NEW HAMPSHIRE
VULNERABLE ROAD USER SAFETY ASSESSMENT

November 2023

New Hampshire DOT
Department of Transportation

GPI

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PLAN CONTENTS

The comprehensive Vulnerable Road User Safety Assessment (VRUSA) is comprised of distinct sections, each contributing to a holistic understanding of vulnerable road user (VRU) safety performance and the development of effective countermeasures. The following chapters provide a detailed overview of the contents within this assessment:

- **Section 1: Introduction** provides an overview of the VRUSA and the federal requirements surrounding the effort. In addition, this section defines a VRU and provides a summary of the relevant planning and strategic documents that directly supported the development of the VRUSA.
- **Section 2: Target and Approach** sets the stage by exploring current VRU crash trends and presenting statewide VRU safety targets. The Safe System Approach is also introduced, which acts as the foundational strategy in reducing the number and severity of VRU crashes.
- **Section 3: Consultation** summarizes the extensive stakeholder outreach performed throughout the assessment, underlining the significance of diverse perspectives in road safety enhancement.
- **Section 4: Data-Driven Analyses** provides a comprehensive examination of historical crash data and its relationship to various factors such as roadway characteristics, land use patterns, and demographics. This analysis aims to pinpoint high-risk areas and vulnerable populations within the state. Additionally, it outlines the creation of a high-risk injury network, revealing specific locations with elevated crash risks.
- **Section 5: Proven Countermeasures** offers a high-level overview of proven safety countermeasures related to pedestrian and bicyclist safety and promulgated by the Federal Highway Administration (FHWA).
- **Section 6: Strategies and Recommendations** presents a compilation of strategically derived programs and strategies, aimed to reduce VRU crash frequency and severity statewide, setting the stage for safer roads for all users.

These sections collectively contribute to the State's commitment to fostering a safer and more secure transportation system for all VRUs.

01|| INTRODUCTION

The Vulnerable Road User Safety Assessment (VRUSA) is a significant effort aimed at addressing a growing concern: the safety of pedestrians and bicyclists on New Hampshire's roads. Over the past two decades, New Hampshire has seen a steady decrease in the number of overall Vulnerable Road User (VRU) crashes. However, a concerning trend has recently emerged: the number of fatal and serious injury crashes involving pedestrians and bicyclists has been on the rise. This escalation of severe VRU crashes observed in New Hampshire also coincides with the broader national pattern, thus requiring a comprehensive, data-driven approach to understand and mitigate the severity and frequency of these incidents, ultimately ensuring safer roads for all.

This assessment stems from the Infrastructure Investment and Job Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), which was enacted on November 15, 2021 and mandates that all states conduct a VRU Safety Assessment as part of their Highway Safety Improvement Program (HSIP) as specified in 23 U.S.C. 148(1). This mandate is driven by a commitment to an inclusive and equitable transportation system that prioritizes safety for all road users, including pedestrians and bicyclists.

The VRUSA has multiple objectives. It offers a comprehensive overview of New Hampshire's performance concerning vulnerable road user safety and employs data-driven analyses to identify high-risk areas and vulnerable populations, while considering factors such as roadway characteristics, land use generators, and demographic influences. Ultimately, this assessment aims to provide a program of projects and strategies designed to reduce both the number and severity of VRU crashes across the state. Furthermore, these efforts align with principles of the Safe System Approach, which advocates for a comprehensive, proactive, and collaborative strategy to strive for the elimination of all road-related fatalities and serious injuries.

The following sections of this report will delve into the specifics of the assessment process, present findings derived from thorough analyses, and offer a well-considered array of strategies and actions based on identified risk factors in New Hampshire that will create a safer environment for pedestrians and bicyclists across the state.

WHAT IS A VULNERABLE ROAD USER?

A Vulnerable Road User (VRU), as defined by the Federal Highway Administration (FHWA), refers to non-motorists with a Fatality Analysis Reporting System (FARS) person attribute code that includes pedestrians, bicyclists, other cyclists, individuals on personal conveyances, or injured persons equivalent to pedestrians or pedal cycles. This category encompasses people walking, biking, or using other non-motorized modes of transportation. It also includes highway workers who are on foot within work zones, as they are treated as pedestrians for safety considerations. Notably, FHWA's definition of Vulnerable Road Users does not include motorcyclists, distinguishing it from definitions used by the National Highway Traffic Safety Administration (NHTSA) and the National Safety Council.

RELEVANT SUPPORTING DOCUMENTS

While the VRUSA is a dedicated effort focused on the safety of pedestrians and bicyclists, its objectives and strategies are closely aligned with other statewide and regional strategic plans. The following efforts directly supported the development process of the VRU Safety Assessment:

- **Strategic Highway Safety Plan, 2022 – 2026** The New Hampshire Strategic Highway Safety Plan (SHSP) is a part of the State's Highway Safety Improvement Program (HSIP), which is a Federal-aid program that uses funds to implement strategies and countermeasures to reduce fatalities and serious injuries on all public roads. The SHSP provides an outline as to how funds will be allocated to address the plan's Critical Emphasis Areas (CEAs), one of which is Non-

Motorized Vulnerable Rod Users. The SHSP identified several strategies specifically targeting non-motorized safety as follows:

- Institutionalize and implement complete streets practices.
- Utilize advanced technologies, such as passive cell phone location data, to understand non-motorized travel volumes and origin-destination information for all travel modes to help inform infrastructure planning decisions. Action items include partnering with research experts, initiating pilot programs with regional planning commissions (RPCs), and implementing methodologies such as Bicycle Level of Traffic Stress (LTS) to enhance performance-based planning, reduce severe crashes, and improve low LTS streets based on demand, while also providing access to LTS and Strava data.
- Enhance infrastructure design and funding practices for vulnerable road users by incorporating best practices, including pedestrian and bicyclist accommodations, into the NHDOT Highway Design Manual, providing staff training on safe design principles, and applying the LTS concept to roadway infrastructure projects in collaboration with engineers and planners.
- Advocate for a vulnerable road user law through the development of and collaboration with a coalition of safety-oriented organizations.
- Create and disseminate educational materials to promote awareness of bicyclists, pedestrians, and e-bikes through partnering with agencies to develop and air public service announcements (PSAs) on the rights and responsibilities of non-motorized users and drivers in their interactions, including providing adequate clearance depending on speed, and continued outreach to encourage the use of bicycle helmets.
- Increased pedestrian and bicyclist safety-focused coordination among State, regional, and local agencies on data collection, data sharing, and enforcement through the improvement of data collection and analysis and the development of an interagency effort to better document crash injuries among non-motorized road users combining crash reports with hospital patient data.
- Investigate funding opportunities for maintenance of pedestrian and bicyclist safety infrastructure projects.
- Create age-appropriate safety curriculum (pre-drivers ed), which would include vehicular passenger, pedestrian, and bicyclist safety for middle and high-school students.
- Work with State police and local law enforcement to develop and implement in-service training for officers on bicyclist and pedestrian laws and enforcement techniques.

- **New Hampshire Pedestrian and Bicycle Plan, 2023** New Hampshire's Pedestrian and Bicycle Plan will be used in conjunction with the SHSP to create an environment where the use of any mode of travel, whether by motor vehicle, transit, bicycle, or walking, will be safe and convenient for people of all ages and abilities. The plan aims to improve safety through the reduction of severe non-motorized crashes, improve access by addressing gaps in the multimodal network, and ensuring residents have access to low stress bike and pedestrian facilities, and create a culture of safety by formalizing NHDOT's Complete Streets approach and design guidelines at the state and RPC level. The following key action items were identified:

  - Update staff training at NHDOT on current best practices for pedestrian and bicyclist safety design from AASHTO and NACTO, as well as training on Complete Street applications.
  - Maintain an interactive web map that highlights key existing condition findings from the Plan. Specifically, the bicycle levels of traffic stress (LTS) network and the desired network improvements.
  - Acquire data for shoulder width.

- Collaborate with stakeholders to prioritize and implement key policy, program, and general practice recommendations.
- Develop bicyclist, pedestrian, and Complete Streets design guidance that NHDOT and its partners can use that is responsive to various land use contexts and the unique character of New Hampshire.
- Conduct a systematic safety audit of bicyclist and pedestrian crashes to understand trends and identify crash risks.
- Supplement active transportation design guidelines to better reflect current best practices for pedestrian and bicyclist safety.
- Develop more specific performance targets for each of the three plan goals and evaluate progress. Consider releasing an annual progress report on NHDOT's website to inform partners and the public about accomplishments and challenges.
- Acquire data for traffic volume and nonmotorized user volume to allow ongoing LTS analysis and calculation of non-motorized crash rates.
- Pursue new annual programmatic funding for pedestrian and bicyclist improvements (including rail trails) in the Ten-Year Plan in addition to existing sources, such as Congestion Mitigation & Air Quality (CMAQ) Improvement Program, Transportation Alternatives Program (TAP), and Highway Safety Improvement Program (HSIP).
- Update and provide ongoing officer training (at academy and in-service) on data collection at scene of non-motorized crashes and education and enforcement of traffic laws related to pedestrian and bicyclist safety.

- **New Hampshire Statewide Transportation Improvement Program, 2023 – 2026** The Statewide Transportation Improvement Program (STIP) is a federally required four-year plan that provides details about transportation projects that are being implemented in New Hampshire. The STIP, developed in cooperation with the New Hampshire Metropolitan Planning Organizations (MPOs) and RPCs, contains federally funded projects, in addition to regionally significant projects. The STIP is required per 23 CFR 450.218 to include a financial plan that shows all current available funding and is financially constrained. There are some planned projects aimed to improve safety and access for bikes and pedestrians within the current STIP.

- **New Hampshire Long Range Transportation Plan, 2010 – 2030** The NH Long Range Plan provides a high-level strategic vision for the State and Department of Transportation over a 20-year horizon, The plan focuses on achieving four strategic objectives as follows:

  - Unify transportation planning and investment with broader state goals and actions.
  - Integrate planning and investment decision-making across all transportation modes, facilities, and services.
  - Increase investment in the areas of transportation infrastructure preservation and maintenance, travel demand management, and travel choices.
  - Establish new, more effective collaboratives partnerships to better leverage resources and to achieve long term goals.

  The strategic goals within the Long-Range Plan align with those of the VRUSA by providing safe and intentional multimodal infrastructure.

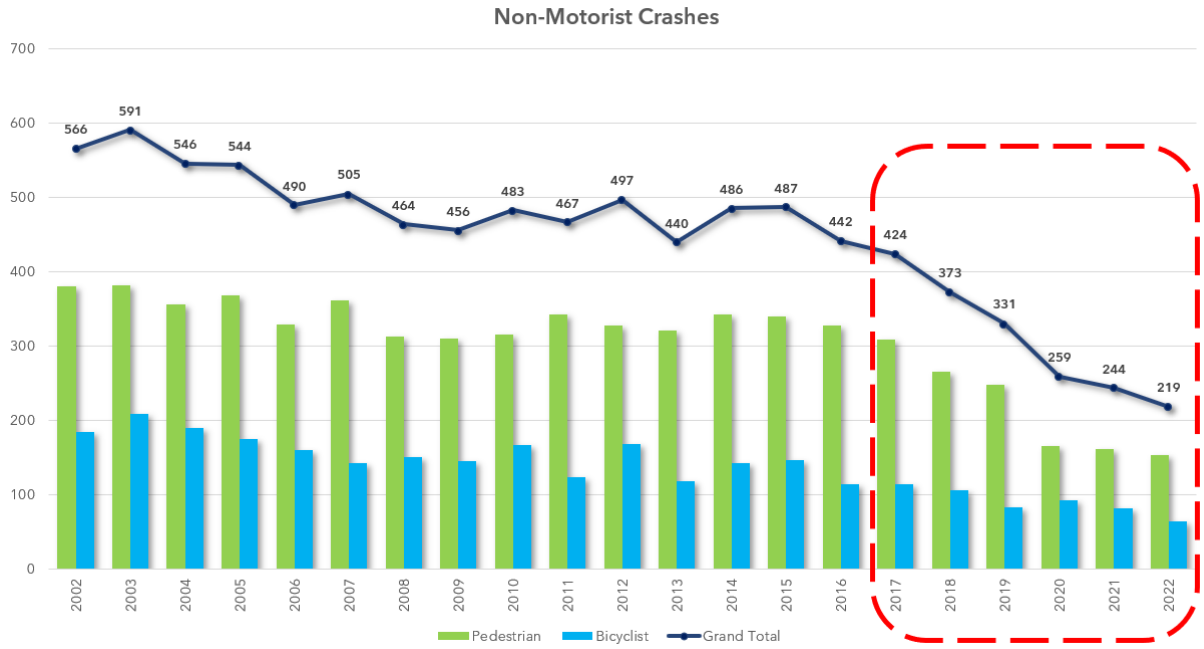
- **New Hampshire Americans with Disabilities Act (ADA) Title II Transition Plan 2023** The New Hampshire ADA Transition Plan serves as the guideline to ensure that NHDOT rights-of-way, including sidewalks, curb ramps, and crosswalks, are accessible to and usable by people of all abilities. In conjunction with the VRUSA, these documents align to ensure that infrastructure is not only inclusive but also conducive to reducing VRU crashes and addressing the specific needs of vulnerable road users.

02|| TARGET AND APPROACH

CURRENT TRENDS

The number of VRU crashes has been steadily declining over the past two decades, as shown in Figure 1, likely due to the introduction of pedestrian and bicyclist facilities such as sidewalks and bike lanes throughout the State. In looking at the past six years, 2017 – 2022, there was a steep decline in total number of VRU crashes in 2020 (a reflection of COVID and lower than normal traffic volumes).

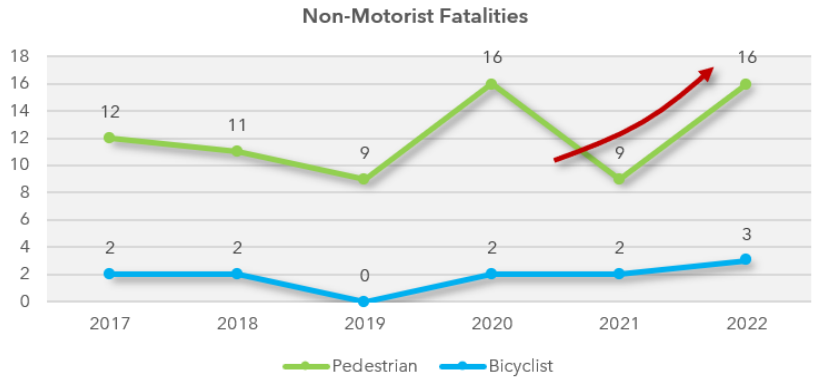
Figure 1. Non-Motorist Crashes 2002 - 2022



However, during this time, there was also a resurgence in walking and biking, alongside a decrease in motor vehicle traffic volumes that only encouraged higher speeds. These factors, along with others, may have contributed to the escalation in the severity of VRU crashes. As seen in Figures 2 and 3, there has been a marked increase of fatalities and serious VRU injuries, which is the impetus of this VRUSA.

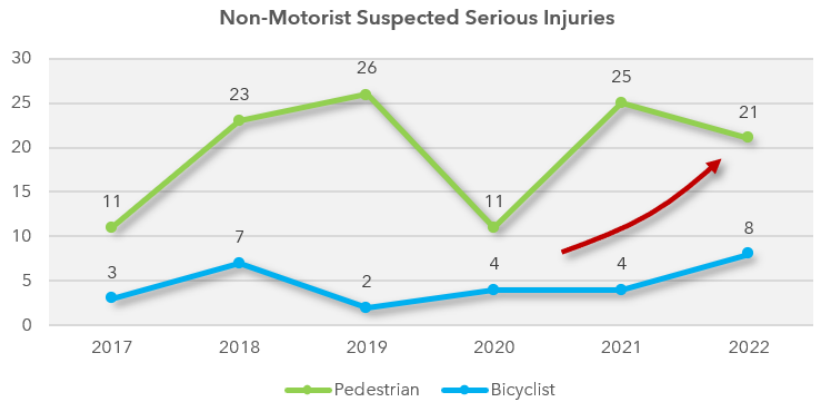
The non-motorist fatalities chart indicates the number of pedestrians and bicyclists who died in crashes. Pedestrian deaths increased from 2019 to 2020 but dropped to 2019 levels in 2021 and then returned to 2020 values in 2022. There were relatively few bicyclist fatalities, with three or less per year over the analysis period.

Figure 2. Non-Motorist Fatal Crashes 2017 - 2022



The number of pedestrians that sustained serious injuries increased from 2017 to 2019 then declined in 2020 before rapidly increasing again in 2021. The total number of bicyclists who sustained serious injuries remained relatively steady between 2017 and 2021 but experienced a sharp incline in 2022.

Figure 3. Non-Motorist Suspected Serious Injury Crashes 2017 - 2022



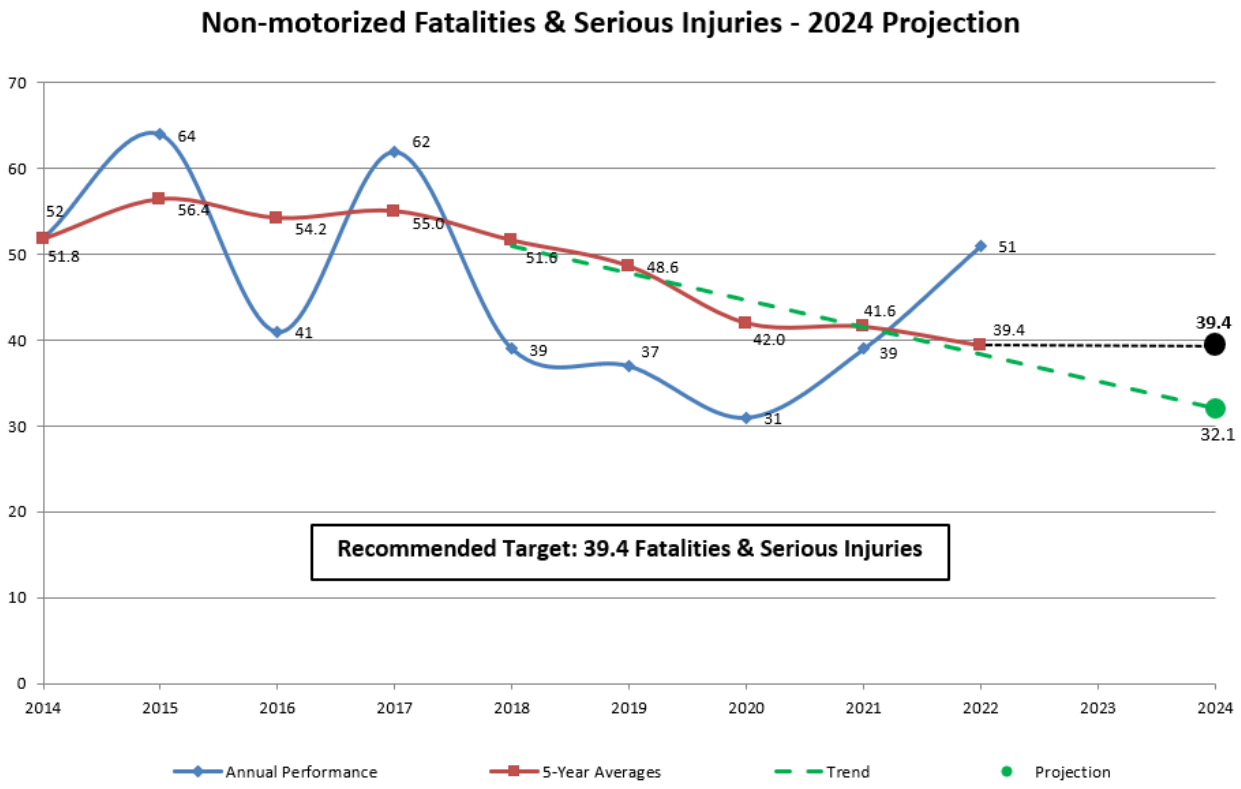
VRU SAFETY PERFORMANCE MEASURES

In 2016, the Federal Highway Administration mandated that both State Departments of Transportation and Metropolitan Planning Organizations (MPOs) set targets related to overall traffic safety and the reduction of nonmotorized fatalities and serious injuries.

Statewide targets were based on five-year rolling averages of pedestrian and bicyclist fatalities and serious injuries. Trend analysis has been used as the basis for developing initial 2024 safety performance targets, which have then been evaluated qualitatively and modified to produce targets that are reasonable and achievable. The future safety performance required to achieve these 2024 targets would be comparable to or slightly better than past performance, and much better than was experienced in 2022.

As depicted in Figure 4, the number of non-motorized fatalities and severe injuries rose substantially in 2022; nevertheless, the computed five-year average of fatalities and serious injuries continued its decline that began in 2017. It is important to note that, despite motor vehicle traffic volumes not yet having fully returned to pre-pandemic levels, the number of VRU fatalities was the highest seen in the past five years.

Figure 4. Non-Motorized Fatalities and Serious Injuries Performance Projection



Proposed Non-Motorized Fatalities and Serious Injuries Safety Target

The computed trend line is yielding a 2024 projected target of 32.1; however, achieving this target would require annual performance of 19.8 fatalities and serious injuries, which is substantially better than all prior performance and likely unattainable. Therefore, the computed 2022 performance has been adopted for the 2024 target of 39.4 fatalities and serious injuries, as outlined in Table 1. Achieving this target would require annual performance of 38.0 fatalities and serious injuries, which is comparable to recent performance but much better than experienced in 2022. This projection strengthens the case for taking bold action to reduce pedestrian and bicyclist crashes.

Table 1. Non-Motorized Fatalities and Serious Injuries Performance Measures

Performance Measure	2022 Performance		2024 Targets	
	Annual	5-Year Average	Computed Target	**Adopted Target**
Non-Motorized Fatalities and Serious Injuries	51	39.4	32.1	**39.4**

SAFE SYSTEM APPROACH

The Safe System Approach is a roadway safety framework, derived from Vision Zero, that emerged as a response to the growing concern of roadway traffic fatalities and serious injuries. This innovative approach, since adopted and further refined in various nations, revolves around the ultimate goal of achieving Vision Zero – an ambitious initiative to eliminate all road fatalities and serious injuries.

The Safe System Approach is founded on the core principle that deaths and serious injuries on roadways are unacceptable. Its philosophy is firmly rooted in recognizing that humans make errors, road users are vulnerable, and safety is a shared responsibility among all users. Safe System takes a proactive approach, emphasizing the importance of identifying and mitigating risks before crashes occur. It highlights the need for redundancy in the system, ensuring that safety is not compromised if one element of the system fails. By focusing on these fundamental principles, the Safe System Approach forms a robust foundation for advancing road safety and holds the potential to transform how bicyclist and pedestrian safety is addressed.

Figure 5. Safe System Approach; Source: FHWA

The objectives of the Safe System Approach – safer users, safer roads, safer vehicles, safer speeds, and post-crash care – are critical when considering a mixed urban/rural region such as the State of New Hampshire in the context of bicyclist and pedestrian safety. In the State of New Hampshire, the application of these objectives will address unique challenges and concerns:

Safe Users

In a mixed rural and urban region, people have varying levels of familiarity with traffic dynamics and safety measures. Promoting safer users requires tailored education campaigns that acknowledge both urban and rural contexts. While urban areas may benefit from campaigns focused on issues like pedestrian safety at intersections, rural areas may require education on sharing the road with non-motorized users.

Safe Roads

Safe road design becomes especially crucial in a state with diverse contexts. While urban roads tend to be more structured and provide more pedestrian and bicycle facilities, rural areas often have limited multi-modal infrastructure. The objective of safer roads is to ensure both environments are designed with sustainable pedestrian and bicyclist safety in mind, meaning designs should be context sensitive.

Safe Vehicles

The objective of safe vehicles applies in all contexts, and works to expand the availability of vehicle features that can detect bicyclist and pedestrian activity as well as minimize the impact of crashes on these vulnerable road users.

Safe Speeds

Speed management measures are essential, given the varying speed limits and conditions in urban and rural areas. In urban settings, factors like traffic congestion and abundant infrastructure naturally lead to slower speeds. In rural areas, higher speeds combined with limited non-motorized infrastructure pose significant risks to vulnerable road users, even if there is typically low exposure in these areas. The challenge is to align speed limits with the specific conditions. This balance may involve reducing speeds in urban areas, emphasizing intersection safety and traffic calming, through a variety of approaches including speed limit reduction, school zone automated enforcement, police enforcement, installation of speed humps, reduced vehicular travel lane widths, intersection turn calming, and community outreach. Higher speeds may be addressed in rural areas through tailored speed management measures focused more so on road design and enforcement tactics.

Post-Crash Care

This objective is crucial in both urban and rural settings, focused on the accessibility of healthcare facilities. In remote rural areas, quick access to medical care may be limited, making it vital to establish and enhance efficient post-crash care.

In summary, the objectives of the Safe System Approach are adaptable to mixed urban and rural regions, but their implementation requires specific strategies that consider the unique characteristics and challenges of each context. By adopting the Safe System Approach, the State of New Hampshire can effectively improve pedestrian and bicyclist safety across the roadway network in both its urban and rural areas.

03|| CONSULTATION

The success of any roadway safety initiative, particularly one focused on Vulnerable Road Users (VRUs), relies significantly on the input and collaboration of a wide array of stakeholders. In this context, stakeholders encompass a broad spectrum of entities and individuals who play vital roles in enhancing pedestrian and bicyclist safety across the state of New Hampshire.

STAKEHOLDERS COMMITTEE

Given the multifaceted nature of the issue, a VRU Stakeholder Committee was established to include participants from the public and private sectors with a wide range of expertise in the realms of education, enforcement, engineering, and advocacy. Two virtual style meetings were conducted to not only present the data findings but also gather feedback and additional local context as it relates to identified high risk areas and populations.

SEPTEMEBER 19, 2023 - STAKEHOLDERS COMMITTEE

The first Stakeholder Committee meeting was held virtually on September 19, 2023. During this meeting, the project team presented the preliminary findings of the data analysis and provided stakeholders with the opportunity to provide feedback as to how high-risk areas and populations could be identified.

The following recommendations were suggested by Stakeholder Committee members and served as valuable steps in identifying specific VRU high risk factors/areas and developing targeted strategies for safety improvements across various regions and roadway types.

- Utilize bicycle level of traffic stress data to better evaluate the risk of crashes involving bicyclists. This data can provide valuable insights into areas where bicyclist safety improvements are needed.
- Investigate the distribution of crashes occurring within the 5 PM – 6 PM hour throughout the year. Understanding if these incidents are more prevalent during winter months can lead to recommendations for improved street lighting and snow plowing to enhance safety.
- Consider normalizing crash data for the population of each town/county to present crashes and injuries on a per capita basis and determine where crashes are more relevant in comparison to the perceived exposure to risk.
- Address the concerning trend of seniors being involved in severe crashes by developing targeted recommendations and strategies to improve their safety.
- Recognize that arterials, both major and minor, pose higher risk factors and prioritize safety countermeasures in these areas to reduce vulnerabilities for pedestrian and bicyclists.
- Promote the development of safety action plans among local communities and RPCs to foster a proactive approach to improving road safety for vulnerable road users.
- Introduce prioritization metrics that incorporate vulnerable road user risk data into the selection criteria for Transportation Alternatives Program (TAP) projects, ensuring that safety improvements are targeted where they are most needed.
- Recommend material procurement strategies to efficiently focus on vulnerable road user improvements in disadvantaged communities and populations, emphasizing the importance of equitable safety enhancements.
- Integrate hospital data with crash data to gain deeper insights into the nature and severity of injuries sustained by vulnerable road users.
- Investigate the specific location of severe crashes in rural areas and if they are concentrated in transition zones, where high-speed roadways meet low-speed community centers. Identifying these specific areas as potential high-risk areas is essential for implementing targeted speed management safety measures and appropriate countermeasures.

OCTOBER 19, 2023 - HSIP COMMITTEE

In addition to engaging with our VRU Stakeholder Committee, the project team virtually collaborated with the Highway Safety Improvement Program (HSIP) Committee. This combined effort ensured a comprehensive and inclusive approach to addressing vulnerable road user (VRU) safety across the state. The following recommendations were brought forth by the HSIP committee in relation to the development of strategies:

- In regard to crashes with unknown crash severity reported, the NH Department of Health and Human Services (NHDHHS) has been working with hospital emergency department data to better understand and identify VRU serious injuries. It is recommended to integrate hospital data with crash data to gain deeper insights into the nature and severity of injuries sustained by vulnerable road users.
- In regard to underreported VRU crashes, it is recommended that NHDOT work collaboratively with NH Department of Safety (NHDOS) to improve crash reporting procedures to better capture VRU crash data. This is a recommendation brought forth in both the Strategic Highway Safety Plan and the New Hampshire Pedestrian and Bicycle Plan.
- The VRU Assessment analysis shows a prevalence of crashes where high speed roads transition into village centers. These roads are often state owned; however, NHDOT's policy has been that the state does not have the resources to maintain ped/bike infrastructure (crosswalks, bike lane markings, pedestrian beacons) on state highways. It is recommended that this policy be revisited.
- There is a significant percentage of impairment among VRU users involved in severe crashes. It is recommended that the VRU Assessment include a strategy to reduce impairment through substance avoidance education, targeted communication campaigns, and partnerships with social service agencies.

OCTOBER 26, 2023 - STAKEHOLDERS COMMITTEE

The second Stakeholder Committee meeting was held virtually on October 26, 2023. During this meeting, the project team provided a recap of the preliminary findings of the data analysis, including recommendations brought forth by the committee at the previous meeting. Also provided was an overview of the High Injury Network and the development of programs and strategies to address the identified high-risk factors/areas/populations. The following summarizes the feedback received at the second stakeholder's meeting:

- Consider strategies that will reduce traffic volumes through expanded public transportation, and intentional land use planning, as well as implement transportation demand management techniques such as variable school and work hours.
- Consider a strategy to expand the use of electronic reporting of crashes and the thorough documentation of crash data among both state and local law enforcement agencies.
- In regard to local training efforts, consider the New Hampshire Local Technical Assistance Program (NH LTAP) through the University of New Hampshire Technology Transfer Center (UNH T2) an interested partner as their funding from FHWA and NHDOT allows them to be well positioned and structured to help in this area. The organization recently rolled out their Road Safety Advocate program which focuses heavily on the Safe System Approach and community partnerships to improve roadway safety, so additional training on the VRU topic may fit well.
- In regard to the need for crash data improvements regarding analysis, access, and transparency, consider NH LTAP at UNH T2 an interested partner in this initiative as well. For instance, some LTAP centers develop individualized crash data reports for each of their states' municipalities annually.

OCTOBER 30, 2023 - NHDOT CONSULTATION

Furthermore, to ensure understanding and adoption of the VRU safety assessment findings and recommendations, the project team delivered a presentation to the NHDOT Commissioner and Department Heads on October 30, 2023. The presentation provided a summary of the data analysis, an overview of the High Injury Network, and the compilation of programs and strategies aim to address the identified high-risk factors/areas/population.

This served as a crucial step in garnering support and commitment from the highest levels of NHDOT leadership, fostering a united commitment to enhance pedestrian and bicyclist safety across the State of New Hampshire. The following recommendations were brought forth during the Front Office meeting:

- Exercise caution when presenting findings on school proximity crashes within 2,000 foot buffer zones, as the size of these areas makes it challenging to directly associate these crashes with school related foot and bike traffic.
- Consider implementing a prioritization or ranking system for the numerous strategies and action items to enhance clarity and focus moving forward.
- Consider including an action item that recommends the state conduct peer reviews for municipalities, especially those undertaking local projects and pedestrian/bicyclist safety initiatives.

Incorporating valuable feedback and insights from a diverse array of stakeholders, including state government officials, local communities, regional planning commissions, and a multitude of advocacy groups, has been instrumental in the formulation and refinement of the Vulnerable Road User Safety Assessment. All outreach materials have been compiled in an accompanying document including presentations, meeting minutes, and attendance lists. Meeting recordings and transcripts are available to watch and review via the New Hampshire DOT website.

04|| DATA DRIVEN ANALYSIS

DATA SOURCES

Crash Data

For this effort, several crash related databases were consulted for the period of January 1, 2017, to December 31, 2022. GPI obtained 'Run Lists' for the years 2017-2022 from the NHDOT Department of Safety – Office of Highway Safety (OHS), which are the comprehensive listings of annual fatal crashes and their circumstances. In addition, the National Highway Traffic Safety Administration's (NHTSA) FARS data was researched for more comprehensive detail regarding the fatal crashes.

Statewide crash data was also obtained from the NHDOT Bureau of Planning and Community Assistance. The data is from New Hampshire DMV's VISION Crash Records Management Systems (CRMS) which includes State and Local individual crash reports. The Run Lists were utilized for identifying fatal crashes and the statewide crash data was filtered to obtain severe injury crashes.

Infrastructure Data

Crash data was spatially joined with infrastructure data using the NHDOT GIS Roadway Inventory file. This allowed crash data to be correlated with roadway characteristics such as roadway classification, traffic volumes, roadway widths, and posted speed amongst other factors.

Socioeconomic Data

Crashes were also investigated through an equity lens by spatially joining crash data with socioeconomic data to get a better understanding of the makeup of the communities in which these crashes are occurring. The project team utilized the U.S. DOT Equitable Transportation Community (ETC) Explorer, which is an interactive web application that uses 2020 Census Tracts and data (2020 US Census and 2016-2020 American Communities Survey (ACS) 5-year estimates), to identify communities that experience burden as a result of underinvestment in transportation. Socioeconomic indicators such as population, employment, vehicle availability, median income levels, racial makeup, age distribution, amongst others were utilized to distinguished at-risk populations. Readers can learn more about the USDOT ETC Tool here.

Land Use Data

Crash data was also investigated in relation to proximity to schools, recreation areas, transit stops and community centers. Land use data was obtained from NHDOT GIS sources. These points of interest represent potential bike and pedestrian generators that could relate to risk or at least the presence of VRUs.

CHALLENGES AND LIMITATIONS

Several challenges and limitations were encountered during the crash data analysis phase. They are as follows:

- **Inconsistent Data.** As explained above, data was obtained from several different data sources. Performing data analysis using two different sources can be challenging due to data incompatibility and variations in data quality. In this case, the fatal crash data is precise in terms of location but lacks some of the general crash details such as weather and road conditions. Conversely, the statewide crash data provided has known reliability concerns regarding data location attributes. The known reliability issues were taken into consideration and therefore, data trends were focused on the neighborhood (census tract) or community (city/town) level.

- **Unknown Data.** For many crash records in the statewide crash database, various fields are left blank by the reporting officer. Occasionally, a report will have "unknown" listed rather than a blank field. Without this information, it is difficult to capture a complete understanding of the circumstances surrounding the crash. In particular, there were a significant number of crashes

represented within the comprehensive crash list with severity listed as unknown. This may be due to enforcement being unwilling or unable to determine the severity at the time of the incident. It is probable that a number of these crashes did result in some form of injury, indicating the data may be skewed.

- **Underreported Data.** Crashes involving pedestrians and bicyclists have traditionally gone underreported, especially if no injuries occurred. In fact, a recent study from Washington D.C. found that almost one in three car crashes involving a cyclist or pedestrian goes unreported, especially in predominately Black communities. This underreporting can further skew the available data.

- **Lack of Individual Demographic Data.** The crash data provided does not contain data relating to the individual – with the exception of age for fatal crashes. Therefore, it is unviable to derive trends associated with an individual's race, disability, and economic status. Socioeconomic trends were derived utilizing census data sources and therefore are focused on the neighborhood (census tract) or community (city/town) level, assuming that most pedestrian and bicyclist related crashes occur relatively close to an individual's home or work location.

- **Frequency of Crashes.** Compared to motor vehicle crashes, pedestrian and bicyclist related crashes are typically much less frequent. Given New Hampshire's relatively low volume of pedestrians and bicyclists compared to more urban states, the number of crashes is also relatively lower. In standard safety analyses, the frequency of crashes is typically utilized to identify "hot spots". Consequently, when these standard methods are applied to a low frequency of pedestrian and bicyclist crashes, they may lead to misleading conclusions as it is difficult to reveal clear trends.

- **Exposure Data.** Data relative to motor vehicle traffic volumes is typically widely available in the state of New Hampshire. Count data related to pedestrians and bicyclists, on the other hand, is scarce and is typically conducted only for specific projects or locations in the State. Without comprehensive data on pedestrian and bicyclist activity, it becomes difficult to accurately assess the risk and exposure levels for these users – potentially resulting in misidentified hot spots.

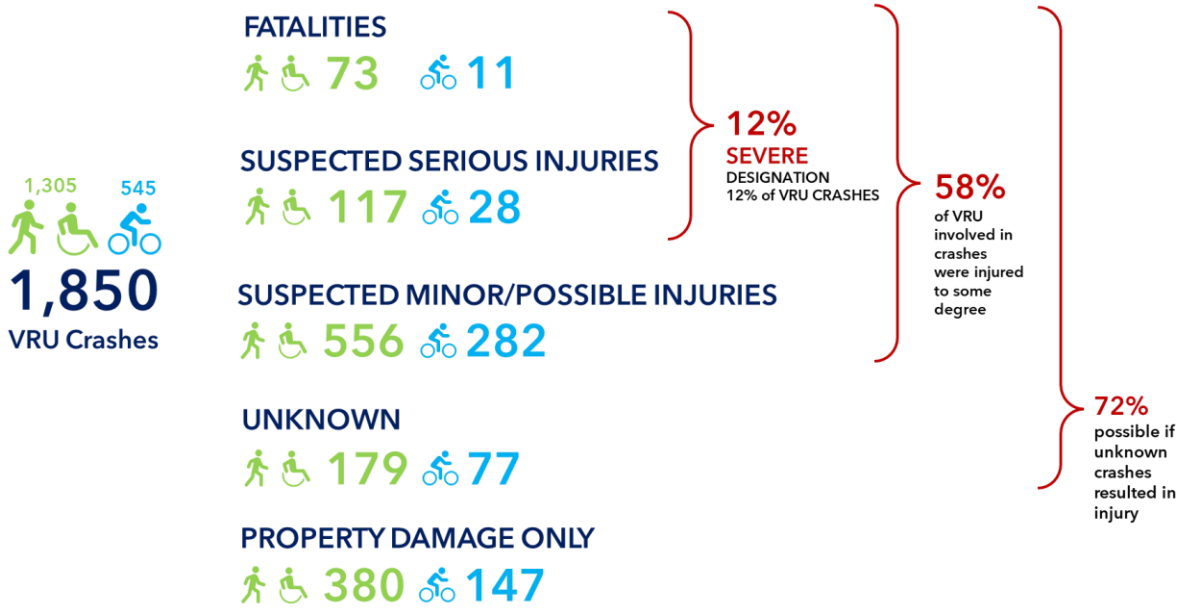
- **Time Constraints.** Due to time constraints, crash narratives for fatal and suspected serious injury crashes were not reviewed. It is recommended that the State of New Hampshire pursue a more thorough analysis of these crash narratives to understand contributing circumstances in severe crashes and identify underlying trends.

CRASH SEVERITY

A total of 1,850 VRU-involved crashes were reported in New Hampshire over the six-year study period, extending from January 1, 2017, to December 31, 2022. Approximately 1,305 crashes involved a pedestrian, with the remaining 545 involving bicyclists. When this data is further analyzed in terms of severity, the findings revealed **84 fatalities**, comprising 73 pedestrians and 11 bicyclists, along with **145 incidents of serious injuries**, including 117 pedestrians and 28 bicyclists. These statistics represent the **severe crashes that account for 12% of the total VRU crashes over the six-year study period**. (Figure 6)

Additionally, there were a total of 838 crashes (556 involving pedestrians and 282 involving bicyclists) resulting in suspected minor or possible injuries. When combined with the severe crashes, this indicates that 58% of VRUs involved in these crashes sustained some degree of injury. Furthermore, there was a substantial number of crashes (**approximately 14%) reported with "unknown" severity** (179 involving pedestrians and 77 involving bicyclists). It is probable that some, perhaps many, of these incidents resulted in injury, suggesting that the percentage of VRU crashes resulting in injury is likely higher than 58% as previously reported, and could be as high as 72%. Lastly, there were a total of 527 crashes (380 involving pedestrians and 147 involving cyclists) that resulted in property damage only. While this study encompasses all VRU crashes, the key findings were primarily derived from the characteristics surrounding severe crashes.

Figure 6. VRU Crash Severity Crash Tree



Severity Index

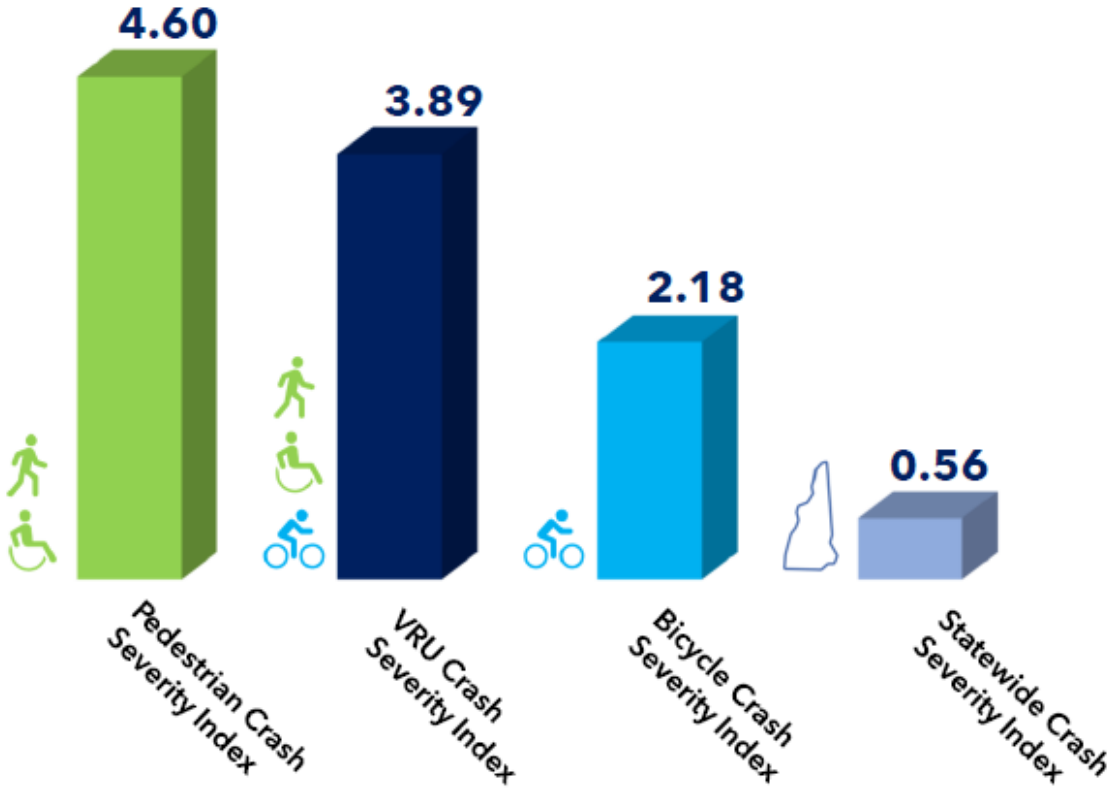
To assess the crash severity across various attributes, a severity index was established (adopted from the Montana DOT Traffic and Safety Bureau). This index involved assigning weights to the number of crashes or injuries based on specific criteria or areas of interest. The severity index assigns higher weight to fatalities and serious injuries, intermediate weight to minor injuries/possible injuries, and lower weight to crashes resulting in property damage only. It serves as a tool for comparing the severity of crashes within defined geographic zones (urban versus rural), user attributes (bicyclists versus pedestrians), or road-related crash characteristics (arterial roads versus local roads). The severity index formula is presented in Figure 7.

Figure 7. Crash Severity Index Formula

$$\text{Severity Index} = \frac{(66.7 \times \text{Fatal}) + (3.53 \times \text{Serious Injury}) + (1.29 \times \text{Minor Injury}) + (0.73 \times \text{Possible Injury}) + (0.12 \times (\text{PDO} + \text{Unknown}))}{\text{Total Crashes or Injuries}}$$

The crash severity index was instrumental in comparing VRU safety performance to overall safety performance. The crash severity for pedestrian-involved crashes was 4.60, compared to a crash severity index of 2.18 for bicyclist-involved crashes. Combined, all VRU-involved crashes (including both pedestrians and bicyclists) had a crash severity index of 3.89. For all motor vehicle crashes that occurred in New Hampshire over the same six-year period, the overall crash severity index was 0.56 (Figure 8). The data clearly demonstrates that **VRU crashes tend to be substantially more severe than typical traffic crashes.** This stark contrast in severity emphasizes the need for targeted safety measures to protect VRUs.

Figure 8. VRU Crash Severity vs. State Crash Severity



Cost Analysis

Assessing crashes through an economic lens is also a valuable tool as it provides a quantified measure of financial burden associated with these crashes. Not only does this help highlight the potential savings that can be achieved through safety countermeasures but also helps in justifying investments in safety initiatives as they relate to bicyclist and pedestrian safety. Comprehensive crash costs, often referred to as societal costs, were assigned to the severe crashes that occurred over the six year study period. It should be noted that current monetized values were derived from the FHWA 2023 Benefit-Cost Analysis Guidance for Discretionary Grant Programs Document and represent both the measurable economic impacts and the monetized evaluation of pain and suffering (expressed in Quality-Adjusted Life years).

The comprehensive crash cost for the severe crashes over the six-year study period was approximately $1,073,000,000, resulting in an average annual cost of approximately $179,000,000, as summarized in Figure 9. This figure may act as a compelling catalyst to prioritize funding for bicycle and pedestrian infrastructure and safety.

Figure 9. Severe VRU Crash Comprehensive Crash Costs

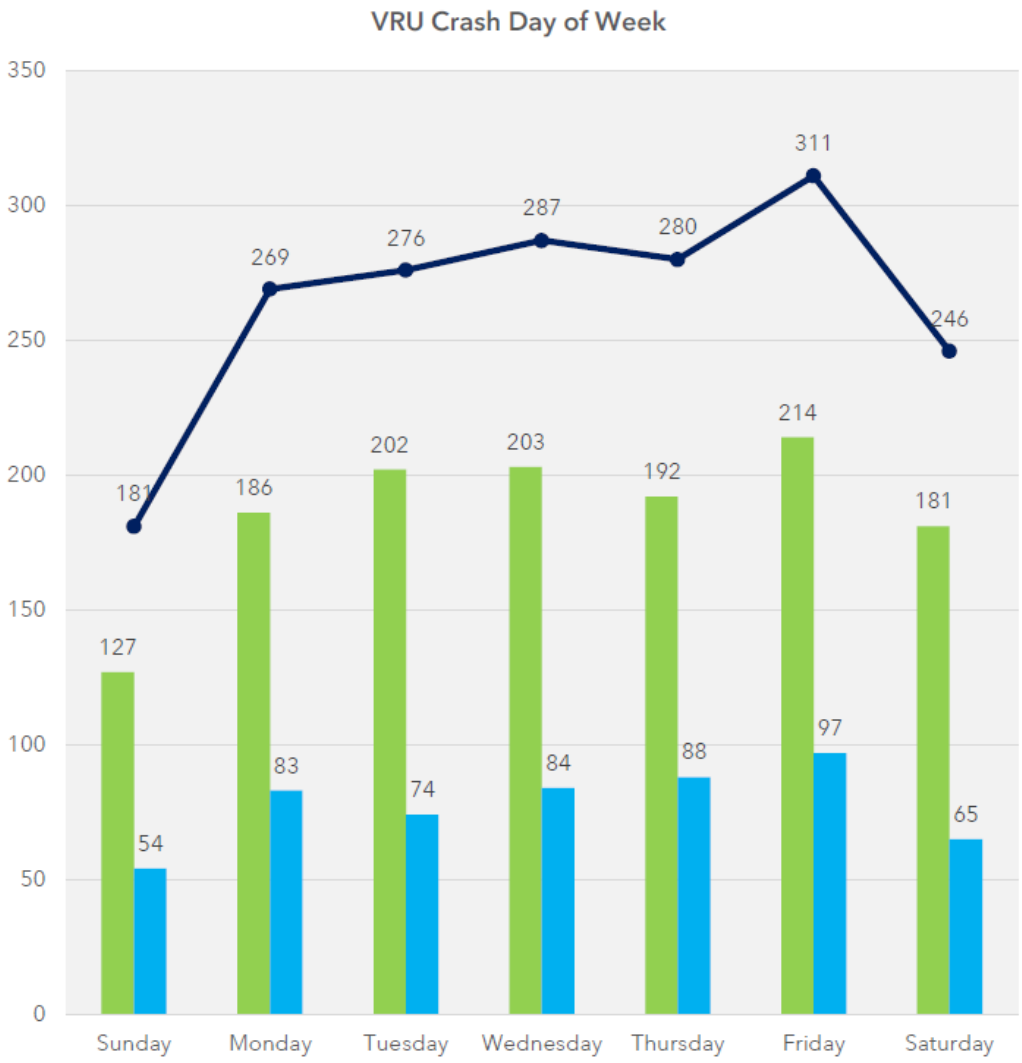
The following sections summarize crash details and other crash characteristics associated with these VRU crashes that occurred within New Hampshire over the analysis period.

WHEN ARE CRASHES OCCURRING?

Day of the Week

The distribution of crashes and severe injuries based on the day of the week in which the crash occurred is presented in Figure 10. With respect to the day of the week in which non-motorist-involved crashes occurred, a higher number of crashes occurred on weekdays (87 percent) compared to weekends. This suggests a possible trend with regular commuting patterns and generally higher traffic exposure on weekdays.

Figure 10. VRU Crash Day of Week



As shown in Figure 11, the highest number of reported pedestrian fatalities occurred on Saturdays (17) followed by Wednesdays (13) and Thursdays (14). Wednesdays accounted for the most bicyclist fatalities (4 total).

Figure 11. Fatal VRU Crash Day of Week

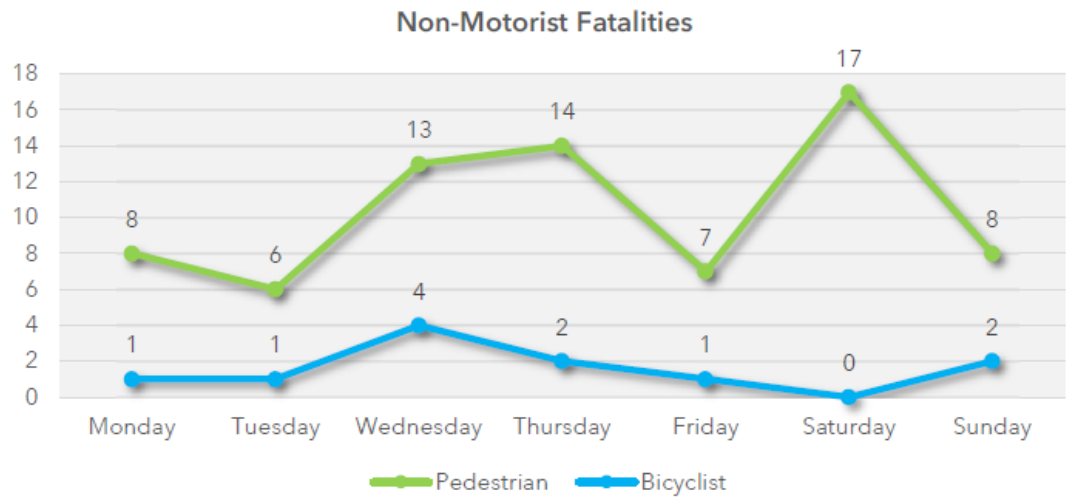
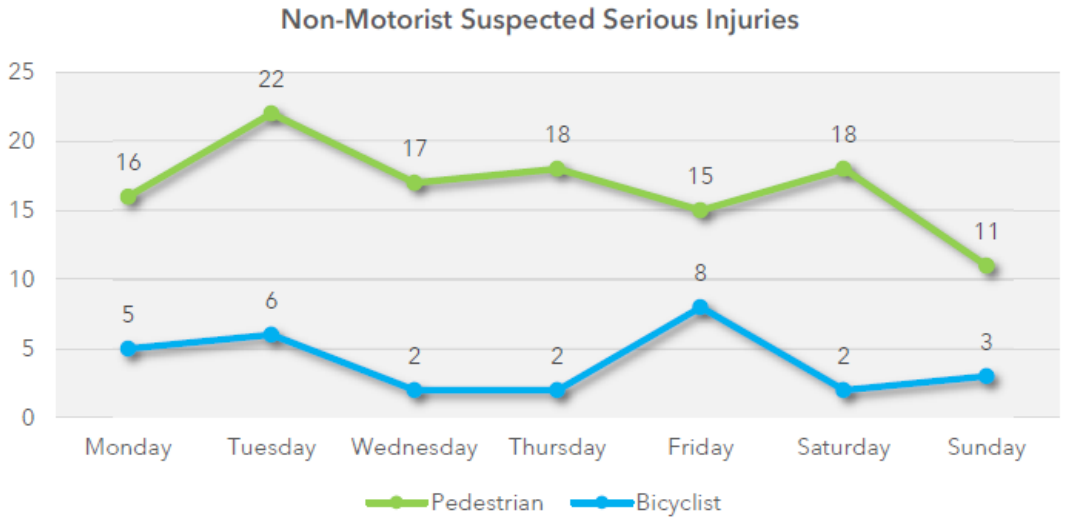


Figure 12 suggests that Tuesdays were the highest for pedestrian suspected serious injuries (22), while Fridays were the highest for bicyclist serious injuries (8).

Figure 12. Serious Injury VRU Crash Day of Week



Month

Figure 13 shows the distribution of reported non-motorist-involved crashes based on the month of the year in which the crash occurred. Approximately 70% of bicyclist-involved crashes occurred in the summer and fall months (June through October) while 58 percent of pedestrian-involved crashes occurred in the fall and winter months (September through February). Total VRU-involved crashes were highest in the summer months (June through September) and lowest in the winter months (December through April).

Figure 13. VRU Crash Month

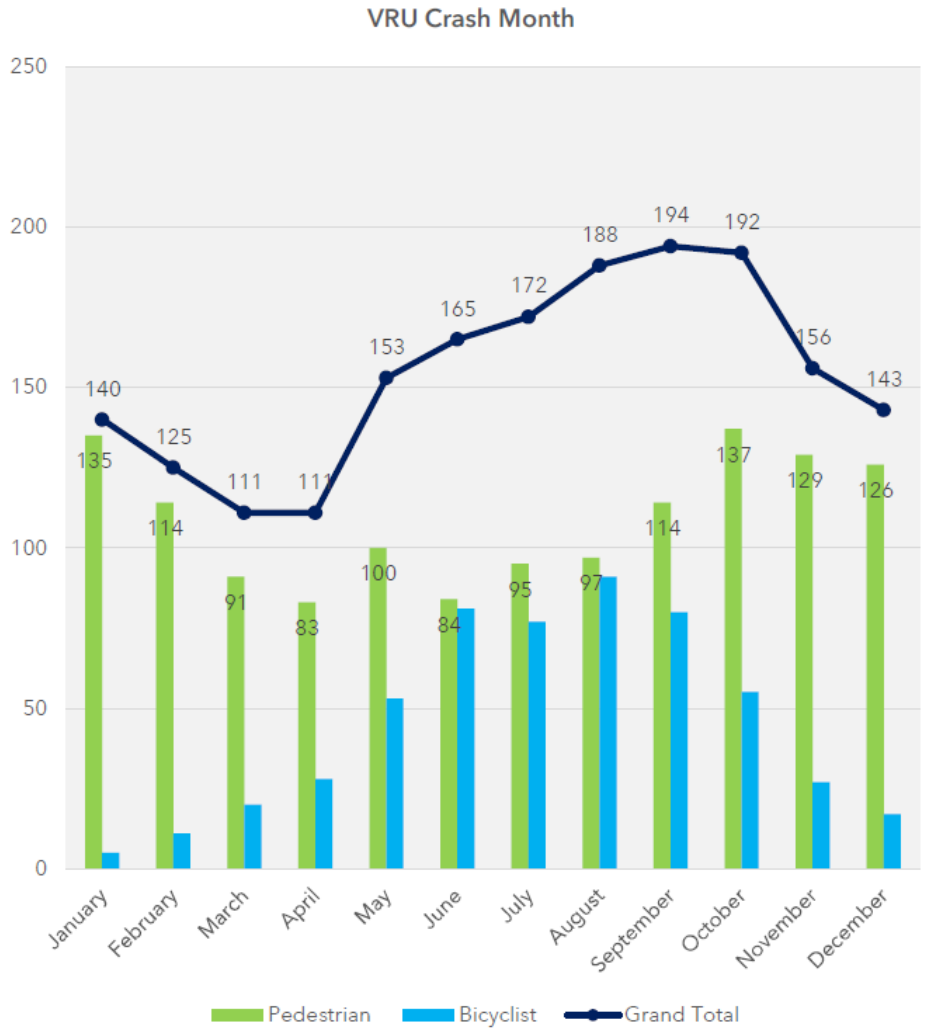


Figure 14 illustrates the distribution of fatal VRU crashes based on the month of year in which they occurred. Pedestrian fatalities peaked in December (15) while bicyclist fatalities peaked in September (3).

Figure 14. Fatal VRU Crash Month

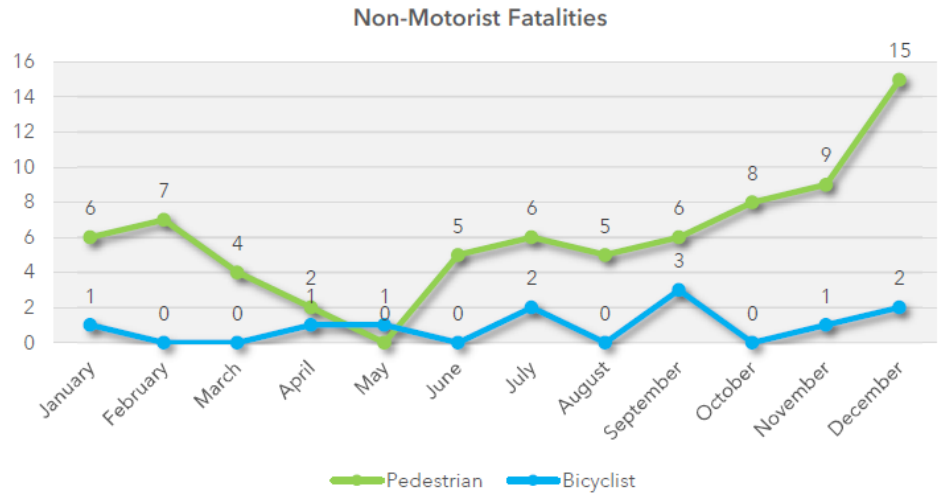
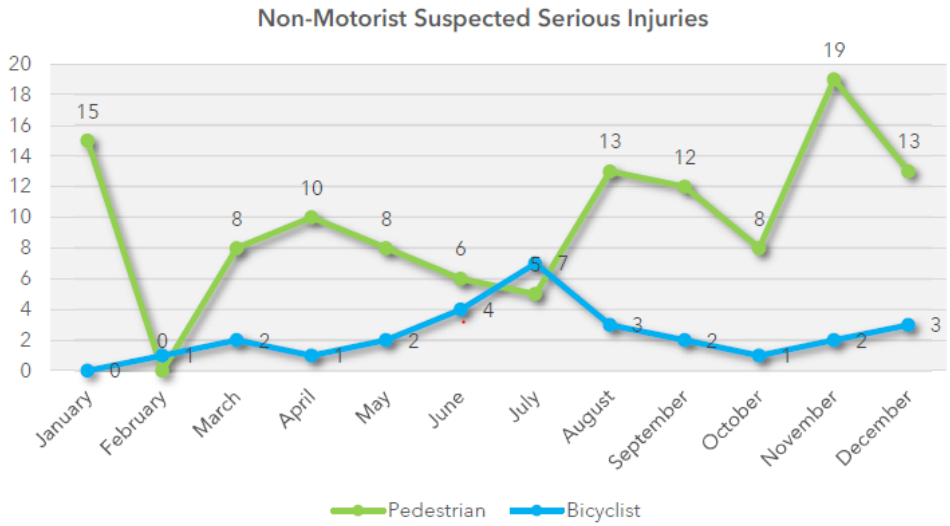


Figure 15 illustrates the distribution of serious injury VRU crashes based on the month of year in which they occurred. pedestrian suspected serious injuries were highest in the winter months of November (19), January (15), and December (13). Bicyclist serious injuries peaked in July (7).

Figure 15. Serious Injury VRU Crash Month

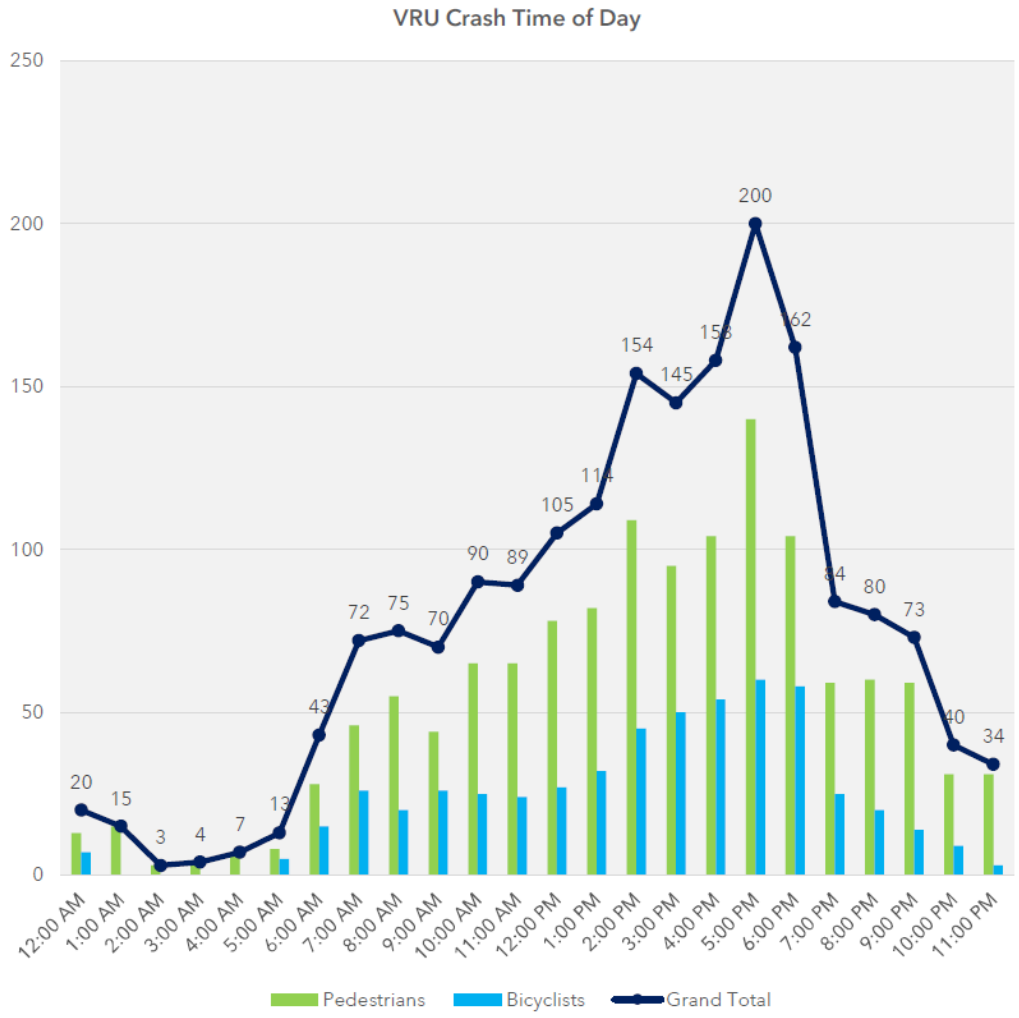


The higher frequency of pedestrian-related crashes during winter months may point to issues with winter maintenance of pedestrian facilities (snow banks, etc.), consideration of daylight savings time and lack of adequate street lighting. Conversely, these findings may suggest bicyclist activity is highest during warmer months which is exacerbated by higher traffic volumes due to increased travel and tourism.

Time of Day

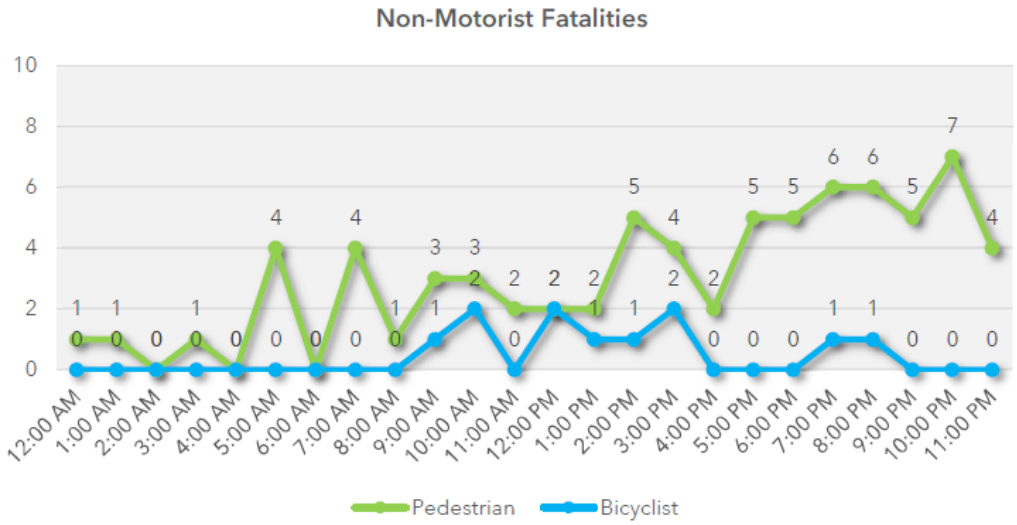
The time-of-day distribution for all VRU crashes is presented in Figure 16. Two prominent peaks can be seen, with one around 7:00 AM and the other between 4:00 PM and 6:00 PM (particularly the 5 PM hour), likely corresponding to morning and evening commutes as well as school start and release times. As mentioned previously, pedestrian crashes are highest during the winter months. Therefore, the 5 PM hour was further investigated in regard to pedestrian crashes indicating that **over 50% of the pedestrian crashes occurring within the 5 PM hour occurred during the winter months of November to January, further supporting that this is a high-risk time period for pedestrians in particular.**

Figure 16. VRU Crash Month



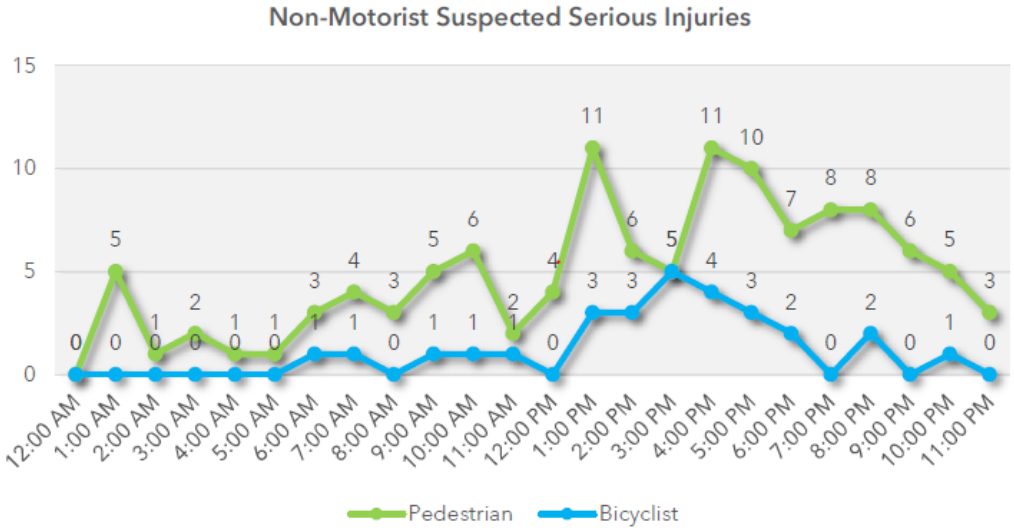
Pedestrian fatalities were highest in the evening hours, from approximately 7:00 PM to 10:00 PM, suggesting inadequate street lighting as a contributing factor to these crashes. Small peaks in bicyclist fatalities were observed at 10:00 AM – 3:00 PM. These statistics are shown in Figure 17.

Figure 17. Fatal VRU Crash Month



Non-motorist suspected serious injuries, depicted in Figure 18, occurred more randomly throughout the day, with the greatest number of pedestrian serious injuries at 1:00 PM, between 4:00 and 5:00 PM, and between 7:00 and 8:00 PM. Bicyclist suspected serious injuries peaked between 1:00 PM and 5:00 PM.

Figure 18. Serious Injury VRU Crash Month



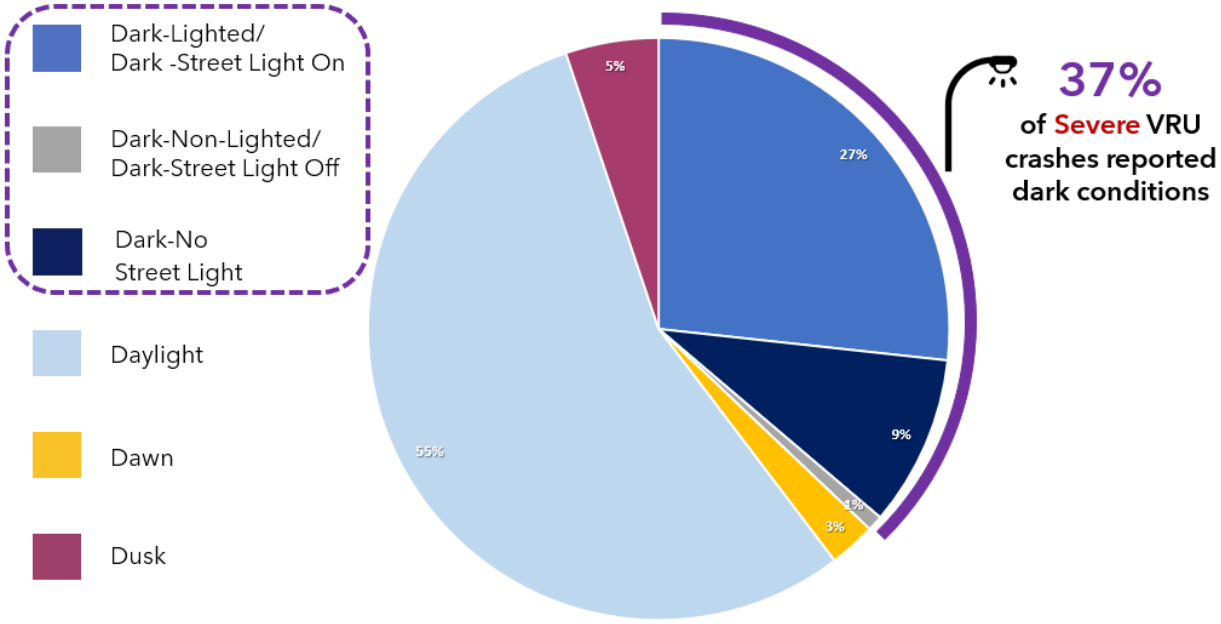
IN WHAT CONDITIONS ARE CRASHES OCCURRING?

Lighting Conditions

Investigating lighting conditions in the context of bicyclist and pedestrian crash data is crucial because it helps identify how visibility, or the lack thereof, affects the occurrence and severity of these crashes. The lighting condition analysis performed indicated that **37% of severe VRU crashes reported dark conditions**, as shown in Figure 19. When investigating when these dark condition crashes were occurring, it was determined that 62% occurred in winter months and 55% of which occurred during the hours of 4 PM – 7 pm. This can be correlated with students and employees commuting from school or work during the winter months where daylight is limited.

It is also important that note that 27% of crashes reported dark conditions but the street light was on. While this indicates that there is lighting, it may not be adequate. This is a common occurrence as most street lighting was typically designed with the motorist in mind rather than the pedestrian or bicyclist, especially in more rural contexts. This holds true particularly at intersections and midblock crossings. Street lighting, when designed and implemented properly, is a proven safety countermeasure and can dramatically improve safety in areas of high concern such as crosswalks, school zones and intersections which typically experience higher bike and pedestrian activity.

Figure 19. Severe VRU Lighting Conditions Breakdown



Environmental Conditions

Approximately 13% of severe VRU crashes occurred in wet/icy conditions indicating there can be improvements in winter maintenance (i.e., snow plowing to remove sight distance issues cause by snow banks) as well as driver education campaigns.

WHERE ARE CRASHES OCCURRING?

Town

NH Town boundaries were imported to GIS and crashes were spatially joined to see how many crashes were occurring in each town. This was then looked at in terms of population to obtain the number of crashes per capita occurring in each town, which helps provide insight into the relative risk and impact of crashes on a local scale. Essentially, this approach helps identify areas with higher concentration of crashes compared to their population, indicating potential safety concerns that may require specific attention.

Figure 20 illustrates all VRU crashes per capita for each town. This indicates that **VRU crash occurrences are more frequent in the more populous towns/cities** such as Manchester, Concord, Nashua, Laconia, and Keene. This correlation is to be expected as these more densely populated areas tend to have higher levels of pedestrian and bicyclist activity, along with more infrastructure to support these users.

Conversely, Figure 21 illustrates the number of severe crashes (fatal and serious injuries) per capita per town. While VRU crashes are more frequent in more populous areas, **VRU crashes tend to be more severe in rural areas**. Therefore, higher rates of severe crashes are revealed in towns like Gorham, Bartlett, Littleton and Lisbon.

Figure 20. Total VRU Crashes per Capita

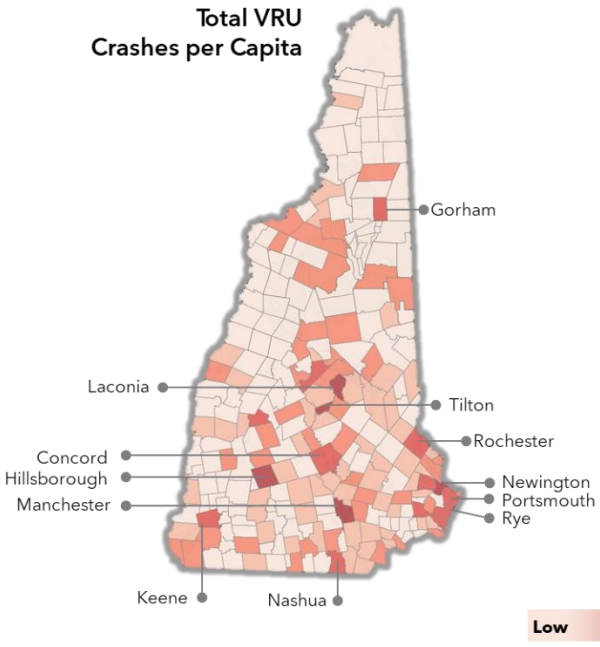
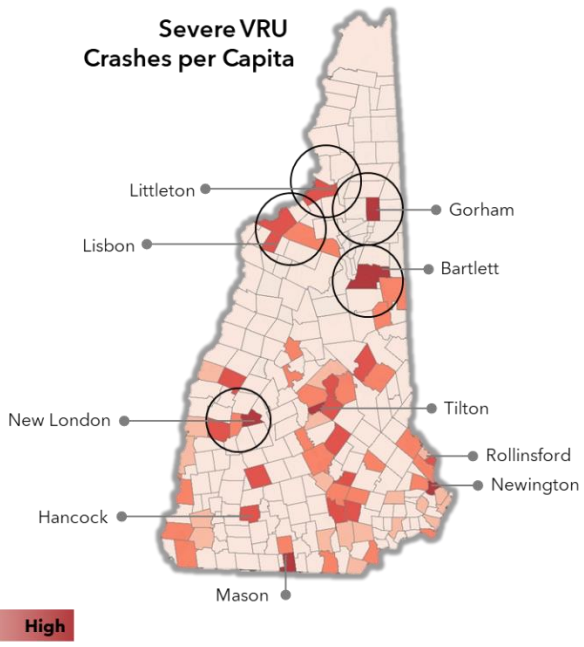


Figure 21. Severe VRU Crashes per Capita



County

This evaluation was duplicated for counties to allow for a more regional analysis and to help aid MPOs and RPCs understand how their general area is performing. Figure 22 illustrates all VRU crashes per capita for each county while Figure 23 represents severe crashes per capita per county. Most notably, **Belknap County**, home of the Lakes Region as well as several ski destinations, experiences a high number of total VRU crashes as well as severe VRU crashes per capita, highlighting this county as an area of concern. Also important to note are Coös and Carroll counties, both of which experience a relatively low number of VRU crashes but when crashes occur they tend to be more severe due to their rural nature.

Figure 22. Total VRU Crashes per Capita

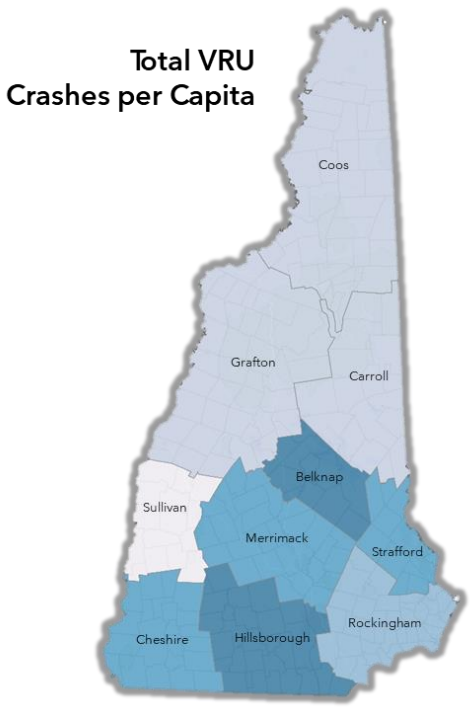
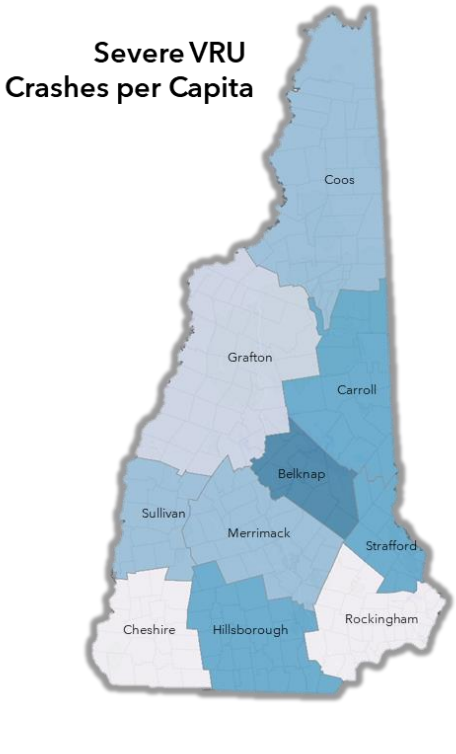


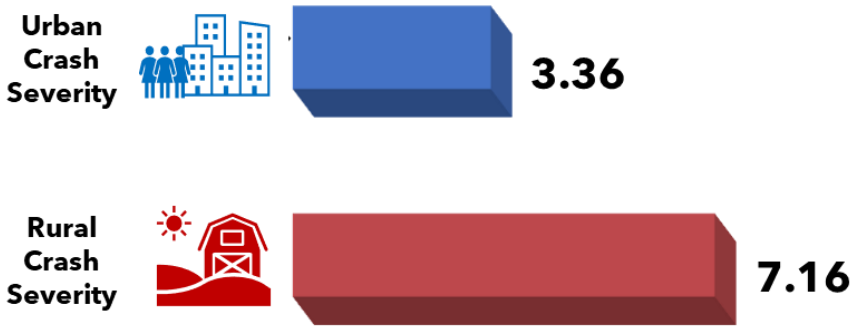
Figure 23. Severe VRU Crashes per Capita



Urban vs. Rural

The 2020 US Census Bureau identifies 25 designated urban zone areas in New Hampshire. These 25 urban zone areas account for 86% of the total number of VRU crashes occurring in the state of New Hampshire. However, crashes in rural areas tend to be much more severe than those in urban areas. The crash severity index for urban area crashes was 3.36, compared to a crash severity index of 7.16 for rural area crashes. (Figure 24)

Figure 24. Urban vs. Rural Severity Index



Therefore, **a crash occurring in a rural area is over 2x more likely to result in injury than one in an urban setting**. There are likely several factors contributing to this:

Higher Speed Limits. Rural roads often have higher speed limits than urban streets. When crashes occur at higher speeds, the severity of injuries tends to be greater.

Limited Infrastructure. Rural areas may lack proper pedestrian and bicycle infrastructure, such as sidewalks, crosswalks, and bike lanes. This forces pedestrians and cyclists to share the road with motor vehicles, increasing the risk of collisions.

Lower Population Density. Rural areas typically have lower population densities, leading to fewer pedestrians and bicyclists on the road. While crashes are relatively infrequent, their infrequency can lead to a lack of awareness and preparedness among both motorists and emergency responders.

Lack of Street Lighting. Rural roads often have limited or no street lighting, making it more difficult for drivers to see pedestrians and bicyclists at night. This reduced visibility increases the likelihood of crashes.

Limited Public Transportation. Public transportation is typically very limited or nonexistent in rural areas which can result in more people walking or biking for transportation thus increasing their exposure.

Limited Access to Healthcare/Longer Response Times. Emergency response times in rural areas may be longer which can delay medical assistance to crash victims. Longer response times in conjunction with dispersed healthcare facilities may result in more severe or fatal injuries.

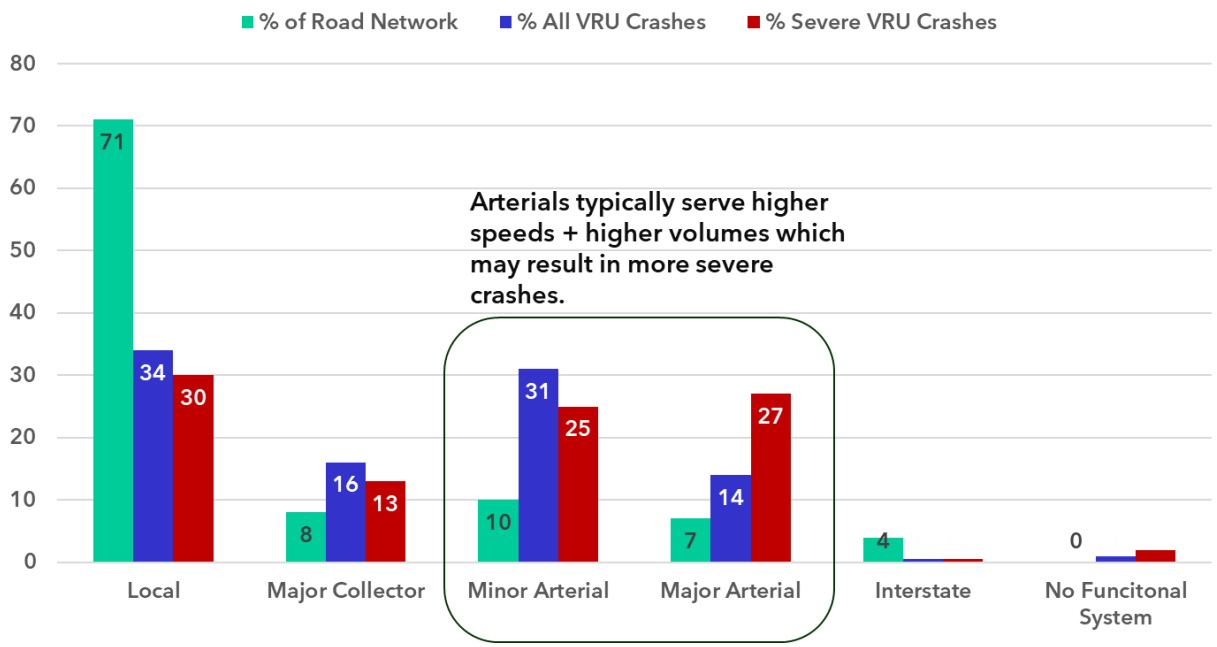
Route Ownership

Understanding the owner of the roadway on which a crash occurs can help identify agencies that are responsible for the maintenance and improvement of high-risk corridors. Approximately 20% of all VRU involved crashes occurred on NHDOT-owned roadways, while 75% occurred on routes owned and maintained by cities or other municipal agencies, and 5% occurred on private or turnpike owned roadways. Comparatively, the percentage of severe VRU crashes is 29% on state owned roads and 65% on local roads, indicating that crashes occurring on state owned roads tend to be more severe which is expected as these roads tend to have higher speeds and higher volumes thus higher risk.

Functional Classification

Crashes were further analyzed to investigate how they correlate with the roadway network as depicted in Figure 25. When comparing the total number of VRU crashes and the number of severe VRU crashes to functional classification, it is observed that minor and principal arterials experience a disproportionately high number of severe VRU crashes compared to their proportion of the overall roadway network. Principal and minor arterials make up approximately 7% and 10% of the roadway network, respectively, yet they account for 27% and 25% of severe VRU crashes, respectively. This indicates that **more than half of severe VRU crashes occur on arterial roadways in the State of New Hampshire**. In contrast, local roadways make up over 70% of the roadway network but only have about 30% of the severe VRU crashes occurring over the six-year study period. This suggests that pedestrians and cyclists face a much higher risk of injury when traveling on arterial roadways due to the higher volumes and speeds typically associated with these roads.

Figure 25. Total + Severe VRU Crashes per Roadway Classification

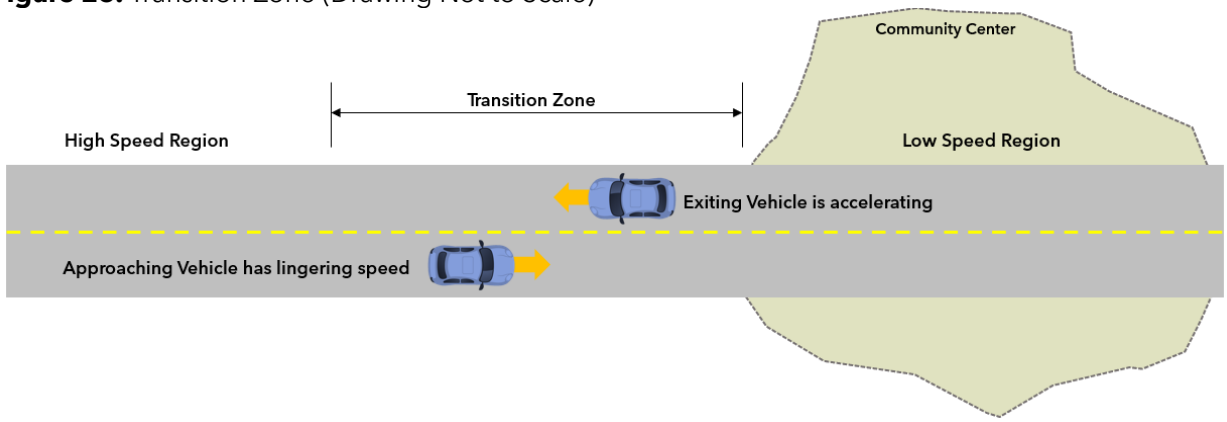


When considering potential solutions, it is important to note that the functional classification of a roadway limits its design. For example, some design treatments that would be appropriate on a low-speed local road would not be permissible on a principal arterial because they would deter from the roads' function. Therefore, pedestrian and bicyclist related safety measures must be implemented in ways which foster sustainable safety.

Arterial Roads + Transition Zones

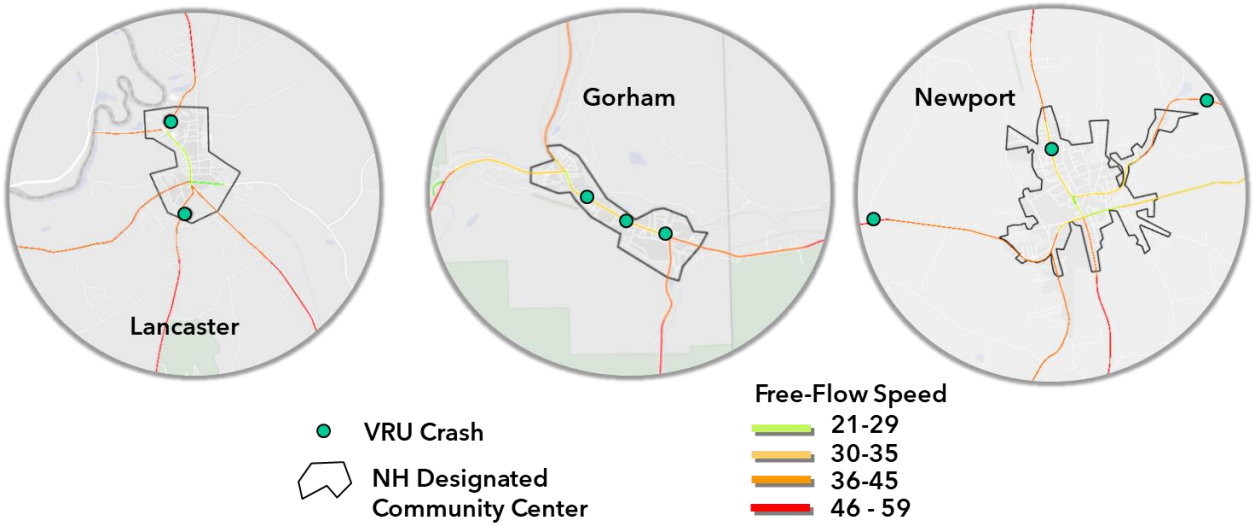
Severe crashes were further investigated, particularly in the more remote areas. It was found that it is common for severe crashes to occur within transition zones, or areas where there is a change in the characteristics of the roadway, particularly a transition from higher speeds to lower speeds and vice versa. Transition zones, as depicted in Figure 26, are areas where high speed vehicles are approaching community centers (speed lingering) or where vehicles are transitioning from a low-speed region to high-speed region and therefore are accelerating. Transition Zones are crucial because they require drivers to adapt to new conditions, such as adjusting their speed or being aware of changes in the environment.

Figure 26. Transition Zone (Drawing Not to Scale)



As evident in several communities such as Lancaster, Gorham, and Newport (Figure 27), severe crashes occurring on the outskirts of these community centers coincide with changes in the road environment, shifting from an open, high-speed nature to a more constrained, low-speed area and vice versa. This underscores the importance of implementing speed management measures and enhancing visibility in these zones. These efforts serve to alert motorists that the road context is changing and they need to be more aware of potential bicyclist and pedestrian activity.

Figure 27. NH Severe Crashes in Transition Zones



School Proximity

Analyzing bicyclist and pedestrian crash data in proximity to schools is crucial due to the greater vulnerability of students and the common practice of walking and biking to school. It should be noted that RSA 189:6 Transportation of Pupils states that local school districts shall furnish transportation to all pupils in grades 1-8 who live more than 2 miles from the school to which they are assigned. However, many students are not likely to walk or bike to school for a distance greater than 2 miles. Therefore, initially, 2,000-foot buffers were applied to each school (K-12 as well as higher education facilities) throughout the state, representing an approximately ½ mile walk or bike to school – a walking/biking distance consistent with the National Institute of Transportation Engineers (ITE) Safe Routes to School program. It was observed that 44% of all VRU crashes occurred within these 2,000-foot buffers.

The analysis buffer was further refined per stakeholder feedback and reduced to 500 feet to better reflect potential correlation of crashes to school related traffic as well as to better reflect the extents of a reduced speed limit zone (at least 200 feet in advance of the school grounds per Part 7 of the Manual on Uniform Traffic Control Devices (MUTCD). This analysis revealed that 6.5% of all VRU crashes and 7% of severe VRU crashes occurred within these 500-foot boundaries. At a broader level, these statistics emphasize the significance of improving infrastructure around schools and advocating for the Safe Routes to School (SRTS) Program. However, it is important to exercise caution in overgeneralizing these statistics, given the lack of comprehensive data that definitively links these incidents to school-related pedestrian and bicycle traffic, i.e. a crash may occur within these boundaries but the individual involved has no association with the school especially in more urban areas where a variety of pedestrian/bike generators may exist within that same boundary. Figure 28 provides an example of the 500-foot analysis.

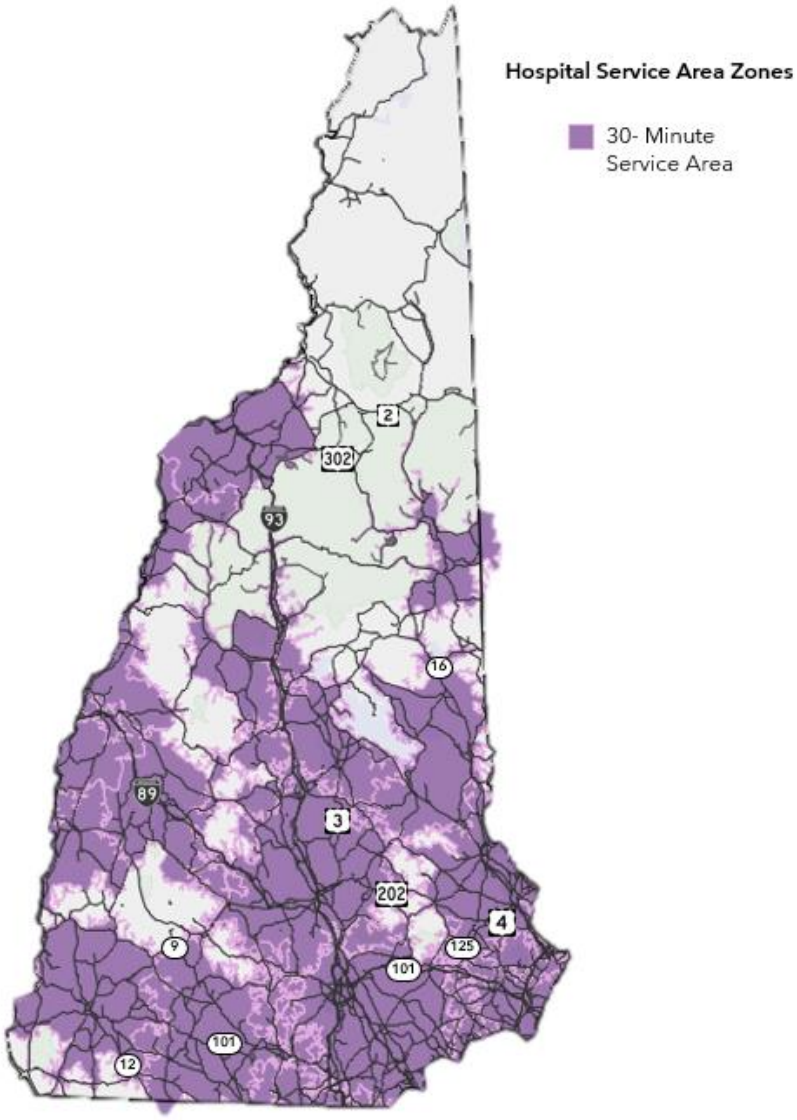
SRTS implementations may include enhancing crosswalk visibility, incorporating traffic calming measures, conducting targeted safety campaigns, improving sidewalks and bike lanes, establishing safe drop-off/pick-up procedures, enforcing traffic laws in school zones, and actively involving the school community in safety initiatives.

Figure 28. School Buffer Zones in Manchester

Hospital Proximity

Analyzing hospital proximity is crucial when examining pedestrian and bicyclist crashes as it directly impacts the response time of emergency medical services and the potential for timely and life-saving medical care. To better understand the correlation between severe crashes and their proximity to health care facilities, facilities from NHDOT GIS database were imported into ArcGIS Pro and 30-minute drive time service areas were developed using spatial analysis tools. While a limited number of severe VRU crashes (approximately 2%) occurred outside of these service areas, this area does represent **approximately 12% of New Hampshire's population residing outside a 30-minute service area zone** (Figure 29). Therefore, investigation of ways to provide more timely post-crash care in these more remote areas may be warranted.

Figure 29. Hospital Service Area Zones



CRASHES VS. TRANSPORTATION EQUITY

A crucial aspect of the analysis process for the VRUSA involves examining VRU demographics including both the location where VRU fatalities and serious injuries occurred as well as the characteristics of the individuals involved in the crashes. Unfortunately, the data provided does not include demographics (except for age) associated with the individual. Therefore, it eliminates the possibility of recognizing socioeconomic trends on the individual level that may aid in targeting populations to focus education campaigns or identify groups that are more likely to be involved in VRU crashes. As a result, socioeconomic and demographic conclusions were made at the neighborhood (census tract) or community (town/city) level.

Disadvantaged Communities

When analyzing crash data, it is important to spatially understand where crashes are occurring with respect to disadvantaged communities that have often experienced decades of underinvestment as it relates to transportation.

The USDOT is in the process of implementing the Justice40 Initiative which was created as a byproduct of Executive Order 14008, Tackling the Climate Crisis at Home and Abroad. Justice40 aims to allocate 40% of the benefits of certain federal investments to disadvantaged communities to advance equity. Through Justice40, USDOT aims to identify and prioritize projects that benefit rural, suburban, and urban communities facing barriers to affordable, equitable, reliable, and safe transportation.

The USDOT has created a mapping tool, the USDOT Equitable Transportation Community (ETC) Explorer. The tool uses data from the Center of Disease Control's Social Vulnerability Index, the US Census Bureau's American Community Survey, the Environmental Protection Agency's Smart Location Map and Environmental Justice Screen, the United States Department of Housing and Urban Development's Location Affordability Index, and the Federal Emergency Management Agency's Resilience Analysis & Planning Tool and National Risk Index among others.

The tool provides users a deeper understanding into how a community is experiencing disadvantage and how transportation investments may mitigate and reverse those burdens. The ETC provides data on a state level to help understand how a community is experiencing transportation disadvantage compared to all other census tracts in the state across five disadvantage components.

The five components of disadvantage are as follows:

1. **Transportation Insecurity**. Transportation Insecurity occurs when people are unable to get to where they need to go to meet the needs of their daily life regularly, reliably, and safely. Nationally, there are well-established policies and programs that aim to address food insecurity and housing insecurity, but not transportation insecurity. A growing body of research indicates that transportation insecurity is a significant factor in persistent poverty. The set of indicators measure transportation access, transportation cost burden, and transportation safety.
2. **Social Vulnerability**. Social Vulnerability is a measure of socioeconomic indicators that have a direct impact on quality of life. This set of indicators measure lack of employment, educational attainment, poverty, housing tenure, access to broadband, and housing cost burden as well as identifying household characteristics such as age, disability status and English proficiency.
3. **Environmental Burden**. The Environmental Burden component of the index includes variables measuring factors such as pollution, hazardous facility exposure, water pollution and the built environment. These environmental burdens can have far-reaching consequences such as health disparities, negative educational outcomes, and economic hardship.
4. **Health Vulnerability**. The Health Vulnerability category assesses the increased frequency of health conditions that may result from exposure to air, noise, and water pollution, as well as lifestyle factors such as poor walkability, car dependency, and long commute times.

5. **Climate and Disaster Risk Burden**. Climate and Disaster Risk Burden reflects sea level rise, changes in precipitation, extreme weather, and heat which pose risks to the transportation system. These hazards may affect system performance, safety, and reliability. As a result, people may have trouble getting to their homes, schools, stores, and medical appointments.

The Disadvantaged Community Index, which drives the USDOT Equitable Transportation Community Explorer, is a composite measure that defines census tracts as being disadvantaged communities in the US based on several dimensions of disadvantage. The index is based on multiple publicly available government data sources that include indicators such as the percent of households without a car, average commute time, walkability index, frequency of transit services per square mile, jobs within a 45-minute drive, calculated average annual cost of transportation as a percent of household income, traffic fatalities, and air quality indicators like ozone and particulate matter levels. The index also considers socioeconomic indicators, such as poverty level, education, employment, housing, health, language proficiency, and age demographics, as well as data on disaster risk, climate change, and land use. The aim of the index is to provide communities with the data to understand how they are experiencing transportation disadvantage, using multiple dimensions of disadvantage including transportation insecurity, social vulnerability, health vulnerability, environmental burden and climate and disaster risk burden. The overall Disadvantage Component Scores are created by normalizing and then summing indicators within each component. The ETC Explorer provides the percentile ranking of these normalized sums (in the State Results tool census tracts are percentile ranked against all other census tracts in a particular state). Census Tracts at "0%" are considered the least disadvantaged and "100%" are the most. DOT considers a census tract to be experiencing disadvantage if the overall index score places it in the 65% (or higher) of all US census tracts.

As shown in Figure 30, approximately **73% of census tracts in New Hampshire experience transportation insecurity**- indicating that many communities experience long commute times, a lack of multimodal infrastructure, lack of public transportation, and low walkability/bikability thus a greater reliability on automobiles and a greater transportation cost burden.

Figure 30. NH Overall Disadvantage Component Scores

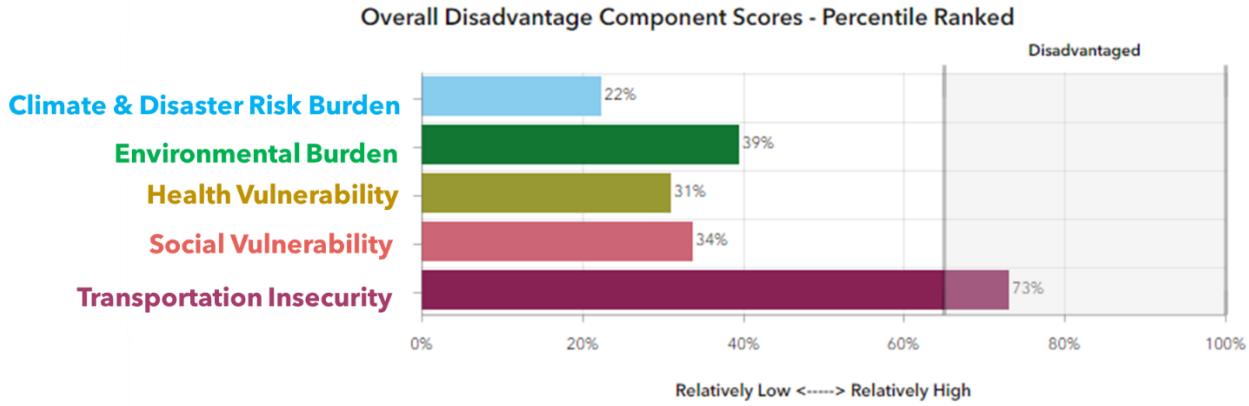
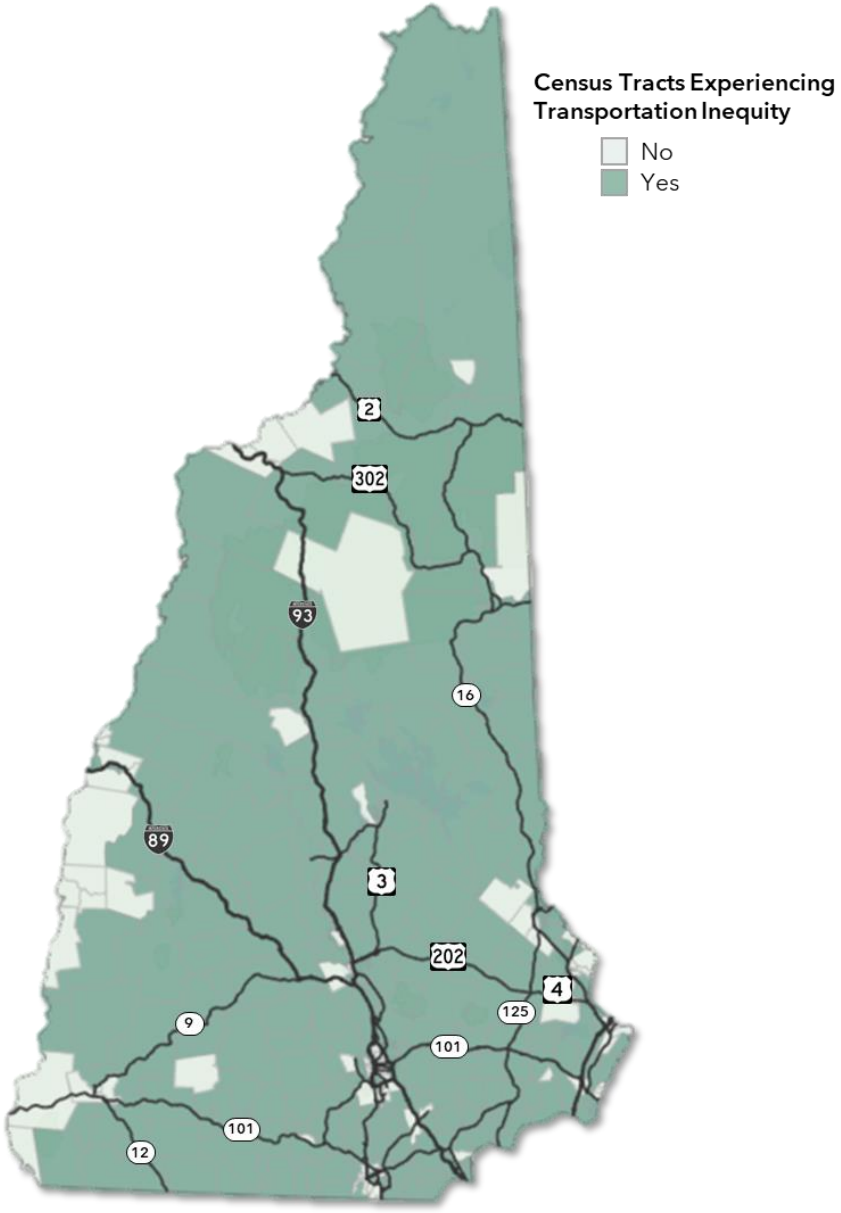


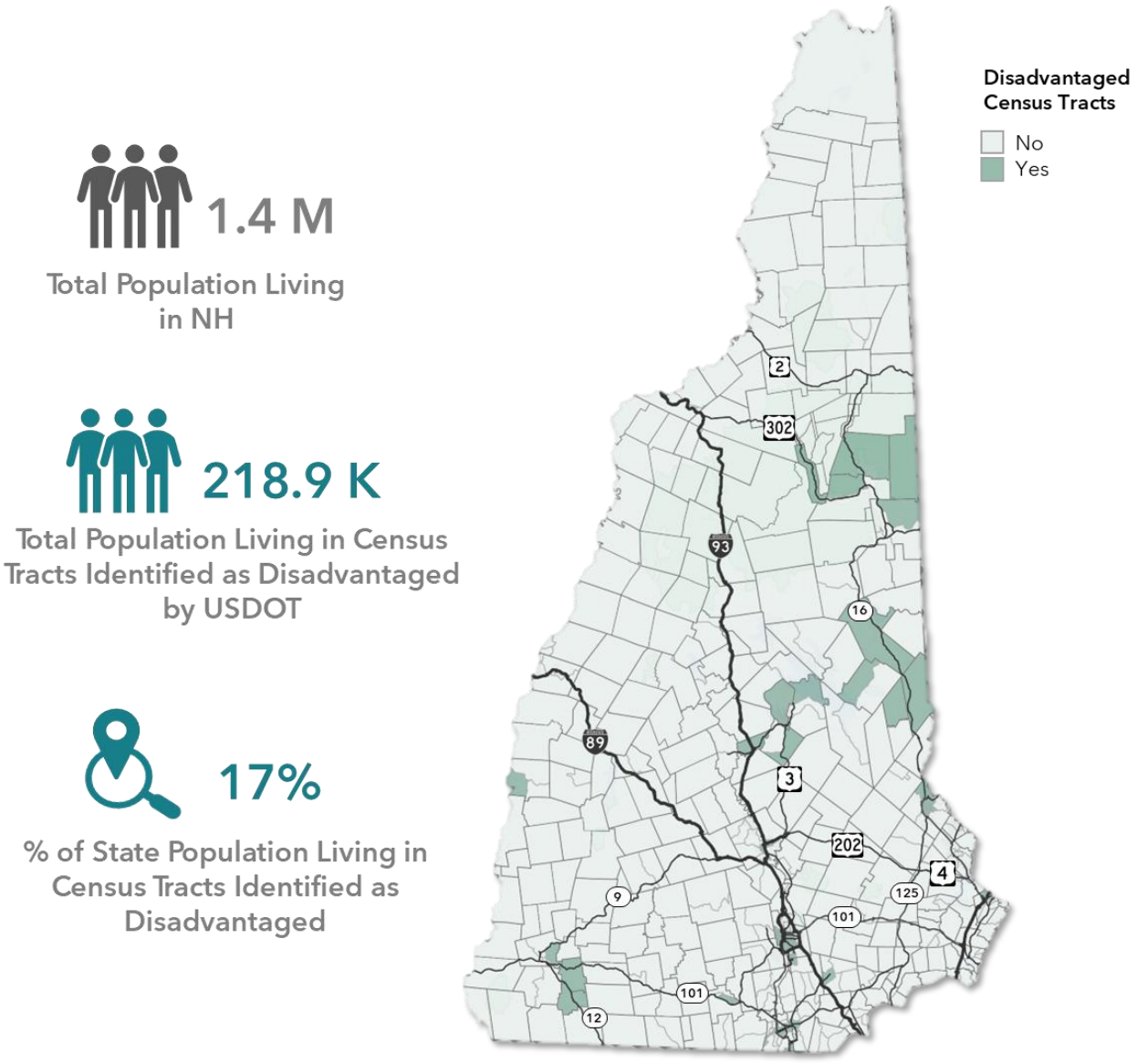
Figure 31. NH Census Tracts Experiencing Transportation Insecurity



Taking all five components of disadvantage into account, **17% of New Hampshire's Census Tracts are disadvantaged**, representing approximately 218.9 K of New Hampshire's total population as portrayed in Figure 32. Disadvantaged individuals or groups residing in these areas may be more likely to experience negative outcomes such as unemployment, poor health, or reduced access to services and opportunities. In the context of transportation, disadvantaged individuals or communities may also experience negative impacts from transportation sources, which can impact health, or receive fewer benefits from transportation services, which can limit their ability to access jobs, healthcare, education, and other essential services. A majority of disadvantaged communities also face disproportionate transportation insecurity. However, there are some disadvantaged communities in more densely populated areas that do not experience disproportionate transportation insecurity due to the availability of public transportation and more refined multimodal infrastructure, allowing enhanced access to jobs and other services.

When looking at these areas in relation to VRU crashes, a total of **34% of severe crashes** occurred in disadvantaged communities while **40% of all VRU crashes** occurred in these areas. Thoughtful investment should be made in these historically disadvantaged communities. Strategies may include targeted outreach and improved infrastructure, as well as, mobility management strategies such as the promotion of public transportation and ride share programs to improve access to jobs and services in these areas.

Figure 32. NH Disadvantaged Communities



OTHER FATAL VRU CRASH STATISTICS

As previously noted, the availability of detailed data regarding the individuals involved in VRU crashes is limited, except for fatal incidents. Within this data subset, several notable trends were identified:

Approximately **20% of pedestrian fatalities involved non-motorists who were impaired**. Pedestrian crashes involving individuals under the influence may be linked to high crash risks within the homeless population. This association can be attributed to the greater likelihood of substance abuse issues among homeless individuals, coupled with their heightened exposure to vehicular traffic as they often walk along streets. Although the data does not definitively establish this correlation, it is an emerging trend nationally. Therefore, targeted safety measure and safety education campaigns, coupled with substance abuse mediations may reduce the number and severity of pedestrian under the influence fatalities.

Approximately **45% of bicyclists involved in fatalities were not wearing a helmet**. While it may not indicate causation, it does highlight the importance of helmet use in reducing the severity of injuries and fatalities in bicyclist crashes.

Approximately **30% of VRU fatalities were 65 years or older. Statewide, individuals aged 65 years or older make up 20% of the population**. This reveals a notable disproportion in fatalities among senior citizens, indicating this is a high-risk population. As New Hampshire continues to shift towards an aging population, this indicates the need for targeted measures that enhance safety and mobility for seniors and that can include age -friendly crosswalks, well maintained sidewalks, effective safety campaigns and really promoting and implementing elder-friendly transportation options.

It is important to emphasize that the aim of presenting this data is not to assign blame to these individuals, but rather to use this data to inform and enhance targeted measures and safety campaigns.

HIGH INJURY NETWORK

Federal regulations mandate that states must pinpoint areas of elevated risk for vulnerable road users as part of the Vulnerable Road User Safety Assessment. Typically, this is done by developing a High Injury Network (HIN) which identifies specific locations or corridors within a region where a disproportionately high number of severe and fatal traffic injuries occur. Once identified, these areas become top priorities for safety interventions.

Therefore, a HIN was developed by first conducting an optimized hot spot analysis to determine statistically significant clusters of pedestrian and bicyclist crashes. "Hot spot" clusters indicate areas (2,000 meters by 2,000 meters) experiencing a higher concentration of VRU crashes compared to its surroundings. These areas may be candidates for safety campaigns and area wide safety improvements.

Severe crashes were then spatially joined with the roadway network in order to identify roadway segments that make up the HIN. Segments were weighted based on the severity and number of crash occurrence. These segments are great candidates to receive spot improvements. The Proven Safety Countermeasures, described in detail in the following Section of this report may be used to mitigate known safety issues along these corridors. Figures 33 and 34 illustrate the HIN for pedestrian and bicyclist crashes, respectively.

Pedestrian High Injury Network

The pedestrian HIN is depicted in Figure 33.

Neighborhoods. Within the Pedestrian HIN, a majority of the statistically significant hot spots are located within Hillsborough County, most notably in Manchester, with other higher rankings in Concord, Laconia, Hooksett, Nashua, and Goffstown.

Corridors. Approximately 17% of the top high injury pedestrian networks are located on state owned roads while the remaining 83% are located on locally owned roads – indicating the need to provide technical assistance and guidance to these communities in order to achieve bicyclist and pedestrian safety on a statewide level. Approximately 70% occurred on principal and minor arterials, further proving VRU are at high risk traveling on these roadways. Once again, most are located in Hillsborough County, Manchester in particular. However, other higher ranked segments were located in Laconia, Nashua, Keene, Dover, Bristol, and Littleton.

Bicyclist High Injury Network

The pedestrian HIN is depicted in Figure 34.

Neighborhoods. Within the Bicyclist HIN, a majority of the statistically significant hot spots are also located within Hillsborough County, most notably in Manchester, with other hot spots identified in Nashua, Concord, Rye, and Goffstown.

Corridors. Segments with the highest risk bicyclist scores are located most in Manchester but also Hampton, Gilford, Rochester and Nashua. About 50% were located on arterials roads and 35% on local roads. A majority were locally owned roads. That being said, roadway segments identified through the high injury network are great candidates for spot improvements through the introduction of bike lanes, road diets, and other proven safety countermeasures to enhance bike safety throughout the network.

Figure 33. Pedestrian High Injury Network

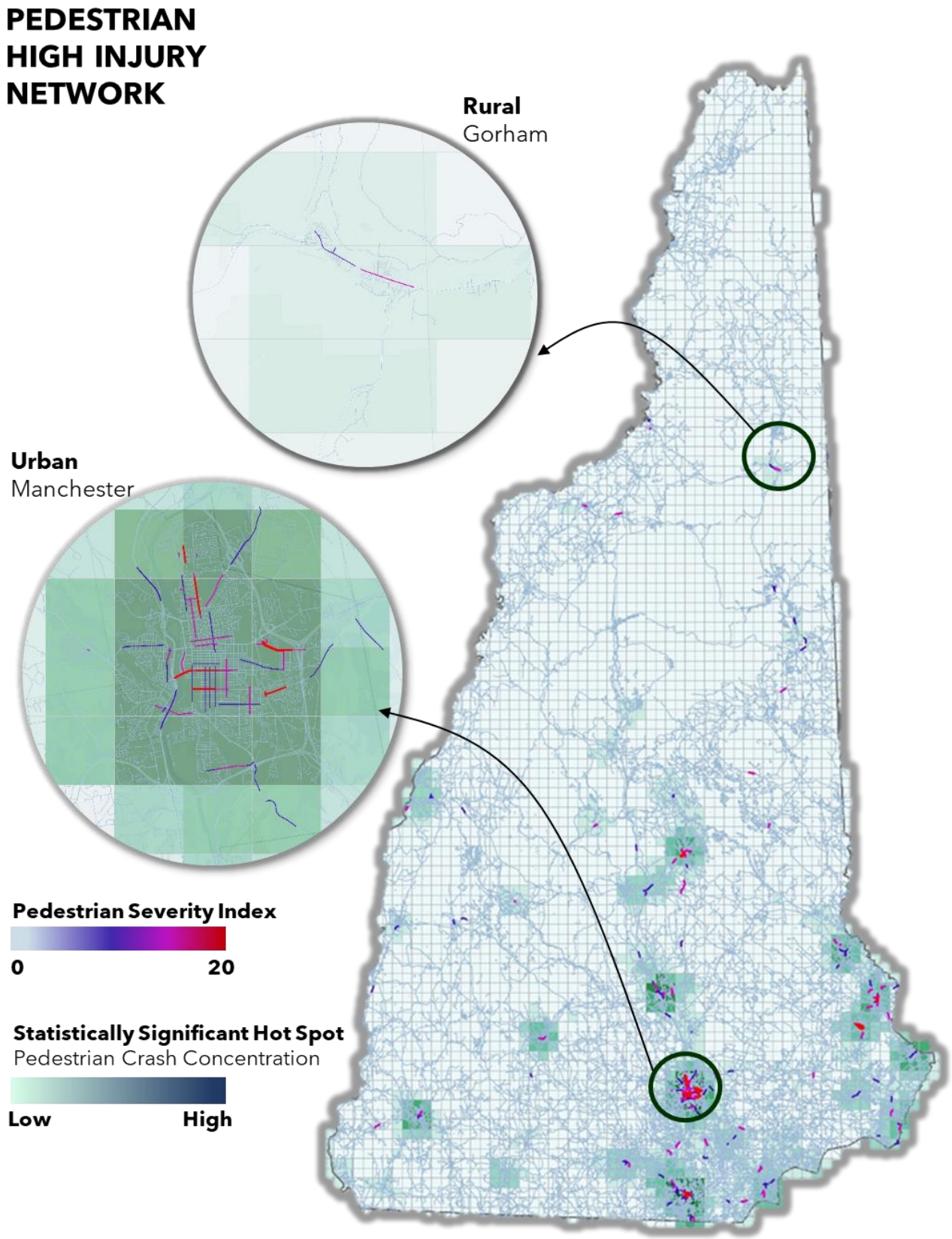
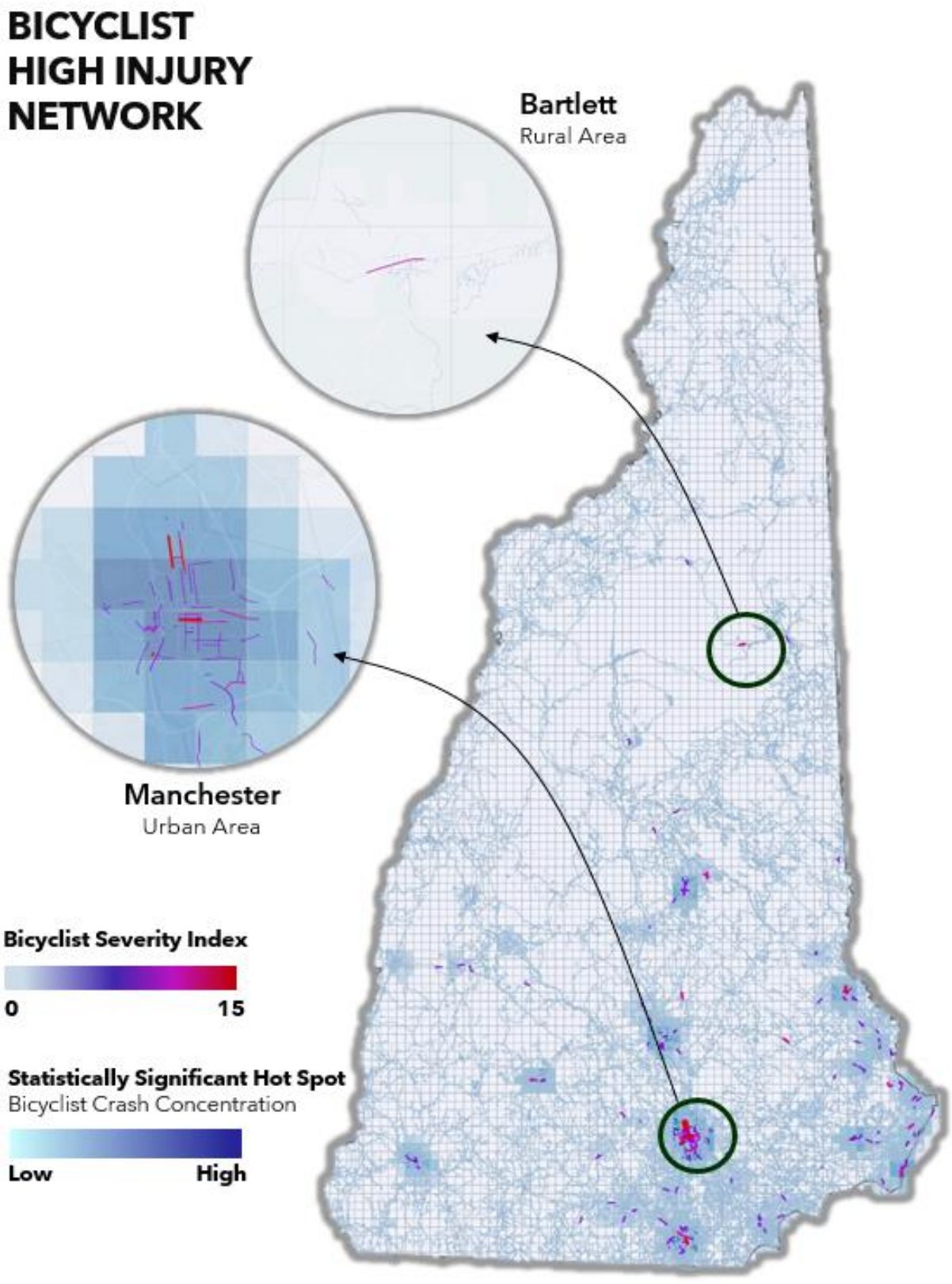


Figure 34. Bicyclist High Injury Network



HIGH RISK AREA/POPULATIONS SUMMARIZED

In summary, several crucial takeaways emerge from the data analysis:

VRU crashes occur more frequently in urban areas such as Manchester, Concord, Nashua, Keene, Portsmouth, Laconia, or cycling destinations such as Rye.

VRU crashes, while proportionate to population in urban areas, exhibit greater severity in rural regions. Rural areas are emerging as high-risk areas, primarily due to their limited infrastructure, road characteristics such as speed and lack of lighting, and the perception of walking and biking in these communities.

Principal and minor arterials experience disproportionately severe VRU crashes, putting pedestrians and cyclists at significant risk. This heightened risk is linked to factors like traffic volumes, roadway widths (e.g., lack of shoulders), and most critically, vehicle speed.

Severe VRU crashes commonly occur within transition zones adjacent to community centers, emphasizing the need for speed management measures in these vulnerable areas.

The absence of proper street lighting is a critical risk factor for severe VRU crashes, highlighting the need for well-designed and properly implemented street lighting that enhances bicyclist and pedestrian visibility.

Approximately 40% of VRU crashes occurred in historically disadvantaged communities, underlining the need for strategic investments in non-motorized safety. These communities typically experience lower incomes and a higher percentage of households without access to vehicles, making the multimodal network a vital resource.

Approximately 6.5% of all VRU crashes and 7% of severe VRU crashes occurred within 500’ buffers to schools, signifying that schools may represent potential high-risk areas and underscoring the importance of enhancing the Safe Routes to School program.

The senior population experiences a disproportionate number of VRU crashes, and the demographic group continues to grow as the State ages. This situation calls for age-friendly infrastructure and alternative mobility options to support older residents across the state.

SHIFTING TO A SYSTEMIC APPROACH

While the HIN indicates areas of known VRU risk, a systemic approach can be advantageous, particularly when dealing with a region, such as New Hampshire, where there is a relatively low number of severe crashes as well as a lack of consistent measures of non-motorized exposure (i.e. pedestrian and bicyclist counts). Therefore, to complement the HIN, it is recommended that the State of New Hampshire shift towards a systemic approach to identify and address risk factors across the entire transportation network, thus working to prevent bicyclist and pedestrian crashes rather than reacting to specific high-injury locations. This approach considers infrastructure indicators and proximity to land use generators and promotes equity by addressing underserved communities.

05|| PROVEN COUNTERMEASURES

The implementation of countermeasures to enhance pedestrian and bicyclist safety necessitates differentiation between urban and rural contexts, as well as considering variations in roadway classification. In urban settings, the primary concern often revolves around the challenges posed by high volume traffic, complex intersections, and the shared usage of constrained road space by pedestrians, cyclists, and motor vehicles.

Conversely, rural areas face the issues of high-speed roadways and very limited pedestrian and bicyclist infrastructure, which intensifies the severity of crashes. Out of New Hampshire's ten counties, nearly half the population resides in areas classified as rural, which encompasses a vast 84% of the state's total land mass. This extensive rural landscape in New Hampshire can present unique challenges for pedestrian and bicycle travel. In these less densely populated regions, transportation infrastructure may not be as developed for non-motorized users leading to safety issues and a lack of encouragement to walk or bike.

Therefore, it is important to identify countermeasures that cater to the specific risks faced in urban and rural environments, ultimately leading to the overall goal of ensuring safe mobility for pedestrians and bicyclists across the State of New Hampshire. The following section describes proven safety countermeasures as identified by the Federal Highway Administration.

SIDEWALKS/WALKWAYS

Sidewalk or walkways are designated areas for pedestrians and individuals using wheelchairs. These include sidewalks, side paths, shared-use paths, and pedestrian lanes in rural contexts. Ensuring accessibility is an essential aspect of effective sidewalk planning and design.

Risk Factors Addressed

The lack of sidewalks throughout the state leaves people to walk in the roadway where there is a greater risk of conflict with motor vehicles. This is particularly dangerous on high speed, high volume roadways. Providing a dedicated space for pedestrian travel greatly improves mobility and safety for pedestrians.

BIKE FACILITIES

Nationally, most fatal and severe injury crashes involving bicyclists take place away from intersections. These non-intersection crashes often occur when motor vehicles attempt to pass cyclists, leading to potential hazards due to differences in speed and size between the two. Such crashes can deter individuals from cycling out of fear of these situations. To enhance bicyclist safety and encourage a wider range of cyclists, the state should consider implementing bicycle facilities appropriate to a specific roadway context.

The concept of bicycle lanes, particularly those that provide a spatial separation from motor vehicles, align with the Safe System Approach, which acknowledges the vulnerability of bicycle users. In an urban context, bike lanes, buffered bike lanes, one-way separated bike lanes, two-way separated bike lanes, and side paths may be appropriate based on the roadway classification. In more rural contexts, bicycle facilities may include shared lanes, bicycle boulevards or advisory lanes on low volume, low speed roads while side paths and shared-use paths should be considered on more high-volume, high-speed roads. In both urban and rural contexts, separated facilities are preferred where applicable as they provide an exclusive facility that is physically separated from motor vehicles and sidewalks.

The New Hampshire DOT has taken proactive steps to enhance cycling infrastructure statewide, securing FHWA Interim Approvals (IA) for Green Colored Pavement for Bike Lanes (IA-14) and Bicycle Boxes (IA-18). Per the National Association of City Transportation Officials (NACTO), colored pavement within a bicycle lane increases the visibility of the facility, identifies potential areas of conflict, and reinforces priority to bicyclists in conflict areas and in areas with pressure for illegal parking. Colored pavement can be used corridor wide or as a spot treatment, such as a bike box which is a designated area at the head of a traffic lane at a signalized intersection that provides bicyclists with a safe and visible way to get ahead

of queuing traffic during the red signal phase. Bike boxes increase visibility of bicyclists, help facilitate bike turning maneuvers, and improve safety by preventing right-hook conflicts with turning vehicles at the start of a green indication and providing a buffer for pedestrians from reduced vehicle encroachment into the crosswalk. These Interim Approvals are applicable to all local highway agencies in the State, allowing municipalities to deploy these treatments as well.

Risk Factors Addressed

Bicycle facilities provide bicyclists with a designated space with a reduced risk of crash, increase the level of comfort and ultimately encourage bike use.

CROSSWALK VISIBILITY ENHANCEMENTS

Poor crosswalk visibility heightens the risk of pedestrian-vehicle crashes. Factors such as inadequate lighting, faded or absent markings, a lack of clear warning signage, and sight obstructions such as parked vehicles or vegetation can obscure pedestrians from drivers. Addressing these inadequacies via means of improved lighting, high visibility crosswalk markings, at and in advance pedestrian warning signage, and daylighting is crucial in enhancing crosswalk visibility and overall pedestrian safety.

The NHDOT has developed several programs with the goal of enhancing and assessing the suitability of crosswalks. NHDOT's practice is to evaluate uncontrolled crossings in conjunction with the NHDOT pavement resurfacing program, through NHDOT capital improvement and Local Public Agency (LPA) projects, as a component of driveway permit application reviews, and in response to municipal requests. Crosswalks that are deemed to be in appropriate locations are formally permitted and improved with signage, markings, and ADA accessible pedestrian curb ramps. Crosswalks in inappropriate locations, whether due to unsafe conditions, lack of necessity, or redundancy, are removed. The goal of NHDOT's practice is to ensure compliance with ADA and evolving design standards, as well as encourage uniformity in the appearance of uncontrolled crossings in all jurisdictions.

Risk Factors Addressed

Motorists failing to stop or yield to pedestrians within a crosswalk is a major contributing factor to severe crashes. This behavior jeopardizes pedestrian safety and diminishes the overall experience of walking throughout the state of New Hampshire. Utilizing more visibility crosswalk, particularly when coupled with speed management solutions, promotes yielding behavior. Additionally, crosswalk visibility enhancements can serve as an incentive for pedestrians to utilize these crossings rather than crossing in areas without marked crosswalks. Crosswalk visibility enhancements can be relatively low-cost solutions for both urban and rural communities.

MEDIANS AND PEDESTRIAN REFUGE ISLANDS

A median refers to the space that separates lanes of opposing traffic, which can be established by pavement markings, raised medians or islands (often with landscaping). Typically found along the length of multi-lane roads in suburban or urban areas, medians reduce the likelihood of head-on vehicle collisions and offer a refuge for pedestrians navigating multi-stage road crossings. Wide medians can be used to create pedestrian refuge islands which reduce crossing distances and provide a protected refuge area at intersection or midblock crossings. Pedestrian crossing islands should be a minimum of 6' wide and are often enhanced with highly visible signs, crosswalk markings, and traffic signals.

Risk Factors Addressed

Medians and pedestrian refuge islands are designed to mitigate safety challenges associated with multi-lane roads, typically those with four or more lanes, where speeds exceed 35 miles per hour and/or where annual average daily traffic (AADT) is 9,000 or higher. They are also a candidate treatment option for uncontrolled pedestrian crossings on 3-lane or 2-lane roads that have high vehicle speeds or volumes.

These interventions prove especially effective on roads with significant distances between intersections and crosswalks, and they are particularly valuable on routes served by public transit.

RECTANGULAR RAPID FLASHING BEACONS (RRFB)

Rectangular Rapid Flashing Beacons (RRFBs) are pedestrian activated signals, paired with marked crosswalks, to notify drivers to yield the right-of-way to pedestrians crossing the road. They display a distinctive irregular flashing pattern that captures the attention of motorists, reinforcing the importance of giving way to pedestrians and enabling a safe crossing. RRFBs are typically installed in areas where a complete traffic signal is not warranted but where pedestrians need to cross, particularly near schools, shared-use paths, parks, and other locations with substantial pedestrian activity. The RRFB is a treatment option at many types of established pedestrian crossings but are particularly effective at multilane crossing with speed limits less than 40 miles per hour.

The New Hampshire DOT has adopted the use of RRFBs through its FHWA Interim Approval: "IA-21 Rectangular Rapid Flashing Beacon". This Interim Approval is applicable to all local highway agencies in the State, allowing municipalities to deploy RRFBs, where appropriate, on locally owned roads.

Risk Factors Addressed

Statewide, there are many roadways where there are no marked or signalized crossings for pedestrian, despite a significant need for safe pedestrian crossings. The absence of safe places to cross presents a significant safety risk for pedestrians statewide. In addressing this issue, RRFBs offer a valuable solution for creating highly visible marked crosswalks on roads where the posted speed limit is up to 35 mph and high vehicle traffic volumes make pedestrian crossings challenging.

LEADING PEDESTRIAN INTERVAL

Vehicle-pedestrian crashes frequently occur at signalized intersections, particularly when a pedestrian is in the process of crossing during a WALK interval. Pedestrians, especially those vulnerable to left-turning vehicles, benefit from Leading Pedestrian Intervals (LPIs). LPIs can be incorporated into traffic signal programming to reduce potential conflicts between pedestrians crossing a roadway and turning vehicles, whether left or right. LPIs grant pedestrians with a head start, displaying the WALK signal 3-7 seconds prior to allowing motor vehicles to proceed through the intersection. This head start minimizes the likelihood of conflicts between pedestrians and turning vehicles. LPIs increase the proportion of drivers yielding the right of way to pedestrians since pedestrians are already within the crosswalk when the traffic signal turns green for parallel vehicle movements.

Risk Factors Addressed

Crashes involving turning vehicles are a frequent factor in crashes between vehicles and pedestrians and cyclists. Even when pedestrian have the right-of-way and are crossing with the traffic signal in their favor, they often face challenges from left- and right-turning vehicles that may not yield to them. LPIs address this issue by providing pedestrians with an advance crossing time, enhancing their visibility, and increasing the likelihood of motorists yielding to them. LPIs are particularly beneficial for pedestrians who may require more time to navigate intersections, such as seniors. For reference, approximately 30% of VRU fatalities were people aged 65 years or older.

PEDESTRIAN HYBRID BEACONS

A pedestrian hybrid beacon (PHB), also referred to as a HAWK (High-Intensity Activated crosswalk) signal, is a pedestrian activated signal that uses flashing and solid lights to enhance the safety of roadway crossings. When activated, the signal initially flashes yellow to alert drivers, followed by a change to a solid red stop signal. This requires vehicles to stop, allowing pedestrians to receive a walk indication and

cross the road. PHBs are typically deployed in circumstances where a conventional traffic signal may not be warranted but where pedestrians need to cross where vehicle speeds and/or volumes are high, particularly near schools, shared-use paths, parks, and other locations with substantial pedestrian activity. A PHB provides more control than a flashing beacon as it assigns right-of-way and requires vehicles to stop, but isn't a full pedestrian signal and allows motorists to proceed once pedestrians have safely crossed the road.

Risk Factors Addressed

Statewide, 42% of pedestrian crashes occurred at non-intersection locations. In New Hampshire, pedestrians face elevated risks on roads characterized by high speeds, multiple lanes, and limited opportunities for safe crossings. PHBs are a candidate treatment for roads with three or more lanes that generally have annual average daily traffic volumes greater than 9,000 and on roadways with speed limits equal to or greater than 40 miles per hour. PHBs may be particularly beneficial on roadways parallel to rail trails to improve connectivity to the off-road facilities.

ROAD DIETS

Road diets are roadway configurations that involve modifying delineated travel lanes using new pavement markings. A typical road diet converts an existing four-lane, undivided roadway to two through lanes and center, two-way-left-turn-lane (TWLTL). Road diets are often supplemented with painted, textured, or raised center islands. Road diets not only enable left turning vehicles to exit traffic flow while they wait for an opportunity to turn, they also opens up space to be reallocated to other users such as bicycle lanes, pedestrian refuge islands, curb extensions, on-street parking, widened sidewalks and landscaped buffers.

Risk Factors Addressed

Road diets optimize street space to benefit all road users through the introduction of bicycle lanes and reduction of crossing distance and exposure for pedestrians, all while reducing vehicle speeds and potential for rear-end crashes. These treatments may be considered for roadways with documented safety concerns, moderate volumes (less than 15,000 ADT, up to 25,000 ADT in special cases), and along priority bicycling and walking routes.

SPEED MANAGEMENT

Research shows that speed plays a vital role in the safety of pedestrians and bicyclists. Statistics highlighted in "Impact Speed and Pedestrian's Risk of Severe Injury or Death", published by Brian Tefft with the AAA Foundation for Traffic Safety, indicates that if a vehicle were to strike a pedestrian at 40 mph, there is a 77% likelihood that a pedestrian will suffer a severe injury or death. Conversely, if a vehicle were to strike a pedestrian traveling at 25 mph, there would be an 18% likelihood that the pedestrian would suffer a severe injury or death. These statistics demonstrate the importance of controlling motor vehicle speeds to improve bicyclist and pedestrian safety.

Speeding is a complex and situation-specific issue. As such, a comprehensive approach to managing speed is often recommended for agencies and the communities they serve. Traditionally, speed limits have been set utilizing the 85th percentile speed which aligns with the natural speed of most drivers. However, this approach has limitations when it comes to protecting vulnerable road users. Lowering speed limits below what is considered 'credible' by drivers can lead to driver non-compliance and may not address the specific safety needs of pedestrians and cyclists. Newer speed management strategies require a more holistic approach, considering road characteristics, adjacent land uses and safety goals to set contextual speed limits. Implementing traffic calming measures and road design changes, along with educational campaigns and technology solutions such as driver feedback signs, can help strike a

balance between road user safety and compliance. These measures may be most beneficial in rural transition zones as well as in the proximity to land uses that typically generate high pedestrian and bicyclist activity such as schools, community centers, and transit services.

Risk Factors Addressed

Studies suggest that even a modest reduction in average vehicle speeds can result in significantly fewer and less severe bicyclist and pedestrian crashes.

STREET LIGHTING

Street lighting, when implemented properly, improves safety for all road users by illuminating otherwise dark locations on both streets and sidewalk areas. Illuminance design standards for street lighting are typically based on street classification and the level of pedestrian activity. For example, high volume roadways with high pedestrian activity require more lighting in terms of quantity and intensity than do low volume roads with little to no pedestrian activity. Street lighting can be used to highlight areas of particular concern such as crosswalks, school zones, and intersections with high pedestrian and bicyclist activity.

Risk Factors Addressed

Crash statistics throughout North American indicate that more than 50% of fatal crashes occur during nighttime hours despite the fact that an estimated 25% of daily traffic actually occurs during these hours. Therefore, fatality rates are disproportionately higher during nighttime hours than daytime hours. These statistics hold true in the State of New Hampshire with approximately 37% of severe VRU crashes occurring in reported dark conditions, 62% of which occurred during the winter months of October to February, and 55% of which occurred during the hours of 4 PM to 7 PM. This can be correlated with students and employees walking/biking home from school/work. Street lighting, when designed and implemented properly, is a proven safety countermeasure and can dramatically improve safety depending on the type of roadway and area.

NHDOT should continue to apply best practices and adapt to evolving technology and treatments.

06|| STRATEGIES + RECOMMENDATIONS

THE 5 E'S + SAFE SYSTEM APPROACH

The 5 E's framework – Engineering, Education, Encouragement, Enforcement, and Evaluation – is a comprehensive approach to improving pedestrian and bicyclist safety and coincides with the Safe System Approach. Collectively, these elements work together to create safer environments for pedestrians and cyclists, help reduce crash frequency and severity, and promote active transportation.

Engineering

In the 5 E's framework, engineering focuses on designing and improving the physical infrastructure to make roads safer for all users, including pedestrians and cyclists. Similarly, the Safe System Approach emphasizes the importance of safe roads by advocating for road designs that are forgiving and minimize the consequences of human error and crashes. Engineering efforts can lean on the proven countermeasures highlighted in the previous section.

Education

The 5 E's framework includes educational programs aimed at raising awareness about safe behaviors for pedestrians, bicyclists and motorists with a focus of promoting understanding and compliance with traffic laws and safe practices (proper equipment, etc.). This aligns with the Safe System Approach which emphasizes a shared responsibility for road safety, where everyone (pedestrians, bicyclists and motorists alike) plays a role in promoting and practicing safe behaviors.

Encouragement

Encouragement in the 5 E's framework aims to promote and foster active transportation modes like walking and biking as viable and appealing options for commuting and recreation. This includes initiatives such as community events like "Bike-to-Work" days, creating safe and well-maintained bike and pedestrian facilities, and improving infrastructure for active transportation. In this context, encouragement also includes the possibility of state programs that offer funding and resources as incentives to communities that actively support and cultivate active transportation networks. Encouragement aligns closely with the Safe System Approach, which underscores the significance of safe mobility for all users. Safe mobility entails not only the availability of safe transportation options but also ensuring that these options come with reduced crash risks.

Enforcement

Within the 5 E's framework, enforcement is a critical component focused on ensuring compliance with traffic laws and regulations Law enforcement efforts aim to deter unsafe behaviors, including vehicle speeding, and promote adherence to safety rules among all road users. This includes measures to enforce speed limits, jaywalking, wrong way riding, and impairment amongst others. Similarly, the Safe System Approach highlights the importance of promoting safe road behaviors and managing speeds to ensure that they are safe and allow for human errors without resulting in severe consequences.

Evaluation

Finally, evaluation is a pivotal component within the framework that emphasizes data collection and analysis to not only identify potential problem areas but also assess the effectiveness of safety programs and infrastructure enhancements. Similarly, the Safe System Approach underscores the importance of ongoing monitoring and evaluation as essential elements in tracking progresses and identify areas of risk. These approaches align to create a safe system that is proactive rather than reactive.

STRATEGY 01 ENHANCE BICYCLIST AND PEDESTRIAN SAFETY IDENTIFIED WITHIN THE HIGH INJURY NETWORK

The following action items will facilitate the implementation of proven safety countermeasures on state-owned high injury network corridors and provide local entities with the guidance, resources and technical assistance they need to address high injury corridor within their jurisdictions thus addressing safe roads and safe speeds within the Safe System Approach.

High Risk Areas/Population Addressed

- Implementing Strategy 1 will address the high-risk corridors identified through the High Injury Network. These represent corridors with known safety issues. By implementing proven safety countermeasure on these roadways, the number and severity of VRU crashes may decline.

Action Item # 1 – Develop and implement a comprehensive statewide project dedicated to addressing all state-owned high injury network corridors.

- Prioritization Process – Develop a transparent and data-driven process for prioritizing projects, ensuring that high-risk and historically disadvantaged communities receive priority funding
- Road Safety Audits – Conduct Road Safety Audits (RSAs) for each identified corridor to assess safety issues and potential countermeasures.
- Safety Countermeasure Implementation – Implement proven safety countermeasures on high injury network corridors, tailored to specific needs identified during RSAs.
- Monitoring and Evaluation – Conduct before- and after-studies to evaluate the impact of safety improvements.

Action Item # 2 – Develop and provide a framework to MPOs, RPCs, and communities to address locally owned corridors on the High Injury Network. The framework may include the following steps:

- Local Corridor Identification – Collaborate with MPOs, RPCs, and local communities to identify locally owned corridors on the high injury network.
- Safety Assessment and Prioritization – Encourage local entities to conduct Road Safety Audits at local locations and prioritize corridors for intervention. Social equity should be a contributing factor in prioritization.
- Identify Potential Funding Sources – Assist MPOs, RPCs, and communities in identifying potential funding sources, including grants and state programs.
- Technical Assistance – Provide technical assistance to local entities in the form of expertise, guidance, and best practices for safety improvements.
- Implementation and Evaluation – Support local entities in implementing proven safety countermeasures and monitoring their effectiveness.

Action Item # 3 – Regularly update the High Injury Network on an annual or biennial basis, taking into account the most recent crash data, evolving traffic patterns, and the effectiveness of previously implemented countermeasures. This data should be shared with MPOs, RPCs, and local communities.

STRATEGY 02 IDENTIFY, ADOPT, AND ENCOURAGE THE USE OF BEST PRACTICES

The following action items will adopt and utilize best practices to ensure that roadways are designed for all users. In addition, this strategy seeks to facilitate knowledge sharing amongst key stakeholders thus aligning with the Safe System Approach's goals of Safer Roads, Safer Speeds, and Safer Users.

High Risk Areas/Population Addressed

- Implementing the Action Items within Strategy 2 will help in the reduction of VRU crashes by providing local communities the technical guidance to apply best practices on their local roadways. As reported, approximately 75% and 65% of total VRU crashes and severe VRU crashes, respectively, occurred on local roadways.

Action Item # 1 - Institutionalize a Statewide Complete Streets Program

- Institutionalize and implement a Complete Streets policy, program, and guiding document that directs transportation engineers and planners to routinely design and operate the right-of-way to enable safe access for all road users. As reported, rural crashes tend to be more severe due to high speeds but also a general lack of multimodal infrastructure. Applying a Complete Streets approach will shift the New Hampshire roadway network to a more inclusive one for all road users.
- Encourage local entities to create their own Complete Street policies and directives.

Action Item # 2 – Develop an Online Comprehensive Inventory of Best Practices and Policies

- Develop an online comprehensive inventory of pedestrian and bicyclist safety best practices (including engineering, education, enforcement, encouragement, and evaluation measures) to be publicly available.
- Establish a policy-focused Work Group to find and follow legislation as it relates to bicyclist and pedestrian safety and funding.

Action Item # 3 – Implement an effort to review and update programs, policies, and guidelines to incorporate multi-modal transportation concepts into project delivery.

Action Item # 4 – Encourage local entities to conduct local studies that help identify and prioritize bicyclist and pedestrian safety initiatives. These may include ADA assessment plans, traffic calming procedures/policies, and Bicyclist and Pedestrian Safety Action Plans. This will help address safety on a statewide level.

STRATEGY 03 DEVELOP A SERIES OF PROGRAMS INTENDED TO PROVIDE TECHNICAL ASSISTANCE TO LOCAL ENTITIES

The following action items will help facilitate the procurement and implementation of low-cost, short-term safety countermeasures, in alignment with the Safe System Approach of Safe Roads and Safe Speeds. By offering local entities a cost-effective solution, this strategy empowers municipalities to address high-risk areas and improve pedestrian and bicyclist safety more systematically.

High Risk Areas/Population Addressed

- Implementing the Action Items within Strategy 3 will help in the reduction of VRU crashes by providing local communities the technical assistance to implement relatively low-cost improvements on their roadways. As reported, approximately 75% and 65% of total VRU crashes and severe VRU crashes, respectively, occurred on local roadways.
- By enhancing the Safe Routes to School Program, the number and severity of crashes may decline within walking distances to school. As reported, 6.5% of all VRU crashes and 7% of severe VRU crashes occurred within 500' of schools.
- By introducing a Transition Zone procurement program, the number and severity of VRU crashes may decline in high speed areas approaching community centers.

Action Item # 1 – Develop a series of programs intended to provide technical assistance to local entities. These material procurement programs may include the following:

- **Quick Build/Demonstration Project** – Develop and implement a new safety program that supports the purchase and use of low-cost, short-term traffic control devices and equipment that demonstrates impact of traffic safety countermeasures. This may include utilizing striping and cones to demonstrate curb extensions or using planters to designate separated bike lanes.
- **Safe Routes to School** – Continue to improve and support the Safe Routes to School program by developing a Signs and Markings program that supports the purchase of school zone equipment. This may include pavement marking stencils, school zone signs and beacons, and speed feedback signage.
- **Road Safety Audit Program** – Continue to improve and promote Road Safety Audits. It is also recommended that this program be streamlined and consideration made to its requirement as part of project delivery.
- **Transition Zone** – Develop and implement a new safety program that supports the purchase and use of speed management measures known to improve transitional zones (rural to small community centers). This may include technical assistance to purchase and implement raised medians, gateway signage or speed feedback signs among other visual cues to alert to motorists they are entering a vulnerable area susceptible to elevated bike and pedestrian activity.

STRATEGY 04 EDUCATE STATE EMPLOYEES, EXTERNAL PARTNERS, AND THE PUBLIC ABOUT NEEDS OF VULNERABLE ROAD USERS

The following action items will foster awareness and understanding about the critical importance of pedestrian and bicyclist safety, especially in the context of a state characterized by its rural nature and typically low walkability/bikeability to various stakeholders. This aligns with the Safe System Approach of increasing Safe Road Users with the understanding that responsibility is shared.

High Risk Areas/Population Addressed

- Targeted safety campaigns as such provide the public with information about their responsibility as road users as well, encouraging the use of helmets and proper equipment and wearing bright clothing, specifically at night to enhance visibility.
- Targeted outreach may reduce the disproportionate number and severity of VRU crashes involving seniors.
- Targeted outreach may reduce the number of crashes involving impaired pedestrians.

Action Item # 1 - Develop a statewide safety campaign for pedestrians and bicyclists. Many states nationally have implemented bike and pedestrian focused safety campaigns that New Hampshire may choose to model after. Programs typically provide municipalities with print and digital resources to support local bike and pedestrian safety efforts. In addition, safety education videos and social media content are developed to push information to the public.

Action Item # 2 - Expand existing training programs to improve education and outreach regarding non-motorized transportation safety issues.

- Provide training on Complete Streets for NHDOT employees.
- Partner with MPOs and RPCs to provide training to municipalities who would like to expand their walking and biking network.

Action Item # 3 - Increase Outreach and Education towards Seniors through partnerships with Councils on Aging as well as public transportation providers.

Action Item # 4 - Help reduce impairment through substance avoidance education, targeted communication campaigns, and partnerships with social service agencies.

Action Item # 5 - Partner with NHDMV to create a curriculum geared towards walking and biking safety for driver education programs.

STRATEGY 05 IMPROVE DATA COLLECTION + ANALYSIS

This strategy aims to improve data accuracy, comprehensiveness and analysis capacities related to pedestrian and bicyclist crashes, thus enabling data-driven decision making and targeted safety interventions. As previously mentioned, there are several challenges and limitations with the available crash dataset including inconsistencies, unknown (or missing) data, lack of individual demographic data, underreported data, lack of exposure data, and lack of a centralized platform containing interagency data sources (i.e., crashes, roadways, healthcare).

High Risk Areas/Population Addressed

- Improved data collection and data analysis will allow for more clearly derived trends, resulting in a more systemic approach. This will allow the state and municipalities to take a more proactive approach and enhance safety before crashes even occur through the careful placement of proven safety countermeasures in areas of identified high risk.

Action Item # 1 – Enhance Crash Data Collection

a. Collaborate with law enforcement agencies to standardize data collection procedures for pedestrian and bicyclist-related crashes which includes the addition of data collection fields that may include the following: specific location coordinates, roadway characteristics (such as speed limit, shoulder condition, etc.), ped/bike infrastructure characteristics (sidewalk condition, bike lane condition, crosswalk condition, lighting, etc.) as well as vehicle information (SUV, truck, etc.). In addition, it is recommended that data collection efforts be expanded to collect contributing factors for all involved parties, not just the motor vehicle. For instance, it would be very beneficial to know where the bicyclist was riding, or perhaps where the pedestrian was crossing, etc. This information will help provide more context and help derive more clear trends.

Action Item # 2 – Enhance Crash Analysis

a. Develop and utilize a systemic crash analysis methodology to identify high risk corridors where crashes have yet to occur using roadway characteristics, level of stress analyses, land use data and demographic data.

Action Item # 3 – Create a Crash Data Integration and Sharing Interface

a. Work to develop a centralized platform containing interagency data sources (i.e. crashes, roadways, healthcare).
b. Create a public facing platform allowing MPOs, RPCS, and communities to access crash data to make more well-informed decisions and help tailor their local safety efforts.

Action Item # 4 - Develop a Statewide Non-Motorized Count Program.

a. Consider partnering with RPCs and the New Hampshire Local Technical Assistance Program (NH LTAP) through the University of New Hampshire Technology Transfer Center (UNH T2) to collect and host bicyclist and pedestrian count data.

STRATEGY 06 INVEST IN PEDESTRIAN AND BICYCLIST SAFETY

The objective of this strategy is to develop dedicated funding sources and support research and development initiatives aimed at advancing pedestrian and bicyclist safety. This strategy, through the implementation of its Action Items, realizes all the Safe System objectives of safe roads, safe speeds, safe vehicles, safe road users, and post-crash care.

High Risk Areas/Population Addressed

- Severe VRU crashes in New Hampshire have had an average annual comprehensive crash over of approximately 174 million dollars over the past six years. Investing in pedestrian and bicyclist safety initiatives and infrastructure will likely reduce the number and severity of crashes and thus the societal costs that ensue.
- Approximately 40% of VRU crashes occur in historically disadvantaged communities. By providing funding sources, these communities may implement safety initiatives to reduce the number and severity of VRU crashes.
- Approximately 12% of New Hampshire's population lives outside of a 30-minute hospital service area increasing their risk of severe injury due to longer response and transport times. Investing in R&D to improve post-crash care by reducing response times may reduce the severity of injuries.

Action Item # 1 – Create a bicyclist and pedestrian grant award.

- Work to develop a specific funding mechanism that is awarded to projects enhancing the pedestrian and bicycle network. By providing funding sources dedicated to pedestrian and bicycle safety, the State will reflect a commitment to protect Vulnerable Road Users.

Action Item # 2 – Update prioritization metrics in TIP/TAP funding to include ped/bike safety.

- Integrate bicyclist and pedestrian safety criteria into project prioritization scoring in regard to TIP/TAP funding. This reflects a proactive approach to safety and acknowledges that a well-rounded transportation network must consider the needs of all road users.

Action Item # 3 – Invest in Research and Development for Safer Vehicles

- Consider partnering with neighboring states to create a coalition to conduct research and development on what States can do to prepare for autonomous vehicles as well as what can be done on a policy front in regard to vehicle design that improves bicyclist and pedestrian safety.

Action Item # 4 – Invest in Research and Development for Enhanced Post-Crash Trauma Care

- Consider partnering with neighboring states to create a coalition to conduct research and development on what States can do to enhance post-crash care in regard to law enforcement trainings and emergency detection services, especially in more remote areas.

07|| IMPLEMENTATION + NEXT STEPS

ONGOING PARTNERSHIPS

In addressing VRU safety, the State of New Hampshire should proactively identify and cultivate partnerships with a range of stakeholders and organizations. Collaborating with local government agencies is crucial, as they play a significant role in managing and maintaining road infrastructure. Engaging with RPCs and MPOs is equally important to ensure VRU safety aligns with broader regional transportation efforts. Non-profit advocacy groups specializing in pedestrian and bicyclist safety are valuable allies, as they can offer expertise, insights, and community support. Moreover, forging partnerships with academic institutions, such as the UNH T^2 Center, and research organizations, such as the New England Transportation Consortium, can facilitate data analysis, research, and the development of innovative safety solutions. By fostering these diverse partnerships, states can work collectively toward creating safer and more accommodating environments for pedestrians and cyclists on their roadways. Table 2 in the section below identifies potential partners as the State moves to prioritize strategies for implementation.

PRIORITIZATION + IMPLEMENTATION

In the pursuit of enhancing VRU safety across the state of New Hampshire, numerous action items have been identified as crucial steps toward achieving this goal. To streamline and prioritize these efforts, a comprehensive table has been developed, which assigns each action item a priority, estimates it associated cost, established a timeline for implementation, and identifies potential partner organization/agencies that may contribute to its execution. The timeline for these action items is categorized into ongoing (effort is currently underway and will likely always be), immediate (less than two years), intermediate (2 – 5 years), and long term (more than five years). Expected costs are classified qualitatively as low, medium, or high. Priority status ranges from low to medium or high. Action items identified as high priority hold the most potential for effectively reducing both the frequency and severity of VRU crashes. Table 2, on the following page, serves as a strategic roadmap, guiding the state's commitment to reducing the number and severity of VRU crashes across New Hampshire.

NEXT STEPS

As mandated by federal regulations, the New Hampshire Vulnerable Road User Safety Assessment will be appended to the existing Strategic Highway Safety Plan (SHSP). This assessment will be revised alongside the periodic updates of the SHSP, conducted on a five-year cycle. These future revisions will succinctly outline ongoing endeavors related to the collection and evaluation of VRU crash data, the enhancement of crash analysis, and the identification of high-risk areas, as well as the documentation of advancements in mitigating VRU safety concerns throughout the State of New Hampshire.

STRATEGIES AND SUPPORTING ACTION ITEMS	PRIORITY	ANTICIPATED COST	TIMELINE	LEAD AGENCY	POTENTIAL PARTNERS
STRATEGY 01 - ENHANCE BICYCLIST AND PEDESTRIAN SAFETY IDENTIFIED WITHIN THE HIGH INJURY NETWORK					
Develop and implement a comprehensive statewide project dedicated to addressing all state-owned high injury network corridors.	High	Medium	Intermediate	NHDOT	-
Develop and provide a framework to MPOs, RPCs, and Communities to address locally owned corridors on the High Injury Network.	High	Medium	Intermediate	NHDOT, RPCs, and Local Agency	UNH LTAP
Regularly update the High Injury Network on an annual or biennial basis, considering the most recent crash data, evolving traffic patterns, and the effectiveness of previously implemented countermeasures. This data should be shared with MPOs, RPCs, and local communities.	High	Low	Ongoing	NHDOT	UNH LTAP, Consultant
STRATEGY 02 - IDENTIFY, ADOPT, AND ENCOURAGE THE USE OF BEST PRACTICES					
Institutionalize a statewide Complete Streets Program.	High	Medium	Immediate	NHDOT, Complete Streets Advisory Committee (CSAC)	RPCs, Bike-ped Advocates NH Municipal Association, AARP, American Heart Association, NH Office of Strategic Initiatives
Develop an online comprehensive inventory of best practices and policies.	Medium	Low	Immediate	NHDOT, CSAC	RPCs
Implement an effort to review and update programs, policies, and guidelines to incorporate multi-modal transportation concepts into project delivery.	Medium	Low	Ongoing	NHDOT, CSAC	RPCs
Encourage local entities to conduct local studies that help identify and prioritize bicyclist and pedestrian safety initiatives. These may include ADA assessment plans, traffic calming procedures/policies, and Bicyclist and Pedestrian Safety Action Plans. This will help address safety on a statewide level.	Medium	Low	Immediate	NHDOT, RPCs, OHS, Local Agencies, UNH LTAP	Local Communities
STRATEGY 03 - DEVELOP A SERIES OF PROGRAMS INTENDED TO PROVIDE TECHNICAL ASSISTANCE TO LOCAL ENTITIES					
Develop a series of programs intended to provide technical assistance to local entities through material procurement programs such as Safe Routes to School, Quick Build/Demonstrations Projects, Transition Zone Projects, High Risk Crosswalk Visibility Improvements, and Road Safety Audits.	High	Medium	Intermediate	NHDOT, CSAC, RPCs, UNH LTAP	UNH LTAP, Consultant
STRATEGY 04 - EDUCATE STATE EMPLOYEES, EXTERNAL PARTNERS, AND THE PUBLIC ABOUT NEEDS OF VULNERABLE ROAD USERS					
Develop a statewide safety campaign for pedestrians and bicyclists.	Medium	Medium	Intermediate	NHDOS, BWANH, DHHS-IPP	OHS, NH Association of Chiefs of Police, NH Safe Kids, CHaD IPC, DHHS-IPP
Expand existing training programs to improve education and outreach regarding non-motorized transportation safety issues.	High	Medium	Immediate	NHDOT, RPCs, OHS, Local Agencies	USDOT, CSAC
Increase outreach and education towards seniors through partnerships with Councils on Aging as well as public transportation providers.	Medium	Low	Immediate	NHDOT, RPCs, State Commission on Aging, State Coordination Council (SCC) and Regional Coordination Council (RCC) for Community Transportation	NHDHHS, RPCs, Transit Agencies, SCC, healthcare sector
Help reduce impairment through substance avoidance education, targeted communications campaigns, and partnerships with social service agencies.	Medium	Low	Immediate	OHS, Association of Chiefs of Police	Local and State Law Enforcement Agencies
Partner with DMV to create a curriculum geared towards walking and biking safety for driver education programs.	Low	Low	Intermediate	NHDMV, NHDOS, DHHS-IPP	NHDETA, NHDOT, Drivers Ed Companies

STRATEGIES AND SUPPORTING ACTION ITEMS	PRIORITY	ANTICIPATED COST	TIMELINE	LEAD AGENCY	POTENTIAL PARTNERS
STRATEGY 05 - IMPROVE DATA COLLECTION + ANALYSIS					
Enhance crash data collection.	High	High	Intermediate	NHDOT, NHDOS, RPCs, NH Association of Chiefs of Police	RPCs, UNH SADES Bike-ped Advocates Planning Commissions, Consultants OHS/NHDOT MPOs, BWANH, Police Stds and Training/ Chief of Police Assoc. BWANH NH Assoc of Chiefs of Police
Enhance crash analysis.	High	Medium	Intermediate	NHDOT, NHDOS, RPCs	RPCs, UNH SADES Bike-ped Advocates Planning Commissions, Consultants OHS/NHDOT MPOs, BWANH, UNH LTAP
Create a crash data integration and sharing interface.	Medium	High	Intermediate	NHDOT, NHDOS, RPCs, NHDHHS IPP	OHS, NHDOT, Local Law Enforcement, CSAC, CHaD IPC, National Safety Council
Develop a state non-motorized count program.	Medium	High	Intermediate	NHDOT, NHDOS	UNH LTAP, T2
STRATEGY 06 - INVEST IN PEDESTRIAN AND BICYCLIST SAFETY					
Create a bicyclist and pedestrian grant award.	High	High	Intermediate	NHDOT	Legislature RPCs Municipalities, CSAC
Update prioritization metrics in TIP/TAP funding to include pedestrian and bicyclist safety.	Medium	Low	Intermediate	NHDOT	Legislature RPCs Municipalities, CSAC
Invest in research and development for safer vehicles	Low	Medium	Long	NHDOT	Legislature RPCs Municipalities, CSAC
Invest in research and development for enhanced post-crash trauma care.	Low	Medium	Long	NHDOT	Legislature RPCs Municipalities, CSAC

BWANH	Bike-Walk Alliance of New Hampshire
CHAD IPC	Children's Hospital at Dartmouth Injury Prevention Center
CSAC	Complete Streets Advisory Committee
NHDETA	New Hampshire Driver Education Teachers Association
NHDHHS-IPP	Department of Health and Human Services – Injury Prevention Program
NHDOS	New Hampshire Department of Safety
NHDOT	New Hampshire Department of Transportation
OHS	Office of Highway Safety
SCC	State Coordination Council
UNH LTAP	University of New Hampshire Local Transportation Assistance Program
USDOT	United States Department of Transportation