BCD REGIONAL FREIGHT MOBILITY PLAN

APPENDIX G

Technical Memorandum

Rail Assessment and Recommendations

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BCDCOG
BERKELEY-CHARLESTON-DORCHESTER
COUNCIL OF GOVERNMENTS

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1. INTRODUCTION

The Berkeley Charleston Dorchester Council of Governments (BCDCOG) Regional Freight Mobility Plan includes rail recommendations to improve freight movements throughout the region. Recommendations for the BCD region focused on highway-rail grade (at-grade) rail crossings and community strategies intended to improve safety and reduce incidents and conflict on the transportation network. At-grade crossings present the greatest opportunity for people, automobiles, and trains to collide. An at-grade crossing, as shown in Figure 1, is the intersection of a roadway and a rail line that are on level ground. A grade separated crossing would have either the roadway go above or under the rail line where no conflict between modes would occur.

Figure 1 - At Grade Crossings at Romney and Hugeunin Streets

2. RAIL CROSSING ANALYSIS

Nationwide, 97 percent of all rail-related injuries and fatalities occur as a result of trespassing or other incidents at at-grade crossings. For BCDCOG, identifying all the at-grade crossings in the study area is the first step to target recommendations aimed at lowering these numbers.[1]

The Federal Railroad Administration (FRA) provides geographic coordinates for all public and private crossings within the United States (US) through the FRA – Safety Map.[2] Each crossing data point within the Safety Map contains a unique identifier, the DOT Crossing Inventory Number. The Crossing Inventory Report must be filed with the FRA once every three years by the State Department of Transportation and the primary operating railroad of the crossing.[3] The Crossing Inventory Report contains:

- Location and Classification Information;
- Railroad Information;
- Highway or Pathway Traffic Control Device Information;
- Physical Characteristics; and
- Public Highway Information.

Likewise, the Accident/Incident Report must be filed with the FRA no later than 30 days after the end of the month when an accident/incident results in injury, death, or when damage to either equipment or roadbed occurs.[4] The Accident/Incident Report describes details on when, how, and who was involved in the accident. It also contains the historical record of all the accidents that occurred at the crossing. This data is compiled by the FRA and then geocoded within the Safety Map for public consumption.

The BCD study area has a total of 389 railroad crossings that are open and in use depicted in Figure 2, while Table 1 shows the counts by county. Open crossings consist of both at-grade and grade separated crossings. Within the BCD region, there are 342 at-grade crossings and 47 grade separated crossings.

[1] https://railroads.dot.gov/sites/fra.dot.gov/files/2020-02/Grade%20Crossing%20Business%20Plan.pdf
[2] https://fragis.fra.dot.gov/gisfrasafety/
[3] https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/18855/Crossing_Inventory_Guide_01916.pdf
[4] https://www.govinfo.gov/content/pkg/USCODE-2018-title49/html/USCODE-2018-title49-subtitleV-partA-chap209-sec20901.htm

Figure 2 - BCD Open Rail Crossings

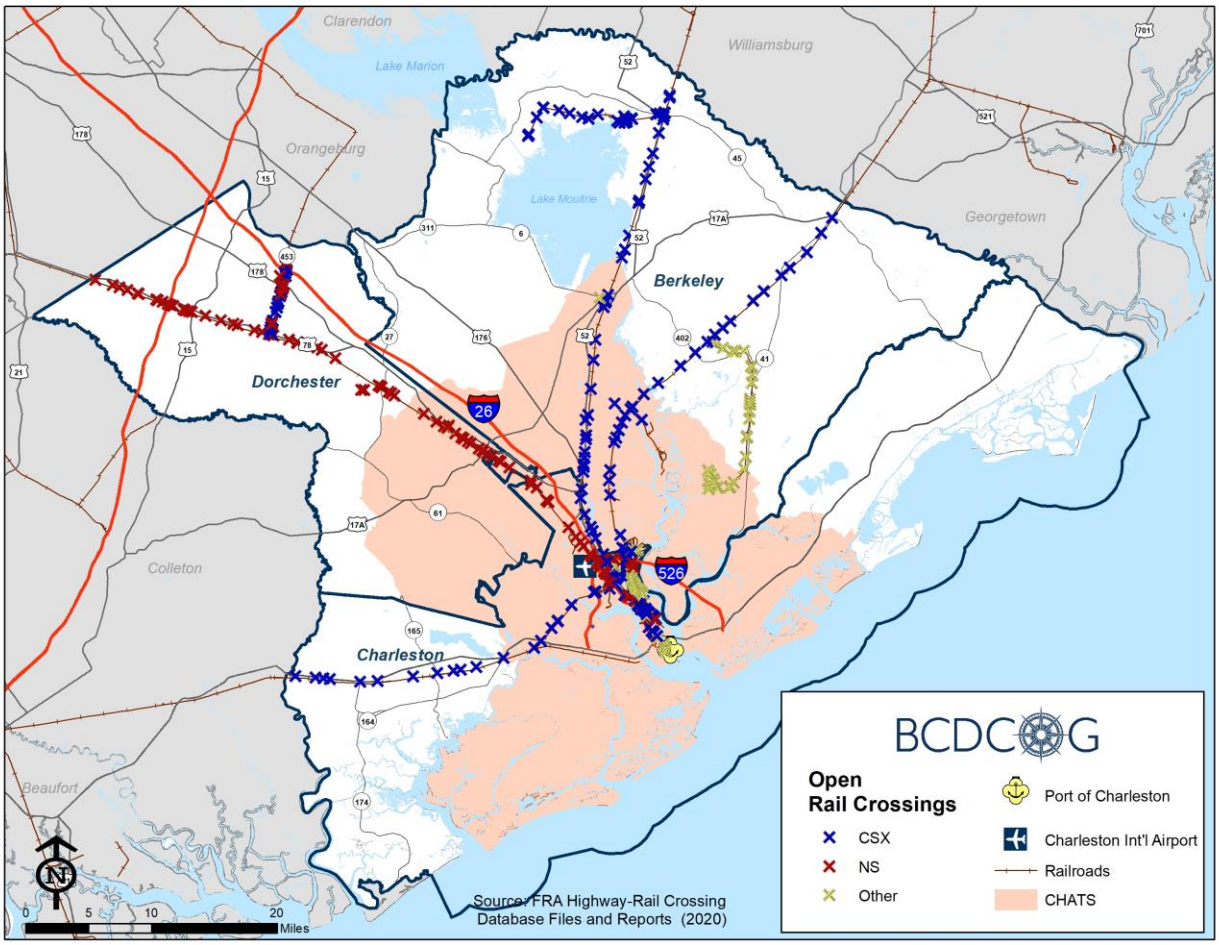


Table 1 – BCD Region Open Rail Crossings By County

County	At-Grade Crossings	Grade Separated Crossings	Open Crossings
Berkeley	113	6	119
Charleston	133	37	170
Dorchester	96	4	100
Totals	**342**	**47**	**389**

Source: FRA Highway-Rail Crossing Database Files and Reports (2020)

Closed crossing data is also maintained by the FRA to reflect historical records of crossing infrastructure and accidents. Table 2 breaks down the total number of closed crossings in the study area by county, totaling 122 for the entire region. Closing an at-grade crossing can occur for various reasons, such as consolidating redundant crossings, enhancing safety, road or track adjustments that are made to avoid

intersections, grade separating either the road or the track, or the removal of a track which is no longer in service.

Table 2 - BCD Region Closed Rail Crossings by County

County	Closed Crossings
Berkeley	9
Charleston	107
Dorchester	6
Total	**122**

Source: FRA Highway-Rail Crossing Database Files and Reports (2020)

3. STRATEGIES FOR COMMUNITIES

Communities, local governments, and regional planning entities have a variety of strategies available to them to help mitigate the negative externalities that occur from rail operations. These strategies are described below, under the topic headings: quiet zones; crossing consolidation; noise and vibration impacts; and trespassing. Each section will present background information on the topic as well as best practices for implementation.

3.1 QUIET ZONES

The FRA Train Horn Rule (49 CFR Part 222) requires that locomotive horns sound 15-20 seconds before entering public highway-rail grade crossings, or no more than one-quarter mile in advance of the crossing. The horn sound warns motorists and pedestrians that a train is approaching the grade crossing. The Train Horn Rule was spurred by an increase in train collisions in the late 1980s, particularly in areas where nighttime whistle bans were instituted. In 2005, the final Train Horn Rule, which included regulations on quiet zones, was adopted into the Code of Federal Regulations.

Figure 3- Signage within a Quiet Zone

Source: Daily Independent

A quiet zone is a section of track, at least one-half mile long, which contains one or more consecutive at-grade crossings, at which horns are not routinely sounded when trains are approaching the crossings. Exceptions to this rule include emergencies or when a superseding FRA rule applies. Quiet zones are established to reduce noise and promote and improve the quality of life in a given locality, without compromising the safety of motorists, pedestrians, or the train.

Only a public authority, the governmental entity responsible for traffic control/law enforcement at the identified crossing, is permitted to create a quiet zone. In order to establish a quiet zone, a community must work with the railroad as well as the state transportation authority to complete the following process:

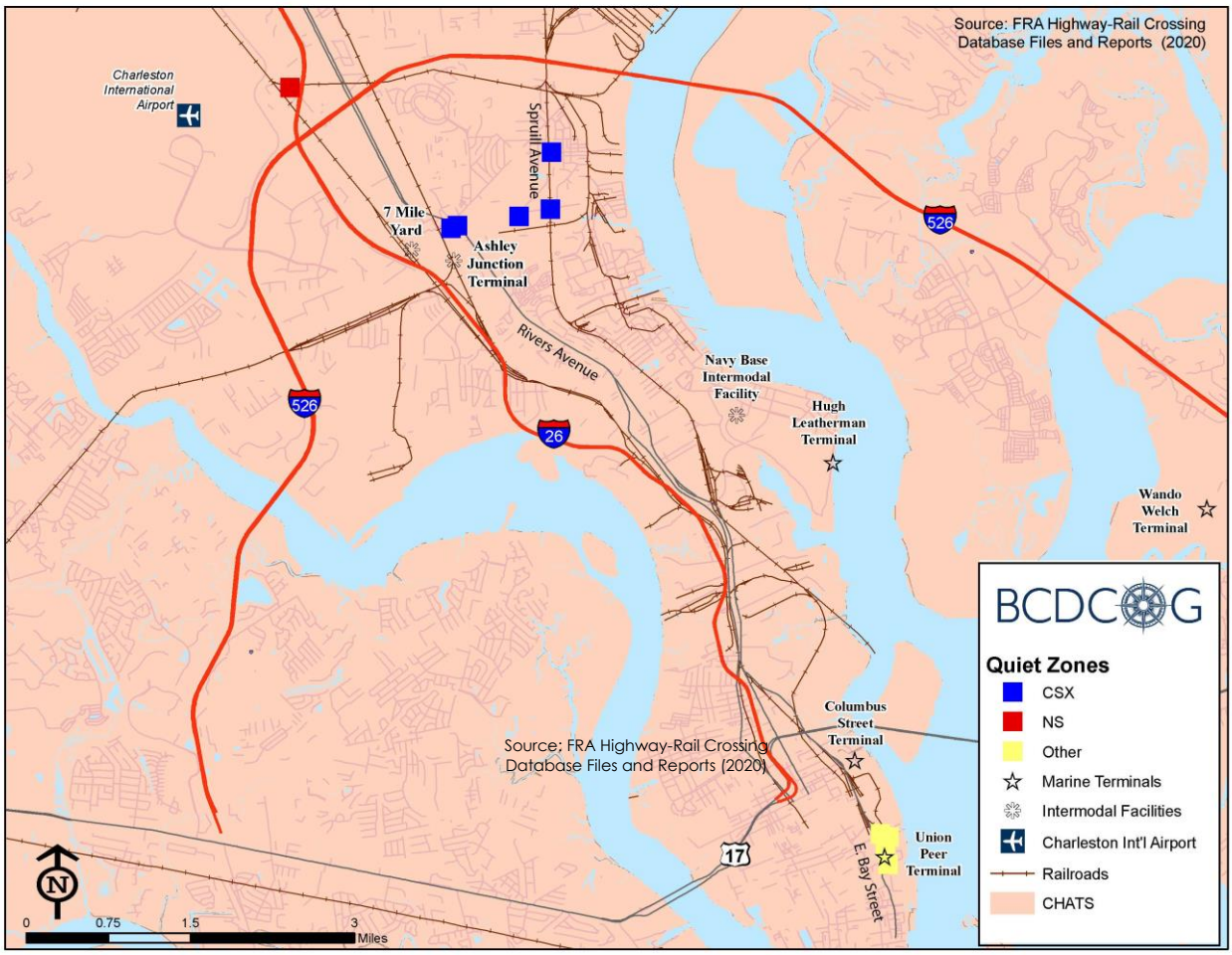
- **Step 1: DETERMINE** which railroad crossings will be included within the proposed quiet zone;
- **Step 2: IDENTIFY** privately owned rail crossings located inside of the proposed quiet zone;
- A diagnostic review of the crossing must be performed if it allows access to the public or active industrial or commercial sites;
- **Step 3: IDENTIFY** any pedestrian crossings located inside of the proposed quiet zone;
- A diagnostic review must be performed;
- **Step 4: UPDATE** the US DOT Crossing Form with the current conditions at each public, private, and pedestrian crossing located within the proposed quiet zone;
- **Step 5: PROVIDE** a Notice of Intent to the State agencies responsible for highway safety, rail crossing safety, and all railroads operating over crossings within the proposed quiet zone;
- **Step 6: APPLY** to FRA for Alternative Safety Measures that are proposed as part of the project;
- **Step 7: DETERMINE** the methodology for establishing the quiet zone using one of four approved FRA criteria;
- **Step 8: COMPLETE** the installation of Supplementary Safety Measures, Alternative Safety Measures, and any improvements necessary to satisfy compliance requirements;

Public authorities wishing to institute a quiet zone must submit required documentation throughout the establishment process; the FRA provides guidance and checklists to

follow as technical assistance.[5] Additional technical assistance is also available via FRA's Regional Grade Crossing Managers as well as a State's department of transportation or rail regulatory agency. Public authorities pursuing a quiet zone should coordinate closely with State agencies responsible for rail crossing safety through the entirety of the process. States may have additional administrative or legal requirements in order to modify a public rail crossing. Communities wishing to establish a crossing quiet zone must send a Notice of Intent and Notice of Quiet Zone Establishment to all railroads operating over the identified public crossing within the quiet zone. Railroad officials should also be included as part of the diagnostic team.

There are currently ten crossings where train horns are not routinely sounded, located within the BCD region (Figure 4), all of which are located in Charleston County. The City of North Charleston and the City of Charleston each have five crossings where train horns are not routinely sounded within their jurisdictional boundaries.

Figure 4 - BCDCOG Region Quiet Zones



[5] https://railroads.dot.gov/elibrary/how-create-quiet-zone

3.2 CROSSING CONSOLIDATION

The FRA's Crossing Consolidation Guidelines are a strategy to increase public safety and promote economic development through the selective closure of identified rail crossings.[6] This tactic is used to reduce traffic congestion, noise, and other effects of railroad crossings. In 2004, the USDOT Secretary's Action Plan on Highway-Rail Crossing Safety and Trespass Prevention cited "Closing Unneeded Crossings" as one of its nine key initiatives and resulted in an effort to update the FRA crossing consolidation manual.[7] This plan developed national standards and guidelines for crossing consolidation to offer clarity, best practices, and technical assistance for consolidation projects.

Figure 5 – Closed Railway Crossing

Source: Town of Cary, North Carolina Website

States take varying approaches regarding who possesses the authority to open and close highway rail crossings. In states where this authority is vested with the state department of transportation or a regulatory agency, uniform crossing selection processes are a matter of procedure. In these instances, consolidation projects are typically assigned to areas with the greatest need, and not necessarily to projects with the greatest level of support. However, state agencies have the means to help negotiate cooperation among stakeholders and diffuse opposition. State agencies may also offer more resources and funding to assist with consolidation projects. In

[6] USDOT FRA Crossing Consolidation Guidelines "Research Results", RR 09-12 (2009) https://railroads.dot.gov/elibrary/crossing-consolidation-guidelines
[7] USDOT Secretary's Action Plan on Highway-Rail Crossing Safety and Trespass Prevention https://railroads.dot.gov/elibrary/secretarys-action-plan-highway-rail-crossing-safety-and-trespass-prevention-secretary

instances where local governments have jurisdiction and authority over rail crossings, responsibility for leading the crossing selection process typically is entrusted with those with first-hand experience of the crossing and its context within the community.

The consolidation process begins with site selection, where the governing agency develops a list of potential crossings for consolidation. A corridor approach can also be undertaken when performing crossing consolidation. The corridor approach seeks to reduce administrative costs, enhance safety and mobility, and engage stakeholders when evaluating multiple crossings along a given rail line. An important consideration when evaluating potential crossings for consolidation is public versus private ownership of the crossing, as private crossings are typically unregulated by state and local governments. In instances of private ownership, close coordination with the private owner is imperative to meet the objectives of all involved parties.

Once a crossing is selected as a potential candidate for consolidation, a diagnostic review team is organized, preferably comprised of stakeholders from all parties involved with the effort. The review team will gather data relevant to the crossing, such as accident history, number of tracks and road lanes, average daily traffic, and proximity to other crossings. This information is then compiled for the governing agency to make informed and prioritized decisions. Ranking crossing closure projects by considering factors such as safety, redundancy, and costs helps to efficiently expend limited funding allocations for crossing closure projects.

As cited in the FRA Crossing Consolidation Guidelines, the greatest impediment to a successful consolidation initiative is local opposition. Community and public involvement must occur early in the planning process for successful crossing consolidations. Public engagement opens dialogue between residents, state and local officials, and rail owners to increase solidarity for the proposed crossing consolidation.

The FRA Crossing Guidelines publication recognizes the North Carolina Department of Transportation (NCDOT) as having implemented a successful crossing consolidation model that offers best practices for other states. The NCDOT approach incorporates three primary elements as part of their crossing consolidation process: coordination, communication, and consistency. Coordination and communication serve to keep the public aware of the project and further developments, while consistency is achieved through established and predictable criteria for evaluating safety and providing incentives.

A recent case study from Calhoun County, South Carolina involves the closure of an at-grade crossing in order to facilitate the development of the Tri-County Global Industrial Park.[8] Norfolk Southern policy requires that two crossings are eliminated prior to

[8] The Times and Democrat, "Calhoun County Council approves rail crossing closure; change to help industrial park development", Harris, B., (2020) https://thetandd.com/news/local/government-and-politics/calhoun-county-council-approves-rail-crossing-closure-change-to-help-industrial-park-development/article_83b023f0-7f72-5d1d-85e1-0c5143ac754d.html

constructing a new crossing. One of the proposed closures will occur at the crossing at Hemlock Road. The South Carolina Department of Transportation (SCDOT) required Calhoun County to assume maintenance responsibilities for the road, allowing the county to apply to Norfolk Southern for closure. The County Council approved the motion authorizing the application for the closure of the crossing at Hemlock Road.

3.3 Noise and Vibration Impacts

Noise and vibration can disturb sleep and impact physical and mental health, interfere with daily activities, lower land value, and structurally damage nearby buildings and infrastructure. In rural settings, noise and vibration can affect nearby ecosystems and land productivity. According to an article published by the National Institute of Health, unwanted noise is the primary complaint related to railroads, switching stations, and rail hubs.[9]

Fiaure 6 – Railway Noise Barrier

Source: https://www.guardrailbarrier.net/guardrails/railway-sound-barrier.html

Adverse noise and vibration effects related to rail operations can arise as result of introducing a new rail line into a community, neighborhood expansion adjacent to existing facilities, and changing operations on existing facilities. Increased train movements and extended rail operating hours can also be contributing factors.

Track and railcar conditions also play a large role in excess noise and vibration. Slight imperfections in the geometry of the track and wheel surfaces as well as local track defects can lead to increased vibrations. Other factors leading to increased vibration

[9] Bunn, F., and Zannin, P. Noise Annoyance through Railway Traffic – a Case Study; Journal of Environmental Health Science and & Engineering (2014) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3896847/

and noise include sharp curves in the rail line, locomotive engineers breaking or accelerating too hard, and switches and crossings that create gaps and alignment changes.

It is critical that the condition of local rail infrastructure be proactively monitored and maintained as a countermeasure to increased noise and vibration. Introduction of new rolling stock and upgraded track infrastructure are also effective in combating noise and vibration effects. Sound barriers can also serve as a solution to undesirable noise effects. While sound barriers will not prevent noise from a train horn, they can help mute wheel and engine noise.

Quiet zones and crossing consolidation are both policy-driven strategies to minimize or eliminate the impacts of railway noise and vibration. Additional initiatives to reduce noise and vibration impacts from existing rail operations, including:

- Noise abatement programs to address existing acute levels of heavy rail noise on a priority basis. These programs should specify agreed-upon methods for assessing and prioritizing requests for mitigation. The U.S. Department of Housing and Urban Development (HUD) offers additional resources regarding noise abatement via its website.
- Planning guidelines for new residential, commercial, and mixed-use developments alongside rail lines.

3.4 TRESPASSING

According to the FRA's National Strategy to Prevent Trespassing on Railroad Property – Report to Congress, more people are struck and killed by trains each year while trespassing, than are killed in motor vehicles collisions with trains at rail crossings.[10] Further, 74 percent of all rail line trespasser deaths and injuries (11/2013-10/2017) occurred within 1,000 feet of a rail crossing. Trespassing issues are a result of several factors, including, but not limited to a lack of education/knowledge related to the dangers of trespassing, lack of enforcement, and poor community planning-decisions.

To help decrease the number of injury and death-causing accidents on railroad right-of-way, the FRA has developed a National Strategy to Prevent Trespassing on Railroad Property, focusing on four key subject areas: Data Gathering and Analysis; Community Site Visits; Funding; and Develop Partnerships with Stakeholders. By performing data collection and analysis, it will enable the FRA to identify areas with high occurrences of trespassing incidents. Once determined, the FRA is empowered to focus and expend resources on areas of largest need.

[10] Federal Railroad Administration National Strategy to Prevent Trespassing on Railroad Property – Report to Congress (2018) https://railroads.dot.gov/elibrary/national-strategy-prevent-trespassing-railroad-property

Technology is also being explored and deployed to help decrease the occurrences of trespassing and resulting injuries or fatalities. This section highlights two approaches in the use of technology to combat trespassing on railroad right-of-way.

Figure 7 – Trespassing Monitoring at Police Dispatch

Source: FRA National Strategy to Prevent Trespassing on Railroad Property

The first initiative, Trespasser Detection Systems on Railroad Rights-of-Way, put forth by the FRA Office of Research, Development, and Technology, developed a detection system using cameras that were deployed at selected locations with demonstrated trespassing issues in the past.[11] A main component of this study was integrating the system with a local law enforcement agency to monitor and enforce violations. The system was deployed in Brunswick, Maine with the cooperation and support of the area's law enforcement dispatch center.

Lessons learned from this study indicate that integration of trespassing detection systems with local law enforcement increases response time and provides consistent monitoring of the location. However, false alarms and technology limitations can hinder the effectiveness of the system.

A second study, Artificial Intelligence-Aided Automated Detection of Railroad Trespassing[12] recognized the lack of data available related to trespassing incidents. Trespassing incidents are frequently missed, because no bodily harm occurred, and the trespasser was not observed/reported. The lack of relevant data prevents a thorough analysis of risk and mitigation strategies. In recent years, saturation of CCTV systems has provided increased surveillance of railroad infrastructure; however, given the volume of

[11] USDOT Federal Railroad Administration: Trespasser Detection Systems on Railroad Rights-of-Way (2020) https://railroads.dot.gov/sites/fra.dot.gov/files/2020-08/Trespassers%20on%20ROW-A.pdf
[12] Zaman, A., Ren, B., and Liu, X: Artificial Intelligence-Aided Automated Detection of Railroad Trespassing (2019) https://cee.rutgers.edu/sites/default/files/uploads/Zaman%20Ren%20%26%20Liu.pdf

footage available from CCTV systems, using current methods and resources, analyzing this data is a nearly impossible task.

This trespassing study sought to integrate an algorithm that would enable detection of trespassing incidents aided by artificial intelligence. Once a region of interest is identified within the system, the algorithm monitors camera feeds to detect unlawful occupiers in the area. In addition to trespassing incidents involving pedestrians, the system is also able to recognize events such as vehicles driving around crossing gates, and other similar infractions. When detected, an alert notification, such as an email or text message is distributed to the end-user for review. This data can also be saved in a database for future use.

Technology will be an important tool in monitoring and decreasing the number of rail trespassing incidents. Based on recent studies on the topic, solutions are coming online for both rail operators and law enforcement. Implementing successful detection systems will be driven by advancements in camera and artificial intelligence technologies as well as the integration with human-operated monitoring processes.

4. GRADE SEPARATION EXAMPLES

Highway-rail grade separation projects remove a conflict point between automobiles and trains by building a road over or under a rail line. Likewise, a rail line can be lifted over or channeled under a roadway as well. While there is no way to provide a per unit cost equivalent, similar to highway lane per mile, for a grade separation project, grade separation example projects are given below.

4.1 CLAREMORE, OK GRADE SEPARATION PROJECT

The City of Claremore grade separation project for a BNSF Railway Company line was approximately 3.6 miles long with eight grade crossings, a ninth creek crossing, and a tenth crossing over a Union Pacific Railroad (UPRR) line. A 2.2-mile siding track was also constructed in conjunction with the separation project to address future operational issues associated with the grade separation being limited to single track construction.

Estimated Construction Costs - $50,000,000

Project Status – Project did not advance past preliminary engineering due to funding constraints.

Figure 8 - Claremore Grade Separation Rendering

4.2 OLATHE, KS GRADE SEPARATION PROJECT

The City of Olathe owns several at-grade railroad crossings that presented safety hazards and required that trains from the BNSF Railway Company blow their whistles as they pass through. To eliminate the risk of accidents and the need for whistles, the City of Olathe sought to separate the crossing grades. Four grade separations were constructed utilizing an elevated track that minimized disruption to car and truck traffic on the affected roads, while allowing for rail traffic to operate without interruption.

Figure 9 - Olathe Grade Separation Project

Construction Cost - $42,000,000

Completion – December 2010

4.3 HEMPHILL LAMAR TAYLOR CONNECTOR

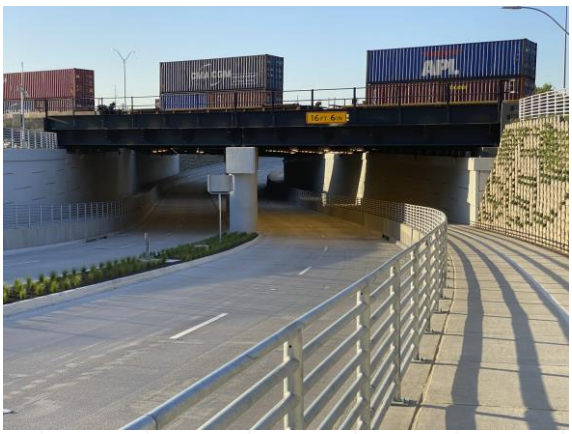
Hemphill Road, in Fort Worth, TX was constructed as a four-lane roadway with a 400-foot tunnel that was built underneath the railroad tracks and IH-30. The 2,100-foot concrete roadway has a raised median and extensive aesthetic design feature, including etched retaining walls, decorative lighting, and landscaping.

Figure 10 - Hemphill Lamar Grade Separated Median

Construction Cost - $12,000,000

Completion – April 2020

Figure 11 - Hemphill Lamar Taylor Connector

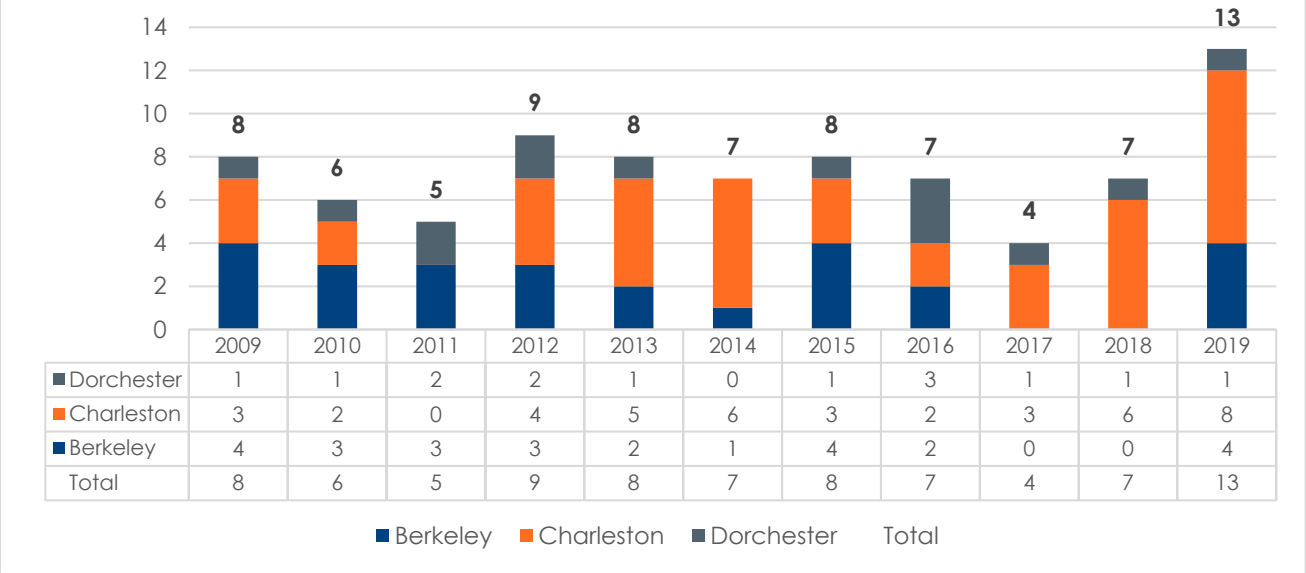


5. HOTSPOT ANALYSIS

The hotpot analysis will examine all at-grade crossings in the study area to determine which intersections have the most accidents between vehicles and trains. The accident data pulled from the FRA is longitudinal, meaning it tracks accidents that occur on at-grade crossings over time. For the purposes of this analysis, a few conditions were established to focus the data on train movements. First, closed crossings were removed from the data set as they might have included recent accident records that would have skewed the results. The implication being closed crossings would no longer present issues for future accidents. Next, a small subset of the entire data was selected to focus on a recent 10-year period between 2009 and 2019. The accident data goes back further than 2009, but a more recent sample was used to identify where accidents were most frequently occurring. The data was reviewed to determine if a warning device upgrade occurred during the analysis period. No substantial upgrades occurred for the crossings selected for detailed analysis; therefore, all accidents were used in the analysis. Lastly, partial year data from 2020 was excluded from the analysis.

Figure 12 displays accidents, by county, that occur near at-grade rail crossings between 2009 and 2019. For the 10-year period, there is an average of 7 accidents per year. For the three most recent years, 2017 to 2019, there is a slight uptick, with an average of 8 accidents per year.

Figure 12 - BCD Region Accidents by County 2009-2019



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Dorchester	1	1	2	2	1	0	1	3	1	1	1
Charleston	3	2	0	4	5	6	3	2	3	6	8
Berkeley	4	3	3	3	2	1	4	2	0	0	4
Total	8	6	5	9	8	7	8	7	4	7	13

Source: FRA Accident/Incident Data (2020)

Charleston County has the most at-grade crossing accidents with 42 over the 10-year period (Table 3) with six occurring in 2018 and eight in 2019. Berkeley County has 26 accidents while Dorchester County had 14 accidents over the same 10-year period.

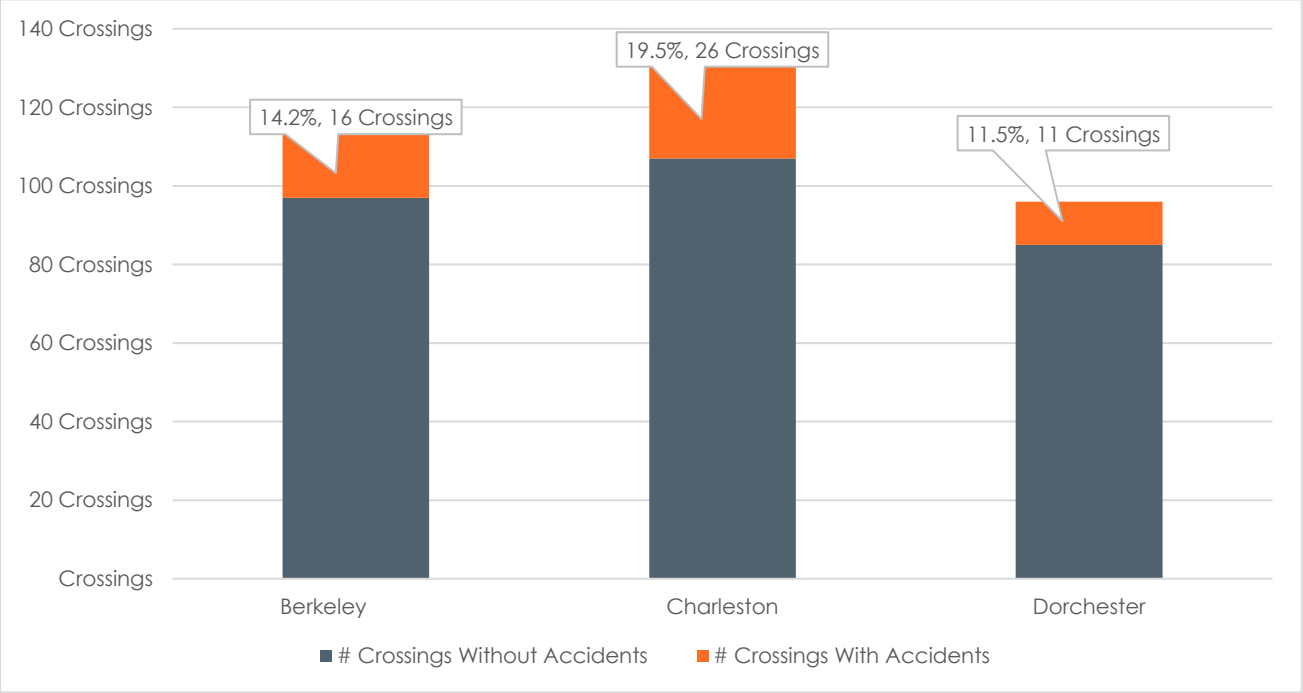
Table 3 – At-Grade Accidents within the BCD Region, 2009-2019

County	Accidents
Berkeley	26
Charleston	42
Dorchester	14
Total	**82**

Source: FRA Accident/Incident Data (2020)

Figure 13 illustrates the total number of at-grade crossings by county in comparison with the at-grade crossings that have had an accident. Charleston County has the highest number of at-grade crossings with accidents (26), while Berkeley County and Dorchester County have 16 and 11 respectively.

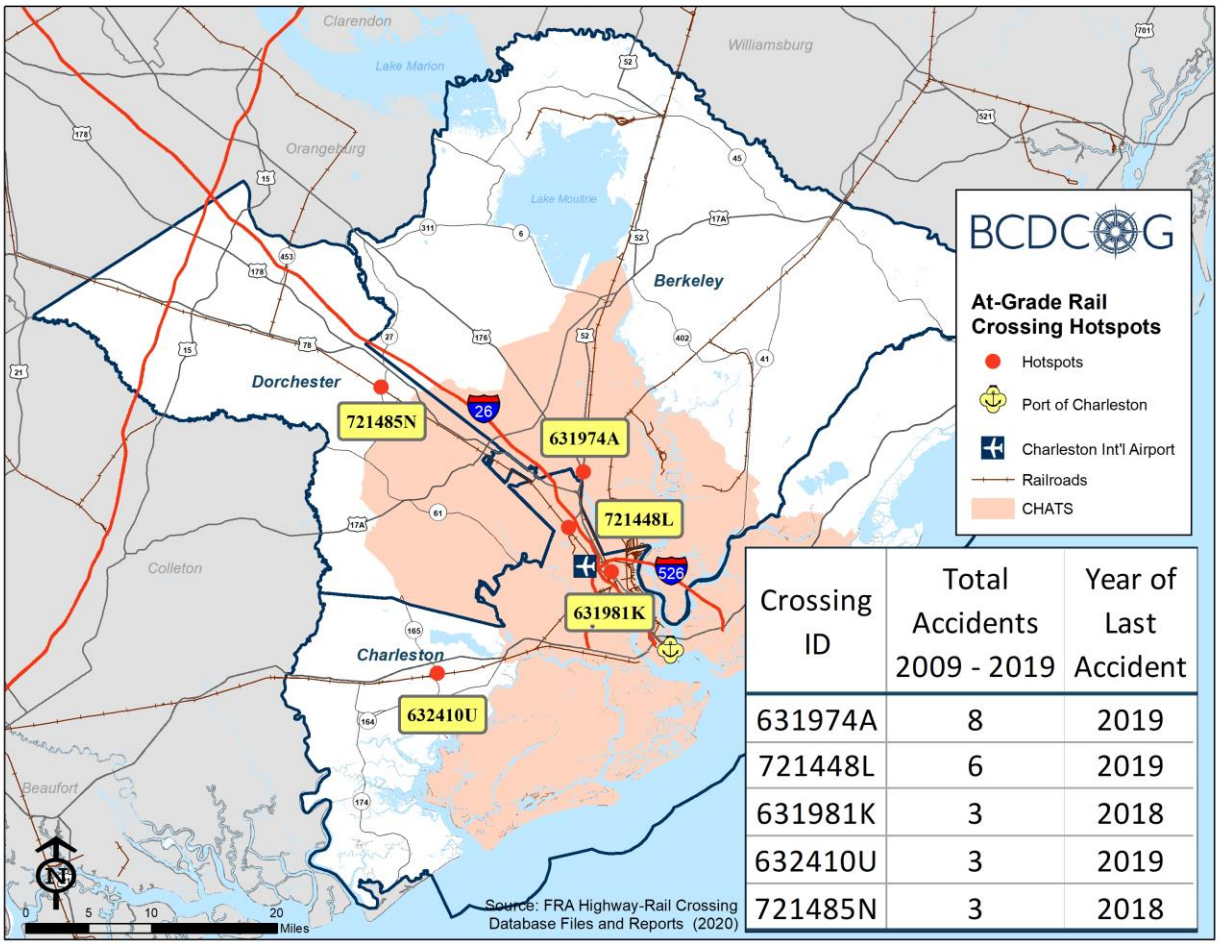
Figure 13 - BCD Region Percent of Rail Crossings with Accidents by County



Source: FRA Accident/Incident Data (2020)

Between 2009 and 2019 there were a total of 53 at-grade crossings that had accidents within the BCD region. Figure 14 provides the top three crossing hotspots within the region, showing that East Montague Avenue, SC 165, and North Main Street are tied for third position based on the total number of accidents that occurred. Figure 14 also depicts the location of each at-grade crossing hotspot within the region. Three occur in Charleston County, with one each occurring in both Dorchester and Berkeley Counties.

Figure 14 – BCD Region At-Grade Crossing Hotspots



Crossing ID	Total Accidents 2009 - 2019	Year of Last Accident
631974A	8	2019
721448L	6	2019
631981K	3	2018
632410U	3	2019
721485N	3	2018

6. RAIL CROSSING RECOMMENDATIONS

6.1 General Rail Crossing Recommendations

Some general rail crossing recommendations for communities within the BCD region are:

- On-going monitoring of highway-rail grade crossings to reduce conflicts at priority highway-rail grade crossings;
- Consider highway-rail grade separations to improve safety;
- Foster public-private partnerships between railroads and governmental entities to address institutional and infrastructure issues; and
- On-going monitoring of local and county land use plans to limit the development of land uses that are incompatible with railroad corridors.

6.2 Specific Rail Crossing Recommendations

A desktop audit was used to examine each at-grade crossing hotspot in the BCD region in more detail. The first step in the desktop audit was to evaluate each individual FRA Inventory Report and Accident/Incident Report. The next step was to evaluate each at-grade crossing hotspot using Google Earth or NearMap imagery for a visual inspection.

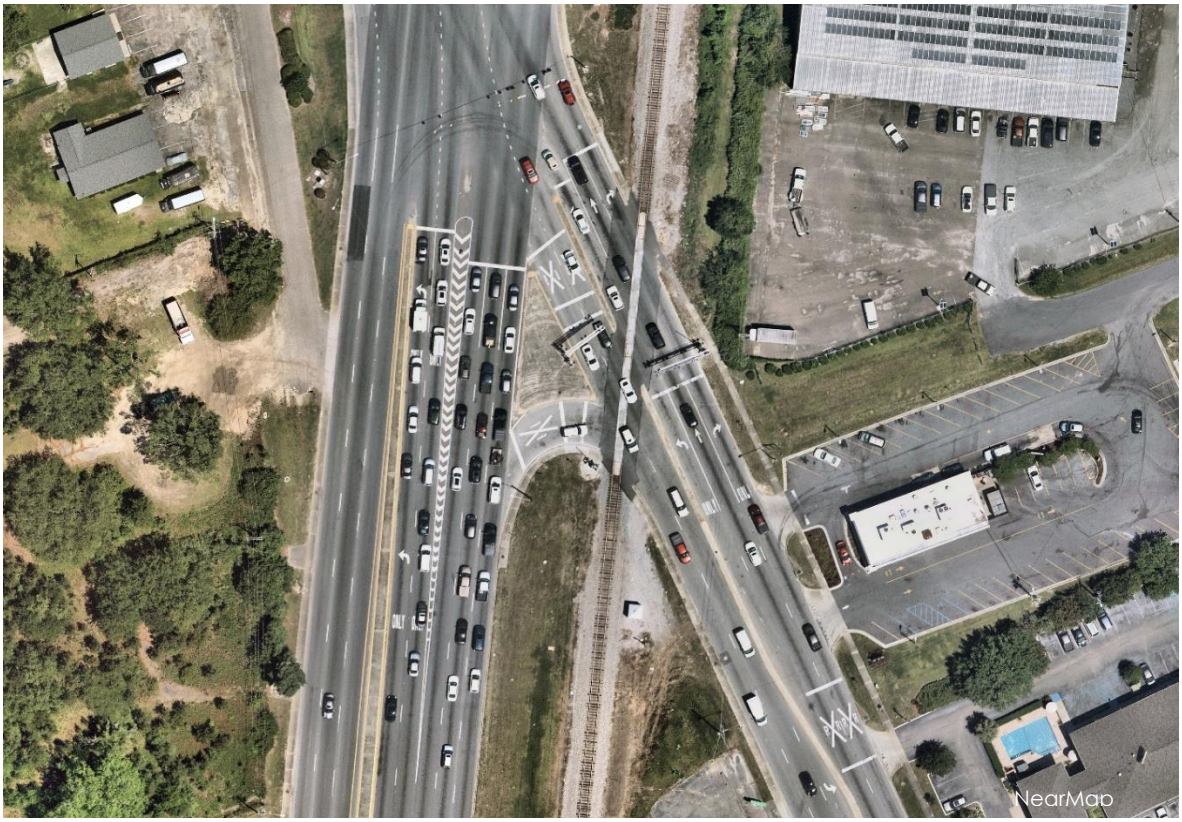
6.2.1 Red Bank Road

The Inventory and Accident/Incident Reports helped to identify at-grade crossing information for Red Bank Road:

- Located in Goose Creek, SC, at the intersection of S. Goose Creek Boulevard (Figure 15);
- Operated by CSX Transportation
- FRA Crossing Inventory Number 631974A;
- Inventory report date of 01/20/2020;
- One Track Crossing (Figure 15);

- Not located within a quiet zone;
- Not documented as being integrated with adjacent intersection traffic signals; and
- 8 reported accidents between 2009 and 2019 with important incidents to note:
  - March 2019 – Pedestrian fatally struck at crossing;
  - March 2016 – Pedestrian fatally struck at crossing;
  - April 2015 – Train struck vehicle stopped on crossing – no injuries reported; and
  - July 2011 – Train struck vehicle stopped on crossing – one injury reported.

Figure 15 – Red Bank Road Rail Crossing



Train and Transportation Network

During a 2020 train count, there were:

- 19 trains per day:
  - 6 of those trains occurred during the day;
  - 11 of those trains occurred during the night; and
  - 2 were switching trains.

There is a 79 mile per hour (mph) Maximum Timetable Speed and the typical train speed range was 60-79 mph. The posted speed limit for vehicles is 45 mph. In 2020, there were:

- Average Annual Daily Trip (AADT) 22,367 vehicles:[13]
  - 12% were trucks, and
  - 20 daily school buses.

Current Conditions and Recommendations

Figure 16 through Figure 20 depict the current conditions at the crossing and were used to make recommendations for improvements, which are described below:

Crossing Signal Equipment (Good Condition): Two quadrant protection and cantilever signal masts for Red Bank Road; gate protection for on-coming traffic protection for the S Goose Creek northbound turn lane. Gates are noticeably long and only located at the edge of roadway. Sidewalks are not protected in remaining quadrants. Northbound roadway for Red Bank Road does not have a queue cutter signal prior to the at-grade crossing allowing cars to queue on the crossing surface at red lights.

Roadway Surface (Good Condition): Crossing surface consists of concrete gauge panels with flangeway filler outside the rails, notably repaved recently as part of a railroad improvement project for this crossing. Approach pavement appears to be in good condition. Red Bank Road has narrow medians on each crossing approach that appear to be mountable.

Railroad Crossing Signs (Good Condition): The Red Bank Road northbound approach and S Goose Creek Boulevard northbound turn lane both have clear passive warning signs.

Railroad Crossing Pavement Markings (Poor Condition): Pavement markings are present for all crossing approaches but are cracking and scaling off. Nighttime visibility may be impacted from the deteriorated condition.

Drainage (Good Condition): No apparent drainage issues. Crossing surface and ballast approaches appear clear from sand or debris. No apparent erosion or undermining in trackbed or edge of pavement.

Track Approach Sightlines (Good Condition): All track sightlines clear of large tress or other obstructions.

Pedestrian Access and Curbing (Fair Condition): Sidewalk is present on each side of both approaches to the crossing surface. No detectable warning pads are present at any of the sidewalk approaches to the crossing surface. The southeast sidewalk

[13] https://railroads.dot.gov/crossing-and-inventory-data/grade-crossing-inventory/crossing-inventory-dashboards-data-downloads

approach appears to be deteriorating and not meeting ADA standards, as it appears relatively thin and to have been temporarily paved. Mountable curbing is present for all approaches. The southeast approach curbing appears to be deteriorating at the crossing surface.

Figure 16 - Red Bank Road - Looking Northwest

Figure 17 - Red Bank Road Looking Southeast

Figure 18 - Red Bank Road - Looking North

Figure 19 - Red Bank Road - Looking South

Figure 20 - Red Bank Road Crossing Pavement Markings

Planning Level Cost Estimates

Planning level cost estimates are detailed in Table 4, understanding that additional costs may arise from a diagnostic meeting and inspection of the existing at-grade crossing. Diagnostic meetings are engagement opportunities for the stakeholders to participate in the process by visiting the site and building consensus on their requested needs. The recommended improvements for the Red Bank Road at-grade crossing are:

- Replace south sidewalk with ADA compliant concrete sidewalk;
- Install pre-emption with intersection signals to clear queue for train arrival;
- Remove and replace stop bar and railroad crossing pavement markings;
- Install pedestrian gates at open sidewalks in three locations;
- Improve existing signal system for additional gates; and
- Install detectable warning pads for all sidewalk approaches.

Table 4 – Red Bank Road At-Grade Crossing Planning Level Cost Estimate

Crossing Signal Equipment	Item Cost	Unit	Quantity	Total Cost
New Signal Mast with Gate and Flashers	$75,000.00	EA	3	$225,000.00
Improve Signal System for additional gates	$40,000.00	EA	1	$40,000.00
Install preemption interface between signals	$100,000.00	EA	1	$100,000.00
Railroad Crossing Pavement Markings	Item Cost	Unit	Quantity	Total Cost
RR Crossing Pavement Marking with Lines	$600.00	EA	5	$3,000.00
Stop Lines	$40.00	LF	100	$4,000.00
Pedestrian Access and Curbing	Item Cost	Unit	Quantity	Total Cost
Remove and install new sidewalk	$50.00	SF	100	$5,000.00
Tactile Warning Pad	$400.00	EA	4	$1,600.00
		Grand Total		**$378,600.00**

Special Consideration

A queue cutter signal may be warranted for this crossing, but has a greater cost associated than any of the recommendations as shown in Table 5. A queue cutter signal is an extension of the intersection traffic signal that is placed prior to the at-grade crossing and prevents vehicles from queuing on top of the crossing during a red light.

Table 5 - Queue Cutter Signal Planning Level Cost Estimate

Crossing Signal Equipment	Item Cost	Unit	Quantity	Total Cost
Preemption Queue Cutter Signal	$500,000.00	EA	1	$500,000.00
		Grand Total		**$500,000.00**

6.2.1.1 Ashley Phosphate Road

The Inventory and Accident/Incident Reports helped to identify at-grade crossing information for Ashley Phosphate Road:

- Located in North Charleston, SC, between Southrail Road and Palmetto Commerce Parkway (Figure 21);
- Operated by Norfolk Southern Railway Company;
- FRA Crossing Inventory Number 721448L;
- Inventory report date of 08/12/2019;
- Single Track Crossing;
- Westbound vehicles stopped at signalized intersection of Palmetto Commerce Parkway typically queue across crossing (Figure 22);
- Not located within a quiet zone; and
- 6 reported accidents between 2009 and 2019, with recent incidents to note:
  - June 2019 – Train struck vehicle that went around gates – no injuries reported;
  - March 2018 – Train struck vehicle stopped on crossing – no injuries reported;
  - December 2014 – Train struck vehicle stopped on crossing – two highway users injured;
  - September 2013 – Train struck vehicle stopped on crossing – one highway user injured; and
  - February 2013 – Train struck vehicle that went around gates – no injuries reported.

Figure 21 - Ashley Phosphate Road Rail Crossing

Figure 22 – Ashley Phosphate Road Westbound Queuing

Train and Transportation Network

During a 2017 train count, there were:

- 15 trains per day:
  - 5 of those trains occurred during the day;
  - 4 of those trains occurred during the night; and
  - 6 were switching trains.

There is a 49 mile per hour (mph) Maximum Timetable Speed and the typical train speed range was 40-49 mph. The posted speed limit for vehicles is 35 mph. In 2013, there were:

- Average Annual Daily Trip (AADT) 57,339 vehicles:
  - 15% were trucks; and
  - 24 daily school buses.

Current Conditions and Recommendations

Figure 23 through Figure 30 depict the current conditions at the crossing and were used to make recommendations for improvements, which are described below:

Crossing Signal Equipment (Good Condition): Signalized with two-quadrant protection, cantilever signal masts and two-gate roadway protection for each approaching roadway (median and edge of roadway with sidewalk coverage). Sidewalks in opposite quadrants are not protected.

Roadway Surface (Good Condition): Consists of asphalt and rubber flangeway filler, notably repaved recently as part of a railroad improvement project for this crossing. Approach pavement appears to be in good condition. Ashley Phosphate Road has a raised median; however, it appears to be mountable.

Railroad Crossing Signs (Fair Condition): Advance crossing warning signs are present for both Ashley Phosphate Road approaches. The west approach advance warning appears to be overgrown by adjacent trees (Figure 23). There is no advance warning sign present on Southrail Road.

Railroad Crossing Pavement Markings (Fair Condition): Pavement markings appear to be in good/fair condition. Stop Bars and railroad crossing markings are present on each approach Except for Southrail Road.

Drainage (Good Condition): No apparent drainage issues. Crossing surface and ballast approaches appear clear from sand or debris. No apparent erosion or undermining in trackbed or edge of pavement.

Track Approach Sightlines (Good Condition): Sightlines are clear of trees and other obstructions in all four approach quadrants to the crossing.

Pedestrian Access and Curbing (Fair Condition): Sidewalk is present with mountable curbing on both sides of each approach, with smooth transitions to the crossing surface. The 2020 street view images show that the southwest quadrant detectable warning pad has separated completely from the deteriorated sidewalk (Figure 30), and vegetation is beginning to overgrow the sidewalk approach.

Figure 23 - Ashley Phosphate Road - Looking East (1)

Figure 24 - Ashley Phosphate Looking East (2)

Figure 25 - Ashley Phosphate Road - Looking West (1)

Figure 26 - Ashley Phosphate Road - Looking West (2)

Figure 27 - Ashley Phosphate Road - Looking North

Figure 28 - Ashley Phosphate Road - Looking South

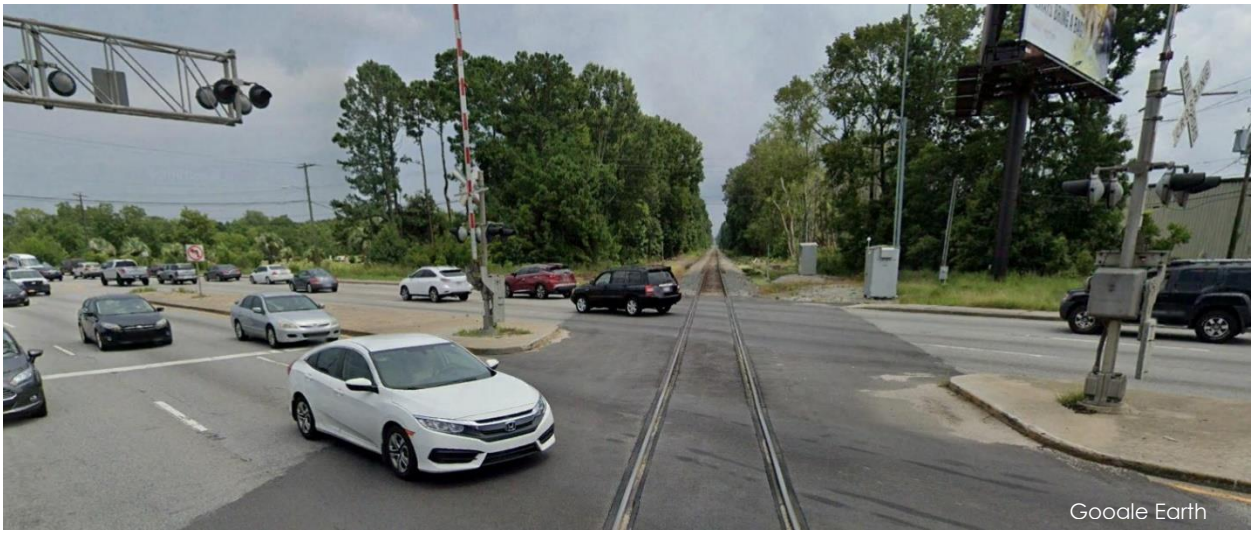


Figure 29 - Ashley Phosphate Crossing Pavement Markings

Figure 30 - Ashley Phosphate Crossing Detectable Warning Pad SW quadrant

Planning Level Cost Estimates

Planning level cost estimates are detailed in Table 6, understanding that additional costs may arise from a diagnostic meeting and inspection of the existing at-grade crossing. Diagnostic meetings are engagement opportunities for the stakeholders to participate in the process by visiting the site and building consensus on their requested needs. The recommended improvements for the Ashley Phosphate Road at-grade crossing are:

- Install Queue Cutter Signal with Crossing Preemption for westbound roadway;
- Install pedestrian gates in open quadrants;
- Improve existing system for additional gates;
- Remove vegetation around west approach advance warning sign;
- Remove and replace southwest sidewalk at crossing; and
- Remove remaining detectable warning pads and install new pads.

Table 6 – Ashley Phosphate Road At-Grade Crossing Planning Level Cost Estimate

Crossing Signal Equipment	Item Cost	Unit	Quantity	Total Cost
New Signal Mast with Gate and Flashers	$75,000.00	EA	2	$150,000.00
Improve Signal System (to include pedestrian gates & preemption)	$60,000.00	EA	1	$60,000.00
Queue Cutter Traffic Mast & Integration	$500,000.00			$500,000.00
Railroad Crossing Signs	Item Cost	Unit	Quantity	Total Cost
Remove Vegetation around Signs	$300.00	EA	1	$300.00
Advance Warning sign on Southrail Rd	$ 500.00	EA	1	$500.00
Pedestrian Access and Curbing	Item Cost	Unit	Quantity	Total Cost
Remove and install new sidewalk	$50.00	SF	20	$1,000.00
Tactile Warning Pad	$400.00	EA	4	$1,600.00
Remove Tactile Warning Pad	$100.00	EA	3	$300.00
			Grand Total	**$713,700.00**

6.2.2 SC 165

The Inventory and Accident/Incident Reports helped to identify at-grade crossing information for SC 165:

- Located in Ravenel, SC between Drayton Street and Martin Street;
- Operated by CSX Transportation Company and Amtrak;
- FRA Crossing Inventory Number 632410U;
- Inventory report date of 05/09/2019;
- Two Track Crossing (Figure 31);
- 24-hour quiet zone; and
- 3 reported accidents between 2009 and 2019, incidents to note:
  - November 2019 – Train struck vehicle stuck on track – no injuries reported;
  - May 2019 – Train struck vehicle that went around gates – no injuries reported; and
  - April 2014 – Vehicle stopped and then proceeded to drive into train at crossing.

Figure 31 – SC 165 Rail Crossing

Train and Transportation Network

During a 2019 train count, there were:

- 20 trains per day:
  - 6 of those trains occurred during the day;
  - 12 of those trains occurred during the night; and
  - 2 were switching trains.

There is a 79 mile per hour (mph) Maximum Timetable Speed and the typical train speed range was 40-49 mph. The posted speed limit for vehicles is 30 mph. In 2013, there were:

- Average Annual Daily Trip (AADT) 4,582 vehicles:
  - 6% were trucks, and
  - 0 daily school buses.

Current Conditions and Recommendations

Figure 32 through Figure 42 depict the current conditions at the crossing and were used to make recommendations for improvements, which are described below:

Crossing Signal Equipment (Good Condition): Signalized with two-quadrant protection. Gates only extend over approaching lanes. No sidewalks are present at this crossing.

Roadway Surface (Fair Condition): Crossing surface consists of asphalt and rubber flangeway filler. Approach pavement appears cracked, but not deteriorating. Low clearance drag marks are present on the south approach. North approach has a sawcut line through the asphalt immediately north of the crossing surface.

Railroad Crossing Signs (Poor Condition): Advanced warning sign present on Drayton Street (SC 165) east approach to the crossing (See Figure 5). Advance warning sign on SC 165 north approach is located far in advance of the crossing (approximately 700 feet), and approximately 300 feet in advance of the railroad crossing pavement marking (See Figure 38 & Figure 39). No advance warning signage is posted on Martin Street or the Drayton Street west approach to the crossing.

Railroad Crossing Pavement Markings (Poor Condition): Stop bars and railroad crossing pavement markings appear to be in poor condition with cracking and deterioration (See Figure 36 & Figure 38). Advance warning pavement markings are not present on east approach of Drayton Street and Martin Street (See Figure 33 & Figure 40).

Drainage (Good Condition): No apparent drainage issues. Crossing surface and ballast approaches appear clear from sand or debris. No apparent erosion or undermining in trackbed or edge of pavement.

Track Approach Sightlines (Good Condition): Sightlines are clear of obstructions in all four approach quadrants to the crossing.

Pedestrian Access and Curbing (Not Applicable): Sidewalk and curbing is not present at the crossing surface and immediate approaches. No crosswalks or transitions are present to the crossing surface.

Figure 32 – SC 165 South Approach Looking North

Figure 33 - Drayton Street East Approach to Crossing Looking West

Figure 34 - SC 165 Drayton Street West Approach to Crossing Looking East

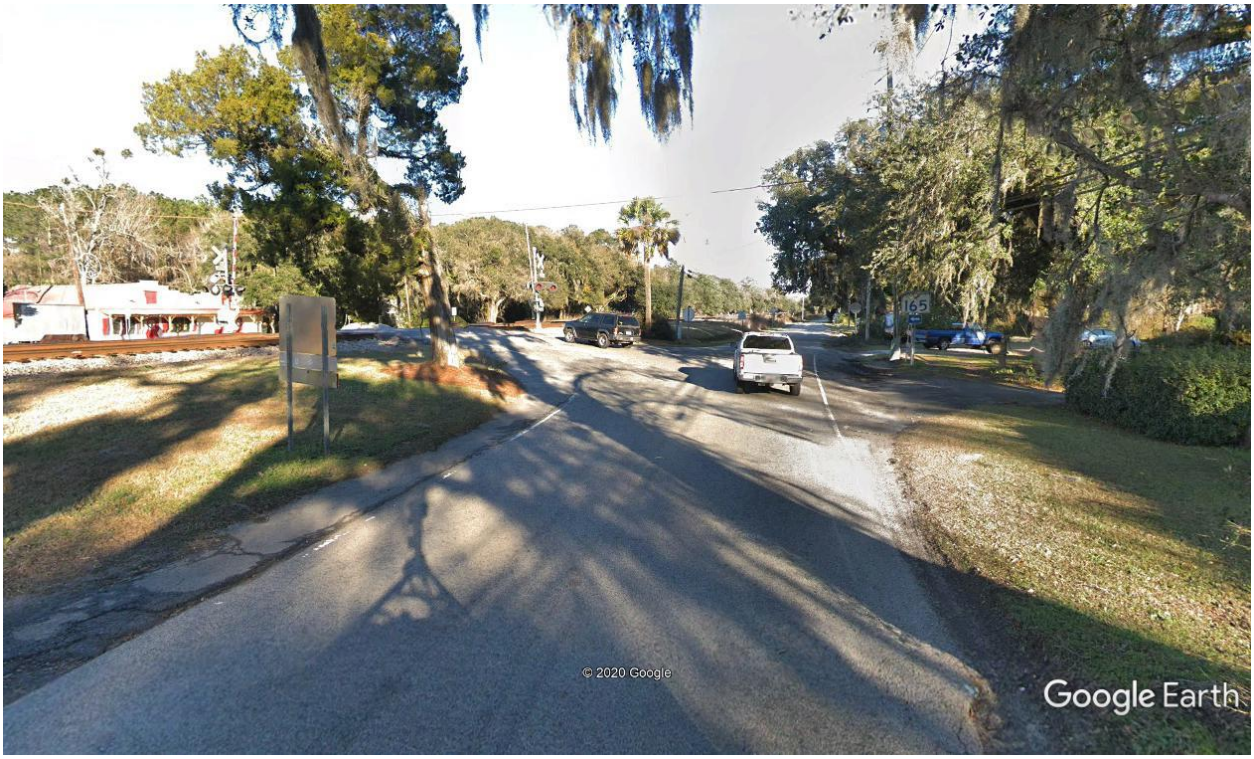


Figure 35 - SC 165 Drayton Street West Approach Advance Warning Signs and Pavement Marking Looking East

Figure 36 - Drayton Street West Approach Railroad Crossing Pavement Marking Looking East

Figure 37 - SC 165 North Approach Looking South

Figure 38 - SC 165 North Approach Looking South (1)

Figure 39 - SC 165 North Approach Looking South (2)

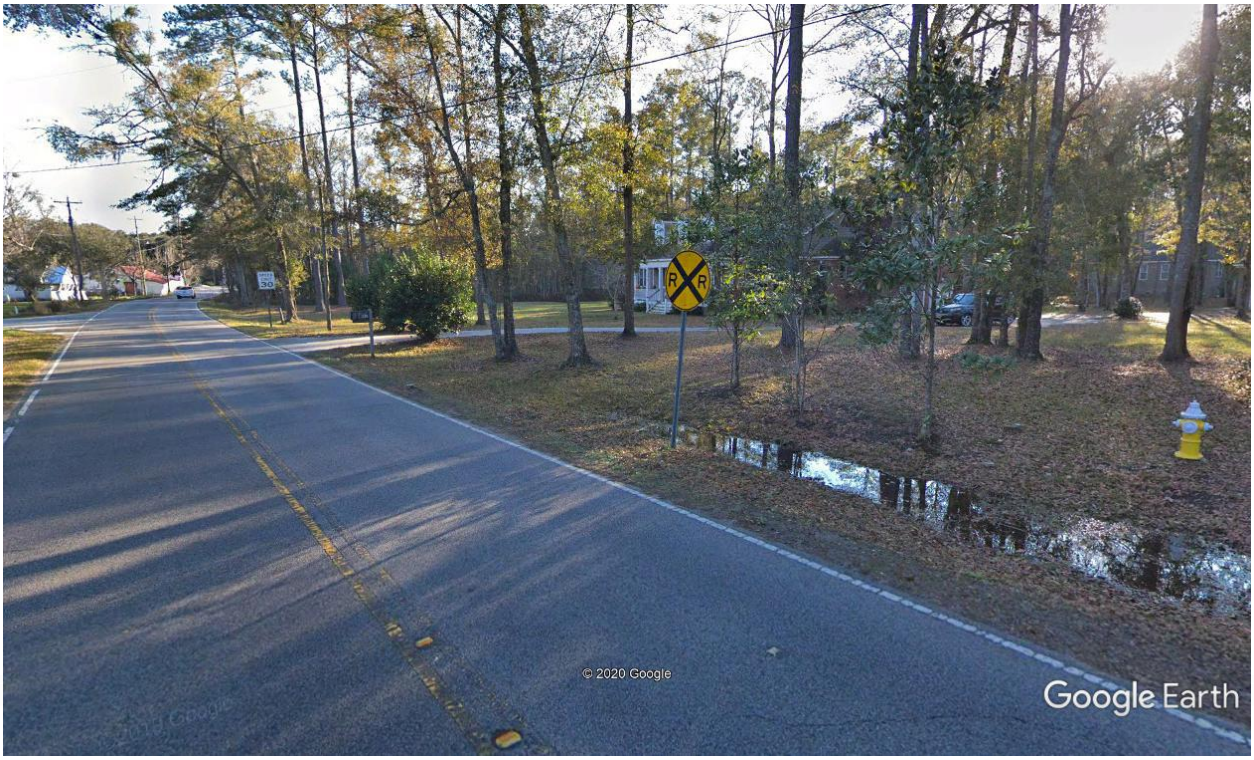


Figure 40 - Martin Street T intersection with SC 165 Looking West

Figure 41 - SC 165 Crossing Surface Looking East

Figure 42 - SC 165 Crossing Surface Looking West

Planning Level Cost Estimates

Planning level cost estimates are detailed in Table 7, understanding that additional costs may arise from a diagnostic meeting and inspection of the existing at-grade crossing. Diagnostic meetings are engagement opportunities for the stakeholders to participate in the process by visiting the site and building consensus on their requested needs. The recommended improvements for the SC 165 at-grade crossing are:

- Install 20' long traffic separator medians with delineator panels and R4-7 "Keep Right" sign at each approach to the crossing to prevent drivers traversing diagonally through the crossing to Martin Street;
- Install new railroad crossing pavement markings at all approaches;
- Install new stop bar markings at crossing;
- Remove and relocate advance warning sign on SC 165 north approach; and
- Install advance warning on Martin Street and Drayton Street east approach.

Table 7 – SC 165 At-Grade Crossing Planning Level Cost Estimates

Crossing Improvements	Item Cost	Unit	Quantity	Total Cost
Curbed Traffic Separator Median	$200.00	LF	40	$8,000.00
Panel or Tubular Delineators	$50.00	LF	40	$2,000.00
Railroad Crossing Signs	Item Cost	Unit	Quantity	Total Cost
New Advance Warning Signs	$200.00	EA	2	$400.00
New "Keep Right" R4-7 signs	$200.00	EA	2	$400.00
New Signpost	$1,000.00	EA	4	$4,000.00
Remove and Relocate Existing Signs	$1,000.00	EA	1	$1,000.00
Railroad Crossing Pavement Markings	Item Cost	Unit	Quantity	Total Cost
RR Crossing Pavement Marking with Lines	$600.00	EA	4	$2,400.00
Stop Lines	$40.00	LF	25	$1,000.00
		Grand Total		**$19,200.00**

6.2.3 East Montague Avenue

The Inventory and Accident/Incident Reports helped to identify at-grade crossing information for East Montague Avenue:

- Located in North Charleston, SC, between Gaynor Street and Railroad Avenue;
- Operated by CSX Transportation Company and Amtrak;
- FRA Crossing Inventory Number 631981K;
- Inventory report date of 06/25/2020;
- Two Track Crossing (Figure 43);
- Not located within a quiet zone; and
- 3 reported accidents between 2009 and 2019, incidents to note:
  - January 2018 – Train struck vehicle on crossing – no injuries reported;
  - August 2014 – Train struck vehicle on crossing – no injuries reported; and
  - June 2017 – Train struck pedestrian who went around gates, pedestrian injured.

Figure 43 - East Montague Avenue Rail Crossing

Train and Transportation Network

During a 2020 train count, there were:

- 18 trains per day:
  - 5 of those trains occurred during the day;
  - 10 of those trains occurred during the night; and
  - 3 were switching trains.

There is a 79 mile per hour (mph) Maximum Timetable Speed and the typical train speed range was 40-79 mph. The posted speed limit for vehicles is 35 mph. In 2013, there were:

- Average Annual Daily Trip (AADT) 15,068 vehicles;
  - 14% were trucks, and
  - 8 daily school buses.

Current Conditions and Recommendations

Figure 44 through Figure 50 depict the current conditions at the crossing and were used to make recommendations for improvements, which are described below:

Crossing Signal Equipment (Good Condition): Two quadrant protection, cantilever signal masts with roadway and sidewalk protection for each approaching roadway. Gates are noticeably long and only located at the edge of roadway. Sidewalks are not protected in remaining quadrants.

Roadway Surface (Good Condition): Crossing surface consists of concrete panels with asphalt between tracks. Crossing area was repaved more recently than the rest of East Montague Ave. Deep cut lines are present on each side of crossing surface. There is a very short median present on the east side of the crossing that was previously used for signal masts. This median is almost completely removed.

Railroad Crossing Signs (Good Condition): Signs mounted on the cantilever signal masts at the crossing are in good condition and clearly visible. The west approach advance warning sign is obstructed by trees and is located 180 feet prior to railroad crossing pavement markings (See Figure 48). Prior to the crossing is an additional advance intersection warning sign, placed approximately 110 feet in advance of the crossing (See Figure 49). The east approach advance warning sign is clearly visible.

Railroad Crossing Pavement Markings (Fair Condition): Stop bars and railroad crossing pavement markings appear to be in fair condition. Markings are in the early stages of cracking and scaling.

Drainage (Good Condition): No apparent drainage issues. Crossing surface and ballast approaches appear clear from sand or debris. No apparent erosion or undermining in trackbed or edge of pavement.

Track Approach Sightlines (Poor Condition): The track sightlines for southwest and southeast quadrants are obstructed by large trees. Sightlines are clear of obstructions in the northwest and northeast roadway quadrants.

Pedestrian Access and Curbing (Fair Condition): Sidewalk is present on each side of the roadway and through the crossing surface. The southeast quadrant detectable warning pad is missing and the remaining detectable warning pads are present however all are located within the gated area with the northeast and southwest pads immediately below gates.

Figure 44 - East Montague Avenue Crossing Looking East

Figure 45 - East Montague Avenue Crossing West Approach Looking East

Figure 46 - East Montague Avenue Crossing Looking West

Figure 47 - East Montague Avenue Crossing East Approach Looking West

Figure 48 - East Montague Avenue West Approach Advance Warning Sign Looking East

Figure 49 - East Montague Avenue West Approach Advance Intersection Warning Sign Looking East

Figure 50 - East Montague Avenue Pavement Markings

Planning Level Cost Estimates

Planning level cost estimates are detailed in Table 8, understanding that additional costs may arise from a diagnostic meeting and inspection of the existing at-grade crossing. Diagnostic meetings are engagement opportunities for the stakeholders to participate in the process by visiting the site and building consensus on their requested needs. The recommended improvements for the East Montague Avenue at-grade crossing are:

- Install pedestrian gates in unprotected quadrants;
- Improve existing signal system for additional gates;
- Remove remaining detectable warning pads and install new detectable warning pads clear of the gates;
- Remove and reset west approach advance sign in line west advance railroad crossing pavement marking per FHWA's Manual on Uniform Control Devices (MUTCD); and
- Remove trees and brush in southwest and northwest quadrants.

Table 8 – East Montague Avenue At-Grade Crossing Planning Level Cost Estimate

Crossing Signal Equipment	Item Cost	Unit	Quantity	Total Cost
New Ped. Signal Mast with Gate and Flashers	$75,000.00	EA	2	$150,000.00
Improve Signal System	$40,000.00	EA	1	$40,000.00
Railroad Crossing Signs	Item Cost	Unit	Quantity	Total Cost
Remove and Relocate Existing Signs	$1,000.00	EA	1	$1,000.00
Pedestrian Access and Curbing	Item Cost	Unit	Quantity	Total Cost
Tactile Warning Pad	$400.00	EA	4	$1,600.00
Remove Tactile Warning Pad	$150.00	EA	3	$450.00
Track Approach Sight Lines	Item Cost	Unit	Quantity	Total Cost
Remove Trees	$1,500.00	EA	4	$6,000.00
Clear and remove Obstructions (ground brush)	$5.00	SF	500	$2,500.00
		Grand Total		**201,550.00**

6.2.4 North Main Street

The Inventory and Accident/Incident Reports helped to identify at-grade crossing information for North Main Street:

- Located in Ridgeville, SC, between N Railroad Avenue and S Railroad Avenue;
- Operated by Norfolk Southern Railway Company;
- FRA Crossing Inventory Number 721485N;
- Inventory report date of 06/01/2019;
- Single Track Crossing (Figure 51);
- Not located within a quiet zone; and
- 3 reported accidents between 2009 and 2019, incidents to note:
  - January 2018 – Train struck vehicle stopped on crossing – three railroad employees injured;
  - June 2012 – Train struck vehicle stopped on crossing – no injuries reported; and
  - October 2009 – Train struck concrete truck stopped on crossing – one highway user and railroad employee injured.

Figure 51 - North Main Street Rail Crossing

Train and Transportation Network

During a 2017 train count, there were:

- 15 trains per day:
  - 5 of those trains occurred during the day;
  - 4 of those trains occurred during the night; and
  - 6 were switching trains.

There is a 49 mile per hour (mph) Maximum Timetable Speed and the typical train speed range was 40-49 mph. The posted speed limit for vehicles is 30 mph. In 2013, there were:

- Average Annual Daily Trip (AADT) 575 vehicles:
  - 5% were trucks; and
  - 4 daily school buses.

Current Condition Analysis

Figure 52 through Figure 55 depict the current conditions at the crossing and were used to make recommendations for improvements, which are described below:

Crossing Signal Equipment (Good Condition): Signalized with two-quadrant protection. Gates only extend over approaching lanes. No sidewalks present at this crossing.

Roadway Surface (Fair Condition): Consists of asphalt and rubber flangeway filler. The Rubber flangeway filler appears to be deteriorating and has pockets of sand and debris throughout the crossing surface. Also appears to be scrapes and low clearance drag marks across the crossing surface.

Railroad Crossing Signs (Poor Condition): Advance crossing warning sign is only posted on the North Main Street north approach and appears to be unclean and tilted away from the roadway. No advance warning signage is posted on either N Railroad Avenue or S Railroad Avenue.

Railroad Crossing Pavement Markings (Poor Condition): Pavement markings appear to be in fair/poor condition with cracking and deterioration. Advance warning pavement markings are not present on N Railroad Avenue or S Railroad Avenue.

Drainage (Good Condition): No apparent drainage issues. Crossing surface and ballast approaches appear clear from sand or debris. No apparent erosion or undermining in trackbed or edge of pavement.

Track Approach Sightlines (Good Condition): Sightlines are clear of obstructions in all four approach quadrants to the crossing. The southeast corner does have one large tree, but with a high canopy and good visibility from roadways to the track.

Pedestrian Access and Curbing (Not Applicable): Sidewalk and curbing is not present at the crossing surface and immediate approaches. Existing sidewalk is present on N Railroad Avenue and S Railroad Avenue, opposite the crossing intersection. No crosswalks or transitions are present to the crossing surface.

Figure 52 – North Main Street - Looking Northeast

Figure 53 – North Main Street Looking Southwest

Figure 54 – North Main Street Looking Southeast

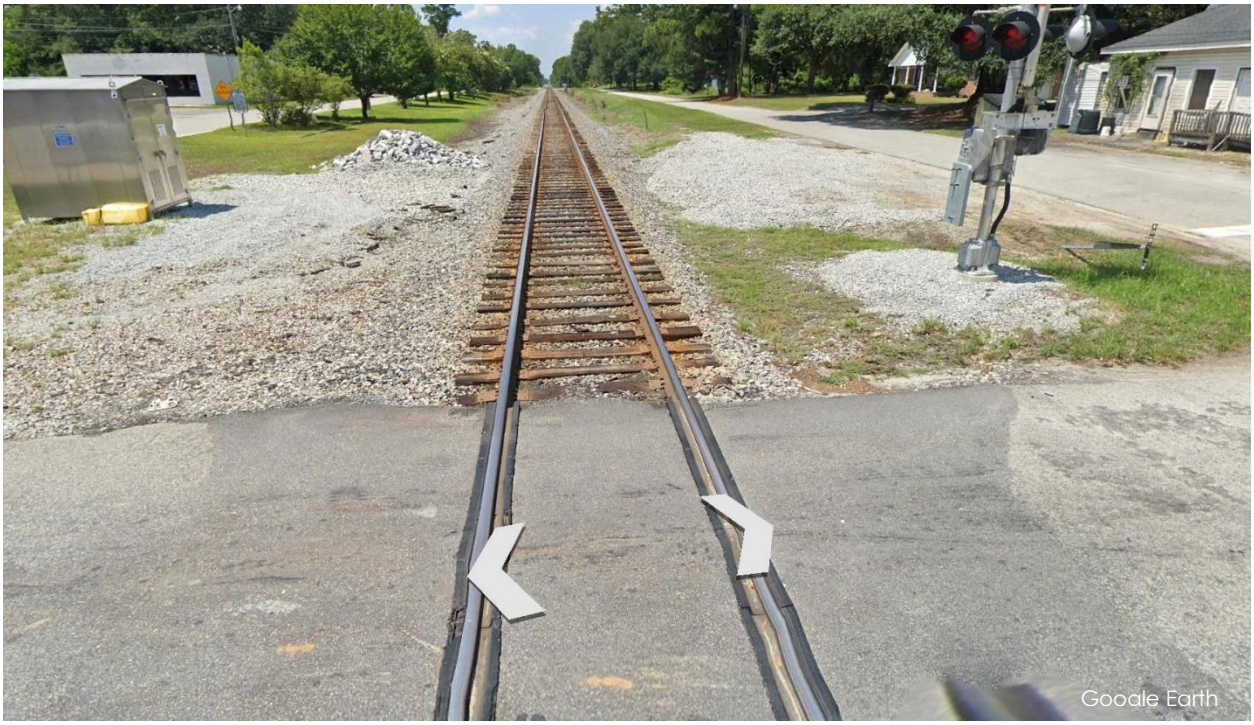


Figure 55 – North Main Street- Looking Northwest

Figure 56 - North Main Street Crossing Pavement Markings

Planning Level Cost Estimates

Planning level cost estimates are detailed in Table 9, understanding that additional costs may arise from a diagnostic meeting and inspection of the existing at-grade crossing. Diagnostic meetings are engagement opportunities for the stakeholders to participate in the process by visiting the site and building consensus on their requested needs. The recommended improvements for the North Main Street at-grade crossing are:

Due to the close proximity of the Church Street at-grade crossing, North Main being a secondary road crossing, and the accident history at North Main, it is recommended to close the North Main Street at-grade crossing. A planning level estimate for closing the at-grade crossing is shown in Table 9.

Table 9 – North Main Street At-Grade Closure Planning Level Cost Estimate

Railroad Crossing Closure Costs	Item Cost	Unit	Quantity	Total Cost
Remove crossing surface (asphalt & rubber) and signal conduit along track	$60.00	TF	35	$2,100.00
Remove & regrade crossing approaches (asphalt)	$30.00	SY	350	$10,500.00
Seed / landscape crossing approaches	$2,000.00	LS	1	$2,000.00
Remove advance crossing sign	$100.00	EA	1	$100.00
Mill railroad crossing pavement markings	$300.00	EA	1	$300.00
Remove existing signal system	$20,000.00	LS	1	$20,000.00
		Grand Total		**$35,000.00**

Special Consideration

Alternatively, due to the low roadway volume, small scale improvements can be implemented to increase safety at the crossing. Including:

- Replace crossing surface in kind (asphalt and rubber);
- Placement of signage for North Railroad Ave to be right run only (away from crossing)
- Remove tree in southwest quadrant;
- Install 20' long traffic separator medians with delineator panels and R4-7 "Keep Right" sign at each approach to the crossing to prevent drivers traversing diagonally through the crossing
- Replace existing advance sign on North Main north approach;
- Install advance warning signs on all other roadway approaches; and
- Install railroad pavement markings on all approaches.

Table 10 shows the planning level cost estimates for the recommended improvements.

Table 10 – North Main Street At-Grade Crossing Improvements

Roadway Surface	Item Cost	Unit	Quantity	Total Cost
Rubber and asphalt crossing surface	$300.00	LF	32	$9,600.00
Curbed Traffic Separator Median	$200.00	LF	40	$8,000.00
Panel or Tubular Delineators	$50.00	LF	40	$2,000.00
Railroad Crossing Signs	**Item Cost**	**Unit**	**Quantity**	**Total Cost**
New Signs	$200.00	EA	6	$1,200.00
New Post	$1,000.00	EA	5	$5,000.00
Remove Sign	$50.00	EA	1	$50.00
Railroad Crossing Pavement Markings	**Item Cost**	**Unit**	**Quantity**	**Total Cost**
RR Crossing Pavement Marking with Lines	$600.00	EA	6	$3,600.00
Track Approach Sight Lines	**Item Cost**	**Unit**	**Quantity**	**Total Cost**
Remove Trees	$1,500.00	EA	1	$1,500.00
		Grand Total		**$30,950.00**