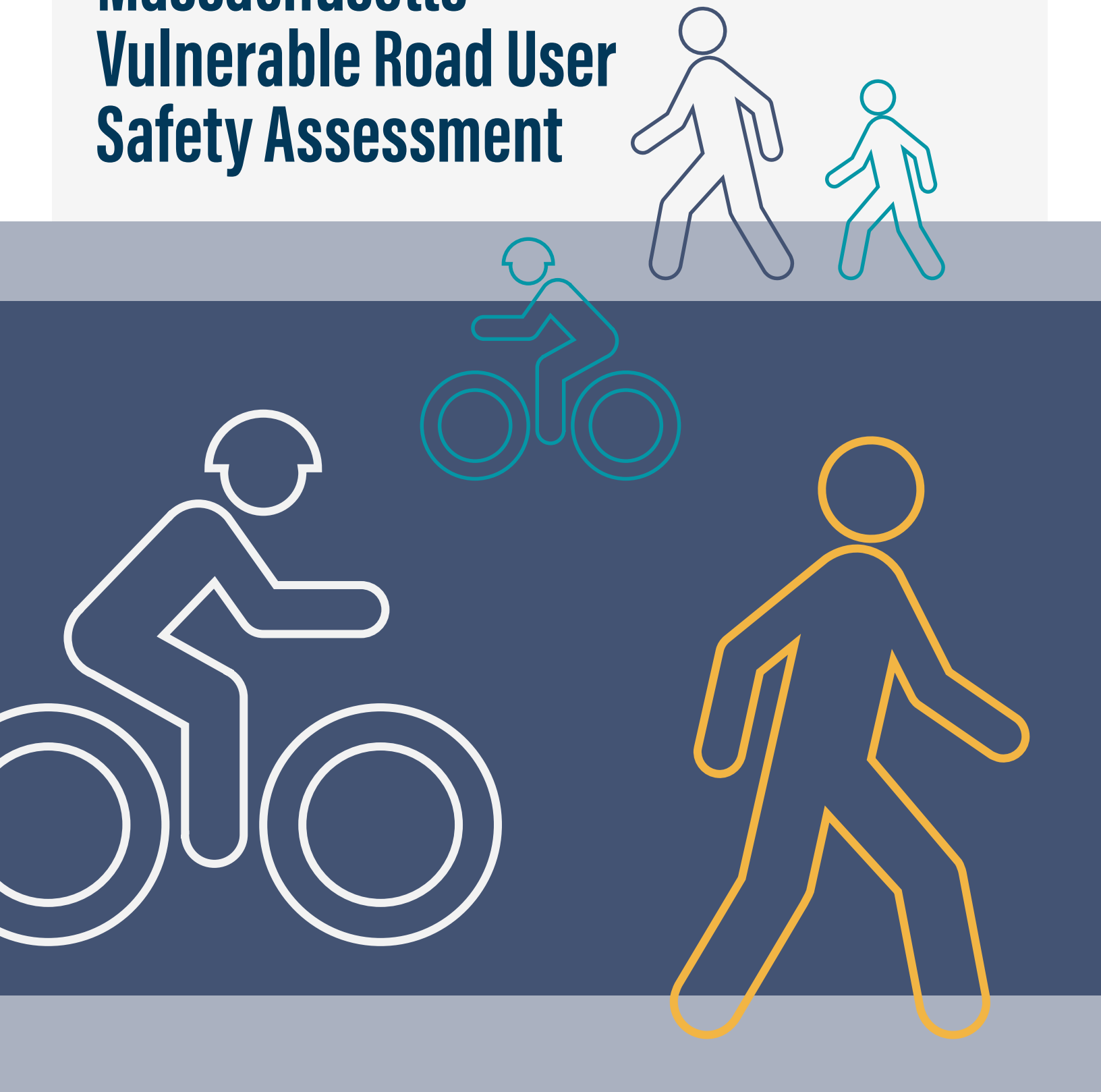
2023
Massachusetts Vulnerable Road User Safety Assessment




SPEED
LIMIT
30
YOUR
SPEED
SLOW
DOWN
Leominster Rd

Contents

Introduction

*A **Vulnerable Road User (VRU)** is a nonmotorist with a Fatality Analysis Reporting System (FARS) person attribute code for pedestrian, bicyclist, other cyclist, and person on personal conveyance as defined in the ANSI D16.1-2007. A VRU Safety Assessment analyzes State safety performance with respect to these vulnerable users, with an emphasis on fatal and serious injuries, and the State's plan to improve safety as described in 23 U.S.C. 148(l).*

Massachusetts' most recent Strategic Highway Safety Plan (SHSP), published in 2023, incorporates the elements and principles of the Safe System Approach,[1] as outlined by the United States Department of Transportation's (USDOT) National Roadway Safety Strategy.[2] The VRU Safety Assessment is guided by the following six initiatives established in the SHSP:

1. Implement Speed Management to Realize Safer Speeds.

2. Address Top-Risk Locations and Populations.

3. Take an Active Role to Affect Change in Vehicle Design, Features, and Use.

4. Accelerate Research and Adoption of Technology.

5. Double Down on What Works.

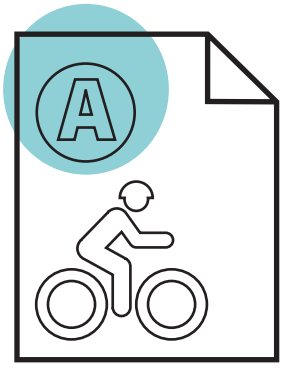
6. Implement New Approaches to Public Education and Awareness.

1 https://highways.dot.gov/safety/zero-deaths

2 https://www.transportation.gov/NRSS

Massachusetts is actively working on programs and strategies to improve safety for VRUs and promote and encourage walking and cycling. Statewide planning efforts—including the 2023 SHSP, the 2019 Statewide Pedestrian Plan, and the 2019 Statewide Bicycle Plan—identify multidisciplinary and multiagency strategies to eliminate fatalities and serious injuries of people walking and bicycling. At the municipal level, Massachusetts, and USDOT through Safe Streets and Roads for All (SS4A), awarded grants to local communities and Metropolitan Planning Organizations (MPOs) to plan and implement VRU safety projects.

In 2022, the League of American Bicyclists ranked Massachusetts first in the Bicycle Friendly State Report Card and gave Massachusetts a grade of "A" for Infrastructure and Funding, Education and Encouragement, and Policies and Programs.



Despite these efforts, in 2022, Massachusetts saw a record number of pedestrian fatalities and VRUs accounted for an average of 15 percent of total roadway fatalities and serious injuries from 2018 to 2022. For the same time period, VRU fatalities accounted for more than 22 percent of total fatalities. There is a need to better understand the factors involved in VRU crashes, especially those resulting in death or serious injury. With that knowledge, the State can better target projects and strategies to address the underlying factors. Further, there is a need to understand what has been working well (and not so well) to address VRU safety statewide. This VRU Safety Assessment is organized in the following sections:

1. Overview of VRU safety performance over the past 5 years.

2. Summary of the quantitative analysis to determine high-risk areas.

3. Summary of consultations with the local and regional agencies within the high risk areas.

4. Program of strategies targeting the results of the data analysis and consultations.

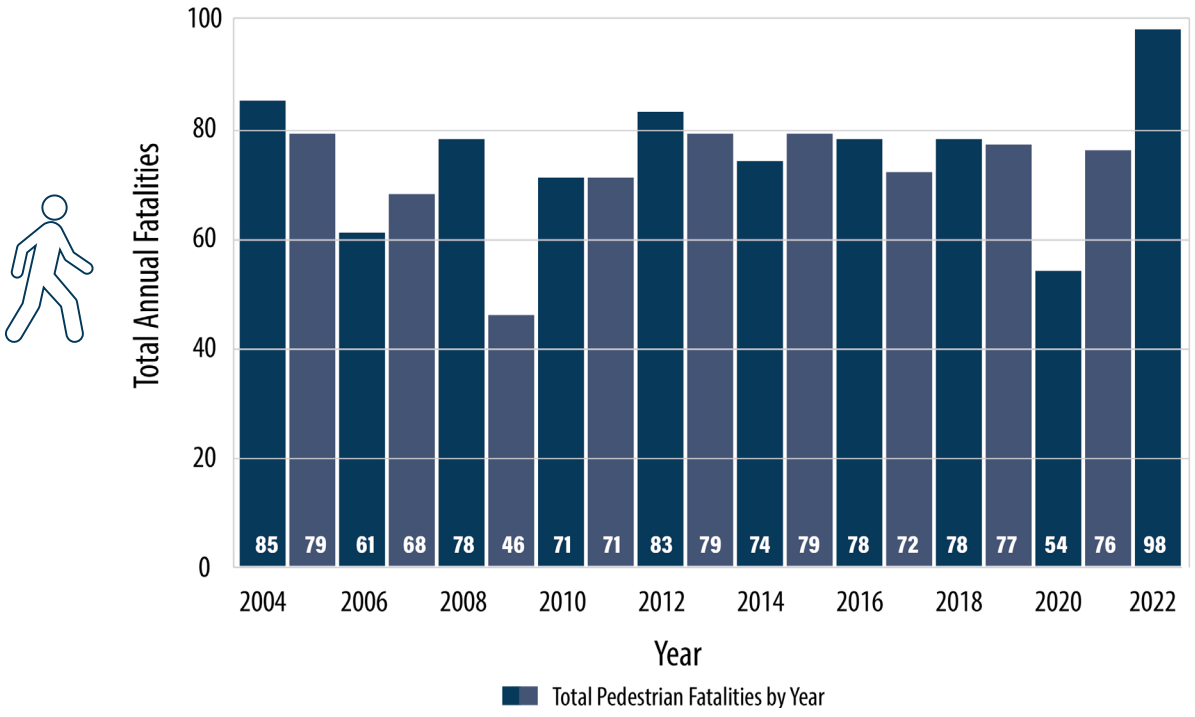
5. Implementation of the VRU Safety Assessment's findings.

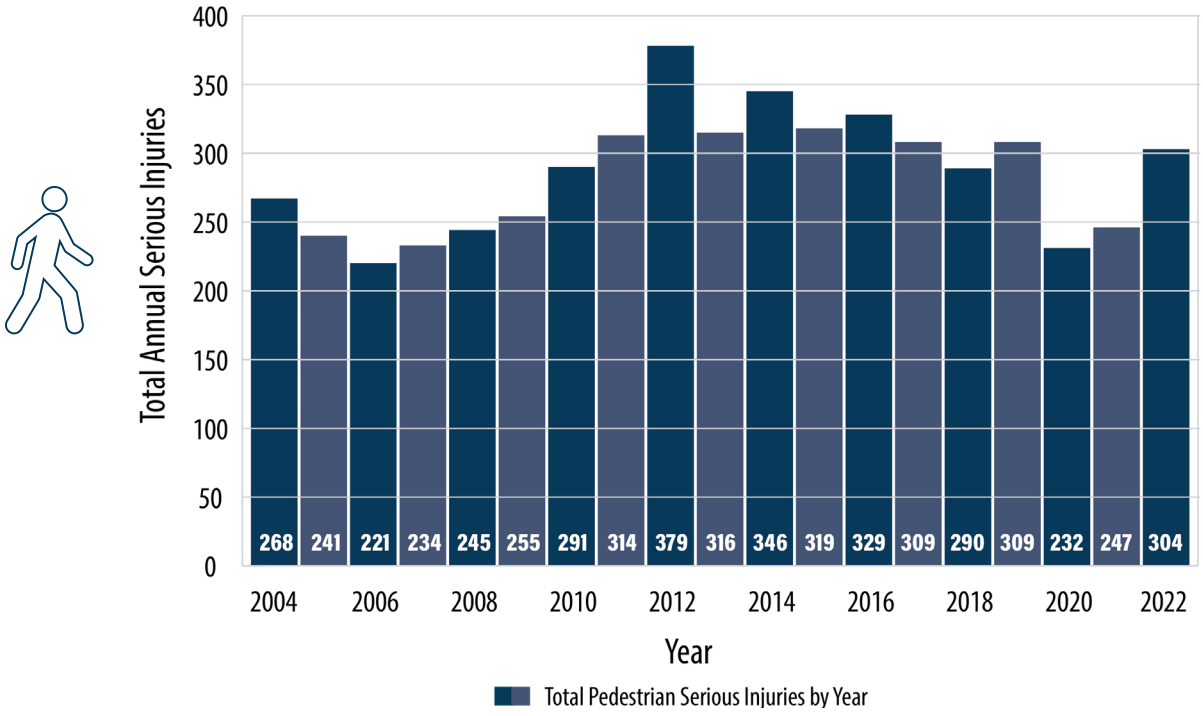
As a supplement to this Assessment, the Massachusetts Department of Transportation (MassDOT) developed an interactive story map[3] showing VRU safety performance and factors and the spatial data analysis used to identify high risk areas.

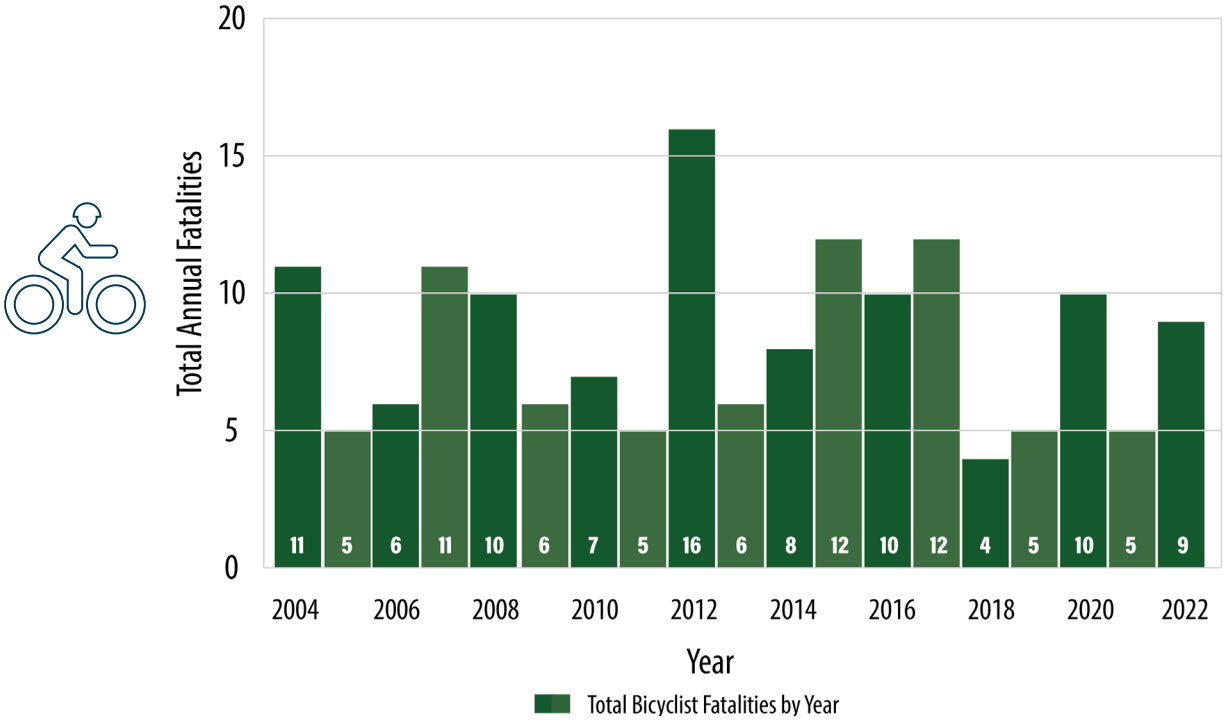
3 https://storymaps.arcgis.com/stories/8b36ed2f1f3749b7ac085c0ca5b8efa7

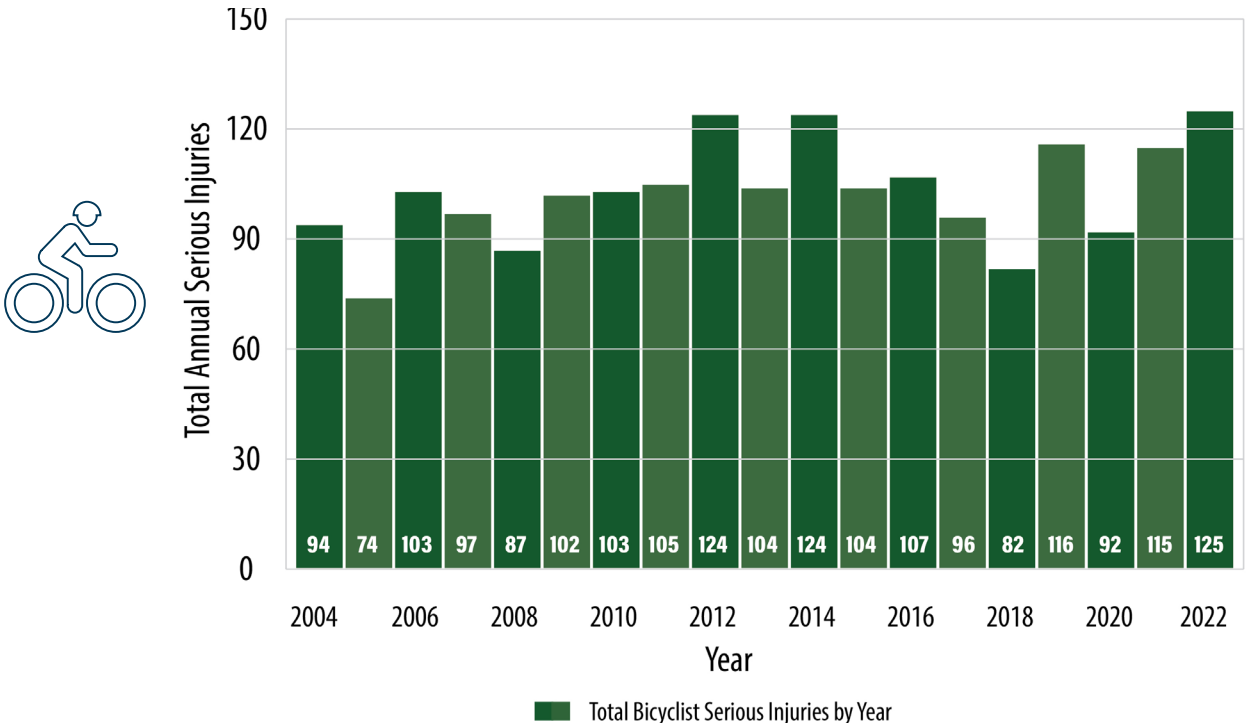
Overview of VRU Safety Performance

In recent years, the overall number of VRU crashes in the United States has increased, including in Massachusetts. VRU crashes sharply decreased in 2020 as a reflection of the absence in normal traffic volumes; however, an increase of pedestrian fatalities and serious injuries and cyclist serious injuries has trended upward from 2020 to 2022.









Source: MassDOT IMPACT Fatal Crash Information for fatalities and MassDOT IMPACT Serious Injury Information for serious injuries. Note that any crash records or data provided for the years after 2020 are subject to change at any time and are not to be considered up-to-date or complete.

Performance Targets

Consideration of VRU safety and investment in VRU safety projects is needed to combat recent trends.

Through the Highway Safety Improvement Program (HSIP) and Highway Safety Plan (HSP), Massachusetts sets performance targets for five metrics, with one being the number of non-motorized fatalities and serious injuries. The actual 5-year average for 2017-2021 (467.2) was lower than the established target for 2021 (506). However, recent increases from 2020 will raise the 5-year average. Consideration of VRU safety and investment in VRU safety projects is needed to combat recent trends.

Analyzing Crash Factors

MassDOT analyzed the factors in VRU fatal and serious injury crashes to reveal patterns and trends. These factors include road characteristics, area type, proximity to transit and schools, impairment, and community-based socioeconomic data. Understanding these factors will guide the selection of appropriate countermeasures and strategies to reduce these crashes in the future.

Pedestrian Fatal and Serious Injury Crashes 2016-2020

Overall

96% occurred in urban areas.

52% occurred at a non-intersection location.

24% occurred on a road where the police-reported speed limit is 30 mph.

52% occurred in dark lighting conditions.

33% occurred between 4 pm and 8 pm.

Intersection

28% occurred when the vehicle was turning.

62% occurred when the vehicle was traveling straight ahead.

56% contained a pedestrian in a marked crosswalk.

53% occurred during daylight hours.

83% had curbs on both sides of the road.

41% occurred at signalized intersections, but less than 10% of all intersections statewide are signal-controlled.

30% of intersection crashes on State-owned intersections are overrepresented as only 14% of all intersections statewide are State-owned.

Non-Intersection

81% occurred when the vehicle was traveling straight.

65% had curbs on both sides of the road.

62% contained a pedestrian in the roadway.

37% occurred on a principle arterial roadway, but only 7% of statewide road mileage is principle arterial.

54% occurred during dark hours.

7% of pedestrian fatalities occurred on interstate roads.

93% occurred on 2-lane roadways, consistent with the 2-lane centerline mileage statewide (86%).

83% occurred on locally owned roads, which generally matches the proportion of locally-owned roads in the State (82%).

Bicycle Fatal and Serious Injury Crashes 2016-2020

Overall

98% occurred in urban areas.

78% occurred during daylight hours.

55% occurred at an intersection.

Intersection

31% occurred when the vehicle was turning left.

55% occurred when the vehicle was traveling straight ahead.

54% contained a cyclist in the roadway/ shoulder.

76% occurred during daylight hours.

64% had curbs on both sides of the road.

31% occurred at signalized intersections, but less than 10% of all intersections statewide are signal-controlled.

20% occurred at State-owned intersections, and the proportion of State-owned intersections statewide is 14%, meaning State-owned intersection crashes are overrepresented.

Non-Intersection

66% occurred when the vehicle was traveling straight.

54% had curbs on both sides of the road.

77% occurred during daylight hours.

80% contained a cyclist in the roadway.

90% occurred on 2-lane roadways, consistent with the 2-lane centerline mileage statewide (86%).

74% occurred on locally owned roads, which roughly matches the proportion of locally-owned roads in the State (82%).

School Proximity:

Student rates of walking to school decreased as the distance to school increased and biking rates peaked when the distance to school was between 0.5 and 1 miles. When distance to school was < 0.5 miles, walking was the most common mode for urban and rural regions.[4]

Within 2,000 feet of K-12 Public, Charter, and Private Schools Statewide:

44%
of fatal serious injury pedestrian crashes

41%
of fatal and serious injury bicyclist crashes

21%
of centerline miles

4 E. Kontou, N.C. McDonald, K. Brookshire, N.C. Pullen-Seufert, S. LaJeunesse, *U.S. Active School Travel in 2017: Prevalence and Correlates*, Preventive Medicine Reports (2019), doi: https://doi.org/10.1016/j.pmedr.2019.101024.

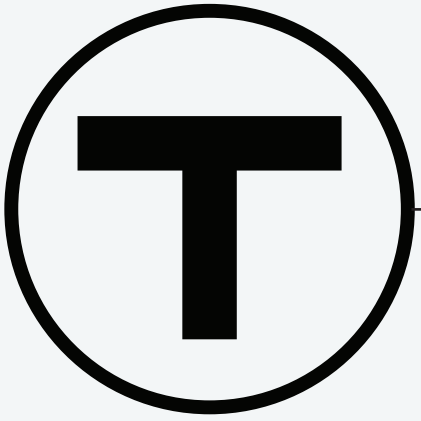
Transit Proximity:

Within 300 feet of Bus Stops statewide

41%
of fatal and serious injury pedestrian crashes

34%
of fatal and serious injury bicyclist crashes

6%
of centerline miles



Transit Proximity:

Within 300 feet of Massachusetts Bay Transit Authority (MBTA) Bus Stops:

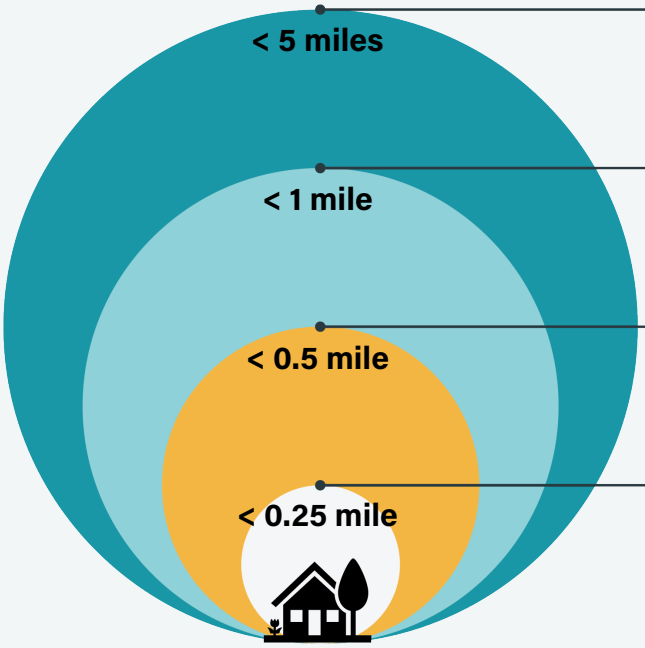
50%
of fatal and serious injury pedestrian crashes

45%
of fatal and serious injury bicyclist crashes

16%
of centerline miles

Home Proximity:

A large percentage of VRU fatal and serious injury crashes occur within 5 miles of the person's home, but these percentages differ by user type. Compared to vehicles, cyclists and pedestrians are at higher risk of death and serious injury in the communities they reside.



Distance from Home	Drivers	Pedestrians	Cyclists
< 5 miles	67%	82%	81%
< 1 mile	29%	58%	44%
< 0.5 mile	16%	46%	26%
< 0.25 mile	9%	34%	16%

Impairment:

*Alcohol and Drug Use in Persons Hospitalized for Non-fatal Motor Vehicle Crash Injuries 2017-2022**

	Alcohol and/or Drug Use	Alcohol Use	Drug Use	Cannabis Use	Opioid Use**
Pedestrians	25%	15%	15%	6%[3]	8%
Cyclists	16%	9%[1]	12%[2]	No Data	No Data

*Reported federal fiscal year (FFY)(2017-2022): Oct. 1 - Sep. 30 MA residents only.
**Opioid use for chronic pain excluded.
[1] 2019 and 2021 data omitted due to confidentially
[2] 2018 and 2019 data omitted due to confidentially
[3] 2017 data omitted due to confidentially
Data years with under 11 counts omitted due to confidentially guidelines.

Hospital Data:

For Motor Vehicle Traffic-related Deaths and Injury-related Hospital Stays from 2017-2022:

Pedestrians ≥ 55 years old had a death rate two times higher than that of younger age groups, on average.

100% of all Asian pedestrians and cyclists who died were foreign born.

Black pedestrians had rates of injury-related hospital stays 3 times higher on average than white pedestrians (2016-2021).

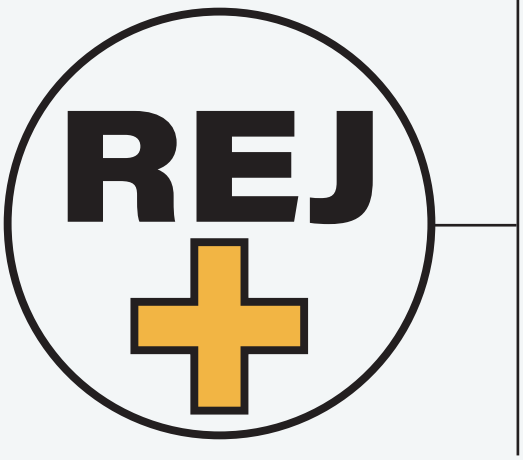
Male pedestrians had rates of injury-related hospital stays 1.5 times higher than female pedestrians.

Environmental Justice:

The State analyzed how the characteristics of a community relate to pedestrian and bicycle safety. A Regional Environmental Justice "Plus" (REJ+) Community is a designation assigned to census block groups with relatively high shares of residents that are especially impacted by changes in or to transportation networks.[5] This designation is "regional" because the characteristics that designate REJ+ status are considered in relation to regional percentiles; the designation is called 'plus' because this analysis includes characteristics beyond traditional 'environmental justice' definitions. To qualify as an REJ+ Community, a census block group must meet at least one of the following thresholds that correspond to traditional environmental justice criteria:

- **Income** – annual median household income ≤ MPO 25th percentile.
- **Race and ethnicity** – percentile of individuals that identify as Hispanic or Latino; Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian or Other Pacific Islander; some other race or two or more races and do not identify as White alone ≥ MPO 75th percentile.
- **Limited English-speaking Proficiency (LEP)** – percent of households with limited English-speaking members ≥ MPO 75th percentile.

The analysis showed the following:



50% of pedestrian and 38% percent of bicycle

fatal and serious injury crashes occurred in a REJ+ Community, with low-income and non-White being the most dominant factors.

82% of pedestrian HSIP clusters

are 50% or more within a REJ+ Community. Low income and non-White are the most dominant REJ+ factors.

64% of bicycle HSIP clusters

are 50% or more within a REJ+ Community, with low income and zero vehicle ownership as the most dominant REJ+ factors.

5 https://www.pvpc.org/sites/default/files/files/REJ%2B%20Project%20Description%20031923.pdf

Summary of Quantitative Analysis

To determine high risk areas for VRUs, MassDOT used both a reactive (crash-based) and proactive (risk-based) approach. For the crash-based approach, the State considered historical crash frequency at specific locations as one aspect of VRU safety. For the risk-based approach, the State considered roadway and community characteristics that are associated with a higher risk of pedestrian and cyclist fatalities and serious injuries. Layering these analyses leads to a more complete understanding of pedestrian and cyclist safety issues and which areas to focus VRU safety improvements.

The MassDOT Vulnerable Road User Safety Assessment includes an interactive statewide map showing the crash clusters used in the crash-based analysis and the risk-based screening for pedestrian and bicyclist segments and intersections. Figure 5 shows screenshots of these tools.

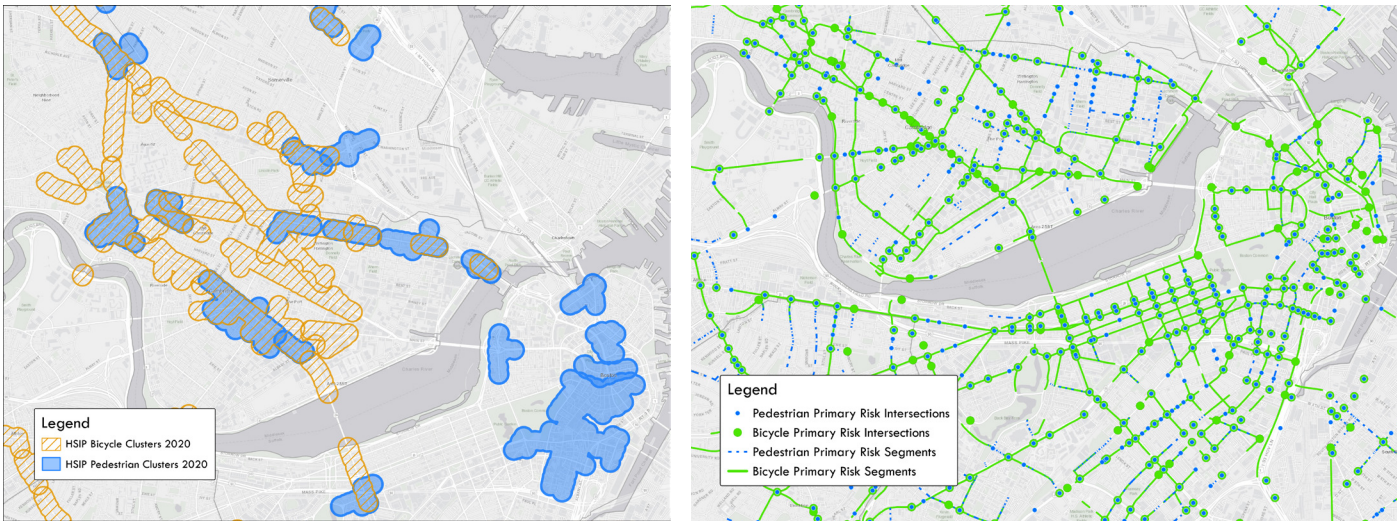


Figure 5. Crash-based (left) and risk-based segments and intersections (right).

The risk-based analysis included roadway attributes and community-based factors.

The roadway attributes included:

- Functional class.
- Traffic volumes.
- Median presence.
- Number of lanes.
- Intersection type.
- Intersection control type.

Community-based factors included:

- Employment density.
- Population density.
- Zero vehicle households.
- Proportion of employment in food service, retail, and accommodation.
- Proportion of population living in poverty.
- Median household income.
- Environmental justice communities.
- Transit stops.

Determining High Risk Areas

The State calculated a score for each town to identify high-risk areas. The criteria for each town included the following:

Percent of pedestrian and bicyclist fatal and serious injury crashes compared to all fatal and serious injuries in the town.

Percent of pedestrian and bicyclist fatal and serious injury crashes in a community compared to Statewide total pedestrian and bicyclist fatal and serious injury crashes.

Percent coverage of top risk pedestrian and bicyclist intersections.

Percent coverage of top risk pedestrian and bicyclist segment miles.

The percentages for each measure were ranked. As a result of the analysis, the State determined the top 5 percent towns identified as high-risk areas (shown in Figure 2). These top 5 percent communities accounted for 38 percent of all the fatal and serious injury bicyclist crashes and 40 percent of all the fatal and serious injury pedestrian crashes. Five MPOs are included in the high-risk areas that cover the high-risk towns, which are the Boston Region MPO, Merrimack Valley MPO, Northern Middlesex MPO, Pioneer Valley MPO, and Southeastern Massachusetts MPO. Almost every community (14 of 17) are predominately REJ+ areas, meaning over 50 percent of the community are in REJ+ areas. Medford (47 percent), Newton (7 percent), and Fall River (27 percent) fell below the 50 percent threshold.

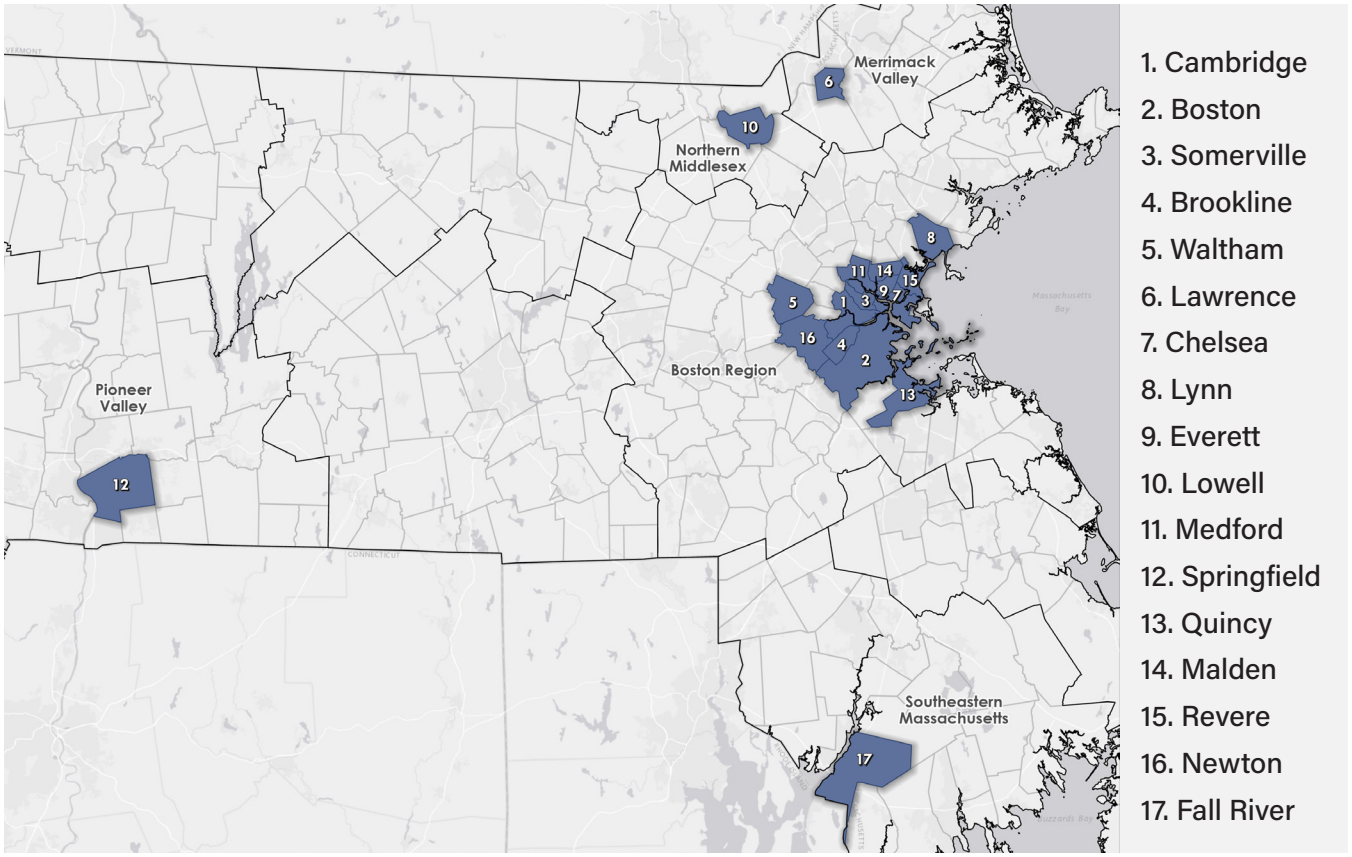


Figure 6. Top 5% VRU Risk Towns.

Summary of Consultation

MassDOT conducted outreach meetings with 17 municipalities, 5 MPOs covering the high-risk areas, and other stakeholders regarding the data analysis and potential programs of strategies and projects. These meetings were held to gain a better understanding of the needs and challenges of VRUs, and to develop appropriate strategies.

After completing the VRU data analysis, MassDOT held meetings with the Massachusetts Regional Planning Agencies (MARPA) Transportation Managers Group (TMG), the MARPA Data Users Group (DUG), and the Massachusetts Bicycle and Pedestrian Advisory Board (MABPAB) to review the data findings and ask for comment.

MassDOT held additional discussion with MARPA TMG and DUG on its methodology on determining the high-risk areas, potential strategies and projects for top-crash locations and systemic projects, and procurement contracts for implementing potential VRU projects. Regional Transit Authorities provided feedback on pedestrian crossing enhancements at bus stops.

In 2022, all 17 communities were either granted an SS4A grant as individual cities or are part of a regional planning agency (RPA) service area where the RPA received an SS4A grant. Of the 17 grants, 15 were planning grants and 2 (Boston and Springfield) were implementation grants funding construction activities. The consultation meetings with the top 17 communities and 5 MPOs included discussions of specific eligible project types and potential systemic countermeasures for consideration. MassDOT will continue conversations with these communities to determine their needs as they begin developing their SS4A Action Plans or implementing projects. Recommendations provided in these Action Plans will help to generate systemic community-wide projects or material procurement projects or some other types of needs that could be funded with VRU funds. The intention is to fund high risk community projects over the next four years with VRU funds.

17 communities

Program of Strategies

Massachusetts adopted a Safe System Approach in its 2023 SHSP to work toward zero roadway deaths and serious injuries. The Safe System Approach acknowledges that humans make mistakes and is predicated on keeping impact energy on the human body at tolerable levels, especially for VRUs that do not have the added protection offered inside a vehicle. Critical to the success of the plan is identifying and mitigating risks in the transportation system to prevent serious crashes, rather than waiting for crashes to occur and reacting afterward. Implementing this approach requires shared responsibility across agencies and communities.

MassDOT will support towns and MPOs to plan and implement proven countermeasures that align with Safe System elements (i.e., Safer Roads, Safer Speeds, Safer Users, Safer Vehicles, and Post Crash Care). The State is creating redundancy within the system by layering various types of strategies. The following strategies were developed based on crash data analysis, consultations, and the Safe System principles and elements.

Strategy 1. Implement site-specific projects.

This strategy will account for 25 to 40 percent of activities and will target the locations with the highest crash frequencies. Safety improvements will vary based on the target crash type, road characteristics, and area context.

Strategy 2. Implement systemic projects.

This strategy consists of lower-cost improvements spread across a jurisdiction at locations with risk factors present. An example stemming from the transit proximity VRU data analysis is to enhance pedestrian crossings near bus stops, which is anticipated to account for 15 to 30 percent of activities.

Other systemic projects include adequate walk time at signalized intersections, introduction of No-Turn-On-Red (specifically at locations with exclusive pedestrian phasing), leading pedestrian interval (LPI), enhanced pedestrian crossings, and pedestrian countdown timers.

District or regional pavement marking contracts are being explored to assist MassDOT and local communities with enhancing and updating VRU specific markings.

Strategy 3. Material procurement.

MassDOT will target 10 to 30 percent of activities for material procurement for public roadways. Example materials include signing for the minimum “safe” passing distance of 4 feet when passing a VRU, school zones sign assemblies with speed feedback, rapid rectangular flashing beacons (RRFBs), and No-Turn-On-Red signs.

Strategy 4. Support the Top 5 Percent VRU Communities for Targeted VRU Projects.

Approximately 5 to 30 percent of activities will include targeted systemic improvements for the top 5 percent VRU communities and will include plans/studies and implementation.

- For pedestrians, implement countermeasures that facilitate safer crossings at intersections, such as, but not limited to:

  - o LPI.
  - o Pedestrian Countdown Signals.
  - o High Visibility Crosswalks.
  - o Lighting.
  - o Turn Restrictions.
  - o Left-Turn Hardening.
  - o Signal Timing (red and yellow clearance intervals).
- For pedestrians, implement countermeasures that facilitate safer mid-block crossings, especially roads with more than two lanes and higher speeds:
  - o Pedestrian Hybrid Beacon (PHB).
  - o RRFB.
  - o Pedestrian Refuge Islands.
  - o High Visibility Crosswalks.
  - o Enhanced signing (including in-road signs).
  - o Lighting.
  - o Speed management/traffic calming.
- For bicyclists, install protected intersections and implement left-turn restrictions.
- Install bicycle lanes, which separate bicyclists from vehicular traffic. Separated bicycle lanes with vertical elements should be prioritized where appropriate.
- Enforce safer speeds through automated enforcement, such as speed safety cameras and possible pilot test safety cameras.

Strategy 5. Prioritize Projects based on Community Risk Factors

The data analysis used factors for both crash history and locations with risk factors to develop the top risk communities. The results show that 14 of the 17 top risk communities are more than 50 percent in REJ+ areas; special consideration should be given to improve VRU safety in these areas. This includes prioritizing project locations from previous strategies in these areas. Enforcement should also be prioritized in these areas to target underlying factors such as speeding that increase the risk of severe VRU crashes. Finally, outreach and education should target those population groups that are over-represented in at-fault crashes and risky behaviors.

14 of the 17

top risk communities are more than 50 percent in REJ+ areas.

Implementation

The strategies from the VRU Safety Assessment align with previous and ongoing VRU safety efforts—beginning at a statewide level through the 2023 SHSP, the 2019 Statewide Pedestrian Plan, and the 2019 Statewide Bicycle Plan—all sharing a common goal to eliminate fatalities and serious injuries of people walking and bicycling.

Guided by Initiatives 1 and 4 from the SHSP (i.e., *Implement Speed Management to Realize Safer Speeds and Accelerate Research and Adoption of Technology*), Massachusetts desires to conduct pilot testing of emerging technologies to reduce speeds, which reduce the likelihood of death or serious injuries especially for VRUs. Regarding speeds, the State aims to change behavior and shift the social norm of what is acceptable. Consistent with Initiative 6 of the SHSP, *Implement New Approaches to Public Education and Awareness*, campaigns and programs are needed to raise awareness, educate, and promote speed management techniques.

Initiative 2 of the SHSP, *Address Top-Risk Locations and Populations*, includes a strategy to evaluate effectiveness of safety interventions. MassDOT's evaluates all HSIP projects, including projects improving VRU safety. Effectiveness evaluations can help determine the most effective interventions to be replicated, and interventions that are not working well, indicating to agencies the need to make changes.

MassDOT will continuously work with MPOs and local agencies as they progress through SS4A activities (i.e., planning efforts or implementation) to understand their needs.

Recent legislation specific to VRUs are expected to contribute to safer roads, safer users, safer speeds, and improvements in data collection to enhance analyses. In 2023, new VRU laws went into effect as part of *An Act to Reduce Traffic Fatalities*[6] and include the following:

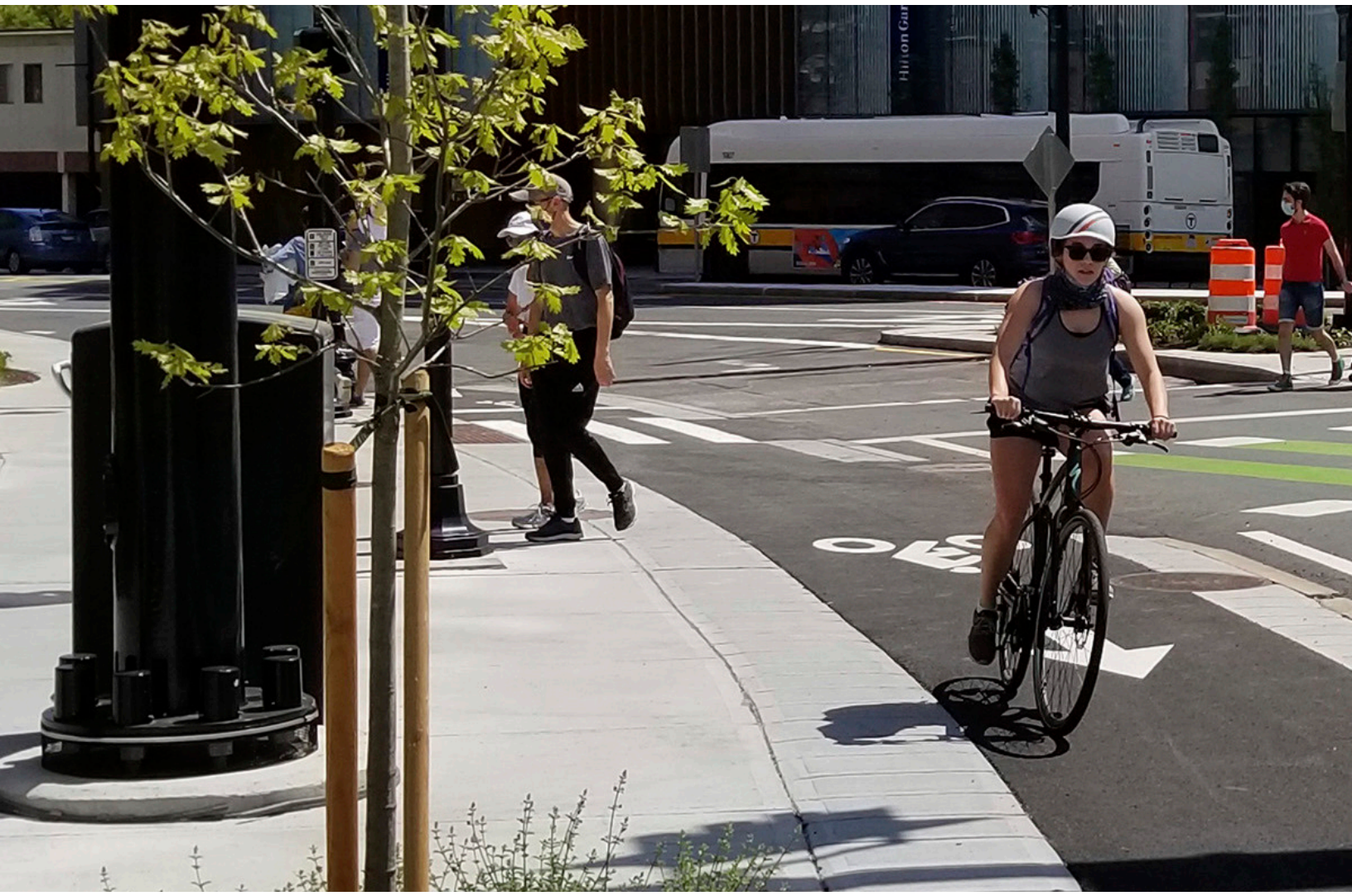
- **Safe Passing.** Drivers must provide a "safe passing distance" of at least 4 feet when passing VRUs. Motorists are explicitly allowed to cross a double-yellow line in order to pass "when it is safe to do so and adhering to the roadway speed limit." MassDOT is required to put up signage to this effect across the Commonwealth and will work in collaboration with municipalities to do so on public roadways.
- **Rear Red Light Requirement.** Bicyclists are required to use a front white light and rear red light and rear reflector when riding at night to increase visibility.
- **Safer Speed Limits.** The process for municipalities to alter speed limits in thickly settled areas from 30 mph to 25 mph both on State-controlled roads and on the roads they control has been clarified. This is an update on the previously implemented Chapter 90, Section 18, giving authority to local jurisdictions to create safer roadways in their communities.
- **Truck Safety Devices.** State-owned and contracted heavy trucks will be required to be equipped with convex mirrors, cross-over mirrors, and sideguards, which help prevent injuries to a VRU in the event of a collision, particularly from falling underneath the vehicle. A study on Direct Vision is expected on July 1, 2024 that will identify the range of direct vision afforded to drivers in heavy trucks and produce evidence-based safety recommendations stipulating a minimum acceptable level of direct vision to be met by future applicable State-owned and leased vehicles.
- **Crash Reporting.** To improve statewide data collection surrounding VRU crashes, a standardized analysis tool will be used to report crashes and incidents involving a person biking or walking. This includes 19 additional fields specific to VRUs. Standardized crash reporting will allow safety stakeholders to systematically measure, report, and track crashes and then to make data-informed changes that increase roadway safety.

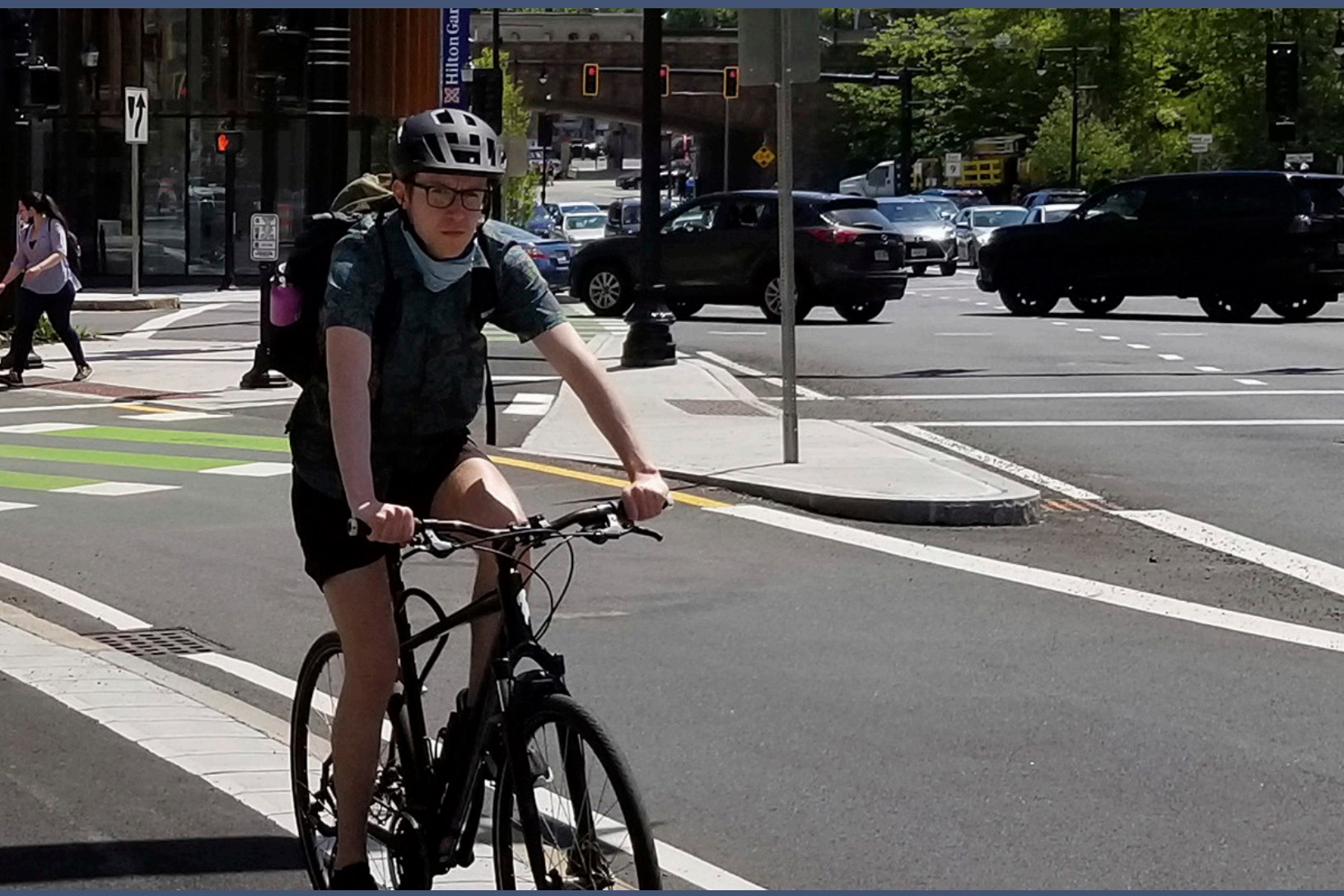
6 https://assets.nationbuilder.com/massbike/pages/7444/attachments/original/1678718123/MA_Vulnerable_Road_Users_Laws_-_Public_One-Pager_-_0323.pdf?1678718123

The recommendations in this Assessment are consistent with those strategies and include a focus on continuing to accommodate pedestrian and cyclists in the roadway network through implementing systemic projects involving top-risk locations, proven safety countermeasures, roadway design, educational programs, and planning activities. Examples of these efforts include the following:

- MassDOT is updating emphasis area risk models using 2017-2021 data for past SHSP emphasis areas, including pedestrians and bicyclists.
- Through the HSIP and other Federal and State funds, MassDOT has, and will continue to, fund and construct pedestrian and bicyclist facilities, such as sidewalks, crosswalks, and protected bicycle lanes, which are proven to reduce fatal and serious injury crashes.
- Advance the Every Day Counts Nighttime Visibility for Safety initiative.

Eliminating VRU fatalities and serious injuries will require efforts from both the State and local agencies that own and maintain roadways. MassDOT provides data, tools, and support to municipalities that were awarded SS4A implementation and planning grants. MassDOT collaborates with municipalities to foster a coordinated, consistent effort regarding VRU safety.

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