

Highway–Railroad Grade Crossing Collision  
Rosedale, Maryland  
May 28, 2013



**Accident Report**

NTSB/HAR-14/02  
PB2014-109131



**National  
Transportation  
Safety Board**

NTSB/HAR-14/02  
PB2014-109131  
Notation 8511A  
Adopted October 8, 2014

# Highway Accident Report

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**National  
Transportation  
Safety Board**

490 L'Enfant Plaza SW  
Washington, DC 20594

**National Transportation Safety Board. 2014. *Highway–Railroad Grade Crossing Collision, Rosedale, Maryland, May 28, 2013*. Highway Accident Report NTSB/HAR-14/02. Washington, DC.**

**Abstract:** On May 28, 2013, about 1:59 p.m., a 2003 Mack Granite truck, operated by Alban Waste, LLC, was traveling northwest on a private road in Rosedale, Maryland, toward a private grade crossing. The truck was carrying a load of debris to a recycling center located 3.5 miles from the carrier terminal. About the same time, a CSX Transportation Company (CSXT) freight train—which consisted of two locomotives, 31 empty cars, and 14 loaded cars—was traveling southwest at a speed of 49 mph. As the train approached the crossing, the train horn sounded three times. The truck did not stop and was hit by the train. Three of the 15 derailed cars contained hazardous materials. The other derailed cars contained non-US Department of Transportation-regulated commodities, or were empty. One car loaded with sodium chlorate crystal and four cars loaded with terephthalic acid released their products. Following the derailment, a postcrash fire resulted in an explosion at 2:04 p.m., which caused widespread property damage. The fire remained confined to the derailed train cars. The truck driver was seriously injured in the collision. Three workers in a building adjacent to the railroad tracks and a Maryland Transportation Authority police officer who responded to the initial incident received minor injuries as a result of the explosion. Major safety issues identified in this investigation were distraction, federal oversight of new entrant motor carriers, obstructive sleep apnea, safety systems at private grade crossings, and oxidizing and flammable or combustible materials. The National Transportation Safety Board makes recommendations to the Federal Motor Carrier Safety Administration; the Federal Railroad Administration; the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico; the Association of American Railroads; the American Short Line and Regional Railroad Association; the National Fire Protection Association; and CSXT.

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## Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ABS	antilock brake system
BASIC	behavior analysis and safety improvement category [FMCSA]
BCCC	Baltimore County Central Communications
BCFD	Baltimore County Fire Department
BMI	body mass index
CAP	corrective action plan
CDL	commercial driver's license
CFR	<i>Code of Federal Regulations</i>
CMV	commercial motor vehicle
CPAP	continuous positive airway pressure
CR	compliance review
CSA	Compliance, Safety, Accountability [FMCSA program]
CSXT	CSX Transportation Company
CTEH	Center for Toxicology and Environmental Health LLC
DOT	US Department of Transportation
DVIR	driver vehicle inspection report
EPA	US Environmental Protection Agency
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FMCSRs	<i>Federal Motor Carrier Safety Regulations</i>
FR	<i>Federal Register</i>
FRA	Federal Railroad Administration
hazmat	hazardous materials
HOS	hours of service
IC	incident commander
LPR	license plate reader
MAP-21	Moving Ahead for Progress in the 21st Century Act



MCAC	Maryland Coordination and Analysis Center [Anti-Terrorism Advisory Council of Maryland]
MCSAC	Motor Carrier Safety Advisory Committee [FMCSA]
MCSAP	Motor Carrier Safety Assistance Program
MDE	Maryland Department of the Environment
MDSHA	Maryland State Highway Administration
MDTA	Maryland Transportation Authority
MEP	medical expert panel [FMCSA]
MRB	Medical Review Board [FMCSA]
MUTCD	<i>Manual on Uniform Traffic Control Devices for Streets and Highways</i>
MVA	Motor Vehicle Administration [Maryland]
NHTSA	National Highway Traffic Safety Administration
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
OOS	out-of-service
OSA	obstructive sleep apnea
PED	portable electronic device
PHMSA	Pipeline and Hazardous Materials Safety Administration
PM	preventive maintenance
psi	pounds per square inch
RSIA	Rail Safety Improvement Act of 2008
SMC	safety management cycle [FMCSA]
SMS	Safety Measurement System [FMCSA]
USAR	urban search and rescue
USC	<i>United States Code</i>
USDOT	US Department of Transportation [motor carrier number]
VECU	vehicle electronic control unit
WBAPS	web-based accident prediction system [FRA]

# Executive Summary

## Investigation Synopsis

On May 28, 2013, about 1:59 p.m., a 2003 Mack Granite three-axle roll-off straight truck, operated by Alban Waste, LLC, was traveling northwest on a private road in Rosedale, Maryland, toward a private highway–railroad grade crossing. The grade crossing consisted of two tracks and was marked on each side with a crossbuck sign. The truck was carrying a load of debris to a recycling center located 3.5 miles from the carrier terminal. About the same time, a CSX Transportation Company (CSXT) freight train—which consisted of two locomotives, 31 empty cars, and 14 loaded cars—was traveling southwest at a recorded speed of 49 mph. As the train approached the crossing, the train horn sounded three times. The truck did not stop; and as the train traversed the crossing, it struck the truck on the right side, causing the truck to rotate and overturn before coming to rest on the earthen embankment on the northwest side of the tracks. The first 15 cars of the 45-car train derailed.

Three of the 15 rail cars (cars 7, 8, and 15) contained hazardous materials. The other derailed cars contained non-US Department of Transportation (DOT)-regulated commodities, or were empty. The seventh car (loaded with sodium chlorate crystal)—and the ninth through twelfth cars (loaded with terephthalic acid)—released their products. Following the derailment, a postcrash fire resulted in an explosion at 2:04 p.m. The overpressure blast from the explosion shattered windows and damaged property as far as approximately 0.5 mile from the site. The fire remained confined to the derailed train cars. The truck driver was seriously injured in the collision. Three workers in a building adjacent to the railroad tracks and a Maryland Transportation Authority police officer who responded to the initial incident received minor injuries as a result of the explosion.

## Probable Cause

The National Transportation Safety Board (NTSB) determines that the probable cause of the Rosedale, Maryland, crash was the truck driver's failure to ensure that the tracks were clear before traversing the highway–railroad grade crossing. Contributing to the crash were (1) the truck driver's distraction due to a hands-free cell phone conversation; (2) the limited sight distance due to vegetation and roadway curvature; and (3) the Federal Motor Carrier Safety Administration's (FMCSA) inadequate oversight of Alban Waste, LLC, which allowed the new entrant motor carrier to continue operations despite a serious and consistent pattern of safety deficiencies. Contributing to the severity of the damage was the postcrash fire and the resulting explosion of a rail car carrying sodium chlorate, an oxidizer.

The crash investigation focused on the following safety issues:

- Distraction due to hands-free cell phone use.
- FMCSA oversight of new entrant motor carriers.

- Systems to prevent drivers with untreated obstructive sleep apnea from being granted unrestricted medical certification.
- Systems to address safety at private highway–railroad grade crossings.
- Proximity of oxidizing and flammable or combustible materials in a train.

## **Recommendations**

As a result of this crash investigation, the NTSB makes recommendations to the FMCSA; the Federal Railroad Administration; the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico; the Association of American Railroads; the American Short Line and Regional Railroad Association; the National Fire Protection Association; and CSXT. The NTSB reiterates two recommendations to the FMCSA and one to the 50 states and the District of Columbia. In addition, the NTSB reclassifies two recommendations previously issued to the DOT.

# 1 Factual Information

## 1.1 Crash Narrative

About 1:59 p.m. on May 28, 2013, a 2003 Mack Granite three-axle roll-off straight truck, driven by a 50-year-old male and operated by Alban Waste, LLC, departed the carrier terminal and traveled northwest on a private road in Rosedale, Baltimore County, Maryland, toward a private highway–railroad grade crossing (US Department of Transportation [DOT] crossing 140833J).<sup>1,2</sup> The private grade crossing, located approximately 0.2 mile from the carrier terminal (see figures 1 and 2), consisted of two tracks and was marked on each side with a crossbuck sign.<sup>3</sup> The truck was carrying a load of debris to a recycling center located 3.5 miles from the carrier terminal. About the same time, a CSX Transportation Company (CSXT) freight train (Q40927)—which consisted of two locomotives, 31 empty cars, and 14 loaded cars—was traveling southwest and approaching the crossing at a recorded speed of 49 mph. The temperature was approximately 70°F with no precipitation, and the roadway was dry.

As the train approached the crossing, the train horn sounded three times. The truck did not stop before it proceeded into the crossing. The train struck the truck on the right side near the rear drive axles, causing the truck to rotate and overturn before coming to rest on the earthen embankment on the northwest side of the tracks. Following the collision, the first 15 cars of the 45-car train derailed.

Three of the 15 derailed rail cars contained hazardous materials (cars 7, 8, and 15). The other derailed cars contained non-DOT-regulated commodities or were empty. The seventh car (loaded with sodium chlorate crystal) and the ninth through twelfth cars (loaded with terephthalic acid) released their products. Following the derailment, a postcrash fire resulted in an explosion at 2:04 p.m. The overpressure blast from the explosion shattered windows and damaged property as far as approximately 0.5 mile from the crash site. The fire remained confined to the derailed train cars.

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<sup>1</sup> All times in this report are eastern daylight time.

<sup>2</sup> A roll-off container is typically an open steel receptacle used to remove and contain construction, demolition, or other waste.

<sup>3</sup> A crossbuck sign is an X-shaped warning symbol for vehicular traffic at a railroad grade crossing. The crossbuck displays the words “railroad” on one arm and “crossing” on the other.

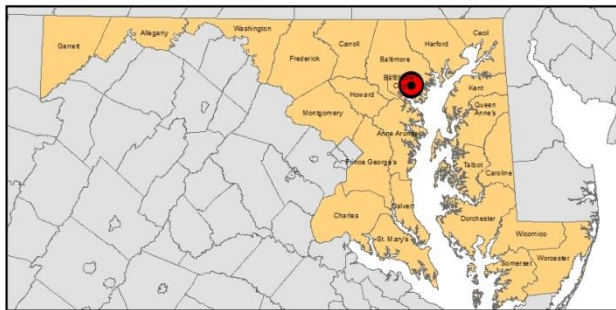


Figure 1. Regional map and view of crash site.



**Figure 2.** Aerial view of accident highway–railroad grade crossing and surrounding area. (Source: Google Earth, August 2010)

The train engineer and the conductor stated that their trip was normal until the collision. They went on duty in Philadelphia, Pennsylvania, at 8:15 a.m. Train Q40927 departed Philadelphia at 10:48 a.m. en route to Richmond, Virginia. At the time of the crash, the train had been operating on green (proceed) signal aspects for approximately 10 miles. The locomotive event recorder indicated that for 5 miles in advance of the crossing, the train speed was maintained below 50 mph, the maximum track speed. As the train approached the crossing, it was traveling 49 mph. According to the forward-facing locomotive audio/video recorder, the train horn sounded three times.<sup>4</sup> A 3-second sounding began at 1:59:10, followed by a 4-second sounding at 1:59:15. The third sounding began at 1:59:21 and continued until impact approximately 6 seconds later.<sup>5</sup>

The truck driver was familiar with both the vehicle and the grade crossing, which he typically traversed several times daily. At the time of the crash, the air conditioning was on, the radio was off, and the cab windows were rolled up. The driver's cell phone indicated that he answered a phone call using his wireless hands-free headset at 1:59:09, 1 second before the first train horn sounded. Following the crash, the driver said that he did not typically stop at the crossing but relied on the sound of the train horn to alert him if a train was approaching. He said that as he approached the crossing, he glanced left and right and did not see anything, so he continued across the tracks. Data from the truck's vehicle electronic control unit (VECU) indicated no service brake applications or clutch depressions prior to the collision. The VECU

<sup>4</sup> Train crews are not required to sound horns at private crossings. On approach to public highway–railroad grade crossings, the rules call for a pattern of two longs, a short, and a long horn sound. However, engineers will often continue sounding the horn when there is a pending collision.

<sup>5</sup> Video data from the locomotive show the truck first coming into view from behind the foliage at 1:59:23.40. The right front tire crossed the nearest rail at 1:59:25.07, and the impact with the train occurred at 1:59:27.87.

showed that the truck speed decreased gradually during the 10 seconds prior to the collision, from about 16 to 8 mph. Using data from the forward-facing audio/video on the lead locomotive, investigators estimated that the truck averaged 9.9 mph as it began to traverse the grade crossing.<sup>6</sup> The driver stated that he did not hear the train horn until right before the collision.

Following the collision, the first 15 cars of the 45-car train derailed and separated from the locomotives, which remained on the tracks. The train engineer contacted the CSXT dispatcher to declare an emergency. The dispatcher advised the crew to continue moving the locomotives farther down the track away from the derailment and from possible exposure to hazardous materials. As the locomotives continued down the track, the conductor and the engineer heard and felt an explosion originating from the area where the cars had derailed. The explosion occurred approximately 1,000 feet from the grade crossing.

Appendix A presents background information on the National Transportation Safety Board (NTSB) launch to Rosedale, Maryland.

## 1.2 Injuries

As a result of the collision, the truck driver was seriously injured and was transported to an area hospital for treatment. Three workers in an adjacent building (7517 Lake Drive)—and a Maryland Transportation Authority (MDTA) police officer, who responded to the initial incident and was in her vehicle on Lake Drive approximately 100 yards from the explosion site—also received minor injuries as a result of the explosion. The train crew members were uninjured. Table 1 summarizes the injury data.

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<sup>6</sup> Video data showed that the truck slowed from about 10.7 to 8.7 mph as it began to traverse the crossing.

**Table 1.** Injury levels for the truck driver, train crew, and others (including emergency responders and workers in a nearby building).

Injuries <sup>a</sup>	Truck Driver	Train Crew	Others	Total
Fatal	0	0	0	0
Serious	1	0	0	1
Minor	0	0	4	4
None	0	2	--	2
<b>Total</b>	1	2	4	7

<sup>a</sup> Title 49 *Code of Federal Regulations* (CFR) 830.2 defines fatal injury as any injury that results in death within 30 days of the accident. It defines serious injury as an injury that requires hospitalization for more than 48 hours, commencing within 7 days of the date of injury; results in a fracture of any bone (except simple fractures of fingers, toes, or nose); causes severe hemorrhages, or nerve, muscle, or tendon damage; involves any internal organ; or involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.

### 1.3 Emergency and Hazardous Materials Responses

Table 2 provides a timeline of the emergency and hazardous materials (hazmat) responses to the Rosedale collision. The events are described in detail in the sections that follow.



**Table 2.** Timeline of emergency and hazardous materials responses to the highway–railroad grade crossing collision, fire, and explosion, May 28, 2013.

Time <sup>a</sup>	Event
2:00 p.m.	911 call received by Baltimore County Central Communications (BCCC) dispatch
2:04 p.m.	MDTA police officer arrives on scene Explosion occurs
2:08 p.m.	First Baltimore City Police Department officer arrives First Baltimore County Fire Department (BCFD) unit arrives (engine 16) First Baltimore City Fire Department unit arrives (engine 51) Initial incident command established BCCC dispatch notified of chemicals on train
2:14 p.m.	First emergency medical service units arrive
2:17 p.m.	BCFD Division Chief of Emergency Operations assumes incident commander (IC) role and establishes command post
2:22 p.m.	Baltimore County Office of Emergency Management arrives on scene
2:23 p.m.	Baltimore City hazmat unit arrives on scene, begins air monitoring, and establishes hazmat exclusion zone
3:10 p.m.	Team inspects scene and IC decides to “allow the product to burn off” until all materials can be identified and confirmed
5:00 p.m.	Fire suppression continues until fire is extinguished during early morning of May 29
<sup>a</sup> Times are truncated to the minute.	

### 1.3.1 Emergency Response

The Baltimore County Central Communications (BCCC) dispatch was notified of the crash through its 911 system at 2:00:34 p.m. The crash location was subject to the Baltimore Region Emergency Assistance Compact, which provides for mutual aid assistance among several regional agencies. The MDTA police officer arrived on scene at 2:04 p.m., and the explosion occurred less than 1 minute later.<sup>7</sup> The first dispatched Baltimore City police officer, the first dispatched Baltimore County Fire Department (BCFD) unit (engine 16), and the first Baltimore City Fire Department unit (engine 51) arrived on scene at 2:08 p.m. The engine 16 captain immediately assumed the role of initial incident commander (IC). Also at 2:08 p.m., the BCCC dispatch received a call from CSXT informing it of four chemical placards on the train. Upon learning of the potential for hazardous materials on board the train, the IC initiated a “level II staging,” which required incoming fire department units to stop and wait at a designated location

<sup>7</sup> According to video obtained from Eastern Truck and Trailer, a nearby facility, the explosion occurred at 2:04:51.

on 68th Street approximately three blocks from the explosion site until the IC allowed them to enter the incident area. Three additional BCFD units arrived within the next 3 minutes, and the first emergency medical service unit arrived at 2:14 p.m. The Baltimore County Office of Emergency Management, which is part of the BCFD, was en route at 2:10 p.m. and arrived at 2:22 p.m.

While driving to the scene, the BCFD division chief of emergency operations heard that there had been an explosion with collapsed buildings, and he asked the BCCC dispatch to send the BCFD urban search and rescue (USAR) collapse assignment team. The division chief arrived on scene at 2:13 p.m., assumed the IC role at 2:17 p.m., and set up a command post in a parking lot at the corner of 68th Street and Pulaski Highway, approximately 1,000 feet upwind of the burning train cars. After the IC notified the BCCC dispatch that he had established a command post, the IC, the Baltimore City senior on-duty fire chief, and a Baltimore County police officer formed a unified command.

Upon arrival on scene, the IC was told that the truck driver was trapped in his vehicle. He assigned a ladder company, an engine company, a rescue squad, and an ambulance to assist the driver and transport him to a hospital. It was later determined that the driver was not trapped in the truck, and no rescue tools were required. Meanwhile, the USAR team searched the damaged buildings along Lake Drive and determined that no occupants were trapped in any of the buildings.

### 1.3.2 Hazardous Materials Response

The Baltimore City hazmat unit was dispatched at 2:12 p.m., arrived on scene at 2:23 p.m., and within 10 minutes set up air monitoring stations. Additionally, two CSXT environmental response contractors (Arcadis and the Center for Toxicology and Environmental Health LLC [CTEH]), the Maryland Department of the Environment (MDE), and the US Environmental Protection Agency (EPA) conducted air, water, soil, and waste sampling. Environmental monitoring was focused in the work area and within a 2-mile radius of the site. CTEH conducted fixed station monitoring, roaming hand-held monitoring, and analytical sampling.

The BCFD firefighters initially directed unmanned master water streams at the fire, but then—following the recommendation of the hazmat unit director—they ceased this activity and delayed fire suppression efforts until they had identified the materials and confirmed the integrity of the tank cars.<sup>8</sup> After considering the wind direction and determining that there were no pressurized containers or inhalation hazards, the BCFD established an exclusion zone of approximately 500 feet surrounding the explosion site.<sup>9</sup>

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<sup>8</sup> Master stream devices are used to produce high-volume water streams for large fires. Unmanned master streams are typically employed when there is a risk of explosion or injury.

<sup>9</sup> A hazmat exclusion zone, also known as a “hot zone,” refers to an area that can only be entered by credentialed hazmat personnel with appropriate personal protective equipment. Although the 500-foot radius was lower than the 0.5-mile radius suggested by the Pipeline and Hazardous Materials Safety Administration *Emergency Response Guidebook* (PHMSA 2012), the BCFD determined that the smaller radius was justified because there were no dangerous toxic inhalation hazards, and it was conducting ongoing atmospheric monitoring.

At 3:10 p.m., 1 hour and 10 minutes following the crash, the BCFD, CSXT, and the MDE–Emergency Response Division first responders jointly entered the hazmat exclusion zone to inspect the scene and conduct a photographic survey. They discovered that two rail cars containing terephthalic acid (cars 9 and 10) were burning and severely damaged (see figure 3). Because the air monitoring did not detect any substances that were a threat to public health, the IC decided to “allow the product to burn off” until responders could identify and confirm all of the materials.<sup>10</sup> As a precaution, the IC issued a voluntary evacuation of the adjacent community.



**Figure 3.** Burning rail cars containing terephthalic acid, May 28, 2013, 3:14 p.m.  
(Source: Maryland Department of the Environment)

At 5:00 p.m., the BCFD and other assisting agencies resumed fire suppression by ground and elevated master water streams. At a 7:29 p.m. IC briefing, responders reported that they were continuing fire suppression and using thermal imaging to identify additional areas where fire was present. The postexplosion fire was extinguished during the early morning of the following day, May 29. The fire suppression consumed an estimated 750,000–1 million gallons of water.

The IC role was transitioned to a CSXT hazardous materials manager on May 29, at the completion of the emergency response phase. After the fire was extinguished, no combustion gases or volatile organic compounds were detected in the surrounding community, and particulate matter was within normal limits for an urban area. Some of the surface water and sediment sampling locations closest to the derailment were within or adjacent to an EPA

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<sup>10</sup> The operations section chief also noted that concerns about contamination from water runoff influenced the decision to allow the fire to burn until 5:00 p.m.

Superfund site.<sup>11</sup> Surface water and sediment sampling revealed that measurable levels of terephthalic acid and other contaminants had entered a tributary of the Back River downstream of the crash site. Remediation activities—including the removal and disposal of released sodium chlorate, terephthalic acid, and potentially contaminated debris—were completed on June 4. Total cleanup costs were estimated at \$3.6 million.

## 1.4 Physical Damage

### 1.4.1 Truck Wreckage

The lead locomotive struck the truck on the right side near the rear drive axles. The truck rotated, overturned, and came to rest in the earthen embankment northwest of the tracks. As shown in figure 4, the truck sustained severe damage, affecting all major mechanical systems. The driver's seat was in place in the truck; however, because of the crush damage to the cab, the seat was touching both the rear of the cab and the steering wheel. The driver's seat belt was found unbuckled, retracted, and hanging from the upper attachment point to the left of the driver's seat location.<sup>12</sup>



**Figure 4.** Wreckage of Mack truck adjacent to railroad tracks.

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<sup>11</sup> A Superfund site is “an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people.” See [www.epa.gov/superfund/sites/index.htm](http://www.epa.gov/superfund/sites/index.htm), accessed February 21, 2014.

<sup>12</sup> Although hospital records stated “positive seat belt,” the driver told investigators that he was not wearing his seat belt at the time of the crash.

### 1.4.2 Train and Track Damage

Damages to the railroad equipment, cars, and locomotives—and to the track structure—were estimated to be \$502,920 and \$100,000, respectively. The first 15 rail cars following the locomotives derailed approximately 500 feet beyond the highway–railroad grade crossing. Car 7, the aluminum hopper car containing sodium chlorate (UNPX 128076), failed catastrophically in the postcrash fire and explosion, and several other cars had thermal damage. The track ballast was displaced in the area of the explosion, leaving the surface with a cratered appearance. As shown in figure 5, approximately 80 feet of wooden crossties was missing from both sets of tracks in this area. Vegetation south of the tracks was burned, and trees were defoliated or blown over; the damaged area extended approximately 120 feet south of the approximate center of the explosion.



**Figure 5.** Aerial photograph, May 29, 2013, showing explosion site, derailed cars, and damaged tracks.

### 1.4.3 Damage to Surrounding Area

The BCFD chief fire protection engineer conducted damage and safety assessments on four of the five steel frame storage/industrial buildings along Lake Drive parallel to the area of the explosion.<sup>13</sup> All four buildings were placarded as unsafe due to overhead risks from loose exterior wall panel material, and damage to interior lighting and heat fixtures. The most severe damage was observed on the south façades of the three buildings closest to the explosion site. Several industrial buildings on the streets that run perpendicular between Lake Drive and Pulaski Highway and several residential dwellings in the Maryland Manor subdivision were also damaged. As of July 12, 2013, CSXT had received 64 damage reports from property owners within an approximate 0.5-mile radius of the crash site. Figure 6 depicts the locations of the properties named in the damage reports, which cited siding damage, broken windows, cracked walls, cracked pipes, and damaged furniture.

## 1.5 Truck Driver

The driver of the 2003 Mack roll-off truck was a 50-year-old male. At the time of the crash, he held a Maryland class A commercial driver's license (CDL) with a prescription glasses restriction.<sup>14</sup> The license was issued on October 7, 2008, and expired on October 16, 2013. The driver held a current medical card with an issue date of March 7, 2012, and an expiration date of March 7, 2014.

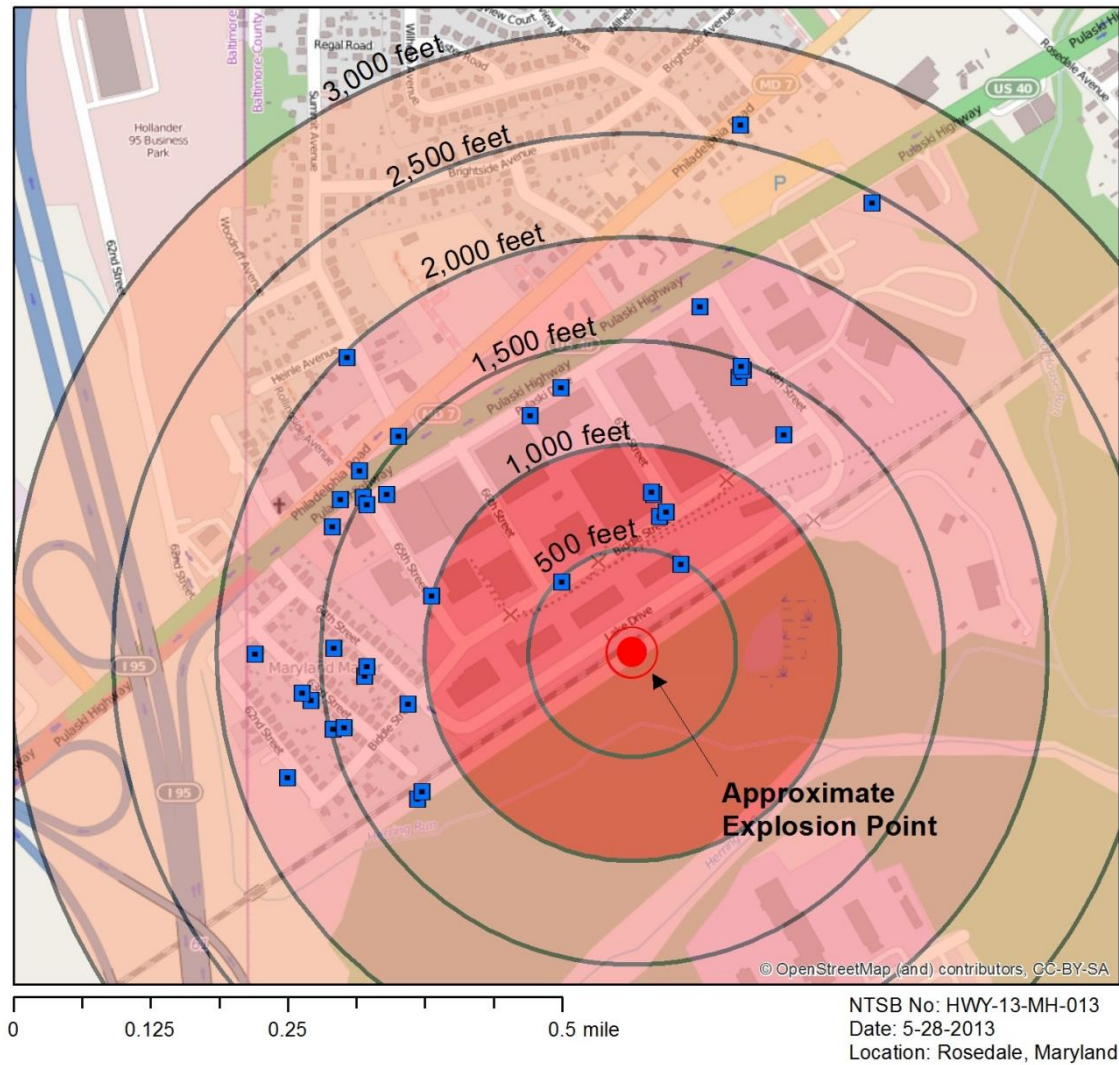
### 1.5.1 Employment and Driving History

In an interview with NTSB investigators, the truck driver stated that he obtained his CDL training during his employment with the BCFD and began operating commercial vehicles in 1982. The driver operated fire trucks as a full-time firefighter for the BCFD until retiring in 2008. Between 2005 and 2008, he held various positions at three roll-off container companies. In 2011, he began his own roll-off business, Alban Waste, LLC. In addition to being the company owner and president, he routinely drove the 2003 Mack roll-off truck involved in the crash.

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<sup>13</sup> The engineer assessed the buildings at 7455, 7475, 7501, and 7517 Lake Drive. The fifth building (7525 Lake Drive) was not as close to the explosion area and was not included in the formal assessment; however, it did sustain minor damage to the exterior and to interior ceiling panels.

<sup>14</sup> A Maryland class A CDL allows the operation of any combination of vehicles with a gross combination weight rating of 26,001 pounds or more, provided that the gross vehicle weight rating of the vehicle or vehicles towed exceeds 10,000 pounds.



**Figure 6.** Plotted damage reports near crash location in Rosedale, Maryland. [Note: Map reflects only those property and business reports that were successfully geocoded based on submitted claims.]

At the time of the crash, the following violations were listed in the truck driver's Maryland Motor Vehicle Administration (MVA) record:

- June 10, 2011: Operation of handheld telephone while operating a motor vehicle.
- October 5, 2006: Failure to carry registration card in vehicle; operating a motor vehicle while not restrained by seat belt.
- May 31, 2002: Operating a motor vehicle while not restrained by seat belt.
- August 26, 1998: Defective lights.
- August 31, 1997: Exceeding maximum speed limit by 10 mph.

### **1.5.2 Recent Activity and Sleep History**

The truck driver's activities in the days leading to the crash were reconstructed based on a variety of evidence sources, including a driver interview, cell phone records, receipts, logs, and electronic toll data. Table 3 summarizes the documented precrash activities. The driver was unable to recall his exact sleeping and waking times; however, he told investigators that he had approximately 7 hours of time in bed on each of the three nights prior to the crash. The driver stated that on days he has to work, he typically goes to bed by 9:00 or 10:00 p.m. and gets up between 4:00 and 5:00 a.m. The driver stated that he had not experienced any significant life changes or stressors in the days and weeks prior to the crash. He told investigators that he has no trouble falling asleep or awaking and that he does not take sleep aids. He stated that he generally sleeps well and described the quality of his sleep as good or average; however, he noted that he has been told by family members that he snores.



**Table 3.** Truck driver's precrash activities, May 26–28, 2013.

Time	Event	Source
<b>Sunday, May 26</b>		
	Driver reports day off	Alban records
7:24 a.m.	Outgoing phone call <sup>a</sup>	Phone records
7:44 p.m.	Outgoing phone call	Phone records
<b>Monday, May 27</b>		
5:23 a.m.	Incoming phone call	Phone records
2:31 p.m.	EZ Pass toll, Baltimore Harbor Tunnel	MDTA <sup>b</sup>
3:51 p.m.	EZ Pass toll, Fort McHenry Tunnel	MDTA
8:15 p.m.	Incoming phone call	Phone records
<b>Tuesday, May 28</b>		
4:41 a.m.	Outgoing phone call	Phone records
5:35 a.m.	LPR tag scan, southbound Fort McHenry Tunnel	MCAC <sup>c</sup>
6:31 a.m.	LPR tag scan, northbound Fort McHenry Tunnel	MCAC
7:17 a.m.	Baltimore Recycling Center entry <sup>d</sup>	Entry/exit log
7:23 a.m.	Baltimore Recycling exit	Entry/exit log
8:07 a.m.	Baltimore Scrap Corp entry	Entry/exit log
8:30 a.m.	Baltimore Scrap exit	Entry/exit log
8:31 a.m.	EZ Pass toll, Baltimore Harbor Tunnel	MDTA
9:46/10:31 a.m.	Baltimore Scrap scale photo/entry	Entry/exit log
10:39/10:43 a.m.	Baltimore Scrap scale photo/exit	Entry/exit log
10:51/11:36 a.m.	Baltimore Scrap scale photo/entry	Entry/exit log
11:45/11:48 a.m.	Baltimore Scrap scale photo/exit	Entry/exit log
12:42 p.m.	Baltimore Scrap entry	Entry/exit log
12:53 p.m.	Baltimore Scrap exit	Entry/exit log
1:02 p.m.	EZ Pass toll, Baltimore Harbor Tunnel	MDTA
1:59 p.m.	Incoming phone call	Phone records
2:00 p.m.	<b>Crash occurs</b>	
<p><sup>a</sup> Cell phone calls listed include only the first and last calls of each day.</p> <p><sup>b</sup> EZ Pass transactions were obtained from the Maryland Transportation Authority (MDTA).</p> <p><sup>c</sup> License plate reader (LPR) transactions were obtained from the Maryland Coordination and Analysis Center (MCAC). LPRs record license plates as vehicles pass stationary sensors located on interstate roads.</p> <p><sup>d</sup> Baltimore Recycling Center transactions were documented from receipts.</p>		

### 1.5.3 Alcohol and Drug Use

The truck driver told NTSB investigators that he drinks alcohol one or two times a month. He stated that he takes over-the-counter antihistamines for seasonal allergies and does not use any illicit drugs. A blood sample taken from the driver less than 2 hours after the crash was analyzed by the Federal Aviation Administration Civil Aerospace Medical Institute toxicology laboratory and found to be negative for alcohol and all tested classes of drugs.<sup>15</sup>

### 1.5.4 Medical Factors

When interviewed by NTSB investigators, the truck driver described his general health as good and stated that he was not experiencing any health issues on the day of the crash. Medical records from the hospital that treated the driver did not indicate any serious medical conditions that would have affected him at the time of the crash.

Investigators also reviewed medical records obtained from the driver's personal physician and records from his DOT commercial driver fitness determination exams. Federal regulations require drivers to undergo a DOT fitness exam and be certified by a medical examiner as physically qualified before operating a motor vehicle.<sup>16</sup> The driver's medical records indicate that he underwent DOT fitness exams in November 2007, February 2010, and March 2012. The 2007 and 2010 exams were performed by the driver's personal physician, and the 2012 exam was conducted by a physician assistant at a different practice. In each case, the driver did not report any medical conditions and was issued a 2-year certificate.

**1.5.4.1 Vision and Hearing.** At his March 2012 DOT fitness exam, the truck driver's corrected Snellen distance visual acuity was recorded as 20/20 with both eyes, and his horizontal field of view was recorded as 85 degrees with each eye.<sup>17</sup> The report noted that the driver could recognize and distinguish between standard red, green, and amber colors. The report stipulated that the driver met visual acuity requirements only when wearing corrective lenses. When interviewed by NTSB investigators, the driver stated that he wears glasses because he is nearsighted. He said that he was wearing his glasses at the time of the crash and was not experiencing any problems with his vision that day.

With respect to his hearing, the truck driver told investigators that he has "high tone deafening" in his left ear, which was diagnosed several years ago during his employment with

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<sup>15</sup> The test results were negative for alcohol, amphetamines, opiates, marijuana, cocaine, phencyclidine, benzodiazepines, barbiturates, antidepressants, and antihistamines.

<sup>16</sup> See 49 CFR 391.41 and 49 CFR 391.43. As of May 21, 2014, medical exams must be performed by a medical examiner listed on the National Registry of Certified Medical Examiners under 49 CFR 390(D).

<sup>17</sup> The Snellen fraction is a measure of visual acuity (sharpness of sight). In the fraction, the first number represents the test distance (20 feet), and the second represents the distance at which the average eye could see the letters on a certain line of the chart. A fraction of 20/20 is considered normal vision.

the BCFD.<sup>18</sup> His medical records contained no mention of treatment for this condition. During his most recent DOT fitness exam, the driver underwent a hearing examination and was noted to be able to hear a forced whispered voice at 5 feet in both ears.

**1.5.4.2 Obstructive Sleep Apnea.** According to the truck driver's medical records, he sought treatment in January 2007 from his personal physician for excessive daytime sleepiness, impaired cognition, snoring, and insomnia. The driver was referred to a sleep medicine specialist and subsequently underwent a sleep study. As a result of the study, he was diagnosed with severe obstructive sleep apnea (OSA), a sleep disorder characterized by pauses in breathing during sleep that can affect sleep quantity and quality, and lead to daytime sleepiness and cognitive impairment.<sup>19</sup>

The driver's personal physician prescribed continuous positive airway pressure (CPAP) therapy as treatment for the disorder in February 2007. The driver told NTSB investigators that he did not follow the prescribed treatment plan because in the months following the sleep study, he lost weight and no longer experienced symptoms.<sup>20</sup> At the time of the diagnosis, his height was 74 inches and his weight was 318 pounds (BMI of 40.8).<sup>21</sup> A historical review of the driver's weight/BMI measured on 11 occasions between 2007 and 2013 showed that he lost 42 pounds between January and November 2007. Between 2008 and 2013, his weight fluctuated between 281 and 300 pounds (BMI of 36.1–38.5).

The driver did not participate in a followup sleep study after the original 2007 diagnosis. Additionally, his medical records state that on three additional occasions, he complained to his personal physician about fatigue: in February 2010, May 2010, and September 2012. Notes from the May 2010 visit indicate that a referral request for a sleep study was filled out, and the physician recorded "OSA needs re-eval" and "Likely needs CPAP." Notes from the September 2012 visit include "OSA needs to retest."

On his 2007 and 2010 DOT fitness exam forms, the driver indicated that he did not have a history of "sleep disorders, pauses in breathing while asleep, daytime sleepiness, or loud snoring." In each instance, despite having diagnosed the driver with OSA and being aware that it was not being treated, the driver's personal physician issued a 2-year unconditional medical certification. The physician made no note or other documentation of the driver's condition or any reasons for issuing the certification without further intervention.

The driver's most recent DOT fitness exam prior to the crash was conducted in March 2012 by a physician assistant at another medical practice. His weight was recorded as

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<sup>18</sup> High frequency hearing loss is the most common form of acquired hearing loss, resulting most often from prolonged exposure to loud noises. This condition makes higher pitched sounds harder to hear. In terms of human hearing, 2,000 hertz and above is considered "high frequency."

<sup>19</sup> The driver's apnea-hypopnea index was 43.6 episodes per hour. Normal is less than five episodes per hour, and more than 30 episodes per hour constitutes severe sleep apnea. In addition, the driver's blood oxygen saturation dropped as low as 81 percent; normal is above 92 percent.

<sup>20</sup> There is a significant relationship between obesity and OSA, with an increased risk of OSA with increasing body mass index (BMI).

<sup>21</sup> The US Centers for Disease Control and Prevention classifies a BMI of 30 or greater as obese.

300 pounds, which corresponds to a BMI of 38.5. In that exam, the driver reported no prior history of medical issues or diagnosis other than seasonal allergies. He indicated that he took over-the-counter medication, as needed, to treat allergy symptoms. As a result of this DOT fitness exam, the driver was qualified for 2 years.

Following the crash, the Federal Motor Carrier Safety Administration (FMCSA) cited the driver for making a false entry on his medical examiner's certificate; however, no action was taken to disqualify his medical certification. In March 2014, the driver's medical card expired. In his renewal application, he self-reported having OSA, and he was issued a 3-month medical certificate with an expiration date of June 2014.<sup>22</sup>

### **1.5.5 Cell Phone Use**

The truck driver stated that he was using his cell phone at the time of the crash. The cell phone indicated that he answered a voice call, for which he said he used a hands-free headset, approximately 18 seconds prior to the collision and 1 second before the first train horn sounded. The person who initiated the call was interviewed by NTSB investigators and acknowledged being on the phone with the driver for a short time before the call abruptly ended.

Neither Maryland law nor federal regulations prohibit using a hands-free cell phone while driving. The truck driver stated that though there is no written company policy on cell phone use, he verbally counseled his employees to use a hands-free device when using a cell phone while operating company vehicles. When interviewed, both the driver and a relative said that he "always" uses his wireless earpiece.

### **1.5.6 Grade Crossing Approach**

The truck driver was familiar with the grade crossing because it must be traversed to travel to and from the carrier terminal. The driver said that he did not typically stop at the crossing but relied on the sound of the train horn to alert him if a train was approaching. He said that he has stopped at the crossing when he could see a train parked to check whether another train was approaching on the other track. However, he believed that it was not possible to see to the right without some portion of the truck being on the track.

A review of security video from a nearby business for daylight hours during the 3 days prior to the crash and on the morning of May 28 indicated that the accident driver and others routinely drove across the grade crossing without slowing or stopping. During the observation period, trains traversed the crossing between two and seven times per day, and highway vehicles traversed the crossing between 10 and 23 times per day. Across the entire observed period, highway vehicles crossed the tracks 67 times, including five tractor-trailer trucks, 23 straight trucks, and 39 pickup trucks or passenger vehicles. Of these 67 crossings, in only eight instances did the vehicles stop in advance (11.9 percent). In two of those eight cases, a train was traversing

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<sup>22</sup> When NTSB investigators spoke to the driver at the end of June 2014, he reported that he was undergoing additional testing for OSA.

the crossing as the highway vehicle approached. The accident driver was observed driving through the crossing without stopping three times on the day of the crash.

Both Maryland law and federal regulations require commercial motor vehicle (CMV) operators to slow down when approaching a crossing and ascertain that the course is clear before continuing.<sup>23,24</sup> Additionally, the *Maryland CDL Manual* has two pages of material to inform commercial drivers about safely approaching and traversing highway–railroad grade crossings, including a section on passive crossings, which states, “Passive crossings require you to recognize the crossing, search for any train using the tracks and decide if there is sufficient clear space to cross safely.”<sup>25</sup> (MVA 2005, 2-28)

According to Maryland MVA records, the truck driver successfully renewed his CDL on August 6, 2013. On October 1, 2013, he was found guilty of proceeding across a railroad crossing when unsafe (on the day of the Rosedale collision, May 28, 2013). In January 2014, the MVA sent the driver a license disqualification letter; however, the following month the disqualification was stayed, and a hearing was scheduled. At the hearing, the judge suspended the driver’s license for 60 days. The driver had his CDL reinstated on May 18, 2014.

## 1.6 Motor Carrier

Alban Waste, LLC, specialized in the transport of construction debris, refuse, and recyclable materials in roll-off containers. It engaged in both interstate and intrastate commerce.<sup>26</sup> The company registered with the FMCSA as a for-hire carrier and was issued US Department of Transportation (USDOT) number 2118654 on February 9, 2011.

At the time of the crash, the carrier operated three straight trucks, two truck-tractors, one service truck, and one leased trailer, which was dedicated to a local scrap company. The carrier employed 10 commercial drivers, four of whom worked full time.

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<sup>23</sup> See *Annotated Code of Maryland*, Transportation Article, §21-703.1. “Procedure upon approaching a railroad crossing” states that the operator of every CMV must slow down and check that the tracks are clear of an approaching train and must stop before reaching the crossing if the tracks are not clear.

<sup>24</sup> See 49 CFR 392.11, “Railroad grade crossings; slowing down required.” Every CMV other than those listed in 49 CFR 392.10 must, upon approaching a railroad grade crossing, be driven at a rate of speed that allows it to be stopped before reaching the nearest rail of such crossing and must not be driven on or over such crossing until due caution has been taken to ascertain that the course is clear. Title 49 CFR 392.10 states that buses transporting passengers and CMVs transporting hazardous materials must stop at all railroad grade crossings.

<sup>25</sup> A passive crossing is a highway–railroad grade crossing without train-activated signals or gates to warn of an approaching train.

<sup>26</sup> The carrier operated in Maryland, Pennsylvania, Virginia, West Virginia, New Jersey, Delaware, and Washington, DC.

### 1.6.1 Alban Waste Programs and Policies

The *Federal Motor Carrier Safety Regulations* (FMCSRs) address motor carrier responsibilities concerning driver qualifications, drug and alcohol testing, hours of service (HOS), and vehicle maintenance. A postcrash review by NTSB investigators showed that Alban Waste was not compliant with several regulations in these areas.

With respect to driver qualifications, 49 CFR 391.51 requires that motor carriers maintain a driver qualification file for each driver regardless of his or her shift or position, and that the file include the driver's application for employment, state motor vehicle records, certificate of road test, and medical certificate. Alban Waste did not have driver qualification files for each of its drivers; for example, the carrier had no records for the four night-shift drivers who assisted with its shiploading operations. The owner stated that he only hired drivers with a CDL and experience in the roll-off business, but he did not say that he gathered any other information when hiring new drivers.

According to the owner, Alban Waste was enrolled in a random drug and alcohol testing program; however, drivers used in the carrier's occasional shiploading operations were not included in its random drug/alcohol testing pool. The carrier had a written drug and alcohol policy, but there was no evidence that drivers received a copy of the policy or educational materials pertaining to the misuse of alcohol or controlled substances as required in 49 CFR 382.601.

The owner stated that the carrier exercised the 100-air-mile-radius driver exemption from the HOS regulations, which states that a driver may be exempt from the requirement to record his/her daily duty status if several criteria are met, including the maintenance and retention of 6 months of records showing driver time on duty.<sup>27</sup> Although the owner provided drivers with time sheets to record their hours, he did not use a time clock, manual records, or a computer program for tracking drivers' hours. Time sheets provided to investigators were missing the information required under 49 CFR 395.1(e)(1). The owner stated that he "was lackadaisical" and "had not been keeping 100 percent track of the drivers' hours."

The owner stated that he performed "99 percent of all the maintenance" on his vehicles—including all brake work, tire maintenance, oil changes, and oil leaks—and that anything major would go to the dealer for repair. He was not a licensed mechanic and did not hold any brake certifications or mechanic credentials.<sup>28</sup> The carrier did not record when vehicles were due for service, nor did it have a systematic method of inspecting, repairing, and maintaining vehicles as

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<sup>27</sup> As outlined in 49 CFR 395.1(e)(1), a driver is exempt from the requirements of 395.8 if: (i) the driver operates within a 100-air-mile radius of the normal work reporting location; (ii) the driver returns to the work reporting location and is released from work within 12 hours on duty; (iii) a property-carrying CMV driver has at least 10 consecutive hours off duty separating each 12 hours on duty; (iv) a property-carrying CMV driver does not exceed the maximum driving time in 395.3(a)(3) following 10 consecutive hours off duty; and (v) the motor carrier maintains and retains for a period of 6 months accurate and true time records showing the time the driver reports for duty each day, the total number of hours the driver is on duty each day, the time the driver is released from duty each day, and the total time for the preceding 7 days in accordance with 49 CFR 395.8(j)(2) for drivers used for the first time or intermittently.

<sup>28</sup> Brake inspector qualifications are required under 49 CFR 396.25.

required under 49 CFR 396.3. No vehicle maintenance records were maintained for fleet vehicles except for receipts for vehicle parts, which lacked identifying information to match them to any particular vehicle. The carrier did not have any driver vehicle inspection reports (DVIRs) for any vehicles operating during the 30 days prior to the crash. The owner stated that he “was lackadaisical” in making the drivers fill out the required DVIRs.

Although the FMCSRs do not require written safety policies, the carrier had no driver’s handbook, seat belt policy, cell phone policy, or disciplinary guidance. The carrier did not conduct any driver training or have any recurrent training program. The owner stated that he held occasional driver safety meetings that covered such topics as “wearing seat belts” and “using their Bluetooths if they’re talking on their cell phones,” but none of the safety meetings were documented.

## 1.6.2 FMCSA Oversight

**1.6.2.1 New Entrant Program.** In 2003, the FMCSA instituted the New Entrant Safety Assurance Program.<sup>29</sup> A motor carrier can obtain a USDOT number and begin interstate operations as a new entrant after completing registration forms on the FMCSA website.<sup>30</sup> After the new entrant satisfies a set of basic preoperational requirements, it is subject to an 18-month safety monitoring period.

According to the FMCSA, during this period the carrier’s roadside inspections are monitored and it undergoes a safety audit to assess whether it is meeting regulatory requirements in the areas of driver qualification, driver duty status, vehicle maintenance, accident registry, and controlled substances and alcohol testing. The safety audit results in either a “pass” or “fail” determination. If the carrier passes the audit, it continues to be monitored for the remainder of the 18-month period, and if the carrier remains compliant, it is granted full authority. If the carrier fails the audit, it is given 60 days to provide a corrective action plan (CAP) identifying how it will remedy its safety practices.<sup>31</sup>

During the 18-month safety monitoring period, the carrier may also be subject to an expedited action in response to issues identified during roadside inspections or by other means. Examples of issues that may lead to expedited actions include using a driver who does not have a valid CDL, using a driver who tests positive for controlled substances or alcohol, operating with a driver or vehicle out-of-service (OOS) rate of 50 percent or greater, or operating a CMV without proper insurance.<sup>32</sup> Expedited actions may result in an expedited safety audit or a compliance review (CR), or require a written response from the carrier.

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<sup>29</sup> See 67 *Federal Register* (FR) 31983, May 13, 2002, as amended at 73 FR 76490, December 16, 2008, FMCSA–New Entrant Safety Assurance Process, at [www.fmcsa.dot.gov/safety/new-entrant-safety-assurance-program](http://www.fmcsa.dot.gov/safety/new-entrant-safety-assurance-program), accessed June 17, 2014.

<sup>30</sup> See [www.fmcsa.dot.gov/registration/getting-started](http://www.fmcsa.dot.gov/registration/getting-started), accessed May 16, 2014.

<sup>31</sup> The requirement is 45 days for passenger and hazardous materials carriers. See [www.fmcsa.dot.gov](http://www.fmcsa.dot.gov) for additional information.

<sup>32</sup> For a comprehensive list of issues that can lead to an expedited action, refer to 49 CFR 385.308.

Alban Waste became a new entrant on April 1, 2011.<sup>33</sup> On November 21, 2011, the carrier failed its new entrant safety audit, conducted by the Maryland State Police, because of its failure to implement a random drug/alcohol testing program, maintain a driver qualification file on each driver, and require drivers to complete DVIRs.<sup>34</sup>

Alban Waste submitted a CAP to the FMCSA on February 1, 2012; however, it was rejected for lacking the following elements:

- A copy of the carrier's controlled substances and alcohol testing policy.
- Evidence that drivers had received a copy of the carrier's drug and alcohol testing policy.
- Copies of any random drug or alcohol tests conducted on current drivers.
- A copy of procedures for a consortium/third-party administrator of random testing if applicable.
- Copies of any procedures if the carrier did not have a third-party administrator for random testing.
- A list of drivers currently in the random testing program.
- A written statement that the carrier would operate in compliance with the FMCSRs and hazardous material regulations. (This statement must be signed by a corporate official or the owner of the company.)

The FMCSA placed Alban Waste out of service and revoked its registration effective February 3, 2012. Under 49 CFR 385.329, a new entrant whose DOT registration has been revoked, and whose operations have been placed out of service, may reapply for registration no sooner than 30 days after the date of revocation. If the registration was revoked because the carrier failed the safety audit, the new entrant must submit evidence that it has corrected the deficiencies, reapply, and restart the 18-month new entrant monitoring cycle if the application is approved. Alban Waste reapplied to the new entrant program and submitted a second CAP. The FMCSA accepted the CAP; granted Alban Waste operating authority on March 23, 2012; and notified the carrier that the new entrant safety monitoring period would restart on March 26, 2012.

**1.6.2.2 Driver and Vehicle Roadside Inspections.** Between May 30, 2012, and May 30, 2013, the carrier was subject to 33 driver inspections and 30 vehicle inspections, which resulted in no driver OOS violations and 16 vehicle OOS violations. The carrier's vehicle OOS rate was 43.3 percent, compared to a national average of 20.7 percent. The carrier profile reflected that

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<sup>33</sup> A motor carrier typically becomes a new entrant shortly after requesting a USDOT number; however, in this case, there was a 2-month delay because of a legal dispute over rights to the carrier's name.

<sup>34</sup> The requirements concerning these three areas are described in 49 CFR 382.305, 49 CFR 391.51(a), and 49 CFR 396.11(a), respectively.



the accident truck had been subject to three roadside inspections over the 24 months prior to the crash. Those inspections resulted in violations regarding lights and tires, none of which placed the vehicle out of service. As shown in table 4, the truck driver was subject to nine roadside inspections over the previous 24 months. Those inspections resulted in four OOS violations for load securement.

**Table 4.** Truck driver and accident truck roadside inspections.

Date	Truck Driver Inspections/Violations	Accident Truck Inspections/Violations	Inspection Level <sup>a</sup>
08/09/11	No violations	No violations	2
04/10/12	Load securement (OOS), lights	No violations	2
09/17/12	No violations	Lights, tires, other	1
01/11/13	No violations	No violations	2
03/18/13	Load securement (OOS)	Lights	2
04/27/13	No violations	No violations	2
04/29/13	Load securement (OOS)	Lights	3
05/14/13	No violations	Not applicable	3
05/25/13	Load securement (OOS)	No violations	2
<sup>a</sup> A level 1 roadside inspection is a full inspection, of both the driver and the vehicle, to include the undercarriage of the vehicle and brake measurements. Level 2 is a walk-around inspection of the vehicle and a driver inspection. Level 3 is the driver only; level 4, special studies; and level 5, a terminal inspection conducted at the carrier's terminal and without a driver.			

The FMCSA sent two expedited action letters to Alban Waste. The first letter, for operating CMVs with a driver or vehicle OOS rate of 50 percent or greater during the 90 days prior, was dated June 8, 2012. Alban Waste responded with a CAP dated July 11, 2012, which was accepted by the FMCSA, allowing the carrier to continue operating. Two days following the crash, on May 30, 2013, the carrier received a second expedited action letter for operating CMVs with an OOS rate of 50 percent or greater.<sup>35</sup> An order to revoke the carrier's new entrant registration and cease all interstate transportation went into effect on July 1, 2013. On the same day, the FMCSA received a CAP dated June 27, 2013, and the revocation order was rescinded.

**1.6.2.3 Compliance, Safety, Accountability Program and Safety Measurement System.** In 2010, the FMCSA introduced the Compliance, Safety, Accountability (CSA) program as an initiative to improve large truck and bus safety and ultimately to reduce CMV-related crashes, fatalities, and injuries. The new enforcement and compliance model allows the FMCSA and its state partners to contact a larger number of carriers earlier, with the goal of addressing safety problems before crashes occur. Along with the CSA, the FMCSA also instituted an operational model called the Safety Measurement System (SMS), which replaced its predecessor, Safestat.

<sup>35</sup> The letter was unrelated to the crash.

The SMS is designed to help the FMCSA and its state partners identify high-risk carriers and drivers before they have a crash. The SMS uses motor carrier data from roadside inspections (including all safety-based violations), state-reported crashes, and the federal motor carrier census to quantify performance in the behavior analysis and safety improvement categories (BASICS) described in table 5.

**Table 5.** FMCSA behavior analysis and safety improvement categories.

<b>BASIC</b>	<b>Definition</b>	<b>FMCSRs</b>	<b>Example Violations</b>
Unsafe driving	Operation of CMVs in a dangerous or careless manner	Parts 392, 397	Speeding, reckless driving, improper lane change, inattention
HOS <sup>a</sup> compliance	Operation of CMVs by drivers who are ill, fatigued, or noncompliant with HOS regulations; includes violations pertaining to records of duty status as they relate to HOS requirements and management of CMV driver fatigue	Parts 392, 395	Operating a CMV while ill or fatigued
Driver fitness	Operation of CMVs by drivers who are unfit due to lack of training, experience, or medical qualifications	Parts 383, 391	Failure to have valid and appropriate CDL or being medically unqualified to operate a CMV
Controlled substances/alcohol	Operation of CMVs by drivers who are impaired due to alcohol, illegal drugs, and misuse of prescription or over-the-counter medications	Parts 382, 392	Use or possession of controlled substances/alcohol
Vehicle maintenance	Failure to properly maintain a CMV or properly prevent shifting loads	Parts 392, 393, 396	Brakes, lights, and other mechanical defects; failure to make required repairs; or improper load securement
Hazardous materials compliance	Unsafe handling of hazardous materials on a CMV	Part 397; hazardous materials regulations parts 171, 172, 173, 177, 178, 179, 180	Release of hazardous materials from package; no shipping papers or no placards/markings when required
Crash indicator	Histories or patterns of high crash involvement, including frequency and severity; based on state-reported crashes	Not applicable	Not applicable

<sup>a</sup> HOS = hours of service.

A carrier's measurement for each BASIC depends on how many adverse safety events it experiences, the severity of violations or crashes, and when the adverse events occurred (more recent events are weighted more heavily). After a measurement is determined, the carrier is placed in a peer group with other carriers with similar numbers of inspections. Percentiles are then determined by comparing the BASIC measurements of the carrier with the measurements of other carriers in the peer group. A percentile of 100 indicates the worst performance. The FMCSA has established threshold levels, as summarized in table 6. When a carrier exceeds a threshold for one of the BASICs, a warning symbol is shown alongside the corresponding entry on the safer.com website.

**Table 6.** BASIC thresholds.

<b>BASIC</b>	<b>Passenger Carriers (%)</b>	<b>Hazardous Materials Carriers (%)</b>	<b>All Other Motor Carriers (%)<sup>a</sup></b>
Unsafe driving HOS compliance <sup>b</sup> Crash indicator	50	60	65
Driver fitness Controlled substances/alcohol Vehicle maintenance	65	75	80
Hazardous materials compliance	80	80	80
Source: <a href="http://csa.fmcsa.dot.gov/FAQs.aspx">csa.fmcsa.dot.gov/FAQs.aspx</a> .			
<sup>a</sup> Alban Waste is classified under "all other motor carriers."			
<sup>b</sup> HOS = hours of service.			

Between May 2012 and May 2013, Alban Waste exceeded its BASIC thresholds eight times. These BASICs included unsafe driving and vehicle maintenance (improper loading). At the time of the crash, Alban Waste had an unsafe driving BASIC of 90.2 percent and a vehicle maintenance BASIC of 66.4 percent. Table 7 lists the carrier's BASIC scores that exceeded thresholds.

**Table 7.** Alban Waste BASIC scores exceeding thresholds.

Date	BASIC	Threshold (%)	Alban Waste (%) <sup>a</sup>
May 2012	Vehicle maintenance (improper loading)	80	98.3
June 2012	Vehicle maintenance (improper loading)	80	98.4
July 2012	Vehicle maintenance (improper loading)	80	98.7
August 2012	Vehicle maintenance (improper loading)	80	98.8
September 2012	Vehicle maintenance (improper loading)	80	98.7
October 2012	Vehicle maintenance (improper loading)	80	99.8
March 2013	Unsafe driving	65	89.9
April 2013	Unsafe driving	65	90.2
<sup>a</sup> A percentile of 100 indicates the worst performance. Percentages exceeding the established thresholds require agency action.			

**1.6.2.4 Compliance Reviews.** In addition to safety audits for new entrants and roadside inspections to evaluate driver and vehicle safety, the FMCSA also conducts CRs to ensure adherence to the safety fitness standards defined in 49 CFR 385.5. There are two types of CRs: focused or comprehensive. A focused CR is conducted when two or fewer BASICs exceed the preestablished thresholds. Such reviews do not normally result in a formal safety rating. A comprehensive CR is conducted when three or more BASICs exceed their thresholds or when a carrier is subject to a fatal crash or a complaint. A comprehensive CR addresses all aspects of the carrier's operation and normally results in a safety rating determined through a methodology that evaluates patterns of critical or acute violations.<sup>36</sup>

As a result of this crash, the FMCSA conducted a comprehensive CR of Alban Waste. One acute and nine critical violations were discovered, resulting in an "unsatisfactory" safety

<sup>36</sup> Appendix B, 49 CFR Part 385, defines critical and acute violations. Safety ratings are "satisfactory," "conditional," or "unsatisfactory," using the factors prescribed in 49 CFR 385.7 as computed under the safety fitness methodology. (1) A **satisfactory** rating means that a motor carrier has in place and functioning adequate safety management controls to meet the safety fitness standard prescribed in 49 CFR 385.5. (2) A **conditional** rating means that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which could result in occurrences listed in §385.5 (a) through (k). (3) An **unsatisfactory** rating means that a motor carrier does not have adequate safety management controls in place to ensure compliance with the safety fitness standard, which has resulted in occurrences listed in §385.5 (a) through (k). (4) **Unrated** refers to a situation where the FMCSA has not assigned a safety rating to the motor carrier.

rating. As a property-carrying CMV operator, Alban Waste was given 60 days to comply. The carrier failed to do so and was placed out of service on September 13, 2013.

### 1.6.3 State of Maryland Oversight

The *Maryland Vehicle Law*, title 23, subtitle 21, authorizes the state to regulate CMVs. The Maryland State Police performs roadside inspections, safety audits, and CRs of motor carriers located in Maryland. Additionally, the Maryland State Police monitors motor carrier compliance with the state preventive maintenance (PM) program.

To comply with the PM program, the registrant of a vehicle with a registered weight, actual weight, or rated gross vehicle weight over 10,000 pounds must certify that he or she has personal knowledge of applicable federal and state motor carrier safety rules, regulations, and standards. This certification must be made when purchasing new registration plates and at the time of their renewal. Vehicle owners must also have the vehicles inspected, maintained, and repaired at least every 25,000 miles, or every 12 months (whichever occurs first), and retain maintenance records.

On July 19, 2013, the Maryland State Police conducted a maintenance audit on Alban Waste and discovered that it failed to use any type of maintenance form that meets the PM requirements, failed to maintain maintenance records as required, and failed to produce records for the required time period. As a result of violations documented during the maintenance audit, the Maryland State Police issued the owner of Alban Waste a citation for \$2,600.

## 1.7 Train Crew

The train crew consisted of an engineer and a conductor. The engineer was hired by CSXT in 1996 as a brakeman, was promoted to engineer in 1998, and had been working as such for 14 years at the time of the crash. His regular run was operating trains between Richmond and Philadelphia. The engineer had a current 49 CFR Part 240 certification.<sup>37</sup> He had been observed by supervisors 103 times in the 12 months preceding the crash and had properly complied with the railroad's rules and procedures during all of the observations.

CSXT hired the conductor in 2011. After training, he started working in January 2012. During that year, he was furloughed 6–7 months nonconsecutively. Because of his limited seniority, he had been on an “extra list” to cover other jobs when regular employees were not available. He had infrequently worked on the Richmond-to-Philadelphia territory; however, he stated that he had been “territory qualified” and felt comfortable being assigned to this job. The conductor had been observed by supervisors 78 times in the 12 months preceding the crash and had properly complied with the railroad's rules and procedures in all but one observation, during which he was reminded to complete the reports associated with designating the placement of railroad cars.

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<sup>37</sup> Title 49 CFR Part 240 requires that engineers be certified every 3 years. The engineer must pass a written knowledge examination and operate a train while being monitored by a supervisor.

Both the engineer and the conductor were current with all required training programs, including a “hazardous materials awareness for transportation employees” class. According to cell phone records, neither the engineer nor the conductor was using his phone at the time of the crash. The train crew members did not undergo postcrash toxicological testing, nor were they required to do so.<sup>38</sup> Their duty hours were within the requirements of the HOS regulations for railroad employees (49 CFR Part 228). Both crew members reported having had adequate sleep on the night of May 27, 2013, and feeling rested the following day.

## 1.8 Highway–Railroad Grade Crossing

The crash occurred at the intersection of a private road known as “68th Street” or “Dump Road” and a CSXT railroad track at milepost BAK 87.40 (DOT crossing number 140833J).<sup>39</sup> From the carrier terminal to the railroad crossing, the roadway exhibited an initial northwestward heading, perpendicular to the rail line. It then curved left 90 degrees and paralleled the rail line in a southwesterly direction for about 425 feet. The roadway curved to the right, northwestward, approximately 150–175 feet before the first set of tracks,. (See figure 2.) At the onset of the curve, its radius measured about 120 feet; the radius decreased to just over 60 feet closer to the crossing, at which point the curve ended with a short tangent segment that preceded the first set of tracks. The roadway crossed the tracks at an angle of 83–86 degrees. The average width of the road was 19–22 feet, and it widened slightly to 26–29 feet through the curve. The width of the paved crossing surface was about 31.4 feet.

The railroad tracks in the surrounding area are essentially level and tangent, but the road approaching the crossing is on a grade. Pavement elevation 30 feet south of the nearside rail on the northwest approach was 31 inches lower than at the rail, resulting in a grade of 9.6 percent at that point. The grade varied from 8.8 to 12.3 percent slightly farther southeast of the crossing.

Figure 7 shows the northwest approach to the highway–railroad grade crossing. No pavement stripes, advance railroad crossing warning signs, or railroad crossing pavement markings were present on this approach. No speed limit signs were posted on the private road.<sup>40</sup>

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<sup>38</sup> Title 49 CFR 219.201, Events for which testing is required. (b) *Exceptions*. No test may be required in the case of a collision between railroad rolling stock and a motor vehicle or other highway conveyance at a rail/highway grade crossing.

<sup>39</sup> Baltimore County records show that a public road known as 68th Street ends at its connection with Lake Drive and that a private road provides access to several buildings on the south side of the railroad tracks.

<sup>40</sup> The *Annotated Code of Maryland*, Transportation Article 21-801.1, states that 30 mph is the maximum speed limit in a business district.



**Figure 7.** Truck driver's approach view of grade crossing when heading northwestward on private road from carrier terminal (STOP sign not visible).

A crossbuck sign was located on each side of the crossing.<sup>41</sup> On the southeast side, the crossbuck sign was 25 feet from the nearest rail; and on the northwest side, the sign was 17 feet from the nearest rail. STOP signs were located to the right of each crossbuck sign; however, the signs were not compliant with the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD; Federal Highway Administration [FHWA 2009]). The yellow paint on both STOP signs had faded significantly, and both signs had been displaced from their original mountings prior to the crash. Both signs featured stamped metal embossed with the words “stop, look, listen.” The STOP sign that should have been regulating traffic moving northwestward, shown in figure 8, was facing away from the roadway, rusted bolt holes had allowed it to rotate upside down, and it was completely obscured from view by vegetation. Figure 9 shows a detail view of the STOP sign.

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<sup>41</sup> Because this grade crossing was considered private, it was exempt from all other traffic control and highway design guidelines and requirements as specified in the Railroad Safety Improvement Act of 2008 (RSIA).



**Figure 8.** View of STOP sign facing away from roadway, relative to road, railroad, and crossbuck sign.



**Figure 9.** Detail view of STOP sign at grade crossing.



On June 12, 2013, NTSB investigators requested that CSXT cut back vegetation at the crossing to improve sight lines and work with the Maryland State Highway Administration (MDSHA) to perform an engineering analysis to determine the need for upgraded warning devices. CSXT responded by removing the vegetation approximately 27.5 feet from the nearest rail and installing a YIELD sign at the southeast approach to the crossing; however, it said that it expected MDSHA to take the lead in determining if additional improvements were needed. The NTSB also asked MDSHA to work with CSXT in conducting an engineering study at the accident crossing; however, the agency refused, citing liability concerns and a prohibition in *23 United States Code (USC) Section 130* about using public funds for improvements at private crossings.

### **1.8.1 Traffic at Grade Crossing**

The maximum authorized train speed at DOT crossing 140833J was 50 mph. According to CSXT, average daily train frequency was between seven and nine trains southwestbound and 10 and 12 northeastbound, for a total of 17–21 trains every 24 hours. Additionally, a review of footage from a nearby security camera indicated that highway vehicles traversed the crossing between 10 and 23 times per day during daylight hours.

### **1.8.2 Grade Crossing Land Ownership and Responsibilities**

The land where the grade crossing is situated was deeded between 1851 and 1853 to the White family along with right-of-way agreements to the Baltimore and Ohio Railroad Company, which were dated in 1954.<sup>42</sup> The 23.8-acre parcel of land located south and immediately adjacent to the railroad tracks was deeded to Marley Neck–Patapsco Company, a subsidiary of CSX Realty Inc., in February 1972.

The Alban Waste terminal was situated on a 6.1-acre parcel of land located southeast of and adjacent to the CSX property. Real estate records listed Robb and Elizabeth Tyler as the owners of this property from February 1972 until January 1999. When the Tylers purchased the property in 1972, they entered into an agreement that gave them an easement to use the private roadway that extended from the property to the grade crossing. The Deed of Easement and Agreement states that Marley Neck–Patapsco Company has the right to use the private roadway “without any obligation for the maintenance of the same.” CSX has asserted that this language shows that it does not have a duty to maintain the roadway.

In 1999, Pulaski & 68th Street LLC obtained ownership of the 6.1-acre property from the Tylers. According to CSX, easement rights and the responsibility for maintaining the roadway conveyed to Pulaski & 68th Street LLC when the change of ownership occurred. Consequently, CSX asserts that Pulaski & 68th Street LLC was the private landowner and responsible for maintaining the roadway on the date of the crash.

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<sup>42</sup> Right-of-way refers to the right to build and operate a railway line or a highway on land belonging to another, or the land so used (Garner 2014).

The NTSB was unable to locate any correspondence or other supporting agreements between CSX and Pulaski & 68th Street LLC that specified responsibilities for maintaining the private roadway, signage, and vegetation clearance at the crossing.

### 1.8.3 Other Collisions at Accident Site

Two other highway–railroad grade crossing collisions have occurred at the accident site (DOT 140833J). In both cases, there were no fatalities, but each collision involved trucks that failed to stop before traversing the crossing and were struck by trains. One collision occurred on August 5, 1988, and the other on August 5, 2014—approximately 14 months after the May 28, 2013, collision that is the subject of this report. The operator of the truck involved in the August 2014 collision was Nova Services Inc.

NTSB investigators documented preliminary information about the August 5, 2014, collision. It, too, involved a three-axle straight truck configured for roll-off service traveling northwest on the private road.<sup>43</sup> Surveillance and forward-facing locomotive videos showed the truck emerging from behind foliage near the crossbuck sign at a speed inconsistent with having stopped in advance of the crossing. The truck was observed to continue at a fairly constant rate of speed into the crossing and onto the tracks, where it was struck by a CSXT locomotive in the vicinity of the third axle. The locomotive event data recorder indicated that the train was approaching the crossing at a speed of approximately 33 mph and that the locomotive was placed into emergency braking prior to the collision. The locomotive did not derail and was returned to service later in the day. The truck was towed from the scene. No injuries were reported.

Examination of the crossing and surrounding area on August 5, 2014, indicated no apparent change in signage or foliage clearing compared to the time of the May 28, 2013, collision.

### 1.8.4 Grade Crossing Inventory Program

The purpose of the DOT grade crossing inventory program is to provide a uniform national inventory database to facilitate the improvement of safety at highway–railroad grade crossings.<sup>44</sup> The Federal Railroad Administration (FRA) has managed the database since 1975. Its web-based accident prediction system (WBAPS) uses accident data and grade crossing inventory data to estimate predicted collisions per year for public crossings. The resulting estimates can be used by state and local officials to identify and prioritize public grade crossings that may require specialized attention, including physical improvements or enhancements.<sup>45</sup> WBAPS does not provide estimates for private crossings.

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<sup>43</sup> The truck involved in the August 5, 2014, collision was not carrying a roll-off container.

<sup>44</sup> See [www.fra.dot.gov/Page/P0111](http://www.fra.dot.gov/Page/P0111), accessed June 13, 2014.

<sup>45</sup> Notably, a December 2013 WBAPS search for Baltimore County, Maryland, listed crossing 141518W (a closed spur crossing) as the crossing with the highest predicted collisions, which suggests that there are errors in either the grade crossing inventory or WBAPS.

As part of the grade crossing inventory program, every highway–railroad grade crossing in the United States is required to have a unique inventory number. Railroads are responsible for assigning FRA-generated numbers to crossing locations, filing grade crossing inventory reports with the FRA, and posting inventory numbers on both sides of crossings. Once an inventory number is assigned to a specific crossing, it permanently remains with that location and in the grade crossing inventory and cannot be reused.

At the time of the crash, the emergency notification sign posted beneath the crossbuck sign at the accident crossing incorrectly listed DOT crossing number 141518W, which the grade crossing inventory identified as a public crossing with 2,300 highway vehicles traversing per day.<sup>46</sup> Following the crash, CSXT corrected the grade crossing inventory by designating crossing 141518W as closed and also modified (and later replaced) the emergency notification sign at the crossing to read “140833J.”<sup>47</sup>

The grade crossing inventory entry for crossing 140833J at the time of the crash indicated that it was a private crossing. The inventory did not include any information about average daily highway traffic. Crossing 140833J was listed as being located at milepost 87.40, with latitude 39.3056830 and longitude -76.5619580; however, the coordinates were incorrect and indicated a location approximately 2.3 miles from the actual crossing. CSXT confirmed that the geographic coordinates of the crossing listed in the inventory did not accurately reflect the location of the accident crossing, and stated that it would measure the coordinates and correct the entry in the DOT inventory.<sup>48</sup>

### 1.8.5 Sight Distance at Crossing

Postcrash, NTSB investigators examined the sight distance available at the southeastern quadrant of the crossing to determine the impact of vegetation in the area. Examination of three-dimensional scanner information revealed that the cutback distance of the foliage ranged from 13 to 24 feet from the southern nearest rail, though the cutback extended to about 27 feet immediately adjacent to the roadway. NTSB investigators conducted tests at the crossing with an exemplar truck to assess sight distances.<sup>49</sup> The front of the truck was positioned northwestward on the private road 15 feet from the nearest rail (the minimum distance required by state statute

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<sup>46</sup> Investigators learned from MDSHA that this traffic count was taken from a nearby public location, 68th Street near the intersection with Biddle Street.

<sup>47</sup> On December 12, 2013, in response to a request from the NTSB, CSXT stated that it had not determined why the incorrect DOT crossing number was posted; however, it explained that crossing 141518W was the identifier for the highway–railroad grade crossing of a defunct spur line that intersected a public section of 68th Street.

<sup>48</sup> In June 2013 (and December 2013), NTSB investigators attempted to find the accident crossing using the FRA “rail crossing locator” smartphone application. The crossing listed for the location of the crash was identified as 140827F and designated as a public crossing that runs under the Southeast Freeway. When investigators entered the number of the accident crossing (140833J), the system erroneously indicated that it was located in the Orangeville industrial area between North Macon Street and East Federal Street. A recheck of the rail crossing locator was conducted in June 2014, and the errors had been corrected.

<sup>49</sup> Investigators compared measurements of the exemplar truck, a Freightliner, to the Mack specifications and determined that it was a suitable exemplar for the sight distance tests.

for stopping before a crossing, and a standard design practice).<sup>50</sup> The results of those tests showed that a driver looking to the right had a sight distance of about 230 feet down the tracks. Investigators estimated that a driver would have had to position the front of the truck approximately 7–8 feet from the nearest rail to be able to see 1,000 feet or more down the tracks.<sup>51</sup>

The sharp horizontal curve proximate to the crossing, along with the skewed (83 degree) crossing angle, further reduced the sight distance triangle that was already obstructed by vegetation. Tests indicated that when the exemplar truck was stopped 15 feet from the nearest rail, it would be oriented approximately 66 degrees relative to the rails, and the driver position would be 24–25 feet from the nearest rail. In this orientation, the line of sight for the accident driver would have been less than 230 feet to the right down the tracks.

The term “clearing sight distance” refers to the minimum distance at which the driver of a stopped highway vehicle can detect a train that will reach the crossing before the vehicle has time to clear it. Both the American Association of State Highway and Transportation Officials (AASHTO 2011) and the FHWA (2007) recommend that larger design vehicles be used to determine clearing sight distances.<sup>52</sup> Design charts from both sources indicate that 1,205 feet of clearing sight distance should be available for a 73.5-foot-long truck-tractor semitrailer at a level 90 degree one-track crossing. The design documents also indicate that the distance should increase if a crossing is not level, has multiple tracks, or has a skewed approach angle.

### 1.8.6 Review of Nearby CSXT Highway–Railroad Grade Crossings

NTSB investigators reviewed four highway–railroad grade crossings located within 2 miles east of the collision site: DOT crossings 140831V, 140828M, 140829U, and 140830N. Three of the crossings were listed as private in the grade crossing inventory, and one (140830N) was listed as public. According to the inventory, crossing 140830N became public in 2010, and the crossing warning devices were upgraded from crossbuck signs to gates and train-activated lights with a constant warning time. MDSHA indicated that Baltimore County took public jurisdiction of crossing 140830N so that the state could obtain federal funding for improvements.

A total of 31 crashes occurred at these four crossings and the accident crossing between 1975 and 2012. Nineteen of those crashes involved heavy trucks and 12 involved automobiles, vans, or pickup trucks. An inspection of the four nearby crossings conducted on May 31, 2013, showed that visibility at the three private crossings was restricted by overgrowth of vegetation on the railroad right-of-way. Additionally, one of the private crossings (140829U) had a severe

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<sup>50</sup> *Annotated Code of Maryland*, Transportation Article 21-701, “. . . the driver of a vehicle shall stop within 50 but not less than 15 feet from the nearest rail in the crossing.”

<sup>51</sup> The prescribed distance for the train’s dynamic envelope (danger zone) is 6 feet from the rail.

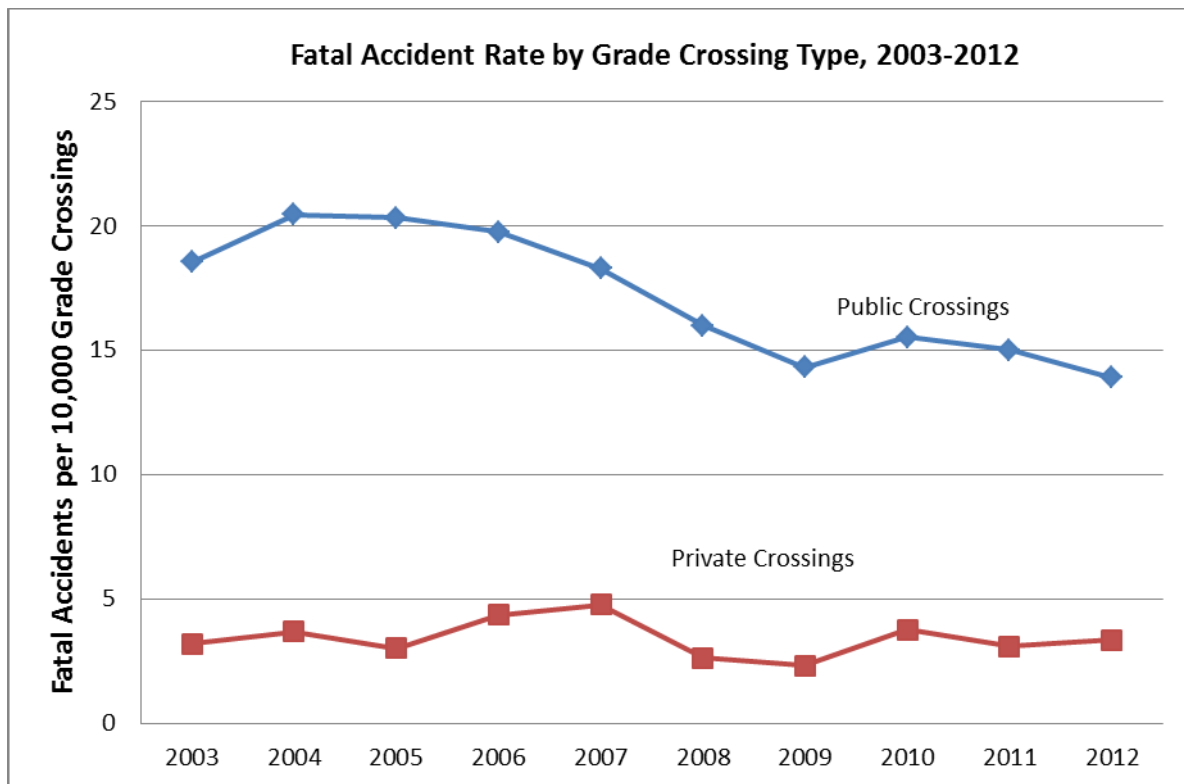
<sup>52</sup> The AASHTO guide does not apply to private grade crossings. It is used in this report for comparative purposes. Similarly, the FHWA Handbook states that “The maintenance of the sight triangle, beyond highway and railroad right of way, presents a unique problem. Except for the portions on the rights of way, this involves private property. The removal of trees, brush, crops, buildings, signs, storage facilities, and other obstructions to the driver’s view requires access to the property and an agreement with the landholder for the removal of the obstruction.” (FHWA 2007, 186)

humped profile; the vertical profile was so steep that approaching traffic on the other side of the crossing was not visible.

### 1.8.7 National Highway–Railroad Grade Crossing Accident Data

NTSB staff reviewed national highway–railroad grade crossing accident and fatality data for 2003–2012. Investigators also considered the number and type of grade crossings in use during this period, employing data from the grade crossing inventory and the FRA grade crossing accident database. The FRA (2011) defines a highway–railroad grade crossing accident as any impact between on-track railroad equipment and a highway user at a highway–railroad grade crossing.

From 2003 to 2012, the total number of public and private highway–railroad grade crossings decreased by approximately 11 and 8 percent, respectively. During the same 10-year period, the total number of fatal accidents per year decreased by approximately 25 percent at public crossings but showed no change at private crossings. Figure 10 shows the fatal accident rate per 10,000 crossings for both public and private highway–railroad grade crossings during the same period.



**Figure 10.** Fatal accident rate per 10,000 grade crossings for public and private grade crossings in the United States, 2003–2012.

In 2012, a total of 210,222 grade crossings were in use in the United States, of which 80,582 (38 percent) were private crossings. In the same year, 232 people died in grade crossing accidents, and 31 (13 percent) of those fatalities occurred at private grade crossings.

Large trucks are overrepresented in all highway–railroad grade crossing accidents. Although they account for 4 percent of registered vehicles and 9 percent of vehicle miles traveled, large trucks were involved in about 23 percent of all grade crossing accidents between 2003 and 2012.<sup>53</sup> Additionally, grade crossing accidents involving large trucks are about three times more likely to result in a train derailment than those involving all motor vehicles (2.6 percent versus 0.8 percent).

### 1.8.8 Vegetation at Highway–Railroad Grade Crossings

Various federal and state regulations address vegetation clearance at highway–railroad grade crossings. Title 49 CFR 213.37 states that “Vegetation on railroad property which is on or immediately adjacent to roadbed shall be controlled so that it does not—(a) become a fire hazard to track-carrying structures; (b) obstruct visibility of railroad signs and signals (1) along the right-of-way, and (2) at highway–rail crossings.”

Seventeen states require the removal of vegetation at or near highway–railroad grade crossings (Jennings 2009).<sup>54</sup> Maryland is one of 33 states without such laws. The state laws that do address vegetation removal vary considerably. Certain laws specify a distance around the crossing that must remain clear, and others specify which parties are responsible for maintenance of the area. Examples of several state laws are provided below:

- In Illinois, railroads must remove from the right-of-way all vegetation 500 feet in either direction from each grade crossing (625 ILCS 5/18c7401).
- In Minnesota, local governing bodies of towns/municipalities may require railroads, road authorities, or private land owners to remove visual obstructions near public or private grade crossings (Minn. Stat. §219-384(1)(2)).
- In Missouri, all railroads are responsible for maintenance of their rights-of-way at highway–railroad grade crossings. Crossings must be kept clear of vegetation, undergrowth, or other debris for a distance of 250 feet each way from the near edge of the crossing (Mo. Rev. Stat. §389.665).
- In New Hampshire, the state department of transportation may order the railroad to clear visual obstructions from the area surrounding crossings (N.H. Rev. Stat. Ann. §373:18).

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<sup>53</sup> See [www.nrd.nhtsa.dot.gov/Pubs/811868.pdf](http://www.nrd.nhtsa.dot.gov/Pubs/811868.pdf), accessed April 22, 2014.

<sup>54</sup> Arkansas, Colorado, Connecticut, Idaho, Illinois, Indiana, Louisiana, Maine, Massachusetts, Minnesota, Missouri, New Hampshire, Ohio, South Carolina, Virginia, Washington, and Wisconsin.

CSXT also has a policy concerning vegetation clearance at grade crossings. It includes annually spraying vegetation for weed control at all crossings, including private crossings, 30 feet from each side of the track center, for a distance of 200 feet before and after any crossing and including all four quadrants of the road crossing. CSXT also “brush sprays” all four quadrants of the crossing (that is, covers brush up to a height of 15 feet above the top of the rail), including private crossings, on a 3-year rotation, 30 feet from the center of the track, for a distance of 200 feet before and after the crossing. In conjunction with the brush control schedule, brush is cut along railroad rights-of-way and road crossings when spraying cannot be performed adequately, economically, or safely. The policy also specifies that vegetation control activities be performed in accordance with all applicable local, state, and federal requirements.

According to CSXT records, the railroad bed approaching the accident crossing and the railroad crossing itself had been sprayed annually. The vegetation at the railroad bed and at the crossing was sprayed 6 weeks before the crash, on April 16, 2013.

### **1.8.9 Federal and State Laws on Private Grade Crossing Safety**

According to 23 CFR 924.11(b), federal highway safety improvement funds distributed to states under the 23 USC 130(f) railway–highway grade crossing program are limited to safety projects on public roads. Traffic control requirements found in the MUTCD and in the AASHTO (2011) geometric and sight distance guidelines apply to the design of public highways and certain private roads.<sup>55</sup> Beginning in 2014, as part of RSIA, private highway–railroad grade crossings are required to have blue and white emergency notification signs giving the DOT crossing number and a toll-free emergency number that can be used by pedestrians or vehicle operators to report obstructions.

Twenty-three states, including Maryland, have laws addressing private highway–railroad grade crossings.<sup>56</sup> Examples of these laws include

- Requiring railroads to build or maintain private crossings in a safe condition, generally as stipulated by a state agency (California, New Jersey, Oklahoma, South Carolina, South Dakota).
- Requiring or giving state agencies authority to install—or require the installation of—traffic control or warning devices at private grade crossings (California, Florida, Maryland, Missouri, Oregon).
- Designating financial responsibility for building or maintaining private grade crossings in a safe condition (Connecticut, Michigan, Missouri, Nebraska).

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<sup>55</sup> The MUTCD requirements were expanded to include a definition of “private road open to public travel” in 2009; however, the new definition exempts private highway–railroad grade crossings. See [mutcd.fhwa.dot.gov/pdfs/2009/pdf](http://mutcd.fhwa.dot.gov/pdfs/2009/pdf), part 3, Markings, 347, accessed August 15, 2014.

<sup>56</sup> California, Connecticut, Florida, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nebraska, New Hampshire, New Jersey, New York, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, South Dakota, Utah, and Virginia.

- Giving public agencies authority to convert roads and grade crossings from private to public (Maryland, New Hampshire).

In Maryland, approximately half of all highway–railroad grade crossings are private.<sup>57</sup> Several laws in the *Annotated Code of Maryland*, Transportation Article, address safety at private highway–railroad grade crossings, including the following:

- §21-702: MDSHA and any local authority with the approval of MDSHA may place a STOP sign at any railroad grade crossing of a highway that the local authority or state designates as particularly dangerous. The law further requires that drivers adhere to the stop.
- §25-106.1: Owners of private property used by the public in general may erect traffic control devices intended to control traffic only if those devices conform to the state MUTCD.
- §8-639(b): The state transportation secretary has authority to approve the construction or modification of a railroad grade crossing or a change of crossing protection equipment and to impose conditions necessary to ensure public safety.
- §8-640(a): At each grade crossing of a highway and a railroad, the railroad is obligated to keep its roadbed and the highway in proper repair so as to provide absolutely safe and easy approach to and crossing of the track; or subject to approval by MDSHA, construct a railroad grade separation.
- §8-640(b): MDSHA may abandon, relocate, construct, or reconstruct any railroad grade crossing or railroad grade separation that is dangerous or inconvenient for public travel, or construct a railroad grade separation.

## 1.9 Vehicles

### 1.9.1 Accident Truck

The accident truck was a 2003 Mack CV713 Granite roll-off truck. The truck driver routinely drove the truck and was familiar with its operation. He stated that on the day of the crash, he did not observe any anomalies in the vehicle's operation.

At the time of the crash, the truck had been driven 327,497 miles according to the VECU. Its gross vehicle weight rating was 62,000 pounds. The empty weight of the truck, obtained from a weight ticket issued by the Baltimore Recycling Center on the morning of the crash, was recorded as 34,340 pounds. Individual axle weights could not be obtained because of the postcrash condition of the truck.

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<sup>57</sup> As of 2012, 644 of 1,276 highway–railroad grade crossings in Maryland were designated as private.



NTSB investigators examined the mechanical condition of the truck—including the steering and suspension systems, tires, transmission, and air and braking systems—to identify components that could have affected the handling or control of the vehicle. Investigators also reviewed vehicle maintenance records and recall databases for factors that may have contributed to the vehicle's condition. Because of the severely damaged postcrash condition of the vehicle, no functional check of the steering system was possible; however, a video surveillance recording from a nearby business documented the truck successfully negotiating a curve just prior to entering the grade crossing. Additionally, the damage to the suspension system components was consistent with the overall damage to the vehicle and appeared to be related to the collision.

With respect to the truck tires, the observed damage was consistent with damage caused by the collision with the train and the subsequent impact with the earthen embankment. All but one of the truck's tires was below the maximum pressure of 120 pounds per square inch (psi) specified by the tire manufacturer. The left steer axle tire had an inflation pressure of 143 psi. The primary consequences of operating an overinflated tire include uneven tire wear and the increased risk of a blowout; however, in this case, the overinflated tire remained intact during the collision sequence.

Direct functional checks of the air and braking systems were also precluded due to vehicle damage. However, pushrod stroke measurements obtained for all but two of the brakes were found to be at or within the maximum adjustment limits.<sup>58</sup> Antilock brake system (ABS) sensors were in place on four of the wheels as designed. The wire leading from the wheel speed sensor on the left side of axle 4 was severed, and the end of the insulating material was worn, indicating that it had been severed for some time prior to the collision. Although the break in the wheel speed sensor wiring from the left side of axle 4 would have disabled the ABS for the left side of both drive axles, the brake system would have reverted to non-ABS for those brakes. The effects of the severed wheel speed sensor wire would have been limited to only the left side of the drive axles and would not have affected the remainder of the ABS.

## 1.9.2 Train

The Q40927 train had two locomotives. The lead locomotive, CSXT 5310 (model number ES44DC), was built by General Electric. The second locomotive, CSXT 8583 (model number SD50-2), was built by Electro-Motive Diesel. The train—which was 2,979 feet long—contained 14 loaded cars and 31 empty cars, with a total weight of 2,890 tons. The lead locomotive air horn was a center-mounted five-tone Nathan K-5HL-R2. The fundamental frequencies of the five tones were 261, 311, 370, 470, and 512 hertz.<sup>59</sup> Postcrash tests demonstrated that the sound level of the locomotive horn complied with the requirements of 49 CFR 229.129.<sup>60</sup>

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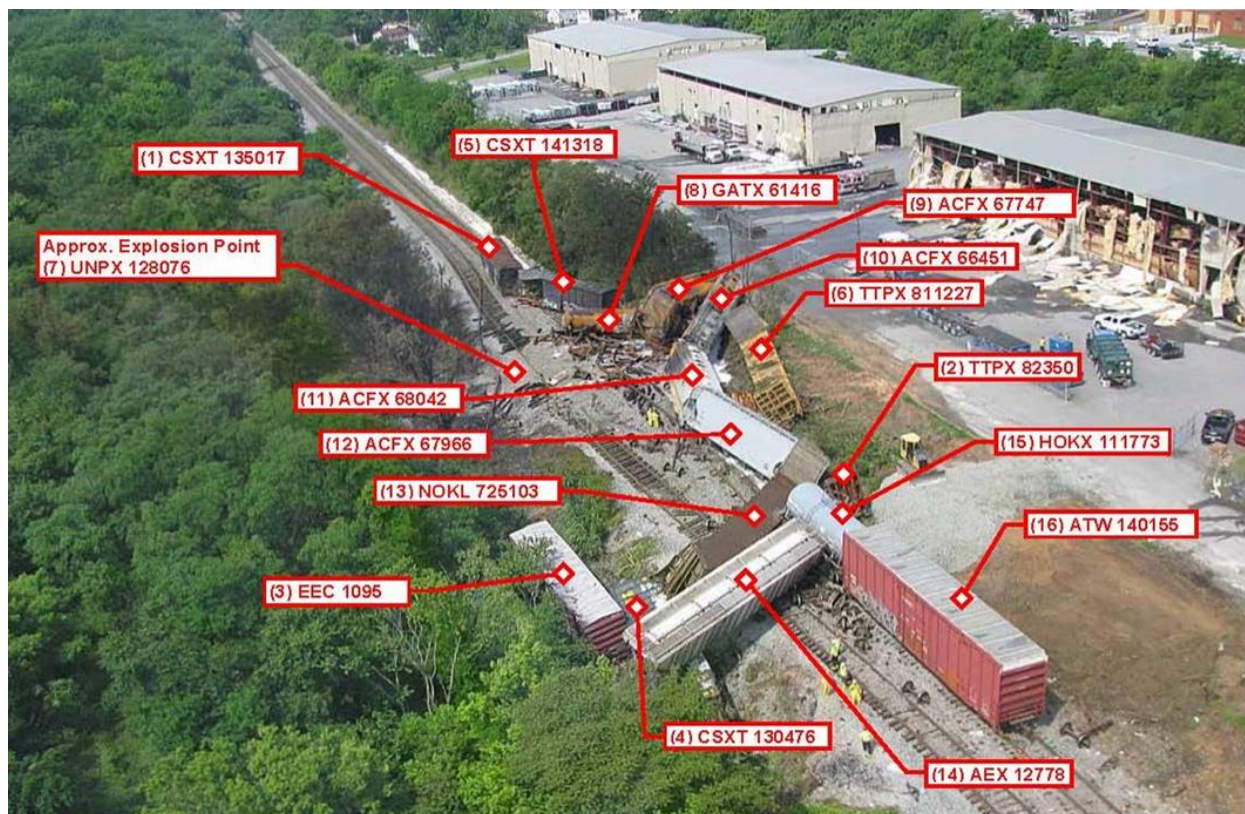
<sup>58</sup> The two brakes not measured had collision-related damage.

<sup>59</sup> See [www.microprecisiongroup.com](http://www.microprecisiongroup.com), accessed June 25, 2014.

<sup>60</sup> Federal regulations require the train horn to be at least 96 decibels but no more than 110 decibels at 100 feet forward of the cab in the direction of travel (49 CFR 229.129).

Additionally, the lead locomotive was equipped with a headlamp and right and left auxiliary lights (ditch lights). Title 49 CFR 229.125 requires that auxiliary lights and the headlamp be continuously illuminated immediately prior to and during movement of the locomotive, except as provided by railroad operating rules, timetables, or special instructions, unless such exception is disapproved by the FRA. The lead locomotive event recorder indicated that the front headlamp and auxiliary lights were illuminated prior to and at the time of impact. A review of video surveillance footage from the nearby facility showed that the headlamp was visibly illuminated as the train approached the crossing. Investigators reviewed 16 video images (frames) from the time the locomotive headlamp came into view until the time of the crash, representing an elapsed time of approximately 1 second. In several frames, investigators observed spots of visible brightness in the vicinity of the right and left auxiliary lights.

Three of the 15 derailed cars contained hazardous materials (cars 7, 8, and 15). The other derailed cars contained non-DOT-regulated commodities or were empty. Figure 11 shows the postcrash locations of the derailed cars; and table 8 describes the car type, load, commodity, and fire damage for each derailed car. Additional details are provided about the cars containing hazardous materials and the non-DOT-regulated material (terephthalic acid) that was involved in the postcrash fire.



**Figure 11.** Aerial photograph taken May 29, 2013, showing 15 derailed cars labeled by position in train (in parentheses), followed by car reporting marks. (Car 16 is included and labeled, but it did not derail.)

**Table 8.** Derailed cars for train Q40927 (hazardous materials highlighted in yellow).

Position	Reporting Marks	Load	Commodity	Car Type	Fire Damage
1	CSXT 135017	Empty	Scrap or waste paper	A332 box	No
2	TTPX 82350	Empty	Plate, iron, or steel	F253 flat	No
3	EEC 1095	Empty	Malt liquors	A402 box	No
4	CSXT 130476	Empty	Pulpboard or fiberboard	A302 box	No
5	CSXT 141318	Empty	Pulpboard or fiberboard	A302 box	Yes
6	TTPX 811227	Empty	Beams, iron, or steel	F453 flat	No
7	UNPX 128076	218,279 pounds	Sodium chlorate, class 5.1, UN1495	C712 covered hopper	Yes
8	GATX 61416	Residue	Fluorosilicic acid, class 8, UN1778	DOT-111A100W5	Yes
9	ACFX 67747	198,680 pounds	Terephthalic acid	C414 covered hopper	Yes
10	ACFX 66451	199,257 pounds	Terephthalic acid	C414 covered hopper	Yes
11	ACFX 68042	199,099 pounds	Terephthalic acid	C214 covered hopper	Yes
12	ACFX 67966	198,460 pounds	Terephthalic acid	C414 covered hopper	No
13	NOKL 725103	Empty	Plate, iron, or steel	F343 flat	No
14	AEX 12778	Empty	Monoammonium phosphate	C113 covered hopper	No
15	HOKX 111773	199,000 pounds	Sodium hydroxide solution, class 8, UN 1824	DOT-111A100W1	No

Car 7 (UNPX 128076, shown in figure 12) was an Association of American Railroads type C712 two-bay cylindrical aluminum covered hopper car loaded with 218,279 pounds of sodium chlorate crystal (hazard class 5.1, oxidizer).<sup>61</sup> This car was destroyed in a postcrash explosion and released its entire contents.



**Figure 12.** Precrash photo of cylindrical aluminum covered sodium chlorate hopper car UNPX 128076, September 29, 2012. (Source: Railroad Picture Archives)

Sodium chlorate is used commercially for bleaching paper and pulp. Its material safety data sheet describes it as an inorganic white-to-yellow crystalline solid that is a strong oxidizing agent. Its crystals are similar in appearance to table salt. It is odorless and is highly soluble in water. The material has a specific gravity of 2.49 and a melting point of 248°C (478°F). Sodium chlorate, due to its oxidizing nature, accelerates the combustion of organic materials (such as wood, paper, oil, or clothing) and increases the intensity of a fire—in which it melts, decomposes at 265°C (510°F), and releases oxygen. It reacts violently, either as a solid or a liquid, with all organic matter and some metals.

Car 8 (GATX 61416, shown in figure 13) was a class DOT-111A100W5 tank car that contained fluorosilicic acid (hazard class 8, corrosive liquids) residue.<sup>62</sup> The empty car weight was about 29 tons. No evidence of liquid release was observed from this tank car.

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<sup>61</sup> Oxidizers are materials that, generally by yielding oxygen, can cause or enhance the combustion of other materials (49 CFR 173.127).

<sup>62</sup> Per 49 CFR 173.136 and 49 CFR 173.137, corrosive materials are liquids or solids that cause full thickness destruction of human skin at the site of contact within a specified period, or liquids that have a severe corrosion rate on steel or aluminum based on criteria in 49 CFR 173.137(c)(2). A liquid is considered to have a severe corrosion rate if it corrodes steel (SAE 1020) or aluminum (nonclad 7075-T6) faster than 6.25 millimeters (0.246 inch) a year at a temperature of 55°C (131°F).



**Figure 13.** Precrash photo of fluorosilicic acid tank car GATX 61416, July 10, 2011.  
(Source: Railroad Picture Archives)

Fluorosilicic acid, also known as hydrofluorosilicic acid, is mainly used as a fluoridation agent for drinking water. It is extremely corrosive to the skin, eyes, and mucous membranes through direct contact, inhalation, or ingestion. The material is nonflammable; however, during a fire, it can react with many metals to produce flammable and explosive hydrogen gas. Hydrofluorosilicic acid decomposes above 108°C (227°F), producing toxic, irritating, and corrosive fumes, including hydrofluoric acid and silicon tetrafluoride.

Car 15 (HOKX 111773) was a loaded class DOT-111A100W5 tank car containing 199,000 pounds of sodium hydroxide solution (hazard class 8, corrosive liquids). The tank shell and fittings were not damaged, and there was no release of material from this car.

Sodium hydroxide solution is not combustible. The substance itself does not burn, but it can decompose upon heating to produce corrosive or toxic fumes, and containers can explode when heated. Sodium hydroxide solution can severely irritate skin, eyes, and mucous membranes. It is toxic by ingestion and corrosive to metals and tissues.

Cars 9, 10, 11, and 12 were loaded with a combined total of 795,496 pounds of terephthalic acid, a non-DOT-regulated commodity. Cars 9 and 10 were involved in the postcrash fire.

Terephthalic acid is a precursor in the production of polyethylene terephthalate, a thermoplastic polymer resin that is used to produce beverage, food, and liquid containers. It is a carboxylic acid that can be oxidized by strong oxidizing agents and generate heat. The material has a specific gravity of 1.51, a flash point of 260°C (500°F), and an autoignition temperature of 496°C (925°F). Terephthalic acid is considered stable to mechanical impact, but it can burn at high temperatures and its dust can form explosive mixtures in the air. During a fire, it can generate irritating and toxic gases and fumes.

### **1.9.3 Auditory Study**

On September 4–5, 2013, investigators returned to the scene of the crash to measure ambient noise inside the cab of an exemplar roll-off truck under a variety of conditions. Measurements and qualitative observations were made inside the truck at various distances from the grade crossing and under various engine operating conditions. Because the testing was conducted at the grade crossing on an active set of tracks, the train speed and direction could not be controlled. The truck windows were closed for all tests. In all but one instance, an observer inside the truck was able to hear the train horn as the train made its approach to the crossing. In the case where the observer did not hear the horn, the truck was positioned 300 feet from the crossing.

## 2 Analysis

### 2.1 Introduction

About 1:59 p.m. on May 28, 2013, a roll-off straight truck carrying a load of debris to a recycling center departed the company terminal and traveled northwest on a private road in Rosedale, Baltimore County, Maryland, toward a private highway–railroad grade crossing. Once the truck left the Alban Waste facility and passed through the property gates, it traveled approximately 0.2 mile along the paved road before reaching the grade crossing. About the same time, a CSXT freight train traveling southwest was approaching the crossing at 49 mph. The crossing had no active warning devices such as gates or lights. The only visible signage was a crossbuck sign and an emergency notification sign with an incorrect crossing identifier number. As described in section 1.8, the design of the crossing and vegetation growth obstructed sight lines to the northeast in the direction of the approaching CSXT train.

Title 49 CFR 392.11 states that a CMV shall, “upon approaching a railroad grade crossing, be driven at a rate of speed which will permit said commercial motor vehicle to be stopped before reaching the nearest rail of such crossing and shall not be driven upon or over such crossing until due caution has been taken to ascertain that the course is clear.”

Security video from a building in the area and data from the truck’s VECU and the train’s locomotive event recorder and forward-facing locomotive video were analyzed to evaluate the relative positions of the truck and the train. When the front of the truck reached the crossbuck sign, the train was about 312 feet from the crossing and traveling 49 mph. At this point, the truck was 25 feet from the nearest rail, traveling 13 mph, and vegetation completely obscured the train from the truck driver’s view. Figures 14 and 15 depict the relative positions of the truck and the train at this location and time. After passing the vegetation, the truck driver did not reduce his speed or stop to ensure that the railroad tracks were clear. About 1.6 seconds later, the front of the truck began to cross the nearest rail. The train struck the truck on the right side near the rear drive axles about 2.8 seconds later. The NTSB concludes that had the truck driver slowed and stopped his truck before traversing the crossing, he could have seen the train and the crash could have been prevented.

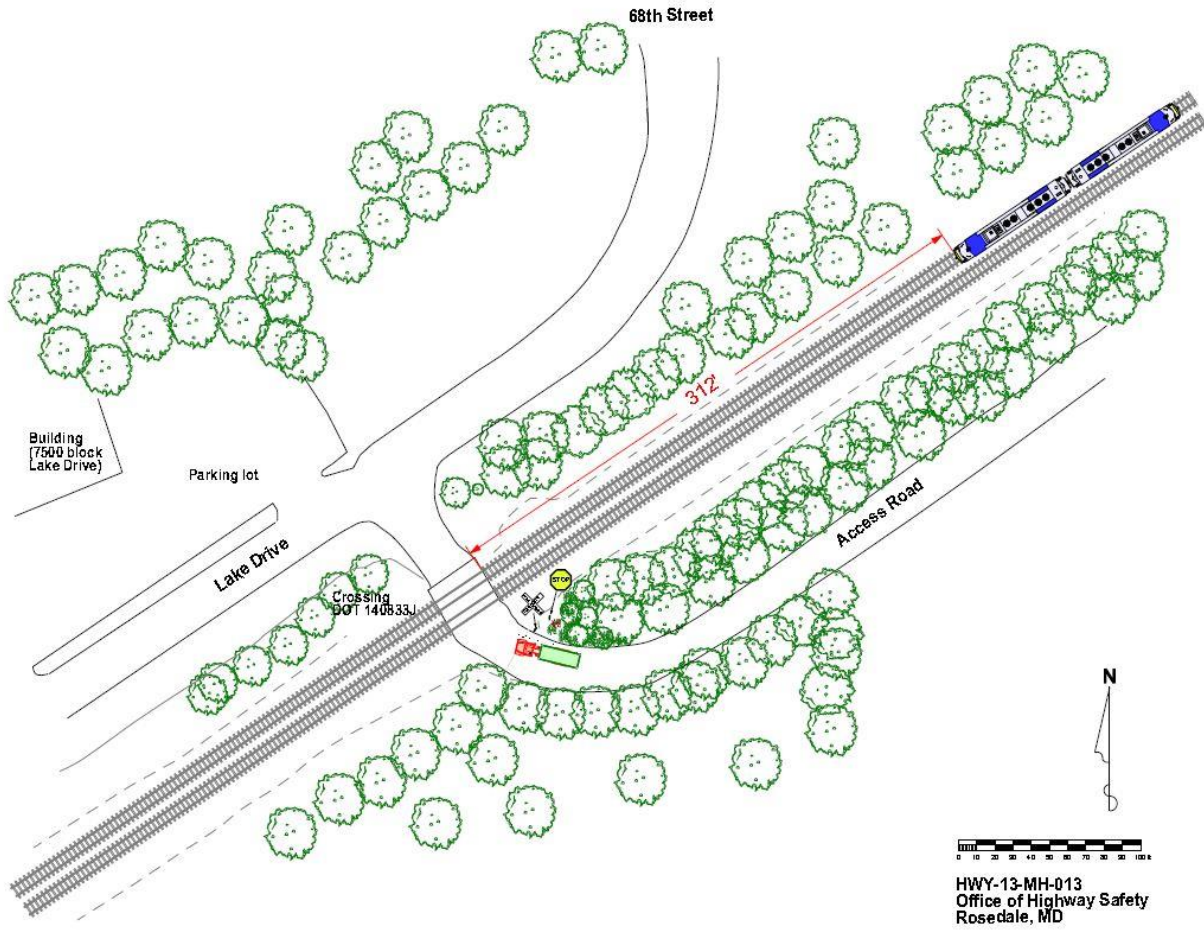


Figure 14. Crash scene diagram.





**Figure 15.** View from forward-facing locomotive video showing accident truck (at left of center) emerging from behind foliage.

The following analysis discusses possible reasons why the driver did not stop at the crossing and potential countermeasures for improving highway–railroad grade crossing safety, in addition to describing unsafe conditions that were revealed as a result of the investigation.

Specifically, the following safety issues are discussed in greater detail:

- Distraction due to hands-free cell phone use.
- FMCSA oversight of new entrant motor carriers.
- Systems to prevent drivers with untreated OSA from being granted unrestricted medical certification.
- Systems to address safety at private highway–railroad grade crossings.
- Proximity of oxidizing and flammable or combustible materials in a train.

NTSB investigators examined both the accident truck and the train and found no preexisting mechanical conditions related to the circumstances of the crash. The locomotive event recorder showed that the train crewmembers had maintained the train below track speed for several miles leading to the crossing and that they sounded the train horn as they approached the crossing, even though they were not required to do so. The security video showed that the

locomotive head lamp and ditch lights were illuminated. The truck driver held a current CDL, had several years of experience driving roll-off trucks, and was very familiar with his vehicle. Postcrash toxicology test results confirmed the driver's self-report that he had used no drugs or alcohol prior to the crash. There was no precipitation at or near the time of the crash, and the road surface was dry. Investigators also examined the condition and loading of the rail cars in the train, with particular focus on the sodium chlorate hopper car that was destroyed in the postcrash explosion. The hopper car was not found to have any mechanical defects, and it was loaded within acceptable weight limits.

The NTSB therefore concludes that none of the following were factors in the crash: (1) mechanical condition of the roll-off truck, (2) mechanical condition of the train, (3) driver experience or licensing, (4) alcohol or drug use, (5) weather, or (6) operation of the train through the grade crossing. Additionally, the NTSB concludes that neither the mechanical condition of the sodium chlorate hopper car nor its loading contributed to the release of sodium chlorate or to the explosion following the derailment.

Emergency responders received timely and effective communications about the identity and location of all hazardous materials, which enabled them to establish an appropriate exclusion zone and to employ proper equipment to measure impacts to the community. The IC coordinated a thorough evaluation of the materials involved in the fire and explosion, and the resulting fire suppression activities were effective. The NTSB concludes that the emergency response and fire suppression activities were timely and effective.

## **2.2 Distraction**

### **2.2.1 Overview**

Investigators considered whether the truck driver's cell phone conversation as he approached the highway–railroad grade crossing contributed to his failure to slow his vehicle or to notice the approaching train. The driver reported that the radio in the truck was off because he was using his phone. Additionally, as evidenced by his statements and the surveillance video, the driver did not typically stop at the crossing. He claimed that it was difficult to see oncoming trains without pulling very close to the tracks and said that he relied on the train horn to alert him to an approaching train.

### **2.2.2 Audibility of Train Horn and Driver Expectancies**

For a train horn to be an effective warning device, a driver must be able to detect the sound, recognize it, and respond to it by taking the appropriate action. Audio data from the forward-facing video on the lead locomotive indicated that the train horn sounded three times as the train approached the crossing. Table 9 shows the times when the horn was sounded and the corresponding positions of the front of the locomotive and the truck from impact. The final horn sound commenced approximately 6 seconds prior to the collision, when the truck was approximately 72 feet from the crossing. Postcrash tests showed that the train horn met regulatory standards for loudness. The results of a postcrash study on train horn audibility at the

grade crossing using exemplar vehicles found that under a variety of conditions, an in-cab observer heard the horn before the train reached the crossing.

**Table 9.** Train horn soundings and relative positions of train locomotive and truck from impact.

Time	Event	Locomotive Distance to Impact (ft)	Truck Distance to Impact (ft)
1:59:10.13	First horn sounding begins	1267.6	Not available <sup>a</sup>
1:59:13.40	First horn sounding ends	1032.6	287.4
1:59:15.13	Second horn sounding begins	913.0	243.8
1:59:19.13	Second horn sounding ends	628.1	159.9
1:59:21.73	Third horn sounding begins	441.3	99.2
1:59:27.87	Impact	--	--

<sup>a</sup> The truck VECU began recording approximately 2 seconds after the first horn sounding; therefore, truck location estimates are not available prior to that time.

Despite evidence that the train horn was sounding and should have been audible from within the truck cab as the truck approached the crossing, the driver indicated that he did not hear the horn until just prior to the collision. In addition to considering whether the driver's cell phone use distracted him from attending to train horn sounds, investigators considered whether his hearing impairment or his expectancies about the presence of trains at the crossing may have influenced his ability to detect the horn sound.

The driver told investigators that he had "high tone deafening" in his left ear, which was diagnosed while he was an employee with the BCFD. He did not report any hearing problems with his right ear, nor did medical records or DOT fitness exam reports indicate any level of hearing loss. Furthermore, high frequency hearing loss is unlikely to affect the ability to hear a train horn because the horn chimes are not in the high frequency range. Because the driver reported regularly hearing train horns near the crossing, it is unlikely that any hearing impairment contributed to his not hearing the train horn at the time of the crash.

With respect to driver expectancy, research has shown that the probability of train horn detection is influenced by whether a motorist expects to encounter a train. Specifically, drivers who think that there is a high probability of a train at a crossing are more likely to detect the sound of a train horn (Rapoza 1999). In this case, it is unclear whether the truck driver's experiences at the crossing would have led him to expect a train. Although the driver claimed that he heard trains approaching the crossing on many occasions, he also reported that he typically did not stop at the crossing unless he heard a train horn. Thus, it is not possible to determine whether the driver anticipated a train at the crossing at the time of the crash, or whether expectancies affected his attentiveness to the train horn sound.

### 2.2.3 Hands-Free Portable Electronic Devices

With respect to distraction, the driver did not report any distractions inside or outside of the vehicle as he approached the crossing, but he did report that he was engaged in a cell phone conversation. He answered a voice call approximately 18 seconds prior to the crash and 1 second before the first train horn sounded, and he said that he used a hands-free headset. The person who initiated the call was interviewed by NTSB investigators and acknowledged being on the phone with the driver for a short time before the call abruptly ended. Studies conducted in simulators and in instrumented vehicles have shown that cell phone conversations, including hands-free conversations, can significantly increase cognitive distraction (Strayer and others 2013) and driver reaction time to auditory warnings (Mohebbi and Gray 2009). Therefore, the NTSB concludes that the truck driver was distracted by his hands-free cell phone conversation.

Neither Maryland law nor federal regulations prohibited the truck driver from using a hands-free cell phone while driving. The driver, who was also the owner of the company, stated that there was no written company policy on cell phone use and driving, but that he verbally counseled his employees to use hands-free devices when operating company vehicles. Both the driver's candor in telling investigators about his cell phone use at the time of the crash and the fact that he counseled his drivers to use hands-free devices while driving suggest that he was not aware of the risks of cognitive distraction posed by hands-free cell phone use.

Driver distraction is increasingly recognized as a serious safety issue. Eliminating distraction in transportation is currently an issue area on the NTSB Most Wanted List. The National Highway Traffic Safety Administration (NHTSA 2014) reports that 3,328 people were killed in crashes involving distracted drivers in 2012; of those, 378 died in crashes in which the use of a cell phone was cited as a distraction. Because of the challenges inherent in determining the role of cell phone use in crashes, these numbers likely underestimate the true scope of the problem.

The NTSB has used the term portable electronic device (PED) to refer to cell phones and other devices, such as music players or navigational systems, that are not integrated into the vehicle. Research has shown that both the visual-manual distraction of manipulating PEDs (Hickman and others 2010) and the cognitive distraction of using hand-free PEDs (Strayer and others 2013) significantly impair driver performance. Although using a hands-free device to operate a PED may mitigate, to some degree, the visual-motor distractions associated with certain subtasks, such as keying in a phone number, it does not mitigate the cognitive distraction associated with being involved in a conversation while driving.

## 2.2.4 Previous Safety Recommendations

Following the investigation of a fatal truck-tractor combination vehicle crossover accident in Munfordville, Kentucky, on March 26, 2010—which was caused by a truck driver’s distraction from cell phone use—the NTSB (2011b) recommended that the FMCSA

Prohibit the use of both handheld and hands-free cellular telephones by all commercial driver’s license holders while operating a commercial vehicle, except in emergencies. (H-11-26)

In December 2011, the FMCSA and the Pipeline and Hazardous Materials Safety Administration (PHMSA) published a final joint rule, at 49 CFR 392.82,<sup>63</sup> specifically prohibiting interstate truck and bus drivers from using hand-held cell phones while operating their vehicles; however, the rule did not prohibit hands-free use of PEDs. By contrast, since 2008, all railroad employees engaged in the movement of a train have been banned from using all PEDs.<sup>64</sup> In May 2013, because the FMCSA had not satisfied the full intent of Safety Recommendation H-11-26, the NTSB reclassified the recommendation “Closed—Unacceptable Action.”

The NTSB has also called on the states to address distraction due to the use of PEDs while driving. Following the investigation of a fatal multivehicle collision in Gray Summit, Missouri, on August 5, 2010, the NTSB (2011a) made recommendations to all 50 states and the District of Columbia to

(1) Ban the nonemergency use of portable electronic devices (other than those designed to support the driving task) for all drivers; (2) use the National Highway Traffic Safety Administration model of high visibility enforcement to support these bans; and (3) implement targeted communication campaigns to inform motorists of the new law and enforcement, and to warn them of the dangers associated with the nonemergency use of portable electronic devices while driving. (H-11-39)

## 2.2.5 Survey Data and Safety Recommendations

According to the Insurance Institute for Highway Safety, which tracks state driver safety laws, as of June 2014, 44 states and Washington, DC, ban text messaging for all drivers; 13 states and Washington, DC, ban hand-held cell phone use while driving for all drivers; and 37 states and Washington, DC, ban all cell phone use by novice drivers. To date, no state has banned all PED use by all drivers. A recent national survey found that most drivers believe that talking on cell phones while driving is a somewhat (30.9 percent) or very (57.7 percent) serious threat to their personal safety; however, the same survey found that about two-thirds of all

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<sup>63</sup> See 76 FR 75470, December 2, 2011.

<sup>64</sup> The only exception is for the use of devices provided by the railroad for an authorized business purpose, after a safety briefing, provided that all assigned personnel on the crew agree that it is safe to do so. See 73 FR 58702, October 7, 2008.

drivers (67.2 percent) report having talked on a cell phone while driving within the past 30 days, and over one-fourth (27.9 percent) report talking on their cell phone while driving fairly often or regularly (AAA Foundation for Traffic Safety 2014).

Surveys also show that drivers feel differently about hand-held and hands-free cell phone use. In the AAA Foundation survey, nearly twice as many respondents (61.8 percent) thought that it was acceptable for drivers to use hands-free cell phones while driving compared to using hand-held cell phones (31.0 percent). Additionally, in a NHTSA-sponsored survey of over 6,000 respondents, 41 percent reported that they would feel safe as a passenger in a vehicle in which the driver was talking on a cell phone with a hands-free device, compared to only 10 percent who would feel safe if the driver was talking on a hand-held cell phone (Schroeder and others 2013).

The NTSB continues to maintain that distraction from the use of hands-free PEDs while driving poses an unnecessary safety risk. Current laws that ban hand-held but not hands-free PED use can foster an environment in which drivers erroneously believe that the use of hands-free PEDs is as safe as not using PEDs at all. The circumstances of the Rosedale highway–railroad grade crossing collision demonstrate that distractions from hands-free conversations can lead to catastrophic results. Therefore, the NTSB recommends that the FMCSA modify 49 CFR 392.82 to prohibit any use of a hands-free PED by a CDL holder while the driver is operating a commercial vehicle, except in emergencies. Additionally, the NTSB reiterates Safety Recommendation H-11-39 to the states.

## **2.3 FMCSA Oversight**

### **2.3.1 Alban Waste as New Entrant**

Alban Waste conducted interstate and intrastate operations. At the time of the crash, the company had been in business for approximately 2 years and was classified as a new entrant. The carrier had not been visited by the FMCSA but had undergone a Maryland State Police safety audit and roadside inspections that revealed numerous safety deficiencies. Additionally, during the 2 months prior to the crash, the carrier had exceeded the alert threshold for the unsafe driving BASIC. In the postcrash CR, the FMCSA found that Alban Waste was noncompliant with several FMCSRs, which resulted in an “unsatisfactory” safety rating. The areas of noncompliance concerned the carrier’s (1) drug and alcohol program, (2) documentation of driver qualifications, (3) HOS, and (4) maintenance program. Based on the CR, it was clear that the carrier had never been in compliance in several of the areas addressed. Therefore, the NTSB concludes that Alban Waste demonstrated a consistent and serious pattern of noncompliance with the FMCSRs from the time that it registered as a carrier until the crash.

Several of the violations documented in the CR had previously been documented during the safety audit or during roadside inspections. On multiple occasions, the FMCSA made written contact with the carrier based on its failed safety audit, its high OOS rate, and other issues. Table 10 displays a timeline of events since Alban Waste was established in February 2011. The table shows that the FMCSA repeatedly documented deficiencies, and the carrier repeatedly completed the necessary paperwork to remain in operation. However, in spite of its written

commitments, the carrier did not make the necessary changes to improve safety and comply with regulations—nor did the FMCSA verify the carrier’s progress in doing such. The NTSB concludes that the FMCSA was aware of problems with Alban Waste since November 2011 but did not take adequate steps to ensure that the carrier complied with the FMCSRs or, failing that, to prevent its operation.

**Table 10.** Alban Waste critical events, February 11, 2011–September 13, 2013.

Date	Action
February 11, 2011	Receives USDOT number
April 1	Enters new entrant program
November 21	Fails safety audit
February 1, 2012	Submits CAP
February 3	FMCSA rejects CAP; places carrier out of service
February 3	Crash with injuries
March 23	FMCSA restores carrier operating authority
March 26	FMCSA accepts new CAP, places carrier back in new entrant program
June 8	FMCSA issues expedited action letter
July 11	FMCSA accepts CAP for expedited action
May 28, 2013	<b>Crash occurs</b>
May 30	FMCSA issues second expedited action letter
June 4	FMCSA begins CR
July 11	FMCSA accepts CAP for second expedited action
July 15	FMCSA completes CR, deems carrier unsatisfactory
September 13	FMCSA declares carrier out of service/unfit

Alban Waste was classified as a “new entrant” for over 31 months, which is almost double the normal 18-month probationary period. Ostensibly, carriers are closely monitored and under heightened scrutiny during this period. In the case of Alban Waste, though the new entrant safety audit detected problems, those problems were never remediated—which suggests deficiencies in the new entrant program.

### 2.3.2 Previous Safety Recommendations

In its investigation of the fatal motorcoach/tractor-semitrailer collision near Loraine, Texas, on June 9, 2002, the NTSB (2003) focused on the oversight of new entrants. In this case, a motor carrier had operated for 22 months without following numerous FMCSRs but had experienced no oversight other than roadside inspections. The NTSB concluded that the FMCSA’s new entrant safety assurance process lacked meaningful safeguards to ensure that a carrier is aware of, understands, and has a safety management system in place to comply with the FMCSRs. The NTSB recommended that the FMCSA

Require all new motor carriers seeking operating authority to demonstrate their safety fitness prior to obtaining new entrant operating authority by, at a minimum: (1) passing an examination demonstrating their knowledge of the *Federal Motor Carrier Safety Regulations*; (2) submitting a comprehensive plan documenting that the motor carrier has management systems in place to ensure compliance with the *Federal Motor Carrier Safety Regulations*; and (3) passing a Federal Motor Carrier Safety Administration safety audit, including vehicle inspections. (H-03-2)

In June 2003, the FMCSA concurred that it was “reasonable to expect a new motor carrier to plan its operations and record keeping systems to assure compliance with the FMCSRs.” However, the agency argued that meaningful reviews could only be undertaken after a carrier begins operations, and it pointed to the new entrant safety audit as the time when this review would occur. In August 2008, the FMCSA began applying an evasion detection algorithm screening process to identify corporate information associated with passenger carriers with histories of poor safety performance before granting them operating authority. On the basis of these FMCSA actions, and a commitment by the agency to make further progress, Safety Recommendation H-03-2 was classified “Open—Acceptable Response.” The NTSB noted, however, that the FMCSA had not yet fully addressed the recommendation, particularly with respect to element (1).

In its investigation of the motorcoach roadway departure and overturn near Doswell, Virginia, on May 31, 2011, the NTSB (2012) found that the motorcoach operator did not undergo a safety audit until it had been in business for nearly 2 years. Although the carrier had no effective safety programs in place and had safety deficiencies in three important areas, it passed the new entrant audit and the FMCSA confirmed its operating authority.

As a result of the Doswell investigation, the NTSB reiterated Safety Recommendation H-03-2 and also recommended that the FMCSA

As a component of your new entrant safety audits, review with each new entrant motor carrier a structured process, such as the Safety Management Cycle, to (1) identify the root cause of safety risks and (2) maintain an effective safety assurance program. (H-12-31)

In response to Safety Recommendation H-12-31, the FMCSA responded that it had integrated the safety management cycle (SMC) into investigations for its CSA enforcement program.<sup>65</sup> The FMCSA also reported that it had trained its investigators and Motor Carrier Safety Assistance Program (MCSAP) personnel on the SMC and had placed information about the SMC on its website.<sup>66</sup> The NTSB responded that—though those efforts were encouraging—it was reclassifying Safety Recommendation H-12-31 “Open—Unacceptable Response” because the SMC had not yet been incorporated into new entrant safety audits.

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<sup>65</sup> The FMCSA describes the SMC as “a holistic systems view of the management processes and improvement practices a motor carrier may implement to achieve greater levels of compliance with FMCSA regulations.”

<sup>66</sup> MCSAP is a grant system that provides financial assistance to states to enforce the FMCSRs through activities such as roadside inspections.



### 2.3.3 Revised New Entrant Safety Assurance Process

The Moving Ahead for Progress in the 21st Century Act (MAP-21) was signed into law on July 6, 2012. Section 32101 requires the Secretary of Transportation to

Establish through a rulemaking a written proficiency examination for applicant motor carriers pursuant to section 13902(a)(1)(D) of title 49, *United States Code*. The written proficiency examination shall test a person's knowledge of applicable safety regulations, standards, and orders of the Federal government. (HR 4348-373)

In response to the requirement, in December 2013, the FMCSA published a notice stating that it would conduct a listening session on January 13, 2014, to solicit ideas and information concerning MAP-21 Section 32101.<sup>67</sup> The notice asked that session participants consider and be ready to respond to several questions concerning potential written proficiency examinations, including the following:

- Should the exam be limited to the applicable FMCSA regulations or include both the regulations and industry best practices?
- If the exam covers industry best practices, what specific best practices should be included?
- What industry best practices manuals/publications are available for new entrants to study prior to taking a proficiency exam?
- Are private-sector training courses available to teach new entrants industry best practices?
- Should the FMCSA limit the exam to company officers or employees responsible for safety and compliance, or should the agency allow safety consultants to complete the exam on behalf of the new entrant?

The FMCSA held two additional listening sessions, on March 28 and April 7, 2014. Transcripts from the sessions were posted in a public docket in June 2014 (FMCSA-2013-0518). According to the docket summary, the FMCSA is considering whether to implement a proficiency examination as part of its revised new entrant safety assurance process.

### 2.3.4 Safety Recommendations

The NTSB concludes that stronger oversight of new entrants is needed to ensure that carriers address safety deficiencies in a timely fashion and are swiftly placed out of service if they fail to improve. The NTSB, therefore, recommends that the FMCSA require a full CR of new entrants that fail their safety audits, fail their corrective action plans, or are issued expedited action letters. We further recommend that the FMCSA establish criteria for revoking the

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<sup>67</sup> See 78 FR 248, December 26, 2013, 78474.

certification of any new entrant that demonstrates a pattern of safety deficiencies. The NTSB also reiterates Safety Recommendations H-03-2 and H-12-31.

## 2.4 Obstructive Sleep Apnea

### 2.4.1 Accident Truck Driver

In 2007, the truck driver was diagnosed with severe OSA, a sleep disorder that has been associated with a significantly increased motor vehicle crash risk compared to the general driving population (Tregear and others 2009). The driver was prescribed CPAP therapy; however, he did not fill the prescription or begin treatment, nor did he ever note the diagnosis on subsequent DOT commercial driver fitness exam forms. When questioned by NTSB investigators, the driver claimed that he lost weight following his 2007 diagnosis and was no longer experiencing symptoms. However, records of his weight recorded on 11 occasions between 2007 and 2013 showed that his BMI never dropped below 35.<sup>68</sup> In addition, his medical records from 2010 and 2012 indicate that he continued to experience fatigue. The driver's BMI at the time of the crash (38.4) and his self-report of snoring and daytime fatigue are all strong risk factors for OSA (Hartenbaum and others 2006).

According to 49 CFR 391.41(b)(5), "A person is physically qualified to drive a commercial motor vehicle if that person—has no established medical history or clinical diagnosis of a respiratory dysfunction likely to interfere with his/her ability to control and drive a commercial motor vehicle safely." In the case of the accident truck driver, the same personal physician who diagnosed his severe OSA in February 2007 certified him as medically qualified 9 months later, with no mention of OSA on the DOT fitness exam forms. In February 2010, on the same day that the personal physician again certified the driver as qualified, records show that the driver complained of fatigue. Although the physician wrote a referral for another sleep study in May 2010, the driver did not obtain the test.

The NTSB concludes that the truck driver had severe, untreated OSA that likely affected his alertness, but he did not disclose this diagnosis on the DOT fitness exam forms and continued to operate as a CMV driver; moreover, though his personal physician was aware of his severe OSA, on two occasions he medically certified the driver. During the postcrash CR, the FMCSA cited the driver for making a false entry on his medical examiner's certificate; however, no action was taken to disqualify his medical certification or to require that he provide evidence of treatment for OSA.

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<sup>68</sup> BMIs at or above this level are strongly associated with OSA (Islam and others 2010).

## 2.4.2 Previous Safety Recommendations

The NTSB has investigated a number of accidents involving operators with sleep disorders in all modes of passenger transportation. In an October 2009 safety recommendation letter to the FMCSA—based on investigation of the July 26, 2000, work zone collision between a tractor-semitrailer and a law enforcement vehicle in Jackson, Tennessee (NTSB 2002), among other investigations—the NTSB (2009) made the following recommendations:

Implement a program to identify commercial drivers at high risk for obstructive sleep apnea and require that those drivers provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (H-09-15)

Develop and disseminate guidance for commercial drivers, employers, and physicians regarding the identification and treatment of individuals at high risk of obstructive sleep apnea (OSA), emphasizing that drivers who have OSA that is effectively treated are routinely approved for continued medical certification. (H-09-16)

Safety Recommendations H-09-15 and -16 are classified “Open—Acceptable Response.”

## 2.4.3 FMCSA Initiatives

Over the past decade, the FMCSA has examined OSA issues in great detail. The agency convened a medical expert panel (MEP) on the topic of OSA in 2007, and the panel’s recommendation report was made public in January 2008 (FMCSA 2008). The FMCSA also solicited and received guidance from its Medical Review Board (MRB), an advisory body established by Congress in 2005.<sup>69</sup> In 2010, the MRB recommended OSA screening for all drivers with BMIs over 30.<sup>70</sup>

In August 2011, the FMCSA tasked its Motor Carrier Safety Advisory Committee (MCSAC) and the MRB to jointly provide information the agency should consider in developing OSA regulatory guidance for motor carriers, CMV drivers, and medical examiners, and in determining whether drivers with this condition should be medically certified to operate CMVs in interstate commerce. MCSAC and the MRB submitted short-term recommendations to the FMCSA in December 2011 and long-term recommendations for regulatory action in February 2012. The recommendations included specific criteria for unconditional and

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<sup>69</sup> According to [www.mrb.fmcsa.dot.gov/](http://www.mrb.fmcsa.dot.gov/), “The MRB is composed of five of our Nation’s most distinguished and scholarly practicing physicians. These physicians were chosen from a field of many qualified candidates who possess a wide variety of expertise and experience. MRB members specialize in the areas most relevant to the bus and truck driver population. The MRB will provide information, advice, and recommendations to the Secretary of Transportation and the FMCSA Administrator on the development and implementation of science-based physical qualification standards.”

<sup>70</sup> Summary of the FMCSA MRB Recommendations, updated June 17, 2010.

conditional certification of drivers with OSA.<sup>71</sup> On April 20, 2012, the FMCSA published the MCSAC–MRB recommendations in a Request for Public Comment; however, the request was withdrawn a week later and was not republished.<sup>72</sup> At present, though recommendations from the MEP and MRB reports are available to the public, it is not clear whether the FMCSA has accepted or endorsed those recommendations—or any recommendations from these advisory groups.

On October 15, 2013, the president signed Public Law 113-45, which states that the “Secretary of Transportation may implement or enforce a requirement providing for the screening, testing, or treatment (including consideration of all possible treatment alternatives) of individuals operating commercial motor vehicles for sleep disorders only if the requirement is adopted pursuant to a rulemaking proceeding.”<sup>73</sup> It further states that this requirement will “not apply to a requirement that was in force before September 1, 2013.” Thus, the FMCSA could clarify existing guidance regarding the certification of commercial drivers with a diagnosis of OSA.

In April 2014, the FMCSA published guidance and advisory criteria concerning several disorders in its online *Medical Examiner Handbook*, including guidance for the certification or recertification of drivers with chronic sleep disorders.<sup>74</sup> Although the guidance does not provide any information about screening commercial drivers for OSA, it does provide specific examples of when drivers with sleep disorders should not be certified (if the driver has narcolepsy or untreated symptomatic OSA) and of when a 1-year certification is recommended (if successful nonsurgical therapy with resolution of apneas is confirmed by a repeated sleep study during treatment).

In the Rosedale crash, it is not clear whether the truck driver’s personal physician was aware of the risks of OSA or his responsibility to restrict or withhold the driver’s medical certification pending successful resolution of the disease. Although the current *Medical Examiner Handbook* does not fully address all the elements of NTSB Safety Recommendations H-09-15 and -16, it represents a step forward in providing some guidance on OSA and other sleep disorders. The NTSB encourages the FMCSA to continue its efforts to provide guidance concerning OSA not only to physicians, but also to drivers and their employers. The NTSB also encourages the FMCSA to implement the recommended program to screen and fully evaluate commercial drivers at high risk for OSA, even if such a program must be established through a rulemaking proceeding. Pending completion of these actions, Safety Recommendations H-09-15 and -16 remain classified “Open—Acceptable Response.”

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<sup>71</sup> See [www.mrb.fmcsa.dot.gov/documents/Meetings2012/Task11-05FinalCoverLetterandReport\\_2-21-12.docx](http://www.mrb.fmcsa.dot.gov/documents/Meetings2012/Task11-05FinalCoverLetterandReport_2-21-12.docx), accessed April 22, 2014.

<sup>72</sup> See 77 FR 23794, April 20, 2012; and 77 FR 25226, April 27, 2012.

<sup>73</sup> See [www.gpo.gov/fdsys/pkg/PLAW-113publ45/html/PLAW-113publ45.htm](http://www.gpo.gov/fdsys/pkg/PLAW-113publ45/html/PLAW-113publ45.htm), accessed March 24, 2014.

<sup>74</sup> See [nrcme.fmcsa.dot.gov/mehandbook/respiratory4\\_dis\\_secondary\\_sleep\\_ep.aspx](http://nrcme.fmcsa.dot.gov/mehandbook/respiratory4_dis_secondary_sleep_ep.aspx), accessed April 22, 2014.

## 2.4.4 Safety Recommendations

The circumstances of this crash, in which the driver was not medically disqualified even after the FMCSA cited him for making a false entry on his medical examiner's certificate, suggest that—in addition to providing guidance to drivers, employers, and physicians concerning OSA—the FMCSA should also create a policy for reporting medically related violations to states or others with the authority to disqualify or restrict medical certification. Therefore, the NTSB recommends that the FMCSA develop a system whereby the authority responsible for issuing commercial driver medical certification will be notified when FMCSA investigators discover violations that could result in a driver's medical disqualification.

## 2.5 Safety Systems at Private Grade Crossings

### 2.5.1 Accident Grade Crossing

When NTSB investigators asked the truck driver why he did not stop in advance of the grade crossing, he said that he did not like stopping at the crossing because he “had to stop nearly on the tracks to be able to see.” The results of postcrash measurements with a three-dimensional scanner and tests with an exemplar truck showed that when the front of the truck was positioned facing northwest on the private road 15 feet from the nearest rail, a driver looking to the right could have seen only about 230 feet down the tracks due to the roadway curvature and vegetation. The available sight distance was well below the 1,205 feet of clearing sight distance indicated by AASHTO (2011) and the FHWA (2007) for a 73.5-foot-long truck-tractor semitrailer at a level 90 degree one-track crossing.<sup>75</sup>

Investigators estimated that the driver would have had to position the front of the truck approximately 7–8 feet from the nearest rail to be able to see 1,000 feet or more down the tracks.<sup>76</sup> The analysis also showed that the sharp horizontal roadway curve near the crossing, along with the skewed (83–86 degree) crossing angle, further reduced the sight distance triangle—which was already negatively affected by vegetation growth. The NTSB concludes that the vegetation and sharp horizontal curve near the highway–railroad grade crossing limited the truck driver's ability to see oncoming trains on the approach to the crossing.

In the months following the crash, NTSB investigators also evaluated the safety of four highway–railroad grade crossings nearby—three private and one public. They found that each of the private crossings had visibility obstructions that were equivalent to or worse than those at the accident crossing.

On June 12, 2013, NTSB investigators requested that CSXT cut back vegetation at the accident crossing to improve sight lines and also work with MDSHA to perform an engineering analysis to determine if upgraded warning devices were needed. CSXT responded by trimming the vegetation approximately 27.5 feet from the nearest rail and installing a YIELD sign at the

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<sup>75</sup> The AASHTO guide does not apply to private grade crossings. It is used in this report for comparative purposes.

<sup>76</sup> The prescribed distance for the train's dynamic envelope (danger zone) is 6 feet from the rail.

northwest approach to the crossing, but stated that it expected MDSHA to take the lead in the diagnostic process to determine if additional improvements were needed. Although it appears that Maryland state laws give MDSHA the authority to evaluate and modify private grade crossings, the agency refused, citing liability concerns and a prohibition in 23 USC Section 130 against using federal funds for improvements at private crossings.<sup>77</sup>

## 2.5.2 Public–Private Design and Maintenance Responsibilities

The inadequate sight distances at the private highway–railroad grade crossings observed during this investigation, as well as the lack of a comprehensive response from multiple parties to address the safety deficiencies at the accident crossing, reflect a larger problem affecting safety at private grade crossings. The design and maintenance of such crossings are typically governed by agreements between private landowners and the railroads. As noted in section 1.8, neither CSXT nor the state of Maryland accepted responsibility for the clearance of vegetation or the posting of signage at the crossing. Despite the seriousness of this crash, this issue was not resolved, and another collision occurred at the same crossing on August 5, 2014. Examination of the crossing and the surrounding area on that day indicated that visibility was still limited.

On August 11, 2014, CSXT stated:

Regardless of fault, train accidents endanger the traveling public, CSXT’s employees, neighbors, and the environment. Because CSXT is committed to minimizing such risks, CSXT is actively investigating additional safety measures that it can take at the accident crossing. This week, CSXT is working on removing all of the trees, shrubbery, and fencing on its property near the crossing. This will improve visibility both at the crossing and along the road approaching the crossing, increasing opportunities for drivers to have notice of approaching trains. After the foliage and fencing are gone, CSXT will re-evaluate visibility at the crossing and assess possible additional measures.

On August 25, 2014, an NTSB investigator documented the area surrounding the accident grade crossing and observed that substantial clearing of trees and other foliage had taken place at all four quadrants of the crossing. In addition, STOP signs and signs that read “PRIVATE CROSSING—LOOK” had been installed at both approaches to the crossing.

The NTSB is encouraged by CSXT actions to improve visibility and safety at the accident grade crossing. However, at present, there are no systematic efforts to identify hazardous grade crossings, and few state laws give state agencies the authority to evaluate

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<sup>77</sup> The railway–highway crossings program provides for up to \$220 million in funds annually from the Highway Safety Improvement Program to be used to fund safety improvements to reduce fatalities, injuries, and crashes at public grade crossings (23 USC Section 130). In accordance with the law, each state must conduct and systematically maintain a survey of all highways to identify those railroad crossings that may require safety improvements and implement a schedule of projects for this purpose. Fifty percent of a state’s apportionment is dedicated to the installation of protective devices at public crossings. The remainder of the funds can be used for any hazard elimination project. If a state satisfactorily demonstrates that it has met all its needs for installation of protective devices at railway–highway crossings, the funds can be used for other highway safety improvement purposes (23 USC 130(e)). See [www.fhwa.dot.gov/map21/factsheets/rhc.cfm](http://www.fhwa.dot.gov/map21/factsheets/rhc.cfm), accessed June 16, 2014.

private crossings and to require that they be safe. Although private grade crossings used solely by private landowners may not present a significant hazard, many such crossings are accessible to the public and—because public roads can flow seamlessly into private roads—give the appearance of being public roads. Furthermore, as demonstrated in this crash, the damage caused by collisions at private highway–railroad grade crossings can extend beyond the borders of the private land and threaten the safety of neighboring communities. The NTSB concludes that there was a lack of clear delineation of oversight responsibility for the design, maintenance, vegetation clearance, and implementation of safety systems at the accident grade crossing.

### 2.5.3 Previous Safety Recommendations

The NTSB has a long history of calling for safety improvements at private grade crossings. For example, in its safety study on passive grade crossings, which was based on the investigation of 60 highway–railroad grade crossing crashes, the NTSB (1998) addressed a broad range of safety issues, including the relationship between inadequate sight distances and crashes, and the need to establish clear responsibility for the safety of private crossings.<sup>78</sup> As a result of the study, the NTSB recommended that the DOT, in conjunction with the states

Determine within 2 years governmental oversight responsibility for safety at private highway–rail grade crossings and ensure that traffic control on these crossings meets the standards within the *Manual on Uniform Traffic Control Devices*. (H-98-32)

This recommendation was classified “Open—Acceptable Response” in 2004 based on DOT commitments, including an FRA plan to conduct an inquiry on issues associated with private crossings. In 2003, Safety Recommendation H-98-35, a companion recommendation made to the states, was reclassified “Closed—Unacceptable Action” based on the overall response of the states; however, for seven states the recommendation was classified “Closed—Acceptable Action.”<sup>79</sup>

Less than a year after completion of the safety study on passive grade crossings, the NTSB (1999) concluded that the probable cause of the June 18, 1998, collision involving a passenger train and a long combination vehicle in Portage, Indiana, was ineffective action by federal, state, and private agencies to eliminate safety problems at the accident grade crossing. As a result of this investigation, the NTSB recommended that the DOT

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<sup>78</sup> The other issues addressed in the study were (a) the adequacy of warning systems at passive crossings; (b) roadway and track conditions that affect a driver’s ability to detect an oncoming train; (c) behavioral factors that affect a driver’s ability to detect an oncoming train; (d) the adequacy of existing driver education material regarding safety at passive grade crossings; and (e) the need for a systematic and uniform approach to passive grade crossing safety.

<sup>79</sup> These seven states were Alaska, Hawaii, Minnesota, New Hampshire, New Jersey, North Dakota, and Rhode Island. The Maryland recommendation was classified “Closed—Reconsidered” in February 1999, based on the state’s claim that it already had jurisdiction over private crossings.

Eliminate any differentiations between private and public highway–rail grade crossings with regard to providing funding for, or requiring the implementation of, safety improvements. (I-99-2)

## 2.5.4 DOT Oversight

**2.5.4.1 Private Grade Crossings.** In a December 23, 1998, letter to the NTSB, with respect to clarifying oversight responsibility for safety at private crossings, the DOT stated, “The Department recognizes this as a necessary step for improving overall crossing safety.” However, in the following years, the DOT was not successful in addressing private grade crossing safety. For example, in 1999, the FHWA proposed adding language to the MUTCD to define private highway–railroad grade crossings and issuing standards for traffic control devices at those crossings.<sup>80</sup> In response to that proposal, the NTSB classified Safety Recommendation I-99-2 “Open—Acceptable Response.” However, the agency ultimately did not make those changes, citing objections from the railroad industry and from states concerning economic impacts and jurisdiction over private roads.<sup>81</sup> Also, in 1997, the DOT included in its National Economic Crossroads Transportation Efficiency Act reauthorization package a proposal to allow the use of federal (Section 130) safety funds for improvements to private crossings that serve the public need;<sup>82</sup> however, Congress did not include the provision in the 1998 Transportation Equity Act for the 21st Century.

In 2006, the FRA (2010) commenced a safety inquiry into private crossings, concluding that, among 34 findings:

- The data currently stored in the Grade Crossing Inventory for private crossings are generally not current and not suited for most analyses, and were historically not intended to support effective resource allocation.
- Absence of a cohesive policy or regulatory structure has led to the existence of private crossings that are redundant, inadequately designed, and/or poorly maintained.
- Motorists represent only a portion of the populations at risk because of incidents at private crossings. The risks of collision and of derailment mean that the train crews, train passengers, and others in the vicinity of the crossing may be exposed to derauling equipment or hazardous materials releases.
- Because crossing signage is inconsistent and can vary greatly depending on [the] crossing, it is evident that a minimum standard is necessary.

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<sup>80</sup> See 64 FR 244, December 21, 1999, or docket FHWA-1999-6298.

<sup>81</sup> The FHWA added a definition for “private road open to public travel” to the MUTCD in 2009; however, the new definition exempts private highway–railroad grade crossings. See [mutcd.fhwa.dot.gov/pdfs/2009/pdf](http://mutcd.fhwa.dot.gov/pdfs/2009/pdf), part 3, Markings, 347, accessed August 15, 2014.

<sup>82</sup> See [www.epw.senate.gov/105th/dot\\_5-07.htm](http://www.epw.senate.gov/105th/dot_5-07.htm), accessed February 25, 2014.



- Population increases, changes in land use, and both recent and projected growth in rail and highway traffic suggest that exposure to incident risk at private crossings is likely to continue increasing. Accordingly, the number of opportunities for incidents, and therefore for casualties, will also increase unless new initiatives for improving private crossing safety are not [*sic*] identified and effectively implemented.

The NTSB concludes that the DOT's efforts to improve government oversight of private highway–railroad grade crossings over the past two decades have largely been unsuccessful. Therefore, the NTSB reclassifies Safety Recommendations H-98-32 and I-99-2 “Closed—Unacceptable Action.” The NTSB concludes that because private highway–railroad grade crossings continue to pose a risk to the safety and health of motorists, train crews, and train passengers—as well as to surrounding communities—actions are needed to identify high-risk private highway–railroad grade crossings and to implement safety improvements at the local level.

**2.5.4.2 Grade Crossing Inventory.** Despite its lack of currency, the grade crossing inventory represents the best available source of information about the nation's private highway–railroad grade crossings and a potential means of identifying high-risk crossings. The states currently use grade crossing inventory data to identify high-risk public crossings using tools such as the FRA WBAPS, as described in section 1.8.4. Additionally, a new tool—the rail crossing locator smartphone mobile application—can be used to locate crossings and to report safety concerns to the FRA.<sup>83</sup>

During the early stages of this investigation, there was confusion about the DOT number for the accident crossing and whether the crossing was considered public or private. It was eventually determined that the emergency notification sign at the crossing was incorrect and that there were corresponding errors in the grade crossing inventory database. Although some of the errors were corrected in the weeks after the crash, other errors remained in the database for more than 6 months. Such errors are consistent with the 2010 FRA finding that data in the grade crossing inventory are not current.

In response to a RSIA directive to update the grade crossing inventory, the FRA published a notice of proposed rulemaking (NPRM), “National Highway–Rail Crossing Inventory Reporting Requirements,” in October 2012.<sup>84,85</sup> According to the NPRM, the crossing inventory is intended to provide a uniform database that can be merged with highway–railroad crossing collision files to analyze information for improvement programs by public and private agencies, as well as the railroad industry and academia. The NPRM proposed to require railroads to submit information about all new public and previously unreported private highway–railroad crossings and pathway crossings and to periodically update the data. A DOT (2013) Office of

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<sup>83</sup> See [www.fra.dot.gov/eLib/details/L04641](http://www.fra.dot.gov/eLib/details/L04641), accessed April 22, 2014.

<sup>84</sup> Through RSIA, Congress called on railroads to ensure that the Secretary of Transportation receives information about each previously unreported crossing and to periodically report “current information, including information about warning devices and signage, as specified by the Secretary, concerning each crossing through which it operates or with respect to the trackage over which it operates.”

<sup>85</sup> See 77 FR 64077, October 18, 2012.

Inspector General report noted that the FRA has missed several statutory deadlines for rules called for in RSIA, including those addressing the grade crossing inventory.

## 2.5.5 Safety Recommendations

**2.5.5.1 Data Collection and Risk Assessment.** Because inventory and crash data for private crossings are limited, and the potential exists for those data to improve as a result of the final rule, the NTSB recommends that the FRA require equivalent levels of reporting for both public and private highway–railroad grade crossings. The NTSB also recommends that the FRA develop an algorithm using grade crossing inventory and accident history data to provide annual crash prediction estimates for private highway–railroad grade crossings, similar to its WBAPS tool for public grade crossings, and make the results easily accessible to states, railroads, and the public.

Crash prediction estimates based on grade crossing inventory data could serve as one important tool to identify high-risk private highway–railroad grade crossings. However, such systems rely heavily on previous crash data to predict future events. Additionally, WBAPS—the tool used by the FRA to estimate accident prediction values—does not incorporate several critical crossing characteristics, including sight distance, local topography, and hazardous materials traffic.

Railroad personnel could supplement grade crossing inventory data by conducting first-hand observations at crossings to identify visual obstructions or other hazards. Similarly, railroads are aware of those routes on which they are most likely to carry hazardous materials. Because railroads regularly inspect the tracks and remove vegetation in their rights-of-way, they are in a unique position to identify and correct certain hazardous conditions. The NTSB, therefore, recommends that the Association of American Railroads and the American Short Line and Regional Railroad Association develop and disseminate to their members a model program for railroads to (1) evaluate the safety of private highway–railroad grade crossings in their territories, including identifying visibility obstructions and other factors that increase the risk of grade crossing collisions; and (2) work with landowners and communities to mitigate that risk.

**2.5.5.2 Safety Improvement.** Once high-risk private highway–railroad grade crossings are identified, corresponding safety improvement policies must be implemented. As described in section 1.8.8, 17 states require the removal of vegetation at or near highway–railroad grade crossings, and 23 states have laws addressing various aspects of private grade crossings. Vegetation removal laws typically specify a distance around the crossing that must remain clear or specify the parties that are responsible for maintenance of the surrounding area. With respect to laws addressing the safety of private crossings, there is considerable variability from state to state; however, several states require railroads to build or maintain private crossings in a safe condition.

The state of Maryland has no laws that specifically address vegetation removal around highway–railroad grade crossings, but it does have laws on the safety of all public and private grade crossings. According to the *Annotated Code of Maryland*, Transportation Article, MDSHA has the authority to place STOP signs at crossings designated as dangerous (§21-702) and may also impose conditions to improve safety when crossing construction or modifications are

proposed (§8-639(b)). Maryland law also states that railroads must keep their roadbeds and the highway in proper repair so as to provide absolutely safe and easy approach to and crossing of the track. Further, MDSHA may abandon, relocate, construct, or reconstruct any railroad grade crossing or railroad grade separation that is dangerous or inconvenient for public travel (§8-640). The fact that MDSHA claimed that it does not have the authority to evaluate the accident crossing or to make changes suggests that these laws are not well understood or adhered to.

In an audit of the FRA management of grade crossing safety, the DOT Office of Inspector General (2007) found 689 grade crossing collision reports involving documented sight obstructions and concluded that “FRA has no assurance that sight obstructions are addressed at passive grade crossings in most states.” The DOT called on the FRA to work with the FHWA to develop model legislation for states to improve safety by addressing sight obstructions at grade crossings that are equipped solely with signs, pavement markings, and other passive warnings. This recommendation was reflected in the language of Section 203 of RSIA, which required the FRA, as the Secretary of Transportation’s delegate, to work in consultation with the FHWA and the states to

Develop and make available to States model legislation providing for improving safety by addressing sight obstructions, including vegetation growth, topographic features and standing railroad equipment, at highway–rail grade crossings that are equipped solely with passive warnings, as recommended by the DOT Inspector General in report no. MH-2007-044.

In 2011, the FRA published a model law (the “Adequate Sight Distance at Passive Highway–Rail Grade Crossings Act”) to address sight obstructions at both public and private passive highway–railroad grade crossings. The model law, which is presented in appendix B of this report, includes a requirement for periodic evaluation of sight distance at passive grade crossings; actions to improve sight distance, including removal of obstructions or installation of traffic control devices; and penalties for private property owners who refuse to mitigate visual obstructions.

The model law calls on the states to include private grade crossings in their efforts to remove or mitigate sight obstructions at passive highway–railroad grade crossings. However, in spite of the potential safety benefits and the FRA’s outreach, in the 3 years since publication of the model law, no states have adopted it. Therefore, the NTSB recommends that the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico enact legislation adopting all elements of the FRA’s model law known as the “Adequate Sight Distance at Passive Highway-Rail Grade Crossings Act.” We also recommend that the state of Maryland work with CSXT and private landowners to conduct engineering studies of the accident grade crossing (140833J) and the three other private highway–railroad grade crossings (140831V, 140828M, and 140829U) evaluated in this investigation and take actions to improve their safety, such as removing visual obstructions, installing signage, and altering roadway geometry. The NTSB further recommends that CSXT assist the state of Maryland in taking actions identified by the state to improve the safety of the accident grade crossing (140833J) and the three other private highway–railroad grade crossings (140831V, 140828M, and 140829U) evaluated in this investigation. We also recommend that until the improvements cited in the previous recommendation are made, CSXT take action to reduce the risk of grade crossing accidents

through the corridor comprising highway–railroad grade crossings 140833J, 140831V, 140828M, and 140829U.

## 2.6 Oxidizing and Flammable or Combustible Materials

### 2.6.1 Overview

Three of the derailed train cars—7, 8, and 15—contained the hazardous materials sodium chlorate, fluorosilicic acid, and sodium hydroxide solution, respectively. The potential risks associated with in-train placement of hazardous materials include the exposure of train crews to the catastrophic effects of a release and the commingling of incompatible chemicals in transport. Because the locomotives became decoupled from the train during the crash sequence and the crew quickly moved away from the derailment location, the crewmembers were not at risk of being injured by the postcrash fire and explosion. Additionally, the six empty flat cars and box cars that separated the hazardous materials from the occupied locomotive provided additional protection to the train crew.

### 2.6.2 Derailment, Fire, and Explosion

**2.6.2.1 Sodium Chlorate and Terephthalic Acid.** Photographs and inspection of the scene clearly indicated that the postcrash fire involved both the sodium chlorate hopper car and two of the four terephthalic acid hopper cars. A piece of torn aluminum shell found immediately west of the final resting place of the sodium chlorate hopper car suggested that the car body sustained a large breach that released a significant amount of sodium chlorate during the derailment. Sodium chlorate crystals are a strong oxidizer and require suitable combination with a combustible material to react and sustain a fire.<sup>86</sup>

The cars containing terephthalic acid also derailed and discharged some of their lading. Dust clouds of terephthalic acid—a combustible organic acid in finely divided granular form—are capable of forming hazardous explosive mixtures. There was a relative lack of other bulk combustible materials, except for the railroad ties that had been consumed in the area of the derailment and possibly the lubricants and dried grease on the trucks of the derailed cars.

The NTSB concludes that the force of the derailment likely caused finely divided particles of sodium chlorate and terephthalic acid to combine and react, leading to the observed fire—which likely heated the sodium chlorate within the hopper car, resulting in the explosion. Likely ignition scenarios include an exothermic reaction between the sodium chlorate crystals and organic materials such as the terephthalic acid, rail ties, and lubricants—or sparks caused by the impact and frictional forces generated during the derailment sequence. Within minutes of the collision and fire, the sodium chlorate hopper car exploded. According to the manufacturer's material safety data sheet, when sodium chlorate is heated above 265°C (510°F), it can violently decompose and cause an explosion.

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<sup>86</sup> An oxidizer on its own cannot combust.

**2.6.2.2 In-Train Placement of Commodities.** The circumstances of this crash did not involve the improper segregation of two incompatible hazardous materials, but rather rail car placement—involving a hazardous material and a nonregulated commodity.<sup>87</sup> The sodium chlorate hopper car was separated from the terephthalic acid cars by a residue tank car of nonflammable fluorosilicic acid. However, because some of the cars derailed accordion-style, the sodium chlorate car came to rest near the block of terephthalic acid hopper cars. Based on the chemical hazards identified for sodium chlorate, a class 5.1 oxidizer, had it contacted any other nonregulated, dry bulk combustible commodity—such as wood pulp, paper, or plastic pellets—a similar postcrash fire could have occurred.

In a report to Congress concerning the safe placement of train cars, the FRA (2005) concluded, “Risk analysis regarding product combinations has not indicated any compelling need to alter existing requirements that provide for the separation of certain commodities to limit, insofar as is practical, undesirable interactions should the train derail. Accordingly, existing in-train placement requirements appear to provide for an appropriate level of safety.” Additionally, a review of incident report data contained in the DOT hazmat intelligence portal yielded no evidence to suggest that the placement of sodium chlorate hopper cars near nonregulated combustible materials poses a high risk.<sup>88</sup> The review found that over the 23-year history of aluminum hopper cars transporting sodium chlorate, 18 serious accidents have occurred, none of which—apart from the Rosedale, Maryland, crash—involved an explosion. Nonetheless, the circumstances of this crash demonstrate the potential for oxidizers to produce violent explosions when heated by fire, or commingled with combustible or flammable materials.

Hazardous materials regulations at 49 CFR 172.602 require supplemental emergency response information, including the risk of fire or explosion, to be provided on a shipping paper or other document. In this case, the sodium chlorate hazardous materials information was appended to the train consist and clearly described the associated risks of fire and explosion.<sup>89</sup> However, because the explosion occurred within minutes of the derailment, emergency responders would not have had adequate time to review the train consist had that been their only available source of information.<sup>90</sup>

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<sup>87</sup> In accordance with the restrictions of 49 CFR 174.85, rail cars containing class 5 oxidizers may not be placed next to certain other hazardous materials, including division 1.1 and 1.2 explosives, class 2.3 poisonous gases and certain class 6.1 poisonous liquids, and class 7 radioactive materials. The placement of rail cars containing class 5 oxidizers next to class 3 flammable materials or nonregulated combustible materials, such as terephthalic acid, is not prohibited.

<sup>88</sup> The hazmat intelligence portal is an information repository designed by PHMSA to facilitate the analysis and identification of hazardous materials safety trends. See [hip.phmsa.dot.gov/EntryWeb/abouthip.html](http://hip.phmsa.dot.gov/EntryWeb/abouthip.html), accessed February 26, 2014.

<sup>89</sup> Title 49 CFR 174.26 requires that a train crew have a train consist that reflects the current position in the train of each rail car containing a hazardous material. The train consist must be maintained on board the occupied locomotive of every train.

<sup>90</sup> CSXT verbally communicated information about the hazardous materials to the emergency responders, with the exception of the MDTA police officer who had been injured earlier by the explosion.

### **2.6.3 Safety Recommendations**

The NTSB concludes that though accident statistics indicate that explosions involving bulk oxidizer shipments are rare events, the potential for death or serious injury is significant, and emergency responders should be reminded that derailments involving rail car fires can occasionally have such catastrophic outcomes. Therefore, the NTSB recommends that the National Fire Protection Association notify its members of the circumstances of the Rosedale, Maryland, crash and advise them of the potential sudden and catastrophic consequences when oxidizing materials are exposed to heat or to combustible or flammable materials.

## 3 Conclusions

### 3.1 Findings

1. None of the following were factors in the crash: (1) mechanical condition of the roll-off truck, (2) mechanical condition of the train, (3) driver experience or licensing, (4) alcohol or drug use, (5) weather, or (6) operation of the train through the grade crossing.
2. Neither the mechanical condition of the sodium chlorate hopper car nor its loading contributed to the release of sodium chlorate or to the explosion following the derailment.
3. The emergency response and fire suppression activities were timely and effective.
4. Had the truck driver slowed and stopped his truck before traversing the crossing, he could have seen the train and the crash could have been prevented.
5. The truck driver was distracted by his hands-free cell phone conversation.
6. Alban Waste, LLC, demonstrated a consistent and serious pattern of noncompliance with the *Federal Motor Carrier Safety Regulations* from the time that it registered as a carrier until the crash.
7. The Federal Motor Carrier Safety Administration was aware of problems with Alban Waste, LLC, since November 2011 but did not take adequate steps to ensure that the carrier complied with the *Federal Motor Carrier Safety Regulations* or, failing that, to prevent its operation.
8. Stronger oversight of new entrants is needed to ensure that carriers address safety deficiencies in a timely fashion and are swiftly placed out of service if they fail to improve.
9. The truck driver had severe, untreated obstructive sleep apnea that likely affected his alertness, but he did not disclose this diagnosis on the US Department of Transportation fitness exam forms and continued to operate as a commercial motor vehicle driver; moreover, though his personal physician was aware of his severe obstructive sleep apnea, on two occasions he medically certified the driver.
10. The vegetation and sharp horizontal curve near the highway–railroad grade crossing limited the truck driver’s ability to see oncoming trains on the approach to the crossing.
11. There was a lack of clear delineation of oversight responsibility for the design, maintenance, vegetation clearance, and implementation of safety systems at the accident grade crossing.

12. The US Department of Transportation's efforts to improve government oversight of private highway–railroad grade crossings over the past two decades have largely been unsuccessful.
13. Because private highway–railroad grade crossings continue to pose a risk to the safety and health of motorists, train crews, and train passengers—as well as to surrounding communities—actions are needed to identify high-risk private highway–railroad grade crossings and to implement safety improvements at the local level.
14. The force of the derailment likely caused finely divided particles of sodium chlorate and terephthalic acid to combine and react, leading to the observed fire—which likely heated the sodium chlorate within the hopper car, resulting in the explosion.
15. Although accident statistics indicate that explosions involving bulk oxidizer shipments are rare events, the potential for death or serious injury is significant, and emergency responders should be reminded that derailments involving rail car fires can occasionally have such catastrophic outcomes.

### **3.2 Probable Cause**

The National Transportation Safety Board determines that the probable cause of the Rosedale, Maryland, crash was the truck driver's failure to ensure that the tracks were clear before traversing the highway–railroad grade crossing. Contributing to the crash were (1) the truck driver's distraction due to a hands-free cell phone conversation; (2) the limited sight distance due to vegetation and roadway curvature; and (3) the Federal Motor Carrier Safety Administration's inadequate oversight of Alban Waste, LLC, which allowed the new entrant motor carrier to continue operations despite a serious and consistent pattern of safety deficiencies. Contributing to the severity of the damage was the postcrash fire and the resulting explosion of a rail car carrying sodium chlorate, an oxidizer.



## 4 Recommendations

As a result of its investigation, the National Transportation Safety Board makes the following safety recommendations.

### 4.1 New Recommendations

#### **To the Federal Motor Carrier Safety Administration:**

Modify Title 49 *Code of Federal Regulations* 392.82 to prohibit any use of a hands-free portable electronic device by a commercial driver's license holder while the driver is operating a commercial vehicle, except in emergencies. (H-14-26)

Require a full compliance review of new entrants that fail their safety audits, fail their corrective action plans, or are issued expedited action letters. (H-14-27)

Establish criteria for revoking the certification of any new entrant that demonstrates a pattern of safety deficiencies. (H-14-28)

Develop a system whereby the authority responsible for issuing commercial driver medical certification will be notified when Federal Motor Carrier Safety Administration investigators discover violations that could result in a driver's medical disqualification. (H-14-29)

#### **To the Federal Railroad Administration:**

Require equivalent levels of reporting for both public and private highway–railroad grade crossings. (R-14-48)

Develop an algorithm using grade crossing inventory and accident history data to provide annual crash prediction estimates for private highway–railroad grade crossings, similar to your WBAPS tool for public grade crossings, and make the results easily accessible to states, railroads, and the public. (R-14-49)

#### **To the 50 states, the District of Columbia, and the Commonwealth of Puerto Rico:**

Enact legislation adopting all elements of the Federal Railroad Administration's model law known as the "Adequate Sight Distance at Passive Highway–Rail Grade Crossings Act." (R-14-50)

**To the state of Maryland:**

Work with CSX Transportation Company and private landowners to conduct engineering studies of the accident grade crossing (140833J) and the three other private highway–railroad grade crossings (140831V, 140828M, and 140829U) evaluated in this investigation, and take actions to improve their safety, such as removing visual obstructions, installing signage, and altering roadway geometry. (R-14-51)

**To the Association of American Railroads and the American Short Line and Regional Railroad Association:**

Develop and disseminate to your members a model program for railroads to (1) evaluate the safety of private highway–railroad grade crossings in their territories, including identifying visibility obstructions and other factors that increase the risk of grade crossing collisions; and (2) work with landowners and communities to mitigate that risk. (R-14-52)

**To the National Fire Protection Association:**

Notify your members of the circumstances of the Rosedale, Maryland, crash and advise them of the potential sudden and catastrophic consequences when oxidizing materials are exposed to heat or to combustible or flammable materials. (R-14-53)

**To CSX Transportation Company:**

Assist the state of Maryland in taking actions identified by the state to improve the safety of the accident grade crossing (140833J) and the three other private highway–railroad grade crossings (140831V, 140828M, and 140829U) evaluated in this investigation. (R-14-54)

Until the improvements cited in Safety Recommendation R-14-54 are made, take action to reduce the risk of grade crossing accidents through the corridor comprising highway–railroad grade crossings 140833J, 140831V, 140828M, and 140829U. (R-14-55)

## 4.2 Previous Recommendations Reiterated in This Report

The National Transportation Safety Board also reiterates the following safety recommendations:

### **To the Federal Motor Carrier Safety Administration:**

Require all new motor carriers seeking operating authority to demonstrate their safety fitness prior to obtaining new entrant operating authority by, at a minimum: (1) passing an examination demonstrating their knowledge of the *Federal Motor Carrier Safety Regulations*; (2) submitting a comprehensive plan documenting that the motor carrier has management systems in place to ensure compliance with the *Federal Motor Carrier Safety Regulations*; and (3) passing a Federal Motor Carrier Safety Administration safety audit, including vehicle inspections. (H-03-2)

As a component of your new entrant safety audits, review with each new entrant motor carrier a structured process, such as the Safety Management Cycle, to (1) identify the root cause of safety risks and (2) maintain an effective safety assurance program. (H-12-31)

### **To the 50 states and the District of Columbia:**

(1) Ban the nonemergency use of portable electronic devices (other than those designed to support the driving task) for all drivers; (2) use the National Highway Traffic Safety Administration model of high visibility enforcement to support these bans; and (3) implement targeted communication campaigns to inform motorists of the new law and enforcement, and to warn them of the dangers associated with the nonemergency use of portable electronic devices while driving. (H-11-39)

## 4.3 Previous Recommendations Reclassified in This Report

The National Transportation Safety Board reclassifies the following safety recommendations to the US Department of Transportation:

Determine within 2 years governmental oversight responsibility for safety at private highway–rail grade crossings and ensure that traffic control on these crossings meets the standards within the *Manual on Uniform Traffic Control Devices*. (H-98-32)

Eliminate any differentiations between private and public highway–rail grade crossings with regard to providing funding for, or requiring the implementation of, safety improvements. (I-99-2)

Safety Recommendations H-98-32 and I-99-2 are reclassified “Closed—Unacceptable Action.”

**BY THE NATIONAL TRANSPORTATION SAFETY BOARD**

**CHRISTOPHER A. HART**  
Acting Chairman

**ROBERT L. SUMWALT**  
Member

**MARK R. ROSEKIND**  
Member

**EARL F. WEENER**  
Member

**Adopted: October 8, 2014**

## Appendix A: Investigation

The National Transportation Safety Board was notified of this crash on May 28, 2013. An investigative team comprising staff from the Office of Board Member Robert L. Sumwalt; the Office of Highway Safety; the Office of Railroad, Pipeline and Hazardous Materials; the Office of Research and Engineering; and the Office of Communications was dispatched to the site. Groups were established to investigate human performance, motor carrier operations, vehicle recorders, highway factors, vehicle factors, survival factors, hazardous materials, and railroad operations. Member Sumwalt was the spokesperson on scene.

Parties to the investigation were representatives from the Federal Motor Carrier Safety Administration; Federal Railroad Administration; Federal Highway Administration; Maryland State Police; Baltimore County Police; Baltimore County Fire Department; Maryland State Highway Administration; CSX Transportation Company; Brotherhood of Locomotive Engineers and Trainmen; International Association of Sheet Metal, Air, Rail and Transportation Workers; Mack Trucks, Inc.; and PROCOR Limited.

No depositions were taken, and no public hearing was held.

## **Appendix B: Model State Law to Address Sight Obstructions at Passive Highway–Rail Grade Crossings**

### **ADEQUATE SIGHT DISTANCE AT PASSIVE HIGHWAY–RAIL GRADE CROSSINGS ACT**

Section 1. Section 1 would provide that the Act may be cited as the “Adequate Sight Distance at Passive Highway-Rail Grade Crossings Act”.

Section 2. Section 2 would provide that the purpose of this Act would be to mandate that the highest official of the public authority that has responsibility to inspect highway-rail grade crossings (hereinafter referred to as the “head of the responsible public agency”) establish a Statewide program to improve sight distance at passive highway-rail grade crossings. Sight distance obstructions, such as vegetation, topographic features, structures and standing railroad equipment, have been shown to contribute to grade crossing collisions by reducing the road user’s ability to detect approaching trains and other railroad equipment. In the absence of train-activated warning devices, such as automatic gates and flashing lights, sight distances at highway-rail grade crossings play a critical role in the road user’s determination as to whether it will be safe to enter and travel through the crossing.

Section 3. Section 3 consists of two broad proposals. The first would require the head of the responsible public agency to establish a program to improve sight distances at passive highway-rail grade crossings. The second proposal would establish a minimum and maximum stopping distance requirement for road users of passive highway-rail grade crossings.

Under the first proposal addressing sight distances, the responsible public agency would conduct periodic evaluations of the clearing sight distance, corner sight distance, and stopping sight distance at passive highway-rail grade crossings and take corrective action where needed. Section 3 would also establish a minimum and maximum stopping distance requirement for road users at passive highway-rail grade crossings.

If the Act is enacted, the responsible public agency charged with implementation of this sight-distance evaluation program should employ the sight distance analysis methods outlined in the publication entitled, “Guidance On Traffic Control Devices At Highway-Rail Grade Crossings,” and “Railroad-Highway Grade Crossing Handbook – Revised Second Edition (August 2007)” which have been published by the Federal Highway Administration (FHWA). In addition, personnel qualified in engineering and design should be deployed by the responsible public agency to perform the sight distance evaluations that are required herein. The responsible public agency should also consider including provision, in its sight-distance evaluation program, for unscheduled or “expedited” sight distance evaluations, in response to complaints regarding moveable objects (such as standing rail equipment) that may be obstructing the required clearing sight distance, corner sight distance, or stopping sight distance at individual passive highway-rail grade crossings.

Subsection (b) would address the requisite inspection authority that the responsible public agency would need to implement the sight-distance evaluation program described in subsection (a). At a minimum, officers, employees, and agents of the responsible public agency would need authority to enter private, as well as public, property for the purposes of determining the adequacy of the clearing sight distance, corner sight distance, and stopping sight distance at passive highway-rail grade crossings and evaluating sight distance obstructions caused, in whole or in part, by structures, topography, standing railroad equipment, trees, and other vegetation located within close proximity to those crossings.

Subsection (c) would require the responsible public agency to take action, upon discovery of an obstruction of the clearing sight distance, corner sight distance, or stopping sight distance at a passive highway-rail grade crossing. In light of the economic realities associated with the removal of permanent physical obstructions, subsection (c)(1) would provide a list of alternate options that would be authorized to be available to the responsible public agency in order to mitigate the impact of the obstruction. For example, if removal of the obstruction would be cost-prohibitive or otherwise unfeasible, the responsible public agency may choose to install speed limit signs with a reduced regulatory speed or advisory speed plaques to better accommodate a limited corner sight distance condition.

Subsection (c)(2) would contain a penalty provision for use by the responsible public agency, should the responsible public agency choose to order a railroad corporation or other private property owner to remove or otherwise mitigate an obstruction located on private property. This penalty reflects current civil penalty provisions under State law for the failure of railroad companies to comply with vegetation standards at highway-rail grade crossings. See ARK. CODE ANN. § 23-12-201 (Michie 2010)(Arkansas law that imposes a fine of not less than \$100 or more than \$500 for each violation); IND. CODE § 8-6-7.6-2 (2010); LA. REV. STAT. ANN. § 48:386.1 (West 2010)(Indiana and Louisiana laws that impose a fine of \$100 per day subject to a maximum fine of \$5,000); MINN. STAT. ANN. § 219.384 (West 2010)(Minnesota law that imposes a fine of \$50 per day); S.C. CODE ANN. § 58-17-4 1450 (Law. Co-op. 2009) (South Carolina law that imposes a fine of not less than \$100 or more than \$500, plus \$100 per day after a specified period of time); and VA. CODE ANN. § 56-411 (Michie 2009) (Virginia law that imposes a fine of not more than \$500 for each offense). However, the responsible public agency may also choose to exercise independent authority to address sight obstructions through the pursuit of injunctive relief against particularly recalcitrant private property owners. If the responsible public agency does not possess such authority, the State may wish to add a provision to this model state law that would confer such authority to the responsible public agency upon enactment. In recognition of the right of the railroad corporation or other private property owner to appeal an order issued by the responsible public agency in the exercise of its power of eminent domain, subsection (c)(2) would allow the railroad corporation or other private property owner to toll the issuance of civil penalties by filing an appeal of the order.

If the obstruction is located on public property maintained by a State or local government, subsection (c)(3) would authorize the responsible public agency itself to remove or otherwise mitigate the obstruction, after providing written notice and adequate opportunity for the State or local government to do so. If the responsible public agency chooses to remove or otherwise mitigate the obstruction, the responsible public agency would be authorized to seek

reimbursement for any costs incurred from the State or local government with maintenance responsibility for the public property on which the obstruction had been located. A comparable provision can be found in South Carolina law, which specifically authorizes reimbursement of expenses incurred by the State department of transportation to remove sight distance obstructions located on the right-of-way of highways and roads maintained by counties and municipalities. See S.C. CODE ANN. § 58-17-1450 (Law. Co-op. 2009).

Subsection (d) would define certain terms, including “clearing sight distance” and “corner sight distance”. With respect to the term “clearing sight distance”, it should be noted that the determination of minimum required clearing sight distance would be dependent upon maximum train speed over the crossing, as well as the length and acceleration characteristics of the various types of motor vehicles that routinely use the crossing. Similarly, the determination of “corner sight distance” would be dependent upon train and vehicular speeds on approach to the crossing. The corner sight distance requirement would, however, also require an unobstructed field of vision along the approach sight triangle.

Subsection (d) would also provide a definition of “passive highway-rail grade crossing”, which includes private and public highway-rail grade crossings that are solely equipped with traffic control devices that are not activated by trains (such as one or more signs and pavement markings). While this definition closely follows the definition of “crossing” contained in section 2 of the Rail Safety Improvement Act of 2008 (division A of Public Law No. 110-432), the definition of “passive highway-rail grade crossing” would exclude pedestrian crossings that are equipped with passive warning devices.

The second proposed amendment under Section 3 titled, “Vehicles approaching passive highway-rail grade crossings”, would establish a minimum and maximum stopping distance requirement for road users of passive highway-rail grade crossings. This amendment would also require road users to observe conditions along both directions of the railroad track and determine that the crossing will remain clear for a sufficient amount of time before entering and clearing the crossing.

Subsection (a) would establish a stopping distance requirement for road users of passive highway-rail grade crossings under certain specified conditions. This subsection would require road users to stop within 15 to 50 feet of the nearest rail of the track at the passive highway-rail grade crossing under the following conditions: 1) upon approach of a train or other railroad equipment that is likely to occupy the crossing before the road user can safely enter and clear the crossing, 2) if a train approaching the crossing is sounding the locomotive horn or other locomotive audible warning device, or 3) if a stop sign is posted at the crossing. By complying with this stopping distance requirement, the road user should be able to determine whether the crossing will remain clear long enough to safely enter and clear the railroad tracks.

Subsection (b) would govern the actions that must be taken before the road user enters the passive highway-rail grade crossing. To make a well-informed decision as to whether it will be safe to enter and travel across the crossing, especially in the absence of train-activated warning devices such as automatic gates and flashing lights, the road user must look, as well as listen, in both directions along the railroad track for evidence of an approaching train or other railroad equipment before entering the crossing. The road user may enter the crossing after determining that the crossing will remain clear for a sufficient amount of time within which to



enter, travel through the crossing, and then reach a location at which the entire length of the road user's vehicle would be at least 15 feet past the far rail prior to the arrival of a train or other railroad equipment at the crossing.

Subsection (c) would define certain terms, including "passive highway-rail grade crossing", and "road user". The definition of "passive highway-rail grade crossing" would include private and public highway-rail grade crossings that are solely equipped with traffic control devices that are not activated by trains (such as one or more signs or pavement markings). While this definition closely follows the definition of "crossing" contained in section 2 of the Rail Safety Improvement Act of 2008, the definition of "passive highway-rail grade crossing" would exclude pedestrian crossings that are equipped with passive warning devices. It should also be noted that the definition of "road user" would be somewhat broad in scope and include individuals other than motor vehicle operators, such as bicyclists, pedestrians, and persons with one or more disabilities.

## **A BILL**

To amend [State or Commonwealth Code], and for other purposes.

Be it enacted by [ ] legislature assembled in the [State or Commonwealth] of [ ],

### **SECTION 1. SHORT TITLE.**

This Act may be cited as the "Adequate Sight Distance at Passive Highway-Rail Grade Crossings Act".

### **SEC. 2. PURPOSE.**

The purpose of this Act is to establish a Statewide program to improve sight distance at passive highway-rail grade crossings.

### **SEC. 3. AMENDMENTS TO THE TRANSPORTATION LAWS.**

Section [ ] of chapter [ ], of title [ ], [State or Commonwealth General Laws], is amended [to read as follows:] [Chapter [ ] of title [ ], [State or Commonwealth General Laws], is amended by adding at the end thereof the following new sections:]

#### **"§[ ]. Adequate sight distance at passive highway-rail grade crossings**

**"(a) PERIODIC EVALUATION OF SIGHT DISTANCE AT PASSIVE HIGHWAY–RAIL GRADE CROSSINGS.**--The [head of the public authority that has the responsibility to inspect highway-rail grade crossings] (hereinafter referred to as the "head of the responsible public agency") shall establish a program to determine the adequacy of the clearing sight distance, corner sight distance, and stopping sight distance at each passive highway-rail grade crossing on a periodic basis.

**"(b) INSPECTION AUTHORITY.**—To carry out this section, an officer, employee, or agent of the public authority that has the responsibility to inspect highway-rail grade crossings

(hereinafter referred to as the “responsible public agency”), at reasonable times and in a reasonable way, may enter public or private property for the purposes of determining the adequacy of the clearing sight distance, corner sight distance, and stopping sight distance at passive highway-rail grade crossings and evaluating sight distance obstructions caused, in whole or in part, by structures, topography, standing railroad equipment, trees, or other vegetation located within close proximity to those crossings.

**“(c) ACTIONS TO IMPROVE SIGHT DISTANCE AT PASSIVE HIGHWAY-RAIL GRADE CROSSINGS.—**

“(1) If the head of the responsible public agency finds that structures, topography, standing railroad equipment, trees, or other vegetation are obstructing the required clearing sight distance, corner sight distance, or stopping sight distance at a passive highway-rail grade crossing, the head of the responsible public agency shall take action to correct the deficiency. Such action may include, but shall not be limited to the following:

“(A) ordering the removal or other mitigation of the obstruction by the owner of any private property on which the obstruction may be located;

“(B) providing written notice of the obstruction to the appropriate State or local government with maintenance responsibility for any public property on which the obstruction may be located;

“(C) installing additional traffic control devices; or

“(D) installing speed limit signs with a reduced regulatory speed or advisory speed plaques for road users.

“(2) Any private property owner who receives an order to remove or otherwise mitigate an obstruction, pursuant to subsection (c)(1)(A) of this section, shall either comply with, or file an appeal to, the order within sixty (60) days of receipt. A person that fails to comply with, or properly file an appeal to, an order to remove or otherwise mitigate an obstruction that has been issued pursuant to subsection (c)(1)(A) of this section is liable to the [State or Commonwealth of [ ]] for a civil penalty of not less than one hundred dollars, but not more than five hundred dollars, for each day on which the obstruction continues unabated. The head of the responsible public agency may, however, compromise the amount of a civil penalty citation imposed under this subsection.

“(3) If the responsible public agency provides written notice of an obstruction on public property maintained by the State or local government, the State or local government will have sixty (60) days to remove or otherwise mitigate the obstruction. Upon expiration of this sixty (60) day period, the responsible public agency may remove or otherwise mitigate the obstruction and then seek reimbursement for costs incurred from the State or local government with maintenance responsibility for the public property on which the obstruction was located.

**“(d) DEFINITIONS.--**In this section—

“(1) ‘clearing sight distance’ means the distance required along each direction of track for the road user stopped 15 feet short of the near rail at a highway-rail grade crossing to be able to see far enough down the track, in both directions, to determine if sufficient time exists for moving safely across the tracks to a point 15 feet past the far rail, prior to the arrival of a train;

“(2) ‘corner sight distance’ means the length of highway on the approach to a highway-rail grade crossing that would be required by a road user to detect an approaching train from either direction of track in sufficient time to safely stop a vehicle traveling at the posted speed limit at least 15 feet before the near rail;

“(3) ‘passive highway-rail grade crossing’ means a location, equipped solely with traffic control devices that are not activated by trains (such as one or more signs or pavement markings), where a public highway, road, or street, or a private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade;

“(4) ‘road user’ means a vehicle operator, bicyclist, or pedestrian, including a person with one or more disabilities, within a public highway, road, or street, or a private roadway, including associated sidewalks and pathways; and

“(5) ‘stopping sight distance’ means the length of highway on the approach to a highway-rail grade crossing required to safely stop a vehicle traveling at the posted speed limit at least 15 feet before the near rail.

#### “§[ ]. Vehicles approaching passive highway-rail grade crossings

“(a) **STOPPING DISTANCE.**--Upon approach to a passive highway-rail grade crossing, the road user shall come to a full stop within 15 to 50 feet of the nearest rail of the track under any of the following circumstances:

“(1) the approach of a train or other railroad equipment that is likely to occupy the crossing before the road user can safely enter and clear the crossing;

“(2) the sounding of a locomotive horn or other locomotive audible warning device by a train approaching the crossing; or

“(3) if a stop sign is posted at the crossing.

“(b) **DURATION OF STOP.**--While stopped at least 15 feet from the nearest rail of the track at a passive highway-rail grade crossing, the road user shall listen and look in both directions along the railroad track for evidence of the approach of a train or other railroad equipment. The road user shall not enter the crossing until the road user has determined that the crossing will remain clear of approaching trains and other railroad equipment for a sufficient amount of time to allow the road user to enter and clear the crossing.

“(c) **DEFINITIONS.**--In this section—

“(1) ‘passive highway-rail grade crossing’ means a location, equipped solely with traffic control devices that are not activated by trains (such as one or more signs or pavement

markings), where a public highway, road, or street, or a private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade; and

“(2) ‘road user’ means a vehicle operator, bicyclist, or pedestrian, including a person with one or more disabilities, within a public highway, road, or street, or a private roadway, including associated sidewalks and pathways.”

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