Introduction

This technical memo provides a comprehensive analysis of fatal (K) and serious injury (A) crashes for the five-county region of Buncombe, Haywood, Henderson, Madison, and Transylvania. Understanding the dynamics, trends, and contributing factors to such crashes is imperative for developing effective transportation policies and infrastructure improvements to enhance road safety. The method of data analysis presented in this memo serves as an essential foundation for informed decision-making processes concerning road safety mitigation measures, allocation of resources, and prioritization of projects to mitigate the occurrence and severity of crashes.

This memo aims to identify key areas of historical crash concerns by examining patterns of fatal and serious injury crashes. Ultimately, the objective is to leverage data-driven insights toward intervention strategies that promote safer travel experiences and safeguard the well-being of all road users within the FBRMPO and LOSRPO region. By examining the patterns and characteristics of fatal and serious crashes over the specified period, this memo aims to identify key areas of concern that could inform potential risk factors on the region's roads.

Data

The project team obtained crash data from the North Carolina Department of Transportation (NCDOT) for 2017 through 2023. This data included several characteristics such as location, roadway facility type, crash type, and crash severity, which were pulled to generate tables and figures explored throughout this report. The project team obtained NCDOT's route characteristics file in a geographic information systems (GIS) format. The combination of crash and roadway characteristics informed this preliminary risk-based analysis.

Methodology

The scope of work includes analysis of crashes occurring on the entire system of roads in the five-county region, to understand historic trends and inform a risk-based or systemic approach for identifying safety problems in the region. The systemic, or risk-based, analysis consists of three principal components:

1. Identify focus crash types

2. Identify focus facility types for focus crash emphasis areas

3. Identify risk factors related to focus crashes on focus facilities

This memorandum focuses on the first 2 components of this analysis. Future analyses will develop custom risk factors for specific crash types on facilities (e.g., road types) based on the focus crash and facility types agreed upon with FBRMPO.

Focus Crash Type Approach

Using FHWA templates for crash data, emphasis areas were identified and compared to the five-county region of Buncombe, Haywood, Henderson, Madison, and Transylvania. KA crashes, as well as KABCO (all crash types, including fatal, serious injury, evident and possible injury, and property damage only), crashes to cross-reference

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County and State values; identify areas of overrepresentation within the study area. The project team reviewed focus crash types based on emphasis areas (EAs) identified in North Carolina's Strategic Highway Safety Plan (SHSP).[1] As part of the analysis, EAs include:

- **Speed-Related Crashes:** Contributing circumstances related to the driver are recorded as exceeding the posted speed limit or driving too fast for conditions.

- **Alcohol-Related Crashes:** The drivers are confirmed or suspected of being under the influence of alcohol.

- **Drug-Related Crashes:** The drivers are confirmed or suspected of being under the influence of a drug other than alcohol.

- **Distracted Driver Crashes:** Contributing circumstances related to the driver are recorded as inattention or distraction (by devices or other factors).

- **Animal Involved Crashes:** Crash/Collision type are recorded as an "Animal"

- **Older Driver Crashes:** Involve a driver over the age of 64.

- **Teen Driver Crashes:** Involve a driver between 15 and 19 years old.

- **Intersection-Related Crashes**: The roadway feature at the crash location is an at-grade intersection.

- **Unbelted Crashes:** Driver or occupant recorded as not using a restraint.

- **Motorcycle-Involved Crashes**: The vehicle type involved in the crash is recorded as a motorcycle.

- **Heavy Truck-Involved Crashes**: The vehicle type involved in the crash are recorded as Truck/Trailor, Truck/Tractor, Tractor/Semi-Trailor, Tractor/Doubles, or Unknown Heavy Truck.

- **Pedestrian-Involved Crashes:** Crash/Collision type, "vehicle" type, or person type recorded as a pedestrian.

- **Bicyclist-Involved Crashes**: Crash/Collision type, "vehicle" type, or person type recorded as a bicycle.

- **Lane Departure Crashes:** Crash/Collision type recorded as running off the road, rollover/overturn, striking fixed object, sideswipe in opposite directions, or head on.

To identify focus crash types, the project team created two comparisons:

1. Five-county region fatal and serious injury (KA) crashes against total crashes.

2. KA crashes by individual county against five-county region KA crashes.

To identify focus crash types, the project team looked for EAs that had a greater share of KA crashes compared to total crashes. For instance, if Lane Departure accounts for 47% of KA crashes but only 18% of total crashes, then Lane Departure should be considered a priority for further risk factor development. Furthermore, comparisons at the county-level inform differences within the five-county region that can inform where certain crash types are more prevalent and could be prioritized more locally.

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[1] https://spatial.vhb.com/ncdotshsp/

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Focus Facility Type Approach

The project team spatially joined crash data in GIS to link roadway attribute spatial values with crashes. For the purposes of this preliminary review, the project team focused on NCDOT's route class and functional class attributes. The project team compared the proportion of crashes that occurred on a given facility type (e.g., a route classification or a functional classification) against the proportion of mileage for that facility. For instance, if 31% of total KA crashes occurred on US routes and 3% of all roads in FBRMPO and LOSRPO are US Routes, then those facilities would be a focus for further risk factor analysis. All data was pulled from FHWA and NCDOT standard crash reporting formats.

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Focus Crash Type Results

The following sections summarize the comparisons used to generate focus crash types.

5-County Region KA Crashes Relative to 5-County Region Total Crashes

In Figure 1 **Lane Departure, Occupant Protection, Impaired Driving, Speed, Older Driver, Motorcycle, Pedestrian, Heavy Truck, and Bicyclist** EAs are overrepresented in KA crashes compared to all crashes. For instance, Lane Departure crashes constitute 53% of KA crashes but only 23% of all crashes. These EAs are critical focal points for the 5-county region, indicating the types of countermeasures, policies, and interventions that may most impact improving road safety. However, these proportions vary within the 5-county region. Therefore, comparing these rates at the county-level to statewide rates is critical in understanding regional safety issues.
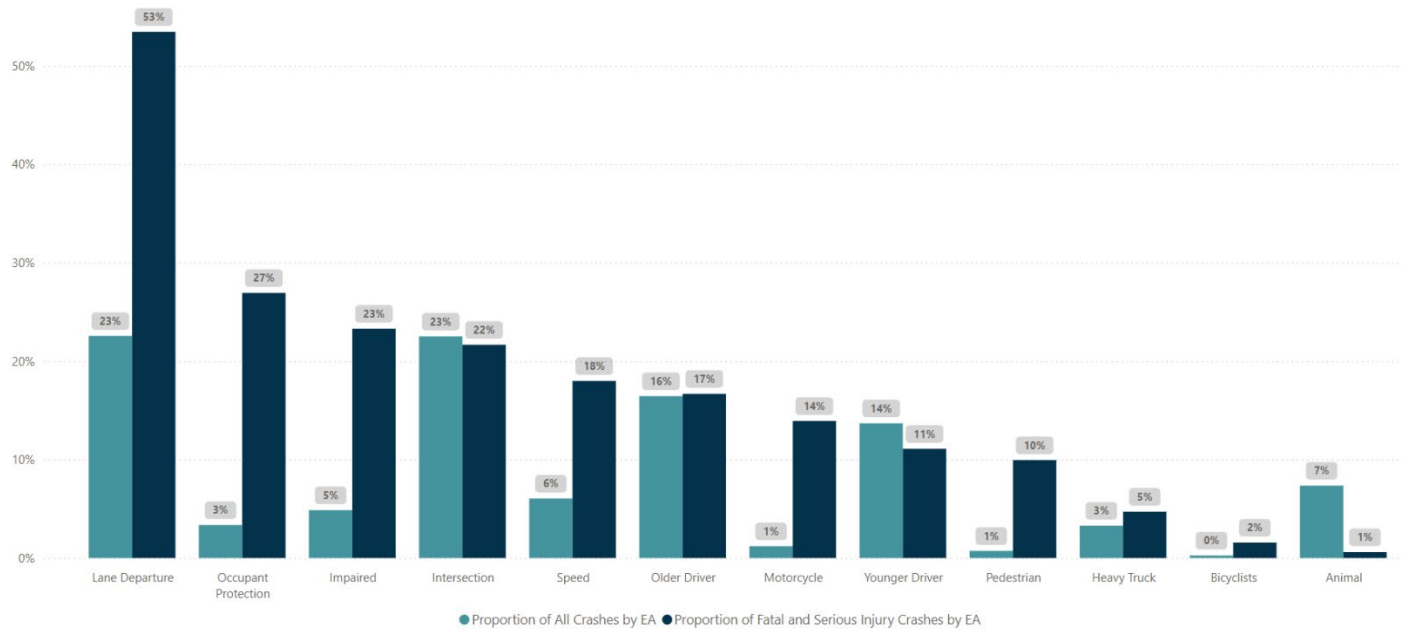

Figure 1: Comparison of Emphasis Areas (EA) in All Crashes vs. Fatal and Serious Injury Crashes

Focus Crash Type Comparisons

› **FBRMPO and LOSRPO Emphasis Areas Relative to State by KA Crashes**

If the region's proportion of KA crashes exceeded 1% of all Crashes, it was marked as a focus crash type for FBRMPO and LOSRPO. Additionally, anything with a 1% (or less) difference in overrepresentation was excluded from the critical areas, except for older drivers. This removed Animal and Younger Drivers as focus crash types for the region. Older drivers and Intersections were kept as a focus crash type because they represent a relatively large share of severe crashes. As for bicyclists, bicyclists and pedestrians are considered vulnerable road users

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and often have overlapping safety concerns. Table 1 illustrates how each county's proportion of KA crashes by EA compares to the statewide proportion.

Emphasis Areas	Buncombe	Haywood	Henderson	Madison	Transylvania	Statewide
Animal	0%	0%	0%	3%	0%	1%
Bicyclist	2%	1%	2%	0%	4%	2%
Heavy Truck	3%	7%	5%	5%	1%	5%
Impaired	24%	15%	23%	12%	14%	23%
Intersection	17%	13%	22%	12%	17%	22%
Lane Departure	51%	65%	56%	71%	68%	53%
Motorcycle	18%	26%	19%	29%	28%	14%
Occupant Protection	25%	20%	22%	26%	21%	27%
Older Driver	23%	27%	22%	21%	29%	17%
Pedestrian	11%	6%	9%	2%	5%	10%
Speed	14%	17%	14%	19%	13%	18%
Younger Driver	10%	7%	7%	12%	4%	11%

Table 1: Proportion of Fatal and Serious Injury Crashes by County and Emphasis Area Compared to Statewide Rates

Please note that crashes per county will add up to more than 100%. This is because one crash can be associated with multiple EAs. This overlap will be important in future steps of the analysis, as countermeasures for one EA could help with crashes in another EA (e.g., reducing speeds could help prevent lane departure).

Table 2 highlights in **orange** the EAs recommended for each county based on overrepresentation. Since Figure 1 illustrated that 9 EAs represent major contributing factors to severe crashes:

- Bicyclist
- Heavy Truck
- Impaired Driving
- Intersection
- Lane Departure
- Motorcycle
- Older Driver
- Pedestrian
- Speed

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These are the focus for the analysis moving forward.

Emphasis Area(s)	Buncombe	Haywood	Henderson	Madison	Transylvania
Bicycle	■		■		■
Heavy Truck		■	■	■	
Impaired Driving	■				
Intersection			■		
Lane Departure		■	■	■	■
Motorcycle	■	■	■	■	■
Older Driver	■	■	■	■	■
Pedestrian	■				
Speed				■	

Table 2: Counties with Higher Proportions of Fatal and Serious Crashes by Emphasis Area Compared to Statewide Proportions

Table 2 helps inform the next step in the analysis by highlighting specific crash types in specific counties that can help inform the risk-based analysis. Other key conclusions include:

- **Majority of Counties:** Three out of five counties exhibit higher proportions of fatal and serious injury crashes than the state in at least five out of nine EAs, and all counties are overrepresented in at least four EAs.

- **Critical Emphasis Areas:** Motorcycle and Older Driver fatal and serious injury crashes are over-represented across all counties than the statewide rate.

- **Urban Concerns:** Buncombe County, the most urban county within the five-county region, is uniquely overrepresented in Pedestrian and Bicyclist involved fatal and serious injury crashes.

- **Rural Concerns:** Madison County contains the most overrepresented fatal and serious injury crashes, with six of nine EAs.

By focusing on these overrepresented EAs, FBRMPO and LOSRPO can allocate resources and develop strategies that proactively address each county's most pressing safety concerns.

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Focus Network

Based on focus crash types (i.e., EAs), the analysis then reviewed roadway types that have a disproportionately high number of KA crashes.

North Carolina Roadway Classification

Route class refers to the route's signage (e.g., US 70 or NC 55), which correlates with road maintenance. Interstates, US Routes, NC Routes, and Secondary Routes are NCDOT maintained, while Non-System roads are not NCDOT maintained. Figure 2 compares the proportion of KA crashes and total crashes on each route classification, as well as the total mileage in the five-county region.
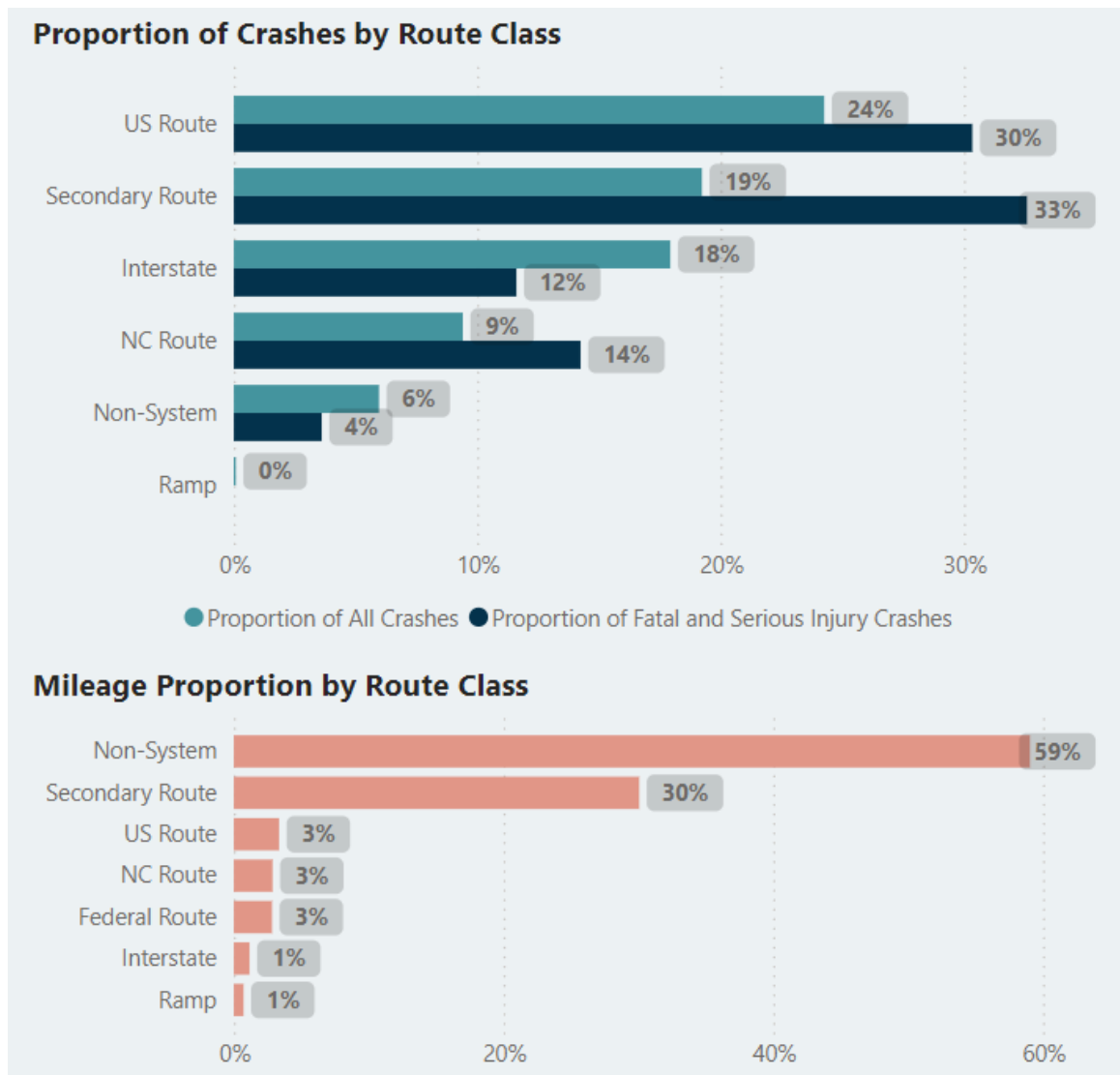
Proportion of Crashes by Route Class

Route Class	Proportion of All Crashes	Proportion of Fatal and Serious Injury Crashes
US Route	24%	30%
Secondary Route	19%	33%
Interstate	18%	12%
NC Route	9%	14%
Non-System	6%	4%
Ramp		0%

● Proportion of All Crashes ● Proportion of Fatal and Serious Injury Crashes

Mileage Proportion by Route Class

Route Class	Mileage Proportion
Non-System	59%
Secondary Route	30%
US Route	3%
NC Route	3%
Federal Route	3%
Interstate	1%
Ramp	1%

Figure 2: Disparity in Crash Distribution vs. Road Mileage by Route Class

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Some key takeaways include:

- **Secondary Routes:** While they account for a significant portion of road mileage (30%), they are involved in a disproportionate number of KA crashes (33%) relative to total crashes (19%).

- **US Routes:** Representing just 3% of road mileage, these routes account for 33% of KA crashes, indicating a substantial overrepresentation.

- **NC Route:** These comprise only 3% of the total road mileage but represent 14% of the KA crashes, indicating a substantial overrepresentation.

Such disparities highlight the differential distribution of crash incidents across various route classifications between the two datasets, indicating potential discrepancies in crash reporting or differing safety profiles across different types of roadways within the FBRMPO and LOSRPO jurisdiction.

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Federal Functional Classification

Functional class is a federally mandated classification for public roads. Per the Federal Highway Administration (FHWA)," functional classification carries with it expectations about roadway design, including its speed, capacity and relationship to existing and future land use development."[2] This is highly correlated with route class (i.e., a US Route will tend to be a freeway or arterial in the functional class framework), but they are not identical. Table 4 presents crash data categorized by functional class for FBRMPO and LOSRPO, comparing KA and KABCO crashes for the 5-county region.
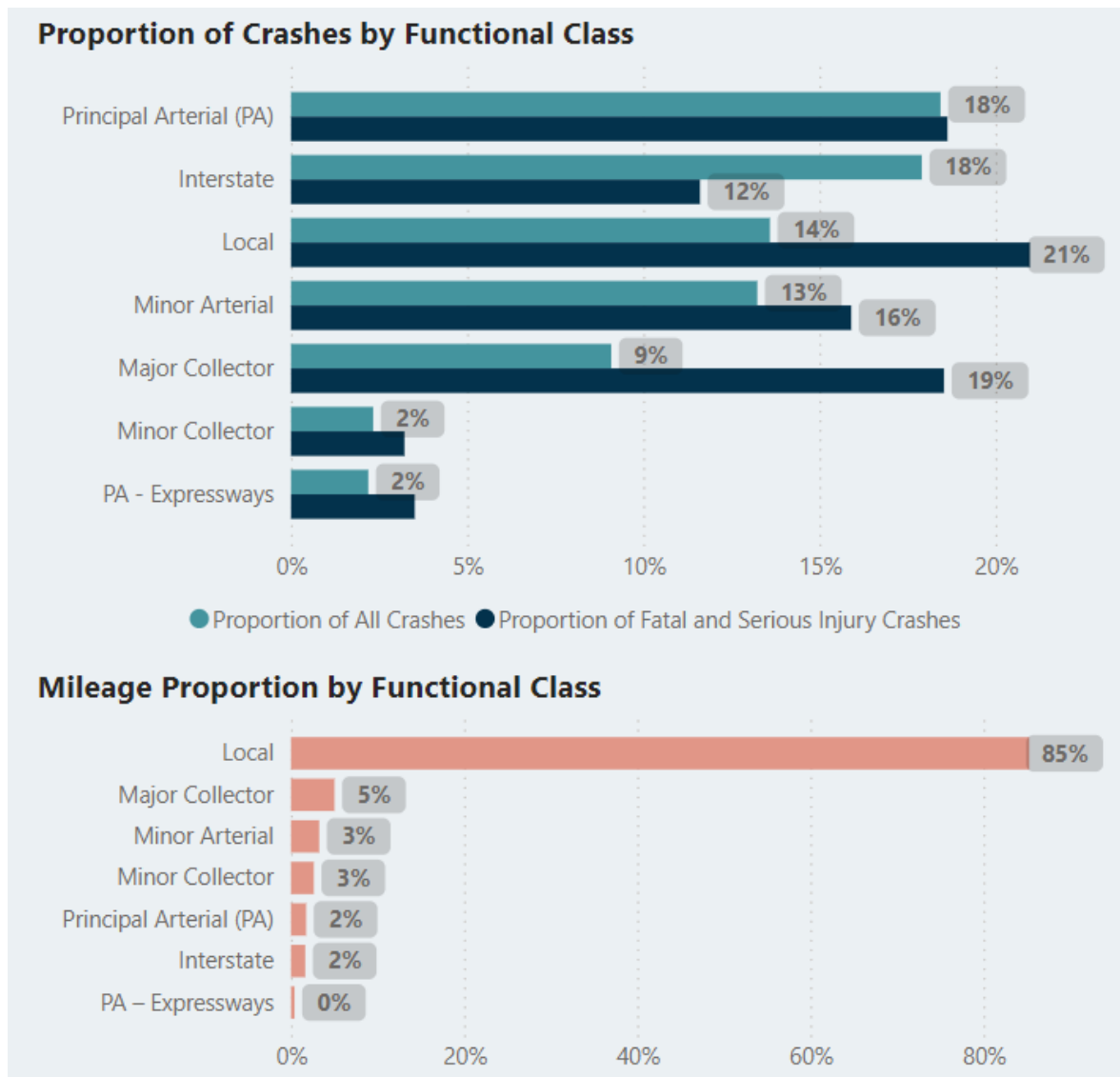
Proportion of Crashes by Functional Class

Functional Class	Proportion of All Crashes	Proportion of Fatal and Serious Injury Crashes
Principal Arterial (PA)	18%	18%
Interstate	18%	12%
Local	14%	21%
Minor Arterial	13%	16%
Major Collector	9%	19%
Minor Collector	2%	2%
PA - Expressways	2%	2%

Mileage Proportion by Functional Class

Functional Class	Mileage Proportion
Local	85%
Major Collector	5%
Minor Arterial	3%
Minor Collector	3%
Principal Arterial (PA)	2%
Interstate	2%
PA – Expressways	0%

Figure 3: Disparity in Crash Distribution vs. Road Mileage by Functional Class

[2] https://www.fhwa.dot.gov/planning/processes/statewide/related/hwy-functional-classification-2023.pdf

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Key takeaways include:

- **Principal Arterials - Other:** These routes make up 19% of KA crashes but only 2% of road mileage, highlighting a significant overrepresentation.

- **Local Roads:** Although they account for 85% of road mileage, they are involved in only 21% of KA crashes, a considerable underrepresentation.

- **Minor Arterials:** These roads represent 16% of KA crashes while comprising only 3% of the road network, indicating a significant overrepresentation.

- **Major Collectors:** These routes make up 19% of KA crashes but only 5% of road mileage, another considerable overrepresentation.

- **Expressways:** With less than 1% of the mileage contributing to 4% of KA crashes, expressways are also notably overrepresented.

However, due to geolocation concerns in North Carolina's crash data, the project team does not recommend using functional class as the basis for further analysis. Unlike route class, which is defined in the crash data directly, crashes on lower functional classes (e.g., local) tend not to be locatable. Since spatial location is essential to developing the proportions in Figure 3, there is a slight skewing in favor of higher functional class roads. This would bias the safety analysis against roads not maintained by NCDOT.

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Overrepresented Networks

Table 3 compares the distribution of fatal and serious injury crashes by focus crash type (i.e., EA) on the FBRMPO and LOSRPO road network. The 3 "Fatal and Serious Injury Crash Proportion" columns list the percentage of crashes that occur on each route class and functional class, and the "Mileage Proportion" columns list the proportion of road mileage in each class. The "Difference" columns show the difference between the two; a positive difference is indicative of key parts of the network that would be the focus for more detailed risk factors.

Emphasis Area(s)	Fatal and Serious Injury Crash Proportion			Mileage Proportion			Difference		
	US Route	NC Route	Secondary Route	US Route	NC Route	Secondary Route	US Route	NC Route	Secondary Route
Lane Departure	25%	13%	41%	3%	4%	30%	22%	11%	11%
Older Driver	37%	17%	27%	3%	4%	30%	34%	13%	-3%
Impaired Driving	29%	12%	33%	3%	4%	30%	26%	8%	3%
Intersection									
Heavy Truck	25%	7%	52%	3%	4%	30%	22%	3%	22%
Speed	23%	13%	37%	3%	4%	30%	20%	9%	7%
Motorcycle	31%	22%	28%	3%	3%	30%	28%	19%	-2%
Pedestrian	38%	6%	27%	3%	4%	30%	35%	2%	-3%
Bicycle	13%	13%	50%	3%	3%	30%	10%	10%	20%

Table 3: Disparity in Fatal and Serious Injury Crashes by Route Class and Emphasis Area

Summary of Focus Crash and Facility Types by County

Based on the results noted in the previous sections, the project team will pursue risk factor identification for the following crash types and facilities for each county in the five-county region (Table 4). When reviewing for specific risk factors, the project team will focus on factors that contribute to crash types on focus facilities (Table 3) with an emphasis in counties where that crash type was overrepresented in terms of fatal and serious injury crashes (Table 4). Examples of risk factors to be considered in the next phase of the analysis include:

- Transit presence and transit stop location.
- Municipal boundaries and urbanized area.
- Bicycle and pedestrian infrastructure (where present/available).
- Horizontal curvature (where present/available).
- Employment and demographic characteristics.
- Parcel density (as a proxy for land use), land use records (where available), and land cover (if needed).

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Focus Crash Type	Lane Departure	Older Driver	Intersection	Impaired Driving	Heavy Truck	Speed	Motorcycle	Pedestrian	Bicycle
Focus Facility Types	• US Route • NC Route • Secondary Route	• US Route • NC Route	• US Route • NC Route • Secondary Route	• US Route • NC Route • Secondary Route	• US Route • NC Route • Secondary Route	• US Route • NC Route • Secondary Route	•US Route •NC Route	• US Route •NC Route	•US Route •NC Route • Secondary Route
Priority Counties	• Haywood • Madison • Transylvania	• Buncombe • Haywood • Henderson • Madison • Transylvania	• Henderson	• Haywood • Transylvania	• Haywood • Madison • Transylvania	• Haywood • Henderson • Madison • Transylvania	•Buncombe •Haywood •Madison •Transylvania	• Buncombe • Transylvania	•Buncombe •Transylvania

Table 4: Proposed Focus Crash Types and Facility Types by County

Other Considerations

The county crash summaries presented at the June 2024 Stakeholder Summit noted the "Who", "What", "When", and "Why" associated with crashes in the five-county region. Although this memorandum is primarily concerned with the "What" and "Where" for next steps in the risk analysis, the project team plans to integrate the following considerations in the plan development:

- **When:** Crash comparisons noted considerable overrepresentation for fatal and serious injury crashes overnight (6 pm to 5 am), during weekend days (Saturday and Sunday), and during the spring and summer months (April to October). The project team will consider these factors when assessing potential risk by EAs, as well as strategies the Safe Streets for WNC could take to focus on these temporal factors.

- **Who:** The crash summaries noted that not all communities are affected equally by transportation safety concerns. When assessing disproportionate impacts by community, the project team will consider the following:

  o Employment and population density are key indicators for safety trends. These will be reviewed as part of the risk factor analysis.

  o Race and historical disadvantage are key indicators for the equitable distribution of countermeasures or community engagement. The project team will use these factors as part of plan development and implementation.