



Safety Needs and Technology Assessment Project

PROJECT REPORT



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Executive Summary

Transportation safety is a critical concern in suburban areas of the New York Metropolitan Transportation Council (NYMTC) planning area, where distinct governmental ideals and practices are not always translated beyond jurisdictional boundaries and represent a challenge to consistent and effective safety outcomes. With increasing urbanization and rising traffic volumes, vulnerable road users such as pedestrians and bicyclists face significant risks, particularly in suburban counties like Nassau, Suffolk, Westchester, Rockland, and Putnam. This study addresses the need for a coordinated safety program that aligns policies and actions across jurisdictions to improve safety outcomes, focusing on inter-jurisdictional collaboration, data integration, enforcement, public education, and emerging technologies. By leveraging existing resources and frameworks, the research aims to create a cohesive strategy to reduce crashes and enhance safety for all road users.

1. Literature Review

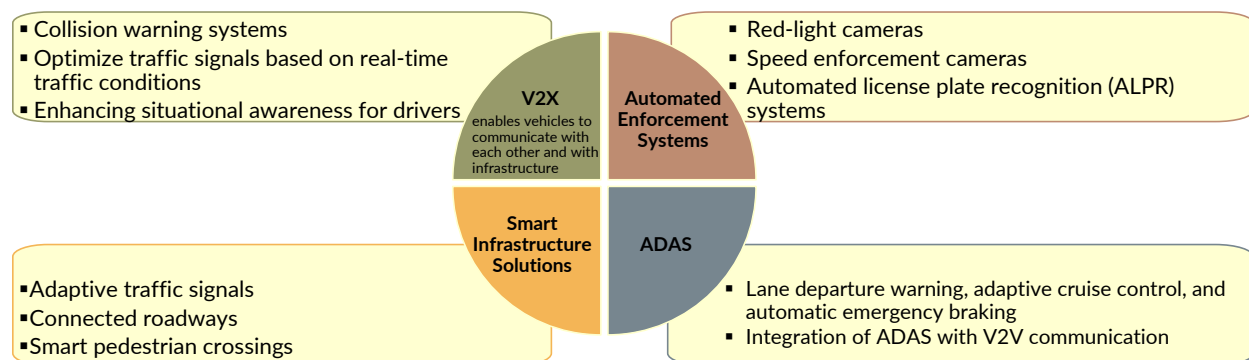


Figure A. Summary of Technology Solutions for Transportation Safety

2. Practical Experience – Interviews with MPO officials

Summary of takeaways from interviews

- Integration of advanced technologies, such as predictive analysis, adaptive signalization, and real-time communication tools, can significantly enhance safety outcomes and support proactive measures.
- Utilizing a Safe System Approach and integrating comprehensive crash data analyses are essential for prioritizing safety initiatives and identifying crash hotspots.
- Stakeholder involvement and community feedback are vital for developing relevant safety initiatives that reflect the needs and concerns of all affected groups, with particular attention to vulnerable communities.
- Strong leadership is necessary to foster trust, coordinate efforts across agencies, and ensure that safety improvements are effectively implemented and sustained.
- Ongoing communication with communities and agencies is essential for identifying practical safety solutions and ensuring alignment with broader safety goals.

3. Safety Assessment

Below is a summary of the analytical and programmatic aspects in the study area by county:

3.1. Nassau County

- Concentrated crash hot spots are observed in the Hempstead municipality, specifically West Hempstead, Inwood, and Garden City along Fulton Avenue, Front Street, State Route 27, Nassau Expressway, and Meadowbrook State Parkway. In North Hempstead, hot spots are found on Northern State Parkway and Interstate 495. Crash hot spots are also observed in Long Beach and Oyster Bay municipalities as well, with less concentration compared with Hempstead.
- Hot spots of pedestrian and bicyclist crashes are observed clearly along Fulton Avenue, Front Street, State Route 27 in Hempstead; and East Park Avenue in Long Beach underscoring the need for pedestrian-focused safety interventions.
- Higher crash rates are prevalent in areas with lower incomes, higher social vulnerability, and reduced vehicle ownership. These factors highlight the importance of equitable safety measures, particularly for residents reliant on non-motorized and public transportation. In Nassau county, highest crash rates are observed in Hempstead and Long Beach municipalities.
- Nassau County currently implements a range of safety programs, including Walk Safe Nassau, Town of Hempstead School Bus Stop-Arm Program, Photo Enforcement - Red Light Camera Program, Engineering Interventions, Enforcement Measures, and various Education Efforts.

3.2. Suffolk County

- Concentrated crash hot spots were found along primary roads, particularly in the western and central parts of Suffolk County, including areas such as Huntington, Babylon, Islip, and Brookhaven, reflecting significant safety concerns.
- Pedestrian and bicyclist crash hot spots were prevalent in the same areas as general traffic crashes, with higher concentration in Huntington, Babylon, and Islip, highlighting the need for focused interventions in suburban and semi-urban settings.
- Higher crash rates were observed in census tracts with lower average incomes and higher social vulnerability. Additionally, areas with higher zero-vehicle ownership showed a correlation with increased crash density, pointing to transportation equity and accessibility concerns. High crash rates were observed in eastern census tracts in Suffolk municipality, even though the area did not record very high crash density.
- Suffolk County currently implements a range of safety programs, including the School Bus Safety Program, Town of Brookhaven Wildlife and Ecology Center Safety Town, Teen Driver Safety Program, Suffolk County Red Light Safety Program, and the Complete Streets Resolution.

3.3. Putnam County

- The most notable crash hot spots are located in Southeast and Carmel, with additional moderate-density areas spread along Taconic State Parkway across the county, indicating localized areas requiring targeted interventions.
- Pedestrian and bicyclist crash hot spots are concentrated in Southeast and Carmel, aligning with general crash trends and highlighting the need for enhanced safety measures in these areas.

- Higher crash rates are observed in areas with elevated social vulnerability and lower vehicle ownership, including majority of Carmel municipality, western side of Philipstown, and the southern west of Putnam Valley. This emphasizes the need for equitable safety improvements tailored to communities with higher dependency on non-motorized transport.
- Putnam County currently implements a range of safety programs, including the Complete Streets Analysis, Engineering Solutions, Education Measures, and the Putnam County School Bus Safety Program.

3.4. Rockland County

- The highest crash densities are concentrated in Ramapo and Clarkstown along State Route 59, North Main Street, and Interstate 287 indicating these areas require focused safety interventions.
- Pedestrian and bicyclist crash hot spots are observed in Ramapo, along State Route 59, North Main Street, and the State Route 306 highlighting the need for targeted measures to protect vulnerable road users.
- Higher crash rates are observed in areas with lower average incomes and elevated social vulnerability. These areas also show a significant overlap with low vehicle ownership, emphasizing the need for equitable transportation safety improvements. The concentration of high crash rate census tracts is observed in east Haverstraw, east Ramapo, and northern-east side of Orangetown.
- Rockland County currently implements a range of safety programs, including Engineering Solutions and the Complete Streets Approach (serving as guidance for inclusive road designs).

3.5. Westchester County

- Concentrated crash hot spots are observed in the southern municipalities, including Yonkers, Mount Vernon, and White Plains, with additional notable activity near Rye and New Rochelle.
- Similar to overall crash trends, pedestrian and bicyclist crash hot spots are clustered in southern areas like Yonkers, New Rochelle, and White Plains, underscoring the need for pedestrian-focused safety interventions.
- Higher crash rates are prevalent in areas with similar trend noticed in other counties. New Rochelle, west Yonkers, north Somers, west Ossining were observed with high crash rates.
- Westchester County currently implements a range of safety programs, including Community Outreach and Education Initiatives, the Community Traffic Safety Program, and Proactive Engagement with Vulnerable Groups.

4. Coordinated Safety Program

The program was developed to address region-wide safety challenges and foster collaboration between jurisdictions within the NYMTC suburban counties. This program integrates both policy initiatives and actionable steps to align safety efforts across the region. The program is presented in two parts: the Coordination Policy Framework and the Action Items, illustrated in the figures below.

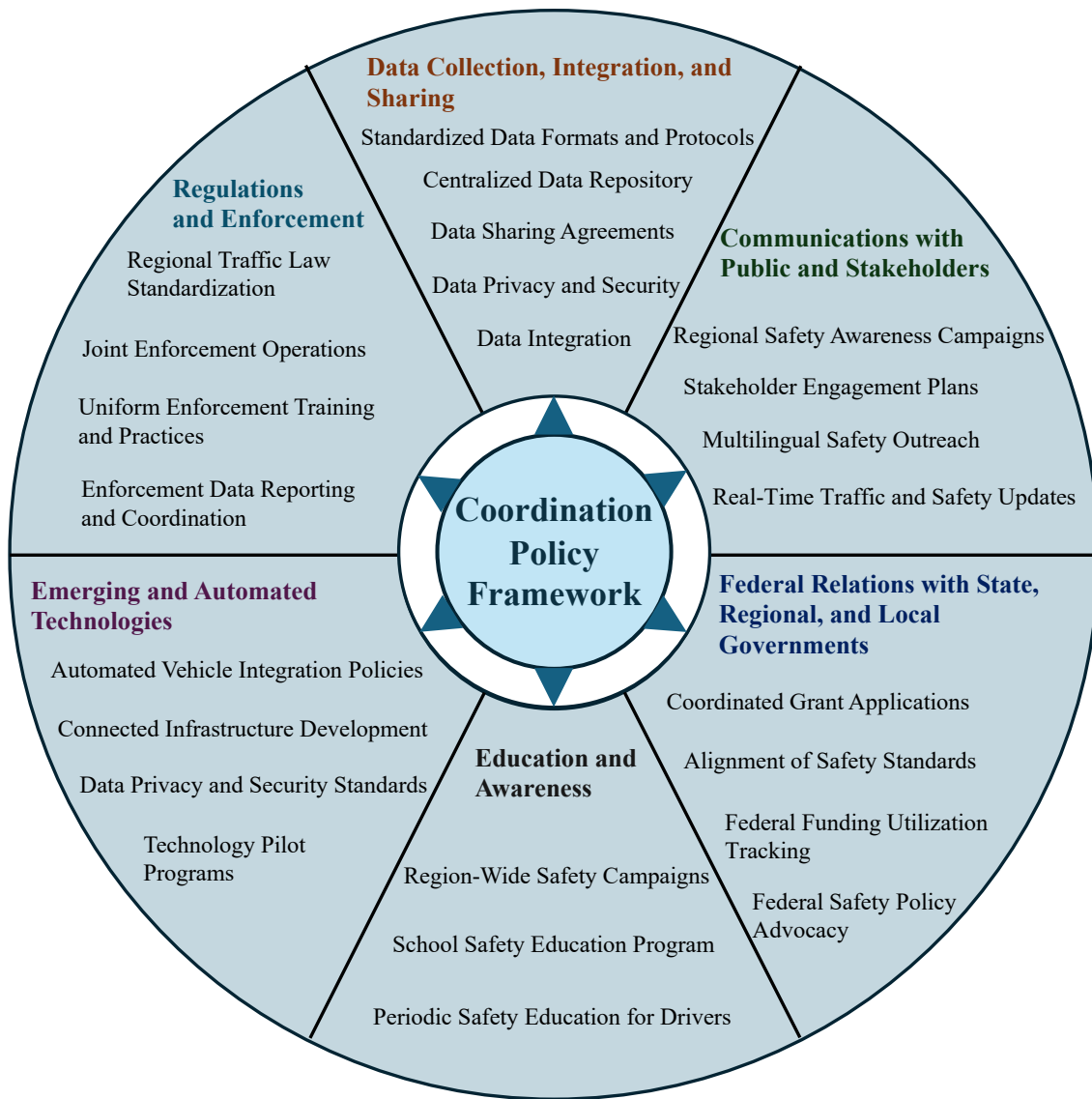


Figure B. Policy Framework of the Coordinated Safety Program



Figure C. Action Items Included within the Coordinated Safety Program

The development of the program was informed by the findings from literature review, interviews with other MPOs, safety analysis and programmatic review, and input from the TCCs. The Coordinated Safety Program is essential for fostering a unified approach to transportation safety, bridging gaps in data sharing, enforcement, and policy alignment across jurisdictions. By providing clear strategies and actionable steps, the program aims to reduce crashes, enhance safety for vulnerable road users, and improve overall coordination between regional stakeholders, ultimately contributing to a safer and more efficient transportation system.

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Chapter 1: Introduction

1.1. Background

Transportation safety is a critical concern for metropolitan regions, especially in suburban areas where varying jurisdictional policies and practices can result in inconsistent safety outcomes. Improving transportation safety requires not just addressing local issues but also fostering coordination between jurisdictions to create a cohesive and effective safety strategy. As urbanization continues and suburban areas experience increased traffic volumes, pedestrian and bicyclist safety becomes increasingly urgent, especially with vulnerable road users at higher risk of severe crashes. Addressing these issues requires a coordinated effort that aligns policies and actions across multiple jurisdictions to create a safer, more efficient transportation network.

The need for an inter-jurisdictional approach is underscored by the fragmented governance structure in many metropolitan planning organizations (MPOs), where various counties and municipalities operate under different regulations, enforcement protocols, and funding mechanisms. In response to this challenge, this study aims to develop a coordinated safety program that enhances collaboration between suburban areas within the New York Metropolitan Transportation Council (NYMTC) planning area, aligning safety efforts and promoting the adoption of common policies and actions to address region-wide safety concerns.

1.2. Study Area

The study focuses on the suburban counties within the NYMTC planning area. These counties include Nassau and Suffolk on Long Island, along with Westchester, Rockland, and Putnam in the Hudson Valley region. These areas, though adjacent to New York City, have distinct suburban characteristics that influence transportation safety, presenting unique challenges related to vehicle reliance, road infrastructure, and pedestrian accessibility.

Nassau and Suffolk counties are densely populated and heavily reliant on automobile travel, contributing to a higher number of vehicle crashes compared to the Hudson Valley counties. The road network in these areas often lacks pedestrian-friendly infrastructure, which exacerbates risks for vulnerable road users such as pedestrians and bicyclists. Meanwhile, Westchester, Rockland, and Putnam counties, though slightly less densely populated, face similar issues due to a suburban environment dominated by car travel and lower levels of public transportation.

In reviewing crash data from 2019 to 2023, it is evident that traffic safety remains a significant concern across these counties. The total number of traffic crashes fluctuated over this period, with the highest recorded in 2019, with over 119,000 crashes, followed by a notable decrease in 2020 during the pandemic. However, traffic crashes began increasing again post-pandemic. The overall trend across all counties points to sustained issues with speeding, pedestrian safety, and intersection design.

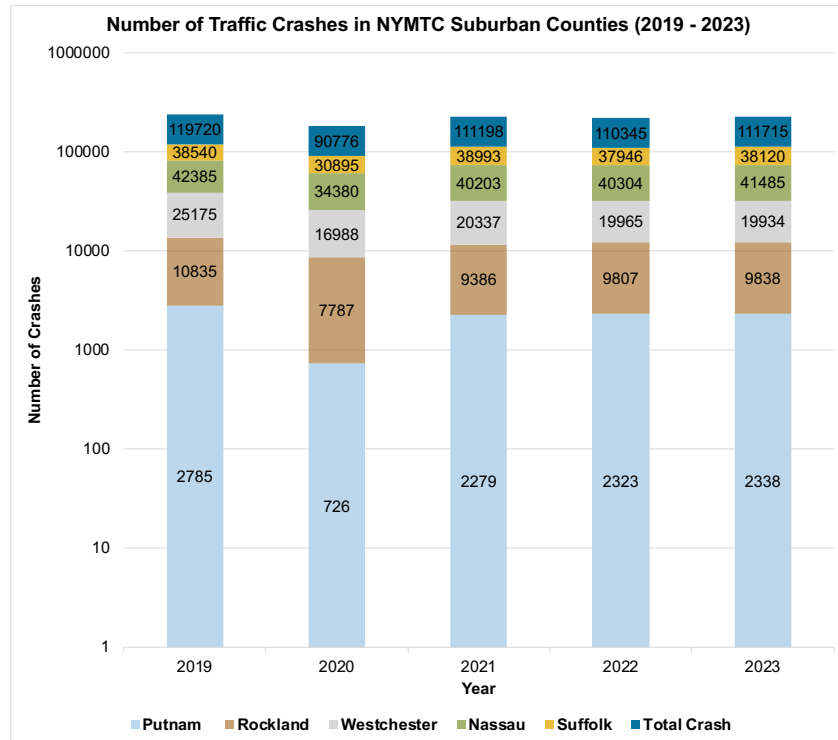


Figure 1 Number of Traffic Crashes in NYMTC Suburban Counties (2019 - 2023)

The accompanying graphs provide a visual breakdown of traffic crash occurrences in each county, highlighting significant trends in crash volume and fatal crashes. Notably, Suffolk County shows the highest percentage of fatal crashes from 2019 to 2023, peaking in 2022 with a fatality rate of 0.33%. Nassau County follows, though with a slight reduction in fatal crashes over the years. Similarly, Westchester County saw an uptick in fatal crashes in 2022, before seeing a decrease in 2023.

These data points underscore the urgency of addressing safety issues, particularly for vulnerable road users, and emphasize the need for the coordinated safety program that this study aims to develop. The rise and fall in both crash volume and fatality rates suggest that while some measures may have been effective, there remains a critical need for more comprehensive, cross-jurisdictional safety strategies across the NYMTC suburban counties.

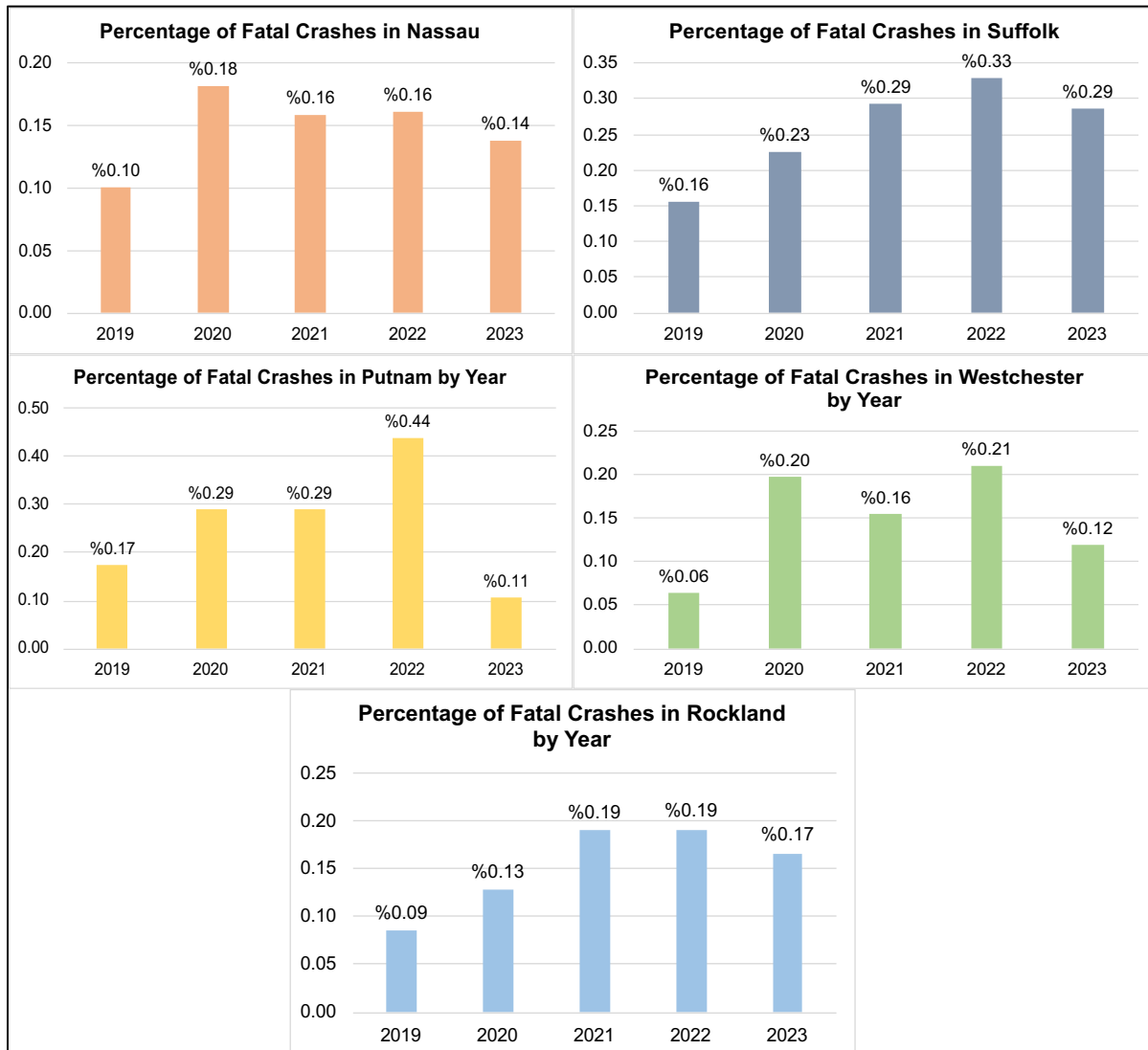


Figure 2 Percentage of Fatal Crashes in NYMTC's Suburban Counties by Year

1.3. Research Problem and Objectives

The primary problem addressed in this study is the lack of coordination between suburban jurisdictions in implementing safety measures, leading to gaps in enforcement, data sharing, and the application of new technologies. These gaps have hindered the effectiveness of existing safety programs, making it difficult to create a unified approach to reduce crashes and improve safety for all road users.

The objectives of this study are threefold:

- To identify key policies and actions that can enhance inter-jurisdictional coordination and improve safety outcomes across suburban areas.
- To assess the current state of transportation safety efforts in the NYMTC suburban subareas and identify barriers to effective collaboration.
- To develop a coordinated safety program that aligns policies and actions between jurisdictions, focusing on areas such as data integration, enforcement standardization, public education, and the adoption of emerging technologies.

1.4. Significance of the Study

This study holds significance for transportation planning professionals, policymakers, and local governments aiming to address safety issues in suburban areas. By focusing on coordination between jurisdictions, this research highlights how shared policies and actions can improve safety outcomes without the need for entirely new programs. Instead of developing safety efforts from scratch, the study emphasizes leveraging existing resources and frameworks to enhance collaboration between different levels of government and agencies.

Furthermore, the study addresses the broader implications of inter-jurisdictional coordination, offering insights into how regions with similar governance structures can adopt similar strategies to improve transportation safety. By developing a model of cooperation, the findings from this study can help guide other metropolitan areas in implementing coordinated safety programs, ultimately contributing to a reduction in crashes, injuries, and fatalities.

1.5. Report Organization

The report is organized into several key sections. The first section, Places for Enhancing Inter-Jurisdictional Coordination, examines the critical areas where coordination between jurisdictions can be strengthened, such as data collection and sharing, enforcement, public communication, and integration of emerging technologies. The second section, Actions to Strengthen Safety Collaboration, outlines specific actions that can be taken to foster collaboration, such as joint enforcement operations, shared data repositories, and regional safety campaigns.

The subsequent sections detail the key findings from stakeholder consultations and data analysis, followed by recommendations for implementing a coordinated safety program. The report concludes with a discussion on future work, offering pathways for continuous improvement in transportation safety and collaboration efforts across jurisdictions.

Chapter 2: Literature Review

Transportation systems face various safety challenges that compromise the well-being of passengers, pedestrians, and infrastructure. One prominent concern is road traffic crashes, that remain a leading cause of death worldwide, claiming millions of lives annually (1). These crashes result from different contributory factors including the uncertainties arising from environmental conditions, hardware and software, which can cause failures in transportation systems; these uncertainties are mitigated through measures such as testing, inspections and maintenance (2, 3). In addition, transportation systems are socio-technical systems, where human factors play a key role. It is widely acknowledged that in transportation systems the human factors, such as errors and failures in operating safe practices due to fatigue, stress or inadequate skill levels, constitute a prominent source of uncertainty (3–6). Moreover, the typology of an area impacts the risk of different types of traffic crashes in different typologies. Cities, for instance, have a higher rate of pedestrian and bicyclist deaths, as well as intersection-related fatalities, whereas rural areas have a greater rate of heavy truck occupant fatalities and high-speed-road mortality. Rural areas comprise 20% of the US population and 32% of vehicle miles driven. However, they also account for 40% of crash fatalities (7 – 8). Additionally, public transportation systems, while crucial for mobility, are susceptible to crashes and security breaches, posing risks to passengers and operators.

Furthermore, the rise of new mobility trends, such as ride-sharing services and micro-mobility solutions, introduces additional safety challenges. These services often operate within complex regulatory frameworks, raising concerns about driver vetting, vehicle maintenance standards, and passenger safety protocols. Additionally, the rise of unmanned aerial vehicles (UAVs), or drones, presents both opportunities and risks for transportation safety. While drones offer efficient delivery solutions and aerial surveillance capabilities, unauthorized or reckless drone operations pose threats to airspace security and public safety (9). Addressing these safety issues requires a holistic approach that integrates technological innovations and conventional approaches such as, training (10), policy interventions (11), and public awareness campaigns (12) to foster a culture of safety and resilience in transportation systems.

To address safety issues in the conventional and advanced transportation systems, safety enhancement strategies and technological innovations have been emerging as crucial tools. From advanced driver assistance systems (ADAS) and collision avoidance technologies to intelligent transportation systems (ITS) and vehicle-to-vehicle (V2V) communication, various technologies are being deployed to enhance safety across the different modes of transportation. These technologies offer promising solutions to address common causes of crashes, such as human error, inadequate infrastructure, and adverse weather conditions. Moreover, the integration of artificial intelligence, machine learning, and big data analytics enables real-time monitoring, predictive analysis, and proactive interventions to prevent crashes before they occur. As transportation networks continue to evolve, understanding the utilization and effectiveness of these technologies is paramount to fostering safer and more resilient transportation systems.

Despite the growing interest in utilizing technologies for transportation safety, there is still a notable gap in a comprehensive review that investigates the utilization, effectiveness, and impact of these innovations in enhancing transportation safety. This lack hinders the understanding of the practical challenges, limitations, and opportunities associated with implementing these technologies in diverse transportation contexts. To address this gap, this document adopts a dual approach by examining theoretical literature, including Vision Zero (VZ) plans and articulated

literature, and practical experiences from professionals. By complementing the theoretical understanding with practical inputs, this document could comprehensively provide an understanding of the current status of technologies and their utilization in improving transportation safety.

VZ initiatives, which advocate for the elimination of traffic fatalities and severe injuries, provide valuable insights into the strategic priorities and technological interventions prioritized by policymakers and transportation agencies worldwide. By analyzing VZ plans from various jurisdictions, this document aims to identify common themes, innovative strategies, and technological solutions implemented to enhance safety outcomes. In parallel, a review of articulated literature offers a systematic assessment of the existing body of research, empirical studies, and case analyses on the effectiveness and utilization of transportation safety technologies. Synthesizing insights from both VZ plans and scholarly literature provides a comprehensive overview of the current landscape of technologies deployed to improve transportation safety, offering valuable insights for policymakers, researchers, and industry stakeholders.

Other safety plans and actions on federal, state, regional, and local levels are being implemented and are considering emerging technology to improve safety in transportation networks. On the federal level, the Federal Highway Administration (FHWA) stated that Intelligent Transportation Systems (ITS) improve transportation safety and mobility and enhance American productivity through the integration of advanced communications technologies into the transportation infrastructure and within vehicles. ITS applications focus on both the infrastructure and the vehicle as well as integrated applications between the two. On the state level, states' departments of transportation (DOTs) encourage the adoption of emerging technologies in traffic safety plans. In the regional and local levels, Metropolitan Planning Organizations (MPOs) and other governmental bodies develop transportation safety plans and introduce several technological actions as a part of the developed plans.

In this chapter, an inventory of current and developing technologies that hold promise to improve transportation safety and security was completed. Vision zero plans, technical reports, and articulated literature were reviewed. This chapter starts with identifying several technologies for enhancing transportation safety on different levels including vehicle, infrastructure, and the integration between both. Then, the implementation and integration challenges that hinder the wide and quick adoption of these technologies are identified. In addition, a review of several safety actions from VZ plans is presented.

2.1. Technologies for Enhancing Transportation Safety

Technological advancements for transportation safety could be classified into three key categories, including vehicle safety technologies that focus on equipping vehicles with advanced features to assist drivers and prevent crashes; infrastructure safety technologies, which encompass systems designed to enhance roadways and transportation infrastructure for safer operations; and safety communication technologies that facilitate real-time communication between vehicles, infrastructure, and emergency services to improve response times and coordination in critical situations. The following sections discuss each of these categories and their associated technological applications. In addition, this section emphasizes how these technologies were adopted by several vision zero plans across the nation.

2.1.1. Vehicle Safety Technologies

Safety technologies in vehicles play a crucial role in reducing the frequency and severity of crashes on the road and enhancing safety for occupants and other road users. The National Highway Traffic Safety Administration (NHTSA) reported that in 2012, vehicle safety technologies saved an estimated 27,621 lives in cars and light trucks and vans (i.e., pick-up truck, sport utility vehicles (SUVs), minivans, and full-sized vans) (17). Current technologies such as seatbelts, energy absorbing steering assemblies, and frontal and side air bags have been found to be significantly impactful in reducing traffic fatalities (17). More advanced technologies in vehicles leverage advanced sensors, algorithms, and connectivity, to construct autonomous vehicles (18 – 20) and safety systems, such as advanced driver assistance systems (ADAS) (21 – 23) and collision avoidance systems (24 – 26). The subsections below review how each of these approaches contributes to enhancing safety in transportation systems, specifically focusing on their application in suburban areas and their consideration for pedestrians and vulnerable road users.

A. Autonomous Vehicles (AVs)

AVs, also known as self-driving cars, represent the pinnacle of vehicle safety technology. These vehicles utilize an array of sensors, including cameras, radar, lidar, and GPS, to perceive their surroundings and navigate autonomously without human intervention. One example is Waymo, the autonomous driving subsidiary of Alphabet Inc., which has developed a fleet of self-driving cars capable of navigating complex urban environments (27 – 28). Waymo's vehicles have logged millions of miles on public roads, demonstrating their ability to operate safely and efficiently in real-world conditions. Another example is Cruise (29), another leading AV company that partners with cities to provide services that support communities through driverless ride hail and delivery.

In suburban areas, AVs can enhance safety by reducing the incidence of crashes caused by human error, such as distracted driving and impaired driving (20). Suburban environments often have a mix of residential roads, local streets, and higher-speed arterial roads, which AVs can navigate with precision, reducing the likelihood of crashes. AVs are also equipped to detect and respond to pedestrians and Vulnerable Road Users (VRUs) through advanced sensor technology and real-time data processing, enhancing safety for all road users.

Several VZ plans define action items to support safe adoption and operation of autonomous vehicles. For instance, VZ in San Francisco stated that AVs will be a major component of the developing policy guide “Automated Vehicle Technology Vision and Policy Playbook”; comments on potential Federal and State rulemaking related to autonomous vehicles are being provided by city agencies to ensure that safety is elevated (30). In addition, the VZ plan in Franklin County in Massachusetts highlighted that distracted driving is a particular problem that may be solved through the driverless/autonomous vehicles of the future (31). In accordance, the VZ included associated action items such as coordinate with local communities and Massachusetts Department of Transportation to prepare existing roadways for best accommodation of self-driving vehicles, which would include maintaining clear pavement markings and signage that can be perceived by autonomous vehicle systems on all roadways (31).

B. Advanced Driver Assistance Systems (ADAS)

ADAS comprise a suite of technologies designed to assist drivers and enhance vehicle safety. These systems typically include features such as adaptive cruise control, lane-keeping assist,

automatic emergency braking, and blind-spot monitoring (21). Research shows that vehicles fitted with ADAS have potential to decrease crash rates by 47 percent (32).

In suburban areas, ADAS technologies are particularly beneficial given the mix of residential and higher-speed roads. For instance, Drowsy Driver Warning Systems observe drivers for indications of tiredness or lack of focus during driving. Lane Departure Warning Systems utilize cameras to identify lane markings and notify the driver when the vehicle starts to change lanes without signaling, which is essential for safety on winding suburban roads. Additionally, Automatic Emergency Braking Systems engage the vehicle's brakes automatically to prevent or alleviate an imminent frontal collision with another vehicle (33). This is critical in suburban areas where unexpected stops may occur due to pedestrian crossings or vulnerable road users.

Tesla's Autopilot system is a prominent example of ADAS, offering a semi-autonomous driving experience that combines adaptive cruise control with lane-keeping functionality. Tesla vehicles equipped with Autopilot can automatically maintain a safe distance from other vehicles, stay within lane markings, and detect and avoid potential collisions (34). These technologies help prevent crashes by alerting drivers to potential hazards, assisting with vehicle control, and mitigating the consequences of human error. Several initiatives have been implemented to support the use of ADAS for safer fleets. For instance, in 2022, New York City (NYC) initiated a pilot of Intelligent Speed Assistance (ISA) in 50 fleet vehicles aimed at controlling speeds and enhancing safety. This initiative was subsequently extended to 300 vehicles, encompassing 50 school buses. ISA technology functions by limiting a vehicle's top speed, thereby ensuring compliance with local speed regulations, and promoting road safety (35). Moreover, VZ plans cited ADAS as an emerging technology that supports safer driving (36).

C. Collision Avoidance Systems

Collision avoidance systems employ sensors and algorithms to detect and mitigate potential crashes with other vehicles, pedestrians, or obstacles. These systems often incorporate features such as forward collision warning, automatic emergency braking, and pedestrian detection. Volvo's City Safety system is a prime example of a collision avoidance system that has been widely praised for its effectiveness in preventing crashes (37 – 39). City Safety uses radar and camera technology to detect vehicles, cyclists, pedestrians, and large animals in the vehicle's path and automatically applies the brakes if a collision is imminent.

In suburban settings, where pedestrians, cyclists, and other VRUs are common, collision avoidance systems are particularly valuable. Studies have shown that collision avoidance systems can significantly reduce rear-end and pedestrian crashes, making them a vital component of modern vehicle safety technology (40). For instance, suburban roads often have lower traffic volumes but higher speeds, which can lead to severe accidents if not managed properly. Collision Avoidance Systems help mitigate these risks by providing timely warnings and automatic interventions, enhancing safety for all road users. Studies have shown that these systems can significantly reduce crashes, particularly those that occur due to slower reaction times of the driver (41).

2.1.2. Infrastructure Safety Technologies

Infrastructure safety technologies play a key role in enhancing the safety and efficiency of transportation systems by improving traffic flow, reducing congestion, and minimizing the risk of crashes. The subsections below provide a review of technological approaches to improve

infrastructure safety and ultimately reduce traffic crashes, specifically focusing on their application in suburban areas and their consideration for pedestrians and vulnerable road users.

A. Smart Traffic Management Systems

These systems are technological solutions that could be integrated into traffic systems for fast and cost-effective enhancements in safety and reliability. Smart traffic management systems leverage advanced technologies such as real-time data analytics, predictive modeling, and connected infrastructure to optimize traffic flow and improve safety on roadways (42). These systems often incorporate traffic signal optimization, which helps traffic signals operate more efficiently (43). Management of traffic signals could achieve several benefits including improving air quality, reducing fuel consumption, minimizing traffic injuries and fatalities, improving driving behaviors such as red-light violations, and reducing congestion (43).

In suburban areas, where traffic patterns can vary significantly between peak and off-peak hours, smart traffic management systems can dynamically adjust signal timings to accommodate fluctuating traffic volumes, thus reducing wait times and improving traffic flow. Additionally, these systems can prioritize pedestrian crossings during school hours or other high pedestrian activity periods, enhancing safety for vulnerable road users.

Dynamic lane management is an advanced strategy consisting of reassigning road space based on current expected demand to use existing infrastructure more efficiently. This strategy provides an alternative to constructing additional roadways by offering capacity to certain types of traffic at certain times. It includes reversible lanes, merge or junction control, and part-time shoulder use (44). In suburban areas, dynamic lane management can help manage traffic flow during rush hours, school pick-up and drop-off times, and special events, reducing congestion and the potential for accidents.

Moreover, congestion pricing strategies are proven to alleviate traffic congestion and reduce the likelihood of crashes (45). In suburban contexts, congestion pricing can be applied selectively during peak travel times to discourage unnecessary trips and encourage the use of alternative routes or public transportation, thus improving overall safety.

Challenges such as high implementation costs, interoperability issues, and privacy concerns may hinder widespread adoption of these technologies. Nonetheless, transportation agencies develop plans and offer initiatives that could alleviate the implementation of these technologies. For instance, the VZ plan in the City of Phoenix identified several action items that support traffic signals optimization such as establishing yellow change and all-red clearance intervals and modifying left-turn phasing at signalized intersections on the high injury networks to reduce conflicting movements (46).

B. Intelligent Transportation Systems (ITS)

ITS encompass a broad range of technologies and applications aimed at improving the efficiency, safety, and sustainability of transportation networks. ITS solutions typically involve the integration of communication, sensor, and control technologies to enable real-time monitoring and management of traffic and transportation assets. Examples of ITS include dynamic message signs, traffic surveillance cameras, and electronic toll collection systems. One notable example is the E-

ZPass electronic toll collection system used in many U.S. states, which allows vehicles to pass through toll booths without stopping, thereby reducing traffic congestion, and improving safety.

In suburban areas, ITS can provide critical real-time information to drivers about road conditions, traffic incidents, and alternative routes, which is particularly beneficial in areas with limited road networks and higher speeds. Dynamic message signs can inform drivers of upcoming hazards or detours, improving safety for all road users, including pedestrians and vulnerable road users.

To enhance the adoption of ITS approaches, VZ plans include action items that emphasize evaluating and implementing ITS improvements (46). ITS offer advantages such as improved traffic management, enhanced emergency response, and increased operational efficiency. However, challenges such as cybersecurity risks, data privacy concerns, and the need for infrastructure investment may pose barriers to implementation.

C. Roadway Sensors and Cameras

Roadway sensors and cameras are crucial to collect real-time data about traffic conditions, vehicle movements, and road infrastructure. These sensors and cameras are often deployed along roadways to monitor traffic flow, detect incidents, and provide valuable information to transportation agencies and motorists (47). For instance, traffic cameras installed at intersections can capture images and video footage of traffic violations, enabling authorities to enforce traffic laws and improve safety. Roadway sensors can also detect adverse weather conditions, pavement quality, and vehicle speeds, allowing transportation agencies to proactively address potential hazards.

In suburban areas, roadway sensors and cameras can be particularly effective in monitoring traffic near schools, parks, and residential neighborhoods, where pedestrian and vulnerable road user activity is high. These technologies can help ensure that drivers adhere to speed limits and stop at crosswalks, thereby enhancing safety for pedestrians and vulnerable road users. Furthermore, real-time data from sensors can be used to optimize traffic signals and manage congestion, improving overall traffic flow and reducing the likelihood of crashes.

Advantages of roadway sensors and cameras include improved situational awareness, enhanced traffic management, and quicker incident response times. Moreover, road sensors provide key inputs for other safety technologies such as ITS applications (47). Challenges such as maintenance costs, privacy concerns, and data security vulnerabilities need to be addressed to ensure the effective and ethical use of these technologies.

2.1.3. Safety Communication Technologies

Safety communication technologies enhance transportation safety by enabling vehicles to communicate with each other and with infrastructure, as well as facilitating rapid emergency notifications. The subsections below provide a review of safety communication technologies and their role in reducing traffic crashes, specifically focusing on their application in suburban areas and their consideration for pedestrians and vulnerable road users.

A. Vehicle-to-Vehicle (V2V) Communication

V2V communication enables vehicles to exchange real-time data about their speed, position, and trajectory, allowing them to anticipate and react to potential crashes on the road. This technology relies on dedicated short-range communication (DSRC) or cellular networks to facilitate

communication between vehicles within close proximity. V2V technology is different from vehicle-resident technologies (such as cameras and sensors) and operates separately from, or complementarily to, ADAS. V2V utilizes signals that are capable of reception even in situations where there are physical obstacles or challenging weather and lighting conditions, without encountering the line-of-sight constraints that vehicle-based technologies may encounter (48).

In suburban areas, V2V communication can be particularly beneficial due to the mix of residential streets, school zones, and local businesses. For example, collision warning and avoidance systems using V2V communication can alert drivers to imminent crashes at intersections or when approaching stopped school buses, thereby enhancing safety for all road users, including pedestrians and vulnerable road users. Providing warnings is an early implementation format of the V2V communication which will quickly advance and provide details about direction, proximity, and nature of the issue (49). By integrating received data with other technologies, such as automated emergency braking, vehicles can react to potential hazards more effectively.

Advantages of V2V communication include enhanced crashes avoidance, reduced traffic congestion, and improved overall traffic safety. However, challenges such as interoperability between different vehicle manufacturers, cybersecurity risks, and privacy concerns may impede widespread adoption.

B. Vehicle-to-Infrastructure (V2I) Communication

V2I communication enables vehicles to exchange data with roadside infrastructure such as traffic signals, road signs, and traffic management centers. This technology allows vehicles to receive real-time information about traffic conditions, crashes, sharp curves, speeds, and traffic signal timings, enabling drivers to make informed decisions and improve safety on the road (50 – 51). In addition, V2I technology links vehicles, utilities, and pedestrians to provide businesses with real-time data about road and traffic conditions (51).

In suburban settings, V2I communication can greatly enhance safety and efficiency. For example, adaptive traffic signal control systems that adjust signal timings based on traffic flow can reduce congestion and improve traffic efficiency at busy intersections, especially during peak hours. V2I communication can also inform drivers about school zones, pedestrian crossings, and other VRU-heavy areas, allowing them to adjust their driving behavior accordingly.

Advantages of V2I communication include improved traffic management, enhanced driver awareness, and increased roadway safety. Preliminary research suggested that V2I safety application could address an additional 12 percent of crash scenarios (52). The goal of V2I technology is to develop safety applications specifically tailored to prevent or minimize crashes involving various vehicle types, especially focusing on scenarios not addressed by V2V research. The wide and quick deployment of V2I communication technologies could be hindered by some challenges such as the need for infrastructure investment, interoperability issues, and data privacy concerns.

C. Emergency Notification Systems

Emergency notification systems enable rapid communication of critical information to drivers and emergency responders in the event of crashes, natural disasters, or other emergencies. These systems utilize various communication technologies such as cellular networks, satellite

communications, and connected vehicle platforms to deliver emergency alerts and notifications to motorists. For instance, in-vehicle eCall service automatically notifies emergency services in the event of a crash, providing precise location information and facilitating a timely response (53).

In suburban areas, emergency notification systems can enhance safety by ensuring that emergency responders are quickly informed of incidents, even in less densely populated areas. These systems can also notify drivers of local emergencies, such as severe weather or road closures, enabling them to take appropriate action to avoid danger.

Advantages of emergency notification systems include improved emergency response times, enhanced coordination between agencies, and increased situational awareness for drivers. However, challenges such as false alarms, communication failures, and privacy considerations need to be addressed to ensure the effectiveness and reliability of these systems.

2.1.4. Integration and Implementation Challenges

Integrating and implementing new technologies into existing transportation systems can be a complex process with challenges that need to be addressed effectively.

A. Considerations for integrating various technologies into existing transportation systems

Integrating new technologies into existing transportation systems requires careful consideration of factors such as infrastructure compatibility, regulatory requirements, and user acceptance. For example, retrofitting existing vehicles with advanced safety features like collision avoidance systems may require modifications to vehicle hardware and software, as well as compliance with relevant safety standards. Similarly, deploying ITS on roadways necessitates coordination with transportation agencies, utility providers, and local governments to ensure seamless integration with existing infrastructure. The successful integration of technologies into transportation systems often requires interdisciplinary collaboration and stakeholder engagement to address technical, regulatory, and logistical challenges.

B. Challenges related to scalability, interoperability, and cost-effectiveness

Scalability, interoperability, and cost-effectiveness are key challenges that arise when implementing new technologies in transportation systems. Scalability refers to the ability of technology solutions to accommodate increasing demand and expand to serve larger populations or geographic areas. For instance, deploying smart traffic management systems across a city-wide or regional scale may require significant investment in infrastructure and resources to support the increased data processing and communication needs. Interoperability, on the other hand, pertains to the seamless integration and communication between different technologies and systems. Ensuring interoperability between diverse hardware and software platforms is crucial for enabling data exchange and collaboration among stakeholders. Additionally, cost-effectiveness considerations determine the feasibility and sustainability of technology deployments. Balancing the upfront costs of implementing new technologies with the long-term benefits and cost savings is essential for gaining buy-in from decision-makers and securing funding for transportation projects.

C. Strategies for overcoming implementation barriers

To overcome implementation barriers and ensure the successful adoption of new technologies in transportation systems, various strategies can be employed. These may include conducting

thorough pilot studies and demonstrations to assess the feasibility and performance of technology solutions in real-world conditions. Engaging with industry partners, research institutions, and government agencies can facilitate knowledge sharing, resource pooling, and collaborative problem-solving. Moreover, developing clear and consistent regulatory frameworks and standards can provide guidance and certainty to stakeholders involved in technology deployments. Investing in workforce training and capacity building is also essential for ensuring that personnel have the necessary skills and expertise to operate and maintain new technologies effectively. Additionally, exploring innovative financing mechanisms such as public-private partnerships (PPPs) and grant funding can help alleviate financial barriers and incentivize investment in transportation innovation. By employing these strategies, transportation agencies and stakeholders can navigate the complexities of technology integration and implementation more effectively, ultimately leading to safer, more efficient, and sustainable transportation systems.

2.2. Vision Zero Plans and Transportation Safety Improvement

Forty-three Vision Zero plans developed for various cities across the United States using the FHWA list were analyzed. We investigated each of the plan's websites for the action plans and activities they implemented, as well as any written reports, records, or plans. We also added any updated yearly reports summarizing the action plans that might be located on their website. The following six ventures were clustered based on the plans. They are pedestrian safety, bicycle safety, safe roads, speed management, safe school zones, and engagement as visualized below.

Under these clusters multiple initiatives have been taken for urban, suburban, or both urban and suburban areas. In the following section, the initiatives and their applicable areas are discussed.



Pedestrian Safety



Bicycle Safety



Safe roads



Speed Management



Safe School Zones



Engagement

2.2.1. Pedestrian Safety

Pedestrians are extremely vulnerable when crossing the road, so the plans prioritize their safety. The action plans include several actions and initiatives aimed at pedestrian safety.

A. Urban

Actions that have been taken for pedestrian safety focusing on urban areas are discussed below:

A.1. Involving People Walking and Biking

The vision zero action plans in various cities engage people in practicing walking and cycling to travel within the city through outreach initiatives and other training programs. It also includes protecting pedestrians and bicyclists. To limit the number of cars during peak periods, the city of Phoenix encourages residents to commute by walking or cycling within the city (54).

A.2. Visible and Raised Crosswalks

Wherever possible, the action plans in the city recommended the construction of raised crosswalks to make them more apparent. The City of Berkeley in California has shown that pedestrians are more likely to be involved in a crash while attempting to cross the road with a non-yielding vehicle or driver (55). Unlike speed bumps, raised crosswalks elevate the entire car and have a flat upper surface. They are often longer and more appropriate for high-speed zones. Raised crosswalks are normally 3-3.5 inches high, 22 feet long, and located in areas with speed limits ranging from 25 to 45 mph. Raised midblock crossings offer safer pedestrian crossings amid the road (56).



Figure 3 Raised Crosswalk in Indianapolis (56)

B. Suburban

The following initiatives have been found that were used for pedestrian safety in the suburban areas.

B.1. Mid-block crossings at priority arterials

Suburban arterials with longer lengths typically allow automobiles to accelerate. Meanwhile, refuge islands that decrease lane width allow pedestrians to cross the street in less time, which is especially beneficial for the elderly and children. The designs proposed building pedestrian refuge islands/medians when the route is wide enough, and the speed limit is 30 to 40 mph (57 – 58).



Figure 4 Pedestrian crossing beacons with a median island in the suburban area (59)

B.2. Install additional lighting on non-signalized crosswalks

Because most suburban areas are poorly lit, identifying pedestrians at night becomes extremely difficult if the crosswalk is not signalized. To address the issue, one alternative proposed by the action plans is to install additional lighting where crossings are not signalized. The city of Tempe, Arizona, is identifying these crossings to enhance lighting conditions, as outlined in its Vision Zero Action Plan (60).

B.3. Pedestrian Crossing Beacons

Like crosswalk illumination for unsignalized crosswalks, pedestrian crossing beacons are another alternative for pedestrian crossing safety (61 – 65). The City of Fremont, California has placed a pedestrian High-Intensity Activated Crosswalk (HAWK) signal to control traffic at the crossing (71). HAWK signals, also known as pedestrian hybrid beacons or signals, activate flashing lights when a pedestrian presses a button or is identified.

C. Urban/Suburban

The following actions have been taken for the urban and suburban areas in the Vision Zero plans for the safety of pedestrians.

C.1. Accessible Pedestrians Crossing

Another suggestion by the plans is to make sure that the crossing is accessible to all kinds of people. Using accessible push buttons at signalized crossings or flashing beacons along with audible crossing instructions can ensure the safety of all pedestrians including those who have a disability.



Figure 5 Accessible pedestrian crossing (66)

C.2. Leading Pedestrian Interval

A leading pedestrian interval (LPI) permits pedestrians to access a crosswalk at a junction 3-7 seconds before vehicles receive a green indication. Pedestrians can establish their presence in the crosswalk before motorists are given the option to turn right or left. Tempe's and Phoenix's Vision Zero programs in Arizona are attempting to implement these measures and have included them in their action plans (60).

2.2.2. Bicycle Safety

Bicyclists, like pedestrians, are vulnerable on the roads. Cyclists are sometimes more vulnerable than pedestrians due to their abrupt movement, speed, and lack of reflectivity in the dark (69). In addition to the aforementioned concerns, bicyclists are susceptible to roundabouts and intersections (69). Vision Zero proposes to implement several programs for bicyclists to address the following variables and measure the hazards they face.

A. Urban

Following initiatives have been taken for the safety of bicycles in the urban areas by the Vision Zero plans:

A.1. Bicycle safety education for communities

Similar to pedestrian safety, local authorities offer various seminars to teach residents about the safety of bicycle riding as well as the laws of maneuvering. The Contra Costa County, California, Vision Zero Plan incorporates community programs to ensure the safety of locals who ride bicycles (69).

A.2. Hybrid left turn signal

Bicycle signals and beacons make it easier for cyclists to cross the road. Bicycle signals make junctions safer for bicyclists by indicating when to enter and restricting competing vehicle movements. Bicycle detection can be done manually or automatically (e.g., in-pavement loops, video, microwave). Many signalized intersections use inductive loop vehicle detection, which is calibrated to a vehicle's size or metallic mass. Los Angeles Vision Zero has suggested using this kind of hybrid signalization using push buttons or loop detectors for cyclists (70).



Figure 6 High-intensity activated crosswalk (HAWK) installed on Mowry Avenue at Waterside Circle in Fremont for pedestrians and bicyclists

B. Suburban

The following measures have been taken for bicycle safety in the suburban areas by the Vision Zero action plans.

B.1. Buffer Lane Inclusion

The inclusion of a buffer lane between the bike lane and the main street ensures safety for the bicyclists and the moving vehicles as well. These buffer lanes can be installed by pavement markings or any kind of physical barrier like concrete blocks, bollard posts or flower pots (71 – 74).



Figure 7 Inclusion of buffer lanes in the street

C. Urban/Suburban

The following measures have been taken for bicycle safety for both urban and suburban areas by the Vision Zero action plans.

C.1. Protected and Dedicated bike lanes

Protected and dedicated bike lanes are also crucial safety measures for bicyclists. The most essential action plans are 'Protected and Dedicated bike lanes', which have been implemented by the majority of the plans. The Vision Zero plan in Montgomery County, Maryland, has also taken steps to ensure cyclist safety by constructing protected bike lanes and establishing a buffer zone

between the bus lane and the bike lane to ensure bicyclist safety while also making room for bus passengers (74). San Jose, California, is renovating its current protected bikeway with concrete separation, which includes concrete planter boxes. Protected junctions will be built to reduce vehicle speeds, cut pedestrian crossing lengths, and improve overall roadway visibility (75). In 2023, Jersey City, New Jersey, began testing Green Endurance, an Endurablend surface to provide high visibility and traction, on conventional bike lanes on Greenville Avenue (62).

C.2. Street Markings for Bike lanes

Where physical separation is not possible, the use of street markings is the best solution to provide safety for the bicyclists. The city of Fremont has improved the pavement markings for the bicycles by properly building buffer zones, protected lanes, and others (71). Similarly, the city of San Jose has also taken initiatives to improve the bicycle facilities by providing markings for the cyclist. Colored asphalt or slurry seal seems to be the best slip-resistant marking, although it might not match FHWA color requirements. Although paint that has had more sand added to it is more slip-resistant, paint usually wears off after two years, thus upkeep is required.



Figure 8 Bicycle facility improvement at an intersection in San Jose, CA

Preformed thermoplastic seems to be the most economical material. According to ASTM E 303, preformed thermoplastics like Flint Trading's ViziGrip® have a minimum skid resistance value of 60 BPN. A minimum thickness of 90 millimeters (2.29 mm) or 125 millimeters (3.15 mm) must be given. (98).

2.2.3. Safe Roads

Safe roads mean providing a safe environment for all road users by reducing the chance of crashes or traffic fatalities. By reviewing the Vision Zero plans we came to know the specific initiatives that are being taken by the city planners to make the roads safer for everyone.

A. Urban

The following major actions have been taken for safe roads in the urban areas by the Vision Zero action plans.

A.1. No Turn on Red at High-risk intersections

By detecting the high-risk intersections using the crash statistics and historical data, the authorities found the high-risk intersections where the no turn on red instructions are placed to prevent crashes (78).

A.2. Retroreflective backplates

Backplates attached to a traffic signal head increase the visibility of the signal's LED face by providing a controlled-contrast background. A 1- to 3-inch yellow retroreflective border frames a signal head with a backplate, enhancing its visibility. Signal heads with retroreflective backplates are more visible and noticeable throughout the day and at night (78). South Carolina DOT used these plates in their signalization at the intersections. The city of Minneapolis also suggested these measures in its Vision Zero plans (80). According to FHWA, it reduces crashes by about 15%. According to the NYSDOT, signal backplates must be utilized for signal faces on approaches with engineered speed limits or 85th-percentile speeds of 45 mph or more if the signal is being installed (99).

B. Suburban

The actions that have been taken for safe roads for the suburban areas are discussed below.

B.1. Install streetlights at the intersections

Installation of streetlights at the intersections is an important measure for the locations where there is low visibility during the night. As the suburban areas are known for high speed of vehicles and not well equipped with lighting, installation of streetlights at the intersections is important for the safety of pedestrians as well as other vehicles (80 – 82).

B.2. Hardened centerlines

Hardened centerlines in between the lanes help the vehicles to slow down while turning left. Centerline hardening is one of numerous left-turn traffic-calming solutions gaining popularity throughout the country. It has been observed by the Institute of Highway Safety that crashes were reduced by 70% in the intersections and the speed was reduced by 10% (83).

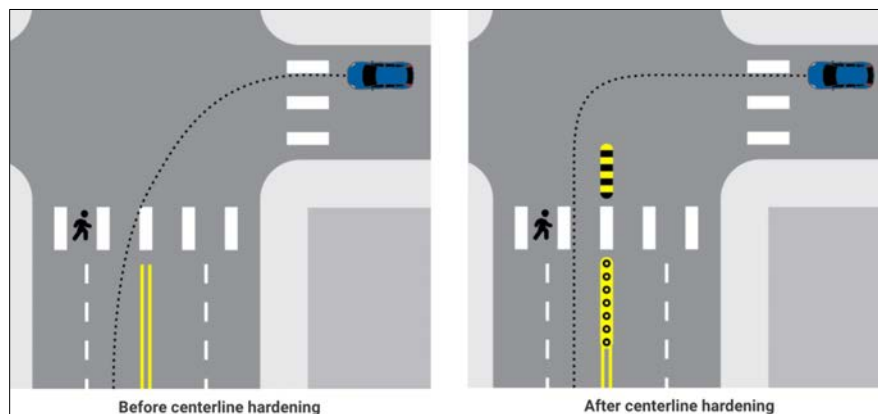


Figure 9 Inclusion of hardened centerlines before and after scenarios (83)

C. Urban/Suburban

The following actions have been taken by both urban and suburban vision zero plans.

C.1. Dedicated left turn

Install a dedicated left turn where the traffic volume is high. Dedicated left lanes can be built to allow for deceleration before a turn, as well as storage of cars that have stopped and are waiting for an opportunity to complete a turn. Installing left- and/or right-turn lanes on major road

approaches should be considered to improve safety at both three- and four-leg crossings with stop control on the minor road, where high turning volumes exist, or where turn-related crashes have occurred in the past (84 – 86).

C.2. Daylighting at Intersections

Daylighting means making the intersection more visible to the drivers to reduce the chance of any collision or other crashes. Daylighting can be performed quickly and inexpensively by installing flexible, vertical poles at crossroads and near crosswalks. The intersections where the crash fatalities are high, near the school zones, and near the High Injury Network are locations selected primarily to implement daylighting (71, 73, 85).



Figure 10 Before and after the daylighting of the intersection

C.3. Installation of speed humps

Jersey City vision zero planning authority has restricted the right turns on red for more than 190 intersections along with the installation of more than 50 speed humps in the residential streets in 2023 which made the number of total speed humps to be more than 680 since 2019 (85). These safety programs sometimes use a "quick build" strategy, utilizing low-cost interim materials to expedite street design changes while major infrastructure changes are discussed with the community. Speed humps were installed in arterial or collector road with a speed limit of 35 mph (85).

2.2.4. Speed Management

According to the plans reviewed, the initiatives taken by each action plan for speed management include restricting the speed limit to 25 mph within the city area, installing automated speed detection cameras within the city areas, and implementing pop-up barriers for lane width reduction to control speed. The following sections discuss the actions for different plans from different areas.

A. Urban

Vision zero actions taken for the urban areas by the plans are discussed in the following segment.

A.1. Implement a “car-free” or “slow zones”

Car-free and slow zones can enhance traffic safety in areas with heavy pedestrian traffic and traffic volumes. Denver, Colorado, has effectively applied both treatments during the last few years.

Downtown Denver currently has car-free zones on Larimer Street, the 16th Street Mall, and streets surrounding parks. During school pick-up and drop-off, nearby streets become temporary slow zones (64). This measure has reduced the number of crashes in the city of Denver in the last few years.

B. Suburban

The following action item has been taken by the suburban vision zero plans for speed management.

B.1. Prioritize traffic signal timing on high-injury networks (HIN)

The plans suggested investigating the high-injury networks in the city or suburban region to prioritize the signal timing accordingly. The HINs are the segments or corridors where the injuries or crash fatalities are high in comparison to the other locations. Daly City has mentioned the necessary actions and guidelines for signal timing prioritization in the HIN in its action plan (88).

C. Urban/Suburban

The following action plans have been taken for the speed management programs in both urban and suburban areas.

C.1. 25 MPH speed limits

Reduced speed limits must be installed on highways where speed limits were previously higher in order to maintain safe speeds in some places. Various action plans have proposed varied speed limits for urban and suburban regions, but the most common speed limit is 25 mph, which has been implemented in Las Vegas, Berkeley, Portland, Boston, Seattle, and other places (65, 89, 90). The Seattle Vision Zero Action Plan has imposed a speed limit of 25 mph on several roadways, down from 35 mph. The analysis found that after implementing the 25-mph speed limit, the number of all crashes decreased by 35% and the number of injury crashes decreased by 21% (90). At the same time, speeding by high-end speeders (40 mph or more) has been reduced by 64% (90). It is worth mentioning that reducing speed limits is usually accompanied with other physical changes, such as lane width narrowing, addition of bike lanes, etc.

C.2. Automated speed detection cameras

Automated speed detection cameras were put at intersections and in the middle of route segments to measure speed. Over time, the enforcement approach has proven effective in lowering speed and reducing crashes caused by reckless driving. FHWA reported that stationary speed cameras can reduce up to 54% of all crashes and 48% of injury crashes on urban principal arterials. This approach was launched by the NYC Vision Zero Plan, which reveals that in 2014, there were half-million summonses issued by automated speed cameras; by 2022, the number had climbed to 6 million (63).

C.3. Pop-up barrier for lane width reduction to control speed

Using the bollard post or other temporary measures the speed of the vehicles can be controlled especially in the curve of the roads to reduce the chance of the vehicles going out of the lanes during turning. These techniques have been taken by the Atlanta Vision Zero plans (91).

2.2.5. Safe School Zones

Regarding maintaining the safety of the school zones, the vision zero action plans took multiple initiatives which include inserting additional pavement markings on school zones, allocating crossing guards at school zones, converting existing parking to drop off/pick up zones during school hours, and installing speed humps where necessary. These initiatives are discussed in the following section with the respective areas of the plan.

A. Urban

The following actions have been found in the Urban Vision Zero plans for safe school initiatives.

A.1. *Insert additional pavement markings on school zones*

Pavement markings for pedestrian crossings, parking facilities, speed control, yield, and stop signs are necessary at the school zones for maintaining the safety of the school children and the parents as well. The City of Tempe has focused on these markings in the Vision Zero plans (60). Some plans suggested the crosswalk be painted at a skewed angle which will make the pedestrians turn, making it easy to look at the vehicles coming towards them. Also, the Drive Slow marking in the pavements should be placed at least 200-500 feet before the start of the school zones.



Figure 11 Curb Extension with flashing beacons for the pedestrian crossing at School Zones (92)

B. Suburban

The following actions were taken for the suburban action plans for school safety.

B.1. *Allocate crossing guards at school zones*

Some suggestions recommended stationing school guards in school zones while students cross the street. Although there are no national guidelines for deciding which street crossings require a crossing guard, the Manual on Uniform Traffic Control Devices (MUTCD) provides broad advice on how to determine the need for a guard at a given location. One of them is the following: "Adult crossing guards may be used to provide gaps in traffic at school crossings where an engineering study has shown that adequate gaps need to be created, and where authorized by law" (57, 93).



Figure 12 Crossing guard assisting pedestrians to cross the street

B.2. Convert existing parking to drop off/pick up zones during school hours

If during school hours a sudden surge of vehicles comes in the school zones for drop off or pick up, the existing parking areas could be converted to drop off/pick up zones (93). Implementing temporary street closures during student arrival and departure times can also enhance the safety and efficiency of school drop-off and pick-up. Temporary closures remove motor vehicles in congested areas with pedestrians and bicycles. A comparable strategy is to make a street one-way during arrival and departure times. This strategy requires supportive regulatory actions and road signs.

2.2.6. Engagement

Participation of the community and the society's engagement in implementing the safety programs taken by the action plans is also important to consider. In this regard, the plans have considered the engagement of the people by educating them, organizing different events, and providing training for the commuters. The urban and suburban engagement are discussed in the next section.

A. Urban

Urban areas have the following actions for engaging people for different purposes.

A.1. Educate commuters through training

Various seminars and functions have been organized by the authorities to make the local people educated about the safety rules of different measures including such training programs as pedestrian safety, bicycle safety, defensive driving, traffic rules, etc. Cleveland City Vision Zero Plan has organized multiple events and in-person community engagements to survey the locals about their concerns for the safety of their families and neighbors. From the survey of 182 people, the following three



Figure 13 Community engagement event in Cleveland's Union-Miles neighborhood (94)

concerns were commented on by the people: speeding vehicles (23%), personal safety (14%), and distracted drivers (9%) (94).

B. Suburban

The following are the suburban actions taken by the plans for the engagement programs in the regions.

B.1. Make outreach programs available in all languages

As different people live in the same area with different ethnicities and races, the plans suggested making the outreach program available in all languages. It will help people who are not native English speakers to understand the rules and regulations. According to the statistics other ethnic populations are at risk of falling in a crash which makes these initiatives crucial.

2.2.7. Summary of the Action Items

To determine the most frequent initiatives for each cluster, a word cloud was prepared. Figure 14 depicts the generated word cloud. Bigger font sizes of the words indicated higher frequency of implementing the associated action. The word cloud shows that protected and dedicated bike lanes, pedestrian crossing beacons, 25mph speed limit inclusion, dedicated left turn phases, buffer lane inclusion, automated speed detection cameras and educate commuters through training are the most important and frequently taken actions by the reviewed VZ plans.

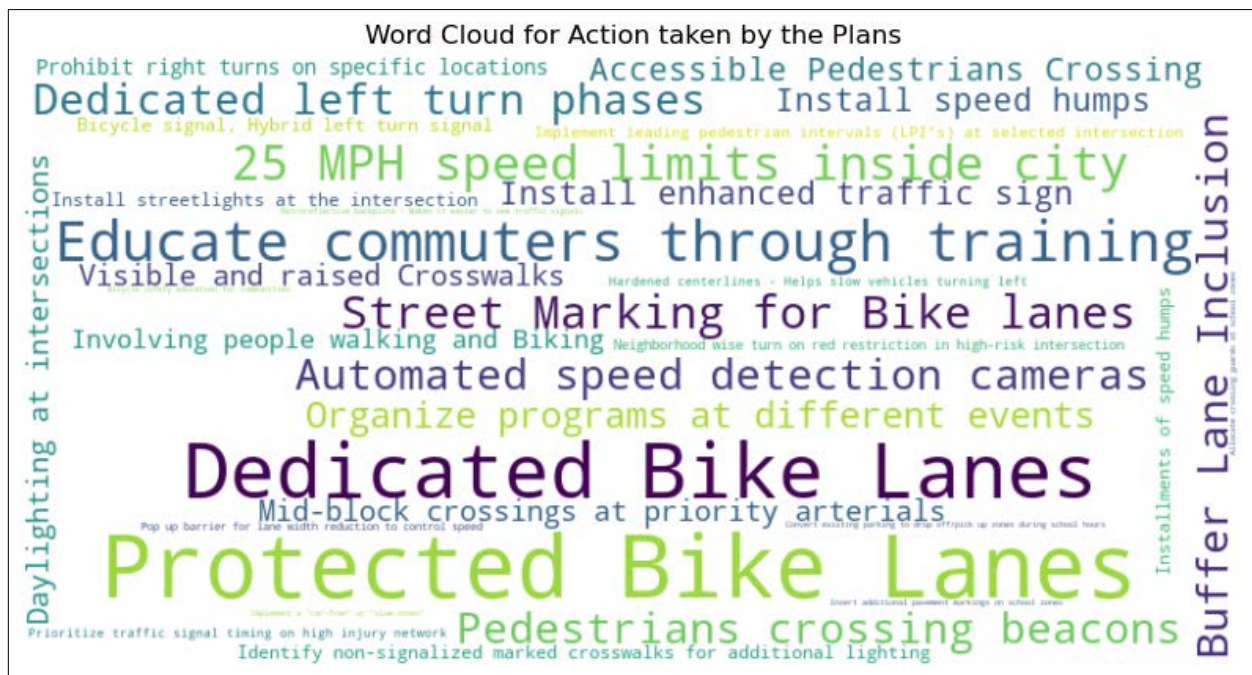


Figure 14 Word cloud for the action by the plans

Chapter 3: Practical Experience – Interviews with MPO Officials

This chapter investigates the lessons learned from prior experiences related to adopting technologies for transportation safety by performing the interviewing approach. Researchers utilized this approach to gain in-depth learning regarding an expert's experience, expertise, and co-produced insights related to an identified study topic. An in-depth interview is an active conversation between a researcher and an expert, which focuses on the expert's experience detailed in the interview (95).

Interviewing is identified as an indispensable tool for qualitative data acquirement and research. It enables informants to articulate their thoughts and experiences using their own words (96). The literature categorized interviews into three main types: structured (fixed questions format and script), semi-structured (identified key topics to focus on and flexible questions), and unstructured interviews (general topic), which could be performed on either a one-to-one or one-to-many basis (97). A semi-structured interviewing approach was followed. Interview questions were structured to cover two focus topics: transportation safety challenges in suburban areas, and technologies to enhance transportation safety. Appendix A includes the interview questions.

The participating metropolitan planning organizations (MPOs) were recruited based on a predefined criterion (matching the study area's MPO size), and the sampling method was mixed between judgment (MPOs that match the study area in size) and convenience (in total, 14 MPOs were defined and only 10 interviewed).

The interview design facilitated the interviewees to reflect on the questions and share information that otherwise would have been missed. Participants were allowed to digress and ask probing questions, which enabled discussions of exemplary cases and issues. This mode achieved a clearer and more detailed response from the participants. The interviews were conducted on a one-to-one basis via the online platform Microsoft Teams with an average duration of approximately one hour. The dialogues were audio-recorded and transcribed verbatim. Thereafter, the transcripts were summarized based on the six defined topics, which exemplified the multiple levels, facets, and angles to unveil thematic conclusions and lessons relevant to the identified goals of the interviews. These topics included safety challenges in suburban areas, safety assessment methods and metrics, safety programs and initiatives, technology emergence, challenges in technologies implementation and incorporation, and stakeholders and public engagement.

3.1. Summary of the Interviews

The summary of the interviews is discussed based on the six focus topics identified from the interviews. The major findings that emerged from the qualitative data on each topic are reported herein.

3.1.1. Safety Challenges in Suburban Areas

Transportation safety in suburban areas presents a complex landscape defined by several interconnected challenges. Interviewees highlighted several key factors contributing to safety concerns. Firstly, the prevailing reliance on automobiles coupled with expansive roadway designs tailored to accommodate high volumes of vehicular traffic exacerbates safety risks. Such designs, particularly prevalent in suburban regions, often encourage speeding, leading to an increased incidence of run-off-road crashes. Compounding these issues are longer crossing distances and

hazardous pathways, discouraging alternative modes of transportation like walking or biking for short commutes.

Moreover, the institutional framework governing transportation safety in suburban areas adds another layer of complexity. Insufficient staffing within agencies impedes the effective management of safety programs, while funding constraints further limit the implementation of mitigation measures. The jurisdictional intricacies between various agencies contribute to coordination challenges, impacting the cohesive implementation of safety initiatives. Notably, disparities in priorities between local and state levels, influenced by factors such as differing land use patterns and variations in mobility needs, underscore the need for tailored approaches to address safety concerns in suburban contexts.

Overall, suburban areas face unique safety challenges shaped by a combination of roadway design, institutional complexities, and funding limitations. While infrastructure predominantly caters to automobiles, limited provisions for alternative modes of transportation exacerbate safety risks, particularly for pedestrians and cyclists.

3.1.2. Safety Assessment Methods and Metrics

Interviews shed light on the methodologies and key metrics utilized in transportation safety assessments, revealing a complex approach aimed at addressing diverse safety challenges. Central to these assessments is the adoption of the Safe System Approach, emphasizing components such as safe speeds and road design to mitigate safety risks effectively. Collaboration between MPOs, local, and state-level entities emerge as a pivotal strategy, enabling a comprehensive examination of safety concerns and facilitating targeted interventions, including the identification of crash hotspots.

The integration of safety considerations into regional transportation planning was highlighted as another approach for safety assessment. Initiatives such as the prioritization of bicycle and pedestrian traffic within Regional Transportation Plans underscore a concerted effort to enhance safety for vulnerable road users. The implementation of programs like the Go Humane initiative in California further underscores a commitment to promoting active transportation while addressing disparities in access to resources among underserved communities. Key metrics encompass a range of factors, from the quantification of fatalities and serious injuries to the analysis of historical crash data, including geospatial distribution and roadway characteristics. Moreover, efforts to enhance crash data by incorporating additional layers of information and analyzing risk factors associated with specific roadways underscore a comprehensive approach to safety assessment aimed at prioritizing interventions in areas most affected by traffic crashes and underserved communities.

3.1.3. Safety Programs and Initiatives

The interviews highlighted a range of actions, programs, and initiatives implemented to enhance transportation safety and address identified safety challenges. Safety action plans emerged as a critical tool, incorporating detailed crash data analysis, policy reviews, and preventative strategies aimed at improving mobility for vulnerable road users. Leveraging proven safety countermeasures recommended by the Federal Highway Administration (FHWA), initiatives were designed to yield both short-term and long-term safety benefits for all users, reflecting a commitment to holistic safety improvement efforts.

One of the prominent challenges identified was the limited availability of pedestrian and bicycle movement data, hindering the ability to conduct comprehensive cost-benefit analyses and secure funding for these modes. In response, strategies were devised to improve road safety and enhance accessibility for vulnerable road users. This included infrastructure enhancements such as combining lanes, facilitating left turns, and increasing shoulder width to accommodate non-motorized transportation modes. Additionally, the integration of off-road systems with existing roadways aimed to provide secure commuting options for pedestrians and cyclists, while measures to manage access and implement road diet programs further contributed to creating safer transportation environments. Traffic calming measures were also emphasized, particularly in corridors where steady traffic flow was essential, highlighting an approach to address safety challenges.

3.1.4. Technology Emergence

The conducted interviews revealed that the integration of emerging technologies has become instrumental in addressing transportation safety challenges. A notable shift towards predictive analysis, as opposed to reactive crash data collection, signifies a future-oriented approach to safety management. Technologies enabling the capture of driver information alongside speed data were highlighted pivotal for enhancing safety measures, with integrated maps facilitating real-time communication with drivers regarding changing road conditions, such as narrowing lanes. The utilization of ITS signs, and connected vehicles underscores the importance of technological advancements in fostering safer transportation environments.

Innovations in engineering design, such as the increasing adoption of roundabouts in certain regions, reflect ongoing efforts to leverage technological solutions for enhanced safety outcomes. Adaptive signalization, driven by artificial intelligence or managed through traffic control centers, aims to optimize traffic patterns and maintain safe speeds, mitigating congestion and enhancing safety benefits. The potential of autonomous or connected vehicles for safer trip planning and operation on roadways is recognized, signaling phased advancements towards safer transportation systems. Furthermore, the deployment of video cameras to monitor high bike/pedestrian intersections, the use of drones for crash analysis, and the implementation of automated speed safety cameras underscore the diverse technological interventions aimed at improving transportation safety. The utilization of connected car and cell phone data, alongside the development of predictive models to identify crash hotspots, further exemplifies the integration of advanced technologies in proactively addressing safety challenges.

3.1.5. Challenges in Technologies Implementation and Incorporation

Implementing and incorporating technologies within current transportation systems poses several challenges, as highlighted by insights gathered from interviews. A significant hurdle identified is the consolidation of database dashboards onto a central Regional Data Platform, requiring the integration of multiple platforms. This process is compounded by the diverse mandates of different regions, necessitating considerations for various demographics to ensure inclusivity in technology deployment. Moreover, concerns regarding bias in training detection models for vehicles underscore the importance of equitable technological advancements that cater to inclusive user populations. Additionally, the market-driven approach currently prevalent in technology adoption may not always align with inclusive practices, highlighting the need for a more holistic approach to technology integration.

Practical considerations also emerge as critical challenges in the implementation of technologies within existing infrastructure. Safety concerns dictate that certain technologies cannot be operated under imperfect conditions, emphasizing the need for rigorous testing and pilot programs to ensure efficacy. Political and policy challenges further complicate the landscape, requiring alignment and cooperation across various stakeholders to navigate regulatory frameworks and facilitate the adoption of emerging technologies. Funding constraints and the accumulation of costs present additional hurdles, necessitating strategic planning and resource allocation to support technology integration efforts. Ultimately, the emphasis on the practical performance of technologies on roads, rather than solely focusing on market policies, underscores the importance of real-world applicability and effectiveness in addressing transportation safety challenges.

3.1.6. Stakeholders and Public Engagement

Engaging with stakeholders and the public emerges as a keystone of transportation safety initiatives, as revealed through insights collected from interviews. The establishment of the Regional Safety Task Force, comprising a diverse array of members from local and state agencies, consultants, stakeholders, nonprofits, activists, and academic institutions, serves as a pivotal platform for fostering collaboration and addressing community concerns. Through regular meetings and discussions, the Task Force facilitates dialogue on ongoing projects, community issues, and promotes cross-community collaboration to enhance transportation safety measures. Moreover, Comprehensive Transportation Plans, conducted every four to five years, play a vital role in identifying community needs, exploring funding options, and prioritizing safety initiatives, thereby ensuring alignment with public interests and priorities.

Various methods of public engagement were mentioned to solicit feedback and involve communities in safety actions. These include town halls, roundtables, surveys, and touch point events, aimed at gathering input from diverse stakeholders and fostering inclusive decision-making processes. Notably, efforts to design equitable engagement programs underscore a commitment to ensuring representation and participation from all segments of society. Additionally, innovative approaches such as utilizing exercise, games, and coloring books for children serve to make safety discussions more accessible and engaging for broader audiences. Decision-making processes are informed by community feedback, with careful consideration given to project prioritization, evaluation of public support, and strategies for engaging dissenting voices. Collaborative efforts with local and state agencies further enhance stakeholder engagement, with established working groups and regular meetings facilitating coordination on new technologies, strategies, and alignment with statewide targets, ensuring a unified approach towards achieving transportation safety objectives.

3.2. Takeaways and Lessons Learned

- Effective leadership plays a pivotal role in engaging with stakeholders and the public, ensuring that their concerns are heard and addressed. Strong leadership fosters trust and confidence, driving collective efforts towards achieving transportation safety goals.
- Alignment between different agencies, both at the local and state levels, is essential for coordinating efforts and implementing cohesive safety measures. Ensuring alignment minimizes duplication of efforts and maximizes resources for effective safety improvements.

- Balancing needs between accommodating high-speed, high-volume roads and local roads is critical for ensuring safety and accessibility for all road users. This balance requires careful planning and design considerations tailored to the specific needs of each road type.
- Shifting the focus from vehicular traffic to the needs and behaviors of all people using the roads is essential for designing safer and more inclusive transportation systems. Understanding travel patterns and preferences informs decision-making and leads to more user-centric design solutions.
- Traditional benefit-cost analyses are supplemented by safety analyses to assess project impacts on roadway safety. This approach includes monetizing potential lives saved or lost, providing a more comprehensive evaluation of project effectiveness.
- Prioritizing pedestrian and cyclist-friendly design elements, such as pedestrian cut-throughs and fully separated paths, enhances safety and promotes active transportation in suburban environments.
- Safer roadway design elements, including medians and road diets, improve safety for all road users by reducing conflict points and managing traffic speeds.
- Enhancing access management in suburban shopping centers improves safety and traffic flow, creating more efficient and secure environments for both motorists and pedestrians.
- Ongoing engagement and coordination with local communities are essential for identifying and implementing feasible safety improvements that address local needs and concerns.
- Conducting outreach and coordination efforts with agencies at the local and state levels facilitates collaboration and ensures that safety initiatives are effectively implemented across jurisdictions.
- Prioritizing outreach and safety measures for vulnerable communities ensures that transportation safety efforts are inclusive and equitable, addressing the specific needs of these populations.

Chapter 4: Safety Assessment in the Study Area

4.1. Safety Assessment Template

The development of the safety assessment template for the study area was conducted in several phases to ensure a comprehensive evaluation of transportation safety conditions across the five suburban counties. The template serves as a structured tool for assessing safety concerns, identifying high-risk locations, and evaluating existing safety programs within the study area.

4.1.1. Socio-Economic, Demographic and Safety Data – Inventory and Analysis

The data collection process involved compiling both socio-economic, demographic and safety (crash) data to identify potential correlations between traffic crashes and specific socio-demographic factors. This integrated approach allowed for a more comprehensive understanding of how socio-economic conditions might influence transportation safety in the five suburban counties of Nassau, Suffolk, Rockland, Westchester, and Putnam.

Socio-economic factors play a significant role in shaping transportation safety outcomes, influencing both the behavior of road users and the infrastructure available to support them. By overlaying traffic crash hot spots with key socio-economic indicators such as income levels, vehicle ownership, social vulnerability index, and ethnicity, we aimed to uncover patterns and correlations that might point to inequities in transportation safety. These insights allow for more targeted and informed interventions, ensuring that safety improvements are not only data-driven but also address the needs of vulnerable and underserved populations. The following sections discuss the importance of each of these socio-economic factors and their potential impact on traffic safety in the study area.

- *Income Levels:* Income levels are a crucial socio-economic indicator when analyzing transportation safety. Lower-income communities may face increased risk for traffic-related incidents due to a variety of factors, such as fewer resources for road safety improvements and infrastructure, lower vehicle ownership rates leading to higher rates of pedestrian and bicycle travel, and older or less safe vehicles in use. By overlaying crash data with income data, the analysis can help identify whether lower-income areas correlate with higher crash frequencies and more severe crashes. This allows for targeted safety interventions in communities where economic disadvantages may be influencing traffic safety outcomes.
- *Vehicle Ownership:* The rate of vehicle ownership directly influences the mode of transportation that individuals in a community rely on, which in turn impacts transportation safety. In areas with lower vehicle ownership, residents may be more likely to walk, bike, or use public transportation, making them vulnerable road users. Conversely, high vehicle ownership may contribute to higher traffic volumes and congestion, leading to an increased risk of vehicle collisions. By comparing vehicle ownership data with crash hot spots, the study can assess whether areas with lower vehicle ownership experience more crashes involving pedestrians or bicyclists, or whether areas with higher vehicle ownership see more vehicle-to-vehicle collisions. This analysis helps in understanding the relationship between vehicle access and safety outcomes.
- *Social Vulnerability Index (SVI):* The Social Vulnerability Index (SVI) is a metric that captures a community's ability to respond to and recover from adverse events, such as natural disasters or economic challenges, including traffic incidents. Communities with high social vulnerability may face challenges such as limited access to healthcare, lower education levels,

and higher poverty rates, all of which can affect transportation safety. By overlaying crash data with the SVI, the analysis can identify whether socially vulnerable populations are disproportionately impacted by traffic crashes. This can inform equitable transportation safety policies that prioritize interventions in areas where residents are not only at higher risk for traffic crashes but may also lack the resources to recover from such incidents.

- *Ethnicity*: Ethnicity plays an important role in transportation equity and safety, as certain ethnic groups may face greater risks in traffic environments due to systemic inequalities in infrastructure, enforcement, and access to safety resources. Minority populations may live in areas with less investment in pedestrian and cycling infrastructure, increasing their vulnerability as non-motorized road users. Additionally, cultural factors and language barriers may affect road safety behaviors and access to safety education. By overlaying crash data with ethnic demographic information, the analysis can highlight whether certain ethnic groups are disproportionately represented in traffic crashes, which can help inform more inclusive safety policies and targeted interventions in these communities.

Simultaneously, historical crash data was collected from the Clear database, an online platform managed and owned by the New York State Department of Transportation (NYSDOT). This database provided comprehensive data on crash frequency, severity, types, and contributing factors, forming the basis for identifying high-risk areas in the study. The crash data was then analyzed using ArcGIS Pro, starting with hot spot analysis to identify high-crash locations across the five counties. Following the hot spot analysis, crash rates were calculated to account for exposure differences, providing a clearer picture of areas with elevated risks relative to the population or road usage.

Hot spot analysis is a spatial statistical method used to identify areas with a concentration of events—in this case, traffic crashes—over a given geographical area. This technique is crucial for pinpointing specific locations where crashes occur at significantly higher rates compared to surrounding areas. By using ArcGIS Pro, we applied hot spot analysis to the crash data across the five counties (Nassau, Suffolk, Rockland, Westchester, and Putnam). The importance of hot spot analysis lies in its ability to visually and statistically highlight areas that experience a disproportionate share of crashes. These areas can then be targeted for deeper investigation to understand the underlying causes of higher crash frequencies. This may involve looking at road design issues, traffic volumes, or local behavioral patterns. In our study, hot spot analysis was used to inform the subsequent stages of the safety assessment, such as identifying priority locations for safety interventions and overlaying socio-economic data to assess potential correlations with socio-demographic factors.

Crash rate analysis provides a more detailed and accurate measure of crash risk by considering exposure factors such as traffic volume and road length. Rather than focusing solely on the total number of crashes, crash rate analysis adjusts for how much traffic an area sees or how long road segments are, giving a clearer picture of the risk in different locations. This is especially important in large areas like our five-county study area (Nassau, Suffolk, Rockland, Westchester, and Putnam), where traffic volumes and road infrastructure vary significantly.

In this study, the crash rate was calculated for each census tract using the following equation:

$$R_{Tract} = \frac{C_{Tract} * 100,000,000}{\sum_{j=1}^r \sum_{i=1}^n L_i * V_{ij} * 365}$$

Where:

R_{Tract} = Crash rate for census tract (crashes per 100 million vehicle-miles of travel)

C_{Tract} = Total number of crashes in the census tract

n = Number of road segments in the census tract

i = the i_{th} segment

r = number of years

j = the j_{th} year

L_i = Length of the i_{th} segment (mile)

V_{ij} = Traffic volume of the i_{th} segment at the j_{th} year

This formula adjusts the total number of crashes by the length of the road segments and the traffic volume, ultimately calculating the number of crashes per 100 million vehicle-miles of travel. By accounting for these variables, crash rate analysis helps reveal areas where crashes may be disproportionately high in relation to road use, even if the total number of crashes is not the highest.

The calculated crash rates were crucial in identifying census tracts with a higher risk of crashes relative to the volume of traffic and the size of the road network. These tracts were then prioritized for further investigation and safety interventions. Combined with the hot spot analysis and socio-economic data overlays, the crash rate analysis provided a comprehensive understanding of where safety improvements were most urgently needed in the study area.

The next step was to overlay the crash data onto selected socio-demographic factors, creating layered maps that revealed any spatial correlations between crash hot spots and specific socio-economic variables. By layering crash data over factors such as population density, income levels, and age distribution, patterns emerged that highlighted potential associations between socio-demographic characteristics and areas with high crash rates. This geospatial analysis provided valuable insights into how socio-economic conditions might influence transportation safety, helping to identify priority areas for intervention.

This integrated mapping approach enabled the study team to visually and analytically explore the relationship between socio-economic factors and traffic safety, offering a powerful tool for understanding risk distribution across the study area.

To effectively visualize and communicate the findings of the socio-economic and crash data analysis, a series of maps were created using ArcGIS Pro. These maps serve as a critical tool in identifying and understanding the spatial relationships between traffic crashes and socio-demographic factors in the five suburban counties. Each map presents a different layer of the analysis, from crash hot spots to crash rates, and overlays these findings with relevant socio-economic data. The visual representation of this data allows for a clearer understanding of high-risk areas and how specific demographic factors may correlate with increased crash incidences, providing a comprehensive picture of transportation safety across the region.

Below is a series of maps detailing the results of this analysis:

A. Nassau County

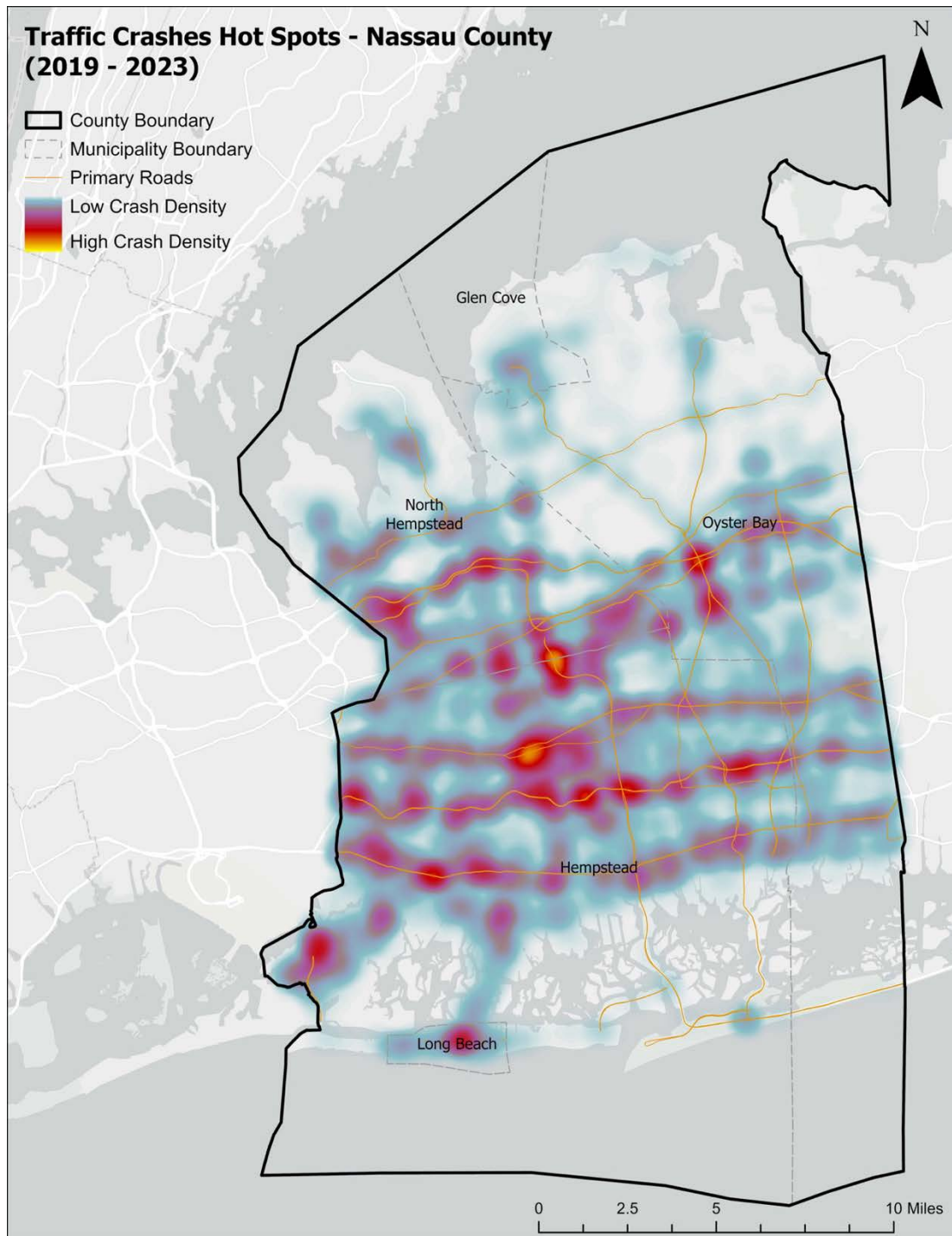


Figure 15 Traffic Crashes Hot Spots - Nassau County (2019 - 2023)

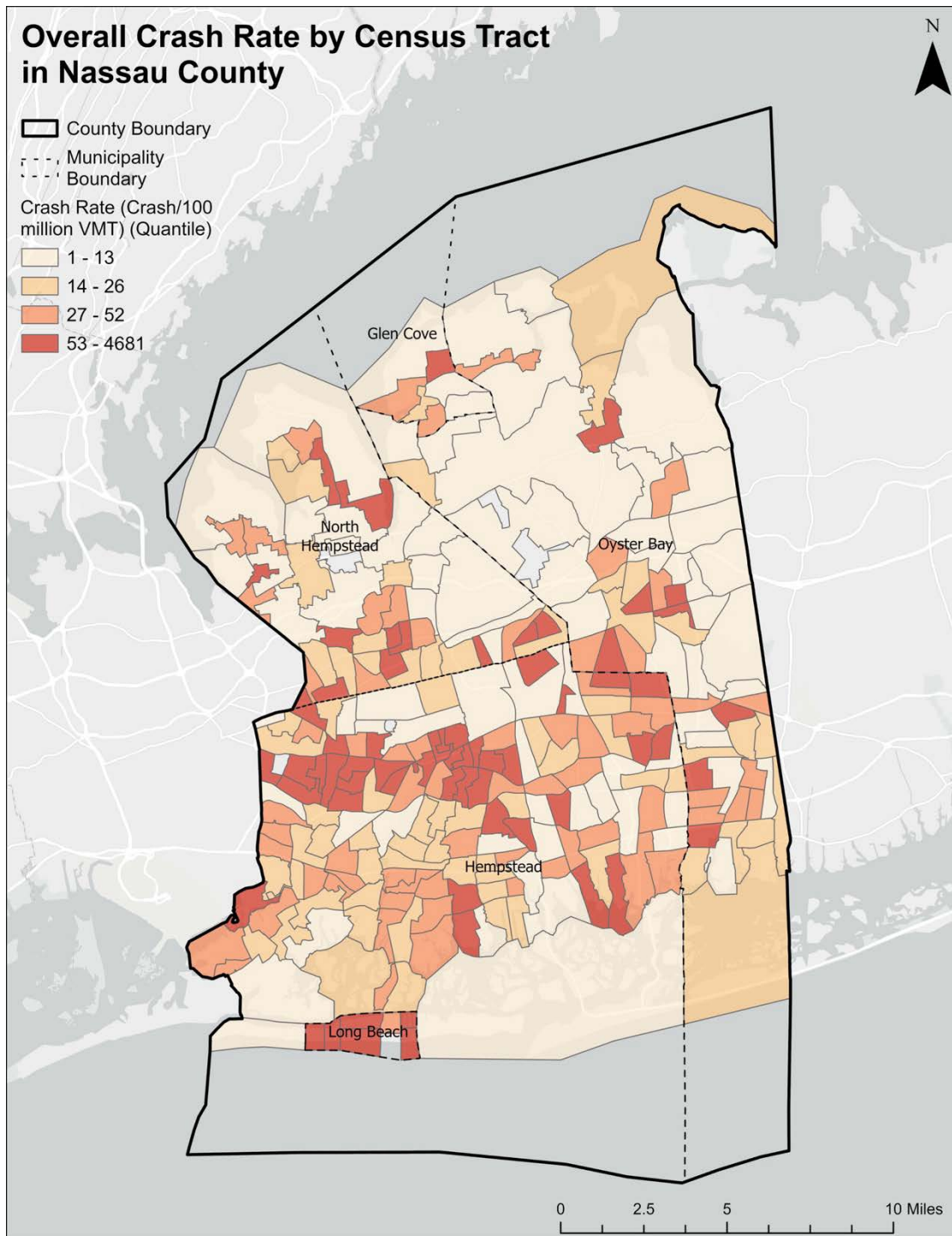


Figure 16 Overall Crash Rate by Census Tract in Nassau County

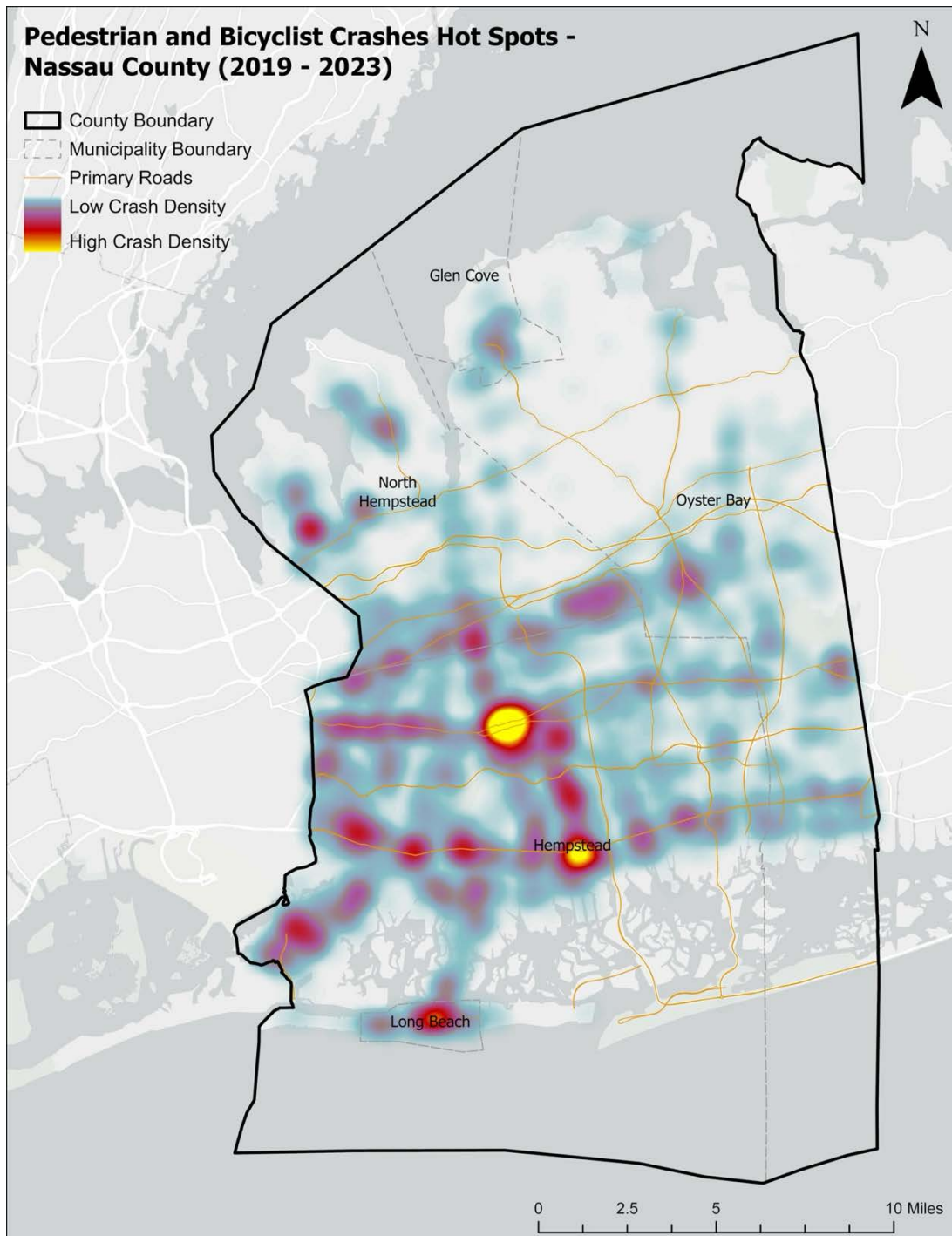


Figure 17 Pedestrian and Bicyclist Crashes Hot Spots - Nassau County (2019 - 2023)

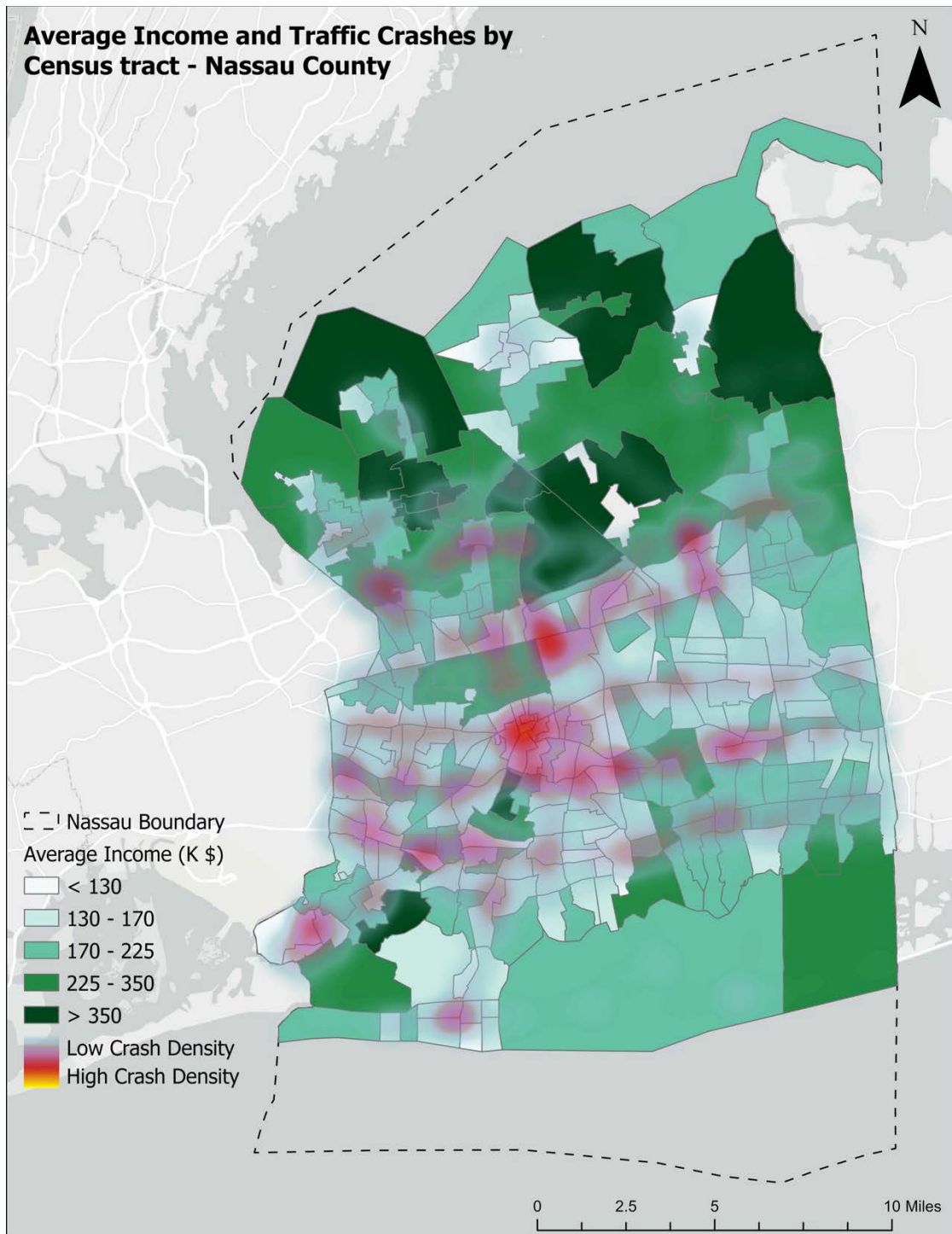


Figure 18 Average Income and Traffic Crashes by Census Tract in Nassau County

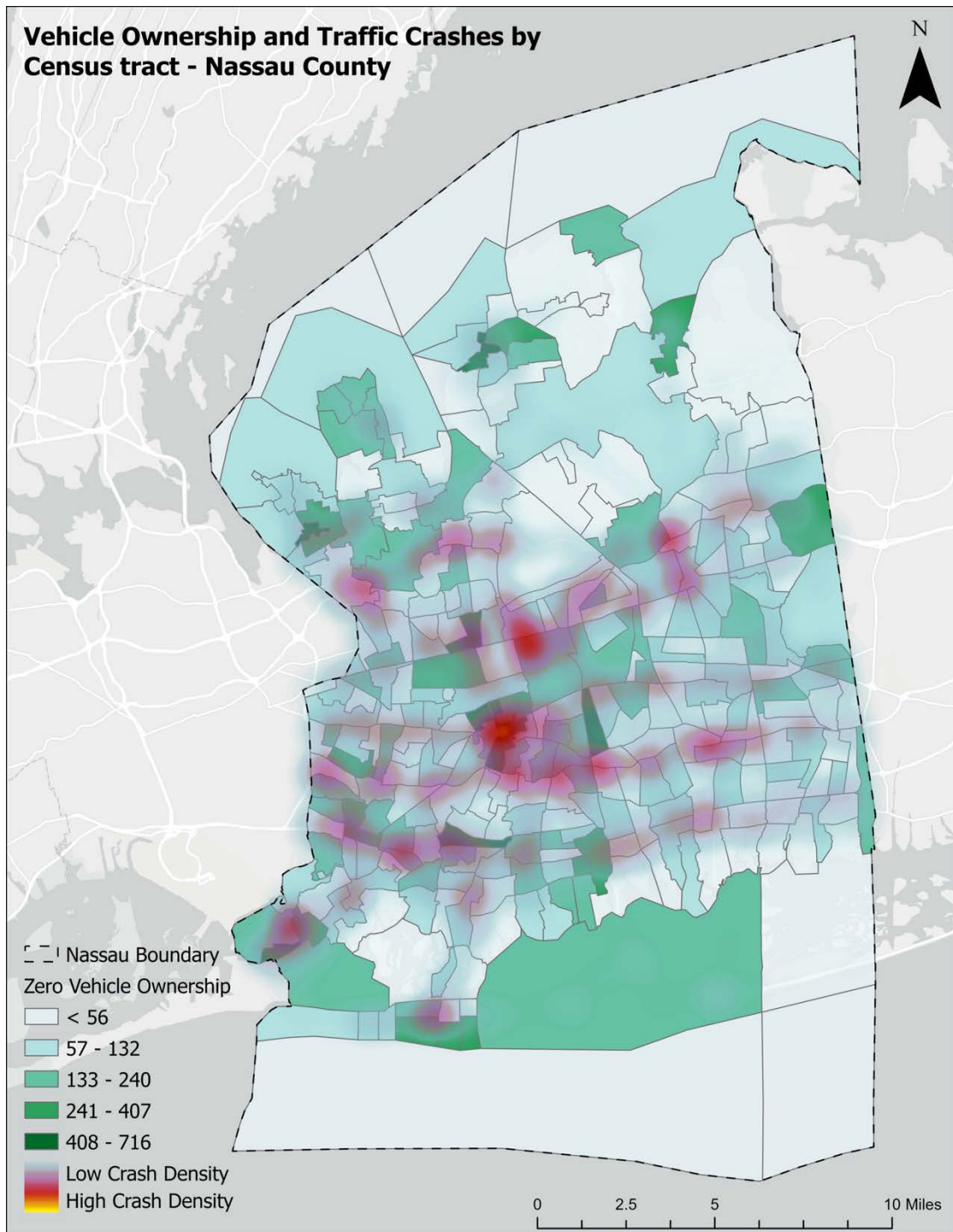


Figure 19 Vehicle Ownership and Traffic Crashes by Census Tract in Nassau County

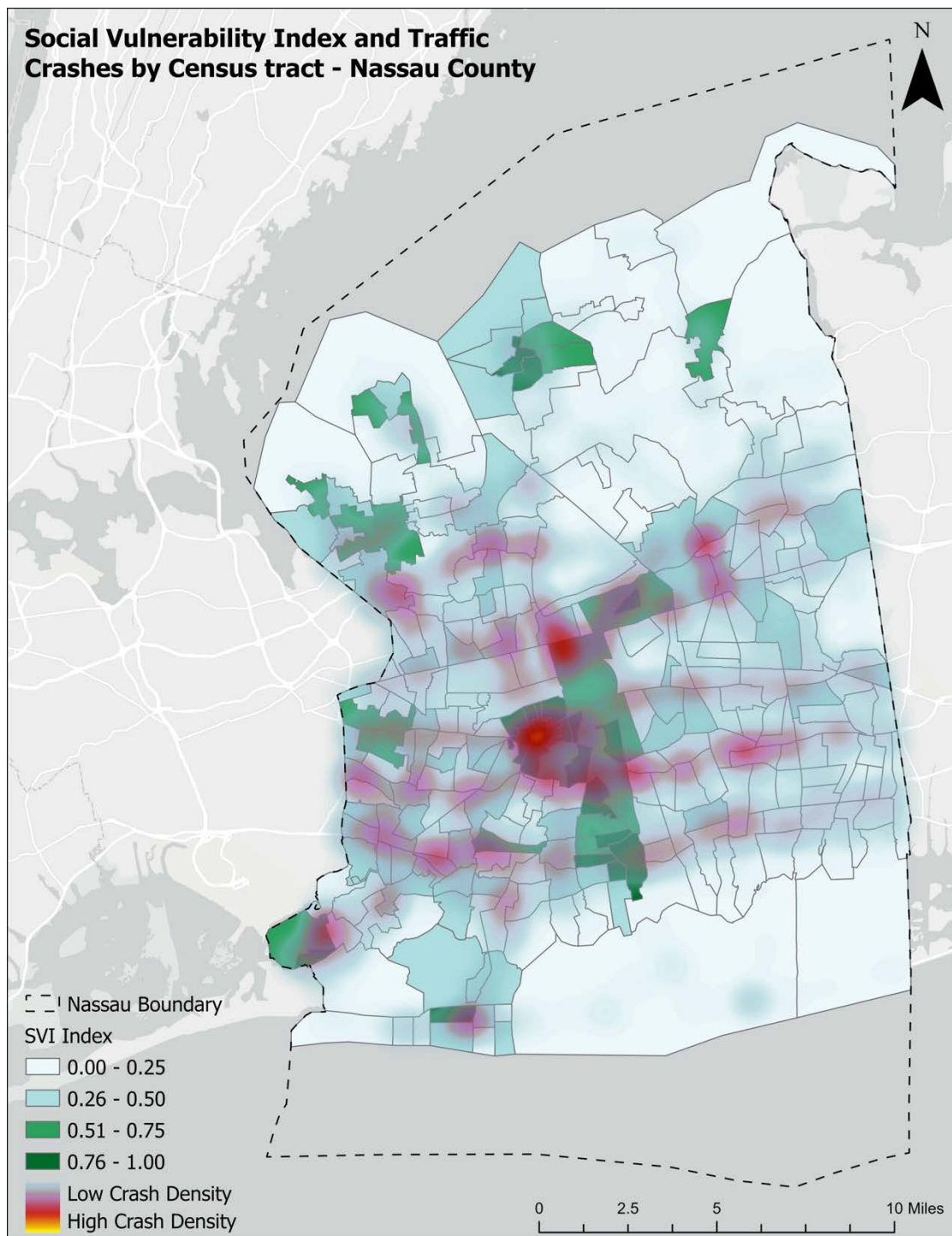


Figure 20 Social Vulnerability Index and Traffic Crashes by Census Tract in Nassau County

B. Suffolk County

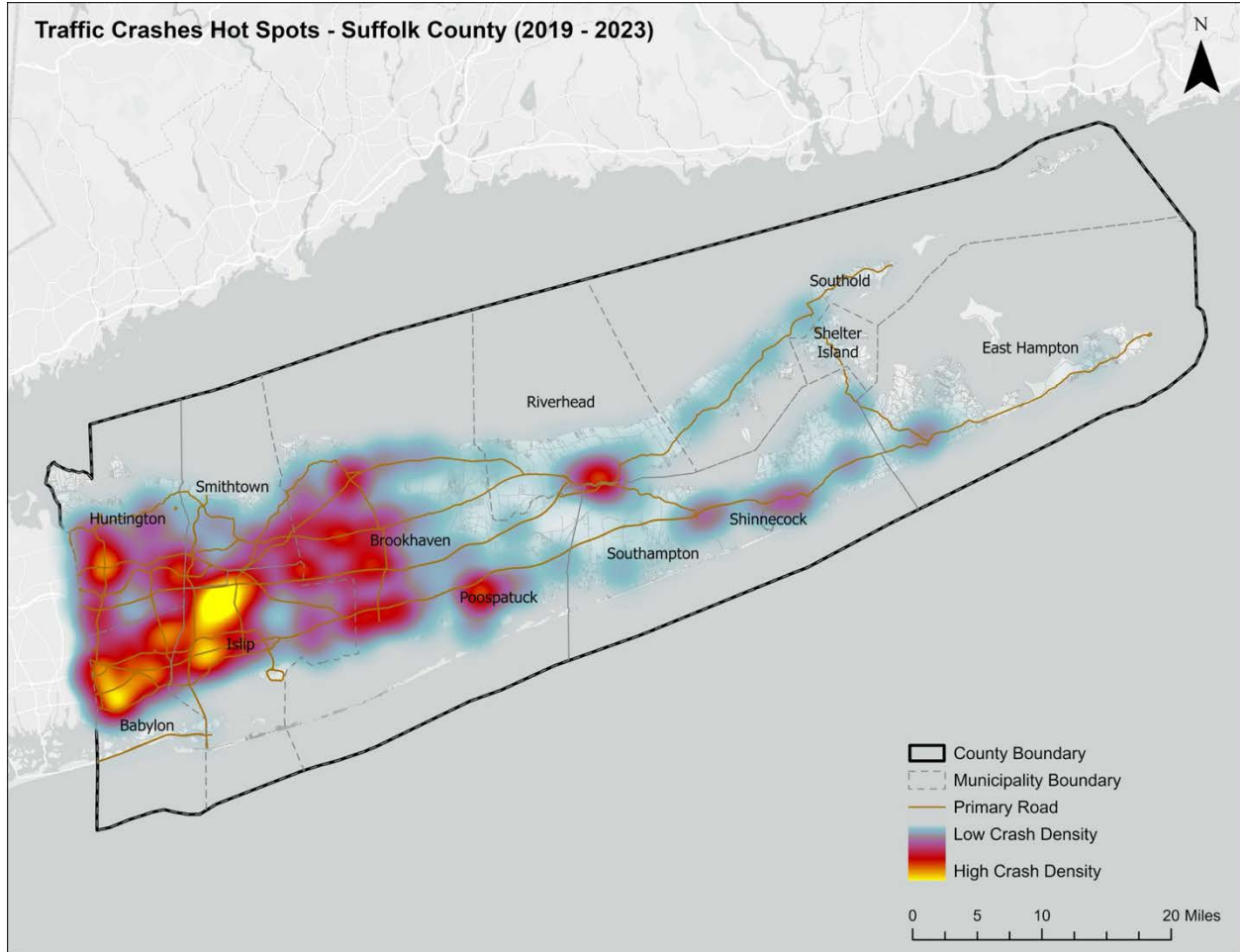


Figure 21 Traffic Crashes Hot Spots in Suffolk County (2019 - 2023)

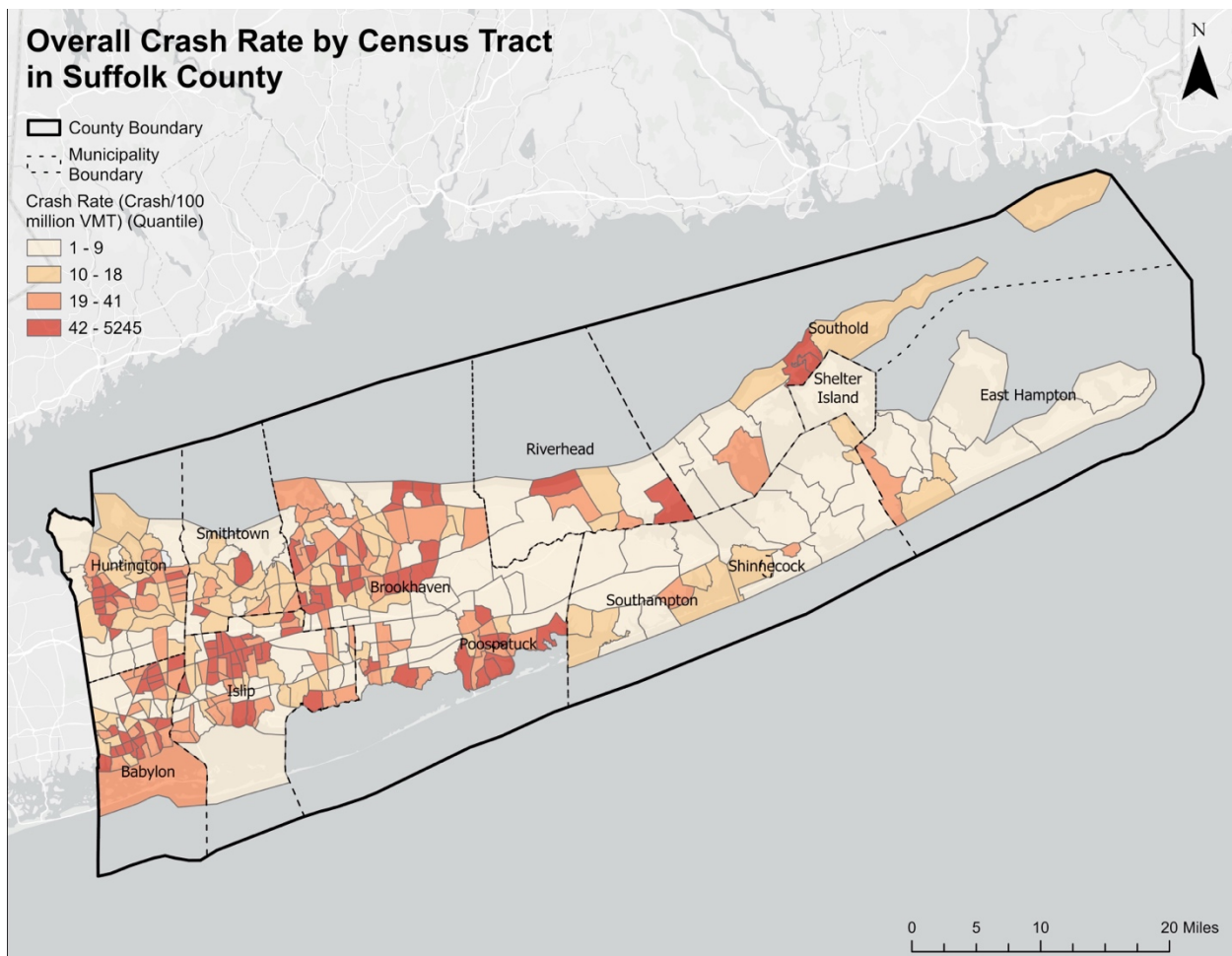


Figure 22 Overall Crash Rate by Census Tract in Suffolk County

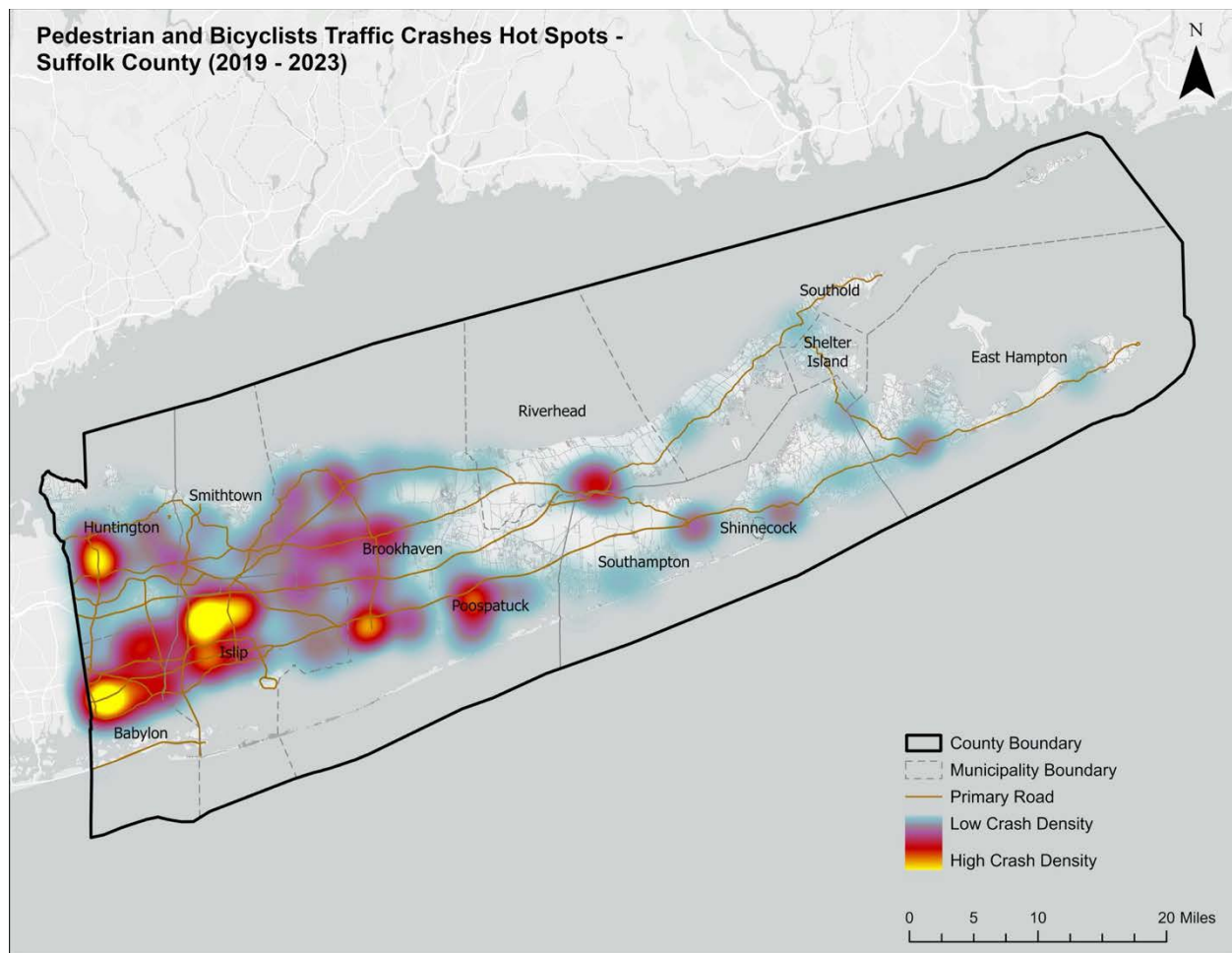


Figure 23 Pedestrian and Bicyclists Traffic Crashes Hot Spots in Suffolk County (2019 - 2023)

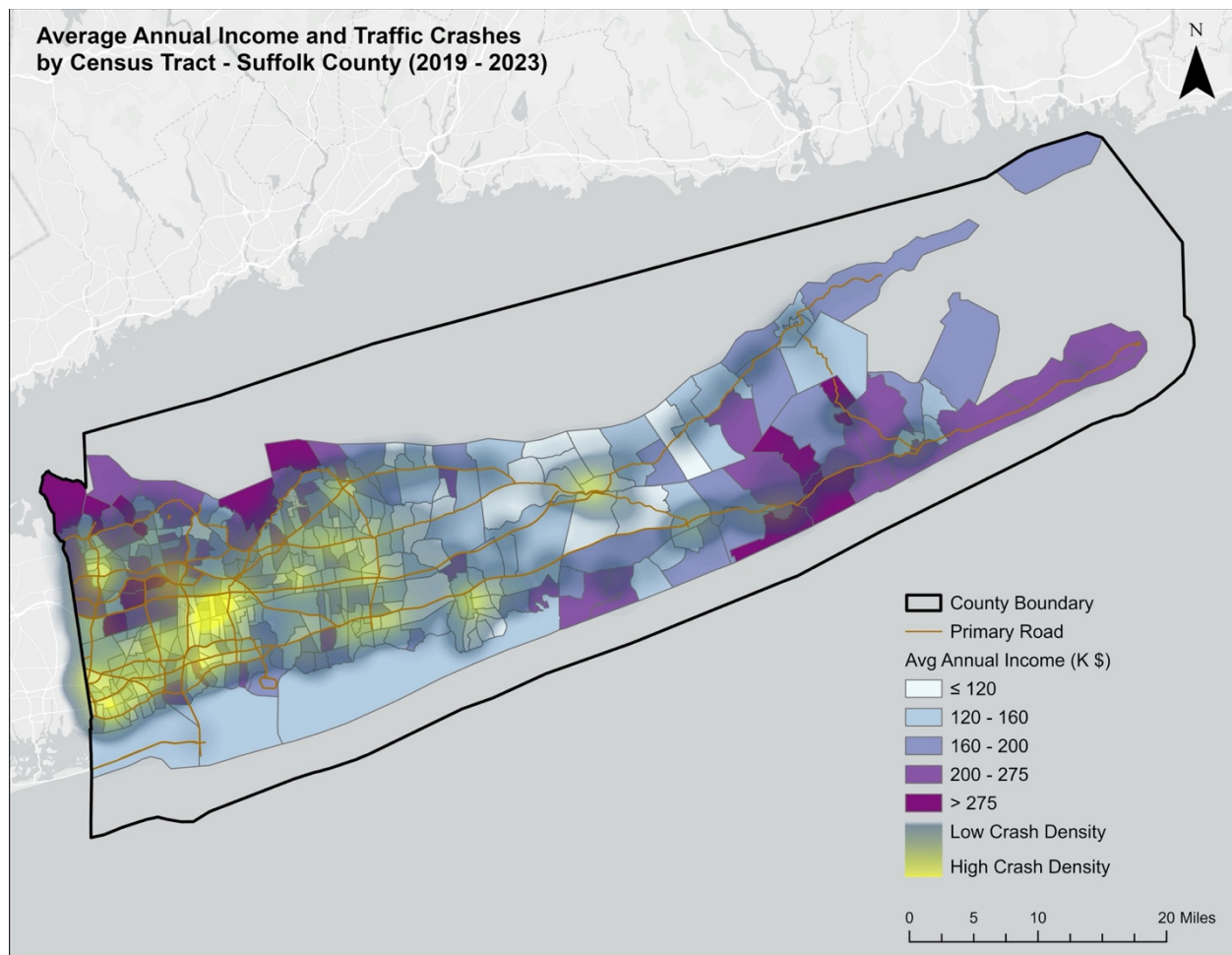


Figure 24 Average Annual Income and Traffic Crashes by Census Tract in Suffolk County (2019 - 2023)

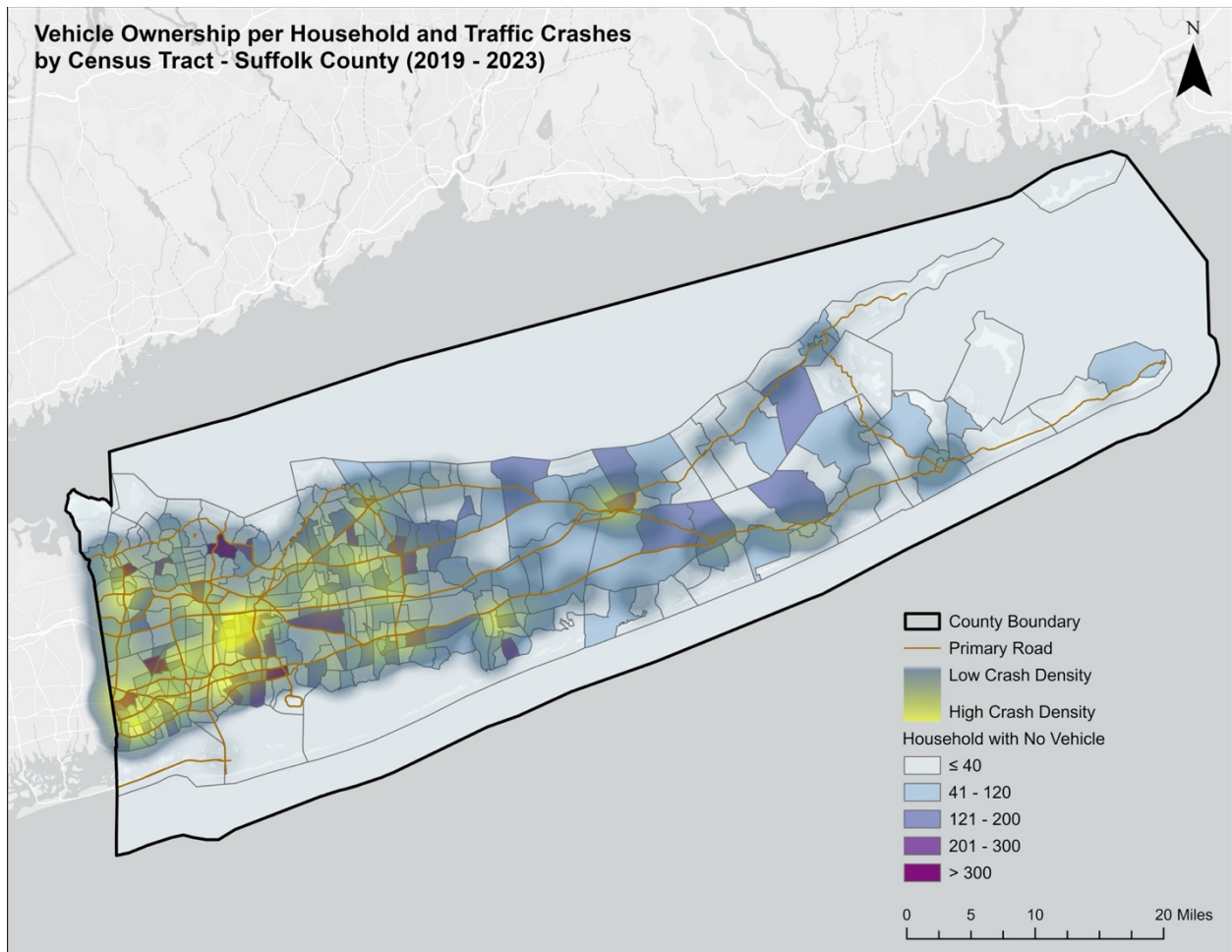


Figure 25 Vehicle Ownership per Household and Traffic Crashes by Census Tract in Suffolk County (2019 - 2023)

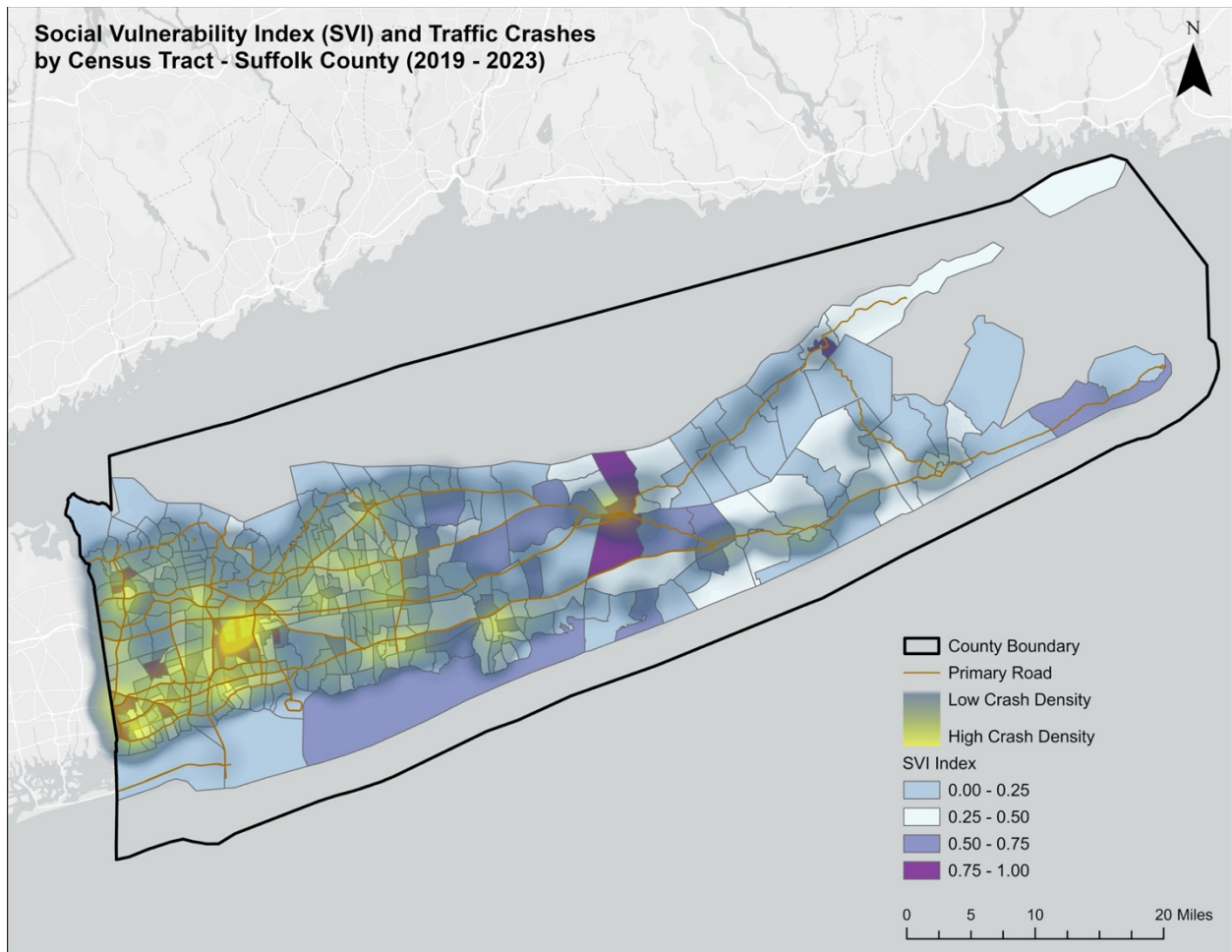


Figure 26 Social Vulnerability Index and Traffic Crashes by Census Tract in Suffolk County (2019 - 2023)

C. Putnam County

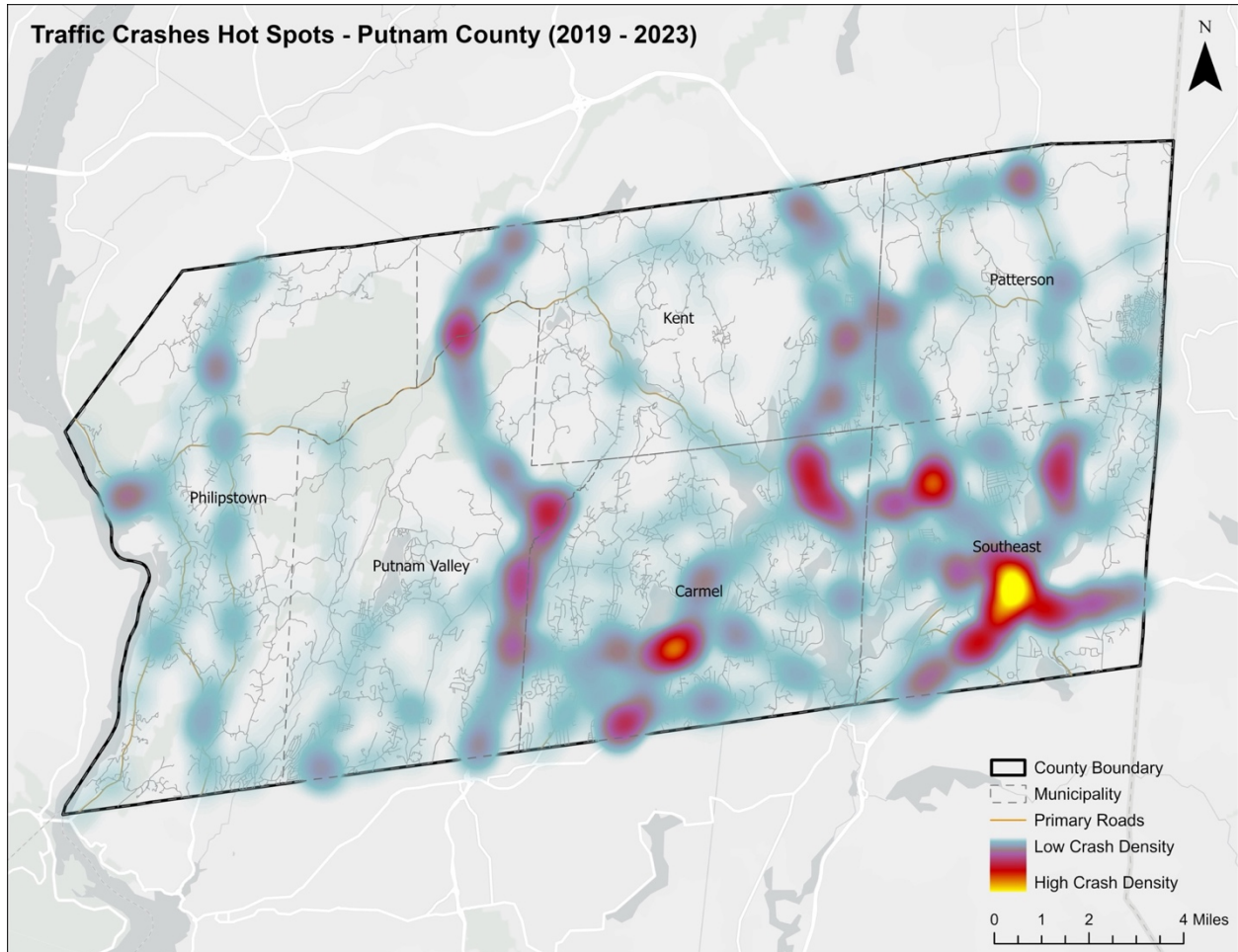


Figure 27 Traffic Crashes Hot Spots in Putnam County (2019 - 2023)

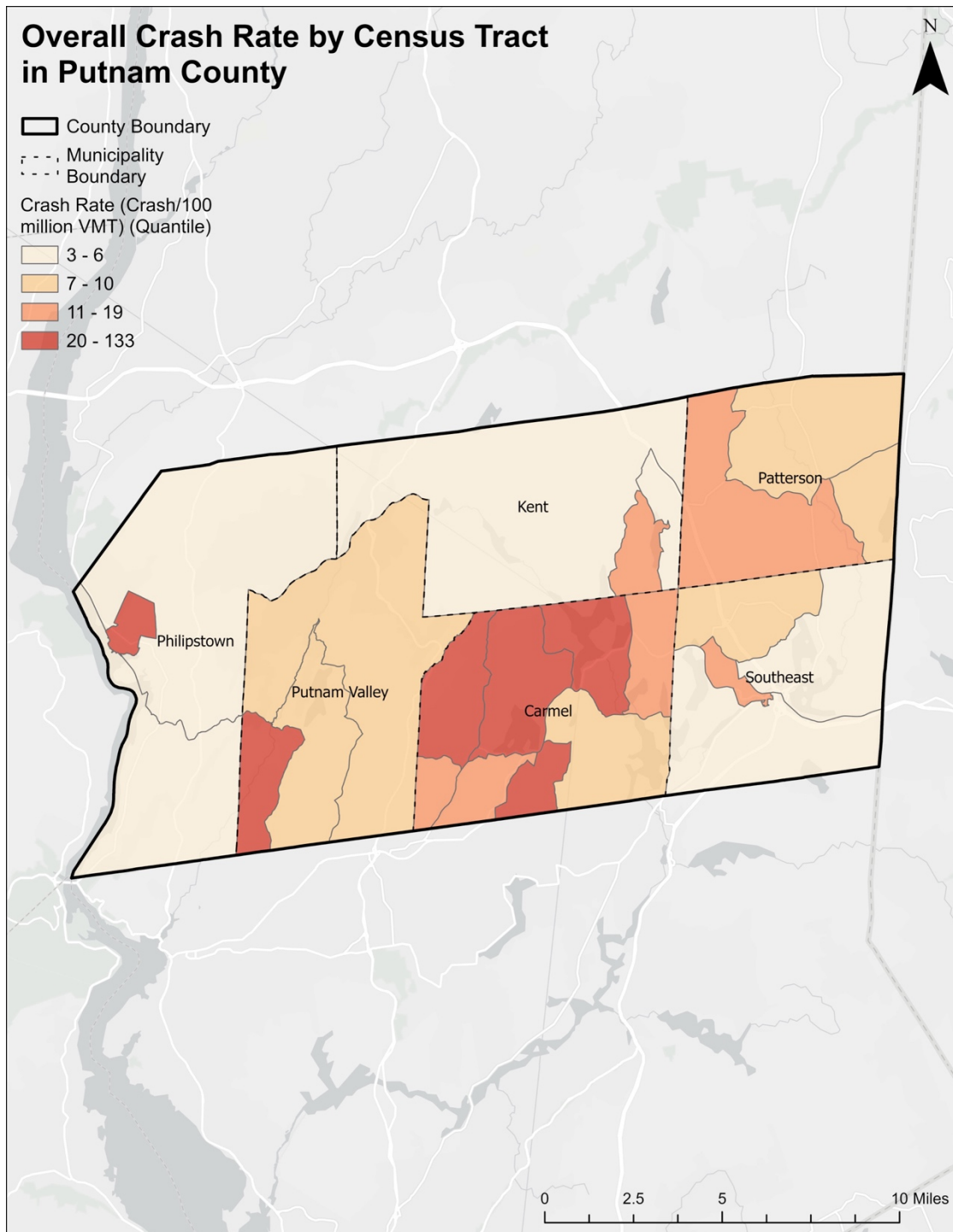


Figure 28 Overall Crash Rate by Census Tract in Putnam County

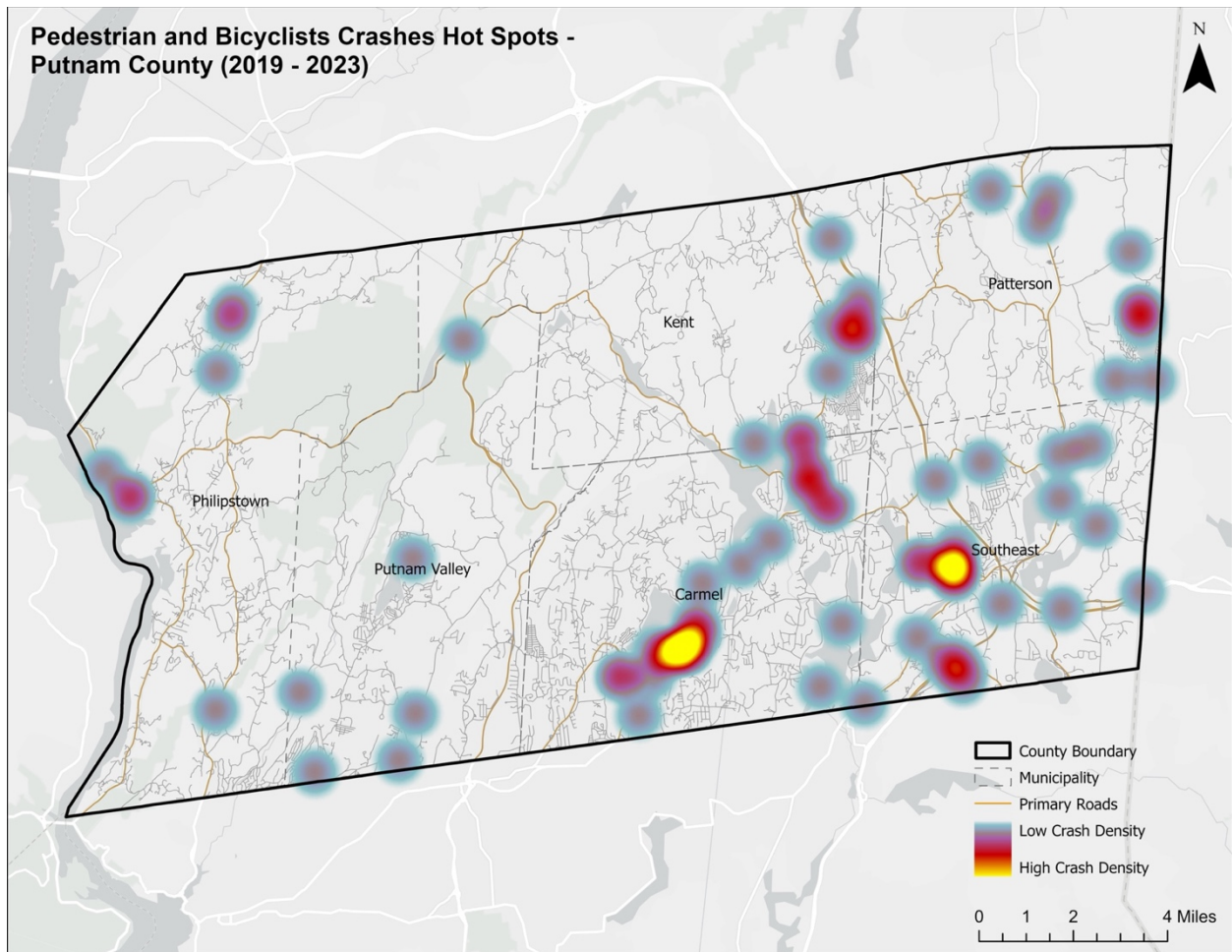


Figure 29 Pedestrian and Bicyclist Crashes Hot Spots in Putnam County (2019 - 2023)

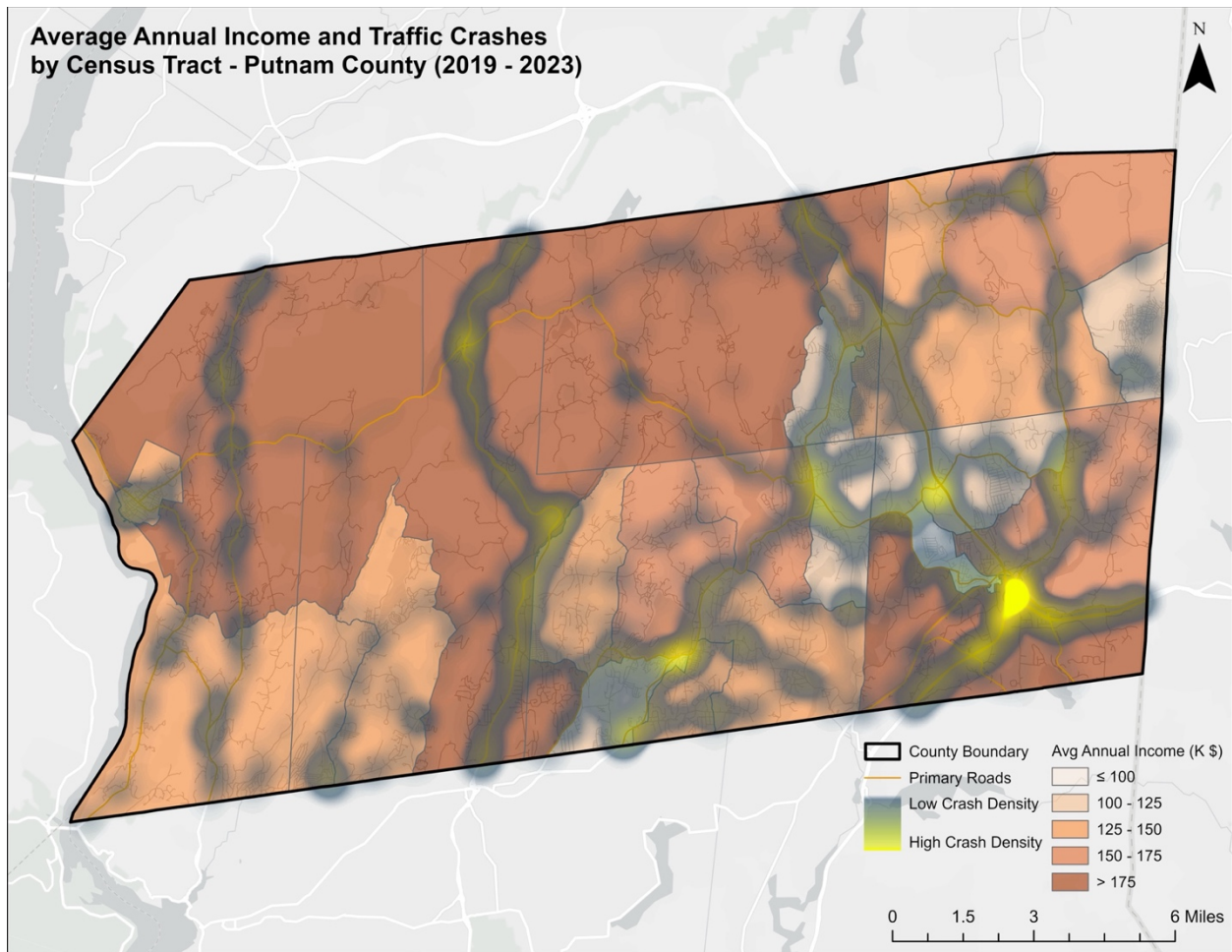


Figure 30 Average Annual Income and Traffic Crashes by Census Tract in Putnam County (2019 - 2023)

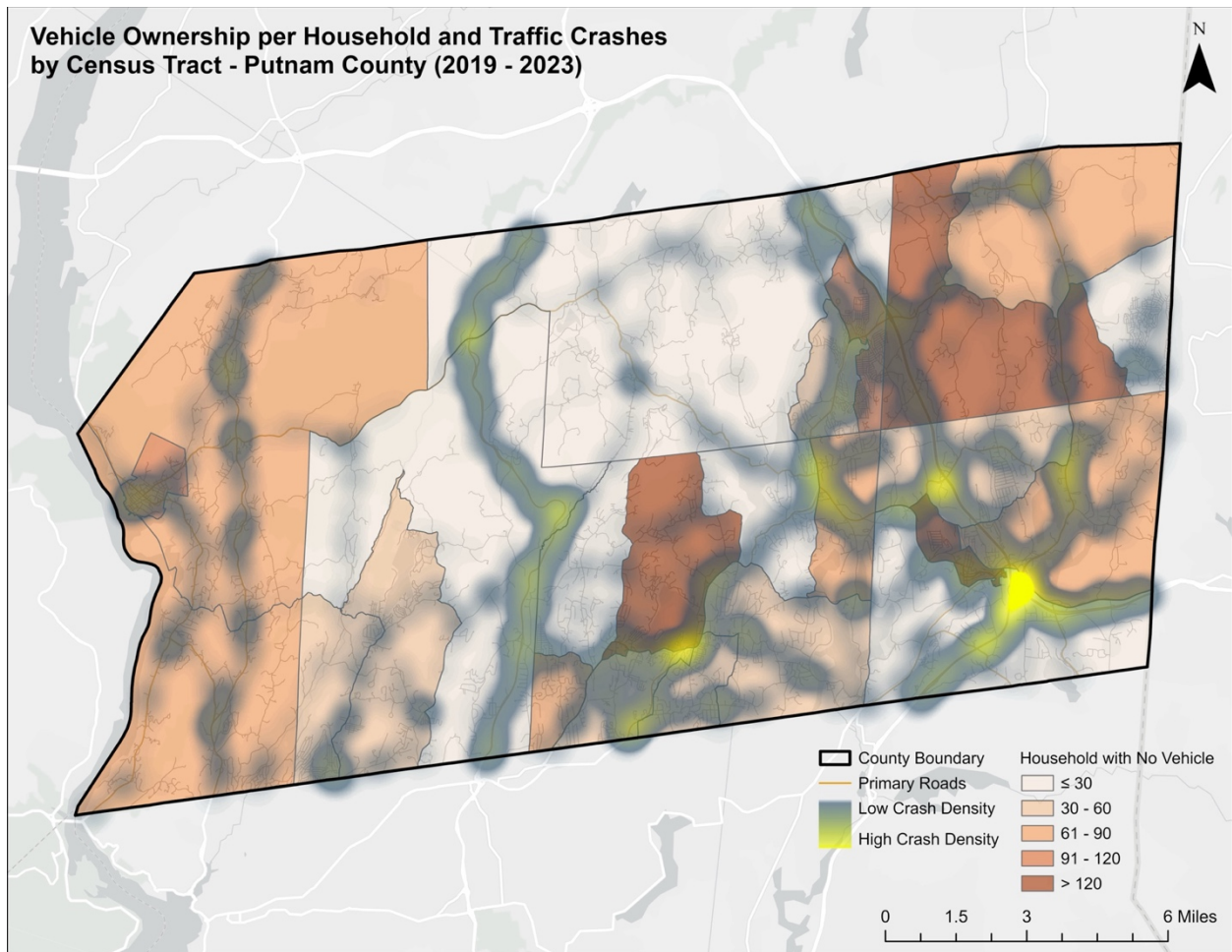


Figure 31 Vehicle Ownership per Household and Traffic Crashes by Census Tract in Putnam County (2019 - 2023)

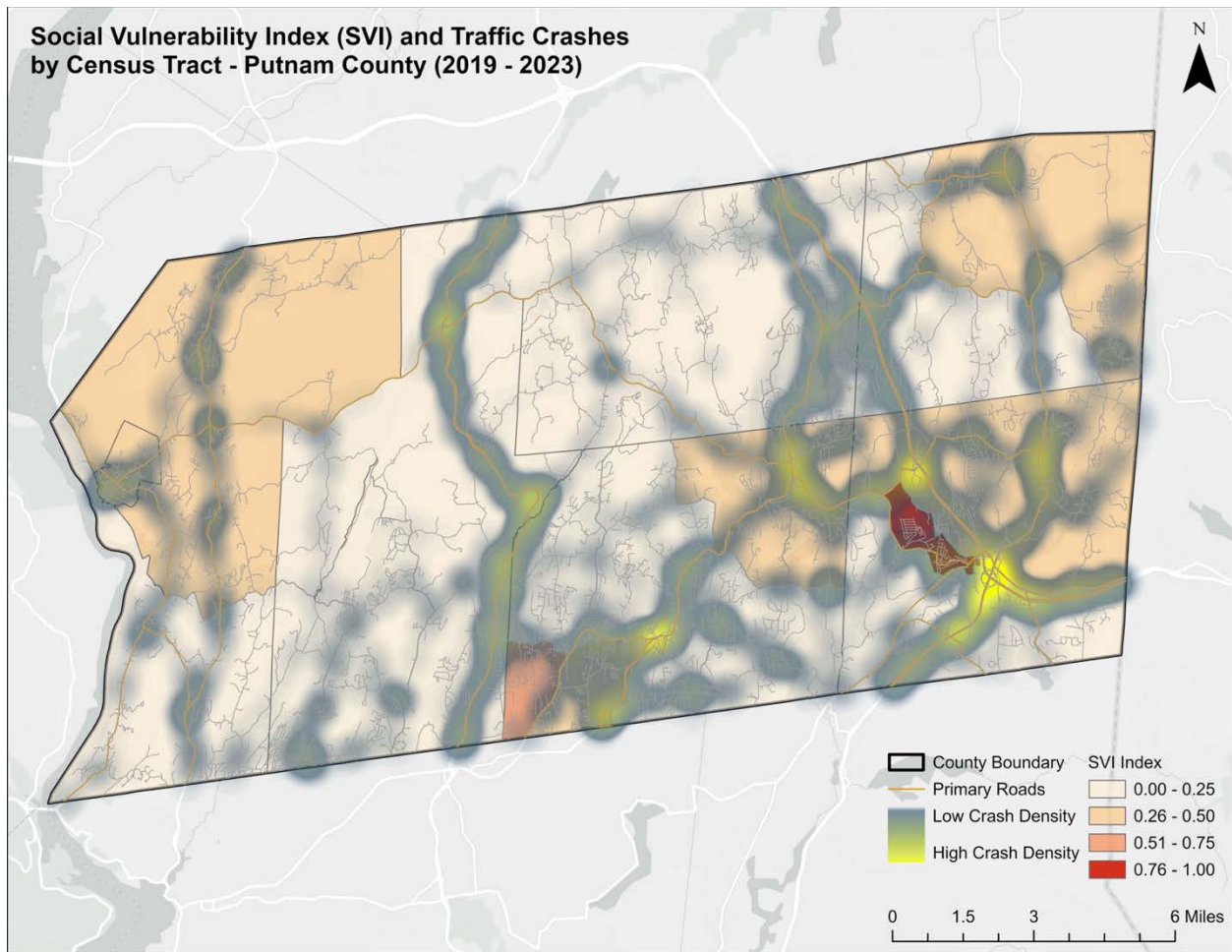


Figure 32 Social Vulnerability Index and Traffic Crashes by Census Tract in Putnam County (2019 - 2023)

D. Rockland County

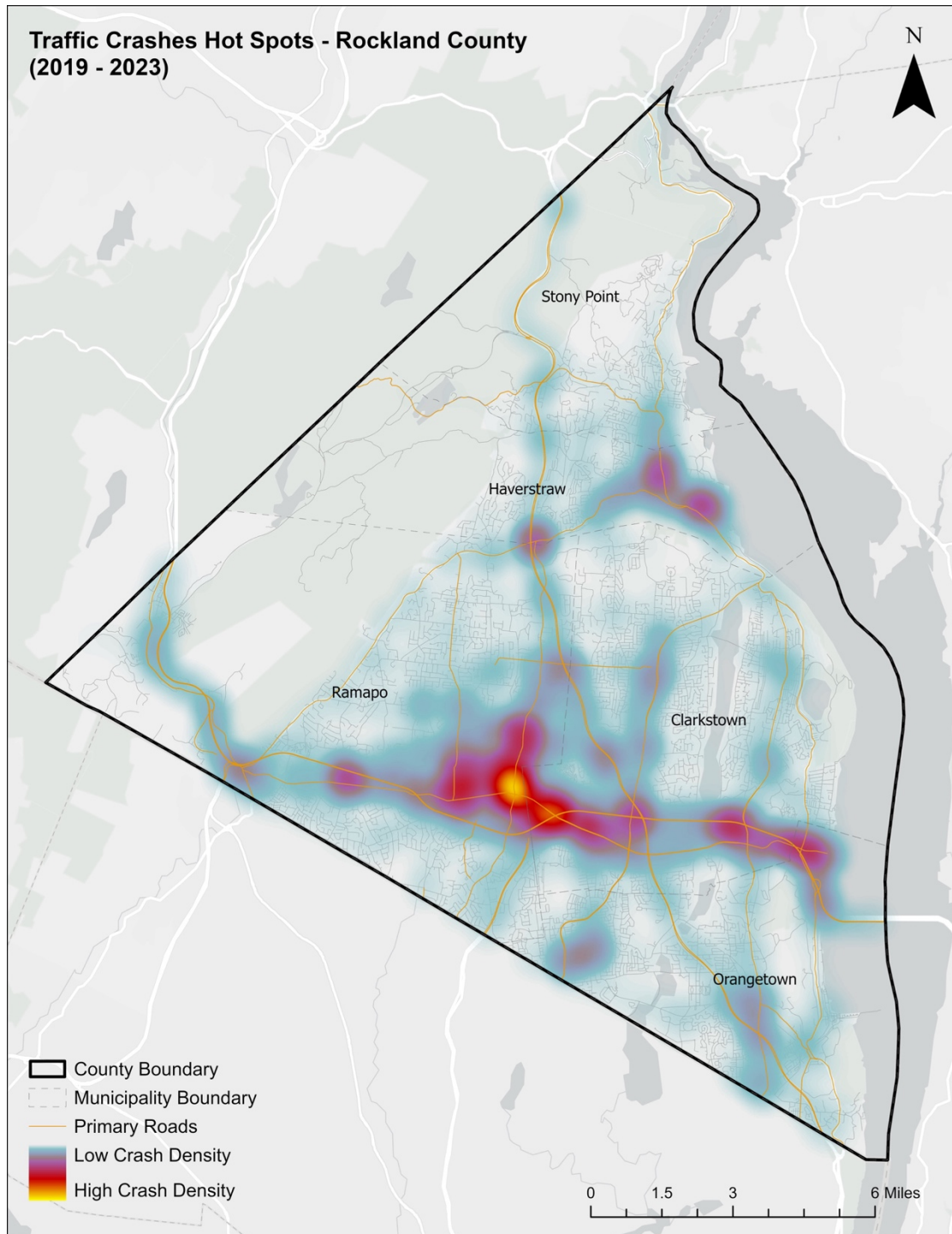


Figure 33 Traffic Crashes Hot Spot in Rockland County (2019 - 2023)

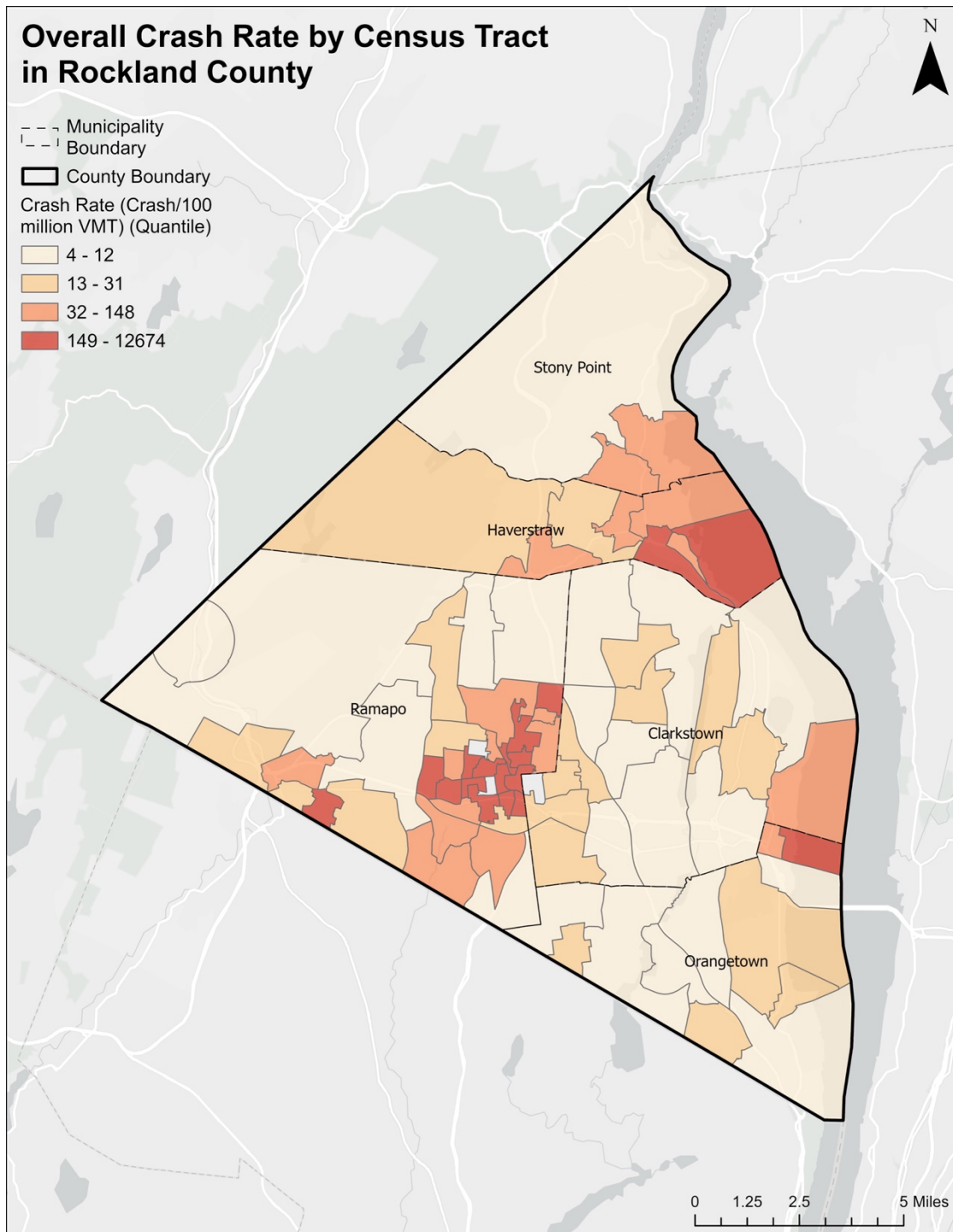


Figure 34 Overall Crash Rate by Census Tract in Rockland County

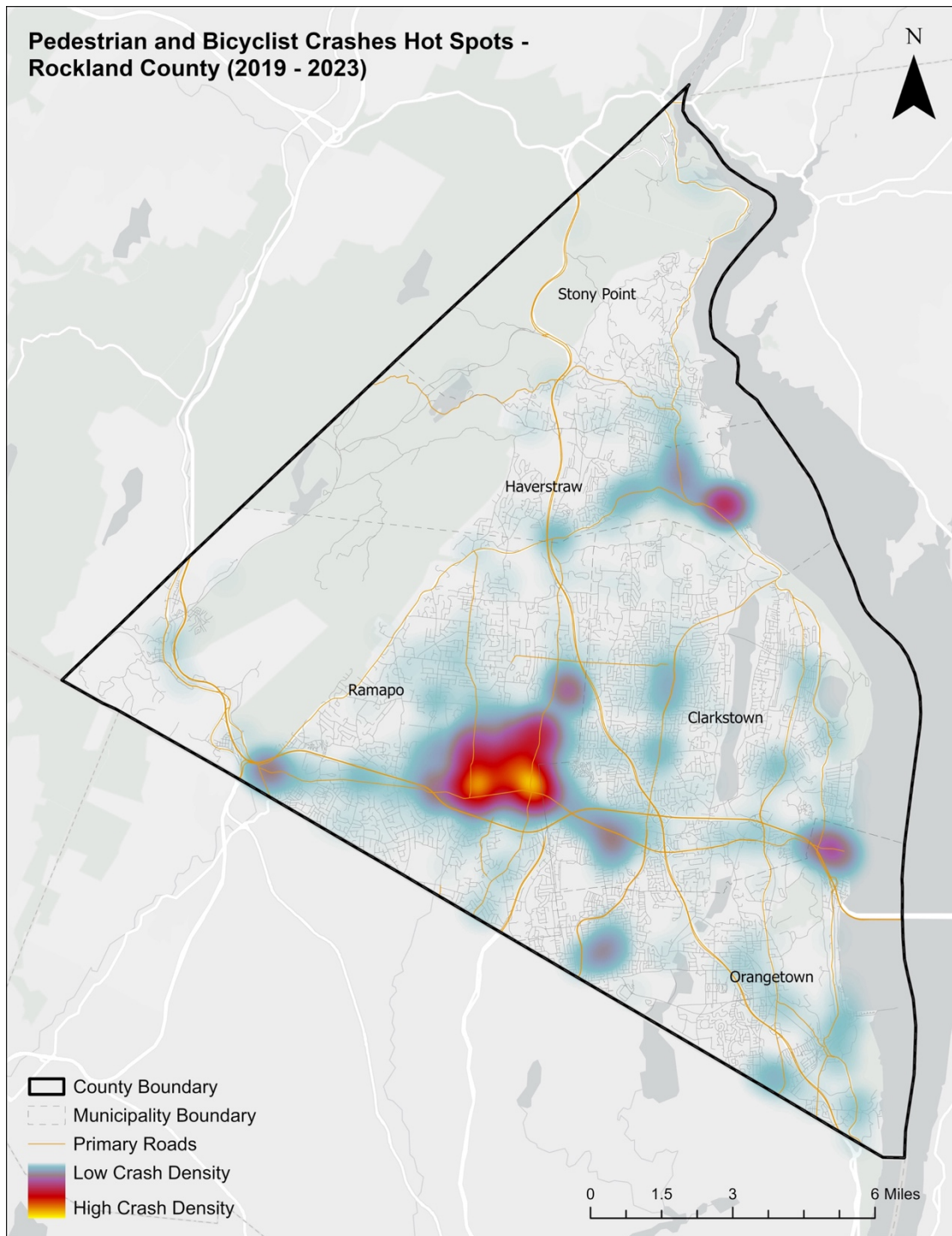


Figure 35 Pedestrian and Bicyclist Crashes Hot Spots in Rockland County (2019 - 2023)

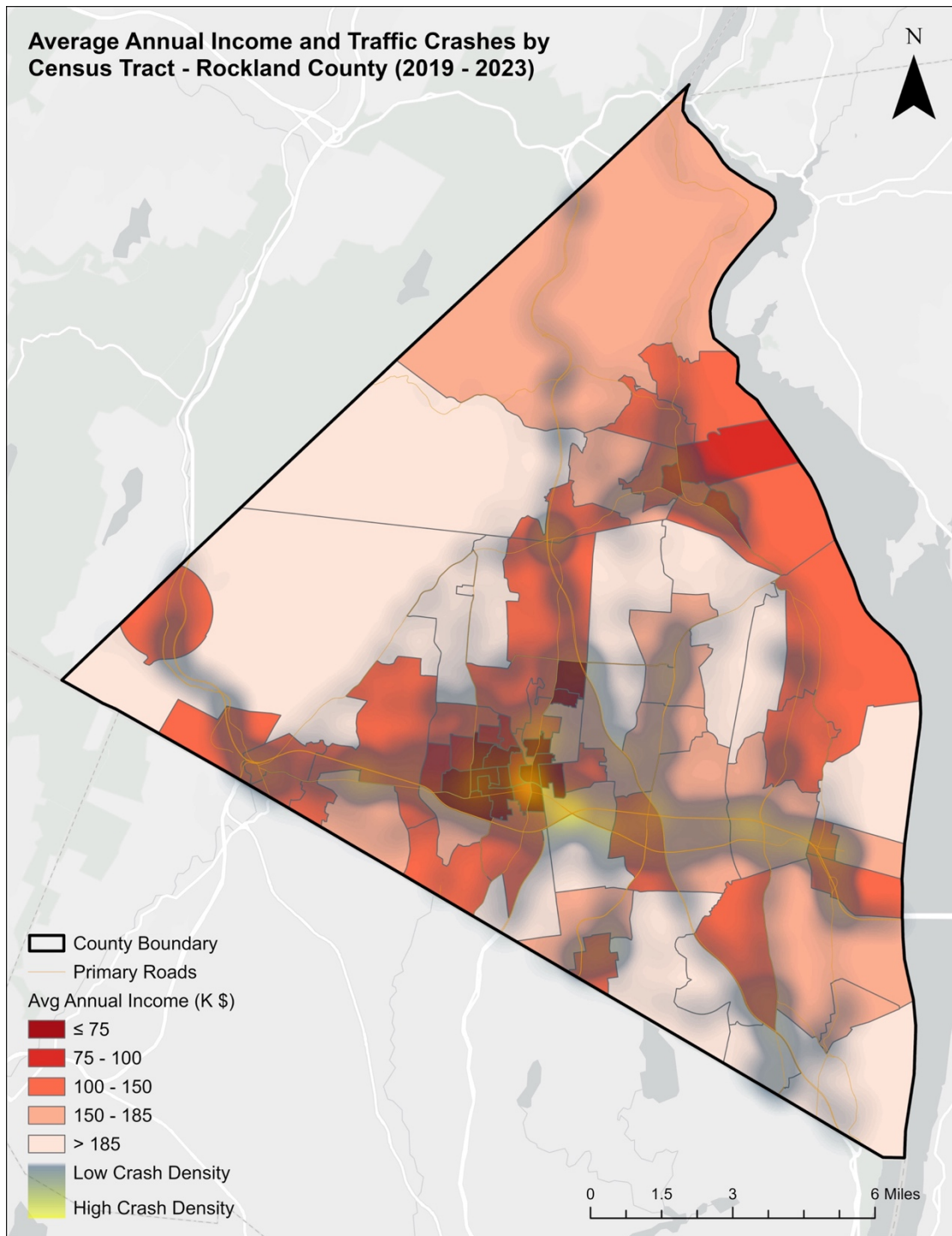


Figure 36 Average Annual Income and Traffic Crashes by Census Tract in Rockland County (2019 - 2023)

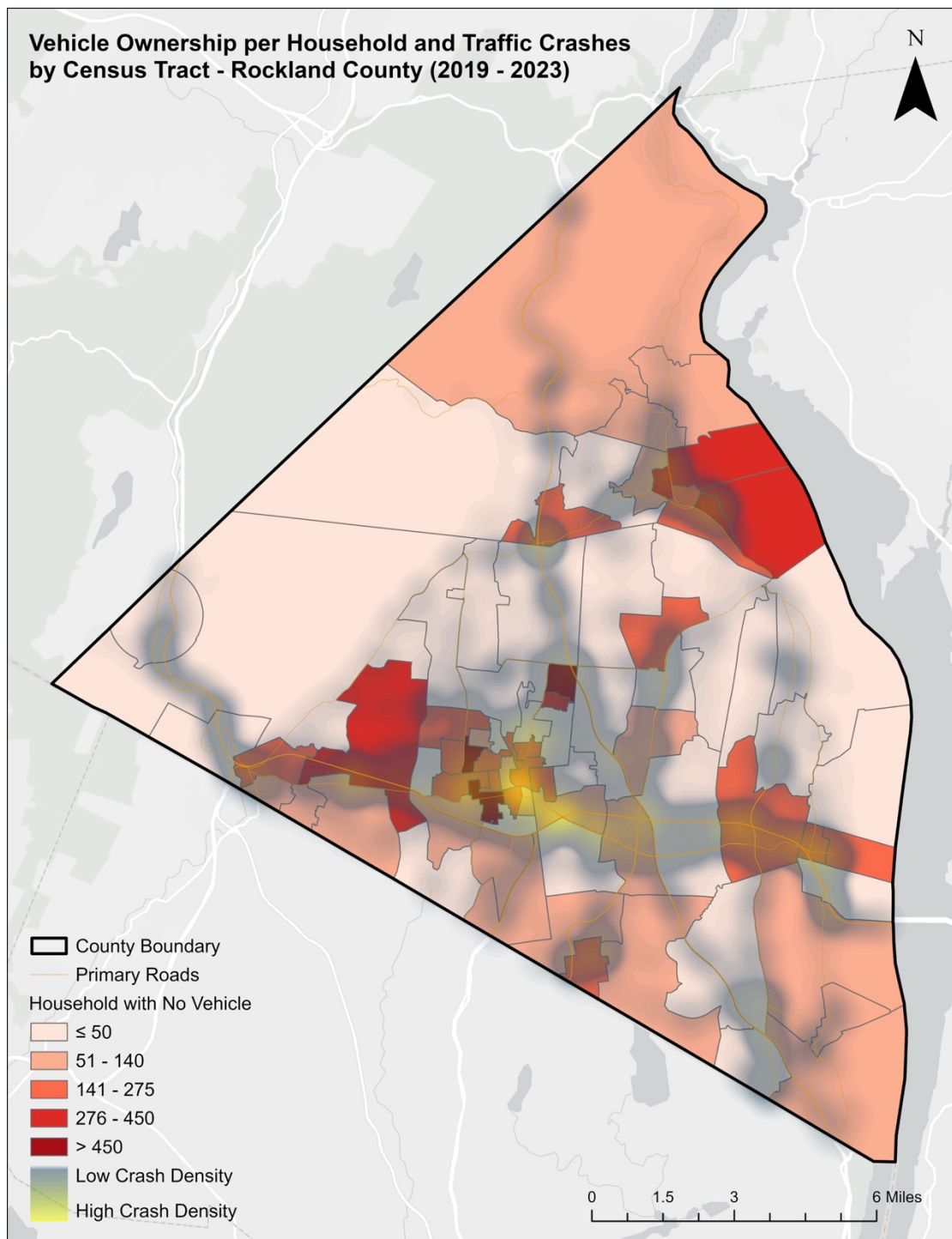


Figure 37 Vehicle Ownership per Household and Traffic Crashes by Census Tract in Rockland County (2019 - 2023)

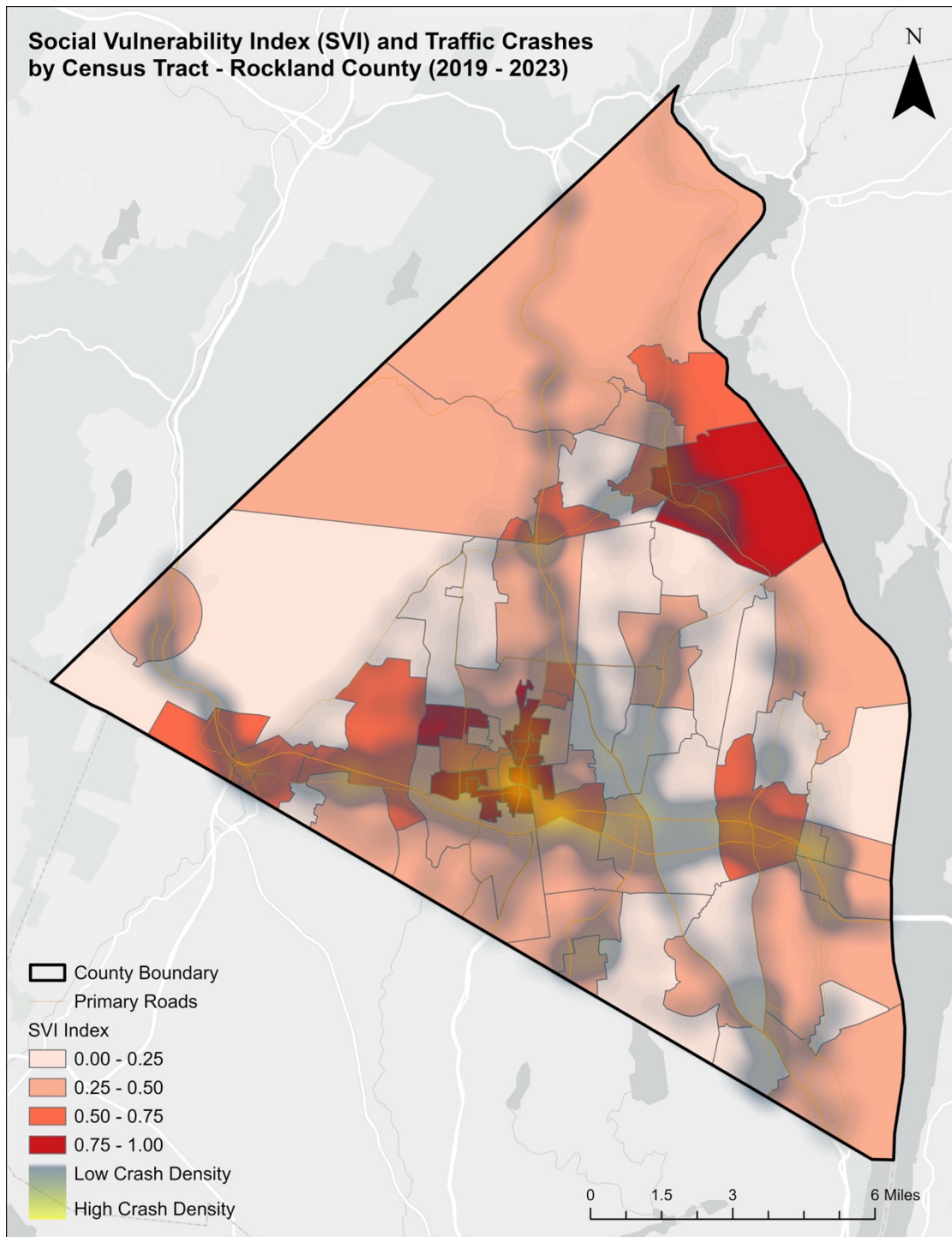


Figure 38 Social Vulnerability Index and Traffic Crashes by Census Tract in Rockland County (2019 - 2023)

E. Westchester County

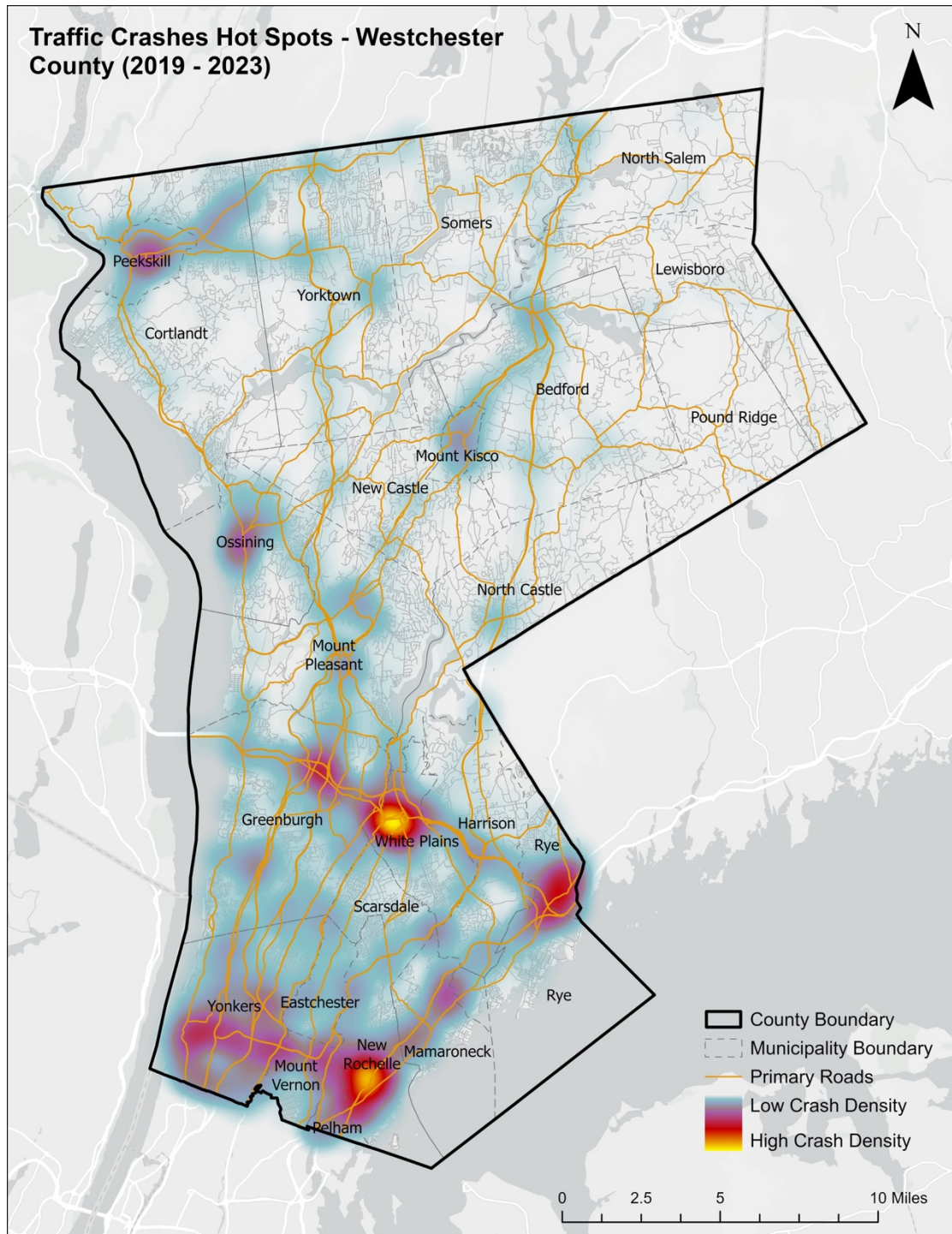


Figure 39 Traffic Crashes Hot Spots in Westchester County (2019 - 2023)

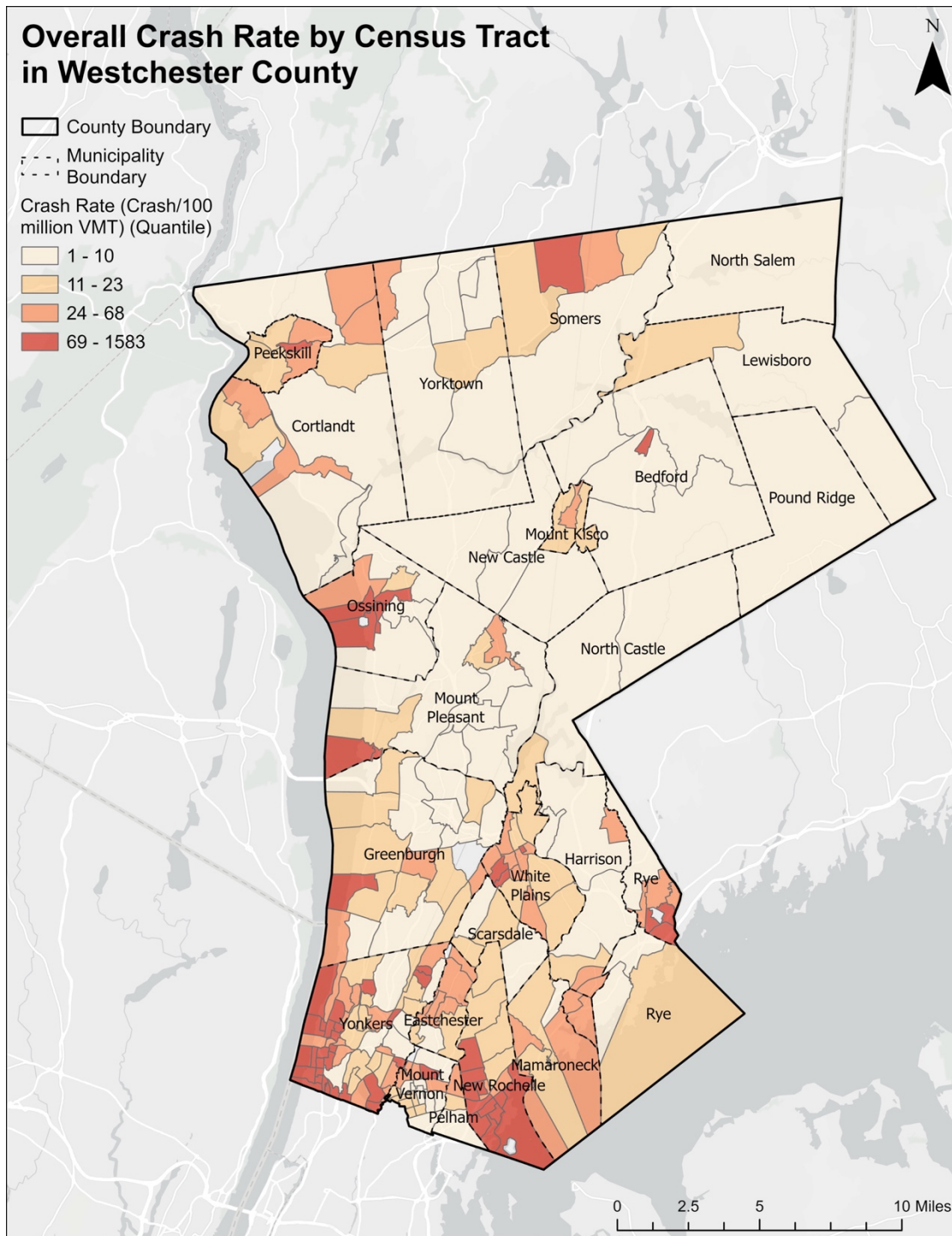


Figure 40 Overall Crash Rate by Census Tract in Westchester County

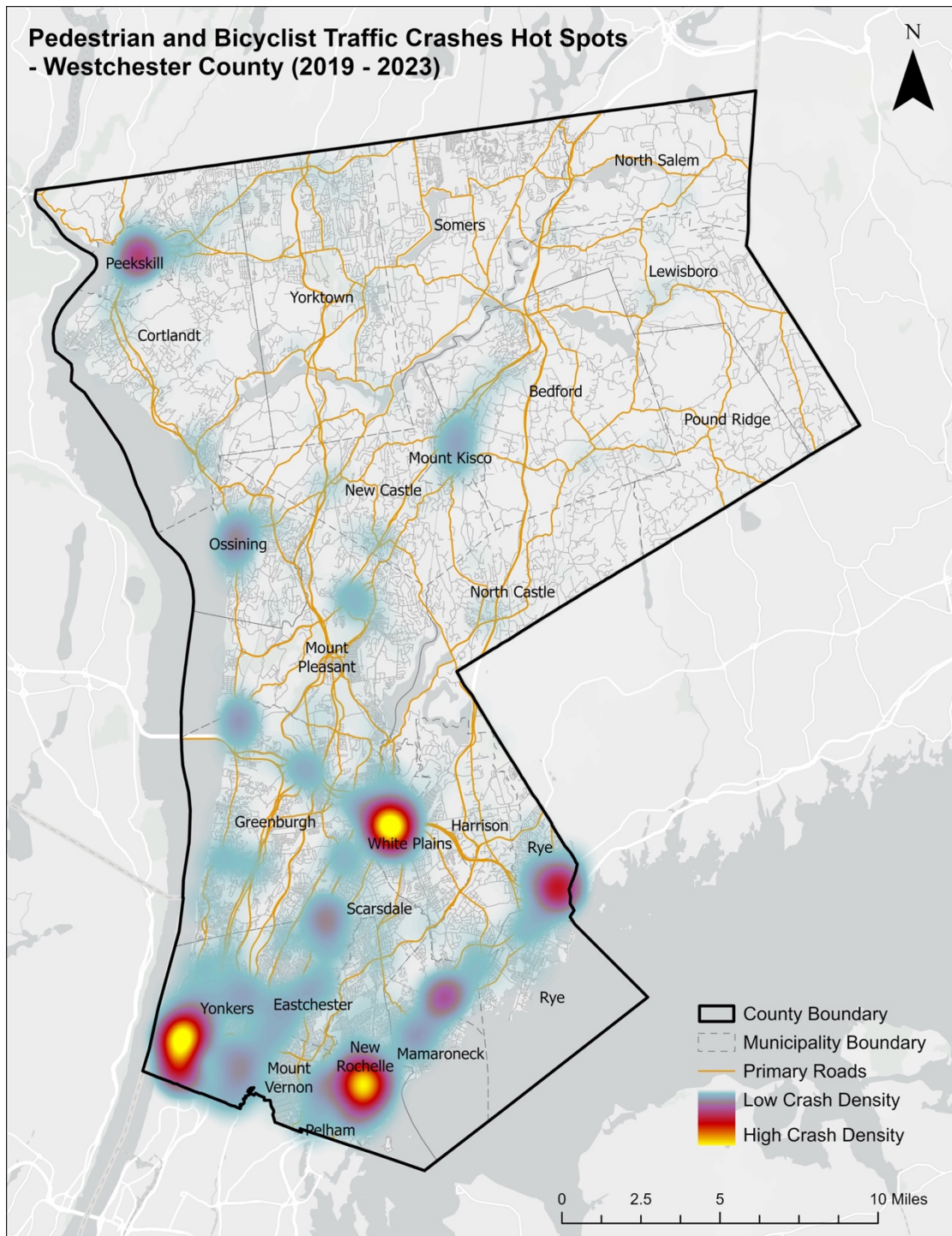


Figure 41 Pedestrian and Bicyclist Crashes Hot Spots in Westchester County (2019 - 2023)

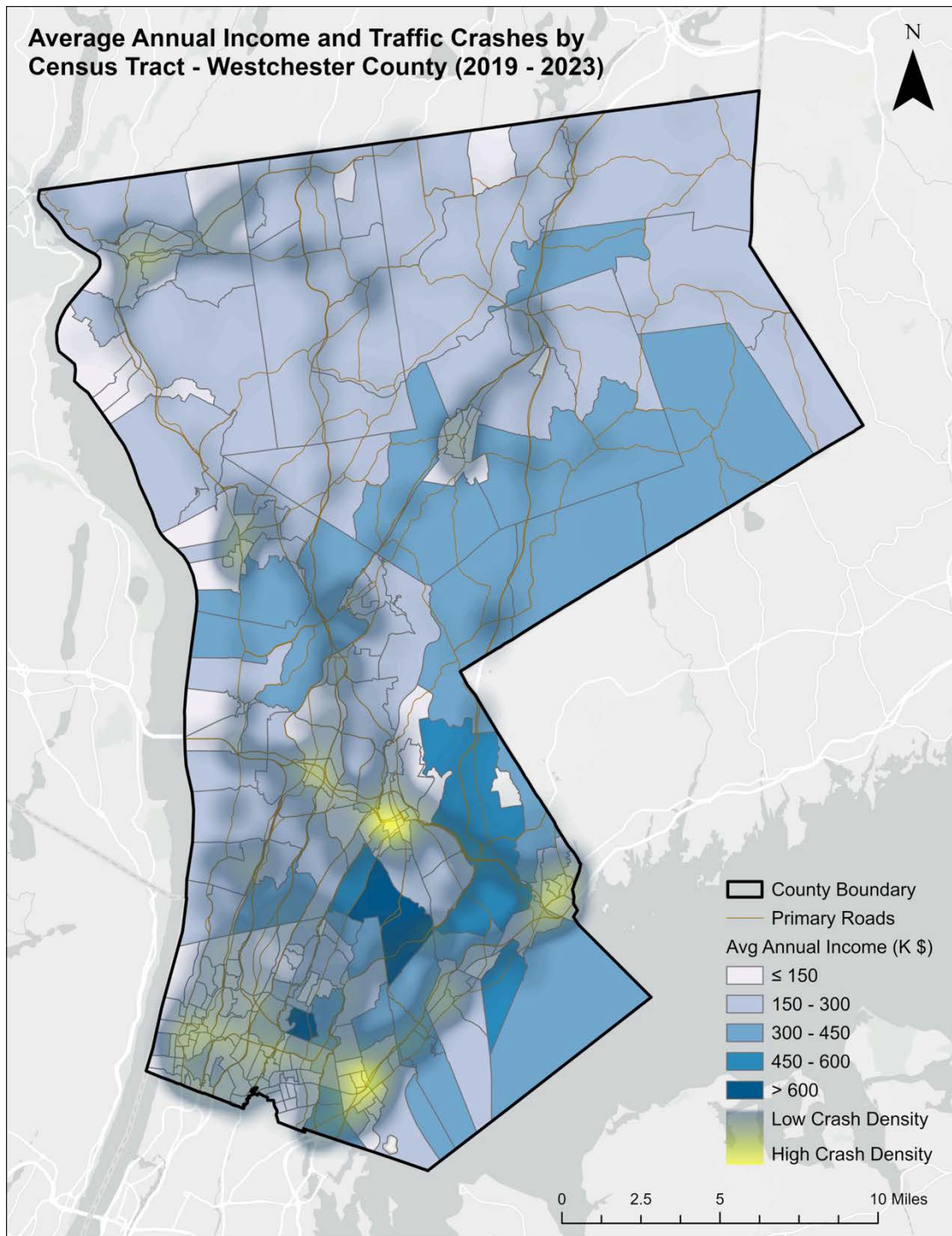


Figure 42 Average Annual Income and Traffic Crashes by Census Tract in Westchester County (2019 - 2023)

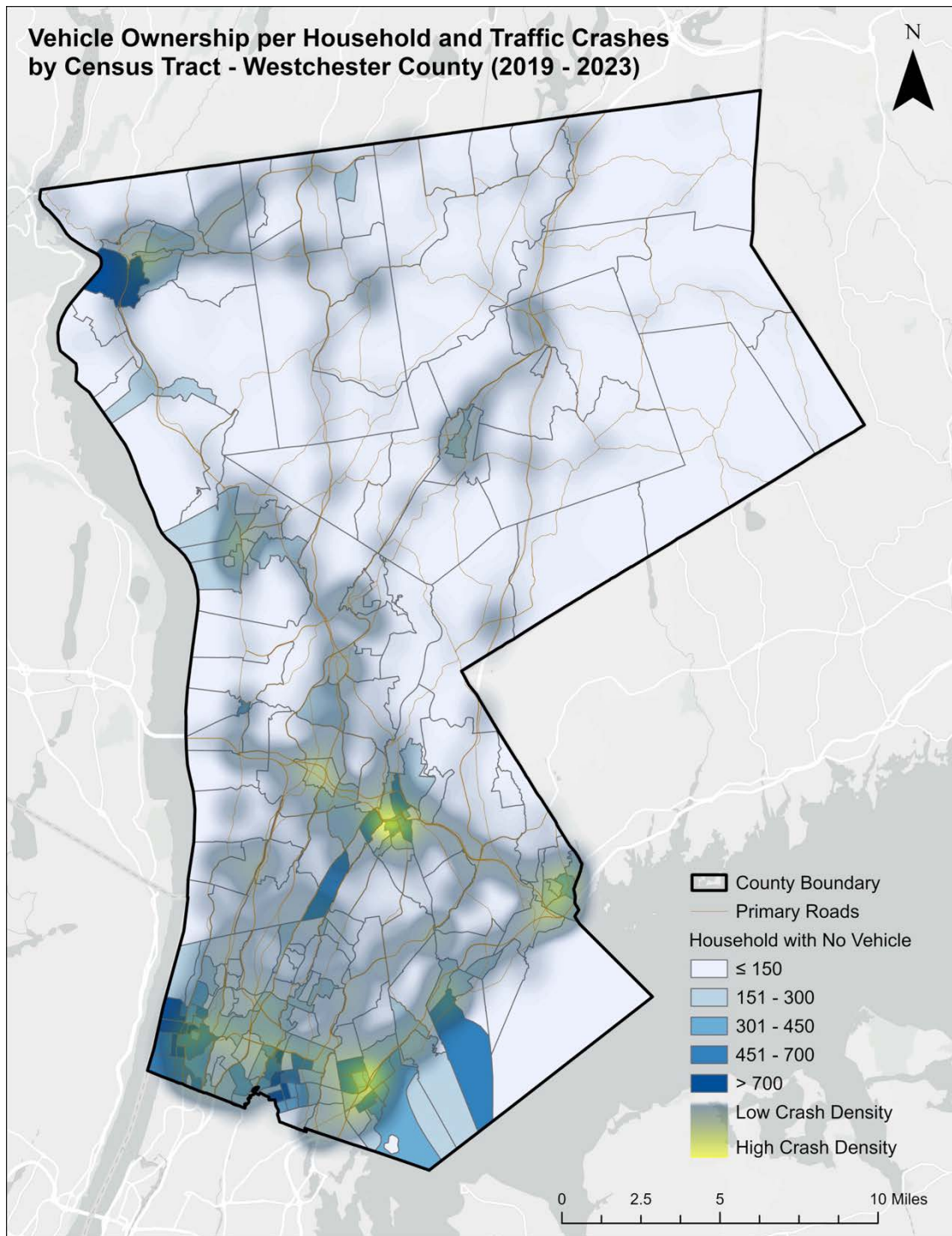


Figure 43 Vehicle Ownership per Household and Traffic Crashes by Census Tract in Westchester County (2019 - 2023)

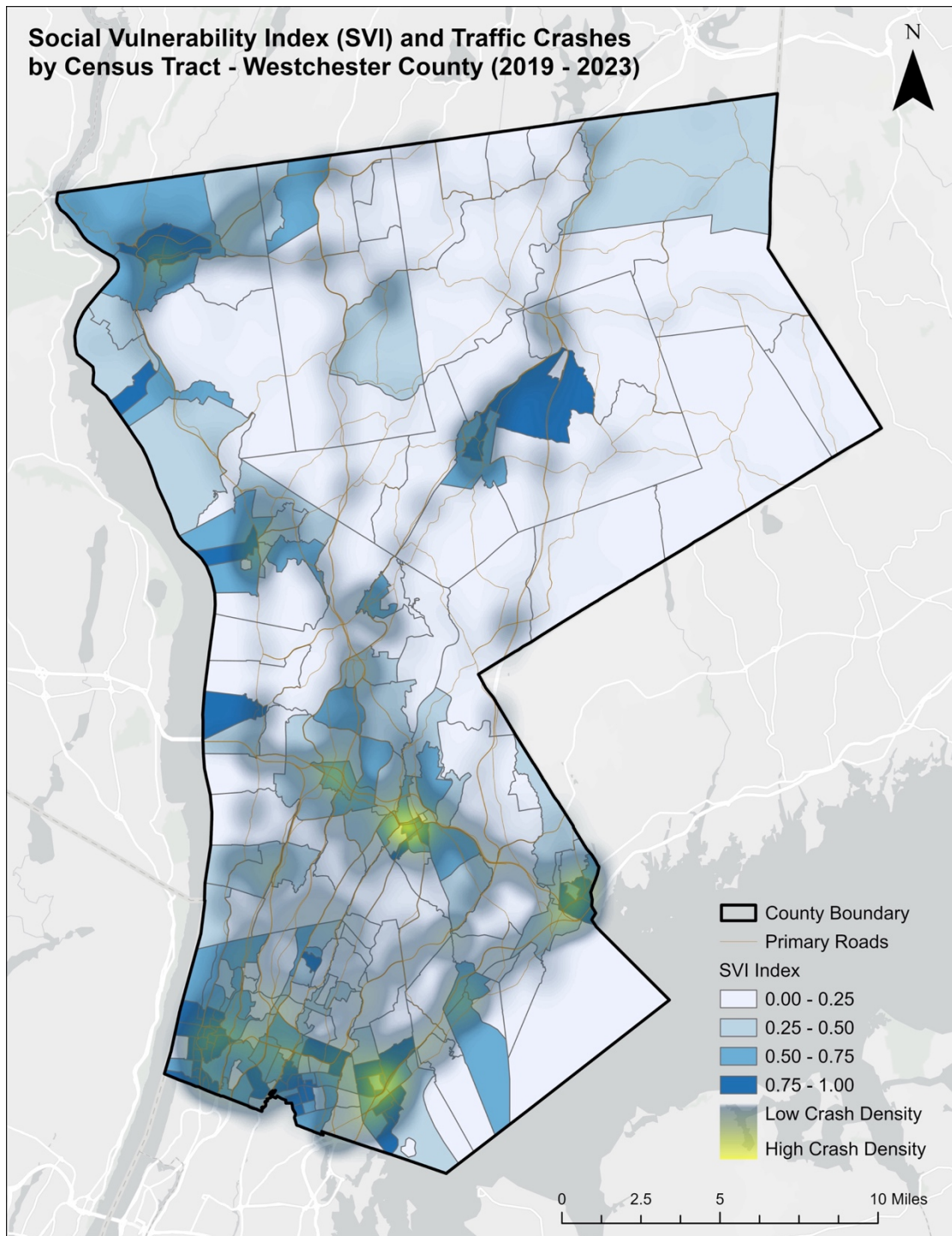


Figure 44 Social Vulnerability Index and Traffic Crashes by Census Tract in Westchester County (2019 - 2023)

In all counties, the patterns point to a potential socio-economic disparity in road safety, where lower-income areas are more vulnerable to traffic crashes. This correlation suggests that future safety improvements should prioritize these regions to address the disproportionate risk faced by these communities. By targeting high-crash areas with lower socio-economic indicators, decision-makers can help improve safety equity and mitigate the systemic factors contributing to the elevated crash rates in these neighborhoods.

The analysis of vehicle ownership across the five counties reveals a clear trend, areas with higher crash hotspots tend to align with census tracts where households report lower vehicle ownership. These tracts, characterized by a higher number of households without access to vehicles, are often located in more densely populated urban or semi-urban regions. In these areas, residents are more reliant on walking, cycling, and public transit, making them more vulnerable to traffic-related incidents. The lack of vehicle ownership increases the likelihood of pedestrian exposure to traffic, particularly in regions where pedestrian infrastructure may be insufficient or underdeveloped. This correlation between non-vehicular households and crash hotspots underscores the need for focused interventions, such as improved pedestrian safety features, better crosswalks, and enhanced public transportation accessibility, to reduce crash risks for residents in these vulnerable areas.

The analysis of the SVI across the five counties indicates a strong correlation between higher crash hotspots and census tracts with elevated SVI scores. These tracts, which are marked by a higher level of social vulnerability, often include underserved populations that are more economically disadvantaged, face language barriers, or have limited access to healthcare and resources. The maps show that areas with higher vulnerability tend to coincide with regions of increased traffic crashes, highlighting the greater risks faced by vulnerable communities. These populations may rely more heavily on walking, cycling, or public transit due to lower vehicle ownership and other socio-economic factors, making them more exposed to dangerous traffic conditions. The presence of crash hotspots in these tracts underscores the need for targeted safety improvements, such as enhanced pedestrian and bicycle infrastructure, increased traffic enforcement, and public education campaigns, to address the heightened risk for socially vulnerable populations.

4.1.2. Existing Safety Programs – Inventory

A parallel inventory was conducted to catalog ongoing safety programs in each of the five suburban counties. This inventory included current policies, initiatives, and projects aimed at improving transportation safety. The purpose was to evaluate how these programs address the safety challenges identified through the socio-economic and crash analysis, and to highlight any gaps or areas for further enhancement.

This analysis also provides insight into how the current safety efforts align with the specific vulnerabilities and risk factors prevalent in the study area. The findings will help inform recommendations for improving coordination and effectiveness across jurisdictions. The study team summarized the existing safety programs in the study area in the following tables.

Table 1 Existing Safety Programs and Initiatives in Nassau County

Program/Initiative	Purpose	Overview
Walk Safe Nassau	Educate pedestrians and drivers	Provides educational flyers and posters to businesses, plans to expand to 56 school districts with educational videos
Walk Safe Long Island	Provide pedestrian and bicycle safety outreach	A regional program offering information, education, and law-based safety materials to high-risk communities. Partners include the Long Island Health Collaborative and hospitals such as NUMC, Good Samaritan, NYU Langone, and Northwell

Program/Initiative	Purpose	Overview
Town of Hempstead School Bus Stop-Arm Program	Ensure school bus safety	Cameras installed on school buses to monitor and issue notices of liability for violations
Photo Enforcement - Red Light Camera Program	Reduce red-light running	Issues notices of liability for red-light violations
Engineering Interventions	Improve traffic safety	Implementations include speed feedback signs, radars, and crosswalk signalization (upgrading crosswalks and installing countdown timers)
Enforcement Measures	Increase police training	Involves additional training for police officers on pedestrian safety
Education Efforts	- Promote pedestrian safety awareness - Promote safe walking and biking	- Presentations by the Traffic Safety Board and the New York Coalition for Transportation Safety - Plans events like “Walk or Bike to School Day”

Table 2 Existing Safety Programs and Initiatives in Suffolk County

Program/Initiative	Purpose	Overview
School Bus Safety Program	Prevent illegal passing of school buses	Safety cameras installed on buses to monitor and deter illegal passing by surrounding vehicles
Town of Brookhaven Wildlife and Ecology Center Safety Town	Educate children on traffic and pedestrian safety	Simulates a miniature village where children use bicycles and small electric cars to learn traffic and pedestrian safety
Teen Driver Safety Program	Educate young drivers about safe driving practices	Incorporates exercises related to driving under the influence and texting while driving to teach safe driving habits
Suffolk County Red Light Safety Program	Reduce red-light running and increase compliance with traffic laws	Uses automated enforcement at red light intersections to enhance motorist safety, involves engineering, education, and enforcement efforts
Complete Streets Resolution	Promote safer streets for all road users	Ensures engineering interventions consider needs of pedestrians and cyclists, leading to increased sidewalks and bike lanes
Walk Safe Long Island	Provide pedestrian and bicycle safety outreach	A regional program offering information, education, and law-based safety materials to high-risk communities. Partners include the Long Island Health Collaborative and hospitals such as NUMC, Good Samaritan, NYU Langone, and Northwell

Table 3 Existing Safety Programs and Initiatives in Putnam County

Program/Initiative	Purpose	Overview
Complete Streets Analysis	Improve pedestrian flow and safety	Uses crash data analysis to identify critical areas for pedestrian safety; maintains signage and crossings in functional condition
Engineering Solutions	Enhance pedestrian safety	Implements sidewalks, enhanced pedestrian crossings with lights and push buttons, and speed feedback signs
Education Measures	Educate students on the dangers of drunk driving	Uses virtual reality devices to simulate drunk driving scenarios for hands-on learning experiences
Putnam County School Bus Safety Program	Safeguard students and tackle illegal school bus passings	Automated stop-arm cameras on school buses to detect and penalize illegal passings

Table 4 Existing Safety Programs and Initiatives in Rockland County

Program/Initiative	Purpose	Overview
Engineering Solutions	Enhance traffic safety through infrastructure	Introduction of crosswalks, left turn lanes, and transit signal priority implementations to improve safety
Complete Streets Approach*	Provide guidelines for inclusive road designs	Incorporates aspects of Complete Streets approach in some projects
* This program is not mandated; it serves as guidance		

Table 5 Existing Safety Programs and Initiatives in Westchester County

Program/Initiative	Purpose	Overview
Community Outreach and Education Initiatives	Enhance public awareness and education on traffic safety	Distributes educational materials and conducts outreach in schools, community organizations, libraries, and events. Focuses on high-crash communities and vulnerable groups
Community Traffic Safety Program	Educate the public on various traffic safety topics	Covers driver, pedestrian, bicycle, and school bus safety through events and campaigns such as “Buckle Up America,” “Child Passenger Safety,” “Back to School Week,” “Drowsy Driving Awareness Week,” and “Aggressive Driving Prevention Week”
Proactive Engagement with Vulnerable Groups	Ensure inclusivity and effectiveness in educational efforts	Actively engages with communities at places like churches and community centers. Partners with neighborhood organizations and minority groups

Chapter 5: Development of the Coordinated Safety Program

The development of a coordinated safety program for the study area is a comprehensive process that draws on input from multiple stakeholders, including the transportation coordinating committees (TCCs) within the study area, analysis from the safety assessment, and findings from literature reviews and interviews with other metropolitan planning organizations (MPOs). The program is designed to address the safety issues identified in the study area, improve coordination between jurisdictions, and enhance existing safety programs to ensure alignment and responsiveness to the needs of the five suburban counties.

5.1. Stakeholder Outreach and Input

The foundation of the coordinated safety program development involved outreach to the two primary Transportation Coordination Committees (TCCs) in the study area, the Mid-Hudson South Transportation Coordinating Committee (MHSTCC) and the Nassau-Suffolk Transportation Coordinating Committee (NSTCC). These committees represent the interests of various jurisdictions within the study area and serve as vital sources of input regarding local safety challenges and coordination efforts. Their insights played a pivotal role in shaping the coordinated safety program, ensuring it reflects local needs and conditions.

To gather the needed input from the TCCs, the study team coordinated closely with the NYMTC to develop a set of questions that would be used to guide discussions. These questions aimed to capture feedback on existing safety programs, challenges to inter-jurisdictional coordination, and suggestions for improving safety outcomes and the coordination between jurisdictions. Appendix B includes the developed questionnaire for TCCs.

The input collection involved structured meetings with each TCC, during which the study team used an interactive platform, Poll Everywhere, to engage committee members and collect their responses in real-time. Each meeting focused on gathering feedback on the fragmented governance structures, funding limitations, policy misalignments, and other factors that impact safety coordination across counties. Participants were asked to identify specific barriers to coordination and suggest areas where joint efforts could be strengthened. A significant part of this input process was centered around identifying areas where enhanced coordination could yield better safety outcomes. TCC members highlighted barriers to coordination, such as conflicting regulations and political differences between jurisdictions, as well as practical concerns like differences in infrastructure needs and priorities across the suburban counties. The poll questions used during these meetings are provided in Appendix C.

TCC members pointed out key challenges, including conflicting regulations between counties, political differences that hinder collaboration, and practical obstacles such as varying infrastructure needs and priorities across the suburban regions. This feedback provided invaluable insight into the complexities of coordination in the study area, highlighting areas where the coordinated safety program could offer solutions.

5.1.1. Findings from TCC Input

The detailed input from the TCCs offered essential guidance in understanding the specific safety and coordination challenges across the study area. The insights gathered laid the groundwork for identifying opportunities to enhance coordination and align safety efforts across jurisdictions. The

following sections will discuss the findings from the TCC members' input, emphasizing the barriers they identified and potential areas for improved coordination.

A. Transportation Safety Concerns in the NYMTC Suburban Subareas

TCCs were asked about the most pressing transportation safety concerns facing the suburban subareas in the NYMTC planning region. The feedback highlighted a wide range of issues that reflect the diverse transportation environments and challenges within these areas. The received responses offer a comprehensive view of the critical safety concerns, helping to inform the development of the coordinated safety program.

A key concern across the suburban subareas was pedestrian safety, which was one of the most frequently mentioned issues. Many respondents emphasized the need for better pedestrian infrastructure, safer crossings, and more attention to pedestrian behavior and the risks associated with speeding vehicles. Several comments also highlighted the lack of protected bike lanes, underscoring the growing safety concerns for bicyclists who share the roads with motor vehicles. This aligns with the recurring mention of speeding, which was consistently identified as a contributing factor to both pedestrian and bicycle safety risks.

Another frequently mentioned concern was congestion, which TCC members noted is contributing to unsafe driving behaviors, road rage, and increased crash risks. The congestion problem is compounded by distracted drivers, which was mentioned as a contributing factor to crashes and unsafe conditions for all road users. These issues suggest that reducing congestion and managing traffic flow are critical areas for action in the coordinated safety program.

In addition, extreme weather events and resiliency emerged as significant concerns. Multiple members expressed the need for improved infrastructure to withstand weather-related hazards, such as snow and ice, and better emergency preparedness for handling such events. Given the region's increasing vulnerability to climate change, particularly the increased frequency of extreme weather, addressing these concerns is essential for ensuring the long-term safety and resilience of the transportation system.

B. Potential Areas for Improved Coordination Between Jurisdictions

To gain insights into areas where coordination between jurisdictions could be enhanced within the suburban subareas of the NYMTC planning region, the study team asked TCC members to rank potential areas for improvement. The responses revealed several key areas for coordination, with a consensus around five main categories:

1. **Infrastructure Planning and Funding:** This area was consistently ranked as a top priority by many respondents. Improved coordination in planning and securing funding for infrastructure projects was seen as critical for addressing safety concerns. Coordinating on infrastructure improvements—such as road design, pedestrian and bicycle facilities, and transit infrastructure—could lead to more cohesive and effective safety outcomes across jurisdictions.
2. **Data Sharing and Analysis:** Data sharing and analysis was also frequently highlighted as an area where coordination could be improved. Respondents indicated that better access to and integration of crash data, socio-economic data, and transportation statistics would allow for more informed decision-making and help identify trends and safety risks across jurisdictions. The ability to share data would foster a more unified approach to addressing regional safety challenges.

3. **Policy Alignment:** Aligning policies between jurisdictions was another frequently mentioned need. Policy differences between counties often lead to disjointed approaches to safety and transportation planning. By coordinating policies on enforcement, road safety standards, and infrastructure development, jurisdictions could create more consistent safety measures across the region, improving overall outcomes.
4. **Joint Enforcement Efforts:** Several respondents emphasized the importance of joint enforcement efforts across jurisdictions. Coordinating traffic enforcement between counties could address issues such as speeding, impaired driving, and other dangerous behaviors more effectively. Joint initiatives could help ensure that enforcement is consistent across borders, improving compliance with traffic laws and reducing crash risks.
5. **Coordinated Public Education Campaigns:** Public education was viewed as an area ripe for improved coordination. Coordinated efforts to educate the public on road safety, pedestrian and bicycle awareness, and emergency preparedness could lead to better safety outcomes. By working together on public messaging and outreach, jurisdictions could enhance awareness of safety issues and encourage safer behaviors across the region.

C. Barriers to Improved Coordination

In addition to identifying areas for improvement, TCC members were asked to list barriers to enhanced coordination between jurisdictions. Several common themes emerged:

- **Fragmented Governance:** One of the most frequently mentioned barriers was the fragmented governance structure across the region. With a large number of municipalities and overlapping jurisdictions, coordinating on safety initiatives can be challenging. The division of responsibilities between different levels of government often hampers the ability to implement coordinated safety measures effectively.
- **Funding Constraints:** Financial limitations were another significant barrier identified by respondents. Limited resources for infrastructure projects, enforcement efforts, and public education campaigns make it difficult for jurisdictions to collaborate and achieve common safety goals. This challenge is compounded by competing priorities for funding at the local level.
- **Conflicting Regulations and Political Differences:** Conflicting regulations and political differences between jurisdictions were seen as obstacles to alignment on safety policies and enforcement strategies. Different local priorities and regulatory frameworks can create challenges when trying to implement region-wide initiatives. In some cases, political disagreements further complicate efforts to cooperate across jurisdictions.
- **Lack of Communication and Information Sharing:** A lack of clear, consistent communication channels between jurisdictions was identified as a key barrier to improved coordination. Respondents noted that better information sharing, and more streamlined communication processes could help break down silos and foster more collaboration.
- **Complicated Permit and Design Processes:** Some respondents highlighted that complicated design guidelines and permit processes slow down coordination efforts. Jurisdictions often face delays in implementing safety improvements due to long review processes and the lack of expedited pathways for government partners. This can inhibit timely responses to safety needs.
- **Staffing Constraints:** The lack of adequate staff to manage coordination efforts between jurisdictions was also mentioned as a barrier. Limited personnel resources can make it difficult to engage in joint initiatives, particularly when coordination requires ongoing communication, data sharing, and policy alignment.

These findings suggest that while there are clear areas for improved coordination, overcoming institutional, financial, and regulatory barriers will be essential for enhancing transportation safety across the region.

D. Prioritized Policy Areas for the Coordinated Safety Program

In order to understand which policy areas should be prioritized within the coordinated safety program, TCC members were asked to rank a variety of policy initiatives. The responses provide clear insights into the priorities of the suburban subareas within the NYMTC planning region, offering a guide for the development of the coordinated safety program. Figure 45 displays the prioritization based on TCC input as listed below:

1. **Pedestrian and Bicycle Infrastructure Standards:** This policy area emerged as the top priority across many of the responses. Improving pedestrian and bicycle infrastructure, such as creating protected bike lanes, safer crosswalks, and accessible sidewalks, is seen as critical to reducing crashes and enhancing safety for vulnerable road users. Given the high frequency of pedestrian and bicycle-related safety concerns mentioned elsewhere by TCC members, this focus aligns with the region's pressing safety needs.
2. **Complete Streets Policy:** The Complete Streets policy, which emphasizes designing streets that accommodate all users (including pedestrians, cyclists, motorists, and transit riders), was another frequently ranked top priority. Respondents highlighted the need for streets that are safer and more inclusive, promoting not just safety but also accessibility and mobility options for all individuals.
3. **Data Collection and Analysis Policies:** Respondents emphasized the importance of data collection and analysis, especially as it relates to tracking crash patterns, understanding safety issues, and monitoring the effectiveness of implemented policies. Consistent data collection and sharing across jurisdictions would allow for better planning and more targeted safety interventions.
4. **Speed Management:** Speed management policies were ranked as a priority in many responses. Speeding has been repeatedly identified as a major safety concern in suburban subareas, and road design characteristics contribute to higher speeds. Implementing more effective speed management strategies could significantly reduce crash rates and improve overall safety.
5. **Vision Zero:** Vision Zero, a policy that aims to eliminate all traffic fatalities and severe injuries, also ranked highly in the responses. This reflects a growing interest in adopting comprehensive, goal-oriented approaches to road safety. Several TCC members emphasized the need to implement Vision Zero strategies, which include data-driven approaches, public engagement, and enforcement to improve safety outcomes.
6. **Traffic Enforcement Strategies:** Traffic enforcement, particularly related to speed management and dangerous driving behaviors, was consistently mentioned as an important policy area. Improved coordination on enforcement measures between jurisdictions could help address issues such as speeding, impaired driving, and other violations that increase crash risk.
7. **Safe Routes to School Policy:** Safe Routes to School programs, which focus on improving the safety of children walking or biking to school, were identified as a priority in multiple responses. Enhancing safety in school zones through infrastructure improvements and targeted programs is seen as essential to protecting the region's younger population.
8. **Public Education and Awareness Campaigns:** Public education campaigns aimed at raising awareness of road safety, pedestrian rights, and responsible driving behaviors were also seen as crucial to the success of a coordinated safety program. Collaboration on education initiatives

could promote safer habits among all road users and improve compliance with traffic regulations.

In addition to these top priorities, a few responses highlighted workplace safety, cybersecurity, and emergency preparedness as potential areas to consider within the broader framework of the safety program. Though these were not as frequently mentioned as the other policy areas, they reflect a concern for safety in various contexts beyond just transportation infrastructure.

Figure 45 visually presents the prioritization of these policy areas, offering a clear illustration of the collective input from TCC members. This input will guide the development of the coordinated safety program, ensuring that it addresses the most pressing safety challenges across the region.

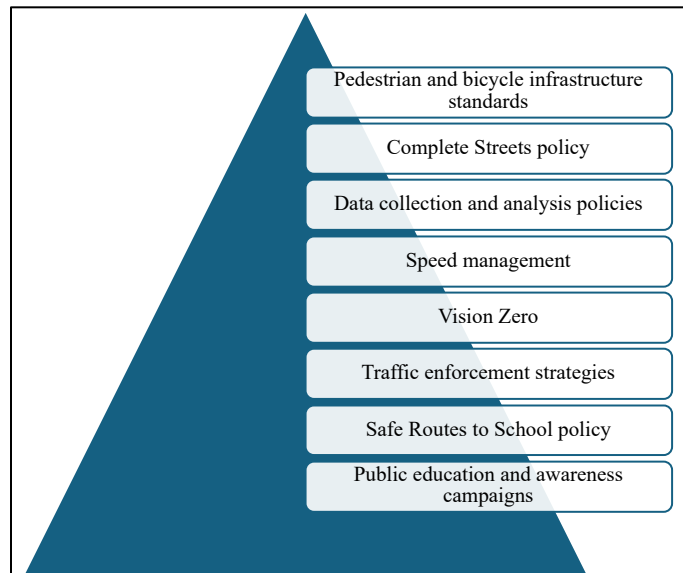


Figure 45 Key Policies Prioritization Based on TCC Members

E. Prioritized Actions for Improving Safety in the Coordinated Safety Program

To further refine the coordinated safety program, TCC members were asked to provide input on the actions they believe should be prioritized to enhance transportation safety in suburban subareas. The responses reflect a diverse range of strategies, from infrastructure enhancements to enforcement measures and public outreach initiatives. This section discusses the top actions identified by the TCCs and ties these actions into the broader policy priorities established in previous sections. Below is the list of actions as prioritized by TCC members:

1. **Pedestrian and Bicycle Network Expansion:** The expansion of pedestrian and bicycle networks consistently ranked as one of the top actions recommended by TCC members. This aligns with the prioritization of pedestrian and bicycle infrastructure standards discussed earlier. Expanding these networks not only improves safety for vulnerable road users but also supports policies like Complete Streets and Vision Zero, which emphasize creating more inclusive, multi-modal transportation systems. As suburban areas often lack extensive pedestrian and bicycle infrastructure, network expansion is seen as essential to reducing crash rates and enhancing mobility.
2. **Intersection Safety Improvements:** Improving safety at intersections was another action frequently identified as a priority. Many suburban roadways, particularly in areas with higher traffic volumes or complex designs, present significant safety challenges at intersections. Enhancing intersection safety directly supports the TCC's emphasis on policies like Traffic Enforcement Strategies and Speed Management, as improved intersection design can help manage speeds and reduce the likelihood of crashes. Intersection improvements can include upgrades to signals, better crosswalks, and adding safety features for pedestrians and bicyclists.

3. **Traffic Calming Measures:** Traffic calming measures, such as speed humps, roundabouts, and road narrowing, were widely recommended as critical actions. These measures are designed to slow down traffic, reduce speeding, and improve safety, particularly in residential or pedestrian-heavy areas. Speeding was a major concern highlighted in previous discussions, and traffic calming strategies tie directly into Speed Management Policies and Complete Streets Initiatives, both of which seek to create safer environments for all road users by managing vehicle speeds.
4. **Address Road Design Issues:** Road design issues, such as improper weaving sections, narrow rights-of-way, and sharp curves, were frequently mentioned as areas requiring attention. In many suburban areas, outdated or inadequate road designs contribute to unsafe conditions for pedestrians, cyclists, and drivers alike. Addressing these issues supports the overall aim of creating safer and more efficient transportation networks, and it ties closely to policies discussed in earlier sections like Complete Streets and Pedestrian and Bicycle Infrastructure Standards. By improving road design, safety enhancements can be integrated into the broader system more effectively.
5. **Enhancing Road Maintenance and Repair:** Poor road conditions, such as potholes, uneven pavement, or damaged signage, can increase the risk of accidents and reduce the effectiveness of other safety measures. Several TCC members highlighted the importance of ongoing road maintenance and repair to ensure that the infrastructure supporting safety initiatives remains functional and reliable. Enhancing maintenance efforts also complements other actions like Pedestrian and Bicycle Network Expansion and Intersection Safety Improvements, as well-maintained roads and pathways are key to their success.
6. **Implementation of Smart Traffic Technologies:** Smart traffic technologies, including traffic signal optimization, automated enforcement, and intelligent transportation systems (ITS), were frequently mentioned as important actions. These technologies can enhance safety by improving traffic flow, reducing human error, and enabling real-time monitoring and responses to incidents. The emphasis on smart technologies ties into the broader policy of Data Collection and Analysis, which was prioritized by the TCCs in earlier discussions. Effective data collection is crucial for deploying these technologies and evaluating their impact on safety outcomes.
7. **Enhanced Enforcement of Traffic Laws:** Strengthening traffic law enforcement was another recommended action, particularly in areas where speeding, distracted driving, or other violations are prevalent. Enhanced enforcement supports policies like Vision Zero and Traffic Enforcement Strategies, as it ensures that safety regulations are consistently upheld. Coordinated enforcement efforts across jurisdictions could also address the governance and communication challenges previously identified by TCC members, improving overall program effectiveness.
8. **Increasing Public Safety Campaigns:** Public education and awareness campaigns were highlighted as essential for changing behaviors that lead to unsafe conditions on the roads. While infrastructure improvements and enforcement play critical roles in reducing crashes, public engagement is key to fostering a culture of safety among all road users. Campaigns focused on issues like speeding, pedestrian safety, and distracted driving can complement actions like Intersection Safety Improvements and Traffic Calming Measures, ensuring that users are aware of and comply with the changes.
9. **Safety Enhancements at School Zones:** Enhancing safety in school zones, including adding crosswalks, signage, and reducing speed limits, was another widely suggested action. This

aligns with the Safe Routes to School policy priority, which was emphasized earlier. School zones are particularly vulnerable areas where children are present, and targeted safety measures can significantly reduce the risk of accidents.

F. Integration with Previous Policy Priorities

The actions identified by the TCC members reflect a comprehensive approach to safety that integrates well with the policies prioritized in earlier discussions. For example, expanding pedestrian and bicycle networks, enhancing road design, and improving intersection safety directly support the Pedestrian and Bicycle Infrastructure Standards and Complete Streets Policy that were previously highlighted as critical to the coordinated safety program. Similarly, the emphasis on smart traffic technologies and data-driven enforcement ties into the Vision Zero and Data Collection and Analysis Policies, ensuring that safety interventions are informed by the latest data and technologies. By focusing on these coordinated actions, the safety program can address the unique challenges of suburban areas while fostering collaboration across jurisdictions to implement solutions effectively.

G. Support and Resources Needed for Effective Participation in a Coordinated Safety Program

To facilitate successful participation in the coordinated safety program, TCC members were asked to identify the resources and support their jurisdictions would require. The responses underscored the importance of several key areas, including funding, training, technical assistance, and coordination with other stakeholders. This section discusses the prioritized needs and the potential implications for program implementation and sustainability.

1. Funding was the most frequently cited and highest-ranked resource needed for effective participation in the coordinated safety program. Given the financial constraints faced by many suburban jurisdictions, the availability of adequate funding is essential to cover the costs of infrastructure improvements, technology adoption, enforcement efforts, and educational campaigns. Funding also enables jurisdictions to address long-term maintenance needs and adopt cutting-edge safety measures such as smart traffic technologies. This focus on funding reflects the challenges previously identified in coordinating safety efforts, particularly the fiscal constraints that were highlighted as barriers to improved safety coordination. To address this, the program must ensure access to flexible and reliable funding sources, possibly through federal or state grants, public-private partnerships, or cost-sharing agreements between jurisdictions.
2. Training and education emerged as another top priority, highlighting the need to equip local staff with the knowledge and skills to implement safety programs effectively. This need reflects a recognition that many jurisdictions may not have sufficient in-house expertise in areas like smart traffic technologies, data analytics, or pedestrian and bicycle safety measures. Providing targeted training will not only help build capacity but also enhance the consistency and quality of safety interventions across the region. Moreover, training ties directly into the policy priorities discussed earlier, particularly around education and awareness campaigns and data-driven enforcement strategies, ensuring that staff are well-prepared to handle the complex tasks associated with modern safety programs.
3. Communication tools were also identified as critical resources, particularly for improving coordination between jurisdictions and stakeholders. Effective communication platforms can help facilitate the sharing of data, resources, and best practices between MPO members and enhance public engagement. Tools such as collaborative software, public feedback systems,

and real-time traffic monitoring can all play roles in improving safety outcomes. As highlighted in earlier sections, communication is key to fostering collaboration in joint enforcement efforts, policy alignment, and coordinated public safety campaigns. By providing access to robust communication tools, the program can help overcome the fragmented governance issues previously identified as barriers to coordination.

4. Several TCC members emphasized the need for data and analytics support to participate effectively in the coordinated safety program. Access to comprehensive and real-time data is critical for understanding traffic patterns, identifying high-risk areas, and evaluating the effectiveness of safety interventions. This need for data aligns with the policies discussed earlier around data collection, integration, and sharing, which were identified as key components of a successful safety program. By providing access to centralized data platforms and analytics tools, the program can enable jurisdictions to make data-driven decisions and improve the targeting of interventions. Additionally, analytics support can enhance the adoption of smart traffic technologies, which rely on real-time data to optimize traffic flows and reduce crash risks.
5. Coordination with external stakeholders, such as property owners to resolve right-of-way (ROW) limitations, was identified as another important resource. Suburban jurisdictions often face challenges related to limited ROW, which can restrict the ability to install safety amenities like pedestrian crossings, curb ramps, or traffic calming measures. Coordinating with property owners and other parties can help jurisdictions overcome these physical barriers and create more effective safety solutions. This need ties directly into earlier discussions around road design issues and the difficulties suburban jurisdictions face in balancing safety improvements with ROW constraints. Providing technical assistance and mediation support for negotiations with property owners could be crucial for unlocking opportunities for safety improvements.
6. Technical assistance was also highlighted as an important need for jurisdictions, especially in implementing new safety technologies, data systems, and design interventions. Jurisdictions may lack the internal capacity to deploy these solutions effectively without expert guidance, and technical assistance can fill that gap. This resource is particularly critical in ensuring that smaller or resource-constrained jurisdictions can fully participate in the coordinated safety program. Technical assistance complements the need for training and aligns with the emphasis on smart technologies and data-driven enforcement discussed earlier, ensuring that safety interventions are implemented correctly and efficiently.

The prioritized support and resources identified by TCC members highlight the diverse needs of suburban jurisdictions when participating in a coordinated safety program. Funding, training, and communication tools emerged as top priorities, reflecting the need for both financial and technical support to overcome existing barriers to safety coordination. The coordinated safety program must address these needs to ensure that all jurisdictions, regardless of size or resource constraints, can effectively contribute to and benefit from the program's efforts.

5.2. Policy Framework for the Coordinated Safety Program

The coordinated safety program is structured to enhance the alignment and collaboration of safety efforts across jurisdictions in the suburban areas of the NYMTC region. The program seeks to identify policies and actions that improve the coordination between the existing safety programs in each jurisdiction. This collaborative approach ensures that resources are optimized, and that safety improvements can be made more effectively and efficiently across municipal boundaries.

The program is divided into two key components: policies that support inter-jurisdictional coordination and the specific actions that jurisdictions can implement to facilitate this collaboration. The policy framework focuses on ensuring consistent standards and practices across jurisdictions, addressing gaps in communication, data sharing, and aligning goals around safety enforcement and infrastructure improvements. Policies such as shared data protocols, unified enforcement strategies, and collaborative public awareness campaigns are designed to remove barriers and streamline efforts across multiple jurisdictions.

In addition to these policies, the coordinated safety program also outlines practical actions that aim to support the collaboration between jurisdictions. These actions include joint infrastructure projects, coordinated traffic calming measures, and shared resources for implementing smart traffic technologies. By focusing on these collaborative efforts, the program enables jurisdictions to leverage each other's strengths and create a more integrated and efficient safety network.

With the framework for enhanced coordination established, the following sections will explore in detail the policies and actions that form the coordinated safety program, emphasizing how they support and strengthen inter-jurisdictional collaboration.

Based on the input from the TCCs, safety data from the previous chapter, and findings from the literature review and interviews with other MPOs, the policy framework was developed to guide the coordinated safety program. This framework is structured to address the safety issues identified in the study area, foster inter-jurisdictional collaboration, and align existing efforts across the counties. These policies focus on key areas such as data management, enforcement, communication, federal relations, emerging technologies, and education. By aligning efforts across jurisdictions, these policies will enable a more streamlined and comprehensive approach to transportation safety, ensuring that safety initiatives are both data-driven and uniformly implemented throughout the region.

5.2.1. Data Collection, Integration, and Sharing

Effective coordination hinges on the availability and accessibility of reliable transportation safety data. In New York State, the Traffic Records Coordinating Council (TRCC) plays a central role in this coordination. The TRCC is a coalition of agencies and organizations committed to improving traffic safety through enhanced data systems. It is chaired by the Director of the Governor's Traffic Safety Committee and is formally chartered to guide the development and implementation of the state's Traffic Safety Information Systems Strategic Plan. Six executive-level agencies form the core of the TRCC's membership, each responsible for a critical traffic data system. These include the Department of Health (DOH), which oversees injury surveillance systems such as CODES and pre-hospital care reporting; Department of Motor Vehicles (DMV), which manages the Accident Information System (AIS), driver license files, and citation systems; Department of Transportation (DOT) that maintains roadway data systems like the Roadway Inventory System (RIS) and Crash Location Editing & Analysis Repository (CLEAR); Division of Criminal Justice Services (DCJS), involved in enforcement-related records; Division of State Police (NYSP), which contributes data via enforcement and crash reporting systems such as Niche RMS and TraCS; and the office of Court Administration (OCA) that operates the Universal Case Management System (UCMS) that captures adjudication outcomes.

To ensure a consistent and collaborative approach to transportation safety across jurisdictions, the following policy measures are proposed:

- **Standardized Data Formats and Protocols:** Region-wide policy for collecting and reporting transportation safety data that would align with the Model Minimum Uniform Crash Criteria (MMUCC). Data format and protocol standardization will facilitate integration and comparative analysis across agencies and jurisdictions.
- **Centralized Data Repository:** A centralized data repository, potentially building on tools like the Traffic Safety Statistical Repository (TSSR), would allow seamless access to data across the MPO region, supporting planning, evaluation, and research. This can be managed by the MPO and would serve as a shared platform where all jurisdictions can upload and access transportation safety data.
- **Mandatory Data Sharing Agreements:** Formal agreements between local, regional, and state agencies would outline the types of data to be shared, the frequency of sharing, and each party's responsibilities. These agreements ensure that all stakeholders have access to critical safety data, fostering transparency and collaboration.
- **Real-Time Data Integration for Safety Monitoring:** Policies requiring the integration of real-time data from traffic sensors, vehicle data, and pedestrian counts would enable continuous safety monitoring. By leveraging real-time information, jurisdictions can respond more quickly to emerging safety issues. This can be completed through utilizing systems such as TraCS and the forthcoming Crash Reporting Information System (CRIS).
- **Data Privacy and Security Policy:** To protect sensitive information, policies must define how transportation safety data is anonymized and safeguarded during the collection, sharing, and integration processes. Ensuring data privacy is crucial for maintaining public trust and complying with legal requirements.

5.2.2. Regulations and Enforcement

Consistency in traffic regulations and enforcement practices across jurisdictions is essential for ensuring safety and accountability. The following policies aim to harmonize regulations and standardize enforcement efforts region-wide:

- **Regional Traffic Law Standardization:** By harmonizing key traffic regulations such as speed limits, distracted driving laws, and pedestrian right-of-way rules, the region can ensure that all road users experience consistent safety measures, regardless of the jurisdiction they are in.
- **Uniform Enforcement Training and Practices:** Standardized enforcement training protocols for issues such as DUI enforcement, speeding violations, and pedestrian safety measures would promote uniform application of the law across jurisdictions, ensuring fair and consistent enforcement practices.
- **Joint Enforcement Operations:** Encouraging jurisdictions to conduct joint enforcement operations would provide a broader, more coordinated approach to traffic law enforcement, enabling agencies to share resources and target high-risk areas more effectively.
- **Enforcement Data Reporting and Coordination:** A regional approach to enforcement data reporting would facilitate a coordinated response to emerging safety issues. By sharing enforcement data, jurisdictions can align their strategies, identify high-risk areas, and develop data-driven enforcement plans.

5.2.3. Communications with Public and Stakeholders

Clear and consistent communication is vital for ensuring that the public and stakeholders are well-informed about regional safety initiatives and policies. The following policies aim to enhance outreach and engagement:

- **Regional Safety Awareness Campaigns:** Developing and promoting region-wide safety awareness campaigns would ensure consistent messaging on road safety rules and initiatives, helping to reinforce positive behaviors among drivers, pedestrians, and cyclists across all jurisdictions.
- **Stakeholder Engagement Plans:** Formalized engagement plans would ensure that local governments, advocacy groups, and the public are regularly informed and involved in safety program updates. Consistent stakeholder communication strengthens community involvement and feedback in safety initiatives.
- **Multilingual Safety Outreach:** Implementing multilingual outreach campaigns would ensure that safety messages reach all communities, especially non-English-speaking populations, fostering inclusivity and maximizing the impact of safety campaigns.
- **Real-Time Traffic and Safety Updates:** The development of regional apps or websites to provide real-time traffic and safety updates would keep the public informed about traffic conditions, road safety initiatives, and enforcement activities. This would empower individuals to make safer travel decisions and stay aware of ongoing safety efforts.

5.2.4. Federal Relations with State, Regional, and Local Governments

Collaborating with federal agencies is essential to ensure that regional safety initiatives align with national standards and take advantage of available funding opportunities. The following policies aim to strengthen these relationships:

- **Coordinated Grant Applications:** Encouraging jurisdictions to submit joint applications for federal and state safety grants would maximize funding opportunities for regional safety projects, allowing for larger-scale improvements.
- **Alignment of Safety Standards:** Policies that ensure alignment between state and regional safety standards and federal safety regulations would promote consistency in crash reporting, vehicle standards, and safety protocols.
- **Federal Safety Policy Advocacy:** Establishing a regional task force to advocate for federal policies that support local and regional safety priorities would give the region a unified voice in influencing national safety initiatives.
- **Federal Funding Utilization Tracking:** A system for tracking the use of federal safety funding would ensure compliance with federal requirements and optimize the allocation of resources for maximum safety improvements.

5.2.5. Emerging and Automated Technologies

Integrating emerging technologies into transportation safety efforts can significantly improve outcomes. These policies focus on fostering the adoption of new technologies and coordinating efforts across jurisdictions:

- **Technology Pilot Programs:** Establishing pilot programs for testing new transportation safety technologies (e.g., automated vehicles, connected infrastructure) would allow jurisdictions to experiment with innovative solutions before scaling them region-wide.

- **Automated Vehicle Integration Policies:** Defining specific areas where automated vehicles can be tested or deployed, in coordination with local jurisdictions, ensures that these technologies are introduced safely and in a controlled manner.
- **Connected Infrastructure Development:** Prioritizing the installation of smart traffic signals and other V2I (vehicle-to-infrastructure) technologies at critical intersections would enhance communication between vehicles and traffic management systems, improving overall safety.
- **Data Privacy and Security Standards:** As emerging technologies increasingly rely on data, establishing robust privacy and security policies is crucial to protect sensitive information while maximizing the benefits of technological integration.

5.2.6. Education and Awareness

Public education and awareness are key components of any successful safety initiative. The following policies aim to promote safety education at the regional level:

- **Region-Wide Safety Campaigns:** Developing comprehensive safety campaigns focused on shared safety issues such as distracted driving, pedestrian safety, and speeding would help align public safety messaging across jurisdictions.
- **School Safety Education Programs:** Implementing safety education programs in schools would raise awareness among children, parents, and staff about the importance of road safety, particularly around school zones.
- **Periodic Safety Education for Drivers:** Providing refresher courses for drivers on new traffic laws and safe driving techniques would ensure that road users are kept up-to-date on best practices for road safety.

By implementing these policies, the coordinated safety program ensures a unified and comprehensive approach to transportation safety, while addressing the unique needs and challenges of each jurisdiction within the NYMTC region.

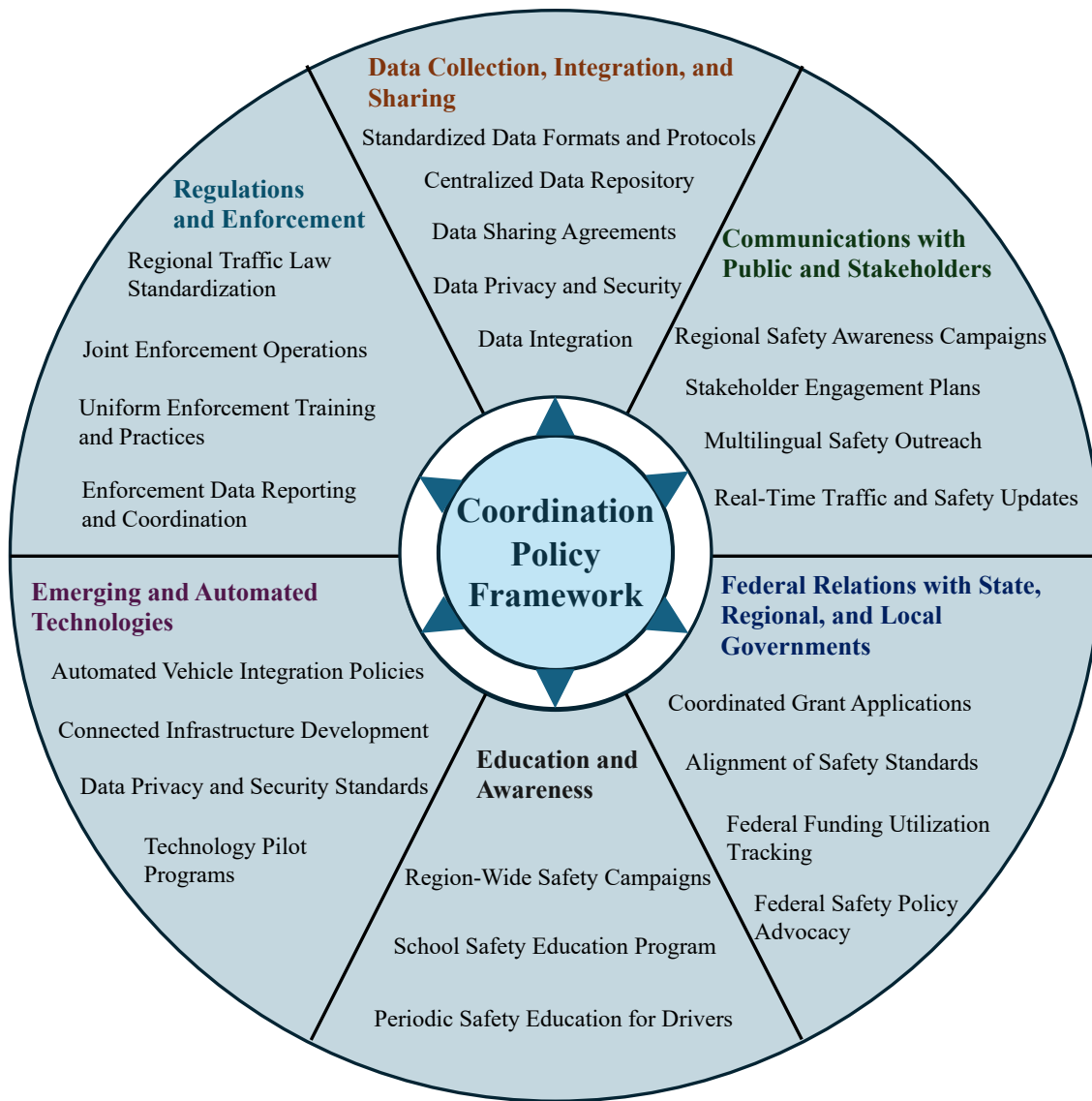


Figure 46 Policy Framework of the Coordinated Safety Program

5.3. Actions to Strengthen Safety Collaboration

In order to improve coordination and collaboration across the NYMTC suburban subareas, the following actions are designed to operationalize the policies outlined above. These actions focus on enhancing inter-jurisdictional communication, optimizing the use of data and resources, and fostering regional cooperation to address shared safety concerns. By implementing these actions, the coordinated safety program will facilitate a more unified, effective approach to transportation safety, leveraging each jurisdiction's strengths while addressing common challenges.

5.3.1. Establish a Centralized Data Sharing Platform

One of the most critical actions for improving collaboration is creating a centralized data-sharing platform managed by the MPO. This platform will enable all jurisdictions to upload and access transportation safety data in real time, fostering transparency and better decision-making across

the region. The platform will standardize data formats, ensuring consistency and making it easier for jurisdictions to analyze and compare safety data.

- **Create a centralized data repository:** Build a secure, cloud-based system that allows for the storage, retrieval, and analysis of transportation safety data across all jurisdictions.
- **Standardize data collection protocols:** Develop a set of regional data standards to ensure that all jurisdictions collect and report transportation safety data in a consistent manner.
- **Facilitate data sharing agreements:** Draft and implement mandatory data-sharing agreements that outline the type, frequency, and security of the data to be shared among jurisdictions and agencies.

5.3.2. Launch Joint Enforcement Operations

Coordinated enforcement efforts across jurisdictions will strengthen traffic law enforcement and reduce safety risks in high-priority areas. Joint enforcement operations will allow local law enforcement agencies to pool their resources and increase their presence in areas with high rates of traffic violations and crashes.

- **Coordinate joint enforcement actions:** Set up periodic joint operations between neighboring jurisdictions to tackle key safety issues such as speeding, distracted driving, and DUI enforcement.
- **Standardize enforcement protocols:** Develop region-wide protocols for key traffic law enforcement areas to ensure uniformity in enforcement, training, and reporting across all jurisdictions.
- **Share enforcement data regionally:** Regularly update the centralized data platform with enforcement data to track progress, identify trends, and adjust enforcement strategies as needed.

5.3.3. Implement Region-Wide Public Safety Campaigns

A consistent, unified message on road safety across the entire NYMTC region will increase public awareness and encourage safer behaviors among drivers, pedestrians, and cyclists. These campaigns will be designed to address the most pressing safety concerns identified in the suburban areas, such as pedestrian safety and speeding.

- **Develop multilingual safety campaigns:** Ensure all communities are reached by providing safety messaging in multiple languages and targeting all population groups within the suburban subareas.
- **Create school-based education programs:** Partner with schools to educate students, parents, and staff on road safety, with a particular focus on pedestrian safety in and around school zones.
- **Promote real-time traffic safety updates:** Use regional apps and websites to provide real-time updates on road safety initiatives, traffic conditions, and enforcement activities. These tools will help keep the public informed and engaged in regional safety efforts.
- **Coordinate safety messages on Dynamic Message Signs (DMS):** Leverage DMS infrastructure to enhance safety campaign messaging and provide real-time updates to road users. Messages on DMS can be tailored to emphasize current safety concerns, such as speeding or pedestrian crossings, and to promote specific safety initiatives or enforcement

activities in the region. By integrating DMS into public safety campaigns, the NYMTC region can amplify its messaging while delivering actionable, timely information to drivers.

5.3.4. Facilitate Cross-Jurisdictional Collaboration on Infrastructure Projects

Coordinating infrastructure improvements across jurisdictions is essential for ensuring that safety measures are implemented consistently and effectively. This action focuses on promoting collaboration on critical projects, such as installing smart traffic signals and other connected infrastructure, to reduce safety risks across the region.

- **Coordinate cross-jurisdictional infrastructure planning:** Facilitate meetings between neighboring jurisdictions to align priorities and coordinate infrastructure projects, particularly along shared corridors or intersections.
- **Dedicate funding for smart infrastructure:** Allocate regional funding to install and maintain smart traffic signals, V2I (vehicle-to-infrastructure) technology, and other connected infrastructure along high-traffic corridors and intersections.
- **Implement pilot programs for emerging technologies:** Collaborate on pilot programs to test new transportation safety technologies, such as automated vehicles and connected infrastructure, and ensure that these technologies are integrated across jurisdictions.

5.3.5. Strengthen Inter-Jurisdictional Communication Channels

Effective communication is key to maintaining collaboration between jurisdictions and ensuring the success of the coordinated safety program. Establishing clear, regular communication channels will enable jurisdictions to share information, address challenges, and collaborate on solutions.

- **Set up a regional communication task force:** Establish a task force consisting of representatives from each jurisdiction to oversee coordination, share updates, and resolve any challenges related to the safety program.
- **Host regular coordination meetings:** Organize monthly or quarterly meetings with local, regional, and state stakeholders to review the progress of safety initiatives, share best practices, and identify areas for improvement.
- **Create a shared digital communication platform:** Develop a digital platform where stakeholders can communicate in real-time, share documents, and collaborate on regional safety initiatives.

5.3.6. Secure Joint Federal and State Funding for Safety Projects

Access to adequate funding is critical for implementing safety measures. Encouraging jurisdictions to apply jointly for federal and state safety grants will maximize the chances of securing funding for regional safety projects.

- **Coordinate joint grant applications:** Develop a strategy for submitting joint applications for federal and state safety grants, ensuring that all jurisdictions benefit from the funding.
- **Track federal funding utilization:** Implement a system for tracking the use of federal and state funding, ensuring that funds are allocated efficiently and used in compliance with all regulations.
- **Advocate for federal safety policies:** Establish a task force to advocate for federal safety policies that support regional priorities, ensuring that the needs of suburban areas are reflected in national safety initiatives.

By implementing these actions, the coordinated safety program will foster stronger collaboration between jurisdictions, making it easier to share resources, align enforcement efforts, and implement consistent safety measures. The focus on data sharing, joint operations, infrastructure coordination, and communication will enhance the overall safety environment across NYMTC's suburban subareas, creating a safer, more unified transportation network.

The action program of the coordinated safety initiative translates the policy framework into concrete steps and projects that can be implemented by the participating jurisdictions. The action program is designed to be flexible enough to accommodate local variations in needs and resources while promoting regional collaboration and efficiency.



Figure 47 Action Items Included within the Coordinated Safety Program

Chapter 6: Conclusion

The development of a coordinated safety program for NYMTC's suburban subareas revealed several important insights into the challenges and opportunities for enhancing inter-jurisdictional cooperation in transportation safety. The discussions with Transportation Coordinating Committee (TCC) members and extensive research highlighted the significant barriers that jurisdictions face in coordinating their safety efforts. These include fragmented governance structures, conflicting regulations, funding limitations, and communication gaps. In addition, design constraints like right-of-way limitations, especially in areas such as Long Island and Hudson Valley, further complicate efforts to improve transportation safety.

The feedback from TCC members also made it clear that funding, training and education, communication tools, and technical assistance are crucial for enabling jurisdictions to participate effectively in a coordinated safety program. Data sharing and analytics support were also frequently mentioned, underscoring the importance of real-time data integration to improve safety monitoring and decision-making across the region. The discussions identified that rather than starting new safety programs from scratch, this initiative should aim to enhance coordination between existing safety efforts within different jurisdictions.

Central to improving coordination are policies that focus on standardized data collection, integration, and sharing, as well as the need for joint enforcement strategies and region-wide public safety campaigns. Technological advancements, including pilot programs for emerging technologies like automated vehicles and smart infrastructure, were also identified as critical to ensuring a modern and coordinated approach to transportation safety. Additionally, ensuring alignment of safety standards with federal guidelines will help secure and optimize federal funding for regional projects.

Several key takeaways emerged from these findings. Most importantly, the coordinated safety program will not involve creating new safety initiatives but will instead focus on enhancing collaboration between jurisdictions, ensuring that existing efforts are better aligned and coordinated. A centralized data platform, managed by the MPO, will serve as the foundation for this coordination, providing a standardized system for data collection and sharing. The program will also prioritize joint enforcement operations, ensuring that safety regulations are uniformly enforced across the region. Public engagement through multilingual, region-wide safety awareness campaigns will play a vital role in addressing safety issues like speeding, distracted driving, and pedestrian safety. Lastly, improved communication between jurisdictions, facilitated by regular coordination meetings and shared digital platforms, will foster better cooperation and knowledge-sharing across the region.

To ensure the success of this coordinated safety program, the following recommendations are proposed:

- Develop a centralized data platform by establishing a repository for safety data, standardizing data formats across jurisdictions, and implementing real-time data sharing protocols to inform decision-making.
- Implement joint enforcement strategies by organizing cross-jurisdictional enforcement operations and aligning training and enforcement protocols to ensure uniform traffic law application across the region.

- Focus on public awareness through the launch of region-wide safety campaigns that are multilingual and accessible, targeting key safety concerns such as pedestrian safety, speeding, and distracted driving.
- Invest in emerging technologies by dedicating funding and resources to pilot smart infrastructure projects, such as connected vehicle technology and smart traffic signals, to modernize the region's transportation systems.

Looking toward the future, it will be important to expand pilot programs for emerging transportation technologies, particularly automated and connected vehicles. Ensuring these systems are integrated with regional traffic management will be key to their success. As real-time data collection and sharing become more prevalent, stronger data privacy and security standards will also need to be developed. The program will require continuous evaluation and adaptation, allowing for iterative improvements based on new data and changing safety needs. A formal, long-term framework for inter-jurisdictional collaboration should also be established to ensure that the coordinated safety program remains effective and sustainable.

In conclusion, this program seeks to strengthen inter-jurisdictional collaboration by implementing policies and actions that align safety efforts across suburban subareas of NYMTC. With a focus on data integration, joint enforcement, public engagement, and the adoption of emerging technologies, the program aims to foster a safer and more unified transportation network in the region.

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Appendix A

Agency Questionnaire

Section 1: Interviewee Information

1. What is your name?
2. What is your job title?
3. Briefly describe your responsibilities in the position.
4. How long have you been working in this capacity?
5. What is your experience with the development of the safety program?

Section 2: Body of Interview

1. What are the major transportation safety challenges overall and specifically in suburban areas?
2. Could you describe the current methods and tools your agency uses for safety assessments?
3. What key components/metrics do you believe should be included in an effective safety assessment template?
4. How frequent the safety assessment methods are being updated?
5. What current safety initiatives or programs are in place within your agency?
6. How technologies/emerging technologies were incorporated in addressing safety challenges? and what safety-enhancing technologies are currently being used by your agency?
7. What are the major challenges faced in the implementation of these technologies?
8. How do policy decisions impact the adoption of safety technologies in your agency?
9. Can you describe how your agency engages with stakeholders (e.g., government bodies, the public, private sector) in decisions regarding safety technologies?
10. What strategies does your agency employ to raise safety awareness among the public?
11. How does your agency maintain the coordination with other jurisdictions?
12. Do you have any key take aways/ recommendations for improving transportation safety through technology and a successful utilization of technology approaches?
13. What steps do you think are necessary for the successful integration and adoption of new safety technologies?

Appendix B

Transportation Coordination Committees (TCCs) Poll Questions

1. Each subarea in the NYMTC planning region can have their own unique set of safety concerns. Please share at least 4 of your safety concerns
2. What types of interventions will have the most impact on improving safety? Please rank this list from the most important to the least:
 - Enforcement measures
 - Infrastructure improvements
 - Public education campaigns
 - Traffic calming
 - Traffic control
3. What policies do you consider important in a coordinated safety plan? (Please rank this list by ordering from the most important to the least)
 - Communications with public and stakeholders
 - Data (collection, integration, and sharing)
 - Education and awareness
 - Emerging and automated technologies
 - Federal relations with state, regional, and local governments
 - Human behavior
 - Regulations and enforcement
4. Which of these safety issues would you like to address in your area? (Select all that apply)
 - Distracted driving
 - High traffic volume near schools
 - Lack of pedestrian infrastructures (e.g., crossings, sidewalks, and lighting)
 - Road design issues (e.g., sharp curves, ROW limitations)
 - Speeding
5. Are there any active safety programs and initiatives missing from your subarea listing? If yes, please list them

County	Nassau		Suffolk
Safety programs	▪ Walk Safe Nassau ▪ Town of Hempstead School Bus Stop-Arm Program ▪ Photo Enforcement - Red Light Camera Program ▪ Engineering Interventions ▪ Enforcement Measures ▪ Education Efforts		▪ School Bus Safety Program ▪ Town of Brookhaven Wildlife and Ecology Center Safety Town ▪ Teen Driver Safety Program ▪ Suffolk County Red Light Safety Program ▪ Complete Streets Resolution
County	Rockland	Putnam	Westchester
Safety Programs	▪ Engineering Solutions ▪ Complete Streets Approach	▪ Complete Streets Analysis ▪ Engineering Solutions ▪ Education Measures ▪ Putnam County School Bus Safety Program	▪ Community Outreach and Education Initiatives ▪ Community Traffic Safety Program ▪ Proactive Engagement with Vulnerable Groups

6. Which of the following safety focus areas are currently being addressed in your jurisdiction? (Select all that apply)

- Pedestrian safety
- Bicycle safety
- School zone safety
- Speed management
- Traffic enforcement
- Public education and awareness

7. Among the existing transportation safety policies in your region, are there any that you think it should be revised or strengthened? If yes, please specify

8. In what areas do you see potential for improved coordination between jurisdictions within the MPO planning area? (Order based on importance, most important first and least important last)

- Coordinated public education campaigns
- Data sharing and analysis
- Infrastructure planning and funding
- Joint enforcement efforts
- Policy alignment

9. List any barriers you see which could hamper improved coordination between jurisdictions?

10. Which policy areas should be prioritized in the coordinated safety program? (Order based on importance, most important first and least important last)

- Complete Streets policy
- Data collection and analysis policies
- Pedestrian and bicycle infrastructure standards
- Public education and awareness campaigns

- Safe Routes to School policy
 - Speed management
 - Traffic enforcement strategies
 - Vision Zero
11. Consider existing safety policies in your area. List those which could be aligned or adapted for a coordinated safety program
12. Considering a coordinated safety program, indicate which actions you would include to improve safety
- Address road design issues
 - Enhancing road maintenance and repair
 - Enhanced enforcement of traffic laws
 - Implementation of smart traffic technologies
 - Address road design issues
 - Enhancing road maintenance and repair
 - Enhanced enforcement of traffic laws
 - Implementation of smart traffic technologies
 - Intersection safety improvements
 - Increasing public safety campaigns
 - Pedestrian and bicycle network expansion
 - Safety enhancements at school zones
 - Traffic calming measures (e.g., speed humps, roundabouts)
13. How can enforcement be effectively integrated into these actions? (Select all that apply)
- Conducting regular DUI checkpoints
 - Increasing fines for traffic violations
 - Increasing the presence of traffic police in high-risk areas
 - Implementing automated enforcement (e.g., speed cameras)
 - Launching community-based enforcement initiatives
 - Offering incentives for safe driving behavior (e.g., insurance discounts)
14. Are there any ongoing or planned projects in your jurisdiction that could benefit from regional coordination? (If yes, please list them and describe how coordination could enhance its impact)
15. What support or resources would your jurisdiction need to effectively participate in a coordinated safety program? (Order based on importance, most important first and least important last)
- Communication tools
 - Coordination with other parties (e.g., with property owners to resolve ROW limitations)
 - Data and analytics support
 - Funding
 - Technical assistance

- Training and education

16. How frequently should coordination meetings or check-ins occur to ensure effective collaboration?

- Monthly
- Quarterly
- Biannually
- Annually

17. Are there any additional comments/recommendations you would like to provide?

18. Are there any specific stakeholders or agencies that should be involved in the coordinated safety program? (example: transportation service provider, state DOT, county department of transportation, public health agency, law enforcement agencies)