ROANOKE VALLEY REGIONAL TRANSPORTATION SAFETY STUDY

Prepared for: Roanoke Valley Transportation Planning Organization, Staffed by the Regional Commission

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CAMBRIDGE SYSTEMATICS

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1 INTRODUCTION

Virginia is a Toward Zero Deaths (TZD) state, meaning even one fatality occurring on the transportation network is too many. The Virginia Department of Transportation (VDOT), in coordination with state and regional partners, is implementing the 2017-2021 *Strategic Highway Safety Plan* (*SHSP*). The *SHSP* frames the major safety issues in the Commonwealth and proposes strategies and actions to address them. To move closer to the zero goal, many stakeholders need to play a role in implementing this plan and prioritizing transportation safety improvements. Locality and regional safety plans have been shown to bring collaboration and resources to reducing fatalities and injuries. Since safety issues are localized, an action of the SHSP is to work with regional planning organizations to develop safety plans. The Roanoke Valley Transportation Planning Organization (RVTPO) has committed to support the statewide efforts toward reducing fatalities and serious injuries on its roadways.

The Roanoke Valley 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:

- Multidisciplinary stakeholder engagement 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 RVTPO and solutions to proactively address these concerns.

The Roanoke Valley Regional Transportation Safety Plan includes the following sections:

- **Regional Safety Trends:** This section highlights general traffic safety trends in the RVTPO. 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 RVTPO with a focus towards fatal and injury crashes.
- **Crash Locations:** This section examines the geographic locations of crashes in the RVTPO.
- **Next Steps:** This section outlines information that the RVTPO should consider to reduce the number of fatalities and serious injuries on its roadways. The RVTPO may complete an addendum to this report with detailed implementation steps. The following subsections are included:
  - **Countermeasures That Work:** This section describes possible countermeasures with proven safety benefits that could be implemented by stakeholders in the RVTPO.
  - **Implementation Options:** This section reviews options for implementing proposed countermeasures. This includes policies, programs, and projects that address behavioral and infrastructure needs.

2 Regional Safety Trends

This section examines the number and rate of crashes and injuries in the RVTPO and how they compare to trends statewide and throughout other metropolitan planning organizations (MPOs) and transportation planning organizations (TPOs) in Virginia. Five years of crash data (2013-2017) 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

2.1 Crash Frequency and Severity

Figure 1 displays the statewide trends in fatalities and serious injuries per year. The number of fatalities reached a statewide high of 1,027 fatalities in 2007, declined to a low point of 703 fatalities in 2014, and has risen in each year since up to 843 fatalities in 2017. **Figure 2** displays the trends in fatalities and serious injuries between 2006 and 2017 within the current boundaries of the RVTPO. The geospatial information for crash data prior to 2006 was not accurate enough to summarize trends within TPO boundaries. While the trend for the RVTPO does not reflect the statewide high for fatalities in 2007, it does mirror the low point in 2014, followed by increasing fatalities through the end of 2017. Similarly, the trends for serious injuries in the RVTPO reflect a similar downward trend to the statewide values.

Figure 1: Statewide Fatalities and Serious Injuries by Year

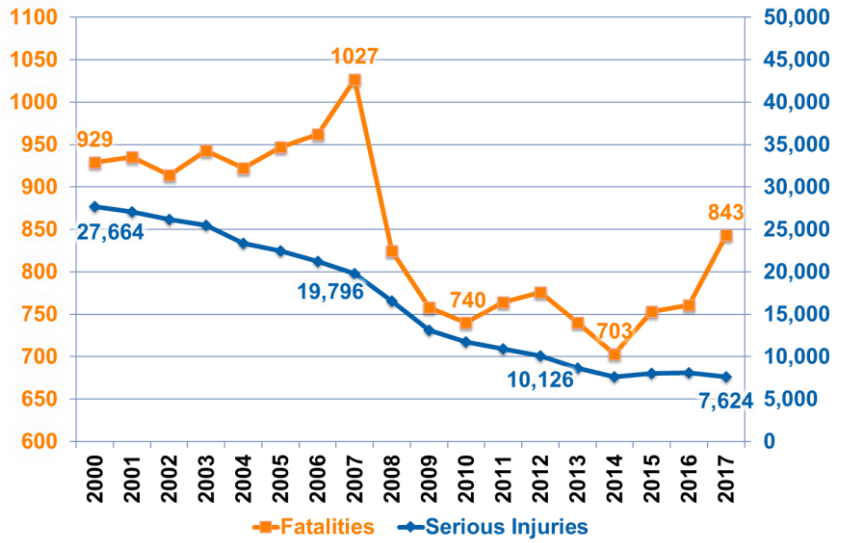


Figure 2: Roanoke Valley Fatalities and Serious Injuries by Year

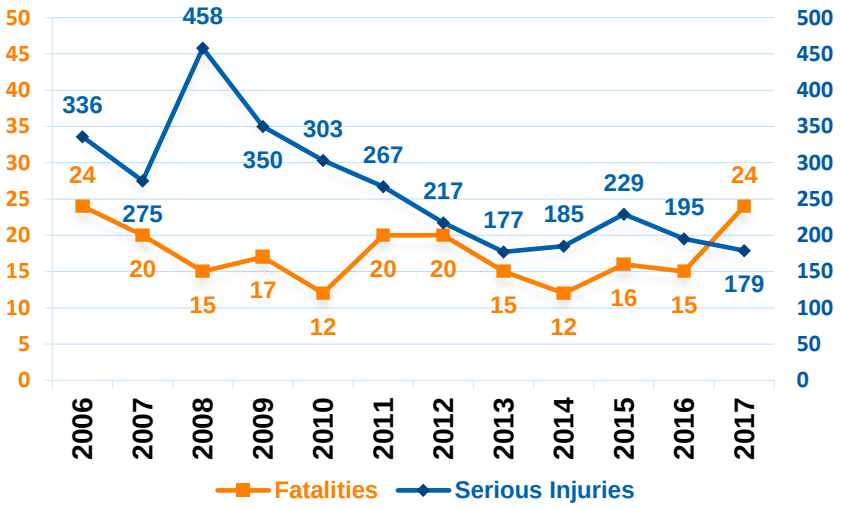
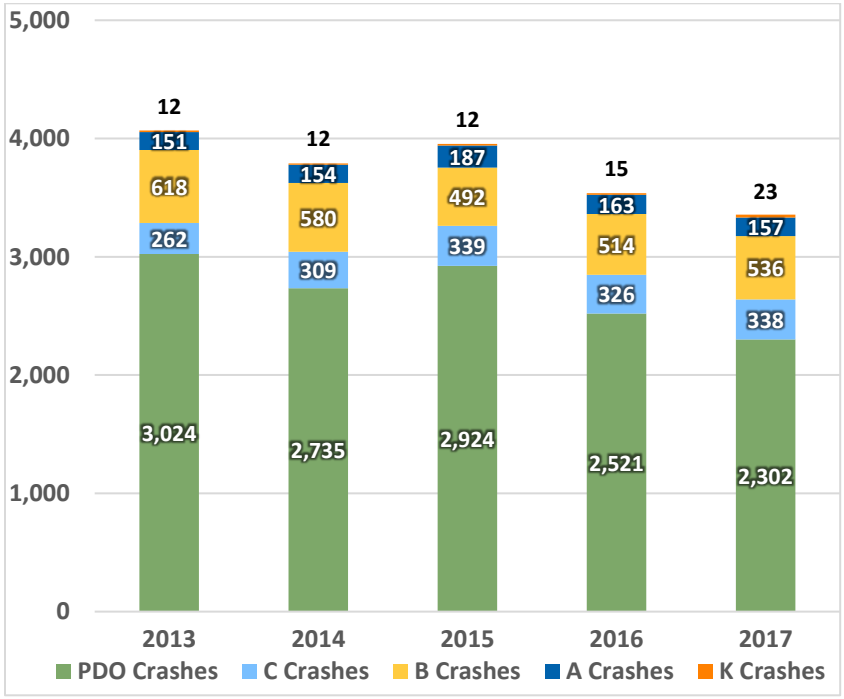


Figure 3 shows a breakdown of crash severity by year for the five-year study period. The total number of crashes in the RVTPO has decreased by approximately 17 percent since 2013, while the total number of crashes statewide has increased by five percent over the same period. Across the five-year period, less than one percent of all crashes resulted in a fatality while four percent of crashes resulted in a serious injury.

Figure 3: Total Crashes in RVTPO (2013 – 2017)



2.2 Crash Rate

Crash rate relates the number of crashes to the number of vehicle miles traveled (VMT) in a given area. Total crash rates (expressed in crashes per 100 million VMT) and fatal crash rates (expressed in fatalities per 100 million VMT) for the RVTPO were calculated and compared to the statewide and VDOT Salem District rates in **Figure 4** and **Figure 5**, respectively. On a yearly basis, the total crash rate is higher than the district and statewide rates; however, the total crash rate decreased over the five-year period. The fatal crash rate has been consistently lower than the district rate and comparable to the statewide rate.

Figure 4: Total Crash Rate (2006 – 2017)

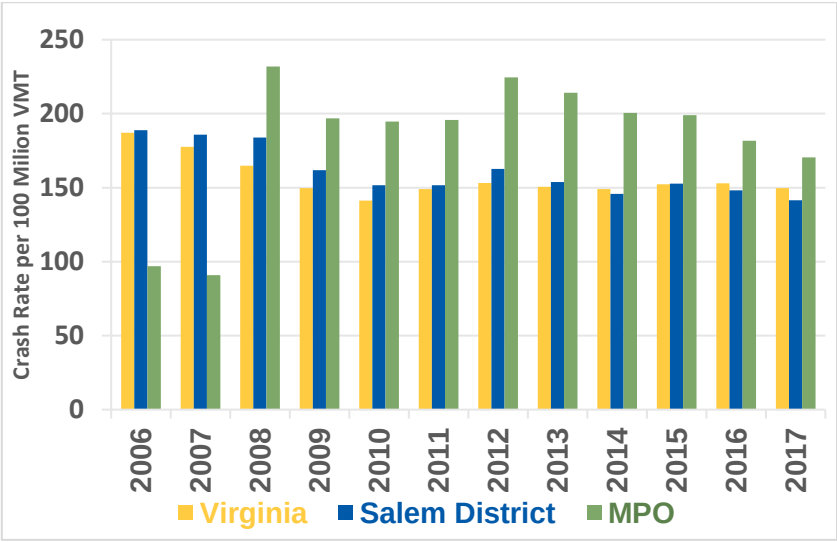
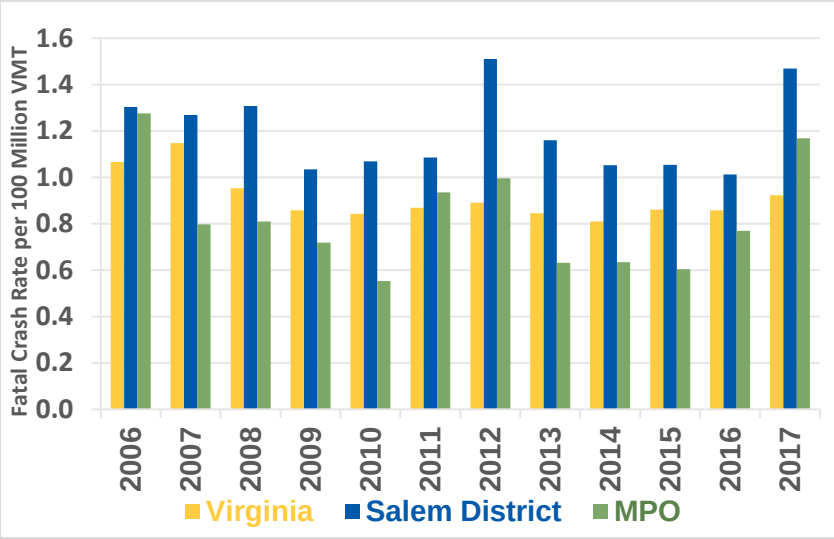


Figure 5: Fatal Crash Rate (2006 – 2017)



The crash rates in RVTPO are typical of crash rates in other MPOs and TPOs throughout the state. The average total crash rate and fatal crash rates for various MPOs/TPOs are summarized in **Figure 6** and **Figure 7**. The RVTPO experiences very similar total and fatal crash rates to the Richmond TPO, Central Virginia MPO, and New River Valley MPO.

Figure 6: Average Total Crash Rate by MPO/TPO (2013 – 2017)

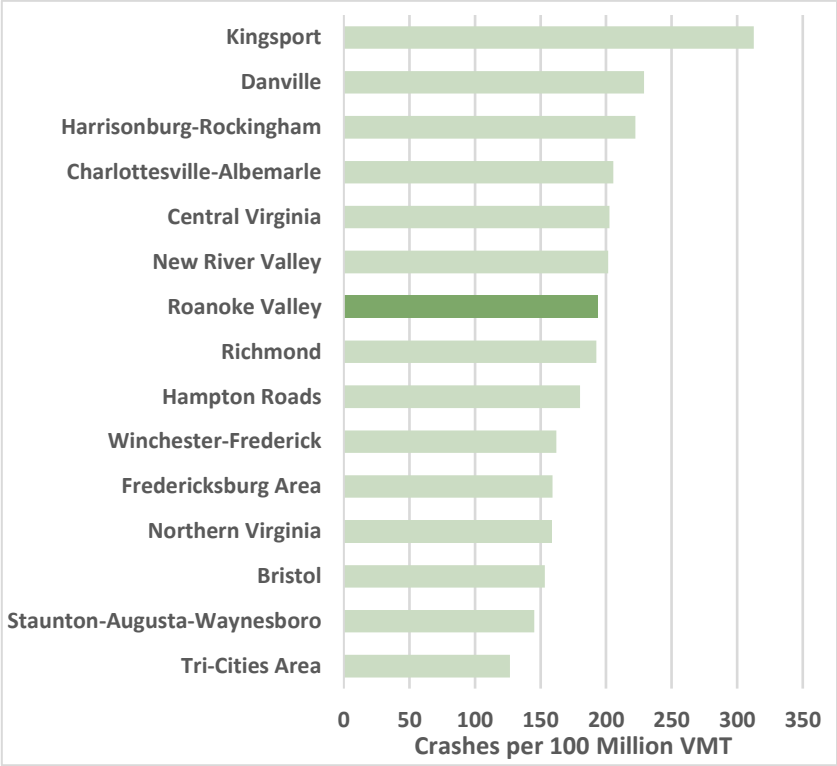
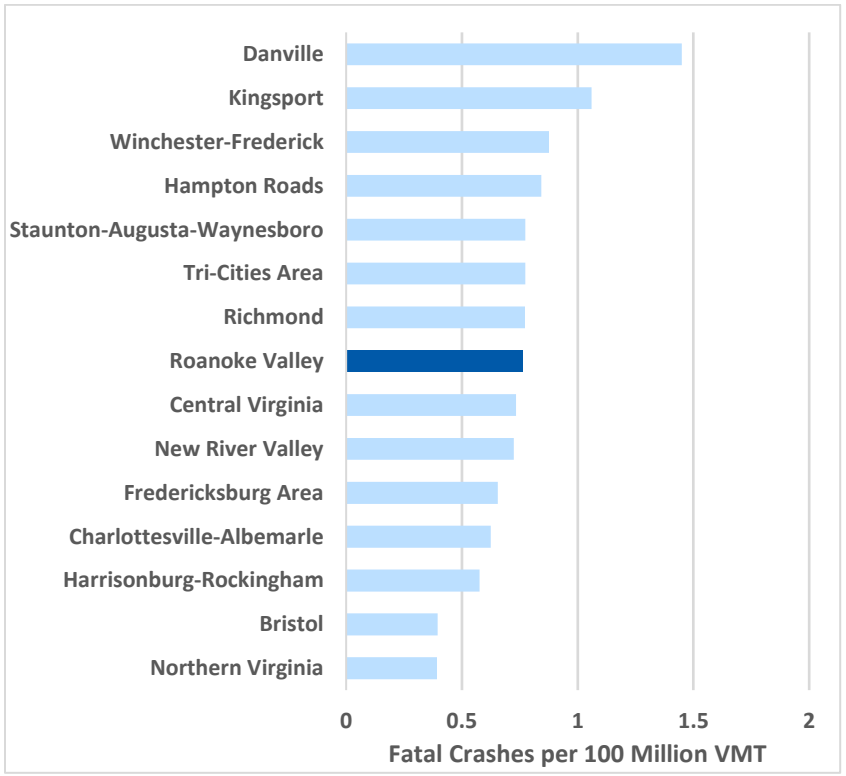


Figure 7: Average Fatal Crash Rate by MPO/TPO (2013 – 2017)



3 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 RVTPO relating to the following characteristics:

- Crash type
- Involvement of pedestrian or bicyclist
- Time of day
- Behavioral crash patterns
  - Distracted driving
  - Unbelted driving
  - Impaired driving
  - Speeding
- Involvement of young driver

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 map be viewed in map view through VDOT's ArcGIS Online account. Behavioral crash patterns and involvement of young drivers should be considered on a regional or corridor level. **Section 6.2** references maps created by the Department of Motor Vehicles (DMV) that may be used in conjunction with the maps provided in this report to identify priority locations with behavioral crash patterns.

3.1 Crash Type

The primary crash types in the RVTPO for 2013-2017 are documented in **Figure 8** for all crashes and **Figure 9** for fatal and serious injury crashes. The predominant crash types included rear-end (33 percent), angle (28 percent), and fixed object (18 percent) crashes. More than three out of every four crashes were one of these crash types.

Despite comprising only 18 percent of all crashes, fixed object crashes comprised 31 percent of all fatal and serious injury crashes. Rear-end (16 percent) and angle (29 percent) crashes also made up significant percentages of fatal and serious injury crashes.

Head on and bicycle/pedestrian crashes make up less than two percent and one percent, respectively, of total crashes from 2013 to 2017; however, five and eight percent of fatal and serious injury crashes are head on and pedestrian/bicycle crashes.

Figure 8: Crash Type – All Crashes (2013 – 2017)

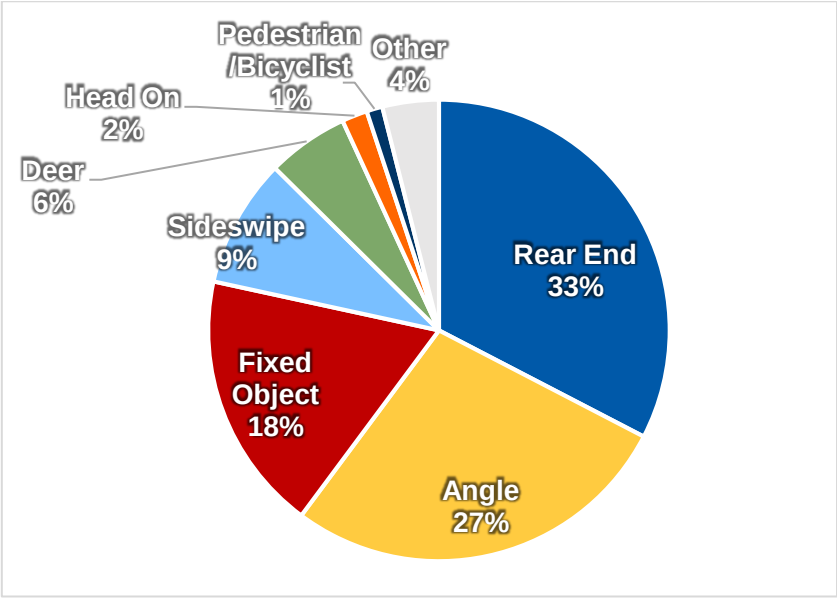
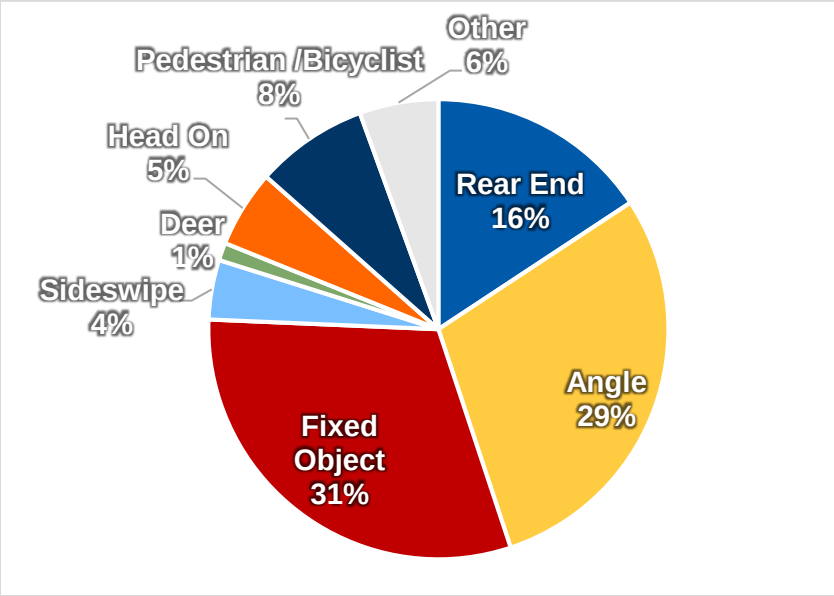


Figure 9: Crash Type – Fatal and Serious Injury Crashes (2013 – 2017)



3.2 Pedestrian and Bicycle Involved Crashes

From 2013 to 2017, 233 crashes involving pedestrians and 68 crashes involving bicyclists occurred in the RVTPO. **Figure 10** and **Figure 11** display the percentage of pedestrian- and bicycle-related crashes for each crash severity. Seven and 24 percent of the pedestrian-related crashes resulted in a fatality and serious injury, respectively. Two and 25 percent of the bicycle-related crashes resulted in a fatality and serious injury, respectively.

Figure 10: Pedestrian Crashes by Severity (2013 – 2017)

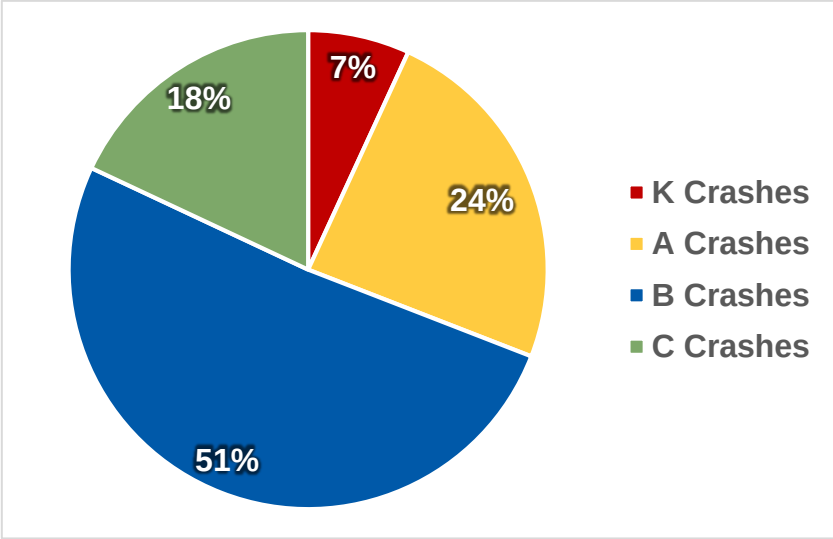


Figure 11: Bicycle Crashes by Severity (2013 – 2017)

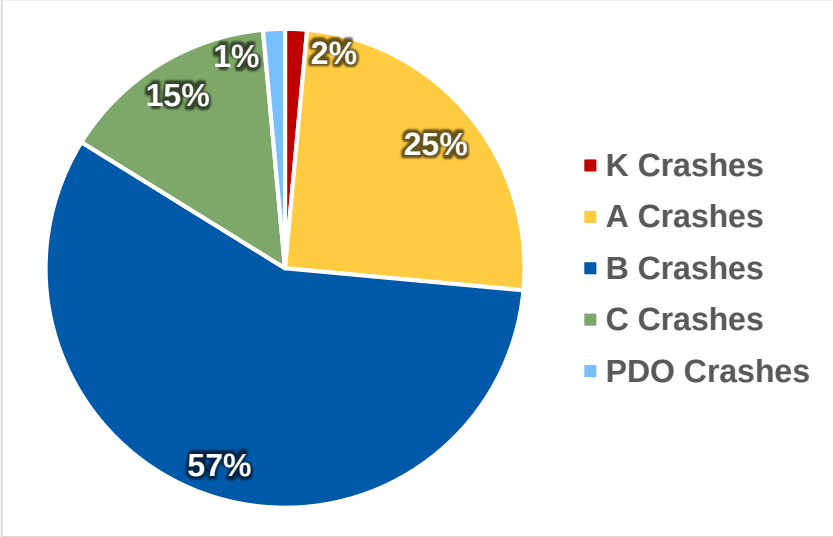


Figure 12 documents the percentage of fatal crashes that involve pedestrians (22 percent) or bicyclists (1.4 percent). The statewide averages for the same period are 12.8 percent and 1.5 percent, respectively. **Figure 13** compares the number of pedestrian- and bicycle-related fatal crashes in the RVTPO to other MPOs/TPOs in Virginia. RVTPO has the seventh highest percentage of fatal crashes that involve bicycles or pedestrians and the sixth highest percentage of fatal crashes that involve pedestrians.

Figure 12: Bicycle and Pedestrian Fatal Crashes (2013 – 2017)

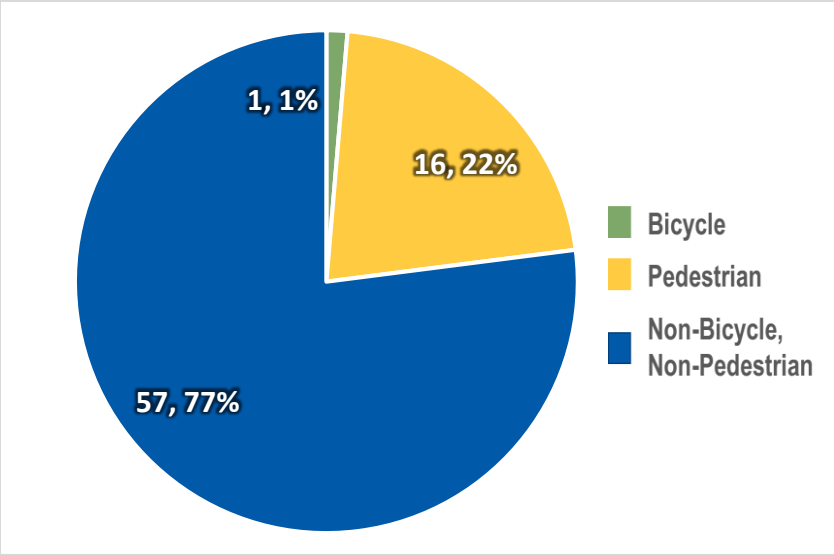
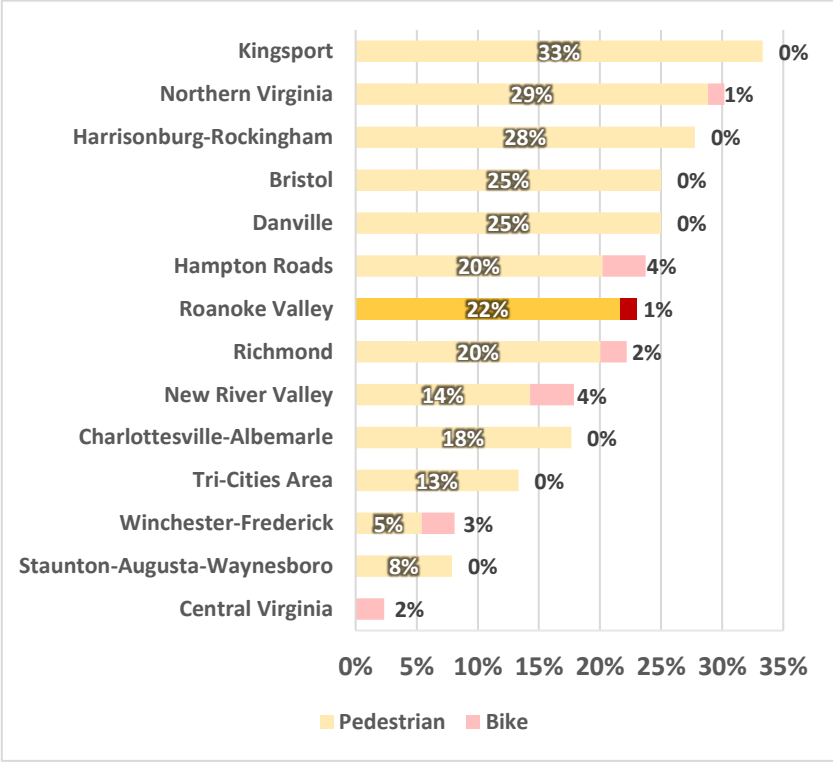


Figure 13: Bicycle and Pedestrian Fatal Crashes by MPO (2013 – 2017)



Specific characteristic of pedestrian crashes were further examined. Pedestrian ages ranged from younger than 1 to 86 but were evenly distributed across all age groups as shown in **Figure 14**. The 20 to 29 age grouping made up the highest percentage of crashes at 19 percent. Pedestrian crashes occur mostly in the afternoon and evening hours as shown in **Figure 15**. **Figure 16** summarizes the lighting conditions for all pedestrian crashes during the five-year period. Sixty-seven percent of pedestrian crashes occurred in daylight, dawn, or dusk conditions. Another 23 percent occur in darkness, but with the roadway lighted according to the reporting officer, meaning 90 percent of pedestrian crashes in the five-year period occurred in lighted conditions.

Figure 14 Pedestrian Crashes by Pedestrian Age (2013 – 2017)

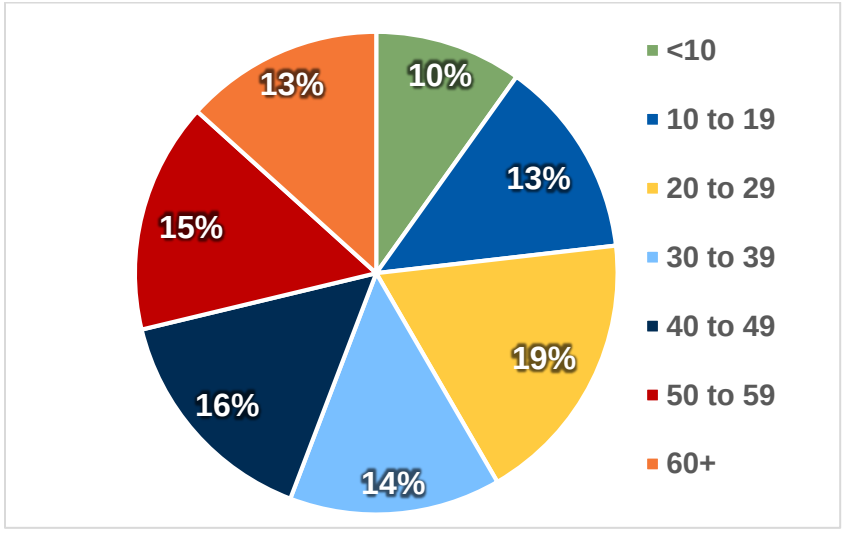


Figure 15: Pedestrian Crashes by Time of Day (2013 – 2017)

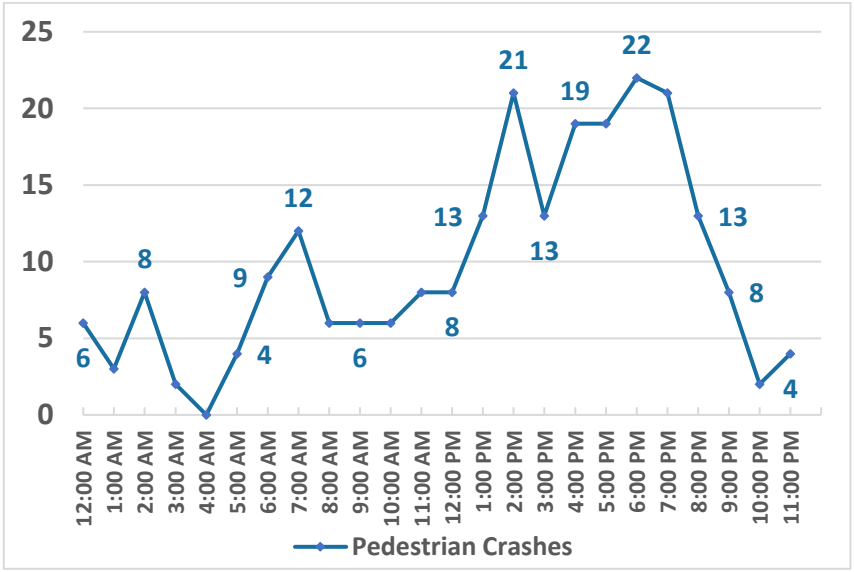
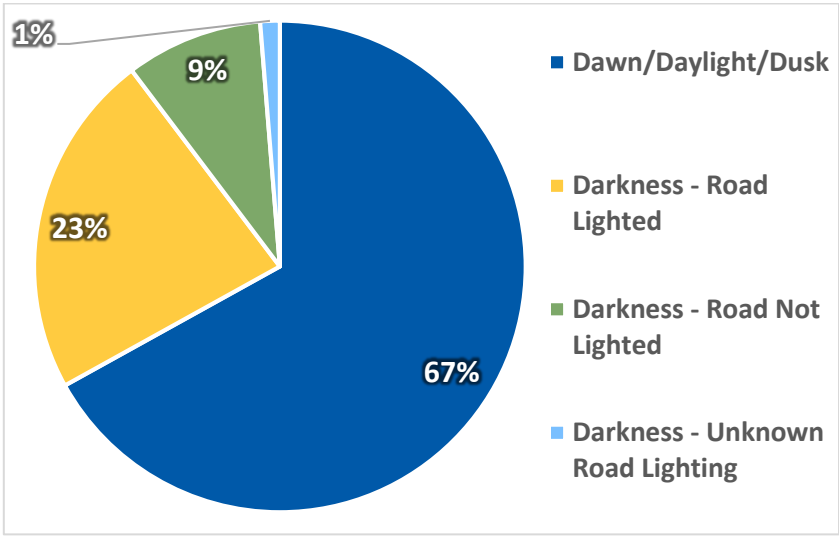


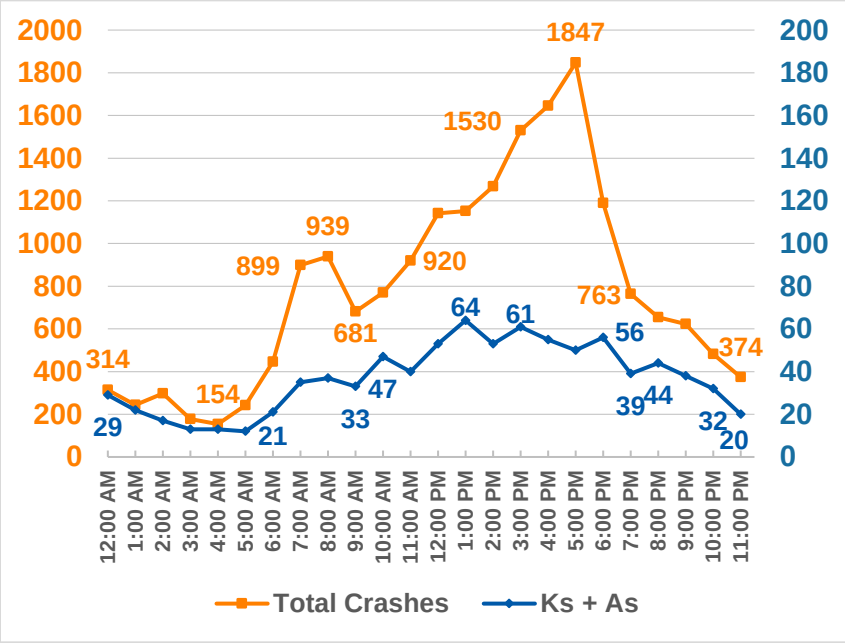
Figure 16: Pedestrian Crashes by Lighting Conditions (2013 – 2017)



3.3 Time of Day

Crashes in the RVTPO typically occur in the afternoon hours. **Figure 17** summarizes the total crashes and fatal and serious injury crashes by hour. The frequency of total crashes peaked in the 5:00 to 6:00 PM hour with 1,847 crashes. The fatal and serious injury crashes occurred more often in the afternoon and were distributed equally across the afternoon hours, plateauing between 1:00 and 7:00 PM.

Figure 17: Crashes by Hour (2013 – 2017)



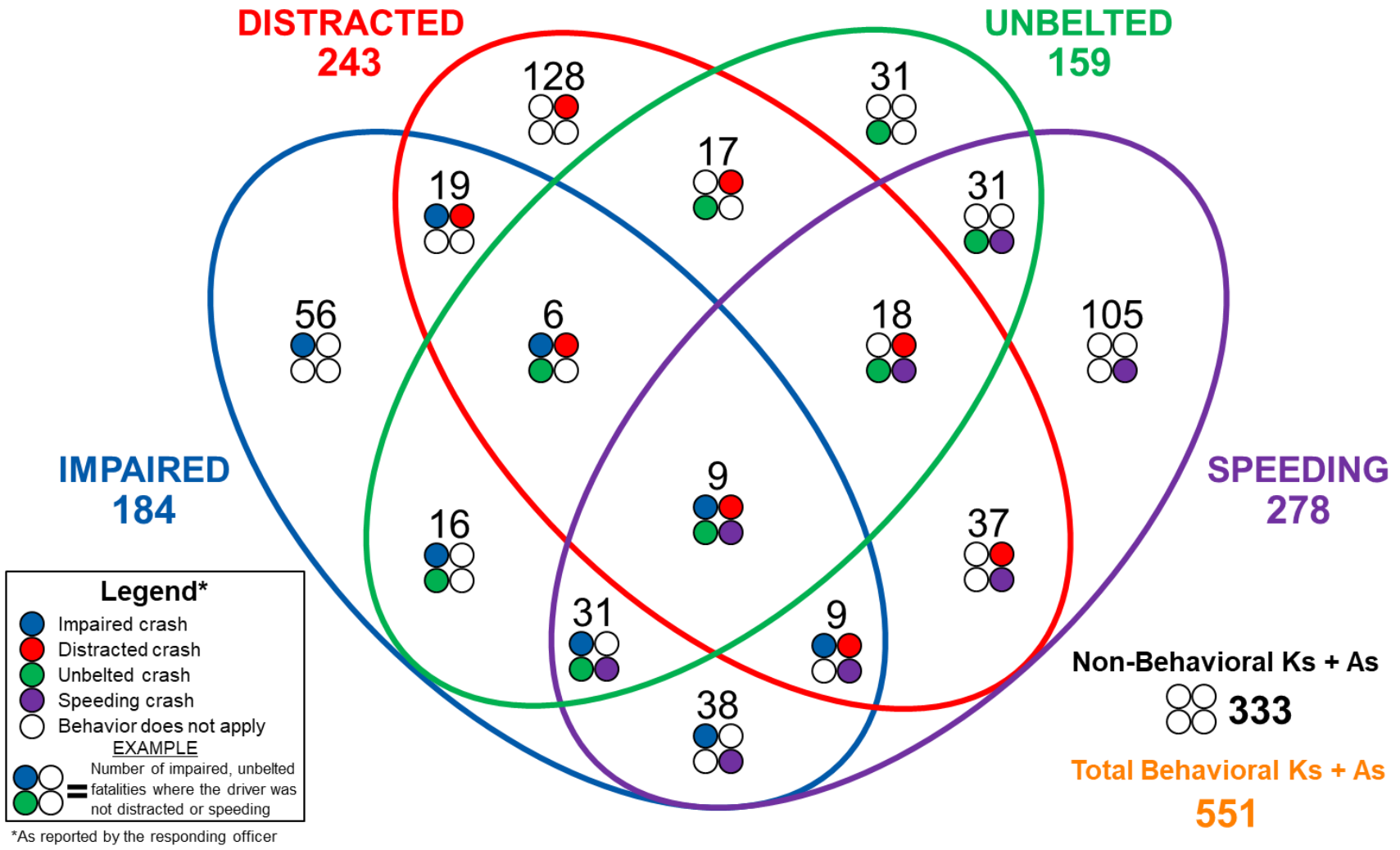
3.4 Behavioral Crash Patterns

More than 50 percent of the fatal and serious injury crashes in the RVTPO can be attributed to four specific driver behaviors:

- Distracted driving
- Unbelted driving
- Impaired driving
  - Drunk driving
  - Drowsy driving
  - Drugged driving
- Speeding – includes driving over the posted speed limit or maximum safe speed

During the five-year crash period, 884 crashes resulted in a fatal or serious injury. One or more of these four behaviors contributed to 551 (62 percent) of the crashes. The Venn diagram in **Figure 18** illustrates the overlap of these four driver behaviors for fatal and serious injury crashes over the five-year period.

Figure 18: Behavioral Crash Venn Diagram – Fatal and Serious Injury Crashes (2013 – 2017)

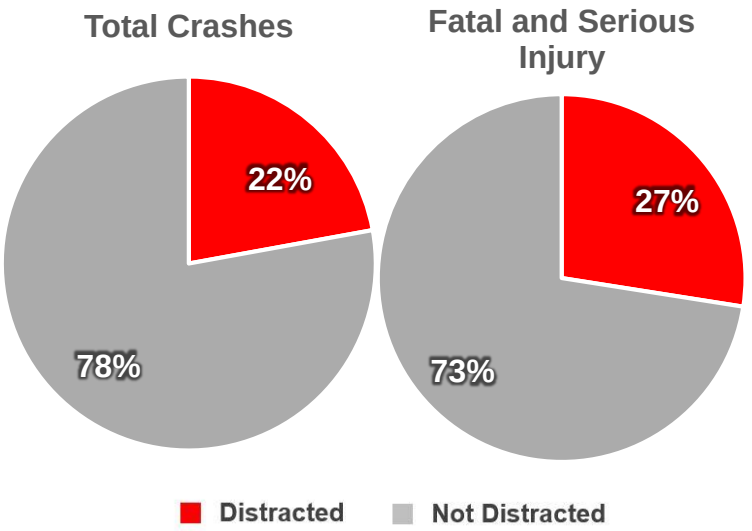


3.4.1 Distracted Driving

Figure 19 displays the percentage of total crashes and fatal and serious injury crashes that involved one or more distracted drivers during the five-year period. Distracted driving constituted 27 percent of fatal and serious injury crashes in the RVTPO, while only representing 22 percent of all crashes in the region. These percentages are slightly higher than the statewide averages of 22 percent for fatal and serious injury crashes and 21 percent for all crashes for the same five-year period.

Distracted driving in the RVTPO encompassed the following distractions: texting, interacting with a navigation device, adjusting vehicle controls, eating or drinking, daydreaming, looking at scenery, adjusting the radio or CD player, interacting with a passenger(s), looking at a roadside incident, driver fatigue, talking on cell phone, driving with eyes not on the road, and other. Distracted driving is often self-reported by the driver and is generally considered to be underreported.

Figure 19: Distracted Driving Crashes (2013 – 2017)



3.4.2 Unbelted Driving

The *SHSP* states that the seat belt use in Virginia in 2015 was 80.9 percent, well below the national rate of 87 percent for the same year. **Figure 20** displays the percentage of total crashes and fatal and serious injury crashes that involved one or more occupants not wearing a seatbelt. Unbelted crashes made up three percent of total crashes and 18 percent of fatal and serious injury crashes in the RVTPO for the five-year period.

These percentages are slightly lower than the statewide averages of four and 22 percent, respectively. **Figure 21** displays the number and percentage of crashes for each severity type that involved unbelted occupants. Greater than 30 percent of all fatal crashes involved an unbelted driver compared to less than two percent of all property damage only crashes, indicating that the injury and death risk is significantly greater if an occupant is not wearing a seatbelt.

Figure 20: Unbelted Driving Crashes (2013 – 2017)

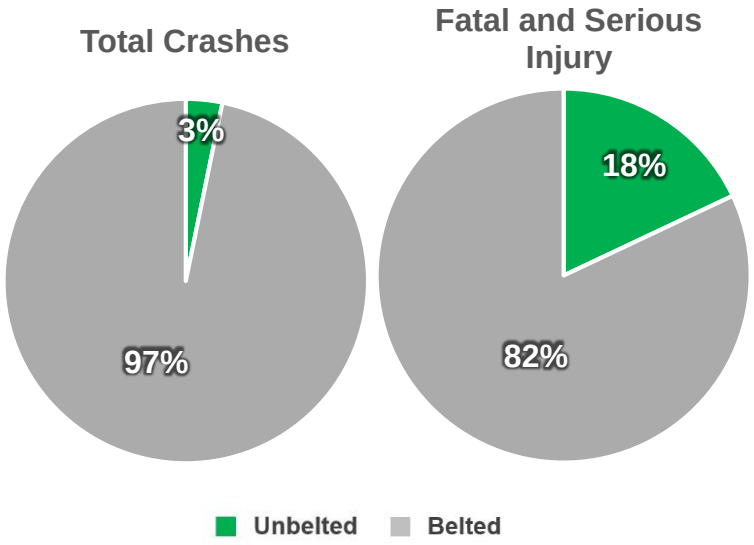
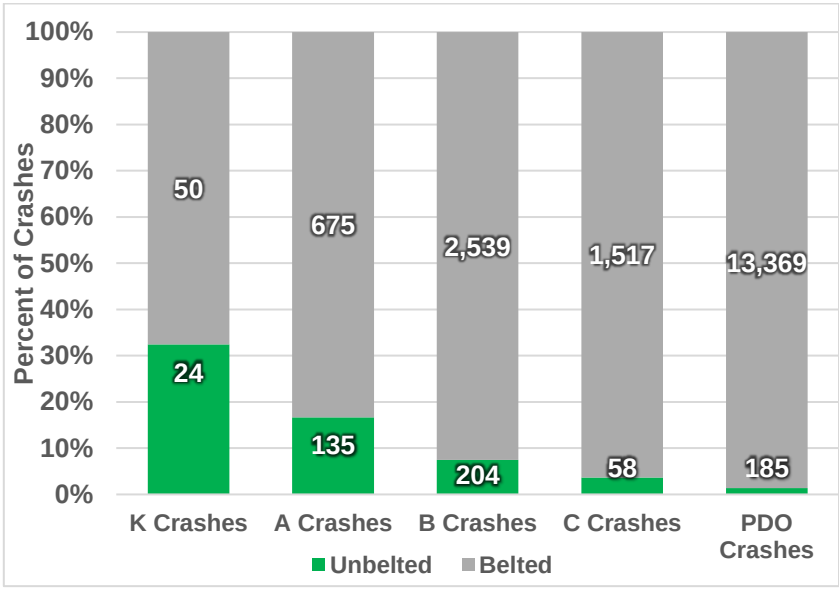


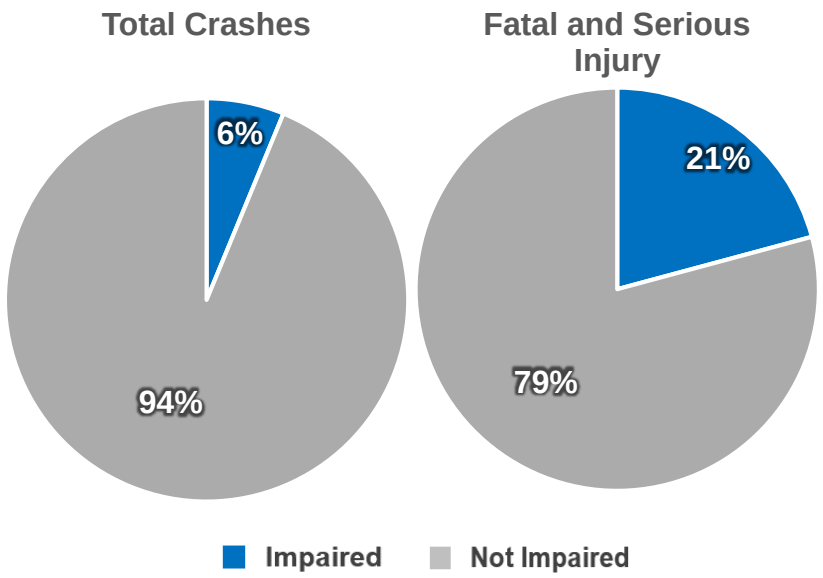
Figure 21: Seat Belt Use in Relation to Crash Severity (2013 – 2017)



3.4.3 Impaired Driving

Figure 22 displays the percentage of total crashes and fatal and serious injury crashes that involved one or more impaired drivers during the five-year period. An impaired driver was defined as a driver who was drowsy or under the influence of alcohol or drugs. In the RVTPO, one or more impaired drivers were involved in 6 percent of all crashes and 21 percent of fatal and serious injury crashes. The percentage of fatal and serious injury crashes involving one or more impaired drivers is slightly higher than the statewide average of 18 percent for the same five-year period.

Figure 22: Impaired Driving Crashes (2013 – 2017)



3.4.4 Speeding

In Virginia, a driver is speeding if he or she is driving faster than the maximum safe speed for conditions or the posted speed limit. **Figure 23** displays the percentage of crashes (total and fatal and serious injury) that involved one or more speeding vehicles. The percentage of crashes involving one or more speeding vehicles was almost twice as high for fatal and serious injury crashes (31 percent) than for all crashes (17 percent). **Figure 24** illustrates the proportion of crashes for each severity that involved a driver exceeding the posted speed limit or maximum safe speed by zero to ten miles per hour and greater than ten miles per hour. Approximately 36 percent of fatal crashes in the RVTPO involved a driver exceeding the speed limit and 28 percent involved a vehicle traveling greater than ten miles per hour over the posted speed limit or maximum safe speed.

Figure 23: Speeding Crashes (2013 – 2017)

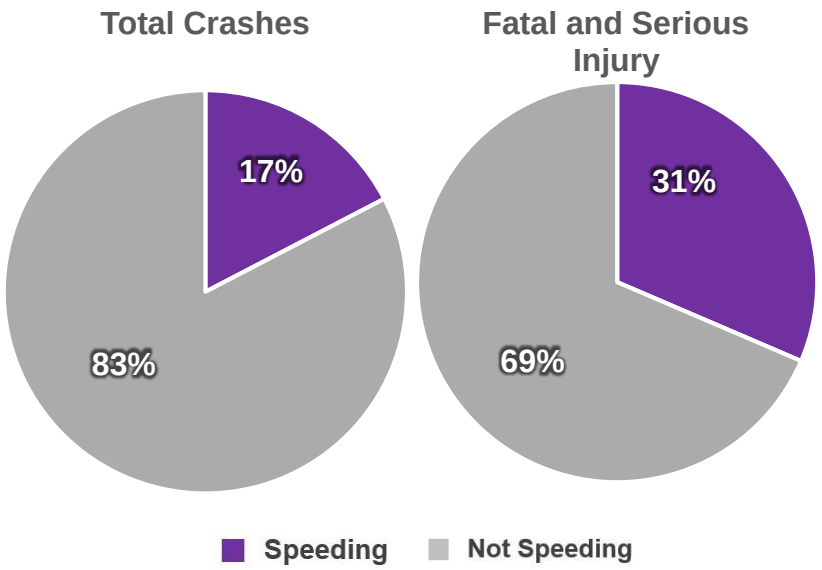
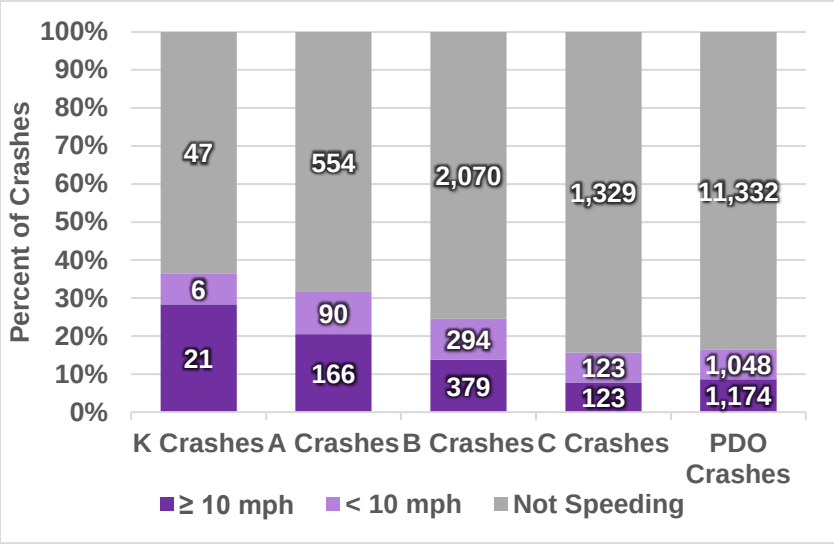


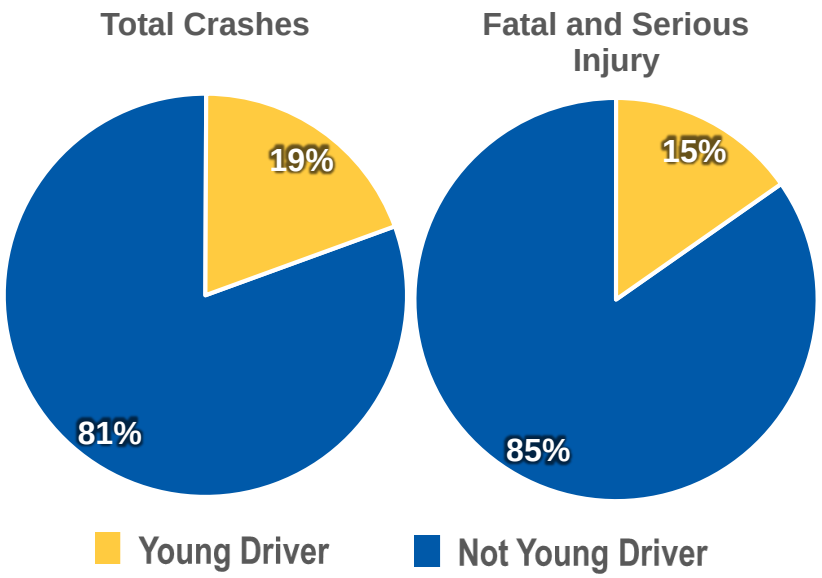
Figure 24: Speeding in Relation to Crash Severity (2013 – 2017)



3.5 Young Driver

Young drivers are defined as persons between the ages of 15 and 20. **Figure 25** displays the percentage of all crashes and fatal and injury crashes that involved a young driver during the five-year period. While the RVTPO average of 19 percent for all crashes matches the statewide percentage for the same period, the RVTPO average of 15 percent for fatal and serious injury crashes is lower than the statewide average of 17 percent.

Figure 25: Young Driver Involved Crashes (2013 – 2017)



4 CRASH LOCATIONS

This section examines the locations of crashes within the RVTPO related to the following characteristics:

- Jurisdiction
- Crash Density
- Intersection
- Route
- Roadway Departure Crash Locations
- Speeding Crash Locations
- Potential for Safety Improvement
- Pedestrian Crash Locations

Each of these characteristics has been mapped to be referenced for additional analysis. The RVTPO map layers are available at https://www.arcgis.com/home/item.html?id=4989ec6b2cee4fd597fa4fb8ebe2cae3.

The maps and information outlined in this chapter should guide the selection of locations for infrastructure countermeasures or to help prioritize areas for selected behavioral enforcement. Crash data should be further investigated on a localized or project level to determine applicable countermeasures.

4.1 Crash Density

Crashes within the RVTPO were analyzed with a density map to determine where all crashes or specific crash types are clustered. The crash density map for all crashes within the RVTPO is shown in **Figure 26**. Crashes are clustered around urban areas in the City of Roanoke and City of Salem, and clustered around major interchanges and intersections. The crash density map for fatal and serious injury crashes is shown in **Figure 27.** The highest densities of the more severe crashes are clustered within the City of Salem. However, higher densities are still present in the City of Roanoke and along major routes.

Figure 26: Crash Density – Total Crashes (2013 – 2017)

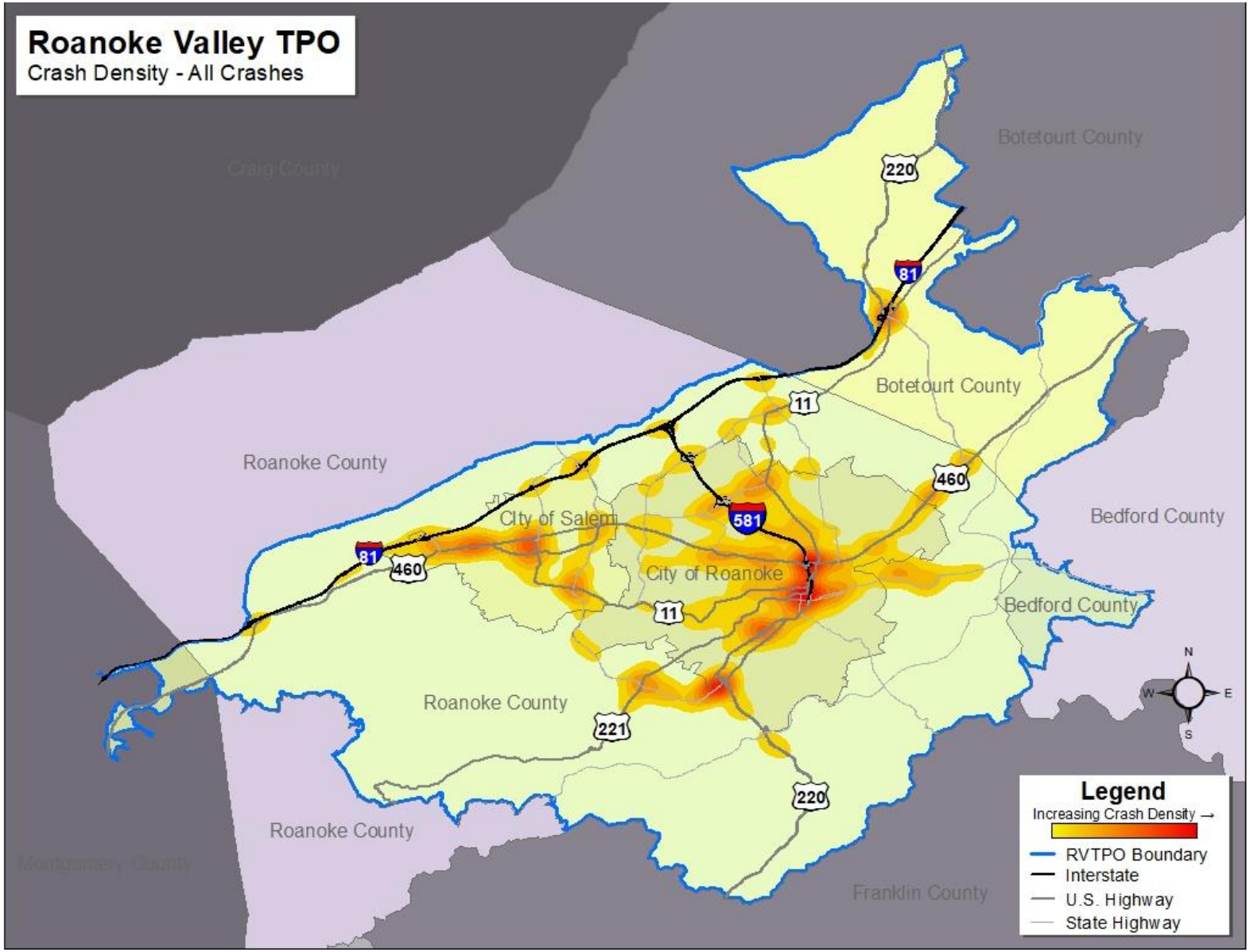
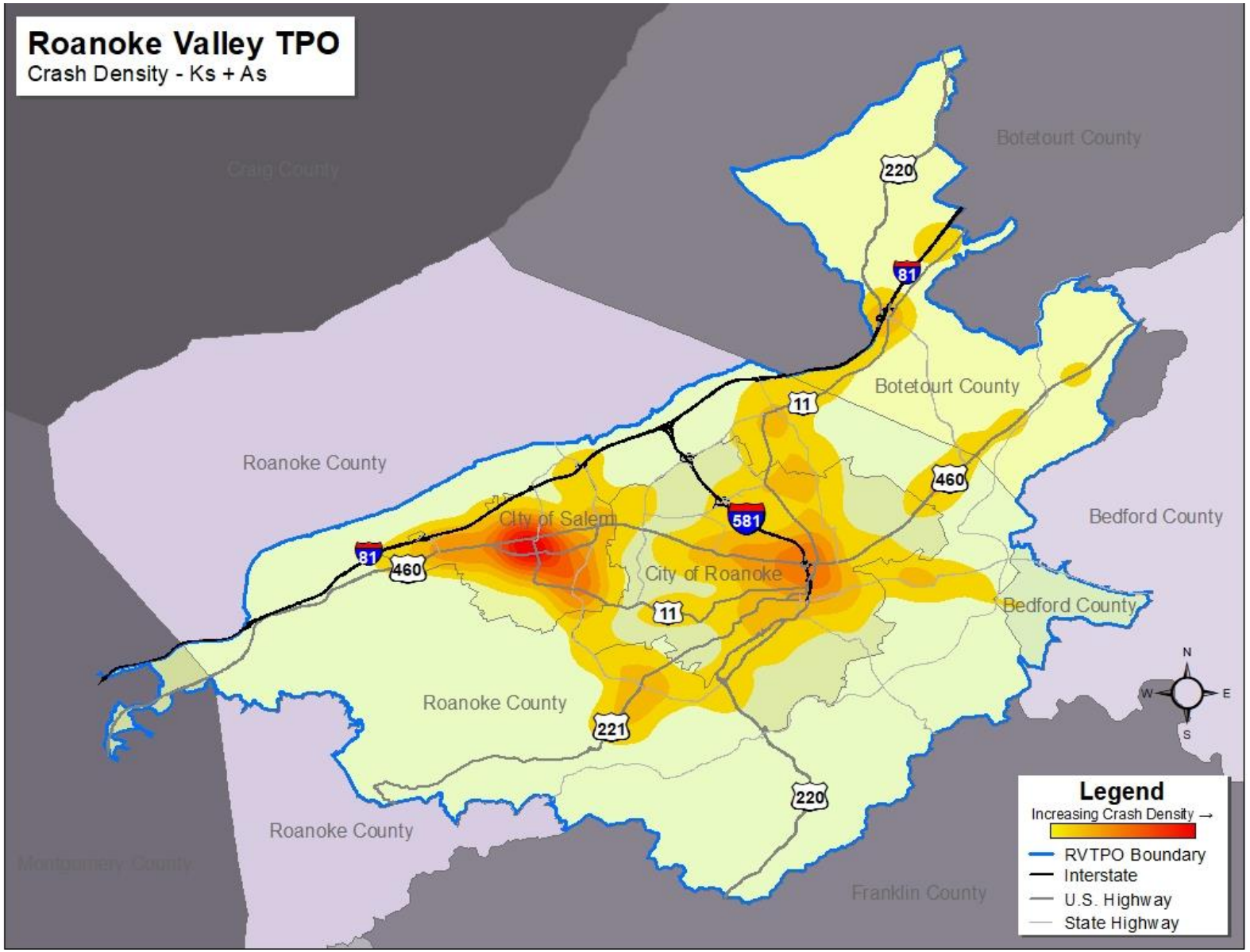


Figure 27: Crash Density – Fatal and Serious Injury Crashes (2013 – 2017)



4.2 Crashes by Intersection

Signalized intersections within the RVTPO were evaluated to determine the intersections with the highest number of equivalent property damage only (EPDO) crashes from 2013 to 2017. The EPDO rating scale, based on the estimated value of harm, provides greater value to the more severe crashes based on the following weights:

- K (fatal injury) = 85
- A (suspected serious injury) = 85
- B (suspected minor injury) = 10
- C (possible injury) = 5
- PDO (property damage only) = 1

Crashes were assigned to the nearest signalized intersection if they occurred within 250 feet of the center of the intersection. The top ten signalized intersections by EPDO crashes for the five-year period are summarized in **Table 1**. Seven of the ten signalized intersections in the RVTPO with the most severe crashes are maintained by the City of Salem. Five of the top ten intersections are located on Route 419, while another three intersections are located on US 460. The highest-ranked intersection was the intersection of Route 419 and Roanoke Boulevard in the City of Salem. The EPDO crash totals for additional intersections is included in **Appendix A**

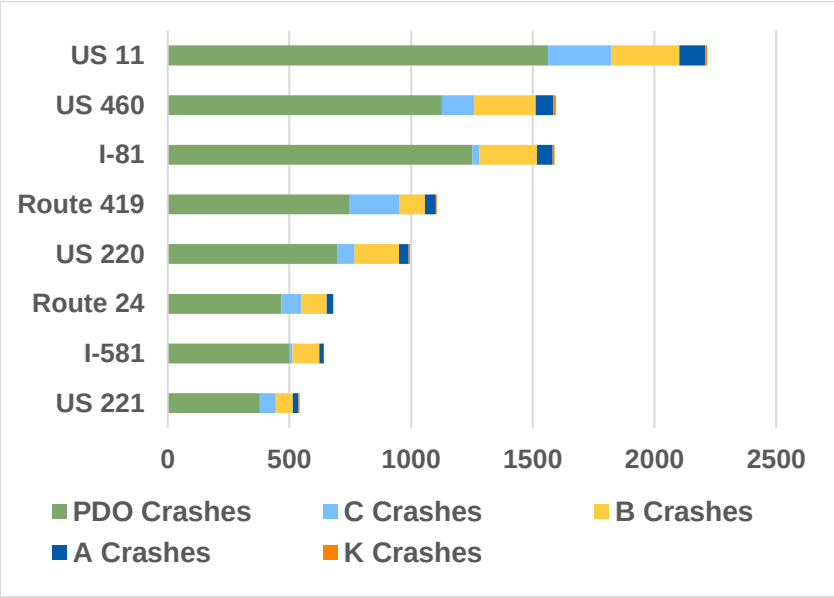
Table 1: Signalized Intersections by EPDO Crashes (2013 – 2017)

Intersection	Total EPDO Crashes	Ownership	Jurisdiction
Route 419 (Electric Road) & Roanoke Boulevard	718	City of Salem	City of Salem
Route 419 (US 460 ALT/US 11 Alt) & Springfield Avenue	522	City of Salem	City of Salem
Route 419 (Electric Road) & Colonial Avenue	492	VDOT	Roanoke County
US 11 (Lee Highway) & US 220 (Roanoke Road)	435	VDOT	Botetourt County
US 460 (Orange Avenue) & Kimball Avenue/ Plantation Road	393	City of Roanoke	City of Roanoke
US 460/US 11 (East Main Street) & Broad Street	376	City of Salem	City of Salem
US 11 (Apperson Drive) & Route 419 (Electric Road)	355	City of Salem	City of Salem
US 460/US 11 (West Main Street) & Route 112 (Wildwood Road)	341	City of Salem	City of Salem
Route 419 (Electric Road) & Braeburn Drive	339	City of Salem	City of Salem
US 460/US 11 (West Main Street) & Turner Road/Hurt Lane	332	City of Salem	City of Salem

4.3 Crashes by Route

Figure 28 illustrates the number of crashes during the five-year period for the nine routes with the highest crash frequencies. Only the crashes occurring on the portions of the routes within the RVTPO boundary were included. US 11 had the highest number of crashes over the five-year period with nearly 700 more crashes than US 460. US 11 also had the highest number of fatal and serious injury crashes (114). Based on a review of the crash database, crashes that occurred on the US 11 and US 460 overlap were primarily assigned to US 11 by the responding officer. A list of the routes with the highest crash frequencies by EPDO is included in **Appendix B**.

Figure 28: Total Crashes by Route (2013 – 2017)



4.4 Roadway Departure Crash Locations

The *SHSP* defines a roadway departure crash as one that involves a vehicle leaving the travel lane (left or right) or encroaching into the opposite lanes or shoulder and roadside environment. Roadway departure crashes in the RVTPO for the five-year period are summarized by route in **Figure 29** and by density in **Figure 30**. Interstate 81 has more than twice as many total roadway departure crashes than any other major route within the MPO. A more extensive list of the routes with the highest roadway departure crash frequencies is included in **Appendix B**.

Figure 29: Roadway Departure Crashes by Route (2013 – 2017)

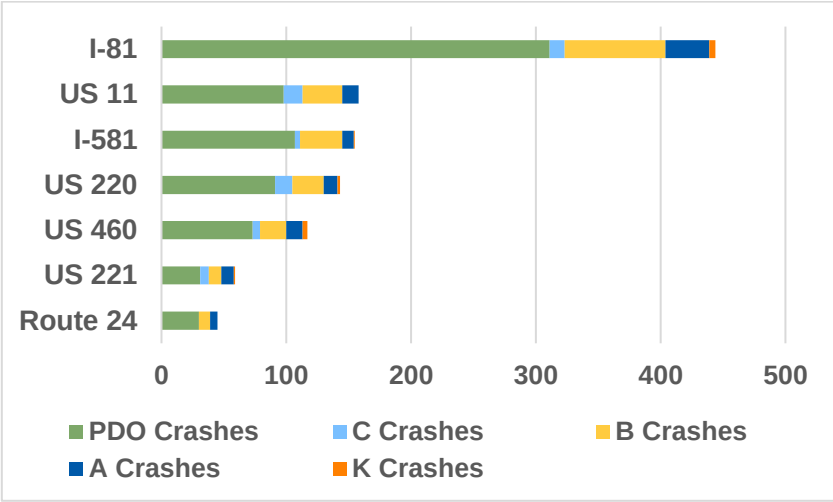


Figure 31 and **Figure 32** display a density map and point map for roadway departure crashes that resulted in a fatality or serious injury. Although the highest density for all roadway departure crashes was centered near the City of Roanoke, the more severe roadway departure crashes occurred near the City of Salem and the section of Interstate 81 adjacent to Salem.

Figure 30: Roadway Departure Crash Density – Total Crashes (2013 – 2017)

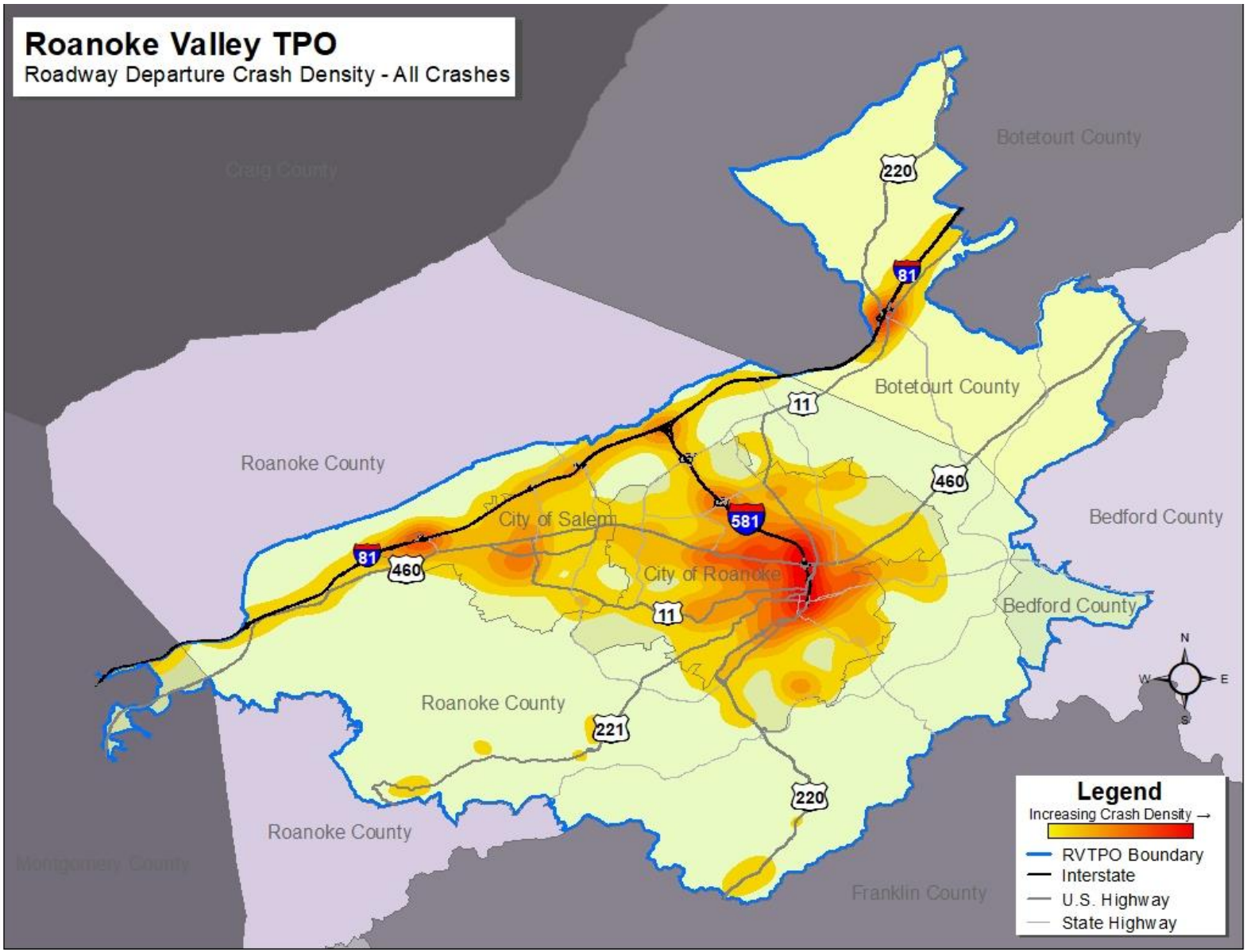


Figure 31: Roadway Departure Crash Density – Fatal and Serious Injury Crashes (2013 – 2017)

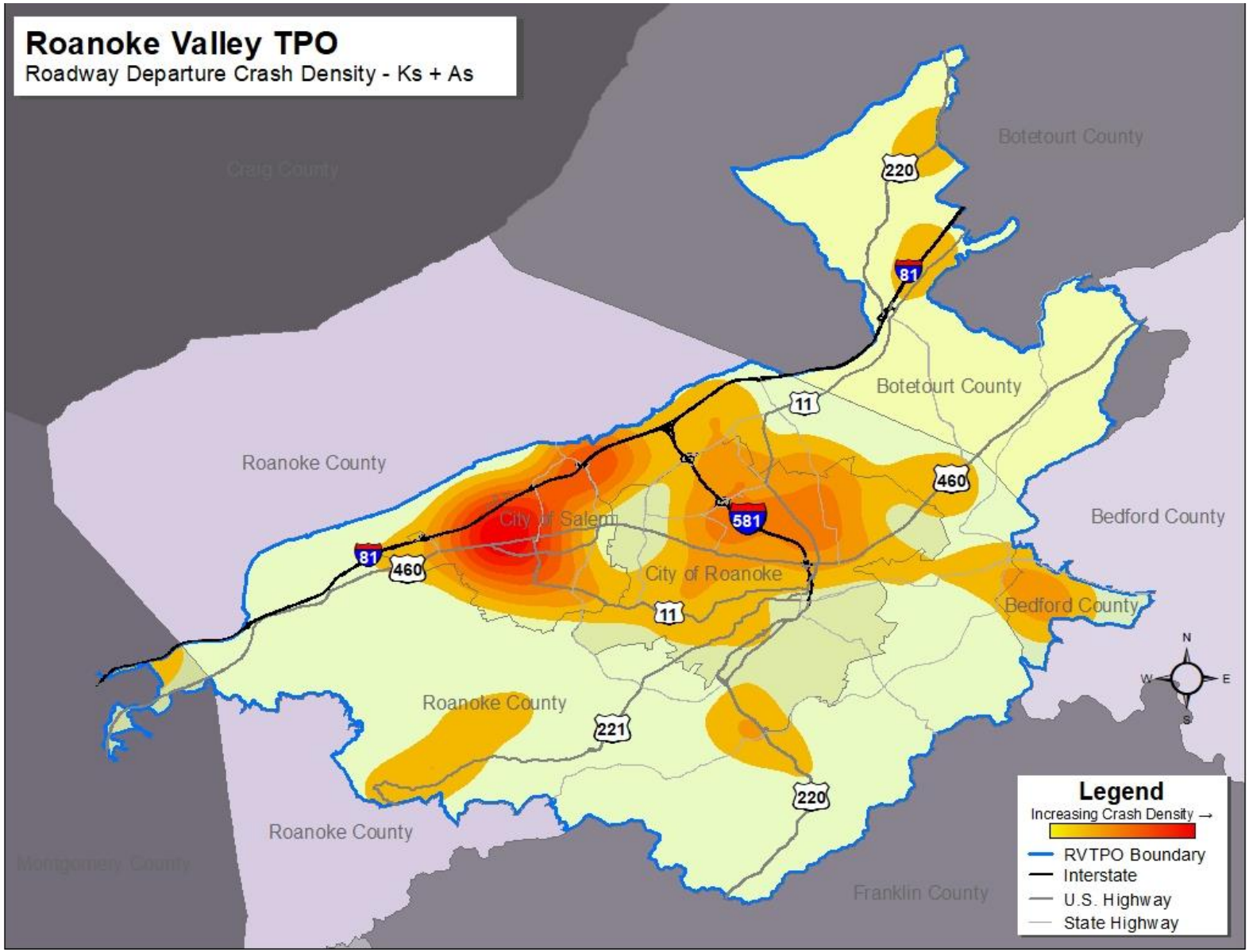
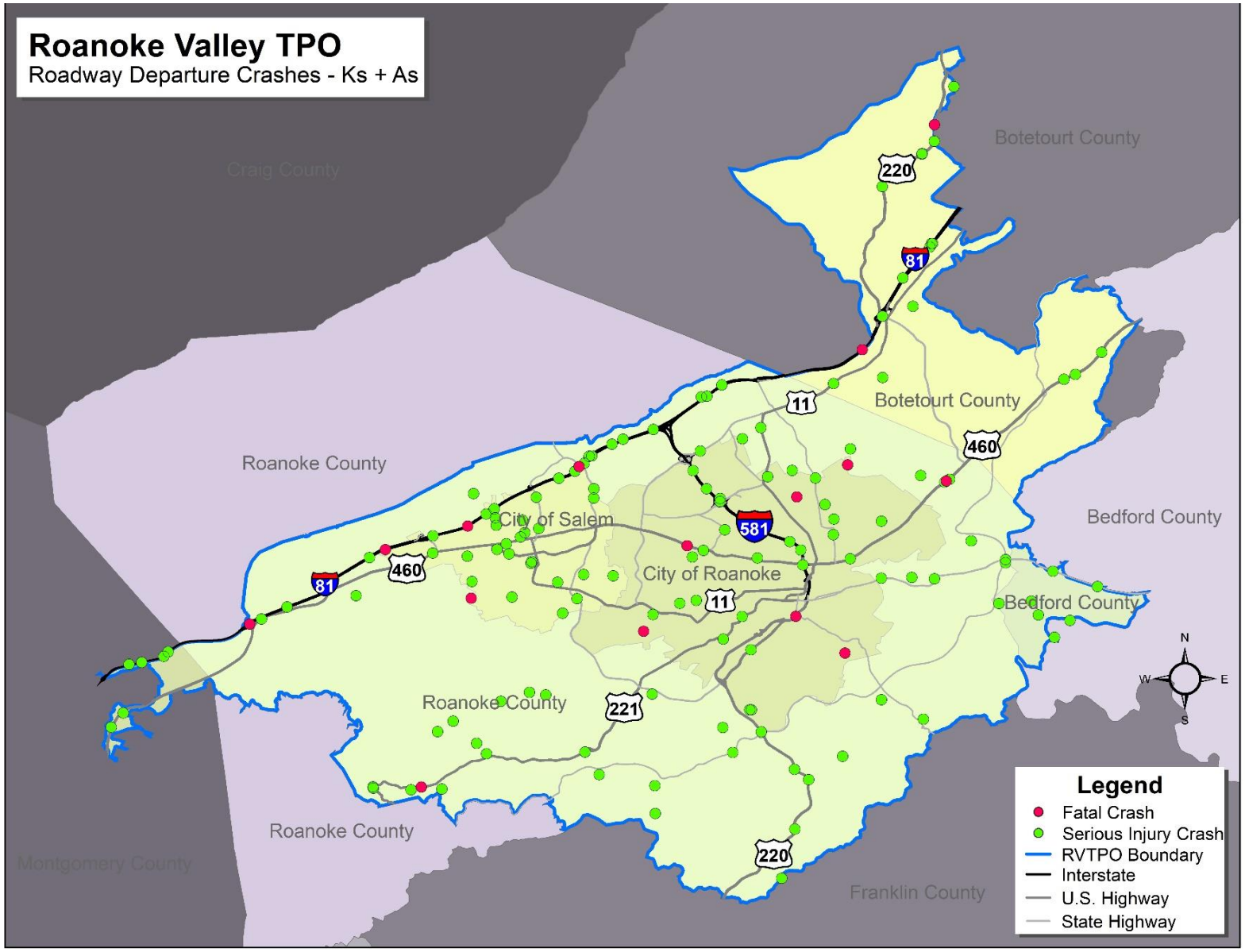


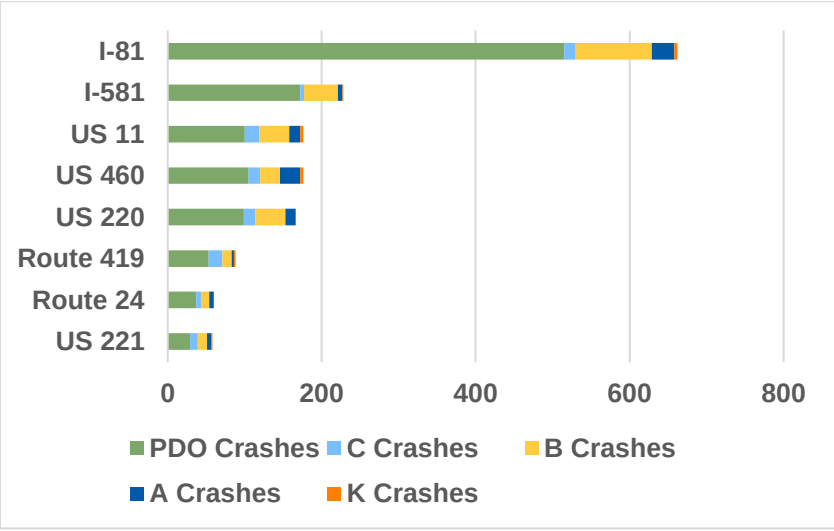
Figure 32: Roadway Departure Crash Locations Fatal and Serious Injury Crashes (2013 – 2017)



4.5 Speeding Crash Locations

Crashes that involved a vehicle traveling above the posted speed limited are classified as a speed related crash. **Figure 33** displays the speeding crashes in the RVTPO between 2013 and 2017 by route. A more extensive list of the routes with the highest speeding crash frequencies is included in **Appendix B**. Like the roadway departure crashes, nearly three times as many speed related crashes occurred on Interstate 81. This is also shown in **Figure 34**, as high densities of speeding crashes are present on Interstate 81. There is also a very high density of speeding crashes clustered over the center of the City of Roanoke. **Figure 35** illustrates the density of fatal and serious injury speeding crashes. High densities of fatal and serious injury crashes are present in the centers of both the City of Roanoke and City of Salem.

Figure 33: Speeding Crashes by Route (2013 – 2017)



4.6 Potential for Safety Improvement

Each year, VDOT uses the methodologies outlined in the American Association of State Highway and Transportation Officials (AASHTO) *Highway Safety Manual (HSM)* to identify intersections and segments statewide with Potential for Safety Improvement (PSI). At each location, the *HSM* methodologies are used to calculate a predicted and expected number of crashes. The number of predicted crashes is based on the crash history at locations statewide with similar volumes and geometry. The number of expected crashes is based on the crash prediction and factored based on the crash history at the specific location. A site is identified as having a PSI if the expected number of crashes is higher than the predicted number of crashes (i.e., more crashes are happening at the individual location than at similar sites statewide).

An intersection or segment is identified as a targeted safety need (TSN) if the location had a PSI for three or more of the past five years. **Figure 36** illustrates the TSN segments and intersections throughout the RVTPO based on the PSI analyses completed from 2012 through 2016. Lists of the TSN intersections and segments are included in **Appendix C**.

The lists and maps of the TSN intersections or segments should be reviewed in conjunction with the other maps and information in this chapter to identify target locations for infrastructure countermeasures.

Figure 34: Speeding Crash Density – Total Crashes (2013 – 2017)

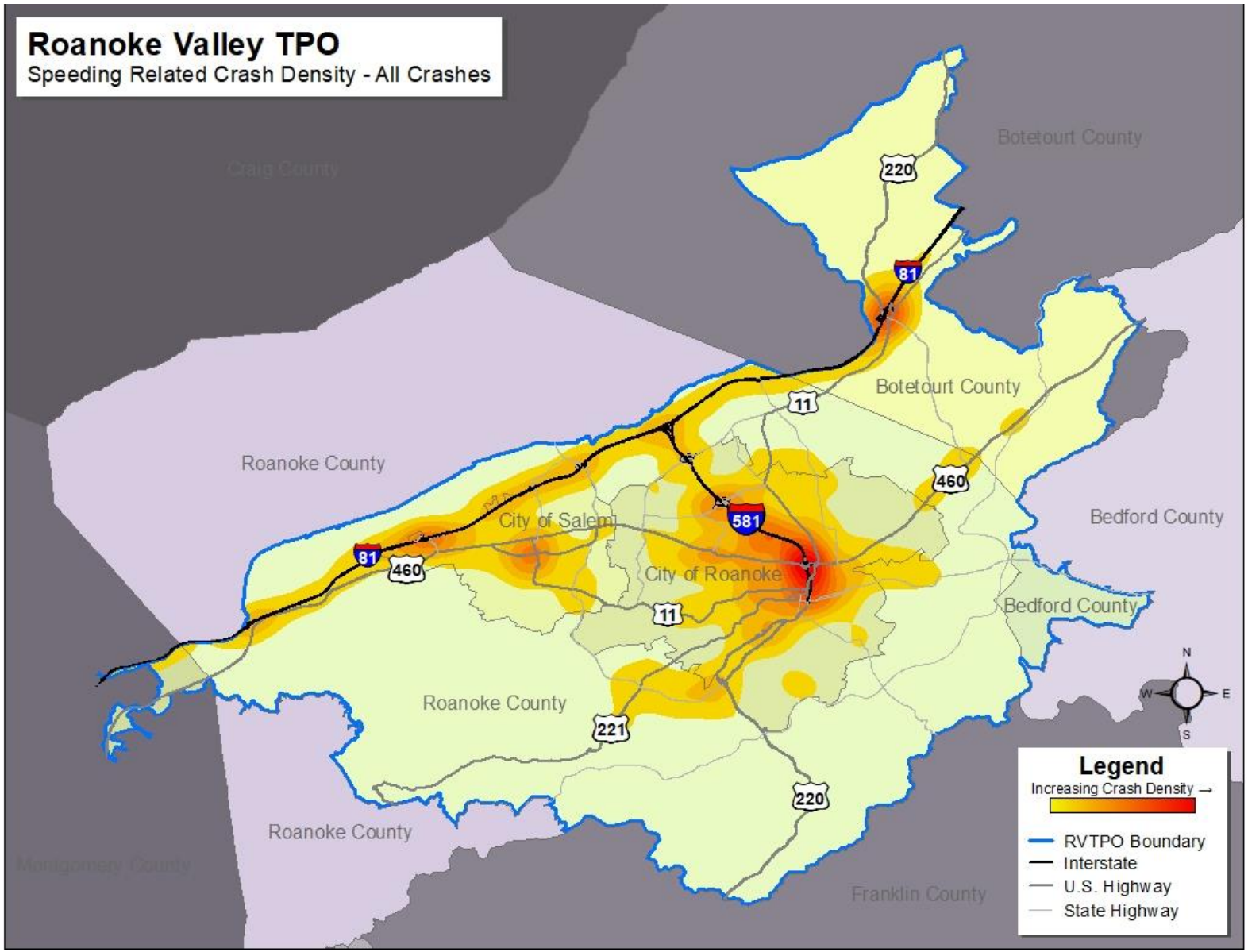


Figure 35: Speeding Crash Density – Fatal and Serious Injury Crashes (2013 – 2017)

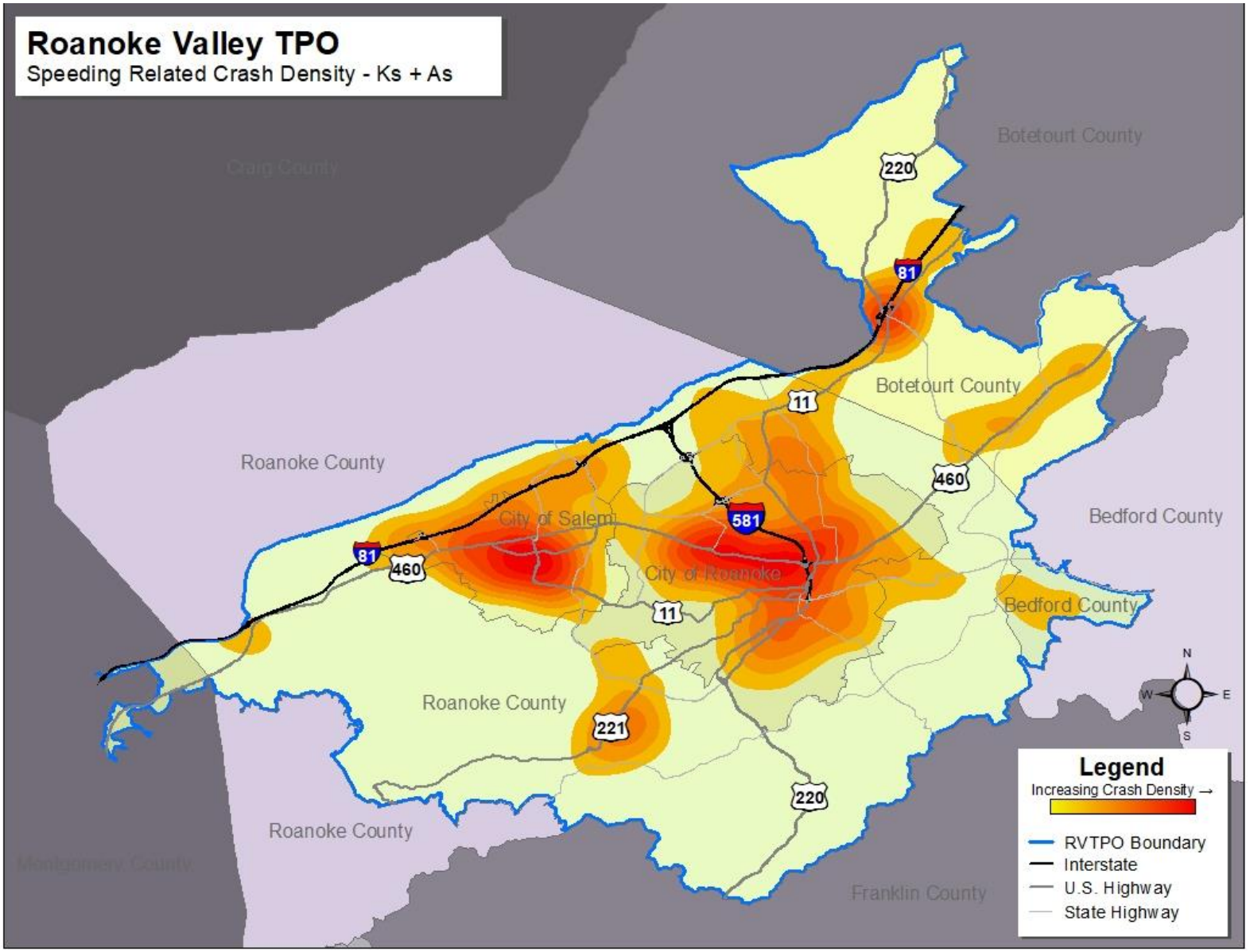
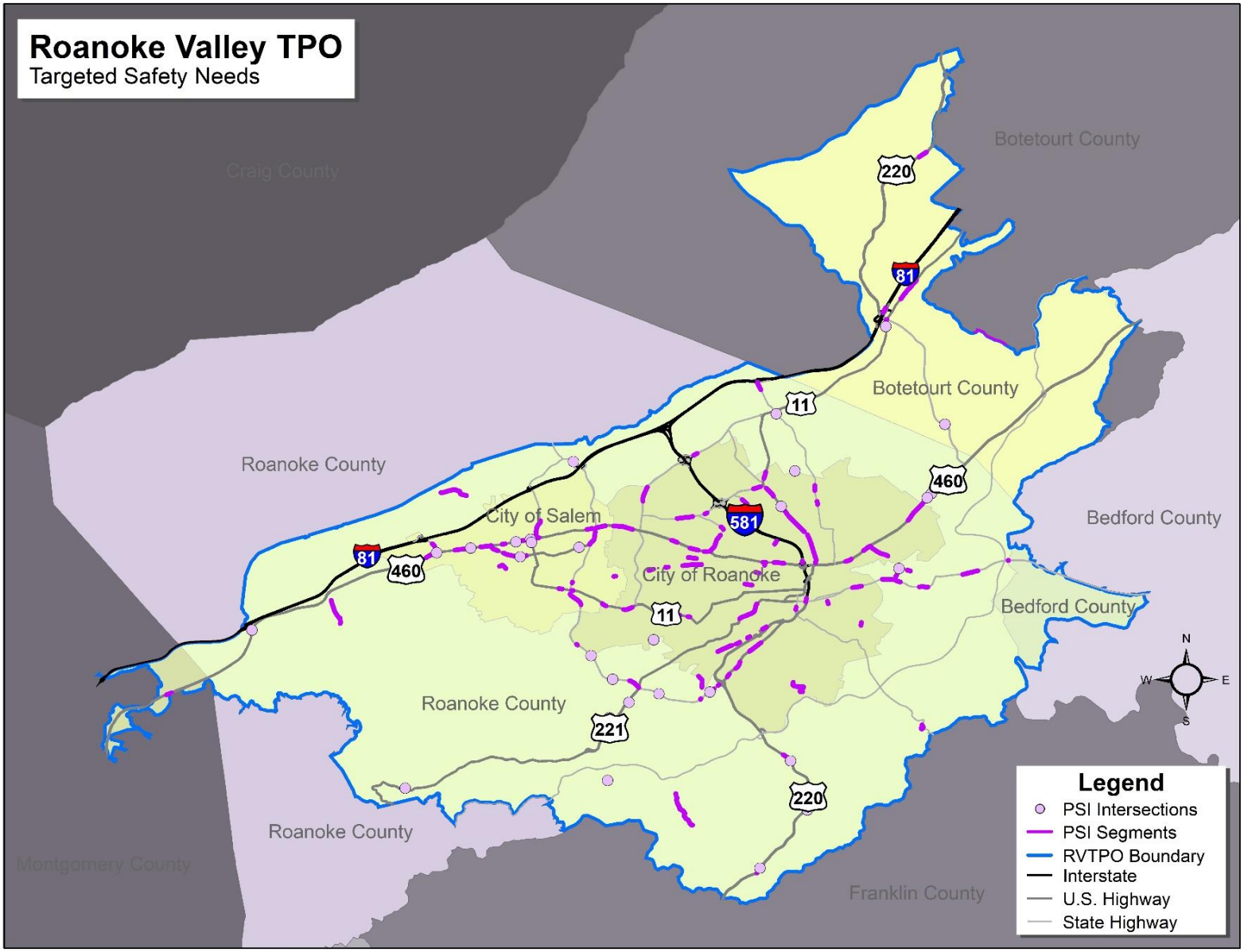


Figure 36: Potential for Safety Improvement Locations (2012 – 2016)



4.7 Pedestrian Crashes

A systemic, predictive approach consistent with the VDOT statewide *Pedestrian Safety Action Plan (PSAP)* was used to review pedestrian safety and identify the corridors in the RVTPO with elevated crash potential or exposure for pedestrians. Each roadway segment in the RVTPO was scored based on the following criteria and weighting:

- High Weight
  - Annual average daily traffic (AADT)
  - Posted speed limit
  - Zero vehicle households (Census block group-level)
  - Population density (Census block group-level)
- Medium Weight
  - Number of lanes and presence of a median
  - Density of employed persons (Census block group-level)
  - Urban/rural context (as defined by Census-defined urbanized boundaries)
  - Proximity to a school (within ¼ mile)
- Low Weight
  - Population below the poverty line (Census block group-level)
  - Existing pedestrian crash history
  - Proximity to transit (within ¼ mile)
  - Proximity to a park (within ¼ mile)

While the pedestrian crashes from 2013 to 2017 were considered (**Figure 37**), the intent of the *PSAP* analysis was not to highlight the roads with the most crashes in the past. Rather, the *PSAP* analysis highlighted the roads with the elevated potential for pedestrian crashes based on pedestrian generators and difficult roadway conditions.

Each roadway segment in the RVTPO was scored based on the criteria and weighting. A higher pedestrian crash potential score represents a higher potential for pedestrian crashes. **Figure 38** illustrates the resulting scores for all roads. Most of the high pedestrian crash potential corridors are located within the Cities of Roanoke and Salem, although some corridors extend into the counties. **Figure 39** highlights only the corridors that scored in the top 25th percentile for pedestrian crash potential.

Figure 37: Pedestrian Crash Locations (2013 – 2017)

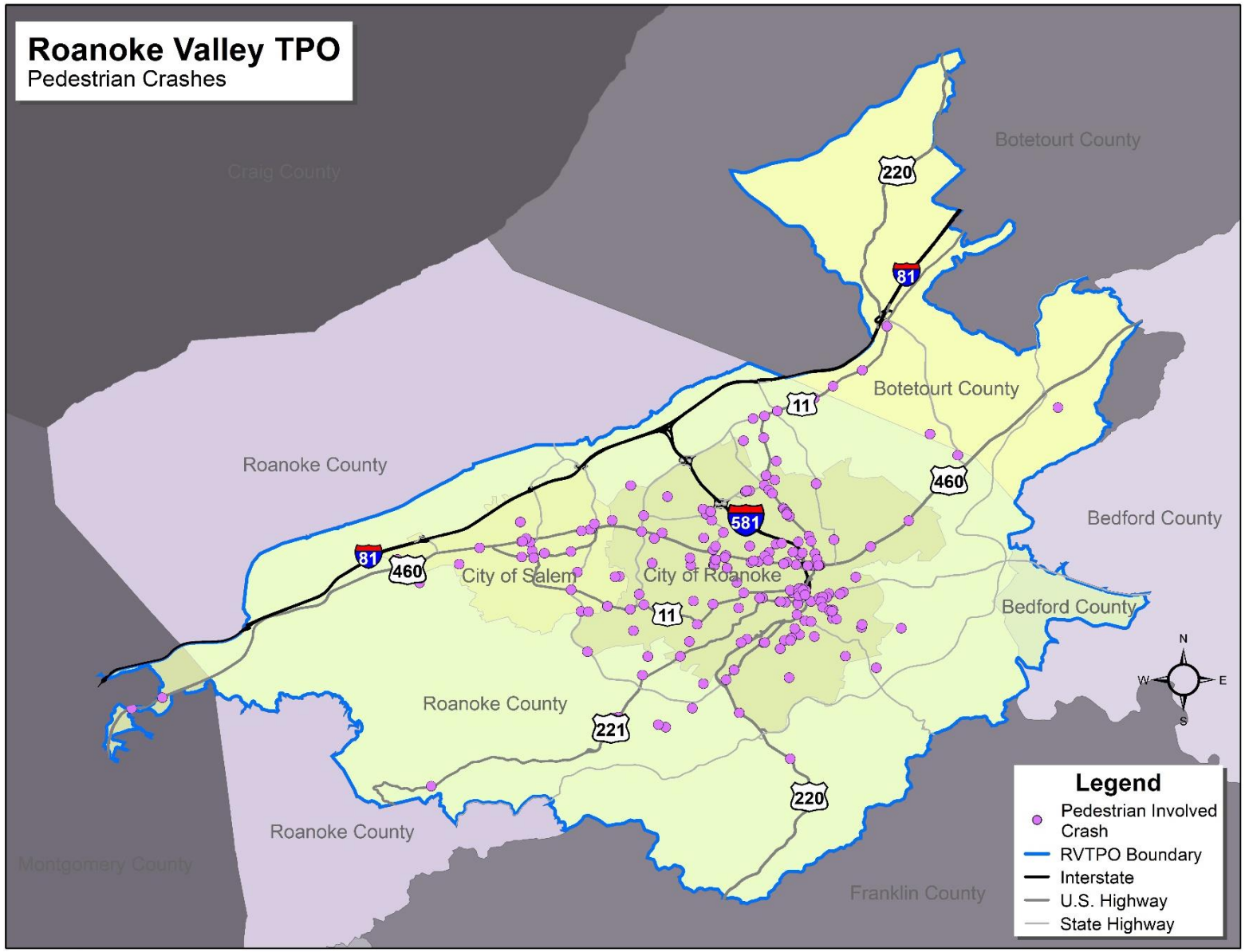


Figure 38: Pedestrian Crash Potential

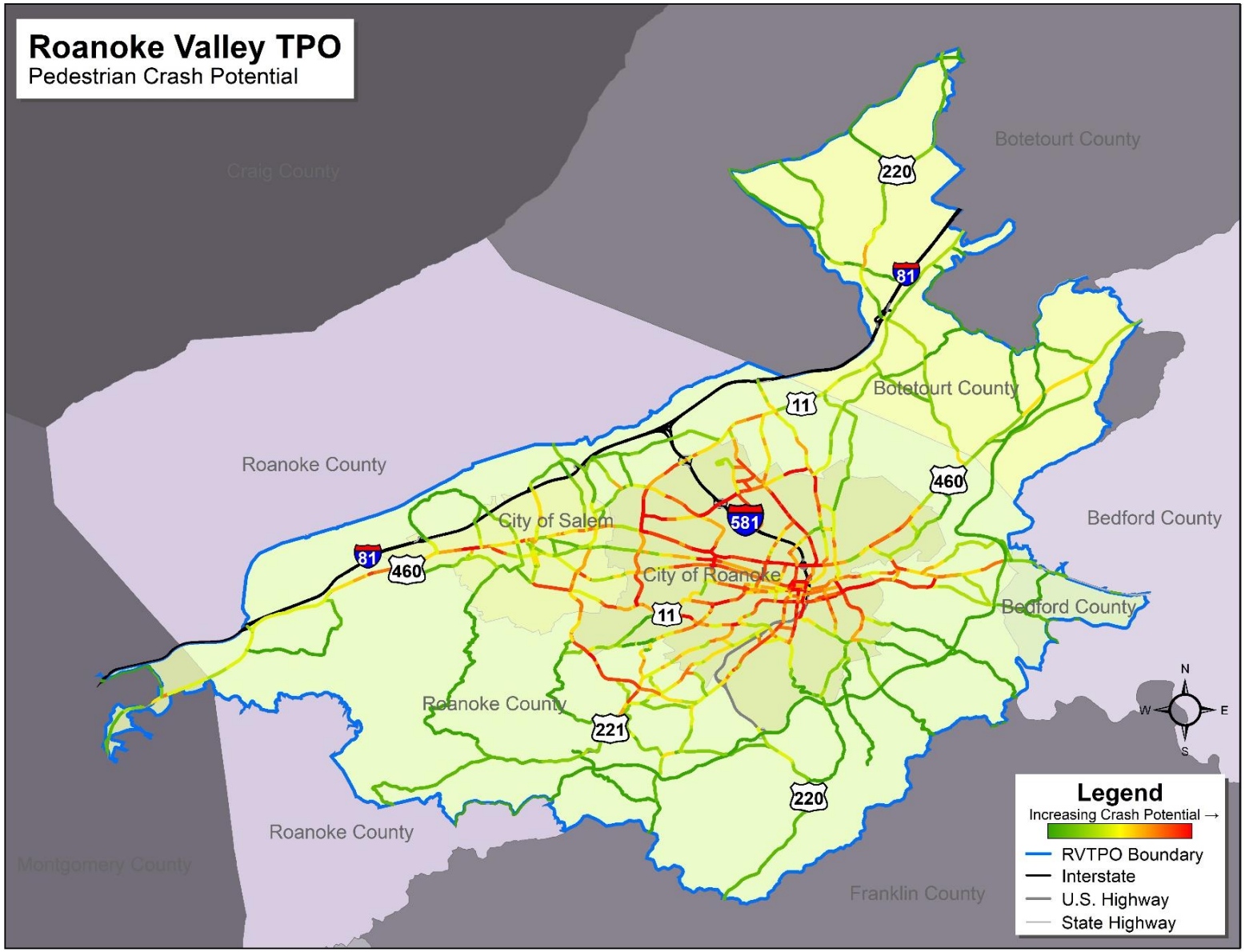
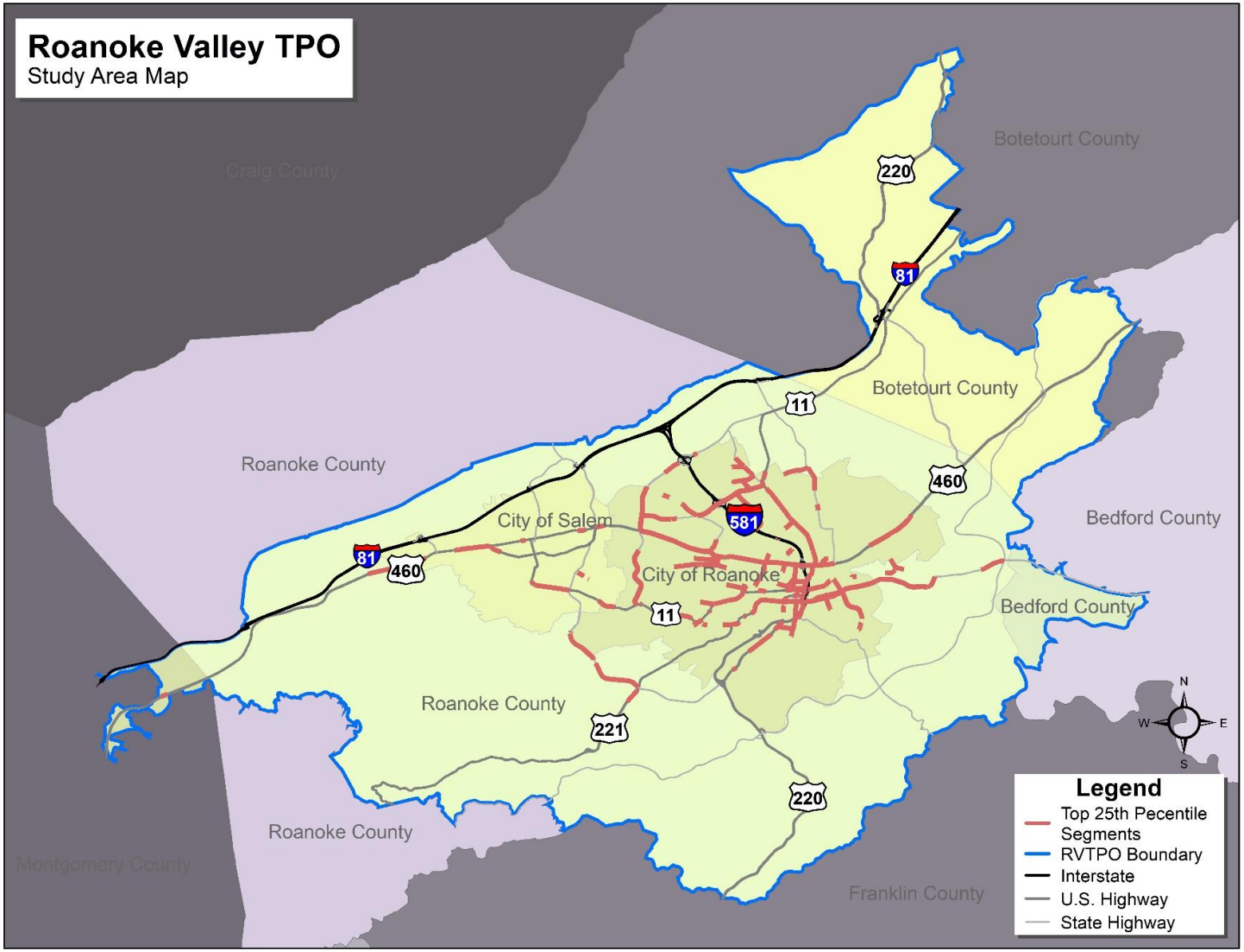


Figure 39: Pedestrian Crash Potential – Top 25th Percentile Segments



5 COUNTERMEASURES THAT WORK

National resources, including the National Highway Traffic Safety Administration (NHTSA) *Countermeasures That Work*, the National Cooperative Highway Research Program (NCHRP) Report 500, and the Federal Highway Administration (FHWA) Proven Countermeasures, list countermeasures that are effective in reducing fatalities and serious injuries. On the state level, VDOT published a list of preferred crash modification factors (CMFs). A CMF is a multiplicative factor used to calculate the expected number of crashes at a given site after implementing a specific countermeasure. 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 in the RVTPO. 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.

5.1 Behavioral Countermeasures

- Speeding
  - Communications and outreach supporting enforcement
  - Use targeted conventional speed enforcement programs at locations known to have speeding-related crashes
  - Automated enforcement
- Distracted Driving
  - Graduated Driver Licensing (GDL) requirements for beginning drivers
  - High-visibility cell phone/text messaging enforcement
  - Encourage employers to offer fatigue management programs to employees working nighttime or rotating shifts
  - Enhance enforcement of commercial motor vehicle hours of service regulations
- Seat Belt Use
  - GDL requirements for beginning drivers
  - Learner's permit length, supervised hours
  - Intermediate – nighttime restrictions
  - Intermediate – passenger restrictions
  - Enforcement of GDL and Zero Tolerance laws
  - Publicize and enforce safety belt laws
- Impaired Driving
  - Administrative License Revocation or Suspension
  - Publicized sobriety checkpoints
  - Saturation patrols
  - Preliminary breath test devices (increases arrests)
  - Passive alcohol sensors (detects impairment)
  - DWI courts (reduces recidivism)
  - Limits on diversion and plea agreements (increases conviction)
  - Alcohol problem assessment and treatment
  - Alcohol ignition interlocks
  - DWI offender monitoring
  - Alcohol screening and brief intervention
  - Mass-media campaigns
  - Zero tolerance law enforcement (young drivers)
  - Alcohol vendor compliance checks
- Bicycles
  - Bicycle helmet laws for children
  - Bicycle helmet laws for adults
  - Safe Routes to School programs
  - Active lighting and rider conspicuity

- Pedestrians
  - Elementary-age child pedestrian training
  - Safe Routes to School programs
  - Pedestrian safety zones
  - Conspicuity enhancement (reflective lighting)
  - Enforcement strategies (increase compliance with laws)
  - Provide education, outreach, and training
- Intersections
  - Guide motorists more effectively through complex intersections

5.2 Infrastructure Countermeasures

- Speeding
  - Speed limits
  - Provide adequate change and clearance intervals at signalized intersections
  - Provide adequate sight distance for expected speeds
- Distracted Driving
  - Install shoulder and/or centerline rumble strips
  - Implement other roadway 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 sharp curves
  - Provide improved highway geometry for horizontal curves
  - Widen and/or pave shoulders
  - Design safer slopes and ditches to prevent rollovers
  - Remove/relocate objects in hazardous locations
- Intersections
  - Reduce frequency and severity of intersection conflicts through traffic control and operational improvements
  - Reduce intersection conflicts through geometrics
  - Improve sight distance
  - Improve access management
  - Choose appropriate intersection traffic control to minimize crash frequency and severity
- Bicycles
  - Reduce and enforce speed limits
  - 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
  - Install overpasses/underpasses
  - Provide crosswalk enhancements
  - Implement lighting/crosswalk illumination measures
  - Install traffic calming—road sections
  - Install traffic calming—intersections

6 Implementation Options

The overall goal of this plan is to help the RVTPO progress toward its safety performance targets by reducing fatalities and serious injuries. 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. Roanoke Valley-Alleghany Regional Commission (RVARC) staff, who staff the RVTPO, 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.

6.1 Organizational

Culture

The RVTPO has several transportation priorities, but a safe systems 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.

- RVARC staff read "Zero Road Deaths and Serious Injuries" and propose next steps for the region

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.

- RVARC staff prepare and present a summary of this analysis to stakeholders

Project Selection

The RVTPO 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.

- RVTPO adopt project prioritization and incorporate safety into prioritization

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 Blue Ridge Transportation Safety Board currently meets bimonthly to discuss safety in the Roanoke Valley region. The multidisciplinary committee consists of members from law enforcement, emergency services, engineering, research, health advocacy groups, and government. Continued coordination with the Blue Ridge Transportation Safety Board will help the RVTPO identify, prioritize, and accomplish safety initiatives.

- RVARC staff continue to attend Blue Ridge Transportation Safety Board meeting
- RVARC staff serve as a liaison to communicate between RVTPO and the Blue Ridge Transportation Safety Board

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.

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

6.2 Behavioral

Countermeasures Being Implemented

Several behavioral strategies are already being implemented in the region, in coordination with the Blue Ridge Transportation Safety Board, the Regional DUI Task Force, and others.

- Through liaison with the Blue Ridge Transportation Safety Board, continue tracking and sharing results of behavioral strategies

Countermeasure and Strategy Prioritization

In addition to the countermeasures already underway, other proven solutions could be implemented to address unbelted, young driver, speeding, impaired driving, and distracted driving crashes.

- RVARC staff review the countermeasures list and coordinate with safety stakeholders, such as local law enforcement and the Blue Ridge Transportation Safety Board, in the region to prioritize and implement behavioral countermeasures

Resource/Information Sharing

Statewide campaigns are led every year around occupant protection, impaired drivers, 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 RVTPO.

- Become familiar with statewide and regional campaigns and schedules through the Blue Ridge Transportation Safety Board and Virginia's Towards Zero Deaths (https://tzdva.org/) initiative and identify opportunities to partner with outreach and education

Density Maps

As part of this study, density maps for speed and roadway departure crashes were developed. These maps could be shared with law enforcement to better target education and enforcement efforts. In addition, 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 National Highway Transportation Safety Administration (NHTSA) funded grant programs. The DMV prepares an interactive map through the Traffic Records Electronic Data System (TREDS) for all jurisdictions (https://www.treds.virginia.gov/mapping/map/crashesbyjurisdiction) and behavioral program maps for all legislative boundaries (https://www.dmv.virginia.gov/safety/#crash_data/house_summ.asp).

- RVARC staff share maps with Blue Ridge Transportation Safety Board
- RVARC staff develop maps for other emphasis areas as needed

6.3 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,

including the City of Roanoke, 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.

- RVARC staff read Zero Road Deaths and Serious Injuries and propose next steps for the region

Priority Locations

This study identifies intersections and segments as well as pedestrian crash locations with the potential for safety improvement. The RVTPO, 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 RVTPO can review crash patterns and trends at the priority segments and intersections to determine what infrastructure treatments would result in the highest safety benefit. The Hampton Roads TPO performed a similar exercise as the second part of the *Hampton Roads Regional Safety Study*.

- RVTPO prioritize locations
- RVARC staff review this analysis with locality staff to identify countermeasures that can be incorporated into infrastructure projects for funding applications or pursued with local funds and programs
- RVARC staff conduct Roadway Safety Assessments or other analyses to consider the expected safety benefits of design alternatives for infrastructure projects being submitted for funding

Multidisciplinary Strategies

Once the intersections, segments, or pedestrian crash locations have been prioritized for further review, the RVTPO can overlay young driver, distracted driving, impaired driving, unbelted driving, and speeding data on top of these to better determine a combination of multidisciplinary strategies (engineering, enforcement, and education) for implementation.

- RVARC staff serve as a liaison to communicate between RVTPO and the Blue Ridge Transportation Safety Board

Data

Changes to population, commercial and residential development, and other factors over time impact where and why crashes are occurring. It will be important for RVTPO to regularly study crash trends and roadway data to revise the priority list and emphasis areas, as necessary. Updates to this analysis should be considered on a three- to five-year cycle.

- In three to five years, RVARC staff update analysis with the latest data
- RVTPO revise priority list and emphasis areas based on updated analysis
- RVARC staff update countermeasures options using the latest recommendations

APPENDIX A

EPDO Crashes by Intersection (2013 – 2017): Signalized Intersections

Intersection	Total EDPO Crashes	Ownership	Jurisdiction
Route 419 (Electric Road) & Roanoke Boulevard	718	City of Salem	City of Salem
Route 419 (US 460 ALT/US 11 Alt) & Springfield Avenue	522	City of Salem	City of Salem
Route 419 (Electric Road) & Colonial Avenue	492	VDOT	Roanoke County
US 11 (Lee Highway) & US 220 (Roanoke Road)	435	VDOT	Botetourt County
US 460 (Orange Avenue) & Kimball Avenue/Plantation Road	393	City of Roanoke	City of Roanoke
US 460/US 11 (East Main Street) & Broad Street	376	City of Salem	City of Salem
US 11 (Apperson Drive) & Route 419 (Electric Road)	355	City of Salem	City of Salem
US 460/US 11 (West Main Street) & Route 112 (Wildwood Road)	341	City of Salem	City of Salem
Route 419 (Electric Road) & Braeburn Drive	339	City of Salem	City of Salem
US 460/US 11 (West Main Street) & Turner Road/Hurt Lane	332	City of Salem	City of Salem
Route 419 & Elm View Road	331	VDOT	Roanoke County
US 460/US 11 (East Main Street) & US 11 Alt	324	City of Salem	City of Salem
US 460 & Valley Gateway Boulevard	318	VDOT	Roanoke County
Route 24 (Hardy Road) & Vinyard Road	314	Town of Vinton	Town of Vinton
Route 24 & East Vinton Plaza	313	VDOT	Roanoke County
US 11/US 460 (East Main Street) & Route 619 (Academy Street/Union Street)	308	City of Salem	City of Salem
US 11(Williamson Road) & Floraland Drive/Frontier Road	305	City of Roanoke	City of Roanoke
US 460/US 221 & Laymantown Road	300	VDOT	Botetourt County
US 460 & West Ruritan Road	291	VDOT	Roanoke County
US 11 (West Main Street) & Mill Lane/Spartan Drive	291	City of Salem	City of Salem
US 460 (Orange Avenue) & Gus Nicks Boulevard	289	City of Roanoke	City of Roanoke
Route 419 (Electric Road/US 460 Alt) & US 460/East Main Street	279	City of Salem	City of Salem
Roanoke Boulevard & Hemlock Road	272	City of Salem	City of Salem
US 460 (East Main Street) & Route 311 (Thompson Memorial Drive)	272	City of Salem	City of Salem
US 11 & Plantation Road	250	VDOT	Roanoke County
US 11 & Route 117	246	VDOT	Roanoke County

APPENDIX B

EPDO Crashes by Route (2013 – 2017)

Route Name	K Crashes	A Crashes	B Crashes	C Crashes	PDO Crashes	Total Crashes	EPDO Crashes
US 11	7	107	279	260	1,563	2,216	15,343
US 460	11	72	253	133	1,126	1,595	11,376
I-81	8	64	237	29	1,251	1,589	9,886
Route 419	4	45	104	205	748	1,106	6,978
US 220	5	40	183	69	698	995	6,698
Route 24	2	26	105	81	467	681	4,302
US 221	3	24	70	65	379	541	3,699
I-581	2	18	110	12	501	643	3,361
Route 115	1	23	39	38	183	284	2,803
US 460 Alternate	0	23	11	50	147	231	2,462
Route 117	1	7	70	24	275	377	1,775
US 220 Alternate	0	11	54	10	191	266	1,716
Roanoke Boulevard (Excluding Route 11 Overlap)	1	16	3	18	47	85	1,612
Route 116	1	8	52	17	147	225	1,517
Route 101	1	5	62	14	192	274	1,392
Hollins Ave NE/13th Street (Excluding Route 115 Overlap)	0	10	25	2	100	137	1,210

Note: Only Routes with greater than 1,000 EPDO crashes are included in this summary table.

Roadway Departure Crashes by Route (2013 – 2017)

Route Name	K Crashes	A Crashes	B Crashes	C Crashes	PDO Crashes	Total Crashes	EPDO Crashes
I-81	5	35	81	12	311	444	4,581
US 460	4	13	21	6	73	117	1,758
US 11	0	13	32	15	98	158	1,598
US 220	2	11	25	14	91	143	1,516
I-581	1	9	34	4	107	155	1,317
US 221	1	10	10	7	31	59	1,101
Route 24	0	6	9	0	30	45	630
Hollins Avenue NE/13th Street (Excluding Route 115 Overlap)	0	5	5	1	40	51	520
Twelve O'clock Knob Road	1	4	4	2	18	29	493
Mud Lick Road SW/Edgewood Street SW/ Memorial Avenue SW	0	5	0	0	17	22	442
Route 419	1	3	4	4	19	31	419
West Riverside Drive/ Piedmont Avenue/Mulberry Street/Front Ave	0	4	3	4	16	27	406
Route 116	0	2	16	4	25	47	375
Route 115	0	3	8	1	18	30	358

Note: Only routes with greater than 300 roadway departure EPDO crashes are included in this summary table.

Speeding Crashes by Route (2013 – 2017)

Route Name	K Crashes	A Crashes	B Crashes	C Crashes	PDO Crashes	Total Crashes	EPDO Crashes
I-81	4	29	99	15	515	662	4,385
US 460	4	26	26	15	105	176	2,990
US 11	4	14	39	19	100	176	2,115
US 220	0	13	39	15	99	166	1,669
I-581	1	6	44	5	172	228	1,232
US 221	1	6	12	10	29	58	794
Route 115	1	6	8	7	12	34	722
Route 419	2	3	12	18	53	88	687
Route 24	0	6	11	6	37	60	688
US 220 Alternate	0	6	12	0	29	47	659
Hollins Ave NE/13th Street (Excluding Route 115 Overlap)	0	5	7	1	20	33	520
US 460 Alternate	0	4	3	6	20	33	420
Route 116	1	2	12	2	18	35	403
West Riverside Drive/ Piedmont Avenue/Mulberry Street/Front Ave	0	4	2	3	9	18	384
Merriman Road	1	3	2	1	5	12	370
Shenandoah Avenue NW	0	3	10	0	9	22	364

Note: Only routes with greater than 300 speeding EPDO crashes are included in this summary table.

APPENDIX C

Potential for Safety Improvement Intersections

Intersection	Jurisdiction	Number of PSI Years
US 11 (Lee Highway) & Olde Route 604	Botetourt	5
US 220 (Cloverdale Road) & Eastpark Drive	Botetourt	3
US 11 (Williamson Road NW) & Fleming Avenue NW)	City of Roanoke	4
US 220 (Franklin Road) & Webb Road	Roanoke County	5
Route 419 (Electric Road) & Elm View Road	Roanoke County	5
US 460/US 221 (Challenger Avenue NE) & Valley Gateway Boulevard	Roanoke County	5
Colonial Avenue & Merriman Road	Roanoke County	5
Route 625 (Hershberger Road NW) & Oakland Boulevard	Roanoke County	4
US 11/US 460 (West Main Street) & Dow Hollow Road	Roanoke County	4
Cotton Hill Road & Grubb Road	Roanoke County	4
US 220 (Franklin Road) & Route 657 (Crowell Gap Road/Winter Drive)	Roanoke County	4
US 220 (Franklin Road SW) & Clearbrook Lane	Roanoke County	4
Route 419 (Electric Road) & Glen Heather Drive	Roanoke County	4
Route 419 (Electric Road) & McVitty Road/Winterberry Drive	Roanoke County	4
US 221 (Bent Mountain Road) & Strawberry Lane/Countrywood Drive	Roanoke County	4
US 460/US 221 (Challenger Avenue NE) & West Ruritan Road	Roanoke County	3
Grandin Road SW & Garst Mill Road	Roanoke County	3
Roselawn Road & Canter Drive/Rosecliff Road	Roanoke County	3
Route 419 (Electric Road) & Colonial Avenue	Roanoke County	3
Route 115 (Plantation Road) & Dexter Road	Roanoke County	3
Route 419 (North Electric Road) & Loch Haven Drive	Roanoke County	3
US 11/US 460 (West Main Street) & Spartan Drive/Mill Lane	City of Salem	5
US 11/US 460 (East Main Street) & College Avenue	City of Salem	4
US 11/US 460 (West Main Street) & Route 112 (Wildwood Road)	City of Salem	4
US 11 Alt & Union Street	City of Salem	4
US 11/US 460 (East Main Street) & Route 619 (Academy Street/Union Street)	City of Salem	4

Intersection	Jurisdiction	Number of PSI Years
US 11 (College Avenue) & Route 311 (Thompson Memorial Drive)/East Burwell Street	City of Salem	3
US 11 Alt & Lynchburg Turnpike	City of Salem	3
East Washington Avenue & Pollard Street	Vinton	4

Potential for Safety Improvement Segments

Road	From	To	Jurisdiction	Number of PSI Years
IS00081S	151.03	151.19	Botetourt	3
IS00581N	1.2	1.24	City of Roanoke	4
IS00581S	0	0.07	City of Roanoke	5
IS00581S	1.17	1.22	City of Roanoke	5
US00011	133.07	133.17	Montgomery	4
US00011	140.64	140.79	City of Salem	5
US00011	140.79	140.95	City of Salem	5
US00011	141.38	141.57	City of Salem	5
US00011	141.57	141.77	City of Salem	5
US00011	141.98	142.26	City of Salem	5
US00011	142.51	142.57	City of Salem	4
US00011	142.94	143.12	City of Salem	4
US00011	145.21	145.29	City of Salem	4
US00011	145.53	145.57	City of Salem	5
US00011	146.36	146.48	City of Salem	5
US00011	146.36	146.48	City of Roanoke	5
US00011	146.95	147.17	City of Roanoke	4
US00011	148.33	148.42	City of Roanoke	3
US00011	148.6	148.66	City of Roanoke	5
US00011	152.75	152.96	City of Roanoke	5
US00011	152.96	153.09	City of Roanoke	4
US00011	153.09	153.3	City of Roanoke	5
US00011	153.3	153.6	City of Roanoke	4
US00011	153.71	154.11	City of Roanoke	5
US00011	154.11	154.31	City of Roanoke	5
US00011	154.38	154.52	City of Roanoke	4
US00011	154.99	155.18	City of Roanoke	5
US00011	155.6	155.71	City of Roanoke	5
US00011	155.71	155.79	City of Roanoke	5
US00011	161.67	161.9	Botetourt	4

Road	From	To	Jurisdiction	Number of PSI Years
US00011	162.58	163.24	Botetourt	3
US00220	52.89	53.05	Roanoke County	3
US00220	55.09	55.18	Roanoke County	4
US00220	56.81	56.97	Roanoke County	3
US00220	56.97	57.07	Roanoke County	5
US00220	82.25	82.49	Botetourt	4
US00221	96.85	97.3	City of Roanoke	4
US00221	97.3	97.43	City of Roanoke	5
US00460	148.04	148.12	City of Salem	5
US00460	149.29	149.42	City of Salem	5
US00460	149.5	149.74	City of Salem	3
US00460	149.94	150.4	City of Roanoke	3
US00460	151.39	151.54	City of Roanoke	5
US00460	151.89	152.09	City of Roanoke	3
US00460	152.24	152.3	City of Roanoke	5
US00460	153.67	153.75	City of Roanoke	5
US00460	153.93	154.13	City of Roanoke	5
US00460	155.63	155.68	City of Roanoke	4
US00460	155.68	155.79	City of Roanoke	5
US00460	156.18	156.28	City of Roanoke	5
US00460	156.28	156.44	City of Roanoke	3
US00460	157.69	158.07	City of Roanoke	4
US00460	157.69	158.07	City of Roanoke & Roanoke County	4
US00460	158.07	158.29	Roanoke County	5
A2US00460	0	0.22	City of Salem	5
A2US00460	0.4	0.77	City of Salem	5
A2US00460	0.9	0.93	City of Salem	4
A2US00460	2.5	2.85	City of Salem	4
A2US00460	2.85	2.91	City of Salem	5
C2US00220	0.27	0.34	City of Roanoke	5

Road	From	To	Jurisdiction	Number of PSI Years
C2US00220	0.54	0.76	City of Roanoke	4
C2US00220	1.15	1.52	City of Roanoke	5
SR00024	1.39	1.45	City of Roanoke	5
SR00024	1.47	1.62	City of Roanoke	3
SR00024	2.16	2.22	Town of Vinton	5
SR00024	2.22	2.32	Town of Vinton	4
SR00024	2.32	2.39	Town of Vinton	5
SR00024	2.49	2.6	Town of Vinton	4
SR00024	3.07	3.15	Town of Vinton	5
SR00024	3.15	3.29	Town of Vinton	5
SR00024	4.3	4.53	Roanoke County	4
SR00024	4.55	4.67	Roanoke County	5
SR00024	5.46	5.48	Bedford	3
SR00101	0.85	1.22	City of Roanoke	4
SR00101	1.52	1.58	City of Roanoke	5
SR00101	2.92	2.97	City of Roanoke	5
SR00101	2.97	3.09	City of Roanoke	5
SR00112	0	0.29	City of Salem	3
SR00115	2	2.1	City of Roanoke	4
SR00115	2.42	2.56	City of Roanoke	5
SR00115	5.78	5.98	Roanoke County	5
SR00116	15.31	15.4	City of Roanoke	5
SR00116	19.37	19.91	City of Roanoke	3
SR00116	20.1	20.2	City of Roanoke	4
SR00117	3.21	3.32	City of Roanoke	5
SR00117	3.32	3.67	City of Roanoke	4
SR00117	5.08	5.2	City of Roanoke	3
SR00286	19.96	20	City of Roanoke	3

Road	From	To	Jurisdiction	Number of PSI Years
SR00294	10.19	10.47	Roanoke County	3
SR00311	0.17	0.71	City of Salem	4
SR00419	0.03	0.07	Roanoke County	5
SR00419	0.23	0.37	Roanoke County	4
SR00419	0.67	0.69	Roanoke County	5
SR00419	2.28	2.4	Roanoke County	4
SR00419	2.4	2.48	Roanoke County	5
SR00419	2.48	2.57	Roanoke County	5
SR00419	4.32	4.35	Roanoke County	4
SR00419	5.6	6.01	City of Salem	5
SR00419	6.35	6.38	City of Salem	5
1100652	3.01	3.97	Botetourt County	5
8000612	0.16	0.91	Roanoke County	4
8000615	4.43	5.47	Roanoke County	4
8000619	1.82	2.54	Roanoke County	4
12800008	0.96	1.04	City of Roanoke	4
12800017	0	0.17	City of Roanoke	5
12800019	0.88	1.05	City of Roanoke	4
12808001	0.57	0.76	City of Roanoke	3
12808001	0.76	0.95	City of Roanoke	3
12808001	1.06	1.16	City of Roanoke	4
12808001	1.39	1.46	City of Roanoke	5
12808001	1.81	1.86	City of Roanoke	4
12808001	1.86	1.94	City of Roanoke	5
12808003	0.75	1.15	City of Roanoke	5
12808003	1.15	1.33	City of Roanoke	5
12808008	1.94	2.08	City of Roanoke	4
12808008	2.09	2.15	City of Roanoke	5

Road	From	To	Jurisdiction	Number of PSI Years
12808010	0.58	0.7	City of Roanoke	5
12808010	0.99	1.06	City of Roanoke	5
12808010	1.38	1.65	City of Roanoke	3
12808010	1.65	1.85	City of Roanoke	5
12808011	0	0.15	City of Roanoke	4
12808011	0.24	0.38	City of Roanoke	5
12808023	0.49	0.58	City of Roanoke	4
12808030	1.06	1.15	City of Roanoke	3
12808041	0.8	0.85	City of Roanoke	3
12808041	1.53	1.63	City of Roanoke	4
12808050	0	0.14	City of Roanoke	5
12808050	0.14	0.26	City of Roanoke	5
12808050	0.26	0.53	City of Roanoke	4
12908002	1.38	1.58	City of Salem	5
12908010	1.7	1.75	City of Salem	5
14908049	0.11	0.16	Town of Vinton	3
14908050	0.5	0.58	Town of Vinton	5