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## **Appendix C**

Safety and Operational Issues Memo



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# Memo

Date: Monday, May 13, 2019

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Project: Lowcountry Rapid Transit (LCRT)

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To: Type recipient(s) here

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From: Tom Hiles PE, HDR Inc.

Subject: Safety Memorandum – Rivers Avenue

## Purpose of Memorandum

The proposed LCRT corridor alternatives, which run along a 25-mile system composed of several principal arterial roads, will have impacts to current modes of transportation on those roads. This memo discusses the corridor crash rates along the principal arterials that would be impacted by the project, and investigates specific crash hotspots along Rivers Avenue, where a center-running alignment for the LCRT lanes is currently being proposed as an alternative.

## Lowcountry Rapid Transit (LCRT) Corridor Crash Rates

Crash data provided by the SCDOT Office of Traffic Engineering Safety between January 2015 and June 2018 was used to develop corridor crash rates, which are shown below in Table 1. The crash rates are represented as crashes per mile, per year. The average crash rate from SCDOT for roads of similar functional classification and volume are also shown in Table 1 for comparison. The average rates were provided by SCDOT as best-fit trend line equations, of which daily volume is the independent variable.

Table 1 illustrates that along most of the corridors, the crash rates exceed SCDOT averages. It should be noted that while the frequency of crashes occurring on US 17A far exceeds the SCDOT average, the length of this segment of US 17A is 0.6 mile, which is likely skewing the average higher in this case. Crash rates on Rivers Avenue, from the merge of US 78 and US 52 to Piggly Wiggly Drive are twice as high as the state average, and there is a trend towards high pedestrian crash incidents on this section as well. There are also a pedestrian-crash trend seen on Meeting Street and Calhoun Street, which is likely explained by the fact that these sections bisect the downtown Charleston historic district, where pedestrian volumes are very high.

Table 1: LCRT Proposed Corridor Crash Rates and SCDOT Averages

Route	From	To	No. of Crashes	No. of Injury Crashes	No. of Fatal Crashes	No. of Ped. Crashes	Length (mi.)	Crashes/Yr/Mile	SCDOT Avg.
US 17A	Richardson Ave	US 78	347	53	1	2	0.6	165.24	23.9
US 78	US 17A	US 52	1751	469	10	5	8.3	60.28	45.1
US 78/52/Rivers Ave (North)	US 78 and US 52 Merge	Greenridge Rd	534	175	1	2	1.05	145.31	67.9
US 78/52/Rivers Ave (Central)	Greenridge Rd	Piggly Wiggly Dr	1886	499	11	15	6	89.81	41.8
US 78/52/Rivers Ave (South)	Piggly Wiggly Dr	Carner Ave	284	102	3	11	2.55	31.82	23.2
Meeting St (North)	Carner Ave	Mt. Pleasant Rd	158	54	0	2	3.08	14.66	16.1
King St	Mt. Pleasant Rd	Calhoun St	160	54	1	8	2.12	21.56	13.2
Meeting St (South)	Mt. Pleasant Rd	Calhoun St	358	95	1	12	2	51.14	24.5
Calhoun St	Meeting St	Courtenay Dr	346	72	0	13	1	98.86	23.2
Spring	King St	Ashley Ave	92	17	0	2	0.7	37.55	9.1
Cannon	King St	Ashley Ave	58	11	0	0	0.74	22.39	9.1

## US 78/US 52/Rivers Avenue

US 78/US 52/Rivers Avenue is an important component of the 25-mile LCRT system proposed for the metro-Charleston region. The corridor is heavily traveled by vehicles as well as pedestrians, and due to its width, there are several design elements that contribute to above-average crash exposure and operational inefficiencies at the frequent unsignalized driveways and minor streets. The installation of a center-running bus rapid transit (BRT) system would provide not only mobility options for a broad range of users but also offers an opportunity to address motorist and pedestrian safety.

This section of the memo documents findings from the corridor safety assessment and discusses how a proposed superstreet design can help mitigate crash exposure by reducing conflict points, left-hand merges, and high-volume weaving areas. In addition to improvements to safety, design elements of a superstreet corridor can also address areas where operational issues are present, thereby helping to improve traffic flow and addressing ways to improve bottleneck locations.

### Corridor Crash Rates

A corridor crash rate assessment on a seven-mile section of the Rivers Avenue corridor, beginning at the northern terminus where US 78 and US 52 converge, and ending at Durant Drive was conducted, and reveals that crashes consistently occur more frequently on Rivers Avenue than the statewide average for an arterial carrying similar vehicle volumes. As previously noted, this assessment used crash data

ranging from January 2015 through June 2018. These comparisons were made possible through the South Carolina Traffic Engineering Safety Office, which recently developed crash rate equations for various functional classifications that use daily traffic as a variable.

On this section of Rivers Avenue, the number of crashes that occur in a year's time, over the study period, were twice that of the state's yearly average crash frequency on arterials with similar volumes.

### Crash Types

The five typical crash types that were assessed were sideswipes (in the same and opposing directions), rear ends, head-on, angled, and collisions with non-motorized objects, which includes pedestrians and bicyclists. Rear end crashes make up 44% of the total crash dataset, while angled crashes follow at 29%. Sideswipe collisions are third at 18% and the remaining two types make up another 9%.

Rear end collisions are common on high-volume roads where factors such as driveway spacing, congestion, and traffic signals are considered to be contributors. Rear end crashes can vary in severity, however in the study area less than 1% of all rear end crashes resulted in serious or fatal injuries. The two fatal crashes occurring during the time period were a result of DUIs.

Angled crashes are common at intersections and driveways, where vehicles must turn left to cross one or more lanes of traffic. On Rivers Avenue, angled crashes are the second-most frequent crash type and also the second-leading cause of serious injuries or fatalities. These crash types can often be avoided by restricting left turn movements across high-volume roads or by signaling left turn movements.

Sideswipe crashes typically take place on roads with multiple lanes in a single direction, where driveways are frequent, where lane merges take place, and where there is a specific reason for traffic to need to enter a road on one side and weave across multiple lanes to exit the road on the other side. Sideswipe crashes can be addressed by the removal of lane merges, and through design that minimizes the need for traffic to weave from left to right or vice versa.

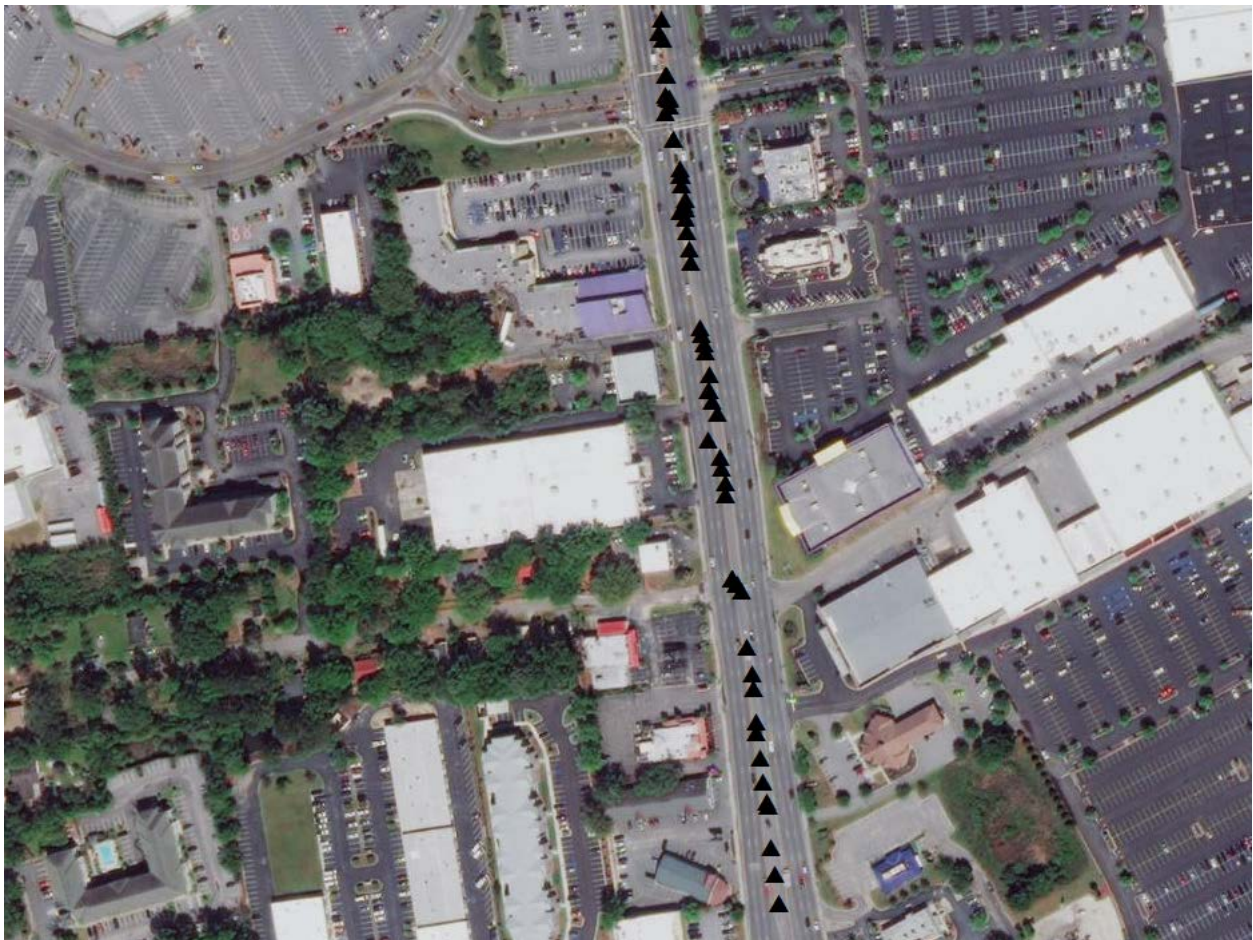
Head on collisions are not common on the corridor, but did contribute to one fatal crash and three serious injury crashes. The cause of these crashes was varied.

Crashes involving other non-motorized objects include crashes with signs, utility poles, animals, and people on foot or bike. These types of crashes can be highly severe. Only 7% of the total crashes within the dataset were crashes of this type, however these were the leading cause of serious injury or fatal crashes. There were a total of six fatal crashes and 18 serious injury crashes. 10 of these crashes involved a pedestrian, and while it is not immediately present in the dataset due to variations in the Accident Description field of the crash reports, it is reasonably possible that this number is higher. There are a number of serious injury crashes that did not involve a second motor vehicle for which the given cause of the accident was "Improper Crossing", which could apply to a pedestrian in the roadway at a location other than a crosswalk.

### Angled Crashes at Unsignalized Intersections and Driveways

Angled crashes are a predominant crash type at many of the unsignalized intersections and driveways along Rivers Avenue and are the cause of several serious injuries and motorist fatalities.

A section of Rivers Ave between Northwoods Boulevard and Ashley Phosphate Road is noted as being a location where angled crashes frequently occur, likely due to the numerous driveways and the unrestricted left turn access to these driveways from the center two-way left turn lane. Additionally, 3 serious injury crashes and 2 fatalities were reported within this section. One fatality was the result of an angled crash and the other was the result of a vehicle striking a pedestrian in the road. Two of the serious injury crashes may have been a result of a vehicle striking a pedestrian as well, given information found in the report dataset. More discussion on pedestrian crossing treatments is found in subsequent sections of this memo.



Example of Angle (black) Crashes in Center Turn Lane from Northwoods Blvd to Ashley Phosphate Rd

Angled crashes are observed at most minor-street intersections, both signalized and unsignalized. This trend occurs throughout the corridor and is largely due to uncontrolled movements in conflict with high volumes of traffic within multiple lanes traveling at high speed.



Crashes at Median Crossovers

Throughout the corridor, there is a noticeable clustering of crashes that take place near the unsignaled median U-turn locations and the median left turn crossover locations. As previously noted, angled crashes often occur at left turn crossover locations, where vehicles turn onto a short section of pavement within the median and wait at a stop bar for gaps in opposing traffic. Drivers often treat these crossover locations as places to make U-turns as well, and there is some indication that this movement causes sideswipe crashes. Similarly, median U-turn locations show some indication of being locations where sideswipe crashes occur, as vehicles are often required to make a U-turn into an acceleration lane and make one lane change from the left-hand side of the travel way before the acceleration lane ends.



Example of Sideswipe (blue) and Angle (black) Crashes at Rivers Avenue near Liberty Mall U-turns



Example of Sideswipe (blue) and Angle (black) Crashes at Rivers Avenue at Hawthorne Drive Crossover

### Pedestrian Crashes

Pedestrian activity along Rivers Avenue appears to be leading to a trend towards pedestrian-related crashes on Rivers Avenue. Signalized crosswalks, which are infrequent along Rivers Avenue, are a result of the infrequent signal spacing, and limited use of crosswalks across Rivers Avenue at existing signals. Destinations along Rivers Avenue, such as businesses and CARTA bus stops, are largely unconnected to opposite sides of the road, which results in several pedestrian crossings being made mid-block across multiple lanes of traffic without signalized protection or pavement markings. A set of crash maps are provided as an attachment to this memo which illustrates each pedestrian crash as a red dot.

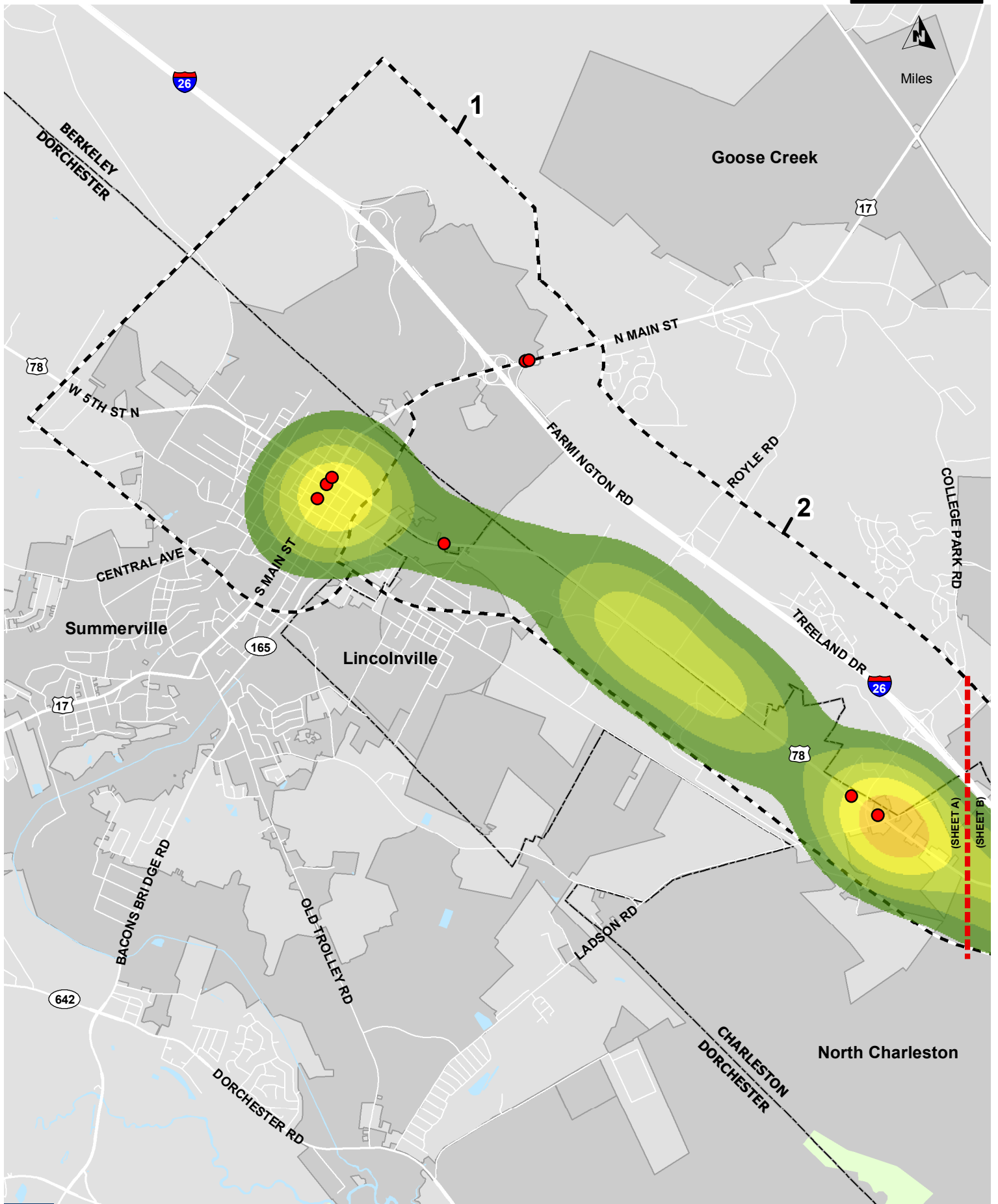
Between Morris Baker Road and the Montague Avenue overpass, which is a 4.20-mile segment of Rivers Avenue carrying more than 40,000 vehicles per day (vpd), there are no marked crosswalks. 11 pedestrian crashes took place within this segment, which resulted in two fatalities and two more serious injury events.

South of the Montague Avenue overpass, a similar trend of mid-block pedestrian crashes is observed in the attachments. Similar conclusions can be drawn as to the cause of this crash activity. Signals with crosswalks do become more frequent between Helm Drive and Carner Avenue, with an average signal spacing of one signal per 0.3 mile. There were a total of 11 pedestrian crashes in this section as well, with five being reported with serious injuries.

### Conclusions

- There is a crash risk associated with unsignalized minor-street crossings and with the median U-turn acceleration lanes along Rivers Avenue. Merging maneuvers, unanticipated lane drops, and uncontrolled crossings across up to three lanes of high-speed, high-volume traffic are contributing to this crash risk.
- The section of Rivers Avenue north of Ashley Phosphate Road, where the center two-way left turn lane is present, is a hotspot for angle crashes, resulting in several serious injury crashes.
- Pedestrian crash activity is elevated along much of Rivers Avenue. Contributing factors include the volume of pedestrian activity present on the corridor, infrequent signalized/marked crossings of Rivers Avenue.





Study Segment Zone  
 City Boundaries

Conservation  
 Match Line

Pedestrian Crash

## Lowcountry Rapid Transit Study Area - Sheet A

Data Source: SCDOT, BCDCOG

