as snowy.

- 79 crashes (52%) involved clear weather conditions, 43 crashes (28%) involved cloudy conditions, and 18 (12%) involved rainy conditions.

- 71 crashes (47%) occurred during daylit conditions, 45 crashes (30%) occurred during dark, but lit, conditions, and 30 crashes (20%) occurred in dark, unlit conditions. (*Figure 3.8*)

47 crashes (31%) were flagged for alcohol use according to the police crash report. In the crash database, crashes are given an alcohol flag if alcohol was perceived as involved. Within specific crash reports, the reporting officer may take note of the party who was intoxicated (pedestrian or driver), but this was not always recorded.
- 117 crashes (77%) involved a vehicle driving straight, 10 crashes (6.6%) involved a vehicle backing up, 8 crashes (5.3%) involved a left-turning vehicle, and 3 crashes (2%) involved a vehicle turning right. This includes both intersection and non-intersection locations. *(Figure 3.9)*

  - 40 intersection-related crashes (78%) involved a vehicle driver who was driving straight, and 7 intersection-related crashes (14%) involved a vehicle driver turning left.

- 126 crashes (83%) had no traffic control, 15 crashes (9.9%) had operating traffic signals, and 4 crashes (2.6%) had stop signs. *(Figure 3.10)*
- 24 crash reports (16%) noted that the driver was driving inattentively, 19 crash reports (13%) noted the driver as failing to yield and 16 crash reports (11%) noted driver condition as playing a role in the crash. In the crash reports, driver condition is most often synonymous with alcohol or drug use. (*Figure 3.11*)

![Crashes by Driver Factor (n=116)](image)

*Too Fast = Too fast for conditions, FVC = Failure to keep vehicle under control, DTC = Disregard for traffic control*

*Figure 3.11*

- 60 crashes (40%) involved the pedestrian walking straight. Most other crashes did not have a pedestrian direction recorded (they may also have been traveling straight).

- 18 crash reports (12%) noted that speed played a role in the crash. However, law enforcement officers are often unable to comment on speed in crash reports due to lack of concrete data. Therefore, speed is likely to be a contributing factor in more crashes than official reports indicate.

**Detailed Analysis**

Of the 80 fatal pedestrian crashes that were studied in closer detail:

- Based on our reading of the police narrative, 42 crash reports (53%) suggested that the vehicle driver was at fault, in 23 crashes (29%) it was the pedestrian, 9 crashes (11%) did not suggest any party as at fault, and in 6 crashes (7.5%) both parties were to blame.

  - The identification of fault was based on our interpretation of the information and opinions provided by the reporting officer through the narrative description.
  - The police reports provide no official indication of fault in each crash. However, the reports do record citations issued.

- A relevant citation was only given in 25 crashes (31%).
This number may be low because citations are not given to fatally-wounded pedestrians, but many crash reports identified fault to the vehicle driver without noting a citation. Note that police may not write a citation to a driver in certain fatal crashes until after a more detailed investigation is completed, so some of these citations may not be captured in the WisTransPortal database.

- In 13 crashes (16%), the pedestrian’s dark clothing was noted as a contributing factor (as indicated in the police report narrative or through the pedestrian action variable).

**Locational Characteristics**

**Non-Intersection** - The following percentages are taken out of the 34 crashes that were identified as non-intersection according to our revised definition of an intersection.

- 28 crashes (82%) occurred on an arterial or collector roadway.
- 22 crashes (65%) occurred on a 2-3 lane roadway, 6 crashes (18%) on 4-5 lane roadways and 6 (18%) on 6 or more lane roadways.
- 9 crashes (27%) had a median present.

**Intersection** - The following percentages are taken out of the 38 intersection crashes that were identified as intersection-related according to our revised definition of an intersection.

- 22 crashes (58%) occurred in the “to” crosswalk, 12 crashes (32%) in the “from” crosswalk, and only 2 crashes (5.3%) in the intersection. Crashes noted as occurring within the “to” or “from” crosswalks include those that occur within 50 feet of the crosswalk. (*Figure 3.12*)
  - 16 (73%) of the 22 “to” crosswalk crashes involved the vehicle driving straight through the intersection, and 5 (23%) involved a left-turning vehicle.
- 22 crashes (58%) occurred within the boundaries of a crosswalk.
- 29 crashes (76%) occurred from an arterial or collector roadway, and 9 crashes (24%) from a local roadway.
- 30 crashes (79%) involved a vehicle driver going to an arterial or collector roadway and 8 crashes (21%) to a local roadway.

### 3.2.2. Fatal Bicycle Crashes

Of the 33 fatal bicycle crashes that were recorded between January 2011 and December 2013:

- 12 crashes (36%) occurred in 2011, 11 crashes (33%) occurred in 2012, and 10 crashes (30%) occurred in 2013.
- 13 crashes (39%) occurred in the southeast region, 9 crashes (27%) in the northeast region, and 4 (12%) in both the southwest and North Central region.
- 5 crashes (15%) occurred in Milwaukee County, 4 (12%) in Dane County, 4 (12%) in Waukesha County, and 4 (12%) in Outagamie County.
- 3 (9.1%) crashes occurred in the City of Milwaukee, 3 (9.1%) in the City of Madison, 2 (6.1%) in the City of Taycheedah, and 2 (6.1%) in the City of Muskego. (Figure 3.13)

- 21 crashes (64%) occurred at a non-intersection location and 12 (36%) occurred at an intersection. (Figure 3.14)
- 22 crashes (67%) occurred on an urban roadway.
- 9 crashes (27%) occurred on a state highway.
  - 7 crashes (78%) occurred on an urban state highway.
- 17 crashes (52%) occurred on a Friday, Saturday or Sunday. (Figure 3.15)

- 9 crashes (27%) occurred between 3 PM and 6 PM, 7 crashes (21%) occurred between 6 PM and 9 PM, and 5 crashes (15%) occurred during the hours of 9 AM to 12 PM. (Figure 3.16)
- 5 crashes (15%) occurred on a 25 mph roadway or lower, 5 crashes (15%) occurred on a 30 mph roadway, 11 crashes (33%) occurred on a 35 to 40 mph roadway, 2 crashes (6.1%) on a 45 to 50 mph roadway and 10 (30%) occurred on a 55 mph roadway or higher. *(Figure 3.17)*

- 20 crashes (61%) involved a male vehicle driver.

- 29 crashes (88%) involved a male bicyclist.

- 5 crashes (15%) involved a bicyclist who was 65 years old or older, 2 crashes (6.1%) involved a bicyclist who was 18-21 years old, and 2 crashes (6.1%) involved a bicyclist who was 22-25 years old.
- 7 crashes (21%) involved a driver who was 65 years or older, 6 crashes (18%) involved a driver who was 21 to 24 years old, and 6 crashes (18%) involved a driver who was 18-20 years old.

**Contributing Crash Factors**

Of the 33 fatal bicycle crashes:
- 28 crash reports (85%) identified no inclement roadway conditions, but 5 (15%) identified the roadway as wet.
- 20 crashes (61%) involved clear weather conditions, 8 crashes (24%) involved cloudy conditions, and 4 (12%) involved rainy conditions.
- 24 crashes (73%) occurred during daylit conditions, 4 crashes (12%) occurred during dark, but lit, conditions, and only 3 crashes (9.1%) occurred in dark, unlit conditions. *(Figure 3.18)*

![Crashes by Lighting Condition (n=33)](image)

- 9 crashes (27%) were flagged for alcohol use according to the police crash report. In the crash database, crashes are given an alcohol flag if alcohol was perceived as involved. Within specific crash reports, the reporting officer may take note of the crash unit who was involved, but this is not always recorded.
  - 4 of the 9 crashes (44%) actually noted alcohol involvement in the crash report.
    - 3 crash reports (75%) noted the driver as being intoxicated
    - 2 crash reports (50%) noted the bicyclist as being intoxicated
- 26 crashes (79%) involved a vehicle driving straight, 2 crashes (6.1%) involved a right-turning vehicle, and 2 crashes (6.1%) involved a vehicle turning left. *(Figure 3.19)*
- 22 crashes (67%) had no traffic control for the involved vehicle, 6 crashes (18%) had operating traffic signals, and 4 crashes (12%) had stop signs. *(Figure 3.20)*

- 30 crash reports (91%) noted that the bicyclist was traveling straight.

- 25 crash reports (76%) noted that no traffic control existed on the bicyclist’s roadway, 5 crash reports (15%) noted that there was operating traffic signals, and 2 crash reports (6.1%) noted that there was a stop sign present

**Detailed Analysis**

Due to the limited number of fatal bicycle crashes, all fatal crashes were studied in closer detail and analysis of the general crash report characteristics is only provided in the previous section of this memo.
Additional analysis was done on crash report accuracy, locational characteristics and driver factors, and that analysis is provided here.

Of the 33 fatal bicycle crashes that were studied in closer detail:

- 9 crashes (27%) involved a bicyclist riding on the sidewalk.
  - 4 of these crashes (44%) involved a bicyclist riding in the wrong direction.
- 5 crashes (15%) involved a bicyclist who crossed against traffic control
- 14 crashes (42%) involved a driver who claimed they did not see the bicyclist
- No crashes specifically identified a bicyclist’s dark clothing as a contributing factor to the crash.
- 13 crashes (39%) involved a bicyclist who was wearing a helmet. Due to the large number of N/A entries in this field, the percentage of bicyclists wearing a helmet may be underestimated.
  - 9 of these crashes (69%) occurred at a non-intersection location.
- The vehicle driver was identified as at fault in 19 crashes (58%), bicyclist at fault in 8 crashes (24%), and no fault was assigned in 5 crashes (15%).
  - The identification of fault was based off of information and opinions provided by the reporting officer and our interpretation of the fault based on the suggestions of the statements made.

**Locational Characteristics**

**Non-Intersection**

- 14 crashes (82%) occurred on arterial or collector roadways.
- 15 crashes (88%) occurred on 2 lane roadways.
- Only one non-intersection crash had a bike lane present, and only 5 (29%) had another bike facility present.
  - Other bike facilities include wide roadway shoulders and multi-use trails (sidepaths).

**Intersection**

- 11 crashes (69%) involved an arterial or collector roadway.
  - All 11 of these crashes involved a “from” roadway that was either an arterial or collector
  - 10 crashes (91%) involved a “to” roadway that was either an arterial or collector.
- 6 crashes (40%) occurred on 2 to 3 lane roadways, 6 (40%) occurred on 4 to 5 lane roadways, and 2 occurred on a 6+ lane roadway.

- 4 crashes (25%) occurred at the intersection's “from” crosswalk, 3 crashes (19%) occurred in the “to” crosswalk, and 7 (44%) occurred in the intersection. (*Figure 3.21*).

- 3 crashes (19%) occurred within the boundaries of the “to” or “from” crosswalk.

- 2 (13%) involved “from” roadways that had bike lanes and 3 (19%) involved “to” roadways that had bike lanes.

### 3.2.3. Severe Pedestrian Crashes

**General Crash Characteristics**

Of the 774 severe pedestrian crashes:

- 258 crashes (33%) occurred in 2011, 262 crashes (34%) occurred in 2012, and 254 crashes (33%) occurred in 2013.

- 381 (49%) crashes occurred in the southeast region, 137 (18%) in the southwest region, and 118 (15%) in the northeast region.

- 238 (31%) crashes occurred in Milwaukee County, 55 (7.1%) in Dane County, 40 (5.2%) in Waukesha County and 38 (4.9%) in Racine County.

- 173 (22%) crashes occurred in the City of Milwaukee, 43 (5.6%) in the City of Madison, 21 (2.7%) in the City of Racine, and 21 (2.7%) in the City of Green Bay. (*Figure 3.22*)
- 376 crashes (49%) occurred at a non-intersection location, 253 (33%) occurred at an intersection, 113 crashes (15%) in a parking lot, and 32 crashes (4.1%) on private property. (Figure 3.23)

- 602 crashes (78%) occurred on an urban roadway.

- 181 crashes (23%) occurred on a state highway.
  - 131 crashes (72%) occurred on an urban state highway

(Figure 3.22)
- 347 crashes (45%) occurred on a Friday, Saturday or Sunday. *(Figure 3.24)*

![Crashes by Day of the Week (n=774)](image1)

*Figure 3.24*

- 287 crashes (37%) occurred on a 25 mph roadway and 168 (22%) occurred on a 30 mph roadway. *(Figure 3.25)*

![Crashes by Posted Speed Limit (n=655)](image2)

*Figure 3.25*

- 423 crashes (55%) involved a male driver.
- 430 crashes (56%) involved a male pedestrian.
- 40 crashes (5.2%) had no traffic control on the pedestrian’s roadway
- 162 crashes (21%) were deemed a hit-and-run.

- 457 crashes (59%) occurred on a roadway that wasn’t divided and 124 crashes (16%) occurred on a divided highway without a traffic barrier.

- 133 crashes (17%) occurred between 6 PM and 9 PM, 111 crashes (14%) between 3 PM and 6 PM, and 109 crashes (14%) between 9 AM and 12 PM. (Figure 3.26)

- 224 crashes (29%) involved pedestrians who were under 21 years old.
  - 72 (9.3%) of these crashes involved pedestrians who were 9 years old or younger and 64 crashes (8.3%) involved pedestrians who were between 18 and 21 years old.

- 116 crashes (15%) involved pedestrians who were 65 years old or older.

- 96 crashes (12%) involved a vehicle driver who was 65 years old or older, 73 crashes (9.4%) involved a vehicle driver who was 21 to 24 years old, and 57 crashes (7.4%) involved a vehicle driver who was 18-20 years old.

**Contributing Crash Factors**

Of the 774 severe pedestrian crashes:

- 591 crash reports (76%) identified no inclement roadway conditions, but 120 (16%) identified the roadway as wet and 45 (5.8%) identified it as snowy.

- 433 crashes (56%) involved clear weather conditions, 234 crashes (30%) involved cloudy conditions, and 59 (7.6%) involved rainy conditions.

- 430 crashes (56%) occurred during daylit conditions, 239 crashes (31%) occurred during dark, but lit, conditions, and only 80 crashes (10%) occurred in dark, unlit conditions. (Figure 3.27)
- 91 crashes (12%) were flagged for alcohol use according to the police crash report.

- 500 crashes (65%) involved a vehicle driving straight, 104 crashes (13%) involved a left-turning vehicle, and 63 crashes (8.1%) involved a vehicle backing up. \((\text{Figure 3.28})\)

- 570 crashes (74%) had no traffic control, 124 crashes (16%) had operating traffic signals, and 40 crashes (6.5%) had stop signs. \((\text{Figure 3.29})\)
- 180 crash reports (23%) noted the driver as failing to yield and 159 crash reports (21%) noted that the driver was driving inattentively. *(Figure 3.30)*

- 324 crashes (42%) involved the pedestrian walking straight.

- 52 crash reports (6.7%) noted that speed played a role in the crash.
3.2.4. Severe Bicycle Crashes

*General Crash Characteristics*

Of the 307 severe bicycle crashes:

- 105 crashes (34%) occurred in 2011, 115 crashes (38%) occurred in 2012, and 87 crashes (28%) occurred in 2013.

- 118 (38%) crashes occurred in the southeast region, 77 (25%) in the southwest region, and 65 (21%) in the northeast region.

- 59 (19%) crashes occurred in Milwaukee County, 42 (14%) in Dane County and 27 (8.8%) in Waukesha County.

- 28 (9.1%) crashes occurred in the City of Milwaukee, 27 (8.8%) in the City of Madison, 11 (3.6%) in the City of Kenosha, and 10 (3.3%) in the City of La Crosse. *(Figure 3.31)*

- 196 crashes (64%) occurred at an intersection location, 95 (31%) occurred at a non-intersection, 10 crashes (3.3%) in a parking lot, and 6 crashes (2%) on private property. *(Figure 3.32)*
- 231 crashes (75%) occurred on an urban roadway.
- 81 crashes (26%) occurred on a state highway.
  - 62 crashes (77%) occurred on an urban state highway.
- 115 crashes (37%) occurred on a Friday, Saturday or Sunday.
- 81 crashes (26%) occurred between 3 PM and 6 PM, 72 crashes (24%) occurred between 12 PM and 3 PM, and 44 crashes occurred both during the hours of 9 AM to 12 PM and 6 PM to 9 PM. (Figure 3.33)
The following characteristics reflect the 301 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 156 crashes (54%) occurred on a roadway with a posted speed of 25 mph or lower, 81 crashes (28%) occurred on a 30 to 35 mph roadway, 35 (12%) occurred on a 40 to 50 mph roadway and 17 crashes (5.9%) occurred on a roadway that had a posted speed of 55 mph or higher. The percentages provided reflect the 289 crash reports that identified a posted speed. (Figure 3.34)

- 157 crashes (52%) involved a male vehicle driver.

- 220 crashes (73%) involved a male bicyclist.

- 41 crashes (14%) involved a bicyclist who was 14-17 years old, 34 crashes (11%) involved a bicyclist who was 18-21 years old, and 30 crashes (10%) involved a bicyclist who was 10-13 years old.

- 41 crashes (14%) involved a driver who was 65 years or older, 24 crashes (8%) involved a driver who was 21 to 24 years old, and 23 crashes (8%) involved a driver who was 18-20 years old.

**Contributing Crash Factors**

Of the 307 severe bicycle crashes:

- 289 crash reports (94%) identified no inclement roadway conditions, but 13 (4.2%) identified the roadway as wet and 5 (1.6%) identified it as snowy.

- 220 crashes (72%) involved clear weather conditions, 74 crashes (24%) involved cloudy conditions, and 11 (3.6%) involved rainy conditions.

- 248 crashes (81%) occurred during daylit conditions, 31 crashes (10%) occurred during dark, but lit, conditions, and only 12 crashes (3.9%) occurred in dark, unlit conditions. (Figure 3.35)
11 crashes (3.6%) were flagged for alcohol use according to the police crash report.

The following characteristics reflect the 301 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 167 crashes (55%) involved a vehicle driving straight, 56 crashes (19%) involved a right-turning vehicle, and 49 crashes (16%) involved a vehicle turning left. (Figure 3.36)
- 177 crashes (59%) had no traffic control for the involved vehicle, 72 crashes (24%) had operating traffic signals, and 45 crashes (15%) had stop signs. (*Figure 3.37*)

![Chart](chart.png)

*Chart reflects only the top 5 most commonly identified forms of traffic control.*

*Figure 3.37*

- 247 crash reports (82%) noted that the bicyclist was traveling straight.

- 182 crash reports (60%) noted that no traffic control existed on the bicyclist’s roadway, 66 crash reports (22%) noted that there was operating traffic signals, and 46 crash reports (15%) noted that there was a stop sign present.
3.2.5. Non-Severe Pedestrian Crashes

General Crash Characteristics

Of the 3,931 B, C, or no injury pedestrian crashes:

- 1259 crashes (32%) occurred in 2011, 1324 crashes (34%) occurred in 2012, and 1348 crashes (34%) occurred in 2013.

- 2,120 (54%) crashes occurred in the southeast region, 804 (21%) in the southwest region, and 551 (14%) in the northeast region.

- 1518 (39%) crashes occurred in Milwaukee County, 374 (9.5%) in Dane County, 182 (4.6%) in Racine County and 147 (3.7%) in Waukesha County.

- 1,214 (31%) crashes occurred in the City of Milwaukee, 271 (6.9%) in the City of Madison, 131 (3.3%) in the City of Racine, and 98 (2.5%) in both the City of Green Bay and Kenosha. (Figure 3.38)

- 1,730 crashes (44%) occurred at an intersection location, 1,275 (32%) occurred at a non-intersection, 798 crashes (20%) in a parking lot, and 128 crashes (3.3%) on private property. (Figure 3.39)
- 3,347 crashes (85%) occurred on an urban roadway.
- 645 crashes (16%) occurred on a state highway.
  - 534 crashes (83%) occurred on an urban state highway
- 1,153 crashes (29%) occurred on a Friday, Saturday or Sunday.
- 1,468 crashes (37%) occurred on a 25 mph roadway and 821 (21%) occurred on a 30 mph roadway. Only 485 crashes (12%) occurred on a 35 mph roadway or higher. (Figure 3.40)
- 1,879 crashes (48%) involved a male driver.
- 2,096 crashes (53%) involved a male pedestrian.
- 993 crashes (25%) were deemed a hit-and-run.
- 2,314 crashes (59%) occurred on a roadway that wasn’t divided and 444 crashes (11%) occurred on a divided highway without a traffic barrier.
- 1,054 crashes (27%) occurred between 3 PM and 6 PM, 686 crashes (18%) occurred between 12 PM and 3 PM, and 683 crashes (17%) occurred between 6 PM and 9 PM. Only 220 crashes (5.6%) occurred between 12 AM and 3 AM. Nine crashes reports did not identify a time of crash, so the percentages above are taken out of 3,922 crashes. *(Figure 3.41)*

![Crashes by Time of Day (n=3,922)](image)

- 407 crashes (10%) involved a pedestrian was 18-21 years old, 396 crashes (10%) involved a pedestrian who was 14-17 years old, and 360 crashes (9.2%) involved a pedestrian who was 65 years old or older.
- 431 crashes (11%) involved a driver who was 65 years or older, 340 crashes (8.6%) involved a driver who was 21 to 24 years old, and 223 (5.7%) involved a driver who was 18 to 20 years old.

**Contributing Crash Factors**

Of the 3,931 B, C, or no injury pedestrian crashes:
- 3,054 crash reports (78%) identified no inclement roadway conditions, but 558 (14%) identified the roadway as wet and 227 (5.8%) identified it as snowy.
- 2,343 crashes (60%) involved clear weather conditions, 1,052 crashes (27%) involved cloudy conditions, and 320 (8.1%) involved rainy conditions.

- 2,526 crashes (64%) occurred during daylit conditions, 1,065 crashes (27%) occurred during dark, but lit, conditions, and only 190 crashes (4.8%) occurred in dark, unlit conditions. (Figure 3.42)

- 273 crashes (6.9%) were flagged for alcohol use according to the police crash report.

- 1,906 crashes (48%) involved a vehicle driving straight, 713 crashes (18%) involved a vehicle turning left, 479 crashes (12%) involved a vehicle turning right, and 464 crashes (12%) involved a vehicle backing up. (Figure 3.43)
- 2,582 crashes (66%) had no traffic control on the driver’s roadway, 825 crashes (21%) had operating traffic signals, and 413 crashes (11%) had stop signs. (Figure 3.44)

- 1,022 crash reports (26%) noted the driver as failing to yield and 771 crash reports (20%) noted that the driver was driving inattentively. (Figure 3.45)
- 40 crashes (5.2%) had no traffic control on the pedestrian’s roadway.

- 324 crashes (42%) involved the pedestrian walking straight.

- 123 crash reports (3.1%) noted that speed played a role in the crash.

**Our Analysis**

Outside of the initial analysis done on the crash characteristics that were identified by the reporting police officer, additional analysis was done on crash report accuracy, locational characteristics and driver factors.

Of the 64 non-severe pedestrian crashes that were studied in closer detail:

- Based on our reading of the police narrative, 39 crash reports (61%) suggested that the vehicle driver was at fault, in 16 crashes (25%) it was the pedestrian and 9 crashes (14%) did not suggest any party as at fault.
  
  - The identification of fault was based on our interpretation of the information and opinions provided by the reporting officer through the narrative description.
  - The police reports provide no official indication of fault in each crash. However, the reports do record citations issued.

- A relevant citation was only given in 21 crashes (33%).

- In 2 crashes (3.1%), the pedestrian’s dark clothing was noted as a contributing factor (as indicated in the police report narrative or through the pedestrian action variable).
**Locational Characteristics**

Most (37 of 64) of the non-severe pedestrian crashes occurred at intersections. 11 occurred at on roadway segments away from intersections, and 16 occurred in parking lots or on private property.

**Non-Intersection** - The following percentages are taken out of the 11 crashes that were identified as non-intersection according to our revised definition of an intersection.

- 5 crashes (45%) occurred on an arterial or collector roadway.
- 11 crashes (100%) occurred on a 2-3 lane roadway.
- 1 crash (9.1%) had a median present.

**Intersection** - The following percentages are taken out of the 37 intersection crashes that were identified as intersection-related according to our revised definition of an intersection.

- 21 crashes (57%) occurred in the “to” crosswalk, 11 crashes (29%) in the “from” crosswalk, and only 3 crashes (8%) in the intersection. (*Figure 3.46*)
  - 11 (52%) of the 21 “to” crosswalk crashes involved the vehicle making a left turn at the intersection, and 7 (11%) involved a vehicle driving straight.
- 22 crashes (60%) occurred within the boundaries of a crosswalk.
- 26 crashes (70%) had an arterial or collector involved.
- 22 crashes (59%) occurred from an arterial or collector roadway, and 12 crashes (32%) from a local roadway.
- 24 crashes (38%) involved a vehicle driver going to an arterial or collector roadway and 10 crashes (27%) to a local roadway.

### 3.2.6. Non-Severe Bicycle Crashes

#### General Crash Characteristics

Of the 3,025 B, C, or no injury bicycle crashes:

- 1003 crashes (33%) occurred in 2011, 1098 crashes (36%) occurred in 2012, and 924 crashes (31%) occurred in 2013.

- 1171 (39%) crashes occurred in the southeast region, 863 (29%) in the southwest region, and 609 (20%) in the northeast region.

- 743 (25%) crashes occurred in Milwaukee County, 463 (15%) in Dane County and 163 (5.4%) in Winnebago County.

- 468 (16%) crashes occurred in the City of Milwaukee, 371 (12%) in the City of Madison, and 104 (3.4%) in the City of La Crosse. *(Figure 3.47)*

- 2,084 crashes (69%) occurred at an intersection location, 743 (25%) occurred at a non-intersection, 159 crashes (5.3%) in a parking lot, and 39 crashes (1.3%) on private property. *(Figure 3.48)*
- 2,608 crashes (86%) occurred on an urban roadway.

- 647 crashes (21%) occurred on a state highway.
  
  - 526 of those state highway crashes (82%) occurred on an urban state highway.

- 1,046 crashes (35%) occurred on a Friday, Saturday or Sunday.

- 966 crashes (32%) occurred between 3 PM and 6 PM, 613 crashes (20%) occurred between 12 PM and 3 PM, and 523 crashes (17%) occurred between 6 PM and 9 PM. (Figure 3.49)
The following characteristics reflect the 2,989 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 1,816 crashes (65%) occurred on a roadway that had a posted speed of 25 mph or lower, 762 crashes (27%) occurred on a 30 to 35 mph roadway, 118 (4.2%) occurred on a 40 to 50 mph roadway and only 86 crashes (3.1%) occurred on a roadway that had a posted speed of 55 mph or higher. These percentages are taken out of the 2,782 crash reports that identified a posted speed limit. (Figure 3.50)

- 1,446 crashes (48%) involved a male vehicle driver.

- 2,185 crashes (73%) involved a male bicyclist.

- 448 crashes (15%) involved a bicyclist who was 14 to 17 years old, 423 (14%) involved a bicyclist who was 10 to 13 years old, and 421 (14%) involved a bicyclist who was 18 to 21 years old.

- 362 crashes (12%) involved a vehicle driver who was 65 years old or older, 241 crashes (8.1%) involved a vehicle driver who was 21-24 years old, and 141 crashes (4.7%) involved a vehicle driver that was 18-20 years old.

**Contributing Crash Factors**

- 2,751 crash reports (91%) identified no inclement roadway conditions, but 233 (7.7%) identified the roadway as wet and 15 (0.5%) identified it as snowy.

- 2,043 crashes (68%) involved clear weather conditions, 771 crashes (26%) involved cloudy conditions, and 151 (5%) involved rainy conditions.

- 2,500 crashes (83%) occurred during daylit conditions, 356 crashes (12%) occurred during dark, but lit, conditions, and 96 crashes (3.2%) occurred in lighting conditions described as “dusk.” (Figure 3.51)
77 crashes (2.5%) were flagged for alcohol use according to the police crash report.

The following characteristics reflect the 2,989 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 1,219 crashes (41%) involved a vehicle driving straight, 933 crashes (31%) involved a right-turning vehicle, and 480 crashes (16%) involved a vehicle turning left.

- 1,343 crashes (45%) had no traffic control for the involved vehicle, 852 crashes (29%) had operating traffic signals, and 724 crashes (24%) had stop signs. (Figure 3.52)

- 2,609 crash reports (87%) noted that the bicyclist was traveling straight.
- 1,731 crash reports (58%) noted that no traffic control existed on the bicyclist’s roadway, 822 crash reports (28%) noted that there was operating traffic signals, and 327 crash reports (11%) noted that there was a stop sign present. (Figure 3.53)

![Figure 3.53: Crashes by Traffic Control on the Bicyclist's Roadway (n=2,989)](image)

**Detailed Analysis**

After analyzing all bicycle crashes that were identified with an injury severity of B, C or no injury, 73 of these crashes were studied in further detail. In this detailed analysis, the written narrative sections of each of the 73 crash’s MV4000 forms were reviewed. These detailed police accounts of the crash were not coded in the WisTransPortal database, but they provided additional insights into the circumstances related to each crash. This in-depth review also included identifying each crash location and documenting the characteristics of the site using aerial imagery (Google Earth) and street-level imagery (Google Street View).

Of the 73 non-severe bicycle crashes that were studied in closer detail:

- 28 crashes (38%) involved a bicyclist riding on the sidewalk.
  - 20 of these crashes (71%) involved a bicyclist riding in the wrong direction.

- 15 crashes (21%) involved a bicyclist who crossed against traffic control

- 24 crashes (33%) involved a driver who claimed they did not see the bicyclist

- Only 1 crash report (1.4%) identified the bicyclist’s dark clothing as playing a role in the crash.

- The vehicle driver was identified as at fault in 33 crashes (45%), bicyclist at fault in 28 crashes (38%), and no fault was assigned in 8 crashes (11%).
The identification of fault was based off of information and opinions provided by the reporting officer and our interpretation of the fault based on the suggestions of the statements made.

**Locational Characteristics**

Of the 73 non-severe bicycle crashes that were studied in further detail, 56 (77%) were identified as intersection crashes, 10 (14%) were identified as non-intersection, and 6 (8.2%) were identified as occurring in a driveway, either at a residence or a commercial location. In addition, there was 1 crash (1.4%) that occurred in a parking lot. These crash locations were identified through our revised crash location definition.

**Non-Intersection**
- 10 crashes (83%) occurred on arterial or collector roadways.
- 8 crashes (67%) occurred on 2 lane roadways.
- 4 (40%) of non-intersection crashes had some sort of bicycle facility present.
  - 2 non-intersection crashes (17%) had a bike lane present.

**Intersection**
- 42 crashes (75%) involved an arterial or collector roadway. (n=56)
  - 25 crashes (44%) involved a “from” roadway that was either an arterial or collector. (n=57)
  - 34 crashes (61%) involved a “to” roadway that was either an arterial or collector. (n=56)
- 40 crashes (55%) occurred on 2-3 lane roadways, 15 (21%) occurred on 4 to 5 lane roadways, and 3 (4.1%) occurred on a 6+ lane roadway.
- 32 crashes (54%) occurred in the intersection, 19 crashes (32%) occurred at the intersection’s “from” crosswalk, and 8 crashes (14%) occurred in the “to” crosswalk. (n=59) (Figure 3.54)
- 25 crashes (43%) were noted as taking place within the boundaries of a marked crosswalk.

- 7 (12%) of intersections had some form of bicycle facility present on at least one approach.

- 7 (12%) involved “from” roadways that had bike lanes and 5 (8.5%) involved “to” roadways that had bike lanes.

**B, C and Property Damage - Bicycle Crash Types**
- 17 crashes (23%) involved a motorist who struck a bicyclist that was approaching from the right on the near side of the intersection.
  - 14 of these crashes (82%) involved a bicyclist who had been riding on the sidewalk.
  - 10 of these crashes (59%) involved a motorist who was turning right.

- 13 crashes (18%) involved a motorist who struck a bicyclist that was approaching from the left on the near side of the intersection.

- 11 crashes (15%) involved a motorist who struck a bicyclist approaching from the right on the far side of the intersection.

- 10 crashes (14%) involved a motorist who struck a bicyclist while turning left.

- 9 crashes (12%) involved a motorist who overtook or sideswiped the bicyclist.
  - 6 of these crashes (67%) involved a motorist or bicyclist sideswiping the other unit.
  - 2 of these crashes (22%) involved a motorist rear-ending the bicyclist.
3.3. Pedestrian and Bicycle Crash Types
This section summarizes the LMCM and NHTSA crash types by pedestrian and bicycle injury severity category. Crash types were identified for all 296 pedestrian and 229 bicycle crashes analyzed in detail. Crash types help explain the actions that contributed to each crash and inform recommendations for engineering, education, and enforcement measures to reduce future pedestrian and bicycle crashes.

3.3.1. Pedestrian Crash types
Table 3.5 ranks the LMCM crash types and Table 3.6 ranks the NHTSA crash types for all pedestrian crashes reviewed in detail. Each table shows the proportion of fatal injury, severe injury, and non-severe injury (minor- and no-injury) crashes by type. Both tables identify crash types that have a significantly different proportion of fatal versus non-severe injury crashes (according to a Z-test of the difference between two proportions). Crash types that have a significantly higher proportion of fatalities have plus symbols (+) in the right column; crash types that have a significantly lower proportion of fatalities have minus symbols (-). Appendix D includes a matrix that shows how the top LMCM pedestrian crash types correspond with the top NHTSA pedestrian crash types.

Pedestrian Crash Locations and Movements
Unlike the NHTSA typology, the LMCM classification provides useful information about the type of roadway location where crashes occurred and the directions that the motorist and pedestrian were moving prior to the crash. The results presented in this subsection are also based on the sample of crashes that has a higher proportion of fatal and severe-injury crashes than the state as a whole.

Most of the pedestrian crashes analyzed in detail occurred at intersections (45%) and along roadways at non-intersection locations (35%). Smaller proportions of pedestrian crashes occurred in parking lots (12%), and driveways (1.7%). Other situations, such as train crashes, driverless vehicle crashes, multi-unit crashes where the pedestrian crash was due to the pedestrian being struck by a vehicle that had already been struck by another vehicle, accounted for the remaining 6.4% of crashes. Pedestrian crashes with different levels of injury severity had different roadway location characteristics. A higher percentage of fatal pedestrian crashes occurred at roadway non-intersection locations (45%) than at intersection locations (43%). In contrast, non-severe crashes were more likely to occur at intersections (47%) than roadway non-intersections (24%). The difference between the percentage of fatal crashes (45%) and non-severe crashes (24%) that occurred at non-intersection locations was significant at the 95% confidence level.

The majority of pedestrian crashes (65%) involved a motorist traveling straight along a roadway segment or through an intersection. Only 16% involved motorists turning (the remaining 19% of pedestrian crashes were classified as parking lot, driveway, and other). Further, pedestrian injury severity varied by motorist movement. Four out of five fatal pedestrian crashes (80%) involved motorists traveling straight. This proportion decreased for severe-injury pedestrian crashes (66%) and non-severe injury crashes (42%). The difference between the percentages of fatal crashes and non-severe crashes involving motorists traveling straight is significant at a 99% confidence level. Further, the three crash types that produced significantly higher percentages of fatal versus non-severe pedestrian crashes all involved motorists going straight (N_RRD_X, I_FS_ST_L, and N_RRD_L). Vehicles going straight may create a particularly high risk of severe injuries because they are more likely to produce a higher-speed collision.
Pedestrians were often struck by vehicles when they were approaching from the motorist’s right (35%) or the motorist’s left (28%). Just under 18% of pedestrian crash victims were standing, sitting, or laying in the roadway or traveling from an unknown direction (the remaining 19% of pedestrian crashes were classified as parking lot, driveway, and other). Injury severity also varied by pedestrian movement. 35% of fatal pedestrian crashes occurred when pedestrians were approaching from the motorist’s left, while only 21% of non-severe pedestrian crashes occurred when pedestrians were approaching from the left (this difference is significant at a 90% confidence level). In contrast, 37% of non-severe pedestrian crashes involved pedestrians approaching from the right while only 28% of fatal pedestrian crashes involved pedestrians approaching from the right (this difference is not statistically significant).

Top Fatal and Severe Pedestrian Crash Types
The LMCM revealed that the most common crash type producing pedestrian fatalities was a straight-traveling motorist striking a pedestrian in the roadway (the pedestrian was not approaching from left or right) (N_RRD_X). The next-most-common fatal pedestrian crash types involved a straight-traveling motorist striking a pedestrian approaching from the right at a non-intersection location (N_RRD_R), a straight-traveling motorist striking a pedestrian approaching from the left on the far side of an intersection (I_FS_ST_L), and a straight-traveling motorist striking a pedestrian approaching from the left at a non-intersection location (N_RRD_L). These fatal (“K”) pedestrian crash types are illustrated and their key behavior and roadway characteristics are listed in Figure 3.55.a, Figure 3.55.b, Figure 3.55.c, and Figure 3.55.d. The top four fatal pedestrian crash types tended to involve high speeds, darkness, and were more likely to note alcohol as a contributing factor to the crash. Crashes within these crash types tended to occur at multi-lane roadway intersections or high speed, two-lane roadway, non-intersection locations.

Four of the top five severe-injury (“A”) pedestrian crash types are represented by Figure 3.56.a, Figure 3.56.b, Figure 3.56.c, and Figure 3.56.d. These top severe-injury pedestrian crash types tended to involve multi-lane roadways, moderate speeds, darkness, and urban locations. Note that the fourth-highest severe-injury pedestrian crash type was “other movements that do not fit into other crash type categories, including driverless vehicle crashes” (OTH), so it does not have a diagram. The top non-severe-injury pedestrian crash types are shown in Appendix E.

---

10 Pedestrians were considered to be approaching from the motorist’s left if they were crossing the street from left to right in front of a straight-traveling motorist or left to right in front of a turning motorist on the near side of the intersection. They were also considered to be approaching from the motorist’s left in situations such as: 1) pedestrian traveling north in a far crosswalk and struck by a left-turning motorist going from a northbound to a westbound direction (I_FS_LT_S) or 2) pedestrian traveling south in a far crosswalk and struck by a right-turning motorist going from a northbound to an eastbound direction (I_FS_RT_O). The mirror situations are considered to be pedestrians approaching from the motorist’s right.
<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Fatal Injury (K)</th>
<th>Severe Injury (A)</th>
<th>Non-Severe</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RRD_R</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian approaching from right</td>
<td>11.3%</td>
<td>18.2%</td>
<td>8.1%</td>
<td></td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection</td>
<td>12.5%</td>
<td>9.7%</td>
<td>3.2%</td>
<td>++</td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection</td>
<td>8.8%</td>
<td>8.4%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>N_RRD_X</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian in roadway, pedestrian not approaching from left or right</td>
<td>16.3%</td>
<td>4.5%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian approaching from left</td>
<td>11.3%</td>
<td>5.2%</td>
<td>3.2%</td>
<td>+</td>
</tr>
<tr>
<td>OTH</td>
<td>Other movements that do not fit into other crash type categories, including driverless vehicle crashes</td>
<td>3.8%</td>
<td>8.4%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>P_B</td>
<td>Parking lot/Private property: Backing motorist strikes pedestrian</td>
<td>6.3%</td>
<td>4.5%</td>
<td>9.7%</td>
<td></td>
</tr>
<tr>
<td>P_F</td>
<td>Parking lot/Private property: Forward-traveling motorist strikes pedestrian</td>
<td>1.3%</td>
<td>5.2%</td>
<td>12.9%</td>
<td>--</td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Intersection: Left-turning motorist strikes pedestrian traveling from opposite direction in far crosswalk</td>
<td>2.5%</td>
<td>4.5%</td>
<td>11.3%</td>
<td>--</td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from right on far side of intersection</td>
<td>7.5%</td>
<td>4.5%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from right on near side of intersection</td>
<td>5.0%</td>
<td>5.2%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_S</td>
<td>Intersection: Left-turning motorist strikes pedestrian traveling from same direction in far crosswalk</td>
<td>2.5%</td>
<td>3.9%</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>N_RSH_X</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian on right roadway shoulder</td>
<td>1.3%</td>
<td>3.9%</td>
<td>6.5%</td>
<td>-</td>
</tr>
<tr>
<td>I_FS_RT_S</td>
<td>Intersection: Right-turning motorist strikes pedestrian traveling from same direction in far crosswalk</td>
<td>0.0%</td>
<td>1.9%</td>
<td>4.8%</td>
<td>--</td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Intersection: Right-turning motorist strikes pedestrian approaching from right on near side of intersection</td>
<td>0.0%</td>
<td>2.6%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>D_B</td>
<td>Driveway: Backing motorist strikes pedestrian</td>
<td>1.3%</td>
<td>1.3%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_X</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian in roadway on near side of intersection, no pedestrian direction</td>
<td>1.3%</td>
<td>1.9%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>7.5%</td>
<td>5.8%</td>
<td>11.3%</td>
<td></td>
</tr>
</tbody>
</table>

**Total Crashes**

80 154 62

1) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes resulting in a fatal (K) injury versus the proportion of crashes resulting in a non-severe injury for a particular crash type. “++” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 90% confidence level; “−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 95% confidence level; “−−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 90% confidence level.
Table 3.6. Pedestrian Crashes: NHTSA Pedestrian Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Fatal Injury (K)</th>
<th>Severe Injury (A)</th>
<th>Non-Severe</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>741</td>
<td>The pedestrian ran into the roadway and was struck by a vehicle whose view of the pedestrian was not obstructed</td>
<td>12.5%</td>
<td>14.9%</td>
<td>3.2%</td>
<td>++</td>
</tr>
<tr>
<td>770</td>
<td>The motorist failed to yield to the pedestrian</td>
<td>16.3%</td>
<td>8.4%</td>
<td>9.7%</td>
<td></td>
</tr>
<tr>
<td>760</td>
<td>The pedestrian failed to yield to the motorian</td>
<td>10.0%</td>
<td>10.4%</td>
<td>11.3%</td>
<td></td>
</tr>
<tr>
<td>742</td>
<td>The pedestrian walked or ran into the roadway and was struck by a motorist whose view of the pedestrian was blocked until an instant before impact</td>
<td>6.3%</td>
<td>13.0%</td>
<td>8.1%</td>
<td></td>
</tr>
<tr>
<td>781</td>
<td>The motorist was initially traveling on a parallel path with the pedestrian before making a left turn and striking the individual</td>
<td>5.0%</td>
<td>6.5%</td>
<td>12.9%</td>
<td>-</td>
</tr>
<tr>
<td>830</td>
<td>The motor vehicle struck a pedestrian in a parking lot</td>
<td>1.3%</td>
<td>3.9%</td>
<td>17.7%</td>
<td>--</td>
</tr>
<tr>
<td>214</td>
<td>The pedestrian was struck in a parking lot by a vehicle that was backing with a driver at the controls</td>
<td>3.8%</td>
<td>4.5%</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>410</td>
<td>The pedestrian was walking/running along the roadway with traffic and was struck from behind</td>
<td>3.8%</td>
<td>2.6%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Vehicle lost control due to mechanical failure, surface conditions, driver error or impairment</td>
<td>3.8%</td>
<td>2.6%</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>230</td>
<td>The pedestrian was struck while near or next to a disabled vehicle (including a vehicle that had been in a crash) or while walking to or from a disabled vehicle</td>
<td>6.3%</td>
<td>2.6%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td>680</td>
<td>The crash occurred at a nonintersection location, but actions of the pedestrian prior to the crash cannot be determined</td>
<td>5.0%</td>
<td>2.6%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>710</td>
<td>The pedestrian entered the traffic lane in front of stopped or slowing traffic and was struck by a vehicle traveling in the same direction as the stopped or slowing traffic</td>
<td>1.3%</td>
<td>4.5%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>690</td>
<td>The crash occurred at an intersection, but the actions of the pedestrian prior to the crash cannot be determined or it cannot be determined who failed to yield</td>
<td>2.5%</td>
<td>3.2%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>The pedestrian stumbled, fell, or rolled into path of vehicle due to surface conditions, impairment or other mishap</td>
<td>1.3%</td>
<td>1.9%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>440</td>
<td>The pedestrian was walking/running along the roadway against traffic and was struck from the front</td>
<td>3.8%</td>
<td>0.6%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>The pedestrian was lying in the roadway when struck</td>
<td>5.0%</td>
<td>0.6%</td>
<td>0.0%</td>
<td>+</td>
</tr>
<tr>
<td>791</td>
<td>The motorist was initially travelling on a parallel path with the pedestrian before making a right turn and striking the individual</td>
<td>0.0%</td>
<td>1.3%</td>
<td>3.2%</td>
<td>-</td>
</tr>
<tr>
<td>120</td>
<td>The pedestrian was struck by a vehicle during a domestic altercation or other dispute</td>
<td>0.0%</td>
<td>1.9%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>The pedestrian was struck as a result of a prior vehicle-into-vehicle or vehicle-into-object crash</td>
<td>1.3%</td>
<td>0.0%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>610</td>
<td>The pedestrian was standing in the roadway prior to the crash, but the crash cannot be further classified</td>
<td>1.3%</td>
<td>0.6%</td>
<td>3.2%</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>The pedestrian was struck in a roadway by a vehicle that was backing with a driver at the controls</td>
<td>1.3%</td>
<td>1.9%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>794</td>
<td>The motorist was initially traveling on a crossing path with the pedestrian before making a right turn on a red signal, and striking the individual</td>
<td>0.0%</td>
<td>1.9%</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>8.8%</td>
<td>9.1%</td>
<td>6.5%</td>
<td></td>
</tr>
</tbody>
</table>

Total Crashes: 80 (Fatal) 154 (Severe) 62 (Non-Severe)

¹) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes resulting in a fatal (K) injury versus the proportion of crashes resulting in a non-severe injury for a particular crash type. “++” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 90% confidence level; “--” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 95% confidence level; “-” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 90% confidence level.
Figure 3.55.a. Fatal Pedestrian Crash Type #1

**#1 Fatal Pedestrian Crash Type**

**N_RRD_X**: Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian not approaching from left or right (13 crashes)

**Crash Scenario 1: 5 Crashes**
Pedestrian walking in roadway, with or against traffic, struck by vehicle in roadway lane.

**Night Crashes**
- 3 crashes (60%) occurred between Midnight and 6 am
- 4 crashes (80%) involved dark, unlit conditions

**Alcohol Involvement**
- 3 crashes (60%) were flagged for alcohol involvement

**Speed**
- 4 crashes (80%) were on roads with speed limits of 45 mph or higher

**Crash Scenario 2: 4 Crashes**
Pedestrian struck by vehicle while lying/sitting in roadway.

**Night Crashes**
- 4 crashes (100%) occurred between 6 pm and 6 am
- 3 crashes (75%) involved dark, but lit conditions

**Driver Awareness**
- 3 crashes (75%) noted that the driver did not see the pedestrian

**Alcohol Involvement**
- 3 crashes (75%) were flagged for alcohol involvement

**Urban Roadways**
- 3 crashes (75%) occurred on an urban roadway

**Other Crashes: 4 Crashes**
- 2 crashes involved a pedestrian who was dealing with a disabled vehicle at the time of crash
- 2 crashes involved a pedestrian whose action in the roadway could not be determined
**#2 Fatal Pedestrian Crash Type**

**I_FS_ST_L**

*Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (10 crashes)*

**Crash Scenario 1: 6 Crashes**
No traffic control on vehicle driver’s roadway, but a crosswalk was present.

**Peak Period and Night Crashes**
- 3 crashes (50%) occurred between 3 pm and 6 pm
- 2 crashes (33%) occurred between 9 pm and midnight

**Urban Roadways**
- 5 crashes (83%) occurred on an urban roadway
- 6 crashes (100%) occurred on roadways with speed limits of 25-30 mph

**Lighting Condition**
- 5 crashes (83%) occurred during darkness, but there were street lights

**Crash Scenario 2: 3 Crashes**
Vehicle driver had a green traffic signal and the pedestrian was noted as disobeying traffic control.

**Peak Period Crashes**
- 2 crashes (67%) occurred between 6 am and 9 am
- 1 crash (33%) occurred between 3 pm and 6 pm

**Urban Roadways**
- 3 crashes (100%) were deemed to occur on an urban roadway

**Multi-lane, Moderate Speed Roadways**
- 3 crashes (100%) occurred on roadways with speed limits of 30-35 mph
- 2 crashes (67%) involved a 5 lane roadway

**Other Crashes: 1 Crash**
- 1 crash involved a pedestrian crossing at a non-crosswalk location with no traffic control on the driver’s roadway

**Other Characteristics:**
- 8 crashes (60%) involved pedestrians who were 60+ years old
**N_RRD_R:** Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the right (9 crashes)

**Crash Scenario 1: 8 Crashes**
Straight-traveling motorist strikes pedestrian approaching from right with no noted obstructions.

**Daytime Crashes**
• 6 crashes (75%) occurred between 9 am and 6 pm

**Higher-Speed Urban Roadways**
• 7 crashes (88%) occurred on urban roadways
• 5 crashes (63%) occurred on roadways that were 30 mph or higher

**Two-Lane Roadways**
• 5 crashes (63%) occurred on 2-lane roadways

**Other Crashes: 1 Crash**
• 1 crash involved a pedestrian who had entered the roadway from between two parked vehicles

**Other Characteristics:**
• None of the crashes in this crash type involved a marked or unmarked crosswalk
Figure 3.55.d. Fatal Pedestrian Crash Type #4

**N_RRD_L**: Non-intersection: Straight-traveling motorist strikes pedestrian in roadway; pedestrian approaching from the left (9 crashes)

**Crash Scenario 1: 9 Crashes**
Straight-traveling motorist strikes pedestrian approaching from the left with no noted obstructions.

**Evening Crashes**
- 6 crashes (67%) occurred between 6 pm and midnight

**Higher Speed, Rural Roadways**
- 6 crashes (67%) occurred on rural roadways
- 8 crashes (89%) occurred on roadways that were 35 mph or higher
- 5 crashes (56%) occurred on 2 lane roadways
- No crosswalks present

**Alcohol Involvement**
- 4 crashes (44%) were flagged for alcohol involvement

**Other Characteristics:**
- All crashes involved pedestrians who were 40+ years old
Figure 3.56.a. Severe Pedestrian Crash Type #1

**#1 Severe Pedestrian Crash Type**

**N_RRD_R:** Non-Intersection: Straight-traveling motorist, in a right roadway lane of travel, strikes pedestrian approaching from the right *(28 crashes)*

**Crash Scenario 1: 18 Crashes**
No noted obstructions.

**Evening and Night Crashes**
- 9 crashes (60%) occurred between 3 pm and 9 pm
- 6 crashes (33%) occurred between 9 pm and 3 am

**Urban Roadways**
- 18 crashes (100%) occurred on urban roadways

**Mid-Block, Multi-Lane Locations**
- 15 crashes (83%) occurred on roadways that were 25-30 mph
- 12 crashes (67%) occurred on multi-lane roadways
- 13 crashes (87%) had no crosswalk present

**Crash Scenario 2: 6 Crashes**
Obstructions played a role in the crash.

**Early Evening Crashes**
- 6 crashes (83%) occurred between 3 pm and 9 pm
- 4 crashes (67%) involved day/night conditions

**2-Lane, Local Roadways**
- 4 crashes (67%) occurred on 2-lane roadways

**Urban Roadways**
- 6 crashes (100%) occurred on an urban roadway

**No Crosswalk Present**
- 6 crashes (100%) occurred at a non-crosswalk location

**Pedestrian Age**
- 4 crashes (67%) involved pedestrians who were under 20 years old

**Other Crashes: 4 Crashes**
- 2 crashes were multiple threat crashes
- 2 crashes were in marked crosswalks; weather and lighting condition noted as contributing factor
Figure 3.56.b. Severe Pedestrian Crash Type #2

**#2 Severe Pedestrian Crash Type**

**I_FS_ST_L** : Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (15 crashes)

**Crash Scenario 1: 13 Crashes**
No traffic control on vehicle driver’s roadway, but a marked or unmarked crosswalk was present.

**Afternoon - Evening Crashes**
- 4 crashes (31%) occurred between 3 pm and 6 pm
- 5 crashes (38%) occurred between 6 pm and midnight

**Urban Roadways**
- 13 crashes (100%) occurred on an urban roadway
- 7 crashes (54%) occurred on roadways with speed limits of 30 mph
- 11 crashes (85%) occurred on multi-lane roadways

**Lighting Condition**
- 7 crashes (54%) occurred during darkness, but there were street lights

**Other Crashes: 2 Crashes**
- 2 crashes involved a vehicle driver who struck a pedestrian while crossing on a green light

**Other Characteristics:**
- It was noted more often that the driver did not see the pedestrian in crashes with unmarked crosswalks (60%), than crashes with a marked crosswalk (25%)
- It was noted more often that the pedestrian was outside of the crosswalk in crashes with an unmarked crosswalk present (100%), than crashes with a marked crosswalk present (25%)
Figure 3.56.c. Severe Pedestrian Crash Type #3

**I_NS_ST_L** - Intersection: Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection (13 crashes)

### Crash Scenario 1: 5 Crashes
No traffic control on vehicle driver’s roadway, but a marked or unmarked crosswalk was present.

**Peak Period Crashes**
• 4 crashes (80%) occurred between 3 pm and 9 pm

**Urban Roadways**
• 4 crashes (80%) occurred on an urban roadway
• 5 crashes (100%) occurred on multi-lane roadways
• 3 crashes (60%) occurred on a 30 mph roadway

**Pedestrian Age**
• 3 crashes (60%) involved a pedestrian who was 10-19 years old

### Other Crashes: 8 Crashes
• 4 crashes occurred at an intersection with traffic lights present
• 1 crash occurred at an intersection controlled by stop signs on all four sides
• 3 crashes occurred at a non-crosswalk location

**Other Characteristics:**
• 8 crashes (62%) involved a pedestrian who was in the crosswalk
Figure 3.56.d. Severe Pedestrian Crash Type #5

**N_RRD_L**: Non-Intersection: Straight-traveling motorist, in a right roadway lane of travel, strikes pedestrian approaching from the left (8 crashes)

**Crash Scenario 1: 5 Crashes**
No noted obstructions.

No Crosswalks Present

Late Evening - Early Morning Crashes
- 3 crashes (60%) occurred between midnight and 6 am

Urban Roadways
- 5 crashes (100%) occurred on urban roadways

Moderate-Speed, Multi-lane Roadways
- 5 crashes (100%) occurred on roadways that were 25-30 mph
- 4 crashes (80%) occurred on multi-lane roadways

**Other Crashes: 3 Crashes**
- 2 crashes involved a pedestrian darting into the roadway from behind obstructions
- 1 crash was a multi-threat crash

**Other Characteristics:**
- 4 crashes (50%) noted that the driver did not see the pedestrian
3.3.2. Bicycle Crash types
Table 3.7 ranks the LMCM crash types and Table 3.8 ranks the NHTSA crash types for all bicycle crashes reviewed in detail. Each table shows the proportion of fatal injury, severe injury, and non-severe injury (minor- and no-injury) crashes by type. Both tables identify crash types that have a significantly different proportion of fatal versus non-severe injury crashes (according to a Z-test of the difference between two proportions). Crash types that have a significantly higher proportion of fatalities have plus symbols (+) in the right column; crash types that have a significantly lower proportion of fatalities have minus symbols (-). Appendix D includes a matrix that shows how the top LMCM bicycle crash types correspond with the top NHTSA bicycle crash types.

The top NHTSA bicycle crash types identified from the sample of 2011 to 2013 were compared to the top crash types identified in Wisconsin in 2003 (Amsden and Huber 2006), though this comparison must be made with caution (see paragraph below). In general, the top three crash types were the same, although type 141 accounted for more crashes (14%), and 144 and 212 accounted for fewer crashes (7% and 6%, respectively) in 2003. Crash type 155 accounted for fewer than 4% of bicycle crashes in 2003, but its proportion was 9% during the 2011 to 2013 period. In addition, crash type 231 was noted in less than 1% of bicycle crashes in 2003, but it represented 8% of crashes during 2011 to 2013.

Caution is needed when making this comparison because the bicycle crash sampling methods were different. The 2011 to 2013 analysis oversampled fatal and severe crashes. In other words, the 2011 to 2013 dataset includes a greater proportion of fatal and severe crashes than the 2003 sample (which included all bicycle crashes, many more of which were non-severe). This helps explain the much larger proportion of “motorist overtaking” crashes in 2011 to 2013 compared to 2003. The comparisons between 2003 and 2011 to 2013 crash types are presented above to ensure they are made with appropriate caution.

Bicycle Crash Locations and Movements
Unlike the NHTSA typology, the LMCM classification provides useful information about the type of roadway location where crashes occurred and the directions that the motorist and pedestrian were moving prior to the crash. The results presented in this subsection are also based on the sample of crashes that has a higher proportion of fatal and severe-injury crashes than the state as a whole.

Most of the bicycle crashes analyzed in detail occurred at intersections (67%). Less than one-third (30%) occurred along roadways at non-intersection locations. A few bicycle crashes occurred in parking lots (1.7%), and driveways (1.3%). Bicycle crashes with different levels of injury severity had different roadway location characteristics. A higher percentage of fatal pedestrian crashes occurred at roadway non-intersection locations (61%) than at intersection locations (39%). In contrast, non-severe crashes were more likely to occur at intersections (84%) than roadway non-intersections (15%). The difference between the percentage of fatal crashes (61%) and non-severe crashes (15%) that occurred at non-intersection locations was significant at the 99% confidence level.

Most bicycle crashes (63%) involved a motorist traveling straight along a roadway segment or through an intersection. Just over 34% involved motorists turning (the remaining 3% of bicycle crashes were classified as parking lot or driveway). Motorists were significantly more likely to be traveling straight in fatal bicycle crashes (90%) than in non-severe bicycle crashes (53%) (99% confidence level). Further, the three crash types that produced significantly higher percentages of fatal versus non-severe bicycle crashes all involved motorists going straight (N_RRD_S, N_RSH_S, and N_LRD_O). Based on the NHTSA crash types 231, 232, 235, and 239, the majority of “motorist overtaking” crashes were due to a
motorist not seeing the bicyclist or misjudging the space required to pass a bicyclist. Vehicles going straight may create a particularly high risk of severe injuries because they are more likely to produce a higher-speed collision.

Bicyclists were struck by vehicles when they were traveling from the motorist’s right (30%), from the motorist’s left (23%), in the same direction as the motorist (28%), and in the opposite direction as the motorist (16%)\(^\text{11}\). Less than 1% of bicycle crashes in roadway or intersection locations involved a bicyclist traveling in an unknown direction. The remaining 3% of bicycle crashes occurred in parking lots or driveways. Fatal crashes were significantly more likely to involve a motorist traveling in the same direction as a bicyclist (46%) than non-severe crashes (19%) (99% confidence level).

**Top Fatal and Severe Bicycle Crash Types**
The LMCM revealed that the most common crash type producing bicycle fatalities was a straight-traveling motorist striking a bicyclist on the right side of the roadway (in the travel lane) (N_RRD_S) (30%). The second-most-common fatal bicycle crash type involved a straight-traveling motorist striking a bicyclist approaching from the left on the near side of an intersection (I_NS_ST_L). The top four fatal (“K”) bicycle crash types are illustrated and their key behavior and roadway characteristics are listed in Figure 3.57.a, Figure 3.57.b, Figure 3.57.c, and Figure 3.57.d. The top fatal bicycle crash types tended to involve two-lane roadways, high speeds, and darkness.

The top severe-injury (“A”) bicycle crash types are represented by Figure 3.58.a, Figure 3.58.b, Figure 3.58.c, and Figure 3.58.d. The top severe-injury bicycle crash types tended to involve moderate to high speeds, multi-lane roadways, and urban locations. The top non-severe-injury bicycle crash types are shown in Appendix E.

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\(^{11}\) Bicyclists were considered to be approaching from the motorist’s left if they were crossing the street from left to right in front of a straight-traveling motorist or in front of a turning motorist on the near side of the intersection. They were considered to be approaching from the motorist’s right if they were crossing the street from right to left in front of a straight-traveling motorist or in front of a turning motorist on the near side of the intersection. Bicyclists were considered to be traveling in the same direction as the motorist if they were struck from behind by a straight-traveling motorist. They were also considered to be traveling in the same direction as the motorist if they were 1) traveling north on the left side of the roadway and struck by a left-turning motorist going from a northbound to a westbound direction or 2) traveling north on the right side of the roadway and struck by a right-turning motorist going from a northbound to an eastbound direction. The mirror situations are considered to be bicyclists traveling in the opposite direction as the motorist.
### Table 3.7. Bicyclist Crashes: Wisconsin LMCM Bicycle Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Fatal Injury (K)</th>
<th>Severe Injury (A)</th>
<th>Non-Severe</th>
<th>Sig.(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RRD_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane but not a bicycle lane or shoulder), bicyclist traveling in same direction (includes door-related crashes)</td>
<td>30.3%</td>
<td>18.0%</td>
<td>10.8%</td>
<td>++</td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>15.2%</td>
<td>9.0%</td>
<td>16.2%</td>
<td></td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Intersection: Right-turning motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist)</td>
<td>3.0%</td>
<td>13.9%</td>
<td>10.8%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Intersection: Left-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection</td>
<td>3.0%</td>
<td>9.8%</td>
<td>14.9%</td>
<td>-</td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection (contra-flow bicyclist)</td>
<td>9.1%</td>
<td>8.2%</td>
<td>10.8%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist)</td>
<td>6.1%</td>
<td>4.9%</td>
<td>10.8%</td>
<td></td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (contra-flow bicyclist)</td>
<td>0.0%</td>
<td>5.7%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist approaching from left (crossing or merging at non-intersection location; includes trail crossings)</td>
<td>3.0%</td>
<td>4.1%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>I_NS_RT_L</td>
<td>Intersection: Right-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>0.0%</td>
<td>1.6%</td>
<td>6.8%</td>
<td></td>
</tr>
<tr>
<td>N_RSH_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction</td>
<td>9.1%</td>
<td>3.3%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td>I_FS_RT_O</td>
<td>Intersection: Right-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection (contra-flow bicyclist)</td>
<td>0.0%</td>
<td>2.5%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>N_RRD_R</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist approaching from right (crossing or merging at non-intersection location; includes trail crossings)</td>
<td>3.0%</td>
<td>1.6%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_S</td>
<td>Intersection: Left-turning motorist strikes bicyclist traveling from same direction on far side of intersection (contra-flow bicyclist)</td>
<td>0.0%</td>
<td>1.6%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>N_LRD_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in same direction (contra-flow bicyclist)</td>
<td>3.0%</td>
<td>0.8%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>I_NS_LT_L</td>
<td>Intersection: Left-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>0.0%</td>
<td>0.8%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>N_LRD_O</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in opposite direction</td>
<td>9.1%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td>P_F</td>
<td>Parking lot/Private property: Forward-traveling motorist strikes bicyclist</td>
<td>0.0%</td>
<td>1.6%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>D_F</td>
<td>Driveway: Forward-traveling motorist strikes bicyclist (outside of public right-of-way)</td>
<td>0.0%</td>
<td>2.5%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>6.1%</td>
<td>9.8%</td>
<td>5.4%</td>
<td></td>
</tr>
<tr>
<td><strong>Total Crashes</strong></td>
<td></td>
<td><strong>33</strong></td>
<td><strong>122</strong></td>
<td><strong>74</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

1) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes resulting in a fatal (K) injury versus the proportion of crashes resulting in a non-severe injury for a particular crash type. “++” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 90% confidence level; “−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 95% confidence level; “−−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 90% confidence level.
### Table 3.8. Bicyclist Crashes: NHTSA Bicycle Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Fatal Injury (K)</th>
<th>Severe Injury (A)</th>
<th>Non-Severe</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
<td>The motorist was facing the sign or flashing signal and drove into the crosswalk area or intersection and collided with the bicyclist after stopping or yielding</td>
<td>12.1%</td>
<td>7.4%</td>
<td>16.2%</td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>The bicyclist violated the sign or flashing signal and rode into the intersection and collided with the motorist</td>
<td>0.0%</td>
<td>10.7%</td>
<td>12.2%</td>
<td>--</td>
</tr>
<tr>
<td>212</td>
<td>The motorist turned left in front of a bicyclist coming from the opposite direction</td>
<td>3.0%</td>
<td>9.0%</td>
<td>13.5%</td>
<td>-</td>
</tr>
<tr>
<td>155</td>
<td>The bicyclist violated the signal and rode into the intersection and collided with the motorist</td>
<td>15.2%</td>
<td>7.4%</td>
<td>8.1%</td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>The motorist was overtaking the bicyclist and failed to detect the bicyclist</td>
<td>24.2%</td>
<td>8.2%</td>
<td>1.4%</td>
<td>++</td>
</tr>
<tr>
<td>235</td>
<td>The bicyclist swerved or moved suddenly into the path of an overtaking vehicle</td>
<td>3.0%</td>
<td>7.4%</td>
<td>5.4%</td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>The motorist was facing a red signal, stopped, &amp; then drove into the crosswalk area or intersection and collided with the bicyclist</td>
<td>0.0%</td>
<td>7.4%</td>
<td>4.1%</td>
<td></td>
</tr>
<tr>
<td>239</td>
<td>The motorist was overtaking the bicyclist, but the specific circumstances surrounding the overtaking maneuver do not conform to the other situations described or are unknown</td>
<td>15.2%</td>
<td>0.0%</td>
<td>1.4%</td>
<td>++</td>
</tr>
<tr>
<td>211</td>
<td>The motorist turned left in front of a bicyclist going in the same direction</td>
<td>0.0%</td>
<td>1.6%</td>
<td>4.1%</td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>The motorist drove into the roadway or sidewalk/driveway crossing area and into the path of a bicyclist from a residential driveway</td>
<td>0.0%</td>
<td>3.3%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>910</td>
<td>The crash occurred off the street network (e.g., parking lots, driveways, alleys, trails, and other open areas)</td>
<td>0.0%</td>
<td>3.3%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>318</td>
<td>The bicyclist rode into the roadway and into the path of a motor vehicle from a midblock area other than a driveway or alley</td>
<td>6.1%</td>
<td>1.6%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>The motorist violated the sign or flashing signal and drove into the crosswalk area or intersection and collided with the bicyclist</td>
<td>0.0%</td>
<td>0.8%</td>
<td>4.1%</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>The motorist turned right in front of a bicyclist going in the same direction</td>
<td>0.0%</td>
<td>1.6%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>311</td>
<td>The bicyclist rode into the roadway and into the path of a motor vehicle from a residential driveway</td>
<td>0.0%</td>
<td>3.3%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>232</td>
<td>The motorist was overtaking the bicyclist and misjudged the width and distance required to pass the bicyclist</td>
<td>0.0%</td>
<td>3.3%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>The motorist turned right in front of a bicyclist coming from the opposite direction</td>
<td>0.0%</td>
<td>1.6%</td>
<td>2.7%</td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>The motorist violated the signal and drove into the crosswalk area or intersection and collided with the bicyclist</td>
<td>0.0%</td>
<td>1.6%</td>
<td>1.4%</td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>The motorist was facing a red signal, stopped, and then drove into the crosswalk area or intersection and collided with the bicyclist while attempting to make a right turn on red</td>
<td>3.0%</td>
<td>1.6%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>222</td>
<td>The bicyclist turned or merged left in front of a motorist coming from the opposite direction</td>
<td>0.0%</td>
<td>2.5%</td>
<td>0.0%</td>
<td></td>
</tr>
<tr>
<td>322</td>
<td>The motorist drove into the roadway or sidewalk/driveway crossing area and into the path of a bicyclist from a commercial driveway or alley</td>
<td>0.0%</td>
<td>0.0%</td>
<td>4.1%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>18.2%</td>
<td>16.4%</td>
<td>14.9%</td>
<td></td>
</tr>
<tr>
<td><strong>Total Crashes</strong></td>
<td></td>
<td>33</td>
<td>122</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

¹ Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes resulting in a fatal (K) injury versus the proportion of crashes resulting in a non-severe injury for a particular crash type. “++” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes resulting in a fatal injury is significantly higher at a 90% confidence level; “−−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 95% confidence level; “−” indicates that the proportion of crashes resulting in a fatal injury is significantly lower at a 90% confidence level.
Figure 3.57.a. Fatal Bicycle Crash Type #1

#1 Fatal Bicyclist Crash Type

N_RRD_S: Non-intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related) (10 crashes)

Crash Scenario 1: 9 Crashes
Vehicle driver rode straight into the bicyclist, with no suggestion of the bicyclist swerving into the vehicle’s path of travel

Night Crashes
• 2 crashes (22%) occurred between 6 pm and 9 pm
• 3 crashes (33%) occurred between midnight and 3 am

High Speed, 2 Lane Roadways
• 8 crashes (89%) occurred on roadways that were 35+ mph
• 7 crashes (78%) occurred on 2 lane roadways

Limited Visibility
• 4 crashes (44%) noted that the driver did not see the bicyclist

Other Crashes: 1 Crash
• 1 crash involved a bicyclist who swerved into the passing vehicle

Additional Crash Characteristics:
• Bike lanes were not present in any of the crashes
• 3 crash reports (33%) noted alcohol as a potential contributing factor to the crash
Figure 3.57.b. Fatal Bicycle Crash Type #2

**#2 Fatal Bicyclist Crash Type**

*I_NS_ST_L*: Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (5 crashes)

**Crash Scenario 1: 3 Crashes**

Vehicle driver had a stop sign.

**Limited Bike Facilities**

- 2 crashes (67%) had no bike facility.

**Urban Roadways**

- 3 crashes (100%) occurred on urban roadways

**Limited Visibility**

- 2 crashes (67%) noted that the driver did not see the bicyclist

**Other Crashes: 2 Crashes**

- 1 crash occurred at an intersection controlled by a traffic light and involved a bicyclist who disobeyed traffic control
- 1 crash occurred at an intersection with a commercial parking lot driveway
Figure 3.57.c. Fatal Bicycle Crash Type #3

#3 Fatal Bicyclist Crash Type

I_FS_ST_R : Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection (3 crashes)

Crash Scenario 1: 3 Crashes
Bicyclist disregarded traffic control in each crash.

No bike lanes present

Multi-lane, Urban Roadways
• 2 crashes (67%) occurred on urban roadways
• 3 crashes (100%) occurred on multi-lane roadways

Limited Visibility
• 2 crashes (67%) noted that the driver did not see the bicyclist

Alcohol Involvement
• 2 crashes (67%) noted that alcohol potentially played a role in the crash
Figure 3.57.d. Fatal Bicycle Crash Type #4

**N_RSH_S** : Non-intersection: Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction *(3 crashes)*

**Crash Scenario 1: 3 Crashes**
Vehicle driver noted at fault. Bicyclist was in the bike lane or on the shoulder in each crash.

**Rural, High Speed Roadways**
- 3 crashes (100%) occurred on rural roadways
- 3 crashes (100%) occurred on 2 lane roadways
- 3 crashes (100%) had a posted speed limit of 55 mph

**No Visibility Obstructions**
- 3 crashes (100%) involved daylit conditions
- 3 crashes (100%) noted no obstructions
- 1 crash (33%) had a bicycle lane present

**No Citations Given**
- Driver deemed at fault in each crash, but no citations given
**N_RRD_S:** Non-Intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related) (22 crashes)

### Crash Scenario 1: 11 Crashes
Vehicle driver straight into the back of bicyclist.

**Late Afternoon - Evening Crashes**
- 3 crashes (27%) occurred between 3 pm and 6 pm
- 5 crashes (45%) occurred between 6 pm and 3 am

**High Speed, 2 Lane Urban Roadways**
- 8 crashes (73%) occurred on a roadway that was 35+ mph
- 7 crashes (63%) occurred on a 2 lane roadway
- 9 crashes (82%) occurred on an urban roadways

**Reduced Visibility**
- 5 crashes (45%) occurred in dark, unlit conditions

### Crash Scenario 2: 6 Crashes
Bicyclist swerved into the path of the vehicle.

**Afternoon Crashes**
- 5 crashes (83%) occurred between noon and 6 pm
- 6 crashes (100%) involved daylit conditions

**Urban Roadways**
- 3 crashes (50%) occurred on a 2 lane roadway
- 3 crashes (50%) occurred on a 4 lane roadway
- 4 crashes (67%) occurred on a roadway that was 35+ mph
- 4 crashes (67%) occurred on an urban roadway

**Alcohol Involvement**
- 2 crashes (33%) were flagged for alcohol involvement, and both noted the bicyclist as the unit that was under the influence

### Other Crashes: 5 Crashes
- 1 crash involved a vehicle that opened its door in the path of the oncoming bicyclist
- 4 crashes involved other circumstances that do not fit into the above categories
Figure 3.58.b. Severe Bicycle Crash Type #2

### #2 Severe Bicyclist Crash Type

**I_NS_RT_R**: Intersection: Right-turning motorist strikes bicyclist approaching from right on near side of intersection (17 crashes)

#### Crash Scenario 1: 6 Crashes
Vehicle driver attempted to turn on a red light.

**Bicyclist riding on the sidewalk in all crashes**

**Multi-lane Roadways**
- 6 crashes (100%) occurred on urban roadways
- 6 crashes (100%) involved a vehicle turning onto a 4+ lane roadway

**Driver Awareness**
- 3 crashes (50%) noted that the driver did not see the bicyclist

**Daytime Crashes**
- 5 crashes (83%) occurred in daylit conditions

#### Crash Scenario 2: 6 Crashes
Vehicle driver had a stop sign on their roadway.

**Urban Roadways**
- 5 crashes (83%) occurred on an urban roadway
- 3 crashes (50%) involved a vehicle driver turning from a 2-lane roadway onto a multi-lane roadway

**No Traffic Control**
- 4 crashes (67%) involved no traffic control on the bicyclist’s roadway

**Driver Awareness**
- 3 crashes (50%) noted that the driver did not see the bicyclist

#### Other Crashes: 5 Crashes
- 2 crashes involved a vehicle that had a green light, but was struck by a bicyclist who ignored traffic control
- 3 crashes involved other circumstances that do not fit into the above categories
#3 Severe Bicyclist Crash Type

**I_FS_LT_O**: Intersection: Left-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection (12 crashes)

**Crash Scenario 1: 7 Crashes**
No traffic control on vehicle driver’s roadway.

**Urban Roadways**
- 6 crashes (86%) occurred on urban roadways

**Lower Speed, 2 Lane Roadways**
- 5 crashes (71%) occurred on a 2 lane roadway.
- 6 crashes (71%) occurred on roadways with posted speed limits of 25-30 mph

**Driver Awareness**
- 4 crashes (57%) noted that the driver did not see the bicyclist
- 3 crashes (43%) involved a roadway with a bike lane

**Daytime Crashes**
- 5 crashes (71%) occurred in daylight conditions

---

**Crash Scenario 2: 5 Crashes**
Green light on vehicle driver’s roadway.

**Peak Period Crashes**
- 3 crashes (60%) occurred between 3 pm and 6 pm

**Urban Roadways**
- 4 crashes (80%) occurred on an urban roadway
- 5 crashes (80%) involved a multi-lane roadway

**Driver Awareness**
- 3 crashes (60%) noted that the driver did not see the bicyclist
- No crash reports noted an obstructed view
- 1 crash (20%) involved a roadway with a bike lane
Figure 3.58.d. Severe Bicycle Crash Type #4

**I_NS_ST_L**: Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (11 crashes)

**Crash Scenario 1: 3 Crashes**
Vehicle driver had a green light and the bicyclist ignored traffic control.

- No bike lanes present

**Peak Period Crashes**
- 2 crashes (67%) occurred between 3 pm and 6 pm

**High Speed, Urban Roadways**
- 2 crashes (67%) occurred on urban roadways
- 3 crashes (100%) occurred with a posted speed limit of 30+ mph

**Other Crashes: 8 Crashes**
- 2 crashes involved a bicyclist who ignored a stop sign
- 2 crashes involved a bicyclist who had not cleared the intersection before the vehicle driver had a green light
- 2 crashes involved a bicyclist who disregarded a flashing red traffic signal
- 1 crash was a multiple threat crash
- 1 crash occurred at an intersection that had no traffic control on any roadway

**Other Characteristics:**
- 6 crash reports (56%) noted that the vehicle driver did not see the bicyclist
3.4. Fatal and Severe Injury Crash Hot Spots
This summarizes an analysis of fatal and severe injury “hot spots” in Wisconsin. Hot spots are locations with high spatial concentrations of pedestrian and bicycle crashes.

3.4.1. Hot Spot Identification Method
Hot spots were identified using the GIS kernel density analysis function for 50- by 50-meter analysis grid cells with a 500-meter search radius. The "Location" column lists the approximate center of each hot spot, "Crashes/sq. km" provides the highest crash density value observed for any of the 50- by 50-meter analysis cells, and "Total Crashes" gives the number of crashes located within an area of minimum crash density around the center of the hot spot. The threshold for minimum crash density was 4 crashes/sq. km for pedestrian hot spots and 2 crashes/sq. km for bicycle hot spots.

After preliminary hot spot locations were reviewed by WisDOT, crashes at each of the hot spots were examined. Data fields available from the WisTransPortal database were used to summarize the most common crash characteristics at the all-pedestrian and all-bicycle crash hot spots. The specific police crash report narratives were used to conduct a more in-depth analysis of the hot spot crash characteristics. Variables explored in this analysis are described in Appendix F.

3.4.2. Pedestrian and Bicycle Hot Spot Locations
Table 3.9 lists hot spots identified from the 926 “K” or “A” injury pedestrian crashes, and Table 3.10 lists hot spots identified from the 340 “K” or “A” injury bicycle crashes reported between 2011 and 2013. Each table includes 20 hot spots. At least two hot spots are identified in each WisDOT region to provide geographic representation across the state. Tables with detailed descriptions of each hot spot location and maps of each pedestrian and bicycle crash hot spot are provided in Appendix G.

In general, these hot spots were in urban or near-suburban areas (Figure 3.59). Many pedestrian crash hot spots were concentrated in Milwaukee; many bicycle crash hot spots were concentrated in and near Madison. Hot spots were related to higher levels of pedestrian and bicycle activity. Other common characteristics of both pedestrian hot and bicycle hot spots included:

- Multilane arterial roadway corridors
- Roadway corridors with 30+ mile per hour speed limits
- Roadway corridors controlled by traffic signals (many crashes occurred at the uncontrolled intersections between signals)

These characteristics are discussed in more detail in the sections below.
<table>
<thead>
<tr>
<th>WisDOT Region</th>
<th>Location</th>
<th>City</th>
<th>Crashes/sq. km</th>
<th>Total Crashes</th>
<th>Hot Spot</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southeast</strong></td>
<td>Near Fond du Lac Ave. and Center St.</td>
<td>Milwaukee</td>
<td>20.89</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water St. and Juneau Ave.</td>
<td>Milwaukee</td>
<td>14.71</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Atkinson Ave. and 11th St.</td>
<td>Milwaukee</td>
<td>14.12</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Lincoln Ave. and National Ave. and 94th St.</td>
<td>West Allis</td>
<td>13.71</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Durand Ave. &amp; West Blvd. and Durand Ave. &amp; Drexel Ave.</td>
<td>Racine</td>
<td>13.3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>35th St. &amp; Wisconsin Ave.</td>
<td>Milwaukee</td>
<td>12.68</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>National Ave. &amp; Layton Blvd.</td>
<td>Milwaukee</td>
<td>11.06</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Greenfield Ave. &amp; 11th St.</td>
<td>Milwaukee</td>
<td>9.91</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>76th St. corridor near Silver Spring Dr.</td>
<td>Milwaukee</td>
<td>9.81</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>6th St. corridor near Lincoln Ave.</td>
<td>Milwaukee</td>
<td>9.71</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Oakland Ave. &amp; North Ave.</td>
<td>Milwaukee</td>
<td>9.34</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>WI 32 in Downtown Port Washington</td>
<td>Port Washington</td>
<td>8.9</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td><strong>Southwest</strong></td>
<td>Between Johnson St. and University Ave. at Frances St. and Lake St.</td>
<td>Madison</td>
<td>15.52</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Losey Blvd. &amp; State Rd.</td>
<td>La Crosse</td>
<td>9.44</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td><strong>Northeast</strong></td>
<td>College Ave. through Lawrence University Campus</td>
<td>Appleton</td>
<td>8.79</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Main St. area</td>
<td>Green Bay</td>
<td>8.72</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td><strong>North Central</strong></td>
<td>Arnold St. near Peach Ave. and Ash Ave.</td>
<td>Marshfield</td>
<td>7.41</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Grand Ave. near 14th Ave. and 15th Ave.</td>
<td>Wisconsin Rapids</td>
<td>7.4</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td><strong>Northwest</strong></td>
<td>Water St. &amp; 4th Ave.</td>
<td>Eau Claire</td>
<td>10.55</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Hammond Ave. area</td>
<td>Superior</td>
<td>7.68</td>
<td>3</td>
<td>18</td>
</tr>
</tbody>
</table>
### Table 3.10. Wisconsin Bicycle Fatal and Severe Injury Crash Hot Spots

<table>
<thead>
<tr>
<th>WisDOT Region</th>
<th>Location</th>
<th>City</th>
<th>Crashes/sq km</th>
<th>Total Crashes</th>
<th>Hot Spot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>30th Ave. &amp; Washington Rd.</td>
<td>Kenosha</td>
<td>7.23</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Lapham Blvd. and Mitchell St. near 3rd St. and 4th St.</td>
<td>Milwaukee</td>
<td>6.59</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>National Ave. &amp; 84th St. area</td>
<td>West Allis</td>
<td>5.97</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Oakland Ave. near Shorewood Blvd. and Menlo Blvd.</td>
<td>Shorewood</td>
<td>5.85</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>North Ave. near Booth St. and Hubbard St.</td>
<td>Milwaukee</td>
<td>5.74</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>52nd St. near 22nd Ave.</td>
<td>Kenosha</td>
<td>5.68</td>
<td>2</td>
<td>17</td>
</tr>
<tr>
<td>Southwest</td>
<td>Beld St. &amp; Wingra Dr.</td>
<td>Madison</td>
<td>7.46</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Johnson St. and Dayton St. near Frances St. and Lake St.</td>
<td>Madison</td>
<td>6.7</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>1st St. near Washington Ave. and Johnson St.</td>
<td>Madison</td>
<td>6.08</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>McKee Rd. near Woods Edge Rd. and Osmundsen Rd.</td>
<td>Fitchburg</td>
<td>5.55</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Main St. corridor and Verona Ave. corridor</td>
<td>Verona</td>
<td>5.46</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>Northeast</td>
<td>9th Ave. &amp; US 41</td>
<td>Oshkosh</td>
<td>11.02</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Winneconne Ave. &amp; Commercial St.</td>
<td>Neenah</td>
<td>7.48</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Murdock Ave. &amp; Vinland St.</td>
<td>Oshkosh</td>
<td>7.37</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Business Dr. &amp; Union Ave. area</td>
<td>Sheboygan</td>
<td>7.02</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Hall Ave. near Madison Ave. and Stephenson St.</td>
<td>Marinette</td>
<td>6.29</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>North Central</td>
<td>Riverview Expwy. &amp; Grand Ave.</td>
<td>Wisconsin Rapids</td>
<td>7.6</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>County KK near Rifle Rd.</td>
<td>Mosinee</td>
<td>3.82</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Northwest</td>
<td>Broadway St. &amp; Elm Ave.</td>
<td>Menomine</td>
<td>7.62</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tower Ave. near 24th St. and 26th St.</td>
<td>Superior</td>
<td>7.16</td>
<td>2</td>
<td>8</td>
</tr>
</tbody>
</table>
3.4.3. Pedestrian Hot Spot Characteristics
The 20 pedestrian crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings, bus stops, and mixed land uses. These characteristics are associated with higher levels of pedestrian activity as well as a more complex environment for drivers to negotiate. However, a review of the crash narratives at each hot spot also showed that driver and pedestrian behavior as well as randomness also contributed to the occurrence of crashes.

3.4.4. Bicycle Hot Spot Characteristics
The 20 bicycle crash hot spots had several common characteristics. One of the most prominent characteristics was being located along multilane arterial roadway corridors. Many of these corridors had speed limits of 30 miles per hour or higher and additional turn lanes that allow greater traffic capacity and allow drivers to maintain faster speeds. Many were signalized corridors, and many of the crashes occurred at intersections between signals. These corridors often had a large number of driveway crossings and mixed land uses. These characteristics are associated with higher levels of bicycle activity as well as a more complex environment for drivers to negotiate. Notably, most of the hot spots did not have bicycle facilities. Like crashes at pedestrian crash hot spots, the crash narratives showed that driver and bicyclist behavior as well as randomness contributed to the occurrence of crashes.
3.5. Special Focus: Young Pedestrian and Bicyclist Crashes
WisDOT has focused on reducing crashes involving young pedestrians and bicyclists through programs such as Safe Routes to School and Share and Be Aware. Common crash types experienced by young pedestrians and bicyclists were compared with common crash types experienced by other age groups. This was done to gain a better understanding of the actions involved in these crashes and to inform future young pedestrian and bicyclist education strategies.

3.5.1. Young Pedestrian Crash Types
Pedestrians younger than age 20 accounted for approximately 28% (1,343 of 4,751) of all pedestrian crashes (with pedestrian age information) reported between 2011 and 2013. Approximately 20% (59 of 289) of the 2011 to 2013 pedestrian crashes analyzed in detail (with pedestrian age information) involved pedestrians younger than age 20. Pedestrian crash types were analyzed using both the Wisconsin LMCM crash types (Table 3.11) and the NHTSA crash types (Table 3.12).

According to the LMCM, the most common type of crash for young pedestrians was a straight-traveling motorist striking a pedestrian approaching from the right at a non-intersection location (N_RRD_R) (27%). This crash type was also the most common for pedestrians age 20 and older, but it is significantly more common to occur to young pedestrians. In some cases, drivers may not expect to see a child or adolescent entering the roadway, especially between parked cars in the middle of a block (NHTSA crash type 742). In other cases, children may dash into the roadway (NHTSA crash type 741). The second- and third-most common LMCM young pedestrian crash types involved pedestrians crossing from the left and motorists traveling straight at intersections. Pedestrians struck on the near side of the intersection in this situation (I_NS_ST_L) accounted for 14% and pedestrians struck on the far side of the intersection in this situation (I_FS_ST_L) accounted for 10% of young pedestrian crashes. In some of these intersection crashes, pedestrians were disobeying a traffic signal. However, in others, the young pedestrians were crossing legally in a crosswalk but drivers did not yield to them. The NHTSA crash types suggest that young pedestrian crashes commonly involve pedestrians failing to yield to motorists and motorists failing to yield to pedestrians (types 770 and 760).

A detailed review of the individual crashes within the top three LMCM young pedestrian crash types identified several common characteristics associated with each crash type.

- **Non-intersection:** Straight-traveling motorist strikes pedestrian approaching from right (N_RRD_R) (16 crashes). Most of these crashes occurred on local, two-lane roadways (10 of 16) during the daytime (11 of 16). In most crashes (9 of 16), the driver reported not seeing the pedestrian before the crash. The primary reason for not seeing the pedestrian was that the pedestrian entered the roadway from between parked cars. The pedestrians involved in these crashes tended to be younger than other pedestrian crash types (11 of the 16 pedestrians were age 13 or younger).

- **Intersection:** Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection (I_NS_ST_L) (8 crashes). Many of these crashes occurred on major roadways with more than two lanes (only one was at an intersection of two-lane local roadways). About half of the pedestrians were crossing at uncontrolled locations where drivers should have yielded.

- **Intersection:** Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection (I_FS_ST_L) (6 crashes). Many of these crashes occurred on major roadways with more than two lanes (only one was at an intersection of two-lane local roadways). All of the crashes occurred when it was dark, and half involved some type of pedestrian distraction (e.g., cell phone, argument, harassment). These crashes tended to occur to older adolescents (5 of
the 6 pedestrians were age 15 or older). More than half of the pedestrians were crossing at uncontrolled locations, but drivers should have yielded.

Note that the young pedestrian crash types identified in this analysis reflect crashes that produced more severe injuries than young pedestrian crashes as a whole throughout the state. This is because the crash selection method oversampled fatal and severe crashes.
Table 3.11. Young Pedestrian Crashes: Wisconsin LMCM Pedestrian Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Pedestrian Under 20</th>
<th>Pedestrian Age 20+</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RRD_R</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian approaching from right</td>
<td>27.1%</td>
<td>11.3%</td>
<td>++</td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection</td>
<td>10.2%</td>
<td>9.1%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection</td>
<td>13.6%</td>
<td>6.5%</td>
<td>+</td>
</tr>
<tr>
<td>N_RRD_X</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian in roadway, pedestrian not approaching from left or right</td>
<td>0.0%</td>
<td>8.3%</td>
<td>--</td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian approaching from left</td>
<td>6.8%</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>OTH</td>
<td>Other movements that do not fit into other crash type categories, including driverless vehicle crashes</td>
<td>5.1%</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>P_B</td>
<td>Parking lot/Private property: Backing motorist strikes pedestrian</td>
<td>5.1%</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>P_F</td>
<td>Parking lot/Private property: Forward-traveling motorist strikes pedestrian</td>
<td>8.5%</td>
<td>5.2%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Intersection: Left-turning motorist strikes pedestrian traveling from opposite direction in far crosswalk</td>
<td>1.7%</td>
<td>6.5%</td>
<td></td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from right on far side of intersection</td>
<td>3.4%</td>
<td>6.1%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian approaching from right on near side of intersection</td>
<td>1.7%</td>
<td>5.7%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_S</td>
<td>Intersection: Left-turning motorist strikes pedestrian traveling from same direction in far crosswalk</td>
<td>1.7%</td>
<td>4.8%</td>
<td></td>
</tr>
<tr>
<td>N_RSH_X</td>
<td>Non-intersection: Straight-traveling motorist strikes pedestrian on right roadway shoulder</td>
<td>1.7%</td>
<td>3.9%</td>
<td></td>
</tr>
<tr>
<td>I_FS_RT_S</td>
<td>Intersection: Right-turning motorist strikes pedestrian traveling from same direction in far crosswalk</td>
<td>5.1%</td>
<td>1.3%</td>
<td>+</td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Intersection: Right-turning motorist strikes pedestrian approaching from right on near side of intersection</td>
<td>5.1%</td>
<td>0.9%</td>
<td>++</td>
</tr>
<tr>
<td>D_B</td>
<td>Driveway: Backing motorist strikes pedestrian</td>
<td>0.0%</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_X</td>
<td>Intersection: Straight-traveling motorist strikes pedestrian in roadway on near side of intersection, no pedestrian direction</td>
<td>1.7%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>1.7%</td>
<td>8.7%</td>
<td></td>
</tr>
<tr>
<td>Total Crashes ¹</td>
<td></td>
<td>59</td>
<td>230</td>
<td></td>
</tr>
</tbody>
</table>

1) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes involving pedestrians younger than age 20 versus the proportion of crashes involving pedestrians age 20 or older for a particular crash type. “++” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly higher at a 90% confidence level; “--” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly lower at a 95% confidence level; “-” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly lower at a 90% confidence level.

2) 7 of the 296 total crashes have an unknown age.
Table 3.12. Young Pedestrian Crashes: NHTSA Pedestrian Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Pedestrian Under 20</th>
<th>Pedestrian Age 20+</th>
<th>Sig. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>741</td>
<td>The pedestrian ran into the roadway and was struck by a vehicle whose view of the pedestrian was not obstructed</td>
<td>16.9%</td>
<td>10.8%</td>
<td></td>
</tr>
<tr>
<td>770</td>
<td>The motorist failed to yield to the pedestrian</td>
<td>10.2%</td>
<td>11.3%</td>
<td></td>
</tr>
<tr>
<td>760</td>
<td>The pedestrian failed to yield to the motorian</td>
<td>10.2%</td>
<td>10.9%</td>
<td></td>
</tr>
<tr>
<td>742</td>
<td>The pedestrian walked or ran into the roadway and was struck by a motorist whose view of the pedestrian was blocked until an instant before impact</td>
<td>20.3%</td>
<td>7.8%</td>
<td>++</td>
</tr>
<tr>
<td>781</td>
<td>The motorist was initially traveling on a parallel path with the pedestrian before making a left turn and striking the individual</td>
<td>3.4%</td>
<td>8.7%</td>
<td></td>
</tr>
<tr>
<td>830</td>
<td>The motor vehicle struck a pedestrian in a parking lot</td>
<td>6.8%</td>
<td>6.1%</td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>The pedestrian was struck in a parking lot by a vehicle that was backing with a driver at the controls</td>
<td>3.4%</td>
<td>4.3%</td>
<td></td>
</tr>
<tr>
<td>410</td>
<td>The pedestrian was walking/running along the roadway with traffic and was struck from behind</td>
<td>5.1%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>Vehicle lost control due to mechanical failure, surface conditions, driver error or impairment</td>
<td>0.0%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>230</td>
<td>The pedestrian was struck while near or next to a disabled vehicle (including a vehicle that had been in a crash) or while walking to or from a disabled vehicle</td>
<td>0.0%</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>The crash occurred at a nonintersection location, but actions of the pedestrian prior to the crash cannot be determined</td>
<td>0.0%</td>
<td>3.9%</td>
<td></td>
</tr>
<tr>
<td>710</td>
<td>The pedestrian entered the traffic lane in front of stopped or slowing traffic and was struck by a vehicle traveling in the same direction as the stopped or slowing traffic</td>
<td>5.1%</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>690</td>
<td>The crash occurred at an intersection, but the actions of the pedestrian prior to the crash cannot be determined or it cannot be determined who failed to yield</td>
<td>0.0%</td>
<td>2.6%</td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>The pedestrian stumbled, fell, or rolled into path of vehicle due to surface conditions, impairment or other mishap</td>
<td>3.4%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>440</td>
<td>The pedestrian was walking/running along the roadway against traffic and was struck from behind</td>
<td>0.0%</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>313</td>
<td>The pedestrian was lying in the roadway when struck</td>
<td>0.0%</td>
<td>2.2%</td>
<td></td>
</tr>
<tr>
<td>791</td>
<td>The motorist was initially travelling on a parallel path with the pedestrian before making a right turn and striking the individual</td>
<td>1.7%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>The pedestrian was struck by a vehicle during a domestic altercation or other dispute</td>
<td>0.0%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>The pedestrian was struck as a result of a prior vehicle-into-vehicle or vehicle-into-object crash</td>
<td>1.7%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>610</td>
<td>The pedestrian was standing in the roadway prior to the crash, but the crash cannot be further classified</td>
<td>0.0%</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>The pedestrian was struck in a roadway by a vehicle that was backing with a driver at the controls</td>
<td>0.0%</td>
<td>1.7%</td>
<td></td>
</tr>
<tr>
<td>794</td>
<td>The motorist was initially traveling on a crossing path with the pedestrian before making a right turn on a red signal, and striking the individual</td>
<td>3.4%</td>
<td>0.9%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>8.5%</td>
<td>8.3%</td>
<td></td>
</tr>
<tr>
<td>Total Crashes 2</td>
<td></td>
<td>59</td>
<td>230</td>
<td></td>
</tr>
</tbody>
</table>

1) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes involving pedestrians younger than age 20 versus the proportion of crashes involving pedestrians age 20 or older for a particular crash type. “++” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly higher at a 90% confidence level; “--” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly lower at a 95% confidence level; “-” indicates that the proportion of crashes involving pedestrians younger than age 20 is significantly lower at a 90% confidence level.

2) 7 of the 296 total crashes have an unknown age.
3.5.2. Young Bicyclist Crash types
The study of Wisconsin bicycle crashes reported in 2003 (Amsden and Huber 2006) looked closely at crashes involving young bicyclists, so this report includes a similar analysis. Overall, crashes involving bicyclists under age 20 decreased dramatically over the last decade. These young bicyclists accounted for 62% (657 of 1,065) of bicycle crashes in 2003, but they accounted for only 33% (1,103 of 3,323) between 2011 and 2013. This change may reflect improvements in young bicyclist education and behavior, reductions in bicycling by this age group, or increases in bicycling by other age groups.

Approximately 30% (69 of 227) of the 2011 to 2013 bicycle crashes analyzed in detail (with bicyclist age information) involved bicyclists younger than age 20. Bicycle crash types were analyzed using both the Wisconsin LMCM crash types (Table 3.13) and the NHTSA crash types (Table 3.14).

According to the Wisconsin LMCM, the three most common types of crashes for young bicyclists involved motorists striking bicyclists on the near side of an intersection. One of these three, a motorist traveling straight and striking a bicyclist approaching from the left (I_NS_ST_L) (13%), involves a bicyclist riding in the same direction as adjacent roadway traffic. The other two, a motorist traveling straight and striking a bicyclist approaching from the right on the near side of the intersection (I_NS_ST_R) (12%) and a motorist turning right and striking a bicyclist approaching from the right on the near side of the intersection (I_NS_RT_R) (12%), involve bicyclists riding in the opposite direction as adjacent traffic. Riding in this direction often puts bicyclists in a position that drivers do not expect at driveways and intersections. Notably, I_NS_ST_R and I_NS_RT_R crashes are more common for young bicyclists than bicyclists aged 20 or older (though this difference is not statistically significant). This may be due in part to many young bicyclists riding on the sidewalk in the opposite direction as adjacent traffic, which can result from children and parents 1) not feeling comfortable riding in general roadway lanes or striped bicycle lanes and 2) not being aware of the risk riding in the opposite direction on the sidewalk.

One of the crash types—straight-traveling motorist strikes bicyclist approaching from left on far side of intersection (I_FS_ST_L)—is significantly more common for young bicyclists than bicyclists age 20 or older. This crash type also involves riding in the opposite direction as adjacent traffic. Notably, three of the top six LMCM young bicyclist crash types involve contra-flow bicycling. In many cases, these young bicyclists are riding on the sidewalk in the opposite direction of adjacent traffic. The NHTSA crash types suggest that young bicyclists are often struck by motorists when they violate a stop sign (144) or traffic signal (155). Both of these crash types can involve riding on the wrong side of the roadway and being struck by a motorist on the near side of the intersection.

One of the other top six young bicyclist crash types is a left-turning motorist striking a bicyclist traveling from the opposite direction (though in the same direction as adjacent traffic) on far side of intersection (I_FS_LT_O). This is consistent with the third-most common NHTSA young bicyclist crash type (212). Motorists may not look carefully for bicyclists before turning left or their view of bicyclists may be blocked by oncoming traffic, especially at high-traffic intersections.

The most common type of crash for bicyclists age 20 or older is a straight-traveling motorist striking a bicyclist on right side of roadway (in a travel lane but not a bicycle lane or striped shoulder) when the bicyclist is traveling in same direction (N_RRD_S). However, it is significantly less common for young bicyclists to be involved in this type of crash. This may be due to young bicyclists riding in roadway lanes less often than older bicyclists.
A detailed review of the individual crashes within the top three LMCM young bicyclist crash types identified several common characteristics associated with each crash type.

- **Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (I_NS_ST_L)** (9 crashes). Many of these crashes occurred along major roadways (only three were at intersections of two-lane local roadways). Most (6 of 9) involved a bicyclist disobeying a stop sign or signal, and most (6 of 9) involved a bicyclist riding from a sidewalk into a crosswalk. Two of the bicyclists were struck by motorists who proceeded immediately on green before the bicyclists had a chance to clear the intersection when the light facing them turned red.

- **Intersection: Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_ST_R)** (8 crashes). Most of these crashes occurred on local, two-lane roadways during the daylight conditions. Nearly all (7 of 8), bicyclists entered the intersection crosswalk from the sidewalk. All (8 of 8) were traveling in the opposite direction as adjacent traffic. In about half of these rashes, the driver reported not seeing the pedestrian before the crash.

- **Intersection: Right-turning motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist) (I_NS_RT_R)** (8 crashes). Nearly all of these crashes (7 of 8) involved a motorist turning right onto a major roadway (most of these roads had more than two lanes). Nearly all of these crashes (7 of 8) involved a bicyclist entering the crosswalk from the sidewalk in the opposite direction as adjacent traffic. Half of the drivers reported not seeing the bicyclists before the crash, likely because they did not look right before turning right. In all but one crash, drivers faced some form of traffic control (three stop signs, three red signals, and one yield sign) that should have been obeyed before making their right turn.

Note that the young bicyclist crash types identified in this 2011-2013 analysis may be different from the types identified from the 2003 bicycle crashes because the current method oversampled fatal and severe crashes. The previous analysis examined all bicycle crashes reported in 2003, so it included more non-severe crashes. It is also possible that crash types changed due to behavioral and local environment changes.
<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Bicyclist Under 20</th>
<th>Bicyclist Age 20+</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RRD_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on right side of roadway (in a travel lane), bicyclist traveling in same direction (includes door-related crashes)</td>
<td>4.3%</td>
<td>23.4%</td>
<td>--</td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>13.0%</td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Intersection: Right-turning motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist)</td>
<td>11.6%</td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Intersection: Left-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection</td>
<td>10.1%</td>
<td>10.8%</td>
<td></td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection</td>
<td>10.1%</td>
<td>8.9%</td>
<td></td>
</tr>
<tr>
<td>I_NS_ST_R</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection (contra-flow bicyclist)</td>
<td>11.6%</td>
<td>5.1%</td>
<td>+</td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Intersection: Straight-traveling motorist strikes bicyclist approaching from left on far side of intersection (contra-flow bicyclist)</td>
<td>10.1%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist approaching from left (crossing or merging at non-intersection location; includes trail crossings)</td>
<td>5.8%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>I_NS_RT_L</td>
<td>Intersection: Right-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>4.3%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>N_RSH_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction</td>
<td>0.0%</td>
<td>4.4%</td>
<td>-</td>
</tr>
<tr>
<td>I_FS_RT_O</td>
<td>Intersection: Right-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection (contra-flow bicyclist)</td>
<td>0.0%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>N_RRD_R</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist approaching from right (crossing or merging at non-intersection location; includes trail crossings)</td>
<td>4.3%</td>
<td>0.6%</td>
<td>+</td>
</tr>
<tr>
<td>I_FS_LT_S</td>
<td>Intersection: Left-turning motorist strikes bicyclist traveling from same direction on far side of intersection (contra-flow bicyclist)</td>
<td>1.4%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>N_LRD_S</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in same direction (contra-flow bicyclist)</td>
<td>1.4%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>I_NS_LT_L</td>
<td>Intersection: Left-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
<td>0.0%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>N_LRD_O</td>
<td>Non-intersection: Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in opposite direction</td>
<td>0.0%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>P_F</td>
<td>Parking lot/Private property: Forward-traveling motorist strikes bicyclist</td>
<td>1.4%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>D_F</td>
<td>Driveway: Forward-traveling motorist strikes bicyclist (outside of public right-of-way)</td>
<td>2.9%</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td>All other types</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>7.2%</td>
<td>8.2%</td>
<td></td>
</tr>
</tbody>
</table>

| Total Crashes² | 69 | 158 |

¹) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes involving bicyclists younger than age 20 versus the proportion of crashes involving bicyclists age 20 or older for a particular crash type. “++” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly higher at a 90% confidence level; “--” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly lower at a 95% confidence level; “-” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly lower at a 90% confidence level.

²) 2 of the 229 total crashes have an unknown age.
Table 3.14. Young Bicyclist Crashes: NHTSA Bicycle Crash Types

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Crash Type Description</th>
<th>Bicyclist Under 20</th>
<th>Bicyclist Age 20+</th>
<th>Sig.¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>141</td>
<td>The motorist was facing the sign or flashing signal and drove into the crosswalk area</td>
<td>5.8%</td>
<td>13.3%</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>or intersection and collided with the bicyclist after stopping or yielding</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>144</td>
<td>The bicyclist violated the sign or flashing signal and rode into the intersection</td>
<td>21.7%</td>
<td>4.4%</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>and collided with the motorist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>212</td>
<td>The motorist turned left in front of a bicyclist coming from the opposite direction</td>
<td>10.1%</td>
<td>9.5%</td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>The bicyclist violated the signal and rode into the intersection and collided with the</td>
<td>8.7%</td>
<td>8.2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>motorist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>231</td>
<td>The motorist was overtaking the bicyclist and failed to detect the bicyclist</td>
<td>2.9%</td>
<td>10.8%</td>
<td>--</td>
</tr>
<tr>
<td>235</td>
<td>The bicyclist swerved or moved suddenly into the path of an overtaking vehicle</td>
<td>2.9%</td>
<td>7.6%</td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>The motorist was facing a red signal, stopped, &amp; then drove into the crosswalk area</td>
<td>5.8%</td>
<td>5.1%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or intersection and collided with the bicyclist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>239</td>
<td>The motorist was overtaking the bicyclist, but the specific circumstances surrounding</td>
<td>0.0%</td>
<td>3.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>the overtaking maneuver do not conform to the other situations described or are unknown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>211</td>
<td>The motorist turned left in front of a bicyclist going in the same direction</td>
<td>1.4%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td>321</td>
<td>The motorist drove into the roadway or sidewalk/driveway crossing area and into the</td>
<td>4.3%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>path of a bicyclist from a residential driveway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>910</td>
<td>The crash occurred off the street network (e.g., parking lots, driveways, alleys,</td>
<td>2.9%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>trails, and other open areas)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>318</td>
<td>The bicyclist rode into the roadway and into the path of a motor vehicle other than</td>
<td>5.8%</td>
<td>0.6%</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>a driveway or alley</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>143</td>
<td>The motorist violated the sign or flashing signal and drove into the crosswalk area</td>
<td>0.0%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or intersection and collided with the bicyclist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>213</td>
<td>The motorist turned right in front of a bicyclist going in the same direction</td>
<td>2.9%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td>311</td>
<td>The bicyclist rode into the roadway and into the path of a motor vehicle from a</td>
<td>5.8%</td>
<td>0.0%</td>
<td>++</td>
</tr>
<tr>
<td></td>
<td>residential driveway</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>232</td>
<td>The motorist was overtaking the bicyclist and misjudged the width and distance</td>
<td>0.0%</td>
<td>2.5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>required to pass the bicyclist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>214</td>
<td>The motorist turned right in front of a bicyclist coming from the opposite direction</td>
<td>0.0%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td>154</td>
<td>The motorist violated the signal and drove into the crosswalk area or intersection and</td>
<td>1.4%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>collided with the bicyclist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>The motorist was facing a red signal, stopped, and then drove into the crosswalk area</td>
<td>1.4%</td>
<td>1.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>or intersection and collided with the bicyclist while attempting to make a right turn</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>on red</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>222</td>
<td>The bicyclist turned or merged left in front of a motorist coming from the opposite</td>
<td>0.0%</td>
<td>1.9%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>direction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>322</td>
<td>The motorist drove into the roadway or sidewalk/driveway crossing area and into the</td>
<td>2.9%</td>
<td>0.6%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>path of a bicyclist from a commercial driveway or alley</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All other</td>
<td>All other crash types representing 1% or fewer of all crashes</td>
<td>13.0%</td>
<td>17.7%</td>
<td></td>
</tr>
<tr>
<td>types</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Crashes²</td>
<td><strong>69</strong></td>
<td><strong>158</strong></td>
<td></td>
</tr>
</tbody>
</table>

1) Sig. indicates the result of a Z-test of the difference between two proportions: the proportion of crashes involving bicyclists younger than age 20 versus the proportion of crashes involving bicyclists age 20 or older for a particular crash type. “++” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly higher at a 95% confidence level; “+” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly higher at a 90% confidence level; “-” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly lower at a 95% confidence level; “--” indicates that the proportion of crashes involving bicyclists younger than age 20 is significantly lower at a 90% confidence level.

2) 2 of the 229 total crashes have an unknown age.
3.6. Primary Responsibility for the Crash
In addition to categorizing the 296 pedestrian and 229 bicycle crashes by type, we used the detailed information on the MV4000 forms to interpret which party or parties the police officer viewed as being primarily responsible for the crash. Police do not assign “fault” for crashes in Wisconsin. Therefore, this was a subjective determination based on the type of citation issued for the crash and language used by the officer in the narrative. Citations helped suggest the party primarily responsible for some crashes, but they were not required to determine primary responsibility. In some cases, citations were issued for purposes that were not relevant to the crash (e.g., expired license). In other cases, citations were not issued even though a law was broken, according to the police narrative (in particular, certain fatalities may not include driver citations because the police officer waited for a more detailed investigation before issuing the citation). Here are three examples of how primary responsibility was assigned to crashes:

- If a driver was issued a citation for inattentive driving or failure to yield to a pedestrian, the driver was interpreted as being primarily responsible.
- If a pedestrian was recorded as being struck by an automobile while crossing against a red traffic signal, the pedestrian was interpreted as being primarily responsible (regardless of whether or not the pedestrian was issued a citation).
- If a driver was noted as being intoxicated and struck a bicyclist who failed to stop at a traffic signal, both parties were interpreted as being primarily responsible (regardless of whether or not either party was issued a citation).

<table>
<thead>
<tr>
<th>Primary Responsibility</th>
<th>Fatality (K)</th>
<th>Incapacitating Injury (A)</th>
<th>Other/No Injury (B, C, or O)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorist</td>
<td>53%</td>
<td>46%</td>
<td>63%</td>
<td>51%</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>29%</td>
<td>38%</td>
<td>24%</td>
<td>33%</td>
</tr>
<tr>
<td>Both</td>
<td>8%</td>
<td>8%</td>
<td>0%</td>
<td>6%</td>
</tr>
<tr>
<td>None Assigned</td>
<td>11%</td>
<td>7%</td>
<td>13%</td>
<td>9%</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>154</td>
<td>62</td>
<td>296</td>
</tr>
</tbody>
</table>

While a larger percentage of the 296 pedestrian crashes reviewed in detail assigned primary responsibility for the crash to the motorist, the most common pedestrian crash types tended to assign responsibility to the pedestrian more often than the motorist. In fact, four of the top five pedestrian crash types attributed fault to the pedestrian more often than the driver. These top five crash types are N_RRD_R (74% pedestrian responsibility), I_FS_ST_L (52%), I_NS_ST_L (48%), N_RRD_X (30%), and N_RRD_L (53%). However, the motorist was more likely to be assigned primary responsibility in 21 of 30 observed crash types.

Many crashes are related to drivers failing to yield to pedestrians in crosswalks. Failure to yield was first analyzed for the fatal crash sample. Overall, 28% of fatal crashes involved drivers not yielding to pedestrians in crosswalks. Of these failure-to-yield fatalities, 68% were at intersections where the driver was going straight and no signal or stop sign was present, 18% were at intersections where the driver struck the pedestrian while turning left (none involved right turns), and 14% involved the driver disobeying a signal or stop sign. For comparison, the TOPS lab also codes driver “failure to yield” as a possible contributing circumstance to crashes. An examination of all (not just fatal) pedestrian crashes, from our sample of 296 pedestrian crashes, showed that 26% of crashes involving a motorist traveling straight and 15% of crashes involving a motorist turning were due to motorist “failure to yield.”
Primary responsibility for the 33 pedestrian fatalities that occurred at intersections was analyzed in detail. Of these intersection fatalities, 65% were due to driver error (59% involved a driver not yielding to a pedestrian in a crosswalk\textsuperscript{12}; 6% involved a driver disobeying a traffic signal), 24% were due to some pedestrian and some driver error (18% of the pedestrians were struck near the intersection but outside of the crosswalk; 3% of drivers had a green light, but should have yielded to a pedestrian who had not completed crossing; 3% of drivers failed to yield to a pedestrian in a crosswalk but the pedestrian was noted as darting into the roadway), and 12% were due to pedestrian error (12% involved a driver with a green light striking a pedestrian who violated a red signal).

<table>
<thead>
<tr>
<th>Primary Responsibility</th>
<th>Fatality (K)</th>
<th>Incapacitating Injury (A)</th>
<th>Other/ No Injury (B, C, or O)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorist</td>
<td>58%</td>
<td>44%</td>
<td>47%</td>
<td>47%</td>
</tr>
<tr>
<td>Bicyclist</td>
<td>24%</td>
<td>42%</td>
<td>39%</td>
<td>38%</td>
</tr>
<tr>
<td>Both</td>
<td>3%</td>
<td>9%</td>
<td>5%</td>
<td>7%</td>
</tr>
<tr>
<td>None Assigned</td>
<td>15%</td>
<td>5%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Total</td>
<td>33</td>
<td>122</td>
<td>74</td>
<td>229</td>
</tr>
</tbody>
</table>

The top bicycle crash types have much more variation in the assignment of primary responsibility than the top pedestrian crash types. Primary crash responsibility was assigned to the bicyclists in 4 of the top 8 bicycle crash types. These top 8 crash types are N_RRD_S (vehicle driver responsible in 60% of crashes), I_NS_ST_L (67% bicyclist), I_NS_RT_R (39% bicyclist), I_FS_LT_O (88% vehicle driver), I_FS_ST_R (67% bicyclist), I_NS_ST_R (31% bicyclist and vehicle driver), I_FS_ST_L (72% bicyclist), and N_RRD_L (72% bicyclist). Both parties seemed equally as likely to be deemed responsible in the top two crash types that involved a bicyclist who was either riding in the sidewalk or on the roadway in the opposite direction of traffic (I_NS_RT_R and I_NS_ST_R).

3.7. Crash Report Accuracy
The detailed analysis of 296 pedestrian and 229 bicycle crashes also examined the accuracy of pedestrian and bicycle crash reports. Three different aspects of accuracy were evaluated: crash location, injury severity rating, and citation relevance.

3.7.1. Accuracy of Location Information
The WisTransPortal database includes an official location of each reported crash based on intersection or address information that is provided on the MV4000 form. This information is used to derive the latitude and longitude of each crash. We analyzed the accuracy of this location information by finding the precise location of each crash based on the MV4000 detailed crash narrative and crash diagram. Crashes occurring on a different leg of the intersection or in a location further than 100 feet from the official address or intersection provided in the WisTransPortal database were determined to be incorrect. Crashes that occurred within 100 feet of the official location in the database were determined to be correct. If a crash location was incorrect, we flagged the crash and recorded the coordinates of the correct location. While we accepted crashes that were geocoded within 100 feet of

\textsuperscript{12} Of the 20 pedestrian intersection fatalities that occurred when drivers failed to yield to pedestrians in crosswalks, 16 (80%) involved drivers going straight through an uncontrolled intersection and only 4 (20%) involved drivers turning. All four of the turning crashes involved left turns.
the crash location, a more precisely geocoded location of the crashes could make it easier for future analysis of bicycle and pedestrian crashes.

Most (95%) of the 296 pedestrian and 229 bicycle crashes studied in detail were located accurately. If a crash wasn’t geocoded in the WisTransPortal database, it did not count as an “incorrect location” in this analysis. Many of the crashes that weren’t geocoded occurred in parking lots and private property, as these locations were rarely geocoded. Further, higher severity crashes were often more likely to be geocoded than less severe crashes. Ongoing updates to the database may have filled in some of the previously missing geocoded locations.

We attempted to assign coordinates to all crashes that did not include geocoded latitude and longitude coordinates. Of the 296 pedestrian crashes, 82% were already assigned a geocoded location. Fatal pedestrian crashes were most likely to be geocoded (88% were already geocoded). Severe crashes were slightly less likely to be geocoded (84%) and non-severe (B, C, and property damage) crashes were only geocoded 69% of the time. Parking lot and private property crashes may have played a role in these percentages, as fatal and severe pedestrian crashes rarely occurred in these locations.

Bicycle crashes were more likely to be geocoded than pedestrian crashes. 91% of the 229 bicyclist crashes were geocoded. Similar to pedestrian crashes, fatal crashes had a larger percentage of crashes geocoded (97%). Severe injury crashes were geocoded 91% of the time, and non-severe crashes were geocoded 88%. The higher rate of geocoding shown in bicycle-related crashes may partially be attributed to fewer crashes occurring in parking lots and on private property.

### 3.7.2. Accuracy of Injury Severity Ratings

Most of the analyses in this report use injury severity from the police-assigned KABCO injury scale. Additional analysis was done to study the accuracy of these injury severity classifications. Utilizing hospital and emergency room crash data, linked to WisTransPortal crash data by the Center for Health Systems Research and Analysis at UW-Madison, crash severity was compared to get a sense of the similarities and differences in injury classification between police officers and medical professionals. Each hospital and emergency room crash was assigned an injury severity number according to the Maximum Abbreviated Injury Scale (MAIS). This MAIS number was compared with the KABCO injury severity code available in the WisTransPortal database. Table 3.17 compares the injury severity scales.

<table>
<thead>
<tr>
<th>MAIS</th>
<th>WisTransportal</th>
<th>Report Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = ‘Unknown’</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>1 = ‘Minor’</td>
<td>B, C, O</td>
<td>Non-Severe</td>
</tr>
<tr>
<td>2 = ‘Moderate’</td>
<td>A</td>
<td>Severe</td>
</tr>
<tr>
<td>3 = ‘Serious’</td>
<td>K</td>
<td>Fatal</td>
</tr>
<tr>
<td>4 = ‘Severe’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 = ‘Critical’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 = ‘Maximum’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 = ‘Missing’</td>
<td>Missing</td>
<td></td>
</tr>
</tbody>
</table>

13 MAIS database entries of “0”, “9”, and “Null” were treated as missing records during analysis of injury severity ratings. While the crash-specific reasons for these vary, a greater percentage of each value for fatal crashes and non-severe crashes suggest that they involve fatalities or minor injuries that don’t warrant a trip to the hospital.
Analysis performed throughout this report utilizes the general WisTransPortal KABCO classifications of K = “Fatal”; A = “Severe”; and B, C, or O = “Non-severe”. With this as a framework, MAIS values from 1 to 6 were placed in one of these categories. While this does not create a perfectly-aligned framework for comparing injury severity ratings between police officers and hospital workers, it is fairly close. In fact, the KABCO injury scale shows that of all pedestrian and bicycle crashes between 2011 and 2013, 85% were non-severe, 13% were severe, and 2.2% were fatal. In comparison, the MAIS scale produces 85% non-severe crashes, 14% severe crashes, and only 1.5% fatal crashes (Table 3.18). These MAIS scale percentages only consider the 4,510 crashes that were coded 1 through 6 for severity, and therefore do not take into account 4,070 crashes that were classified as either “0”, “9”, or “Null.”

Table 3.18. Injury Severity by Classification Method, 2011 to 2013

<table>
<thead>
<tr>
<th>Crash Severity</th>
<th>KABCO</th>
<th>MAIS*</th>
<th>KABCO</th>
<th>MAIS*</th>
<th>KABCO</th>
<th>MAIS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Severe</td>
<td>81%</td>
<td>82%</td>
<td>90%</td>
<td>89%</td>
<td>85%</td>
<td>85%</td>
</tr>
<tr>
<td>Severe</td>
<td>16%</td>
<td>16%</td>
<td>9%</td>
<td>10%</td>
<td>13%</td>
<td>14%</td>
</tr>
<tr>
<td>Fatal</td>
<td>3.0%</td>
<td>1.8%</td>
<td>1.0%</td>
<td>0.9%</td>
<td>2.2%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Total Crashes</td>
<td>5,147</td>
<td>2,863</td>
<td>3,428</td>
<td>1,647</td>
<td>8,575</td>
<td>4,510</td>
</tr>
</tbody>
</table>

*MAIS Totals are taken out of 2,863 pedestrian crashes and 1,647 bicycle crashes that were not coded as a "0", "9", or "Null" value.

Table 3.19. Pedestrian Injury Severity by Classification Method, 2011 to 2013

<table>
<thead>
<tr>
<th>KABCO</th>
<th>MAIS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash Severity</td>
<td>Non-Severe</td>
</tr>
<tr>
<td>Non-Severe</td>
<td>39%</td>
</tr>
<tr>
<td>Severe</td>
<td>6.4%</td>
</tr>
<tr>
<td>Fatal</td>
<td>0.2%</td>
</tr>
<tr>
<td>Total Crashes</td>
<td>46%</td>
</tr>
</tbody>
</table>

*Total crash percentages are taken out of all 5,147 pedestrian crashes. This inclusion of "0" and "Null" values produces different "Total Crash" percentages for the MAIS classification method than are displayed in Table 3.18.

Table 3.20. Bicycle Injury Severity by Classification Method, 2011 to 2013

<table>
<thead>
<tr>
<th>KABCO</th>
<th>MAIS*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash Severity</td>
<td>Non-Severe</td>
</tr>
<tr>
<td>Non-Severe</td>
<td>38%</td>
</tr>
<tr>
<td>Severe</td>
<td>5%</td>
</tr>
<tr>
<td>Fatal</td>
<td>0.1%</td>
</tr>
<tr>
<td>Total Crashes</td>
<td>43%</td>
</tr>
</tbody>
</table>

*Total crash percentages are taken out of all 3,428 bicycle crashes. This inclusion of "0" and "Null" values produces different "Total Crash" percentages for the MAIS classification method than are displayed in Table 3.18.

While the breakdown of injury severity is fairly consistent between scales, the higher number of fatal crashes in the WisTransPortal database could be attributed to differences in recording time. Police officers, who fill out the MV4000 form for a crash, follow up on involved units 30 days after the crash.
Therefore, some fatalities may occur after a victim has been admitted to the hospital. The MAIS injury rating represents the hospital or emergency room’s initial rating of the injury severity, which may not yet be fatal. Further, some fatal crashes are deemed fatal before the pedestrian or bicyclist can be transported to the hospital, so these crashes are left out of the hospital’s database. The absence of many fatal and non-severe crashes in the hospital database may also explain the higher percentage of severe crashes produced using the MAIS system. In specifically comparing “0”, “9”, and “Null” values to the WisTransportal Scale, 92% of all crashes that received a “0”, “9”, and “Null” value were classified as a non-severe, “B, C, and O” crash. While the assumption is that these crashes did not receive a 1-6 MAIS code because the involved unit did not go to the hospital, there representation in the data would change the percentage of non-severe crashes in hospital data significantly. This in turn would suggest that the hospital and emergency room injury classifications would tend to be less severe than the officer’s ratings.

As a whole, 47% of pedestrian and bicycle crashes between 2011 and 2013 in the WisTransportal database involved a pedestrian or bicyclist that did not go to the hospital following the crash. Observed by injury severity, non-severe crashes (B, C, and O) were much more likely to not have a matching hospital record, suggesting that they did not go to the hospital after the crash they were involved in. Of B, C, and O crashes, B crashes were more likely to have a hospital record. Fatal crashes (53%) were also less likely to have a matching hospital record, suggesting that a number of pedestrians or bicyclists were pronounced dead at the scene.

Pedestrian crashes, which were shown to be more likely to have high injury severities associated with their crashes, were also more likely to attend the hospital, following a crash. 56% of pedestrians and 48% of bicyclists had a hospital record. Further, 11% of the pedestrian crashes that did not have a hospital record were severe or fatal, while only 4% of bicycle crashes were.

Since the comparison database was constructed from WisTransportal records, we did not have access to hospital records that were not matched with WisTransportal crashes. Therefore, we were not able to estimate the rate of police crash underreporting for pedestrian and bicycle crashes.

3.7.3. Relevance of Citations

Included in the WisTransportal database and provided by the police officer who is filling out the MV4000 form, are a series of state statute numbers that correspond to the citation issued at the crash. In studying the 296 pedestrian and 229 bicycle crashes that were observed in detail, the relevance and consistency of these citations were studied. Relevant citations (i.e., citations related to the actual cause of the crash rather than other types of citations, such as expired/revoked licenses and drivers without liability insurance) were given in 35% of all pedestrian crashes and 42% of all bicycle crashes. The remaining 65% of pedestrian crashes and 58% of bicycle crashes had no citation listed or had citations that did not relate to the cause of the crash. Multiple citations may have been issued in each crash, so crashes were deemed to have a relevant citation if they had at least one relevant citation. The relevancy of the remaining citations in these crashes did not contribute to the percentages above.

Note that police may not write a citation in certain fatal crashes until after a more detailed investigation is completed, so some citations that were eventually issued may not be captured in the WisTransportal database.
Citation not Given and Questionable

In addition to identifying whether a relevant citation was present in each class, each citation given, or not given, was analyzed to identify whether the citation, or lack of citation given, was questionable. While the reason for questioning the citation given, or not given, was often crash specific, the following are three examples of how it may have been determined:

- Citation not given and questionable: The crash report clearly implies that a vehicle driver failed to yield to a pedestrian in a marked crosswalk, but no citation was listed in the report.
- Citation given to one involved party, but not the other: The crash report suggests shared responsibility for the actions that led to the crash, such as the failure of each unit to obey traffic control, but only one unit was given a citation. This type of scenario was classified as “Citation not given and questionable,” because the citation given to one unit was appropriate, but the citation not given to the other unit was questionable. Injury severity appeared to play a major role in this outcome, as crash reports were less likely to list a pedestrian/bicyclist citation in more severe crashes.
- Citation given, but questionable: Citation given, but crash report offers no justification for the citation issued. In this situation, the crash report may offer very limited explanation of the crash, or portray a chain of events that offers little conclusion as to the responsibility for the crash, but the report still lists a citation.

Of the 296 pedestrian crashes observed in detail, 27% were deemed questionable because a citation was not identified by the crash report. In contrast, only 1.0% of crashes that were assigned citations, were noted as being questionable. Although this often coincided with crashes that did not list any citations, the crash analysis could also note that a questionable lack of citation could respond to an individual unit not receiving a citation while the other unit did. 13% of crashes were deemed questionable because the pedestrian did not receive a citation, or the citation they were given was questionable. 18% of crashes were deemed questionable because the vehicle driver did not receive a citation, or the citation they were given was questionable.

Of the 229 bicycle crashes observed in detail, 46% were deemed questionable because a citation was not identified by the crash report. In contrast, only 0.9% of crashes that were assigned citations, were noted as being questionable. 33% of crashes were deemed questionable because the bicyclist did not receive a citation, or the citation they were given was questionable. 22% of crashes were deemed questionable because the vehicle driver did not receive a citation, or the citation they were given was questionable.

Hit-and-Run Follow-up

25% of the 296 pedestrian crashes studied in detail were determined to be a hit-and-run. 57% of these hit-and-run crashes recorded no follow-up in the crash report. Since hit-and-run crashes with no follow-up do not provide the possibility of a citation, these crashes impact the percentage of crashes with relevant citations. Of the 191 pedestrian crashes that did not have citations listed, 19% were also hit-and-run crashes without follow-up.

13% of the 229 bicycle crashes studied in detail were determined to be a hit-and-run. 59% of these hit-and-run crashes recorded no follow-up in the crash report. These hit-and-run crashes impact the ability of police to issue relevant citations. Of the 132 bicycle crashes that did not have relevant citations listed, 12% were also hit-and-run crashes without follow-up.
The total number of crashes that did not have hit-and-run follow-up were queried out of the crashes that were flagged in the MV4000 database as “HITRUN.” If the officer filling out the MV4000 form did not flag the crash as a hit-and-run, then the hit-and-run follow-up data would not be included here.
Part 4. Recommendations
The engineering, education, and enforcement recommendations in this section highlight treatments that are designed to prevent the most common types of fatal and severe pedestrian and bicycle crashes identified by this study. These recommendations complement the pedestrian and bicycle recommendations already included in the WisDOT SHSP. More detail about appropriate contextual characteristics and other important considerations for these recommendations can be found in sources such as the WisDOT Wisconsin Guide to Pedestrian Best Practices (2010) and Wisconsin Bicycle Facility Design Handbook (2009) and the FHWA PEDSAFE (2013) and BIKESAFE (2014) countermeasure selection systems. The FHWA Pedestrian and Bicycle Information Center (PBIC), also provides useful pedestrian and bicycle engineering (http://www.pedbikeinfo.org/planning/facilities.cfm), education (http://www.pedbikeinfo.org/programs/education.cfm), and enforcement (http://www.pedbikeinfo.org/programs/enforcement.cfm) strategies. The final part of this section includes recommendations to improve pedestrian and bicycle safety evaluation.

Note that there are many locations throughout Wisconsin where pedestrian and bicycle safety improvements are needed. In general, resources to implement engineering, education, and enforcement treatments should be targeted to locations where there is the greatest potential to reduce future pedestrian and bicycle crashes, especially those that result in fatal and severe injuries. However, it is also important to take advantage of opportunities to make pedestrian and bicycle safety improvements as a part of routine roadway construction and reconstruction projects and ongoing programs (e.g., routine enforcement, driver education), even when those opportunities do not address the highest-priority pedestrian or bicycle safety need.

4.1. Engineering
Engineering treatments should be used to design roadway segments and intersections to facilitate safe interactions between all travelers, including pedestrians and bicyclists. Pedestrians and bicyclists should be safe when they walk and bicycle along as well as across roadways. Decades of focusing roadway design and traffic signal timing almost exclusively on automobile level of service—to move automobiles along roadways as fast as possible with minimal delay—created an unpleasant and high-risk environment for walking and bicycling in many communities. Therefore, many of the engineering treatments recommended below will create a more even balance between automobile mobility and pedestrian and bicyclist safety.

4.1.1. Engineering Treatments to Improve Pedestrian Safety
The following treatments should be implemented, where appropriate, to reduce fatal and severe pedestrian crashes. The list below also provides examples of specific common fatal and severe crash types that could be addressed by each treatment.

- Construct sidewalks on both sides of urban and suburban roadways (these locations often have moderate to high pedestrian and vehicle activity). Construct paved shoulders on major rural roadways. In particular, this may help reduce pedestrian N_RRD_X crash types.
- Reduce the design speed and posted speed limit on arterial and collector roadways. This would help reduce the severity of all pedestrian crashes. In particular, this may help reduce pedestrian N_RRD_R crash types.
- Reduce the number of travel lanes on arterial and collector roadways. In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L crash types.
- Provide marked crosswalks at key pedestrian crossing locations. These marked crosswalks should be installed according to FHWA crosswalk guidelines (i.e., marked crosswalks across
multi-lane, high-speed, high-volume roadways should be supplemented by median islands, pedestrian crossing beacons, or other treatments) (FHWA 2005). In particular, this may help reduce N_RRD_R, N_RRD_L, and I_FS_ST_L crash types.

- Provide a dedicated left-turn phase at signalized intersections. In particular, this may help reduce pedestrian I_FS_LT_O and I_FS_LT_S crash types.
- Construct curb extensions to reduce crossing distances and increase pedestrian visibility at mid-block and intersection locations. In particular, this may help reduce pedestrian I_NS_ST_L crash types.
- Construct medians and median refuge islands along arterial and collector roadways. In particular, this may help reduce pedestrian I_NS_ST_L and I_FS_ST_L crash types.
- Install pedestrian crossing beacons at uncontrolled crosswalks, where warranted (rectangular rapid flashing beacons or pedestrian hybrid beacons). In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L as well as N_RRD_R and N_RRD_L crash types.
- Prohibit right-turn-on-red at signalized intersections.
- Reduce turning radii at the corners of intersections.
- Eliminate dedicated right-turn lanes at intersections.
- Improve roadway lighting, especially at the sides of the roadway near crosswalks. This may help prevent many of the top pedestrian crash types.
- Provide sidewalks in locations with high pedestrian and vehicle activity. In particular, this may help reduce pedestrian N_RRD_X crash types.
- Remove roadside visibility obstructions, including parked cars near crosswalks. This may help reduce N_RRD_R crash types.

4.1.2. Engineering Treatments to Improve Bicyclist Safety

The following treatments should be implemented, where appropriate, to reduce fatal and severe bicycle crashes. The list below also provides examples of specific common fatal and severe crash types that could be addressed by each treatment.

- Add bicycle facilities along arterial and collector roadways in urban and suburban areas. These facilities include standard, striped bicycle lanes as well as other facilities that are more comfortable for bicyclists, including buffered bicycle lanes and separated bike lanes, as supported by the FHWA memorandum on Bicycle and Pedestrian Facility Design Flexibility (http://www.fhwa.dot.gov/environment/bicycle_pedestrian/guidance/design_guidance/design_flexibility.cfm) (2013) and Separated Bikeway Design Guide (http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikeway_pdg/page00.cfm) (2015). Comfortable, on-road facilities help reduce sidewalk riding and bicycling in the opposite direction as adjacent traffic, which contributes to many bicycle crashes. In particular, this may help reduce bicycle N_RRD_S, I_NS_RT_R and I_NS_ST_R crash types.
- Construct paved shoulders (at least four feet wide) along major roadways in rural areas. Paved shoulders provide space for bicyclists to ride outside of the main travel lanes. These facilities may help reduce the risk of bicyclists being struck from behind by a motorist on rural roadways. In particular, this may help reduce bicycle N_RRD_S crashes.
- Improve roadway lighting, especially in urban and suburban areas where bicyclists are common but may be less visible to motorists, even when they are equipped with lights. In particular, this may help reduce bicycle N_RRD_S crashes.
- Prohibit right-turn-on-red at signalized intersections. In particular, this may help reduce bicycle I_NS_RT_R crashes.
• Reduce the number of roadway lanes on arterial and collector roadways. In particular, this may help reduce bicycle I_FS_LT_O, I_NS_RT_R, and I_NS_ST_L crash types.
• Provide a dedicated left-turn phase at signalized intersections. In particular, this may help reduce bicycle I_FS_LT_O crashes.

4.2. Education
Education is important for increasing public knowledge about laws that are designed to promote pedestrian and bicycle safety. In addition, educational messages can emphasize safe driving, bicycling, and walking behaviors. Ultimately, education should contribute to self-reinforcing, positive social norms. When this is achieved, safe driving, bicycling, and walking behaviors will be exhibited simply by following others without conscious thought. Educational messages can be delivered in a variety of formats, including formal driver training classes, bicyclist training classes, safety brochures, posters, media campaigns through traditional print, radio, and television formats as well as social media. Police departments should also play an important role in educating the public (in addition to having an enforcement role, described below).

The results of this study suggest several educational messages that should be targeted towards motorists, pedestrians, and bicyclists to facilitate safer behaviors.

4.2.1. Safety Messages for Motorists
The following messages should be targeted toward motorists:
• You must yield the right-of-way to a pedestrian in a crosswalk. In other words, you must allow a pedestrian who has stepped off the curb into the crosswalk to cross in front of you before you proceed. In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L crash types.
• You must yield the right-of-way to a pedestrian in a crosswalk when turning left or right at an intersection. In particular, this may help reduce pedestrian I_FS_LT_O crashes.
• You must yield the right-of-way to a pedestrian in a crosswalk when you are traveling straight, even if you are on a main roadway with no stop sign or traffic light and there is a stop sign for automobiles on the side street. In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L crash types.
• Always be ready to yield to pedestrians when traveling straight, including people crossing from either the right or the left. This means that you need to be traveling slow enough to come to a stop before you reach any crosswalk, in case a pedestrian enters it. In particular, this may help reduce pedestrian N_RRD_R and N_RRD_L crash types.
• When passing a bicyclist, provide at least three feet of space between your vehicle and the bicyclist (even when a bicycle lane is present).
• Always look in both directions for vehicles, bicyclists, and pedestrians at a stop sign. In particular, look for pedestrians and bicyclists approaching from the sidewalk on your right before turning right at an intersection. This includes looking to the right before turning right on red and before turning right onto a major street. This may help reduce I_NS_RT_R crashes.
• Look for pedestrians in the crosswalk on the left side of the intersection before turning left. In particular, this may help reduce pedestrian I_FS_LT_O crashes.
• Reduce speed and watch closely for pedestrians near disabled vehicles in the roadway or at the side of the roadway. In particular, this may help reduce pedestrian N_RRD_X crashes.
• Look for bicyclists approaching from the sidewalk on your right before turning right at an intersection. In particular, this may help reduce bicyclist I_NS_RT_R crashes.
• Look for bicyclists traveling through the intersection on the roadway or in the crosswalk on the left side of the intersection before turning left. In particular, this may help reduce bicyclist I_FS_LT_O crashes.
• When driving at night, travel at an appropriate speed to detect and avoid colliding with a pedestrian or bicyclist who is traveling in compliance with legal requirements. Since pedestrians and bicyclists tend to be more difficult to see in the dark, this speed is often lower than the posted speed limit. In particular, this may help reduce pedestrian N_RRD_X, N_RRD_R, and N_RRD_L and bicyclist N_RRD_S crashes.

4.2.2. Safety Messages for Pedestrians
The following messages should be targeted toward pedestrians:
• Obey all traffic control, including traffic signals.
• Cross the street within crosswalks. Motorists are required to yield the right-of-way to you (stop so that you can cross) if you set foot into a crosswalk. In particular, this may help reduce pedestrian N_RRD_R and N_RRD_L crash types.
• Since motorists may not always be aware that you are trying to cross the street in a crosswalk, point your arm in the direction that you intend to cross before setting foot into the crosswalk. In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L crash types.
• Do not cross from between parked cars. This is especially important for children. This may help reduce N_RRD_R crashes.
• Watch for left-turning cars, especially when crossing driveways and minor streets along busy streets. In particular, this may help reduce pedestrian I_FS_LT_O and I_FS_LT_S crash types.
• Be aware that motorists may not see you if they are turning right and you are approaching on their right side (especially if they are turning onto a busy street).
• Be aware that motorists may have a difficult time seeing you at night, especially if you aren’t wearing bright/retroreflective clothing. In particular, this may help reduce N_RRD_X, N_RRD_R, and N_RRD_L crash types.
• If you stop your vehicle on the side of a high-speed roadway, do not get out before the police arrive. This may help reduce N_RRD_X and N_RRD_R crashes.

4.2.3. Safety Messages for Bicyclists
The following messages should be targeted toward bicyclists:
• Obey all traffic control, including stop signs and traffic signals.
• Ride in the street in the same direction as traffic. This is safer when you cross driveways and intersections. In particular, this may help reduce bicyclist I_NS_RT_R and I_NS_ST_R crash types.
• Assume that motorists will not see you if you approach from the right side of their vehicle at an intersection (especially from the sidewalk). In particular, this may help reduce bicyclist I_NS_RT_R and I_NS_ST_R crash types.
• Watch for left-turning cars at intersections on busy streets, even when you have the right-of-way. In particular, this may help reduce bicyclist I_FS_LT_O crash types.
• If you ride when it is dark, have a white light on the front of your bike and a red light on the back of your bike. Go beyond legal requirements and also wear bright/retroreflective clothing. In particular, this may help reduce bicyclist N_RRD_S crashes.
• Be aware that motorists may have a difficult time seeing you at night, especially if you don’t have lights and are not wearing bright/retroreflective clothing. In particular, this may help reduce bicyclist N_RRD_S crashes.
4.3. Enforcement
Enforcement activities help complement education efforts by making sure that pedestrians, bicyclists, and drivers follow traffic rules. Reducing unsafe behaviors and supports social norms that are safer for pedestrians and bicyclists. Enforcement also maximizes the safety benefits of specific roadway designs. Routine traffic enforcement should include all laws that help promote pedestrian and bicycle safety (including yielding to pedestrians in uncontrolled crosswalks), despite the possibility of initially being unpopular. Specific behaviors that should be targeted to reduce pedestrian and bicycle fatalities include:

- Motorists speeding, especially on streets in urban areas (locations with high levels of pedestrian and bicycle activity).
- Motorists not yielding to pedestrians in crosswalks when traveling straight through uncontrolled intersections. In particular, this may help reduce pedestrian I_FS_ST_L and I_NS_ST_L crash types.
- Motorists not yielding to pedestrians in crosswalks when turning at intersections. In particular, this may help reduce pedestrian I_FS_LT_O crashes.
- Motorists driving while intoxicated. This may reduce the likelihood of all pedestrian and bicycle crashes, particularly crashes resulting in fatal and severe injuries.
- Motorists passing within less than three feet of a bicyclist. In particular, this may help reduce bicyclist N_RRD_S and N_RSH_S crash types.
- Pedestrians disobeying traffic signals. In particular, this may help reduce pedestrian I_FS_ST_L crashes.
- Bicyclists disobeying traffic signals. In particular, this may help reduce bicyclist I_FS_ST_R and I_NS_ST_L crash types.
- Bicyclists riding without lights at night. In particular, this may help reduce bicyclist N_RRD_S crash types.

4.4. Evaluation
This study provides additional insights into Wisconsin pedestrian and bicycle crash characteristics, but it does not answer all important safety questions or address all limitations of existing data. The research process led to the following recommendations to improve pedestrian and bicycle crash data and inform future pedestrian and bicycle safety analyses.

4.4.1. Improve Police Pedestrian and Bicycle Crash Reporting Practices
Evaluating police crash report narratives revealed a wide range of quality in reporting practices, including some low-quality reports that provided little detail about the crash circumstances. Low-quality, low-detail reporting can be improved by giving law enforcement officers more training on pedestrian and bicycle laws and the importance of providing details about pedestrian, bicyclist, and motorist movements and behaviors. Since law enforcement officers have limited time to write reports, it is important to make the reporting process as easy and efficient as possible. Therefore, several improvements should also be made to the standard MV4000 crash reporting forms:

- **Identify alcohol involvement by party.** The existing WisTransPortal database shows whether or not alcohol is involved in a crash through an alcohol flag in the database. However, it does not identify which party (automobile driver, pedestrian, or bicyclist) was intoxicated. Party-specific intoxication is sometimes noted in the police report narrative or crash report fields 88-90 (Driver/Pedestrian Condition, Substance Presence, and Alcohol Test/Alcohol Content), but it is not documented consistently. These fields are already available through the crash report, and their inclusion in the database could supplement the database’s use of an alcohol flag.
• Record the bicyclist party in a consistent location on the crash report. The MV4000 form provides space for information about each party in a crash to be entered separately. For automobile-pedestrian collisions, the automobile driver is nearly always recorded as Party 1 and the pedestrian is nearly always recorded as Party 2. However, the motorist and bicyclist are entered as either Party 1 or Party 2 in bicycle crashes. As a result, analysts need to perform extra data cleaning steps to provide a correct summary of bicyclist characteristics. In order to be consistent with pedestrian crashes, the automobile driver should be recorded as Party 1 and the bicyclist should be recorded as Party 2.

• Record the LMCM crash type code on the crash report. The MV4000 form should be updated to include a data field to record the LMCM crash type code for all pedestrian and bicycle crashes. This new data field should also be included in the WisTransPortal database. Making this change will allow analysts to summarize crashes by type using the database rather than reading through each crash narrative in detail. In order to produce consistent data, officers should be trained on the LMCM crash types.

• Change the “Safety Equipment” checkbox options and consistently record bicyclist helmet use in a standard field on the crash report. Currently, police officers are able to record bicycle helmet use in the “Safety Equipment” field for each unit in the crash report, as well as in the crash summary at the end of the report. According to data collected in the “Safety Equipment” field, only 20% of crashes involved a bicyclist who wore a helmet. However, one of the potential input values for the “Safety Equipment” field is “NA,” which is defined as “Not applicable-non-motorist.” In other words, the police officer may have marked “NA” because they identified the unit as a non-motorist (who would not have a seat belt), or left the field blank. Of the 229 bicycle crashes studied in detail, the most common entry in the “Safety Equipment” field for bicyclists was “NA,” which represented 42% of all crashes. Because so many crashes identified “NA” in the “Safety Equipment” field, we don’t have an accurate estimate of bicyclist helmet use. Therefore, the “Safety Equipment” checkbox options should be modified to remove “Not applicable, non-motorist.” Increased consideration of this field is not recommended to suggest that a bicyclist who is in a crash should be blamed or held liable for not wearing a helmet; it is recommended to collect better data on the safety effectiveness of helmets. Helmet use laws vary by jurisdiction, and the safety benefits of helmet use may be muted or reversed if mandatory helmet use laws reduce the number of people who bicycle. More research is needed on this topic.

• Record bicyclist use of lights in a standard field on the crash report. The MV4000 form should be updated to include a data field to record whether or not a bicyclist involved in a crash was using a light at night. Currently, many officers note whether or not bicyclists have lights in the crash narrative or note it in the pedestrian/bicyclist action field in the form, but this is not done consistently, so this information is not useful for quantifying the risk of not having lights at night. Better data on use of lights will make this analysis possible.

• Record whether or not the motorist saw the pedestrian or bicyclist before the crash. Police noted that the driver “did not see” the pedestrian or bicyclist in many of the crashes reviewed in detail. This information may be helpful for future education efforts.

• Record environmental context characteristics that may contribute to the crash. Some crashes are related to environmental conditions at the time of the crash. While weather information is already recorded, officers should make sure to record other types of environmental features that may have contributed to the crash. For example, landscaping or a parked delivery vehicle may have blocked the motorist’s view of a pedestrian before he or she stepped into the
crosswalk or a bicycle lane may have had a pothole or debris that made a bicyclist swerve into traffic.

4.4.2. Collect Pedestrian and Bicycle Counts and Surveys to Account for Exposure
Pedestrian and bicycle activity levels are associated with the number of pedestrian and bicycle crashes observed at particular times and locations. In addition, people in certain socioeconomic groups (e.g., gender, age, income level) may walk or bike more than people in other groups, so they experience more pedestrian and bicycle crashes (all else equal). Data on pedestrian and bicycle activity can be used to control for these differences and understand the underlying differences in crash risk by time, location, and user characteristics. Counts can provide information about pedestrian and bicycle activity at specific locations and specific times. Household travel surveys can indicate pedestrian and bicycle activity levels at different times and for different socioeconomic groups. These data can be used to develop crash rates (number of pedestrian or bicycle crashes per trip, per crossing, or per mile). For example, collecting pedestrian and bicyclist volumes within each of Wisconsin’s top 20 pedestrian and bicycle crash hot spot locations would make it possible to calculate which location (of the 20) had the highest risk of crashes. This could help agencies target safety treatments to locations where the roadway conditions were most dangerous, rather than just targeting locations with the highest levels of pedestrian and bicycle activity. In addition, having exposure data for different hours of the day, days of the week, and seasons of the year could allow education, enforcement, and roadway maintenance activities to be targeted to time periods with the highest risk for pedestrian and bicycle crashes.

4.4.3. Quantify the Impacts Pedestrian and Bicycle Safety Strategies to Inform Future Recommendations
While this study classifies the most common pedestrian and bicycle crashes by type, future studies should quantify the impacts of engineering, education, and enforcement strategies on safety outcomes. For example, specific intersection and roadway characteristics may be associated with higher or lower pedestrian and bicycle crash risk. This relationship is often quantified by single-variable crash modification factors (CMFs) or multi-variable safety performance functions (SPFs). CMFs and SPFs are statistical equations that associate crash risk with pedestrian, bicyclist, and motor vehicle volumes; roadway design characteristics; and other local environment factors. They can be used to predict the increase or decrease in pedestrian and bicycle crashes that would be expected to occur if a roadway is redesigned. For example, the Federal Highway Administration’s CMF Clearinghouse (2014) includes CMFs predicting a 43% increase in pedestrian crashes when right-turn-on-red is allowed at signalized intersections and a 46% decrease in pedestrian crashes at marked, uncontrolled crossings of arterial roadways when median refuges are provided. One challenge for developing CMFs and SPFs is that the analysis process requires data on pedestrian and bicycle volumes at specific locations. Another challenge is having a complete inventory of pedestrian and bicycle infrastructure (and detailed roadway design characteristics that may impact pedestrian and bicycle safety) for all Wisconsin roadways.

In the future, it would be useful to have CMFs and SPFs showing the expected increase or decrease in pedestrian crashes due to changes in characteristics, such as:

- Sidewalk presence
- Posted speed limit
- Number of roadway lanes
- Number of exclusive left- or right-turn lanes
- Number of driveway crossings
- Curb extensions and corner turning radii
• Freeway on- and off-ramp crossing design
• Traffic control (no control, stop control, signal control)

The following characteristics would be useful to test for their relationship with bicycle crashes:
• Bicycle lane presence
• Paved shoulder presence
• On-road bicycle facility width
• Sidpath presence
• Posted speed limit
• Width of roadway lanes
• Number of roadway lanes
• Number of exclusive left- or right-turn lanes
• Number of driveway crossings
• Traffic control (no control, stop control, signal control)

Education and enforcement interventions should also be evaluated.

4.4.4. Analyze Crashes Using Emergency Room Data
Emergency room data may include some pedestrian and bicycle incidents that are not reported to police and may provide a more accurate assessment of injury severity than police crash reports. Therefore, a follow-up study should analyze emergency-room pedestrian and bicycle crash data, compare results to this study, and identify additional insights that could help inform pedestrian and bicycle safety initiatives. The Crash Outcome Data Evaluation System (CODES) database can be used for this purpose. Overall, pedestrian and bicyclist injury severity was rated similarly by police and medical professionals for 2011 to 2013 pedestrian and bicycle crashes in the WisTransPortal database. However, data from the CODES database only provides an injury evaluation for just over half of all crashes, as fatalities and non-severe crashes may not warrant a trip to the hospital. In the case of fatalities, police reports may have a more severe injury rating (“K”) than the emergency-room report because police reports are updated if a fatality occurs within 30 days of the crash. If the comparison considered the many non-severe crashes that do not result in hospitalization, it is likely that police assessments of injury are more severe than hospital assessments of injury. Finally, we did not have access to hospital records that were not matched with WisTransPortal crashes, so we were not able to estimate the rate of police crash underreporting.

4.4.5. Supplement Standard Police Reports with Detailed Reconstruction Data for Fatal Crashes
Many fatal pedestrian and bicycle crashes undergo detailed reconstruction to more precisely identify contributing factors. Crash reconstruction reports are currently classified due to sensitive content, so they were not available for this study. However, it may be possible to obtain non-sensitive portions of these reports to reveal details about vehicle speed, sight lines, and lighting characteristics that are rarely captured in a standard police crash report. This could produce a more complete understanding of fatal crashes.

4.4.6. Analyze all Pedestrian and Bicycle Crashes in Detail
This study focused mainly on fatal- and severe-injury pedestrian and bicycle crashes. As a result, fatal and severe crashes were oversampled for the in-depth analysis of police report narratives. This issue was controlled by analyzing different crash severity levels separately, but it is important to be aware that the overall list of the most common pedestrian and bicycle crash types (and the lists of common
young pedestrian and young bicyclist crash types) correspond with higher-severity crashes. When more resources are available, all crashes can be reviewed in detail to provide the actual percentage of all pedestrian and bicycle crash types at all injury severity levels.
Part 5. References


Federal Highway Administration. BIKESAFE: Bicycle Safety Guide and Countermeasure Selection System, Prepared for the Federal Highway Administration by the University of North Carolina Highway Safety Research Center, Vanasse Hangen Brustlin, Inc., and Toole Design Group, Primary Authors: C. Sundstrom


Wisconsin Department of Transportation (WisDOT). 2011 Wisconsin Traffic Crash Facts, March 2013.


Appendix A. Variables Collected for Detailed Crash Analysis

This appendix lists the key variables that were collected and analyzed for Wisconsin crashes involving pedestrians and bicyclists. The data were collected from a sample of Wisconsin MV4000 crash reports that were filed in the Wisconsin Traffic Operations and Safety Laboratory (TOPS) WisTransPortal crash database between 2011 and 2013. These variables are related to crash background information, crash report accuracy, citations, driver and pedestrian characteristics, roadway and intersection characteristics, and crash causes. Some of the variables are already available in the WisTransPortal crash database. These variables are followed by the specific variable name in the list below. Other variables were derived from the police narrative, other information in the MV4000 crash report, or Google Earth and Google Street View.

### Background Information

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crash Report Number</td>
<td>Crash Report Number (Text)</td>
<td>DOCTNMBR</td>
</tr>
<tr>
<td>Crash Date</td>
<td>Crash Date (Number)</td>
<td>ACCDDATE</td>
</tr>
<tr>
<td>Crash Time of Day</td>
<td>Crash Time of Day (Number)</td>
<td>ACCDTIME</td>
</tr>
<tr>
<td>Crash Day of Week</td>
<td>Crash Day of Week (Text)</td>
<td>DAYNMBR</td>
</tr>
<tr>
<td>Weather Condition</td>
<td>Weather condition at time of crash (Clear, Cloudy, Rain, Snow, Fog, Sleet/Hail, Blowing Sand/Dirt/Snow, Severe Crosswinds, Other, Unknown)</td>
<td>WTHRCOND</td>
</tr>
<tr>
<td>Citation Issued</td>
<td>Party who was given a citation in the crash (Driver, Pedestrian, Bicyclist, or specific combination)</td>
<td>STNM</td>
</tr>
<tr>
<td>Fault</td>
<td>Party who was primarily responsible for the crash, as suggested by the police narrative (Driver, Pedestrian, Bicyclist, or specific combination. “No fault” is also an option). Note that “fault” is not assessed officially by law enforcement officers in Wisconsin. (Text)</td>
<td></td>
</tr>
<tr>
<td>Injury Severity</td>
<td>Classification summarizing the most severe injury experienced by any party in the crash. In nearly all cases, the pedestrian or bicyclist experienced the most severe injury. Injury severity is measured on the KABCO scale (K = Killed, A = Incapacitating, B = Non-incapacitating, C = Possible, Blank = Unreported), but it is summarized into the following three categories: 1 = K, 2 = A, and 3 = B, C, or O)</td>
<td></td>
</tr>
<tr>
<td>Crash dataset</td>
<td>Crashes were sampled for analysis in several different steps. A code is listed to indicate how the crash was originally selected: K_PED_160: Pedestrian fatality from 160 randomly-selected crashes from 2012; K_PED_80: Pedestrian fatality from 80 randomly-selected crashes from 2011-</td>
<td></td>
</tr>
</tbody>
</table>
2013; K_PED_HOT: Pedestrian fatality located within one of the top 20 fatal and severe pedestrian crash concentrations across the state based on data from 2011-2013; K_BIKE: Bicycle fatality from all bicycle fatalities from 2011-2013; K_BIKE_HOT: Bicycle fatality located within one of the top 20 fatal and severe bicycle crash concentrations across the state based on data from 2011-2013; A_PED_160: Pedestrian severe injury from 160 randomly-selected crashes from 2012; A_PED_80: Pedestrian severe injury from 80 randomly-selected crashes from 2011-2013; A_PED_HOT: Pedestrian severe injury located within one of the top 20 fatal and severe pedestrian crash concentrations across the state based on data from 2011-2013; A_BIKE_160: Bicycle severe injury from 160 randomly-selected crashes from 2012; A_BIKE_80: Bicycle severe injury from 80 randomly-selected crashes from 2011-2013; A_BIKE_HOT: Bicycle severe injury located within one of the top 20 fatal and severe bicycle crash concentrations across the state based on data from 2011-2013; B_C_PED: Pedestrian non-severe crash from 160 randomly-selected crashes from 2012; B_C_BIKE: Bicycle non-severe crash from 160 randomly-selected crashes from 2012
## Crash Report Accuracy

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct Report Location</td>
<td>Location of crash in police narrative matches the location listed at the top of the MV4000 form. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Location Problem</td>
<td>Description of the difference between where the police crash report list where the actual location should be. (Text)</td>
<td></td>
</tr>
<tr>
<td>Modified Report Location</td>
<td>Actual location of the crash based on the police narrative. Only listed for crash reports with incorrect location information. (Text)</td>
<td></td>
</tr>
<tr>
<td>GIS Location</td>
<td>Location of crash is given in the WisTransPortal database. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Actual GIS Location</td>
<td>Actual location where the crash should have been geocoded. (Text)</td>
<td></td>
</tr>
<tr>
<td>Questionable Citation Driver</td>
<td>The citation or assessment of fault to the driver is questionable. A questionable LACK of citation is also noted in this field. This variable is determined by the analyst based on their subjective assessment of the situation. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Questionable Citation Pedestrian or Bicyclist</td>
<td>The citation or assessment of fault to the pedestrian or bicyclist is questionable. A questionable LACK of citation is also noted in this field. This variable is determined by the analyst based on their subjective assessment of the situation. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Questionable Citation Reason</td>
<td>Reason why the citation or assessment of fault to driver, pedestrian, and/or bicyclist may be questionable. Only listed for crash reports with questionable citations. (Text)</td>
<td></td>
</tr>
<tr>
<td>Witness</td>
<td>The MV4000 crash report mentions a witness, suggesting that some information in the report was provided by an outside party who observed the crash. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Citation Not Relevant to Crash</td>
<td>Citation that was written was not related to the cause of the crash. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Other Accuracy Problems</td>
<td>Description of any other accuracy problems in the MV4000 form. (Text)</td>
<td></td>
</tr>
</tbody>
</table>
### Driver Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver Age</td>
<td>Age of driver. (Number)</td>
<td>AGE</td>
</tr>
<tr>
<td>Driver Gender</td>
<td>Gender of driver. (Male or Female)</td>
<td>SEX</td>
</tr>
<tr>
<td>Driver Alcohol Involvement</td>
<td>Driver was intoxicated at time of crash. (Yes or No)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Hit-and-Run</td>
<td>Crash involved a hit-and-run vehicle. (Yes or No)</td>
<td>HITRUN</td>
</tr>
<tr>
<td>Hit-and-Run Follow-Up</td>
<td>Follow-up on a hit-and-run crash is described in the MV4000 form. Only listed for crash reports that involve a hit-and-run. (Yes or No)</td>
<td></td>
</tr>
</tbody>
</table>

### Pedestrian Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Age</td>
<td>Age of pedestrian. (Number)</td>
<td>AGE</td>
</tr>
<tr>
<td>Pedestrian Gender</td>
<td>Gender of pedestrian. (Male or Female)</td>
<td>SEX</td>
</tr>
<tr>
<td>Pedestrian Alcohol Involvement</td>
<td>Pedestrian was intoxicated at time of crash. (Yes or No)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Pedestrian Injury Severity</td>
<td>Pedestrian injury severity. (K = Killed, A = Incapacitating, B = Non-incapacitating, C = Possible, Blank = Unreported)</td>
<td>INJSVR</td>
</tr>
<tr>
<td>Pedestrian Dark Clothing</td>
<td>Pedestrian was noted as wearing dark clothing at time of crash. (Yes or No)</td>
<td></td>
</tr>
</tbody>
</table>

### Bicyclist Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bicyclist Age</td>
<td>Age of Bicyclist. (Number)</td>
<td>AGE</td>
</tr>
<tr>
<td>Bicyclist Gender</td>
<td>Gender of Bicyclist. (Male or Female)</td>
<td>SEX</td>
</tr>
<tr>
<td>Bicyclist Alcohol Involvement</td>
<td>Bicyclist was intoxicated at time of crash. (Yes or No)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Bicyclist Injury Severity</td>
<td>Bicyclist injury severity. (K = Killed, A = Incapacitating, B = Non-incapacitating, C = Possible, Blank = Unreported)</td>
<td>INJSVR</td>
</tr>
<tr>
<td>Bicyclist Dark Clothing</td>
<td>Bicyclist was noted as wearing dark clothing at time of crash. (Yes or No)</td>
<td></td>
</tr>
</tbody>
</table>
### Location Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Type</td>
<td>Type of location where crash occurred. (Intersection, Driveway, Freeway Ramp Intersection, Non-Intersection, Parking Lot, Private Property, Other). Note that any crash beyond the crosswalk lines but still within 50 feet of an intersection should be considered an “Intersection” crash for this variable.</td>
<td>ACCDLOC</td>
</tr>
<tr>
<td></td>
<td>(Note that “driveway” intersections are not included in this variable, so this needs to be added)</td>
<td></td>
</tr>
<tr>
<td>Traffic Control</td>
<td>Traffic controls in effect at the time of the crash. (None, Railroad crossing signal, Stop sign, Traffic control person, Traffic signal operation, Traffic signal flashing, Warning sign, Warning sign with flasher, Yield sign, Other)</td>
<td>TRFCNTL</td>
</tr>
</tbody>
</table>

### Roadway Characteristics (only for crashes that occurred in a roadway corridor at a non-intersection, non-driveway location)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roadway Arterial/Highway</td>
<td>Crash location was on an arterial roadway or highway (tend to be highest volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Collector</td>
<td>Crash location was on a collector roadway (tend to be medium volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Local</td>
<td>Crash location was on a local roadway (tend to be lowest volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway One-Way</td>
<td>Crash location was on a one-way roadway. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Number of Lanes</td>
<td>Number of lanes in both directions (plus turning lanes) at crash location. If a lane is used for on-street parking at the time of the crash, it should not be counted. (Number)</td>
<td></td>
</tr>
<tr>
<td>Roadway Speed Limit</td>
<td>Speed limit of roadway at crash location. (Number)</td>
<td>POSTSPD1</td>
</tr>
<tr>
<td>Roadway Median or Median Island</td>
<td>A median or median island was present at crash location. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Curb Extensions</td>
<td>At least one side of the crosswalk where the crash occurred had curb extensions. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Crash In Crosswalk</td>
<td>The roadway crash occurred within the boundary of a marked or unmarked crosswalk. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Marked Crosswalk</td>
<td>The crosswalk where the crash occurred was marked with lines on the pavement. This only applies to crashes in crosswalks. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>Definition</td>
<td>WisTransPortal Variable</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Roadway Unmarked Crosswalk</td>
<td>The crosswalk where the crash occurred was not marked with lines on the pavement (but was still a legal crosswalk because it was at the location of an intersection with a perpendicular roadway). This only applies to crashes in crosswalks. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Bicycle Lane</td>
<td>There was a bicycle lane on the roadway at the location where the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Shared Lane Marking</td>
<td>There was a shared lane marking on the roadway at the location where the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Sidepath</td>
<td>There was a sidepath beside the roadway at the location where the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Other Bicycle Facility</td>
<td>There was a different type of bicycle facility on the roadway at the location where the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Roadway Other Bicycle Facility Type</td>
<td>Description of other bicycle facility on the roadway at the location where the crash occurred. (Text)</td>
<td></td>
</tr>
</tbody>
</table>

**Intersection/Driveway Characteristics** (This applies only to crashes that occurred at an intersection or driveway location. Any crash beyond the crosswalk lines but still within 50 feet of an intersection should be considered an “intersection” crash for this database.)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Standard Intersection</td>
<td>Type of non-standard intersection where crash occurred. Examples include driveway, oblique, ramp exit (ramp leads from highway to local road), ramp entrance (ramp leads from local road to highway), 5-way, 6-way, etc. (Text)</td>
<td></td>
</tr>
<tr>
<td>Crash Occurred in “From” Roadway crosswalk</td>
<td>The crash occurred in (or near...within 50 feet of) the crosswalk on the roadway leg where the driver was coming from. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Crash Occurred in “To” Roadway crosswalk</td>
<td>The crash occurred in (or near...within 50 feet of) the crosswalk on the roadway leg where the driver was going to. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Crash Occurred Within Intersection</td>
<td>The crash occurred in (or near) the middle of the intersection. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Arterial/Highway</td>
<td>Roadway that the driver was coming from was an arterial roadway or highway (tend to be highest volume. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Collector</td>
<td>Roadway that the driver was coming from was a collector roadway (tend to be medium volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Local</td>
<td>Roadway that the driver was coming from was a local roadway (tend to be lowest volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>From Roadway One-Way</td>
<td>Roadway that the driver was coming from was on a one-way roadway. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Number of Lanes</td>
<td>Number of lanes in both directions (plus turning lanes) on the roadway that the driver was coming from. If a lane is used for on-street parking at the time of the crash, it should not be counted. (Number)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Speed Limit</td>
<td>Speed limit on the roadway that the driver was coming from. (Number)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Median or Median Island</td>
<td>A median or median island was present on the roadway that the driver was coming from. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>From Roadway Curb Extensions</td>
<td>At least one side of the crosswalk across the roadway that the driver was coming from had curb extensions. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Arterial/Highway</td>
<td>Roadway that the driver was going to was an arterial roadway or highway (tend to be highest volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Collector</td>
<td>Roadway that the driver was going to was a collector roadway (tend to be medium volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Local</td>
<td>Roadway that the driver was going to was a local roadway (tend to be lowest volume). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway One-Way</td>
<td>Roadway that the driver was going to was on a one-way roadway. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Number of Lanes</td>
<td>Number of lanes in both directions (plus turning lanes) on the roadway that the driver was going to. If a lane is used for on-street parking at the time of the crash, it should not be counted. (Number)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Median or Median Island</td>
<td>A median or median island was present on the roadway that the driver was going to. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>To Roadway Curb Extensions</td>
<td>At least one side of the crosswalk across the roadway that the driver was coming to had curb extensions. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Intersection Crash In Crosswalk</td>
<td>The intersection crash occurred within the boundary of a marked or unmarked crosswalk. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Intersection Marked Crosswalk</td>
<td>The crosswalk where the crash occurred was marked with lines on the pavement. This only applies to crashes in crosswalks. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Intersection</td>
<td>Unmarked Crosswalk</td>
<td>The crosswalk where the crash occurred was not marked with lines on the pavement (but was still a legal crosswalk because it was at the location of an intersection with a perpendicular roadway). This only applies to crashes in crosswalks. <em>(Yes or No)</em></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>From Roadway Bicycle Lane</td>
<td>There was a bicycle lane on the roadway that the driver was coming from. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>From Roadway Shared Lane Marking</td>
<td>There was a shared lane marking on the roadway that the driver was coming from. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>From Roadway Sidepath</td>
<td>There was a sidepath beside the roadway that the driver was coming from. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>From Roadway Other Bicycle Facility</td>
<td>There was a different type of bicycle facility on the roadway that the driver was coming from. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>From Roadway Other Bicycle Facility Type</td>
<td>Description of other bicycle facility on the roadway that the driver was coming from. <em>(Text)</em></td>
<td></td>
</tr>
<tr>
<td>To Roadway Bicycle Lane</td>
<td>There was a bicycle lane on the roadway that the driver was going to. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>To Roadway Shared Lane Marking</td>
<td>There was a shared lane marking on the roadway that the driver was going to. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>To Roadway Sidepath</td>
<td>There was a sidepath beside the roadway that the driver was going to. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>To Roadway Other Bicycle Facility</td>
<td>There was a different type of bicycle facility on the roadway that the driver was going to. <em>(Yes or No)</em></td>
<td></td>
</tr>
<tr>
<td>To Roadway Other Bicycle Facility Type</td>
<td>Description of other bicycle facility on the roadway that the driver was going to. <em>(Text)</em></td>
<td></td>
</tr>
<tr>
<td>Curb Radius Length</td>
<td>Curb radius length of corner around which the vehicle was turning when the crash occurred. This only applies to crashes that involve left- or right-turning vehicles. <em>(&lt;15 feet, 15-30 feet, &gt;30 feet)</em></td>
<td></td>
</tr>
</tbody>
</table>
### Contributing Actions (select all that apply)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>WisTransPortal Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Multiple-Threat</td>
<td>The pedestrian was struck by a vehicle passing another vehicle that was yielding or turning. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bicycle Multiple-Threat</td>
<td>The bicyclist was struck by a vehicle passing another vehicle that was yielding or turning. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Pedestrian crossing against traffic signal</td>
<td>The pedestrian was struck when they were crossing against the traffic signal (against a red light). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bicyclist crossing against traffic signal</td>
<td>The bicyclist was struck when they were crossing against the traffic signal (against a red light). (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Left-Turning Vehicle</td>
<td>The driver was turning left and struck the pedestrian or bicyclist. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Right-Turning Vehicle</td>
<td>The driver was turning right and struck the pedestrian or bicyclist. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Wrong-Way Riding</td>
<td>The bicyclist was riding in the opposite direction of adjacent vehicle traffic when the crash occurred. Technically, riding in this direction is legal in some jurisdictions, so the term “wrong-way” is not used in the text. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bicycling On Sidewalk</td>
<td>The bicyclist was riding along the sidewalk (or in a crosswalk that connected two sections of sidewalk) when the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bicycling in Door Zone</td>
<td>The bicyclist was riding too close to on-street parking and was either struck by an opening door or swerved to avoid an opening door. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Distracted Pedestrian</td>
<td>The pedestrian was not paying attention while they were walking. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Distracted Bicyclist</td>
<td>The bicyclist was not paying attention while they were bicycling. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Distracted Driver</td>
<td>The police report noted that the driver was distracted. This variable is “unknown” for most hit-and-run crashes. (Yes, No, or Unknown)</td>
<td></td>
</tr>
<tr>
<td>Distraction Type</td>
<td>The type of pedestrian, bicyclist, and/or driver distraction that was noted in the police report (e.g., talking on cell phone, texting, talking with passenger, etc.) (Text)</td>
<td></td>
</tr>
<tr>
<td>Drunk Pedestrian</td>
<td>Pedestrian was intoxicated at time of crash. (Yes or No) (This may be the same as the pedestrian characteristic variable)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Field</td>
<td>Description</td>
<td>Code/Text</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Drunk Bicyclist</td>
<td>Bicyclist was intoxicated at time of crash. (Yes or No) (This may be the same as the bicyclist characteristic variable)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Drunk Driver</td>
<td>Driver was intoxicated at time of crash. (Yes or No) (This may be the same as the driver characteristic variable)</td>
<td>ALCFLAG</td>
</tr>
<tr>
<td>Driver Did Not See</td>
<td>The police report specified that the driver did not see the pedestrian or bicyclist until it was too late to stop. (Yes, No, or Unknown)</td>
<td></td>
</tr>
<tr>
<td>Ped/Bike Did Not See</td>
<td>The police report specified that the pedestrian or bicyclist did not see the automobile until it was too late to stop. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Obstructed View</td>
<td>The sight lines between the driver and the pedestrian or bicyclist were blocked before the crash occurred. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Object Obstructing View</td>
<td>Description of object obstructing the driver’s view of the pedestrian or bicyclist. (Text)</td>
<td></td>
</tr>
<tr>
<td>Struck by Object</td>
<td>Pedestrian or bicyclist was struck by an object related to a collision but was not struck by a vehicle. (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Primary Cause</td>
<td>Primary cause of the crash. This is a two-sentence description of the direct actions that led to the crash, including the directions of pedestrian and driver movements and any key factors that led to the crash (e.g., driver said they did not see the pedestrian until it was too late to stop). (Text)</td>
<td></td>
</tr>
<tr>
<td>WI LMCM Crash Type</td>
<td>Type of crash, according to the LMCM classification approach proposed for Wisconsin. See Appendix B for crash type codes and definitions. (Code)</td>
<td></td>
</tr>
<tr>
<td>WI Crash Description</td>
<td>Simple summary of crash, derived from the Primary Cause field. (Text)</td>
<td></td>
</tr>
<tr>
<td>NHTSA Crash Type</td>
<td>Type of crash, according to the NHTSA Pedestrian Crash Type Definitions and Bicycle Crash Type Definitions listed in Appendix F of the FHWA Pedestrian and Bicycle Crash Analysis Tool (PBCAT) Version 2.0 Application Manual (2006). Each entry includes the three-digit code and the crash type description. (Code-Text)</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B. LMCM Pedestrian and Bicycle Crash Type Codes & Definitions

This appendix provides definitions for the full set of pedestrian and bicycle crash types considered during this study. The crash classification used is called the Location-Movement Classification Method (LMCM), and the crash types are summarized below. The LMCM includes 57 distinct pedestrian crash types and 57 distinct bicycle crash types. Every crash that was examined in detail (by reading the narrative of the MV4000 form) was assigned a crash type. Note that this crash type coding framework is different than the National Highway Traffic Safety Administration (NHTSA) crash type coding framework described in the Pedestrian and Bicycle Crash Analysis Tool (PBCAT): Version 2.0 Application Manual. However, the NHTSA crash types were also determined and included in the detailed crash database.

Wisconsin LMCM Pedestrian Crash Types

The pedestrian crash types are classified into four main categories: roadway non-intersection, roadway intersection, parking lot/private property, and other. Note that any crash that occurred beyond the crosswalk lines but still within 50 feet of an intersection crosswalk is considered an “Intersection” crash. Crashes at driveway entrances or exits (except residential house driveways) are also considered to be intersection crashes.

Roadway Non-Intersection

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RSW_X</td>
<td>Straight-traveling motorist strikes pedestrian on right-side sidewalk, pedestrian not moving or direction unknown</td>
</tr>
<tr>
<td>N_RSW_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on right sidewalk <em>(this crash type was treated as N_RSW_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_RSW_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on right sidewalk <em>(this crash type was treated as N_RSW_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_LSW_X</td>
<td>Straight-traveling motorist strikes pedestrian on left-side sidewalk, pedestrian not moving or direction unknown</td>
</tr>
<tr>
<td>N_LSW_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on left sidewalk <em>(this crash type was treated as N_LSW_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_LSW_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on left sidewalk <em>(this crash type was treated as N_LSW_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_RSH_X</td>
<td>Straight-traveling motorist strikes pedestrian on right roadway shoulder, pedestrian not moving or direction unknown</td>
</tr>
<tr>
<td>N_RSH_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on right roadway shoulder <em>(this crash type was treated as N_RSH_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_RSH_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on right roadway shoulder <em>(this crash type was treated as N_RSH_X in this analysis but could be used separately in future studies)</em></td>
</tr>
<tr>
<td>N_LSH_X</td>
<td>Straight-traveling motorist strikes pedestrian on left roadway shoulder, pedestrian not moving or direction unknown</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>N_LSH_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on left roadway shoulder (this crash type was treated as N_LSH_X in this analysis but could be used separately in future studies)</td>
</tr>
<tr>
<td>N_LSH_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on left roadway shoulder (this crash type was treated as N_LSH_X in this analysis but could be used separately in future studies)</td>
</tr>
<tr>
<td>N_RRD_R</td>
<td>Straight-traveling motorist strikes pedestrian approaching from right on right side of roadway</td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Straight-traveling motorist strikes pedestrian approaching from left on right side of roadway</td>
</tr>
<tr>
<td>N_RRD_X</td>
<td>Straight-traveling motorist strikes pedestrian on right side of roadway, pedestrian not approaching from left or right</td>
</tr>
<tr>
<td>N_RRD_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on right side of roadway (this crash type was treated as N_RRD_X in this analysis but could be used separately in future studies)</td>
</tr>
<tr>
<td>N_RRD_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on right side of roadway (this crash type was treated as N_RRD_X in this analysis but could be used separately in future studies)</td>
</tr>
<tr>
<td>N_LRD_R</td>
<td>Straight-traveling motorist strikes pedestrian approaching from right on left side of roadway</td>
</tr>
<tr>
<td>N_LRD_L</td>
<td>Straight-traveling motorist strikes pedestrian approaching from left on left side of roadway</td>
</tr>
<tr>
<td>N_LRD_X</td>
<td>Straight-traveling motorist strikes pedestrian on left side of roadway, pedestrian not approaching from left or right</td>
</tr>
<tr>
<td>N_LRD_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on left side of roadway (this crash type was treated as N_LRD_X in this analysis but could be used separately in future studies)</td>
</tr>
<tr>
<td>N_LRD_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on left side of roadway (this crash type was treated as N_LRD_X in this analysis but could be used separately in future studies)</td>
</tr>
</tbody>
</table>

**Roadway Intersection**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_NS_ST_R</td>
<td>Straight-traveling motorist strikes pedestrian approaching from right on near side of intersection</td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Straight-traveling motorist strikes pedestrian approaching from left on near side of intersection</td>
</tr>
<tr>
<td>I_NS_ST_X</td>
<td>Straight-traveling motorist strikes pedestrian in roadway on near side of intersection, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_NS_ST_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_NS_ST_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_NS_LT_R</td>
<td>Left-turning motorist strikes pedestrian approaching from right in near crosswalk</td>
</tr>
<tr>
<td>Code</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>I_NS_LT_L</td>
<td>Left-turning motorist strikes pedestrian approaching from left in near crosswalk</td>
</tr>
<tr>
<td>I_NS_LT_X</td>
<td>Left-turning motorist strikes pedestrian in near crosswalk, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_NS_LT_O</td>
<td>Left-turning motorist strikes pedestrian traveling in opposite direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_NS_LT_S</td>
<td>Left-turning motorist strikes pedestrian traveling in same direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Right-turning motorist strikes pedestrian approaching from right in near crosswalk</td>
</tr>
<tr>
<td>I_NS_RT_L</td>
<td>Right-turning motorist strikes pedestrian approaching from left in near crosswalk</td>
</tr>
<tr>
<td>I_NS_RT_X</td>
<td>Right-turning motorist strikes pedestrian in near crosswalk, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_NS_RT_O</td>
<td>Right-turning motorist strikes pedestrian traveling in opposite direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_NS_RT_S</td>
<td>Right-turning motorist strikes pedestrian traveling in same direction on near side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Straight-traveling motorist strikes pedestrian approaching from right on far side of intersection</td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Straight-traveling motorist strikes pedestrian approaching from left on far side of intersection</td>
</tr>
<tr>
<td>I_FS_ST_X</td>
<td>Straight-traveling motorist strikes pedestrian in roadway on far side of intersection, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_FS_ST_O</td>
<td>Straight-traveling motorist strikes pedestrian traveling in opposite direction on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_ST_S</td>
<td>Straight-traveling motorist strikes pedestrian traveling in same direction on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_LT_R</td>
<td>Left-turning motorist strikes pedestrian traveling from right (relative to motorist’s direction before turning) on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_LT_L</td>
<td>Left-turning motorist strikes pedestrian traveling from left (relative to motorist’s direction before turning) on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_LT_X</td>
<td>Left-turning motorist strikes pedestrian in far crosswalk, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Left-turning motorist strikes pedestrian traveling from opposite direction (relative to motorist’s direction before turning) in far crosswalk</td>
</tr>
</tbody>
</table>

147
<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_FS_LT_S</td>
<td>Left-turning motorist strikes pedestrian traveling from same direction (relative to motorist’s direction before turning) in far crosswalk</td>
</tr>
<tr>
<td>I_FS_RT_R</td>
<td>Right-turning motorist strikes pedestrian traveling from right (relative to motorist’s direction before turning) on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_RT_L</td>
<td>Right-turning motorist strikes pedestrian traveling from left (relative to motorist’s direction before turning) on far side of intersection (pedestrian in roadway) (this crash type was not used in this analysis but could be used in future studies)</td>
</tr>
<tr>
<td>I_FS_RT_X</td>
<td>Right-turning motorist strikes pedestrian in far crosswalk, no or unknown pedestrian direction</td>
</tr>
<tr>
<td>I_FS_RT_O</td>
<td>Right-turning motorist strikes pedestrian traveling from opposite direction (relative to motorist’s direction before turning) in far crosswalk</td>
</tr>
<tr>
<td>I_FS_RT_S</td>
<td>Right-turning motorist strikes pedestrian traveling from same direction (relative to motorist’s direction before turning) in far crosswalk</td>
</tr>
</tbody>
</table>

**Parking Lot/Private Property**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_F</td>
<td>Forward-traveling motorist strikes pedestrian in parking lot/on private property</td>
</tr>
<tr>
<td>P_B</td>
<td>Backing motorist strikes pedestrian in parking lot/on private property</td>
</tr>
<tr>
<td>D_F</td>
<td>Forward-traveling motorist strikes pedestrian in driveway (outside of public right-of-way)</td>
</tr>
<tr>
<td>D_B</td>
<td>Backing motorist strikes pedestrian in driveway</td>
</tr>
</tbody>
</table>

**Other**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTH</td>
<td>Other movements that do not fit into the categories above, including train crashes, driverless vehicle crashes, multi-unit crashes where the pedestrian crash was due to the pedestrian being struck by a vehicle that had already been struck by another vehicle</td>
</tr>
</tbody>
</table>
Wisconsin LMCM Bicyclist Crash Types

The bicycle crash types are classified into four main categories: roadway non-intersection, roadway intersection, parking lot/private property, and other. Note that any crash that occurred beyond the crosswalk lines but still within 50 feet of an intersection crosswalk is considered an “Intersection” crash. Crashes at driveway entrances or exits (except residential house driveways) are also considered to be intersection crashes.

Roadway Non-Intersection

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>N_RSW_O</td>
<td>Straight-traveling motorist strikes bicyclist on right-side sidewalk or path, bicyclist traveling in opposite direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_RSW_S</td>
<td>Straight-traveling motorist strikes bicyclist on right-side sidewalk or path, bicyclist traveling in same direction</td>
<td></td>
</tr>
<tr>
<td>N_RSW_X</td>
<td>Straight-traveling motorist strikes bicyclist on right-side sidewalk or path, bicyclist direction unknown</td>
<td></td>
</tr>
<tr>
<td>N_LSW_O</td>
<td>Straight-traveling motorist strikes bicyclist on left-side sidewalk or path, bicyclist traveling in opposite direction</td>
<td></td>
</tr>
<tr>
<td>N_LSW_S</td>
<td>Straight-traveling motorist strikes bicyclist on left-side sidewalk or path, bicyclist traveling in same direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_LSW_X</td>
<td>Straight-traveling motorist strikes bicyclist on left-side sidewalk or path, bicyclist direction unknown</td>
<td></td>
</tr>
<tr>
<td>N_RSH_O</td>
<td>Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in opposite direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_RSH_S</td>
<td>Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist traveling in same direction</td>
<td></td>
</tr>
<tr>
<td>N_RSH_X</td>
<td>Straight-traveling motorist strikes bicyclist on right roadway shoulder or bicycle lane, bicyclist direction unknown</td>
<td></td>
</tr>
<tr>
<td>N_LSH_O</td>
<td>Straight-traveling motorist strikes bicyclist on left roadway shoulder or bicycle lane, bicyclist traveling in opposite direction</td>
<td></td>
</tr>
<tr>
<td>N_LSH_S</td>
<td>Straight-traveling motorist strikes bicyclist on left roadway shoulder or bicycle lane, bicyclist traveling in same direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_LSH_X</td>
<td>Straight-traveling motorist strikes bicyclist on left roadway shoulder or bicycle lane, bicyclist direction unknown</td>
<td></td>
</tr>
<tr>
<td>N_RRD_R</td>
<td>Straight-traveling motorist strikes bicyclist approaching from right on right side of roadway <em>(crossing or merging at non-intersection location; includes trail crossings)</em></td>
<td></td>
</tr>
<tr>
<td>N_RRD_L</td>
<td>Straight-traveling motorist strikes bicyclist approaching from left on right side of roadway <em>(crossing or merging at non-intersection location; includes trail crossings)</em></td>
<td></td>
</tr>
<tr>
<td>N_RRD_O</td>
<td>Straight-traveling motorist strikes bicyclist on right side of roadway *(in a travel lane), bicyclist traveling in opposite direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_RRD_S</td>
<td>Straight-traveling motorist strikes bicyclist on right side of roadway *(in a travel lane), bicyclist traveling in same direction <em>(includes door-related crashes)</em></td>
<td></td>
</tr>
<tr>
<td>N_RRD_X</td>
<td>Straight-traveling motorist strikes bicyclist on right side of roadway <em>(in a travel lane), bicyclist direction unknown</em></td>
<td></td>
</tr>
<tr>
<td>N_LRD_R</td>
<td>Straight-traveling motorist strikes bicyclist approaching from right on left side of roadway <em>(crossing or merging at non-intersection location; includes trail crossings)</em></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>Definition</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>N_LRD_L</td>
<td>Straight-traveling motorist strikes bicyclist approaching from left on left side of roadway (crossing or merging at non-intersection location; includes trail crossings)</td>
<td></td>
</tr>
<tr>
<td>N_LRD_O</td>
<td>Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in opposite direction</td>
<td></td>
</tr>
<tr>
<td>N_LRD_S</td>
<td>Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist traveling in same direction <em>(contra-flow bicyclist)</em></td>
<td></td>
</tr>
<tr>
<td>N_LRD_X</td>
<td>Straight-traveling motorist strikes bicyclist on left side of roadway (in a travel lane), bicyclist direction unknown</td>
<td></td>
</tr>
</tbody>
</table>

Roadway Intersection *(these codes do not indicate if the bicyclist is on the sidewalk; that distinction would require another level of information)*

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_NS_ST_R</td>
<td>Straight-traveling motorist strikes bicyclist approaching from right on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_ST_L</td>
<td>Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection</td>
</tr>
<tr>
<td>I_NS_ST_O</td>
<td>Straight-traveling motorist strikes bicyclist traveling in opposite direction on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_ST_S</td>
<td>Straight-traveling motorist strikes bicyclist traveling in same direction on near side of intersection</td>
</tr>
<tr>
<td>I_NS_ST_X</td>
<td>Straight-traveling motorist strikes bicyclist in roadway on near side of intersection, no bicyclist direction</td>
</tr>
<tr>
<td>I_NS_LT_R</td>
<td>Left-turning motorist strikes bicyclist approaching from right on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_LT_L</td>
<td>Left-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
</tr>
<tr>
<td>I_NS_LT_O</td>
<td>Left-turning motorist strikes bicyclist traveling in opposite direction on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_LT_S</td>
<td>Left-turning motorist strikes bicyclist traveling in same direction on near side of intersection</td>
</tr>
<tr>
<td>I_NS_LT_X</td>
<td>Left-turning motorist strikes bicyclist on near side of intersection, no bicyclist direction</td>
</tr>
<tr>
<td>I_NS_RT_R</td>
<td>Right-turning motorist strikes bicyclist approaching from right on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_RT_L</td>
<td>Right-turning motorist strikes bicyclist approaching from left on near side of intersection</td>
</tr>
<tr>
<td>I_NS_RT_O</td>
<td>Right-turning motorist strikes bicyclist traveling in opposite direction on near side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_NS_RT_S</td>
<td>Right-turning motorist strikes bicyclist traveling in same direction on near side of intersection <em>(includes right-hook crashes)</em></td>
</tr>
<tr>
<td>I_NS_RT_X</td>
<td>Right-turning motorist strikes bicyclist on near side of intersection, no bicyclist direction</td>
</tr>
<tr>
<td>I_FS_ST_R</td>
<td>Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection</td>
</tr>
<tr>
<td>I_FS_ST_L</td>
<td>Straight-traveling motorist strikes bicyclist approaching from left on far side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>I_FS_ST_O</td>
<td>Straight-traveling motorist strikes bicyclist traveling in opposite direction on far side of intersection <em>(contra-flow bicyclist)</em></td>
</tr>
<tr>
<td>Code</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>I_FS_ST_S</td>
<td>Straight-traveling motorist strikes bicyclist traveling in same direction on far side of intersection</td>
</tr>
<tr>
<td>I_FS_ST_X</td>
<td>Straight-traveling motorist strikes bicyclist in roadway on far side of intersection, no bicyclist direction</td>
</tr>
<tr>
<td>I_FS_LT_R</td>
<td>Left-turning motorist strikes bicyclist approaching from right (relative to motorist’s direction before turning) on far side of intersection</td>
</tr>
<tr>
<td>I_FS_LT_L</td>
<td>Left-turning motorist strikes bicyclist approaching from left (relative to motorist’s direction before turning) on far side of intersection (contra-flow bicyclist)</td>
</tr>
<tr>
<td>I_FS_LT_O</td>
<td>Left-turning motorist strikes bicyclist traveling in opposite direction (relative to motorist’s direction before turning) on far side of intersection</td>
</tr>
<tr>
<td>I_FS_LT_S</td>
<td>Left-turning motorist strikes bicyclist traveling in same direction (relative to motorist’s direction before turning) on far side of intersection (contra-flow bicyclist)</td>
</tr>
<tr>
<td>I_FS_LT_X</td>
<td>Left-turning motorist strikes bicyclist on far side of intersection, no bicyclist direction</td>
</tr>
<tr>
<td>I_FS_RT_R</td>
<td>Right-turning motorist strikes bicyclist approaching from right (relative to motorist’s direction before turning) on far side of intersection (contra-flow bicyclist)</td>
</tr>
<tr>
<td>I_FS_RT_L</td>
<td>Right-turning motorist strikes bicyclist approaching from left (relative to motorist’s direction before turning) on far side of intersection</td>
</tr>
<tr>
<td>I_FS_RT_O</td>
<td>Right-turning motorist strikes bicyclist traveling from opposite direction (relative to motorist’s direction before turning) on far side of intersection (contra-flow bicyclist)</td>
</tr>
<tr>
<td>I_FS_RT_S</td>
<td>Right-turning motorist strikes bicyclist traveling from same direction (relative to motorist’s direction before turning) on far side of intersection</td>
</tr>
<tr>
<td>I_FS_RT_X</td>
<td>Right-turning motorist strikes bicyclist on far side of intersection, no bicyclist direction</td>
</tr>
</tbody>
</table>

**Parking Lot/Private Property**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>P_F</td>
<td>Forward-traveling motorist strikes bicyclist in parking lot/on private property</td>
</tr>
<tr>
<td>P_B</td>
<td>Backing motorist strikes bicyclist in parking lot/on private property</td>
</tr>
<tr>
<td>D_F</td>
<td>Forward-traveling motorist strikes bicyclist in driveway (outside of public right-of-way)</td>
</tr>
<tr>
<td>D_B</td>
<td>Backing motorist strikes bicyclist in driveway</td>
</tr>
</tbody>
</table>

**Other**

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTH</td>
<td>Other movements that do not fit into the categories above, including train crashes, driverless vehicle crashes, multi-unit crashes where the bicyclist crash was due to a bicyclist being struck by a vehicle that had already been struck by another vehicle</td>
</tr>
</tbody>
</table>

*Note: for a simplified grouping, remove the last letter of the code indicating pedestrian, bicyclist, or motorist direction*
Appendix C. General Characteristics of Crashes Analyzed in Detail

This appendix provides the general characteristics of the sample of crashes analyzed in detail. This sample is summarized in Table C.1. Its purpose is to illustrate how representative the sample is of the full set of pedestrian and bicycle crashes in each injury severity category.

Table C.1. Injury Severity of Sample of Pedestrian and Bicycle Crashes Reviewed in Detail

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>Pedestrian Crash Sample</th>
<th>Total Pedestrian Crashes</th>
<th>Bicycle Crash Sample</th>
<th>Total Bicycle Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatality (K)</td>
<td>80 (52.6%)</td>
<td>152</td>
<td>33 (100%)</td>
<td>33</td>
</tr>
<tr>
<td>Incapacitating Injury (A)</td>
<td>154 (19.9%)</td>
<td>774</td>
<td>122 (39.7%)</td>
<td>307</td>
</tr>
<tr>
<td>Other/No Injury (B, C, or O)</td>
<td>62 (1.6%)</td>
<td>3,931</td>
<td>74 (2.4%)</td>
<td>3,025</td>
</tr>
<tr>
<td>Total</td>
<td>296 (6.1%)</td>
<td>4,857</td>
<td>229 (6.8%)</td>
<td>3,365</td>
</tr>
</tbody>
</table>

Source: WisTransPortal Database (Wisconsin TOPS Laboratory 2014a)

General Characteristics of Fatal Pedestrian Crash Sample

Approximately 53% (80 of 152) of the fatal pedestrian crashes that were studied in detail.

- 33 crashes (41%) occurred in 2011, 27 crashes (34%) occurred in 2012, and 20 crashes (25%) occurred in 2013.
  - When studying all fatal pedestrian crashes between 2011 and 2013, 62 crashes (41%) occurred in 2011, 48 (32%) occurred in 2012, and 42 (28%) in 2013.

- 34 (43%) crashes occurred in the southeast region, 17 (21%) in the southwest region, and 15 (19%) in the northeast region. (All Fatal Crashes: SE Region - 66 crashes (43%); SW Region - 32 crashes (21%); NE Region - 27 crashes (18%))

- 19 (24%) crashes occurred in Milwaukee County, 8 (10%) in Dane County, 4 (5%) in Waukesha County, and 4 (5%) in Washington County. Since Milwaukee County contains 17% of the state’s population, pedestrian fatalities are overrepresented in this community. This may be due to higher rates of walking in Milwaukee County or to more dangerous roadways or pedestrian and driver behaviors. (All Fatal Crashes: Milwaukee County - 37 crashes (24%); Dane County - 13 crashes (8.6%); Waukesha and Kenosha - 8 crashes (5.3%); Racine - 5 crashes (3.3%))

16 (20%) crashes occurred in the City of Milwaukee, 5 (6.3%) in the City of Madison, and 3 (3.8%) in the City of Green Bay. (Figure C.1) (All Fatal Crashes: Milwaukee - 31 crashes (20%); Madison - 8 crashes (5%); La Crosse - 5 crashes (3.3%))
Figure 2

- 43 crashes (54%) occurred at a non-intersection location, 31 (39%) occurred at an intersection, 5 crashes (6.3%) in a parking lot, and 1 crash (1.3%) on private property. These classifications were identified by the police officer recording the crash. (Figure C.2) (All Fatal Crashes: Non-Intersection - 83 crashes (55%); Intersection - 51 crashes (34%); Parking Lot - 13 crashes (8.6%); Private Property - 5 crashes (3.3%))

Figure C.2

- 53 crashes (66%) occurred on an urban roadway. (All Fatal Crashes: Urban roadway - 98 crashes (64%))

- 33 crashes (41%) occurred on a state highway. (All Fatal Crashes: State Highway - 54 crashes (36%))
- 19 crashes (58%) occurred on an urban state highway. (All Fatal Crashes: Urban State Highway - 32 crashes (59%))

- 41 crashes (51%) occurred on a Friday, Saturday or Sunday. (Figure C.3) (All Fatal Crashes: Friday, Saturday, or Sunday - 73 crashes (48%))

- 21 crashes (28%) occurred on a 25 mph roadway or lower, 22 crashes (30%) occurred on a roadway with a posted speed limit of 30, 12 crashes (16%) occurred on a roadway with a posted speed of 35-40 mph, 7 crashes (9.5%) occurred on a 45-50 mph roadway, and 12 crashes (16%) occurred on a roadway that was at or above 55 miles per hour. (Figure C.4) (All Fatal Crashes: 25 mph or lower - 36 crashes (27%); 30 mph - 36 crashes (27%); 45-50 mph - 24 crashes (18%); 45-50 mph - 24 crashes (18%); 45-50 mph - 24 crashes (18%))
- 55 crashes (69%) involved a male vehicle driver and 41 crashes (51%) involved a female pedestrian. (All Fatal Crashes: Male Vehicle Driver - 98 crashes (64%); Male Pedestrian - 85 crashes (56%))

- 19 crashes (24%) were deemed a hit-and-run. (All Fatal Crashes: 29 crashes (19%))

- 53 crashes (66%) occurred on a roadway that wasn’t divided and 12 crashes (15%) occurred on a divided highway without a traffic barrier. (All Fatal Crashes: Undivided Roadway - 97 crashes (64%); Divided Highway without a Traffic Barrier - 22 crashes (15%))

- 17 crashes (21%) occurred between 3 PM and 6 PM, 14 crashes (18%) between 6 PM and 9 PM, and 10 crashes (13%) between both 9 AM and 12 PM and 12 PM and 3 PM. (Figure C.5) (All Fatal Crashes: 3-6 pm - 36 crashes (24%); 6-9 pm - 24 crashes (16%); 9 pm – Midnight - 19 crashes (13%))
- 10 crashes (13%) involved pedestrians who were 21 years old or younger. (All Fatal Crashes: 24 crashes (16%))
  - 5 (50%) of these crashes involved pedestrians who were 9 years old or younger and 4 crashes (40%) involved pedestrians who were 18 to 21 years old. (All Fatal Crashes: 0-9 years old - 12 crashes (50%); 18-21 years old - 9 crashes (38%))
- 28 crashes (35%) involved pedestrians who were 65 years old or older. (All Fatal Crashes: 65+ years old - 47 crashes (31%))
- 11 crashes (7.2%) involved a vehicle driver who was 65 years old or older, 9 crashes (5.9%) involved a vehicle driver who was 21 to 24 years old, 3 crashes (2%) involved a vehicle driver who was 18 to 20 years old, and 3 crashes (2%) involved a vehicle driver who was 16 to 17 years old. (All Fatal Crashes: 65+ years old - 26 crashes (17%); 18-21 years old - 12 crashes (7.9%); 21-24 years old - 11 crashes (7.2%))

**Contributing Crash Factors**

Of the 80 fatal pedestrian crashes that were studied in more detail:
- 62 crash reports (78%) identified no inclement roadway conditions, but 14 (18%) identified the roadway as wet and 3 (3.8%) identified it as snowy. (All Fatal Crashes: No Inclement Roadway Conditions - 112 crashes (74%); Wet Roadway - 29 crashes (19%); Snowy - 7 crashes (4.6%))
- 47 crashes (59%) involved clear weather conditions, 17 crashes (21%) involved cloudy conditions, and 10 (13%) involved rainy conditions. (All Fatal Crashes: Clear - 79 crashes (52%); Cloudy - 43 crashes (28%); Rainy - 18 crashes (12%))

- 37 crashes (46%) occurred during daylit conditions, 25 crashes (31%) occurred during dark, but lit, conditions, and 15 crashes (19%) occurred in dark, unlit conditions. (Figure C.6) (All Fatal Crashes: Daylit - 71 crashes (47%); Dark, but Lit by Streetlights - 45 crashes (30%); Dark, Unlit - 30 crashes (20%))

![Crashes by Lighting Condition (n=80)](image)

- 27 crashes (34%) were flagged for alcohol use according to the police crash report. In the crash database, crashes are given an alcohol flag if alcohol was perceived as involved. Within specific crash reports, the reporting officer may take note of the crash unit who was involved, but this is not always recorded. Of the 27 crashes flagged for alcohol, only 13 (48%) suggested alcohol use in the crash report. In 11 crashes (85%), the motorist was identified as one of the units under the influence of alcohol and in 4 crashes (31%) the pedestrian was. (All Fatal Crashes: Alcohol Flag - 47 crashes (31%))

- 63 crashes (79%) involved a vehicle driving straight, 6 crashes (7.5%) involved a vehicle backing up, and 5 crashes (6.3%) involved a left-turning vehicle. This includes both intersection and non-intersection locations (Figure C.7). (All Fatal Crashes: Straight - 117 (77%); Backing Up - 10 crashes (6.6%); Left-turning - 8 crashes (5.3%); Right-Turning - 3 crashes (2%))

  - Of the crashes with vehicles driving straight, 42 (67%) occurred in urban areas. Those that occurred in urban areas, however, were more likely to occur during the late afternoon to early evening, as 21 crashes (50%) occurred between 3 pm and 9 pm. Only 5 rural crashes (24% of total rural crashes) occurred during that same time frame. 5
rural crashes (24%) occurred between the hours of 9 pm and midnight, and 4 crashes (19%) occurred between 6 am and 9 am. Additionally, 23 crashes (37%) were noted as occurring in daylit conditions, 24 crashes (38%) in dark, but lit conditions, and 15 crashes (23%) occurring in dark, unlit conditions. (All Fatal Straight-Traveling Motorist Crashes: Urban – 76 crashes (65%); Night – 74 Crashes (63%))

- 25 of 31 intersection-related crashes (81%) involved a vehicle driver who was driving straight, and 5 intersection-related crashes (16%) involved a vehicle driver turning left. (All Fatal Intersection Crashes: Straight-traveling Motorist - 40 crashes (78%); Left-Turning Vehicle - 7 crashes (14%))

- 63 crashes (79%) had no traffic control, 10 crashes (13%) had operating traffic signals, and 3 crashes (3.8%) had stop signs. This variable refers to the traffic control governing the driver’s movement (not the pedestrian or bicyclist). (Figure C.8) (All Fatal Crashes: No Traffic Control - 126 crashes (83%); Operating Traffic Signals - 15 crashes (9.9%); Stop Sign - 4 crashes (2.6%))
- 14 crash reports (18%) noted that the driver failed to yield to the right of way, 13 crash reports (16%) noted the driver as driving inattentively and 13 crash reports (16%) noted driver condition as playing a role in the crash. In the crash reports, driver condition is most often synonymous with alcohol or drug use. (Figure C.9) (All Fatal Crashes: Driving Inattentively – 24 crashes (16%); Failure to Yield – 19 crashes (13%); Driver Condition – 16 crashes (11%))
- 32 crashes (40%) noted that the pedestrian walking straight. The majority of crash reports did not indicate a pedestrian action, so this percentage may be lower than the actual amount. (All Fatal Crashes: 60 crashes (40%))

- 8 crash reports (10%) noted that speed played a role in the crash (i.e., the “speed flag” was indicated in these reports). (All Fatal Crashes: 18 crashes (12%))

**General Characteristics of Fatal Bicycle Crash Sample**
All 33 fatal bicycle crashes were reviewed in detail, so the sample characteristics were identical to the characteristics of the full set of crashes.

**General Characteristics of Severe Pedestrian Crash Sample**
Approximately 20% (154 of 774) of the severe pedestrian crashes that were studied in detail.

- 44 crashes (29%) occurred in 2011, 52 crashes (34%) occurred in 2012, and 58 crashes (38%) occurred in 2013.
  - When studying all severe pedestrian crashes between 2011 and 2013, 258 crashes (33%) occurred in 2011, 262 (34%) occurred in 2012, and 254 (33%) in 2013.

- 81 (53%) crashes occurred in the southeast region, 24 (16%) in the northeast region, and 23 (15%) in the southwest region. (All Severe Crashes: SE Region - 381 crashes (49%); SW Region - 137 crashes (18%); NE Region - 118 crashes (15%))

- 62 (40%) crashes occurred in Milwaukee County, 14 (9%) in Dane County, 9 (5.8%) in Brown County, 9 (5.8%) in Racine County, and 8 (5.2%) in Outagamie County. Since Milwaukee County contains 17% of the state’s population, pedestrian fatalities are overrepresented in this community. This may be due to higher rates of walking in Milwaukee County or to more dangerous roadways or pedestrian and driver behaviors. (All Severe Crashes: Milwaukee County - 238 crashes (31%); Dane County - 55 crashes (7.1%); Waukesha and Racine - 38 crashes (4.9%))

  53 (34%) crashes occurred in the City of Milwaukee, 11 (7.1%) in the City of Madison, and 6 (3.9%) in the City of Eau Claire. (**Figure C.10**) (All Severe Crashes: Milwaukee - 173 crashes (22%); Madison - 43 crashes (5.6%); Racine and Green Bay - 21 crashes each (2.7%))
70 crashes (45%) occurred at a non-intersection location, 63 (41%) occurred at an intersection, 17 crashes (11%) in a parking lot, and 4 crashes (2.6%) on private property. These classifications were identified by the police officer recording the crash. *(Figure C.11)* (All Severe Crashes: Non-Intersection - 376 crashes (49%); Intersection - 253 crashes (33%); Parking Lot - 113 crashes (15%); Private Property - 32 crashes (4.1%))

- 135 crashes (88%) occurred on an urban roadway. (All Severe Crashes: Urban roadway - 602 crashes (78%))

- 36 crashes (23%) occurred on a state highway. (All Severe Crashes: State Highway - 181 crashes (23%))
- 33 crashes (21%) occurred on an urban state highway. (All Severe Crashes: Urban State Highway - 131 crashes (72%))

- 73 crashes (47%) occurred on a Friday, Saturday or Sunday. *(Figure C.12)* (All Severe Crashes: Friday, Saturday, or Sunday - 347 crashes (45%))

- 66 crashes (43%) occurred on a 25 mph roadway or lower, 53 crashes (34%) occurred on a roadway with a posted speed limit of 30, 9 crashes (5.8%) occurred on a roadway with a posted speed of 35-40 mph, 1 crash (0.6%) occurred on a 45-50 mph roadway, and 6 crashes (3.9%) occurred on a roadway that was at or above 55 miles per hour. *(Figure C.13)* (All Severe Crashes: 25 mph or lower - 325 crashes (42%); 30 mph - 168 crashes (22%); 55+ mph - 50 crashes (6.5%))
- 77 crashes (50%) involved a male vehicle driver and 87 crashes (57%) involved a male pedestrian. (All Severe Crashes: Male Vehicle Driver - 423 crashes (55%); Male Pedestrian - 430 crashes (56%))

- 39 crashes (25%) were deemed a hit-and-run. (All Severe Crashes: 162 crashes (21%))

- 95 crashes (62%) occurred on a roadway that wasn’t divided and 26 crashes (17%) occurred on a divided highway without a traffic barrier. (All Severe Crashes: Undivided Roadway - 457 crashes (59%); Divided Highway without a Traffic Barrier - 124 crashes (16%))

- 30 crashes (20%) occurred between 3 PM and 6 PM, 24 crashes (16%) between 6 PM and 9 PM, and 24 crashes (16%) between 12 PM and 3 PM. (Figure C.14) (All Severe Crashes: 6-9 pm - 133 crashes (17%); 3-6 pm - 111 crashes (14%); 9 am – Noon - 109 crashes (14%))

- 41 crashes (27%) involved pedestrians who were 21 years old or younger. (All Severe Crashes: 224 crashes (29%))
  - 23 (56%) of these crashes involved pedestrians who were 10 to 19 years old and 18 crashes (44%) involved a pedestrian who was 9 years or younger. (All Severe Crashes: 10 to 18 years old – 116 crashes (52%); 9 years old or younger – 72 crashes (32%))

- 25 crashes (16%) involved pedestrians who were 21 to 24 years old and 14 crashes (9.1%) involved a pedestrian who was 65 years old or older. (All Severe Crashes: 21 to 24 years old – 65 crashes (8.4%); 65+ years old - 116 crashes (15%))
- 23 crashes (14.9%) involved a vehicle driver who was 21 to 24 years old, 22 crashes (14.3%) involved a vehicle driver who was under 21 years old, 14 crashes (9.1%) involved a vehicle driver who was 25 to 29 years old, and 11 crashes (7.1%) involved a vehicle driver who was 65 years old or older. (All Severe Crashes: 65+ years old - 96 crashes (12%); 21-24 years old - 73 crashes (9.4 %); 18-20 years old - 57 crashes (7.4%))

**Contributing Crash Factors**

Of the 154 severe pedestrian crashes that were studied in more detail:

- 115 crash reports (75%) identified no inclement roadway conditions, but 25 (16%) identified the roadway as wet and 11 (7.1%) identified it as snowy. (All Severe Crashes: No Inclement Roadway Conditions - 591 crashes (76%); Wet Roadway – 120 crashes (16%); Snowy - 45 crashes (5.8%))

- 87 crashes (57%) involved clear weather conditions, 47 crashes (31%) involved cloudy conditions, and 8 (5.2%) involved rainy conditions. (All Severe Crashes: Clear – 433 crashes (56%); Cloudy - 234 crashes (30%); Rainy - 59 crashes (7.6%))

- 76 crashes (49%) occurred during daylit conditions, 65 crashes (42%) occurred during dark, but lit, conditions, and 10 crashes (6.5%) occurred in dark, unlit conditions. (Figure C.15) (All Fatal Crashes: Daylit - 430 crashes (56%); Dark, but Lit by Streetlights - 239 crashes (31%); Dark, Unlit - 80 crashes (10%))

![Figure C.15](image)

- 19 crashes (12%) were flagged for alcohol use according to the police crash report. In the crash database, crashes are given an alcohol flag if alcohol was perceived as involved. Within specific crash reports, the reporting officer may take note of the crash unit who was involved, but this is not always recorded. Of the 19 crashes flagged for alcohol, 18 (95%) suggested alcohol use in
the crash report. In 11 crashes (58%), the pedestrian was identified as one of the units under the influence of alcohol and in 7 crashes (37%) the motorist was. (All Severe Crashes: Alcohol Flag - 91 crashes (12%))

102 crashes (66%) involved a vehicle driving straight, 17 crashes (11%) involved a vehicle turning left, and 9 crashes (5.8%) involved a vehicle backing up. This includes both intersection and non-intersection locations (Figure C.16). (All Severe Crashes: Straight - 500 (65%); Left-turning - 104 crashes (13%); Backing Up - 63 crashes (8.1%))

- Of the crashes with vehicles driving straight, 94 (92%) occurred in urban areas. Those that occurred in urban areas, however, were more likely to occur during the late afternoon to early evening, as 36 crashes (38%) occurred between 3 pm and 9 pm. Additionally, 51 of the crashes that involved a motorist driving straight (50%) were noted as occurring in dark, but lit by streetlight conditions, 41 crashes (40%) in daylight conditions, and 7 crashes (6.9%) occurring in dark, unlit conditions. (All Severe Straight-Traveling Vehicle Crashes: Urban – 394 Crashes (79%); Non-Daylit – 250 Crashes (50%))

- 38 of 63 intersection-related crashes (60%) involved a vehicle driver who was driving straight, and 14 intersection-related crashes (22%) involved a vehicle driver turning left. (All Severe Intersection Crashes: Straight-traveling Motorist - 143 crashes (57%); Left-Turning Vehicle - 69 crashes (27%))

- 103 crashes (67%) had no traffic control, 36 crashes (23%) had operating traffic signals, and 10 crashes (6.5%) had stop signs. This variable refers to the traffic control governing the driver’s
movement (not the pedestrian or bicyclist).\((Figure\ C.17)\) (All Severe Crashes: No Traffic Control - 570 crashes (74%); Operating Traffic Signals - 124 crashes (16%); Stop Sign - 40 crashes (6.5%))

- 28 crash reports (18%) noted that the driver failed to yield to the right of way, 24 crash reports (16%) noted the driver as driving inattentively and 8 crash reports (5.2%) noted driver condition as playing a role in the crash. Each crash can be assigned any number of these crash circumstances, so a crash that involved a motorist who failed to yield may also involve an inattentive driver. In the crash reports, driver condition is most often synonymous with alcohol or drug use.\((Figure\ 27)\) (All Severe Crashes: Failure to Yield – 180 crashes (23%); Driving Inattentively – 159 crashes (21%))

- 70 crashes (46%) noted that the pedestrian was walking straight. The majority of crash reports did not indicate a pedestrian action, so this percentage may be lower than the actual amount. (All Severe Crashes: 324 crashes (42%))

- 4 crash reports (2.6%) noted that speed played a role in the crash (i.e., the “speed flag” was indicated in these reports). (All Severe Crashes: 52 crashes (6.7%))
General Characteristics of Severe Bicycle Crash Sample

Approximately 40% (122 of 307) of the severe bicycle crashes that were studied in detail.

- 38 crashes (31%) occurred in 2011, 48 crashes (39%) occurred in 2012, and 36 crashes (30%) occurred in 2013.
  - When studying all severe bicycle crashes between 2011 and 2013, 105 crashes (34%) occurred in 2011, 115 (38%) occurred in 2012, and 87 (28%) in 2013.

48 (39%) crashes occurred in the southeast region, 29 (24%) in the southwest region, and 25 (21%) in the northeast region. (All Severe Crashes: Southeast – 118 crashes (38%); Southwest – 77 crashes (25%); Northeast – 65 crashes (21%))

- 25 (21%) crashes occurred in Milwaukee County, 18 (15%) in Dane County and 10 (8.2%) in Waukesha County. (All Severe Crashes: Milwaukee County – 59 crashes (19%); Dane County – 42 crashes (14%); Waukesha County – 27 crashes (8.8%))

- 12 (9.8%) crashes occurred in the City of Madison, 11 (9.0%) in the City of Milwaukee, 8 (6.6%) in the City of Kenosha, and 5 (4.1%) in the City of Wauwatosa and Oshkosh. (Figure C.18) (All Severe Crashes: Milwaukee – 28 crashes (9.1%); Madison – 27 crashes (8.8%); Kenosha – 11 crashes (3.6%); La Crosse – 10 crashes (3.3%))

- 78 crashes (64%) occurred at an intersection location, 38 (31%) occurred at a non-intersection, 4 crashes (3.3%) in a parking lot, and 2 crashes (2%) on private property. (Figure C.19) (All Severe Crashes: Intersection – 196 crashes (64%); Non-intersection – 95 crashes (31%); Parking Lot – 10 crashes (3.3%); Private Property – 6 crashes (2%))
- 96 crashes (79%) occurred on an urban roadway (All Severe Crashes: 231 crashes (75%))

- 35 crashes (29%) occurred on a state highway. (All Severe Crashes: 81 crashes (26%))
  - 30 crashes (86%) occurred on an urban state highway. (All Severe Crashes: 62 crashes (77%))

- 44 crashes (36%) occurred on a Friday, Saturday or Sunday. (All Severe Crashes: Friday, Saturday or Sunday - 115 crashes (37%))

- 39 crashes (32%) occurred between 3 PM and 6 PM, 26 crashes (21%) occurred between 12 PM and 3 PM, and 17 (14%) crashes occurred during the hours of 9 AM to 12 PM. (Figure C.20) (All Severe Crashes: 3 pm to 6 pm – 81 crashes (26%); 12 pm to 3 pm – 72 crashes (24%); 9 am to 12 pm – 44 crashes (14%))
The following characteristics reflect the 118 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 56 crashes (48%) occurred on a roadway with a posted speed of 25 mph or lower, 35 crashes (30%) occurred on a 30 to 35 mph roadway, 15 (13%) occurred on a 40 to 50 mph roadway and 5 crashes (4.2%) occurred on a roadway that had a posted speed of 55 mph or higher. (Figure C.21) (All Severe Crashes: 25 mph or Lower – 156 crashes (54%); 30 to 35 mph – 81 crashes (28%); 40 to 50 mph – 35 crashes (12%); 55+ mph – 17 crashes (5.9%))
- 62 crashes (53%) involved a male vehicle driver. (All Severe Crashes: Male Vehicle Driver – 157 crashes (52%))

- 90 crashes (76%) involved a male bicyclist. (All Severe Crashes: Male Bicyclist – 220 crashes (73%))

- 17 crashes (14%) involved a bicyclist who was 14-17 years old, 15 crashes (13%) involved a bicyclist who was 21-24 years old, and 13 crashes (11%) involved a bicyclist who was 18-20 years old. (All Severe Crashes: 14-17 years old – 41 crashes (14%); 18-21 years old – 34 crashes (11%); 10-13 years old – 30 crashes (10%))

- 19 crashes (16%) involved a driver who was 65 years or older, 14 crashes (12%) involved a driver who was 25 to 29 years old, and 13 crashes (11%) involved a driver who was 16-20 years old. (All Severe Crashes: 65+ years old – 41 crashes (14%); 21 to 24 years old – 24 crashes (8%); 18 to 20 years old – 23 crashes (8%))

**Contributing Crash Factors**

Of the 122 severe bicycle crashes studied in detail:

- 109 crash reports (89%) identified no inclement roadway conditions, but 8 (6.6%) identified the roadway as wet and 5 (4.1%) identified it as snowy. (All Severe Crashes: No Inclement Roadway Condition – 289 crashes (94%); Wet Roadway – 13 crashes (4.2%); Snowy – 5 crashes (1.6%))

- 78 crashes (64%) involved clear weather conditions, 37 crashes (30%) involved cloudy conditions, and 5 (4.1%) involved rainy conditions. (All Severe Crashes: Clear – 220 crashes (72%); Cloudy – 74 crashes (24%); Rainy – 11 crashes (3.6%))

- 91 crashes (75%) occurred during daylit conditions, 12 crashes (9.8%) occurred during dark, but lit, conditions, and only 7 crashes (5.7%) occurred in dark, unlit conditions. (Figure C.22) (All Severe Crashes: Daylight – 248 crashes (81%); Dark, but Lit by Streetlights – 31 crashes (10%); Dark, Unlit – 12 crashes (3.9%))
- 5 crashes (4.1%) were flagged for alcohol use according to the police crash report. (All Severe Crashes: 11 crashes (3.6%))

The following characteristics reflect the 118 crashes that identified a “Bike” as one of the involved units according to the MV4000 database.

- 67 crashes (57%) involved a vehicle driving straight, 21 crashes (18%) involved a right-turning vehicle, and 16 crashes (14%) involved a vehicle turning left. (Figure C.23) (All Severe Crashes: Straight – 167 crashes (55%); Right Turn – 56 crashes (19%); Left Turn – 49 crashes (16%))
- 69 crashes (58%) had no traffic control for the involved vehicle, 29 crashes (25%) had operating traffic signals, and 16 crashes (14%) had stop signs. (Figure C.24) (All Severe Crashes: No Traffic Control – 177 crashes (59%); Operating Traffic Signals – 72 crashes (24%); Stop Signs – 45 crashes (15%))

![Crashes by Traffic Control on the Vehicle Driver's Roadway (n=118)](image_url)

- 96 crash reports (81%) noted that the bicyclist was traveling straight. (All Severe Crashes: 247 Crashes (82%))

- 69 crash reports (58%) noted that no traffic control existed on the bicyclist’s roadway, 29 crash reports (25%) noted that there was operating traffic signals, and 17 crash reports (14%) noted that there was a stop sign present. (All Severe Crashes: No Traffic Control – 182 crashes (60%); Operating Traffic Signals – 66 crashes (22%); Stop Sign – 46 Crashes (15%))
Appendix D. Comparison of LMCM and NHTSA Crash Types

This appendix shows how individual Location-Movement Classification Method (LMCM) crash types correspond with individual National Highway Traffic Safety Administration (NHTSA) crash types. All of the 296 pedestrian and 229 bicycle crashes reviewed in detail were assigned both a LMCM crash type and a NHTSA crash type. However, when considering all of these crashes, the proportion of crashes by type reflect biases in the sample of crashes chosen for analysis (fatal and severe-injury crashes were oversampled). Therefore, the subsets of 234 fatal and severe pedestrian crashes (Table D.1) and 155 fatal and severe bicycle crashes (Table D.2) that were analyzed in detail. Each matrix shows the number of crashes that were assigned to each combination of LMCM crash type (row) and NHTSA crash type (column). The sections below compare the LMCM and NHTSA crash types for these fatal and severe pedestrian and bicycle crashes.

Information about location and movement are fundamental to understanding the circumstances of a crash. Location describes whether a pedestrian was struck in a crosswalk on the near or far side of the intersection or crossing the roadway at non-intersection location. It also illustrates whether a bicyclist was struck in a travel lane, on a shoulder, or in an intersection crosswalk. Movement describes whether the motorist was turning left, turning right, or traveling straight prior to the crash. It also reveals whether a pedestrian or bicyclist was struck when approaching from the right or left or when traveling in the same or opposite direction as an automobile.

Location and movement data are useful for pedestrian and bicycle safety treatments. Education messages to motorists, pedestrians, and bicyclists can emphasize specific circumstances that are common in pedestrian and bicycle crashes (e.g., should education messages say that motorists should look for pedestrians in general, or should the messages specifically instruct motorists to look for pedestrians in the left crosswalk before making a left turn?). Enforcement can be targeted at common location and movement types (e.g., should enforcement focus on bicyclists riding on the sidewalk in general, or should enforcement discourage sidewalk riding in the opposite direction as adjacent traffic?).

Engineering decisions can also be informed by crash location and movement information. For example, depending on the number of lanes, traffic volumes, and turning movements, which leg of an intersection experiences the most pedestrian crashes? Could the intersection benefit from modified signal timing, fewer lanes on one of the roadways, or curb extensions or a median island on a particular approach? As new bicycle facility designs are developed, are most crashes occurring when motorists first enter the intersection or when they are exiting the intersection? Do these crashes involve bicyclists traveling with or against adjacent traffic or involve motorists turning right or left? Answers to these questions could lead to traffic signal modifications, different types of buffer separation (e.g., parked cars, bollards, planters), and preferences for one-way versus two-way separated bicycle facilities.

Additional applications of the LMCM may include developing specific, targeted pedestrian and bicycle detection capabilities within automated vehicle systems (AVS). If crashes involving pedestrians approaching from the left are particularly common at intersections, AVS may be able to incorporate a left-oriented pedestrian sensor and use algorithms to prioritize inputs from this left-oriented device when the automobile is determined to be in an intersection area.

Location and movement are included in the definitions of some NHTSA pedestrian and bicycle crash types (e.g., Pedestrian 410: "Walking along roadway with traffic—from behind", Pedestrian 781: “Motorist left turn—parallel paths”, Bicycle 213: “Motorist right turn—same direction”). However,
many NHTSA crash types are defined by behavior (e.g., Pedestrian 770: “Motorist failed to yield”, Pedestrian 741: “Dash”, Bicycle 153: “Bicyclist ride-out—signalized intersection”) and circumstances (e.g., Pedestrian 342: “School-bus related”, Bicycle 123: “Bicyclist lost control—alcohol/drug impairment”). Further, several of the NHTSA crash types overlap (e.g., a crash could potentially be classified as either Pedestrian 741: “Dash” or Pedestrian 342: “School-bus related”), while the LMCM crash types are mutually exclusive.

While the behavior- and circumstance-based NHTSA crash types are useful, the LMCM can supplement these crash types with complete information about location and movement. Note that the PBCAT allows location and movement inputs, but it only summarizes crashes using the NHTSA crash types. Therefore, there may be potential to enhance the PBCAT outputs to also include LMCM crash types.

Fatal and Severe Pedestrian Crash Type Comparison

The NHTSA method indicates that the most common types of crashes resulting in fatal and severe pedestrian injuries are: the pedestrian entered the roadway at a location where the motorist’s view was not obstructed (741) (14%), the motorist failed to yield to the pedestrian (770) (11%), the pedestrian entered the roadway at a location where the motorist’s view was obstructed (742) (11%), and the pedestrian failed to yield to the motorist (760) (10%) (Table D.1). However, these NHTSA crash types did not indicate the location of the crash relative to the roadway or the direction of motorist or pedestrian movement.

The points below illustrate the value of analyzing specific NHTSA pedestrian crash types in more depth using the LMCM approach. They highlight common locations and movements that are associated with particular types of fatal and severe pedestrian crashes in Wisconsin. In some cases, these locations and movements can be targeted by pedestrian crash countermeasures, as described below. Note that the specific countermeasures suggested below are not the only strategies that can help reduce these types of pedestrian crashes. In general, most strategies to reduce pedestrian crossing distances and vehicle speeds (e.g., reduce number of travel lanes, narrow travel lanes, add median islands, add curb extensions, install traffic calming in residential areas, enforce speed limits); increase pedestrian visibility, driver attentiveness, and driver yielding to pedestrians (e.g., improve roadway lighting, install flashing beacons at crosswalks, enforce pedestrian right-of-way in crosswalks, reduce driving while intoxicated or while distracted with mobile devices); and increase pedestrian attentiveness and compliance with traffic signals (e.g., enforce pedestrian violations at traffic signals, reduce walking while intoxicated or distracted with mobile devices) will help prevent many types of pedestrian crashes (more information about these and other pedestrian crash countermeasures is available from the WisDOT Wisconsin Guide to Pedestrian Best Practices (2010) and FHWA PEDSAFE countermeasure selection system (2013).

- **Pedestrian entered the roadway at a location where the motorist’s view was not obstructed (741).** The LMCM shows that the majority (63%) of fatal and severe pedestrian crashes of this type occurred at non-intersection locations. Further, nearly three-quarters of these non-intersection crashes involved pedestrians approaching from the right (N_RRD_R) rather than the left (N_RRD_L). Therefore, countermeasures should emphasize protecting pedestrians approaching from the right along roadway segments. In addition, 48% of these crashes and 44% of those that involved a pedestrian entering the roadway from the right (N_RRD_R) occurred with non-daylit conditions. This may suggest that roadway lighting should be improved and that automated pedestrian detection systems need to work in darkness and low-light conditions. Efforts may also focus on multilane roadway locations, as 67% of 741 crashes occurred on a multilane road. Further, 56% of N_RRD_R crashes occurred with multilane roadways.
• **Motorist failed to yield to the pedestrian (770).** Nearly all (92%) of fatal and severe crashes in which the motorist failed to yield to the pedestrian were at intersections. This finding is expected since most legal crosswalks are at intersections. Further, most motorists who failed to yield and produced a fatal or severe pedestrian injury (81%) were traveling straight through an intersection. Twice as many of these 21 motorists struck pedestrians approaching from their left than from their right. Therefore, countermeasures should target motorist awareness and detection of pedestrians approaching from the left. On some roadways, median islands can be added at crosswalks to provide a refuge for pedestrians before they cross the second half of the roadway. Pedestrian flashing beacons may also help increase motorist awareness of pedestrians in these locations. Motorists who failed to yield while traveling straight were at uncontrolled crosswalk locations (i.e., the motorist did not have a stop sign or traffic signal). Therefore, educational messages should emphasize that motorists should anticipate and then yield to pedestrians in crosswalks, even when they are at a location with no other traffic control. Multilane roadway locations should also be emphasized, as 54% of motorist failure to yield crashes occurred on multilane roadways.

• **Pedestrian entered the roadway at a location where the motorist’s view was obstructed (742).** Like NHTSA crash type 741, many (68%) of the fatal and severe pedestrian crashes involving a pedestrian entering the roadway at a location where the motorist’s view was obstructed occurred at non-intersection locations. The pedestrian approached from the right side of the roadway in more than half (56%) of NHTSA crash type 742 crashes (N_RRD_R and I_NS_ST_R). The risk of these crashes could be reduced by adding curb extensions and eliminating on-street parking spaces that are close to crosswalks. While not as common as pedestrians crossing from the right, a notable proportion (40%) of these crashes involved pedestrians crossing from the left. In some cases, pedestrians were struck by a motorist who did not see the pedestrian because he or she was behind another vehicle that had stopped to yield. Countermeasures for this type of “multiple threat” crash include reducing the number of travel lanes and educating drivers to use extreme caution when passing other cars that are stopped in the roadway. 48% of these crashes occur on multilane roadways, so a lane reduction may also reduce speeds and increase safety.

• **Pedestrian failed to yield to the motorist (760).** Nearly all (92%) of the fatal and severe pedestrian crashes in this NHTSA crash type were at intersections. Therefore, they involved pedestrians disobeying traffic signals. Countermeasures should educate pedestrians about when to cross at traffic signals and enforce this law. In some cases, traffic signal cycle lengths could be reduced to increase pedestrian signal compliance. Educational messages could also be given to drivers to make them aware that pedestrians may not always obey traffic signals, and that they should be especially attentive at the far crosswalk (exiting an intersection) when traveling straight. More than twice as many fatalities and severe injuries occur in this situation at far-side crosswalks (I_FS_ST_R, I_FS_ST_L, and I_FS_ST_X) than at near-side crosswalks (I_NS_ST_L and I_NS_ST_R).

The fifth-most common fatal or severe NHTSA pedestrian crash type occurred when a motorist and pedestrian were on parallel paths and the motorist struck the pedestrian while turning left (781) (6%). This crash type does provide information about the motorist’s movement and the relative location of the crash in the intersection. However, it does not include the pedestrian’s direction of movement. The LMCM shows that pedestrians who are struck by left-turning motorists are somewhat more likely to be traveling from opposite direction as the motorist’s approach to the intersection (from the motorist’s right, once he or she has made the turn) (57%) than to be traveling from the same direction as the motorist’s approach to the intersection (from the motorist’s left, once he or she has made the turn).
In either case, it is common for motorists to strike pedestrians when making left turns, since they may focus more on identifying a gap in oncoming traffic than on pedestrians in the left-side crosswalk. These crashes can be reduced at signalized intersections by adding an exclusive left-turn phase or by providing a dedicated left-turn lane (which is often done by reducing the total number of through-lanes on a multilane roadway). Both treatments can help reduce the pressure that motorists may feel from motorists behind them to make a left turn quickly. Educational messages should instruct motorists to look for pedestrians in the left-side crosswalk (approaching from the same direction and from the opposite direction) before they start to make a left turn.

**Fatal and Severe Bicycle Crash Type Comparison**

The NHTSA method indicates that the most common types of crashes resulting in fatal and severe bicycle injuries are: the motorist overtook and struck a bicyclist from behind (231) (12%), the bicyclist struck a motor vehicle after violating a traffic signal (155) (9%), the bicyclist struck a motor vehicle after violating a stop sign (144) (8%), and the motorist struck a bicyclist in a crosswalk or intersection after stopping or yielding (141) (8%) (Table D.2). With the exception of NHTSA crash type 231, these crash types did not indicate the direction of motorist or bicyclist movement. None of the crash types provided detailed information about the crash location relative to the roadway.

The points below illustrate the value of analyzing specific NHTSA bicycle crash types in more depth using the LMCM approach. They highlight common locations and movements that are associated with particular types of fatal and severe bicycle crashes in Wisconsin. In some cases, these locations and movements can be targeted by bicycle crash countermeasures, as described below. Note that the specific countermeasures suggested below are not the only strategies that can help reduce these types of bicycle crashes. In general, most strategies to reduce and vehicle speeds and provide designated roadway space for bicycling (e.g., reduce number of travel lanes, narrow travel lanes, add paved shoulders, add bicycle lanes, install traffic calming in residential areas, enforce speed limits); increase bicyclist visibility, driver attentiveness, and driver respect near bicyclists (e.g., improve roadway lighting, enforce drivers giving at least three feet of space when passing bicyclists, reduce driving while intoxicated or while distracted with mobile devices); and increase bicyclist attentiveness and compliance with traffic devices (e.g., enforce bicyclist violations at traffic signals and stop signs, reduce bicycling while intoxicated or distracted with mobile devices) will help prevent many types of bicycle crashes (more information about these and other bicycle crash countermeasures is provided in other references such as the WisDOT *Wisconsin Bicycle Facility Design Handbook* (2009) and the FHWA *BIKESAFE* countermeasure selection system (2014).

- **Motorist failed to detect the bicyclist and struck the bicyclist from behind (231).** While the NHTSA crash type indicates the direction of the motorist and bicyclist, it does not provide detailed information about the location of the crash on the roadway. The LMCM shows that 72% of these fatal and severe bicycle crashes occurred in the travel lane and 28% occurred on paved shoulders or bicycle lanes. Further, 61% of crashes occurred in non-daylight conditions and 56% occurred on a rural roadway. Note that motor vehicle and bicycle volume data are needed to compare the risk of bicycling on roadways with shared travel lanes versus roadways with shoulders or bicycle lanes. However, adding paved shoulders and bicycle lanes is likely to reduce fatal and severe bicycle crashes since multiple guidelines recommend these facilities to improve bicyclist comfort and safety (FHWA 2014). In addition, reduced speeds and improved lighting could increase driver awareness of bicyclists in the roadway.

- **Bicyclist struck a motor vehicle after violating a traffic signal (155).** The LMCM shows that more than half (57%) of the fatal and severe bicycle crashes within this NHTSA type involved bicyclists riding in the same direction as adjacent traffic (I_NS_ST_L and I_FS_ST_R). However, 43% of
bicyclists violated the traffic signal when traveling in the opposite direction of adjacent traffic, so they were approaching in a manner that the motorists were unlikely to expect. Bicyclist education and enforcement should target these types of traffic signal violations. All but two of these crashes (83%) involved motorists traveling straight. Therefore, it is important to educate motorists so that they are aware of the possibility that bicyclists may cross against traffic signals in front of them. Bicyclist education should also emphasize safe driving at night, as unpredictable actions are much less visible to oncoming traffic. 29% of crashes in this crash type occurred with non-daylit conditions.

- **Bicyclist struck a motor vehicle after violating a stop sign (144).** The LMCM results for this crash type are very similar to NHTSA crash type 155. 54% of the fatal and severe bicycle crashes involved bicyclists riding in the same direction as adjacent traffic (I_NS_ST_L and I_FS_ST_R). However, bicyclists were more likely to be struck on the far side of the intersection (I_FS_ST_R) (5 crashes) than the near side (I_NS_ST_L) (2 crashes). This may be due to motorists having less time to react to a bicyclist unexpectedly running a stop sign from their right. Bicyclist education and enforcement should be targeted to prevent stop sign violations, though enforcement efforts are likely to be most beneficial when they focus on bicyclists who disregard stop signs completely when traffic is approaching than stopping bicyclists who roll slowly through stop signs when there is no traffic nearby.

- **Motorist struck a bicyclist in a crosswalk or intersection after stopping or yielding (141).** A majority (54%) of the fatal and severe bicycle crashes of this type involved bicyclists who were approaching from the motorist’s right on the near side of the intersection (I_NS_RT_R and I_NS_ST_R). Therefore, bicyclists were traveling in the opposite direction of adjacent traffic. While motorists stated that they stopped before the crash, it is likely that they did not look for or detect the bicyclist who was approaching from their right. Riding against adjacent traffic puts bicyclists in a position that is often unexpected by motorists, so it is important to educate bicyclists to ride in the same direction as adjacent traffic. All seven crashes that involved the bicyclist riding against adjacent traffic, also noted that they were riding in the sidewalk or crosswalk when struck. Sidewalk riding is common when people don’t feel comfortable riding in the roadway due to traffic volumes and speeds. Therefore, providing bicycle lanes or other on-road bicycle facilities can help reduce sidewalk riding and reduce these types of crashes. On the other hand, all other crashes of this type (46%) involved motorists striking bicyclists traveling in the same direction as adjacent traffic. Therefore, motorist education should increase awareness of all bicyclists at intersections, including bicyclists approaching traffic and against traffic.

The fifth-most common fatal or severe NHTSA bicyclist crash type occurred when a motorist turned left and struck a bicyclist approaching from the opposite direction (212) (8%). This crash type provides information about the motorist’s movement, bicyclist’s movement, and the relative location of the crash in the intersection. Therefore, it is similar to the LMCM crash type I_FS_LT_O. Motorists may strike bicyclists when making left turns because they may focus mainly on identifying a gap in oncoming motorized traffic and their view of the oncoming bicyclist may be blocked by other vehicles until the last second. In addition, motorists may not expect to see a bicyclist coming from the sidewalk, which represented 17% of these crashes. These crashes can be reduced at signalized intersections by adding an exclusive left-turn phase or by providing a dedicated left-turn lane (which is often done by reducing the total number of through-lanes on a multilane roadway). Both treatments can help reduce the pressure that motorists may feel from motorists behind them to make a left turn quickly. Educational messages should instruct motorists to look for bicyclists when making a left turn.
Considerations
The LMCM provides additional information that is not captured in many NHTSA crash types, but the NHTSA approach is still useful. For example, the most common LMCM crash type producing fatal and severe pedestrian crashes was a straight-traveling motorist striking a pedestrian approaching from the right at a non-intersection location (N_RRD_R) (16%). Of these 37 crash reports, 43% stated that the motorist’s view was not obstructed (NHTSA Crash Type 741) and 35% stated that the motorist’s view was obstructed (NHTSA Crash Type 742). This NHTSA crash type information is useful since obstructed-view crashes may be more appropriate for countermeasures that improve sight lines between drivers and pedestrians, while non-obstructed-view crashes may be more appropriate for countermeasures that increase driver understanding of the law, awareness of pedestrians, and attentiveness (e.g., reduce driving while intoxicated or distracted by a mobile device) and increase pedestrian compliance with traffic signals and attentiveness (e.g., reduce walking while intoxicated or distracted by a mobile device).

Similarly, the most common LMCM crash type producing fatal and severe bicycle crashes was a straight-traveling motorist striking a bicyclist in a travel lane on the right side of the roadway (N_RRD_S) (21%). The circumstances of these crashes involved motorists not detecting bicyclists (NHTSA Crash Type 231) (41%), bicyclists swerving in front of the motorists (NHTSA Crash Type 235) (25%), motorists overtaking bicyclists for an unknown reason (NHTSA Crash Type 239) (13%), and motorists misjudging the space required to pass a bicyclist (NHTSA Crash Type 232) (6%). Some of these circumstances may be addressed more effectively through education to increase motorist awareness of bicyclists and bicyclist visibility, while others may be addressed more effectively by providing better roadway lighting and more designated space for bicycling.

Note that the strategies suggested above are intended to reduce the most common situations producing fatal and severe crash types in Wisconsin. However, strategies to address less-common situations should also be implemented (e.g., if it is more common for pedestrians to be struck when they are approaching from the left for a particular crash type, safety efforts should not ignore pedestrians who approach from the right).

These results do not indicate the relative risk of pedestrian or bicycle crashes in a particular type of location, roadway facility, or movement. Assessing risk requires information about the exposure of pedestrians and bicyclists to potential conflicts with motor vehicles (i.e., pedestrian or bicycle crashes per potential conflict). For example, we are not currently able to compare the risk of the top two LMCM fatal and severe pedestrian crash types (N_RRD_R and I_FS_ST_L). While the sample of pedestrian crashes analyzed in detail included 37 N_RRD_R crashes and 25 I_FS_ST_L crashes (48% more N_RRD_R crashes), we don’t know whether or not there were exactly 48% more opportunities for N_RRD_R crashes. To determine the risk of N_RRD_R crashes, we would need to know how many vehicles traveled along roadways in each direction and how many pedestrians crossed right to left at non-intersection locations relative to each direction of travel. To determine the risk of I_FS_ST_L crashes, we would need to know how many vehicles traveled straight through intersections and how many pedestrians crossed from left to right in the far-side crosswalk relative to each direction of travel. We would need these exposure numbers for the state of Wisconsin between 2011 and 2013. Despite the challenge of quantifying relative risk, locations and movements are still useful for understanding and preventing common types of pedestrian and bicycle crashes.
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<td>4.5%</td>
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<tr>
<td>N_RSH_S</td>
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<td>2</td>
<td>7</td>
<td>4.5%</td>
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<td>N_RRD_L</td>
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<td>1</td>
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<td>2</td>
<td>1</td>
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<td>3.9%</td>
<td></td>
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<tr>
<td>N_RRD_R</td>
<td></td>
<td>2</td>
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<td>3</td>
<td>1.9%</td>
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<tr>
<td>I_FS_RT_O</td>
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<td>3</td>
<td>1.9%</td>
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<tr>
<td>N_LRD_O</td>
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<td>3</td>
<td>1.9%</td>
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<td>3</td>
<td>1.9%</td>
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<tr>
<td>All other types</td>
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<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
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<td></td>
<td>4</td>
<td>12</td>
<td>14.8%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Crashes</td>
<td></td>
<td>18</td>
<td>14</td>
<td>13</td>
<td>13</td>
<td>12</td>
<td>10</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>35</td>
<td>155</td>
<td>100%</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>% of Crashes</td>
<td></td>
<td>11.6%</td>
<td>9.0%</td>
<td>8.4%</td>
<td>8.4%</td>
<td>7.7%</td>
<td>6.5%</td>
<td>5.8%</td>
<td>3.2%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>2.6%</td>
<td>1.9%</td>
<td>1.9%</td>
<td>22.6%</td>
<td>100%</td>
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</tbody>
</table>
Appendix E. Non-Severe-Injury Crash Type Diagrams
This appendix presents the top non-severe-injury ("B", "C", and "O") pedestrian crash types and top non-severe-injury bicycle crash types. Figure E.1.a, and Figure E.1.b summarize pedestrian crash types, and Figure E.1.a, Figure E.1.b, Figure E.1.c., and Figure E.1.d summarize bicycle crash types. Similar figures for fatal and severe injury crash types are provided in the main text of the document. Note that several of the top non-severe crash types (pedestrian non-severe injury crash type #2, pedestrian non-severe injury crash type #3, and bicycle non-severe injury crash type #4) involved private property crashes or did not include enough similar crash characteristics to create a diagram.
Figure E.1.a. Pedestrian Non-Severe Injury Crash Type #1

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I_FS_LT_O</td>
<td>Intersection: Left-turning motorist strikes pedestrian traveling from opposite direction in far crosswalk (7 crashes)</td>
</tr>
</tbody>
</table>

**Crash Scenario 1: 5 Crashes**
Pedestrian had a walk signal.

**Multi-lane Urban Roadways**
- 5 crashes (100%) occurred on an urban roadway
- 3 crashes (60%) occurred on roadways with speed limits of 30 mph
- 4 crashes (80%) involved a vehicle driver that was turning from a multi-lane roadway to another multi-lane roadway

**Marked Crosswalk**
- 5 crashes (100%) involved a pedestrian who was in a marked crosswalk when the crash occurred

**Other Crashes: 2 Crashes**
- 1 crash involved a vehicle with a green turn arrow, who struck a pedestrian crossing against traffic control
- 1 crash involved an intersection controlled by stop signs on the vehicle driver’s roadway. The vehicle driver was turning from a one-way roadway onto another one-way roadway

**Other Characteristics**
The two other crashes within the I_FS_LT_O crash type noted that the vehicle driver did not see the pedestrian, suggesting that Crash Scenario 1 displayed above was less likely to involve visibility concerns than the other crashes of this crash type.
Figure E.1.b. Pedestrian Non-Severe Injury Crash Type #4

#4 Non-Severe Pedestrian Crash Type

N_RRD_R : Non-Intersection: Straight-traveling motorist, in right roadway lane of travel, strikes pedestrian approaching from right (5 crashes)

Crash Scenario 1: 3 Crashes
No noted obstructions.

Daytime Crashes
- 2 crashes (67%) occurred in daylit conditions

Rural Roadways
- 2 crashes (67%) occurred on rural roadways
- 2 crashes (67%) occurred on roadways that were 35+ mph
- 3 crashes (100%) occurred on 2 lane roadways
- 3 crashes (100%) had no crosswalk present

Other Crashes: 2 Crashes
- 2 crashes involved pedestrians who darted out from behind a parked vehicle
**#1 Non-Severe Bicyclist Crash Type**

**I_NS_ST_L**: Intersection: Straight-traveling motorist strikes bicyclist approaching from left on near side of intersection (12 crashes)

### Crash Scenario 1: 6 Crashes

Traffic-controlled intersection.

**No bike lanes present**

**Multi-Lane, Urban Roadways**
- 6 crashes (100%) occurred on an urban roadway
- 6 crashes (100%) occurred on a multi-lane roadway
- 5 crashes (83%) occurred on a roadway with a speed limit of 30 mph

**Bicyclist Action**
- 3 crashes (50%) involved a bicyclist who had disobeyed traffic control
- 3 crashes (50%) involved a bicyclist riding on the sidewalk

**1 crash (17%) was noted as a multiple threat crash**

### Crash Scenario 2: 4 Crashes

Vehicle driver had no traffic control.

**No bike lanes present**

**Urban Roadways**
- 4 crashes (100%) occurred on urban roadways
- 3 crashes (75%) occurred on a roadway with a speed limit of 25 mph

**Bicyclist Action**
- 3 crashes (75%) involved a bicyclist who had disobeyed traffic control

### Other Crashes: 2 Crashes

- 1 crash was controlled by a 4-way stop, and the vehicle driver failed to yield to the right of way
- 1 crash had no traffic control, but the driver was required to yield to the bicyclist’s roadway
Figure E.2.b. Bicycle Non-Severe Injury Crash Type #2

**#2 Non-Severe Bicyclist Crash Type**

**I_FS_LT_O**: Intersection: Left-turning motorist strikes bicyclist traveling from opposite direction on far side of intersection (11 crashes)

**Crash Scenario 1: 5 Crashes**
Green light on vehicle driver’s roadway.

**Afternoon - Evening Crashes**
- 4 crashes (80%) occurred between 3 pm and 9 pm

**Urban Roadways**
- 5 crashes (100%) occurred on an urban roadway
- 4 crashes (80%) occurred on multi-lane roadways

**Visibility**
- 2 crashes (40%) noted that the driver did not see the bicyclist
- No crash reports noted an obstructed view
- 4 crashes (80%) occurred in dark, but lit conditions

**Crash Scenario 2: 4 Crashes**
No traffic control on vehicle driver’s roadway.

**Driveway-related**
- 3 crashes (75%) involved a vehicle driver who was attempting to turn into a commercial or residential driveway
- 2 crashes (50%) involved a bicyclist who was riding in the sidewalk

**Visibility**
- 2 crashes (50%) involved an obstructed view

**Peak Period Crashes**
- 3 crashes (75%) occurred between 3 pm and 6 pm

**Other Crashes: 2 Crashes**
- 2 crashes occurred at a stop sign controlled intersection. In each crash, the vehicle driver was deemed at fault for failing to yield to the bicyclist.
Figure E.2.c. Bicycle Non-Severe Injury Crash Type #3

#3 Non-Severe Bicyclist Crash Type

I_FS_ST_R: Intersection: Straight-traveling motorist strikes bicyclist approaching from right on far side of intersection (8 crashes)

Crash Scenario 1: 5 Crashes
Vehicle driver had no traffic control on their roadway.

Low Speed, Urban Roadways
- 5 crashes (100%) occurred on urban roadways
- 5 crashes (100%) occurred on a 2 lane roadway
- 4 crashes (80%) occurred with a posted speed limit of 25 mph

Limited Visibility
- 3 crashes (60%) occurred in non-daylit conditions

Bicyclist Action
- 4 crashes (80%) involved a bicyclist who had ignored a stop or yield sign

Other Crashes: 3 Crashes
- 2 crashes involved an intersection that was controlled by traffic lights and a bicyclist who disobeyed a red light on their roadway
- 1 crash involved a 4 way stop sign and a vehicle driver who failed to yield to the right of way

Additional Crash Characteristics:
- 6 crashes (75%) involved a bicyclist that disobeyed traffic control
Figure E.2.d. Bicycle Non-Severe Injury Crash Type #5

#5 Non-Severe Bicyclist Crash Type

I_NS_RT_R : Intersection: Right-turning motorist strikes bicyclist approaching from right on near side of intersection (8 crashes)

Crash Scenario 1: 5 Crashes
Vehicle driver had a stop sign on their roadway and the bicyclist had no traffic control.

2 Lane, Urban Roadways
• 5 crashes (100%) occurred on an urban roadway
• 4 crashes (80%) involved a vehicle driver turning from a 2 lane roadway onto a 2 lane roadway

Bicyclist Action
• 4 crashes (80%) noted that the bicyclist was riding in the sidewalk

Driver Awareness
• 3 crashes (60%) noted that the driver did not see the bicyclist

Crash Scenario 2: 3 Crashes
Vehicle driver attempted to turn on a red light.

Urban Roadways
• 2 crashes (67%) occurred on urban roadways
• 2 crashes (67%) involved a vehicle driver turning from a 2 lane roadway onto a multi-lane roadway

Driver Awareness
• 2 crashes (67%) noted that the driver did not see the bicyclist

Bicyclist Action
• 2 crashes (67%) noted that the bicyclist was riding in the sidewalk

Other Characteristics:
• Bike lanes were not present in any of the crashes of this crash type
Appendix F. Pedestrian and Bicycle Crash Hot Spot Variable Definitions

This appendix lists the variables that were collected to describe the Top 20 “hot spots” for pedestrian severe and fatal injury crashes and bicycle severe and fatal injury crashes in Wisconsin. “Hot spots” represent the densest spatial clusters of crashes in all Wisconsin DOT regions. The “hot spots” were identified by examining the locations of all severe and fatal pedestrian and bicycle injury crashes reported in the Wisconsin Traffic Operations and Safety Laboratory (TOPS) WisTransPortal crash database between 2011 and 2013.

Variables

The variables in this database describe physical characteristics of the hot spot (as defined by the specific hot spot boundary). Other crash characteristics, including driver and pedestrian behaviors, weather, lighting, and time-of-day are included elsewhere. Unless noted, these variables apply only to roadway corridors in the hot spot area where crashes were reported (or within 50 feet of an intersection with that corridor). In other words, roadways that pass through the hot spot area but experienced no reported crashes during the study period are not considered when measuring these variables.

Table E.1. Hot Spot Variable Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Highway</td>
<td>Hot spot contains a state highway (Yes or No)</td>
<td>Could also list the state highway number(s)</td>
</tr>
<tr>
<td>Maximum Roadway Lanes</td>
<td>Maximum number of lanes on any roadway within the hot spot, including left- and right-turn lanes (Number)</td>
<td>Includes two-way center turn lanes and left- and right-turn-only lanes</td>
</tr>
<tr>
<td>Maximum Speed Limit</td>
<td>Maximum posted speed limit on any roadway within the hot spot (Number)</td>
<td></td>
</tr>
<tr>
<td>Signalized Corridor</td>
<td>Hot spot contains a signalized roadway corridor (i.e., a roadway controlled by traffic signals rather than stop signs) (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Oblique Intersection</td>
<td>Hot spot contains an oblique intersection (i.e., two roadways that do not meet at a right angle) (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Left-turn-only Lane</td>
<td>A hot spot intersection contains a left-turn-only lane (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Right-turn-only Lane</td>
<td>A hot spot intersection contains a right-turn-only lane (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Non-residential Driveway</td>
<td>A hot spot roadway has more than one non-residential driveway per 200 feet (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Mixed Land Use</td>
<td>A hot spot roadway has more than one major land use category (e.g., residential, retail, restaurant, office, industrial) (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bus Route</td>
<td>A hot spot roadway is a bus route (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Complete Sidewalk Coverage</td>
<td>All hot spot roadways have sidewalks on both sides (Yes or No)</td>
<td></td>
</tr>
<tr>
<td>Bicycle Facility</td>
<td>At least one hot spot roadway corridor has bicycle facilities (Yes or No)</td>
<td>Bicycle lanes, cycle tracks, multi-use trails, and sidepaths count as roadway corridor bicycle facilities. Bicycle route signs and shared lane markings do not count as a roadway corridor bicycle facilities.</td>
</tr>
</tbody>
</table>
Appendix G. Pedestrian and Bicycle Crash Hot Spot Descriptions and Maps
This appendix provides detailed information about the 20 pedestrian and 20 bicycle fatal and severe crash hot spots. The first part of the appendix includes tables with descriptions of each pedestrian and bicycle hot spot (Table G.1 and Table G.2), and the second part includes maps of each hot spot.

Fatal and severe-injury pedestrian and bicycle crashes tend to be along signalized, multilane, arterial roadway corridors in urban and suburban areas with moderate to high levels of pedestrian or bicycle activity. Without controlling for pedestrian and bicycle volumes (or other measures of exposure), it is not possible to determine if these locations experienced more crashes simply because they had more activity or because their conditions were inherently more dangerous. Regardless, these types of locations warrant attention due to high numbers of crashes.
<table>
<thead>
<tr>
<th>WisDOT Region</th>
<th>Location</th>
<th>City</th>
<th>Crashes/ sq. km</th>
<th>Total Crashes</th>
<th>Hot Spot #</th>
<th>Local Environment Description</th>
<th>Common Crash Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>Near Fond du Lac Ave. and Center St.</td>
<td>Milwaukee</td>
<td>20.89</td>
<td>7</td>
<td>1</td>
<td>Area where a major state highway (Fond Du Lac Ave./WI 145) intersects the rectangular street grid on a diagonal, creating several oblique intersections with other major roadways (Center St., 27th St.). The intersections of the major roadways are signalized, but minor street intersections are uncontrolled. The speed limit on all of the major roadways is 30 mph. Fond Du Lac Ave. is two lanes with on-street parking except during peak periods when on-street parking is prohibited in the peak direction; 27th St. is two lanes with on-street parking; Center St. is two lanes with bike lanes and on-street parking. On-street parking is prohibited near all of the intersections so that there are four operational lanes (additional left-turn lane on south leg of Fond Du Lac Ave. at Center St.) Pedestrian volumes are high. Land uses in the area are mixed, including retail, automobile repair, restaurants, churches, and residential, and there are several bus stops and bus transfer points near the major intersections.</td>
<td>Vehicle driving straight. Witnesses for 5 out of 7 crashes. Numerous crashes occur at oblique intersections. 4 out of 7 ped at fault for darting into the roadway.</td>
</tr>
<tr>
<td>Water St. and Juneau Ave.</td>
<td>Milwaukee</td>
<td>Milwaukee</td>
<td>14.71</td>
<td>7</td>
<td>3</td>
<td>Area on the north side of Downtown Milwaukee where two major roadways intersect. The intersections of Water St. &amp; Juneau Ave. and Water St. &amp; Knapp St. are signalized, but the intersections directly to the east, south, and west of Water St. &amp; Juneau Ave. are uncontrolled. The speed limit on both major streets is 30 mph. Water St. is four lanes with bicycle lanes, on-street parking, and is divided by a median. Juneau Ave. is four lanes, on street parking, and is divided by a median. Pedestrian volumes are moderate during the day but can be high in the evening and at night. Land uses in the area are mainly offices, bars, and restaurants, while Milwaukee School of Engineering is located within two blocks.</td>
<td>Crash time ranges from 2:15 to 3:10 between all crashes. 4 out of 5 involved a pedestrian at fault, often for darting into the roadway. Wet road conditions. All crashes are alcohol related, whether it is the driver or pedestrian.</td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>UIC Code</td>
<td>HNR</td>
<td>Pedestrian</td>
<td>Description</td>
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</tr>
<tr>
<td>Atkinson Ave. and 11th St.</td>
<td>Milwaukee</td>
<td>14.12</td>
<td>4</td>
<td>4</td>
<td>Atkinson Ave. is a major roadway corridor, passing through the rectangular street grid on a shallow diagonal, creating oblique intersections with minor streets. The intersections of Atkinson Ave. and 8th St., 9th St., 10th St., 11th St., and 13th St. are uncontrolled. Atkinson Ave. &amp; 12th St. is signalized. Atkinson Ave. has four lanes with on-street parking, though the on-street parking is often light. Pedestrian volumes are low to moderate. Most of the surrounding area is residential, but there are several retail properties, including a liquor store near the intersection of Atkinson Ave. &amp; 11th St. Atkinson Park is on the north side of Atkinson Ave. between 9th and 11th St. Atkinson Ave. is a bus route.</td>
<td></td>
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<tr>
<td>Lincoln Ave. and National Ave. and 94th St.</td>
<td>West Allis</td>
<td>13.71</td>
<td>4</td>
<td>5</td>
<td>Area where a major roadway (National Ave.) intersects the rectangular street grid on a diagonal, creating several oblique intersections with other major roadways (Lincoln Ave., 92nd St.). The intersections of the major roadways are signalized, but minor street intersections are uncontrolled. There are left-turn lanes on nearly all approaches to the National Ave. &amp; Lincoln Ave. and 92nd St. &amp; Lincoln Ave. intersections. The speed limit on Lincoln Ave. and National Ave. is 30 mph; the speed limit on 92nd St. is 25 mph. National Ave. is 2 lanes north of Lincoln Ave. and 4 lanes south of Lincoln Ave., with some on-street parking. 92nd St. is 2 lanes north of Lincoln Ave. and 4 lanes south of Lincoln Ave. Lincoln Ave. is 4 lanes with some on-street parking west of National Ave. and east of 92nd St. Lincoln Ave. also has a sporadic narrow median. Pedestrian volumes are low to moderate. Land uses in the area are mainly residential but include retail and service businesses (with many driveways) along the National Ave. and Lincoln Ave. corridors.</td>
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<tr>
<td>Durand Ave. &amp; West Blvd. and Durand Ave. &amp; Drexel Ave.</td>
<td>Racine</td>
<td>13.30</td>
<td>4</td>
<td>6</td>
<td>Durand Ave. corridor is a major state highway (WI 11) that intersects two other major roadways (West Blvd., Drexel Ave.). It also intersects a multi-use trail that crosses along the west side of the West Blvd. intersection. The intersections of the major roadways are signalized, but minor street intersections are uncontrolled. West Blvd. and Drexel Ave. are both 2 lanes with on-street parking. Durand Ave. is 4 lanes plus a center-turn lane and has no on-street parking. The speed limit on Durand Ave. is 30 mph. Pedestrian volumes are low to moderate. Land uses on the north side of Durand Ave. are mainly residential, and land uses on 3 of 4 crashes involved vehicles driving straight, 3 out of 4 were intersection related, 3 out of 4 identified the pedestrian as at fault, and 3 occurred in marked crosswalks.</td>
<td></td>
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</tr>
</tbody>
</table>
the south side of Durand Ave. are mainly large properties with strip commercial retail and many driveway crossings.

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Speed Limit</th>
<th>Pedestrian Volume</th>
<th>Land Uses</th>
<th>Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>35th St. &amp; Wisconsin Ave.</td>
<td>Milwaukee</td>
<td>12.68</td>
<td>4</td>
<td>Area around where two major roadways (35th St., Wisconsin Ave.) intersect. The intersections in this part of the 35th St. Corridor are all signalized. The intersections along Wisconsin Ave. are unsignalized except for 32nd St., 35th St., and 36th St. 35th St. is 4 lanes with no on-street parking in the vicinity of Wisconsin Ave. Wisconsin Ave. is 4 lanes with a median and on-street parking on the north side near 35th St. The intersection of Wisconsin Ave. &amp; 35th St. has left-turn lanes on all legs except the south leg. The speed limit on both Wisconsin Ave. and 35th St. is 30 mph. Pedestrian volumes are moderate to high. Land uses are mixed, including a high-school on the southeast corner of the intersection, retail and restaurants (with a number of driveway crossings), parks, and residential on the local streets in the area.</td>
<td>2 multi-vehicle crashes that resulted in the injury of pedestrians. 2 crashes that involved pedestrians darting into the roadway. 30-35 mph roadways.</td>
</tr>
<tr>
<td>National Ave. &amp; Layton Blvd.</td>
<td>Milwaukee</td>
<td>11.06</td>
<td>5</td>
<td>National Ave. corridor west of Layton Blvd. Both National Ave. and Layton Blvd. are major roadways. The intersection of National Ave. &amp; Layton Blvd. is signalized, and the intersection of Layton Blvd. &amp; Pierce St. is signalized, but other intersections of National Ave. with local streets are unsignalized (though there is an overhead beacon and a median island at the intersection with 30th St.) between Layton Blvd. and 35th St (another major roadway). National Ave. is 4 lanes with on-street parking and a sporadic median. Layton Blvd. is 4 lanes with on-street parking and a median. Both roadways have additional left-turn lanes at their intersection. The speed limit on National Ave. is 30 mph. The speed limit on Layton Blvd. is 30 mph north of National Ave. and 25 mph south of National Ave. Pedestrian volumes are moderate to high. Land uses are mixed, with retail and restaurants along most of National Ave., including strip shopping centers near the intersection of National Ave. &amp; Layton Blvd.</td>
<td>4 out of 7 crashes involved a bus. 3 out of 7 involved a left-turning vehicle. 5 out of 7 were at intersections. 30 mph posted speed limit. No time of day consistency. 5 of 7 had marked crosswalks.</td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>Score</td>
<td>Injury</td>
<td>Description</td>
<td>Vehicle Description</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Greenfield Ave. &amp; 11th St.</td>
<td>Milwaukee</td>
<td>9.91</td>
<td>5</td>
<td>The Greenfield Ave. corridor is a major roadway on the south side of Milwaukee. Greenfield Ave. intersects many local roadways in the vicinity of 11th St., but none of the intersections are signalized between 6th St. and 12th St. (8th St. has a crosswalk warning sign and median islands). Greenfield Ave. is 2 lanes with no left-turn lanes and on-street parking. 11th St. is 2 lanes south of Greenfield Ave. and one-lane, one-way southbound north of Greenfield Ave. The speed limit on Greenfield Ave. is 30 mph. Pedestrian volumes are moderate to high. Land uses are mixed, including retail and restaurants with some small parking lots and driveways. It is a bus route. One crash in this cluster was at Lapham Blvd. &amp; 11th St. Lapham Blvd. is a major, 30 mph, 4-lane roadway with a wide median, and its intersection with 11th St. is signalized.</td>
<td>Vehicle driving straight. 2 out of 3 at intersections in marked crosswalks. All 3 were flagged for alcohol and occurred late evening or early morning.</td>
</tr>
<tr>
<td>76th St. corridor near Silver Spring Dr.</td>
<td>Milwaukee</td>
<td>9.81</td>
<td>3</td>
<td>The 76th St. Corridor is a major highway (WI 181). It has an interchange with Silver Spring Dr., and there are intersections with the Silver Spring Dr. on- and off-ramps on the north and south sides of the interchange. There are right-turn slip ramps on all corners but the southwest corner. The intersections along 76th St. are unsignalized except where it meets the on-and off-ramps of Silver Spring Dr. 76th St. is 4 lanes with a wide median and on-street parking. 76th St. has a speed limit of 35 mph. Pedestrian volumes are low to moderate. Land use is mixed, including several dense apartment complexes, strip commercial retail (with driveways along 76th St. north of Silver Spring Dr.), This hot spot is one to four blocks north of the major interchange between 76th St. and Fond Du Lac Ave. (WI 145) and the high-speed northbound exit ramp onto 76th St. 76th St. and Silver Spring Dr. are major bus corridors.</td>
<td>4 crashes involved a vehicle driving straight and 3 involved a pedestrian entering the roadway from the right. 4 out 5 had witnesses. 3 out of 5 HNR. All crashes after 5 pm and before 3 am. 2 were alcohol related and 1 drug related.</td>
</tr>
<tr>
<td>6th St. corridor near Lincoln Ave.</td>
<td>Milwaukee</td>
<td>9.71</td>
<td>3</td>
<td>The 6th St. Corridor is a major city street, and it is a state highway (WI 38) north of Lincoln Ave. Its intersection with Lincoln Ave. is signalized, but other intersections to the north and south are uncontrolled. 6th St. is 2 lanes with on-street parking (heavily occupied). 6th St. has a speed limit of 30 mph. Pedestrian volumes are moderate. Land uses in the corridor are primarily residential, except for the block south of Lincoln Ave., which has several convenience stores, restaurants, and the Basilica of Saint Josaphat.</td>
<td>Vehicle straight into pedestrian mid-block. No crosswalks. Young pedestrians darting into roadway (2 out of 3). HNR (2 out of 3). All 3 crashes occurred at night or into the early morning.</td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>Speed Limit</td>
<td>Pedestrian Volumes</td>
<td>Land Use</td>
<td>Crash Type &amp; Situations</td>
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<tr>
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</tr>
<tr>
<td>Oakland Ave. &amp; North Ave.</td>
<td>Milwaukee</td>
<td>9.34</td>
<td>4</td>
<td>14</td>
<td>Oakland Ave. is a major city street. Its intersections with North Ave. (another major street) and Bradord Ave. (a minor street) are both signalized. The North Ave. &amp; Farwell Ave. (WI 32) intersection is signalized and also oblique, since Farwell Ave. runs diagonally to the rectangular street grid. Oakland Ave. is 2 lanes with bicycle lanes and heavily-used on-street parking. North Ave. is 2 lanes with bicycle lanes and heavily-used on-street parking on the south side. North Ave. has left-turn lanes at its intersection with Oakland Ave. Farwell Ave. is a one-way street with 2 lanes and a bicycle lane and on-street parking. Bradford Ave. is 2 lanes with on-street parking. The speed limit on Oakland Ave. is 25 mph, Bradford Ave. is 25 mph, North Ave. is 30 mph, and Farwell Ave. is 30 mph. Pedestrian volumes are moderate to high, and are especially high on evenings and weekends. Land use in the area is mixed, with a significant amount of entertainment, bars, restaurants, retail, and high-density residential.</td>
</tr>
<tr>
<td>WI 32 in Downtown Port Washington</td>
<td>Port Washington</td>
<td>8.90</td>
<td>3</td>
<td>15</td>
<td>WI 32 is a state highway that passes through Downtown Port Washington. The intersection of WI 32 &amp; Wisconsin St. is signalized, but no other intersections through the downtown area are controlled. WI 32 is 2 lanes with on-street parking and has a speed limit of 25 mph. Pedestrian volumes are moderate to high, especially during summer and weekends. Land use is mixed: WI 32 is a historic main street with many small restaurants and stores in buildings at the sidewalk. The surrounding area is residential.</td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>Population</td>
<td>Max Crashes</td>
<td>Actual Crashes</td>
<td>Details</td>
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<tr>
<td><strong>Southwest</strong></td>
<td>Madison</td>
<td>15.52</td>
<td>6</td>
<td>2</td>
<td>Area where a pair of major one-way roadways pass by the southeast part of the University of Wisconsin-Madison campus. Both roadways run east-west but curve to the northeast one block east of Francis St. The intersections of University Ave. and Johnson St. with Frances St. and Lake St. are signalized, but the intersections of Johnson St. &amp; Marion St. and University Ave. &amp; Bassett St. are uncontrolled. The speed limit on the major streets is 25 mph. University Ave. is 3 lanes with a wide bicycle lane and designated bus/right-turn lane in the main direction of travel; it has a buffered, contra-flow bicycle lane on the south side. Johnson St. has 4 lanes. Neither major roadway has on-street parking. The area has very high levels of pedestrian activity, especially when the university is in session. Land uses in the area are mixed, including several multi-story residential dorms, bars, and restaurants along these streets. Major university buildings, the Kohl Center, and the State Street corridor are all within three blocks.</td>
</tr>
<tr>
<td><strong>Losey Blvd. &amp; State Rd.</strong></td>
<td>La Crosse</td>
<td>9.44</td>
<td>3</td>
<td>13</td>
<td>Area around where a major city roadway (Losey Blvd.) and a state highway (State Rd./WI 33) intersect. State Rd. cuts diagonally through the rectangular street grid, creating oblique intersections with local streets. The intersection of Losey Blvd. &amp; State Rd. is signalized, but other local street intersections with Losey Blvd. and State Rd. are unsignalized. Losey Blvd. is four lanes plus a center-turn lane or left-turn pockets. State Rd. is four lanes but narrows to two lanes with on-street parking one block to the west of Losey Blvd. None of the other sections have on-street parking, and there are narrow medians in the block leading up to the intersection of Losey Blvd. &amp; State Rd. from all four directions. The speed limit on Losey Blvd. is 30 mph, and the speed limit on State Rd. is 25 mph. Pedestrian volumes are low to moderate. Land use in the immediate area is large-scale commercial, including several strip commercial buildings, large commercial buildings, and large parking lots with many driveways. Losey Blvd. is a bus route. Farnam St. is a wide, 2-lane collector street on the north border of the commercial area where on-street parking is allowed but not used heavily. It has a speed limit of 25 mph.</td>
</tr>
</tbody>
</table>

Vehicle driving straight 6 out of 8 crashes. Intersection-related for 6 out of 8. Pedestrian at fault, or jointly at fault, in 5 out of 8 crashes. 4 out of 8 crashes saw the pedestrian disregard traffic control. Witnesses for 6 out of the 8 crashes. 25 mph posted speed.
<table>
<thead>
<tr>
<th>Northeast</th>
<th>College Ave. through Lawrence University Campus</th>
<th>Appleton</th>
<th>8.79</th>
<th>3</th>
<th>16</th>
<th>College Ave. is a major roadway passing through the Lawrence University Campus. It has signalized intersections at Durkee St., Drew St., Lawe St., and Meade St. There are two uncontrolled, mid-block pedestrian crossings in the main campus area (Union St. and Park Ave.), and both are served by a wide median. College Ave. is four lanes with a wide median (through the main campus area) with no on-street parking. College Ave. has a speed limit of 25 mph. Pedestrian volumes are low to high, depending on when classes are in session. Land use is mixed, including the campus, restaurants and retail along College Ave. west of campus, and residential along College Ave. east of campus. All 25 mph speed limits and vehicles involved were all driving straight. 2 out of 3 occurred late at night. 2 out of 3 were marked crosswalks. All 3 locations had witnesses, suggesting a heavily occupied location.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main St. area</td>
<td>Green Bay</td>
<td>8.72</td>
<td>4</td>
<td>17</td>
<td>The Main St. corridor is a state highway (US 141/WI 29). It runs parallel to the East River, so it only has local streets intersecting it in this area from the north side. There are no controlled intersections between the signalized intersections at Baird St. and Elizabeth St. Main St. is 4 lanes plus a center left-turn lane and has no on-street parking. Main St. has a speed limit of 30 mph. Pedestrian volumes are low to moderate. Land use includes industrial buildings with individual parking lots on the south (river) side of the roadway and residential on the north side of the roadway. 2 mid-block, 2 intersection. All involved vehicles driving straight. 3 out of 4 HNR. Vehicle at fault in each crash (shared fault in one). Consistently very little information about the pedestrian (which might be because some are HNR and some are fatal). 3 out of 4 alcohol flag.</td>
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</tbody>
</table>
### North Central

**Arnold St. near Peach Ave. and Ash Ave.**

**Marshfield**

| 7.41 | 2 | 19 |

Arnold St. is a collector roadway on the east side of Marshfield. The intersection of Arnold St. & Peach Ave. is unsignalized, and the traffic on Arnold St. is controlled by a stop sign. Arnold St. has a centerline stripe and on-street parking, which is lightly used. Arnold St. has an additional right-turn-only lane on the west leg of its intersection with Peach Ave. Peach Ave. is 2 lanes with on-street parking and a centerline stripe and it has left-turn lanes on the north and south legs of its intersection with Arnold St. Ash Ave. is a local street with 2 lanes and on-street parking. It meets Arnold St. at a "T" intersection and has a stop sign (there are no stop signs on Arnold St. at Ash Ave. Arnold St., Peach Ave., and Ash Ave. all appear to have speed limits of 25 mph. Pedestrian volumes are low. Land use is mixed with residential north of Arnold St. and industrial in the block south of Arnold St.

Vehicle driving straight.
Intersection-related.
In or near the to crosswalk.

### Wisconsin Rapids

**Grand Ave. near 14th Ave. and 15th Ave.**

**Wisconsin Rapids**

| 7.40 | 2 | 20 |

Grand Ave. is a state highway (WI 13/WI 73) on the west side of Wisconsin Rapids. The intersections of Grand Ave. & 14th Ave. and Grand Ave. & 15th Ave. are unsignalized and have stop signs controlling the traffic from 14th Ave. and 15th Ave. Grand Ave. is uncontrolled between Riverview Expwy. and 17th Ave. (0.6 mi). Grand Ave. is 4 lanes with no on-street parking in the vicinity of 14th Ave. and 15th Ave. (it widens to add a left-turn lane at 17th Ave). Grand Ave. has a speed limit of 30 mph. Pedestrian volumes are low to moderate. Land use is mixed along the corridor itself with both residential and moderately-sized commercial buildings. The surrounding neighborhood is residential.

Intersection-related.
Involved pedestrians crossing from the left. 4-lane collector roadways.
Driver did not see in both cases.

### Northwest

**Water St. & 4th Ave.**

**Eau Claire**

| 10.55 | 3 | 9 |

Water St. is a primary commercial corridor in Downtown Eau Claire. 4th Ave. is a minor street. The intersection of 4th Ave. & Water St. has stop signs controlling the traffic on 4th Ave. The intersection of 4th Ave. and Niagara St. is a four-way stop. 4th Ave. as two lanes and on-street parking, and the centerline is not marked. Water St. has 2 lanes, a center-turn lane, and on-street parking. Niagara St. is 2 lanes with on-street parking, and the centerline is not marked. The speed limit on all of these streets is 25 mph. The area has moderate pedestrian activity. There are restaurants, bars, and retail along the Water St. corridor, and there are several parking lots with driveways along Water St. near 4th Ave. and 5th Ave. The surrounding neighborhoods are residential.

Vehicle driving straight. Pedestrian from the right side in 4 out of 5 crashes. 4 crashes occurred at intersections. 3 involved pedestrians disregarding traffic control. 4 occurred on arterial roadways. 3 occurred in marked crosswalks.
Hammond Ave. area  Superior  7.68  3  18  Hammond Ave. is a major roadway corridor. One crash occurred at the intersection of Hammond Ave. & 13th St., and another crash occurred two blocks west of the corridor at 13th St. & John Ave. Hammond Ave. & 13th St. is uncontrolled for Hammond Ave. and has stop signs for 13th St. Hammond Ave. is 2 lanes with a center left-turn lane and on-street parking. It has a speed limit of 30 mph. At the intersection with 13th St. (and other uncontrolled intersections in this part of the corridor), designated right-turn pockets have been added in both directions. The intersection of 13th St. & John Ave. is two local streets with stop signs controlling the 13th St. traffic. Pedestrian volumes are low to moderate. Land use in the area is residential.  2 out of 3 HNR. All crashes occurred at night. All intersection-related. 2 out of 3 had unmarked crosswalks.
<table>
<thead>
<tr>
<th>WisDOT Region</th>
<th>Location</th>
<th>City</th>
<th>Crashes/ sq. km</th>
<th>Total Crashes</th>
<th>Hot Spot #</th>
<th>Local Environment Description</th>
<th>Common Crash Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southeast</td>
<td>30th Ave. &amp; Washington Rd.</td>
<td>Kenosha</td>
<td>7.23</td>
<td>2</td>
<td>7</td>
<td>The 30th Ave. corridor is a major roadway that intersects with another major road (Washington Rd.). The intersection of 30th Ave. &amp; Washington Rd. is signalized, and the nearby intersections along both corridors are unsignalized. 30th Ave. is 4 lanes with no on-street parking (though on-street parking is allowed south of 40th St.). Washington Rd. is 4 lanes with a wide median and no on-street parking. 30th Ave. has a speed limit of 30 mph. Washington Rd. has a speed limit of 30 mph. All approaches to the 30th Ave. &amp; Washington Rd. intersection have an additional left-turn lane. Land use around the intersection is small commercial buildings with large parking lots and many driveways.</td>
<td>Bicyclist at fault in both crashes. Inability to operate a bicycle appropriately on the roadway. Early to mid-afternoon crashes. No citation given.</td>
</tr>
<tr>
<td></td>
<td>Lapham Blvd. and Mitchell St. near 3rd St. and 4th St.</td>
<td>Milwaukee</td>
<td>6.59</td>
<td>2</td>
<td>11</td>
<td>The two crashes in this hot spot occurred in two different, parallel major road corridors (Lapham Blvd. and Mitchell St.). The intersection of Lapham Blvd. &amp; 3rd St. is unsignalized, and stop signs control local traffic on 3rd St. Lapham Blvd. is 4 lanes with a wide median and on-street parking. 3rd St. is 2 lanes with on-street parking. Lapham Blvd. has a speed limit of 30 mph, and 3rd St. has a speed limit of 25 mph. The intersection of Mitchell St. &amp; 4th St. is signalized and is located at the east end of the Mitchell St. bridge over I-43. Mitchell St. is 4 lanes with no on-street parking west of 4th St. and 2 lanes with on-street parking to the east of 4th St. 4th St. is one-way northbound and has two lanes and on-street parking on one side. Mitchell St. has a speed limit of 25 mph, and 4th St. has a speed limit of 30 mph. Land use in this area is primarily residential with a school near the intersection of Mitchell St. &amp; 4th St.</td>
<td>Bicyclist at fault in both crashes. Inability to operate a bicycle appropriately on the roadway. No citation given. Crashes occurred on local roadways.</td>
</tr>
<tr>
<td>Intersection Location</td>
<td>City</td>
<td>Cluster Size</td>
<td>Yearly Crashes</td>
<td>Notes</td>
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<tr>
<td>National Ave. &amp; 84th St. area</td>
<td>West Allis</td>
<td>5.97</td>
<td>2</td>
<td>14</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Intersection crashes. Both crashes occurred during the late afternoon.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Oakland Ave. near Shorewood Blvd. and Menlo Blvd.</td>
<td>Shorewood</td>
<td>5.85</td>
<td>2</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intersection crashes from collector roadways. Bicyclists failed to operate appropriately on the roadway and at an intersection. Bike lanes present. Crash location at or near the to crosswalk. Operating traffic signals.</td>
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<tr>
<td>North Ave. near Booth St. and Hubbard St.</td>
<td>Milwaukee</td>
<td>5.74</td>
<td>2</td>
<td>16</td>
<td></td>
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<tr>
<td>Intersection crashes. Vehicle driver did not see the bicyclist. Crashes occurred during the early to mid-afternoon.</td>
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</tbody>
</table>
controlling traffic on Garfield Ave. The neighborhood is residential.

<table>
<thead>
<tr>
<th>Location</th>
<th>City</th>
<th>Speed Limit</th>
<th>Vehicle Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>52nd St. near 22nd Ave.</td>
<td>Kenosha</td>
<td>52nd St. is a state highway (WI 158) in central Kenosha. The two crashes in this cluster occurred along 52nd St., one at 22nd Ave., and the second to the west of 25th Ave. The intersection of 52nd St. &amp; 22nd Ave. is signalized. 52nd St. is 4 lanes with no on-street parking. It has additional left-turn lanes at the intersection with 22nd Ave. 52nd St. has a speed limit of 30 mph. Land use along the 52nd St. corridor is generally commercial, including restaurants and bars, and service businesses. There are several industrial uses west of 25th St.</td>
<td>5.68</td>
<td>2</td>
</tr>
<tr>
<td>Southwest</td>
<td>Madison</td>
<td>Beld St. is a local roadway that is parallel to Park St. (US 151), which is a major roadway. Wingra Dr. is a collector street with a multi-use trail on the south side. Beld St. is not controlled, and there are stop signs for Wingra Dr. (and the multi-use trail). The intersection of Beld St. &amp; Gilson St. is a &quot;T&quot; intersection, and the Gilson St. leg has a stop sign. All three streets are two lanes, and have lightly-used on-street parking. Beld St. has a speed limit of 25 mph. Wingra Dr. has a speed limit of 25 mph. Land use is mixed in the Beld St. corridor, including residential and industrial properties.</td>
<td>7.46</td>
<td>2</td>
</tr>
<tr>
<td>Johnson St. and Dayton St. near Frances St. and Lake St.</td>
<td>Madison</td>
<td>Johnson St. and Dayton St. are two major roadways passing through the southeast side of the University of Wisconsin-Madison campus. The intersections of Johnson St. with Frances St. and Lake St. are signalized. Dayton St. has no controlled intersections between Park St. and Bassett St. Johnson St. has 4 lanes and no on-street parking. Dayton St. has 2 lanes plus a center-left-turn lane, bike lanes, and no on-street parking. The speed limit on the major streets is 25 mph. Land uses in the area are mixed, including several multi-story residential dorms, bars, and restaurants along these streets. Major university buildings, the Kohl Center, and the State Street corridor are all within three blocks.</td>
<td>6.70</td>
<td>2</td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>Zone</td>
<td># Vehicles</td>
<td># Crashes</td>
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<tr>
<td>1st St. near Washington Ave. and Johnson St.</td>
<td>Madison</td>
<td>6.08</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>City</th>
<th>Zone</th>
<th># Vehicles</th>
<th># Crashes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKee Rd. near Woods Edge Rd. and Osmundsen Rd.</td>
<td>Fitchburg</td>
<td>5.55</td>
<td>2</td>
<td>18</td>
<td>McKee Rd. is a major roadway and Dane County highway in Fitchburg. The crashes in this cluster occurred at the intersections of McKee Rd. &amp; Woods Edge Rd. and McKee Rd. &amp; Osmundsen Rd., both of which are unsignalized and are in a 0.8-mile stretch of McKee Rd. without signals or stop signs. These intersections have very wide turning radii. Stop signs control the traffic from the local streets as they approach McKee Rd. McKee Rd. is 4 lanes with bicycle lanes and no on-street parking. It includes an additional left-turn lane on each approach to both intersections, and there is also an extra right-turn lane on each approach to the Osmundsen Rd. intersection. Both Osmundsen Rd. approaches to the intersections are 2 lanes with a wide median island, and the north Woods Edge Rd. approach to the intersection is 2 lanes with a median island (though the south approach does not have a median island). Land use in this part of the McKee Rd. corridor is almost all residential with no houses accessing McKee Rd. directly. There is an office complex southwest of McKee Rd. &amp; Woods Edge Rd., but its parking lot does not access McKee Rd. directly. Both crashes involved arterial roadways. The posted speed was 40 mph at both locations. The intersection-related crash involved the movement from an arterial roadway to a local one. Both crashes occurred late afternoon to early evening.</td>
</tr>
<tr>
<td>Location</td>
<td>Details</td>
<td>Crashes described</td>
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<tr>
<td>Main St. corridor and Verona Ave. corridor</td>
<td>Verona Ave. and Main St. are the primary roadways (both county highways) through Verona. The two crashes in this cluster each occurred on one of these roadways at the intersection of Verona Ave. &amp; Gilman St. and the intersection of Main St. &amp; Harriet St. Both intersections are unsignalized &quot;T&quot; intersections, with stop control on the local intersecting street. Verona Ave. is 2 lanes with on-street parking. Main St. is 2 lanes with on-street parking on one side. Verona Ave. and Main St. both have speed limits of 25 mph. Land use along both corridors is mixed, including convenience store, retail, service, church, and residential.</td>
<td>Both right turn crashes at intersections. Crashes occurred in the from crosswalk, and the driver did not see the bicyclist in either crash.</td>
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<tr>
<td>Northeast 9th Ave. &amp; US 41 Oshkosh</td>
<td>Interchange area of a major highway (US 41) and another major roadway (9th Ave.). The interchange is served by four roundabouts (two for the entrance and exit ramps to and from US 41 and two for the frontage roads), and the bicycle crashes occurred at these roundabouts. The roundabouts each have two lanes and traffic approaching and exiting from four directions. 9th Ave. itself is 4 lanes with no on-street parking as it approaches the interchange. US 41 is a grade-separated highway with 6 lanes. 9th Ave. has a speed limit of 30 mph. Land use in the 9th Ave. corridor is mixed, including strip commercial retail with large parking lots and residential.</td>
<td>Roundabout-related. All crashes involved bicyclists riding the wrong way in the sidewalk/crosswalk. To roadway is consistently arterial, and from roadway is either arterial or collector (implies high speeds). Driver noted as at fault because of failing to yield in each crash. All 3 crashes occurred in the middle of the afternoon.</td>
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<tr>
<td>Intersection</td>
<td>Location</td>
<td>Score</td>
<td>Bikes</td>
<td>Description</td>
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<tr>
<td>Winneconne Ave. &amp; Commercial St.</td>
<td>Neenah</td>
<td>7.48</td>
<td>2</td>
<td>4</td>
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<td>Intersection of a state highway and a major roadway. The state highway (WI 114) actually turns through the intersection, so it uses the west leg (Winneconne Ave) and the north leg (Commercial St.). The intersection of Winneconne Ave. &amp; Commercial St. is signalized and slightly oblique. Winneconne Ave. is 4 lanes with no on-street parking west of the intersection and 2 lanes east of the intersection. Commercial St. is 4 lanes with no on-street parking. There is a right-turn slip lane on the southwest corner of the intersection, and Church St. meets Winneconne Ave. from the north near where this slip lane starts. Winneconne Ave. has a speed limit of 30 mph. Commercial St. has a speed limit of 25 mph north of the intersection and 30 mph south of the intersection. Land use is mixed around the intersection, including retail, restaurants, and residential. Most of the commercial buildings have their own parking lots and driveway access.</td>
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<td></td>
<td>Right turn crashes into wrong way bicycle riders. Both crashes occurred at an intersection with marked crosswalks, and a vehicle movement that was directed towards an arterial street.</td>
<td></td>
</tr>
<tr>
<td>Murdock Ave. &amp; Vinland St.</td>
<td>Oshkosh</td>
<td>7.37</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Intersection of a state highway (Murdock Ave./US 45) and a collector street (Vinland St.). One crash occurred at this intersection, and another occurred one block east and one block south, at the intersection of two residential streets (Hobbs Ave. &amp; Walnut St.). The Murdock Ave. &amp; Vinland St. intersection is unsignalized, and the Murdock Ave. traffic is not controlled. Stop signs are present on the north leg (Vinland St.) and south leg (Elmwood Ave.). The Murdock Ave. &amp; Vinland St. intersection is slightly oblique since Elmwood Ave. runs at a diagonal to the rectangular street grid. Murdock Ave. has a speed limit of 30 mph, and Vinland St. and Elmwood Ave. have speed limits of 25 mph. The Hobbs Ave. &amp; Walnut St. intersection is controlled only by yield signs on the Hobbs Ave. approaches. Both Hobbs Ave. and Walnut St. are narrow, 2-lane streets with lightly-used on-street parking. Land use in the area is primarily residential.</td>
<td></td>
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<tr>
<td></td>
<td></td>
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<td></td>
<td>Right turn crashes. Bicyclist struck in unmarked crosswalks in both crashes.</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>City</td>
<td>Population</td>
<td>Age Group</td>
<td>Crashes</td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>------------</td>
<td>------------</td>
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<td>---------</td>
<td></td>
</tr>
<tr>
<td>Business Dr. &amp; Union Ave. area</td>
<td>Sheboygan</td>
<td>7.02</td>
<td>2</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Hall Ave. near Madison Ave. and Stephenson St.</td>
<td>Marinette</td>
<td>6.29</td>
<td>2</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Dr. is a state highway corridor (WI 28), and Union Ave. is a major roadway. Separate crashes occurred where each roadway intersects with 16th St. The intersections with crashes were unsignalized, and stop signs controlled the 16th St. approaches. The intersection of Business Dr. &amp; 16th St. is a &quot;T&quot; intersection and has a right-turn slip lane from 16th St. to Business Dr. Business Dr. is 2 lanes with a median, left-turn pockets, and no on-street parking. Union Ave. is 2 lanes with on-street parking. 16th St. is 2 lanes with on-street parking. Business Dr. has a speed limit of 30 mph. Union Ave. has a speed limit of 25 mph. Land use along Business Dr. includes several large-scale commercial buildings; land use along Union Ave. has several small-scale commercial buildings; land use in the 16th St. corridor is primarily residential.</td>
</tr>
<tr>
<td>Hall Ave. is a highway (US 41) passing through Downtown Marinette. Stephenson St. and Madison St. are both local roadways in the downtown area. One crash occurred at the intersection of Hall Ave. &amp; Stephenson St., which is signalized and oblique. Hall Ave. is four lanes with no on-street parking. Stephenson Ave. is 2 lanes with on-street parking, but it includes left-turn lanes at the intersection with Hall Ave. Hall Ave. has a speed limit of 25 mph, and it is likely that Stephenson Ave. also has a speed limit of 25 mph. The other crash occurred at the intersection of Madison Ave. &amp; Maple Ave., two blocks south of Hall Ave. This intersection is unsignalized and appears to have stop signs for Maple Ave. Madison Ave. is 2 lanes with on-street parking. Maple Ave. is 2 lanes with on-street parking. Both Madison Ave. and Maple Ave. appear to have speed limits of 25 mph. Land use in the area is mixed. It is a historic downtown with commercial, office, industrial, institutional, and residential uses.</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>North Central</td>
</tr>
<tr>
<td>County KK</td>
</tr>
<tr>
<td>Northwest</td>
</tr>
</tbody>
</table>

**Crash Location Data:**

<table>
<thead>
<tr>
<th>Location</th>
<th>Time (Minutes)</th>
<th>Bicyclist Age</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>North Central</td>
<td>7.60</td>
<td>207</td>
<td>Intersection of two state highways (Riverview Expwy./WI 34 and Grand Ave./WI 73/WI 13). The intersection of Riverview Expwy. &amp; Grand Ave. is signalized and slightly oblique. Riverview Expwy. is 4 lanes with a wide median. Grand Ave. is 4 lanes with a wide median. Both roadways have an additional left-turn and right-turn lane at the intersection (except the south leg does not have a right-turn-only lane. Riverview Expwy. has a speed limit of 45 mph. Grand Ave. has a speed limit of 30 mph. An abandoned rail line crosses the west leg of the intersection, and a multi-use trail is on the west side of Riverview Expwy. and ends at the southwest corner of the intersection. Land use around the intersection has large commercial retail stores and industrial buildings with many large parking lots and driveways.</td>
</tr>
<tr>
<td>County KK</td>
<td>3.82</td>
<td>207</td>
<td>County KK is a rural highway north of Mosinee. This crash location was not associated with the intersection with Rifle Rd. County KK has 2 lanes with a paved, 5-foot shoulder. The speed limit on County KK appears to be 55 mph. Land use in the area is sparse residential and agricultural.</td>
</tr>
<tr>
<td>Northwest</td>
<td>7.62</td>
<td>207</td>
<td>Intersection of a state highway (Broadway St./US12/WI 25) and a local street (Elm Ave.). The intersection of Broadway St. &amp; Elm Ave. is unsignalized, but it is one block south of the signalized intersection of Broadway St. &amp; Cedar St. Elm Ave. is controlled by stop signs. Broadway St. is four lanes plus a center left-turn lane. Elm Ave. is 2 lanes with on-street parking (lightly used). Broadway St. has a speed limit of 35 mph. Land use in the Broadway St. corridor is mainly commercial, dominated by strip retail with parking lots and many driveway crossings. The surrounding blocks are residential.</td>
</tr>
</tbody>
</table>
| Tower Ave.  
| near 24th St.  
| and 26th St. | Superior | 7.16 | 2 | 8 |

Tower Ave. is a state highway corridor (WI 35). 24th St. and 26th St. are local streets. The intersections of Tower Ave. with 24th St. and 26th St. are unsignalized, and there are stop signs controlling traffic from the local streets. Tower Ave. is 4 lanes plus a 2-way left-turn lane with no on-street parking, and it has a speed limit of 35 mph. Land use in the corridor is mixed, including strip commercial retail on the west side of Tower Ave. and low-to mid-density residential on the east side. Tower Ave. is a bus route.

Wrong way riding bicyclists in sidewalk. Crashes occurred at an intersection in the near crosswalk, with the vehicle driver coming from a local roadway.
Fatal & Severe Pedestrian Hot Spot Maps
WI Pedestrian Crash Hot Spot #8
National Ave. & Layton Blvd., Milwaukee
Based on Severe & Fatal Injury Crashes in WisTransPortal Crash Database (2011-2013)

Crashes per Sq. Km.
- 0.0 to 1.9
- 2.0 to 3.9
- 4.0 to 5.9
- 6.0 to 7.9
- 8.0 to 9.9
- 10.0 to 11.9
- 12.0 to 13.9
- 14.0 to 15.9
- 16.0 to 17.9
- 18.0 to 20.0

Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius
Map created by Bob Schneider & Joe Serbinschik
University of Wisconsin-Milwaukee
August 2014
Fatal & Severe Bicycle Crash Hot Spot Maps
WI Bicycle Crash Hot Spot #1
US 41 & 9th Ave., Oshkosh
Based on Severe & Fatal Injury Crashes in WisTransPortal Crash Database (2011-2013)

Crashes per Sq. Km.
- 0.0 to 0.9
- 1.0 to 1.9
- 2.0 to 2.9
- 3.0 to 3.9
- 4.0 to 5.4
- 5.5 to 6.9
- 7.0 to 7.9
- 8.0 to 8.9
- 9.0 to 9.9
- 10.0 to 12.0

Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius
Map created by Bob Schneider & Joe Steffens
University of Wisconsin-Milwaukee
August 2014
WI Bicycle Crash Hot Spot #11
Lapham Blvd. & Mitchell St. area, Milwaukee
Based on Severe & Fatal Injury Crashes in WisTransPortal Crash Database (2011-2013)

Kernel density was calculated for 50m by 50m grid cells using a 500 m search radius.
Map created by Bob Schneider & Joe Stefanski
University of Wisconsin-Milwaukee
August 2014
WI Bicycle Crash Hot Spot #19
Verona Ave. and Main St. corridors, Verona
Based on Severe & Fatal Injury Crashes in
WisTransPortal Crash Database (2011-2013)

Crashes per Sq. Km.:
- 0.0 to 0.9
- 1.0 to 1.9
- 2.0 to 2.9
- 3.0 to 3.9
- 4.0 to 5.4
- 5.5 to 6.9
- 7.0 to 7.9
- 8.0 to 8.9
- 9.0 to 9.9
- 10.0 to 12.0

Kernel density was calculated for 50m by 50m grid cells using a 500m search radius
Map created by Bob Schneider & Joe Stefaniak
University of Wisconsin-Milwaukee
August 2014
WI Bicycle Crash Hot Spot #20
County KK, Mosinee
Based on Severe & Fatal Injury Crashes in WisTransPortal Crash Database (2011-2013)

Kernel density was calculated for 50 m by 50 m grid cells using a 500 m search radius.

Map created by Bob Schneider & Joe Stefanich
University of Wisconsin-Milwaukee
August 2014