APPENDIX B

High Injury Network Development

UNION COUNTY SAFE STREETS FOR ALL ACTION PLAN

Background

Union County, New Jersey, comprises 21 municipalities and serves approximately 580,000 residents. While the county's road network includes major arterials such as US Route 1&9, Garden State Parkway, I-78, I-95, I-278, local roads make up a majority of the county's roadway mileage. The county roadway system carries heavy traffic volumes comprised of local trips, daily commuters, and freight movement in a built environment that includes both suburban and urban land uses. This mix of roadways throughout most of the county creates a complex transportation environment shared by drivers, bicyclists, pedestrians, and transit users.

Funded by a grant provided by the United States Department of Transportation's (USDOT's) Safe Streets for All (SS4A) grant program, the County is developing a Safety Action Plan aimed at evaluating current conditions and identifying strategies to reduce the number of fatalities and serious injuries on its roadways. The City of Elizabeth, as a subrecipient on the grant, is partnering with Union County on this effort. The plan's goals are to evaluate recent crash data and identify underlying trends, high-injury corridors, and key risk factors that contribute to traffic crashes in Union County and in the City of Elizabeth. By assessing these patterns, the County aims to understand where and why crashes are occurring and to evaluate the potential risk levels across its roadway network. This data-driven approach will inform the development of a prioritized list of locations and recommended countermeasures, forming the basis for an implementation plan that proposes targeted safety interventions.

In consideration of these challenges, and to support the County's efforts to minimize traffic-related deaths and injuries, the project team developed a **"High Injury Network"** which identifies roadway segments where the most serious traffic crashes – those resulting in deaths or serious injuries – have occurred over the most recent five period with full crash data available (2018-2022). This memorandum outlines the process and findings from the development of the high injury network. The goal of this analysis is to support Union County's efforts to reduce traffic-related harm by focusing resources on the corridors with the highest need for safety improvements.

High Injury Network Development

Key Methodology Considerations

CRASH DATA AND ANALYSIS YEARS

The High Injury Network (HIN) for Union County is based on the most recent five years (2018-2022) of complete crash data available on the NJDOT Safety Voyager website. Crash data from the year 2023 was available but incomplete at the time of data collection and therefore was excluded from the analysis. The FY25 SS4A Notice of Funding Opportunity (NOFO) also uses the most recent five years of crash data for reporting.

The project team downloaded and compared data from multiple crash data sources, including the New Jersey Division of Highway Traffic Safety (NJDHTS) Numetrics and NJDOT Safety Voyager for inclusion in the analysis. The comparison indicated that Safety Voyager's data included a higher number of crashes and had a higher geocoding rate compared to Numetrics. Based on these findings, the project team agreed to use crash data from NJDOT Safety Voyager for the analysis.

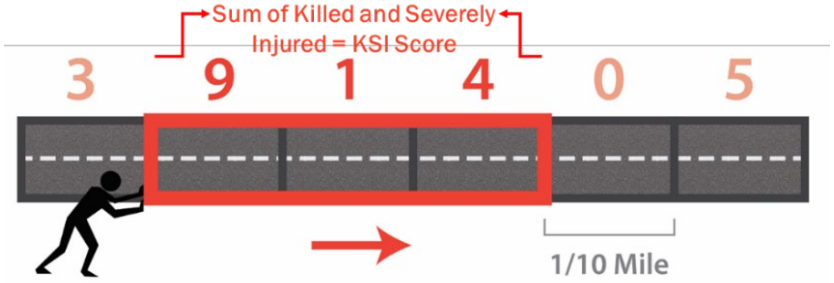
ROADWAY NETWORK DATA

The HIN utilized the single centerline roadway database available through NJDOT 2024 Straight Line Diagrams. This database depicts both divided and undivided roadways as single centerline segments rather than bi-directional segments. A single centerline roadway layer is preferred for HIN analysis as safety implementation rarely occurs on only one side of the road. Additionally, the team recognized that opposite directions of the road are usually similar in roadway and traffic attributes (such as posted speed limits and traffic volumes) and likely experience similar safety challenges. This is particularly applicable to county and local roads.

All county, municipal, and state jurisdiction roads were included in the analysis to provide a comprehensive assessment of safety issues within the county regardless of road ownership. However, limited access highways were not included as they tend to experience a high frequency of crashes but also have very high traffic volumes and vehicle miles traveled, which could skew the analysis towards these locations.

NETWORK SCREENING DATA

Similar to the method used to develop NJDOT's Network Screening Lists, the sliding windows network screening approach was used to screen roadway segments and identify high injury corridors within the county. This approach analyzes crash trends over a series of overlapping segments (commonly referred as windows) along the roadway network incrementally (see below figure). This approach helps standardize the roadway corridors into comparable segments which can be then filtered to identify corridors with the greatest number of fatal and severe injury crashes.



As part of this process, the project team tested different options to determine a suitable window length (typically, 0.5 mile or 1.0 mile) for the HIN. Smaller window segments may overfit crash trends or result in piecemeal segments that may be difficult to translate into corridor projects for implementation, while longer window segments may underfit the data, potentially overlooking high risk locations.

Considering these factors, the project team tested two window length options: 0.5-mile and 1.0-mile. The results were reviewed in coordination with the County. Based on this analysis, a minimum window length of 1.0 mile was selected for county- and state-owned roads to better reflect the nature of the county roadway network, which frequently spans multiple jurisdictions and has longer facility lengths.

A shorter window length of 0.3 miles was selected for the municipal roads based on findings and trends shown in the data analysis. The specified length of 0.3 miles for municipal roads also helped account for the smaller coverage of the municipal roadway corridors on the HIN.

HIN SCORING AND WEIGHTING

Safety action plans emphasize fatal and serious injury crashes; therefore, the team utilized unweighted totals of fatal and serious injury crashes as the HIN scoring metric. The metric did not employ any weighting as both killed (abbreviated “K”) and serious injury (abbreviated “SI”) crashes lead to life altering outcomes for those involved. Additionally, the team recognized that crash incidents involving similar roadway attributes and crash circumstances may lead to different outcomes due to varying reasons (such as a few extra seconds in how the pre-crash events unfold or the presence of children, elderly, or people with disabilities who might be more vulnerable).

As part of the HIN development process, the project team also developed a HIN using the equivalent Property Damage Only (ePDO) scoring approach, similar to the method used in NJDOT’s Network Screening Lists, to understand the high crash areas in the county and compare those results with the unweighted KSI approach. The comparison showed that both approaches produced similar results. Therefore, the unweighted KSI approach was selected to align with the Safe Systems Approach emphasis on reducing fatalities and serious injuries.

HIN THRESHOLD

The project team investigated several KSI minimum thresholds to capture the desired share of roadway miles, share of fatal and serious injury crashes, and extent of geographic distribution across the county. The HIN scoring threshold aims to identify roadway segments with the greatest concentration of killed and serious injury crashes. Typically, HIN analysis aims to capture a significant share of killed and serious injury crashes on a relatively smaller share of the network mileage. Identifying and targeting safety improvements at these locations allows for effective allocation of resources and funding to areas with the greatest concerns and potential for safety impact.

Based on these factors, a threshold of 5 KSI or greater was used for HIN segments on state or county roads, while a threshold of 4 KSI or greater was used on municipal roads (including the City of Elizabeth HIN).

CORRIDOR SCREENING

As the last step, the project team refined the identified HIN corridors using a manual screening process. This process specifically examined the County- and Elizabeth-owned corridors on the HIN. As part of this process, the team investigated the KSI crashes along each individual corridor and filtered those with KSIs at a specific intersection only. This process helped screen corridors that would benefit from corridor projects rather than intersection-specific projects.

Each corridor was then examined in detail and corridor limits (start and end points) were adjusted based on KSI crash patterns, roadway characteristics, and surrounding land uses. This process helped address corridor overhangs (i.e. significant stretches at either end with no KSI crashes) while also adjusting corridor limits to represent more logical extents for implementation purposes. Note that the manual screening process resulted in two HIN corridors having KSI totals that were less than the original minimum threshold.

Finally, the team compiled crash summary statistics for the refined HIN. For Union County, the refined HIN captured 58% of the county's killed and serious injury crashes on 5% of the overall roadway network. For the city of Elizabeth, 76% of the city's KSI crashes were captured on 14% of the overall road network. Union County and Elizabeth HIN analysis results are discussed in detail in the following section.

Step-By-Step Analysis Process

The steps used in developing the HIN are detailed below:

- Identify all roadway corridors using the Standard Route Identifier (SRI) ID to uniquely identify each corridor.
- Develop a Python script to divide the corridor into 0.1-mile segments and join to crashes within 30 feet.
- Determine a suitable window length (typically, ½ mile or 1 mile) by testing a variety of corridors to see how crashes are averaged along the corridor.
- Define HIN segments for a certain threshold (e.g., 5 fatal and serious injuries per window) for roadway corridors based on road ownership.
- Iterate as necessary with different thresholds to achieve the desired share of the roadway network and share of fatal and serious injury crashes.
- Combine overlapping windows to identify all continuous HIN corridors and summarize the total and vulnerable road user crash statistics for each corridor
- Rank the combined HIN corridors based on total KSI per mile for each corridor

Key Findings and Results

Union County High Injury Network

Figure 1 on the following page shows the Union County HIN corridors exceeding the minimum KSI threshold. The network spans a total of 70.9 roadway miles, with about half of the mileage (36.8 miles) being on state-owned roads and 7.9 miles on municipally owned roads (both shown in grey on Figure 1). The remaining 26.2 miles are on roads under the county's jurisdiction and are shown in red on the map. Overall, the Union County HIN comprises a small percentage (5%) of the county's total roadway mileage but captures 58% of the county's total KSI crashes. The frequency of KSI crashes along the HIN corridors ranges from 4.0 to 40.4 per mile. Corridors with higher frequency of KSI crashes are represented with thicker lines on the map.

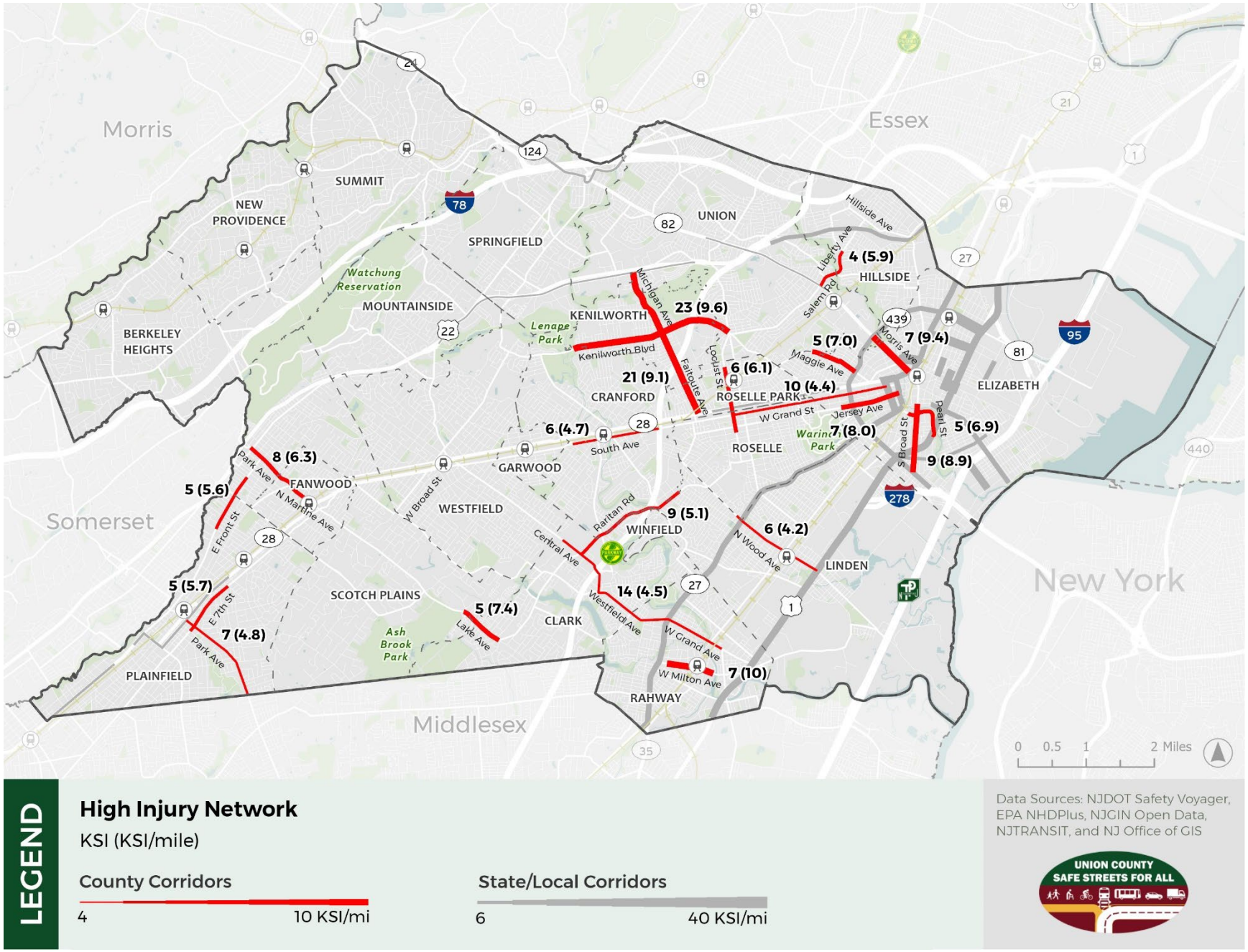
Table 1 summarizes the County's HIN by jurisdiction. The HIN captures a significant share of roads owned by the state (59%) and county (14%), which account for a majority of the KSI crashes on those facilities (91% and 56% respectively). About 1% of local road mileage is represented, corresponding to 23% of the KSI crashes on those roads (almost all within the City of Elizabeth). This is likely a function of roadway characteristics as higher speeds and higher volume streets tend to correlate with increased crash risk and higher likelihood of severe crash outcomes. Conversely, lower-speed residential streets tend to correlate with lower crash risk and more dispersed crash patterns.

The identified HIN corridors are notably clustered in the eastern and southwestern portions of the county, with limited representation in the northwest portion. Thirteen of the 21 municipalities in Union County include at least one HIN corridor. Certain municipalities, particularly those with higher concentrations of high-speed and high-volume roadways, contain multiple HIN corridors.

Table 1: High Injury Network Summary by Roadway Jurisdiction

Jurisdiction	Captured KSI	Total KSI	% of Total KSI Captured	Captured Miles	Total Miles	% of Total Miles Captured
State	252	276	91%	36.8	62.3	59%
County	**143**	254	**56%**	**26.2**	190.7	**14%**
Local	58	257	23%	7.9	1186.7	1%
Total	**453**	787	**58%**	**70.9**	1439.7	**5%**

Figure 1: High Injury Network – Union County



COUNTY-OWNED HIGH INJURY NETWORK

There are 20 county-owned roadway segments on Union County's HIN, located across 13 municipalities. Although these corridors make up only 14% of the county roadway network, they account for four times the share of KSI crashes on those roads. These corridors are concentrated within certain municipalities: 6 segments are in Elizabeth; 4 are in Union; 3 each in Clark, Cranford, Plainfield, Roselle, and Scotch Plains; and 2 each in Kenilworth, Linden, Rahway, and Roselle Park. Altogether, 11 municipalities have more than one HIN corridor. The corridors are located proximally to a mix of residential, commercial, and mixed-use contexts.

Table 2 provides basic information for the 20 county corridors, ranked by the ratio of KSI total per mile. Of these corridors, four experienced ten or more KSI crashes, 19 experienced five or more KSI, and one saw 4 KSI between 2018 and 2022. The full list of county-owned corridors on the HIN is shown below.

Table 2: HIN Corridor List – Union County

Route SRI	CR #	Roadway Segment	Municipality	KSI Total	Segment Length (in miles)	KSI Total per mile
20000648	CR 648	WEST MILTON AVE	Rahway	7	0.70	10.00
00000509	CR 509	KENILWORTH BLVD/GALLOPING HILL RD	Cranford, Kenilworth, Union	23	2.39	9.64
20000629	CR 629	MORRIS AVE	Elizabeth, Union	7	0.74	9.44
20000617	CR 617	FAITOUTE AVE/MICHIGAN AVE	Kenilworth, Roselle Park	21	2.30	9.12
20000623	CR 623	SOUTH BROAD ST	Elizabeth	9	1.01	8.93
20000612	CR 612	JERSEY AVE/WEST JERSEY ST	Elizabeth	7	0.88	7.96
20000655	CR 655	LAKE AVE	Clark, Scotch Plains	5	0.67	7.44
20000618	CR 618	MAGIE AVE	Elizabeth, Union	5	0.71	7.04

Route SRI	CR #	Roadway Segment	Municipality	KSI Total	Segment Length (in miles)	KSI Total per mile
20000614	CR 614	PEARL ST	Elizabeth	5	0.73	6.86
20000655	CR 655	NORTH MARTINE AVE/PARK AVE	Fanwood, Scotch Plains	8	1.26	6.33
20000619	CR 619	LOCUST ST	Roselle, Roselle Park	6	0.98	6.14
00000509	CR 509	SALEM RD/LIBERTY AVE	Hillside, Union	4	0.68	5.88
20000601	CR 601	7TH ST	Plainfield	5	0.87	5.74
20000620	CR 620	EAST FRONT ST/FRONT ST	Plainfield, Scotch Plains	5	0.89	5.61
20000607	CR 607	RARITAN RD	Cranford, Clark, Linden	9	1.76	5.11
00000531	CR 531	PARK AVE	Plainfield	7	1.47	4.76
20000610	CR 610	SOUTH AVENUE	Cranford	6	1.29	4.65
20000613	CR 613	CENTRAL AVE/BRANT AVE/ WESTFIELD AVE/WEST GRAND AVE	Clark, Rahway	14	3.08	4.54
20000610	CR 610	1ST AVE/WEST GRAND ST	Roselle, Elizabeth	10	2.29	4.36
20000617	CR 617	NORTH WOOD AVE	Linden, Roselle	6	1.44	4.17

Elizabeth High Injury Network

Figure 2 on the following page shows the HIN for the City of Elizabeth. Like Union County, a significant share of KSI crashes occurred on a small portion of Elizabeth's roadways: 22.3 miles (14% of the city's road mileage) account for approximately 76% of all KSI crashes. Of the 22.3 HIN miles, a majority (10.7 miles) are owned by the state, and 5.1 miles are owned by the county (both shown in grey on Figure 2). The remaining 6.5 miles are on roads under the City's jurisdiction and are shown in yellow on the map. The frequency of KSIs along the HIN corridors ranges from 4.0 to 40.4 per mile. Corridors with higher frequency of killed and severe injury crashes are shown with thicker lines on the map.

Breaking down KSI crashes by jurisdiction reveals that local roads host a high percentage of KSI crashes on a much smaller share of the network mileage. On state roads, 100% of all KSI crashes occurred on 86% of the network. On county roads, 82% of all KSI crashes happened on 48% of the network. On local roads, close to half of all KSI crashes (48%) occurred on just 5% of the network.

CITY-OWNED HIGH INJURY NETWORK

The City of Elizabeth's HIN includes 10 municipal-owned corridors. Many of these segments are located near or adjacent to major highways and arterials, including US Route 1&9, NJ Route 27, and the New Jersey Turnpike. This proximity to high-volume state-owned routes likely contributes to increased exposure and conflict points, particularly for vulnerable roadway users. A full list of HIN corridors is shown in Table 4.

Table 3: HIN Summary by Jurisdiction – City of Elizabeth

Jurisdiction	Captured KSI	Total KSI	% of Total KSI Captured	Captured Miles	Total Miles	% of Total Miles Captured
State	118	118	100%	10.7	12.5	86%
County	28	34	82%	5.1	10.7	48%
Local	**53**	110	**48%**	**6.5**	131.6	**5%**
Total	**199**	262	**76%**	**22.3**	154.8	**14%**

Figure 2: High Injury Network – City of Elizabeth

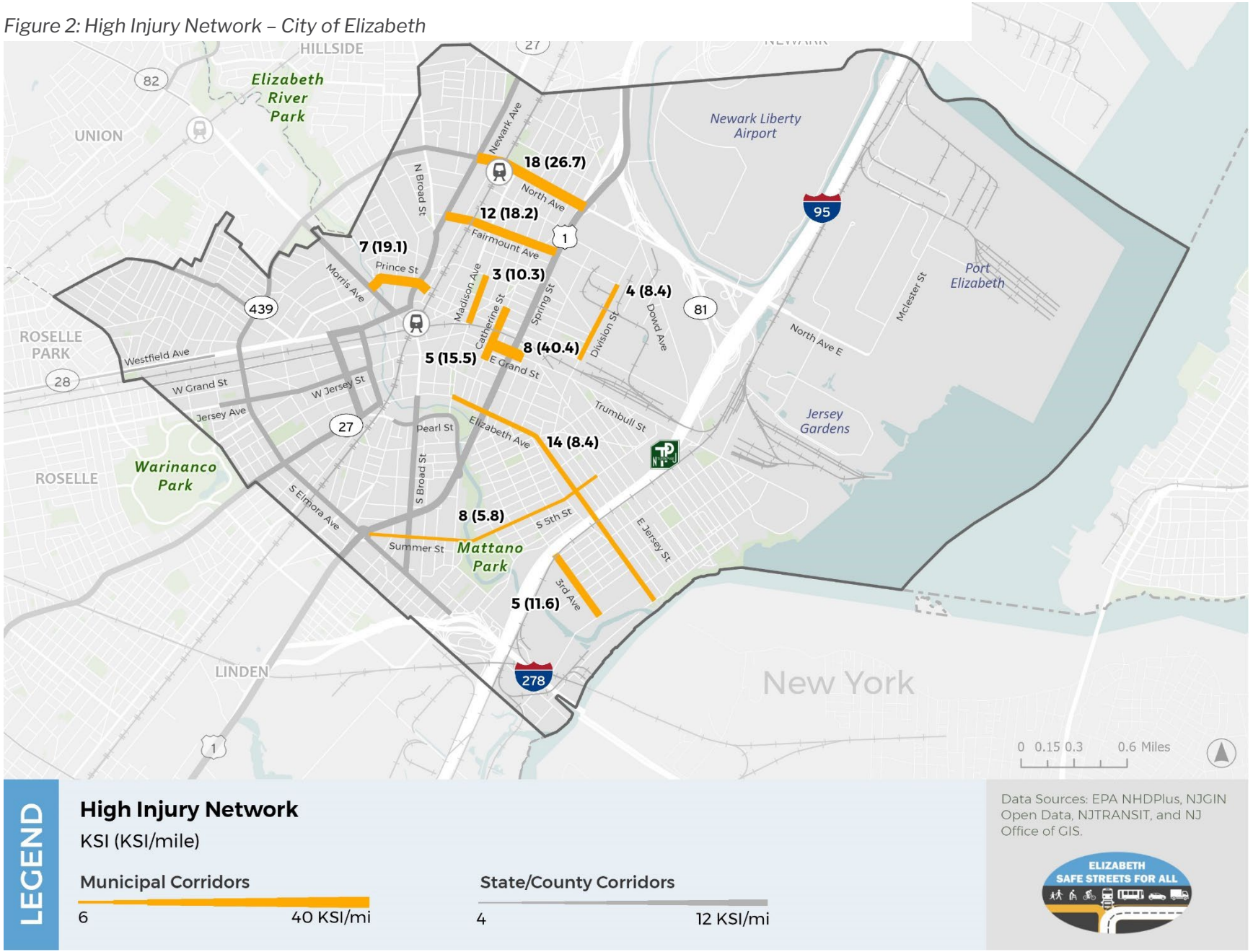


Table 4: HIN Corridor List – City of Elizabeth

Route SRI	Roadway Segment	KSI Total	Segment Length (in miles)	KSI Total per mile
200413862	E GRAND ST	8	0.2	40.4
20041769	NORTH AVE	18	0.7	26.7
20041416	PRINCE ST	7	0.4	19.1
200413971	FAIRMOUNT AVE	12	0.7	18.2
20041132	CATHERINE ST	5	0.3	15.5
20041017	3RD AVE	5	0.4	11.6
20041429	MADISON AVE	3	0.3	10.3
20041420	ELIZABETH AVE	14	1.7	8.4
20041418	DIVISION ST	4	0.5	8.4
20041422	SOUTH 5TH ST/SUMMER ST	8	1.4	5.8

Conclusion

The **High Injury Network (HIN)** methodology serves as a powerful tool for analyzing crash data and identifying roadway corridors where the highest concentrations of severe and fatal crashes occur and is a critical component of USDOT's Safe Streets for All program. The Union County Safe Streets for All (SS4A) Action Plan incorporates the HIN methodology as part of the safety analysis and uses it to identify the highest injury corridors within Union County and the City of Elizabeth. The County and Elizabeth HIN networks were developed based on the sliding windows analysis, which uses an iterative process to analyze and measure crash risk along uniform length segments across the entire roadway network. The analysis focuses on the number of killed and serious injury (KSI) crashes occurring on the roads between 2018 and 2022, the most recent five years of complete crash data available at the time the analysis was completed.

Findings from the HIN analysis revealed that a relatively small share of overall roadway mileage accounts for a disproportionately high percentage of severe and fatal crashes, as follows:

- **In Union County, 70.9 miles (5% of the total roadway network) were identified as HIN corridors, yet these segments accounted for 58% of all KSI crashes**. The overall network includes 20 county-owned corridors that make up 14% of the county road mileage but represented four times the share of KSI crashes on county roads.
- **In the City of Elizabeth, 22.3 miles (14% of the city's network) captured 76% of all KSI crashes.** This network included 10 municipal corridors with nearly half of the local road KSIs on only 5% of the local road mileage. These findings highlight specific corridors by jurisdiction where safety improvements can be most effective and underscore the importance of focusing resources on high-risk locations.

The identification of Union County's HIN provides a data-driven approach for prioritizing safety investments and advancing the goals of the Union County SS4A Action Plan. By understanding where crashes are concentrated, the high injury network analysis will help inform the project prioritization and implementation sections of the Union County SS4A Action Plan.