Rail Network Trespass Statewide Severity Assessment and Predictive Modeling Technology Transfer: Phase I

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16. Abstract

From 2017 to 2020, the Institute for Transportation Research and Education (ITRE) has been engaged in research looking at rail network trespassing events in North Carolina. Events were captured at known hot spots for one-to-two weeks during each season of the year to help describe events by time-of-day, day-of-week, and seasonally. The objective of the presentation delivered under this implementation funding effort is to conduct outreach with community leaders to better relay rail safety issues around pedestrians in the rail right of way. Armed with this new information, it is our desire that community leaders, law enforcement, and NCDOT begin to take appropriate steps to keep pedestrians out of the path of trains, thus reversing the trend of pedestrian strikes can be reversed.

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1. Introduction

From 2017 to 2020, the Institute for Transportation Research and Education (ITRE) has been engaged in research looking at rail network trespassing events in North Carolina. Events were captured at known hot spots for one-to-two weeks during each season of the year to help describe events by time-of-day, day-of-week, and seasonally. In order to reduce these activities, the North Carolina Department of Transportation (NCDOT) has requested that ITRE put together the following technical transfer presentation. The goal of the presentation is to educate community leaders about the issues surrounding rail trespass, its dangers, its prevalence, and what can be done to reduce it, all while encouraging collaboration.

1.1. Objective

The objective of this presentation is to conduct outreach with community leaders to better relay rail safety issues around pedestrians in the rail right of way. By relaying this information, we hope to clear up some of the myths surrounding this issue, as well as quantifying the dangers and beginning to describe the scope of the problem. Armed with this new information, it is our hope that communities can begin to take appropriate steps to keep pedestrians out of the path of trains, and the trend of pedestrian strikes can be reversed.

1.2. Who is at Risk?

Any pedestrian in the right of way is at risk. The right of way was established under the General Railroad ROW Act of 1875. All land owned by the railroad where tracks are constructed, and where trains actively run, is the rail right of way. Right of ways are typically between thirty to two hundred feet wide. Within right of ways, trains operate at all times of the day and night. Their sheer size and speed means that they cannot easily yield for anything that happens to be in their path, so any pedestrian within the right of way is always at risk.

1.3. Who is Walking in the Right-of-Way (ROW)?

Over the course of our research, ITRE has observed many diverse groups walking in the right of way. Three example trespassing events are shown in Figure 1. At a rail bridge in Lumberton, a lone pedestrian attempts to traverse the bridge, only to sprint back moments later when an oncoming train almost meets him head on. At Greensboro, a pedestrian spends upwards of forty minutes in the right of way, experiencing balance issues, and only narrowly avoids a train as it approaches. In the same location, another pedestrian films a music video on the tracks.

Figure 1. Trespassing events in Lumberton (left) and Greensboro (middle and right), NC

Three additional trespassing examples are provided in Figure 2, below. At Elon University, a pilgrimage of pedestrians takes place, with over 50 crossings in the hour before a train speeds by. Near North Carolina State University at Raleigh, a pedestrian crosses the tracks in front of an oncoming train. A pedestrian in Charlotte approaches the right of way to find a parked train blocking the path. Rather than be deterred, the pedestrian simply climbs over the stationary train, and is fortunate that the train did not choose that moment to begin moving. It is clear from these examples that many groups of people cross the rail right of way on a near daily basis.

Figure 2. Trespassing events in Elon (left), Raleigh (middle), and Charlotte (right), NC

1.4. How Many People are Hurt?

Shown in Figure 3, according to the Federal Railroad Administration (FRA), over one thousand people are killed or injured every year from walking along or across the rail right of way. The FRA keeps track of these incidents through an accident form. This trend has remained constant from 2017- 2020. The pandemic did not reduce the number of incidents which occurred, which points to the trips in the right of way being for purposes that the pedestrians consider to be necessary. Despite this data, it is possible that this an underrepresented sample.

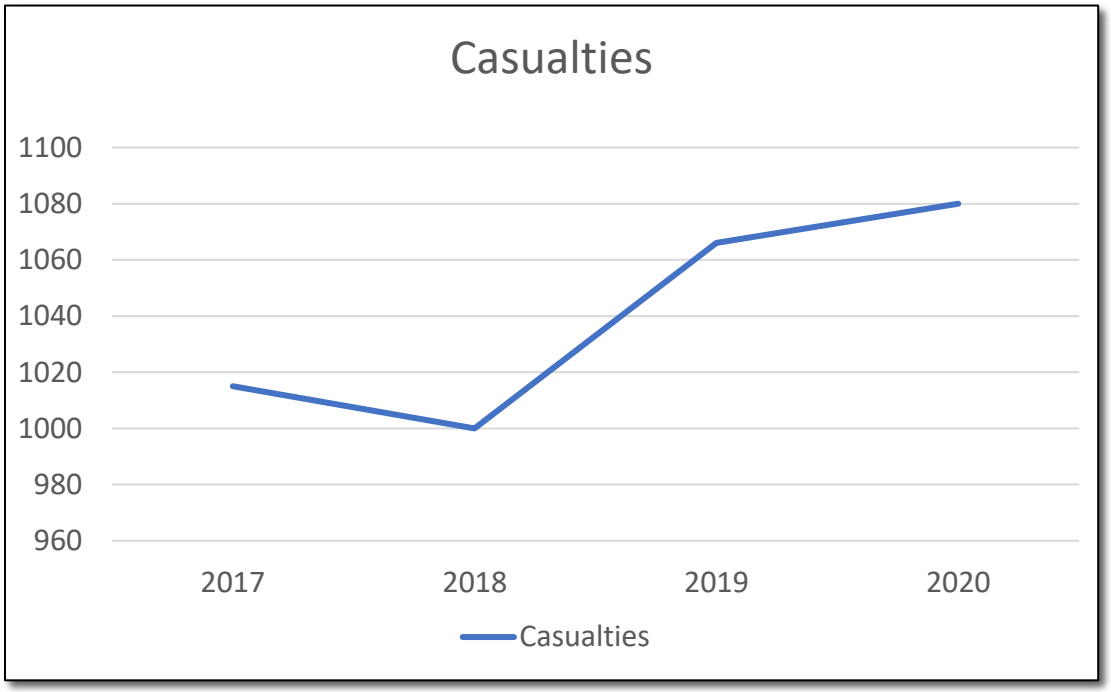

Figure 3. Reported trespassing fatalities (Source: FRA Counts)

1.5. Does this Represent all Strikes in NC?

To attempt to validate and/or supplement FRA counts, ITRE will look at the North Carolina Disease Event Tracking Epidemiologic Collection Tool (NCDETECT) and the National Emergency Medical Services Information System (NEMSIS) to count the number of hospital records from train related injuries and compare them to the FRA Counts.

1.6. Fatalities by Type

Shown in Figure 4, grade crossing fatalities have been a major focus area for decades. They have trended down sharply since early 90's and seem to have plateaued. Trespass related fatalities have remained stable over four decades seems like they may be trending upward in last decade. This is a large motivator behind this research and this outreach. With appropriate action taken, the trend can be driven downward just like the grade crossing fatalities.

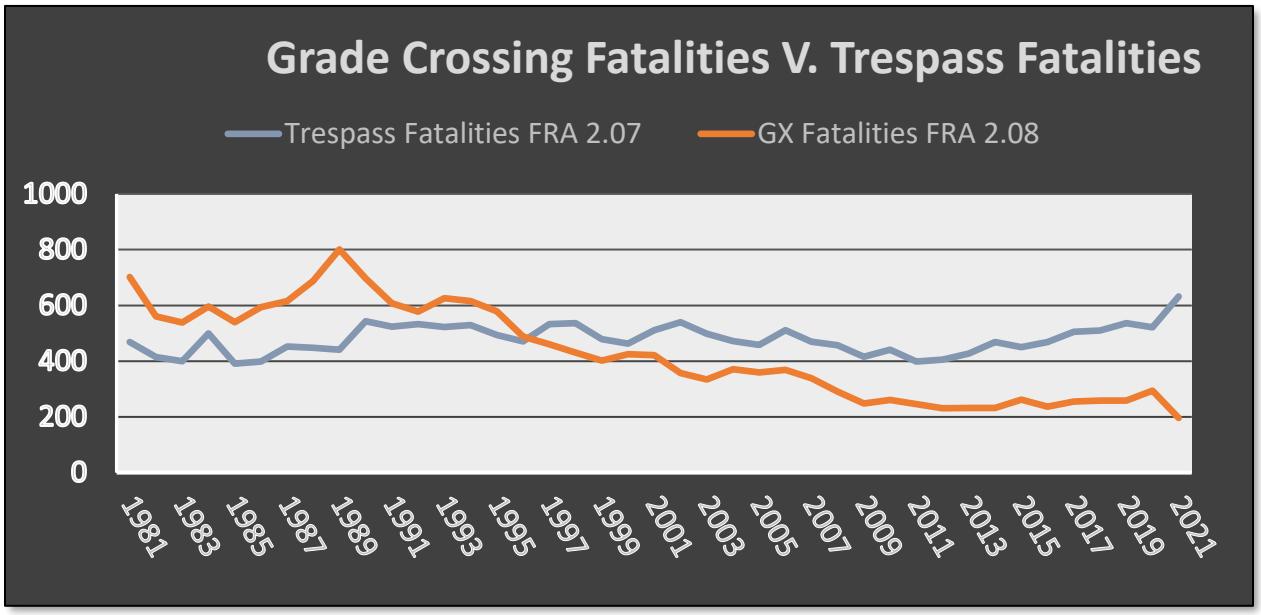

Figure 4. Grade-crossing vs. Trespassing Fatalities (Source: FRA Counts)

2. Perceptions and Risks

2.1. This is Not a Victimless Act.

The operations cost of a rail-pedestrian incident includes premature fatigue of parts, delays, and locomotives being taken out of service temporarily. These, however, are nothing compared to the human costs. The first responders will never forget the devastating injuries caused by the collision – the locomotive engineer will carry the weight of the impact with them for the rest of their life. The victim, if they survive, will carry life altering injuries with them forever.

2.2. Myth 1: Right-of-Way

Most people do not realize that the rail road is private property. After all, a person can walk along the road, so why should a railroad be any different? But the fact of the matter is that rail property is private, and all unauthorized persons are actually trespassing when they walk along the right of way. Railroads are for trains, and anyone entering the right of way is at grave, and misunderstood, risk.

2.3. Myth 2: Event Types

Many people believe that causalities on the rail are either intentional or from homeless. The truth of the matter is that these are the minority. Only a quarter of the pedestrians in the tracks are living on or around the right of way, and only fifteen to twenty-five percent of pedestrian fatalities are related to suicide attempts. Most pedestrians, and most victims, are just regular people, who just wanted to take the shortest available path between two points.

2.4. Myth 3: Train Noise

In the media, trains are portrayed as loud, and the unfortunate protagonist stuck in the path of the oncoming train can hear the train and has twenty or so seconds to wrestle themselves free of whatever plot device kept them there, diving out of the way at the last moment as the train careens by. The reality is far more somber. With most of the noise of a locomotive behind the train, by the time a pedestrian hears the oncoming train, it may already be too late. Figure 5 provides a visual of train horn noise over space and time for reference.

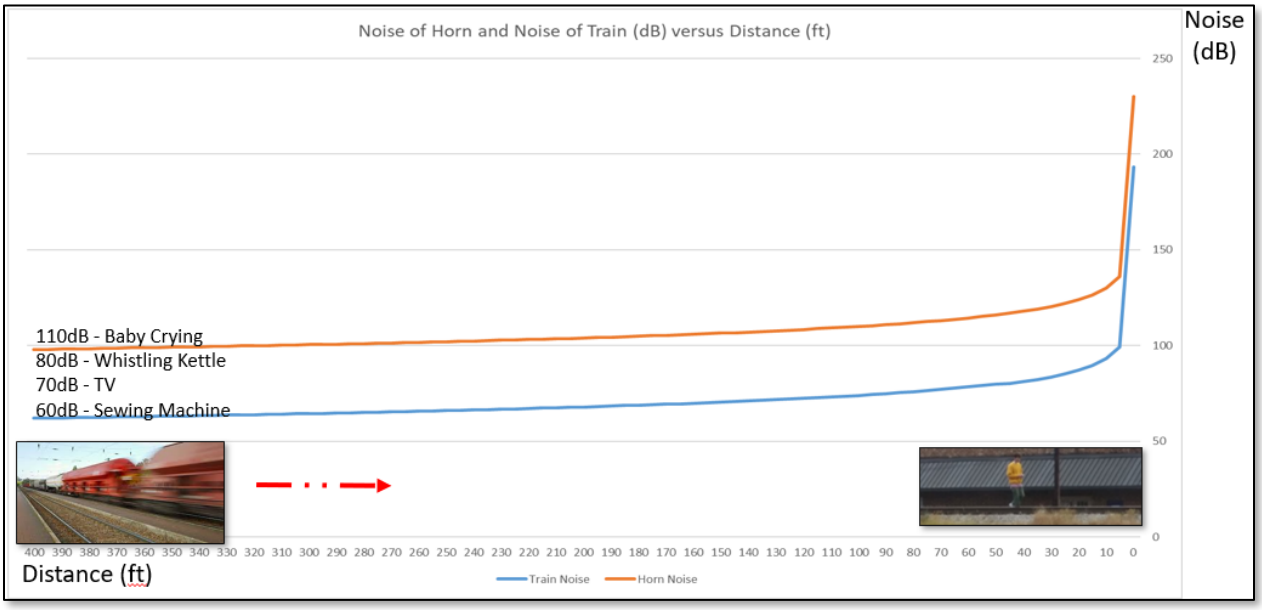

Figure 5. Train horn noise in space and time compared to everyday noises

At one hundred feet away, a train is no louder than a whistling kettle. At four hundred feet away, the train is quieter than a sewing machine. The train is only louder than a crying baby once its less than ten feet away from the pedestrian. The train's horn, while a staggering 100dB at 100

feet away, doesn't manage to be louder than an upset baby until the train and horn are thirty feet away from the pedestrian. And at speed, the train can travel hundreds of feet in a matter of moments.

2.5. Myth 4: Reaction Time

Pedestrians may believe that they have plenty of time to get out of the way of an oncoming train. This could not be further from the truth. It takes around one second to perceive the train, another second to react, and more than one second to move out of the way of the train. This totals to three seconds which are needed to properly evacuate the path of the train. At speed, trains may not provide the time required to escape.

2.6. Myth 5: Train Speeds

While the slowest trains always seem to be the one that's blocking the rail crossing at the time, trains are capable of travelling as fast as 79 miles per hour in some areas. To have time to escape, the train would need to be noticed a whopping 352 feet away from the pedestrian. That's like noticing the train in the outfield from home plate. At even forty miles per hour, the pedestrian would need to see the train 176 feet away to have time to react and escape.

2.7. Train Noise vs. Perception/Reaction

If we pull these slides together, we can look at the chart in the upper left and get a sense of how much distance the train will cover in 3 seconds at various train speeds (Figure 6). As an example, a pedestrian walking the tracks with a train traveling at 35mph would need a minimum of 150' to perceive a train is approaching and get off the tracks safely.

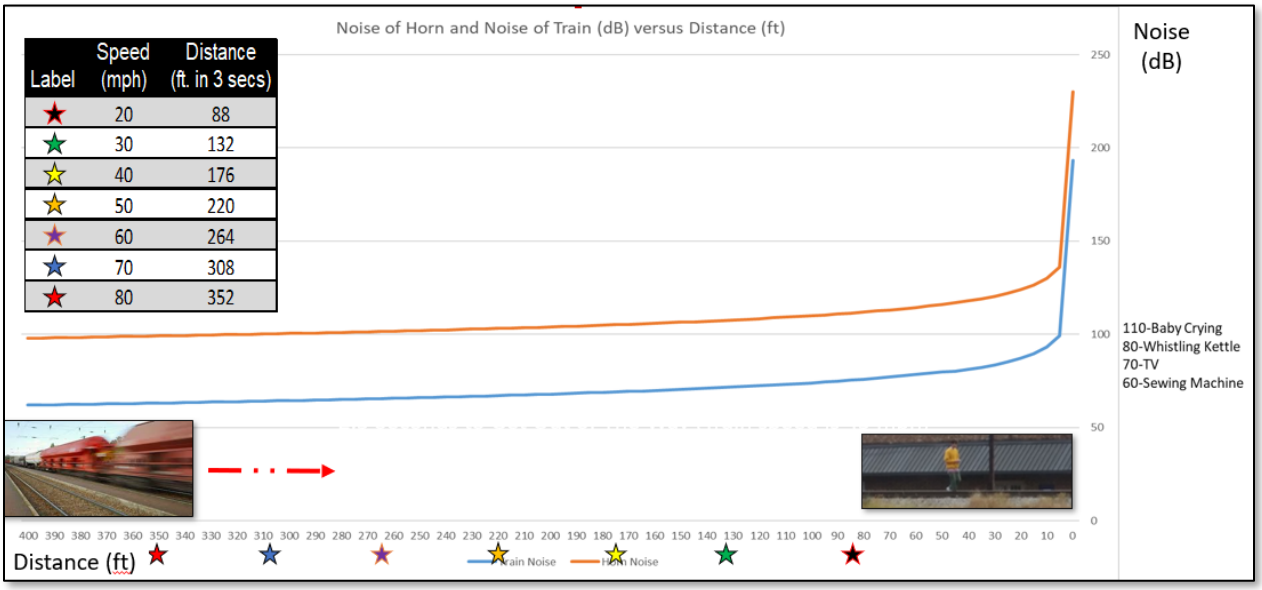

Figure 6. Train horn noise in space and time while considering perception and reaction time and speed of train

2.8. Case Study Example

Shown in Figure 7, on the night of the 31st of December, 2021, a pedestrian was travelling along the tracks. A pizza delivery driver's dash camera caught the ensuing events. According to the train crew, the pedestrian appeared out of the fog, and a witness describes the conductor sounding the horn as the locomotive moved towards the pedestrian.

Despite travelling at the relatively modest speed of 36mph, the pedestrian only turned to notice the oncoming train when it was a mere 75 feet away (Figure 8). This left less than one and a half seconds for the pedestrian to act and escape the path of the nearly ten-foot-wide locomotive. Tragically, the pedestrian was unsuccessful.

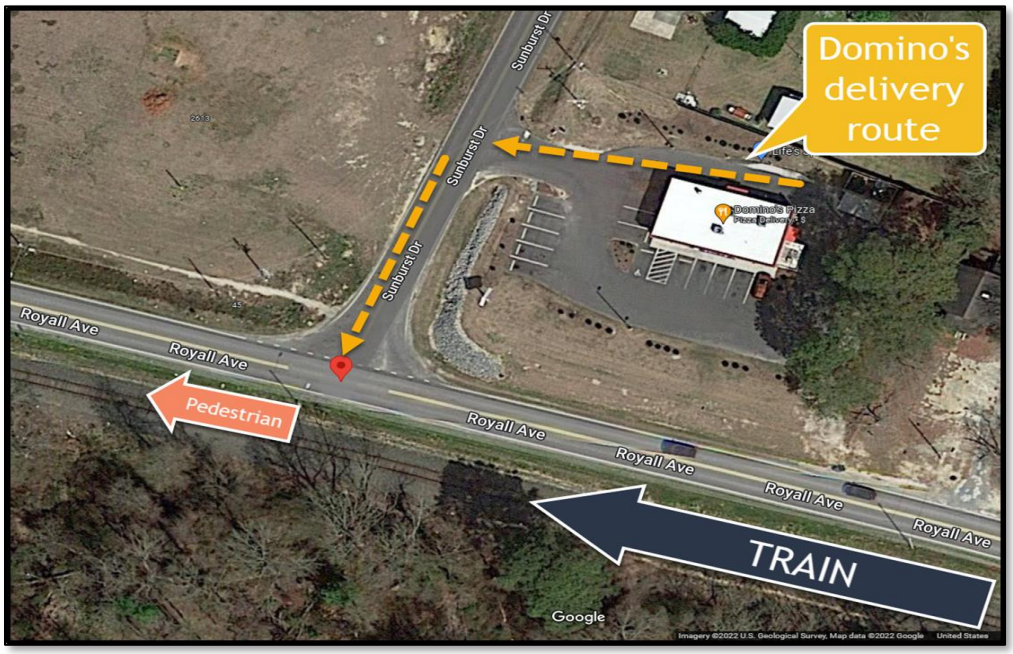

Figure 7. Case study example of a fatal strike in NC

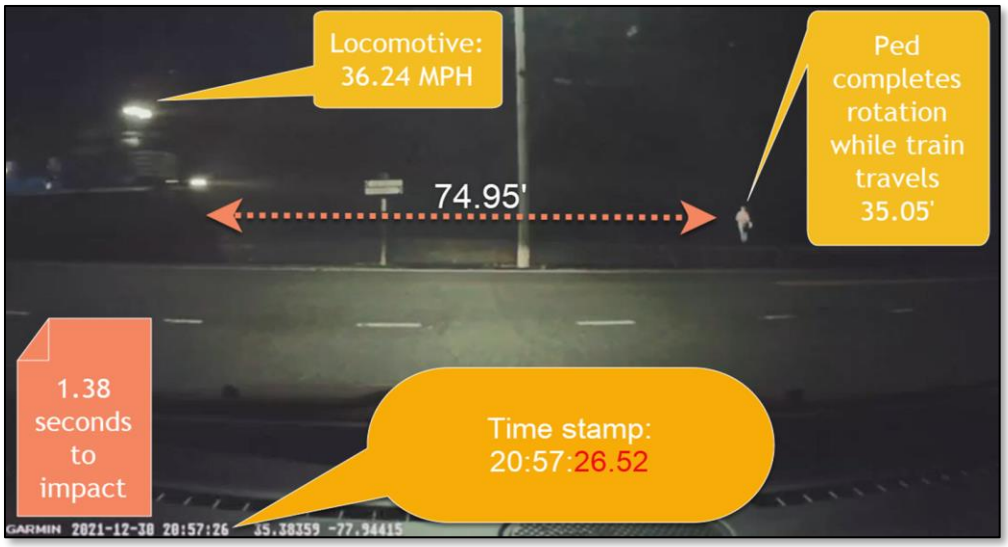

Figure 8. Visual of train and pedestrian at the time the pedestrian perceives the risk

3. North Carolina Statistics

3.1. What is the true scope of the issue?

From 2018 to 2020, the Institute of Transportation Research and Education (ITRE) placed cameras in areas where pedestrians were suspected to cross the rails in North Carolina Communities. In total, 680 days of data were collected. Thermal cameras were setup with motion capture to identify when pedestrians walked in the right of way. Zones of detection were also set up in the camera so as to capture only activity within the right of way.

3.2. NC Statistics

Across the eleven sites studies, fifteen thousand pedestrians were observed in the rail right of way. On average, twenty-three pedestrians per day interacted with the right of way, spending a median of three seconds in the path of a train. Sixty-five percent of events were from a single pedestrian, the rest travelled in groups. During the course of the study, there were one hundred near miss interactions between a pedestrian and a train. Figure 7 provides a visual of the sites studied for this effort.

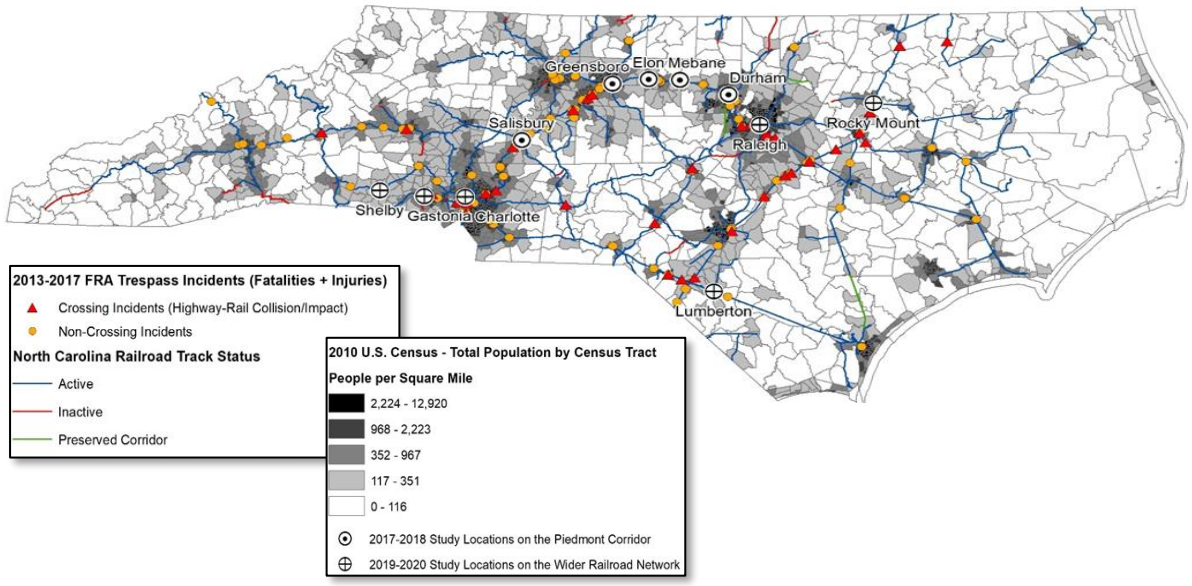

Figure 9. Location of sites where trespassing data was collected

3.3. Observed Pedestrians in the Rail ROW by Location

Shown in Figure 10, most sites averaged between 16 and 42 events per day, with over 90 % of observed days having at least one event. Elon University only had 80% of days with an event, though this is due to new fencing being put in place at the end of the semester when the student body left. Salisbury only had 35% of its days with a trespasser; however, this was likely because the cameras were placed directly at a rail platform. The fact that a rail platform, where trains are expected and signs are placed, still experiences trespassing problems speaks to the issues faced with risk perception.

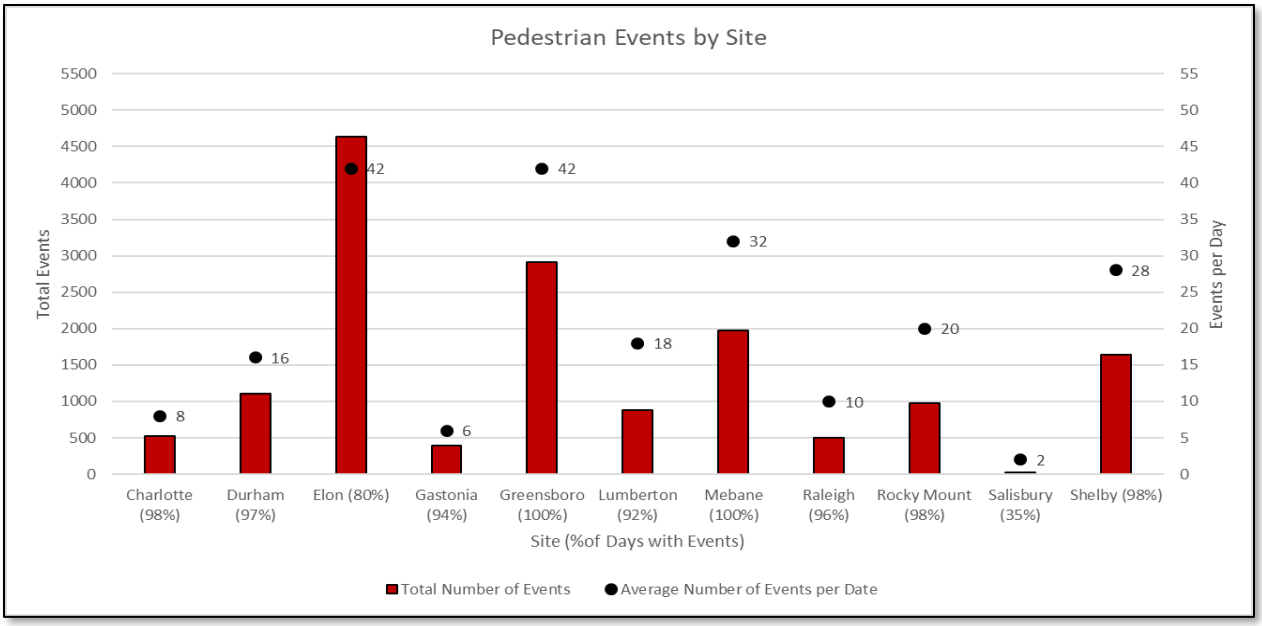

Figure 10. Pedestrian trespassing events by location

3.4. Time-of-Day

Shown in Table 1, for all sites except Elon, the majority of trespassing events occurred between the hours of 6 am and 9 pm. With trespassing fairly uniform across the daylight hours, it shows that the trips to and from the rail right of way occur for a variety of reasons. Elon, with a large body of students, experienced 48% of its trespassing events during nighttime hours.

Table 1. Percent of events by time-of-day and location

Site	6:00-11:00	11:00-4:00	4:00-9:00	9:00-6:00
Charlotte	26%	31%	35%	8%
Durham	22%	38%	27%	13%
Elon	8%	18%	25%	48%
Gastonia	29%	35%	20%	15%
Greensboro	31%	29%	24%	16%
Lumberton	37%	33%	19%	11%
Mebane	24%	37%	32%	7%
Raleigh	21%	47%	26%	6%
Rocky Mount	23%	32%	29%	15%
Salisbury	11%	39%	25%	25%
Shelby	22%	28%	37%	13%

3.5. Estimating the Problem

Based on the team's research, the average daily events can be estimated according to:

$$\text{EAD} = 55.84\,\text{PNV} + 63.03\,\text{BDLIH} - 26.69\,\text{BDR} + 7.05\,\text{BDSS} + 20.98$$

- EAD – Estimated Average Daily Events (pedestrians/day)
- PNV – Percent w/ No Vehicle that Walk to Work
- BDLIH – Business Density in Low Income Housing (per 1,000 people)
- BDR – Business Density (Retail Food, Grocers, Convenience) (per 1,000 people)
- BDSS – Business Density (Social Services) (per 1,000 people)

This model has been shown to be within 6.3 events of the average number of daily events observed during the study. The location characteristics can be found using Census data at the census tract level.

4. Case Study Examples

4.1. Why do People Take the Risk?

Pedestrians use rail right-of-way for a variety of reasons. More often than not, it is the shortest route between their origin and destination. Often, it's the easiest route and risk is perceived to be low with most areas seeing infrequent train activity. It's possible to find examples of repeated use paths (i.e. "goat paths") using satellite imagery.

4.2. Example_Crossing and Lateral

In Lumberton, the rail right of way divides housing from restaurants, church, and shopping (Figure 11). As such, two separate origin and destination sets of paths can be seen from above in google street view.

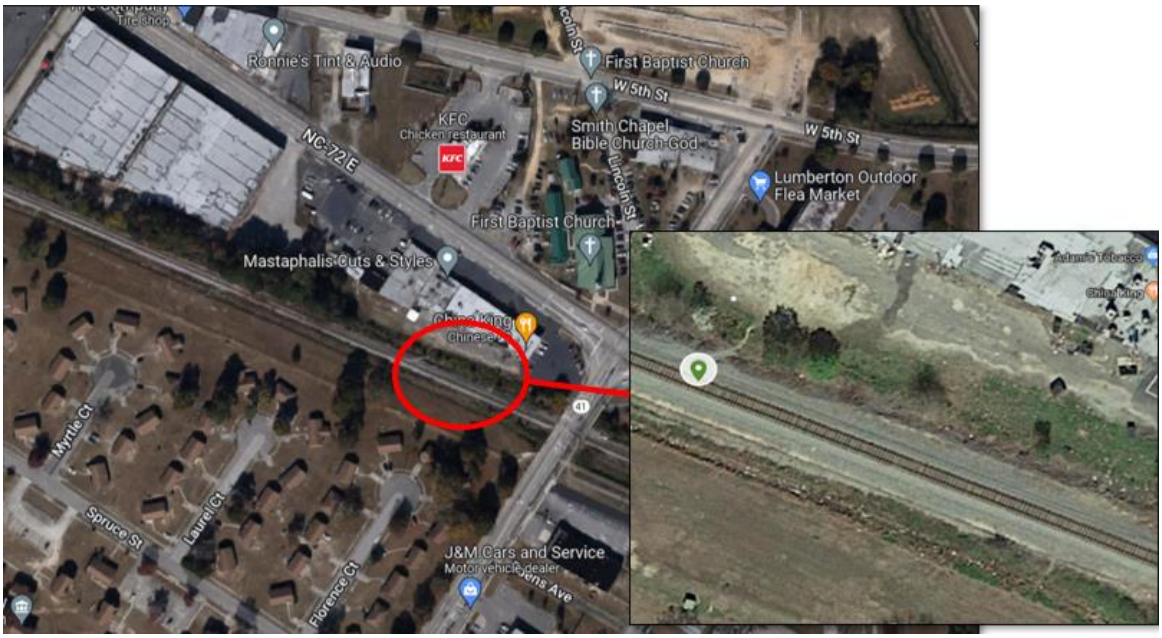

Figure 11. Example of "goat path" identification in Lumberton, NC

4.3. Example_Crossing (Poor Planning)

In Raleigh, poor planning meant that a parking lot is enclosed by the rail right of way (Figure 12). The shortest route to the business involves crossing the tracks from the parking lot.

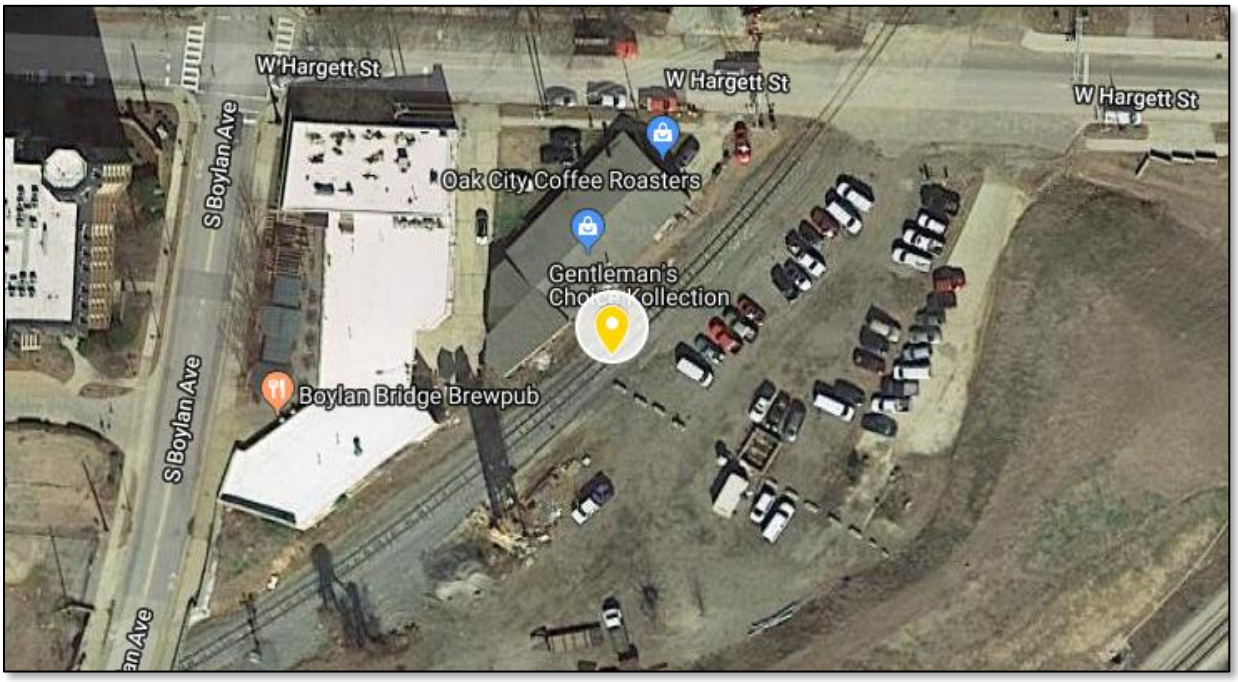

Figure 12. Example of "goat path" identification in Raleigh, NC

4.4. Example_Crossing Location (NC State University)

At North Carolina State University, the right of way separates class buildings and dorm buildings from parking (Figure 13). The path to the rail is visible. Using the model detailed earlier, and using census tract data for the mile surrounding the point at North Carolina State University, it can be estimated that approximately 38 events per day occur at this location.

Figure 13. Example of "goat path" identification in Raleigh, NC near NC State campus

4.5. Example_Recreational Location

In Athens, GA, a network of pedestrian paths exist around the right of way (Figure 14). While some of them may be looking for an alternative to walking along US-129, the Athens perimeter, many of the patterns terminate suddenly with no destination. This would seem to point to recreational activity, along with the vehicle paths which are equally visible, especially in the region in the upper left of the image.

Figure 14. Example of "goat path" identification in Athens, GA

5. Resources

5.1. What Can Be Done?

There are over five thousand miles of rail in NC. Clearly, tracks and trains alone do not deter foot traffic. The following are excellent strategies to curb this issue in the future.

- Education – most people just are not aware of the true risks of using the right-of-way for travel
- Future plans – by providing alternate ways to access points of interest across the right of way, pedestrians will no longer feel the need to cross the tracks
- Safe Systems – when future railways are put in place, they can be designed to discourage foot traffic approaching the Right of Way
- EduForcement - Officers patrolling the Right of Way can educate pedestrians of the true danger they're in, and discourage future visits

Figure 15. Example of a trespassing event taking place over a newly installed fencing treatment

5.2. Further Resources

- Operation Lifesaver - https://oli.org
  - Operation Lifesaver in NC - https://community.oli.org/state/nc#about
- Rail Trespass Prevention F.R.A. - https://railroads.dot.gov/highway-rail-crossing-and-trespasser-programs/trespassing-prevention/trespass-prevention
- Be Rail Safe - http://berailsafe.org/

6. Future Implementation

Now that the presentation is finalized, the next phase will involve visiting community leaders to present the information to decision-makers on the ground. The discussion will be held in a hybrid format, with attendees both in person and online, over the course of an hour over lunch. The goal is to facilitate discussion so we can begin to reduce the severity and impact of rail trespass.

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