Updates to Risk Factors for SHSP Emphasis Areas

Older Drivers (65+)

PREPARED FOR

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Purpose & Background

The Massachusetts Department of Transportation (MassDOT) is updating the risk-based network screening maps in the IMPACT tool to incorporate recent crash data and build on lessons learned from previous analyses. This document describes the updated systemic analysis performed by VHB for older driver crashes using crash data from 2017 through 2021. For this analysis, VHB used the default "Older Driver" query[1] in the MassDOT IMPACT tool. The definition reads as: any crash involving a driver aged 65 to 110 based on the "Age of Driver – Oldest Known" field.[2]

Note that the purpose of this report is to identify the factors most correlated with the frequency and severity of older driver involved crashes; causality was not directly investigated. As such, agencies interested in developing targeted countermeasure programs are encouraged to perform some initial investigation into causality of the target crash in their jurisdiction. This will allow the agency to develop targeted countermeasures.

Data Analysis and Focus Crash Types

To establish context, VHB first used the MassDOT IMPACT "Test of Proportions" tool[3] to summarize fatal injury (K) and suspected serious injury (A) older driver crashes. To identify overrepresented crash attributes, VHB compared KA older driver crashes to all KA crashes in the State. Where the proportion for a given attribute is statistically larger than the proportion for the comparison group, that attribute is flagged as a potential risk factor. Statistical overrepresentation is checked by building 95 percent confidence intervals around the proportion using sampling errors. Figure 1 and Figure 2 show how the lower and upper bounds, respectively, are calculated based on the proportion of crashes (*p*) and the number of crashes in the sample (*N*). If the lower bound of older driver KA crashes is larger than the upper bound of the comparison group, the attribute was considered "overrepresented" for the data.

$$95\%\ Confidence\ Interval, Lower\ Bound\ =\ p - 1.96 * \sqrt{\frac{p(1-p)}{N}}$$

Figure 1. Calculation of the lower bound of the 95 percent confidence interval for the proportion of crashes with an attribute.

$$95\%\ Confidence\ Interval, Upper\ Bound\ =\ p + 1.96 * \sqrt{\frac{p(1-p)}{N}}$$

Figure 2. Calculation of the upper bound of the 95 percent confidence interval for the proportion of crashes with an attribute.

Table 1 summarizes notable overrepresentations found in the analysis. VHB included the following data elements in their analysis:

- Access Control.

[1] https://www.mass.gov/info-details/impact-emphasis-area-definitions

[2] MassDOT. *Impact Emphasis Area Definitions.* Available at: https://www.mass.gov/info-details/impact-emphasis-area-definitions. Accessed March, 2023.

[3] https://apps.impact.dot.state.ma.us/sat/TestofProportions

- County Name.
- Crash Day of Week.
- Crash Month.
- Curb.
- Driver Contributing Circumstances.
- Driver Distracted By.
- Facility Type.
- Federal Functional Class.
- First Harmful Event.
- First Harmful Event Location.
- FMCSA Reportable.
- Functional Class.
- Jurisdiction.
- Left Shoulder Type-linked.
- Left Shoulder Width-linked.
- Light Conditions.
- Manner of Collision.
- Max Injury Severity Reported.
- Median Type.
- Operation.
- Opposite Number of Travel Lanes.
- Right Shoulder Type-linked.
- Right Shoulder Width-linked.
- Road Contributing Circumstance.
- Road Surface Condition.
- Roadway Junction Type.
- Speed Limit.
- Terrain Type.
- Total Lanes.
- Traffic Control Device Type.
- Trafficway Description.
- Urban Type.

- Weather Conditions.

Table 1. Summary of Key Overrepresentation Findings.

Crash Field	Crash Attribute	Percent of Older Driver KA Crashes	Percent of All KA Crashes
Access Control	No Access Control	83.2%	79.2%
County	Barnstable	7.0%	4.6%
Weekday	Thursday	16.4%	13.7%
Driver Contributing Circumstances	Failed to yield right of way	9.5%	6.5%
	Illness	2.7%	1.2%
	Inattention	7.4%	6.0%
	No improper driving	34.8%	29.5%
Driver Distracted By	Not Distracted	49.1%	42.8%
Federal Functional Class	Minor Arterial	33.1%	30.2%
	Principal Arterial – Other	32.2%	27.8%
First Harmful Event	Collision with motor vehicle in traffic	60.5%	46.3%
First Harmful Event Location	Roadway	81.1%	73.0%
Light Conditions	Daylight	77.6%	57.8%
Manner of Collision	Angle	30.0%	22.7%
	Head-on	15.0%	11.0%
	Rear-end	15.6%	13.1%
Median Type	None	79.7%	75.8%
Operation	Two-way traffic	92.9%	91.0%
Road Surface Condition	Dry	83.3%	79.4%
Roadway Junction Type	Four-way Intersection	18.9%	16.0%
	T-intersection	18.8%	15.7%
Speed Limit	35 MPH	13.7%	10.8%
	40 MPH	10.8%	8.4%
Total Lanes	2	71.3%	67.5%
Traffic Control Device Type	Stop signs	13.5%	10.4%
Trafficway Description	Two-way, not divided	64.6%	60.2%

From a safety management perspective, it is notable that a large proportion of older driver-involved crashes occurred on arterial roadways with no access control. These crashes were also overrepresented on undivided two-way roads and at four-way/T-intersections. Several of these results are correlated with the driving patterns of older drivers – such as preferring driving during the day on dry pavement[4]. Additionally, the overrepresentation points to the vulnerability of older drivers and vehicle occupants, with elevated severe crash proportions in multi-vehicle angle, head-on, and rear-end crashes. Similarly, these crashes are overrepresented on relatively lower speed facilities (35-40 mph), indicating their vulnerability even in low energy collisions. Driver contributing factors are overrepresented by older driver specific traits including illness, inattention, and failure to yield right of way. These driver specific traits were also

[4] https://www.nhtsa.gov/older-drivers/how-understand-and-influence-older-drivers

identified in a recent study on older driver crashes using SHRP2 NDS data[5]. The majority of divers were found to be not distracted. MassDOT should consider these findings when identifying potential older driver countermeasures. The National Highway Traffic Safety Administration's (NHTSA) *Countermeasures that Work*[6] includes several examples of effective campaigns targeting older drivers including formal courses, general education, license screening and testing, and license restrictions. While these are notable results, they should not restrict the analysis from focusing on all older driver crashes. These results should be considered when developing projects and countermeasures at older driver risk sites. Ultimately, the focus crash type for this analysis is all older driver involved crashes.

Crash Tree and Focus Facility Type

After concluding that the older driver focus crash type should include all older driver crashes, VHB developed a crash tree to identify the facilities where these crashes occur most often. Figure 3 shows the crash tree. It is evident that most older driver KA crashes were in roadways with no access control, followed by a smaller portion on roadways with full access control. Among the crashes on full access-controlled roadways, most of the crashes were on interstates in urban areas, while crashes on roadways with no access control were mostly outside urban areas. Both four-way and T-intersections shared similar share of older KA crashes and most of these were in urban areas.

[5] Zafian, Tracy, et al. "Using SHRP2 NDS data to examine infrastructure and other factors contributing to older driver crashes during left turns at signalized intersections." Accident Analysis & Prevention 156 (2021): 106141.
[6] https://www.nhtsa.gov/book/countermeasures/countermeasures-work/older-drivers

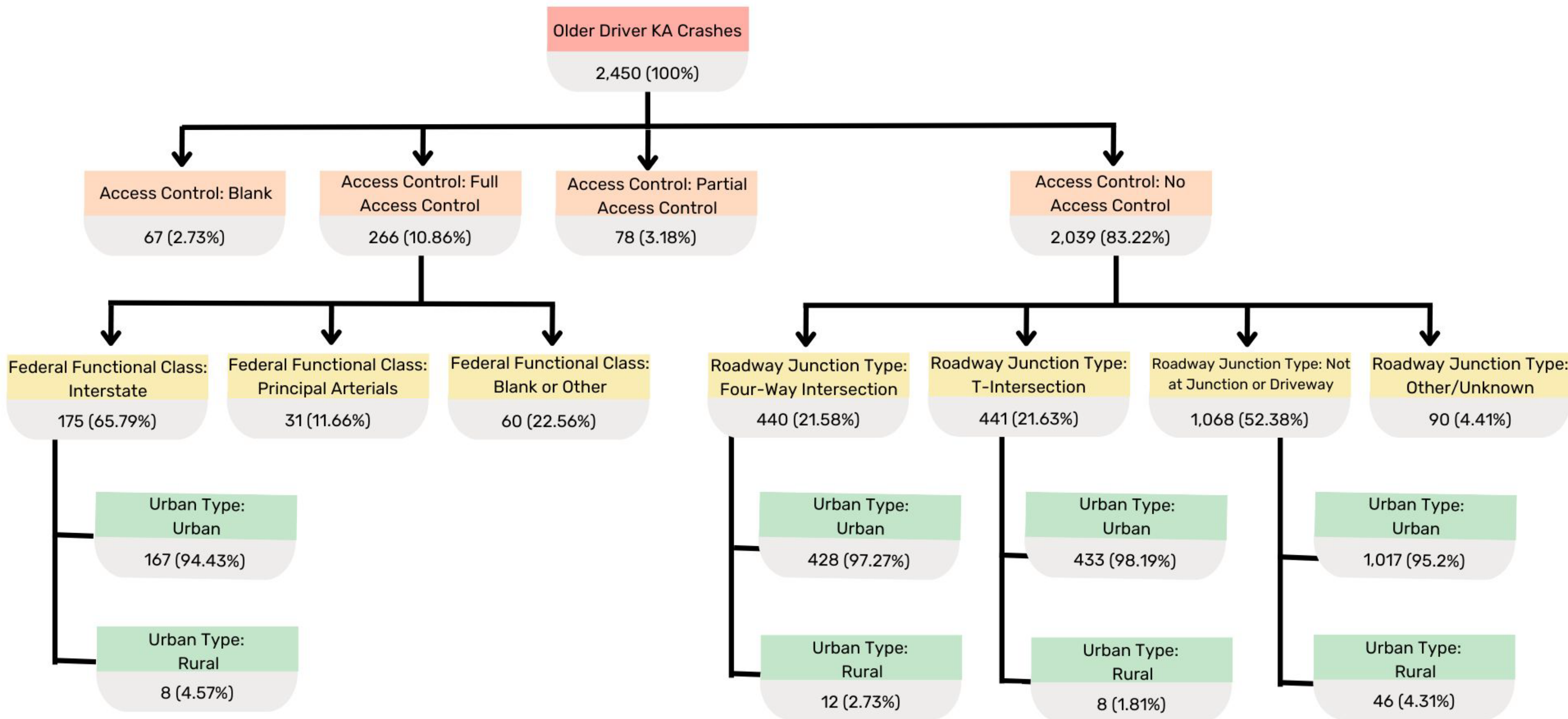

Figure 3. Crash tree summarizing KA older driver crashes in Massachusetts.

The analysis and crash trees above show that older driver crashes tend to occur everywhere and are tough to focus. As a result, this emphasis area will benefit from engineering countermeasures from the lane departure, pedestrian, and intersection analysis. VHB recommends performing a town-level analysis that will prioritize communities for education campaigns focused on addressing the safety of older road users.

Risk Factor Analysis

After identifying focus crash types and trends, VHB proceeded with the risk factor analysis. The following sections describe the methodology, data, and results of this analysis.

Methodology

Negative binomial regression is a standard approach to crash frequency modeling given that crash frequency data are typically overdispersed count data. As such, VHB used a negative binomial count regression modeling approach to identify community-level characteristics associated with higher frequencies of older driver-related KA crashes. Negative binomial regression is commonly used in transportation safety as it applies to over-dispersed count data (i.e., the variance exceeds the mean of the observed data). The dependent variable in the model is the number of older driver-related KA crashes, making a count model appropriate for the data. The functional form of the negative binomial regression model is shown in Figure 4.[7]

$$\lambda_i = e^{\beta X_i + \varepsilon_i}$$

Figure 4. Equation. Negative binomial regression functional form.

Where:

$e^{\varepsilon i}$ = gamma-distributed error term with a mean equal to one and variance equal to α.

λ_i = expected number of older driver-related KA crashes at location i.

β = vector of estimated parameters.

X_i = vector of independent variables that characterize location i and influence older driver-related KA crash frequency.

When modeling, VHB began with road exposure variables and added additional variables one at a time, monitoring the coefficients to ensure the inclusion of a variable did not result in large changes in magnitude. Additionally, VHB included variables with p-values upwards of 0.25 assuming the magnitude of the results made sense. VHB did not select a strict level of significance, as Hauer notes this could lead to misunderstanding or outright disregard for potentially noteworthy results.[8]

Data

VHB used ArcGIS to manage and integrate data for this analysis. VHB aggregated data at the city and town level. In Massachusetts, all roads and geographic areas are covered by town jurisdictions. Due to limitations with crash data acquisition, VHB excluded the City of Boston from the analysis. MassDOT provided VHB with various sources of data, as described in the following sections.

Crash Data

VHB obtained total older driver crashes by town using the MassDOT IMPACT Test of Proportions tool. VHB then joined these totals to the town-level data set.

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[7] Lord, D., Mannering, F., 2010. The Statistical Analysis of Crash-Frequency Data: A Review and Assessment of Methodological Alternatives. Transp. Res. Part A Policy Pract. 44 5 , 291–305. doi:10.1016/j.tra.2010.02.001

[8] Hauer, E. (2004). The harm done by tests of significance. *Accident Analysis & Prevention*, *36*(3), 495-500.

Roadway Data

VHB downloaded the Massachusetts statewide Road Inventory 2021 file, available at https://geo-massdot.opendata.arcgis.com/datasets/342e8400ba3340c1bf5bf2b429ad8294/about. Based on discussions with MassDOT, VHB filtered the roadway data in ArcGIS using mileage counted (equal to 1), jurisdiction (not equal to null), and facility type (less than 7) to identify unique segments that were counted for the Highway Performance Monitoring System (HPMS). Filtering the roadway inventory in this way prevented potential double-counting of mileage and VMT for divided roads and roads with overlapping route numbers. VHB aggregated the roadway data at the town-level, including summing total centerline miles and centerline miles for each Federal Functional Class.

Driver License Data

MassDOT provided driver license data by age, town, and zip code for 2021. VHB used spatial analysis to assign driver license zip codes to the relevant town, joining the driver license totals by age. Additionally, VHB calculated the proportion of drivers that fell within the older driver query definition for each town. VHB integrated these data into the town data set.

School Location Data

VHB obtained primary and secondary school location data from the Massachusetts Bureau of Geographic Information (MassGIS) open data portal (https://www.mass.gov/info-details/massgis-data-massachusetts-schools-pre-k-through-high-school). VHB counted the number of schools present in each town.

College and University Data

VHB accessed college and university location data from the MassGIS open data portal (https://www.mass.gov/info-details/massgis-data-colleges-and-universities). Although these data contain several categories of trade schools and other atypical technical training institutions, VHB only included "Colleges, universities, and professional schools," "Fine arts schools," "Junior colleges," and "Other technical and trade schools" for the purposes of this analysis. VHB then counted the number of colleges and universities present in each town.

Citation Data

VHB obtained traffic citation count data by town for a five-year period between 2015 and 2019. These data included total citations, as well as subsets of counts for speeding-, seat belt-, impaired driving-, and distraction-related traffic citations.

Healthy Aging Data

MassDOT and the University of Massachusetts at Boston provided Healthy Aging Data which provided information related to seniors at the town level. Data elements included proportion of persons aged 65 or older with self-reported cognitive, mobility, or independence challenges as well as counts of assisted living, home health providers, senior care providers, and nonmedical care providers in the town. Additionally, communities are assigned scores based on the reported data. VHB integrated these data at the town level.

Additional Data

VHB obtained several additional data sources for integration into the data set, including census and American Community Survey (ACS) data, public health data from the Massachusetts Department of Public Health (DPH), seatbelt use survey data at the county level, and environmental justice (EJ) data provided by

Environmental Justice Community Block Group Data Update. Note that, regarding EJ data, the reports may change if the final layers were used but they were not available at the time the analyses were performed. The version of Massachusetts 2020 Environmental Justice Block Group data available at the time of the analysis was a preliminary version that was later updated with a final. All of these were aggregated and joined at the town level.

Results

The following sections describe the results of the negative binomial regression modeling effort.

Variables of Interest

To account for unobserved influences due to road facilities and traffic exposure, VHB established a base model that included the natural log of the mile years (i.e., the product of five years of data and total centerline mileage in the town) – this accounts for exposure. Before including additional variables in the negative binomial, VHB developed a correlation matrix of input variables. Highly correlated variables are indicators of potential complications in the model development process. Although VHB considered all potential variables in this matrix, Table 2 shows the correlation matrix for the following 11 variables included in the final older driver model. The largest correlation between any two variables is 0.58, less than the value of 0.70 which typically indicates issues with serial correlation.

1. Proportion of mileage that is interstate, freeway, or expressway.
2. The number of senior care providers in the town is more than 0.
3. Annual impaired driving citations per centerline mile in the town is greater than 0.5.
4. Annual speeding citations per mile in the town is greater than 3.
5. Natural log of persons aged 65 or older in the town.
6. Two or fewer assisted living facilities in the town.
7. The percentage of persons aged 65 or older with self-reported cognitive issues.
8. Proportion of licensed drivers aged 65 or older.
9. Metropolitan Planning Organization (MPO) is either Southeastern Regional Planning & Economic Development District (SRPEDD) or Old Colony Planning Council (OCPC).
10. MPO is the Martha's Vineyard Commission (MVC).
11. MPO is either Cape Cod Commission (CCC) or Boston Region MPO (BRMPO).
12. Natural log of total centerline mile-years

Table 2. Correlation Matrix of Input Variables.

Variable	Functional Class 1	Senior Care	Impaired Citations	Speeding Citations	LN_Person 65+	Assisted Living ≤2	Cognitive Issues	Licensed Driver	MPO= SRPEDD/ OCPC	MPO= MVC	MPO= CCC/ BRMPO
Functional Class 1	1.000										
Senior Care	0.005	1.000									
Impaired Citations	0.136	0.296	1.000								
Speeding Citations	0.285	0.217	0.382	1.000							
LN_Person 65+	0.040	0.471	0.576	0.353	1.000						
Assisted Living ≤2	-0.016	-0.101	-0.174	-0.148	-0.354	1.000					
Cognitive Issues	0.113	0.003	0.141	0.205	0.239	-0.078	1.000				
Licensed Driver	0.063	-0.039	0.017	0.103	0.009	0.057	-0.065	1.000			
MPO= SRPEDD/ OCPC	0.057	0.019	0.216	0.117	0.213	0.079	0.057	-0.023	1.000		
MPO= MVC	-0.132	-0.124	0.012	-0.113	-0.185	-0.027	-0.125	-0.052	-0.062	1.000	
MPO= CCC/ BRMPO	-0.073	0.343	0.220	0.103	0.384	-0.220	-0.028	0.008	-0.312	-0.103	1.000

Model Results

Table 3 documents the results of the final model. The natural log of the product of centerline mileage and 5 years of crash data were included in the model to offset exposure for each town. Two additional risk factors correlate with exposure to older drivers – natural log of population aged 65 or older and the proportion of licensed drivers aged 65 and older. Other healthy aging indicators were found to be correlated with increased older driver crash risk – the percentage of persons aged 65 or older with reported cognitive issues, if the town has 2 or fewer assisted living facilities, and the presence of at least 1 senior care providers in the town – which all point toward potential challenges for older drivers in the town. Additional risk factors appear to be correlated with general risk-taking behaviors on roadways within the town, including less than 80 percent of drivers using their seatbelts, more than 0.5 impaired driving citations per centerline mile, and more than 3 speeding citations per centerline mile. These findings align with prior work on severe older driver crashes.[9] Finally, the higher proportion of interstates, freeways, and expressways points towards a higher proportion of high-speed driving, and thus elevated crash energy, in the town.

[9] Older driver safety: a renewed perspective in a survey study in Illinois, U.S. https://www.mdpi.com/2313-576X/7/4/83

Table 3. Negative Binomial Count Regression Model Results.

Variable (Number)	Coefficient	Standard Error	z-value	P>|z|	95% Confidence Interval	
Proportion of mileage that is interstate, freeway, or expressway	3.139	1.113	2.82	0.005	0.957	5.321
The number of senior care providers in the town is more than 0.	0.288	0.095	3.02	0.003	0.101	0.475
Annual impaired driving citations per centerline mile in the town is greater than 0.5.	0.230	0.102	2.25	0.025	0.030	0.430
Annual speeding citations per mile in the town is greater than 3.	0.193	0.081	2.38	0.017	0.034	0.353
Natural log of persons aged 65 or older in the town.	0.348	0.049	7.03	<0.001	0.251	0.444
2 or fewer assisted living facilities in the town	0.170	0.113	1.51	0.131	-0.051	0.391
The percentage of persons aged 65 or older with self-reported cognitive issues	2.430	1.128	2.16	0.031	0.220	4.640
Proportion of licensed drivers aged 65 or older	0.569	0.552	1.03	0.303	-0.513	1.651
MPO is SRPEDD or OCPC	0.508	0.101	5.02	<0.001	0.310	0.706
MPO is MVC	0.734	0.422	1.76	0.078	-0.083	1.570
MPO is CCC or BRMPO	0.295	0.086	3.43	0.001	0.127	0.463
Constant	-8.506	0.418	-20.32	<0.001	-9.326	-7.686
Natural log of the product of centerline mile length and 5 years of crash data in the town. (Offset)	1	N/A	N/A	N/A	-2.045	-1.433
alpha	0.176	0.156	N/A	N/A	0.129	0.238

Note: Number of observations = 350; Log likelihood = -803.56534; Pseudo R2 = 0.1277; LR chi2(11) = 235.31; Prob > chi2 = <0.0001.

Conclusions and Recommendations

The purpose of this analysis is to identify town-level risk factors for fatal and serious injury older driver crashes. Instead of using the coefficients in the negative binomial regressions results from Table 3, VHB recommends that MassDOT assign risk scores between 0 and 1 based on the character of the risk factor. VHB and MassDOT made this decision to avoid overly weighting any one risk factor, especially considering potential data issues with the risk factor data which may cause biases. Table 4 summarizes the suggested risk-scoring schema. Where the statistical significance of the variable was not strong (i.e., p-value > 0.05), VHB suggests a maximum risk score of 0.5 instead of 1 for the risk factor. Where a binary predictive variable was used, binary risk scores are applied. From a modeling perspective, the cutoffs for the binary variables were determined by using visual representations of the data and smaller bins to find the cutoffs which make the most sense.

Table 4. Town-level risk factors for Older Driver KA Crashes.

Risk Factors for Older Driver KA Crashes	Suggested Scoring
Proportion of mileage that is interstate, freeway, or expressway	Continuous from 0 to 1 for the range of values.
The number of senior care providers in the town is more than 0.	1 if true; 0 otherwise
Annual impaired driving citations per centerline mile in the town is greater than 0.5.	1 if true; 0 otherwise
Annual speeding citations per mile in the town is greater than 3.	1 if true; 0 otherwise
Natural log of persons aged 65 or older in the town.	Continuous from 0 to 2 for the range of values.
2 or fewer assisted living facilities in the town	1 if true; 0 otherwise
The percentage of persons aged 65 or older with self-reported cognitive issues	Continuous from 0 to 0.5 for the range of values.
Proportion of licensed drivers aged 65 or older	Continuous from 0 to 0.5 for the range of values.
MPO is SRPEDD or OCPC	0.75 if true; else
MPO is MVC	1 if true; else
MPO is CCC or BRMPO	0.25 if true; 0 otherwise
Maximum potential score for a town:	**9.0**

Table 5 provides an example application of the risk factors of a hypothetical town. To provide context for these risk factor scores in relation to other emphasis areas, MassDOT can normalize the cumulative score by dividing by the total potential score for a town. This would generate a risk score out of 100 percent for each town. Under this approach, the normalized risk score for the example town is 52.3 percent (4.71 divided by 9.0).

Table 5. Example Risk Score Calculation for Older Driver Crashes.

Variable	Town Characteristic	Risk Factor	Risk Score
Proportion of mileage that is interstate, freeway, or expressway	0.009	Continuous from 0 to 1 for the range of values.	0.25
The number of senior care providers in the town is more than 0.	3	1 if true; 0 otherwise	1
Annual impaired driving citations per centerline mile in the town is greater than 0.5.	0.2	1 if true; 0 otherwise	0
Annual speeding citations per mile in the town is greater than 3.	4.1	1 if true; 0 otherwise	1
Natural log of persons aged 65 or older in the town.	5.011	Continuous from 0 to 2 for the range of values.	1.1
2 or fewer assisted living facilities in the town	3	1 if true; 0 otherwise	0
The percentage of persons aged 65 or older with self-reported cognitive issues	2.1%	Continuous from 0 to 0.5 for the range of values.	0.14
Proportion of licensed drivers aged 65 or older	3.4%	Continuous from 0 to 0.5 for the range of values.	0.47
MPO is SRPEDD or OCPC	MPO is SRPEDD	0.75 if true; else	0.75
MPO is MVC	MPO is SRPEDD	1 if true; else	0
MPO is CCC or BRMPO	MPO is SRPEDD	0.25 if true; 0 otherwise	0
		Total Risk Score:	4.71
		Risk Percent Score (Out of 9):	52.3%

MassDOT ranked the towns at both the statewide and MPO levels using the normalized risk score and the percentile score of ranking (rank kind equal to weak) function in ArcGIS. For each normalized risk score, a percentile rank for the given score was computed relative to all the normalized risk scores. If there are repeated occurrences of the same normalized risk score, then the percentile rank corresponds to values that are less than or equal to the given score. The advantage of the weak ranking approach is that it guarantees that the highest normalized score will receive a percentile rank of 100 percent. For older driver-involved crashes, normalized risk scores range from 0.13 to 0.84. The maximum value (0.84) received a percentile rank of 100 and other values received a percentile rank accordingly. For example, a town with a normalized risk score of 0.80, the calculated state percentile rank was 99.14, and fell in the primary risk town category. MassDOT then assigned risk categories using the computed ranks. For example, towns ranked in the top 5 percentile (95 through 100) were categorized as “Primary Risk Town” and towns ranked in the next 10 percentile (85 through 95) were categorized as “Secondary Risk Town”;

the remaining towns were not categorized. In instances where there are large, repeated occurrences of the same normalized risk score, the percentage of segments computed for top 5 percent or next 10 percent may not be equal to 5 or 10 percent. This is a byproduct of the weak ranking approach.

Table 6 and Table 7 show the distribution of towns and crashes with the normalized risk score (presented as percentages) across these categories for statewide and MPO rankings, respectively. Note the goal was to see a higher proportion of target crashes for primary and secondary risk sites than proportion of towns. Similarly, Figure 5 is a map of the risk towns ranked statewide, while Figure 6 is a map of the risk towns ranked by MPO. These figures indicate the towns in the State that may deserve a higher-level of attention to reduce older driver involved severe crashes. Note that it may be more appropriate to utilize statewide ranking for towns, particularly for the ones that are in the MPOs/RPAs with few towns, as the results for these towns may be skewed. There are a total of 18 towns in the primary risk category (top 5 percent), that captured 14.36 percent of the severe older driver crashes. Similarly, there are 35 towns in the secondary risk category (next top 10 percent), which captured an additional 18.85 percent of the severe older driver crashes. The towns that are in the primary risk category for severe older driver crashes are Fall River, Revere, Saugus, Brockton, New Bedford, Wareham, Bridgewater, Somerset, Somerville, Taunton, Swansea, Peabody, Lynn, Salem, Middleborough, Stoneham, Stoughton, and Westport. Five of these towns were under Boston Region MPO, and three of these were under Pioneer Valley Planning Commission. A higher number of secondary risk category towns for older drivers were also under these two MPOs.

Table 6. Statewide Risk Categories.

State	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Towns	Percent of Scored State Towns	Percent of Target Crashes
MA	Primary Risk Site	74.97%	83.98%	18	5.13%	14.36%
	Secondary Risk Site	68.68%	74.79%	35	9.97%	18.85%

Table 7. Distribution of Risk Towns by MPO.

MPO	Risk Category	Minimum Normalized Risk Score Percentage	Maximum Normalized Risk Score Percentage	Number of Towns	Percent of Scored MPO Towns	Percent of Target Crashes in MPO
Berkshire Regional Planning Commission	Primary	54.80%	60.23%	2	6.25%	27.42%
	Secondary	49.33%	51.84%	3	9.38%	17.74%
Boston Region MPO	Primary	75.40%	77.05%	5	5.15%	9.25%
	Secondary	71.90%	75.36%	10	10.31%	19.29%
Cape Cod Commission	Primary	61.36%	61.36%	1	6.67%	9.30%
	Secondary	59.38%	60.56%	2	13.33%	12.21%
Central Massachusetts Regional Planning Commission	Primary	64.41%	68.68%	2	5.00%	39.81%
	Secondary	62.36%	63.82%	4	10.00%	10.90%
Franklin Regional Council of Governments	Primary	54.29%	67.47%	2	7.69%	35.90%
	Secondary	47.03%	48.80%	2	7.69%	12.82%
Martha's Vineyard Commission	Primary	55.60%	55.60%	1	14.29%	37.50%
	Secondary	53.34%	53.34%	1	14.29%	12.50%
Merrimack Valley Planning Commission	Primary	74.22%	74.22%	1	6.67%	14.06%
	Secondary	67.68%	72.01%	2	13.33%	20.31%
Montachusett Regional Planning Commission	Primary	64.42%	70.85%	2	9.09%	18.75%
	Secondary	58.94%	59.14%	2	9.09%	32.29%
Nantucket Planning and Economic Development Commission	Primary	46.57%	46.57%	1	100.00%	100.00%
	Secondary	N/A	N/A	N/A	N/A	N/A
Northern Middlesex Council of Governments	Primary	73.68%	73.68%	1	11.11%	13.41%
	Secondary	72.43%	72.43%	1	11.11%	36.59%
Pioneer Valley Planning Commission	Primary	70.35%	73.33%	3	6.98%	21.52%
	Secondary	65.33%	70.20%	4	9.30%	34.98%
Old Colony Planning Council	Primary	81.10%	81.10%	1	5.88%	21.13%
	Secondary	75.12%	78.93%	2	11.76%	11.34%
Southeastern Regional Planning and Economic Development District	Primary	80.61%	83.98%	2	7.41%	21.92%
	Secondary	77.84%	80.55%	3	11.11%	22.52%

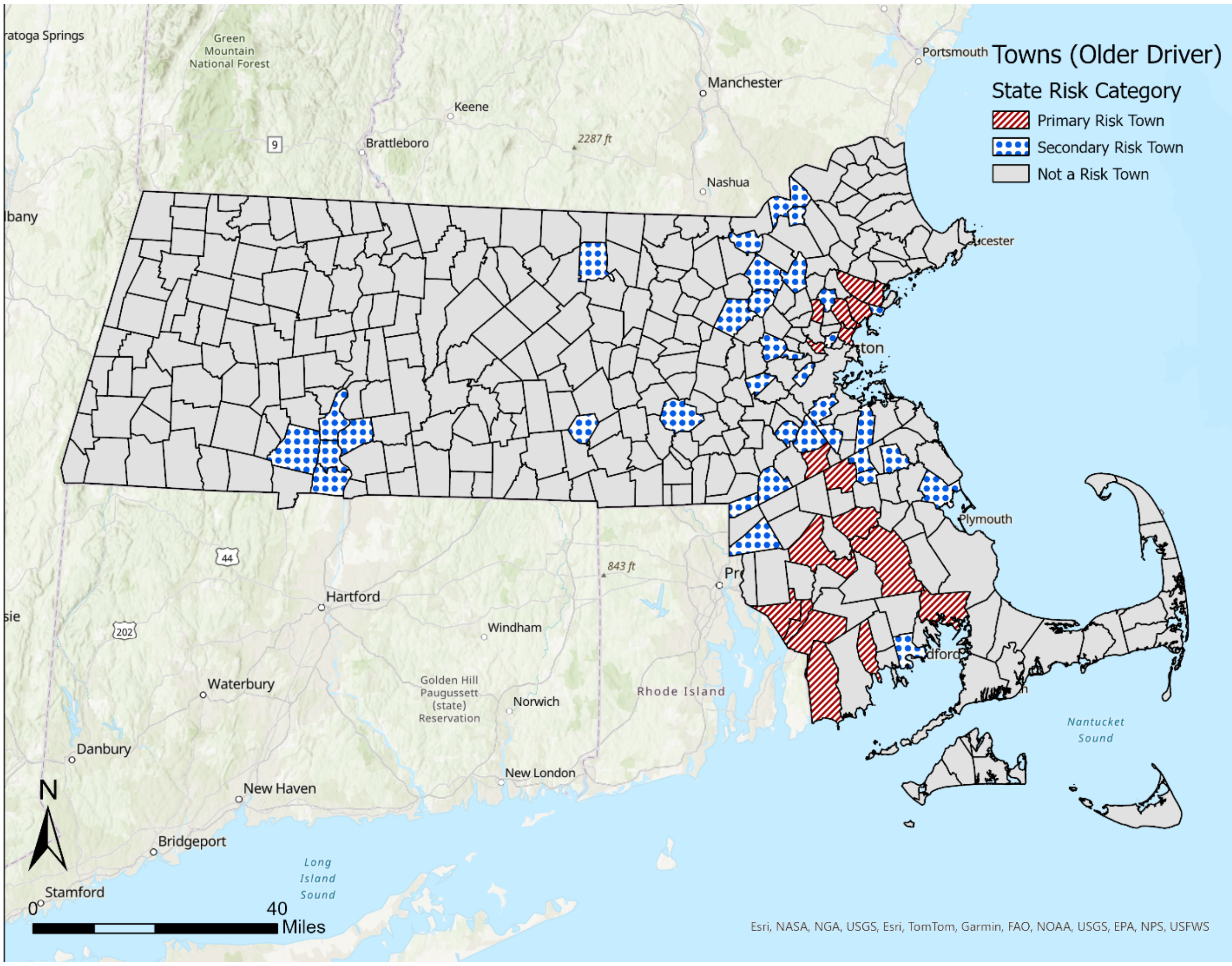

Figure 5. Map depicting the primary and secondary risk towns for severe older driver crashes, ranked statewide.

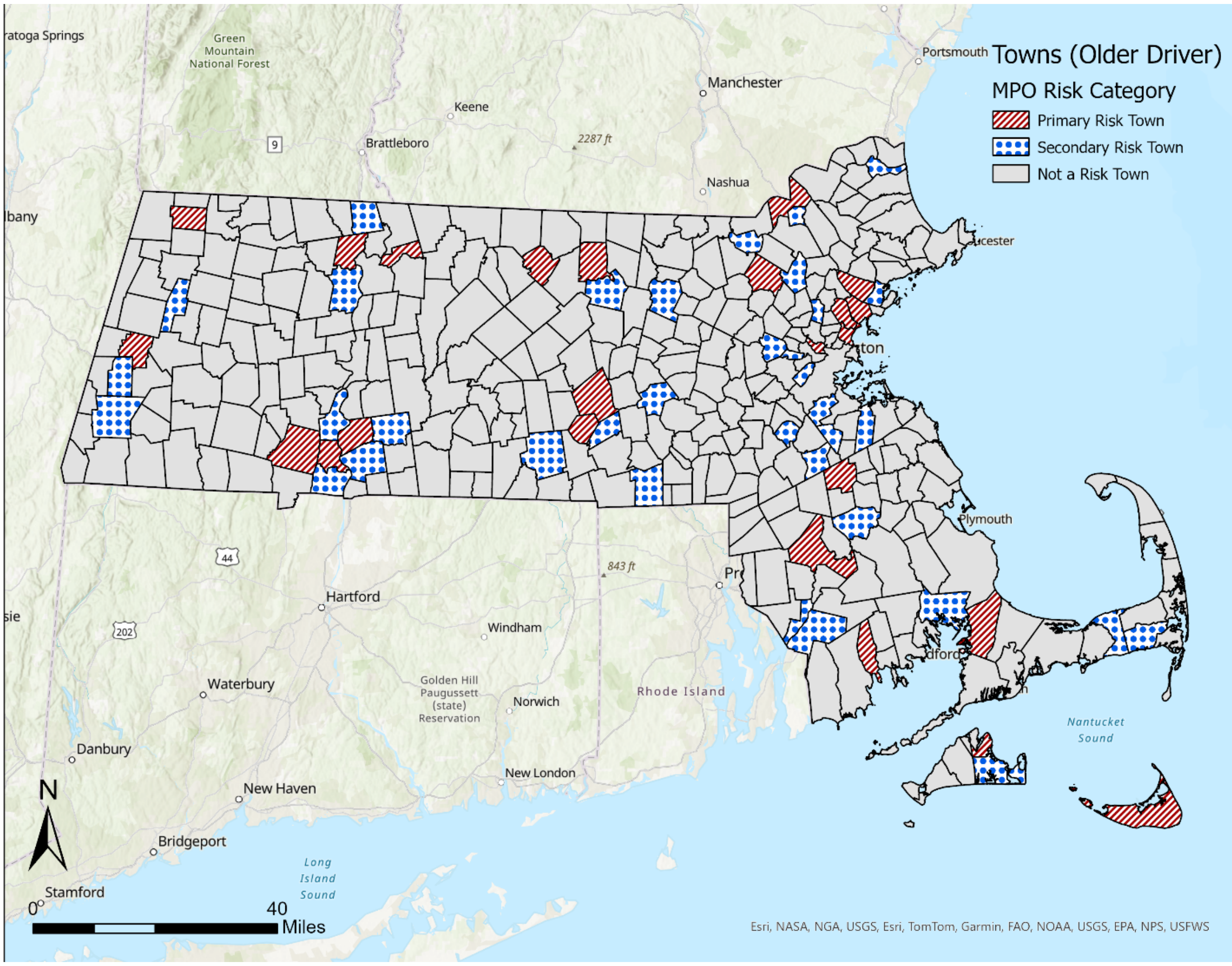

Figure 6. Map depicting the primary and secondary risk towns for severe older driver crashes, ranked by MPO.