METROPOLITAN COUNCIL

# Memorandum

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Met Council

**From:** SRF Consulting Group

**Date:** June 1, 2024

**Subject:** Crash Data Summary and Analysis - Metropolitan Council Regional Safety Plan

# Crash Data Summary and Analysis

## Executive Summary


According to the crash data collected by the Minnesota Department of Public Safety (DPS) and provided Minnesota Department of Transportation (MnDOT), 209,884 total crashes took place in the Metropolitan Council region between 2018 and 2022 and 3,958 of those crashes resulted in at least one person involved receiving a fatal or incapacitating injury. An analysis of these crashes was completed to identify patterns in the data on crashes involving three modes: motor vehicle, bicycle, and motorcycle (pedestrian crashes were not investigated because an analysis of pedestrian crashes in the region was recently completed as a part of the Regional Pedestrian Safety Action Plan - Appendix C-1 Task 4 Crash Data Analysis and Trend Summary Memo). Note that the crash records utilized only include incidents that involved at least one motor vehicle, took place on public right-of-way, and were reported to law enforcement. The analysis includes an examination of the crashes by mode and summarized by basic crash report variables, roadway characteristics, and demographic and economic factors. The patterns identified in the crash summary may be used by communities within the Metropolitan Council region to help prioritize roadway safety investments in the future.

Some key findings of the analysis were:

- Motorcyclists are most likely to be severely injured or killed when involved in a crash (26% of the 2,564 crashes involving a motorcycle resulted in a fatal or incapacitating injury)
- Cyclists are second most likely to be severely injured or killed when involved in a crash (11% of the 2,038 crashes involving a cyclist resulted in a fatal or incapacitating injury)
- Approximately half of all crashes (58%) took place at an intersection.
- Approximately three quarters of all crashes (74%) had speeding listed as a contributing factor.
- Despite helmet usage by motorcyclists is inversely proportional to crash severity (21% of motorcycle crashes resulted in fatal or incapacitating injuries when motorcyclists were wearing a helmet whereas 33% of motorcycle crashes resulted in fatal or incapacitating

injuries when motorcyclists were not wearing a helmet), helmet usage was low (when helmet usage was recorded, 46% of motorcyclists were wearing a helmet)

- Hennepin, Anoka and Ramsey Counties experienced the highest number of fatal and serious injury crashes, however when normalized by fatal and serious injury per 100,000 residents, Scott, Carver, and Anoka Counties were highest.

## Introduction

The Minnesota 2020-2024 Strategic Highway Safety Plan (SHSP) acknowledges that fatal and serious injury crashes occur on all roads, with an over-representation of crashes on local roads. According to MnDOT's - Metropolitan Council Focus Area Summary Sheet (2023), the region's average annualized trends between 2014 and 2022 for fatal crashes increased by 8.6% per year (fatalities increased by 8.3%) and serious injury crashes increased by 5.7% per year (serious injuries increased 4.9% per year). See Appendix for more information.

A Safe System approach focuses on eliminating severe crashes (fatal and serious injury crashes) using a proactive approach, understanding that humans are vulnerable and make mistakes and our system needs to be designed to be accommodating. To support the efforts to reduce the number of fatal and serious injury crashes within the region, the Metropolitan Council is developing a regional safety action plan.

A key step in developing that safety action plan is analyzing the crashes occurring in the region to gain a better understanding of where, when, and how they occur. The crash analysis looked at two types of information: characteristics specific to a given crash and demographic characteristics specific to the area surrounding the location of a given crash. For simplicity, the KABCO injury scale is used throughout the discussion of the analysis (a description of the different designations is shown on Table 1 below).

*Table 1. KABCO Injury Scale*

| Severe (more injurious) | Non-Severe (less injurious) |
|---|---|
| **K** - involves a fatal injury<br>**A** - incapacitating injury (serious injury) | **B** - non-incapacitating injury<br>**C** - possible injury<br>**O** - no injury or a property damage-only (PDO) crash |

Throughout the report, the notation "KA" indicates crashes that resulted in fatal or serious injuries and "BCO" indicates crashes that resulted in less severe injuries or no injuries at all.

The data received from MnDOT was processed and each unit (a vehicle or a pedestrian) involved in a crash was sorted into a mode based on the Unit Vehicle and Vehicle Type fields from the DPS crash dataset. In addition to the three modes being analyzed and pedestrians, units could be sorted into three additional mode types which were then excluded from analysis: other (people riding on/in ATVs, farm equipment, horses, etc.), parked/unoccupied vehicles, and hit-and-run vehicles.

After classifying each unit by mode and excluding pedestrians, units with atypical characteristics, units without occupants, and units on which there was little to no information, the project team determined the Most Severe Injury (MSI) suffered by a person using each of the five modes. For example, if a passenger car with a driver and two passengers strikes a person riding a bicycle and the cyclist is killed (K), the driver receives a minor injury (B), and the two passengers are suspected of having minor injuries (C), the MSI for someone in an motor vehicle would be a minor injury (B), the MSI for a cyclist would be a fatality (K), and the MSI for a motorcycle would be null.

Once the crashes were categorized by mode, crash factors were summarized and further broken down by location – segment (midblock) or intersection. Crash factors included basic crash variables from the DPS crash data, AADTs from Replica, and demographic and economic characteristics from the US Decennial Census and American Community Survey.

As part of the SHSP, sixteen crash types and factors were identified as topics of particular interest. Of the sixteen focus area flags defined by the SHSP, the six most frequently seen in KA crashes are intersection-related crashes, crashes that involved speeding, single vehicles run-off-the-road, at least one impaired road user, at least one unlicensed driver, or at least one motorcycle.

Table 2 shows the sixteen focus areas and their respective crash counts. Note that the crash severity being considered is that the occupants of a motor vehicle, motorcycle, or bicycle and not pedestrians. As a result, there are only 21 KA crashes with the “Pedestrian” flag because pedestrians are not included in the analysis and there are only 21 crashes involving a pedestrian where someone in/on a motor vehicle, motorcycle, or bicycle was fatally or seriously injured. Appendix A includes summary sheets for these top six focus areas.

*Table 2 Fatal and Serious Crashes within the Metropolitan Council Region by Strategic Highway Safety Plan Focus Areas*

| Combined Focus Areas | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Intersection Related | 1,885 | 101,471 | 103,356 | 0.019 |
| Speeding | 1,850 | 144,143 | 145,993 | 0.013 |
| Single Vehicle Run Off Road | 874 | 29,789 | 30,663 | 0.029 |
| Impaired Road User | 822 | 11,729 | 12,551 | 0.070 |
| Unlicensed Driver | 800 | 26,240 | 27,040 | 0.030 |
| Motorcyclist | 661 | 1,903 | 2,564 | 0.347 |
| Older Driver (65+ YO) | 549 | 28,755 | 29,304 | 0.019 |
| Younger Driver (14 to 20 YO) | 539 | 38,369 | 38,908 | 0.014 |
| Unbelted Vehicle Occupant | 465 | 5,728 | 6,193 | 0.081 |
| Inattentive Driver | 275 | 18,408 | 18,683 | 0.015 |
| Cyclist | 230 | 1,808 | 2,038 | 0.127 |
| Commercial Vehicle | 214 | 13,620 | 13,834 | 0.016 |
| In Work Zone | 88 | 8,093 | 8,181 | 0.011 |
| Head-On Collision | 70 | 5,996 | 6,066 | 0.012 |
| Pedestrian | 21 | 2,420 | 2,441 | 0.009 |
| Train | 4 | 83 | 87 | 0.048 |

## Crash Characteristics – General Summary for All Motor vehicle, Bicycle and Motorcycle Crashes

### Basic Crash Report Variables

The first crash variable that was analyzed was the mode (see Figure 1 and Table 3). This involved calculating the MSI for each mode in each crash and counting the number of crashes with each modal MSI. Because the presence of one mode in a crash does not preclude the presence of another mode, it is entirely possible (even likely) that the number of crashes will be less than the sum of the counts of crashes involving each mode. For example, there were 196,955 crashes in the study area during the study period that involved a motor vehicle, a motorcycle, and/or a bicycle but the sum of the crash totals for each of those modes (195,409, 2,038, and 2,557, respectively) is 199,651. The Total Crashes column of Table 3 shows that motor vehicles are the mode most commonly involved in a crash, but the KA to BCO Ratio column (the number of severe crashes divided by the number of non-severe crashes) shows that the likelihoods of bicyclists and motorcyclists involved in crashes receiving a fatal or incapacitating injury are approximately 11 and 29 times higher than for motorists involved in crashes, respectively. That said, crashes involving cyclists (and pedestrians) remain underreported.[1] As a result, the number of crashes in the region that involved a cyclist (especially less severe crashes) is likely higher than the values shown below.

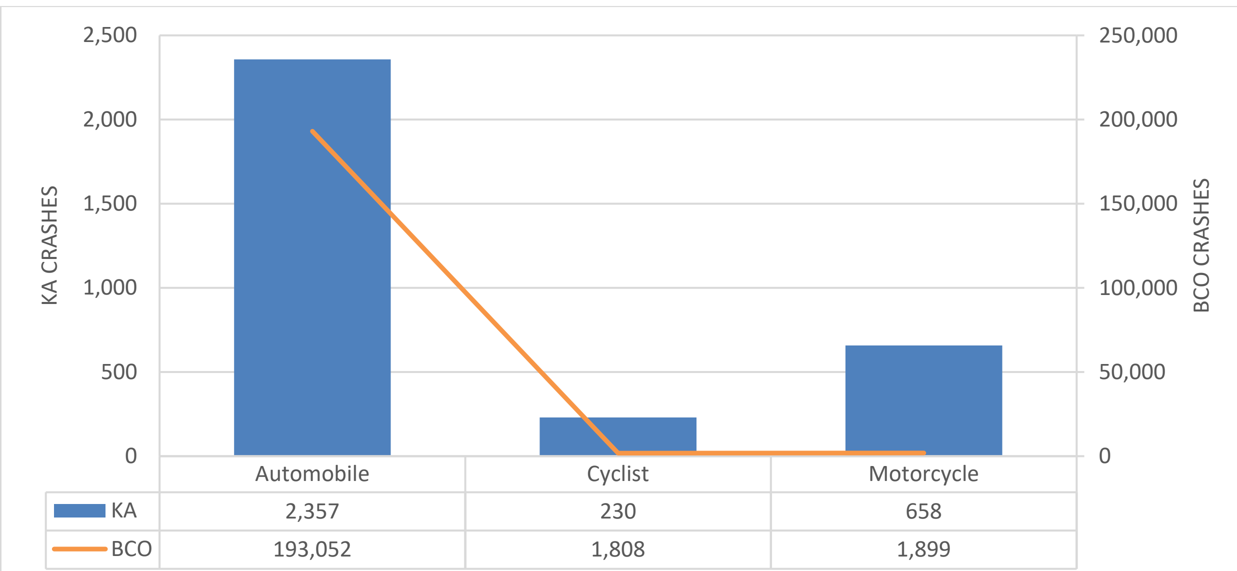


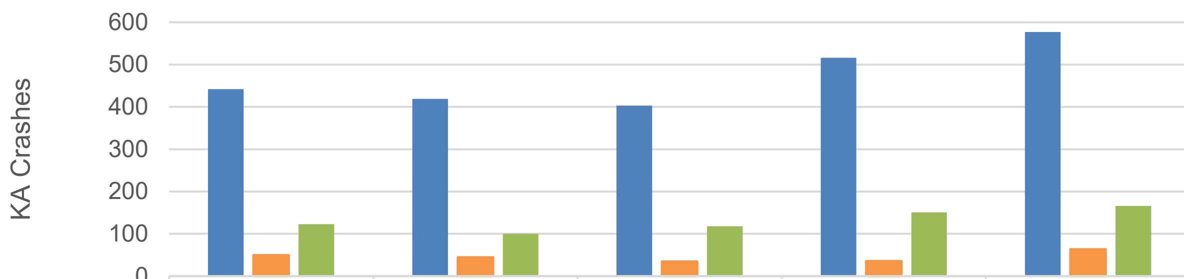

*Figure 1 Crashes by mode (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

[1] Pedestrian and Bicycle Information Center. Studies have shown that pedestrian and bicyclist fatalities represent only the "top of the iceberg" with respect to all crashes involving these modes. Furthermore, research has demonstrated consistent underreporting of crashes involving pedestrians and bicyclists, so as many as 44-75 percent of pedestrian crashes and 7-46 percent of bicyclist crashes may be missing from police-reported crash data.

*Table 3 Crashes by mode (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

| Mode | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Motor Vehicle | 2,357 | 193,052 | 195,409 | 0.012 |
| Cyclist | 230 | 1,808 | 2,038 | 0.127 |
| Motorcycle | 658 | 1,899 | 2,557 | 0.346 |

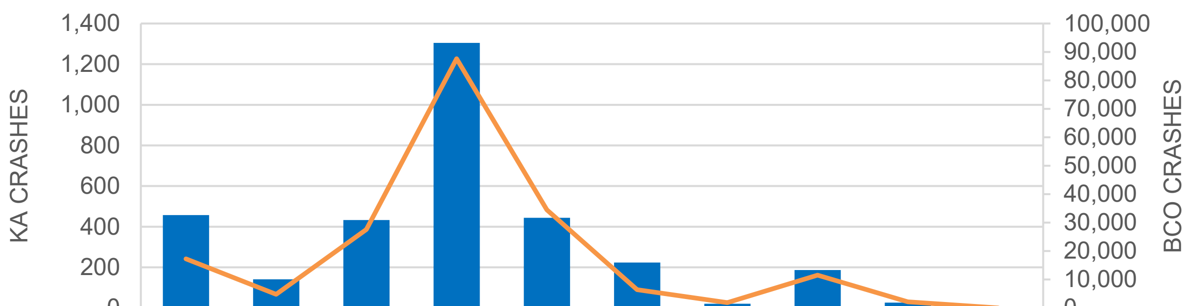
The region experienced a slight increase in fatal and serious injuries across the three modes over the five-year period as shown in Figure 2.




| | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|
| Automobile | 442 | 419 | 403 | 516 | 577 |
| Cyclist | 50 | 45 | 35 | 36 | 64 |
| Motorcycle | 123 | 100 | 118 | 151 | 166 |

*Figure 2 Fatal and Serious (KA) Crashes by Year (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

The region's crashes by the three modes were tabulated by county as shown in Figure 3. The Metropolitan Council's boundary includes seven counties: Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington. (Partial Counties - Sherburne and Wright.) To account for the varying county sizes and population densities, the crash rates per 100,000 residents were calculated (see Table 4). As seen below, Hennepin had the most crashes but had the fourth-most crashes per 100,000 residents behind Scott, Carver, and Anoka Counties.




| | Anoka | Carver | Dakota | Henne-pin | Ramsey | Scott | Sher-burne | Wash-ington | Wright | Un-known |
|---|---|---|---|---|---|---|---|---|---|---|
| KA | 457 | 141 | 433 | 1,305 | 444 | 224 | 21 | 187 | 26 | 2 |
| BCO | 17,248 | 4,823 | 27,582 | 87,625 | 34,481 | 6,439 | 1,861 | 11,532 | 2,154 | 18 |

*Figure 3 Crashes by County (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

*Table 4 Crashes by County (Include Motor vehicle, Bicycle, and Motorcycle crashes only) with Normalization by 100,000 Residents*

| County | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | 2022 Pop. | KA Crashes per 100,000 Residents | BCO Crashes per 100,000 Residents | Total Crashes per 100,000 Residents |
|---|---|---|---|---|---|---|---|---|
| Anoka | 457 | 17,248 | 17,705 | 0.026 | 368,864 | 124 | 4,676 | 4,800 |
| Carver | 141 | 4,823 | 4,964 | 0.029 | 110,034 | 128 | 4,383 | 4,511 |
| Dakota | 433 | 27,582 | 28,015 | 0.016 | 443,341 | 98 | 6,221 | 6,319 |
| Hennepin | 1,305 | 87,625 | 88,930 | 0.015 | 1,260,121 | 104 | 6,954 | 7,057 |
| Ramsey | 444 | 34,481 | 34,925 | 0.013 | 536,413 | 83 | 6,428 | 6,511 |
| Scott | 224 | 6,439 | 6,663 | 0.035 | 154,520 | 145 | 4,167 | 4,312 |
| Sherburne | 21 | 1,861 | 1,882 | 0.011 | 100,824 | 21 | 1,846 | 1,867 |
| Washington | 187 | 11,532 | 11,719 | 0.016 | 275,912 | 68 | 4,180 | 4,247 |
| Wright | 26 | 2,154 | 2,180 | 0.012 | 148,003 | 18 | 1,455 | 1,473 |
| Unknown | 2 | 18 | 20 | 0.111 | | - | - | - |
| **Total** | **3,240** | **193,763** | **197,003** | **0.017** | **3,398,032** | **95** | **5,702** | **5,798** |

The Metropolitan Council developed nine community type designations in 2014 as a part of the [Thrive MSP 2040 plan.] The community designations are assigned to each city and township on the basis of existing development patterns, common challenges, and shared opportunities. They are used by the Council to:

- Guide regional growth and development to areas that have urban infrastructure in place and the capacity to accommodate development and redevelopment.
- Establish land use expectations, including overall densities and development patterns, for different community designations.
- Outline the respective roles of the Council and the individual communities and strategies for planning for forecasted growth.

Since 2014, the region has expanded to include portions of Sherburne and Wright Counties. Crashes occurred most in urban center and suburban community types (See Figure 4).

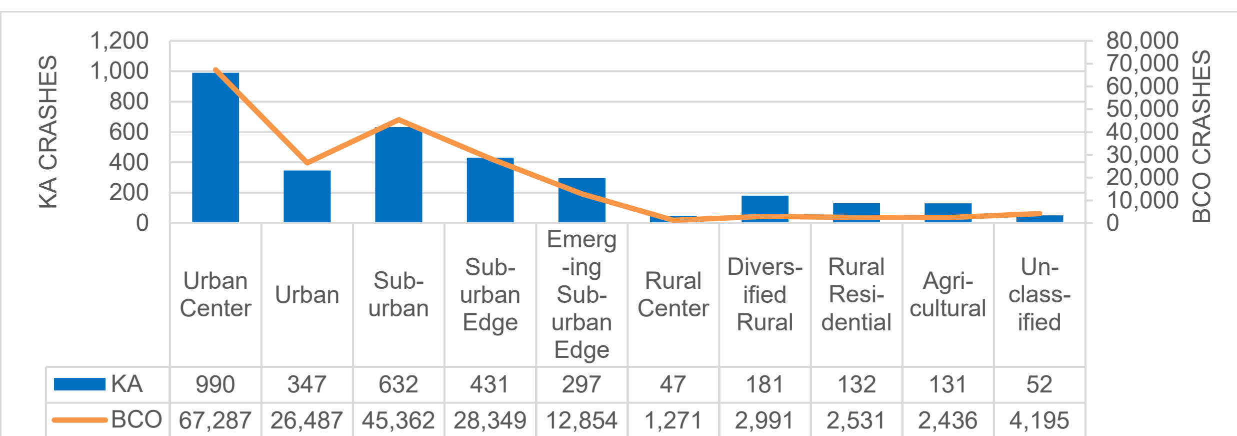



*Figure 4 Crashes by Thrive Community Type (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

*Table 5 Crashes by Thrive Community Type (Include Motor vehicle, Bicycle, and Motorcycle crashes only)*

| Thrive 2040 Community Type | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Urban Center | 990 | 67,287 | 68,277 | 0.015 |
| Urban | 347 | 26,487 | 26,834 | 0.013 |
| Suburban | 632 | 45,362 | 45,994 | 0.014 |
| Suburban Edge | 431 | 28,349 | 28,780 | 0.015 |
| Emerging Suburban Edge | 297 | 12,854 | 13,151 | 0.023 |
| Rural Center | 47 | 1,271 | 1,318 | 0.037 |
| Diversified Rural | 181 | 2,991 | 3,172 | 0.061 |
| Rural Residential | 132 | 2,531 | 2,663 | 0.052 |
| Agricultural | 131 | 2,436 | 2,567 | 0.054 |
| Unclassified | 52 | 4195 | 4247 | 0.012 |
| **Total** | **3,240** | **193,763** | **197,003** | **0.017** |

Figure 5 shows the relative frequency of each vehicle type among vehicles involved in a KA crash that involved a motor vehicle, bicycle, and motorcycle crash. The most common vehicle type was a passenger car (42.9%). The second most common vehicle type involved a sport utility vehicle at 24.7%. Without more data on the relative frequency of each vehicle type in the region and their relative proportions of vehicle miles traveled, it is difficult to say if any of the vehicle types shown in Figure 5 are disproportionately represented.

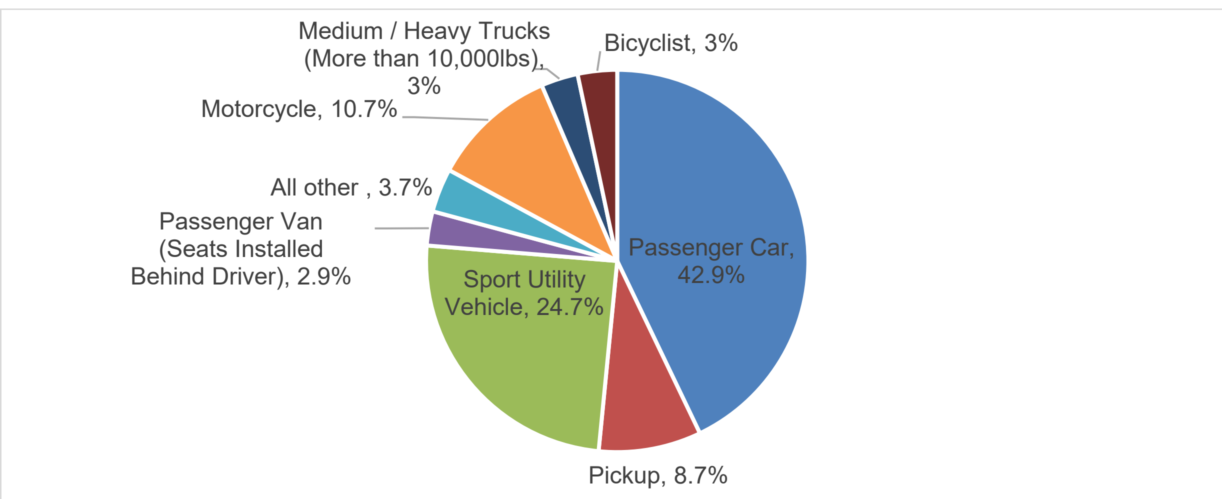



*Figure 5 Percent of Fatal and Serious (KA) Crashes by Vehicle Type (Includes Motor vehicle, Bicycle and Motorcycle crashes only)*

## Crash Report Variables – Involving Motor Vehicles

**The following section includes crash factors for crashes involving at least one motor vehicle within the Metropolitan Council region.**

While it is difficult to determine if crashes are more likely in dark or lit conditions (due to differences in the number of trips occurring during different hours of the day, changes in the number of hours of daylight throughout the year, and changes in sunrise and sunset times throughout the year, etc.), The KA to BCO ratios shown in

Table 6 indicate that crashes that occur in the dark are more likely to result in fatal or incapacitating injuries than those that occur in daylight, at sunrise, or at sunset.

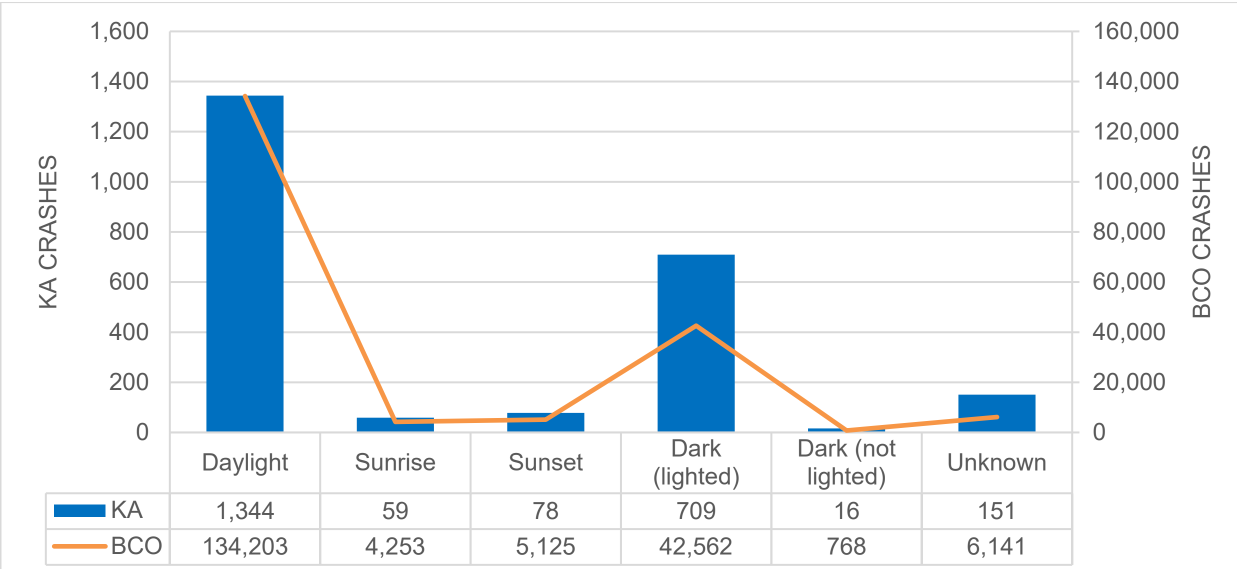



*Figure 6 Crashes by Lighting Conditions (Involving Motor vehicle Crashes)*

*Table 6 Crashes by Lighting Conditions (Involving Motor vehicle Crashes)*

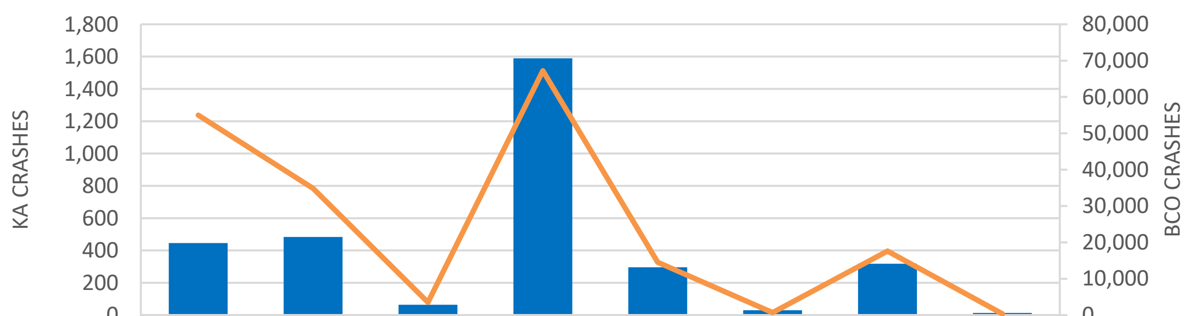
| Lighting Conditions | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Daylight | 1,344 | 134,203 | 135,547 | 0.010 |
| Sunrise | 59 | 4,253 | 4,312 | 0.014 |
| Sunset | 78 | 5,125 | 5,203 | 0.015 |
| Dark (lighted) | 709 | 42,562 | 43,271 | 0.017 |
| Dark (not lighted) | 16 | 768 | 784 | 0.021 |
| Unknown | 151 | 6,141 | 6,292 | 0.025 |
| **Total** | **2,357** | **193,052** | **195,409** | **0.012** |

## *Segment Related Crashes*

**The crashes involving at least one motor vehicle were further split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews segment midblock-specific crashes.**

The functional classification of a road is strongly correlated with other factors analyzed in this section (e.g., number of lanes, AADT, speed limit, etc.), but it is still a meaningful way of describing the character of a roadway. Figure 7 shows the number of KA and BCO midblock crashes involving a motor vehicle that occurred on roads of each of the seven functional classes. The plurality of KA crashes (418 out of 1,037 or 40%) took place on minor arterials and the plurality of BCO crashes (39,195 out of 39,402 or 41%) took place on interstate highways, but this does not account for the relative frequency of each functional class in the network.

Table 7 shows that, per mile, minor arterials have the fourth-highest KA crash rate at 81 crashes per 1,000 directional miles (centerline miles multiplied by the number of directions of travel – one for one-way roads, two for bidirectional roads). Interstates have nearly ten times the network average number of KA crashes per 1,000 directional miles at 261 compared to 28 for the network as a whole. While this accounts for the proportion of the network that each functional class comprises, it does not account for the previously mentioned correlated factors which all tend to be higher for the more crash-prone functional classes.




| | Interstate | Principal Arterial (non-interstate freeway) | Principal Arterial (other) | Minor Arterial | Major Collector | Minor Collector | Local | Unknown |
|---|---|---|---|---|---|---|---|---|
| KA | 446 | 484 | 64 | 1,589 | 296 | 30 | 318 | 13 |
| BCO | 54,990 | 34,841 | 3,511 | 67,222 | 14,534 | 695 | 17,616 | 354 |

*Figure 7 Segment Crashes by Midblock Roadway Functional Classification (Involving Motor vehicle Crashes)*

*Table 7 Segment Crashes by Midblock Roadway Functional Classification (Involving Motor vehicle Crashes) with Normalization by 1,000 Roadway Miles*

| Functional Classification | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| Interstate | 446 | 54,990 | 55,436 | 0.008 | 794 | 562 | 69,246 | 69,807 |
| Principal Arterial (non-interstate freeway) | 484 | 34,841 | 35,325 | 0.014 | 1,066 | 454 | 32,688 | 33,142 |
| Principal Arterial (other) | 64 | 3,511 | 3,575 | 0.018 | 136 | 472 | 25,889 | 26,361 |
| Minor Arterial | 1,589 | 67,222 | 68,811 | 0.024 | 5,174 | 307 | 12,993 | 13,301 |
| Major Collector | 296 | 14,534 | 14,830 | 0.020 | 2,912 | 102 | 4,992 | 5,093 |
| Minor Collector | 30 | 695 | 725 | 0.043 | 910 | 33 | 764 | 797 |
| Local | 318 | 17,616 | 17,934 | 0.018 | 26,423 | 12 | 667 | 679 |
| Unknown | 13 | 354 | 367 | 0.037 | - | - | - | - |
| Total | 3,240 | 193,763 | 197,003 | 0.017 | 37,414 | 87 | 5,179 | 5,266 |

Midblock roadway configuration is strongly correlated with daily volume, speed limit, and roadway functional classification but the existing Metropolitan Council network files do not include midblock configuration, thus preventing the normalization of crash counts by directional miles. Nonetheless, Table 8 shows that most midblock crashes involving a motor vehicle occurred on two-way roads with a median barrier (54,228 out of 95,599 or 57%) but KA crashes were more prevalent on two-way undivided roads (542 out of 1,037 or 52%). Looking at all five midblock road configurations, the KA to BCO ratio generally increases as separation between opposing directions decreases.

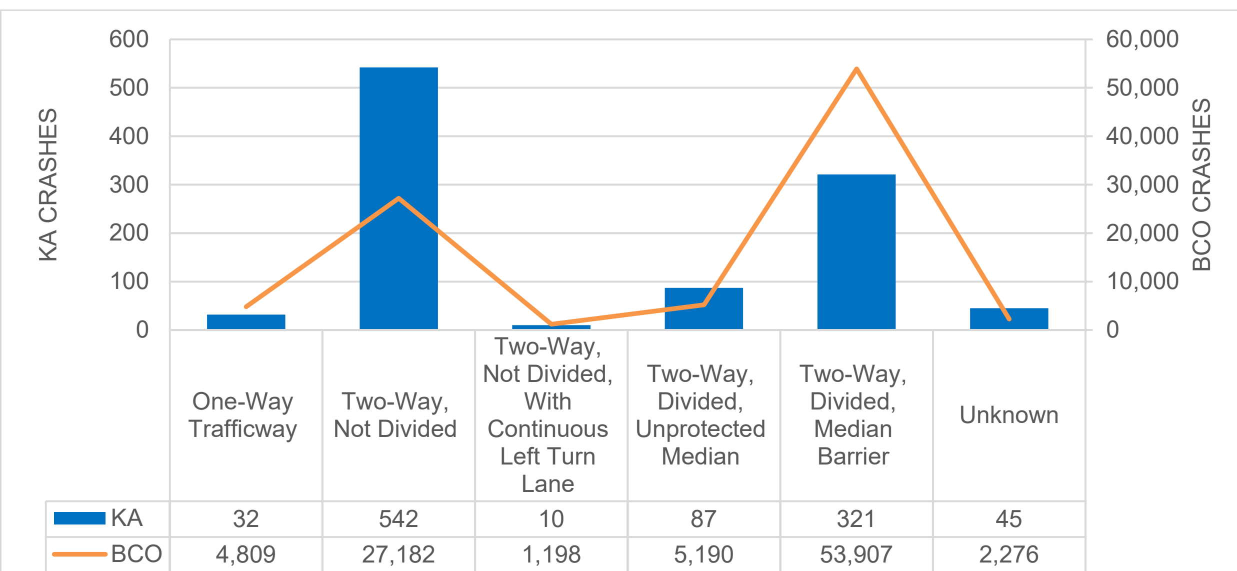
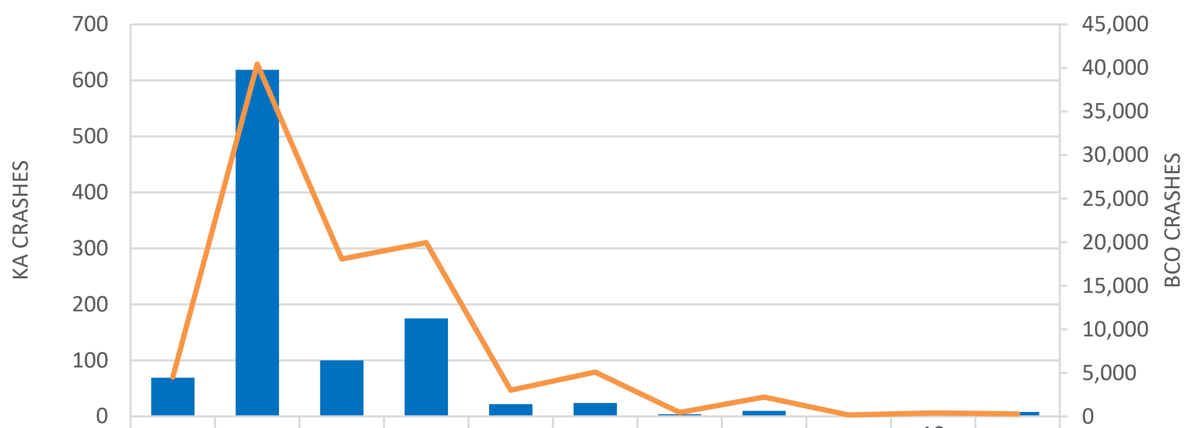



*Figure 8 Segment Crashes by Midblock Roadway Configuration (Involving Motor vehicle Crashes)*

*Table 8 Segment Crashes by Midblock Roadway Configuration (Involving Motor vehicle Crashes)*

| Midblock Road Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| One-Way Trafficway | 32 | 4,809 | 4,841 | 0.007 |
| Two-Way, Not Divided | 542 | 27,182 | 27,724 | 0.020 |
| Two-Way, Not Divided, With Continuous Left Turn Lane | 10 | 1,198 | 1,208 | 0.008 |
| Two-Way, Divided, Unprotected Median | 87 | 5,190 | 5,277 | 0.017 |
| Two-Way, Divided, Median Barrier | 321 | 53,907 | 54,228 | 0.006 |
| Unknown | 45 | 2,276 | 2,321 | 0.020 |
| **Total** | **1,037** | **94,562** | **95,599** | **0.011** |

As seen in Figure 9, the majority of midblock crashes involving a vehicle occur on two-lane roads. However, the tabulation of directional mileage by the number of lanes in Table 9 shows that two-lane roads account for 90% of the network and actually have the fewest crashes per 1,000 directional miles (18 KA crashes and 1,198 BCO crashes per 1,000 directional miles), far lower than the network average of 28 KA crashes and 2,527 BCO crashes. On the other hand, the KA to BCO ratios for one- and two-lane roads (0.015 and 0.015, respectively) are approximately twice as high as those of the other numbers of lanes (0.007, on average) except ten lanes (of which there are only 4.0 miles). It is unclear what is causing one- and two-lane roads to have crashes less frequently but also have higher likelihoods of crashes being fatal.




| | 1 lane | 2 lanes | 3 lanes | 4 lanes | 5 lanes | 6 lanes | 7 lanes | 8 lanes | 9 lanes | 10 lanes | ? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 69 | 619 | 100 | 175 | 22 | 24 | 4 | 10 | 1 | 5 | 8 |
| BCO | 4,514 | 40,447 | 18,067 | 19,942 | 3,006 | 5,077 | 450 | 2,216 | 162 | 387 | 294 |

*Figure 9 Segment Crashes by Number of Lanes (Involving Motor vehicle Crashes)*

*Table 9 Segment Crashes by Number of Lanes (Involving Motor vehicle Crashes) with Normalization by 1,000 Roadway Miles*

| Midblock Number of Lanes | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 1 lane | 69 | 4,514 | 4,583 | 0.015 | 1,177 | 59 | 3,835 | 3,894 |
| 2 lanes | 619 | 40,438 | 41,057 | 0.015 | 33,751 | 18 | 1,198 | 1,216 |
| 3 lanes | 100 | 18,067 | 18,167 | 0.006 | 327 | 306 | 55,319 | 55,625 |
| 4 lanes | 175 | 19,939 | 20,114 | 0.009 | 1,110 | 158 | 17,955 | 18,113 |
| 5 lanes | 22 | 3,006 | 3,028 | 0.007 | 43 | 508 | 69,351 | 69,858 |
| 6 lanes | 24 | 5,077 | 5,101 | 0.005 | 156 | 154 | 32,551 | 32,705 |
| 7 lanes | 4 | 450 | 454 | 0.009 | 23 | 178 | 19,986 | 20,164 |
| 8 lanes | 10 | 2,214 | 2,224 | 0.005 | 25 | 404 | 89,551 | 89,956 |
| 9 lanes | 1 | 162 | 163 | 0.006 | 5 | 200 | 32,433 | 32,633 |
| 10 lanes | 5 | 387 | 392 | 0.013 | 4 | 1,336 | 103,433 | 104,770 |
| ? | 8 | 308 | 316 | 0.026 | - | - | - | - |
| **Total** | **1,037** | **94,562** | **95,599** | **0.011** | **37,414** | **28** | **2,527** | **2,555** |

Table 10 shows that 75% of all roads have a speed limit of 30 mph (note that the network file used to calculate the mileage of each speed limit uses the speed limits of roads at the beginning of the study period in 2018 and does not reflect changes to speed limits since then, including the changing of the default speed limit in Minneapolis and Saint Paul from 30 mph to 20 mph in late 2020). Normalizing by the number of directional miles of road with a given speed limit shows that roads with a speed limit of 30 mph have quite low crash rates per directional mile (7 KA crashes and 607 BCO crashes per 1,000 directional miles), much lower than the network average of 28 KA crashes and 2,534 BCO crashes per 1,000 directional miles. Roads with speed limits of 55, 60, 65, or 70 mph, on the other hand, have much higher crash rates per directional mile with 108, 389, 352, and 329 KA crashes per 1,000 directional miles, respectively. This stands to reason given the fact that crashes at higher speeds are more forceful and drivers have narrower fields of vision and require longer braking distances[2]. Roads with speed limits under 25 mph have high crash rates per directional mile; this may simply be a result of there being relatively few instances of these speed limits, but it could also be due to those segments being disproportionately problematic and warranting lower speed limits. Figure 10 shows that midblock crashes are most likely to occur on roads with a speed limit of 30, 55, or 60 mph (18%, 21%, and 27% of all crashes, respectively).

[2] https://nacto.org/publication/city-limits/the-need/how-speed-kills/

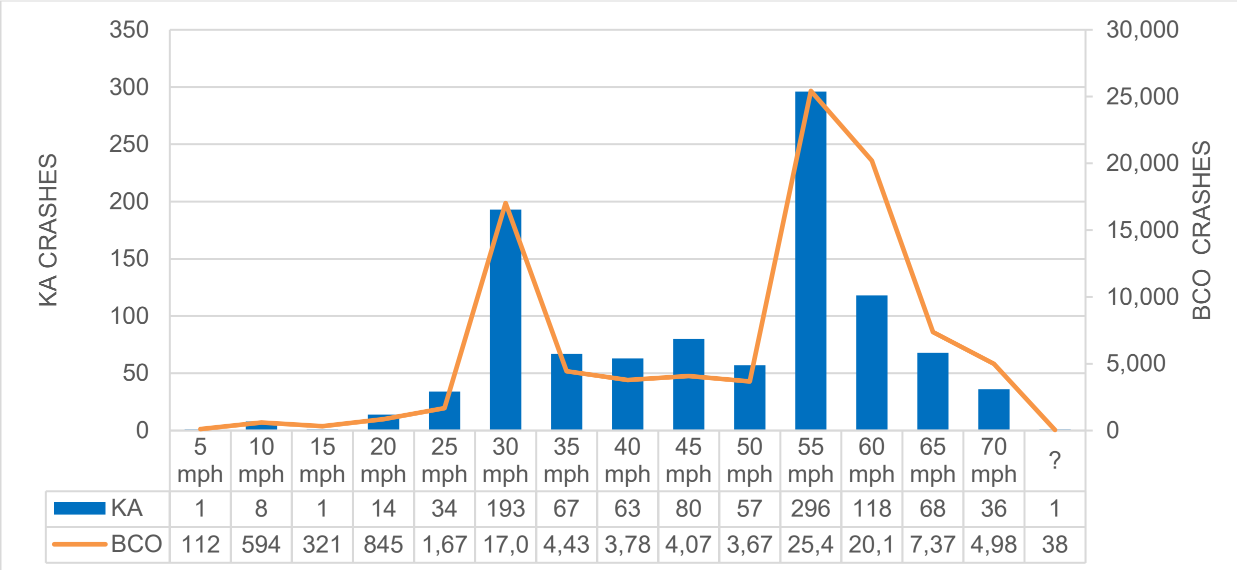
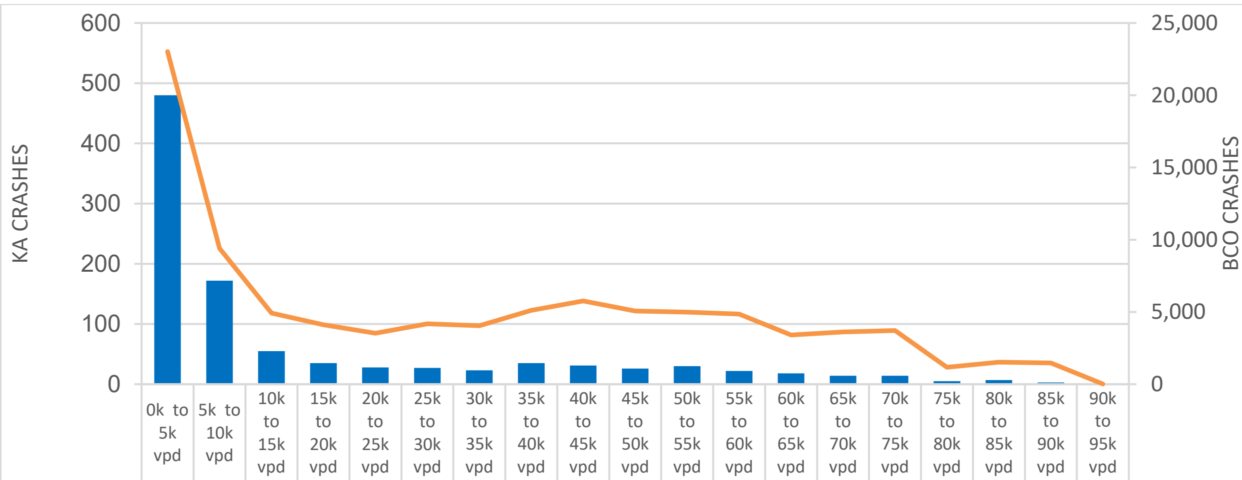



*Figure 10 Segment Crashes by Speed Limit (Involving Motor vehicle Crashes)*

*Table 10 Segment Crashes by Speed Limit (Involving Motor vehicle Crashes)*

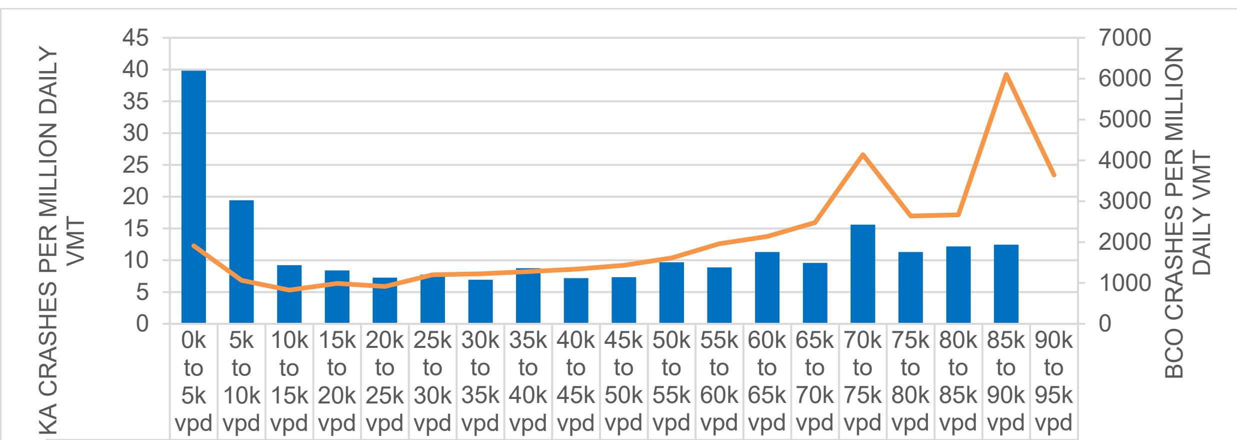
| Midblock Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 5 mph | 0 | 102 | 102 | | 19 | 0 | 5,244 | 5,244 |
| 10 mph | 4 | 393 | 397 | 0.010 | 108 | 37 | 3,625 | 3,662 |
| 15 mph | 1 | 320 | 321 | 0.003 | 76 | 13 | 4,203 | 4,216 |
| 20 mph | 14 | 842 | 856 | 0.017 | 163 | 86 | 5,168 | 5,254 |
| 25 mph | 34 | 1,671 | 1,705 | 0.020 | 662 | 51 | 2,525 | 2,577 |
| 30 mph | 193 | 17,026 | 17,219 | 0.011 | 28,065 | 7 | 607 | 614 |
| 35 mph | 67 | 4,435 | 4,502 | 0.015 | 1,269 | 53 | 3,494 | 3,547 |
| 40 mph | 63 | 3,785 | 3,848 | 0.017 | 796 | 79 | 4,754 | 4,833 |
| 45 mph | 80 | 4,077 | 4,157 | 0.020 | 1,382 | 58 | 2,950 | 3,008 |
| 50 mph | 57 | 3,677 | 3,734 | 0.016 | 1,435 | 40 | 2,562 | 2,602 |
| 55 mph | 296 | 25,423 | 25,719 | 0.012 | 2,746 | 108 | 9,258 | 9,366 |
| 60 mph | 118 | 20,197 | 20,315 | 0.006 | 304 | 389 | 66,501 | 66,889 |
| 65 mph | 68 | 7,372 | 7,440 | 0.009 | 193 | 352 | 38,120 | 38,471 |
| 70 mph | 36 | 4,988 | 5,024 | 0.007 | 109 | 329 | 45,598 | 45,927 |
| ? | 6 | 254 | 260 | 0.024 | - | - | - | - |
| **Total** | **1,043** | **94,812** | **95,855** | **0.011** | **37,414** | **28** | **2,534** | **2,562** |

Like roadway functional classification, number of lanes, and speed limit, roads with higher AADTs tend to have more crashes but also tend to be less common. Comparing Figure 11, which shows the number of KA and BCO crashes broken down by the AADT of the road on which they occurred, and Figure 12, which shows the number of KA and BCO crashes normalized by the number of vehicle miles traveled (VMT) each day on the road on which they occurred and broken down by the AADT of that road, shows that 480 out of 1,025 or 47% of KA crashes occur on low volume roads (under 5,000 vehicles per day) because low-volume roads are by far the most common type of road (according to Table 7, local roads account for 71% of the network and have the fewest KA crashes per directional mile of any of the functional classes). Similarly, low-volume roads have the highest rate of KA crashes per million VMT (40 KA crashes per million VMT) because they have the lowest VMT/mile due to their low volume. Even though local streets have the lowest crashes per mile, their low volumes mean that any crashes that do occur on them are distributed over relatively low AADTs. In other words, low-volume roads have relatively few crashes per mile but comparatively high crash rates per million vehicle miles traveled.




| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 480 | 172 | 55 | 35 | 28 | 27 | 23 | 35 | 31 | 26 | 30 | 22 | 18 | 14 | 14 | 5 | 7 | 3 | 0 |
| BCO | 23022 | 9407 | 4920 | 4120 | 3528 | 4186 | 4049 | 5109 | 5762 | 5072 | 4987 | 4857 | 3406 | 3621 | 3714 | 1169 | 1532 | 1471 | 17 |

*Figure 11 Segment Crashes per Million Daily Vehicle Miles Traveled by AADT (Involving Motor vehicle Crashes)*




| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 40 | 19 | 9 | 8 | 7 | 8 | 7 | 9 | 7 | 7 | 10 | 9 | 11 | 10 | 16 | 11 | 12 | 12 | 0 |
| BCO | 191 | 106 | 825 | 987 | 915 | 120 | 122 | 127 | 133 | 143 | 161 | 196 | 213 | 247 | 414 | 263 | 266 | 610 | 364 |

*Figure 12 Segment Crashes per Million Daily Vehicle Miles Traveled by AADT (Involving Motor vehicle Crashes)*

### *Intersection Related Crashes*

**The crashes involving at least one motor vehicle were split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews the crashes that occurred at an intersection.** According to the Strategic Highway Safety Plan, the focus area with the most crashes was crashes that occur at intersections.

Within the Metropolitan Council region, 58,018 out of 99,810 or 58% of intersection crashes involving at least one motor vehicle occurred at a four-way intersection as seen in Figure 13. This is largely a reflection of the prevalence of four-way intersections in the network.

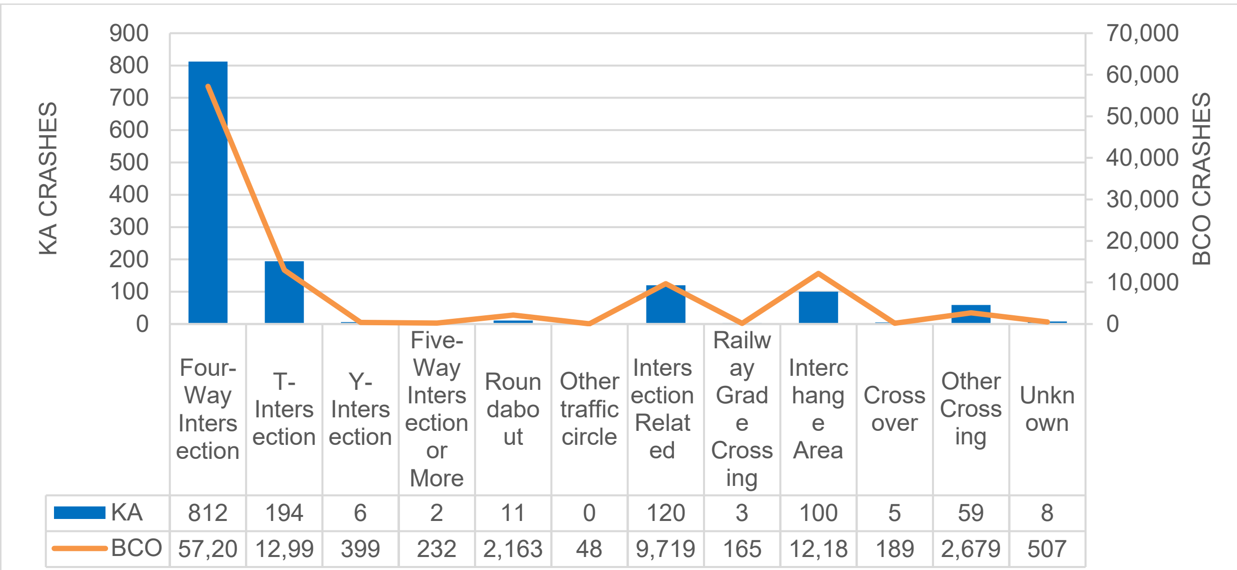
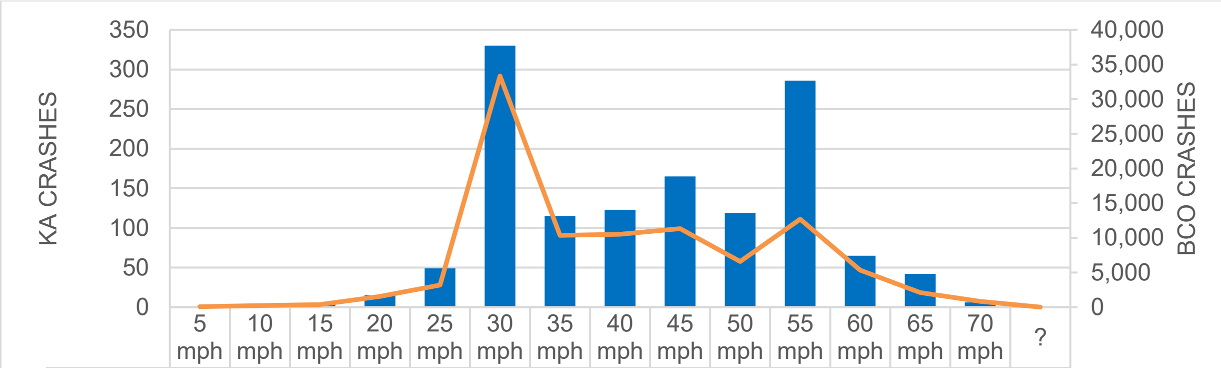



*Figure 13 Crashes by Intersection Configuration (Involving Motor vehicle Crashes)*

*Table 11 Crashes by Intersection Configuration (Involving Motor vehicle Crashes)*

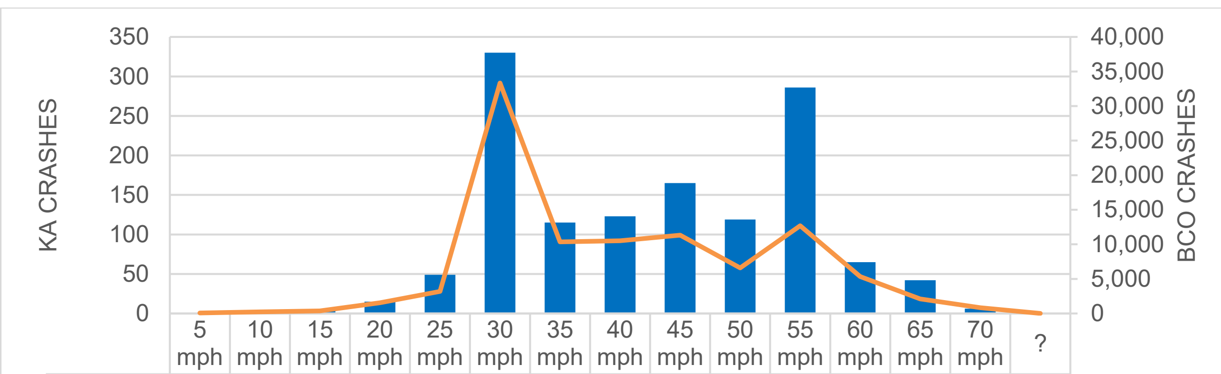
| Intersection Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Four-Way Intersection | 812 | 57,206 | 58,018 | 0.014 |
| T-Intersection | 194 | 12,999 | 13,193 | 0.015 |
| Y-Intersection | 6 | 399 | 405 | 0.015 |
| Five-Way Intersection or More | 2 | 232 | 234 | 0.009 |
| Roundabout | 11 | 2,163 | 2,174 | 0.005 |
| Other traffic circle | 0 | 48 | 48 | - |
| Intersection Related | 120 | 9,719 | 9,839 | 0.012 |
| Railway Grade Crossing | 3 | 165 | 168 | 0.018 |
| Interchange Area | 100 | 12,184 | 12,284 | 0.008 |
| Crossover | 5 | 189 | 194 | 0.026 |
| Other Crossing | 59 | 2679 | 2738 | 0.022 |
| Unknown | 8 | 507 | 515 | 0.016 |
| **Total** | **1,320** | **98,490** | **99,810** | **0.013** |




| | 5 mph | 10 mph | 15 mph | 20 mph | 25 mph | 30 mph | 35 mph | 40 mph | 45 mph | 50 mph | 55 mph | 60 mph | 65 mph | 70 mph | ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 0 | 1 | 4 | 15 | 49 | 330 | 115 | 123 | 165 | 119 | 286 | 65 | 42 | 6 | 0 |
| BCO | 62 | 223 | 367 | 1549 | 3184 | 3333 | 1035 | 1052 | 1132 | 6583 | 1268 | 5340 | 2115 | 838 | 7 |

*Figure 14 shows that crashes occur most frequently at intersections where the maximum speed limit is 30 or 55 mph (33% and 13% of crashes, respectively).*

Table 10 shows that 75% of all roads have a speed limit of 30 mph and that general pattern applies to the distribution of maximum speed limits at intersections. Whereas KA crashes are clustered at intersections with speed limits of 30 or 55 mph (25% and 22% of KA crashes, respectively), BCO crashes are only clustered at 30 mph intersections (34% of BCO crashes). This is in line with the increase in the KA to BCO ratio starting at 55 mph that was seen in Table 8 and stands to reason given the previously discussed fact that crashes at higher speeds are more forceful and drivers have narrower fields of vision and require longer break distances.





| | 5 mph | 10 mph | 15 mph | 20 mph | 25 mph | 30 mph | 35 mph | 40 mph | 45 mph | 50 mph | 55 mph | 60 mph | 65 mph | 70 mph | ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 0 | 1 | 4 | 15 | 49 | 330 | 115 | 123 | 165 | 119 | 286 | 65 | 42 | 6 | 0 |
| BCO | 62 | 223 | 367 | 1549 | 3184 | 3333 | 1035 | 1052 | 1132 | 6583 | 1268 | 5340 | 2115 | 838 | 7 |


*Figure 14 Intersection Crashes by Max Speed Limit (Involving Motor vehicle Crashes)*

*Table 12 Intersection Crashes by Max Speed Limit (Involving Motor vehicle Crashes) with Normalization by 1,000 Roadway Miles*

| Intersection Maximum Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| 5 mph | 0 | 62 | 62 | - |
| 10 mph | 1 | 223 | 224 | 0.004 |
| 15 mph | 4 | 367 | 371 | 0.011 |
| 20 mph | 15 | 1,549 | 1,564 | 0.010 |
| 25 mph | 49 | 3,184 | 3,233 | 0.015 |
| 30 mph | 330 | 33,339 | 33,669 | 0.010 |
| 35 mph | 115 | 10,359 | 10,474 | 0.011 |
| 40 mph | 123 | 10,523 | 10,646 | 0.012 |
| 45 mph | 165 | 11,320 | 11,485 | 0.015 |
| 50 mph | 119 | 6,583 | 6,702 | 0.018 |
| 55 mph | 286 | 12,681 | 12,967 | 0.023 |
| 60 mph | 65 | 5,340 | 5,405 | 0.012 |
| 65 mph | 42 | 2,115 | 2,157 | 0.020 |
| 70 mph | 6 | 838 | 844 | 0.007 |
| ? | 0 | 7 | 7 | - |
| **Total** | **1,320** | **98,490** | **99,810** | **0.013** |

When observing intersection crashes involving at least one motor vehicle, 50% of those crashes occurred at intersections controlled by a traffic control signal and 32% occurred at an interchange or the uncontrolled approach of a yield controlled or two-way stop-controlled intersection (included in the "None" category). This is likely just a reflection of the frequency of these intersection control devices/configurations.

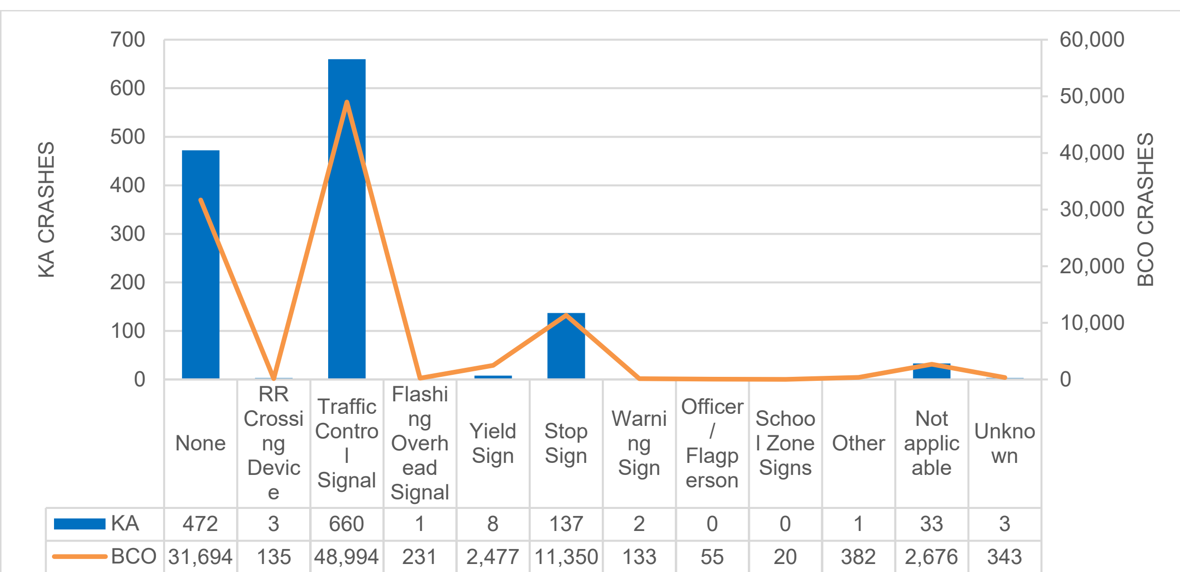



*Figure 15 Intersection Crashes by Traffic Control Device (Involving Motor vehicle Crashes)*

*Table 13 Intersection Crashes by Traffic Control Device (Involving Motor vehicle Crashes)*

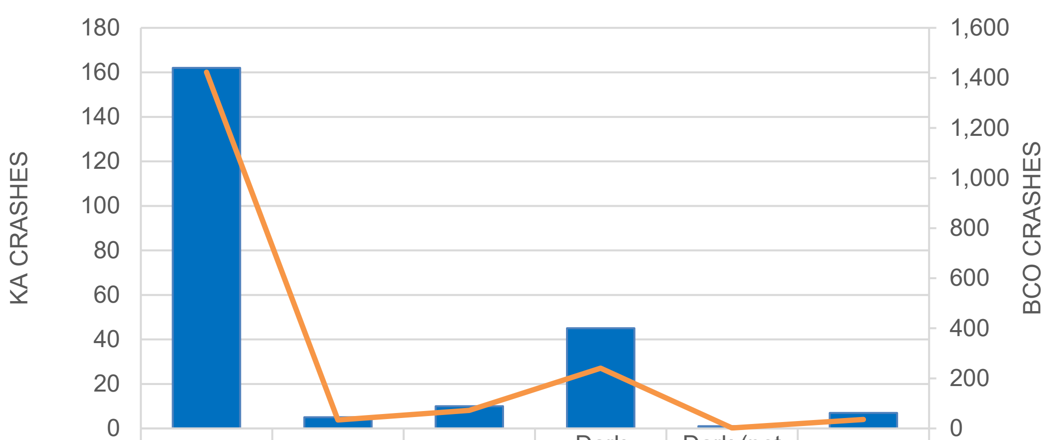
| Intersection Traffic Control Device | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| None | 472 | 31,694 | 32,166 | 0.015 |
| RR Crossing Device | 3 | 135 | 138 | 0.022 |
| Traffic Control Signal | 660 | 48,994 | 49,654 | 0.013 |
| Flashing Overhead Signal | 1 | 231 | 232 | 0.004 |
| Yield Sign | 8 | 2,477 | 2,485 | 0.003 |
| Stop Sign | 137 | 11,350 | 11,487 | 0.012 |
| Warning Sign | 2 | 133 | 135 | 0.015 |
| Officer / Flag person | 0 | 55 | 55 | - |
| School Zone Signs | 0 | 20 | 20 | - |
| Other | 1 | 382 | 383 | 0.003 |
| Not applicable | 33 | 2,676 | 2,709 | 0.012 |
| Unknown | 3 | 343 | 346 | 0.009 |
| **Total** | **1,320** | **98,490** | **99,810** | **0.013** |

## Crash Report Variables – Involving Bicycles

**The following section includes crash factors for crashes involving at least one bicycle within the Metropolitan Council region.**

While it is difficult to determine if crashes are more likely in dark or lit conditions (due to differences in the number of trips occurring during different hours of the day, changes in the number of hours of daylight throughout the year, and changes in sunrise and sunset times throughout the year, etc.), The KA to BCO ratios shown in

Table 14 have small sample sizes but appear to indicate that crashes that occur in the dark are more likely to result in fatal or incapacitating injuries than those that occur in daylight, at sunrise, or at sunset.




| | Daylight | Sunrise | Sunset | Dark (lighted) | Dark (not lighted) | Unknown |
|---|---|---|---|---|---|---|
| KA | 162 | 5 | 10 | 45 | 1 | 7 |
| BCO | 1,423 | 34 | 72 | 241 | 2 | 36 |

*Figure 16 Crashes by Lighting Conditions (Involving Bicycle Crashes)*

*Table 14 Crashes by Lighting Conditions (Involving Bicycle Crashes)*

| Lighting Conditions | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Daylight | 162 | 1,423 | 1,585 | 0.114 |
| Sunrise | 5 | 34 | 39 | 0.147 |
| Sunset | 10 | 72 | 82 | 0.139 |
| Dark (lighted) | 45 | 241 | 286 | 0.187 |
| Dark (not lighted) | 1 | 2 | 3 | 0.500 |
| Unknown | 7 | 36 | 43 | 0.194 |
| **Total** | **230** | **1,808** | **2,038** | **0.127** |

## *Segment Related Crashes*

**The crashes involving at least one bicycle were further split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews segment midblock specific crashes.**

Compared to the KA to BCO ratios of motor vehicle crashes seen in Table 7, the KA to BCO ratios for bicycles found in Table 15 are higher overall with the KA to BCO ratios for arterials being particularly high. The number of KA crashes per 1,000 directional miles are also higher for arterials (between 1 and 7 KA crashes) than the corresponding rates on collectors and local streets (2 and fewer than 1 KA crashes, respectively).

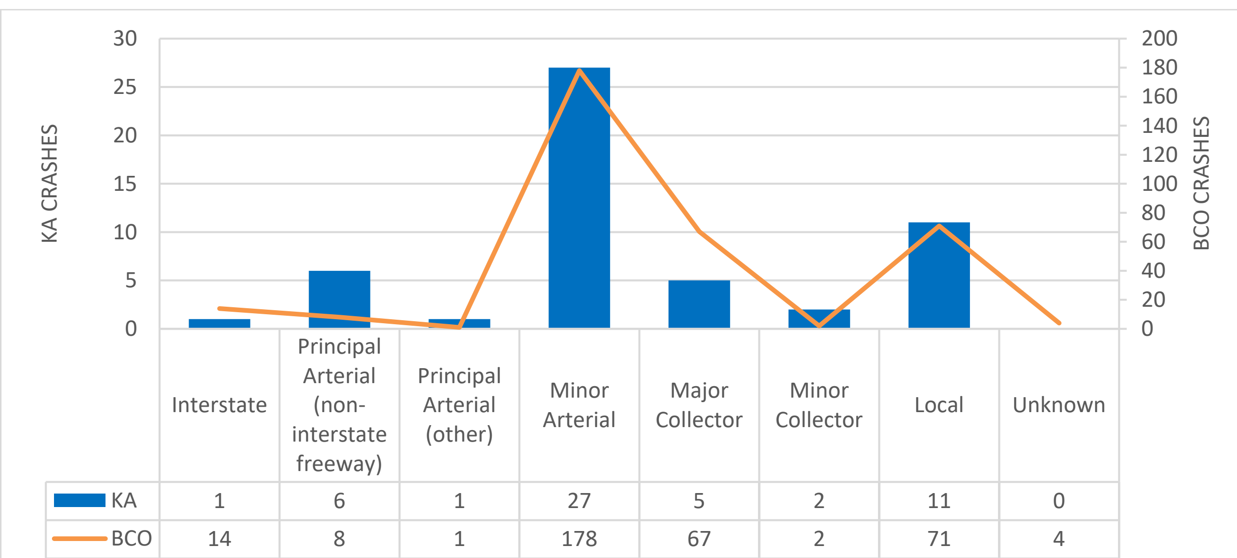



*Figure 17 Segment Crashes by Midblock Roadway Functional Classification (Involving Bicycle Crashes)*

*Table 15 Segment Crashes by Midblock Roadway Functional Classification (Involving Bicycle Crashes) Normalization by 1,000 Roadway Miles*

| Functional Classification | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| Interstate | 1 | 14 | 15 | 0.071 | 794 | 1 | 18 | 19 |
| Principal Arterial (non-interstate freeway) | 6 | 8 | 14 | 0.750 | 1,066 | 6 | 8 | 13 |
| Principal Arterial (other) | 1 | 1 | 2 | 1.000 | 136 | 7 | 7 | 15 |
| Minor Arterial | 27 | 178 | 205 | 0.152 | 5,174 | 5 | 34 | 40 |
| Major Collector | 5 | 67 | 72 | 0.075 | 2,912 | 2 | 23 | 25 |
| Minor Collector | 2 | 2 | 4 | 1.000 | 910 | 2 | 2 | 4 |
| Local | 11 | 71 | 82 | 0.155 | 26,423 | 0 | 3 | 3 |
| Unknown | 0 | 4 | 4 | | - | - | - | - |
| **Total** | **53** | **345** | **398** | **0.154** | **37,414** | **1** | **9** | **11** |

Regarding roadway configurations, most crashes involving at least one bicycle occurred on two-way undivided roads (214 out of 398 or 54% of crashes). This is likely a reflection of the prevalence of this road configuration in the network.

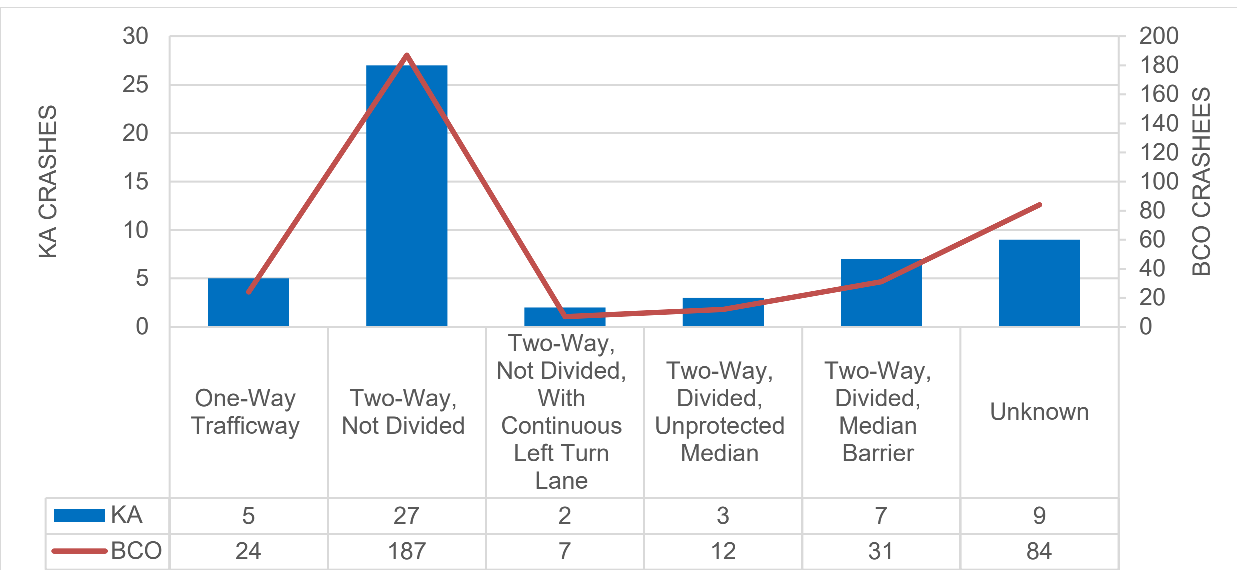
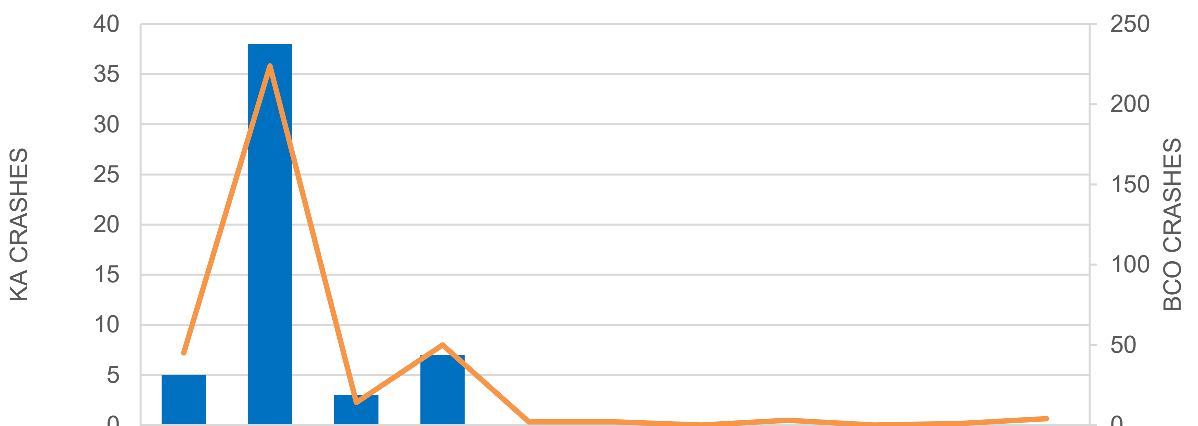



*Figure 18 Segment Crashes by Midblock Roadway Configuration (Involving Bicycle Crashes)*

*Table 16 Segment Crashes by Midblock Roadway Configuration (Involving Bicycle Crashes)*

| Midblock Road Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| One-Way Trafficway | 5 | 24 | 29 | 0.208 |
| Two-Way, Not Divided | 27 | 187 | 214 | 0.144 |
| Two-Way, Not Divided, With Continuous Left Turn Lane | 2 | 7 | 9 | 0.286 |
| Two-Way, Divided, Unprotected Median | 3 | 12 | 15 | 0.250 |
| Two-Way, Divided, Median Barrier | 7 | 31 | 38 | 0.226 |
| Unknown | 9 | 84 | 93 | 0.107 |
| **Total** | **53** | **345** | **398** | **0.154** |

As seen in Figure 19, the majority (262 out of 398 or 72%) of midblock bicycle crashes occurred on two-lane roads. As seen in Table 17, this is largely a reflection of the prevalence of two-lane roads in the network and the number of KA crashes per 1,000 roadway miles is the lowest for two-lane roads with approximately 1 KA crash per 1,000 miles of two-lane roadway.



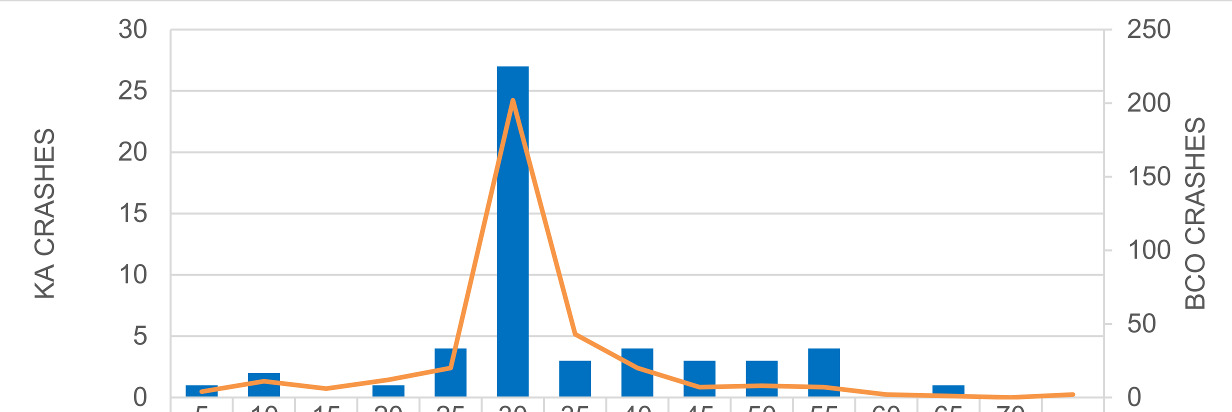

| | 1 lane | 2 lanes | 3 lanes | 4 lanes | 5 lanes | 6 lanes | 7 lanes | 8 lanes | 9 lanes | 10 lanes | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 5 | 38 | 3 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BCO | 45 | 224 | 14 | 50 | 2 | 2 | 0 | 3 | 0 | 1 | 4 |

*Figure 19 Segment Crashes by Number of Lanes (Involving Bicycle Crashes)*

*Table 17 Segment Crashes by Number of Lanes (Involving Bicycle Crashes) with Normalization by 1,000 Roadway Miles*

| Midblock Number of Lanes | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 1 lane | 5 | 45 | 50 | 0.111 | 1,177 | 4 | 38 | 42 |
| 2 lanes | 38 | 224 | 262 | 0.170 | 33,751 | 1 | 7 | 8 |
| 3 lanes | 3 | 14 | 17 | 0.214 | 327 | 9 | 43 | 52 |
| 4 lanes | 7 | 50 | 57 | 0.140 | 1,110 | 6 | 45 | 51 |
| 5 lanes | 0 | 2 | 2 | - | 43 | 0 | 46 | 46 |
| 6 lanes | 0 | 2 | 2 | - | 156 | 0 | 13 | 13 |
| 7 lanes | 0 | 0 | 0 | - | 23 | 0 | 0 | 0 |
| 8 lanes | 0 | 3 | 3 | - | 25 | 0 | 121 | 121 |
| 9 lanes | 0 | 0 | 0 | - | 5 | 0 | 0 | 0 |
| 10 lanes | 0 | 1 | 1 | - | 4 | 0 | 267 | 267 |
| Unknown | 0 | 4 | 4 | - | - | - | - | - |
| **Total** | **53** | **345** | **398** | **0.154** | **37,414** | **1** | **9** | **11** |

As the most prevalent speed limit in the network, 30 mph roads account for most of the bicycle crashes with 229 out of 398 or 58% of the midblock crashes. Due to the low number of crashes on other roadways, little can be drawn from their respective crash rates and KA to BCO ratios.



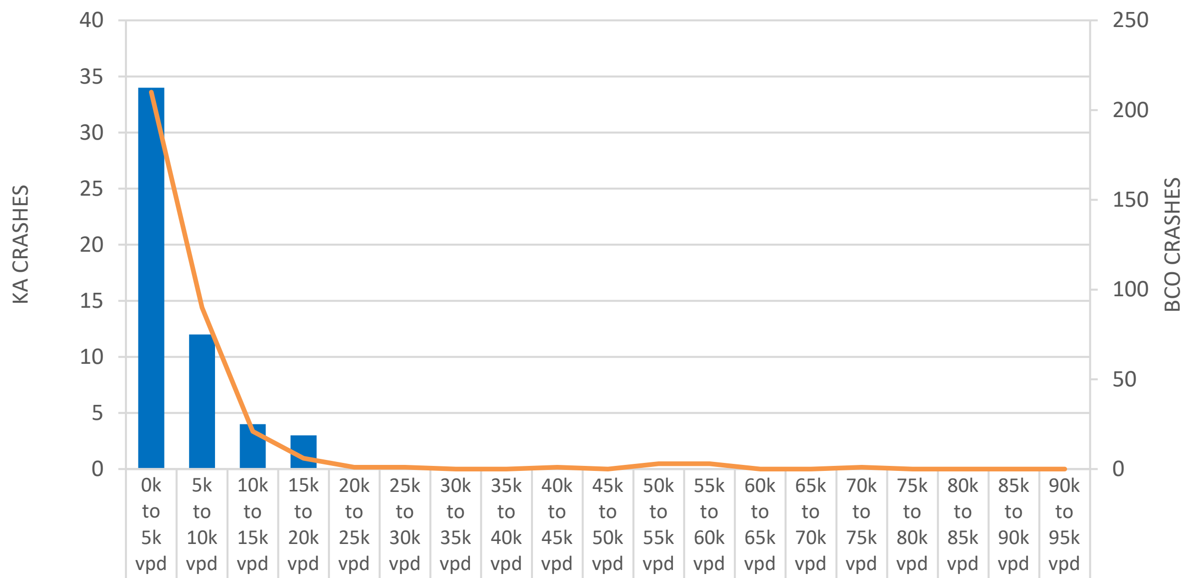

| | 5 mph | 10 mph | 15 mph | 20 mph | 25 mph | 30 mph | 35 mph | 40 mph | 45 mph | 50 mph | 55 mph | 60 mph | 65 mph | 70 mph | ? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 1 | 2 | 0 | 1 | 4 | 27 | 3 | 4 | 3 | 3 | 4 | 0 | 1 | 0 | 0 |
| BCO | 4 | 11 | 6 | 12 | 20 | 202 | 43 | 20 | 7 | 8 | 7 | 2 | 1 | 0 | 2 |

*Figure 20 Segment Crashes by Speed Limit (Involving Bicycle Crashes)*

*Table 18 Segment Crashes by Speed Limit (Involving Bicycle Crashes) with Normalization by 1,000 Roadway Miles*

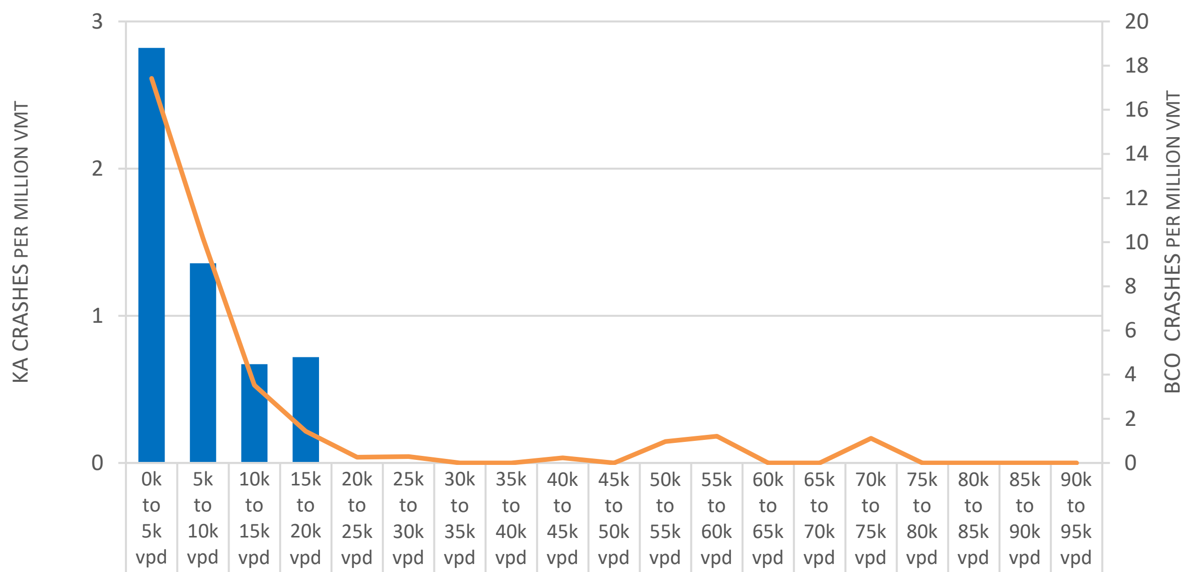
| Midblock Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 5 mph | 1 | 4 | 5 | 0.250 | 19 | 51 | 206 | 257 |
| 10 mph | 2 | 11 | 13 | 0.182 | 108 | 18 | 101 | 120 |
| 15 mph | 0 | 6 | 6 | - | 76 | 0 | 79 | 79 |
| 20 mph | 1 | 12 | 13 | 0.083 | 163 | 6 | 74 | 80 |
| 25 mph | 4 | 20 | 24 | 0.200 | 662 | 6 | 30 | 36 |
| 30 mph | 27 | 202 | 229 | 0.134 | 28,065 | 1 | 7 | 8 |
| 35 mph | 3 | 43 | 46 | 0.070 | 1,269 | 2 | 34 | 36 |
| 40 mph | 4 | 20 | 24 | 0.200 | 796 | 5 | 25 | 30 |
| 45 mph | 3 | 7 | 10 | 0.429 | 1,382 | 2 | 5 | 7 |
| 50 mph | 3 | 8 | 11 | 0.375 | 1,435 | 2 | 6 | 8 |
| 55 mph | 4 | 7 | 11 | 0.571 | 2,746 | 1 | 3 | 4 |
| 60 mph | 0 | 2 | 2 | - | 304 | 0 | 7 | 7 |
| 65 mph | 1 | 1 | 2 | 1.000 | 193 | 5 | 5 | 10 |
| 70 mph | 0 | 0 | 0 | - | 109 | 0 | 0 | 0 |
| ? | 0 | 2 | 2 | - | - | - | - | - |
| **Total** | **53** | **345** | **398** | **0.153** | **37,414** | **1** | **9** | **11** |

While bicycle AADTs are not available for the whole network, examining bicycle crashes grouped by the motor vehicle AADT of the roads on which they occurred (see Figure 21) shows that bicycle crashes tend to occur on lower volume roads (under 20,000 vehicles per day). When normalizing by the number of vehicle miles traveled on those roads (Figure 22), the higher volume roads appear to account for a larger percentage of crashes. However, the numbers of crashes on those roads are so low that their statistical significance is likely quite low.




| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 34 | 12 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BCO | 210 | 90 | 21 | 6 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

*Figure 21 Segment Crashes by AADT (Involving Bicycle Crashes)*



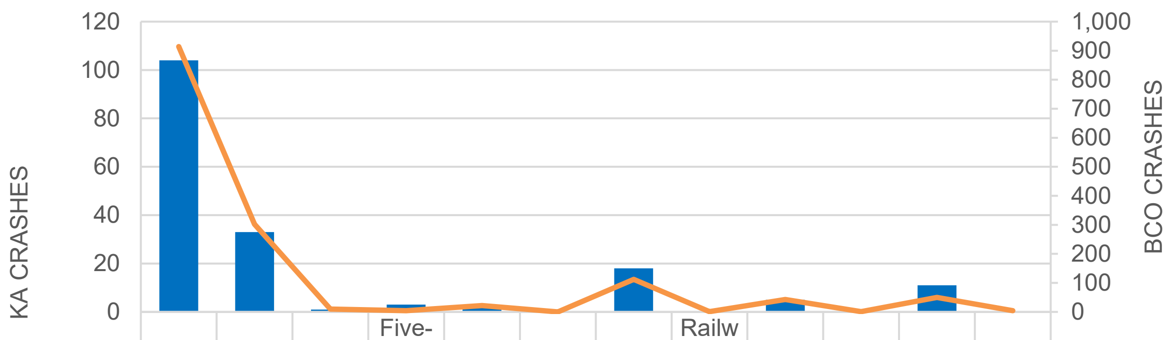

| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| BCO | 17 | 10 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |

*Figure 22 Segment Crashes per Million Daily Vehicle Miles Traveled by AADT (Involving Bicycle Crashes)*

### *Intersection Related Crashes*

**The crashes involving at least one motor vehicle were further split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews the crashes that occurred at an intersection.** According to the Strategic Highway Safety Plan, the most predominant crashes by focus areas occur at intersections.

Within the Metropolitan Council region, 1,018 out of 1,640 or 62% of intersection crashes involving at least one motor vehicle occurred at a four-way intersection as seen in Figure 23. This is largely a reflection of the prevalence of four-way intersections in the network.




| | Four-Way Intersection | T-Intersection | Y-Intersection | Five-Way Intersection or More | Roundabout | Other traffic circle | Intersection Related | Railway Grade Crossing | Interchange Area | Crossover | Other Crossing | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 104 | 33 | 1 | 3 | 2 | 0 | 18 | 0 | 5 | 0 | 11 | 0 |
| BCO | 914 | 302 | 10 | 4 | 22 | 0 | 112 | 1 | 43 | 1 | 50 | 4 |

*Figure 23 Crashes by Intersection Configuration (Involving Bicycle Crashes)*

*Table 19 Crashes by Intersection Configuration (Involving Bicycle Crashes)*

| Intersection Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Four-Way Intersection | 104 | 914 | 1,018 | 0.114 |
| T-Intersection | 33 | 302 | 335 | 0.109 |
| Y-Intersection | 1 | 10 | 11 | 0.100 |
| Five-Way Intersection or More | 3 | 4 | 7 | 0.750 |
| Roundabout | 2 | 22 | 24 | 0.091 |
| Other traffic circle | 0 | 0 | 0 | |
| Intersection Related | 18 | 112 | 130 | 0.161 |
| Railway Grade Crossing | 0 | 1 | 1 | |
| Interchange Area | 5 | 43 | 48 | 0.116 |
| Crossover | 0 | 1 | 1 | |
| Other Crossing | 11 | 50 | 61 | 0.220 |
| Unknown | 0 | 4 | 4 | |
| **Total** | **177** | **1463** | **1640** | **0.121** |

Similar to the patterns observed in Figure 20 which shows that midblock crashes are most likely to occur on roads with a speed limit of 30 mph, Figure 24 shows that crashes occur most frequently at intersections where the maximum speed limit is 30 or 55 mph (33% and 13% of crashes, respectively). Table 20 shows that 75% of all roads have a speed limit of 30 mph and that general pattern applies to the distribution of maximum speed limits at intersections. While KA crashes are clustered at intersections with speed limits of 30 (77 out of 177 or 44% of KA crashes), the KA to BCO ratios tend to increase with speed limits suggesting that crashes with vehicles that are likely moving at higher speeds tend to result in more serious injuries to the cyclist. This stands to reason given the previously discussed fact that crashes at higher speeds are more forceful and drivers have narrower fields of vision and require longer braking distances.

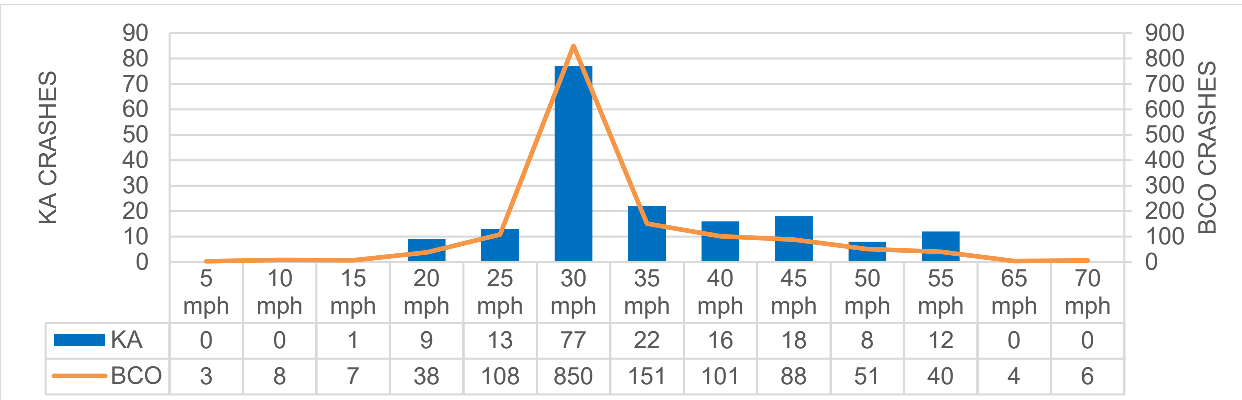



*Figure 24 Intersection Crashes by Max Speed Limit (Involving Bicycle Crashes)*

*Table 20 Intersection Crashes by Max Speed Limit (Involving Bicycle Crashes) with Normalization by 1,000 Roadway Miles*

| Intersection Maximum Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 5 mph | 0 | 3 | 3 | - | 19 | 0 | 154 | 154 |
| 10 mph | 0 | 8 | 8 | - | 108 | 0 | 74 | 74 |
| 15 mph | 1 | 7 | 8 | 0.143 | 76 | 13 | 92 | 105 |
| 20 mph | 9 | 38 | 47 | 0.237 | 163 | 55 | 233 | 289 |
| 25 mph | 13 | 108 | 121 | 0.120 | 662 | 20 | 163 | 183 |
| 30 mph | 77 | 850 | 927 | 0.091 | 28,065 | 3 | 30 | 33 |
| 35 mph | 22 | 151 | 173 | 0.146 | 1,269 | 17 | 119 | 136 |
| 40 mph | 16 | 101 | 117 | 0.158 | 796 | 20 | 127 | 147 |
| 45 mph | 18 | 88 | 106 | 0.205 | 1,382 | 13 | 64 | 77 |
| 50 mph | 8 | 51 | 59 | 0.157 | 1,435 | 6 | 36 | 41 |
| 55 mph | 12 | 40 | 52 | 0.300 | 2,746 | 4 | 15 | 19 |
| 60 mph | 1 | 8 | 9 | 0.125 | 304 | 3 | 26 | 30 |
| 65 mph | 0 | 4 | 4 | - | 193 | 0 | 21 | 21 |
| 70 mph | 0 | 6 | 6 | - | 109 | 0 | 55 | 55 |
| **Total** | **177** | **1,463** | **1,640** | **0.121** | **37,414** | **5** | **39** | **44** |

When observing intersection crashes involving at least one bicycle, 42% of those crashes occurred at intersections controlled by a traffic control signal and 28% occurred at an interchange or the uncontrolled approach of a yield-controlled or two-way stop-controlled intersection (included in the "None" category). This pattern is likely just a reflection of the frequency of these intersection control devices/configurations.

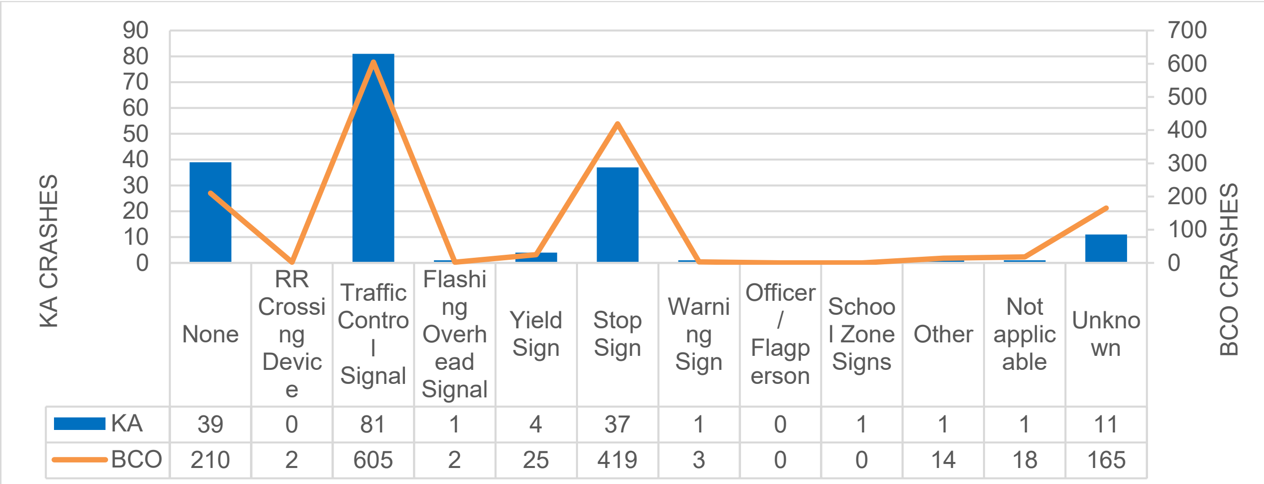



*Figure 25 Intersection Crashes by Traffic Control Device (Involving Bicycle Crashes)*

*Table 21 Intersection Crashes by Traffic Control Device (Involving Bicycle Crashes)*

| Intersection Traffic Control Device | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| None | 39 | 210 | 249 | 0.186 |
| RR Crossing Device | 0 | 2 | 2 | |
| Traffic Control Signal | 81 | 605 | 686 | 0.134 |
| Flashing Overhead Signal | 1 | 2 | 3 | 0.500 |
| Yield Sign | 4 | 25 | 29 | 0.160 |
| Stop Sign | 37 | 419 | 456 | 0.088 |
| Warning Sign | 1 | 3 | 4 | 0.333 |
| Officer / Flag person | 0 | 0 | 0 | |
| School Zone Signs | 1 | 0 | 1 | |
| Other | 1 | 14 | 15 | 0.071 |
| Not applicable | 1 | 18 | 19 | 0.056 |
| Unknown | 11 | 165 | 176 | 0.067 |
| **Total** | **177** | **1,463** | **1,640** | **0.121** |

## Crash Report Variables – Involving Motorcycles

**The following section includes crash factors for crashes involving at least one motorcycle within the Metropolitan Council region.**

While it is difficult to determine if crashes are more likely in dark or lit conditions (due to differences in the number of trips occurring during different hours of the day, changes in the number of hours of daylight throughout the year, and changes in sunrise and sunset times throughout the year, etc.), The KA to BCO ratios shown in Table 22 indicate that crashes that occur in the dark are more likely to result in fatal or incapacitating injuries than those that occur in daylight, at sunrise, or at sunset.

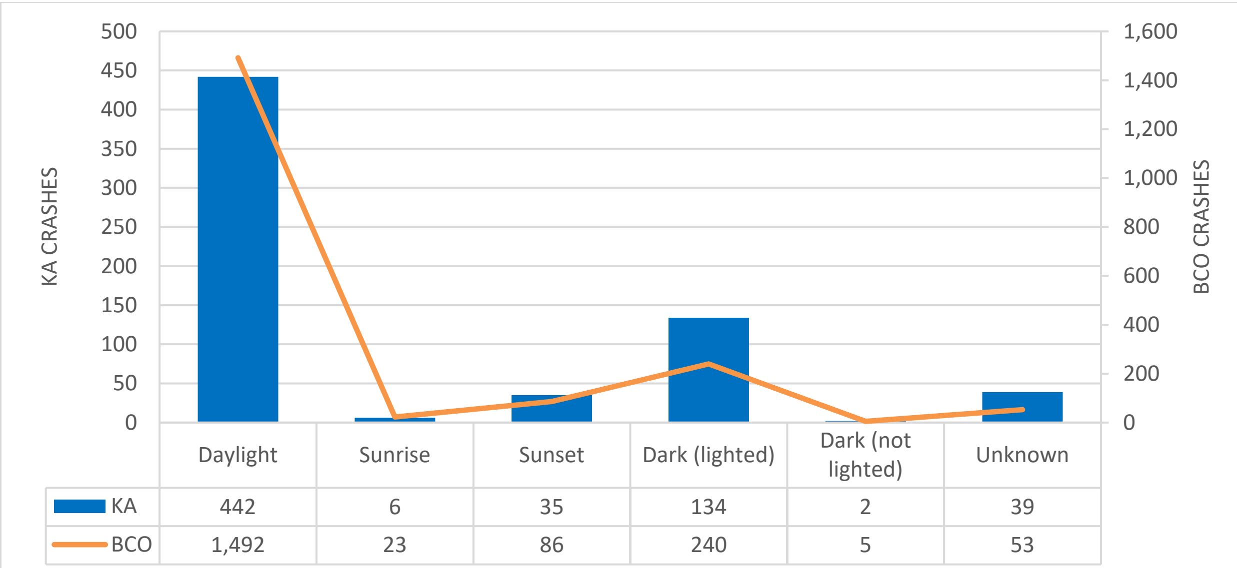



*Figure 26 Motorcycle Crash Severity by Lighting Conditions*

*Table 22 Motorcycle Crash Severity by Lighting Conditions*

| Lighting Conditions | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Daylight | 442 | 1,492 | 1,934 | 0.296 |
| Sunrise | 6 | 23 | 29 | 0.261 |
| Sunset | 35 | 86 | 121 | 0.407 |
| Dark (lighted) | 134 | 240 | 374 | 0.558 |
| Dark (not lighted) | 2 | 5 | 7 | 0.400 |
| Unknown | 39 | 53 | 92 | 0.736 |
| **Total** | **658** | **1,899** | **2,557** | **0.346** |

Although data on helmet use by motorcyclist is largely incomplete, it is apparent from the data KA to BCO ratios in Table 23 that, when helmets were worn (when helmet usage was recorded, only 266 out of 316 or 46% of motorcyclists were wearing a helmet), fatalities were less likely. There were 57 KA crashes and 209 BCO crashes when helmets were worn and 103 KA crashes and 203 BCO crashes when helmets were not worn, equating to KA to BCO ratios of 0.273 and 0.484, respectively.

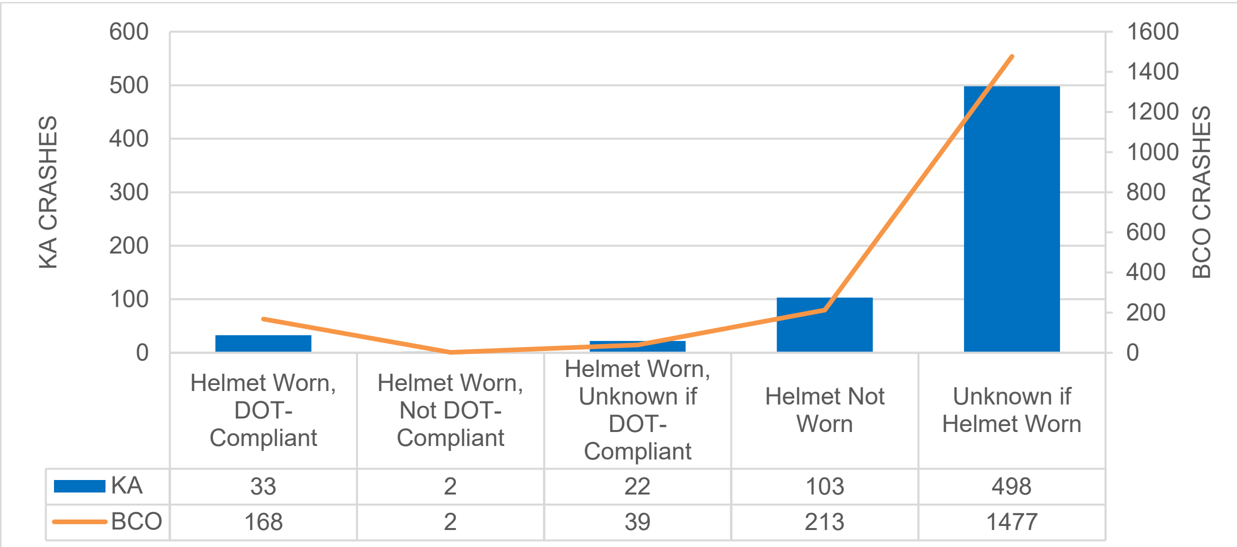



*Figure 27 Crashes by Safety Equipment (Involving Motorcycle Crashes)*

*Table 23 Crashes by Safety Equipment (Involving Motorcycle Crashes)*

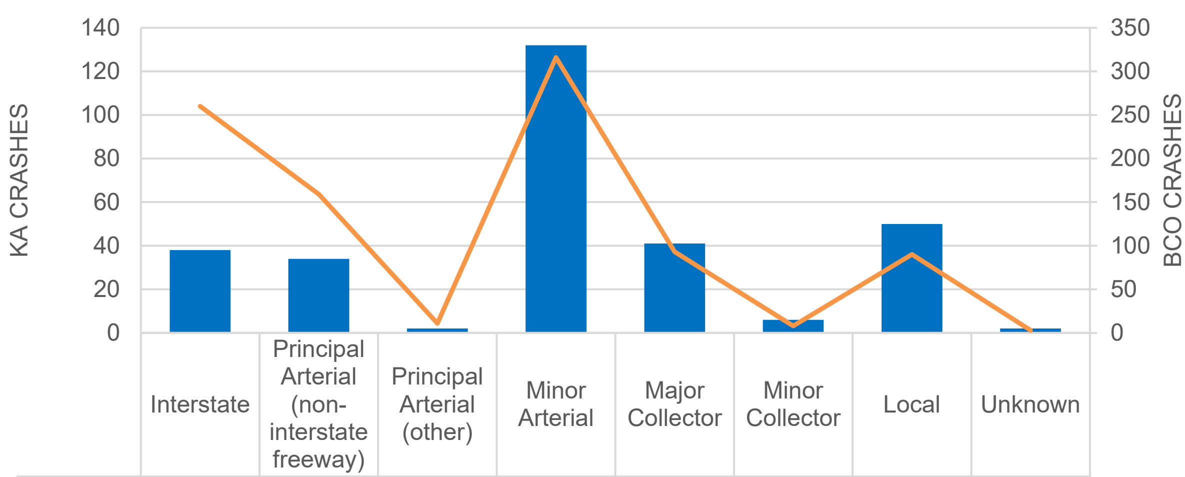
| Motorcyclist Helmet Usage | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Helmet Worn, DOT-Compliant | 33 | 168 | 201 | 0.196 |
| Helmet Worn, Not DOT-Compliant | 2 | 2 | 4 | 1.000 |
| Helmet Worn, Unknown if DOT-Compliant | 22 | 39 | 61 | 0.564 |
| Helmet Not Worn | 103 | 213 | 316 | 0.484 |
| Unknown if Helmet Worn | 498 | 1,477 | 1,975 | 0.337 |
| **Total** | **658** | **1,899** | **2,557** | **0.346** |

### *Segment Related Crashes*

**The crashes involving at least one motorcycle were further split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews segment midblock-specific crashes.**

The functional classification of a road is strongly correlated with other factors analyzed in this section (e.g., number of lanes, AADT, speed limit, etc.), but it is still a meaningful way of describing the character of a roadway. Figure 28 shows the number of KA and BCO midblock crashes involving a motorcycle that occurred on roads of each of the seven functional classes. The plurality of both KA crashes (132 out of 305 or 43%) and BCO crashes (316 out of 940 or 34%) took place on minor arterials, but this does not account for the relative frequency of each functional class in the network.

Table 24 shows that, per mile, minor arterials have the third-highest KA crash rate at 26 crashes per 1,000 directional miles. Interstates have six times the network average number of KA crashes per 1,000 directional miles at 48 compared to eight for the network. While this accounts for the proportion of the network that each functional class comprises, it does not account for the previously mentioned correlated factors which all tend to be higher for the more crash-prone functional classes. The combination of minor arterials' frequency (they are the second-most common functional class) and their high crash rate per mile (they have approximately three times as many KA crashes per mile as the network average), they account for the highest proportion of KA crashes. Compared to the KA to BCO ratios of motor vehicle crashes seen in Table 7, the KA to BCO ratios for motorcycles found in Table 25 are approximately three times higher overall with the KA to BCO ratios for arterials being particularly high.




| | Interstate | Principal Arterial (non-interstate freeway) | Principal Arterial (other) | Minor Arterial | Major Collector | Minor Collector | Local | Unknown |
|---|---|---|---|---|---|---|---|---|
| KA | 38 | 34 | 2 | 132 | 41 | 6 | 50 | 2 |
| BCO | 260 | 159 | 11 | 316 | 93 | 8 | 90 | 3 |

*Figure 28 Segment Crashes by Midblock Roadway Functional Classification (Involving Motorcycle Crashes)*

*Table 24 Segment Crashes by Midblock Roadway Functional Classification (Involving Motorcycle Crashes) with Normalization by 1,000 Roadway Miles*

| Functional Classification | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| Interstate | 38 | 260 | 298 | 0.146 | 794 | 48 | 327 | 375 |
| Principal Arterial (non-interstate freeway) | 34 | 159 | 193 | 0.214 | 1,066 | 32 | 149 | 181 |
| Principal Arterial (other) | 2 | 11 | 13 | 0.182 | 136 | 15 | 81 | 96 |
| Minor Arterial | 132 | 316 | 448 | 0.418 | 5,174 | 26 | 61 | 87 |
| Major Collector | 41 | 93 | 134 | 0.441 | 2,912 | 14 | 32 | 46 |
| Minor Collector | 6 | 8 | 14 | 0.750 | 910 | 7 | 9 | 15 |
| Local | 50 | 90 | 140 | 0.556 | 26,423 | 2 | 3 | 5 |
| Unknown | 2 | 3 | 5 | 0.667 | - | - | - | - |
| **Total** | **305** | **940** | **1,245** | **0.324** | **37,414** | **8** | **25** | **33** |

Midblock roadway configuration is strongly correlated with daily volume, speed limit, and roadway functional classification but the existing Metropolitan Council network files do not include midblock configuration, thus preventing the normalization of crash counts by directional miles. Nonetheless, Table 25 shows that most midblock crashes involving a motorcycle occurred on two-way roads that are note divided (614 out of 1,245 or 49%) or two-way roads with a median barrier (443 out of 1,245 or 36%) but far more KA crashes on two-way undivided roads (199 out of 305 or 65%). Looking at all five midblock road configurations, the KA to BCO ratio increases as separation between opposing directions decreases.

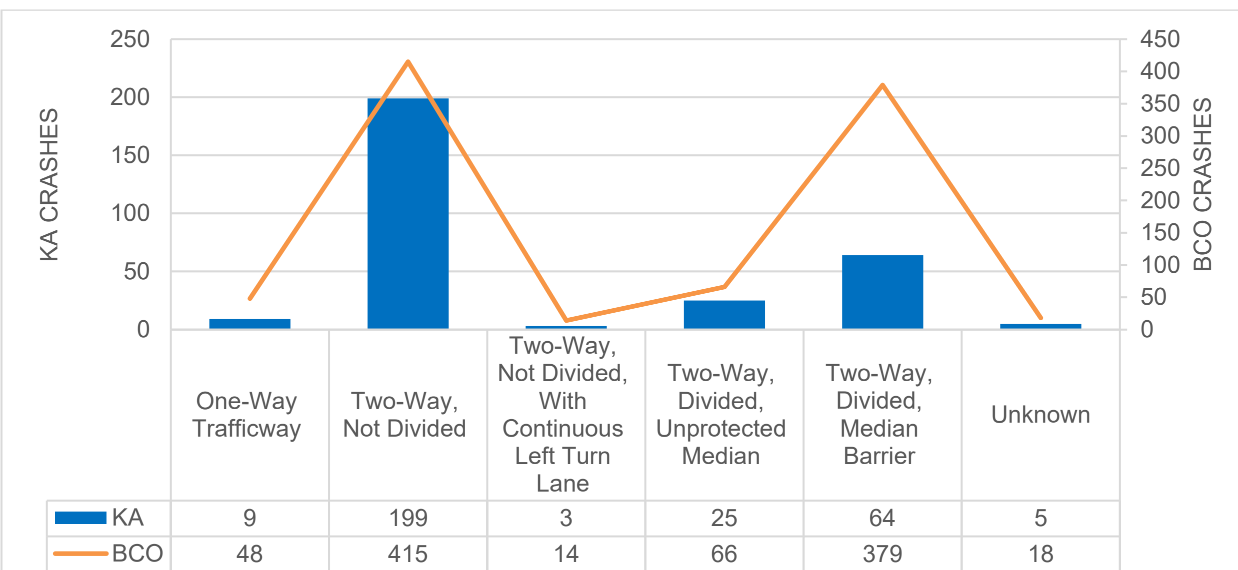
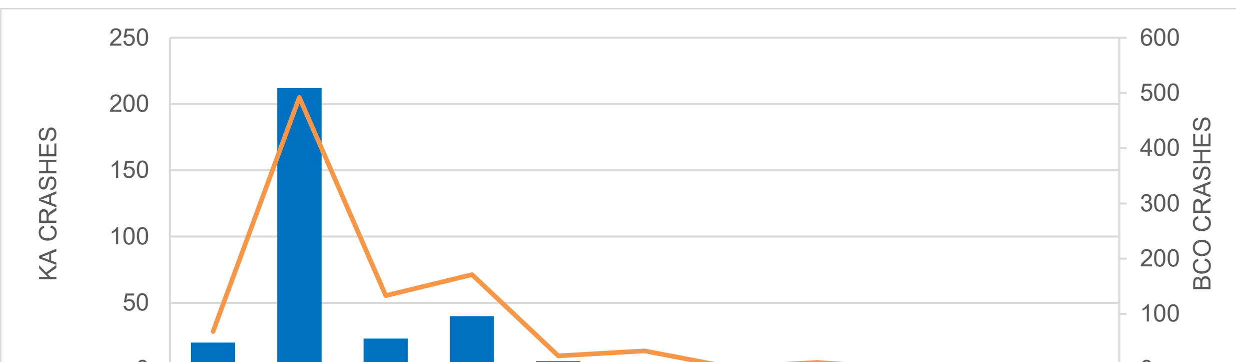



*Figure 29 Segment Crashes by Midblock Roadway Configuration (Involving Motorcycle Crashes)*

*Table 25 Segment Crashes by Midblock Roadway Configuration (Involving Motorcycle Crashes)*

| Midblock Road Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| One-Way Trafficway | 9 | 48 | 57 | 0.188 |
| Two-Way, Not Divided | 199 | 415 | 614 | 0.480 |
| Two-Way, Not Divided, With Continuous Left Turn Lane | 3 | 14 | 17 | 0.214 |
| Two-Way, Divided, Unprotected Median | 25 | 66 | 91 | 0.379 |
| Two-Way, Divided, Median Barrier | 64 | 379 | 443 | 0.169 |
| Unknown | 5 | 18 | 23 | 0.278 |
| **Total** | **305** | **940** | **1,245** | **0.324** |

As seen in Figure 30, the majority (704 out of 1,245 or 57%) of midblock crashes involving a motorcycle occur on two-lane roads. However, the tabulation of directional mileage by the number of lanes in Table 26 shows that two-lane roads account for 90% of the network and actually have the fewest crashes per 1,000 directional miles (6 KA crashes and 15 BCO crashes per 1,000 directional miles) with the exception of 8- to 10-lane roads which have no KA crashes but account for a combined 0.1% of network miles. The per-mile frequency of crashes on two-lane roads is slightly lower than the network average of 8 KA crashes and 25 BCO crashes. On the other hand, the KA to BCO ratio for two-lane roads (0.431) the average ratio of the network (0.324). It is unclear what is causing two-lane roads to have crashes less frequently but also have higher likelihoods of crashes being fatal.




| | 1 lane | 2 lanes | 3 lanes | 4 lanes | 5 lanes | 6 lanes | 7 lanes | 8 lanes | 9 lanes | 10 lanes | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 20 | 212 | 23 | 40 | 6 | 2 | 2 | 0 | 0 | 0 | 0 |
| BCO | 68 | 492 | 133 | 171 | 24 | 33 | 3 | 12 | 1 | 2 | 1 |

*Figure 30 Segment Crashes by Number of Lanes (Involving Motorcycle Crashes)*

*Table 26 Segment Crashes by Number of Lanes (Involving Motorcycle Crashes) Normalization by 1,000 Roadway Miles*

| Midblock Number of Lanes | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 1 lane | 20 | 68 | 88 | 0.294 | 1,177 | 17 | 58 | 75 |
| 2 lanes | 212 | 492 | 704 | 0.431 | 33,751 | 6 | 15 | 21 |
| 3 lanes | 23 | 133 | 156 | 0.173 | 327 | 70 | 407 | 478 |
| 4 lanes | 40 | 171 | 211 | 0.234 | 1,110 | 36 | 154 | 190 |
| 5 lanes | 6 | 24 | 30 | 0.250 | 43 | 138 | 554 | 692 |
| 6 lanes | 2 | 33 | 35 | 0.061 | 156 | 13 | 212 | 224 |
| 7 lanes | 2 | 3 | 5 | 0.667 | 23 | 89 | 133 | 222 |
| 8 lanes | 0 | 12 | 12 | - | 25 | 0 | 485 | 485 |
| 9 lanes | 0 | 1 | 1 | - | 5 | 0 | 200 | 200 |
| 10 lanes | 0 | 2 | 2 | - | 4 | 0 | 535 | 535 |
| Unknown | 0 | 1 | 1 | - | - | - | - | - |
| **Total** | **305** | **940** | **1,245** | **0.324** | **37,414** | **8** | **25** | **33** |

Midblock motorcycle crashes follow a similar same patterns as midblock motor vehicle crashes with the exception that the KA to BCO ratios are higher for motorcycles. Figure 31 shows that midblock crashes are most likely to occur on roads with a speed limit of 30, 55, or 60 mph (25%, 28%, and 12% of all crashes, respectively). However, Table 27 shows that 75% of all roads have a speed limit of 30 mph (note that the network file used to calculate the mileage of each speed limit uses the speed limits of roads at the beginning of the study period in 2018 and does not reflect changes to speed limits since then, including the changing of the default speed limit in Minneapolis and Saint Paul from 30 mph to 20 mph in late 2020). Normalizing by the number of directional miles of road with a given speed limit shows that roads with a speed limit of 30 mph have quite low crash rates per directional mile (3 KA crashes and 8 BCO crashes per 1,000 directional miles), much lower than the network average of 8 KA crashes and 25 BCO crashes per 1,000 directional miles. Roads with speed limits of 55, 60, 65, or 70 mph, on the other hand, have much higher crash rates per directional mile with 32, 69, 67, and 27 KA crashes per 1,000 directional miles, respectively. This stands to reason given the fact that crashes at higher speeds are more forceful and drivers have narrower fields of vision and require longer braking distances. Roadways with speed limits under 30 mph have high crash rates per directional mile; this may simply be a result of there being few instances of these speed limits, but it could also be due to those segments being disproportionately problematic and warranting lower speed limits.

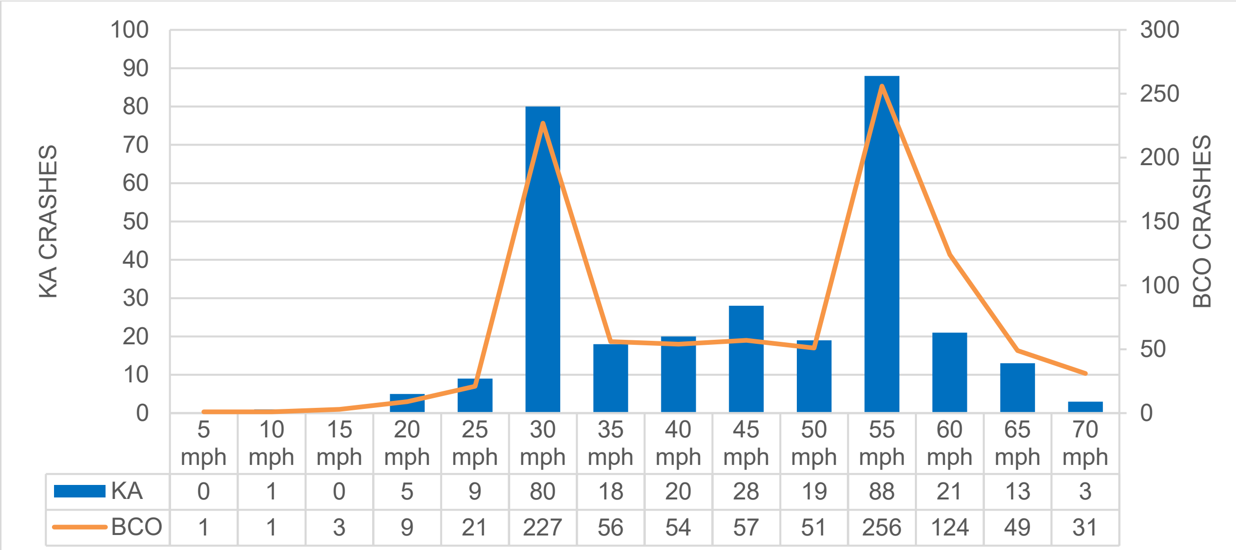
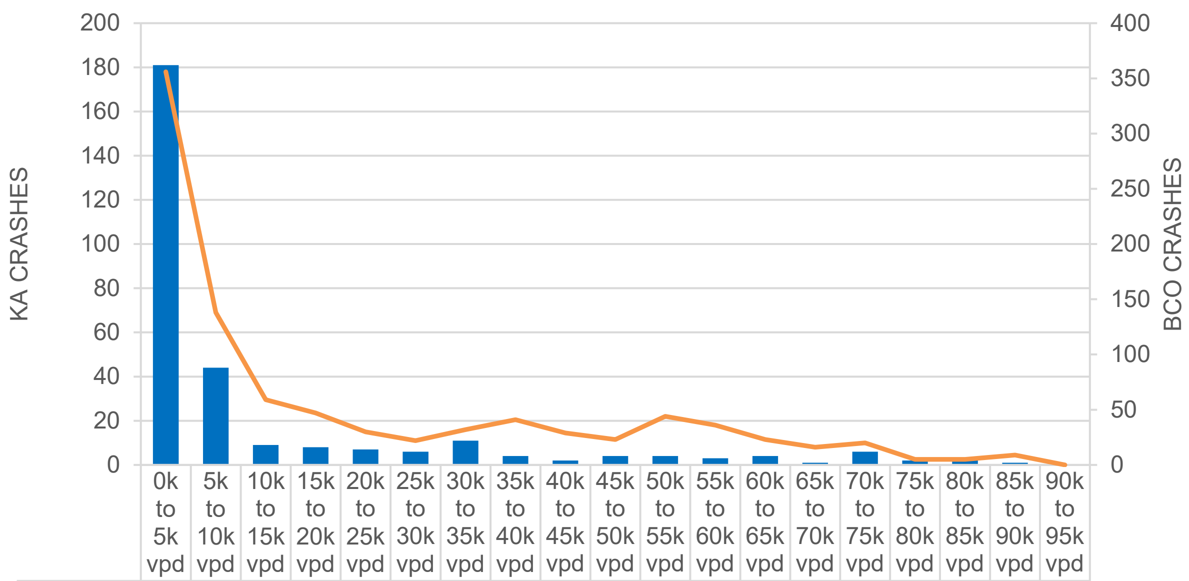



*Figure 31 Segment Crashes by Max Speed Limit (Involving Motorcycle Crashes)*

*Table 27 Segment Crashes by Max Speed Limit (Involving Motorcycle Crashes) with Normalization by 1,000 Roadway Miles*

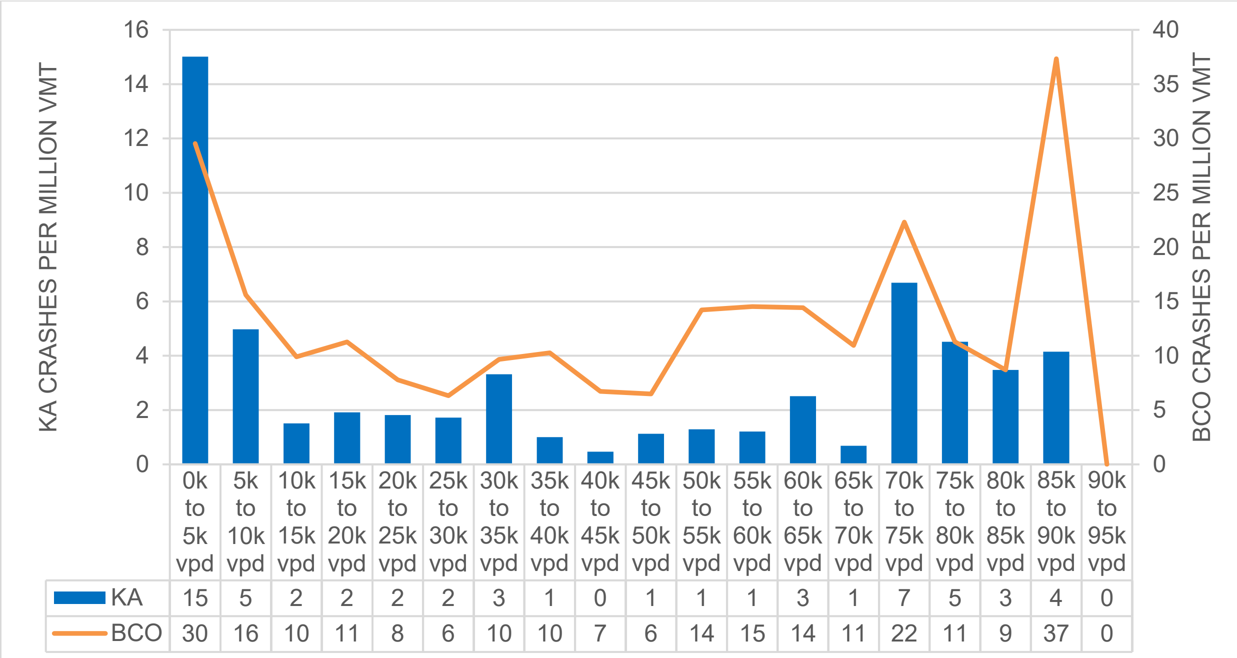
| Midblock Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 5 mph | 0 | 1 | 1 | - | 19 | 0 | 51 | 51 |
| 10 mph | 0 | 0 | 0 | - | 108 | 0 | 0 | 0 |
| 15 mph | 0 | 3 | 3 | - | 76 | 0 | 39 | 39 |
| 20 mph | 5 | 9 | 14 | 0.556 | 163 | 31 | 55 | 86 |
| 25 mph | 9 | 21 | 30 | 0.429 | 662 | 14 | 32 | 45 |
| 30 mph | 80 | 227 | 307 | 0.352 | 28,065 | 3 | 8 | 11 |
| 35 mph | 18 | 56 | 74 | 0.321 | 1,269 | 14 | 44 | 58 |
| 40 mph | 20 | 54 | 74 | 0.370 | 796 | 25 | 68 | 93 |
| 45 mph | 28 | 57 | 85 | 0.491 | 1,382 | 20 | 41 | 61 |
| 50 mph | 19 | 51 | 70 | 0.373 | 1,435 | 13 | 36 | 49 |
| 55 mph | 88 | 256 | 344 | 0.344 | 2,746 | 32 | 93 | 125 |
| 60 mph | 21 | 124 | 145 | 0.169 | 304 | 69 | 408 | 477 |
| 65 mph | 13 | 49 | 62 | 0.265 | 193 | 67 | 253 | 321 |
| 70 mph | 3 | 31 | 34 | 0.097 | 109 | 27 | 283 | 311 |
| **Total** | **305** | **940** | **1,245** | **0.325** | **37,414** | **8** | **25** | **33** |

Much like roadway functional classification, number of lanes, and speed limit, roads with higher AADTs tend to have more crashes but also tend to be less common. Comparing Figure 32, which shows the number of KA and BCO crashes broken down by the AADT of the roadway on which they occurred, and Figure 33, which shows the number of KA and BCO crashes normalized by the number of vehicle miles traveled (VMT) each day on the road on which they occurred and broken down by the AADT of that road, shows that 181 out of 305 or 34% of KA crashes occur on low volume roads (under 5,000 vehicles per day) because low-volume roads are by far the most common type of road (according to Table 24, local roads account for 71% of the network and have the fewest KA crashes per directional mile of any of the functional classes). Similarly, low-volume roads have the highest rate of KA crashes per million daily VMT (2 KA crashes per million daily VMT) because they have the lowest VMT/mile due to their low volume. Even though local streets have the lowest crashes per mile, their low volumes mean that any crashes that do occur on them are distributed over relatively low AADTs. In other words, low-volume roads have relatively few crashes per mile but comparatively high crash rates per million vehicle miles traveled.




| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 181 | 44 | 9 | 8 | 7 | 6 | 11 | 4 | 2 | 4 | 4 | 3 | 4 | 1 | 6 | 2 | 2 | 1 | 0 |
| BCO | 356 | 138 | 59 | 47 | 30 | 22 | 32 | 41 | 29 | 23 | 44 | 36 | 23 | 16 | 20 | 5 | 5 | 9 | 0 |

*Figure 32 Segment Crashes by AADT (Involving Motorcycle Crashes)*



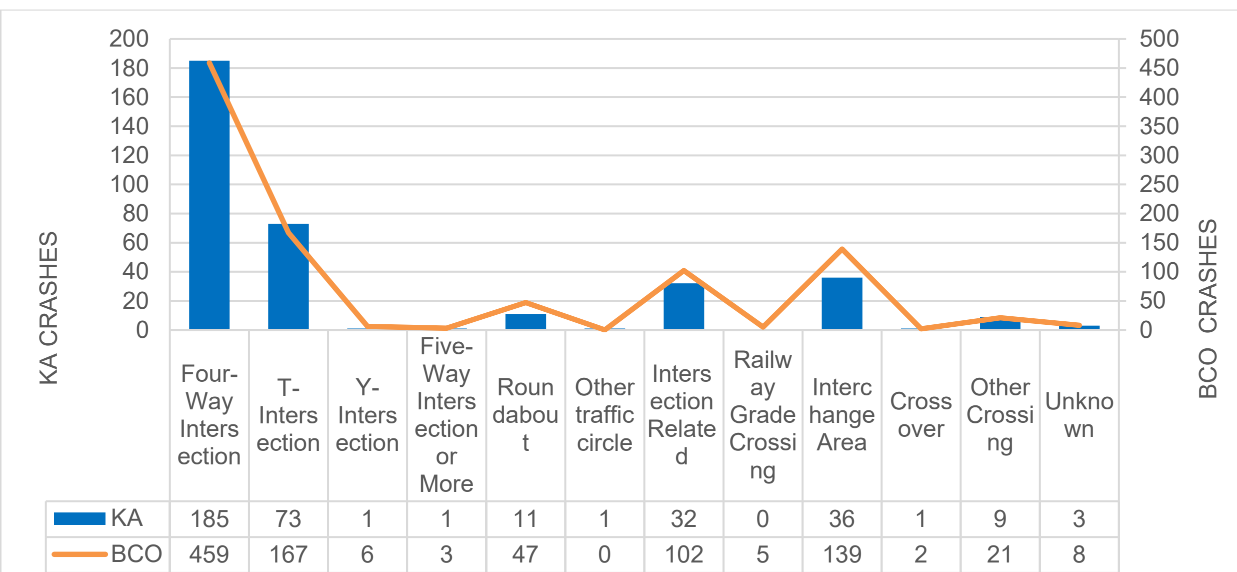

| | 0k to 5k vpd | 5k to 10k vpd | 10k to 15k vpd | 15k to 20k vpd | 20k to 25k vpd | 25k to 30k vpd | 30k to 35k vpd | 35k to 40k vpd | 40k to 45k vpd | 45k to 50k vpd | 50k to 55k vpd | 55k to 60k vpd | 60k to 65k vpd | 65k to 70k vpd | 70k to 75k vpd | 75k to 80k vpd | 80k to 85k vpd | 85k to 90k vpd | 90k to 95k vpd |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 15 | 5 | 2 | 2 | 2 | 2 | 3 | 1 | 0 | 1 | 1 | 1 | 3 | 1 | 7 | 5 | 3 | 4 | 0 |
| BCO | 30 | 16 | 10 | 11 | 8 | 6 | 10 | 10 | 7 | 6 | 14 | 15 | 14 | 11 | 22 | 11 | 9 | 37 | 0 |

*Figure 33 Segment Crashes per Million Daily Vehicle Miles Traveled by AADT (Involving Motorcycle Crashes)*

## Intersection Related Crashes

**The crashes involving at least one motorcycle were split by whether the crash occurred on a segment (midblock) or at an intersection. This section reviews the crashes that occurred at an intersection.** According to the Strategic Highway Safety Plan, the focus area with the most crashes was crashes that occur at intersections.

Within the Metropolitan Council region, 644 out of 1,312 or 49% of intersection crashes involving at least one motor vehicle occurred at a four-way intersection as seen in Figure 34. This is largely a reflection of the prevalence of four-way intersections in the network.



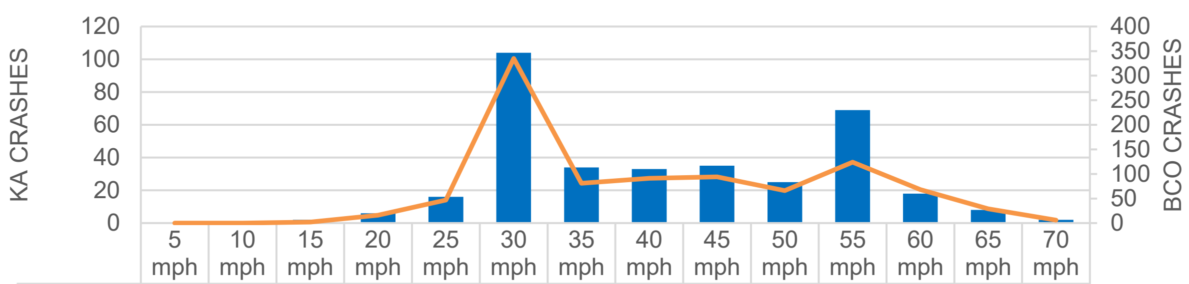

| | Four-Way Intersection | T-Intersection | Y-Intersection | Five-Way Intersection or More | Roundabout | Other traffic circle | Intersection Related | Railway Grade Crossing | Interchange Area | Cross over | Other Crossing | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 185 | 73 | 1 | 1 | 11 | 1 | 32 | 0 | 36 | 1 | 9 | 3 |
| BCO | 459 | 167 | 6 | 3 | 47 | 0 | 102 | 5 | 139 | 2 | 21 | 8 |

*Figure 34 Crashes by Intersection Configuration (Involving Motorcycle Crashes)*

*Table 28 Crashes by Intersection Configuration (Involving Motorcycle Crashes)*

| Intersection Configuration | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| Four-Way Intersection | 185 | 459 | 644 | 0.403 |
| T-Intersection | 73 | 167 | 240 | 0.437 |
| Y-Intersection | 1 | 6 | 7 | 0.167 |
| Five-Way Intersection or More | 1 | 3 | 4 | 0.333 |
| Roundabout | 11 | 47 | 58 | 0.234 |
| Other traffic circle | 1 | 0 | 1 | - |
| Intersection Related | 32 | 102 | 134 | 0.314 |
| Railway Grade Crossing | 0 | 5 | 5 | - |
| Interchange Area | 36 | 139 | 175 | 0.259 |
| Crossover | 1 | 2 | 3 | 0.500 |
| Other Crossing | 9 | 21 | 30 | 0.429 |
| Unknown | 3 | 8 | 11 | 0.375 |
| **Total** | **353** | **959** | **1,312** | **0.368** |

Similar to the patterns observed in Figure 31 which shows that midblock crashes are most likely to occur on roads with a speed limit of 30, 55, or 60 mph, Figure 35 shows that crashes occur most frequently at intersections where the maximum speed limit is 30 or 55 mph (34% and 15% of crashes, respectively). Table 29 shows that 75% of all roads have a speed limit of 30 mph and that general pattern applies to the distribution of maximum speed limits at intersections. Whereas KA crashes are clustered at intersections with speed limits of 30 or 55 mph (30% and 20% of KA crashes, respectively), BCO crashes are only clustered at 30 mph intersections (35% of BCO crashes). This is in line with the increase in the KA to BCO ratio starting at 55 mph that was seen in Table 27 and stands to reason given the previously discussed fact that crashes at higher speeds are more forceful and drivers have narrower fields of vision and require longer braking distances.



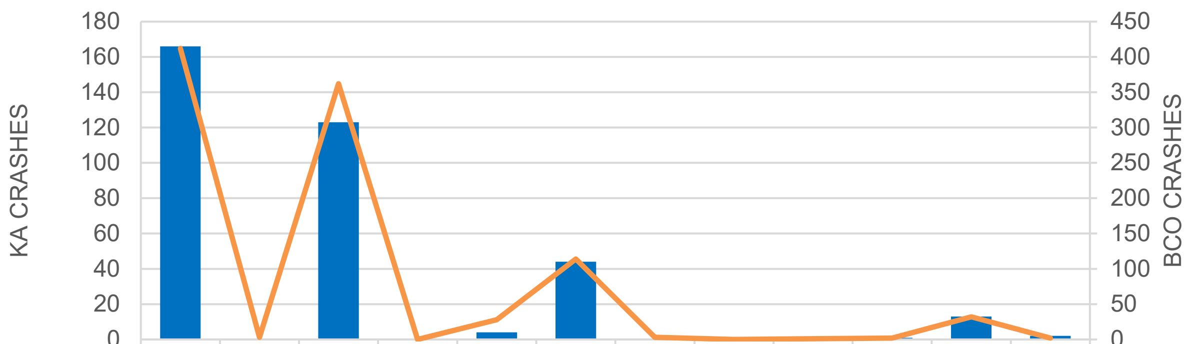

| | 5 mph | 10 mph | 15 mph | 20 mph | 25 mph | 30 mph | 35 mph | 40 mph | 45 mph | 50 mph | 55 mph | 60 mph | 65 mph | 70 mph |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 0 | 1 | 2 | 6 | 16 | 104 | 34 | 33 | 35 | 25 | 69 | 18 | 8 | 2 |
| BCO | 0 | 0 | 2 | 16 | 47 | 335 | 81 | 91 | 94 | 66 | 124 | 68 | 29 | 6 |

*Figure 35 Intersection Crashes by Max Speed Limit (Involving Motorcycle Crashes)*

*Table 29 Intersection Crashes by Max Speed Limit (Involving Motorcycle Crashes) with Normalization by 1,000 Roadway Miles*

| Intersection Maximum Speed Limit | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio | Roadway Miles | KA Crashes per 1,000 Miles | BCO Crashes per 1,000 Miles | Total Crashes per 1,000 Miles |
|---|---|---|---|---|---|---|---|---|
| 5 mph | 0 | 0 | 0 | - | 19 | 0 | 0 | 0 |
| 10 mph | 1 | 0 | 1 | - | 108 | 9 | 0 | 9 |
| 15 mph | 2 | 2 | 4 | 1.000 | 76 | 26 | 26 | 53 |
| 20 mph | 6 | 16 | 22 | 0.375 | 163 | 37 | 98 | 135 |
| 25 mph | 16 | 47 | 63 | 0.340 | 662 | 24 | 71 | 95 |
| 30 mph | 104 | 335 | 439 | 0.310 | 28,065 | 4 | 12 | 16 |
| 35 mph | 34 | 81 | 115 | 0.420 | 1,269 | 27 | 64 | 91 |
| 40 mph | 33 | 91 | 124 | 0.363 | 796 | 41 | 114 | 156 |
| 45 mph | 35 | 94 | 129 | 0.372 | 1,382 | 25 | 68 | 93 |
| 50 mph | 25 | 66 | 91 | 0.379 | 1,435 | 17 | 46 | 63 |
| 55 mph | 69 | 124 | 193 | 0.556 | 2,746 | 25 | 45 | 70 |
| 60 mph | 18 | 68 | 86 | 0.265 | 304 | 59 | 224 | 283 |
| 65 mph | 8 | 29 | 37 | 0.276 | 193 | 41 | 150 | 191 |
| 70 mph | 2 | 6 | 8 | 0.333 | 109 | 18 | 55 | 73 |
| **Total** | **353** | **959** | **1,312** | **0.368** | **37,414** | **9** | **26** | **35** |

When observing intersection crashes involving at least one motorcycle shown in Figure 36 and Table 30, 37% of those crashes occurred at intersections controlled by a traffic control signal and 44% occurred at an interchange or the uncontrolled approach of a yield controlled or two-way stop-controlled intersection (included in the “None” category). This pattern is likely just a reflection of the frequency of these intersection control devices/configurations.




| | None | RR Crossing Device | Traffic Control Signal | Flashing Overhead Signal | Yield Sign | Stop Sign | Warning Sign | Officer / Flagperson | School Zone Signs | Other | Not applicable | Unknown |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KA | 166 | 0 | 123 | 0 | 4 | 44 | 0 | 0 | 0 | 1 | 13 | 2 |
| BCO | 412 | 3 | 362 | 0 | 28 | 114 | 3 | 0 | 1 | 2 | 32 | 2 |

*Figure 36 Intersection Crashes by Traffic Control Device (Involving Motorcycle Crashes)*

*Table 30 Intersection Crashes by Traffic Control Device (Involving Motorcycle Crashes)*

| Intersection Traffic Control Device | KA Crashes | BCO Crashes | Total Crashes | KA to BCO Ratio |
|---|---|---|---|---|
| None | 166 | 412 | 578 | 0.403 |
| RR Crossing Device | 0 | 3 | 3 | - |
| Traffic Control Signal | 123 | 362 | 485 | 0.340 |
| Flashing Overhead Signal | 0 | 0 | 0 | - |
| Yield Sign | 4 | 28 | 32 | 0.143 |
| Stop Sign | 44 | 114 | 158 | 0.386 |
| Warning Sign | 0 | 3 | 3 | - |
| Officer / Flag person | 0 | 0 | 0 | - |
| School Zone Signs | 0 | 1 | 1 | - |
| Other | 1 | 2 | 3 | 0.500 |
| Not applicable | 13 | 32 | 45 | 0.406 |
| Unknown | 2 | 2 | 4 | 1.000 |
| **Total** | **353** | **959** | **1,312** | **0.368** |

## Demographic and Economic Characteristics

**The crash data below characterizes the community in which the crash took place versus the demographic and economic characteristic of the person(s) in the crash. This information is not collected by officers as a part of the crash report.**

The demographic and economic characteristics data came from the US Decennial Census (2020) and American Community Survey 5-year estimates (2021). The tables and their uses can be found in Table 9.

*Table 31 Demographic and Economic Data Sources*

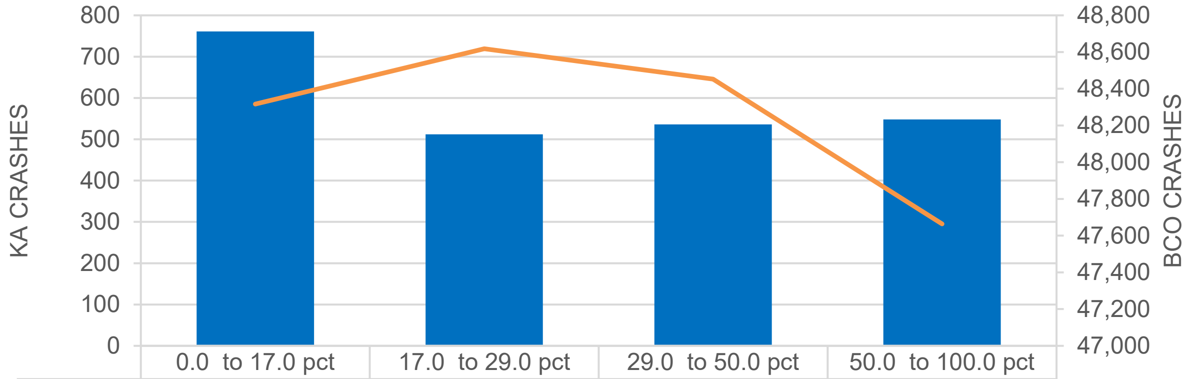
| Table ID | Table Name | Metrics Calculated | Granularity |
|---|---|---|---|
| ACSDT5Y2021.B08201 | Household size by vehicles available | Pct. Households with No Vehicle | Tract |
| ACSDT5Y2021.B16004 | Age by language spoken at home by ability to speak English for the population 5 years and over | Pct. Speaking Only English at Home | Block group |
| ACSDT5Y2021.B17010 | Poverty status in the past 12 months of families by family type by presence of related children under 18 | Pct. Experiencing Poverty in Last 12 Months | Block group |

| Table ID | Table Name | Metrics Calculated | Granularity |
|---|---|---|---|
| | years by age of related children | | |
| ACSDT5Y2021.B19013 | Median household income in the past 12 months (in 2021 inflation-adjusted dollars) | Median Household Income (2021 USD) | Block group |
| ACSDT5Y2021.B25070 | Gross rent as a percentage of household income in the past 12 months | Pct. Burdened Renters (Rent >30% of Gross HH Income) | Block group |
| DECENNIALDHC2020.P9 | Hispanic or Latino, and not Hispanic or Latino by race | Pct. BIPOC and/or Latinx | Block group |

Each crash was joined to a block group and the demographic and economic characteristics of that block were added to the record in the crash table corresponding to that crash. The tables below are a tabulation of crash severity broken down by the characteristics of the block group in which the crash took place. The quartiles shown in the tables correspond to the ranges of the block group characteristics bounded by the 25$^{th}$, 50$^{th}$, 75$^{th}$, and 100$^{th}$ percentiles for that metric across all block groups. Each quartile contains one quarter of all block groups ranked by a given metric. By breaking down the crash severity by quartile, the relationship between the block group characteristics and crash rates can start to be seen. For example, in the case of motor vehicle crashes broken down by the percentage of block group residents who identify as BIPOC and/or Latinx, the number of KA crashes is highest in block groups in the bottom quartile for percentage of BIPOC- and/or Latinx-identifying residents - 761 KA crashes for block groups in the bottom quartile for BIPOC- and/or Latinx-identifying residents (0 to 17% of residents) compared to 512, 536, and 548 KA crashes in block groups in the second, third, and fourth quartile, respectively. If there was no correlation between serious crash frequency and the percentage of BIPOC/Latinx residents, the number of KA crashes would be approximately equal across block groups in all four quartiles.

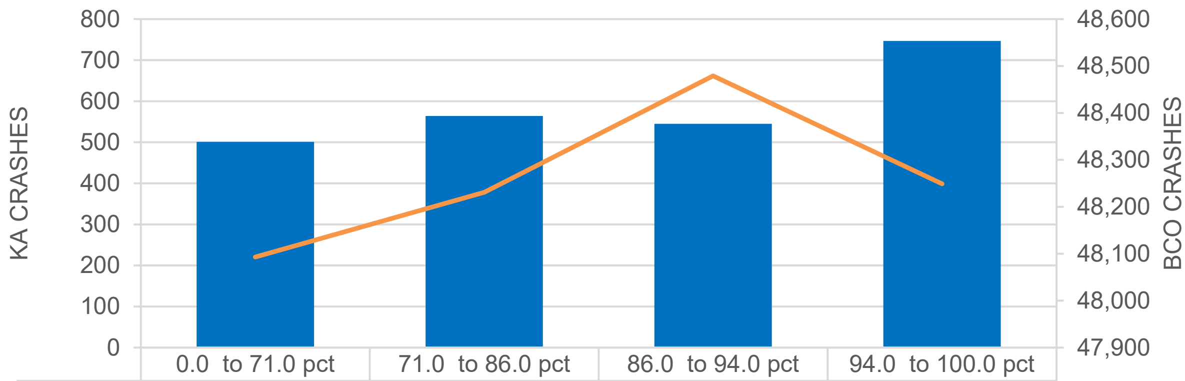
## Motor vehicle Crashes

KA crashes involving at least one motor vehicle appear to be disproportionately frequent in block groups where fewer residents identify as BIPOC and/or Latinx (Figure 37), more residents speak only English at home (Figure 38), have higher median household incomes (Figure 39), 1% to 9% of residents experiencing poverty in the last 12 months (Figure 40), less than 40% or more than 58% of renters paying more than 30% of their household income in rent (Figure 41), or more households do not have an motor vehicle (Figure 42).



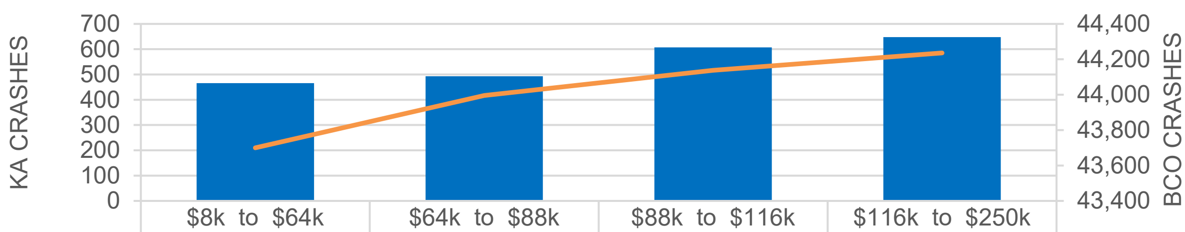

| | 0.0 to 17.0 pct | 17.0 to 29.0 pct | 29.0 to 50.0 pct | 50.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 761 | 512 | 536 | 548 |
| BCO | 48,317 | 48,618 | 48,453 | 47,664 |

*Figure 37 Motor vehicle Crash Severity of Percent Identifying at BIPOC and/or Latinx*




| | 0.0 to 71.0 pct | 71.0 to 86.0 pct | 86.0 to 94.0 pct | 94.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 501 | 564 | 545 | 747 |
| BCO | 48,093 | 48,231 | 48,479 | 48,249 |

*Figure 38 Motor vehicle Crash Severity by Percent Speaking Only English at Home*




| | $8k to $64k | $64k to $88k | $88k to $116k | $116k to $250k |
|---|---|---|---|---|
| KA | 466 | 493 | 607 | 648 |
| BCO | 43,700 | 43,996 | 44,138 | 44,236 |

*Figure 39 Motor vehicle Crash Severity by Median Household Income (in 2022 USD)*

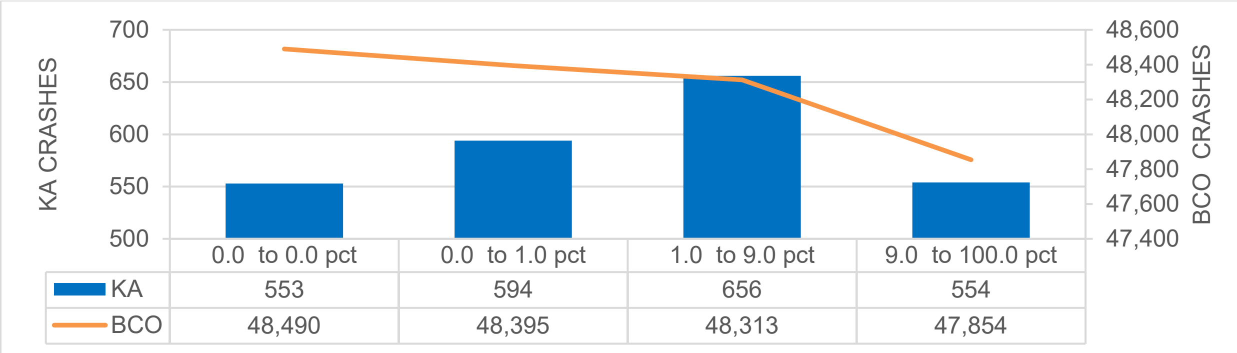



*Figure 40 Motor vehicle Crash Severity by Percent Experiencing Poverty in the Last 12 Months*

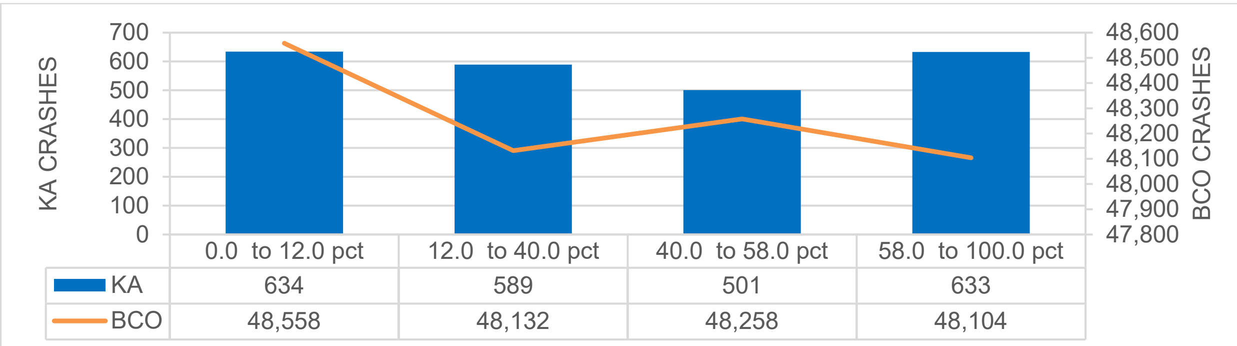



*Figure 41 Motor vehicle Crash Severity by Percent Burdened Renters (Rent > 30% of Gross HH Income)*

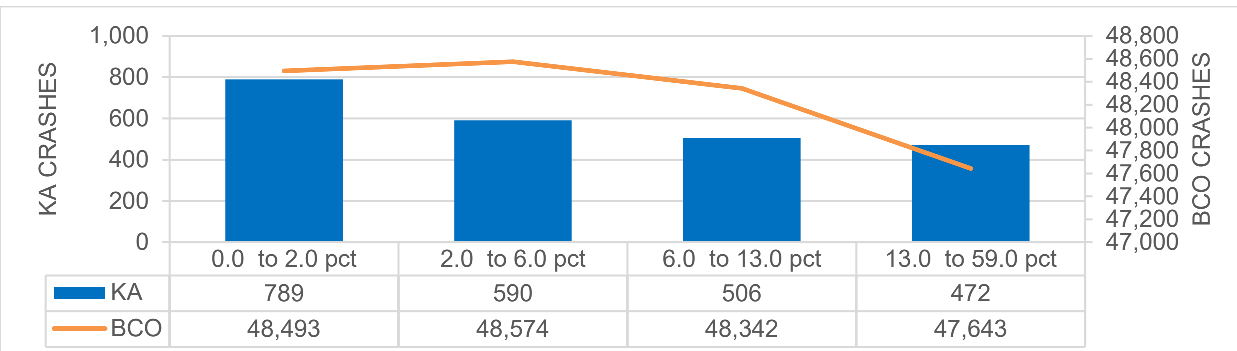
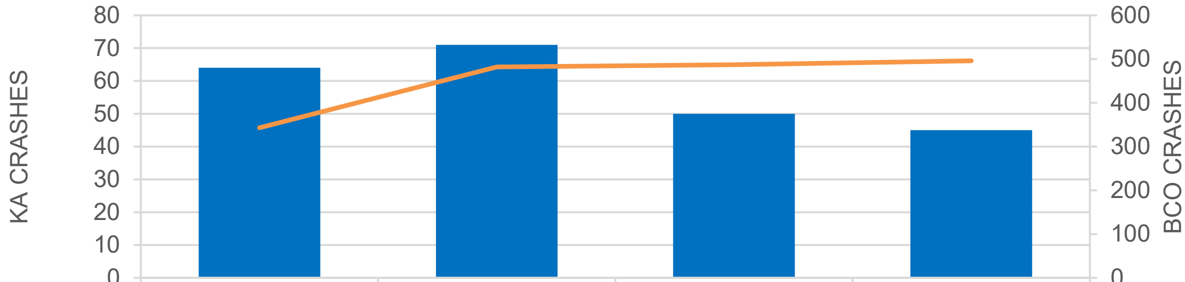



*Figure 42 Motor vehicle Crash Severity by Percent Households with No Vehicle*

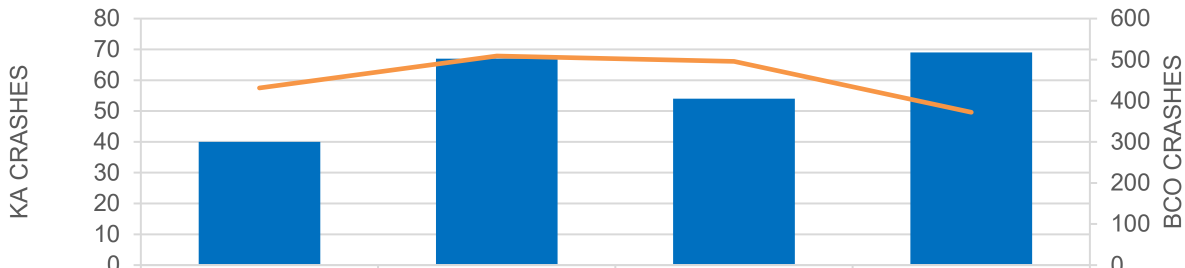
## Bicycle Crashes

KA crashes involving at least one motor vehicle appear to be disproportionately frequent in block groups where 17% to 29% of residents identify as BIPOC and/or Latinx (Figure 43), more residents speak only English at home (Figure 44), have higher median household incomes (Figure 45), fewer residents experiencing poverty in the last 12 months (Figure 46), 12% to 58% of renters paying more than 30% of their household income in rent (Figure 47), or more households do not have an motor vehicle (Figure 48).



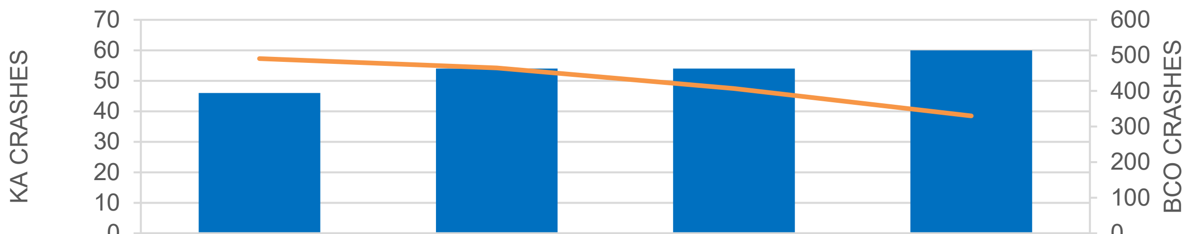

| | 0.0 to 17.0 pct | 17.0 to 29.0 pct | 29.0 to 50.0 pct | 50.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 64 | 71 | 50 | 45 |
| BCO | 343 | 482 | 487 | 496 |

*Figure 43 Cyclist Crash Severity by Percent Identifying as Black and/ or Latinx*



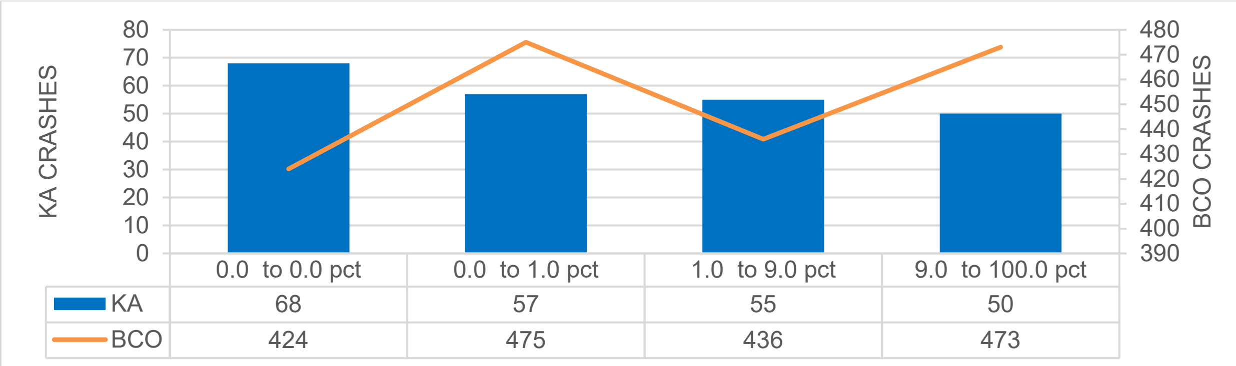

| | 0.0 to 71.0 pct | 71.0 to 86.0 pct | 86.0 to 94.0 pct | 94.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 40 | 67 | 54 | 69 |
| BCO | 431 | 509 | 496 | 372 |

*Figure 44 Cyclist Crash Severity by Percent Speaking Only English at Home*



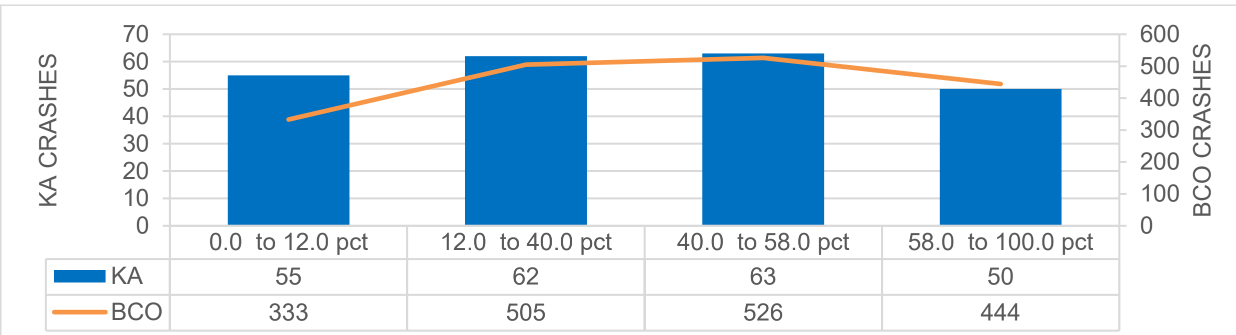

| | $8k to $64k | $64k to $88k | $88k to $116k | $116k to $250k |
|---|---|---|---|---|
| KA | 46 | 54 | 54 | 60 |
| BCO | 491 | 465 | 407 | 330 |

*Figure 45 Cyclist Crash Severity by Median Household Income (in 2022 USD)*



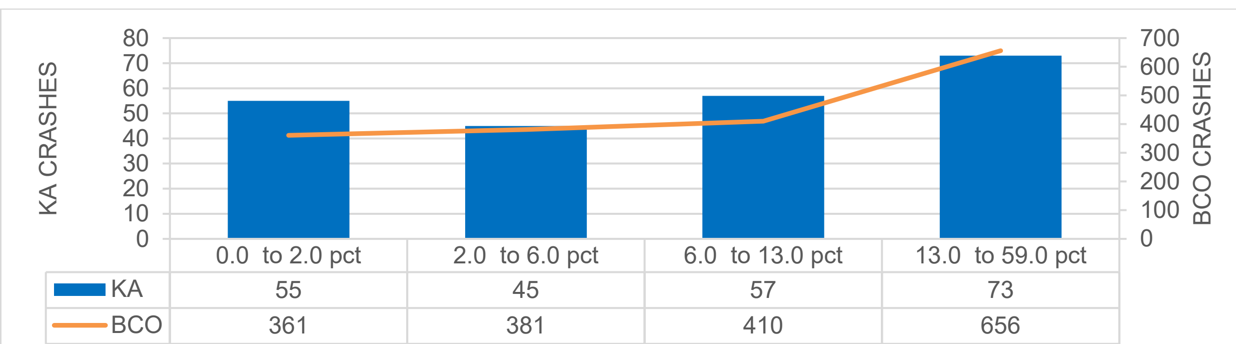

| | 0.0 to 0.0 pct | 0.0 to 1.0 pct | 1.0 to 9.0 pct | 9.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 68 | 57 | 55 | 50 |
| BCO | 424 | 475 | 436 | 473 |

*Figure 46 Cyclist Crash Severity by Percentage Experiencing Poverty in the Last 12 Months*




| | 0.0 to 12.0 pct | 12.0 to 40.0 pct | 40.0 to 58.0 pct | 58.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 55 | 62 | 63 | 50 |
| BCO | 333 | 505 | 526 | 444 |

*Figure 47 Cyclist Crash Severity by Percent Burdened Renters (Rent >30% of Gross HH Income)*

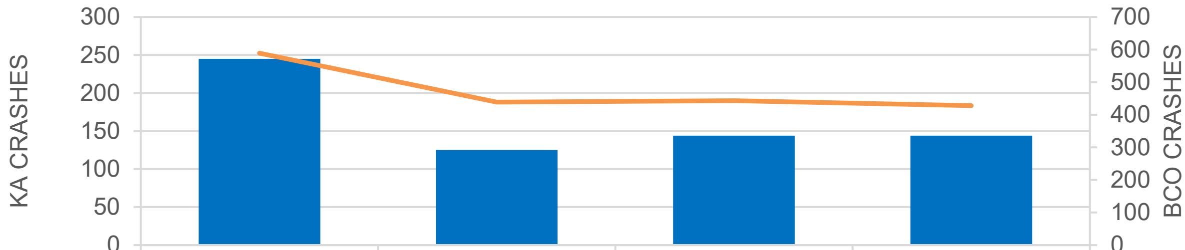



| | 0.0 to 2.0 pct | 2.0 to 6.0 pct | 6.0 to 13.0 pct | 13.0 to 59.0 pct |
|---|---|---|---|---|
| KA | 55 | 45 | 57 | 73 |
| BCO | 361 | 381 | 410 | 656 |

*Figure 48 Cyclist Crash Severity of Percent Households with No Vehicle*

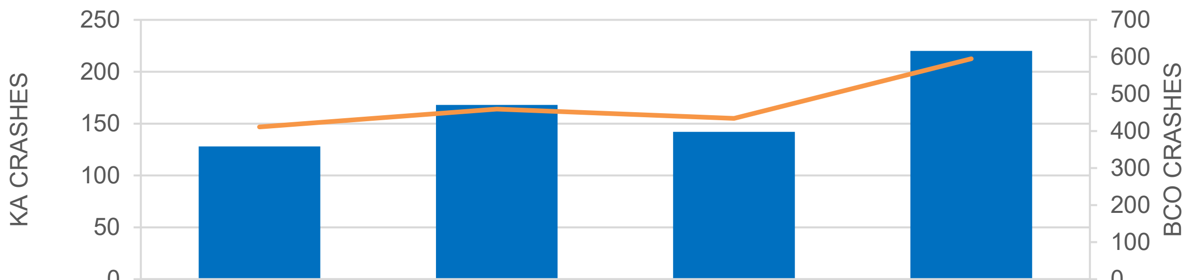
## Motorcycle Crashes

KA crashes involving at least one motor vehicle appear to be disproportionately frequent in block groups fewer residents identify as BIPOC and/or Latinx (Figure 49), more residents speak only English at home (Figure 50), have higher median household incomes (Figure 51), 1% to 9% of residents experiencing poverty in the last 12 months (Figure 52), fewer renters paying more than 30% of their household income in rent (Figure 53), or fewer households do not have an motor vehicle (Figure 54).



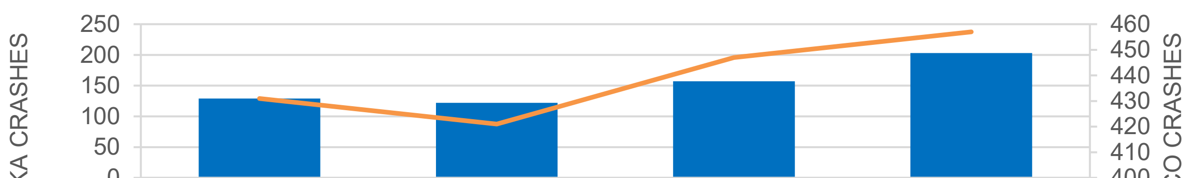

| | 0.0 to 17.0 pct | 17.0 to 29.0 pct | 29.0 to 50.0 pct | 50.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 245 | 125 | 144 | 144 |
| BCO | 589 | 439 | 443 | 428 |

*Figure 49 Motorcycle Crash Severity by Percent Identifying as Black and/or Latinx*



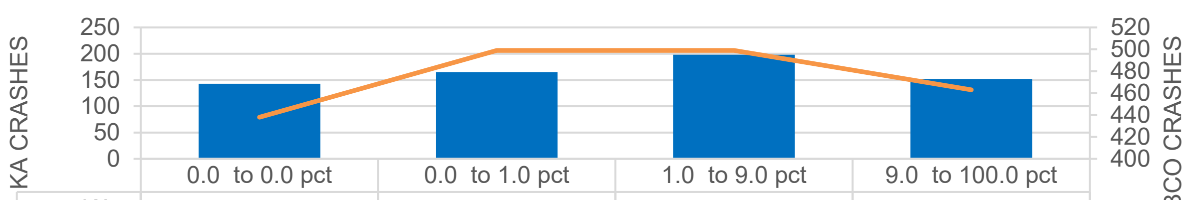

| | 0.0 to 71.0 pct | 71.0 to 86.0 pct | 86.0 to 94.0 pct | 94.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 128 | 168 | 142 | 220 |
| BCO | 411 | 459 | 434 | 595 |

*Figure 50 Motorcycle Crash Severity by Percent Speaking Only English at Home*




| | $8k to $64k | $64k to $88k | $88k to $116k | $116k to $250k |
|---|---|---|---|---|
| KA | 129 | 122 | 157 | 203 |
| BCO | 431 | 421 | 447 | 457 |

*Figure 51 Motorcycle Crash Severity by Median Household income (in 2022 USD)*




| | 0.0 to 0.0 pct | 0.0 to 1.0 pct | 1.0 to 9.0 pct | 9.0 to 100.0 pct |
|---|---|---|---|---|
| KA | 143 | 165 | 198 | 152 |
| BCO | 438 | 499 | 499 | 463 |

*Figure 52 Motorcycle Crash Severity of Percent Experiencing Poverty in the Last 12 Months*

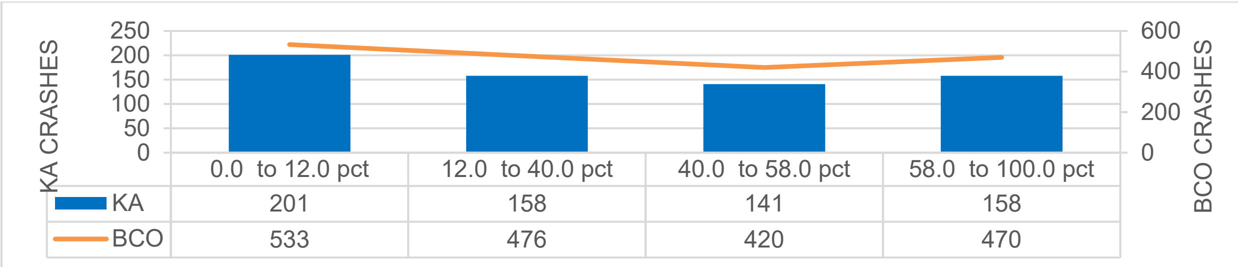



*Figure 53 Motorcycle Crash Severity of Percent Burdened Renters (Rent >30% of Gross HH Income)*

Table 27 reveals that approximately 75 percent of crashes occurred in block groups experiencing 0 to 13 percent of households with no vehicles.

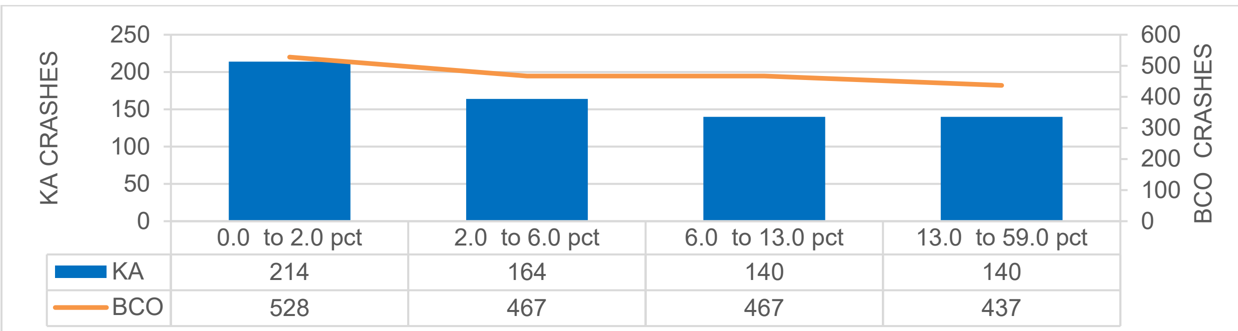



*Figure 54 Motorcycle Crash Severity Percent Households with No Vehicle*

# Appendix

A – MnDOT Crash Reports

- Total KA
- Top 6 Focus Area Reports