Crash Data Review of Rail At-Grade Crossings in the Delaware Valley

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Executive Summary

There once was a time in United States history when trains were more prevalent than automobiles. Today the reverse is true. But as these two systems developed and changed over time, keeping them completely separated was impossible, though it would have been safest. Because trains require gentle curves and gradual changes in elevation, roads were laid out predominantly to accommodate train tracks. This takes two forms: grade-separated and at-grade rail crossings. An at-grade crossing is essentially an intersection where train tracks and a road meet. This report presents the findings of a database analysis focused on where and how often trains and motor vehicles collided over a three-year period in the Delaware Valley region.

An important goal of DVRPC's Long-Range Plan, *Connections*, is monitoring the transportation system to ensure safe movement across all modes throughout the region; this is the foundation of DVRPC's Transportation Safety and Security Program. Toward that goal, this report details Phase one of a two-phase effort, which examines both the New Jersey and Pennsylvania crash databases for crashes involving motor vehicles and trains at at-grade rail crossings in the nine-county region (this includes pedestrian/bicyclist conflicts). The analysis also considers the crash implications resulting from the presence of an at-grade crossing on crashes between vehicles occurring within proximity of a rail crossing. While many transportation safety topics have been explored in previous efforts, this study represents a missing component in DVRPC's safety work to date.

The analysis results presented here help to answer questions regarding the magnitude of train-vehicle crashes as coded in the crash database, and reveal previously unforeseen database coding inconsistencies. The data examined in this exercise conformed only to the involvement of an at-grade crossing, regardless of rail type, purpose, ownership or frequency, urban, suburban, or rural setting.

During the three-year study period (2007—2009), 15 crashes were coded as train-vehicle crashes in the five Pennsylvania counties, 21 in the four New Jersey counties, and none of these incidents involved a pedestrian or bicyclist. These numbers were cross-checked with each state DOT's crash analysis system for accuracy. PennDOT's Crash Data and Analysis Retrieval Tool (CDART) and NJDOT's Plan4Safety system were used as a reference. The first major finding is that of the combined 36 crashes, only three crossings had more than one crash coded to it during the analysis period; all three were in New Jersey, each had two crashes, and each crash was with the River LINE. Thus, train-vehicle crash trends by location are insignificant.

Surprisingly, 141 trolley-vehicle crashes were also identified in the crash database in Philadelphia. At more than nine times the number of train-vehicle crashes in the Pennsylvania counties of the DVRPC region, this was an unexpected finding. Because trolleys run predominantly at-grade, and often traverse the roadway grid diagonally or along side vehicle traffic, the number of crossings is higher and more densely concentrated. Due to the unique characteristics of trolleys, the details of these crashes and associated issues will be the focus of Phase two of this effort.

Vehicle-vehicle crashes occurring within 100 feet of a rail crossing are also considered in this analysis. Chapter five identifies at-grade crossing locations with crash trends, and ranks them by county according to crash frequency, and briefly discusses the top location per state. This resulted in a priority list of locations for further study.

C H A P T E R 1

Introduction

In the Delaware Valley, surface trains crossing the road network are common. Where they cross the roadway at-grade, congestion sometimes follows, especially during commuting hours. These intersections are potential conflict points and should be approached by the traveling public with caution. Typically rail at-grade crossings include safety features to warn of crossing trains at intersections. Common safety features include cross bucks, flashing lights, signs, and roadway stop bars. In the absence of such warnings, train flagmen will sometimes disembark slow-moving trains and stop traffic so the train can pass.

Source: Texas Transportation Institute

Figure 1: DVRPC Region

It is important to note that conflicts between automobiles and trains are very rare. For simplicity, the automobile crashes referred to in this report include crashes that occur with cars, trucks, or motorcycles, etc. In 2009, there were a total of 35 train-vehicle crashes in the state of New Jersey, and 17 in the state of Pennsylvania (up 30% from 2008 in New Jersey, and down by half in Pennsylvania from 2008). As a percentage of the more than 378,000 automobile crashes recorded that year in New Jersey and Pennsylvania combined, this is a small but not insignificant number. Regarding severity within the nine-county Delaware Valley region, there were three fatal crashes involving trains and vehicles identified during the analysis period. A train is a formidable opponent for a motor vehicle, should the two meet, and at locations where trains cross roadways at-grade, the potential for severe injury collisions is even higher as compared to crashes between vehicles.

In two phases, the DVRPC's analysis first identifies crash occurrences between trains and vehicles and associated data issues, as well as vehicle-vehicle crash trends in the immediate vicinity of all crossings in the Delaware Valley. Phase two will examine trolley-vehicle crashes.

This report represents Phase one. Some of the tools used for this effort include crash data for years 2007—2009, a recently conducted rail crossing inventory of Pennsylvania, and a newly created geographic information system (GIS) rail crossing layer for NJ Transit's River LINE passenger service.

C H A P T E R 2

The Rail Network

The nine counties of the Delaware Valley region are served by three Class I and 12 short-line freight rail lines, Amtrak's Northeast and Keystone Corridor services, 17 commuter train lines, eight trolley lines, and three subway/elevated lines. Combined, these lines cross roadways at-grade approximately 500 times in Pennsylvania and 126 times in New Jersey according to the DVRPC GIS database.

The nature of train activity at an individual highway-rail grade crossing can vary markedly, which can have a measurable impact on safety considerations and the potential for associated vehicle crashes. Some of the factors that influence train activity are:

- Train type (freight, passenger, or both)
- Daily service schedule
- Scheduled vs. non-scheduled service
- Allowable speed
- Number of tracks
- Length of trains
- Type of cargo hauled

The Freight Rail Network

The Delaware Valley has a large freight rail network which extends to each county in the region. Utilization of rail freight lines has increased in recent years and reflects the nationwide renaissance of the rail freight industry as well as the success of public-private partnerships to support rail freight activity and rail-intensive industries.

The principal lines which carry heavy volumes of daily freight traffic are Norfolk Southern's Harrisburg and Morrisville lines, and CSX's Philadelphia and Trenton Subdivision lines. In total, there are 29 well demarcated and protected highway-rail grade crossings on these main lines. In addition to these primary routes, local freight operations occur on a number of secondary lines, short lines, and industrial tracks (e.g., Chester Secondary, Wilmington and Northern Branch, Upper Merion and Plymouth, Bethlehem Branch, and New Hope and Ivyland), and even Southeastern Pennsylvania Transportation Authority (SEPTA) and Amtrak lines. Grade crossings on these lines (with the exception of the Amtrak lines) are numerous and the type of warning and safety protection varies.

One highly unique situation that exists in the region is that several freight lines are overseen by a terminal and switching agent for CSX and Norfolk Southern called Conrail. These lines (totaling an estimated 372 miles of track) are collectively referred to as a shared asset area. In Pennsylvania, Conrail service covers several lines in the City of Philadelphia and along the Delaware River in Chester and Lower Bucks counties.

In Southern New Jersey, Conrail basically oversees freight operations on all of the rail lines south of Trenton and provides connections to the short lines serving the remainder of the region. In the New Jersey portion of the Delaware Valley region, the principal lines used for rail freight purposes are the Beesley's Point Secondary, and in the corridor between Trenton and Camden, the New Jersey Transit River LINE (formerly known as the Bordentown Secondary). Both of these lines (and essentially all rail lines in South Jersey) funnel into the Pennsylvania portion of the region and the national rail system via the Delair Bridge in Pennsauken. The Beesley's Point Secondary and the River LINE each have a number of highway-rail grade crossings which are spread throughout various South Jersey communities, but they do not experience the higher level of rail freight operations found on the primary lines in Southeastern Pennsylvania. In the case of the River LINE, rail freight operations are temporally separated from passenger movements and only occur during overnight hours.

Additional rail freight operations occur on rail lines that reach deeper into South Jersey from junctions located at Woodbury (Gloucester County) and Winslow Junction (Camden County). For planning purposes, these lines and the short lines they feed (e.g., Penns Grove Secondary, SMS Rail Lines, Salem Running Track, Vineland Secondary, and Southern Secondary) can all be regarded as secondary lines in terms of the type of traffic they handle.

The Passenger Rail Network

The SEPTA system is the fifth largest transit system in the United States with 500,000 daily riders resulting in nearly one million trips per day between rail, subway, trolley, and bus services. Due to its wide coverage and diverse modes, the SEPTA system accounts for the majority of the region's at-grade rail crossings. Regarding this analysis, only the at-grade crossings that are part of SEPTA's Regional Rail passenger service are included. As stated earlier, crashes with surface trolleys—the only other service that crosses at-grade—have been excluded due to their uniqueness and will be analyzed separately in Phase two.

There are three passenger lines that serve DVRPC's New Jersey counties: 1) New Jersey Transit's (NJ Transit) River LINE light rail traversing Camden, Burlington, and Mercer Counties with 73 at-grade crossings, 2) the NJ Transit Atlantic City Line serving southern New Jersey with connections to Philadelphia which has 16 at-grade crossings, and 3) the Port Authority Transit Corporation (PATCO) High Speed Line which does not cross the roadway at-grade.

CHAPTER 3

Analysis Tools

Crash Data

All crash data used in this analysis came from each state's crash database, and considered years 2007, 2008, and 2009. Both databases contain only reportable crashes. PennDOT's system is called the Crash Data Analysis and Retrieval Tool (CDART), and NJDOT's is called Plan4Safety; each system is proprietary. Several DVRPC staff members are registered users on one or both systems.

Reportable Crashes vs. Non-Reportable Crashes

Knowing the difference between reportable and non-reportable crashes helps to understand crash trends. There is a significant difference in definition between the two states comprising the DVRPC region. In New Jersey, a crash is considered reportable when $500 worth of damage occurs to property, or if someone is injured or killed. By contrast in Pennsylvania, though the same severity threshold applies, the property damage minimum is very different: a vehicle must require towing from the scene to qualify as a reportable crash if no one is injured or worse. Fender-bender crashes in which no one was injured are typically excluded from the Pennsylvania-side analysis, though many of those same crashes would be included in the New Jersey-side analysis. This difference only influences non-injury crash totals. Thus a very high crash total in Pennsylvania may be an indication of greater severity than in New Jersey.

Other Tools

In completing the detailed data verification work required in this effort the following tools were utilized: ArcGIS, Microsoft Access, Microsoft Excel, the Federal Railroad Administration (FRA) Office of Safety Analysis database, and various internet mapping applications.

CHAPTER 4

Crashes between Trains and Motor Vehicles

The main objective of this study was to identify at-grade rail crossings where motor vehicle crashes have occurred, with specific interest in those involving trains, and evaluate details in search of trends. The effort required a two-pronged approach of exploring the crash database using Microsoft Access, CDART, and Plan4Safety, and analyzing these events in the spatial context of ArcGIS. Having never before researched crashes of this nature, it was important to explore each state's crash database to understand how these crashes were categorized, and to compare results between the database and the GIS for consistency. In addition to the analysis results, issues regarding data quality, data organization, and location accuracy were also identified which will inform future efforts.

Although New Jersey and Pennsylvania collect mostly the same information, there are data items unique to each state. Therefore, some analysis findings highlighted in one state may not be found in the other.

Pennsylvania Analysis Findings

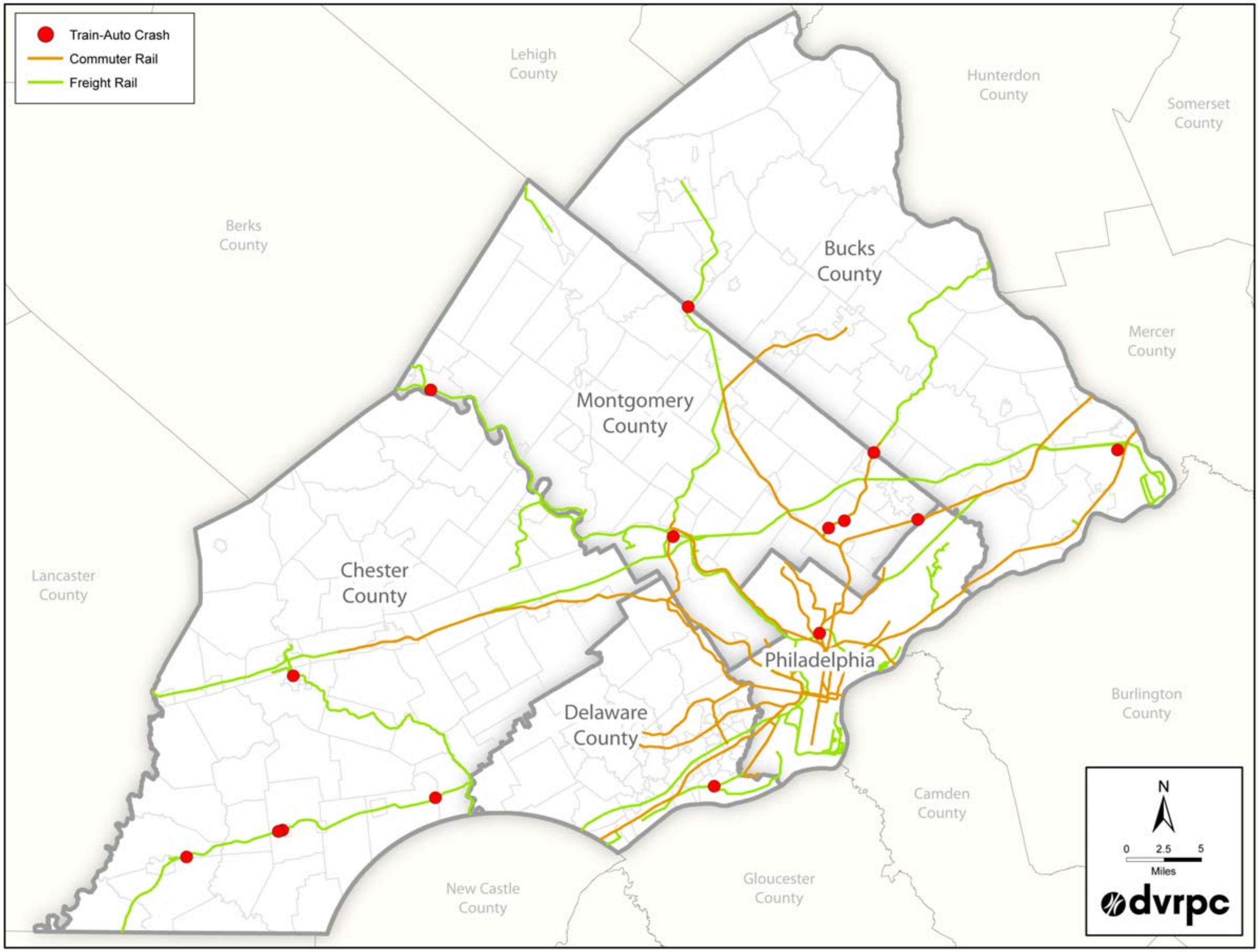
An initial and important finding regarding the Pennsylvania crash database was a data categorization issue: crashes involving motor vehicles and trains are lumped together with crashes involving motor vehicles and trolleys, when filtered using PennDOT's CDART system. Conducting this analysis via DVRPC's database, train-vehicle crashes were able to be filtered separately from trolley-vehicle crashes. Overcoming this data issue also revealed that trolley-auto crashes are a missing component in the analysis and not considered in the original scope. This is only an issue in Pennsylvania as there are no trolleys operating in DVRPC's New Jersey counties.

The following Pennsylvania crash totals resulted from the data investigations for the 2007—2009 study period as shown in Figure 2: 15 train-motor vehicle crashes.

Train-Vehicle Crashes: Issues and Findings

The first attempt to separate the train-vehicle and trolley-vehicle crashes resulted in 19 train-vehicle crashes. Using a CDART crash resume, each crash record was examined. The resume provides a summary of approximately 20 crash details including, but not limited to, chronology, light condition, weather, intersection type, vehicle type, and pre-crash actions for each driver.

Figure 2: Pennsylvania Train-Vehicle Crash Locations



A distinguishing data item was found in the resume that was not included in earlier query results. The abbreviation RRX for rail crossing was listed as the intersection type. In each of these same records an American Association of Railroads (AAR) number was also listed referencing the rail crossing. Only twelve of the original 19 crash records coded as train crashes had RRX intersection types and AAR numbers. And of the 12, only eight could be found in the FRA Office of Safety Analysis database, leaving 11 crashes unable to be confirmed as involving a train based on two databases.

At this point the only option left unexplored was a review of actual police report narratives and diagrams of the remaining crash records. PennDOT District 6-0 provided paper copies of the police report diagrams and narratives which are not available to DVRPC through CDART. After reviewing the police report excerpts, the total number of train-vehicle crashes could be confirmed at 15. The remaining four from the original 19 turned out to be trolley-vehicle crashes that were miscoded. The 15 confirmed train-vehicle crashes were plotted in GIS, and the four others moved to the trolley-vehicle category.

Two more unexpected findings resulted from this exercise. First was that not all train-vehicle crashes found in PennDOT's database included an RRX reference or AAR reference number, despite actually involving a train colliding with an automobile at a rail crossing. The second is that the cross-check of the AAR number in the FRA database did not always identify that a crash had occurred during our study period, indicating that the FRA data was not complete.

The train-vehicle crashes were distributed as follows below. Only one crash was identified in each municipality unless otherwise indicated, and no single crossing location had more than one crash.

Bucks County (2)

- Falls Township (intersection of Newbold Road and the Penn Warner Lead Track)
- Warminster Township (intersection of County Line Road and the SEPTA Warminster Line)

Chester County (5)

- Kennett Township (intersection of Kennett Pike and the Octoraro Branch Line)
- Lower Oxford Township (intersection of Reedville Road and the Octoraro Branch Line)
- South Coatesville Borough (intersection of First Avenue and the Wilmington and Northern Branch)
- West Grove Borough (two crashes both with the Octoraro Branch Line, one at intersection with South Guernsy Road, and one at intersection with Woodland Avenue)

Delaware County (1)

- Tinicum Township (the Chester Secondary crosses the middle of the intersection of Jansen Avenue and Old Tinicum Island Road)

Montgomery County (6)

- Abington Township (two crashes both with the SEPTA Warminster Line, one at the intersection with Jenkintown Road, and one at the intersection of Susquehanna Road and Easton Road)
- Bridgeport Borough (intersection of US 202 / Dekalb Street and the Chester Valley Running Track)
- Lower Moreland Township (intersection of Tomlinson Road and the SEPTA Warminster Line)
- Telford Borough (intersection of County Line Road and the Bethlehem Running Track)
- Pottstown Borough (intersection of Hanover Street and the Harrisburg Line (NS)

City of Philadelphia

- North Planning District (North Philadelphia) (intersection of Blabon Street and the Richmond Branch)

Summary Statistics

The 15 train-vehicle crashes were examined as a group in order to search for trends. It should be noted that significant trends tend to be less common when examining smaller-sized data sets. Regarding severity there was one fatality, seven injuries, and seven property damage only crashes of the 15 events. No pedestrians or bicyclists were involved in the 15 train-vehicle crashes.

Concerning chronology, seven crashes occurred in 2007, three in 2008, and five in 2009. Although crashes were evenly distributed by month, there were six crashes on Tuesdays; three times that of any other day. Much like the monthly distribution, crash frequency by time of day was unremarkable. Also inconsequential were the prevailing environmental factors, road surface conditions, and weather conditions which were favorable in more than 87 percent of the crashes. Also, it was daylight in 73 percent of the crashes. In summary, no obvious trends were identified among these data items.

Though five collision types were recorded for the 15 crashes, angle crashes represent 67 percent of the total. On the Pennsylvania crash reporting form, angle crashes typically reflect the point of impact when two vehicles collide, i.e., t-bone (front end of one vehicle into broadside of another vehicle). Further investigation often reveals that these crashes involve a driver making a left turn (sometimes right turn) that subsequently hits or is hit by an oncoming vehicle. The important distinction here is regarding the pre-crash action of making a turn in front of an oncoming driver. One would assume that since train tracks and roadways typically cross each other at either a perpendicular or angular orientation that angle collision types would dominate the category in this analysis. Surprisingly, in the case of the 15 train-vehicle crashes opposite direction sideswipe

(2), hit fixed object (1), non-collision[1] (1), and rear-end (1) collision types were also represented. In vehicle-vehicle crashes, the collision type trends typically prove more valuable by comparison than in this analysis, especially at intersections. This is predominantly because in the majority of train-vehicle crashes, something extraordinary had often occurred precipitating the collision, e.g.: automobile driver ignored the warning device and crossed onto the tracks into the path of the oncoming train.

Crashes by Location

The 15 crash events were distributed among the five Pennsylvania counties including the City of Philadelphia, with a total of 13 municipalities represented. Montgomery County topped the list with the most total train-vehicle crashes at six, and the most municipalities where a train-vehicle crash occurred with five.

Abington Township, Montgomery County, was the location of two crashes, though not at the same crossing. One of the crashes involved a driver who turned onto the tracks from the cross-street and was hit by an oncoming train at a location away from, but near the actual cross street. Though this is an unusual circumstance and was not considered a rail crossing crash in the police report narrative, it is still included because the driver gained access to the tracks from the at-grade crossing. Both crashes did involve the same train line, but occurred at intersections located approximately one mile apart.

In Chester County, with five crashes in four municipalities, two were identified in West Grove Borough. Although the two crashes involved the same train line, the crashes occurred approximately one block away from each other at separate at-grade crossing locations.

In summary, no single crossing location was the site of multiple train-vehicle crashes during the three-year analysis period.

New Jersey Analysis Findings

In working with the New Jersey crash database there is only one category for train crashes, coded as “railcar-vehicle”. A trolley-crash category does not exist, nor are there any trolleys in DVRPC’s New Jersey counties. Therefore the analysis was more straightforward than in Pennsylvania and police reports were not needed to clarify ambiguities.

However, New Jersey posed a particular problem because while the New Jersey Transit River Line was in the DVRPC ArcGIS database, its at-grade crossings were not included in the NJ At-Grade Crossing ArcGIS shape file. Through a manual process, these points were found and added to the crossing shape file.

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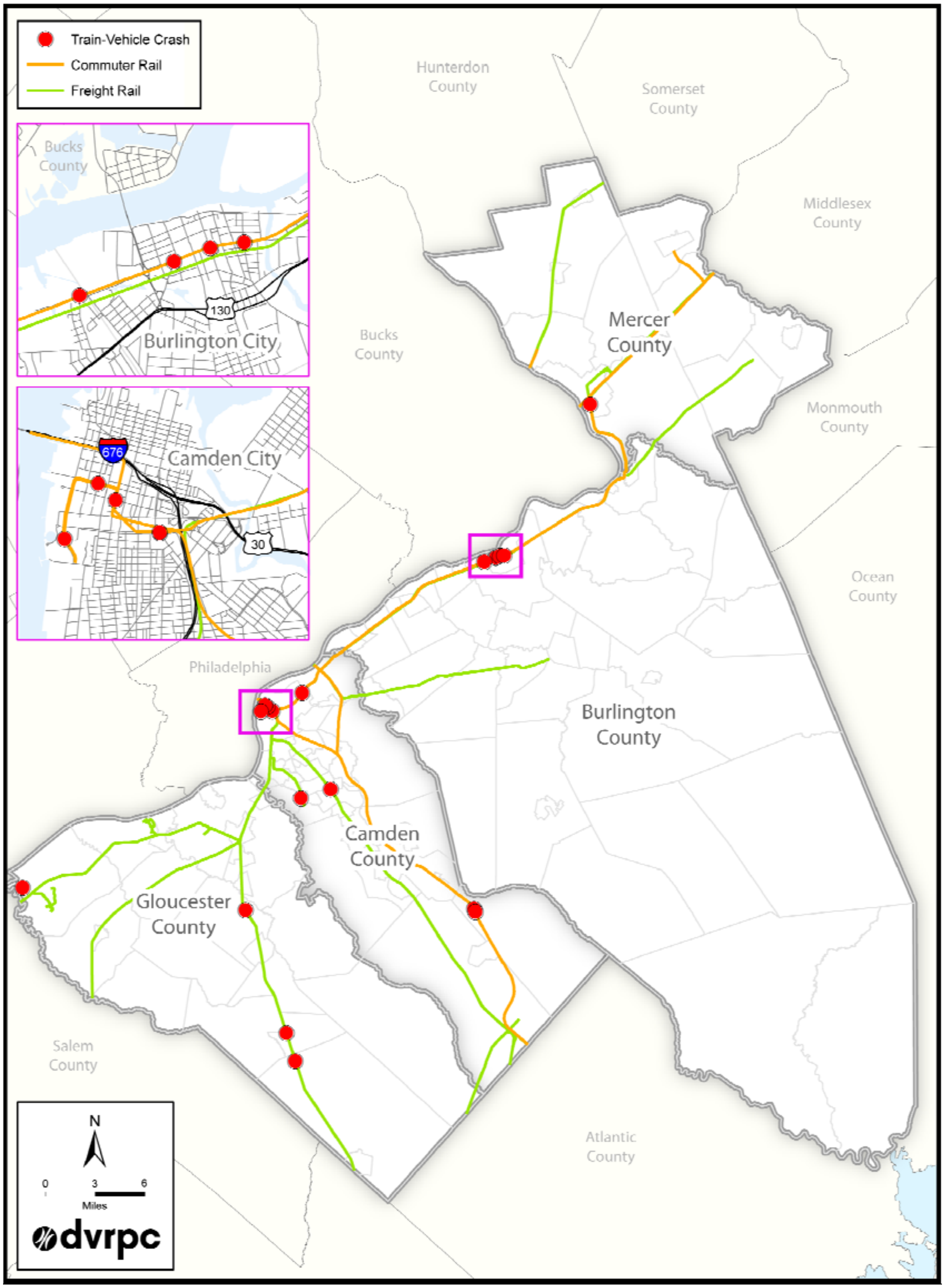
[1] The Pennsylvania crash reporting form (PA AA 500) includes “non-collision” to describe crashes where no collision has occurred but there is still an injury or property damage; e.g.: sudden stop causes injury, mechanical breakdown, car fire, etc.

From a Plan4Safety filter of “Railcar-vehicle” collisions (collision type = 16), 22 train-motor vehicle crashes were initially identified in the DVRPC region for the 2007—2009 study period. After mapping the crash points and cross-checking with internet mapping, one location was determined to be miscoded: the intersection of West Pearl and Stacey Streets in Burlington City. No train tracks exist at this location.

The following New Jersey crash totals resulted from the data investigations for the 2007—2009 study period as shown in Figure 3: 21 train-motor vehicle crashes.

Figure 3: New Jersey Train-Vehicle Crash Locations



Train-Vehicle Crashes: Issues and Findings

Unlike in Pennsylvania, the New Jersey crash records do not include AAR numbers for the related crossings. Thus, a cross-check against the FRA Office of Safety Analysis database was not possible as was done in Pennsylvania.

The train-vehicle crashes were distributed as shown below. Only one crash was identified in each municipality unless otherwise indicated.

Burlington County (5)

- Burlington City (two crashes at the intersection of Broad and High Streets where the River LINE crosses, and one each where the River LINE crosses St. Mary's Street and Washington Avenue both along Broad Street)
- Burlington Township (Devlin Avenue and the River LINE)

Camden County (11)

- Barrington Borough (intersection of Clements Bridge Road (NJ 41) and the Beesleys Point Secondary Freight LINE)
- Bellmawr Borough (intersection of Browning Road (CR 655) and the Grenloch Industrial Track)
- City of Camden (seven crashes: CR 537 Spur at 4th Street (2), CR 561 at Mickle Boulevard (2), Cleveland Avenue, Cooper Street at North 2nd Street, Delaware Avenue at Harbor Boulevard---all with the River LINE)
- Waterford Township (intersection of Bartram Avenue and NJ Transit Atlantic City Line, and at the intersection of Atco Avenue / CR 710 and NJ Transit Atlantic City Line)

Gloucester County (4)

- Clayton Borough (Aura Road and the Vineland Secondary Line)
- Franklin Township (Pleasant Valley Road and the Vineland Secondary Line)
- Logan Township (where a siding/spur from the Penn's Grove Secondary crosses US 130).
- Mantua Township (Cumberland Boulevard and the Vineland Secondary Line)

Mercer County (1)

- City of Trenton (intersection of US 206, NJ 129, and the River LINE)

Crashes by Location

The New Jersey analysis revealed minor trends by location. Both Burlington and Camden counties had single crossings where two crashes were recorded during the study period. Topping the list in Burlington County are the NJ Transit River LINE crossings in Burlington City. Of the four train-vehicle crashes recorded there, all occurred within one-half mile, and two at the same cross street intersection--High Street. High Street is the main thoroughfare through Burlington City, leads to the town's waterfront, and is lined with storefronts within the heart of the business district. The intersection of High Street and West Broad Street where the River Line crosses is a half block from the River Line's Burlington City station.

In Camden County the largest trends by location occurred in the City of Camden. Seven train-vehicle crashes were recorded at five distinct locations, two of which were the sites of multiple crashes:

- Two crashes occurred at the intersection of Market Street (CR 537 Spur) and 4th Street where the River Line crosses.
- Two crashes occurred at the intersection of Mickle Boulevard and Haddon Avenue (CR 561) where the River Line crosses.

In Waterford Township, two train-vehicle crashes occurred along the NJ Transit Atlantic City Line at separate intersections located 0.17 miles apart (approximately four blocks).

Though no single crossing was the site of multiple crashes in Gloucester County, three of the four train-vehicle crashes occurred along the Vineland Secondary line, though a relatively wide distance from one another.

Summary Statistics

The 21 train-vehicle crashes were examined as a group in order to search for trends. As was noted in the Pennsylvania analysis, crash trends are typically harder to identify when the crash total is low. Regarding severity, there were two fatal crashes that resulted in one fatality each—both occurred in Waterford Township, Camden County and each at a unique location—five injury crashes and 14 property damage only crashes. No pedestrians or bicyclists were involved in any of the crashes considered in the analysis.

Concerning chronology, six crashes occurred in 2007, seven in 2008, and eight in 2009, generally trending upward. Approximately 62 percent of the crashes occurred from June through September, with only one crash recorded in each of the remaining months except December when two crashes occurred. Five crashes occurred on Tuesdays; the highest total by day of week, and only one was recorded on a Monday, with the remaining days ranging from two to four crashes each. The distribution of crash frequency by time of day, though somewhat unremarkable, did reveal that 42 percent of the crashes occurred between 12 noon and 6:00 p.m., most likely the busiest time of day for auto traffic.

Although the surface condition was typically favorable as 81 percent of the crashes occurred on dry roads, 38 percent of the crashes occurred at night which is slightly higher than typical.

The two most common contributing circumstances were “failed to obey traffic control device” and “driver inattention” cited almost equally at the top of the list, and more than twice the next contributing circumstance, “none”. The best protected crossings are outfitted with lights, gates pavement markings, and advanced warning signs. In some cases, where there is limited permanent protection, a rail watchman may stand guard at the crossing to alert motorists to stop as the train passes through the crossing.

Of the 21 crash events, only one location was listed as having “no control present” (City of Camden). The remaining crash records contained descriptions that were split evenly between “traffic signal” and “RR watchman (a.k.a. flagman), gates, etc”. Despite the ambiguity of the label “RR watchman, gates, etc” it can be surmised from the data that 20 of the 21 crossing locations had some type of rail safety equipment. Only a field investigation conducted at the time of the incident could prove otherwise.

Differing from the Pennsylvania-side analysis, a discussion of collision types is not possible because “railcar-vehicle” is the collision type on the New Jersey police crash reporting form (along with rear-end, hit fixed object, etc.). Thus, all 21 crashes are coded as railcar-vehicle collision types.

C H A P T E R 5

Motor Vehicle-Motor Vehicle Crash Trends in the Immediate Vicinity of At-Grade Rail Crossings

In the first part of this report the analysis focused on crashes between trains and vehicles. The purpose of the second part was to identify vehicle-vehicle crash trends in close proximity to at-grade rail crossings and consider possible relationships between the presence of an at-grade crossing, and such crash trends.

Methodology

The analysis was conducted mainly in ArcGIS using crash data for years 2007—2009 and a GIS map layer of the at-grade crossings within the region. Utilizing the select-by-location tool, all crashes within a radius of approximately 100 feet of an at-grade crossing were selected within each county. Due to data inconsistencies in the FRA grade crossings data layer, roadway geo-reference data and aerial maps were used to match the crashes with their respective crossings to determine the total number of crashes in the area of consideration near each crossing.

Pennsylvania

This analysis shows the single crossings per county where the highest crash total was identified within the crossing catchment area. After these crossings were identified, additional location information was gathered including the official DOT crossing number from the FRA Office of Safety Analysis database where available.

It must also be mentioned that, upon further inspection, select at-grade crossings shown in the ArcGIS data were no longer rail at-grade crossings. These inconsistencies were found using Google Maps imagery. A glaring example of this problem was the Bustleton Pike crossing in Bucks County (SR 2065, Segment 0020, Offset 0000). The ArcGIS data represented this as an at-grade crossing that had 10 crashes within 100 feet of it (the most of any crossing in the county), but it was later proved that this is no longer an at-grade crossing at all. Another example of this was in Philadelphia at the intersection of State Road and Linden Avenue (DOT #516165B) where six crashes were recorded (the second-most in the county). The reasons why these and a few other lower crash concentration locations were listed as at-grade crossings in the database are unknown. Nor is it known why the track was removed from these locations. A detailed investigation into these issued is beyond the scope of this effort. It should be noted that these errors were removed from the final data set and will be reported to the database managers.

Pennsylvania Findings

The first finding is that the at-grade crossings with a high frequency of vehicle-vehicle crashes in close proximity were different than the ones where a train-vehicle crash occurred during the 2007—2009 study period. In DVRPC's five Pennsylvania counties, approximately 500 at-grade rail crossings were identified in the GIS. Of these, 94 of the crossings had at least one vehicle-vehicle crash within their respective catchment area during the study period. The focus here was on crossings with higher totals with the expectation that trends may emerge in the subsequent analysis. As we have seen with the train-vehicle incidents, crash frequency at these locations was also relatively low. The top location from each county is listed below.

Montgomery County

- Upper Merion Township (intersection of US 202 / East Dekalb Pike and the Chester Valley Running Track/Penn Eastern Rail Line): 12 vehicle-vehicle crashes

Delaware County

- Upper Darby Township (intersection of Lansdowne Avenue and SEPTA Route 101 and 102 Trolley Lines-shared track): 11 vehicle-vehicle crashes

Philadelphia County

- South Philadelphia (intersection of Tasker Street and Columbus Boulevard where the Philadelphia Belt Line follows Columbus Boulevard in the median): nine vehicle-vehicle crashes

Bucks County

- Warminster Township (intersection of Street Road and the SEPTA Warminster Line): eight vehicle-vehicle crashes

Chester County

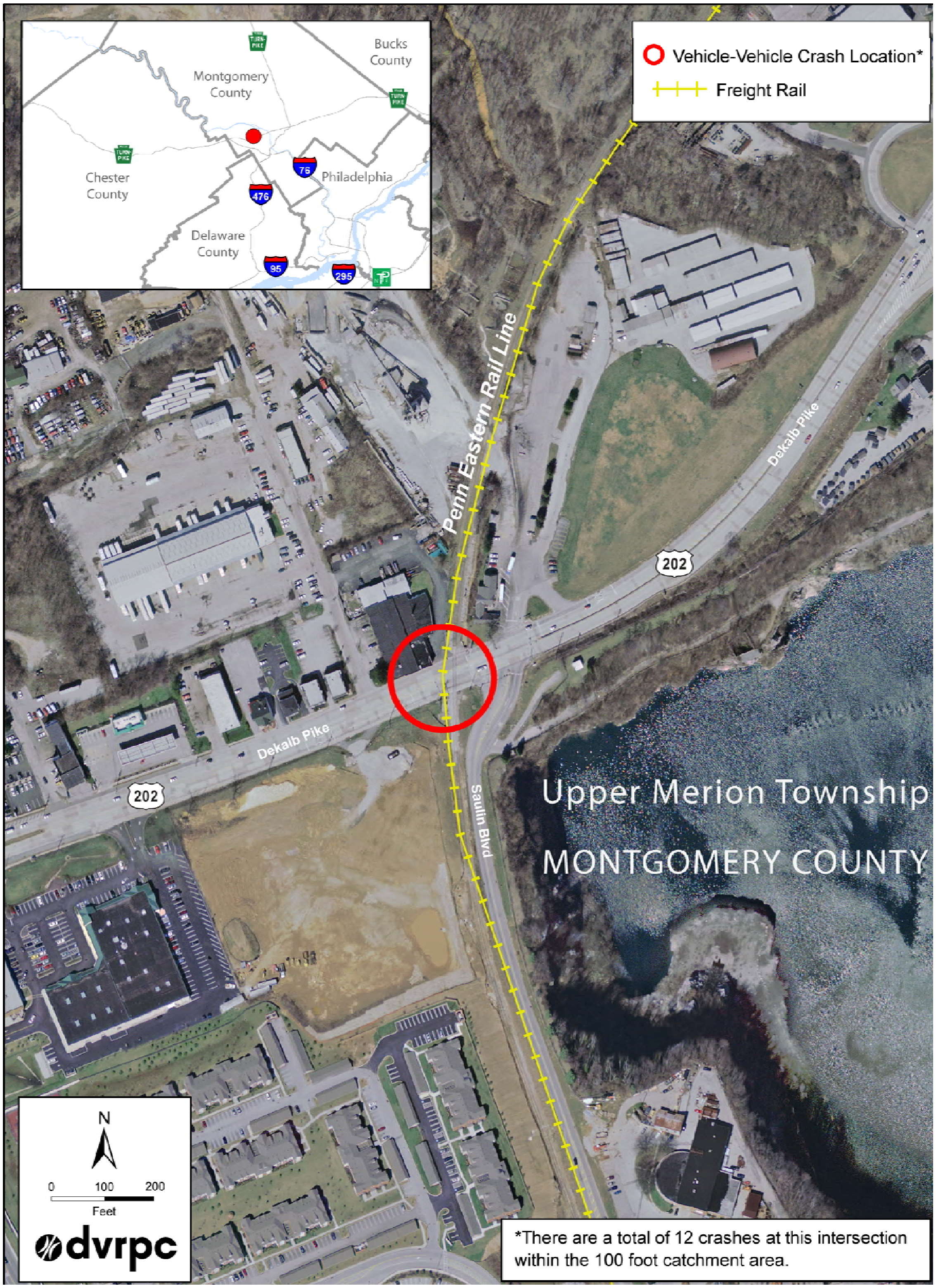
- Phoenixville Borough (intersection of Charlestown Road and Phoenixville Industrial Track): three vehicle-vehicle crashes

At-Grade Crossing with the Most Vehicle-Vehicle Crashes nearby - Pennsylvania

Of the five counties in Pennsylvania, the at-grade crossing with the most crashes is located in Upper Merion Township, Montgomery County as depicted in Figure 4. This at-grade crossing is with US 202 just west of the intersection of US 202 and Saulin Boulevard. The crossing is formally identified as DOT #589723T and located at US 202, Segment 0080, Offset 1421. The high number of crashes may be partially due to this crossing being located on a major road with significant traffic volume, and is just west of the highway's skewed intersection with Saulin Boulevard. The heavy traffic and intersection geometry combine with the rail crossing to create a potentially confusing at-grade crossing area. Despite this location having the highest vehicle-

vehicle crash total in close proximity to a rail crossing, no train-vehicle crashes were recorded during the study period.

Figure 4: Highest Vehicle-Vehicle Crash Frequency Location in Pennsylvania



New Jersey

As in Pennsylvania, New Jersey at-grade crossings and crash data were used to locate all crashes near crossings using ArcGIS and the 2007—2009 crash data. Unlike in Pennsylvania, crashes at intersections in New Jersey are only coded to one of the intersecting roadways. This made the process somewhat less complicated since there was no duplicate intersection data as in Pennsylvania.

Identified Issues

New Jersey posed a particular problem because while the New Jersey Transit River LINE was in the DVRPC ArcGIS database, its at-grade crossings were not included in the NJ At-Grade Crossing ArcGIS shape file. Through a manual process, these points were found and added to the crossing shape file, and State Route Identifier (SRI) and Mile Post data for each cross street were also recorded where available.

New Jersey Findings

The New Jersey FRA rail grade crossing GIS layer has over 700 crossings listed including both at-grade and grade-separated crossings. The GIS analysis revealed this data to be largely outdated and in need of ortho-rectification. Despite its shortcomings, the results of the GIS select-by-location query identified 81 at-grade rail crossings where at least one vehicle-vehicle crash occurred within 100 feet of the crossing.

Unlike in the Pennsylvania-side analysis, one crossing was identified as having crashes within the catchment area and a train-vehicle crash. At the intersection of Clayton-Aura Road and the Vineland Secondary Line, there was one train-vehicle crash, and six vehicle-vehicle crashes within the 100 foot analysis zone. This location is in Clayton Borough, Gloucester County, and ranks second in total vehicle-vehicle crash crossing locations in the county.

The highest crash location per county is as follows:

Camden County

- City of Camden (intersection of CR 551 / Broadway and the NJ Transit River LINE): 43 vehicle-vehicle crashes

Burlington County

- City of Burlington (intersection of NJ 413 and the NJ Transit River LINE): 33 vehicle-vehicle crashes

Mercer County

- City of Trenton (intersection of Lalor Street and the shared track of the NJ Transit River LINE and Bordentown Secondary): 22 vehicle-vehicle crashes

Gloucester County

- City of Woodbury (intersection of NJ 45 and the Salem Running Track): 17 vehicle-vehicle crashes

At-Grade Crossing with the Most Vehicle-Vehicle Crashes nearby – New Jersey

New Jersey has several at-grade crossings with significantly more crashes near them than were identified in Pennsylvania. The at-grade crossing with the most crashes as depicted in Figure 5 was the Broadway crossing in the City of Camden, Camden County, with 43 crashes within a radius of 100 feet of it during the 2007—2009 study period. This is where the New Jersey Transit River LINE crosses Broadway. The official location of this crossing is SRI 551, Mile Post 34.21—34.25. This at-grade crossing is just north of the intersection of Broadway and Mickle Boulevard. Of note, one block east of the Broadway crossing, the CR 561 (Haddon Avenue) crossing with the Rive LINE garnered a total of 31 crashes, which when combined represents an area of concentration (note that the Burlington County top crash location was second highest overall at 33 crashes).

These crossings had, by far, the most crashes near them out of the nine-county region. Like Broadway, the Haddon Avenue crossing is directly north of the intersection of Haddon Avenue and Mickle Boulevard. The boulevard is six lanes plus a planted median that is about the width of a travel lane. Further review of these at-grade crossings is needed and appropriate safety improvements should be identified.

Figure 5: Highest Vehicle-Vehicle Crash Frequency Location in New Jersey

CHAPTER 6

Conclusion

This first phase of analysis of rail at-grade crossing crashes in the nine-county DVRPC region represents an important step toward understanding the frequency and location of vehicle-train crashes and their significance in the larger transportation safety effort. It is anticipated that the lessons learned will inform safety efforts targeted at rail crossings throughout the region.

After several refinements, the analysis of 2007—2009 crash data revealed 15 train-vehicle crashes in the Pennsylvania counties, and 21 in the New Jersey counties. Of the combined 36 crashes, only three crossings had more than one crash coded to it during the analysis period; each of those crossings had two crashes. This is an important finding: no significant crash frequency trend by location was identified. Given the low number of total train-vehicle crashes, and the less significant trend by location finding, it can be surmised that rail at-grade crossing crashes involving trains and vehicles are not a major safety issue in the DVRPC region, especially when compared to the total three-year vehicle crash experience of the nine counties.

It is significant, however, that of the 36 train-vehicle crashes there were three fatal crashes that resulted in a total of three people killed. The important take-away from this is that rail at-grade crossings should be approached with caution, and the importance of rail crossing safety warnings cannot be understated.

The investigation into vehicle-vehicle crashes occurring in proximity to rail at-grade crossings identified much higher total crash numbers, though only one location where both a train-vehicle crash and a minor trend of vehicle-vehicle crashes was identified. The level of investigation conducted for this companion piece was not detailed enough for the researchers to make a determination as to whether or not the mere presence of a crossing had an influence on crash frequency nearby. Those locations where crash totals were relatively high would benefit from a closer investigation. It is also important to note that the vehicle-vehicle crash frequency was significantly higher in New Jersey than in Pennsylvania due in part to the difference in reportable crash definitions between the states.

Lastly, the finding from Phase one which will be explored in more detail in Phase two is the 141 trolley-auto crashes that were identified in the crash database in Philadelphia and Delaware counties. This total is approximately nine times the number of train-vehicle crashes; a much more robust data-set which will provide an opportunity to examine the details in search of trends regarding causal factors. In addition, trolleys differ from other rail cars in several fundamental ways, enough to warrant exclusion from Phase one so that these crashes can be explored in greater detail during Phase two.

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Abstract: This report examines the New Jersey and Pennsylvania crash databases for two trends involving at-grade rail crossings: 1) crashes between trains and motor vehicles, and 2) crashes between motor vehicles occurring within proximity of an at-grade rail crossing. The analysis was conducted using GIS to identify qualifying crashes by location and by type. Crash data from years 2007—2009 were utilized. Important findings include: only three at-grade crossings were the location of multiple train-vehicle crashes, vehicle-vehicle crashes near at-grade crossings were more common than train-vehicle crashes, and crashes between vehicles and trolleys in the City of Philadelphia (predominantly) were the most common crash type identified and will be investigated in Phase two.

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