Richmond Regional Transportation Safety Plan

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Introduction

Virginia has adopted the vision of Toward Zero Deaths, meaning that all roadway users should arrive safely at their destination. To move this vision forward, the Virginia Department of Transportation (VDOT), in collaboration with State and regional partners, is presently updating the 2017-2021 Strategic Highway Safety Plan (SHSP).[1] The SHSP is a five-year, action-based plan that frames the major safety issues in identified priority or emphasis areas and proposed strategies and actions to address them. The updated SHSP prioritizes implementing a safe system approach that is gaining momentum in the United States based on success from associated Vision Zero efforts in Europe. Implementation of the SHSP with a safe system approach requires the engagement, cooperation, and effort from the 5Es of highway safety: Engineering, Education, Enforcement, Emergency Response and Medical Services, and Everyone.

The collaborative approach in the SHSP is also vital because roadway fatalities and serious injuries occur on roadways owned and maintained by both the Commonwealth and local agencies. While the SHSP outlines an overarching statewide approach, local and regional safety plans have been shown to address the issues specific to a jurisdiction, further targeting safety improvements. The Richmond Regional Transportation Planning Organization (RRTPO) has committed to support the statewide efforts toward reducing fatalities and serious injuries on member jurisdiction roadways. Figure 1 shows the nine RRTPO member jurisdictions.

The Richmond Regional Transportation Safety Plan is a data-driven effort, outlining the primary factors preventing people from arriving safely at their destinations as well as locations where safety improvements could make a difference. The planning process included the following:

- Engagement of multidisciplinary stakeholders to review and discuss safety issues.
- Identification of safety priority areas including bicycles and pedestrians, distracted driving, unbelted driving, impaired driving, young drivers, infrastructure, and speeding.
- Identification of crash locations with the potential for safety improvements.
- Identification of solutions to address the behavioral and infrastructure needs.

The remainder of this document details the specific safety challenges in the Richmond region and solutions to proactively address these concerns. The Richmond Regional Transportation Safety Plan includes the following sections:

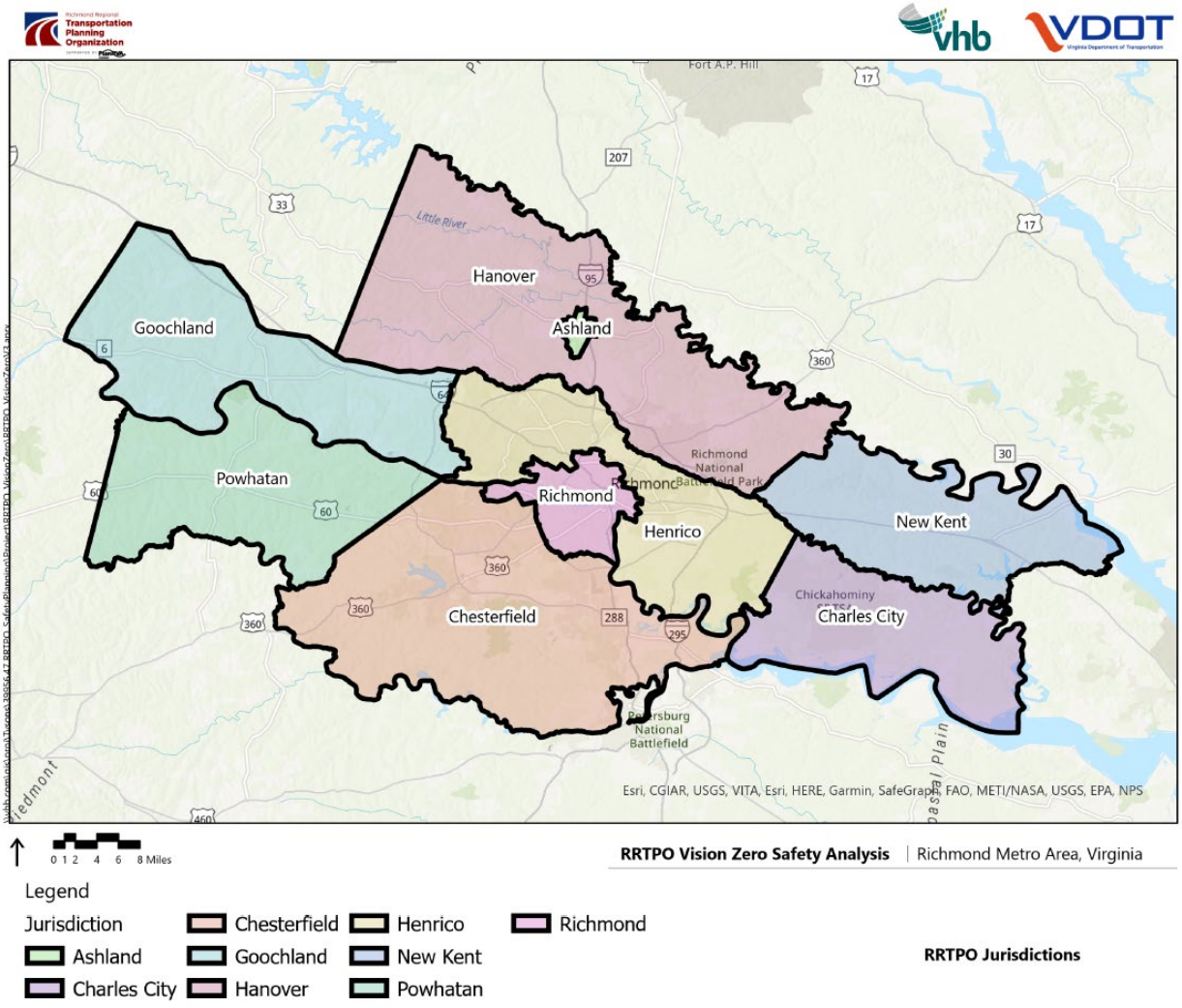
- Regional Safety Trends: This section highlights general traffic safety trends in the Richmond region. Comparisons to statewide trends and to trends in other metropolitan areas in Virginia are examined.
- Crash Characteristics: This section reviews the specific characteristics of crashes in the Richmond region with a focus towards fatal and injury crashes.
- Crash Locations: This section examines the geographic locations of crashes in the Richmond region.
- Next Steps: This section outlines information that the Richmond region should consider reducing the number of fatalities and serious injuries on its roadways. The Richmond region may

[1] Note that VDOT and its partners are updating the SHSP for the 2022-26 period for agency executive concurrence and charter to implement.

complete supporting documentation to this report with detailed implementation steps. The following subsections are included:

- Proven Countermeasures: This section describes possible countermeasures with measurable safety benefits that could be implemented by stakeholders in the Richmond region.
- Implementation Options: This section reviews options for implementing proposed countermeasures. This includes policies, programs, and projects that address behavioral and infrastructure needs.

Figure 1: RRTPO Member Jurisdictions.



Target Setting

The Safety Performance Management Measures federal regulation supports the Highway Safety Improvement Program (HSIP) and requires State Departments of Transportation (DOTs) and Metropolitan Planning Organizations (MPOs) to set HSIP targets for 5 safety performance measures. These performance measures include the following:

1. Number of fatalities
2. Rate of fatalities
3. Number of serious injuries
4. Rate of serious injuries
5. Number of non-motorized fatalities and serious injuries

MPOs establish HSIP targets by either (1) agreeing to plan and program projects so that they contribute toward the accomplishment of the State DOT HSIP target or (2) committing to a quantifiable HSIP target for the metropolitan planning area. To provide MPOs with flexibility, MPOs may support all the State HSIP targets, establish their own specific numeric HSIP targets for all of the performance measures, or any combination. MPOs may support the State HSIP target for one or more individual performance measures and establish specific numeric targets for the other performance measures.

VDOT has developed safety performance statistical models for each measure that incorporate multiple factors, including exposure to crash risk in Vehicle Miles Traveled (VMT), that are predicted for the next year safety targets. Recent statewide upward trend in fatalities and fatality rates are forecasted into 2022 while serious injuries and their rate have declining slightly, they will return to almost 2019 values. RRTPO is currently using the targets for the Richmond region set by VDOT.

Crash Characteristics

This section examines the number and rate of crashes and injuries in the Richmond region and how they compare to trends statewide and throughout other MPOs and transportation planning organizations (TPOs) in Virginia. Five years of crash data (2016-2020) were obtained from VDOT. Crash severity is defined using the KABCO scale:

- K – fatal injury
- A – suspected serious injury
- B – suspected minor injury
- C – possible injury
- PDO – property damage only

Crash Frequency and Severity

A total of 3,782 people have died or were seriously injured (needed post-crash medical facility care) as a result of a crash within RRTPO over the last 5 years. Figure 2 shows the trend of fatalities and serious injury crashes (i.e., KA crashes) during the past 5 years. Since the peak in 2017, each subsequent year has seen a decrease in KA crashes.

Figure 2: RRTPO fatal and serious injury crashes by year.

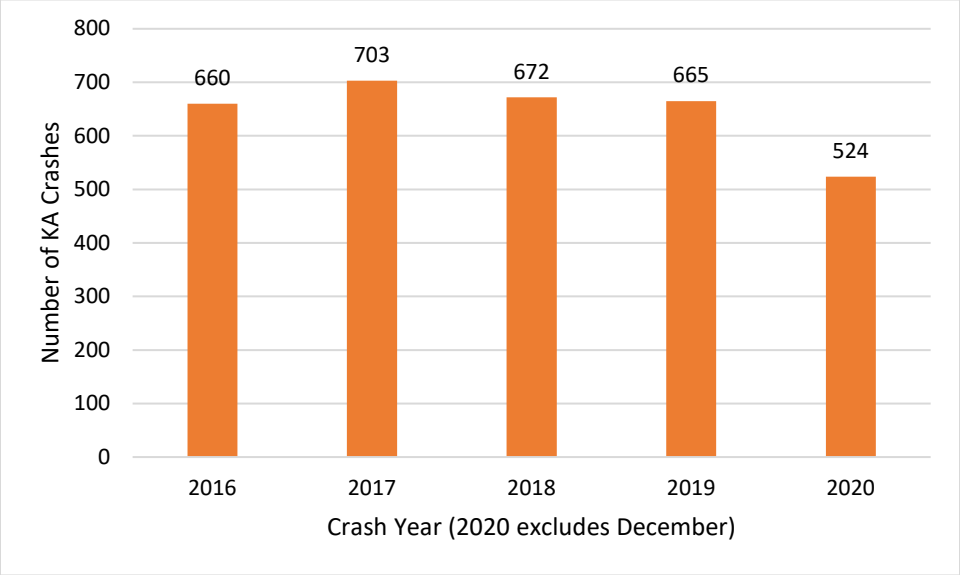


Figure 3 shows the breakdown of the number of K, A, and B crashes over the past 5 years. Note the decrease in A crashes and B crashes from 2019 to 2020, but K crashes increased by 16 to highest number in the 5-year analysis period.

Figure 3: Total crashes in RRPTO for last five years broken down by crash severity.

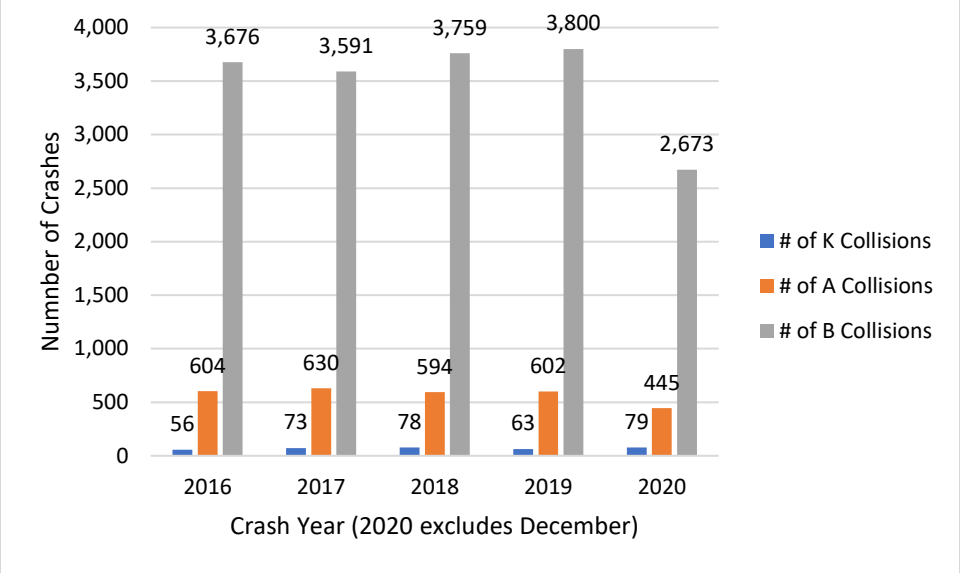
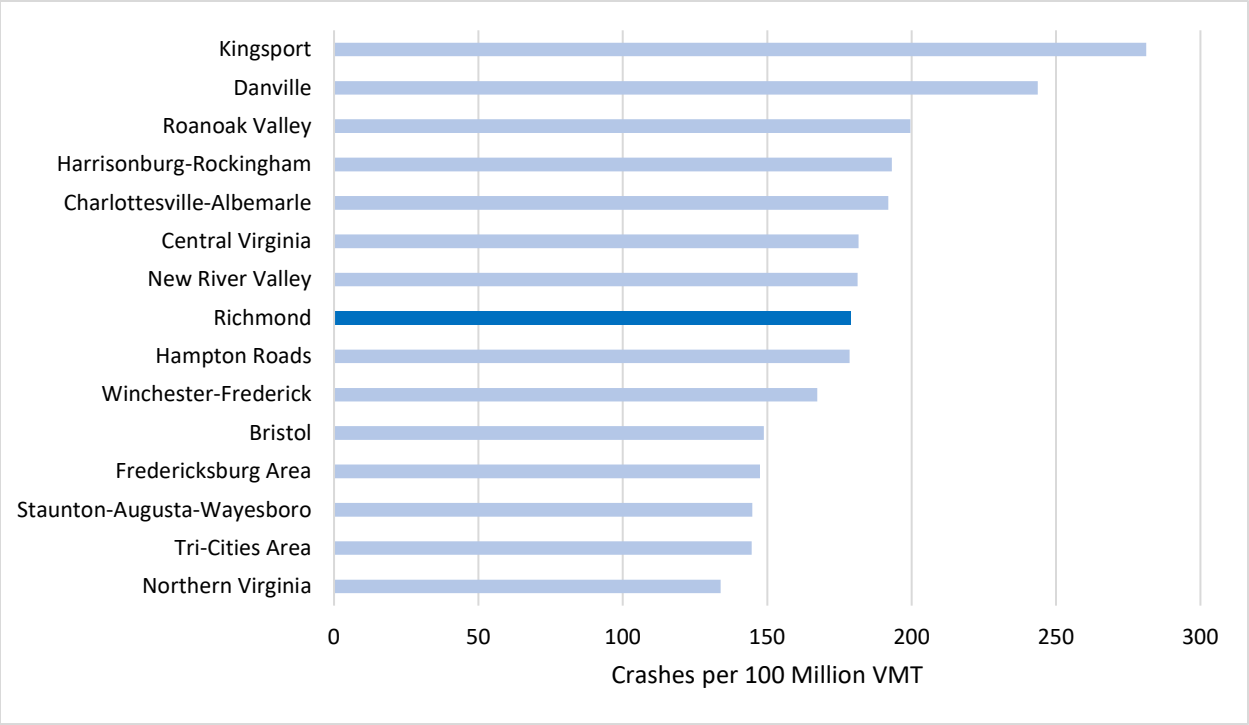


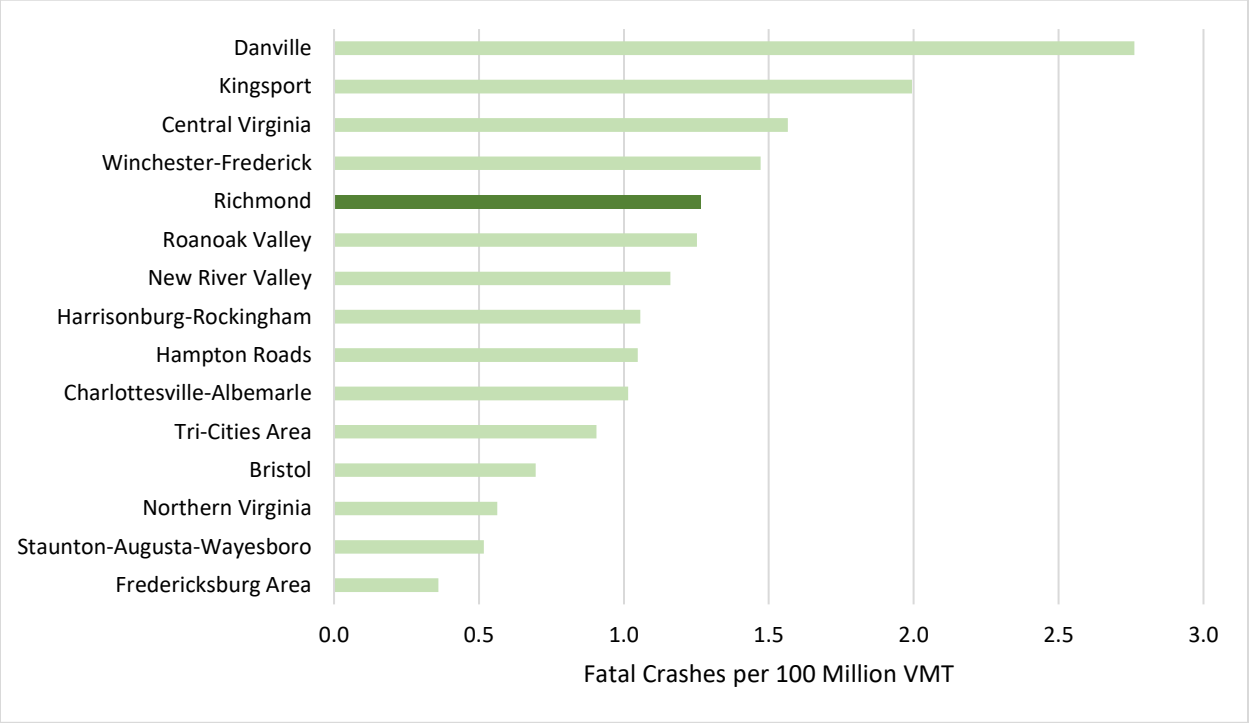
Figure 4 shows the total crashes per 100 million vehicle miles traveled (VMT) of MPOs/TPOs in Virginia. RRTPO's crash rate is approximately 179 crashes per 100 million VMT, putting it near the middle of the ranking.

Figure 4: Total crash rate compared to other Virginia MPOs/TPOs. 2016-2020.



Similarly, Figure 5 shows the fatal crashes per 100 million VMT of MPOs/TPOs in Virginia. RRTPO has a fatal crash rate of 1.27 fatal crashes per 100 million VMT, putting it fifth highest of fifteen MPOs/TPOs.

Figure 5: Fatal Crash Rate compared to other Virginia MPOs/TPOs. 2016-2020.



Crash Characteristics

Crashes can be defined by many characteristics relating to the conditions and/or actions of drivers, vehicles, the roadway, and the environment. This section examines the crash trends in the Richmond region relating to the following priorities in Virginia's SHSP:

- Emphasis areas in Virginia's SHSP
- Time of day
- Overlap of behavioral crash factors (i.e., impaired driving, speed, occupant protection)

Crash type, involvement of pedestrians or bicyclists, and time of day should be investigated on a localized or project level to determine applicable countermeasures. Crash data on a localized or project level can be viewed on map and downloaded for analysis through VDOT's ArcGIS Online account. Behavioral crash patterns and involvement of young drivers should be considered on a regional or corridor level. Behavioral countermeasures implemented references density maps created by the Department of Motor Vehicles (DMV) Highway Safety Office (HSO) that may be used in conjunction with the maps provided in this report to identify priority locations with behavioral crash patterns. Examples of the HSO annual maps provided for statewide, regional and local enforcement, education, and outreach federal grants are provided in their 2022 Highway Safety Plan.

The SHSP emphasis areas include the following:

- Impaired Driving (Drinking, Drugged, Distracted and Drowsy)
- Speed (over posted limit or appropriate speed for traffic/weather conditions)
- Occupant Protection (unbelted occupants of passenger vehicles and trucks with seat belts)
- Roadway Departure (head-on, side-swipe opposite direction, fixed object, overturn crashes)
- Intersections (within 250 feet of VDOT and 150 feet of locality (urban) maintained intersections)
- Young Drivers (crashes involved drivers under 21)
- Bicyclists
- Pedestrians

Table 1 shows the percent overlap between various fatal and serious injury crashes categorized by emphasis areas in the SHSP (defined in Appendix A). Note that the color scale is meant to be read vertically and the percentages are in relation to the column; the column percentage sum may exceed 100% due to the overlap of multiple emphasis area factors (note: all the cross-tabulations in this report are read the same way). It is important to note that there are strong overlaps between roadway departure, occupant protection, speed, and impaired driving. There are also correlations between intersections, pedestrians, bicyclists, and impaired driving. Key findings are:

- 46% of impaired driving KA injury crashes were roadway departures
- 45% of speeding KA injury crashes involved roadway departure, 43% involved intersections, and 33% involved occupant protection.
- Roadway departures were the most prevalent crash type for impaired driving (46%), speeding (45%), and non-belted (50%) crashes.
- Intersection crashes were the most prevalent crash type for young driver (51%), bicycle (60%), and pedestrian (48%) crashes.

Table 1: Cross-Tabulation of RRTPO KA injury crashes by emphasis areas.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		27%	29%	28%	15%	13%	11%	32%
Speed	25%		29%	26%	17%	24%	9%	8%
Occupant Protection	32%	33%		33%	19%	23%	2%	5%
Roadway Departure	46%	45%	50%		4%	28%	7%	0%
Intersections	37%	43%	42%	5%		51%	60%	48%
Young Drivers	11%	22%	18%	14%	18%		20%	16%
Bicycles	2%	1%	0%	1%	3%	3%		0%
Pedestrians	20%	5%	3%	0%	12%	12%	1%	

An example of how this table is read is that 27% of speeding crashes also involved impaired driving. The color scale is meant to be read vertically and the percentages are in relation to the column; the column percentage sum may exceed 100% due to the overlap of multiple emphasis area factors.

Table 2 is similar but includes B injury crashes as well. A potential benefit of using KAB is to add more data points due to some jurisdictions having a relatively small number of KA crashes. Some strong overlaps include impaired driving in roadway departure and intersection crashes, roadway departure crashes involving impaired driving, speed, and occupant protection, young drivers at intersections, and pedestrians and bicyclists at intersections.

When comparing Table 1 (KA crashes) to Table 2 (KAB crashes), it is observed that Table 1 contains more "dark" coloration, which indicates that KA crashes in the Richmond region have a greater prevalence of overlapping emphasis areas as compared to the KAB crashes. In other words, the higher severity crashes are more likely to have multiple crash factors. For example, KA Roadway Departure crashes are more likely than KAB Roadway Departure crashes to also have contributing factors of impaired driving (28% vs. 20%), speed (26% vs. 21%), or non-seatbelt use (33% vs. 19%).

Table 2: Cross-tabulation of RRTPO KAB injury crashes by emphasis areas.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		17%	23%	20%	7%	5%	6%	19%
Speed	20%		23%	21%	9%	14%	3%	4%
Occupant Protection	22%	19%		19%	7%	9%	1%	3%
Roadway Departure	40%	35%	38%		3%	15%	5%	0%
Intersections	45%	48%	48%	9%		59%	69%	56%
Young Drivers	12%	25%	20%	17%	19%		21%	27%
Bicycles	1%	1%	0%	1%	2%	2%		0%
Pedestrians	13%	2%	2%	0%	5%	8%	1%	

An example of how this table is read is that 17% of speeding crashes also involved impaired driving.

Figure 6 shows a Venn diagram of overlapping behavioral crash factors between impaired driving, speed, and occupant protection which together comprise 45 percent of the K and A crashes. This information combined with the Emphasis Area proportions in each jurisdiction provided below indicates that occupant protection has the largest overlap with the other behaviors for outreach and enforcement campaigns. Nearly 50% of drivers without proper protection were also impaired or speeding. That said, there is also a good amount of overlap with both the impaired driving and speeding behaviors, with just a slightly smaller percentage of drivers in each of these categories also engaging in one of the other two behaviors. In summary, all three of these behavioral crash factors are nearly equally present in RRTPO fatal and severe injury crashes and each only exists in isolation approximately half the time it presents.

Figure 6: Venn Diagram of Behavioral Factors in Fatal and Severe Injury Crashes.

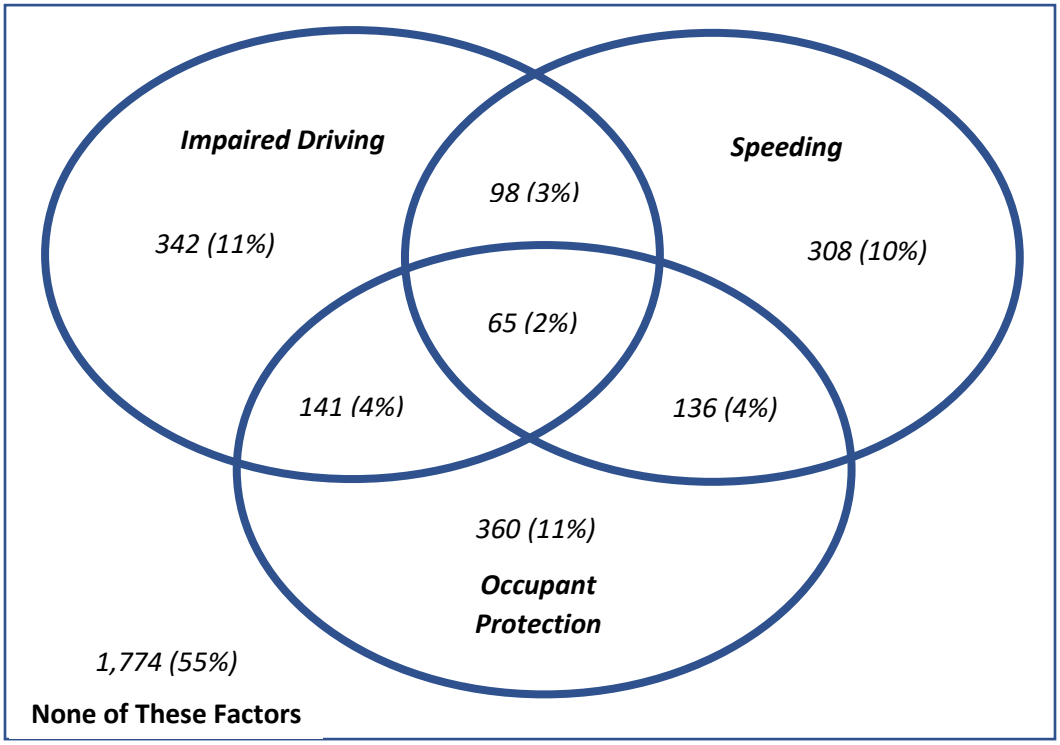
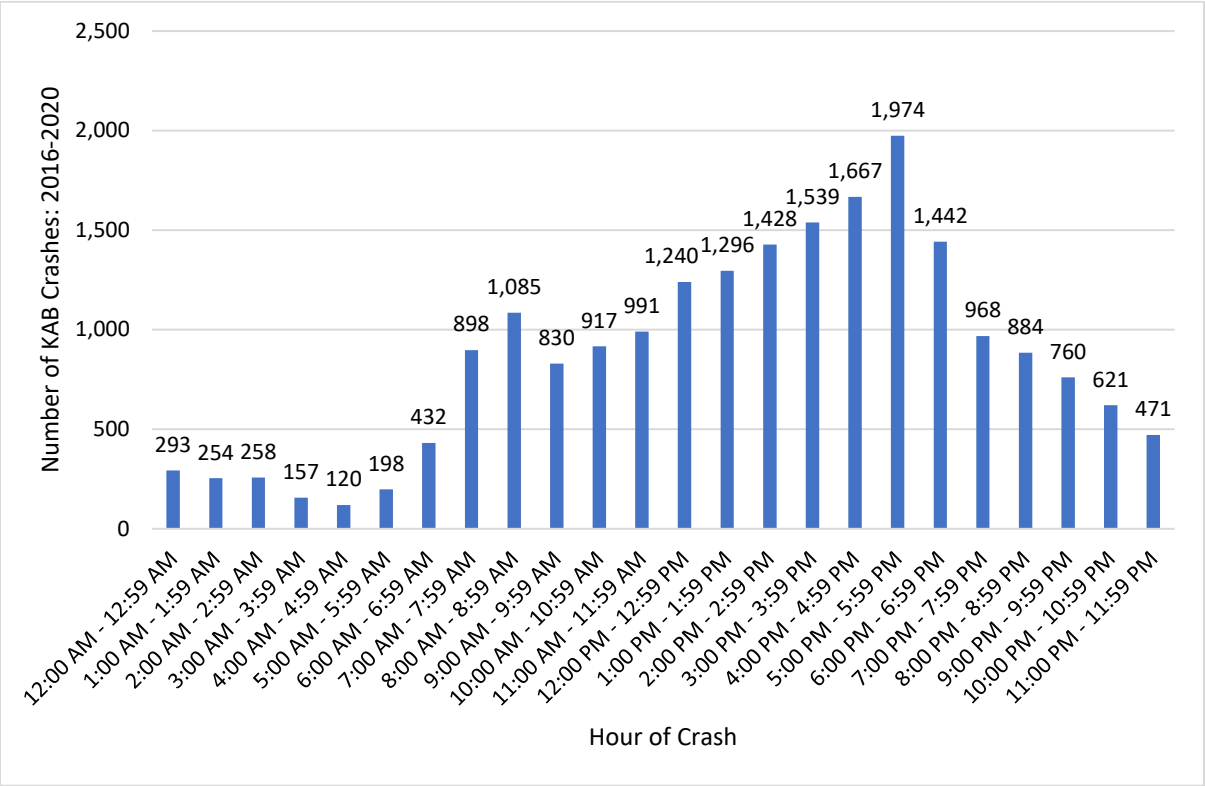


Figure 7 shows the time of day of KAB crashes over the 5-year period. There are peaks in the AM and PM peak traffic hours, but more crashes generally occur in daytime hours, with the highest between 5:00 and 6:00 PM.

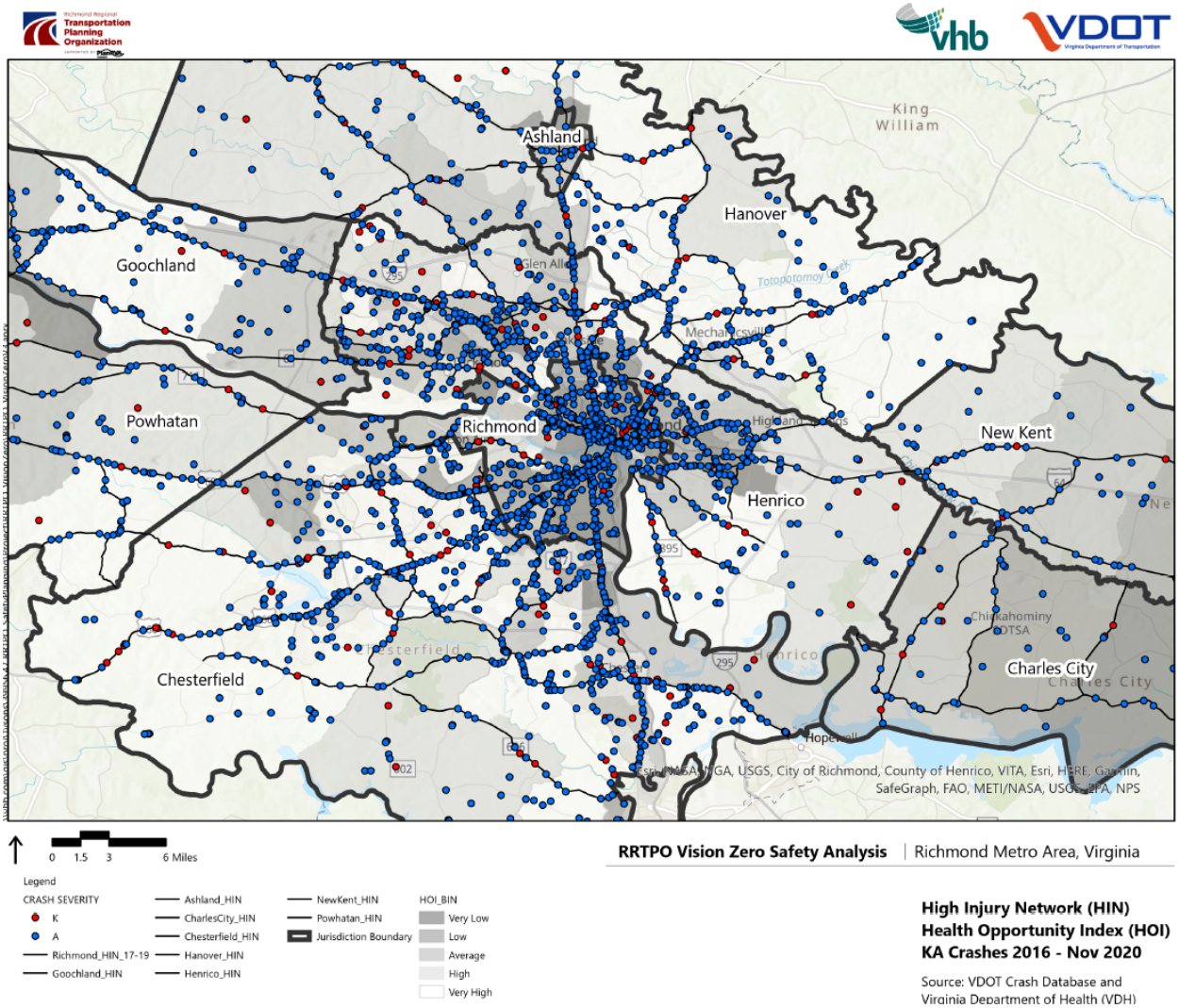
Figure 7: Time of day of crashes.



High-Injury Network and Health Opportunity Index

The Richmond region safety analysis to support State, regional and local vision zero initiatives established a high-injury network (HIN) for the region and assessed the propensity of severe crash outcomes using the Health Opportunity Index (HOI) for each census block. The HIN are roadway segments (corridors) with the highest proportion of fatalities and serious injuries. HOI was developed by the Virginia Department of Health (VDH) to promote health equity in the Commonwealth by factoring 13 indicators of the social determinates of health. VDOT analysis found a strong statewide spatial correlation of pedestrian crashes in areas with lower HOI ratings. *Figure* 8 shows a map of the HIN and HOI for the entire region. Subsequent sections show the HIN and HOI focused on each locality.

Figure 8: High-Injury Network and Health Opportunity Index for the Richmond region.



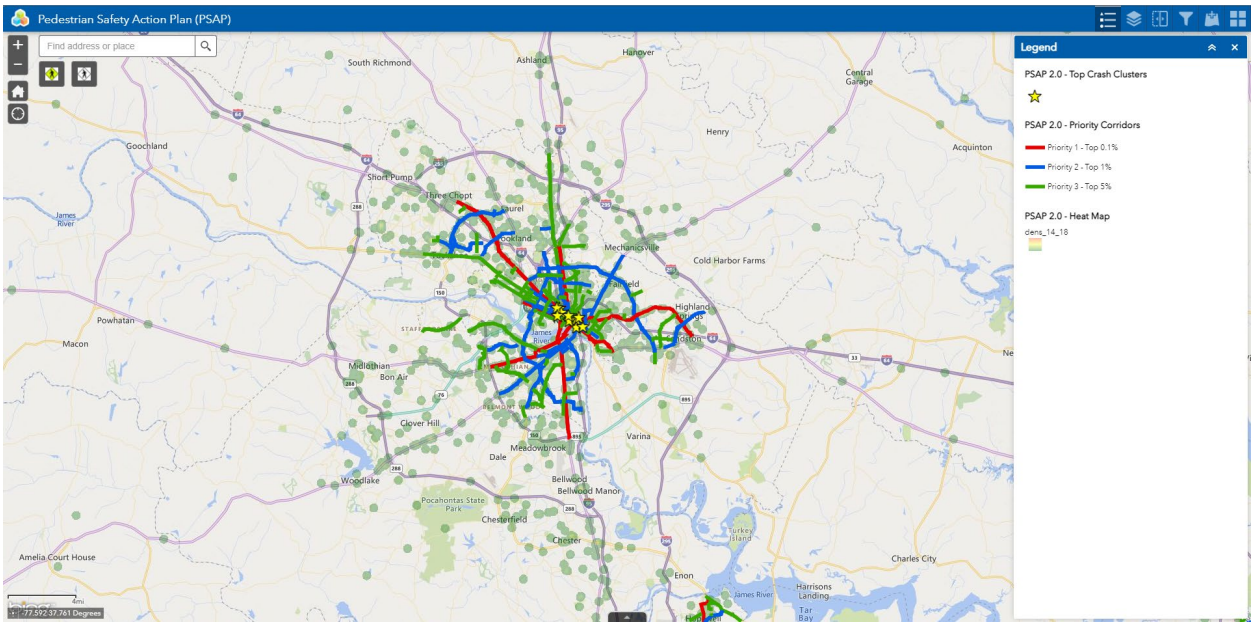
Pedestrian Safety Action Plan Corridors

In 2018, VDOT published the first Pedestrian Safety Action Plan (PSAP). VDOT worked with a multidisciplinary group of stakeholders to identify and address pedestrian safety concerns through a data driven approach. This approach included identifying and addressing locations with a history of pedestrian safety crashes along with proactively addressing pedestrian crash risk through the identification of priority corridors. The PSAP complements and supports other pedestrian safety efforts in Virginia, including the Virginia 2017–2021 SHSP, VDOT Highway Safety Improvement Program (HSIP), SMART SCALE, Transportation Alternatives Program, and Safe Routes to School program.

VDOT created an online PSAP Map Viewer tool that shows pedestrian corridors and crash clusters (see *Figure* 9 for a screenshot) based on statewide ranking. Version 2 is based on pedestrian crashes that occurred between 2014 and 2018 and the priority pedestrian corridors are organized into three tiers. Biannual updates are expected to be published with a third version in early 2022. The PSAP

methodology was re-analyzed for the area and network within the RRTPO boundary for regional comparison. The following sections specific to each RRTPO locality feature a map showing PSAP corridors.

Figure 9: Screenshot of the Statewide PSAP Map Viewer.



Jurisdictional Safety Assessments

In the following sections for each jurisdiction, data analysis shows the overlapping crash factors based on emphasis areas from Virginia's SHSP identified above. These proportions may be used to identify the focus of safe-system efforts and collaboration between the 5Es to identify and prioritize actions. The HIN map and listing of route segments with K, A, and B injury crashes (all types) are provided to begin focusing resources and efforts. Injury B crashes were added in jurisdictions with fewer K and A crashes to provide sufficient counts to identify segments. For vulnerable non-motorized users the PSAP roadway segments are identified as regional and jurisdictional high scoring (greater propensity to walk/bike and risk) priorities. Mitigating the most severe crashes on the identified route segments will also reduce the response resources and economic costs of possible injury and property damage crashes.

Ashland

Key Highlights

Table 3 emphasis area crash proportions show speed-related crashes occurring most commonly for crashes involving roadway departure, intersections, and young drivers. Another highlight is that Intersections are the most common crash factor for impaired driving, speed, occupant protection, young drivers, and bicycles.

Table 3: Cross-Tabulation of KAB Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		15%	30%	13%	7%	8%	23%	50%
Speed	17%		10%	30%	10%	18%	8%	0%
Occupant Protection	13%	4%		7%	5%	3%	0%	0%
Roadway Departure	17%	33%	20%		6%	19%	8%	0%
Intersections	43%	48%	70%	27%		61%	54%	33%
Young Drivers	22%	41%	20%	40%	28%		46%	0%
Bicycles	13%	4%	0%	3%	5%	10%		0%
Pedestrians	13%	0%	0%	0%	1%	0%	0%	

An example of how this table is read is that 15% of speeding crashes also involved impaired driving.

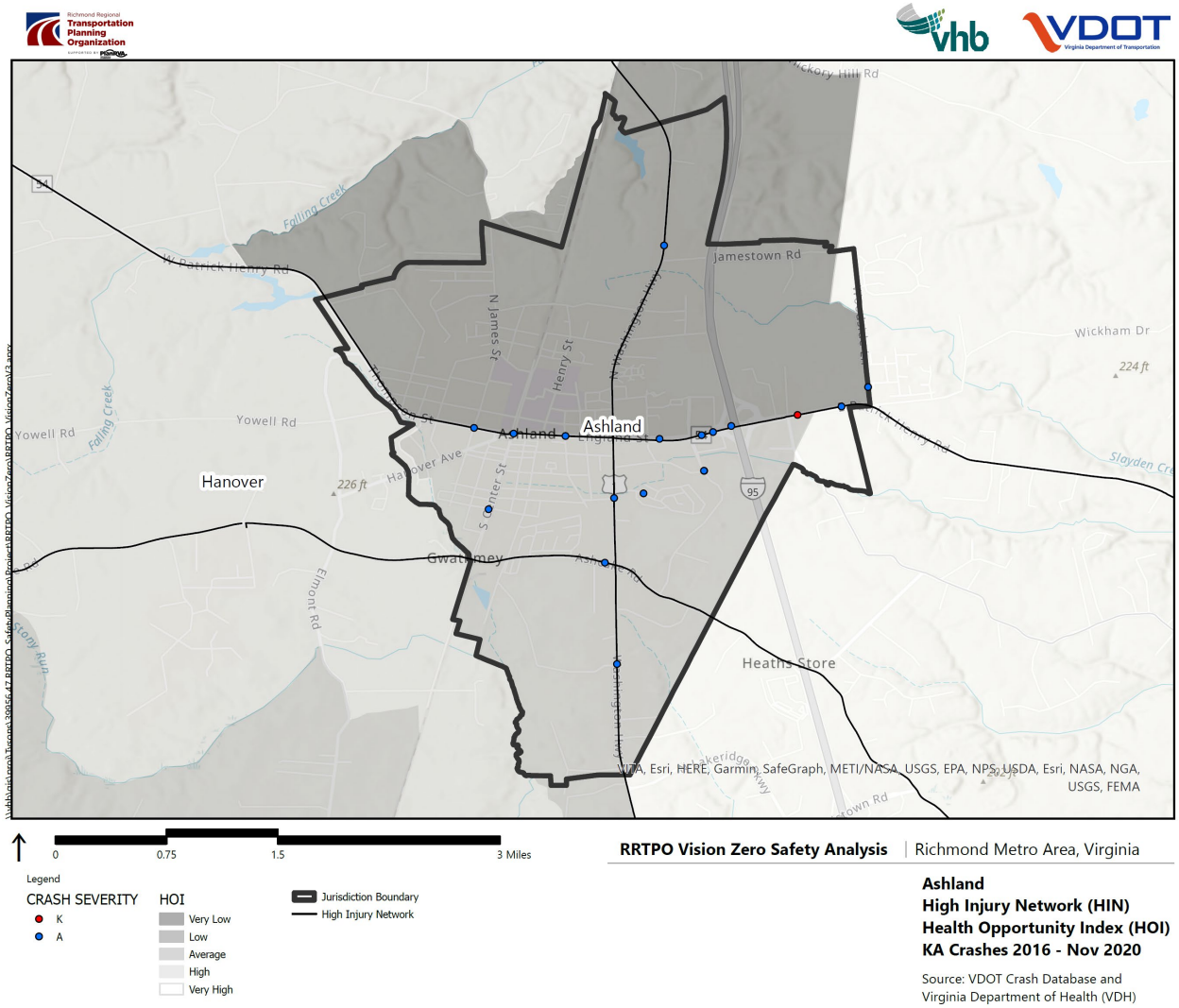
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Intersection Crashes
- Young Driver Crashes
- Bicycle Crashes
- Speeding Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 10, the fatal and serious injury crashes in Ashland were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in average HOI areas.

Figure 10: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Ashland's High-Injury Network in Figure 10 encompasses 6.6 miles of roadway (which is only 5.3 percent of the locality's total roadway mileage). Table 4 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. More than 72 percent of Ashland's KA crashes (and almost 80 percent of KAB crashes) occur on the HIN.

Table 4: High-Injury Network Corridors.

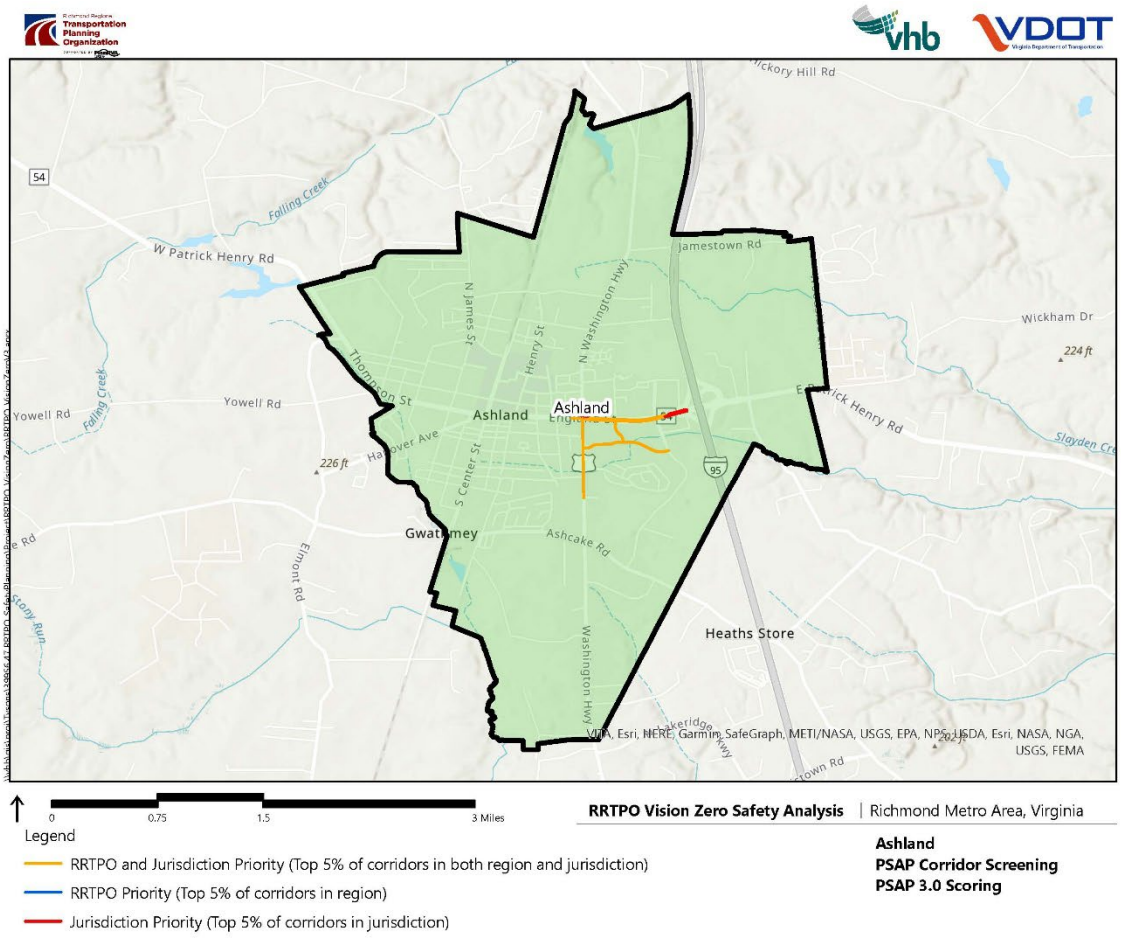
Locality KA Crashes	18
Locality KAB Crashes	206
Locality Roadway Miles	124.6

Corridor	Length	K Crashes	A Crashes	B Crashes	% of Locality KA Crashes	% of Locality KAB Crashes	% of Locality Miles
VA-54 (full length)	3.43	1	8	68	50.0%	37.4%	2.8%
US-1 (full length)	1.72	0	3	63	16.7%	32.0%	1.4%
VA-657 (full length)	1.43	0	1	20	5.6%	10.2%	1.1%
TOTAL	6.58	1	12	151	72.2%	79.6%	5.3%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 11, the PSAP corridors in Ashland are located on England Street (VA-54) and S Washington Highway (US-1). These corridors are mostly prioritized (highest use and risk expected) for Ashland and the Richmond region, with a few corridors in the surrounding area being only a priority for Ashland.

Figure 11: Pedestrian Safety Action Plan Corridors.



Charles City

Key Highlights

Table 5 emphasis area crash proportions shows impaired driving crashes occurring most commonly for crashes involving speed, non-seatbelt use, and roadway departures. Another highlight is the prevalence of speeding and young drivers at intersection crashes.

Table 5: Cross-Tabulation of KAB Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		22%	29%	19%	4%	3%	0%	0%
Speed	67%		59%	45%	40%	41%	0%	0%
Occupant Protection	48%	32%		28%	12%	10%	0%	0%
Roadway Departure	90%	73%	85%		0%	55%	0%	0%
Intersections	5%	16%	9%	0%		28%	100%	0%
Young Drivers	5%	19%	9%	16%	32%		100%	0%
Bicycles	0%	0%	0%	0%	4%	3%		0%
Pedestrians	0%	0%	0%	0%	0%	0%	0%	

An example of how this table is read is that 22% of speeding crashes also involved impaired driving.

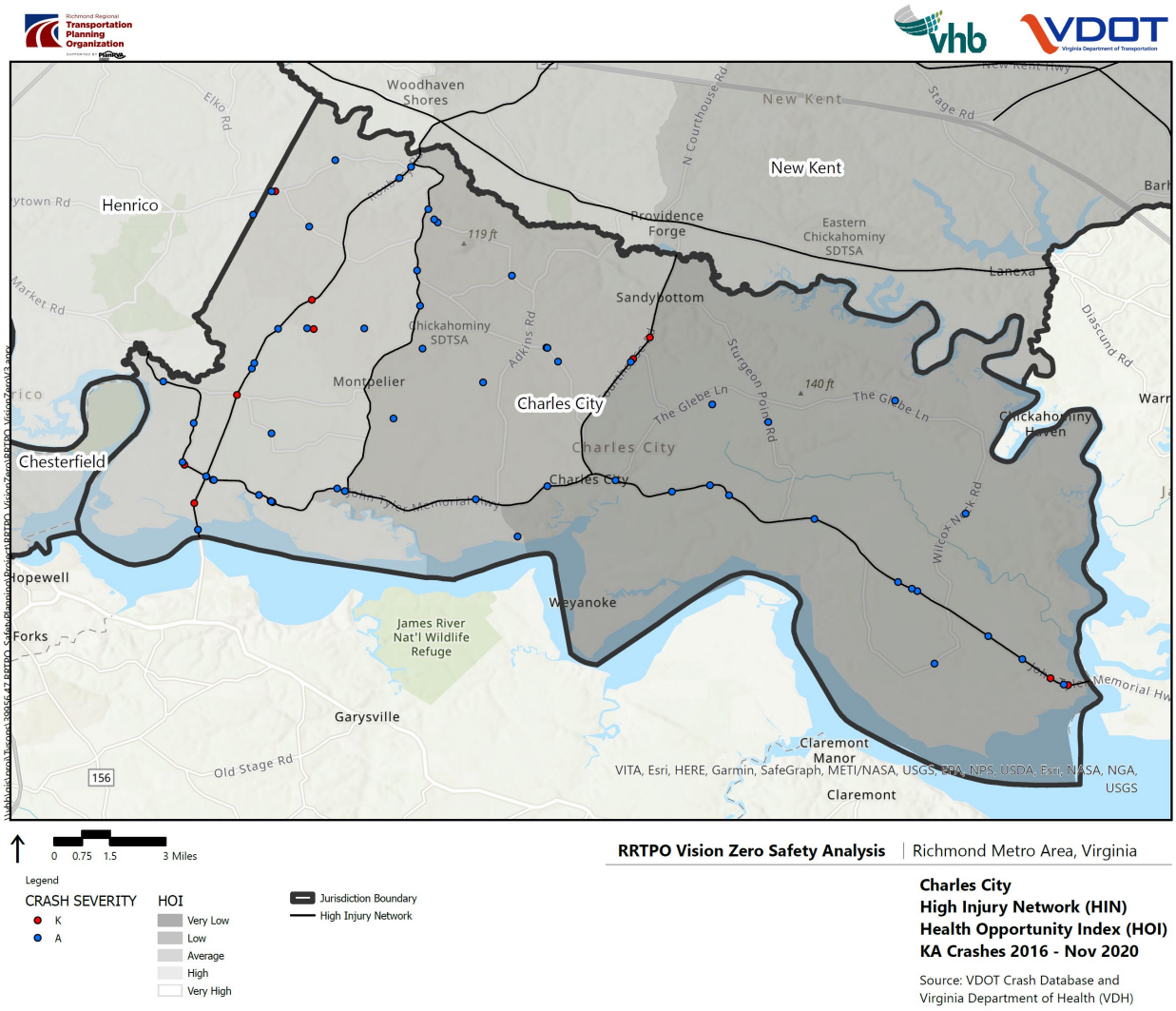
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Roadway Departure Crashes
- Unbelted Crashes
- Speeding Crashes
- Impaired Driver Crashes
- Bicycle Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 12, the fatal and serious injury crashes in Charles City were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in very low and low HOI areas.

Figure 12: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Charles City's High-Injury Network in Figure 12 encompasses 55 miles of roadway (which is only 16 percent of the locality's total mileage). Table 6 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. More than 84 percent of Charles City's KA crashes occur on the HIN.

Table 6: High-Injury Network Corridors.

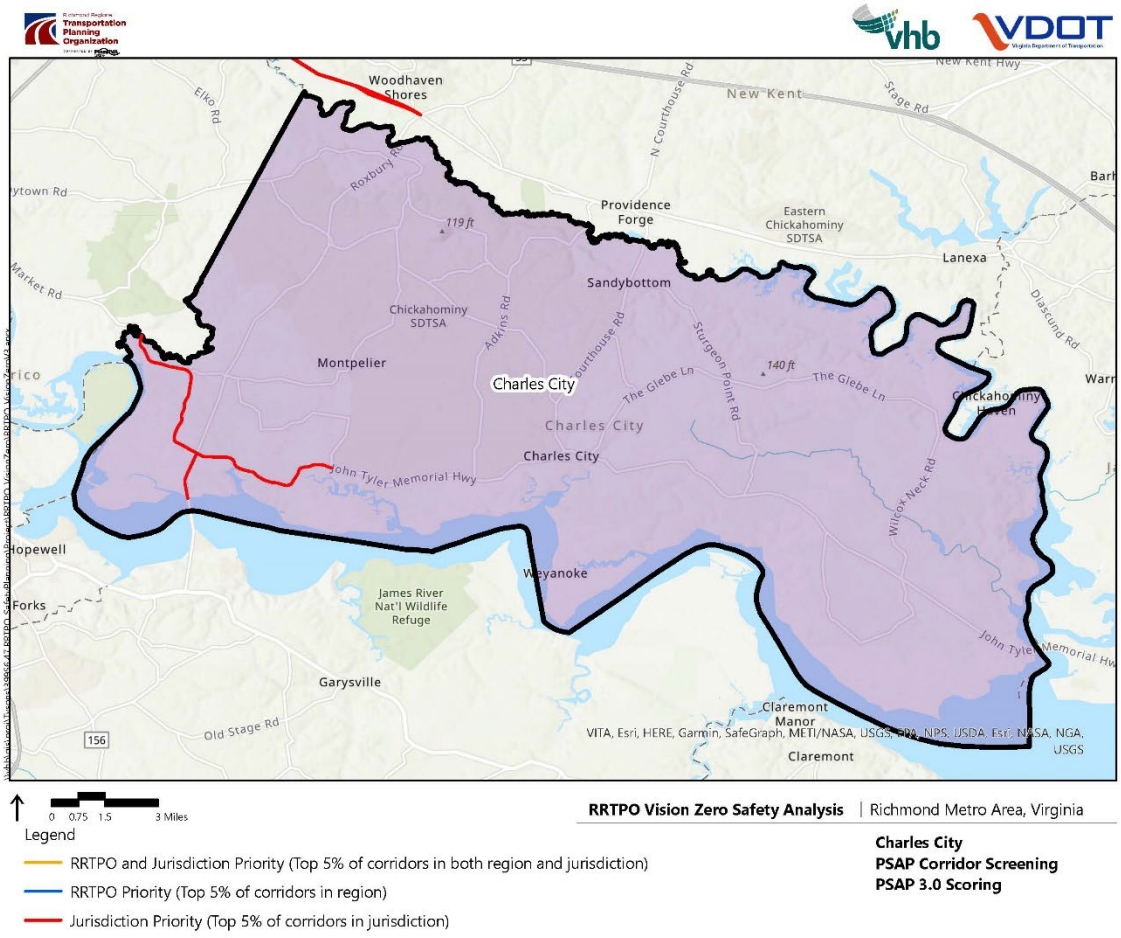
Locality KA Crashes	69
Locality KAB Crashes	151
Locality Roadway Miles	336.2

Corridor	Length	K Crashes	A Crashes	B Crashes	% of Locality KA Crashes	% of Locality KAB Crashes	% of Locality Miles
VA-5 (full length)	26.76	4	26	24	43.5%	35.8%	8.0%
VA-156 (full length)	1.68	2	8	14	14.5%	15.9%	0.5%
VA-106 (full length)	10.26	2	8	14	14.5%	15.9%	3.1%
VA-155 (full length)	6.42	1	4	5	7.2%	6.6%	1.9%
VA-609 (full length)	10.03	0	3	9	4.3%	7.9%	3.0%
TOTAL	55.16	9	49	66	84.1%	82.1%	16.4%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 13, the PSAP corridors in Charles City are located near the western boundary of the jurisdiction. These corridors are mostly only prioritized (highest use and risk expected) for Charles City.

Figure 13: Pedestrian Safety Action Plan Corridors.



Chesterfield

Key Highlights

Table 7: Cross-Tabulation of KA Emphasis Area Crash Factors. emphasis area crash proportions shows roadway departure crashes occurring most commonly for crashes involving impaired driving, speed, and non-seatbelt use. Another highlight is the prevalence of speeding, non-seatbelt use, roadway departure, and intersections for impaired driving crashes. Intersection crashes were the most prevalent factor in impaired driving, speeding, non-belt use, young drivers, bicycles, and pedestrians.

Table 7: Cross-Tabulation of KA Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		35%	34%	33%	19%	14%	0%	38%
Speed	37%		38%	33%	24%	31%	20%	16%
Occupant Protection	35%	36%		36%	21%	25%	0%	6%
Roadway Departure	42%	39%	45%		0%	24%	20%	0%
Intersections	43%	50%	46%	0%		55%	80%	46%
Young Drivers	12%	24%	21%	16%	21%		40%	16%
Bicycles	0%	0%	0%	0%	1%	1%		1%
Pedestrians	15%	6%	2%	0%	8%	8%	20%	

An example of how this table is read is that 35% of speeding crashes also involved impaired driving.

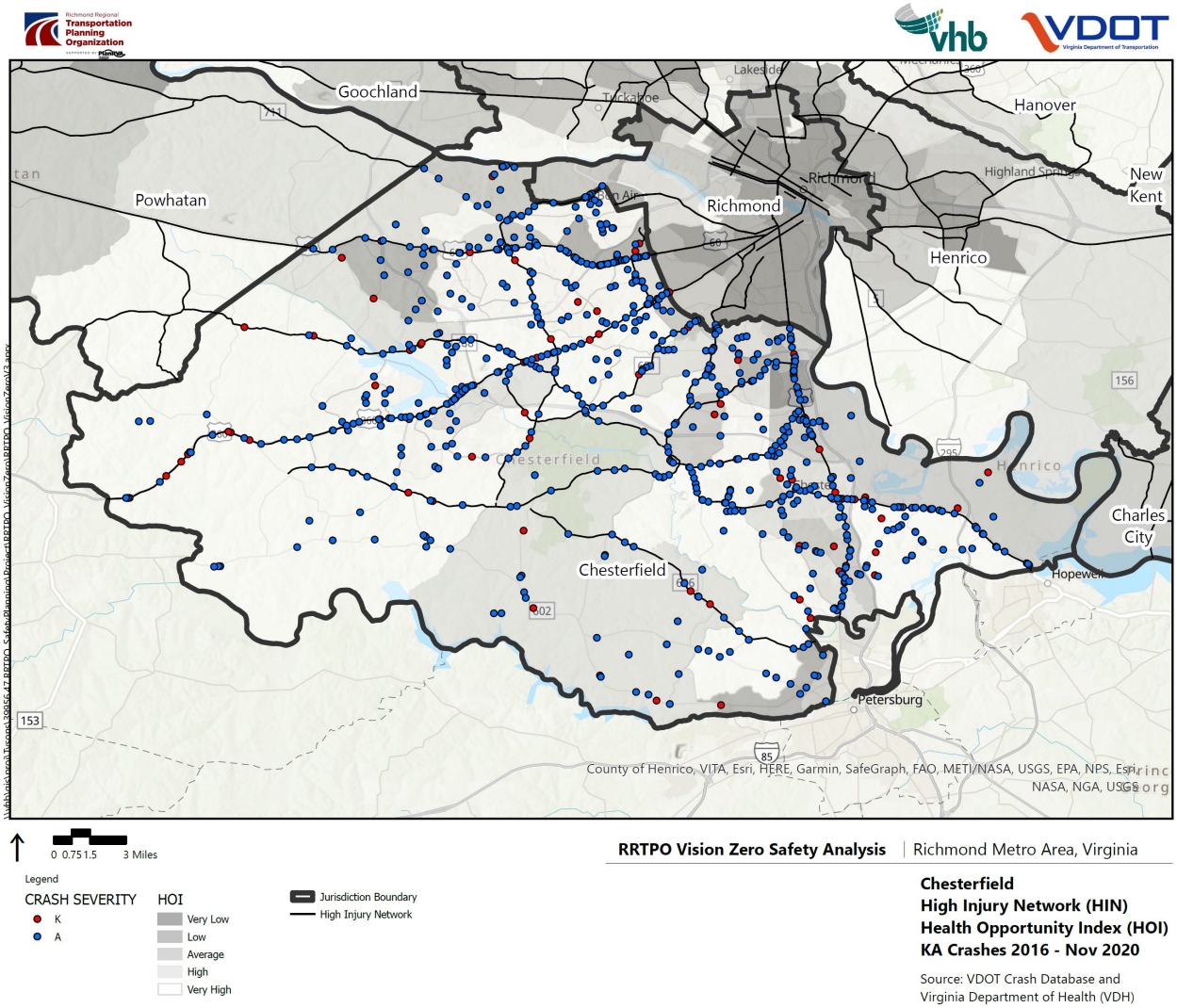
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Bicycle and Pedestrian Crashes
- Speeding Crashes
- Unbelted Crashes
- Intersection Crashes
- Roadway Departure Crashes
- Young Driver Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 14, the fatal and serious injury crashes in Chesterfield were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in very high and high HOI areas.

Figure 14: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Chesterfield's High-Injury Network in Figure 14 encompasses 152 miles of roadway (which is only 6.6 percent of the localities total mileage). Table 8 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Nearly 60 percent of Chesterfield's KA crashes occur on the HIN.

Table 8: High-Injury Network Corridors.

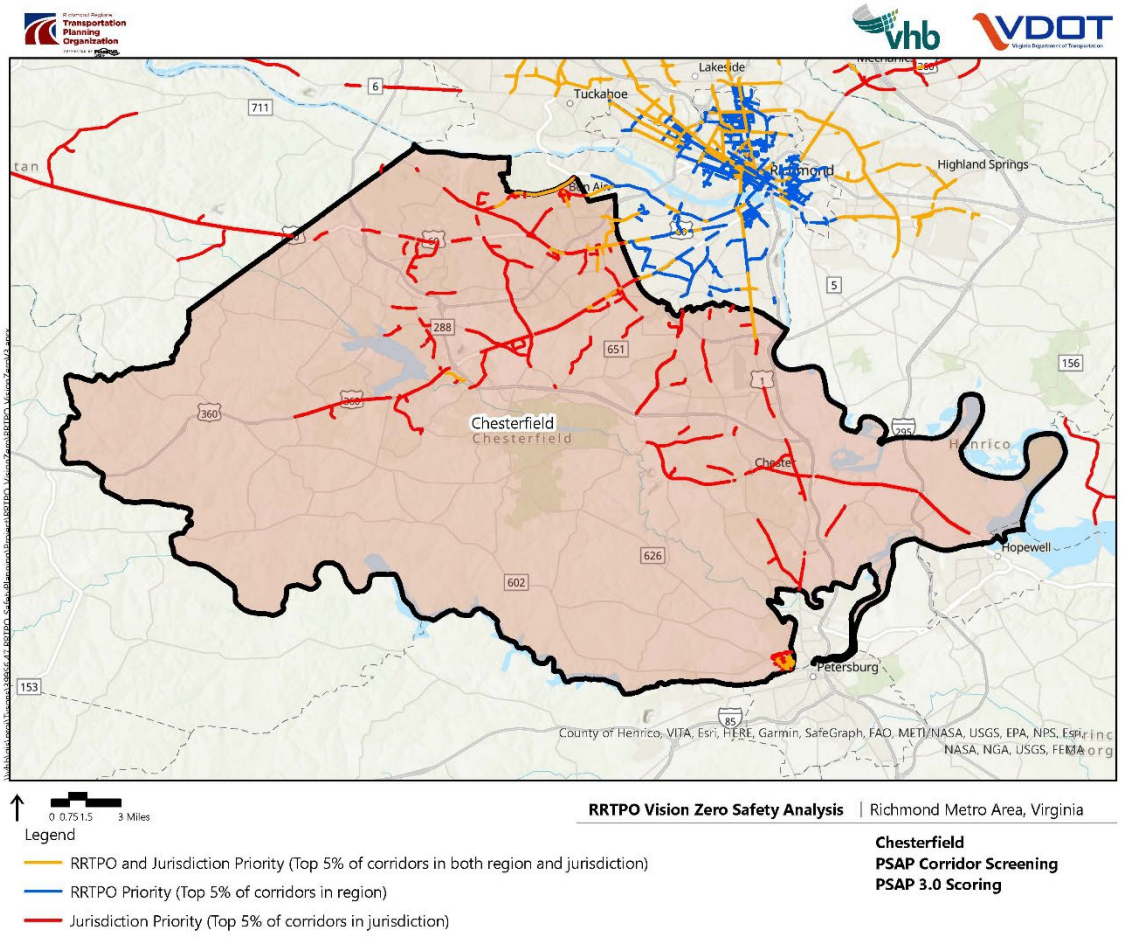
Locality KA Crashes	842
Locality KAB Crashes	5621
Locality Roadway Miles	2300.8

Corridor	**Length**	**K Crashes**	**A Crashes**	**% of Locality KA Crashes**	**% of Locality Miles**
US-1/301 (full length)	12.55	8	61	8.2%	0.5%
US-360 (full length)	21.70	17	75	10.9%	0.9%
US-60 (full length)	12.20	5	48	6.3%	0.5%
VA-10 (full length)	20.59	11	83	11.2%	0.9%
VA-145 (full length)	5.13	1	25	3.1%	0.2%
VA-147 (full length)	4.99	1	15	1.9%	0.2%
VA-604 (full length)	17.72	4	24	3.3%	0.8%
VA-655 (full length)	15.06	3	17	2.4%	0.7%
VA-626 (full length)	12.07	2	9	1.3%	0.5%
VA 641 Beulah Rd (full length)	4.42	2	10	1.4%	0.2%
Boulders Pkwy (full length)	1.41	1	1	0.2%	0.1%
Turner Rd (between US-60 and US-360)	1.98	0	6	0.7%	0.1%
VA-651 (full length)	10.64	4	20	2.9%	0.5%
VA-653 (between VA-655 and US-60)	11.37	4	25	3.4%	0.5%
TOTAL	151.83	63	419	57.2%	6.6%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 15, the PSAP corridors in Chesterfield are located near the northern boundary of the jurisdiction, around Richmond. These corridors are mostly only prioritized (highest use and risk expected) for Chesterfield, with a few corridors also being a priority for the Richmond region or connecting with those identified for Richmond.

Figure 15: Pedestrian Safety Action Plan Corridors.



Goochland

Key Highlights

Table 9 emphasis area crash proportions shows roadway departure crashes occurring most commonly for crashes involving impaired driving, speed, and non-seatbelt use.

Table 9: Cross-Tabulation of KAB Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		27%	25%	21%	10%	9%	0%	20%
Speed	23%		10%	15%	8%	19%	0%	0%
Occupant Protection	33%	16%		21%	17%	19%	0%	0%
Roadway Departure	69%	58%	55%		0%	40%	0%	0%
Intersections	31%	29%	40%	0%		50%	100%	40%
Young Drivers	13%	33%	22%	18%	25%		0%	20%
Bicycles	0%	0%	0%	0%	1%	0%		0%
Pedestrians	2%	0%	0%	0%	1%	1%	0%	

An example of how this table is read is that 27% of speeding crashes also involved impaired driving.

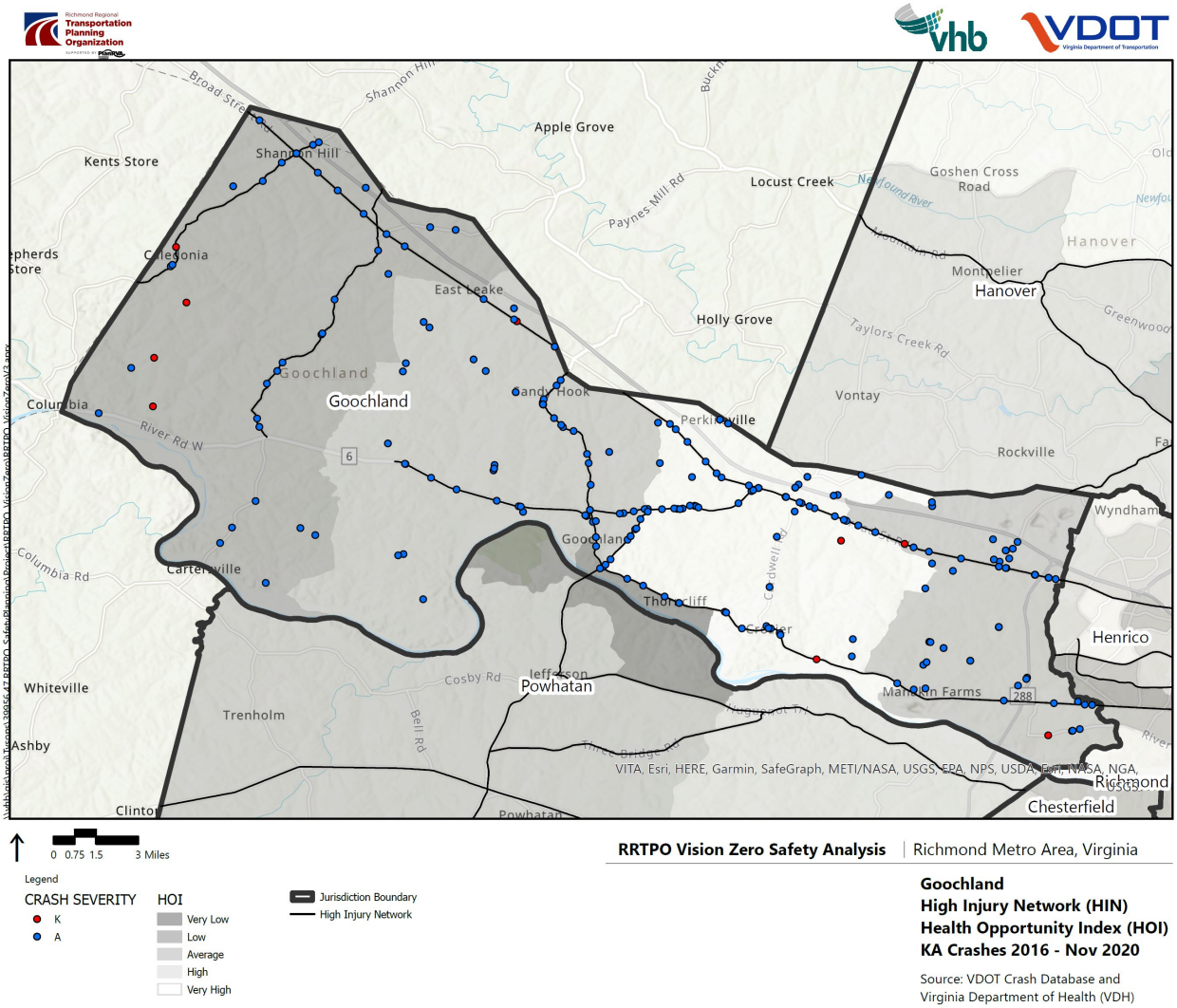
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Impaired Driver Crashes
- Unbelted Crashes
- Roadway Departure Crashes
- Young Driver Crashes
- Speeding Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 16, the fatal and serious injury crashes in Goochland were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are dispersed in very low to average HOI areas.

Figure 16: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Goochland's High-Injury Network in Figure 16 encompasses 82 miles of roadway (which is only 12.5 percent of the localities total mileage). Table 10 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Over 66 percent of Goochland's KA crashes occur on the HIN.

Table 10: High-Injury Network Corridors.

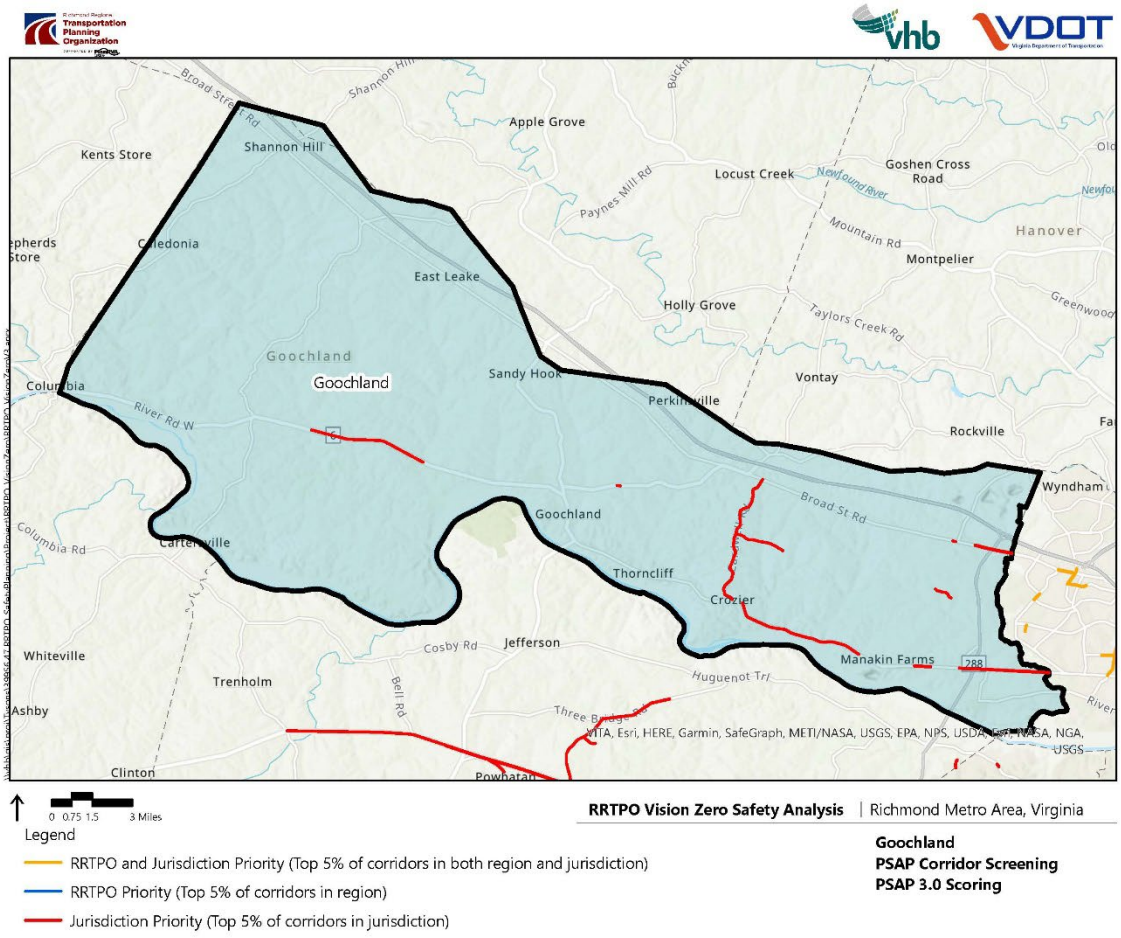
Locality KA Crashes	233
Locality KAB Crashes	380
Locality Roadway Miles	661.1

Corridor	Length	K Crashes	A Crashes	B Crashes	% of Locality KA Crashes	% of Locality KAB Crashes	% of Locality Miles
US-522 (full length)	8.35	0	21	9	9.0%	7.9%	1.3%
US-250 (full length)	26.48	4	52	47	24.0%	27.1%	4.0%
VA-632 (full length)	5.14	1	22	10	9.9%	8.7%	0.8%
VA-634 (between VA-6 & VA 632)	2.45	0	11	3	4.7%	3.7%	0.4%
VA-6 (east of VA-615)	21.73	1	25	16	11.2%	11.1%	3.3%
VA-605 (full length)	7.64	0	8	2	3.4%	2.6%	1.2%
VA-606 (full length)	10.54	0	9	1	3.9%	2.6%	1.6%
TOTAL	82.33	6	148	88	66.1%	63.7%	12.5%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 17, the PSAP corridors in Goochland are primarily located along River Road W (VA-6) and Sandy Hook Road (US-522). These corridors are only prioritized (highest use and risk expected) for Goochland.

Figure 17: Pedestrian Safety Action Plan Corridors.



Hanover

Key Highlights

Table 11 emphasis area crash proportions shows roadway departure crashes occurring most commonly for crashes involving impaired driving, speed, and non-seatbelt use. Another highlight is the prevalence of young drivers, bicyclists, and pedestrian crashes at intersection crashes.

Table 11: Cross-Tabulation of KA Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		26%	32%	25%	16%	12%	17%	24%
Speed	25%		30%	18%	17%	23%	33%	12%
Occupant Protection	45%	45%		33%	24%	29%	0%	6%
Roadway Departure	63%	47%	59%		0%	36%	17%	0%
Intersections	32%	35%	35%	0%		52%	50%	65%
Young Drivers	14%	29%	24%	17%	30%		33%	29%
Bicycles	2%	3%	1%	1%	2%	3%		0%
Pedestrians	6%	3%	0%	0%	8%	6%	0%	

An example of how this table is read is that 26% of speeding crashes also involved impaired driving.

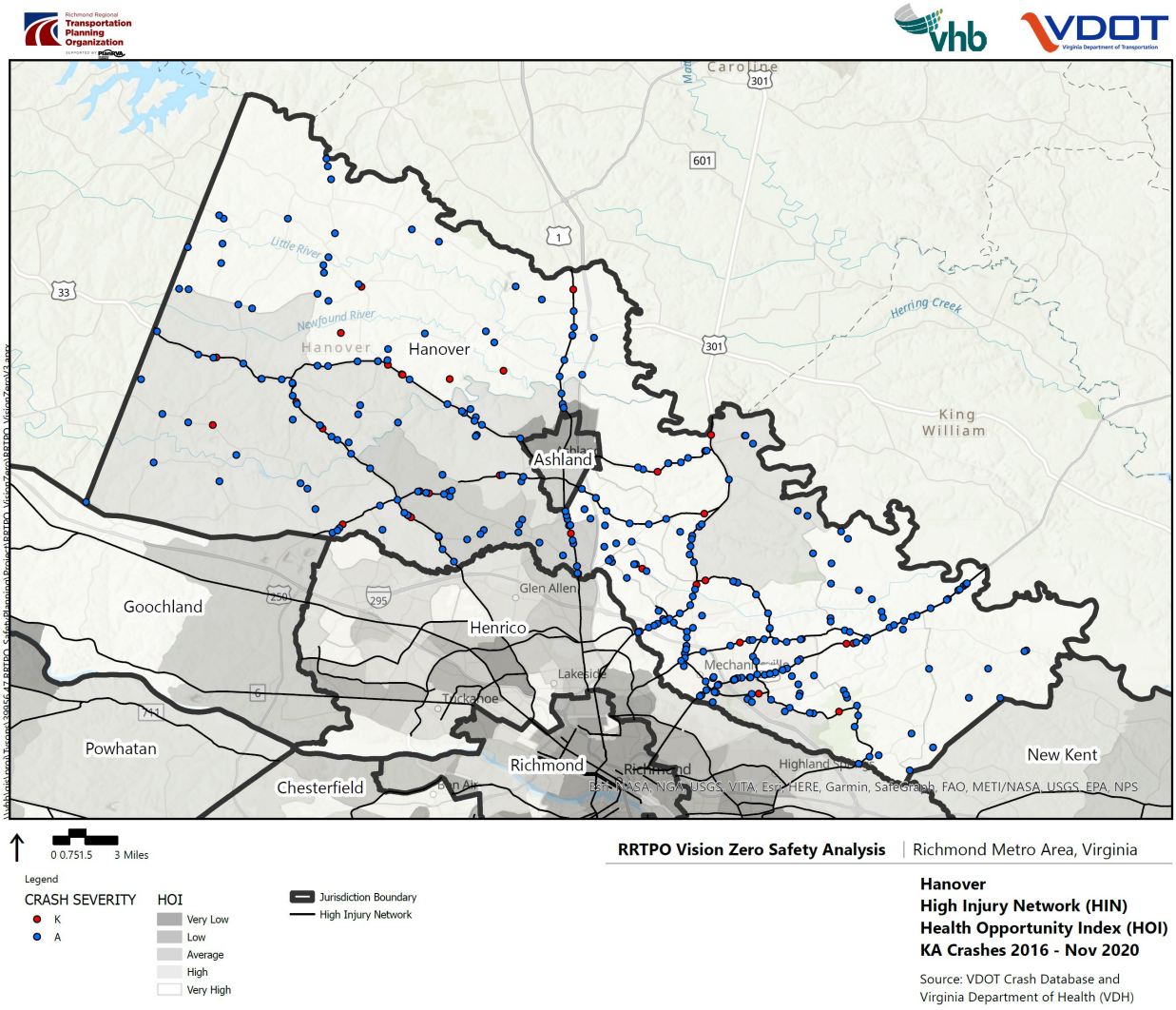
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Unbelted Crashes
- Roadway Departure Crashes
- Young Driver Crashes
- Pedestrian and Bicycle Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 18, the fatal and serious injury crashes in Hanover were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in very high and high HOI areas.

Figure 18: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Hanover's High-Injury Network in Figure 18 encompasses 113 miles of roadway (which is only 8.3 percent of the locality's total mileage). Table 12 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Nearly 59% of Hanover's KA crashes occur on the HIN.

Table 12: High-Injury Network Corridors.

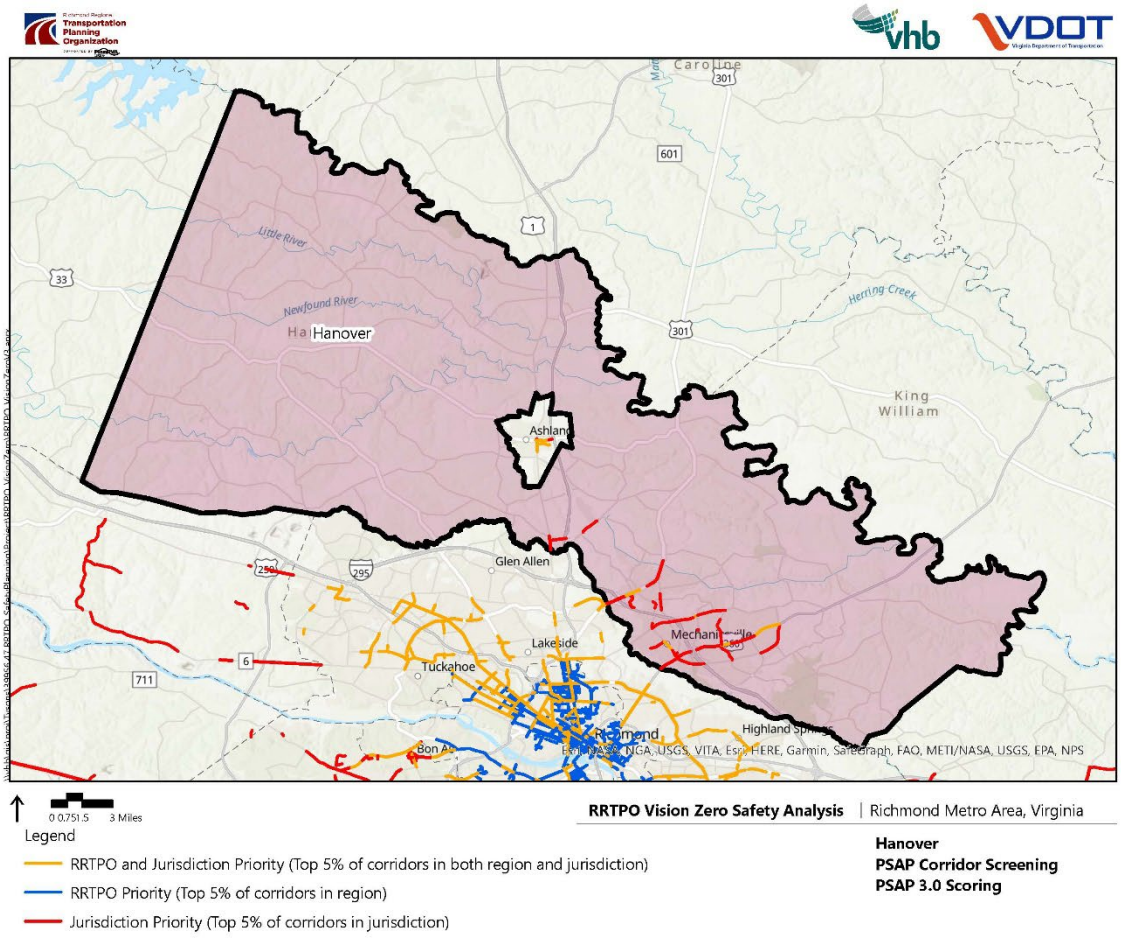
Locality KA Crashes	349
Locality KAB Crashes	1,620
Locality Roadway Miles	1,363.3

Corridor	**Length**	**K Crashes**	**A Crashes**	**% of Locality KA Crashes**	**% of Locality Miles**
US-1 (full length)	10.23	4	17	6.0%	0.8%
VA-54 (full length)	15.14	5	20	7.2%	1.1%
US-33 (full length)	17.46	6	23	8.3%	1.3%
US-301 (full length)	11.93	2	18	5.7%	0.9%
VA-638 (full length)	4.74	0	7	2.0%	0.3%
US-360 (full length)	12.92	7	33	11.5%	0.9%
VA-627 (full length)	8.72	2	12	4.0%	0.6%
VA-657 (east of VA-666)	9.52	2	10	3.4%	0.7%
VA-623 (west of VA-666)	5.63	3	8	3.2%	0.4%
VA-643 (east of US-301)	7.46	1	12	3.7%	0.5%
VA-156 (full length)	9.82	2	10	3.4%	0.7%
TOTAL	113.56	34	170	58.5%	8.3%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 19, the PSAP corridors in Hanover are located near the south eastern boundary of the jurisdiction, around Mechanicsville. These corridors are mostly only prioritized (highest use and risk expected) for Hanover, with a few corridors also being a priority for the Richmond region or connecting with those identified for Henrico County.

Figure 19: Pedestrian Safety Action Plan Corridors.



Henrico

Key Highlights

Table 13 emphasis area crash proportions shows roadway departure crashes occurring most commonly for crashes involving impaired driving, speed, and non-seatbelt use. Another highlight is the prevalence of impaired driving, roadway departure, and intersection crashes in non-belted crashes.

Table 13: Cross-Tabulation of KA Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		19%	28%	33%	14%	16%	8%	33%
Speed	9%		13%	16%	9%	9%	8%	3%
Occupant Protection	24%	23%		31%	17%	13%	0%	1%
Roadway Departure	42%	42%	46%		7%	19%	0%	0%
Intersections	30%	39%	44%	12%		45%	46%	33%
Young Drivers	10%	12%	10%	10%	13%		23%	14%
Bicycles	1%	3%	0%	0%	4%	6%		0%
Pedestrians	28%	6%	1%	0%	13%	19%	0%	

An example of how this table is read is that 19% of speeding crashes also involved impaired driving.

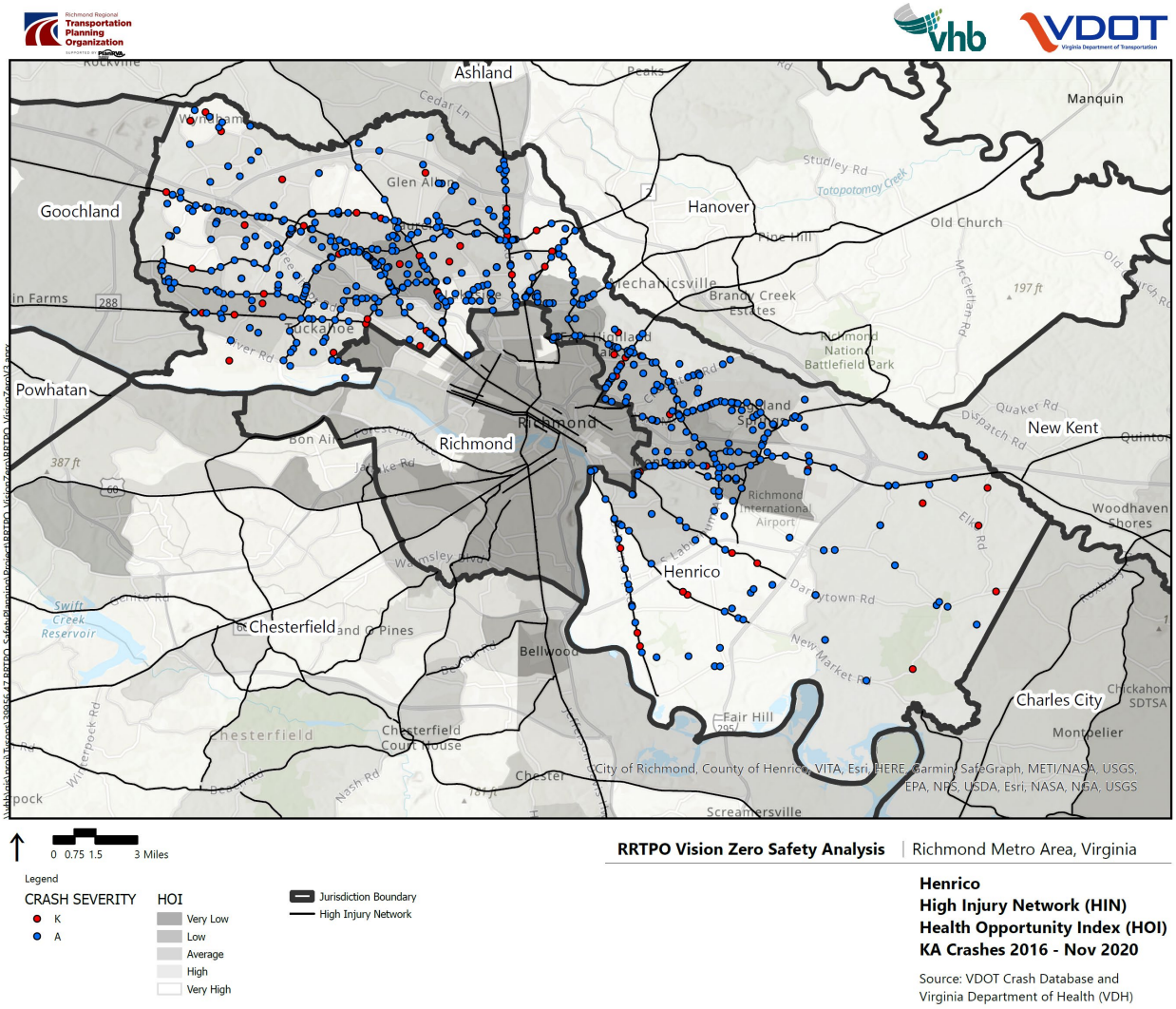
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Unbelted Crashes
- Roadway Departure
- Young Driver
- Bicycle Crashes
- Pedestrian Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 20, the fatal and serious injury crashes in Henrico were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in high and average HOI areas.

Figure 20: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Henrico's High-Injury Network in Figure 20 encompasses 131 miles of roadway (which is only 6.4 percent of the localities total mileage) of roadway. Table 14 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Nearly 63% of Henrico's KA crashes occur on the HIN.

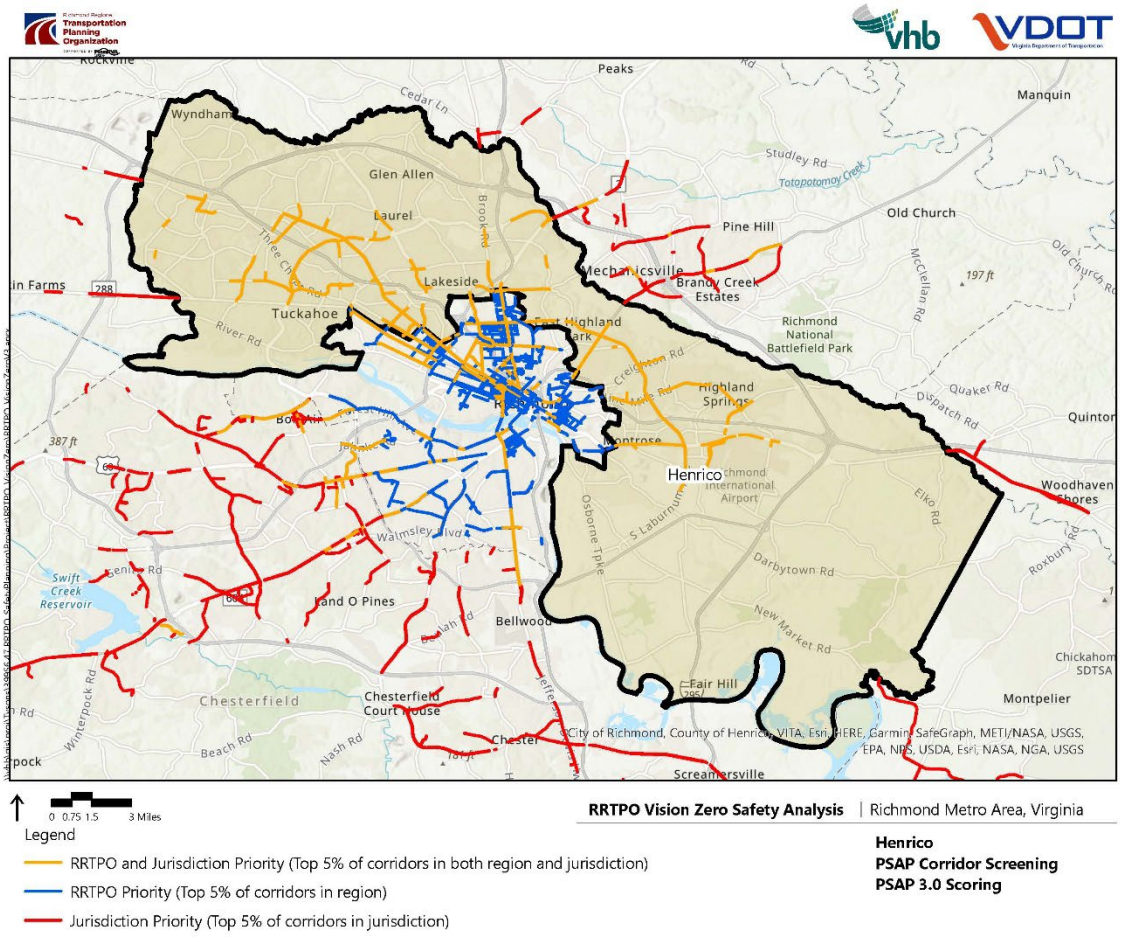
Table 14: *High-Injury Network Corridors.*

Locality KA Crashes	717				
Locality KAB Crashes	6010				
Locality Roadway Miles	2045.0				
Corridor	**Length**	**K Crashes**	**A Crashes**	**% of Locality KA Crashes**	**% of Locality Miles**
US-1 (full length)	5.44	4	18	3.1%	0.3%
US-250 (full length)	10.64	10	54	8.9%	0.5%
US-360 (full length)	2.95	4	19	3.2%	0.1%
US-60 (full length)	10.29	1	27	3.9%	0.5%
VA-5 (west of I-295)	7.52	2	10	1.7%	0.4%
Osborne Turnpike (full length)	6.48	3	9	1.7%	0.3%
VA-33 (Staples Mill Rd) (full length)	8.00	5	24	4.0%	0.4%
VA-33 (Nine Mile Rd) (City Limits to Airport Dr)	4.84	5	17	3.1%	0.2%
VA-6 (full length)	5.16	3	11	2.0%	0.3%
Hungary Rd (full length)	5.86	2	13	2.1%	0.3%
Darbytown Road (west of I-295)	5.93	2	5	1.0%	0.3%
Airport Dr/VA-156 (from VA-895 to border)	7.61	0	13	1.8%	0.4%
Audubon Dr (full length)	1.40	1	5	0.8%	0.1%
Eubank Rd (full length)	1.48	3	4	1.0%	0.1%
Laburnum Ave (City limits to Charles City Rd)	8.35	2	37	5.4%	0.4%
US-301 (full length)	3.19	2	11	1.8%	0.2%
Richmond-Henrico Turnpike/VA 627 (full length)	2.67	0	6	0.8%	0.1%
Parham Rd (full length)	12.17	4	43	6.6%	0.6%
Wilkinson Road (full length)	3.36	1	8	1.3%	0.2%
Glenside Drive (full length)	2.57	3	11	2.0%	0.1%
Forest Ave (full length)	2.70	0	13	1.8%	0.1%
Quioccasin Rd / Gayton Rd (full length)	5.83	1	15	2.2%	0.3%
Ridgefield Parkway (full length)	3.83	1	6	1.0%	0.2%
Gaskins Rd (north of Ridgefield Pkwy)	2.45	3	9	1.7%	0.1%
TOTAL	130.71	62	388	62.8%	6.4%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 21, the PSAP corridors in Henrico are located around Richmond. These corridors are only prioritized (highest use and risk expected) for both Henrico and the Richmond region connecting with those identified for Richmond.

Figure 21: Pedestrian Safety Action Plan Corridors.



New Kent

Key Highlights

*Table 15*5 emphasis area crash proportions shows the prevalence of impaired driving, speeding, occupant protection, and young drivers at roadway departure crashes. Another highlight is the issue of speeding and young driver crashes at intersections.

Table 15: Cross-Tabulation of KAB Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		20%	32%	25%	9%	12%	25%	13%
Speed	43%		46%	42%	23%	40%	0%	25%
Occupant Protection	37%	25%		23%	14%	21%	0%	13%
Roadway Departure	69%	56%	56%		0%	50%	0%	0%
Intersections	14%	17%	19%	0%		24%	0%	38%
Young Drivers	18%	30%	28%	28%	24%		25%	50%
Bicycles	2%	0%	0%	0%	0%	1%		0%
Pedestrians	2%	2%	2%	0%	4%	5%	0%	

An example of how this table is read is that 20% of speeding crashes also involved impaired driving.

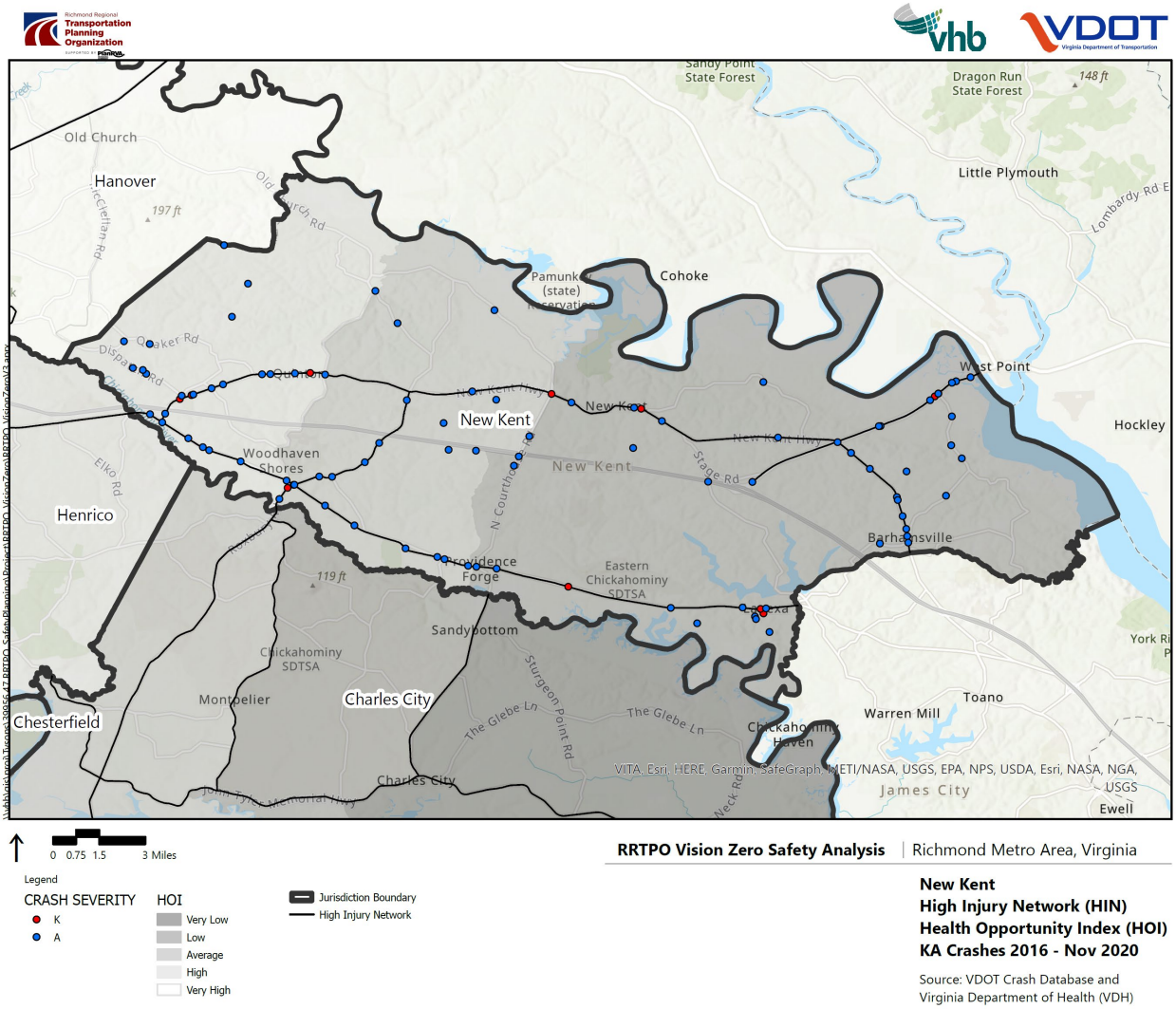
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Impaired Driver Crashes
- Speeding Crashes
- Roadway Departure Crashes
- Young Driver Crashes
- Intersection Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 22, the fatal and serious injury crashes in New Kent were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in low, average, and high HOI areas.

Figure 22: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

New Kent's High-Injury Network in Figure 22 encompasses 55 miles of roadway (which is only 11.2 percent of the localities total mileage). Table 16 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. 66% of New Kent's KA crashes occur on the HIN.

Table 16: High-Injury Network Corridors.

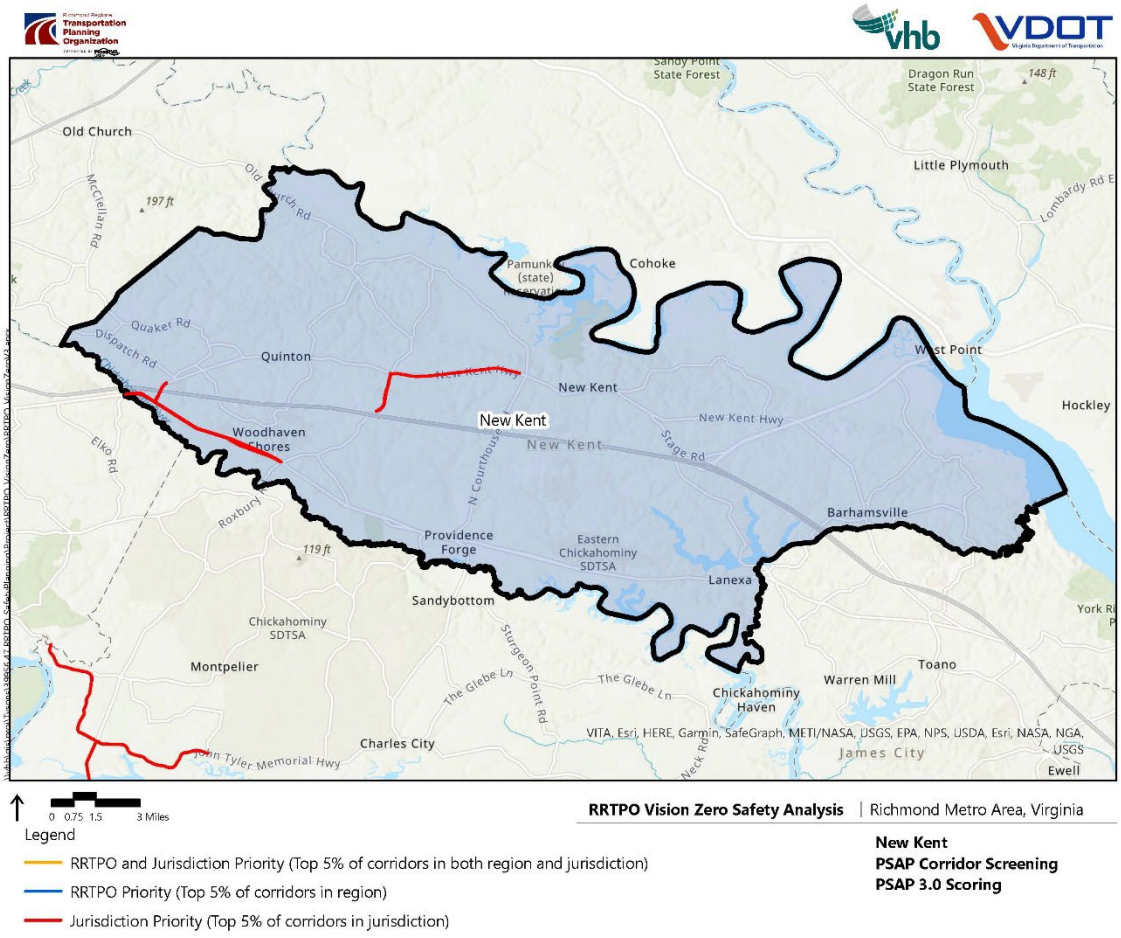
Locality KA Crashes	100
Locality KAB Crashes	302
Locality Roadway Miles	488.9

Corridor	Length	K Crashes	A Crashes	B Crashes	% of Locality KA Crashes	% of Locality KAB Crashes	% of Locality Miles
US-60 (full length)	18.99	2	17	43	19.0%	20.5%	3.9%
VA-249 (full length)	18.74	5	13	32	18.0%	16.6%	3.8%
VA-33 (full length)	2.85	0	1	14	1.0%	5.0%	0.6%
VA-609 (south of VA-106)	5.66	1	8	14	9.0%	7.6%	1.2%
VA-30 (full length)	8.58	2	17	37	19.0%	18.5%	1.8%
TOTAL	54.83	10	56	140	66.0%	68.2%	11.2%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 23, the PSAP corridors in New Kent are primarily located along New Kent Highway (VA-249), Emmaus Church Road (VA-609), and Pocahontas Trail (US-60). These corridors are only prioritized (highest use and risk expected) for New Kent.

Figure 23: Pedestrian Safety Action Plan Corridors.



Powhatan

Key Highlights

Table 17 emphasis area crash proportions shows roadway departure crashes occurring most commonly for crashes involving impaired driving, speed, young drivers, and non-seatbelt use. Another highlight is the prevalence of speeding, roadway departure, and intersections in young driver crashes.

Table 17: Cross-Tabulation of KAB Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		16%	24%	20%	10%	7%	0%	0%
Speed	38%		39%	40%	25%	33%	100%	13%
Occupant Protection	32%	22%		22%	15%	15%	0%	0%
Roadway Departure	66%	54%	54%		0%	40%	0%	0%
Intersections	25%	25%	28%	0%		37%	0%	25%
Young Drivers	14%	29%	23%	25%	32%		0%	0%
Bicycles	0%	1%	0%	0%	0%	0%		0%
Pedestrians	0%	1%	0%	0%	1%	0%	0%	

An example of how this table is read is that 16% of speeding crashes also involved impaired driving.

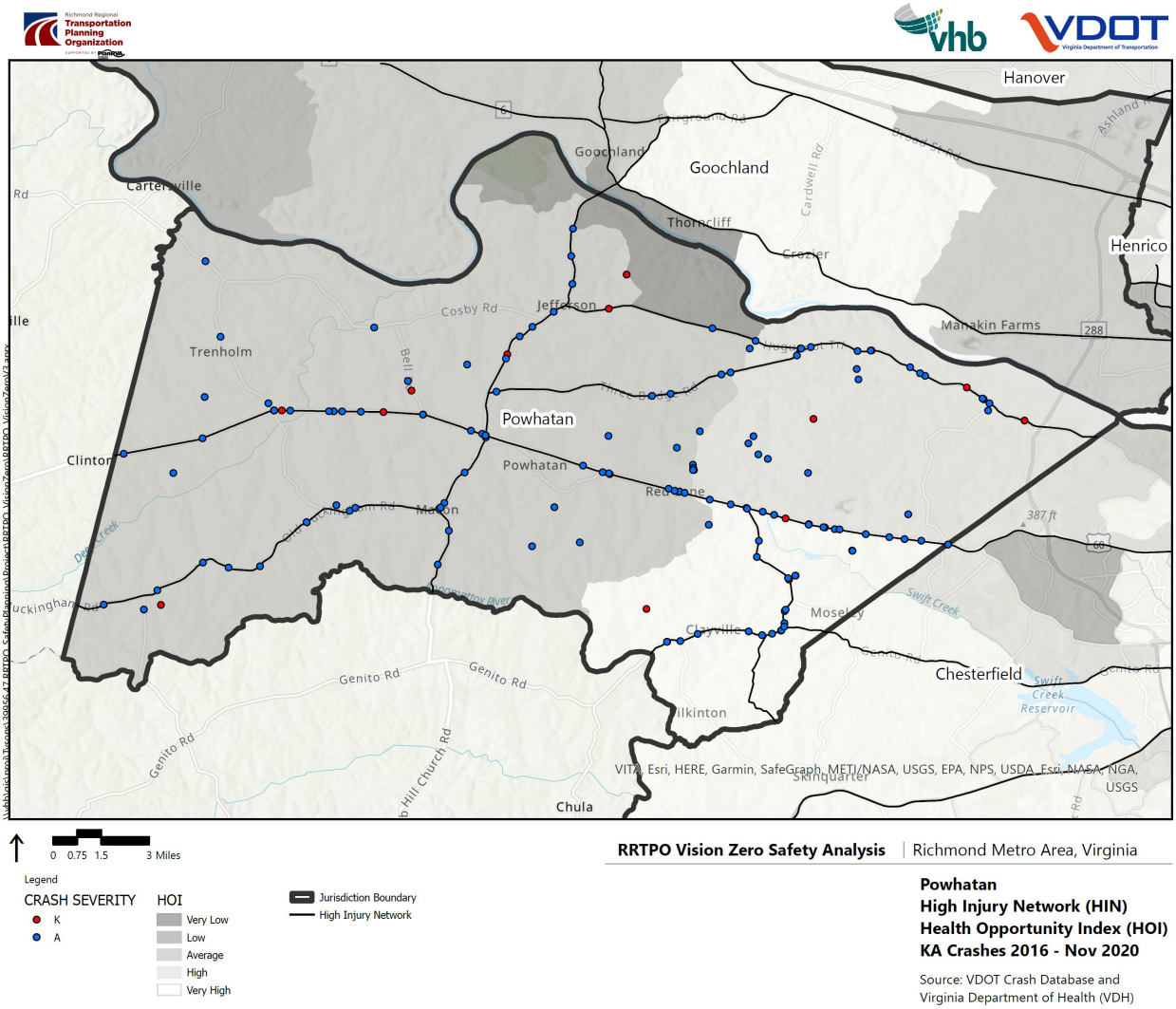
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Impaired Driver Crashes
- Speeding Crashes
- Young Driver Crashes
- Roadway Departure Crashes
- Intersection Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 24, the fatal and serious injury crashes in Powhatan were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in high and average HOI areas.

Figure 24: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Powhatan's High-Injury Network in Figure 24 encompasses 81 miles of roadway (which is only 15.8 percent of the localities total mileage). Table 18 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Nearly 70% of Powhatan's KA crashes occur on the HIN.

Table 18: High-Injury Network Corridors.

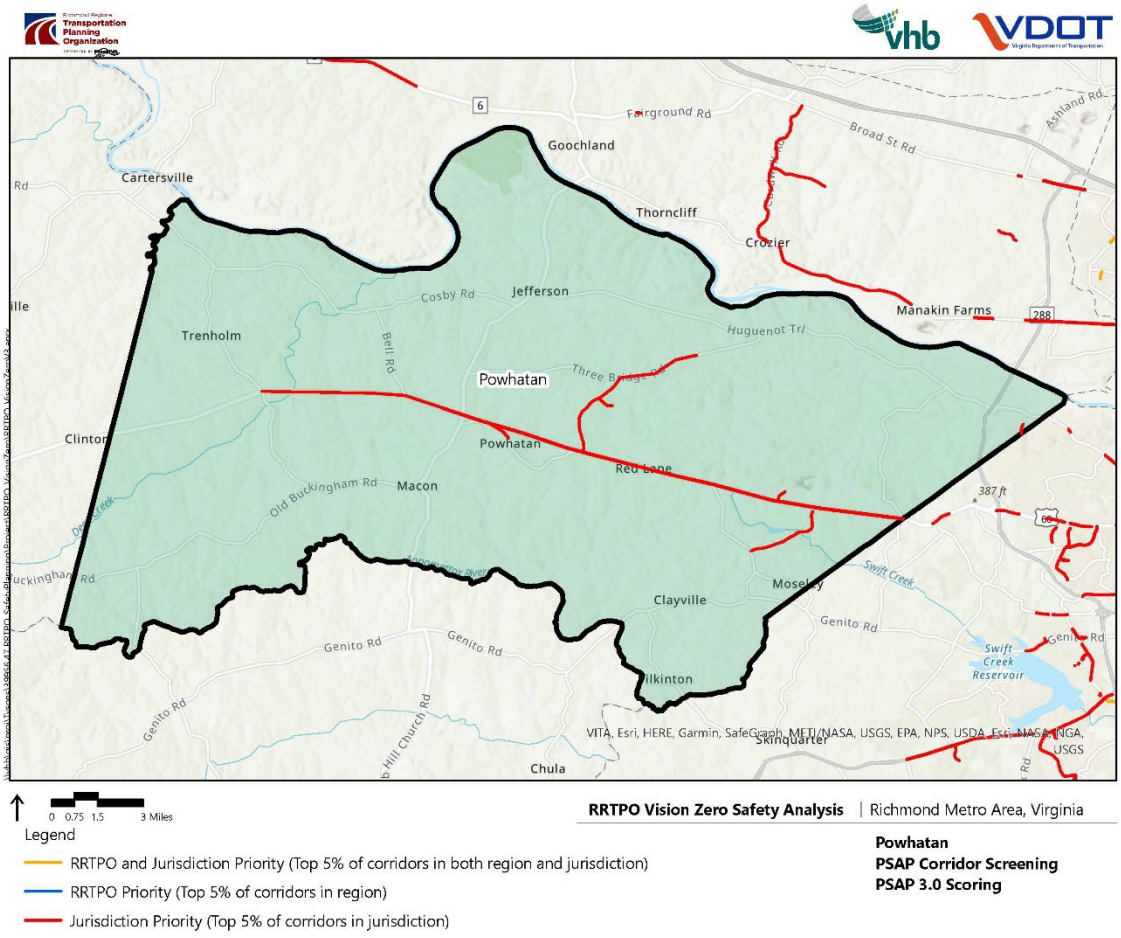
Locality KA Crashes	151
Locality KAB Crashes	485
Locality Roadway Miles	512.8

Corridor	Length	K Crashes	A Crashes	B Crashes	% of Locality KA Crashes	% of Locality KAB Crashes	% of Locality Miles
US-60 (full length)	21.57	4	27	69	20.5%	20.6%	4.2%
VA-13 (west of 1002)	12.88	0	12	23	7.9%	7.2%	2.5%
VA-1002 (full length)	0.33	0	3	2	2.0%	1.0%	0.1%
VA-615 (east of US-522)	8.31	0	8	12	5.3%	4.1%	1.6%
US-522 (full length)	8.60	1	9	24	6.6%	7.0%	1.7%
VA-609 (full length)	2.77	0	3	8	2.0%	2.3%	0.5%
VA-711 (full length)	14.45	4	15	43	12.6%	12.8%	2.8%
VA-604 (full length)	4.76	0	9	19	6.0%	5.8%	0.9%
VA-622 (full length)	7.40	1	9	17	6.6%	5.6%	1.4%
TOTAL	81.07	10	95	217	69.5%	66.4%	15.8%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 25, the PSAP corridors in Powhatan are primarily located along Anderson Highway (US-60), Academy Road (VA-603), Three Bridge Road (VA-615). These corridors are only prioritized (highest use and risk expected) for Powhatan.

Figure 25: Pedestrian Safety Action Plan Corridors.



Richmond

Key Highlights

*Table 19*9 emphasis area crash proportions shows intersections crashes occurring most commonly for crashes involving impaired driving, speed, non-seatbelt use, young drivers, bicycles, and pedestrians.

Table 19: Cross-Tabulation of KA Emphasis Area Crash Factors.

	Impaired Driving	Speed	Occupant Protection	Roadway Departure	Intersections	Young Drivers	Bicycles	Pedestrians
Impaired Driving		21%	24%	22%	15%	12%	12%	31%
Speed	16%		17%	14%	13%	15%	5%	6%
Occupant Protection	26%	24%		35%	17%	20%	5%	8%
Roadway Departure	26%	22%	39%		7%	13%	7%	0%
Intersections	56%	67%	61%	21%		64%	70%	61%
Young Drivers	8%	13%	12%	7%	11%		14%	14%
Bicycles	4%	2%	1%	2%	6%	7%		0%
Pedestrians	39%	10%	9%	0%	20%	27%	0%	

An example of how this table is read is that 21% of speeding crashes also involved impaired driving.

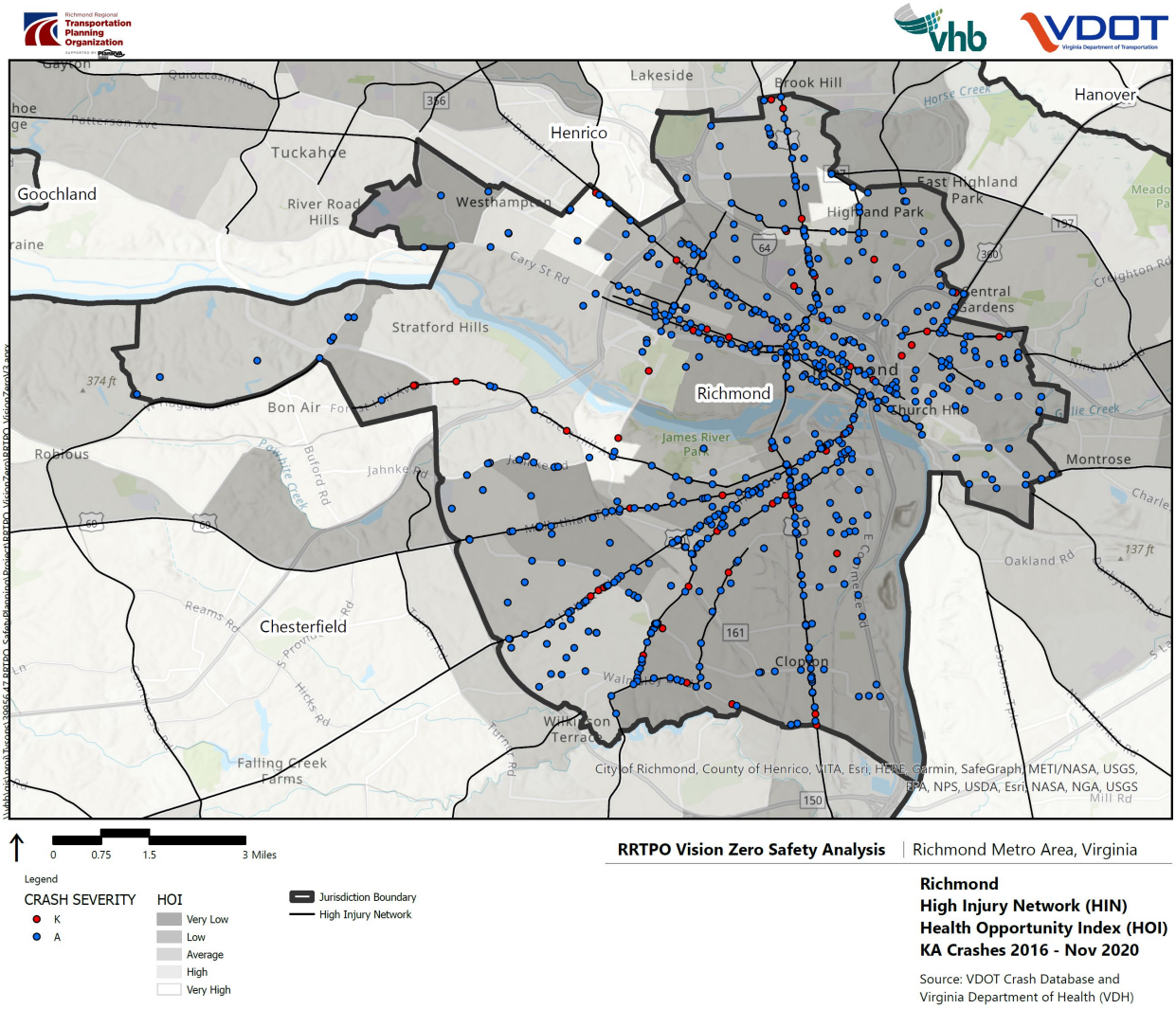
Based on the data analysis, the following key crash factors represent the most potential for safety improvement, considering any overlapping, and may require special consideration for the locality:

- Intersection Crashes
- Bicycle and Pedestrian Crashes
- Speeding Crashes

High Injury Network and Health Opportunity Index

As shown in Figure 26, the fatal and serious injury crashes in Richmond were sufficient to identify and closely align with the High-Injury Network (HIN). The remaining fatal and serious injury crashes are generally located in very low and low HOI areas.

Figure 26: High-Injury Network and Health Opportunity Index Areas.



High-Injury Network Corridors

Richmond's High-Injury Network in Figure 26 encompasses 59 miles of roadway (which is only 5.3 percent of the localities total mileage). Table 20 lists the corridors comprising the HIN and provides statistics on the crashes that occur on these corridors. Nearly 67% of Richmond's KA crashes occur on the HIN.

Table 20: High-Injury Network Corridors.

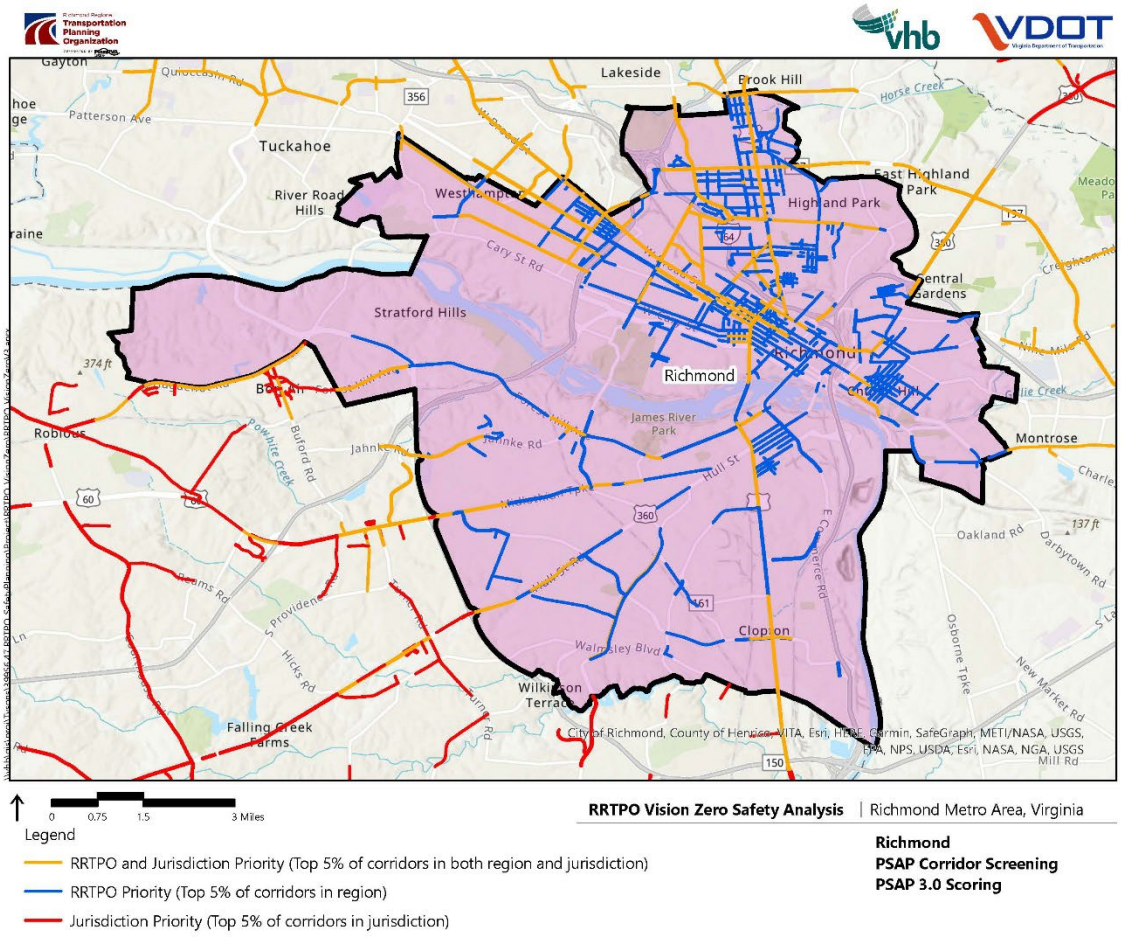
Locality KA Crashes	745				
Locality KAB Crashes	5948				
Locality Roadway Miles	1108.3				
Corridor	**Length**	**K Crashes**	**A Crashes**	**% of Locality KA Crashes**	**% of Locality Miles**
Bainbridge St	0.83	0	2	0.3%	0.1%
Belt Blvd	0.29	0	2	0.3%	0.0%
Broad Rock Blvd	2.42	5	17	3.0%	0.2%
Brookland Pkwy	0.83	0	1	0.1%	0.1%
Chamberlayne Ave	3.28	4	19	3.1%	0.3%
Cowardin Ave	0.66	0	6	0.8%	0.1%
E Broad Rock Road	0.82	4	18	3.0%	0.1%
E Broad St	1.35	2	20	3.0%	0.1%
E Byrd St	0.42	0	7	0.9%	0.0%
E Cary St	0.88	0	3	0.4%	0.1%
E Jackson St	0.31	0	8	1.1%	0.0%
E Main St	1.90	0	26	3.5%	0.2%
Ellwood Ave	0.76	0	7	0.9%	0.1%
Fairfield Ave	1.06	1	6	0.9%	0.1%
Fairfield Way	0.55	0	1	0.1%	0.0%
Fairmount Ave	0.44	2	7	1.2%	0.0%
Forest Hill	0.02	0	0	0.0%	0.0%
Forest Hill Ave	5.23	5	16	2.8%	0.5%
Grove Ave	1.02	0	16	2.1%	0.1%
Hopkins Road	2.24	1	8	1.2%	0.2%
Hull St	5.47	5	66	9.5%	0.5%
Iron Bridge Road	0.71	0	3	0.4%	0.1%
Jefferson Davis Hwy	4.00	0	26	3.5%	0.4%
Maury St	1.96	3	26	3.9%	0.2%
Mechanicsville Tpke	0.70	0	14	1.9%	0.1%
Midlothian Tpke	3.79	3	20	3.1%	0.3%
Moore St	0.38	0	6	0.8%	0.0%
N Arthur Ashe Blvd	1.76	0	5	0.7%	0.2%
N Belvidere St	0.78	0	5	0.7%	0.1%
N Hopkins Road	0.06	0	0	0.0%	0.0%

North Ave	1.08	0	5	0.7%	0.1%
S 14th St	0.64	1	9	1.3%	0.1%
S Arthur Ashe Blvd	0.26	0	3	0.4%	0.0%
S Belvidere St	1.40	1	5	0.8%	0.1%
S St	0.38	0	3	0.4%	0.0%
W Broad St	3.81	1	16	2.3%	0.3%
W Brookland Park Blvd	0.91	2	3	0.7%	0.1%
W Cary St	2.74	2	23	3.4%	0.2%
W Main St	1.88	4	15	2.6%	0.2%
Walmsley Blvd	0.79	0	8	1.1%	0.1%
TOTAL	58.78	46	451	66.7%	5.3%

Pedestrian Safety Action Plan Corridors

In addition to the High-Injury Network, the locality should focus safety investment on the corridors with identified pedestrian safety needs. As seen in Figure 27, the PSAP corridors in Richmond are most densely located around downtown Richmond. These corridors are mostly prioritized (highest use and risk expected) for the entire RRTPO, with many corridors also being a priority for the both the Richmond region and the City of Richmond.

Figure 27: Pedestrian Safety Action Plan Corridors.



General Countermeasures

National resources list behavioral and infrastructure countermeasures that are effective in reducing fatalities and serious injuries. These resources include the following:

- National Highway Traffic Safety Administration (NHTSA) Countermeasures That Work.
- National Cooperative Highway Research Program (NCHRP) 500 Series Reports.
- Federal Highway Administration (FHWA) Proven Safety Countermeasures.

On the State level, VDOT published a list of preferred crash modification factors (CMFs) for certain countermeasures based on the FHWA CMF Clearinghouse published studies. A CMF is a multiplicative factor used to calculate the expected number of crashes at a given site after implementing a specific countermeasure. For example, a 0.80 CMF indicates and expected 20-percent reduction in crashes. VDOT also presently prioritizes eight proven safety countermeasures in its Systemic Safety Plan, which aligns with emphasis areas of the SHSP (see Figure 28). A compilation of effective pedestrian treatments has also been provided in the PSAP document. The following sections describe proven behavioral and infrastructure strategies that could be implemented by stakeholders within the Richmond region. The sources listed above may be referenced for more detailed information. There are several additional countermeasures that have been tried and documented, but the following sections highlight those that have proven successful at local and regional levels.

Behavioral Countermeasures

- Speeding
  - Communications and outreach supporting enforcement
  - Use targeted conventional speed enforcement programs at locations known to have speeding-related crashes
  - Automated enforcement (e.g., speed safety cameras) as permitted in School and Work Zones
  - Variable speed limits
- Distracted Driving
  - High-visibility cell phone/text messaging enforcement
  - Encourage employers to promote phone down/buckle up policies and offer fatigue management programs to employees working nighttime or rotating shifts
  - Enhance enforcement of commercial motor vehicle hours of service regulations
- Seat Belt Use
  - Enforcement and education of GDL and Zero Tolerance laws
  - Publicize phone down/buckle up message and enforce safety belt laws
  - Publicize and engage in Click-it or Ticket campaigns
- Impaired Driving
  - Publicized sobriety checkpoints (Drive Sober or get Pulled Over)
  - Saturation patrols
  - Preliminary breath test devices (increases arrests)
  - DUI dockets (reduces recidivism)
  - Limits on diversion and plea agreements (increases conviction)
  - Alcohol problem assessment and treatment
  - DUI offender monitoring and alcohol ignition interlocks

  - Alcohol screening and brief intervention
  - Mass-media campaigns
  - Zero tolerance law enforcement (young drivers)
  - Alcohol vendor compliance checks
- Bicyclist
  - Bicyclist helmet laws
  - Safe Routes to School programs
  - Elementary-age child bicycle training (consider permanent or temporary riding course/ network to traverse on school property)
  - Promoting active lighting and rider conspicuity
- Pedestrians
  - Elementary-age child pedestrian training (consider permanent or temporary walking course/network to traverse on school property)
  - Safe Routes to School programs
  - Pedestrian safety zones
  - Promote conspicuity enhancement (reflective lighting)
  - Enforcement strategies for all users
  - Provide education and outreach
- Intersections
  - Provide motorists information on traversing more effectively through complex intersections (e.g., driving through new innovative intersections outreach to adjacent aging communities)

Infrastructure Countermeasures

- Speeding
  - Setting appropriate, context sensitive speed limits
  - Provide appropriate corridor speed progression and adequate change and clearance intervals at signalized intersections
  - Provide high visibility and wider markings; curve warning and delineation; and rumble strip(e)s for errant vehicles.
- Distracted Driving
  - Install shoulder, edge line, and/or center line rumble strips and stripes
  - Implement other roadway and roadside improvements to reduce the likelihood and severity of run-off-road and/or head on collisions
- Roadway Departure
  - Provide enhanced shoulder or in-lane delineation and marking for curves
  - Provide improved highway geometry for horizontal curves
  - Widen and/or pave shoulders
  - Increase visibility and edge line width to 6- or 8-inches
  - Median and outside roadside barriers (i.e., cable, concrete, guardrail)
  - Design slopes and ditches to prevent rollovers
  - Remove/relocate objects in clear zones
  - Install rumble strips and stripes
  - Implement pavement wedge on paved shoulders (also known as SafetyEdge^{SM})

- Intersections
  - Reduce frequency and severity of intersection conflicts through traffic control and operational improvements
  - Reduce intersection conflicts through geometrics (innovative designs)
  - Improve sight distance for users exiting minor streets
  - Improve access management
  - Install turn lanes (including offset turn lanes)
  - Install roundabouts and/or traffic circles
  - Provide enhanced and advanced warning signing of unsignalized intersections
- Bicycles
  - Implement traffic calming techniques
  - Provide bicycle lanes, trails, and tracks
- Pedestrians
  - Provide sidewalks/walkways and curb ramps
  - Install or upgrade traffic and pedestrian signals
  - Construct pedestrian refuge islands and raised medians
  - Provide vehicle restriction/diversion measures
  - Provide crosswalk enhancements (e.g., high visibility crosswalk markings, enhanced signing and pavement markings)
  - Install Rectangular Rapid Flashing Beacons (RRFBs)
  - Install Leading Pedestrian Interval (LPI) at signals
  - Re-utilize undivided pavement width to include pedestrian refuge areas
  - Implement lighting/crosswalk illumination measures
  - Install traffic calming— on road sections and/or at intersections
- VDOT Systemic Safety Plan – 8 Proven Safety Countermeasures[2]
  1. High-visibility backplates on signals (up 15-percent crash reduction)
  2. Flashing yellow arrow on signals (up to 20-percent crash reduction)
  3. Curve signs (up to 40-percent crash reduction)
  4. Pedestrian crossings (up to 55-percent crash reduction)
  5. Unsignalized intersection signing and marking enhancements (up to 10-percent crash reduction)
  6. Shoulder wedge (up to 20-percent crash reduction)
  7. Center line rumble strips (up to 60-percent crash reduction)
  8. Edge line rumble strips (up to 50-percent crash reduction)

Figure 28 shows a table of how these systemic countermeasures address the emphasis areas in Virginia's SHSP.

[2] VDOT is enhancing the SSP to include more proven countermeasures for FY2023-27 HSIP funding

Figure 28. Chart showing how systemic safety plan addresses SHSP Emphasis Areas.

Countermeasure	Roadway Departure	Intersections	Pedestrians	Bicyclists	Impaired Driving	Occupant Protection	Speed	Young Drivers
High-Visibility Backplates		★			★			★
Flashing Yellow Arrow		★			★			★
Curve Signs	★				★		★	★
Pedestrian Crossings		★	★	★	★			★
Unsignalized Intersections		★			★			★
Shoulder Wedge	★							★
Centerline Rumble Strips	★				★		★	★
Edgeline Rumble Strips	★				★		★	★

General Implementation Options

The overall goal of safety analysis and planning is to help the Richmond region progress toward its safety performance targets by reducing fatalities and serious injuries from motor vehicle crashes. This progress can occur through the implementation of policies, programs, and projects that address the behavioral and infrastructure needs. The sections below outline suggestions, with specific action items, to advance safety efforts in the region. RRTPO staff may be well suited to take the lead in advancing transportation safety in the region, but it will require many people and organizations to make a real difference. With the recently passed federal transportation funding bill and the 2020 Virginia transportation bill both providing more behavioral and infrastructure safety program resources, the region is well positioned to develop highway safety actions, initiatives and projects to mitigate the impact of crashes.

Organizational

Safety Culture

The Richmond region has several transportation priorities, but a Safe System Approach highlights the importance of prioritizing transportation safety first and foremost. Shifts in leadership, staff, and stakeholder thinking can bring about this safety focus. A good resource for leading the shift is *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System*, a report that describes a paradigm shift in road safety policy being led by a handful of countries. Another resource is FHWA's Safe System Approach webpage, which includes a subsection on safety culture.

- RRTPO staff read these resources and propose next steps for the region through the technical committees and policy board.

Education

Ensuring local jurisdictions, transportation and safety stakeholders, and elected officials understand the key safety issues, needs, and opportunities identified in this analysis will be an important first step to educating everyone about the role they can play in safety planning and programming.

- RRTPO staff prepare and present a summary of this analysis to stakeholders.
- RRTPO consider giving safety briefings to the policy board on a regular basis.

Safety (Sub-)Committee/Working Group

Bringing together regional transportation and safety stakeholders on a regular basis can advance discussions about safety implementation activities; evaluate successes and challenges; and keep momentum going on safety policies, programs, and projects. The RRTPO Vision Zero task force currently meets bimonthly to discuss safety in the Richmond region. A full multidisciplinary committee would consist of members from law enforcement, emergency services, engineering, research, health departments and advocacy groups, and government. Continued coordination with the RRTPO Vision Zero task force will help the Richmond region identify, prioritize, and accomplish safety initiatives.

- RRTPO staff continue to attend and support Vision Zero task force meetings
- RRTPO Vision Zero task force consider expanding the membership to be fully multidisciplinary and promote similar collaboration at the locality level. The Blue Ridge Transportation Safety Board provide a VA model for consideration. Other state and regional practices should be reviewed, for example MPO safety planning in Louisiana and DOT regional safety planning in Minnesota.

Action Plan

The SHSP includes action plans for each of the emphasis areas. Many MPOs that have developed safety plans have outlined specific approaches to determine which countermeasures will be implemented, by whom, and in what timeframe. Developing a regional action plan can provide an organizational structure to address behavioral and infrastructure implementation priorities.

- RRTPO convene a stakeholder committee and discuss the benefits and feasibility of developing a Regional Safety Action Plan with implementation details

Behavioral

Countermeasures Being Implemented

Behavioral strategies and actions are already being implemented in the region. Additionally, other proven solutions could be implemented to address highway behavioral and active transportation issues. In coordination with the RRTPO Vision Zero task force and others.

- RRTPO staff should compile local and regional activities and programs, with consideration of the above resources, to determine priority regional behavioral countermeasures to support and implement. Richmond's Vision Zero Action Plan provides examples of engaging the health department and 5 Es.[3]
- RRTPO continue tracking and sharing results of behavioral strategies and actions across the region.

Resource/Information Sharing

Statewide campaigns are led every year around occupant protection, impaired drivers, speeding and young drivers. Utilizing and sharing the resources developed for these campaigns at the regional and local level can better spread the word about transportation safety. It also saves time and resources as information is already available and can be customized to meet the specific needs in the Richmond region.

- Become familiar with statewide and regional campaigns and schedules through the RRTPO Vision Zero task force and Virginia's Toward Zero Deaths initiative and identify opportunities to partner with outreach and education. For example, the Metropolitan Washington Street Smart Campaign.

Emphasis Area Crash Mapping

As part of this study, the HIN for KA or KAB crashes were developed for each jurisdiction. These maps could be shared with law enforcement to better target education and enforcement efforts. Additionally, maps for the other emphasis areas could be developed to supplement the maps and data prepared by the Highway Safety Office (HSO) of the DMV for NHTSA funded grant programs. The DMV prepares an interactive map through the Traffic Records Electronic Data System (TREDS) for all jurisdictions and behavioral program maps for all legislative boundaries.

- RRTPO Vision Zero task forces members share HIN and PSAP maps with local enforcement partners to collaborate on a safe-system and 5E approaches.

[3] VDH and VDOT collaboration to Prioritize Active Transportation Health and Safety (PATHS) provides references and resources for local and regional 5E efforts.

- RRTPO staff develop maps for behavioral emphasis area HINs as needed using DMV online tools or VDOT's Crash Analysis Tool.

Infrastructure

Policies

At the regional level, there are opportunities to work safety principles into "business" procedures to institutionalize safety in the planning and programming process. For example, many MPOs and localities have instituted complete streets policies to ensure transportation projects are identified and later designed with the safety of all users in mind. *Zero Road Deaths and Serious Injuries: Leading a Paradigm Shift to a Safe System* provides policy ideas to implement.

- RRTPO staff read *Zero Road Deaths and Serious Injuries* and other safe system related resources[4] and propose next steps for the region.

Priority Locations

This study identifies the HIN as well as pedestrian crash risk roadway segments with the potential for safety improvement. Additional network screening for safety project locations are published for the VTRANS mid-term needs. These VTRANS needs locations have been normalized by traffic exposure to identify critical segments and intersections. Thus, overlaying with the HIN will help refine problem identification. The RRTPO, in coordination with the VDOT District Office and member agencies, can prioritize locations and identify systemic or spot treatments to address the key needs. The Hampton Roads TPO performed a similar exercise as the second part of the Hampton Roads Regional Safety Study.

- RRTPO, through the Vision Zero task force collaboration, prioritize locations for VDOT STARS and OIPI (SMART SCALE) Project Pipeline studies.
- RRTPO staff engage in STARS and Pipeline studies, particularly those that are multi-jurisdictional, to promote safety considerations with alternatives analysis. RRTPO staff could conduct or facilitate road safety assessments (RSAs or other safety analyses) with 5E stakeholders to identify improvements to submit for funding. Delaware Valley Regional Planning Commission has seen good success with multidisciplinary RSAs for almost 15 years.

Project Selection

The RRTPO is required to set annual safety performance targets and demonstrate progress toward meeting those targets through transportation projects. To make progress toward meeting targets, select transportation projects that address the safety issues identified in this study or in any future analysis.

- RRTPO elevate and support safety considerations during project planning studies for SMART SCALE, TAP, Revenue Sharing, etc. applications.
- RRTPO consider adopting safety as a high priority for regional projects and support local project prioritized based on safety needs.

Safety Planning

Changes to population, commercial and residential development, and other factors over time impact where and why crashes are occurring. It will be important for RRTPO to regularly study crash trends and

[4] World Road Association (PIARC) Road Safety Manual provides good safe system implementation information and additional references. The Vision Zero Network also provides MPO resources.

roadway data to revise the priority list and emphasis areas, as necessary. Updates to this analysis should be considered on a 3- to 5-year cycle.

- In 3 to 5 years, RRTPO staff update analysis with the latest data from the above referenced VDOT GIS and Crash Analysis Tool.
- RRTPO revise priority list and emphasis areas based on updated analysis.
- RRTPO staff update countermeasures options using the latest Federal and State recommendations.

Appendices

Appendix A – Virginia Strategic Highway Safety Plan (SHSP) Emphasis Areas

Virginia's 2017-2021 Strategic Highway Safety Plan (SHSP) identified eight emphasis areas (EAs) for targeted countermeasure implementation. These eight driving behaviors, crash types/locations, and user groups encompass a large percentage of contributing factors to fatal and serious injury crashes in Virginia. The definitions of these EAs from the SHSP are as follows:

1) **Impaired Driving:** Impaired driving encompasses crash statistics for the 4 Ds – drinking, drugs, distracted, and drowsy. A crash is classified with an impaired driving factor when one of the drivers involved in the crash is identified as being affected by any one of these four Ds.

2) **Speed:** Speeding crashes are defined as driving too fast for conditions, or exceeding the posted speed limit.

3) **Occupant Protection:** A crash is classified with an occupant protection factor when one of the injured individuals was not utilizing a seat belt or child car seat.

4) **Roadway Departure:** Roadway departure crashes involve vehicles leaving the travel lane (to the left or right), encroaching into the opposite lanes, or onto the shoulder and roadside environment.

5) **Intersections:** A crash is classified as occurring at an intersection if it occurs at a location where two or more roads cross or merge. These are locations where there is an inherent possibility for conflict between all road users.

6) **Young Drivers:** In Virginia's SHSP, young drivers are defined as persons between the ages of 15 and 20. A crash is classified with this factor if one or more of the involved drivers meets the young driver criteria.

7) **Bicycles:** A bicycle crash is one that involves one or more bicycles.

8) **Pedestrians:** A pedestrian crash is one that involves one or more pedestrians.