Kingston Rail Crossing Study

Evaluate and Enhance Safety along the West Shore Railroad Corridor

FINAL REPORT

Prepared by

wsp

Prepared by

UCTC
ULSTER COUNTY TRANSPORTATION COUNCIL

TABLES

FIGURES

APPENDICES

LIST OF ABBREVIATIONS AND ACRONYMS

ADA	Americans with Disabilities Act
AI	artificial intelligence
CBG	Census Block Group
CCTV	closed-circuit television
CFR	Code of Federal Regulations
FRA	Federal Railroad Administration
FHWA	Federal Highway Administration
mph	miles per hour
MUTCD	Manual on Uniform Traffic Control Devices
NYSDOT	New York State Department of Transportation
NYS	New York State
RCSS	Rail Crossing Safety Study
SAP	State Highway-Rail Crossing Action Plan
TAC	Technical Advisory Committee

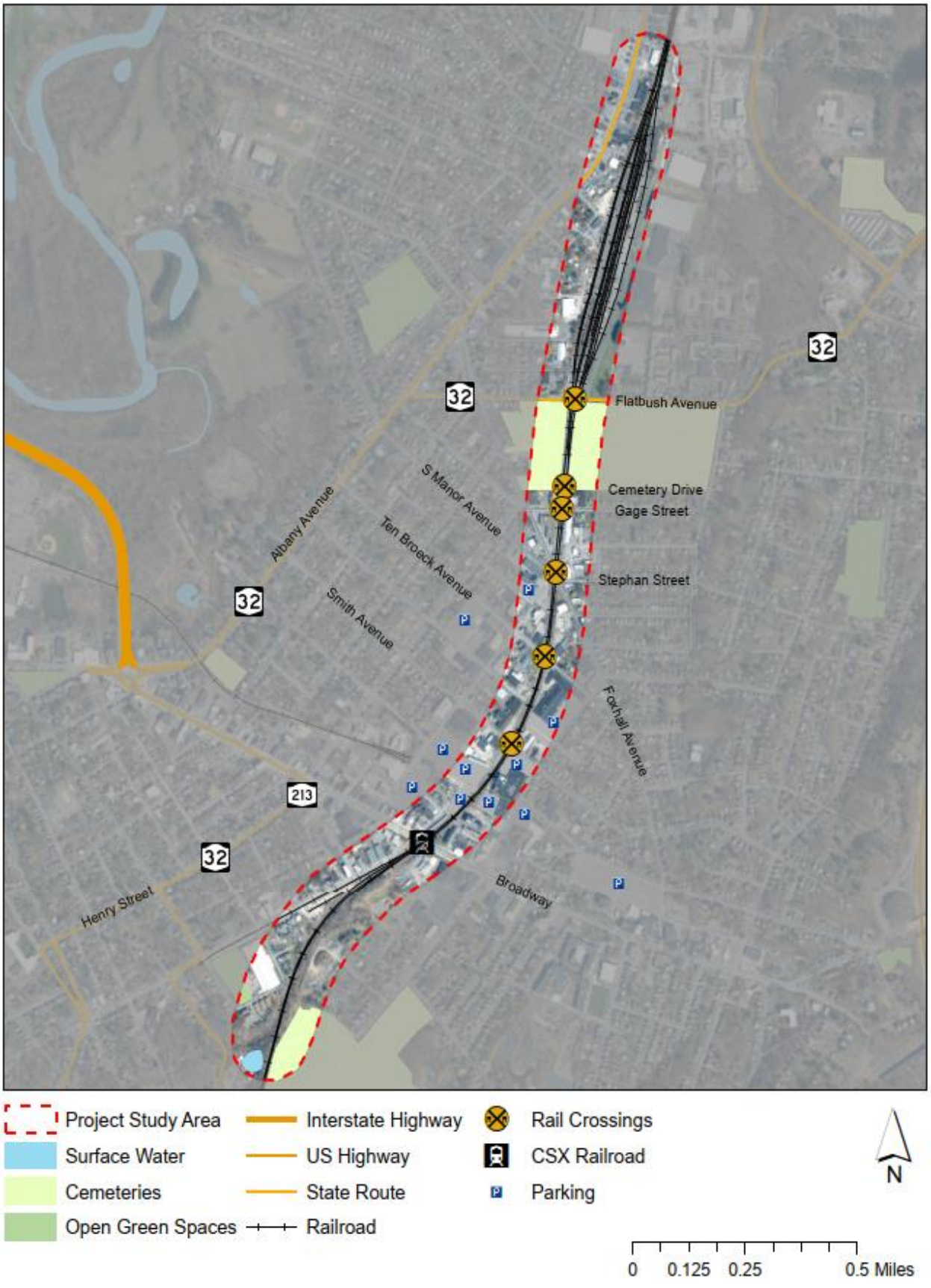
EXECUTIVE SUMMARY

In 2023, Ulster County Transportation Council contracted WSP USA, Inc. to conduct and evaluate safety along the West Shore Rail Corridor in the City of Kingston, NY, which includes six highway-rail grade crossings.

Over the past several years, the City of Kingston has experienced several pedestrian and vehicular accidents, including fatalities. The Rail Crossing Study aims to evaluate the existing highway-rail crossing and trespass events and the physical configuration along the rail corridor to identify solutions to help address the current issue through:

- Enhancing the safety along the rail corridor
- Assessing the current risks posed by hazards or vulnerabilities
- Developing a comprehensive risk reduction strategy by applying appropriate mitigations
- Providing recommended improvements to enhance safety including planning level costs and funding sources

The study considered both vehicular and pedestrian incidents at highway-rail grade crossings as well as trespassing hotspot locations along a 2-mile segment of the rail corridor within the City of Kingston. The plan considered mitigations and safety measures utilizing best practices and guidance from both the Federal Highway Administration (FHWA) as well as the Federal Railroad Administration (FRA).


32
Flatbush Avenue
Cemetery Drive
Gage Street
Stephan Street
S Manor Avenue
Albany Avenue
Ten Broeck Avenue
Smith Avenue
Forhall Avenue
213
Henry Street
Broadway
Project Study Area
Surface Water
Cemeteries
Open Green Spaces
Interstate Highway
US Highway
State Route
Railroad
Rail Crossings
CSX Railroad
Parking
N
0
0.125
0.25
0.5 Miles

Efforts to improve grade crossing and pedestrian safety generally fall into one of three basic approaches, otherwise known as the three "Es": engineering, education, and enforcement. Experience has shown that all three approaches must be aggressively and simultaneously employed on a long term basis by a wide variety of safety partners to be truly effective in reducing crossing incidents and fatalities.

The WSP team conducted field evaluations of the grade crossings and rail right-of-way within the study area. The field evaluations focused on the current conditions and safety measures (e.g., Traffic control devices, pavement markings, signage, and fencing) at the seven crossing and identified trespass locations.

A data driven hazard identification and management process was utilized to evaluate priority risk locations for the study. Crash data for the study area roadway segments were queried from NYSDOT for January 2017 through November 2023 through the Crash Location and Engineering Analysis and Reporting System. Crash data for the study area rail corridor segments (both grade crossing and trespass events) were queried from the FRA incident data as reported under 49 CFR 225 by individual railroads. FRA crossing incident data goes back to 1976 and is current through the 2022 calendar year. For the purpose of this study, FRA data did not factor in any 2023 incidents. Most of the FRA data analysis for highway-rail grade crossing events focused on both the past 46 years and a smaller subset of the past 10 years. The FRA data on trespassing incidents goes back to 2012 and is current to 2022. Because the NYSDOT data and FRA data are submitted by different organization and compiled under separate reporting criteria, there could be inconsistent data when comparing the two sources.

Crash rates for four highway-rail grade crossings far exceed statewide averages, indicating that there are mitigation and countermeasures opportunities, which, if implemented, have the potential for safety improvement. The NYS Route 32/Flatbush Avenue, Foxhall Avenue, and Smith Avenue crossings see higher rates of fatal/injury crashes compared to statewide averages for similar facility types.

Review of preliminary data and site evaluation identified three focus areas along the corridor that present the greatest challenges and risk. These three focus areas are the at-grade crossing at Foxhall/South Manor/Stephan Street; the area between Flatbush Avenue and Cemetery Drive private crossing; and the area south of Broadway along Greenkill Avenue. In addition to these three focus areas, other general highway-rail grade crossing and trespassing concerns were identified.

The comprehensive Study was conducted in cooperation with the project's Technical Advisory Committee (TAC) with involvement from the local communities and other interested stakeholders. Public Outreach and Community Involvement were integral throughout the development of the Study. The goal of the outreach process was to obtain valuable input from key stakeholders and to provide Study progress, as well as to report information back to the stakeholders on an ongoing basis. The public outreach process included:

Technical Advisory Committee Meetings -The TAC was a committee comprised of employees from the City of Kingston and representatives from FRA & CSX. A series of two (2) TAC meetings were held throughout the Study period so the committee could provide direction and guidance on decisions.

Roundtable Discussions – Included an in-person meeting with representatives from the YMCA and the Rural Ulster Preservation Company (RUPCO) provided valuable input about the pedestrian travel patterns of students coming from and going to the Kingston High School and where trespassing may occur.

Public Open Houses – Two (2) Public Open Houses were advertised and held at critical decision points during the Study to collect valuable information from the public. The first of two Public Open Houses was held on June 22, 2023, to introduce the public to the Study and gain input on existing conditions and needs. A Study video was played on a continuous loop and posted on the Study website for the public to view at their convenience. The second Public Open House was held virtually on October 25, 2023, in which the Study progress was presented to date, including a brief overview on Highway-rail grade crossing injuries and fatalities and trespassing incidents.

Based on the information gathered by WSP and the input provided from the public outreach a hazard assessment was conducted and the following key findings were summarized:

Highway Rail Grade Crossings

- The majority of highway-rail grade crossing incidents are a result of motor vehicle drivers violating activated gates and flashers and driving around the gates.
- The NYS Route 32/Flatbush Avenue, Foxhall Avenue, and Smith Avenue crossings see higher rates of fatal/injury crashes compared to statewide averages for similar facility types. Foxhall Avenue, in particular, experiences significantly more crashes than the statewide average for similar facilities. A contributing factor is the offset intersection configuration at Foxhall Avenue, Stephan Street, Cornell Street, South Manor Avenue, and the highway-rail grade crossing. The intersection approaches are skewed, which requires sharp turns and likely causes driver confusion when approaching the intersection.
- Dedicated pedestrian crossings and sidewalks to complement existing pedestrian gates would reduce risk to pedestrians and help separate pedestrian and motor vehicle traffic at the highway-rail grade crossing locations.
- Numerous highway-rail grade crossings fail to meet the following FRA criteria:
  - Advance Warning Signs: Indicators of an impending railroad crossing should be in place to provide advance notice to drivers.
  - Clear Sight Lines: Vegetation and obstructions should be cleared to ensure clear sight lines for drivers and train operators.

- Roadway Surface: The road at the crossing should be level with the tracks and maintained appropriately.

Pedestrian Trespassing

- There is limited fencing along the right-of-way, with access blocked or limited in other areas by adjacent buildings that abut the right-of-way.
- There are no documented hotspot incident locations, but there are two known locations where trespassing has been consistently observed:
  - South of Broadway where students or others are crossing to access the YMCA and Kingston High School. Cyclone fencing was erected in the area south of Broadway, but it has been vandalized and compromised, thereby making the fencing ineffective
  - Pedestrian trespassing is occurring along the rail corridor between Cemetery Crossing and Flatbush Crossing. This is evident by worn foot paths. The ability to deter or eliminate this pedestrian at-risk behavior is unlikely without engineering mitigations.

Based on these findings, the report highlights a series of recommendations as solutions to further enhance highway-rail grade crossing safety and reduce trespass events. The following are the key recommendations. The total list of recommendations are included at the end of this report.

- The City of Kingston should complete the planned implementation of the roadway safety enhancement projects for the Foxhall Avenue, Boices Lane and Flatbush Avenue crossings. Until longer term improvements are implemented at Foxhall crossing, install fencing along Cornell Avenue from the parking lot on Cornell Avenue to the Foxhall Crossing.
- The City of Kingston with support from Ulster County and NYSDOT, as needed, should provide upgrades and safety enhancements to all eight highway Rail Grade Crossings and associated pedestrian pathways. These improvements would include, dynamic envelope markings, pedestrian sidewalks gates and pavement markings, center lane delineators as further defined in this report and represented in the following renderings.
- Investigate the feasibility to install security fencing along the right-of-way between Flatbush and Cemetery crossings. In conjunction with this fencing, install a walkway between the security fencing and cemetery from the Flatbush crossing to Cemetery crossing.

- Replace the chain link fencing just south of Broadway along Greenkill Avenue with high strength security fencing that extends 500 to 1000 yards in each direction, if possible.

- The City of Kingston should partner with CSX to enhance right-of-way signage, installed at regular intervals, to remind individuals of the legalities and dangers of trespassing. Priority areas should be south of Broadway and on both sides of the track between Cemetery Lane and Flatbush.
- The City of Kingston and Ulster County should develop a collaborative working partnership with vested local, county, and state stakeholders to form an ongoing working group focused solely on highway-rail grade crossing and pedestrian safety along the rail corridor.
- CSX and the City of Kingston should collaborate to develop a rail safety public awareness program that educates and raises awareness to the community.
- The City of Kingston Police Department should conduct periodic random patrols and monitoring campaigns at all highway-rail grade crossings, specifically the Foxhall, Flatbush, and Smith grade crossings.

1 INTRODUCTION

This section presents the goals, methodology, and key definitions of this Kingston Rail Crossing Study.

1.1 STUDY PURPOSE

Over the last several years, there have been several pedestrian and vehicular accidents, including some fatalities, along the railway within the City of Kingston. This Rail Crossing Safety Study (RCSS) aims to evaluate existing street/rail crossings and trespass along the rail corridor to determine contributing factors and provide recommended solutions to address the current issues.

1.2 STUDY GOALS

The primary goals of the RCSS are as follows:

- Enhance the safety and reliability along the regional rail corridor.
- Assess the risk posed by hazards or vulnerabilities within the system being evaluated.
- Develop a comprehensive systematic risk reduction strategy that assesses the safety hazards and security vulnerabilities and then applies appropriate safety and security mitigations to reduce the risk.
- Develop recommendations to enhance safety, reduce incidents, improve connectivity, and be cognizant of surrounding land uses.
- Provide a prioritization of recommended improvements, including planning level cost estimates for potential projects and funding sources.

1.3 STUDY APPROACH & METHODOLOGY

The primary goal of the Kingston RCSS is to reduce the risk and occurrence of vehicular and pedestrian incidents and associated impacts in the approximate 2.0-mile segment of the study area along the rail corridor as shown in Figure 1-1 and Figure 1-2.

The study reviewed historical data related to vehicular and pedestrian incidents, including those related to trespassing. The study reviewed current highway-rail grade crossing locations to identify risks and hazards in order to development recommended improvements.

The study considered all reasons for trespassing in its evaluation of risk. Trespassing in railroad rights-of-way generally occurs for one of three reasons:

- Harm to Self: Intentional trespassing to commit harm to oneself (e.g., suicide).

- Harm to System: Intentional trespassing to damage or endanger railroad assets, operations, or the safety of persons in the railroad corridor (e.g., sabotage).
- "Incidental" Trespass: Trespassing in the rail corridor to reach other destinations, such as the YMCA or a business district. This is the most frequent type of trespassing observed in the study area.

All forms of trespassing are evaluated as security incidents because they involve human intent to enter the right-of-way. Incidental trespassing, though not intended to do harm to self or the system, is still considered a security incident because the person still intentionally enters the rail corridor. Therefore, this report uses the security risk assessment process for all three forms of trespassing evaluation.

1.3.1 Approach to Railroad Safety

The vast network of commuter and freight railroads in the United States is governed by the Federal Railroad Administration (FRA). Railroads and the FRA work together to implement mitigations to reduce the number of grade crossing accidents and trespasser incidents that occur on the nation's general rail corridors. In addition to the railroads and FRA, other stakeholders play a significant part in the safety of our communities in and around private railroad rights-of-way.

The FRA issues guidance and regulations on crossing and trespass safety. The FRA also conducts research on ways to improve crossing safety and incorporate crossing safety as part of Connect Vehicles (intelligent transportation system). Through these efforts railroads, state and local government, and the public at large play key roles in crossing and trespass safety.

Railroads must:

- Perform monthly tests of automatic warning devices.
- Place retro-reflective material on rail cars to enhance their visibility at night.
- Have additional set of lights (alerting lights) on locomotives to improve motorists' ability to detect them.
- Sound the horn when approaching public crossings unless within a quiet zone as established under FRA regulations.
- Post signs at crossing with an emergency telephone number so that the public can notify the railroad if a vehicle is stuck on the crossings, if the warning signals are not working properly, or other safety concerns.
- Properly maintain track and signals at the crossing.
- Properly equip locomotives and freight cars with required safety appliances.

States and local governments play a role by exercising their own responsibilities, including:

- Selecting appropriate highway traffic control devices, including grade crossing warning systems, advance roadway signage, and pavement markings.
- Determining with the railroad the need for, and design of, interconnections between grade crossing active warning systems and other highway traffic control signals.
- Investigating motor vehicle accidents occurring on public roads, including grade crossing collisions.
- Instructing, examining, and licensing motor vehicle operators.
- Enforcing state requirements, if any, regarding clearance of sight obstructions on railroad (or other) property in the proximity of highway-rail grade crossings.

Finally, each individual in the general public plays a role in their own safety through the following:

- Approach crossings and train tracks expecting a train.
- Always comply with warning signals and signs.
- Never attempt to beat a train at a crossing.
- If the warning signals are malfunctioning, never drive around lowered gates unless directed to by a uniformed police officer or a member of the train crew.
- Never start to travel over a crossing unless there is enough room on the other side to allow the vehicle to be completely off of the crossings.

Efforts to improve grade crossing and pedestrian safety generally fall into one of three basic approaches, otherwise known as the three "Es": engineering, education, and enforcement. Experience has shown that all three approaches must be aggressively and simultaneously employed by a wide variety of safety partners to be truly effective in reducing crossing incidents and fatalities.

- **Education**: Motorists must learn how to be safe at highway-rail grade crossings, as an estimated 94 percent of collisions and 87 percent of fatalities result from risky driver behavior or poor judgment. Public awareness programs help drivers safely navigate grade crossings.
- **Enforcement**: Consistent enforcement of traffic safety laws by state or local police and a sustained effort by the courts to impose penalties on violators discourage and deter motorists from making poor decisions at highway-rail grade crossings.
- **Engineering**: Engineering improvements such as installing flashing lights and gates, adding traffic channelization that deters motorists from driving around lowered gates, or physically separating the highway from the tracks, greatly reduce or prevent the potential for train-vehicle collisions.

1.3.2 Key Definitions

This report uses several key terms:

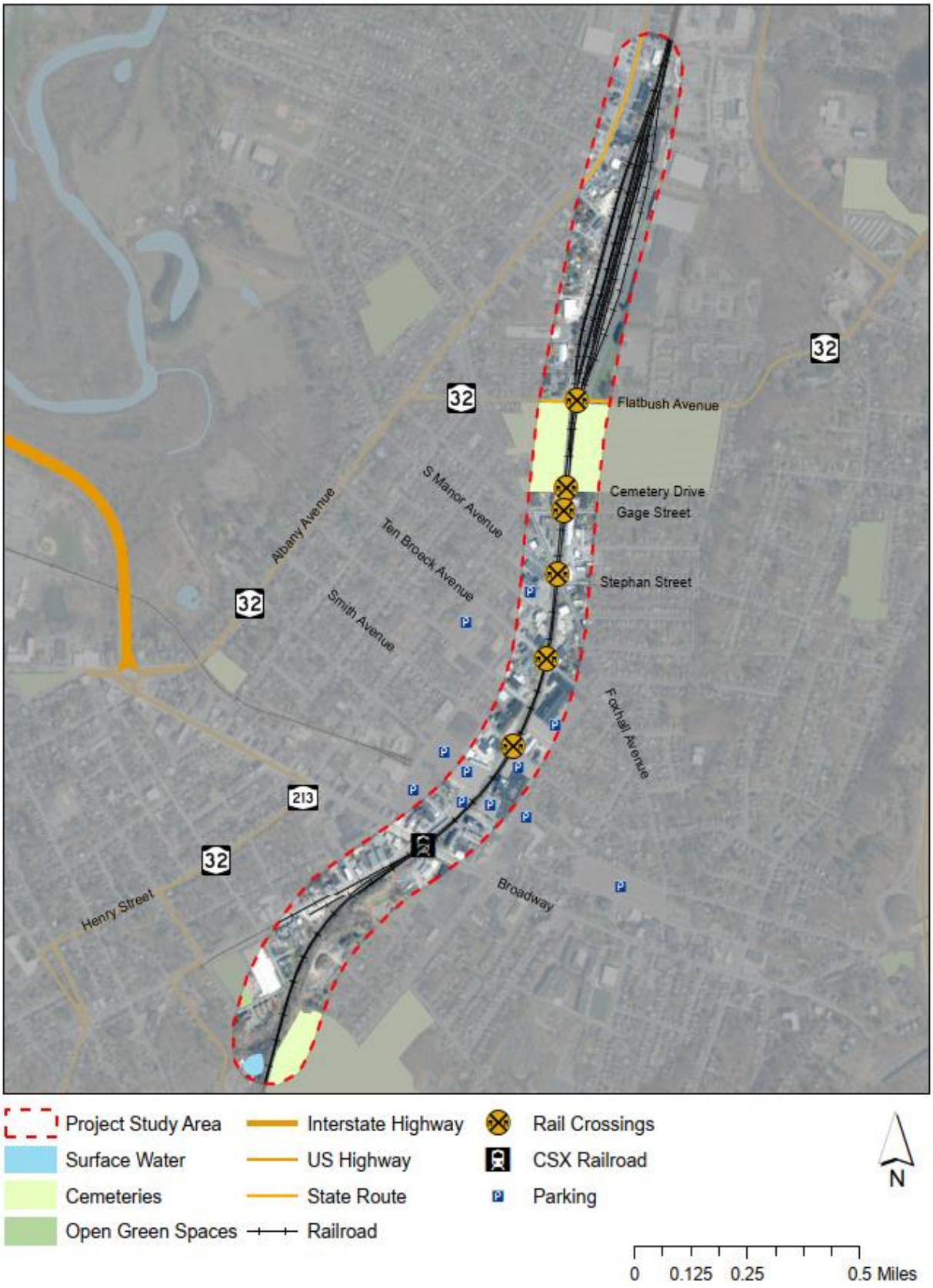
- Safe: Freedom from unintentional harm to people, equipment, reputation.
- Secure: Freedom from intentional harm to people, equipment, reputation.
- Hazard: Real or potential condition that can cause injury, illness, death, damage.
- Threat: Any intentional action with the potential to cause harm in the form of death, injury, destruction, disclosure, interruption of operations, or denial of services.
- Vulnerability: Condition that allows for successful realization of a potential threat.
- Risk: The probability (frequency) or likelihood of a threat or hazard measured against the outcome or consequence (severity) of the threat or hazard.
- Acceptable Risk: When further risk reduction measures will not result in significant reduction of risk.

The analysis, findings, and recommendations in this study are based on the expertise of the staff conducting the assessment and several available reference materials that provide guidance on enhancing safety at highway-rail grade crossings. A list of key reference documents is highlighted in Appendix E

1.4 STUDY AREA

Figure 1-1. Kingston West Shore Railroad Location

Figure 1-2. Kingston West Shore Railroad Study Area



2 PREVIOUS STUDIES

2.1 QUIET ZONE AND CITY OF KINGSTON PEDESTRIAN SAFETY AND MOBILITY ANALYSIS

The following section summarizes the City of Kingston/Town of Ulster Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis Final Report.

The noise of the trains traveling through the City of Kingston and Town of Ulster are considered a nuisance and a possible economic deterrence by many in the Kingston and Ulster. For this reason, a study was sponsored by the Ulster County Transportation Council. The study was completed by R.L. Banks & Associates, Inc., with the final report being issued on April 12, 2006.

As stated in the Executive Summary of the study:

> The purpose of this County of Ulster study is to (1) assess the feasibility and costs of implementing a quiet Zone which includes twelve public grade crossings within the City of Kingston and Town of Ulster, and (2) perform a pedestrian safety and mobility analysis in the City of Kingston, with regard to six grade crossings.

The first part of the study was focused on determining the feasibility and costs of implementing a Quiet Zone. The study did not investigate if the City of Kingston and Town of Ulster location were a good candidate for a Quiet Zone. The study instead seems to be written from the prospective of determining what steps would need to be taken in order to provide justification for implementing the Quiet Zone, rather than discussing the pros and cons of implementing a Quiet Zone.

To assist in determining recommendations, a Diagnostic Team was create composed of local, state, federal, and railroad stakeholders. It appears that Ulster County and members of R.L Banks & Associates, Inc. were also part of the Diagnostic Team.

The Diagnostic Team performed site visits and inspections of the 12 public grade crossings within the City of Kingston and Town of Ulster on October 18, 2005, and arrived at the recommendations summarized in Table 2-1.

Table 2-1. Quiet Zone Recommendations

Crossing Location	Supplementary Safety Measure (SSM)
Smith Avenue	Four-quadrant gates
Ten Broeck Avenue	Four-quadrant gates
Foxhall Avenue	Four-quadrant gates
Gage Street	Permanent closure
Cemetery Road	Permanent closure
Flatbush Avenue	Four-quadrant gates
Boices Lane	Four-quadrant gates
Old Neighborhood Road	Four-quadrant gates
Grant Avenue	One way street
Leggs Mill Road	Medians/channelization
Katrine Lane	Four-quadrant gates
Eastern Parkway	Four-quadrant gates

Per the study, the approximate cost of implementing the Quiet Zone recommendations was $2,500,000. The yearly maintenance of the Supplementary Safety Measures would be an additional cost. The recommendations summarized in Table 2-1 would likely address a significant number of the vehicular safety concerns if the Quiet Zone was implemented. The study did not appear to perform a traffic study to determine the effects of the two permanent crossing closures at Gage Street and Cemetery Road or changing Grant Avenue to a one-way street.

The study did recommend the following:

> Foxhall Avenue is a relatively high-risk crossing. It would be prudent for the City of Kingston to examine this crossing for safety improvements, irrespective of the proposed Quiet Zone.

The report then included the procedure steps needed to implement the Quiet Zone.

The second portion of the study focused on addressing Pedestrian-Railroad Crossing Safety and Mobility Analysis. Again, the report does not appear to address the pros and cons of implementing the Quiet Zone and its effect on the safety of pedestrians, but instead moves directly to determinations of recommendations. The Diagnostic Team's near-term pedestrian safety and mobility improvement recommendations are summarized in Table 2-2.

Table 2-2. Crossing Pedestrian Improvement (Page ES-4)

Crossing Location	Pedestrian Improvement Recommendations
Smith Avenue	Wait stations
Ten Broeck Avenue	Wait stations
Foxhall Avenue	Wait stations, sidewalks
Gage Street	Wait stations
Cemetery Road	Wait stations
Flatbush Avenue	Wait stations, sidewalks
Boices Lane	Wait stations, sidewalks
Leggs Mill Road	Wait station on east side of crossing

The report states the approximate cost of wait stations at all recommended locations to be $112,500.

> Diagnostic Team discussions regarding potential long-term pedestrian safety and mobility improvements generally focused on overpasses (over CSX) and tunnels (under CSX).

Regarding pedestrian safety and trespassing, the report states the following:

> Given the history of trespasser fatalities, it would be prudent for the City of Kingston to work with the railroad and determine what actions may be taken to reduce or prevent trespassing.

Although several pedestrian safety measures appear to have been considered, the study's final recommendations are to provide wait stations, with the addition of sidewalks in some instances. The report states that "wait stations may help those who must wait for a passing train at a grade crossing, in inclement weather." Although the addition of wait stations may make pedestrians more comfortable while waiting for a train to pass during inclement weather, it is unclear how they would reduce the trespasser fatalities. The report fails to adequately address this issue. In addition, the report does not mention that removing the train horns could actually lead to an increase in pedestrian fatalities by removing a significant warning for pedestrians, especially those who may not be at a rail crossing as the train approaches.

2.2 SAFE AND ACCESSIBLE FLATBUSH AND FOXHALL

In early 2020, the City of Kingston hired GPI Construction Engineering Company to design the Safe and Accessible Flatbush and Foxhall Avenues Project, which aims to improve pedestrian and bicycle infrastructure that connects the Colonial Gardens Apartments and residential streets in Midtown to surrounding business districts.

According to the project website, these streets currently have intermittent sidewalks and railroad crossings that can be hazardous for pedestrians and cyclists. Approximately 2 miles of sidewalks will be rehabilitated, and painted crosswalks with Americans with Disabilities Act (ADA)-compliant curb ramps will be installed. Repairs and upgrades will be made all along the route from the intersection of Flatbush Avenue and Colonial Drive to Foxhall Avenue and Broadway. Accommodations for bicycles will also be added along both avenues, connecting to other infrastructure projects, including the Empire State Trail and the Kingston Greenline, which is a network of rail trails, complete streets, and linear parks that winds throughout the city.

The City of Kingston anticipates working with CSX at the two railroad crossings situated on the route to reduce the use of the tracks as a walking path.

The main Project Goals were stated as follows:

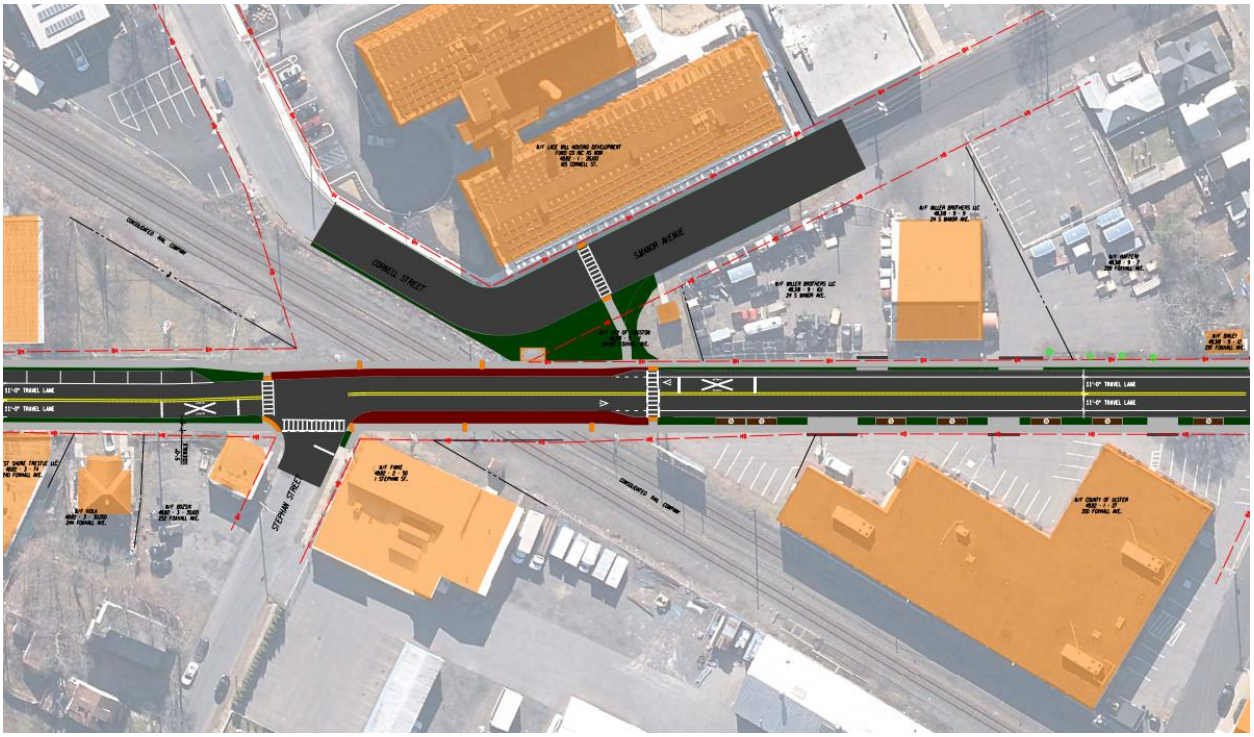
- Improve existing pedestrian facilities.
- Provide bicycle accommodations.
- Improve intersection geometry for pedestrian crossings.
- Upgrade railroad crossings for pedestrian and bicyclist safety.

It appears that most of the Safe and Accessible Flatbush and Foxhall Avenues Project's activities are focused on areas other than the railroad crossings. However, the following planned activities would likely influence the rail safety crossings:

- Designs to improve accommodations for bicycles and pedestrians could lead to an increase in both bicycles and pedestrians crossing the railroad tracks.
- Addition of pedestrian gates to the rail crossing at Flatbush and Foxhall crossings.
- Addition of delineation for pedestrian crossing locations at Flatbush and Foxhall crossings.
- The reconfiguration of the Foxhall/Cornell/South Manor interchange and addition of a traffic signal would likely improve safety of that intersection and the railroad crossing.

According to the City of Kingston, via email correspondence, the Final Report and Final Design Plans for the Safe and Accessible Flatbush and Foxhall Avenues Project have not been completed at this time. Figure 2-1 presents a conceptual level plan at Foxhall Avenue and Cornell Street/South Manor Avenue that was presented during the project's public outreach process.

Figure 2-1. Safe and Accessible Flatbush and Foxhall Project Conceptual Improvement



3 EXISTING CONDITIONS

3.1 RAIL CONSIDERATIONS

3.1.1 Right-of-Way Description

The Regional Westshore rail corridor alignment consists of 2.0 miles of track through the City of Kingston in the study area. The right-of-way consists of a single track to the north and south of the main study area and turns into a two-track configuration through the heart of the city of Kingston. The rail corridor is utilized by CSX freight trains. The civil speed along this section of the rail corridor is 50 miles per hour (mph) on the main track and 30 mph on the siding track. This rail corridor is part of CSX's main corridor between Chicago and New York and carries a high volume of freight traffic. An average of 35 trains a day (24-hour period) run through the study area. The two-track territory serves as a meet point for opposing trains, allowing one train to sit on the siding track while the other travels past on the main track. The corridor in the Kingston area navigates over several highway-rail grade crossings. For this study, five public grade crossings and one private crossing were assessed:

- Flatbush Avenue/Route 32
- Cemetery Drive (Private Crossing)
- Gage Street
- Foxhall/South Manor Avenue/Stephan Street
- Ten Broeck Avenue
- Smith Avenue

The majority of the corridor through the city of Kingston maintains the same elevation relationship with adjacent streets and neighboring communities. This minimized grade separation between adjacent streets and the right-of-way increases the ease of access to the right-of-way for cars and pedestrians.

Just north of the Flatbush Avenue Highway-Rail Grade Crossing is a CSX yard. There are daily moves in the yard, which can also activate the gates and flashers at Flatbush Avenue.

The community on both sides of the rail corridor has limited protective barriers and fencing preventing access to the right-of-way.

3.1.2 Field Evaluations

The WSP team conducted field evaluations of the grade crossings and rail right-of-way within the study area. Review of preliminary data and site evaluation identified three focus areas along the corridor that present the greatest challenges and risk. These three focus areas are the at-grade crossing at Foxhall/South Manor/Stephan Street; the area between Flatbush Avenue and Cemetery Drive private crossing; and the area south of Broadway along Greenkill Avenue.

FOXHALL/SOUTH MANOR/STEPHAN STREET

The crossing at Foxhall Avenue crosses the right-of-way on a skewed angle. The configuration in this location is challenging because of the three additional streets that feed into this highway-rail grade crossing: Cornell Street, South Manor Avenue, and Stephan Street.

This configuration at this crossing can be confusing for privately owned vehicle drivers, and pedestrians cut the angle short when crossing the tracks. Additionally, there are no dedicated pedestrian cross walks across the tracks at Foxhall Avenue. This requires pedestrians to walk in the street alongside vehicle traffic when crossing from one side of the rail corridor to the other. Pedestrians also cut across the tracks rather than using the limited available sidewalks to save time to cross Foxhall Avenue at shown in Figure 3-1.

Figure 3-1. Pedestrian Pathway at Foxhall Avenue

In early 2020, the City of Kingston hired GPI Construction Engineering Company to design the Safe and Accessible Flatbush and Foxhall Avenues Project, which aims to improve pedestrian and bicycle infrastructure that connects the Colonial Gardens Apartments and residential streets in Midtown to surrounding business districts. To improve overall pedestrian and traffic safety at this location the proposed improvements would eliminate the ability for the pedestrians to access the tracks, provide safe sidewalk pathways for pedestrians, and eliminate the confusion to motor vehicles. The current design and site improvement proposed in the 2020 report should continue.

CEMETERY DRIVE

In consecutive field visits, trespassing was observed between the highway-rail grade crossing at Cemetery Drive and Flatbush Avenue (Figure 3-2). There are known destinations to the north of St. Mary's Cemetery that make this area a desirable short cut. There are visible pedestrian paths along the tracks between these two crossings (Figure 3-3).

Figure 3-2. Active Trespassing Location near St. Mary's Cemetery

Figure 3-3. Footpaths near Flatbush Avenue and Cemetery

BROADWAY AND EMPIRE STATE

South of Broadway there are no designated crossings at track grade. Broadway provides a protected grade-separated means to cross the tracks, but this adds several minutes, and the majority of individuals are using the tracks as a short cut. Individuals trespass the rail right-of-way to cross from west of the rail line to access Kingston High School and the local YMCA facility located east of the Rail Line (Figure 3-4).

Figure 3-4. Pedestrian Trespass Path South of Broadway

Traditional chain link fencing was erected in this location to manage this trespass activity, but the fencing was damaged by the public to allow the activity to resume (Figure 3-5).

Figure 3-5. Damaged Fencing South of Broadway

In addition to these three focus areas, some other general highway-rail grade crossing and trespassing concerns were identified.

GENERAL GRADE CROSSING CONCERNS

Highway-Rail crossings, or level at-grade crossings, must adhere to specific safety requirements to safeguard motorists and train passengers. These mandates include the installation of warning signs, lights, and gates to signal approaching trains. Clear sightlines and vegetation management are imperative for visibility. The road surface should also align with the tracks to prevent vehicle damage. Ongoing maintenance and inspections are vital for operational integrity. Furthermore, comprehensive education and awareness initiatives are crucial to educate the public on safe conduct at these crossings, stressing the importance of stopping, looking, and listening for oncoming trains before crossing the tracks.

The Manual on Uniform Traffic Control Devices (MUTCD) is recognized as the national standard for all traffic control devices on any street, highway, or private road open to public travel. Part 8 of the MUTCD provides information regarding traffic control for railroad and light rail transit grade crossings. The section includes all signs, signals, markings and other warning devices and their supports along highways approaching highway-rail grade crossings. The FRA also provides criteria for grade-crossing safety. FRA grade crossing safety requirements can be found in the Code of Federal Regulations (CFR) (49 CFR Part 234). These regulations prescribe the following:

- Maintenance, inspection, and testing standards for highway-rail grade crossing warning systems.
- Standards for the reporting of failures of highway-rail grade crossing warning systems and for the actions that railroads must take when such systems malfunction.
- Requirements for certain identified states to update their existing state highway-rail grade crossing action plans and submit reports about the implementation of their existing plans and for the remaining states and the District of Columbia to develop state highway-rail grade crossing action plans.
- Requirements that certain railroads establish systems for receiving toll-free telephone calls reporting various unsafe conditions at highway-rail grade crossings and pathway grade crossings, and for taking certain actions in response to those calls.
- Requirements for reporting to, and periodically updating information contained in, the U.S. Department of Transportation National Highway-Rail Crossing Inventory for highway-rail and pathway crossings.

These requirements serve the overarching goal of enhancing safety and averting accidents at railroad crossings.

The five public highway grade crossings in the study area all have active warning devices with gates, flashers, and audible bells. Many of these crossings have less than ideal safe pathways for pedestrians to cross. While there are pedestrian gates in addition to highway gates at many of the crossings, the demarcation between the vehicle lanes and pedestrian pathways is often not distinguishable. Dedicated pedestrian crossings with adequate pavement markings to complement existing pedestrian gates would reduce this risk and help separate pedestrian and motor vehicle traffic at the crossing

locations. Intersections with skewed crossings, such as Foxhall, require additional considerations such as pedestrian channeling to get to the safe crossing location and optimization of sight lines.

Table 3-1 provides a summary of the current status of the various control devices that exist at each crossing in the study area. A mitigation marked as "No" in the table indicates an opportunity to improve the safety at that crossing location. To increase safety at these highway-rail grade crossings, improvements should be assessed and implemented to enable each of the columns in the table to change from a status of "No" to a status of "Yes."

Table 3-1. Highway-Rail Grade Crossing Summary

Crossing Location	Roadway Gates / Flashers	Pedestrian Gates	Roadway Pavement Marking	Ped Crossing Pavement Marking	Center Lane Delineation	Clear Line of Site
Boices Lane	Yes	No	No	No	No	Yes
Flatbush Avenue/ Route 32	Yes	No	Yes	No	No	Yes
Cemetery Drive (Private Crossing)	Yes	No	No	No	No	Yes
Gage Street	Yes	Only 1 (West Side)	No	No	No	No Obstructed by Buildings
Foxhall / S. Manor Ave. / Stephan Street	Yes	Yes	No	No	No	South Side Only
Ten Broeck Ave.	Yes	Yes	No	No	No	South side Only
Smith Ave.	Yes	Yes	No	No	No	Yes

As indicated by Table 3-1, the most effective improvement for these crossings would be to provide the following enhancements at each crossing:

- Enhance roadway pavement markings and signs to clearly define the highway grade crossings in accordance with the criteria established in the MUTCD.
- Research the ability to incorporate dynamic clearance envelope pavement markings on the roadway to delineate the entire train clearance envelope at the crossing.
- Incorporate center lane delineators on the approaches on both sides of the crossings to prevent vehicles from driving around active gates. Based on existing widths at some crossings this enhancement may not be feasible at all crossings.
- Enhance pedestrian sidewalks and pedestrian crossing pavement markings and signage to create a clean and safe pathway for pedestrians when navigating over the grade crossing. These enhancements should be in accordance with the MUTCD.

GENERAL TRESPASSING CONCERNS

Trespassing can occur for several reasons. Some trespassers are merely seeking the most direct route between their location and their destination. Other trespassers are seeking to self-harm using the rail as the method. Other trespassers are seeking to harm or damage the rail system through vandalism, graffiti, or sabotage. Some mitigations or controls, such as fencing, may impact all types of trespassers, but other mitigations, such as suicide hotlines signage, are motivation-specific. The reported incidents in the project area seem to fall into the first two categories: those looking for a shortcut to their destination or self-harm. Targeting those behaviors in the project area would be a priority.

Fencing, a primary mitigation for trespassing, can be easily compromised by determined trespassers. It is important to provide fencing that is effective for the situation, as well as safe and easily accessed alternative pathways. There is existing fencing along the rail corridor in the study area. Figure 3-6 provides a map designating the existing fencing along the rail corridor. The existing fencing is in various states of condition, and some has been damaged to support the illegal track crossing south of Broadway. Traditional chain link fence serves as a barrier, but it can be easily damaged and compromised by individuals. The height of the fencing also determines its success as a mitigation. Fencing 48 inches or lower does not deter all individuals from scaling the fence. Fencing in excess of 72 inches will deter more individuals. There are also alternative fencing products and barriers that are difficult to alter, rendering them more effective as a trespass mitigation solution. These options are further discussed in Section 5.1.3.

3.1.3 CSX Highway-Rail Grade Crossing & Pedestrian Safety Efforts

The project team met with CSX employee Robert Rohauer, Senior Manager Strategic Projects, and Community Affairs, to ascertain the various grade crossing and pedestrian safety efforts CSX has implemented along the west shore rail corridor. Aligning with the three "Es" of rail safety mitigation, the discussion focused on the engineering, education, and enforcement solutions that CSX has implemented.

ENGINEERING SOLUTIONS

Several years ago, CSX made track improvements, enabling them to increase the civil speed of their trains through the Kingston rail corridor. These track improvements increased the civil speed limits to 50 mph on the main track and 30 mph on the siding track. These improvements enhanced the meet times between trains, allowing trains to move through the rail corridor more quickly. These speed improvements minimized the time required to activate the gates and flashers, which previously caused traffic to wait longer and often caused drivers to be impatient and drive around the active gates more frequently.

South of Broadway, CSX installed traditional chain link fencing in the area where trespassers were crossing the tracks to access Kingston High School and the YMCA. Shortly after the installation of this fence, sections of the fence were damaged to allow trespassing to continue. CSX also installed "No Trespassing" signs along the rail corridor.

Figure 3-6. Existing Fencing Along the Rail Corridor.

CSX is working with the New York State Department of Transportation (NYSDOT) and UCTC on the modifications to the Boices Lane crossing, which included reconfiguration of the left-turn lane and connecting the traffic lights to the grade-crossing warning devices. This project is currently funded under UCTC PIN 893307. The project is currently in the design phase with construction scheduled for fiscal year 2026.

CSX has assessed the option for crossing consolidation, and the private crossing at St. Mary's Cemetery would be an ideal candidate. CSX has had discussion with the cemetery owner, but the owner is not willing to remove this crossing. The cemetery owns property on both sides of the rail corridor and maintenance crews require access via the current private crossing.

CSX also indicated that there are no CSX grade crossing improvements scheduled along this section of the rail corridor in the foreseeable future.

EDUCATION SOLUTIONS

CSX has implemented public outreach efforts to help educate the community and engaged in an education and enforcement effort in the area between Broadway and Greenkill Avenue. This effort was in partnership with the Kingston Police Department. Additionally, CSX is a partner with Operation Lifesaver and has made several attempts to conduct presentations T Kingston High School. These requests have been met with limited support and the only time CSX has been able to conduct any presentations was for limited school students after school hours. CSX did not find this limited time to be effective.

The City of Kingston constructed a rail trail that terminates in the area of the trespass area south of Broadway along Greenkill Avenue. The City is also considering converting a wooded area near the rail corridor into a community park. This would increase pedestrian traffic along the rail corridor and increase the risk of trespassing on the tracks. CSX indicated that they have met with state and local officials to discuss their concerns with this park development. However, CSX express concerns that the local officials are not focusing on the increased risk this park will create nor are they incorporating mitigation strategies to address the increase in pedestrian trespassing along the tracks that this park will create.

ENFORCEMENT SOLUTIONS

While CSX did have a strong ally in the Kingston Police Department who was very supportive in helping with trespassing enforcement, this individual retired from the Kingston Police Department and CSX has not developed a similar partnership with current Kingston Police Department staff.

The CSX Public Safety Coordination Center in Jacksonville, Florida, receives reports of vehicles or individuals fouling the right-of-way from their toll-free phone number. These reports can be complied to identify high incident locations and shared with local law enforcement organizations to identify hot spots and focus areas that could be used to enhance enforcement efforts.

3.1.4 FRA-Mandated State Highway-Rail Grade Crossing Action Plans

On January 28, 2013, the National Transportation Safety Board issued multiple recommendations to the Federal Highway Administration and the FRA, after investigating a June 24, 2011, highway-rail grade crossing collision in Miriam, Nevada, involving a truck-tractor and an Amtrak passenger train. In two of those recommendations, the National Transportation Safety Board advised the Federal Highway Administration and the FRA to work together to develop a model state grade-crossing action plan that can be used as a resource document by all states.

Under the Rail Safety Improvement Act of 2008, 10 states were mandated to develop state highway-rail grade crossing action plans in accordance with criteria prescribed by the FRA. The 10 identified states were Alabama, California, Florida, Georgia, Illinois, Indiana, Iowa, Louisiana, Ohio, and Texas. The Fixing America's Surface Transportation Act of 2015 mandated that the 10 states previously identified in the Rail Safety Improvement Act of 2008 must, at a minimum, provide FRA an updated state action plan and a report describing what the state did to implement its previous state action plan and how the state will continue to reduce grade-crossing safety risks.

On December 14, 2020, the FRA issued State Highway-Rail Crossing Action Plan (SAP) regulations, which can be found in 49 CFR 234.11. The Fixing America's Surface Transportation Act mandated that the remaining 40 states and District of Columbia develop and implement an SAP. The SAP must identify highway-rail grade crossings and pathway crossings that: (a) have experienced recent grade crossings accidents or incidents; (b) have experienced multiple grade crossings accidents or incidents; or (c) are at high-risk for accidents or incidents as defined in each SAP. Additionally, each SAP must identify specific strategies for improving safety at at-grade crossings and pathway crossings, including closures or grade separations, Each SAP must also specifically designate a state official responsible for managing implementation of the plan. These plans were required to be submitted for FRA review and approval by February 14, 2022.

Within the NYSDOT Office of Modal Safety and Security is the Rail Safety Bureau. The mission of the NYSDOT Highway-Rail Grade Crossing Safety Section is to reduce the frequency and severity of accidents involving vehicles and pedestrians at highway-rail grade crossings. The NYSDOT Rail Safety Bureau's current crossing safety program priorities include the following:

- Addressing crossings that warrant interconnection with highway traffic signals
- Improving pedestrian crossing safety
- Mitigating profile deficient crossings
- Updating existing active warning devices/signals at highway-rail grade crossings
- Updating passive public crossings
- Closing/eliminating crossings

It is not clear if the Rail Safety Bureau is the agency responsible for developing and submitting the required FRA SAP or how much they involved Ulster County or the City of Kingston in the development of this plan. The City of Kingston and Ulster County should establish ongoing

partnerships with the NYSDOT Rail Safety Bureau to ensure the statewide rail safety effort properly incorporates the needs and concerns of the City and County.

3.2 TRANSPORTATION & PLANNING CONSIDERATIONS

3.2.1 Highway-Rail Grade Crossings – Safety Assessment

Implementing or recommending strategies to reduce vehicle-train collisions and pedestrian injuries and fatalities is a focus point of this study. However, to do so, the reported crashes need to be analyzed in a safety assessment to identify patterns and clusters, common factors, probable causes, and crash statistics to understand why crashes are happening at the highway-rail grade crossings in the study area.

Crash data for the study area roadway segments were queried from NYSDOT for January 2017 through November 2023 through the Crash Location and Engineering Analysis and Reporting System. A safety screening was performed on the crash data by calculating segment crash rates and characterizing crash severity for the highway-rail grade crossings.

Highway-rail grade crossings at New York State (NYS) Route 32/Flatbush Avenue, Cemetery Drive, Gage Street, Foxhall Avenue, Ten Broeck Avenue, and Smith Avenue were evaluated in this safety assessment. As shown in Figure 3-7, 70 crashes were identified as at or near the highway-rail grade crossings from 2017 through 2023 and are used in this safety assessment.

Crash Location

The highest concentration of vehicle crashes occurred at the highway-rail grade crossing of Foxhall Avenue, accounting for 69 percent of the total crashes, followed by NYS Route 32/Flatbush Avenue, Smith Avenue, and Gage Street. There were no reported vehicle crashes at Cemetery Drive or Ten Broeck Avenue, as summarized in Table 3-2.

Table 3-2. Crashes by Location

Location	Total Crashes (2017 – 2023)
NYS Route 32/Flatbush Avenue	13
Cemetery Drive	0
Gage Street	4
Foxhall Avenue	48
Ten Broeck Avenue	0
Smith Avenue	5

Figure 3-7. Highway-Rail Grade Crossing – Crashes (All)

Crash Severity

Crash severity indicates the most serious injury sustained by any individual involved in a crash. Analyzing the crash severity of all the crashes queried shows that approximately three-quarters of the crashes during the 7-year study period resulted in property damage only, with the remaining crashes resulting in injuries and one fatality. Crashes that resulted in injuries occurred at NYS Route 32/Flatbush Avenue and Foxhall Avenue. The crash that resulted in a fatality occurred at the Smith Avenue highway-rail grade crossing. Table 3-3 and Figure 3-8 summarizes the crash severity at each highway-rail grade crossing.

Table 3-3. Crash Severity by Location

Location	Fatal	Injury	Property Damage Only
NYS Route 32/Flatbush Avenue	0	4	9
Cemetery Drive	0	0	0
Gage Street	0	0	4
Foxhall Avenue	0	12	36
Ten Broeck Avenue	0	0	0
Smith Avenue	1	0	4

In the crash that resulted in a fatality at Smith Avenue, the driver disregarded the rail crossing gates and drove around them. Two occupants were in the vehicle, and the nearside front passenger did not survive the injuries sustained from the crash. The driver was transported to a nearby medical center to receive medical attention. Figure 3-9 is a schematic showing how the crash occurred.

Figure 3-8. Highway-Rail Grade Crossing – Crash Severity

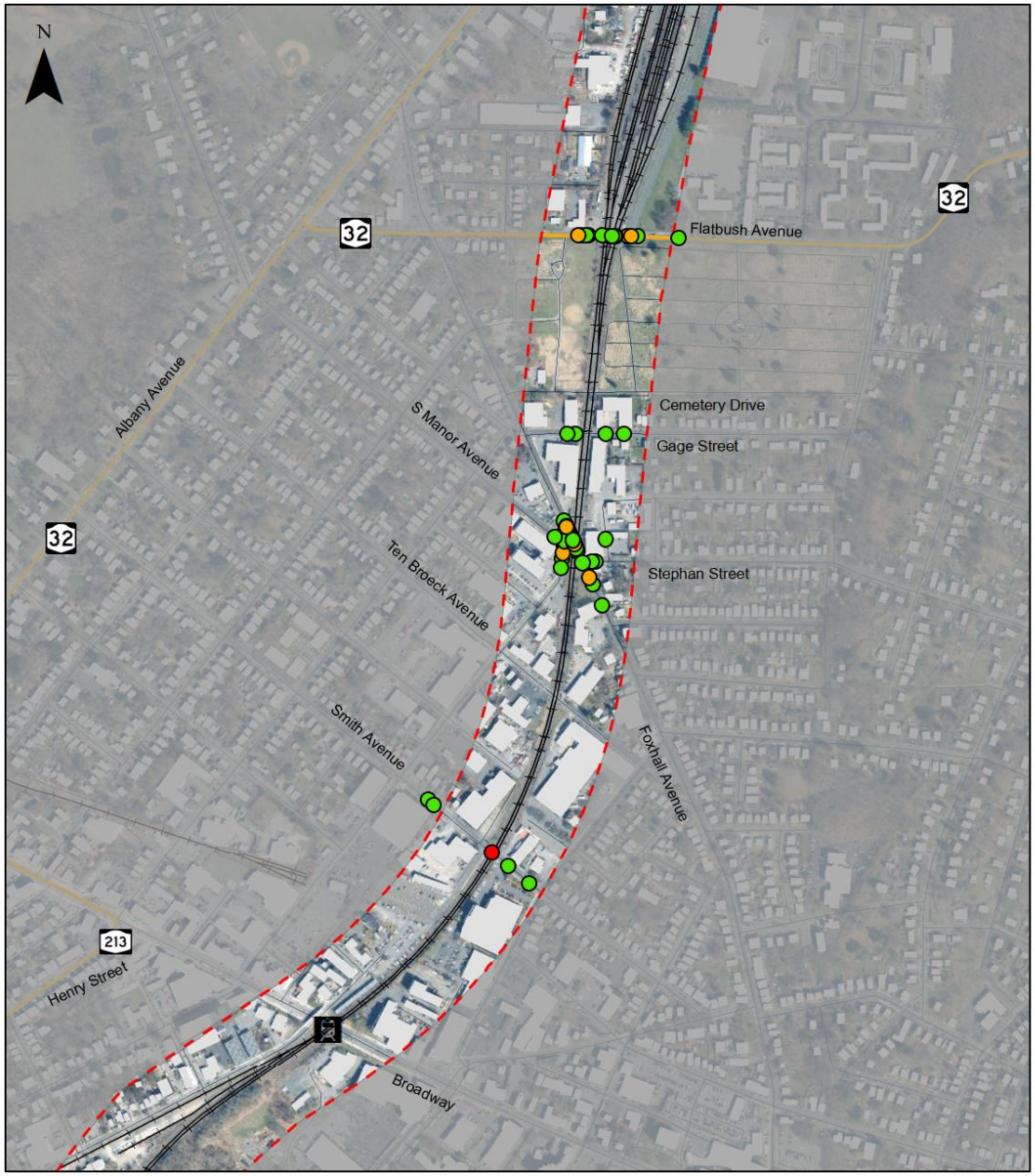
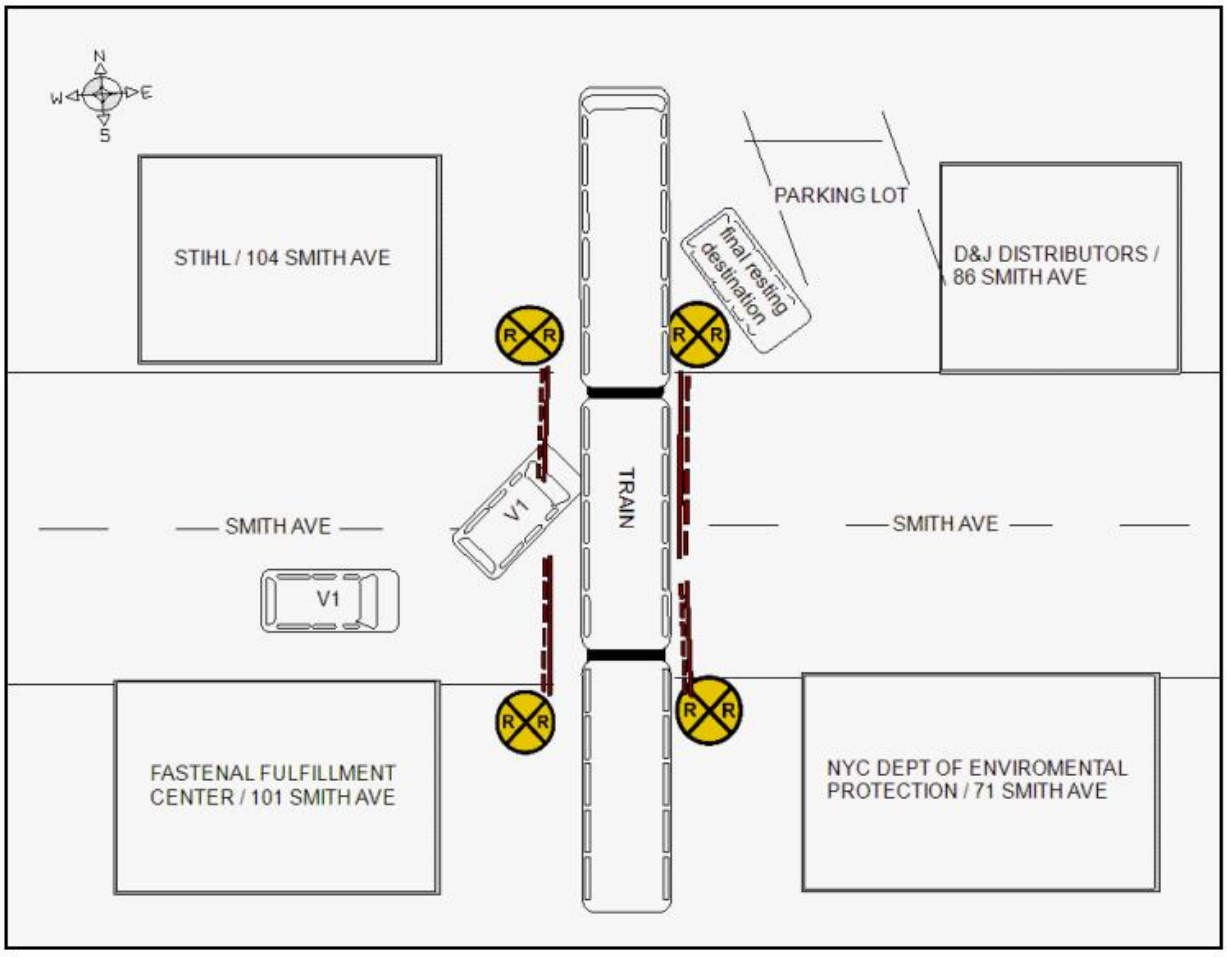


Figure 3-9. Schematic for Fatal Crash



Collision Types

The top four types of collisions that were most predominant for all highway-rail grade crossings were rear-end crashes, crashes with fixed objects, right-angle crashes, and crashes with a train. The breakdown of collision types for all highway-rail grade crossings is shown in Figure 3-10 and summarized in Table 3-4. Foxhall Avenue has the most crashes and a particularly high number of fixed objects, rear-end, right-angle, and train collisions compared to the other locations. Some collisions at Foxhall Avenue include vehicles misjudging a turn and colliding with another vehicle or object, accidentally driving onto the railroad tracks, and not yielding properly to turning vehicles already in the intersection. Five of the eight total collisions with a train occurred at the Foxhall Avenue highway-rail grade crossings.

Figure 3-10. Highway-Rail Grade Crossing – Collision Types

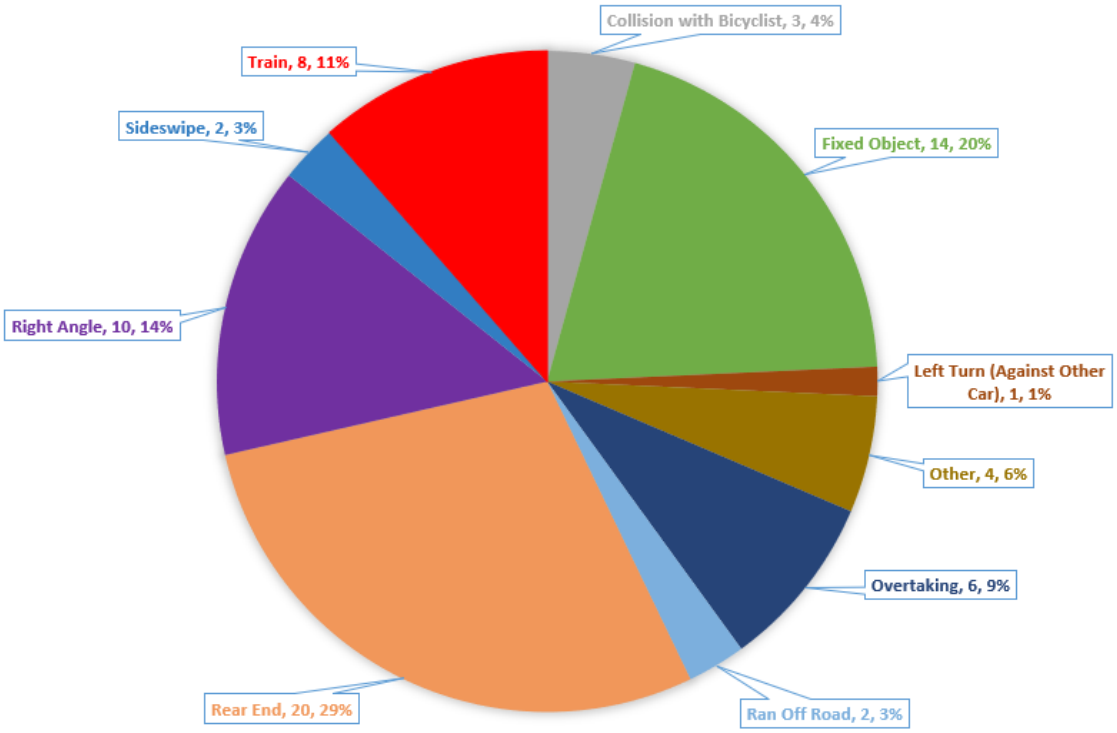


Table 3-4. Collision Type by Location

Location	Bicyclist	Fixed Object	Left Turn	Other	Overtaking	Run off Road	Rear End	Right Angle	Sideswipe	Train	TOTAL
NYS Route 32/ Flatbush Avenue	2	3	0	2	0	0	4	0	0	2	**13**
Cemetery Drive	0	0	0	0	0	0	0	0	0	0	**0**
Gage Street	0	1	0	0	1	0	1	1	0	0	**4**
Foxhall Avenue	1	10	1	2	3	2	14	8	2	5	**48**
Ten Broeck Avenue	0	0	0	0	0	0	0	0	0	0	**0**
Smith Avenue	0	0	0	0	2	0	1	1	0	1	**5**
TOTAL	**3**	**14**	**1**	**4**	**6**	**2**	**20**	**10**	**2**	**8**	**70**

Vehicle-Train Collision Types

Eight vehicle-train collisions occurred at the highway-rail grade crossing during the 7-year study period. Table 3-5 summarizes the crash severity for these eight crashes. Two occurred at NYS Route 32/Flatbush Avenue resulting in property damage only; five occurred at Foxhall Avenue, resulting in injuries; and one occurred at Smith Avenue, resulting in a fatality. Most of these crashes were due to drivers ignoring the descending highway-railroad grade-crossing gates and colliding with the train. A

few of these crashes were also caused by traffic stopping on the tracks while the gates were coming down, without room to move forward or reverse out of the oncoming train's way. Table 3-6 describes each crash in more detail.

Table 3-5. Crash Severity of Crashes Involving Trains

Location	Fatal	Injury	Property Damage Only	TOTAL
NYS Route 32/Flatbush Avenue	0	0	2	**2**
Cemetery Drive	0	0	0	**0**
Gage Street	0	0	0	**0**
Foxhall Avenue	0	5	0	**5**
Ten Broeck Avenue	0	0	0	**0**
Smith Avenue	1	0	0	**1**
TOTAL	**1**	**5**	**2**	**8**

Table 3-6. Summary of Crashes Involving Trains

Date	Crossing	Description
11/02/2018	NYS Route 32/ Flatbush Ave	Vehicle was stuck in traffic when the gates came down and had no room to move out of the way. Train clipped the rear end of the vehicle.
12/23/2018	Foxhall Ave	Vehicle drove around crossing gates in the oncoming lane of traffic while the gates were in the down position, colliding with train.
05/19/2019	Foxhall Ave	Crossing gates came down and vehicle continued straight, striking the crossing gates, and then stopped on the railroad tracks, colliding with train.
06/28/2020	Foxhall Ave	Vehicle struck crossing gates attempting to go around them, then collided with train. Driver was transported to hospital.
06/16/2021	Foxhall Ave	Vehicle was traveling over the railroad tracks when the gates came down. Driver tried reversing to get off tracks but was struck by train. Driver was transported to hospital.
12/01/2021	Smith Ave	Driver ignored crossing gates and went around them. One fatality and one injury occurred as a result.
08/31/2022	NYS Route 32/ Flatbush Ave	Vehicle was traveling over the railroad tracks when the crossing gates came down. Driver attempted to reverse but was blocked by traffic and could not move out of the way of oncoming train.
12/05/2022	Foxhall Ave	Vehicle drove around crossing gates, striking train.

Crash Rates

Crash rates were calculated to take traffic variation into account. These crash rates were then compared with NYSDOT published values for similar facilities (Table 3-7 and Table 3-8).

Table 3-7. Summary of Crash Rates

Location	Average Annual Daily Traffic (AADT)	Crash Rate (Acc/MVM) from 1/2017 to 11/2023	NYSDOT Average Crash Rates for Mainline & Juncture Accidents by Facility Type, Urban Free Access with Two Lanes (Acc/MVM) January 1, 2019 to December 31, 2020
NYS Route 32/ Flatbush Ave	5,853	8.69	3.57
Cemetery Dr	102	0.00	3.57
Gage St	1,383	11.32	3.57
Foxhall Ave	4,947	37.98	3.57
Ten Broeck Ave	1,085	0.00	3.57
Smith Ave	1,772	11.04	3.57

*Crash rates were calculated using the measured road segment
**Highlighted values indicate an above-average crash rate

Table 3-8. Summary of Crash Severity

	Crash Severity from January 2017 to November 2023				NYSDOT Average Crash Severity For Free Access, Urban, Undivided, 2 Lanes Segments January 1, 2019 to December 31, 2020			
Location	Fatal	Injury	Fatal/ Injury	PDO	Fatal	Injury	Fatal/ Injury	PDO
NYS Route 32/ Flatbush Ave	0.00%	30.77%	30.77%	69.23%	0.19%	20.85%	21.04%	78.96%
Cemetery Dr	N/A	N/A	N/A	N/A	0.19%	20.85%	21.04%	78.96%
Gage St	0.00%	0.00%	0.00%	100.00%	0.19%	20.85%	21.04%	78.96%
Foxhall Ave	0.00%	25.00%	25.00%	75.00%	0.19%	20.85%	21.04%	78.96%
Ten Broeck Ave	N/A	N/A	N/A	N/A	0.19%	20.85%	21.04%	78.96%
Smith Ave	20.00%	0.00%	20.00%	80.00%	0.19%	20.85%	21.04%	78.96%

*Highlighted values indicate an above-average proportion of that crash severity category
Key: PDO = property damage only

Crash rates for four highway-rail grade crossings far exceed statewide averages, indicating that there are possible mitigation and countermeasures to suggest at these locations, which, if implemented, have the potential for safety improvement. The NYS Route 32/Flatbush Avenue, Foxhall Avenue, and Smith Avenue crossings see higher rates of fatal/injury crashes compared to statewide averages for similar facility types. Foxhall Avenue, in particular, experiences significantly more crashes than the statewide average for similar facilities. A contributing factor is the offset intersection configuration at Foxhall Avenue, Stephan Street, Cornell Street, South Manor Avenue, and the highway-rail grade crossing. The intersection approaches are skewed, which requires sharp turns and causes driver confusion when approaching the intersection.

Mitigation

Possible crash mitigation measures may include enforcement of traffic control signals to deter drivers from driving around lowered crossing gates through police presence or camera license plate readers. In addition, quad crossing gates may be implemented to completely block access through the crossing when the crossing gates are down to prevent drivers from attempting to go around the

gates. Other crash mitigation measures also include highway-rail grade crossing advance warning signs and/or pavement markings at crossings with higher traffic volumes, such as at NYS Route 32/Flatbush Avenue and Foxhall Avenue, to make the presence of a railroad crossing more obvious and make drivers less likely to stop on the tracks. Flashing signs at certain locations may also be an appropriate mitigation measure to increase the visibility of railroad warning signage.

Regarding the Foxhall Avenue crossing, additional measures should be considered because crashes at this location are highest and more severe when compared to the other study area highway-rail grade crossings. An intersection reconfiguration should be considered here, such as the Safe and Accessible Foxhall and Flatbush study, as referenced in Section 1 of this report. A reconfigured highway-rail grade crossing at the Foxhall Avenue crossing would decrease the number of conflict points at this location.

3.2.2 Planning

WSP reviewed the Ulster Tomorrow economic plan and the Ulster County Comprehensive Plan. These plans are summarized as they pertain to this study in the following section.

Ulster Tomorrow

This strategic planning effort is designed to help Ulster County deliver economic development services. It provides a sound basis for the implementation of economic development strategies to better coordinate the collective activities of the system and provide focus to the strategic economic development efforts of the county. As such, it does not address the specifics of infrastructure or transportation facility provision such as rail safety and does not provide any guidance for the development of the recommendations of the Kingston Rail Crossing Study.

Ulster County Comprehensive Plan/Long Range Transportation Plan

The Ulster County Comprehensive Plan is made up of three elements: the Long Range Transportation Plan, the Housing Development Plan, and the Open Space Plan. The Housing Development Plan does not mention rail safety directly, although it does include the revitalization of older homes in Kingston as a goal, which may lead to more traffic at the relevant highway-rail grade crossings over time. The Open Space Plan does not mention rail safety or include any recommendations in the study area.

The 2045 Long Range Transportation Plan recommends investments in the transportation system that will provide the foundation on which Ulster County can build to achieve its quality of life, economic development, environmental protection, public health, and social equity goals. In each of the Plan's eight goals (System Preservation, Economic Vitality, Safety, Sustainability, Mobility, Accessibility, Environmental Enhancement, and Equity) can be found direction for transportation investments that will help to ensure stronger, more equitable communities.

The Safety, Security, Mobility and Reliability, Environmental Enhancement goals all address rail safety and call for improvements to grade crossings in the County, particularly in the City of

Kingston. Specific recommendations include the implementation of previously completed plans, including the following:

- City of Kingston/Town of Ulster – Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis (2006)
- Ulster County Integrated Advance Train Detection and Arrival Prediction Implementation Plan (2008)
- Town of Ulster – Boices Lane Rail Crossing Study (2013)

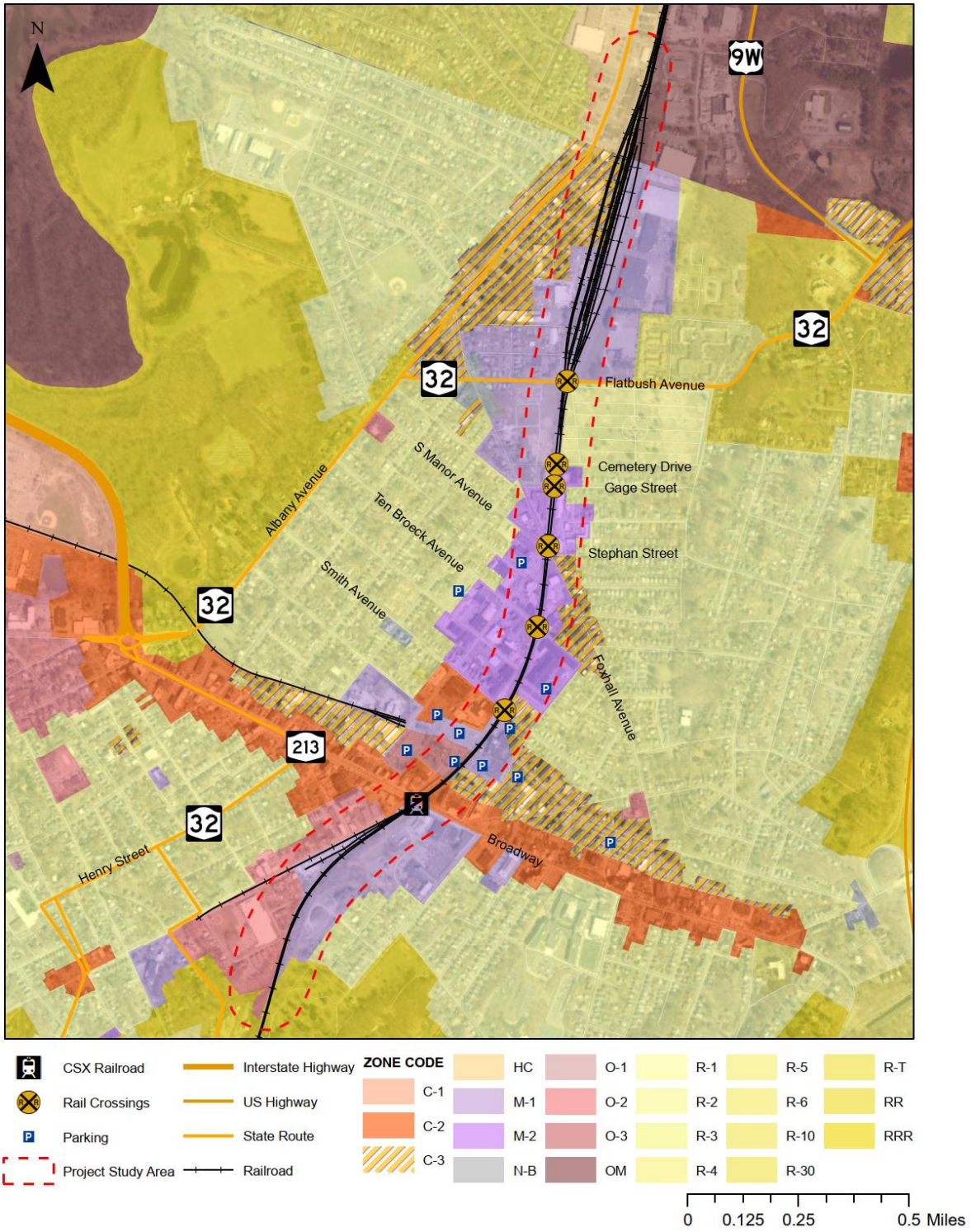
Other recommendations include the following:

- All at-grade rail crossings should be designed in a manner that will protect motorists, pedestrians, bicyclists, and area residents and prevent collisions.
- Implement or upgrade regional Intelligent Transportation Systems technology along regional corridors of significance, including advanced signal detection along rail lines.
- Reduce or eliminate risks at all at-grade railroad crossings in an effort to mitigate the effects of train horn noise and establish new quiet zones, particularly in densely populated areas.

3.2.3 Zoning

Figure 3-11 shows that zoning in the study area is generally composed of Commercial and Office/Manufacturing zones surrounding the rail corridor, as well as some Residential zones within the rail corridor.

Figure 3-11. Kingston West Shore Railroad Study Area Zoning



3.2.4 Land Use

Figure 3-12 shows that land use in the study area is generally composed of Commercial and Industrial uses surrounding the rail corridor, with some Residential, Community Services, and Recreation & Entertainment uses.

3.2.5 Travel Patterns – Pedestrians and Bicyclists

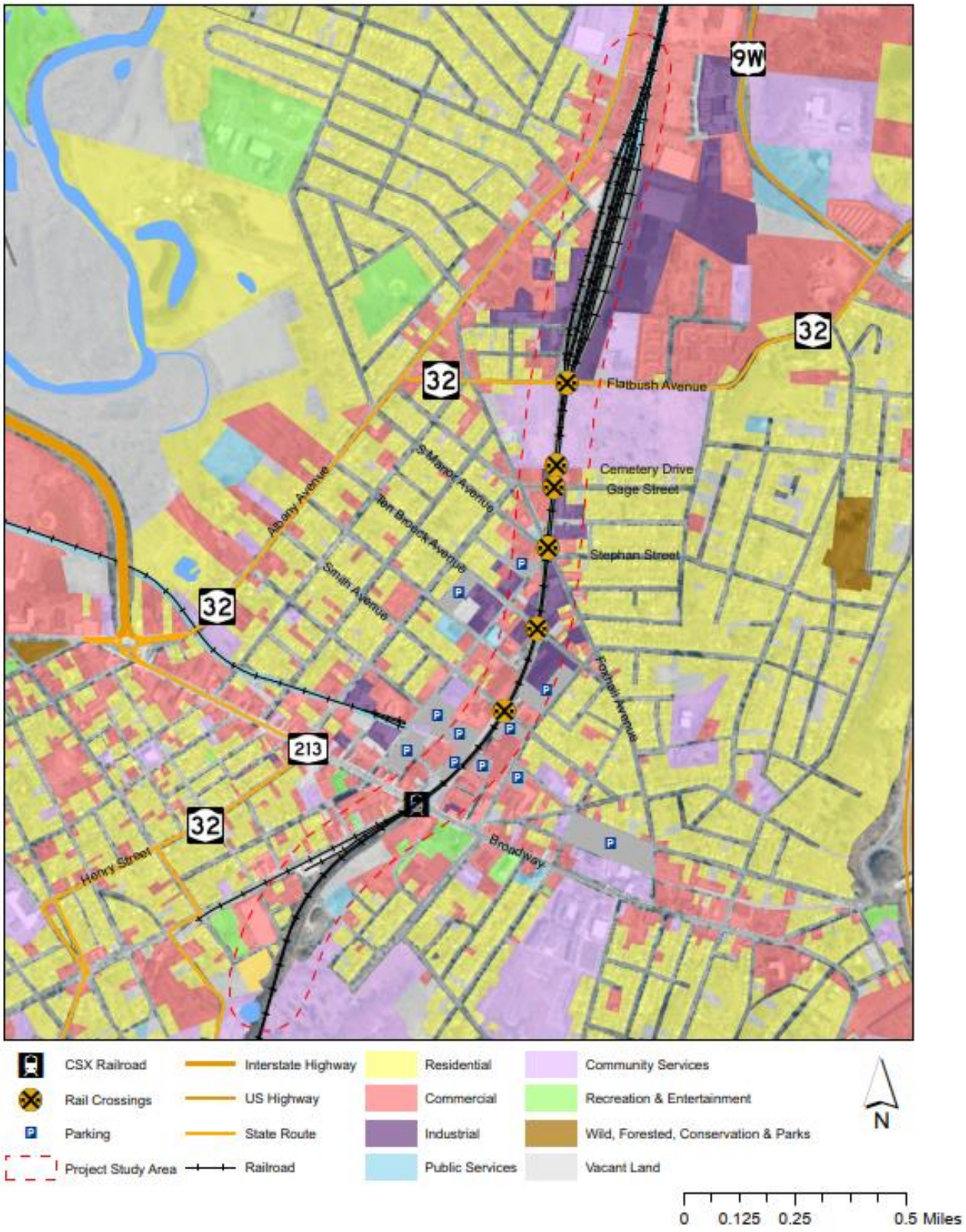
The overall study purpose, as stated in Section 1, is to evaluate the existing street and rail crossings as well as trespassing along the rail corridor to determine contributing factors and provide recommended solutions. In order to recommend solutions, an understanding of the existing travel patterns is needed, particularly for the pedestrians and bicyclists who make up the trespassing activity in the study area. Understanding the number of pedestrians and bicyclists and their travel patterns in the study area will give an overall sense of the potential number of trespassers. To complete this analysis, trip data from Replica was utilized to understand areas that contain the highest demand for walking and biking in the study area.

The study area has eight segments within the Replica model (as defined by designated bicycle or pedestrian crossing locations) ranging from 0.38 miles to 1.423 miles in length to the nearest highway-rail grade crossing location (Table 3-9).

Table 3-9. Distance between Highway-Rail Grade Rail Crossings

From	To	Length (miles)
Ulster Avenue	Flatbush Avenue	1.423
Flatbush Avenue	Cemetery Drive	0.139
Cemetery Drive	Gage Street	0.038
Gage Street	Foxhall Avenue	0.102
Foxhall Avenue	Ten Broeck Avenue	0.134
Ten Broeck Avenue	Smith Avenue	0.150
Smith Avenue	Broadway	0.214
Broadway	West O'Reilly Street	0.988

Figure 3-12. Kingston West Shore Railroad Study Area Land Use



Replica Methodology

Replica is an activity-based model representing the population and their travel patterns within any geography in the United States. The model is based on survey data as well as location-based services data, where synthetic data "agents" are propagated in the model to create trip patterns and travel behavior. To better understand the need for walking and biking facilities, trip origin and destination patterns between Census Block Groups (CBGs) were studied.

CBGs were the most detailed geography within Replica, where reliable data was available. Within the study area, most CBGs are divided by the study area rail corridor. However, CBGs 361119518001 and 361119521001 extend slightly to the west of the study area rail corridor, as shown in Figure 3-13.

Trips were examined in the rail corridor study area with origin-destination pairs of up to 1 mile to determine the potential demand for walking and biking trips. The distance of 1 mile was selected based on the trip distances by mode made available by Replica. The results show that at a distance of 0.25 mile, nearly 77 percent of trips are made by walking and biking; at a 0.5-mile to 1-mile distance, 30 percent of trips are still made by walking and biking. Figure 3-14 and Figure 3-15 summarize the Replica data analyzed by distance and mode share.

Figure 3-13. Location of Census Block Groups

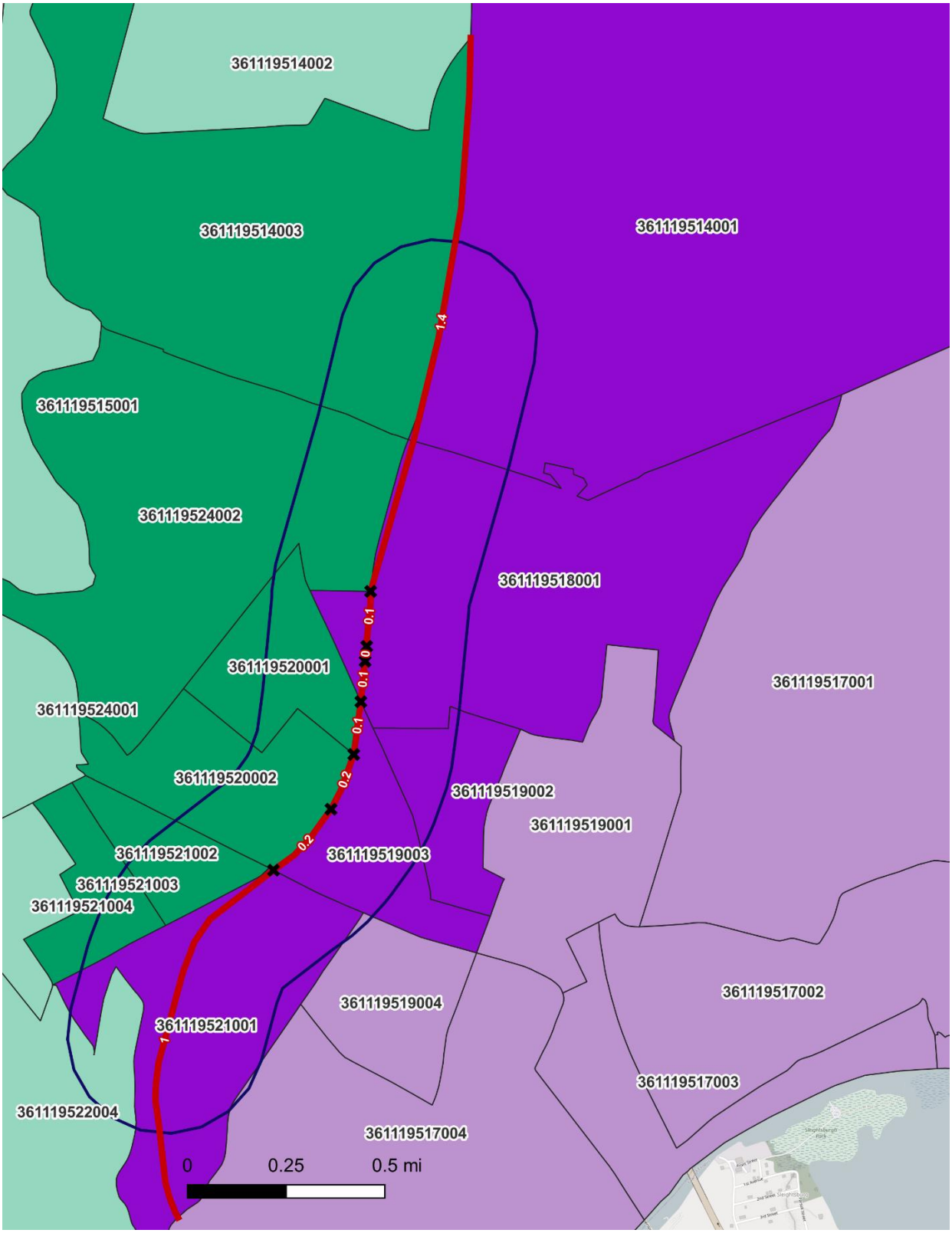


Figure 3-14. Share of Total Trips by Trip Distance

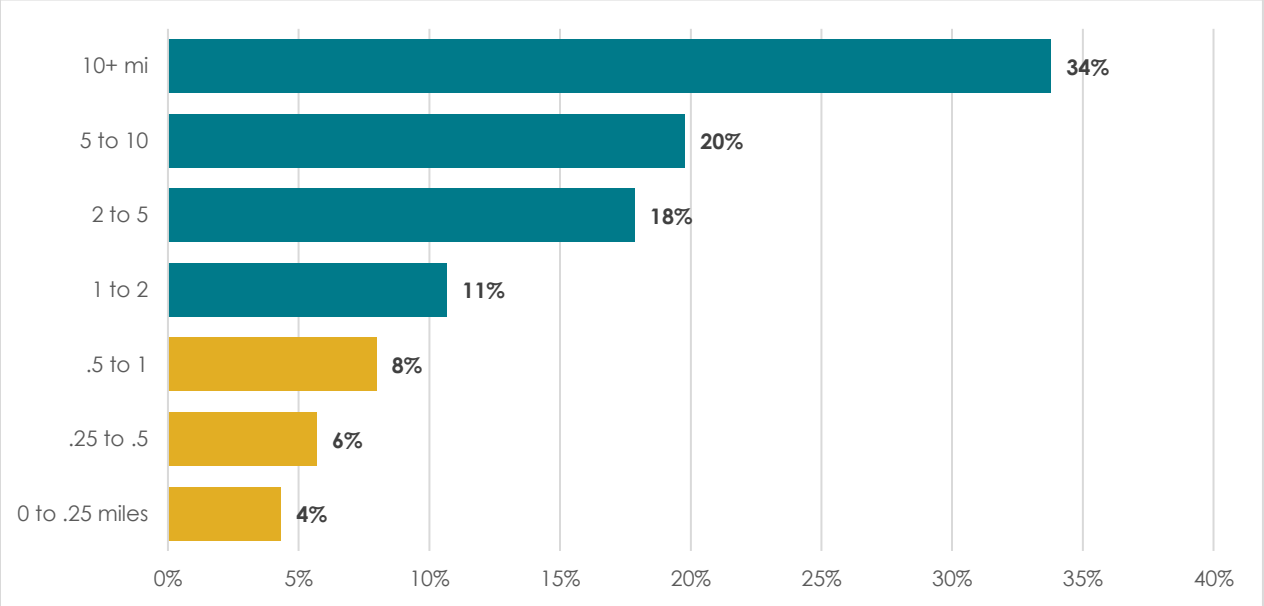
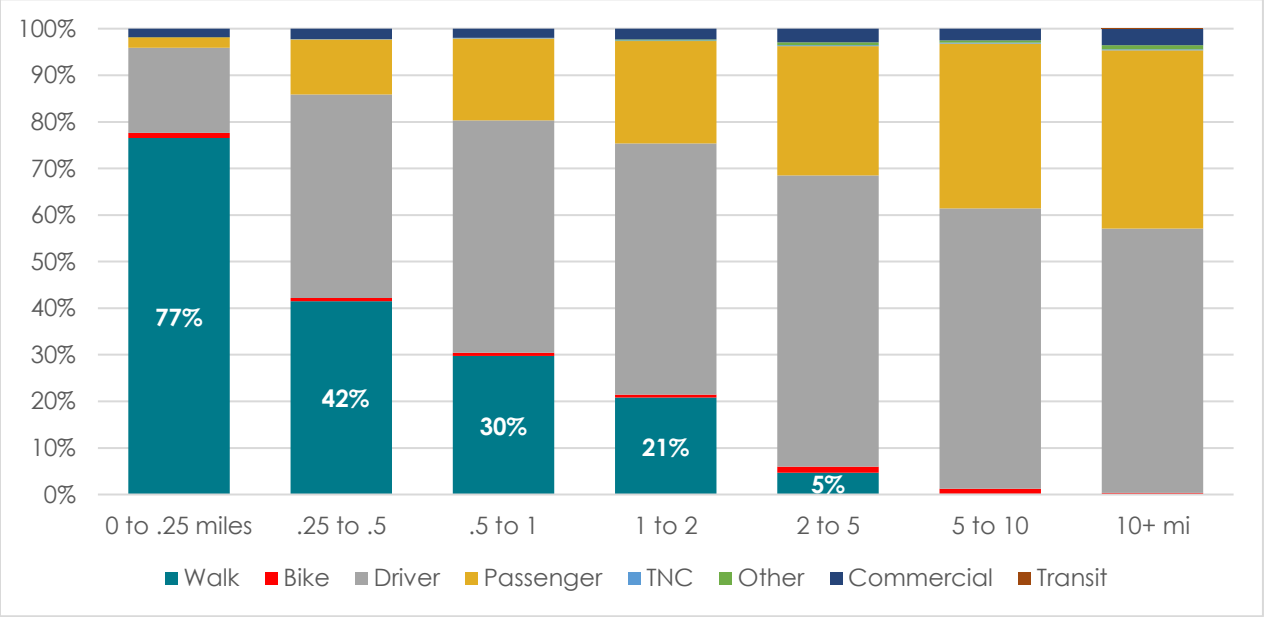


Figure 3-15. Mode Share by Trip Distance



Results and Summary

Two approaches were used to approximate the locations of people walking and biking in relation to the rail corridor. The first approach examined walking and biking trips on specific roadway links and legitimate railroad crossings. The second approach examined the origin and destination of potential walking and biking trips (trips under 1 mile) to infer where railroad trespasses may be occurring.

Both approaches show a concentration of walking and biking activity in the southern portion of the corridor, near Broadway and to the south of Broadway.

Replica assigns walking and biking trips to links and routes defined in their model; therefore, the results of this analysis do not include locations of potential and known areas of pedestrian/bicycle trespassing occurrences within the rail corridor study area. Figure 3-16 shows the network link assigned volumes for pedestrian and bicycle trips.

On a typical weekday, there are around 8,000 (7,936) trips beginning or ending in a census block group directly adjacent to the rail corridor. Approximately 1,000 (960) of these trips were classified as walking or bicycling trips, and approximately 2,000 trips were 1 mile or shorter, which represents the potential for walking and biking trips. Of the potential walking and biking trips, approximately 1,000 of these trips were focused on the southern segment of the railroad corridor (south of Broadway, with around a 1-mile distance between rail crossings), 400 were between the block groups in the northern segment (north of Flatbush, with approximately 1.4 miles between crossings), and 600 crossings were in the middle segment, between Flatbush and Broadway. Figure 3-17 represents the origins and destinations of trips under 1 mile in the study area.

Figure 3-16. Link Assigned Volumes for Walking and Biking Trips

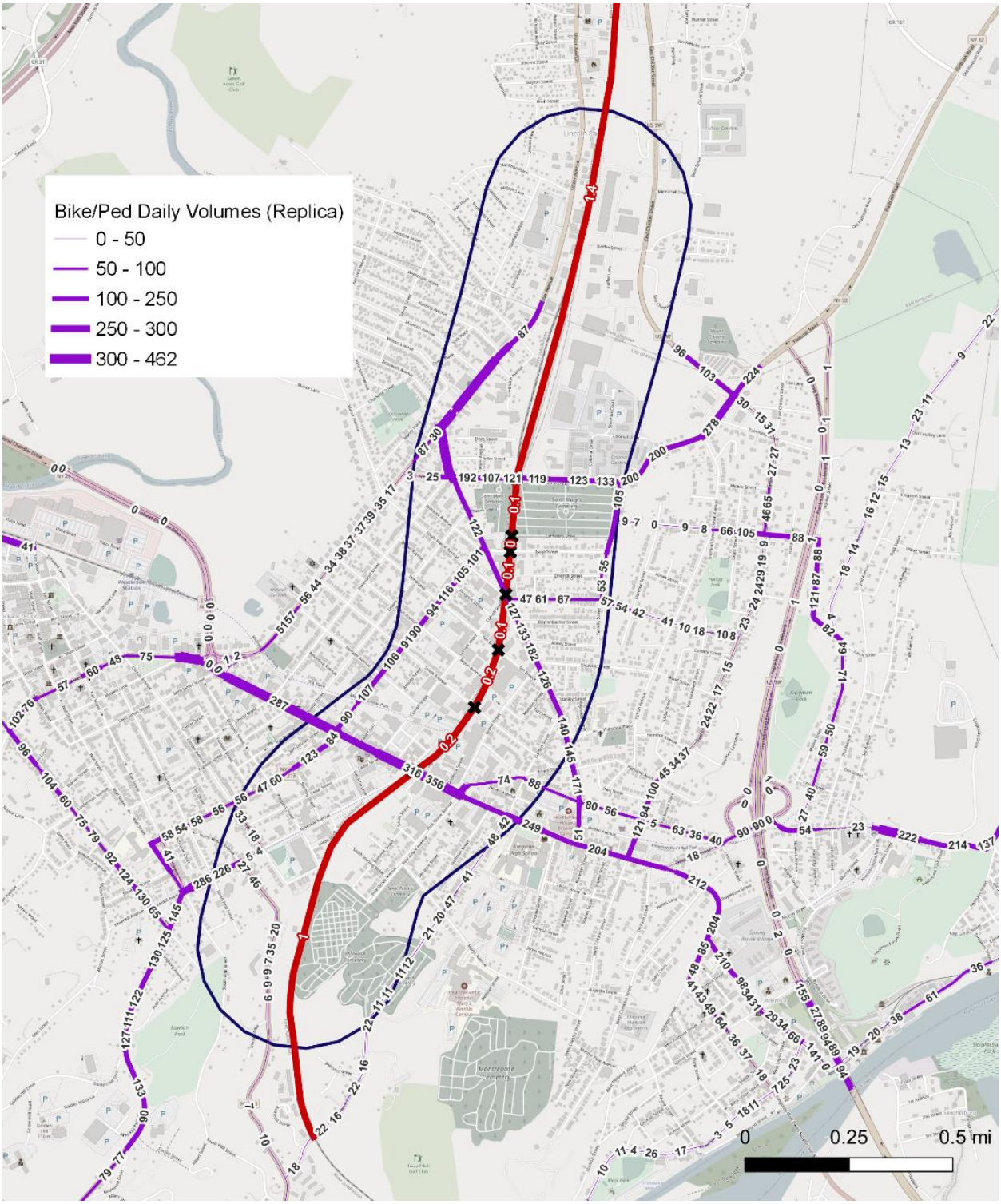
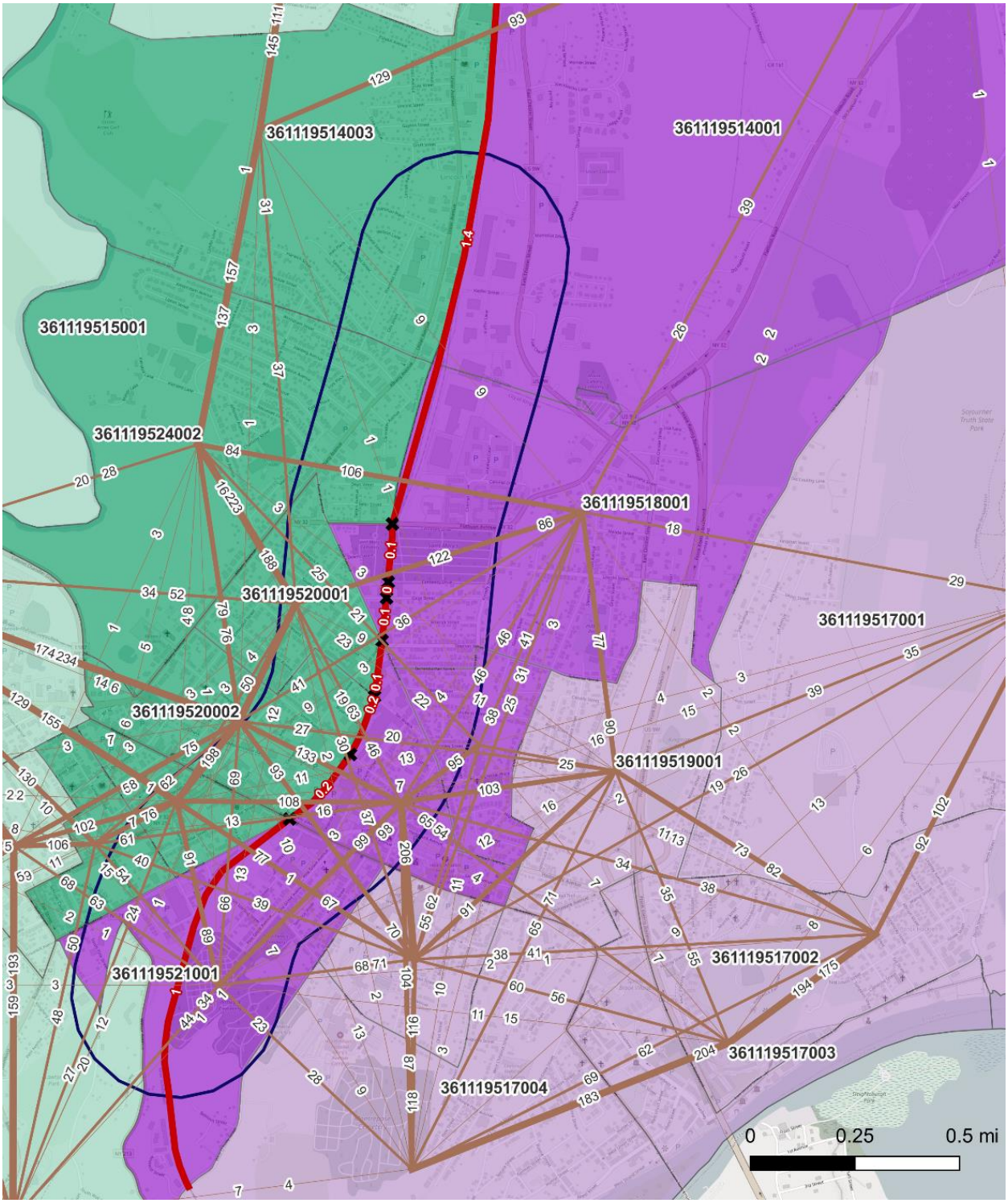


Figure 3-17. Origins and Destinations of Trips Under One Mile



3.3 RAIL SAFETY CONSIDERATIONS

3.3.1 FRA Incident Analysis

This section will highlight the incident history for both vehicular accidents at the six grade crossings in the study area as well as pedestrian trespassing incidents along the right-of-way based on FRA incident data.

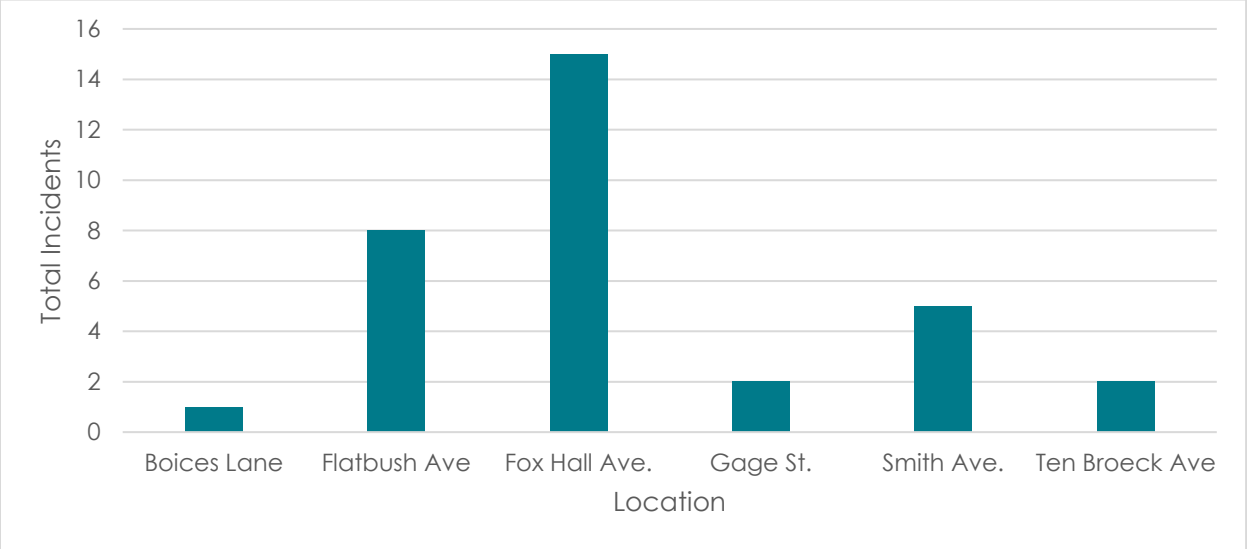
HIGHWAY-RAIL GRADE CROSSING INCIDENTS

FRA crossing incident data goes back to 1976 and is current through the 2022 calendar year. For the purpose of this study, FRA data did not factor in any 2023 incidents. Most of the data analysis focused on both the past 46 years and a smaller subset of the past 10 years. Because the NYSDOT data and FRA data are submitted by different organization and compiled under separate reporting criteria, there could be inconsistent data when comparing the two sources.

TOTAL INCIDENTS

Over the past 46 years (1976 to 2022) there have been a total of 33 highway-rail grade crossing incidents involving a private vehicle and a train. In the past 10 years there was a total of 9 crossing incidents, which account for 27 percent of the total incidents over the past 46 years. Figure 3-18 shows the breakdown of the 33 incidents by crossing location.

Figure 3-18. Total Incidents by Crossing (46-year History)



The Foxhall Avenue crossing had the greatest number of incidents, totaling 15 out of 33 or 45 percent of the total incidents. Flatbush Avenue, accounts for the second highest number of grade crossing incidents. Combined these two locations account for 70 percent of the total number of crossing incidents and represent the highest risk locations to the city of Kingston.

The main contributing factor of these incidents are a result of the drivers of the automobiles intentionally going around the activated highway-rail grade crossing warning devices.

INJURIES/FATALITIES AT HIGHWAY-RAIL GRADE CROSSINGS

Of the 33 incidents, 15 or 45 percent resulted in either injury or fatality. Thirteen of these incidents resulted in injuries to the occupants of the automobiles, and two resulted in the death of an occupant of the automobile (Figure 3-19). Over the past 10 years there have been a total of 9 incidents. Two of the nine incidents did not result on any injury or fatality. One incident resulted in one injury and one fatality. Of the 9 incidents in the past 10 years, 7 or 78 percent involved injuries and 1 incident or 12 percent resulted in a fatality to the occupant of the vehicle (Figure 3-20).

Figure 3-19. Grade Crossing Injuries/Fatalities (46-year History)

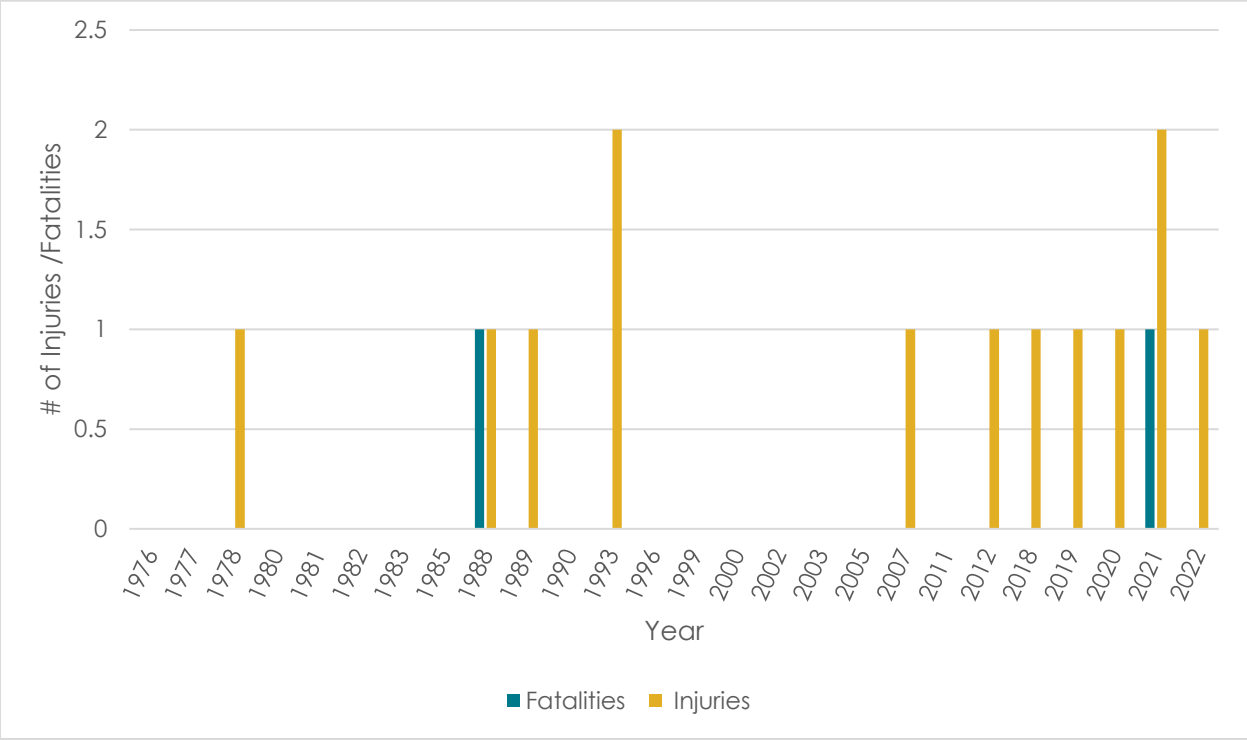


Figure 3-20. Grade Crossing Injuries/Fatalities (10-year History)

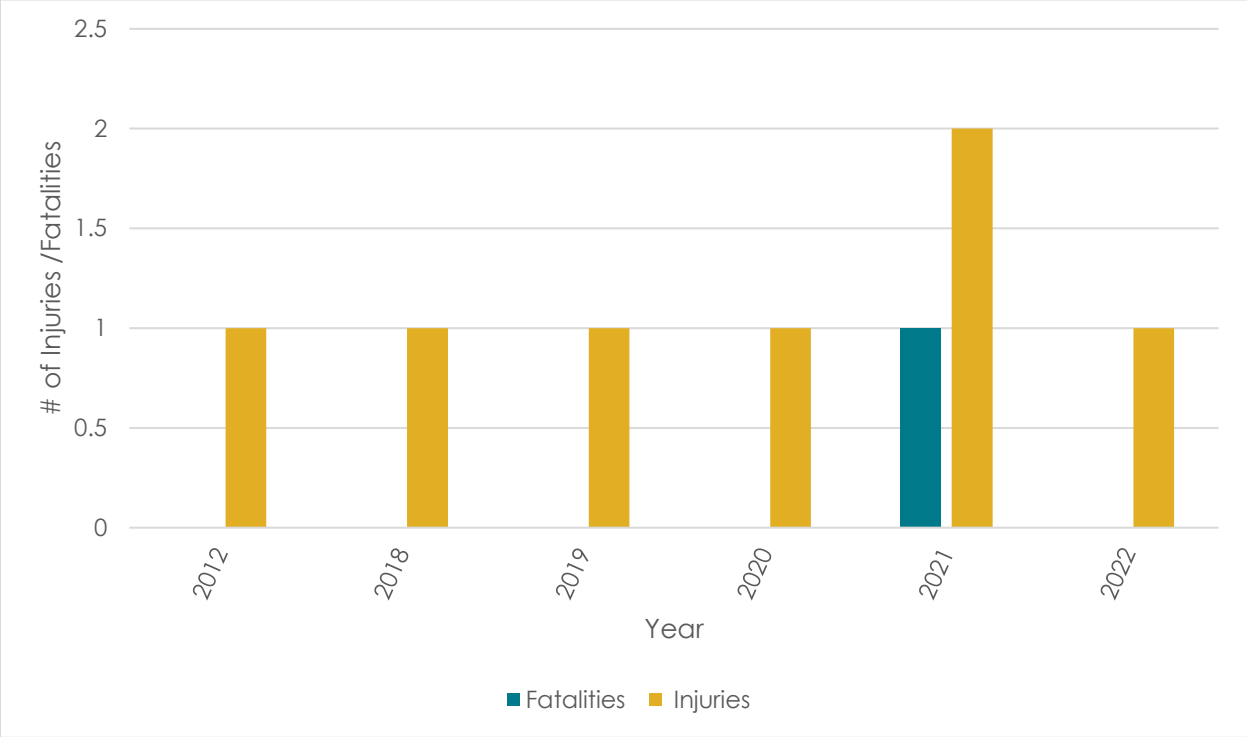


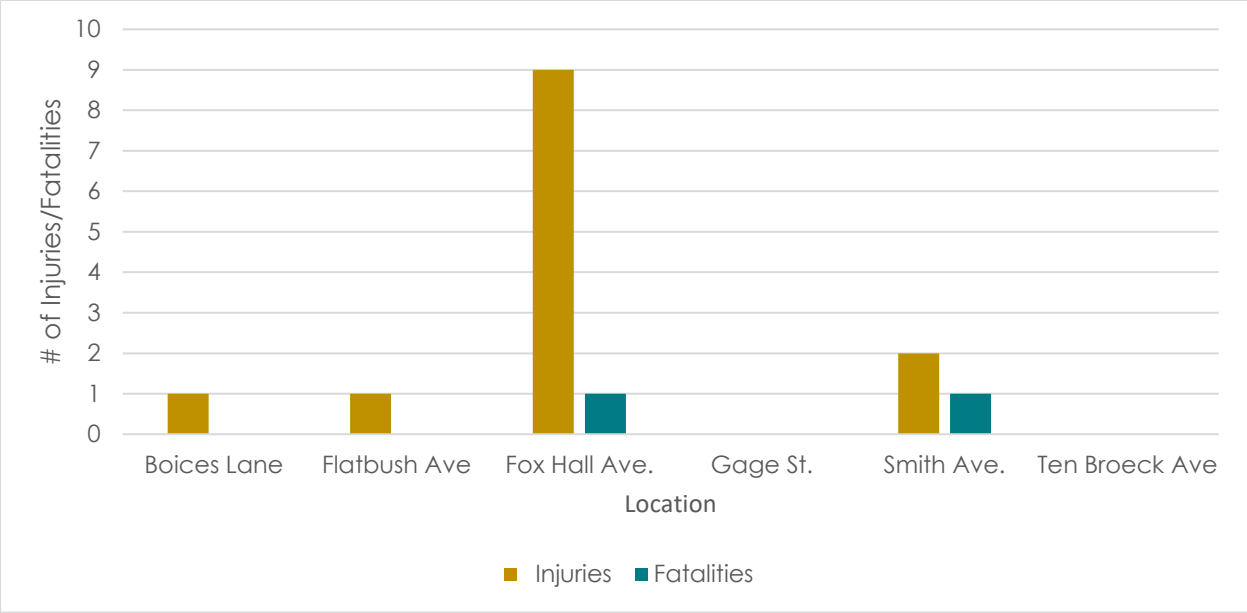
Table 3-10 and Figure 3-21 provide a breakdown of the 15 incidents by crossing location.

Table 3-10. Injuries /Fatalities by Crossing

Location	# Injuries	# Fatality
Boices Lane	1	0
Flatbush Ave	1	0
Foxhall Ave.	9	1
Gage St.	0	0
Smith Ave.	2	1
Ten Broeck Ave	0	0
TOTAL	**13**	**2**

Figure 3-21 breaks out these locations further and shows the number of injuries verse fatalities.

Figure 3-21. Grade Crossing Injuries / Fatalities by Crossing (46-year History)



The Foxhall Avenue crossing represents 66 percent of the grade crossing injury/fatality incidents. . Smith Avenue accounts for 20 percent, and Flatbush Avenue and Boices Lane each contribute one incident each or 7 percent.

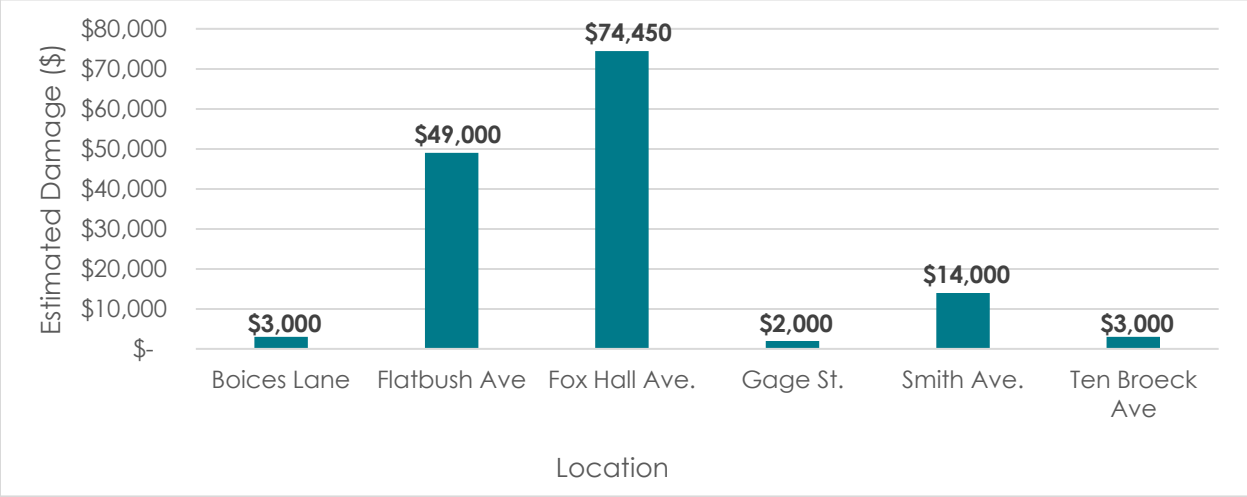
PROPERTY DAMAGE

When reporting grade crossing incidents, railroads are required to provide a cost estimate for the total amount of damaged caused to both railroad and private property (e.g., the automobile). Based on the reported cost estimates, the 33 grade crossing incidents accounted for approximately $145,450 in property damage. Table 3-11 and Figure 3-22 provide a breakdown of the property damage by crossing location over the 46-year history.

Table 3-11. Total Damage Costs by Crossing – 46 yr. History

Location	Damage ($)
Boices Lane	$3,000
Flatbush Ave	$49,000
Foxhall Ave.	$74,450
Gage St.	$2,000
Smith Ave.	$14,000
Ten Broeck Ave	$3,000
TOTAL	**$145,450**

Figure 3-22. Total Damage ($) by Location (46-year History)



Foxhall Avenue and Flatbush Avenue account for the largest percentage of property damage at 51 percent and 34 percent, respectively.

TRAIN DIRECTION OF TRAVEL

Of the 33 incidents, 19 occurred when the train was traveling northbound, and 14 occurred when the train was traveling southbound (Figure 3-23). Northbound and southbound are based on railroad timetable direction. From the 9 incidents in the past 10 years, 7 were northbound and 2 were southbound (Figure 3-24).

Figure 3-23. Incidents by Direction of Travel (46-year History)

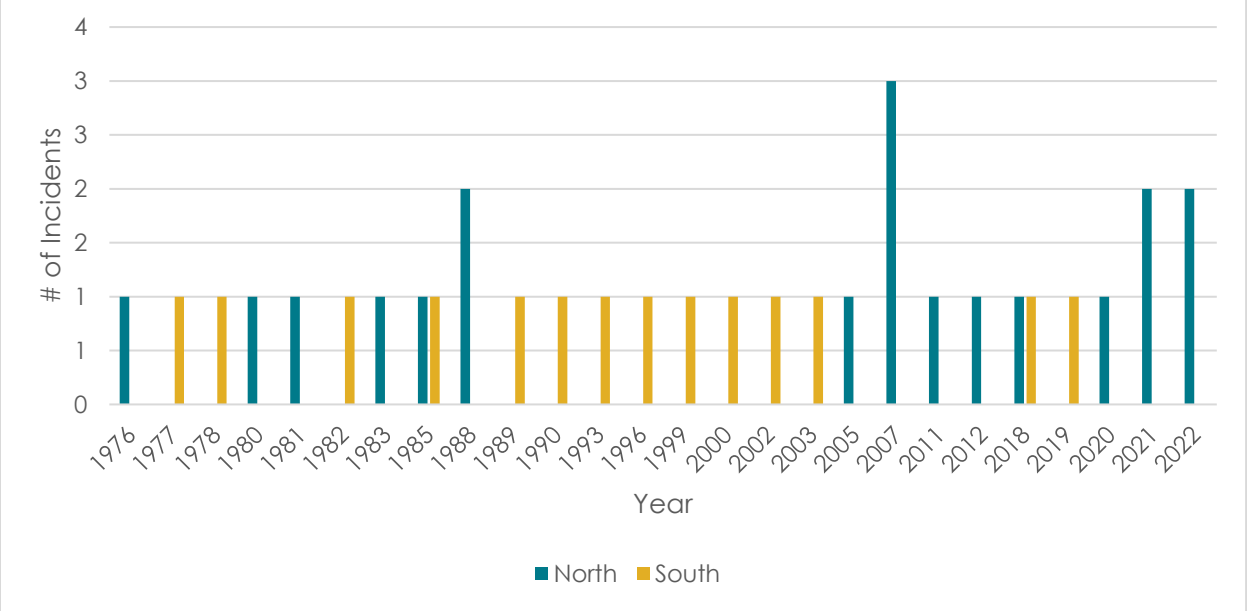
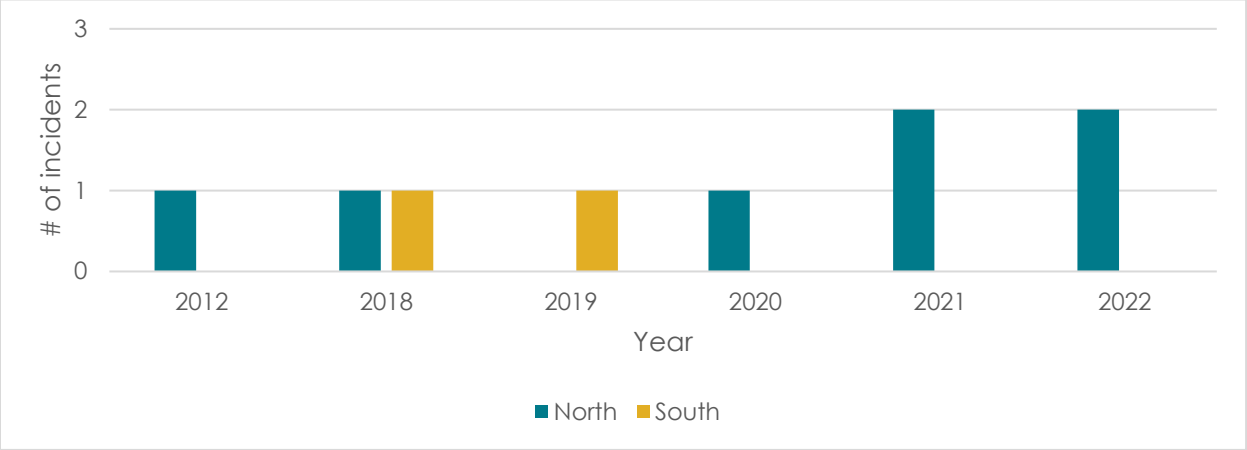


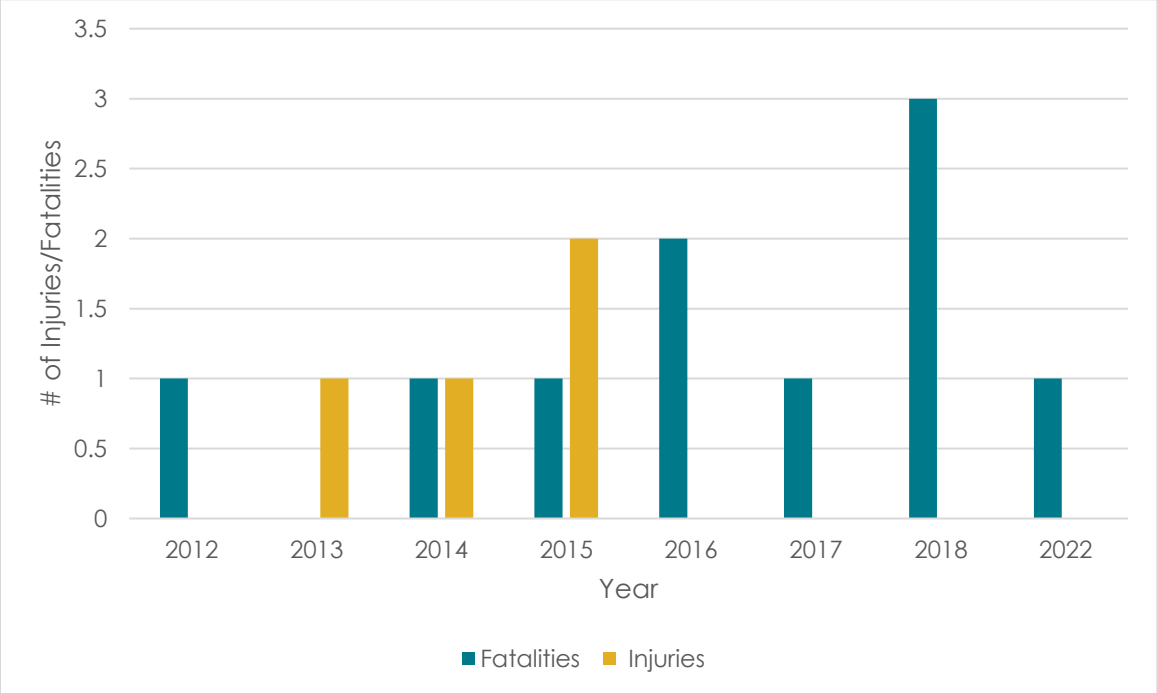
Figure 3-24. Incidents by Year by Direction (10-year History)



PEDESTRIAN TRESPASS INCIDENTS

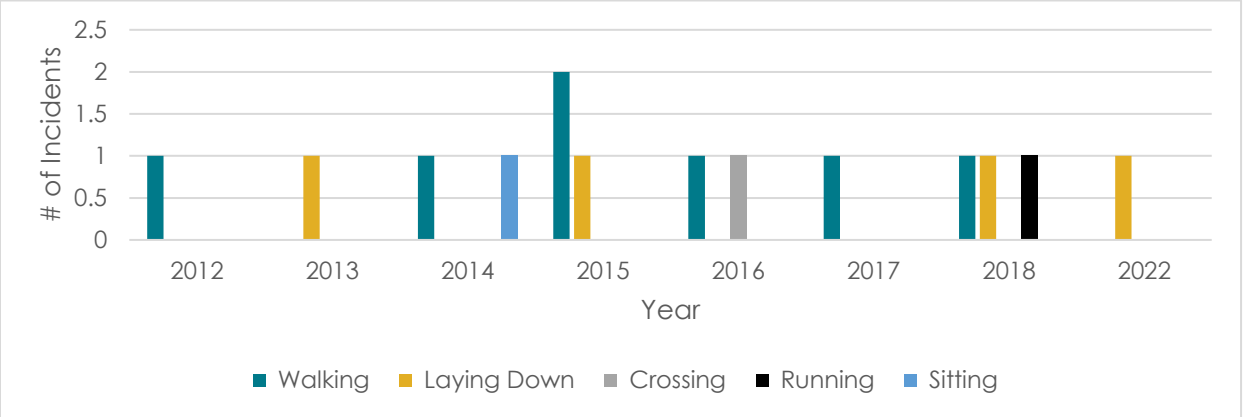
The FRA data on trespassing incidents goes back to 2012 and is current to 2022. For that 10-year period there were 14 incidents of a trespassers being struck along the right-of-way in Ulster County. Out of the 14 incidents, 10 resulted in a fatality and 4 resulted in injury to the trespasser. Figure 3-25 shows the breakdown of fatalities and injuries by year. This study did not determine how many of the fatalities were a result of suicide.

Figure 3-25. Trespassing Injuries/Fatalities by year (10-year History)



The actions of the trespasser were broken down into one of five actions. These five actions were walking, laying down, crossing the right-of-way, running, and sitting in the right-of-way. Seven or 50 percent of the trespassing events were a result of the individual walking on the right-of way. Laying down on the right-of-way was the second highest action taken by trespassers, with four events. Figure 3-26 shows the actions taken by year for the 14 incidents.

Figure 3-26. Trespassing Events by Action by Year



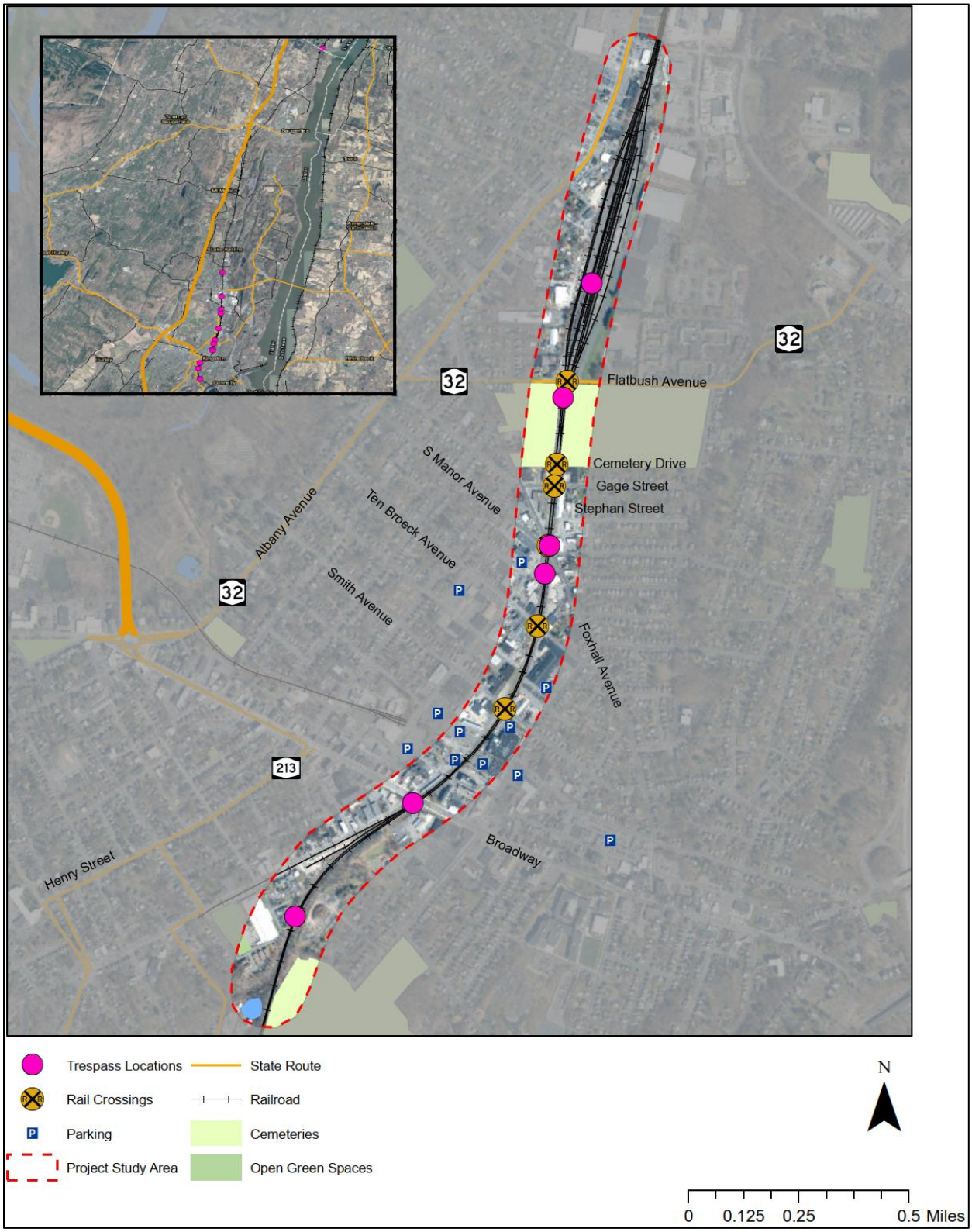
The FRA data pinpoints location by actual latitude and longitude coordinates. When analyzing the location of the 14 incidents, no patterns, hotspots, or trends were identified. The data shows the locations as random rather than near grade crossings, and no location had more than one incident. Six of the reported 14 incidents fall within the RCSS study area and eight are outside the study limits. Table 3-12 shows the trespassing incidents by location.

When analyzing the 14 trespassing incidents, the locations of these incidents were determined to be random, with no trending "hot spot." Two incidents were near Broadway; however, both incidents were on opposite sides of the road. Table 3-12 provides a description of the 14 incident locations based on latitude and longitude.

Table 3-12. Trespass Incidents by Location

Latitude/Longitude	Closest Street	Closest Landmark
41.9348/-73.997725	Foxhall Ave	Universal Metal Fabricators
41.948411/-73.993904	Ulster Ave	Speigel Bros. Paper Co.
42.134287/-73.92532	Route 9 / Quarry Rd	Dense wooded area. Not near Kingston
41.985663/-73.991301	Seremma Ct.	Grace Community Church
41.961221/-73.992199	Morton Blvd.	Winsupply of Kingston/Savona's Pizza
41.92212/-74.007501	Rt 213 – Wilbur Ave.	Mountain Valley Manor Adult Home
41.941189/-73.99634	Flatbush Ave. Crossing	Inside Rail Yard
41.958408/-73.992277	Ulster Overpass	Aldi / Family Dollar
41.92575/-74.006068	S. Prospect St.	Ace Oil & Propane
41.969868/-73.991892	John M. Clark Rd.	Hampton Inn Kingston/
41.928525/-74.002201	Empire State Trl	Ulster Uniform Services/ NAPA Auto Parts
41.915197/-74.006055	W. O'Reilly St.	Nogginsland Therapy & Play Pediatric
41.938399/-73.997273	Flatbush Ave.	St. Mary's Cemetery
41.934109/-73.997889	Cornell St./ Foxhall Ave.	Darmstadt Overhead Doors

Figure 3-27. Trespassing Incidents by Location



4 PUBLIC OUTREACH PLAN

4.1 TECHNICAL ADVISORY COMMITTEE

The first Technical Advisory Committee (TAC) meeting was held remotely on March 16, 2023.

The Attendee List is as follows:

Ulster County Planning Department
Dennis Doyle, Director
David Staas, Senior Transportation Planner

WSP
Katie Craig, Project Manager
Lurae Stuart, Rail Safety Expert
Scott Lagace, Engineer
Susan Blickstein, Public Outreach
Julian Wexer, Public Outreach

TAC Members
Chris Rea, Chief City of Kingston FD
Greg Hart, FRA Grade Crossing Inspector for NYS & others
Keith Phillips, City of Kingston Engineering
Mike Gunther, City of Kingston Engineering
Richard Frumess, Business Owner, R&F Handmade Paints

The meeting began with introductions and an overview of the study. David Stass presented his goals for the study and expressed his concern with the safety of the highway-rail grade crossings, particularly trespass violations. A summary of WSP's anticipated approach to the project was then shared with the TAC. This was followed by an open discussion.

The second TAC meeting was held remotely on October 18, 2023, and was combined with the second Discussion Group.

The Attendee List is as follows:

Ulster County Planning Department
David Staas, Senior Transportation Planner

WSP
Lurae Stuart, Rail Safety Expert
Scott Lagace, Engineer
James Fox, Transit and Rail Engineer

Shaune Middleton, Transit and Rail Engineer
Susan Blickstein, Public Outreach
Julian Wexer, Public Outreach

TAC Members
Emily Flynn, City of Kingston Health, and Wellness
Keith Phillips, City of Kingston Engineering
John Schultheis, City of Kingston
Daniel Coots, NYDOT
Robert Rohauer, CSX Senior Manager of Strategic Projects, and Community Affairs

The meeting provided an overview of the project, as well as insight into the status of data collection and recommendations, informing the TAC of progress that had been made since the previous TAC meeting. The meeting was then opened up for discussion, in which a few important comments were made, including the following:

- It was mentioned that Cemetery Road is a private road. Discussion followed that included how that makes discussion of possible closure much more difficult. CSX has had conversations with the cemetery in the past, but the cemetery has not been very willing or receptive to any closure. The cemetery appears to have easement, and their maintenance facility on the opposite side of the tracks.
- It was asked who typically funds the mitigations. WSP mentioned that there are FRA grants available if there is a good business case. WSP also mentioned significant improvements often fall under the control of CSX.
- It was stated that the City of Kingston is investigating adding an overpass option as a Trespass Mitigation near the YMCA area.
- It was suggested that WSP should investigate adding stairs from Greenkill Avenue to Broadway.
- It was mentioned that there are preliminary discussions about a new park near the YMCA and how that could lead to increased traffic and possibly increased trespass and how that might justify the pedestrian overpass.
- CSX mentioned that they have paid to have fencing and "No Trespassing" signs installed, but that the fencing has been breach and the signs have been removed. CSX mentioned the importance of education.
- CSX suggested adding consolidation of crossings as a grade crossing mitigation (this is included in Quiet Zone Study).

4.2 ROUNDTABLE DISCUSSIONS

The first roundtable discussion was held on June 8, 2023, at the Ulster County Offices.

The Attendees List is as follows:

Ulster County Planning Department
Dennis Doyle, Director
David Staas, Senior Transportation Planner

WSP
Katie Craig, Project Manager
Lurae Stuart, Rail Safety Expert
Scott Lagace, Engineer
Susan Blickstein, Public Outreach
Julian Wexer, Public Outreach

Discussion Group Participants
Tom Folk, YMCA
Chuck Schneider, Rural Ulster Preservation Company (RUPCO)

Important points made during the roundtable discussion include the following:

- Previously there were stairs on the old bridge carrying Greenkill Avenue over Broadway. Using stairs to address the change of grade from Greenkill Avenue would help decrease trespassing by providing better access to Broadway.
- Approximately 25 to 30 children cut through the rail tracks to get to Kingston High School. The children, who typically have a high level of risk tolerance, are dismissed from school from 2:15 to 3:30 p.m., is when kids get out of school. Many then go to the YMCA and some cut across the school.
- During WSP's site visit, the rail crossing gates were not functioning properly at the Foxhall/Manor/Stephan intersection. The gates went down and eventually back up several times with no trains approaching. An issue with switching at the yard may have been causing this activity.
- Gage Street is not heavily crossed and is close enough to alternative streets. Ten Broeck Avenue and Smith Avenue also are not heavily crossed. Flatbush Avenue, Foxhall Avenue, and around Broadway are the main areas of concern.
- Nighttime visibility is poor along some of the streets. It is dark on Ten Broeck Avenue and Greenkill Avenue.
- People are trespassing at the Foxhall Avenue intersection. Additional fencing might solve the issue.

4.3 PUBLIC OPEN HOUSES

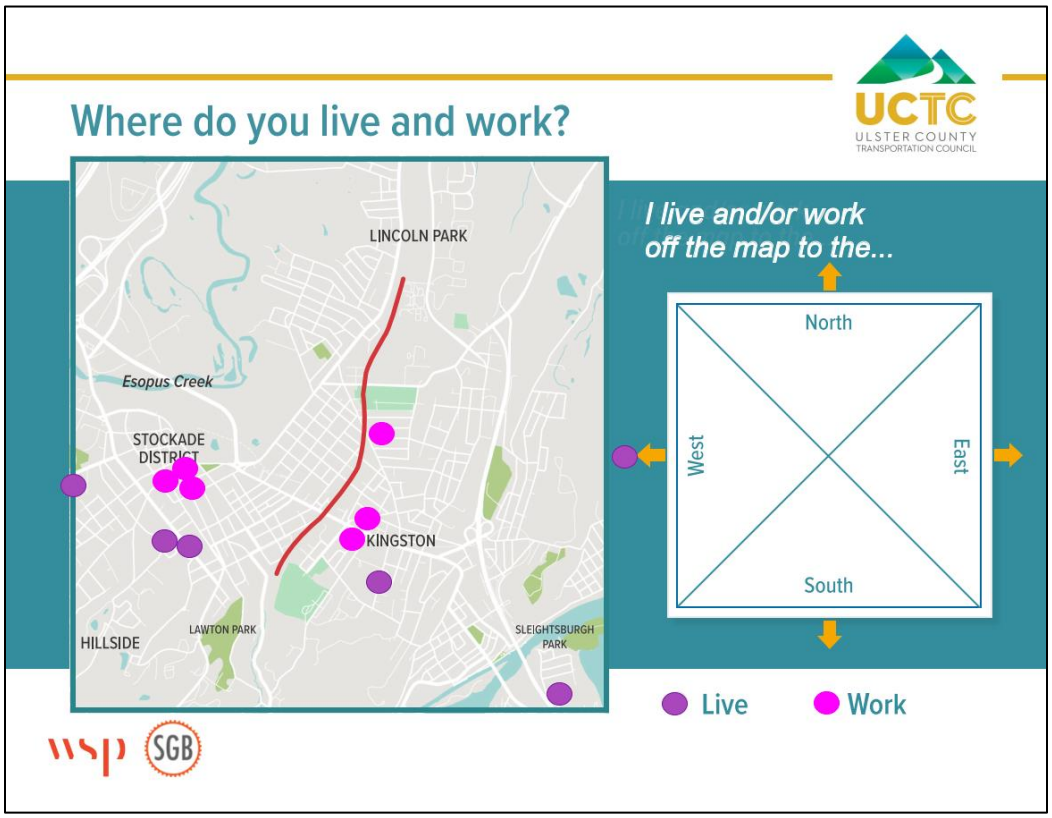
The first public open house was held on June 22, 2023, at the Ulster County Restorative Justice and Community Empowerment Center. The Public Outreach Plans intends to bring constituents and key stakeholders together to understand how people interact within the corridor.

A video was played on a continuous loop that provided an overview of the project. The video started with an introduction from the mayor of Kingston, Steve Noble. Steve provided an overview of the purpose and objective of the project, which is to evaluate and enhance safety along the CSX corridor in the city of Kingston. The video provided information on existing conditions and three initial areas of concern that each have different contributing factors:

- Along the tracks between Flatbush Avenue and Cemetery Drive
- The at-grade crossing at Foxhall Avenue
- The area south of Broadway

A display board was provided that allowed attendees to identify where they live and work in relation to the project site (Figure 4-1).

Figure 4-1. Public Open House #1 – "Where do you live and work?" Results



The meeting was sparsely attended; however, for those that were unable to attend, the video and survey was provided on Ulster County's website at https://ulstercountyny.gov/transportation-council/active-studies/kingston-rail-crossing.

A survey was provided at the meeting and was also posted on the Participate Ulster website, where it received two responses. The survey was also posted on the Ulster County Transportation Council project website and received four responses. The results of the survey are summarized as follows.

PARTICIPATE ULSTER WEBSITE SURVEY RESULTS

Two contributors responded to the survey. Neither contributor attended the first public open house and only one of them watched the study video. Both contributor responses said that they have witnessed railroad crossing violations at Foxhall Avenue. Both contributor responses ranked Foxhall Avenue as the least safe railroad crossing.

ULSTER COUNTY TRANSPORTATION COUNCIL WEBSITE SURVEY RESULTS

Four contributors responded to the survey. One contributor attended the first public open house, and three contributors watched the study video. All four contributors live in Kingston. Two contributors have witnessed railroad trespass along the corridor and one contributor has witnessed railroad crossing violations at Flatbush Avenue. Survey respondents ranked Flatbush Avenue and Foxhall Avenue as the least safe railroad crossing. The following additional comments were provided by the respondents:

- Fencing does not work; a taller tamper proof barrier is needed. Have witnessed strollers pulled across the tracks south of Broadway.
- Biggest concern is Foxhall Avenue. The sidewalk is not continuous making it difficult for pedestrians and people in wheelchairs to cross. The Foxhall Avenue crossing is at an angle with the tracks instead of running perpendicular.
- It is CSX's responsibility to keep the City easily accessible for its citizens. End long and slow train crossings in addition to the harmful and punishingly loud horns going off in the middle of the night.

The second public open house was held remotely on October 25, 2023. A presentation was given that summarized the RCSS progress to date. The presentation discussed the study area and a brief overview that included the RCSS study objective, and the study video was played for attendees. The presentation then reviewed the following FRA data collected and evaluated:

- Highway-rail grade crossing injuries and fatalities
- Trespass incidents

The meeting concluded with a discussion on possible mitigation measures for highway-rail grade crossings and trespass incidents.

The meeting was sparsely attended; however, for those that were unable to attend, the video and survey was provided on Ulster County's website at https://ulstercountyny.gov/transportation-council/active-studies/kingston-rail-crossing.

5 RISK ANALYSIS

5.1 RISK ANALYSIS APPROACH

Motor vehicle drivers put themselves in harm's way when driving around the active gates at highway-rail grade crossings. While this could be considered human intent, grade crossing risk are evaluated as a safety incident with unintentional harm to people, equipment, and reputation. All forms of trespassing are evaluated as security incidents because they involve human intent to enter the rail right-of-way. Incidental trespassing, though not intended to do harm to self or the system, is still considered a security incident because the person still intentionally enters the railroad corridor.

For the purpose of this assessment highway-rail grade crossings were analyzed using a traditional hazard assessment model and trespassing events were analyzed using a traditional threat and vulnerability assessment model.

5.1.1 Hazard Assessment Model

When conducting a hazard assessment, key characteristics regarding the environment, systems, vehicles, and operation are factored into the process.

The associated hazards are then identified. Hazard identification is based on past experience of the safety team, concept of operations, and by current safety data.

The next step is to assess the risk using a qualitative process of classifying the potential severity and probability of occurrence associated with the hazard.

Hazard severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure, or malfunction, as shown in Figure 5-1.

When determining the severity for this study, WSP assessed the risks by location in order to understand the type of risk by location that will assist in prioritizing locations for mitigations.

Figure 5-1. Hazard Severity Categories

SEVERITY CATEGORIES		
Description	**Severity Category**	**Mishap Result Criteria**
Catastrophic	1	Could result in one or more of the following: death, permanent total disability, irreversible significant environmental impact, or monetary loss equal to or exceeding $10M.
Critical	2	Could result in one or more of the following: permanent partial disability,injuries or occupational illness that may result in hospitalization of at least three personnel, reversible significant environmental impact, or monetary loss equal to or exceeding $1M but less than $10M.
Marginal	3	Could result in one or more of the following: injury or occupational illness resulting in one or more lost work day(s), reversible moderate environmental impact, or monetary loss equal to or exceeding $100K but less than $1M.
Negligible	4	Could result in one or more of the following: injury or occupational illness not resulting in a lost work day, minimal environmental impact, or monetary loss less than $100K.

The probability that a hazard will occur during the planned life expectancy of the system can be described in potential occurrences per unit of time, events, items, or activities. The qualitative hazard probability ranking identified in Figure 5-2 is established.

Figure 5-2. Probability Categories

Category Name	Level	Characteristics
Frequent	A	Likely to occur frequently or continuously (weekly, 200K miles, or $>10^{-1}$ events).
Probable	B	Will occur many times in life of an item or at a specific location. (monthly, 800K miles, or $<10^{-1}$ but $>10^{-3}$ events)
Occasional	C	Likely to occur one or more times in life of an item or at a specific location. (yearly, 11 million miles, or $<10^{-3}$ but $>10^{-6}$ events)
Remote	D	Unlikely but possible to occur in life of an item or at a specific location (decade, 110 million miles, or $<10^{-6}$ but $>10^{-8}$ events)
Improbable	E	So unlikely, it can be assumed occurrence will not be experienced at a specific location. Almost inconceivable that the event will occur ($<10^{-8}$ events)

Hazard analyses establish hazard severity category (I through IV) and hazard probability ranking (A through E) which are combined into a Hazard Risk Index (Figure 5-3), reflecting the combined severity and probability ranking for each identified hazard. Utilizing the incident data from Section 3.3 the risk analysis did analyze the number of incidents by Crossing, Fox Hall and Flatbush had the highest number of incidents and this was also factored into the risk analysis when determining both severity and probability of the event. The risk analysis then used potential worse case based on this historic information.

Figure 5-3. Risk Index

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

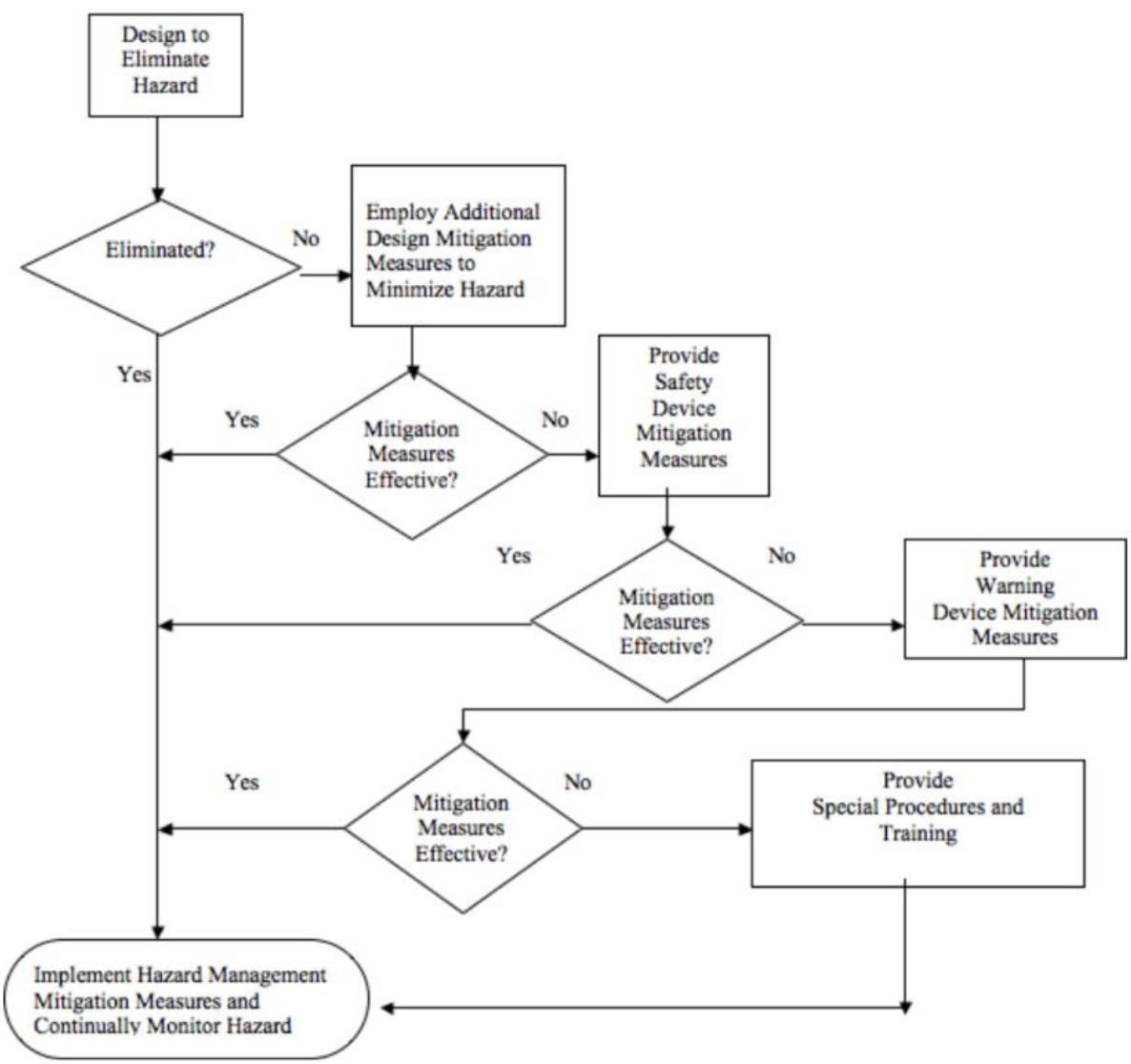
RELATIONSHIP BETWEEN RISK ASSESSMENT CODE AND RISK LEVEL		
Risk Assessment Code	**Risk Level**	**Response**
1A, 1B, 1C, 2A, 2B	High	Unacceptable
1D, 2C, 3A, 3B	Serious	Undesirable
1E, 2D, 2E, 3C, 3D, 3E, 4A, 4B	Medium	Acceptable with concurrence by SSRC
4C, 4D, 4E	Low	Acceptable

The hazard assessment matrix assists the decision-making process in determining whether a hazardous condition should be eliminated, controlled, or accepted, in terms of severity and probability. Each hazard would be examined, qualified, addressed, and resolved based on the severity of a potential outcome and the likelihood that such an outcome will occur. If the potential for an accident/incident reveals a Category 1 (catastrophic) occurrence with a Level A (frequent) probability, the system safety effort would be to eliminate the hazard through design or at the very least to implement redundant hazard control measures. A catastrophic (Category 1) or critical (Category 2) hazard risk may be tolerable if it can be demonstrated that the result of the occurrence would be marginal (Category 3) or negligible (Category 4). This provides a basis for logical management decision-making considering hazard's severity and probability. Adequate elimination or

control of risk is dependent on the ability to identify and eliminate/control the hazard as early as possible.

A variety of control measures would be used to reduce the risk to the lowest practicable level. Military Standard 882-E identifies an order of precedence in the hazard control process. The order of precedence in the hazard control process is the Hazard Reduction Sequence (Figure 5-4). The process emphasizes the elimination of hazards through design.

Figure 5-4. Hazard Reduction Sequence

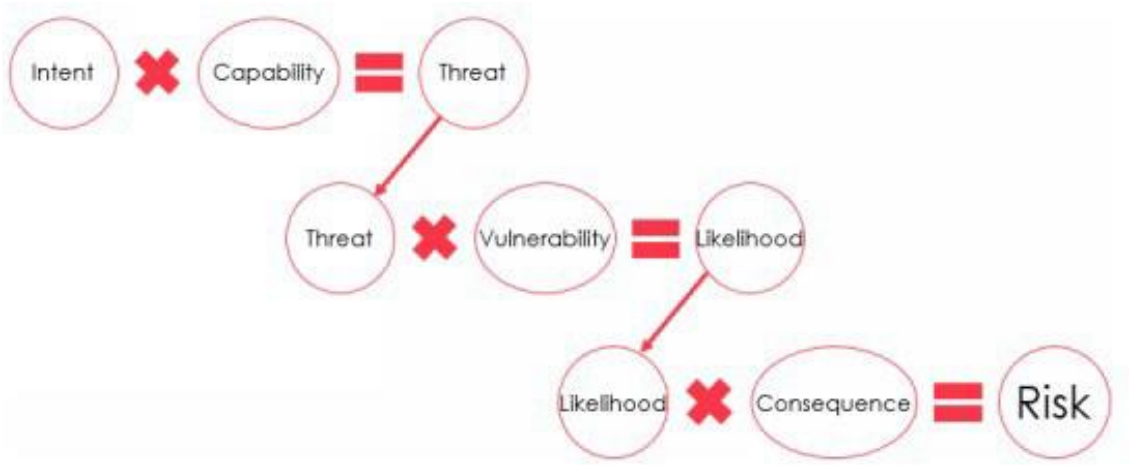


5.1.2 Threat and Vulnerability Assessment Model

The threat and vulnerability assessment process employed includes an assessment of intent and capability to establish threats, an assessment of threats and vulnerabilities to establish likelihood, and

an assessment of likelihood and severity of consequence to establish the appropriate level of risk (Figure 5-5).

Figure 5-5. Threat and Vulnerability Assessment Flow Diagram



Vulnerability is a manifestation of procedural or physical conditions. The evaluation criteria to assess system vulnerability is shown in Figure 5-6.

Figure 5-6. Vulnerability Evaluation Matrix

Vulnerability Level	Assessment Criteria
Very High	• Physical and procedural mitigations that detect, delay, respond, and deter are non-existent • No security awareness culture exists for employees, contractors, or customers • No business or operational contingencies exist to manage known security responses that could have an impact on operations • No process is in place to track industry and local security risks internationally, nationally, or local • No security drills or exercises are conducted to test system security
High	• Physical and procedural mitigations fail to identify more than two of the security components of detect, delay, respond, and deter • Security awareness culture exists but fails to include more than one group (employees, contractors, customers) • Business or operational contingencies exist for at least 25% of the known security responses that could have an impact on operations. • No Process is in place to track industry and local security risks using more one source (internationally, nationally, local) • Security drills or exercises are conducted every three years to test system security
Medium	• Physical and procedural mitigations fail to identify more than three of the security components of detect, delay, respond, and deter • Security awareness culture exists buts fails to include more than two groups (employees, contractors, customers) • Business or operational contingencies plans exist for at least 50% of the known security responses that could have an impact on operations • No process is in place to track industry and local security risks using more than two sources (internationally, national, local) • Security drills or exercises are conducted every two years to test system security
Low	• Physical and procedural mitigations address all the security components of detect, delay, respond, and deter • Security awareness culture exists for employees, contractors, and customers • Business or operational contingencies exist for at least 75% of the known security responses that could have an impact on operations • Process is in place to track industry and local security risks for all three sources (internationally, national, local) • Security drills or exercises are conducted annually to test system security
Very Low	• Physical and procedural mitigations are in place and annually evaluated to address the security components of detect, delay, respond, and deter • Security awareness culture exists, and security awareness campaigns are conducted annually to reeducate employees, contractors, and customers • Business or operational contingencies exist for all of the most likely security responses that could have an impact on operations • Process is in place to track industry and local security risk throughout the industry to include all crime data from all local jurisdictions • Security drills or exercises are conducted biannual to test system security

The likelihood of occurrence evaluates threats against vulnerabilities for the project assets. Likelihood is categorized as shown in Figure 5-7, with the categories defined as shown in Figure 5-8.

Figure 5-7. Vulnerability Matrix

Threat	Vulnerability				
	Very High	High	Moderate	Low	Very Low
Very High	Almost Certain A	Almost Certain A	Highly Likely B	Likely C	Likely C
High	Almost Certain A	Highly Likely B	Highly Likely B	Likely C	Possible D
Medium	Highly Likely B	Likely C	Likely C	Possible D	Possible D
Low	Likely C	Likely C	Possible D	Possible D	Remote E
Very Low	Possible D	Possible D	Possible D	Remote E	Remote E

Figure 5-8. Likelihood Matrix

Likelihood Rating	Likelihood Characteristics
Almost Certain (A)	Vulnerability exists and threat is proven and demonstrated. Threat realization can be expected to occur during the system's operational phases
Highly Likely (B)	Vulnerability exists and threat is proven although may not be demonstrated. Threat realization may be expected during system's operational phases
Likely (C)	Some vulnerability exists and threat has some resource, experience, and skill, though may not be demonstrated. Threat realization may occur during the system's operational phases
Possible (D)	Limited vulnerability and threat may be under resourced or lack experience and skill, should not occur during the system's operational phases
Remote (E)	Limited vulnerability exists or threat has not been proven or demonstrated, not expected during the system's operational phases

Consequence or Severity is the assessed impact and severity of a successful threat against an asset, the system, or network. Consequence is measured by the level of impact on primary areas of people, equipment, and service and by the impact upon the secondary areas of finance and reputation.

Severity categories are defined to provide a qualitative measure of the result of a security incident (Figure 5-9).

Figure 5-9. Consequence Definitions

Severity	Characteristics			
	People	**Equipment/ Services**	**Financial**	**Reputational**
Catastrophic 1	Several deaths and/or numerous severe injuries	Total loss of equipment or system interruption, requiring months to repair	Estimated loss from the incident in excess of $1 million	Ongoing international media coverage, irreparable reputational damage, government intervention, Weeks - Months
Significant 2	Low number of deaths and/or severely injured	Significant loss of equipment or system interruption, requiring weeks to repair	Estimated loss from the incident in the range of $500,000 to $1 million	Prolonged media campaign, serious reputational damage, sustained government involvement, Days - Weeks
Moderate 3	Minor injury and possible serious injury	Some loss of equipment or system interruption, requiring seven or less days to repair	Estimated loss in the range of $ 50,000 to $500,000	Adverse media coverage, reputational damage, government involvement
Minor 4	Possible minor injury	Some loss of equipment, no system interruption, less than 24 hours to repair	Estimated losses are relatively minor, in the range of $1,000 to $49,999	Local media coverage and some reputational damage
None/ Negligible 5	No injury	Minor damage to equipment no system interruption, no immediate repair necessary	Estimated loss from the incident are likely less than $1,000	No adverse media coverage or reputational damage

To determine risk, the consequence and the likelihood of occurrence are combined into a risk matrix (Figure 5-10). The matrix aids in prioritizing the most serious risks requiring resolution. Figure 5-11 identifies the action that must be taken for each level of rated risk.

Figure 5-10. Risk Matrix

Severity of Consequence	Likelihood				
	Almost Certain A	Highly Likely B	Likely C	Possible D	Remote E
Catastrophic – 1	Very High 1A	Very High 1B	High 1C	High 1D	Moderate 1E
Significant – 2	Very High 2A	High 2B	High 2C	Moderate 2D	Moderate 2E
Moderate – 3	High 3A	High 3B	Moderate 3C	Moderate 3D	Low 3E
Minor – 4	Moderate 4A	Moderate 4B	Moderate 4C	Low 4D	Very Low 4E
Low/Negligible – 5	Low 5A	Low 5B	Low 5C	Very Low 5D	Very Low 5E

Figure 5-11. Actions Required per Risk Rating

Risk index	Risk Rating	Action Required
1A, 1B, 2A	VERY HIGH	Risk must be immediately mitigated and constantly monitored
1C, 1D, 2B, 2C, 3A, 3B	HIGH	Risk must be treated and constantly monitored
1E, 2D, 2D, 2E, 3C, 3D, 4A, 4B	MODERATE	Risk should be managed, and reduction strategies implemented
3E, 4D, 5A, 5B, 5C	LOW	Risk may be accepted after a risk review
4E, 5D, 5E	VERY LOW	Risk would normally not be treated

5.1.3 Typical Safety Mitigation Strategies

This section will highlight common mitigation strategies around the three mitigation categories that the railroad industry follows (i.e., engineering, education, and enforcement). These strategies serve as a toolbox of options that can be used in any combination to help reduce current risks involving grade crossing and trespass incidents. Appendix D provides a list of recommended treatments by grade crossing and trespass incidents.

GRADE CROSSINGS MITIGATIONS

Engineering Solutions

Active Warning Device Improvement

Common engineering solutions for improved highway-rail grade crossing safety focus around active gates and flashers. Since the majority of the grade-crossing incidents are a result of drivers of automobiles driving around activated gates, enhancements to existing active warning systems should

be considered. These include quad gates and center lane barriers (e.g., concrete islands or delineators). These are also the same enhancements typically required when converting a crossing to a quiet zone (Figure 5-12).

Figure 5-12. Engineering Solutions for Active Warning Device Improvements

Quad Gates

Center Lane Delineator Barriers

Center Lane Concrete Island

In addition to gates that protect the roadway, pedestrian gates and signage help protect pedestrians when traversing over a highway-rail grade crossing. Ideally dedicated sidewalks in conjunction with pedestrian gates provide a safer option for pedestrians (Figure 5-13).

Figure 5-13. Examples of Pedestrian Grates and Sidewalks

Appendix F provides concept renderings showing how these active pedestrian gates and sidewalk improvements could be implemented to improve the safety for pedestrians and drivers at both the Flatbush and Ten Broeck Avenue highway-rail grade crossing

Crossing Consolidation

An additional solution for reducing risk around grade crossings is to eliminate and consolidate the current number of crossings.

With any crossing consolidation, the elimination of the crossing in question does reduce the risk of incidents between vehicles/pedestrians and trains at that location. The crossing consolidation will redirect traffic to another traffic corridor, ideally one that does not cross the tracks. However, it is not always possible to redirect traffic away from another crossing.

The City of Kingston/Town of Ulster Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis Final Report did recommend the elimination of the Gage and Cemetery Road crossings.

In the case of eliminating the Gage Street Crossing, automobile traffic would be redirected to either Flatbush or Stephen St./Foxhall Crossings. The increase in vehicular traffic at these two locations

would increase the risk of incidents at locations that already experience greater risk of incidents then Gage Street.

Based on the current incident data, Gage is not a crossing that has experienced a high number of injuries or fatalities over the years yet Flatbush and Foxhall crossings have a higher incident rate and would only increase by redirecting traffic from Gage to one of these two adjacent streets. The benefit of the elimination may not outweigh the risk of the increase in traffic at the adjacent crossings. Before any consolidation is considered, further traffic studies and traffic management planning should be conducted to determine what, if any risk/benefit would be gained by the elimination of the crossing at Gage.

Regarding the consolidation of Cemetery Road crossing, CSX has had discussions with the cemetery owner about their private crossing, but due to the required access across the right-of-way the elimination of the cemetery crossing is not something the current owner of the cemetery supports and it is therefore not likely to be a viable option at this time.

At this time WSP would not recommend the consolidation of any of the crossings in the city until additional studies are conducted to evaluate the benefit and impacts to all remaining crossings in the city.

Grade Separation (Underpass /Overpass)

Grade separation is a method of aligning a junction of two or more surface transport axes at different heights (grades) so they will not disrupt traffic flow on other transit routes when they cross each other. Grade separation can take the form of overpasses (i.e., bridges) or underpasses (i.e., tunnels). The advantage of grade separations is the elimination of the highway-rail grade crossing, eliminating the risk of trains impacting private vehicles. The common disadvantages are the cost, land requirements and need to make them ADA accessible for pedestrians (i.e., ramps or elevators).

Broadway Avenue underpass and Ulster Avenue overpass provide ideal grade separation for vehicles and pedestrians along the corridor. The current topography and adjacent infrastructure does not make it financially viable to entertain grade separation at any of the existing grade crossing locations under this study.

Grade Crossing Dynamic Envelope Pavement Markings

Many incidents at highway-rail grade crossings involve vehicles stopping or being stuck on the tracks in traffic, exposing the vehicle to the dynamic envelope of the passing train. Many motorists misjudge the area that will be taken up by a train as it enters the crossing. Pavement markings that help accentuate the train's dynamic envelope can provide visual indication to help drivers maintain the proper space, allowing them to stay clear of the train's dynamic envelop and reducing the chance of being struck. These pavement markings have been known to help reduce crossing incidents (Figure 5-14).

Figure 5-14. Example of Grade Crossing Dynamic Envelope Pavement Markings

Appendix F provides concept renderings of how dynamic envelop pavement marking could be integrated at both the Flatbush Avenue and Ten Broeck Avenue highway-rail grade crossing.

Technology Improvements

Video analysis utilizing artificial intelligence (AI) in concert with closed-circuit television (CCTV) cameras is a newer approach to detecting unsafe behavior at crossings. This technology can not only help detect this behavior but can also notify proper authorities when the unsafe activity is occurring. AI-aided framework automatically detects railroad unsafe events, differentiates types of violators, and generates video clips of infractions. The system uses an object detection algorithm to process video data into a single dataset (Figure 5-15).

Figure 5-15. Example of Video Technology with AI Analysis

Quiet Zone Considerations

As highlighted in section 2.1 of this study, Ulster County Transportation Council implemented a quiet zone and City of Kingston pedestrian safety and mobility analysis in April 2006. The report recommended improvements required to achieve quiet zone status at twelve highway-rail grade crossings in the county of Ulster including the seven crossing in the City of Kingston. The second portion of the study focused on addressing Pedestrian-Railroad Crossing Safety and Mobility Analysis.

The recommended quiet zone improvements from the 2006 focused on four-quadrant gates as supplementary safety measure to achieve a quiet zone and are still applicable. While the 2006 report suggested four-quadrant gates, WSP would also recommend center lane delineators in addition to the four quadrant gates is the county wants to pursue quiet zone determinations. Even if the City of Kingston does not pursue quiet zone determination at their highway-rail grade crossing, these four quadrant gates along with center line delineation are still safety measures that should be considered to reduce grade crossing incidents.

The pedestrian improvements recommended in the 2006 report focuses on wait stations. Before the installation of wait stations should be considered, WSP would recommend the installation of dedicated marked pedestrian walkways/sidewalks at each of the six public crossings. Appendix F provides rendering examples that highlight these sidewalk improvements. Currently, the existing crossings do not provide dedicated pedestrian pathways with pavement markings separating car

lanes from pedestrian lanes. This currently requires pedestrians to walk in the same lanes as automobile traffic as show in Figure 5-16 .

Figure 5-16. Lack of Pedestrian Sidewalk at Foxhall Ave.

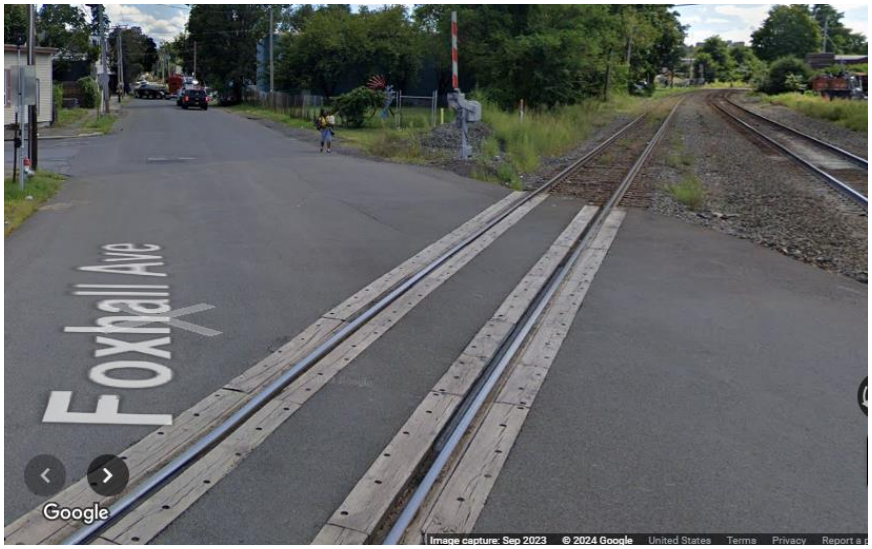


Table 5-1. Quiet Zone Supplementary Safety Measures

Crossing Location	Supplementary Safety Measure (SSM)
Smith Avenue	Four-quadrant gates with Center Lane Delineators and pedestrian sidewalks
Ten Broeck Avenue	Four-quadrant gates with Center Lane Delineators and pedestrian sidewalks
Foxhall Avenue	Four-quadrant gates with and pedestrian sidewalks
Gage Street	Permanent closure
Cemetery Road	Permanent closure
Flatbush Avenue	Four-quadrant gates with and pedestrian sidewalks
Boices Lane	Four-quadrant gates with Center Lane Delineators and pedestrian sidewalks

Education Solutions

Common education solutions focus on information sharing with the community. This can be achieved through public notification via print, video, or social media. Other forms of public awareness occur via in-person presentations and on-site safety events with handouts to raise awareness of the risks of trespassing and safety tips for motorists at highway-rail grade crossings.

This educational awareness effort can be conducted by one or a combination of community partners. This is a shared responsibility. Collaborative efforts involving resources from the City, railroad, schools, universities, business associations, and local first-responders can exponentially blanket the community with safety information to heighten the public's attention in helping reduce at-risk behavior along the rail corridor.

A great resource and partner to support the education solution is Operation Lifesaver, Inc., a nationally recognized organization providing rail safety education. Most of the large freight and commuter railroads partner with Operation Lifesaver to provide educational awareness to school-aged and adult individuals. CSX is a partner with Operation Lifesaver and can be a resource to help with educational campaigns in the Ulster County and Kingston community. More information about Operation Lifesaver can be found on their website, www.oli.org.

Video messaging on local community, township, and school district cable channels is a good means to educate the community on Rail Crossing and Trespass, and these videos can be played frequently. Additionally, messages via social media platforms can reach a large population of the community, with community partners forwarding messages to their population of subscribers on their individual social media channels.

Another effective educational strategy is to develop collaborative partnerships with vested local, county, and state stakeholders to form an ongoing working group focused solely on highway-rail grade crossing and rail safety for motor vehicles and pedestrians. The following partners should be considered for such an effort.

- Ulster County Transportation Council
- The City of Kingston
  - Engineering office
  - Communications & Community Engagement
  - Police Department
  - Fire Department
- Kingston City School District
- CSX
- NYSDOT Rail Safety Bureau
- Ulster County Regional Chamber of Commerce

Structured ongoing discussions with these partners will not only raise global awareness as it pertains to Rail Safety in the region, but will also enable the community to exponentially expand awareness and education to a larger population. This working group will also ensure that all partners are aligned with the current trends, incidents, and mitigation solutions to improve rail safety for the region.

Enforcement Solutions

Enforcement of drivers who disobey and violate highway-rail grade crossing warning devices is key to reducing the likelihood of grade crossing accidents. When the railroad and community law enforcement agencies partner and work together, proactive mitigations can stop and deter this illegal behavior. For the local law enforcement agencies to be successful the railroad needs to educate them

on the problem areas and provide data so police can focus their enforcement efforts at the right areas at the right time of day.

TRESPASSING MITIGATIONS

Engineering Solutions

Common engineering solutions for trespass prevention focus on security fencing, signage, and natural barriers such as vegetation. For fencing and barriers to be effective they must extend 500 to 1000 yards in each direction beyond the trespass location or connect to other natural barriers such as grade differentials or bodies of water. Figure 5-17 provides some examples of these barrier solutions.

Figure 5-17. Examples of Trespassing Engineering Solutions

Appendix F provides concept renderings of high security facing along the area of Greenkill Avenue to help prohibit trespassers from crossing the tracks at that location.

Education Solutions

The same educational solutions mentioned in the grade crossing section above are also applicable to help reduce trespassing activity on railroad rights-of-way.

Enforcement Solutions

Railroad rights-of-way are private property, and it is illegal to trespass on train tracks. Enforcement of violators is key to reduce the likelihood of trespassing events. When railroad and community law enforcement agencies partner and work together, proactive mitigations can stop and deter this illegal behavior. For the local law enforcement agencies to be successful the railroads need to educate them on the problem areas and provide incident data so police can focus their enforcement efforts at the correct areas along the right-of-way. Additional utilization of technology like CCTV cameras and intrusion detection with AI can help identify unusual occurrences along rail corridor, help tend hot spots, and notify the proper authorities when unusual activity is occurring (Figure 5-18).

Figure 5-18. Examples of Enforcement Technology Solutions

5.1.4 Rail Corridor Risk Assessment

The risk assessment provides a general quantified risk score for both grade crossing and trespassing events. While the Foxhall crossing had more incidents than the other grade crossings in Kingston, this does not alter either the Severity or Likelihood criteria. In all cases, regardless of highway-rail grade crossing location, the severity of an event is the same, i.e., potential death and/or serious injury to driver. Similarly for likelihood, based on past incident data, the probability of an event at any crossing is likely to occur at least once annually. For trespassing events, the threat score is generalized because there was not one particular hot spot and trespassing events are spread out. Even when factoring the area south of Broadway as a heavier trespass area, the likelihood and vulnerability at any location along the right-of-way is relatively the same.

Error! Reference source not found. and **Error! Reference source not found.** provide the general ri sk assessments for the Kingston/Ulster right-of-way environment for both grade crossing and trespassing events, respectively. Utilizing the incident data from Section 3.3 the risk analysis did analyze the number of incidents by Crossing. Fox Hall and Flatbush had the highest number of incidents, and this was also factored into the risk analysis when determining both severity and probability of the event. The risk analysis then used potential worse case based on this historic information.

Additional risk assessment for the key problem areas by location can be found in Appendix D.

Table 5-2. Grade Crossing Hazard Assessment

Hazard Type/ Event	Potential Effects	Initial Risk Rating	Mitigations	Residual Risk Rating
Motorist/Vehicle Struck by a Train (Driving around Gates)	• Potential deaths and/or serious injury to Driver • Potential loss of equipment • Significant system interruption • Negative media coverage	**1C**	• Engineering – Install quad gates and/or concrete center lane island or center lane delineator. • Education – Increase grade crossing safety campaigns at schools, local cable channel and throughout community. Education should include an understanding of the Crossing ID # sign and associated call #. • Enforcement – Police incorporate routine patrol and checks at all crossings with an emphasis at Foxhall. • Invest in Video Analytics for Foxhall Crossing to notify CSX Train Control Center.	**1D**
Motorist/Vehicle Struck by a Train (Stuck on Xing)	• Potential deaths and/or serious injury to Driver • Potential loss of equipment • Significant system interruption • Negative media coverage	**1C**	• Engineering – Install quad gates and or concrete center lane island or center lane delineator. • Education – Increase grade crossing safety campaigns at schools, local cable channel and throughout community. Education should include an understanding of the Crossing ID # sign and associated call #. • Enforcement – Police incorporate routine patrol and checks at all crossings with an emphasis at Foxhall. • Invest in Video Analytics for Foxhall Crossing to notify CSX Train Control Center.	**1D**
Crossing Device Equipment malfunction	• Potential deaths and/or serious injury to Driver • Potential loss of equipment • Significant system interruption • Negative media coverage	**1D**	• Invest in Video Analytics for Foxhall Crossing to notify CSX Train Control Center. CSX Train control initiates a zero-speed temporary speed restriction (TSAR) when crossing failure is detected.	**1E**

Table 5-3. Trespassing Threat Assessment

Threat Type/ Event	Potential Effects	Initial Risk Rating	Mitigations	Residual Risk Rating
Trespassing Harm to Self	• Potential deaths and/or serious injury to trespassers • Potential loss of equipment • Significant system interruption • Negative media coverage	**2A: Very High – Mitigate and Monitor**	• Provides physical security barriers (fences) for segments along corridor, focused on areas of the corridor most vulnerable to trespassing. • Minimizes access to railroad right-of-way from legal crossings. • Provides warning signage at key points along the corridor where current trespassing activity is concentrated. • Enhance community education and enforcement, reminding the public about illegal trespassing and grade crossing safety. **Implementation Recommendations:** • On proposed warning signage, include the following information related to trespassing: – Suicide hotline – See something/Say something • When installing fencing, confirm compliance with CPTED principles. * Assumes railroad operations personnel currently report suspicious activity.	**2C: High – Treat and Monitor**
Trespassing Harm to System	• Several deaths and/or numerous serious injuries • Significant loss of equipment • Significant system interruption • Negative media coverage • Loss of observational capability	**1B: Very High – Mitigate and Monitor**	• Provides physical security barriers (fences) for segments along corridor, focused on areas of the corridor most vulnerable to trespassing. • Minimizes access to railroad right-of-way from legal crossings. • Provides warning signage at key points along the corridor where current trespassing activity is concentrated. • Enhance community education and enforcement, reminding the public about illegal trespassing and grade crossing safety. **Implementation Recommendations:** • On proposed warning signage, include the following information related to trespassing: – Operation Lifesaver – See something/Say something • When installing fencing, confirm compliance with CPTED principles. • Ensure key assets are tamper-resistant. * Assumes railroad operations personnel currently report suspicious activity.	**1C: High – Treat and Monitor**

Threat Type/ Event	Potential Effects	Initial Risk Rating	Mitigations	Residual Risk Rating
Trespassing Incidental	• Potential deaths and/or serious injury to trespassers • Potential loss of equipment • Significant system interruption • Negative media coverage	**2A: Very High – Mitigate and Monitor**	• Provides physical security barriers (fences) for segments along corridor, focused on areas of the corridor most vulnerable to trespassing. • Minimizes access to railroad right-of-way from legal crossings. • Provides warning signage at key points along the corridor where current trespassing activity is concentrated. • Enhance community education and enforcement, reminding the public about illegal trespassing and grade crossing safety. **Implementation Recommendations:** • On proposed warning signage, include the following information related to trespassing: • Operation Lifesaver • Wayfinding to safe crossing • Legal consequences • When installing fencing, confirm compliance with CPTED principles * Assumes railroad operations personnel currently report suspicious activity.	**2C: High – Treat and Monitor**

6 FINDINGS

6.1 PRIOR RECOMMENDATIONS

The City of Kingston/Town of Ulster Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis Final Report is a previous study that has some correlation to this report. The City of Kingston/Town of Ulster Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis Final Report focused on converting the existing crossings into quiet zones. Table 6-1 highlights the recommendations identified for each crossing.

Table 6-1. Quiet Zone Recommendations

Crossing Location	Supplementary Safety Measure (SSM)
Smith Avenue	Four-quadrant gates
Ten Broeck Avenue	Four-quadrant gates
Foxhall Avenue	Four-quadrant gates
Gage Street	Permanent closure
Cemetery Road	Permanent closure
Flatbush Avenue	Four-quadrant gates
Boices Lane	Four-quadrant gates
Old Neighborhood Road	Four-quadrant gates
Grant Avenue	One way street
Leggs Mill Road	Medians/channelization
Katrine Lane	Four-quadrant gates
Eastern Parkway	Four-quadrant gates

While this Kingston Rail Crossing Study report did not focus on quiet zone determinations, some of the safety measures and crossing enhancements suggested in the City of Kingston/Town of Ulster Quiet Zone and City of Kingston Pedestrian Safety and Mobility Analysis Final Report are still applicable as solutions to reduce grade crossing events at crossings that are not designated as quiet zones. Beyond the safety measures recommended in the 2006 report, WSP would also recommend the incorporation of center lane delineators and pedestrian sidewalks as highlighted in Table 5-1.

6.2 KEY FINDINGS

In general, highway-rail grade crossings and trespassers do present a risk to railroads and surrounding communities. These risks do exist in Ulster County. Crash rates for four highway-rail grade crossings far exceed statewide averages, indicating that there are possible mitigation and countermeasures for these locations, which, if implemented, have the potential for safety improvement.

6.2.1 Grade Crossings

The following are key findings associated with this RCSS:

- The majority of highway-rail grade crossing incidents are a result of motor vehicle drivers violating activated gates and flashers and driving around the gates.
- The NYS Route 32/Flatbush Avenue, Foxhall Avenue, and Smith Avenue crossings see higher rates of fatal/injury crashes compared to statewide averages for similar facility types. Foxhall Avenue, in particular, experiences significantly more crashes than the statewide average for similar facilities. A contributing factor is the offset intersection configuration at Foxhall Avenue, Stephan Street, Cornell Street, South Manor Avenue, and the highway-rail grade crossing. The intersection approaches are skewed, which requires sharp turns and causes driver confusion when approaching the intersection.
- Over the last 46 years, 15 out of 33 grade crossing incidents that resulted in either injury or death to the vehicle occupant.
- Over the last 46 years, 2 of the 15 grade crossing incidents that resulted in either injury or death to the vehicle occupant resulted in death while 13 resulted in injury.
- The Foxhall Avenue crossing had the greatest number of incidents and presents the greatest risk of all crossings.
- There is a project planned to implement safety improvements at the Foxhall Crossing.
- The Flatbush Avenue crossing is the location with the second highest number of incidents, but the Smith crossing ranks second for the number of injuries/fatalities.
- It is not clear if the Rail Safety Bureau is the agency responsible for developing and submitting the required FRA SAP or how much they involved Ulster County or the City of Kingston in the development of this plan.
- The majority of incidents occurred when the train was traveling north (Railroad North).
- Dedicated pedestrian crossings and sidewalks to complement existing pedestrian gates would reduce this risk and help separate pedestrian and motor vehicle traffic at the highway-rail grade crossing locations.
- Numerous highway-rail grade crossings fail to meet the following FRA criteria:
  - Advance Warning Signs: Indicators of an impending railroad crossing should be in place to provide advance notice to drivers.
  - Clear Sight Lines: Vegetation and obstructions should be cleared to ensure clear sight lines for drivers and train operators.
  - Roadway Surface: The road at the crossing should be level with the tracks and maintained appropriately.

6.2.2 Trespassing Incidents

- For a 10-year period (2012-2022) there were a total of 14 incidents of a trespassers being struck along the right-of-way in Ulster County. Out of the 14 incidents, 10 resulted in a fatality and 4 resulted in injury to the trespasser.
- Two of the 14 incidents were in the vicinity of the Broadway underpass (one on the North side and one on the South side of Broadway).
- The majority of the trespassing incidents seem to be "incidental," where trespassers are looking for the most expediate location to cross the tracks. At least one of the fatalities is considered as a suicide. There were no reports of trespassing related to harm or damage to the railroad.
- There is limited fencing along the right-of-way, with access blocked or limited in other areas by adjacent buildings that abut the right-of-way.
- The majority of the right-of-way is at the same grade level as the adjacent roads and businesses, making access to the tracks easy.
- There are no documented hotspot incident locations, but there are two known locations where trespassing has been consistently observed:
  - South of Broadway where students or others are crossing to access the YMCA and Kingston High School.
  - Pedestrian trespassing is occurring along the rail corridor between Cemetery Crossing and Flatbush Crossing. This is evident by worn foot paths. The ability to deter or eliminate this pedestrian at-risk behavior is unlikely without engineering mitigations.
- Cyclone fencing was erected in the area south of Broadway, but it has been vandalized and compromised, thereby making the fencing ineffective.
- CSX has implemented education efforts but has had limited success in providing Operation Lifesaver presentations in the local schools.
- CSX had a good relationship with a representative from the Kingston Police Department, but that person has since retired and the relationship regarding collaboration on enforcement opportunities has not been the same.

6.2.3 Suggested Mitigations

There are some mitigations that could be implemented to help further reduce the risks associated with highway-rail grade crossing safety and trespasser prevention. The following key mitigations would prove beneficial to reducing risk.

ENGINEERING MITIGATIONS

1. **Roadway safety enhancements at Foxhall and Flatbush Crossings.** In early 2020, the City of Kingston hired GPI Construction Engineering Company to design the Safe and Accessible

Flatbush and Foxhall Avenues Project, which aims to improve pedestrian and bicycle infrastructure that connects the Colonial Gardens Apartments and residential streets in Midtown to surrounding business districts. These crossing enhancement projects should be implemented.

2. **Center Lane barriers.** To reduce the likelihood of individuals driving around active gates, the installation of center lane delineators on each side of the grade crossings would reduce the likelihood of people crossing into the oncoming lane of traffic to drive around the gates.
3. **Grade crossing pavement markings.** The MUTCD defines the standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public travel. Part 8 of the MUTCD describes the street markings and signage that should be used at railroad grade crossings. The crossings throughout Ulster County are missing roadway markings. Installation of clearly marked crossing markings in the roadway will make the crossing area more noticeable to drivers and help reduce the likelihood of grade crossing incidents.
4. **Grade Crossing Dynamic Envelope Pavement Markings.** Installation of dynamic envelope pavement markings will help highlight the area within the highway-rail grade crossing that should be avoided by motor vehicle operators. Refer to Appendix F for examples of Concept Renderings at Flatbush Avenue and Ten Broeck Avenue crossings.
5. **Video Surveillance technology.** Video Surveillance System analytics is a new technology that helps identify issues at a crossing and provides notification of events. Rutgers University is conducting government-supported research to enhance this technology and are looking for railroads to help demonstrate and evolve this technology. There may be FRA Funding and research grant opportunities for Ulster County and CSX to incorporate this technology at the Foxhall Crossing location.
6. **Fencing.** The area south of Broadway near Kingston High School and the YMCA is a known trespass location. The current chain link fence was compromised. This would be an ideal location for higher-strength security fencing. The fencing needs to run 500 to 1000 yards in each direction of the trespass location to be effective.

   There may be the potential to install security fencing between the tracks and the cemetery from the Cemetery crossing and Flatbush Avenue. Complementing this fencing could be a pedestrian walkway between the new security fencing and Cemetery. This would provide a dedicated safe path for pedestrians to use, keeping them separated from the tracks.

   Another use of fencing or some type of barrier is to channel pedestrians to safe locations. This could be part of the solution at Foxhall, to deter pedestrians from taking a "shortcut" across the tracks, rather than walking a few more feet to the marked pedestrian crossing. This barrier or fencing does not need to be high security but could provide enough of an obstacle to make the walk to the marked crossing the easiest path. Refer to Appendix F for examples of concept renderings that incorporate security fencing in the area of Flatbush Avenue and Greenkill Avenue.

7. **Pedestrian Overpass.** In addition to more robust fencing, adding a pedestrian overpass near the known trespass location south of Broadway would provide a safe crossing alternative. This would require a feasibility study to include how ADA might require accommodations for persons with disabilities.
8. **Safe Path designations.** Where possible, providing safe pathways in locations where known trespassing is occurring is the best alternative.

   Paving a path from Iwo Jima Lane to Broadway, including replacing the steps to the Broadway Avenue sidewalk would provide a safe alternative to access the YMCA and Kingston High School, if the pedestrian overpass is not feasible.

   Creating a dedicated walkway from Cemetery to Flatbush Avenue, nestled between new right-of-way fencing and the Cemetery would improve safety in that known trespass location. Appendix F provides concept renderings of this walkway.
9. **Additional Warning Signs.** There are trespass warning signs along the rail right-of-way, but it is minimal. The incorporation of additional "No Trespassing" warning signs along the right-of-way would be beneficial to reducing the likelihood of trespassing events or at least help reduce the liability to CSX and Ulster County.

EDUCATION MITIGATIONS

1. **Field awareness events and educational campaigns at schools.** Events focused on site awareness can be scheduled through a partnership between the Kingston City School District and CSX. The goal of these events is to conduct face-to-face awareness with students and hand out safety literature highlighting the dangers of trespassing and highway-rail grade crossing safety driving tips. In addition to the on-site awareness safety events, regular partnerships with the schools, CSX, and Operation Lifesaver can provide free presentations to the school student population to further strengthen highway-rail grade crossing and trespasser safety education.
2. **Community awareness.** Partnership between the railroad and Ulster County to develop target community educational campaigns can promote awareness of the legality and dangers of trespassing and also help reduce the likelihood of events. These campaigns can be in the form of Operation Lifesaver outreach at community events, awareness videos on town cable channels, social media channels such as X, Facebook or Instagram, and support from community organizations and businesses (e.g., the community YMCA) to help distribute information to spread the rail safety message.

ENFORCEMENT MITIGATIONS

1. **Police patrol.** The Foxhall, Flatbush, and Smith crossings present the most incidents of crossing events. Periodic random police patrol and monitoring campaigns at these targeted locations can help ensure drivers are taking caution and obeying the grade crossing active devices. These campaigns can be coordinated with CSX and timed to monitor driver behavior during times when trains are scheduled through the crossings.

In addition to enhanced monitoring at highway-rail grade crossings, the local law enforcement agencies can partner with CSX to identify any common trespass locations identified by their train engineers. Police could periodically patrol these identified locations to deter trespassing events.

2. **Violation enforcement.** Based on the outcome of enhanced police patrols any violations should be consistently and aggressively enforced. When the public recognizes the legal consequences associated with grade crossing and trespassing violations, it will deter this behavior and reduce the likelihood of future incidents.

6.2.4 Residual Risk

While trespassing and grade crossing risks will remain even if all mitigations are implemented, the proposed recommendations will combine to substantially reduce the number of incidental trespasser and highway-rail grade crossing incidents. The primary sources of any remaining grade crossing and trespassers incidents will be from those who are determined to put themselves in harm's way. When trespassing does occur, the mitigations will reduce liability by clearly communicating and establishing the legality of right-of-way trespassing and highway-rail grade crossing violations and the potential consequences.

When implementing these additional mitigations, the risk is manageable. If these mitigations are implemented the residual risk can be managed through continuous monitoring. **Error! Reference s ource not found.** and **Error! Reference source not found.** and Appendix D provide the risk assessment for the Kingston/Ulster right-of-way environment for both highway-rail grade crossing and trespassing events, as well as the residual risk improvement based on the implementation of the above-mentioned mitigation strategies.

7 RECOMMENDATIONS

The RCSS evaluated existing highway-rail grade crossings as well as trespass along the rail corridor and associated issues and risks. Based on this assessment and the findings listed above, WSP offers the following recommendations as solutions to further enhance highway-rail grade crossing safety and reduce trespass events.

- The City of Kingston should complete the implementation of the roadway safety enhancement projects for the Foxhall and Flatbush crossings.
- The City of Kingston with support from Ulster County and NYSDOT, as needed, should enhance the signage and road markings at all eight crossings to comport with the requirements of the MUTCD for Railroad Crossings. There are FRA grants that could support funding for such a project, such as the Consolidated Rail Infrastructure and Safety Improvements Program: https://railroads.dot.gov/grants-loans/competitive-discretionary-grant-programs/consolidated-rail-infrastructure-and-safety-2.
- The City of Kingston, with support from Ulster County and NYSDOT as needed, should install center lane delineators on both sides of the crossings to deter drivers from attempting to drive around gates. Based on funding availability, delineators should be installed in priority order based on the past number of accidents by crossing, as follows: Foxhall Avenue, Smith Avenue, Flatbush Avenue, Ten Broeck Avenue, Gage Street, and Boices Lane. There are FRA grants that could support funding for such a project.
- Replace the chain link fencing just south of Broadway with high strength security fencing that extends 500 to 1000 yards in each direction, if possible.
- Construct a pedestrian overpass, if feasible, south of Broadway to provide a safe alternative to access the YMCA and Kingston High School.
- If a pedestrian overpass is not feasible, develop a pathway from Iwo Jima Lane to connect with Broadway, reinstalling the steps to gain access to the Broadway Avenue sidewalk.
- Investigate the feasibility to install security fencing along the right-of-way between Flatbush and Cemetery crossings. In conjunction with this fencing, install a walkway between the security fencing and cemetery from the Flatbush crossing to Cemetery crossing.
- The City of Kingston and Ulster County should establish ongoing partnerships with the - NYSDOT Rail bureau to ensure the New York-wide rail safety effort properly incorporates the needs and concerns of the City and County.
- The City of Kingston should work with CSX and NYSDOT as needed to incorporate dynamic envelope pavement markings at each crossing.
- Until longer term improvements are implemented at Foxhall crossing, install fencing along Cornell Avenue from the parking lot on Cornell Avenue to the Foxhall Crossing.

- Work with CSX to research the feasibility of partnering with organizations developing video analytic technology, such as Rutgers University, to pilot CCTV analytics for use in instituting real-time warning of grade crossing anomalies with the ability to create real-time notifications to the railroad. FRA grants are available that could support funding for such a pilot or permanent project.
- The City of Kingston should partner with CSX to enhance right-of-way signage, installed at regular intervals, to remind individuals of the legalities and dangers of trespassing. Priority areas should be south of Broadway and on both sides of the track between Cemetery Lane and Flatbush.
- CSX, their partnership with Operation Lifesaver, and the City of Kingston should collaborate with the Kingston City School district to conduct periodic rail safety educational campaigns. These can be in the form of on-site presentations and safety awareness events near the schools.
- The City of Kingston and Ulster County should develop a collaborative working partnership with vested local, county, and state stakeholders to form an ongoing working group focused solely on highway-rail grade crossing and pedestrian safety along the rail corridor. This working group will raise global awareness as it pertains to rail safety in the region to exponentially expand awareness and education to a larger population of the community. This working group will also ensure that all partners are aligned with the current trends, incidents, and mitigation solutions to improve rail safety for the region.
- CSX and the City of Kingston should collaborate to develop a rail safety public awareness program that educates and raises awareness to the community. This partnership between the railroad and the City should target community safety campaigns that promote awareness of the legality and dangers of trespassing and also help reduce the likelihood of trespassing events. These campaigns could be in the form of Operation Lifesaver presentations at community events, awareness videos on town cable channels, messaging via social media platforms, and support from community organizations and businesses (e.g., the community YMCA) to help distribute literature and information to spread the message.
- The City of Kingston Police Department should conduct periodic random patrols and monitoring campaigns at all highway-rail grade crossings, specifically the Foxhall, Flatbush, and Smith grade crossings. These patrols can help ensure drivers are taking caution and obeying the grade-crossing active warning devices. These campaigns can be coordinated with CSX and timed to monitor driver behavior during times when trains are scheduled through the crossings. In addition to enhanced monitoring at highway-rail grade crossings, the location law enforcement agencies can partner with CSX to identify any common trespass locations identified by their train engineers. Police should periodically patrol these identified locations to deter trespassing events.
- Based on the outcome of enhanced police patrols, any trespassing or other violations should be consistently and aggressively enforced. Consistent enforcement will deter illegal behavior and reduce the likelihood of future incidents.